## REPORT ON: 143 WATERSHED ROAD SUBDIVISION

PROJECT: GEOTECHNICAL ASSESSMENT

CLIENT: LC BUILDERS LTD



#### **EXECUTIVE SUMMARY**

LC Builders Ltd. engaged Resource Development Consultants Ltd (RDCL) to provide this geotechnical assessment for proposed subdivision at 143 Watershed Road, Bunnythorpe (Legal Description: PART LOT 2 DP 480).

RDCL have been supplied with a scheme plan for the proposed development prepared by Geoworks. (Drawing Number: 20-903-SC-001, revision B, dated 11 February 2021); showing

- Proposed new lots (~5000m<sup>2</sup>) situated on generally flat to gently sloping ground atop an eroded marine terrace; and
- A new cul-de-sac traversing gently sloping ground for the most part, and terminating near the crest of a moderately steep gulley slope.

The results of shallow investigations suggest the soil profile is generally consistent across the proposed development area, comprising:

- Silty TOPSOIL to 0.3m bgl; underlain by
- Stiff silty CLAY to Clayey SILT to between 0.3-2.0m bgl; with
- Stiff CLAY to at least 3.5 m bgl.

Based on the results of this investigation, we consider the proposed subdivision development is generally suitable from a geotechnical perspectivee:

- House sites suitable for standard foundations in accordance with NZS3604:2011 are available on all lots;
  - Indicative areas suitable for foundations not requiring specific engineering design are shown in Figure 1;
  - Specific engineering may be required for earthworks and/or foundations proposed to extend beyond the recommended setback (Figure 1).

A statement of professional opinion on suitability of land for building construction (Schedule 2a NZS4404:2010) is attached to this report.

We recommend a suitably qualified geotechnical professional be engaged:

- To confirm bearing for specific foundations at the time of construction;
- To consult for detailed design of earthworks and/or foundations should construction be proposed outside of indicative house sites shown;
- Should ground conditions be found to differ from those contained in this report.



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#### 1 OVERVIEW

LC Builders Ltd. engaged Resource Development Consultants Ltd (RDCL) to provide this geotechnical assessment for proposed subdivision at 143 Watershed Road, Bunnythorpe (Legal Description: PART LOT 2 DP 480).

#### 1.1 UNDERSTANDING OF THE PROJECT

We understand the client intends to subdivide twenty (20) new rural residential lots, and that a geotechnical assessment is required to submit with an application for subdivision consent.

RDCL have been supplied with a scheme plan for the proposed development prepared by Geoworks. (Drawing Number: 19-765-SC-001, revision D, dated 3rd March 2020); showing

- Proposed new lots (~5000m<sup>2</sup>) situated on generally flat to gently sloping ground atop an eroded marine terrace; and
- A new cul-de-sac traversing gently sloping ground for the most part, and terminating on a moderately steep gulley slope.

#### 1.2 SCOPE OF WORK

This work was completed in general accordance with RDCL proposal 20825, issued to the client on 25<sup>th</sup> November 2020.



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#### 2 SITE DESCRIPTION

The proposed development is located northwest of Ashurst, in an area characterized by flat topped ridge spurs and light to moderate incised gulley's generally trending west.

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Indicative house sites are predominantly located on generally flat to gently sloping ground surrounding the head of an incised gulley locally dammed (Figure 1).

- Lots 1-10, 12, 14, 16, 18 and 20:
  - Generally flat to gently sloping ground (slopes <5°), currently in pasture.
- Lots 11, 13, and 15 (shallow watercourse):
  - Gently sloping ground, with moderate slopes (~10°) bounding a shallow gulley toward the southern boundaries.
- Lot 17 (pond):
  - Gently sloping ground ( $<5^\circ$ ) to the north of an existing dammed pond;
- Lot 19 (access crossing watercourse):
  - Proposed house site to the south of a gulley bounded by moderate gulley slopes (<17°);
  - Access required to cross the overland flow path on the downstream side of the pond.
- Lot 21:
  - Generally flat ground available for house site, bounded by a steep (<18°) gulley slope to the southwest.

Slopes are generally smooth and rounded, with minor slip scarps observed on steep sections bounding the watercourse.



Geotechnical Investigation at 143 Watershed Rd, Bunnythorpe, Palmerston North

#### 2.1 REGIONAL GEOLOGY

Regional geological maps (GNS, 2002) indicate the site is underlain by:

- Middle Pleistocene ocean shoreline deposits, comprising:
  - Gravel, sand, and mud; onlapping
- Early Pleistocene Middle Pleistocene sedimentary rocks to the east, comprising;
  - Sandstone, siltstone, bioclastic limestone and conglomerate, including OIS 15-9 marine terrace deposits.

#### 2.2 ACTIVE FAULTS

No active faults directly impacting the proposed development are identified in the GNS Active Faults Database (GNS Science, 2018).

The nearest active fault trace the Pohangina Fault is located approximately 3.0 km to the east.



#### **3 SUBSURFACE INVESTIGATION**

#### 3.1 SUBSURFACE TESTING

Subsurface testing completed for this site comprised (Figure 1):

- Nine (9) Test Pits to between 2.6m and 3.5m bgl; and
- Nine (9) Dynamic Cone Penetrometer (DCP) tests terminated between 0.9m and 1.3m bgl.

Field investigations were carried out in mid-summer with intermittent rain and overcast weather.

Site investigation logs are available in Appendix A.

#### 3.2 NEAR SURFACE MATERIALS

The results of shallow investigations suggest the soil profile is generally consistent across the proposed development area, comprising:

- Silty TOPSOIL to 0.3m bgl; underlain by
- Stiff silty CLAY to Clayey SILT to between 0.3-2.0m bgl; with
  - Undrained shear strengths measured between 96 -140 kPa.
  - Iron concretions and variably well defined pan layers from 0.8-2.0m bgl; and
- Stiff CLAY to at least 3.5 m bgl.

#### 3.3 SHALLOW BEARING CAPACITY

DCP test results have been correlated to Ultimate Bearing Capacity (UBC) in accordance with (Stockwell, M.J. 1977).

- Bearing capacity is variable in the upper ~1.2m; with
  - 300 kPa ultimate bearing capacity is generally from 0.6-1.2m bgl.
  - 200 kPa ultimate bearing capacity is available from a level stripped of topsoil.

#### 3.4 **G**ROUNDWATER

Groundwater was not encountered at the time of site investigations.



#### 4 GEOTECHNICAL ASSESSMENT

#### 4.1 SUITABILITY FOR DEVELOPMENT

Based on the results of this investigation, we consider the proposed subdivision development is generally suitable from a geotechnical perspective:

- House sites suitable for standard foundations in accordance with NZS3604:2011 are available on all lots;
  - Indicative areas suitable for foundations not requiring specific engineering design are shown in Figure 1;
  - Specific engineering may be required for earthworks and/or foundations proposed to extend beyond the recommended setback (Figure 1).

A statement of professional opinion on suitability of land for building construction (Schedule 2a NZS4404:2010) is attached to this report.

#### 4.2 FOUNDATION RECOMMENDATIONS

Shallow foundations are considered generally appropriate for the proposed building areas, with:

- For piles in accordance with NZS3604:2011;
  - 300 kPa ultimate bearing capacity generally available from 0.6-1.2m bgl; and
- For specific engineering of slab foundations (i.e., waffle type slab);
  - 200 kPa ultimate bearing capacity is available at a level stripped of topsoil.

All organic, loose and/or deleterious materials should be stripped from beneath building foundations and fills.



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#### Geotechnical Investigation at 143 Watershed Rd, Bunnythorpe, Palmerston North

#### 4.3 EARTHWORKS

#### 4.3.1 BATTERS

As a general guide:

- Unsupported batters should be finished at angles set out in Table 1; and
- All constructed slopes should be seeded or planted to limit erosion potential.

#### TABLE 1: INDICATIVE BATTER SLOPE ANGLES

Batter Type	Batter Type Material Type				
Cut botton	Topsoil and soft to firm soils	2.5H:1V			
Cut batter	Stiff to very stiff SILT & CLAY	2H:1V			
Fill batter	All	2H:1V			

#### 4.3.2 ENGINEERED FILL

Should fill be required for construction of building platforms and/or access:

- All fill should be placed and compacted in accordance with NZS4431:1989 "Code of Practice for Earth Fill for Residential Development"; and
- Unsupported fill batters should be finished at maximum 2H:1V.

#### 4.3.3 RETAINING WALLS

Should retaining walls be required to form building platforms:

- Soil parameters should be confirmed based on specific excavation locations;
  - Indicative parameters for soils encountered are c' = 6kPa,  $\phi' = 30^\circ$ , Su: 100 kPa;

All retaining walls should be backfilled with free draining materials with "Novaflow" style piping to capture and direct water away for adequate disposal.



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4.4 ACCESS

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As it relates to development of the right of way access:

Geotechnical Investigation at 143 Watershed Rd, Bunnythorpe, Palmerston North

- Appropriate surfacing of roadways needs to consider subgrade conditions, drainage, likely traffic loads, especially construction loads during house building:
  - Subgrade should be stripped of all organic loose and deleterious materials;
  - Indicative  $CBR \ge 5\%$  is generally available from a level stripped of topsoil;
- The carriageway should be shaped to manage surface water flows in a controlled manner. This should at least include:
  - A well-defined "table drain" on the inside of the access-way;
  - Well defined culverts and discharge points to shed water; and
  - Adequate protection of both against erosion.

Access should be specifically designed and constructed under engineering control and in accordance with NZS4404:2010.

#### 4.5 STORMWATER

Stormwater disposal should be specifically designed by professionals with competence in the field. Any comments in this report as it relates to stormwater are for guidance only.

As a minimum we recommend:

- All developments should be undertaken in a manner so as to redirect stormwater from proposed building platforms and other impervious surfaces;
- Stormwater should discharge to a suitable point away from existing slopes and in a manner that reduces the risk of erosion.



#### 4.6 **EFFLUENT DISPOSAL**

Effluent disposal fields should be specifically designed by a competent practitioner experienced in such matters. Any comments in this report as it relates to effluent fields are for guidance only.

- Discharge rate should be specifically tailored to meet the requirements as they relate to the slope angle and soil conditions on site;
- Planting between driplines should be undertaken with suitable species at density recommended by the effluent specialist; and
- Effluent disposal fields should be situated to avoid steep slopes and waterways.

We see no significant impediment to the appropriate placement of effluent fields from a geotechnical perspective;

- Lot 17 may be constrained due to area occupied by the existing pond;
  - Proposed layout should be confirmed suitable for building consent.

#### 5 FURTHER GEOTECHNICAL INPUT

We recommend a suitably qualified geotechnical professional be engaged:

- To confirm bearing for specific foundations at the time of construction;
- To consult for detailed design of earthworks and/or foundations should construction • be proposed outside of indicative house sites shown;
- Should ground conditions be found to differ from those contained in this report.



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Geotechnical Investigation at 143 Watershed Rd, Bunnythorpe, Palmerston North

#### 6 REFERENCES

- Beetham, R.D.; Begg, J.G.; Barker, P.; Levick, S.; Beetham, J. 2011. Assessment of liquefaction and related ground failure hazards in Palmerston North, New Zealand. GNS Science Consultancy Report CR 2011/108 90p.
- 2. Burns, D., Farqhuar, G., Mills, M. and Williams, A. ed. 2005. Field Description of Soil and Rock: New Zealand Geotechnical Society.
- 3. GNS Science. 2002. WAIRARAPA. *Institute of Geological and Nuclear Sciences*, 1:250,000 Geological Map 11. (Lee, J.M.; Begg, J.G., Compilers) GNS Science.
- 4. GNS Science. 2018. *New Zealand Active Faults Database: Active Faults 250K*. [online] Available at https://data.gns.cri.nz/af/ [Accessed 5/10/2020].
- 5. Ministry of Business, Innovation and Employment. 2012. *Guidance: Repairing and rebuilding houses affected by the Canterbury earthquakes (Part A: Technical Guidance).*
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- 7. Standards New Zealand. 2011. *Timber-framed Buildings*. NZS3604:2011. Wellington: Standards New Zealand.
- 8. Standards New Zealand. 1989. *Code of Practice for Earthfill for Residential Development*. *NZS4431:1989*. Wellington: Standards New Zealand.
- Stockwell, M. 1977. Determination of allowable bearing pressure under small structures. New Zealand Engineering, 32(6), pp.132-135.



Geotechnical Investigation at 143 Watershed Rd, Bunnythorpe, Palmerston North

#### 7 LIMITATIONS

- This report has been prepared for the particular purpose outlined in the project brief and no responsibility is accepted for the use of any part in other contexts or for any other purpose.
- Ground conditions assessed in this report are inferred from published sources, site inspection and the investigations described. Variations from the interpreted conditions may occur, and special conditions relating to the site may not have been revealed by this investigation, and which are therefore not taken into account. No warranty is included either expressed or implied that the actual conditions will conform to the interpretation contained in this report.
- Groundwater conditions can vary with season or due to other events. Any comments on groundwater conditions are based on observations at the time.
- This report is provided for sole use by the client and their professional advisors. No responsibility whatsoever for the contents of this report shall be accepted for any person other than the client.



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#### 8 CLOSURE

We trust this meets your current needs. Should you wish to discuss any aspect of the contents of this document please contact the undersigned (Elizabeth) on 021 884 837.

Sincerely,

Prepared by:

Ryan Steadman MSc Engineering Geologist

Approved by:

Elizabeth Cairns MSc Engineering Geologist

CA Wylie

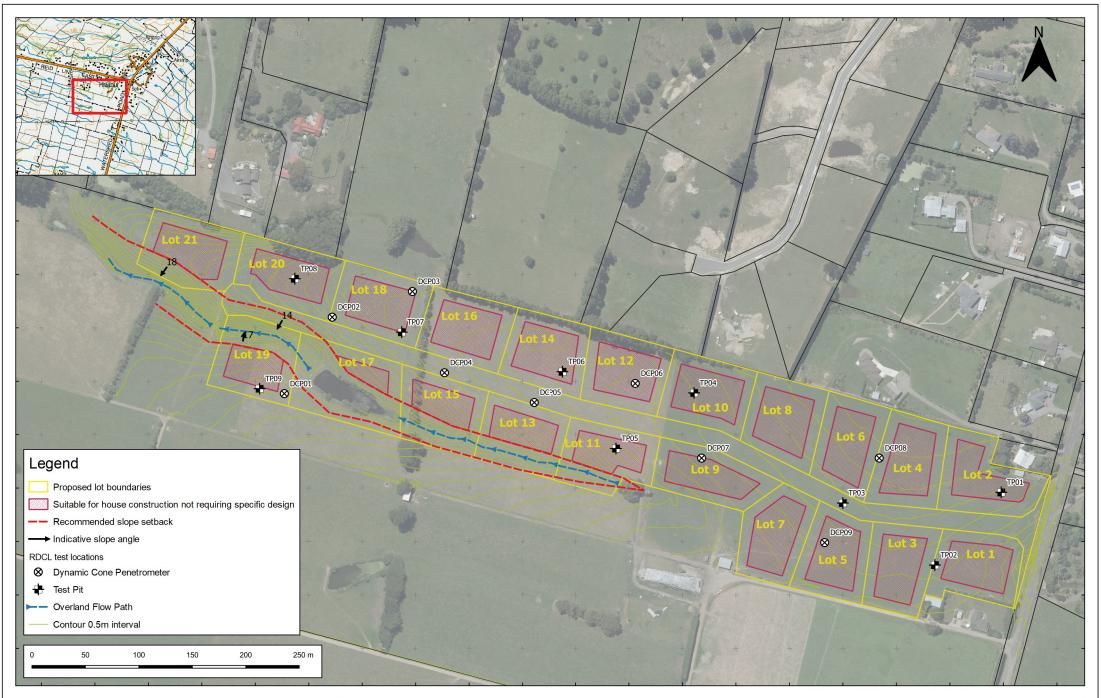
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Attachments: Figure 1: Indicative Site Plan Appendix A: Investigation Logs Schedule 2a NZS4404:2010 - Statement of Professional Opinion Important Information about this Geotechnical Report



FIGURES





	RDCL	Title	Indicative Site Plan	Drawn By EC	Date	11/02/21	A3
RDCL	PO Box 28057   8/308 Queen St East Hastings NZ Tel: +64 6 8771652   Fax: +64 6 877 5015	Project	208250602 - Watershed Road Subdivision	Checked By	Date		
	Email: info@rdcl.co.nz www.rdcl.co.nz	Client	LC Builders Ltd.	Approved By CAW	Date	12/02/21	Figure 1

**APPENDIX A- INVESTIGATION LOGS** 





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EN	IGINE	ER:	EC		DIMENSIO					STATUS: Final da	ta		
CC	NTR	ACT	OR: S	utherland	MACHINE	TYPE	E & M	IODE	EL				
							12	NO					
Ê			0	ROCK / SOIL DESCRIPTION		a N S N	LENC	CLASSIFICATION	DCP BLOWS	SAMPLES	ADDITIONAL REM	ARKS	
DEPTH (m)	Ê	WATER	HH L			STU VDITI	ISIT <sup>V</sup>	SSIF	BLO	& TESTS	,		
DEF	RL (m)	WA	GRAPHIC LOG			MOISTURE CONDITION	бű	CLA	DCF				
-	-		<u>. 54</u> 	SiltyTOPSOIL; brown. Dry; friable.		D							
Ł	È.		<u>м</u> м. тс	-									
ŀ			x <del>x</del> <del>x</del>	Clayey SILT; orange brown. Moderate plasticity; moist; Iron concretions abu	ndant 1.3 to								
-0.5	-0.5		×_×	2.0m and blocky in upper 0.8m.						50/ 0.70			
ŀ	-		× × ×							FSV: 0.70m ● 137/51kPa			
F	-		×_×										
-1.0	-1.0	itered	× * *										
ŀ	F	lcoun	×_×										
ţ.	ļ	Groundwater Not Encountered											
-1.5	-1.5	/ater 1	×_×			м							
Ę	Ę	wpund	<u> </u>										
Ł	Ľ	Ü	×_×										
-2.0	-2.0		<u> </u>	CLAY; greenish grey.		-	<u> </u>	-					
ţ.	ţ.			Stiff; high plasticity; moist.									
ł	-						05						
-2.5	-2.5						SF						
Ł	Ľ												
-				EOH: 2.80m									
-3.0	-3.0												
ŀ	- '												
Ę	F												
-3.5	-3.5												
-	ې -												
ţ.	Į.												
Ŀ	-												
										REMARKS			
										Soils logged in accordance w Description of Soil and Rock	ith NZGS (2005) Field		
										SYMBOLS			
										▼ Standing Water Level			
										↓ Out flow			
	RDCL UNIT 2 182 MAIN ROAD   TAWA   WELLINGTON 5028   NEW ZEALAND												
				Ph: +64 6 8	771652   Em	ail: i	nfo@	)rdc	l.co.	nz			



										SHEET 1 OF 1				
CL	IENT	:	LC Bu	lilders	PROJECTI	ON: I	NZTN	/1200	0	STARTED: 19/01/2021				
PR	OJE	CT:	20825	50602	EASTING:			38.00		FINISHED: 19/01	/2021			
LO	CAT	ION:	143 W	/atershed Road	NORTHING	6: 55	3835	59.00						
					DATUM: -					LOGGED BY: EC	LOGGED BY: EC DATE: 19/01/202			
OF	FICE		RDCL	- WGTN	ELEVATIO					CHECKED BY: EC	DATE: 11/02/2021			
	IGINE				DIMENSIO	NS m	n x m			STATUS: Final da	ita			
CC	)NTR	ACT	OR: S	utherland	MACHINE -	TYPE	E & N	10DE	EL					
							17	NOI						
Ê				ROCK / SOIL DESCRIPTION		a N S	UEN (	CLASSIFICATION	DCP BLOWS	SAMPLES	ADDITIONAL REMARKS			
DEPTH (m)	آ	ВЧ	DHIC			STUF	ISIS1 SITY	SSIF	BLC	& TESTS	ADDITIONAL REMARKS			
DEP	RL (m)	WATER	GRAPHIC LOG			MOISTURE CONDITION	DEN	CLA	DCP					
-	ŀ		<u>36</u>	SiltyTOPSOIL; brown.										
ŀ	-		<u>26</u> 26 26	Dry.		D								
F	F		x <del>x</del> <del>x</del>	Clayey SILT; grey orange; blocky. Stiff; moderate plasticity; moist; tending to pan v	with iron			1						
-0.5	-0.5		×	concretions from 1.2m.	with itom									
ŀ	-		x <del>x</del> x							FSV: 0.70m ● >0 kPa				
ţ.	ţ.		×_*											
-1.0	-1.0	ered	x <del>x</del> x											
ļ	Ę	count	×_*				SF							
ł	-	ot En	x <del>x</del> x											
-1.5	-1.5	Groundwater Not Encountered	×_*			м								
Ł	ť	ewpu	x <del>x</del> x			ivi								
-	-	Grou	××											
-2.0	- 2.0		; <del>_ ×</del> _											
-	- ''			CLAY; gerenish grey.		-		-						
ļ.	ļ.			Stiff to very stiff; high plasticity; moist.										
-	- 2						SF - VSF							
-2.5	-2.5													
_	-			_EOH: 2.80m										
ł														
-3.0	- œ́													
ł	-													
F	F .													
-3.5	-3.5													
-	-													
t	t i													
$\vdash$	I		1			1	1	1						
1										Soils logged in accordance w				
1										Description of Soil and Rock				
1														
1														
1										Standing Water Level	Standing Water Level			
1										← Out flow				
					RDCL									
				UNIT 2 182 MAIN ROAD   Ph: +64 6 8	IGTC nfo@	DN 50 Drdc	)28   I.co.	NEW ZEALAND nz						



<b>TP07</b>
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											SHEET 1 OF 1			
CL	IENT	:	LC Bu	uilders	PROJECTI	ON: N	/2021							
PR	OJE	CT:	20825	50602	EASTING:	18	2903	37.00	)	FINISHED: 19/01	/2021			
LO	CATI	ION:	143 V	Vatershed Road	NORTHING	G: 55	3839	96.00	)					
					DATUM: -					LOGGED BY: EC	LOGGED BY: EC DATE: 19/01/20			
OF	FICE	:	RDCL	- WGTN	ELEVATIO	N: -				CHECKED BY: EC	C	DATE: 11/02/2021		
		EER:			DIMENSIO					STATUS: Final da	ita			
CC	NTR	ACT	OR: S	utherland	MACHINE	TYPE	E & N	10DE	EL					
							1	NOI						
Ê				ROCK / SOIL DESCRIPTION		MOISTURE CONDITION	N N N N N N N	CLASSIFICATION	BLOWS	SAMPLES	ΔΓ	DITIONAL REMARKS		
DEPTH (m)	Ê	ER	DHIC			STUF	ISIS1 SITY	SSIF	BLC	& TESTS				
DEP	RL (m)	WATER	GRAPHIC LOG			MOI		CLA	DCPI					
	-		<u>34</u>	Clayey siltyTOPSOIL; brownish.		D-								
ŀ	ŀ		<u>ак</u> ал ак эт то	Dry to moist.		М								
F	-		×	Clayey SILT/Silty CLAY; orange and grey mottle Stiff; moderate plasticity; moist; Ironstone lense	es. Is from 0.8m		1							
-0.5	-0.5		×		.5 110111 0.0111.									
$\mathbf{F}$	ŀ		×							FSV: 0.70m ● 162/70kPa				
ţ	ļ.	_	×											
-1.0	-1.0	ntered	×											
ļ	ļ	ncou	X											
ł	r	Groundwater Not Encountered	×											
-1.5	-1.5	vater	X											
ł		Npunc	×											
-	-	ğ	×											
-2.0	-2.0		×											
-	- ''			CLAY; greenish grey. Stiff; high plasticity; moist.										
ţ	ļ.													
-	5					М	SF							
-2.5	-2.5		***	·										
-	t –			EOH: 2.70m										
ŀ														
-3.0	-3.0													
ŀ	ŀ													
ļ.	[													
-3.5	-3.5													
F	-													
t	ŧ													
<u> </u>								1		REMARKS				
										Soils logged in accordance w	ith NZ	GS (2005) Field		
1										Description of Soil and Rock		· ·		
1														
SYMBOLS														
										▶ In flow				
				UNIT 2 182 MAIN ROAD	RDC TAWA   WE	ELLIN	IGTO	ON 50	)28	NEW ZEALAND				
				Ph: +64 6 8	771652   Em	iail: i	nto@	yrdc	I.CO.	nz				



<b>TP08</b>
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											SHEET 1 OF 1			
CL	IENT	:	LC Bu	lilders	PROJECTI	ON: N	NZTN	1200	0	STARTED: 19/01/2021				
PR	OJE	CT:	20825	50602	EASTING:	18	2893	87.00		FINISHED: 19/07	1/2021			
LO	CATI	ON:	143 W	/atershed Road	NORTHING	G: 55	3844	6.00						
					DATUM: -					LOGGED BY: E	C DATE: 19/01/2021			
OF	FICE	:	RDCL	- WGTN	ELEVATIO					CHECKED BY: E	C DATE: 11/02/2021			
EN	IGINE	ER:	EC		DIMENSIO					STATUS: Final da	ata			
CC	NTR	ACTO	DR: S	utherland	MACHINE	TYPE	8 N	IODE	EL					
							X	CLASSIFICATION						
Ê				ROCK / SOIL DESCRIPTION		ы No	N N N N N N	ICA1	SWG	SAMPLES	ADDITIONAL REMARKS			
DEPTH (m)	(u	ËR	HI	NOCK / SOIL DESCRIPTION		DITI	<u>ISIST</u> SITY	SSIF	DCP BLOWS	& TESTS				
DEP	RL (m)	WATER	GRAPHIC LOG			MOISTURE CONDITION		CLA	DCP					
-	-		<u>346</u>	SiltyTOPSOIL; brown.		D -			1					
ŀ			<u>ыс ы</u> 24 <sup>1</sup> с.	Dry to moist.		м								
F	-		; <del>_ ×</del> ×	Clayey SILT; grey and orange. Stiff; moderate plasticity; moist; Iron concretior	ns abundant									
-0.5	-0.5		×	0.8 to 1.2m.										
ł	-		× × ×							FSV: 0.70m ● 188/64kPa				
F	-	red	×			1								
-1.0	-1.0	ounte	· _ * _ *											
ŀ	-	ot Enc	×××											
ļ.	[	ter No	·				SF							
-1.5	-1.5	Groundwater Not Encountered	×××			м	5F							
F	-	Grou	× ×											
ţ.	1		× ×	CLAY; greenish grey.		1								
-2.0	-2.0			Stiff; high plasticity; moist.										
ļ	[													
ŀ	ŀ													
-2.5	-2.5			EOH: 2.60m										
	-			2011.2.0011										
ŀ	-													
-3.0	- 3.0													
t														
ŀ	-													
-3.5	-3.5													
ŀ	- `													
F	F					1								
È	-													
										REMARKS				
										Soils logged in accordance v Description of Soil and Rock				
1														
1														
1														
1										SYMBOLS				
1										Standing Water Level				
1										← Out flow				
<u> </u>														
1				UNIT 2 182 MAIN ROAD	RDC   TAWA   WE		IGTC	DN 50	)28	NEW ZEALAND				
				Ph: +64 6 8	3771652   Em	ail: i	nfo@	)rdc	I.co.	nz				



<b>TP09</b>
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SHEET 1 OF 1											SHEET 1 OF 1		
CL	IENT	:	LC Bu	uilders	PROJECTIO	ON: N	IZTM	1200	0	STARTED: 19/01/2021			
PR	OJE	CT:	20825	50602	EASTING:	18	2890	4.00		FINISHED: 19/0	1/2021		
LO	CATI	ON:	143 V	Vatershed Road	NORTHING	: 55	3834	3.00					
					DATUM: -					LOGGED BY: E	C DATE: 19/01/2021		
	FICE			- WGTN	ELEVATION					CHECKED BY: E	B/(12. 11/02/2021		
	GINE				DIMENSIO					STATUS: Final da	ata		
CC	NTR	ACTO	DR: S	utherland	MACHINE	ΓΥΡΕ	& M	IODE	l				
							١٨:	NOI					
Ê				ROCK / SOIL DESCRIPTION		₩S	ENC	ICAT	MS	SAMPLES	ADDITIONAL REMARKS		
TH (r	(r	ER	HIG	ROCK / SOIL DESCRIPTION			<u>SIST</u> SITY	SSIF	BLO	& TESTS	ADDITIONAL REMARKS		
DEPTH (m)	RL (m)	WATER	GRAPHIC LOG			MOISTURE CONDITION		CLASSIFICATION	DCP BLOWS				
-	-	-	<u> 40</u>	Clayey siltyTOPSOIL; brown; blocky.				-					
ŀ	-			Dry.		D							
ļ	ļ		×	Clayey SILT; orange and grey.				1					
-0.5	-0.5		××	Firm; moderate plasticity; moist; Iron concretion abundant 1.0 to 1.8m.	ilenses								
F	F		× × ×							FSV: 0.70m ● 143/57kPa			
ţ	ţ	pe	×_×										
-1.0	- 1-	untere	× × ×				FM						
F	ļ	Groundwater Not Encountered	×_×_×										
E	ŀ	sr Not	x <del>x</del> <del>x</del>										
-1.5	-1.5	dwate	×_×			М							
ţ	ļ.	Broun	$\frac{1}{x} \frac{x}{x}$										
ŀ	ŀ	0	* *	CLAY; greenish grey.			<u> </u>	+					
2.0	-2.0			Stiff; high plasticity; moist.									
Ł	Ŀ						SF						
F	-												
-2.5	-2.5												
-	~			EOH: 2.60m									
F	-												
-3.0	- 3.0												
-	- 7												
ţ	[												
- 													
-3.5	- က် -												
t	t												
ŀ	ŀ												
	•	•	•			•	•	•		REMARKS	-		
										Soils logged in accordance v Description of Soil and Rock	with NZGS (2005) Field		
	SYMBOLS												
										✓ Standing Water Level ✓ Out flow			
										> In flow			
									120 1				
				UNIT 2 182 MAIN ROAD Ph: +64 6 8	TAWA   WE 3771652   Em								

	RDCL DCP LOG													DCP01		
														SHE	ET 1 OF 1	
	IENT		LC Bu								NZTM2000		UB-LOCA			
			2082						EASTING:					19/01/2021		
	CATI	ION:	143 V	Vate	rshed Roa	id			NORTHING		538338.31			19/01/2021 3Y: EC	DATE: 19/01/2021	
OF	FICE		RDCI	N	/GTN				ELEVATIO					BY:EC	DATE: 11/02/2021	
EN	GINE	ER:							AZIMUTH:		PLUNGE: 90		TATUS: F			
Image: matrix of the state stat											SAMPLES & TESTS			ADDITIONAL REMARKS		
DEF	RL (m)	WATER	Lo GR	DATA			8 1 <del>!</del>	2	16							
ŀ	-	Groundwater Not Encountered		3 4												
ŀ	-	Encou		7												
-0.5	-0.5	er Not		4 5												
ļ.	-	ndwat		6 9												
<u> </u>	-	Grou		9 17												
-1.0	-1.0															
ŀ	-															
-																
-1.5	-1.5															
ŀ	-															
-2.0	-2.0															
-	- <sup>(4</sup>															
F	-															
-2.5	-2.5															
ŀ																
ŀ	-															
-3.0	-3.0															
-	-															
-	-															
-3.5	-3.5															
ŀ	-															
F																
-4.0	-4.0															
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-4.5	4.5															
-4.0	- 4															
ļ	-															
-	<u> </u>															
	MARI Is tes		n acco	orda	nce with N	ZGS						SYMB				
												▼ Sta	nding Water flow	Levei		
												⊳ In fl				
						UNIT 2	182 MAIN	ROAD	RDO TAWA   WI	ELLII	NGTON 5028	NEW Z	EALAND			
							Ph:	+64 6 8	8771652   Em	nail: i	info@rdcl.co.r	nz				

			R	D	DCP02								
													EET 1 OF 1
			LC Bi 2082							NZTM2000 828972.00	SUB-LOCA	ATION: : 19/01/2021	
					rshed Road					538410.00		19/01/2021	
	•							DATUM:	-		LOGGED E		DATE: 19/01/2021
	FICE		RDCL	W	/GTN			ELEVATIO				BY: EC	DATE: 11/02/2021
EN	GINE	ER:	EC					AZIMUTH	:	PLUNGE: 90°	STATUS: F	Final data	
										SAMPLES & TESTS		ADDITIONAL F	REMARKS
DEPTH (m)	RL (m)	WATER	GRAPHIC LOG	DATA	4	8	12	16					
-	-			2									
ŀ	-	Groundwater Not Encountered		3 4									
-0.5	-0.5	Not Er		4									
ŀ	-	dwater		4									
ţ	-	Groun		4 13 5									
-1.0-	-1:0			5	for 40mm Dou	ble Bounce	)						
ŀ	-												
-1.5	-1.5												
-													
F	-												
-2.0	-2.0												
ļ	-												
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-2.5	-2.5												
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F	-												
-3.5	-3.5												
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-4.0	-4.0												
ŀ	ŀ												
-4.5	- 2.												
	- 4												
-	F												
	MARI										/MBOLS		
Soi	ls tes	sted i		orda	nce with NZGS						Standing Water	Level	
Doi	uble	Boun	cing								- Out flow		
-								RD	OCL		- In flow		
					UI	NT 2 182 M	IAIN ROAD Ph: +64 6	TAWA   W	VELLI	NGTON 5028   NE info@rdcl.co.nz	W ZEALAND		

	RDCL DCP LOG													CP03	
CL PR	IENT	: CT:	LC Bi 20825	uilde 5060	rs	d			PROJECTI EASTING: NORTHING	18	329047.00	SHI ATION: 0: 19/01/2021 0: 19/01/2021	EET 1 OF 1		
OF	FICE		RDCL						DATUM: - ELEVATIO	N: -		LOGGED CHECKEI	BY: EC DBY:EC	DATE: 19/01/2021 DATE: 11/02/2021	
	1	1		1											
DEPTH (m)	DCP BLOWS										SAMPLES & TESTS		ADDITIONAL REMARKS		
<u>В</u>	אר -		53	2		4	8 1	2	16						
- - -0.5 -	-0.5	Groundwater Not Encountered		3 4 3 2 2 3 15											
-1.0	-1.0														
-1.5	-1.5														
-	-														
-2.0	-2.0														
- -2.5 -															
- -3.0 -	- 3.0														
- 3.5 -															
- 4.0 -	- 4.0														
- - -4.5 -	4.5														
	MARI		n acco	ordai	nce with N	ZGS						SYMBOLS ▼ Standing Wate ⊲- Out flow	er Level		
						UNIT 2	182 MAIN	ROAD	RDC TAWA   WE	L L		≻ In flow			
							Ph:	+64 6 8	771652   Em	ail:	info@rdcl.co.nz				

			R		CL				C	)CP	LO	G			D	CP04
															SHI	EET 1 OF 1
	IENT		LC Bi									NZTM2000		SUB-LOCA		
			2082									329077.00 538358.00			19/01/2021 19/01/2021	
	CAT	ON:	143 V	vate	rshed Roa	IC				TUM: -		00000000		LOGGED E		DATE: 19/01/2021
OF	FICE	:	RDCL	W	/GTN										BY: EC	DATE: 11/02/2021
EN	GINE	ER:	EC						AZI	MUTH:		PLUNGE: 90	0°	STATUS: F	inal data	
											-					
DEPTH (m)	(u	ER	GRAPHIC LOG	T		D	CP BLOWS	6				SAMPLES & TESTS			ADDITIONAL F	REMARKS
DEP.	RL (m)	WATER	GRA	DATA		4	8	12	16							
-	-	pe		4 3												
ŀ	-	Groundwater Not Encountered		5 3												
-0.5	-0.5	ot Enc		3												
ŀ	-	vater N		3												
ŀ	[	roundv		3 4												
-1.0	-1.0	0		11 15												
ŀ	ŀ				for 80mm	Double E	Bounce									
4.5	. 2															
-1.5	-1.5															
ļ	-															
-2.0	-2.0															
ŀ																
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-2.5	-2.5															
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-3.0	-3.0															
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-3.5	-3.5															
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-4.0	- 4.0															
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-4.5	4.5															
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ŀ	ŀ															
	MARI Is tes		n acco	orda	nce with N	ZGS					,			BOLS		
		Boun												tanding Water ut flow	Level	
													N In			
						UNIT 2	182 MAI	N ROAD	TA	RDC WA   WE	ELLIN	NGTON 5028   I	NEW	ZEALAND		
							Pł	n: +64 6	87716	652   Em	ail: i	nfo@rdcl.co.r	nz			

			R		CL				DCP	LO	G			D	CP05
														SHE	ET 1 OF 1
CLI	IENT	:	LC Bu	uilde	rs			P	ROJECTI	ON:	NZTM2000	SUB	-LOCAT	ION:	
PR	OJE	CT:	20825	5060	2			E	ASTING:	18	329161.00	STA	RTED: 1	19/01/2021	
LO	CAT	ON:	143 V	Vate	rshed Road			N	ORTHING	G: 58	538330.00	FINI	SHED: 1	19/01/2021	
								D	ATUM: -					: EC	DATE: 19/01/2021
OF	FICE		RDCL	M	/GTN				LEVATIO					Y: EC	DATE: 11/02/2021
EN	GINE	ER:	EC					A	ZIMUTH:		PLUNGE: 90	)° STA	TUS: Fin	al data	
Ê.			0			DCP B	LOWS				SAMPLES		۵	DDITIONAL F	REMARKS
DEPTH (m)	RL (m)	WATER	GRAPHIC LOG	DATA	I .						& TESTS				
	R		07	3	4	8	12	1	6						
-	-	Groundwater Not Encountered		2											
ļ	1	Encol		7											
-0.5	-0.5	r Not		2											
ļ	[	dwate		3		1									
ŀ	ŀ	Bround		6 8											
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-1.5	-1.5														
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-															
-2.0	-2.0														
ŀ	ŀ														
F	F														
-2.5	-2.5														
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-3.0	-3.0														
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	- o														
-4.0	-4.0														
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-4.5	4.5														
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t	t														
	MARI										F.	SYMBOL	3		
			n acco	orda	nce with NZGS										
Do	uble	Boun	cing									▼ Standin		evel	
												In flow			
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	SCHEDULE 2A
STATE	EMENT OF PROFESSIONAL OPINION ON SUITABILITY OF LAND FOR BUILDING CONSTRUCTION
Develop	ment Watershed Road Subdivision (Part Lot 2 DP 480)
Develop	er LC Builders Ltd.
Location	143 Watershed Road, Bunnythorpe
1	Cam Wylie       of       Resource Development Consultants Limited (RDCL)         (Full name)       (Name and address of firm)
Hereby	confirm that:
	a geo-professional as defined in clause 1.2.2 of NZS 4404:2010 and was retained by the developer as the -professional on the above development.
date bee the	extent of my preliminary investigations are described in my Report(s) numberR208250602A01., ed12.February.2021 and the conclusions and recommendations of that/those document(s) have in re-evaluated in the preparation of this report. The extent of my inspections during construction, and results of all tests and/or re-evaluations carried out are as described in my geotechnical completion ort dated
3. In m	y professional opinion, not to be construed as a guarantee, I consider that (delete as appropriate):
(a)	The earth fills shown on the attached Plan No have been placed in compliance with the requirements of the
(b)	The completed works take into account land slope and foundation stability considerations, subject to the appended foundation recommendations and earthworks restrictions, (which should be read in conjunction with the appended final site contour plan).
(c)	Subject to 3(a) and 3(b) of this Schedule, the original ground not affected by filling is suitable for the erection of buildings designed according to NZS 3604 provided that:
	(i)Recommended setbacks, as shown, should be maintained for all buildings
	(ii)
(d)	Subject to 3(a) and 3(b) of this Schedule, the filled ground is suitable for the erection of buildings designed according to NZS 3604 provided that:
	(i)
	(ii)
(e)	The original ground not affected by filling and the filled ground are not subject to erosion, subsidence, or slippage in accordance with the provisions of section 106 of the Resource Management Act 1991 provided that:
	(i)
	(ii)
	These subclauses may be deleted or added to as appropriate, to include such considerations as expansive soils cluded from NZS 3604, and site seismic characteristics as covered in clause 3.1.3 of NZS 1170.5.

- 4. This professional opinion is furnished to the TA and the developer for their purposes alone on the express condition that it will not be relied upon by any other person and does not remove the necessity for the normal inspection of foundation conditions at the time of erection of any building.
- 5. This certificate shall be read in conjunction with my geotechnical report referred to in clause 2 above and shall not be copied or reproduced except in conjunction with the full geotechnical completion report.

Signed	AAA \\
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(Name, title, a	nd professional qualifications,

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Date 12/02/2021

Copyright waived

# Important Information about This Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

#### While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you - assumedly a client representative - interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

## Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled.* No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.* 

#### Read this Report in Full

Costly problems have occurred because those relying on a geotechnicalengineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full*.

## You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.* 

#### This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

#### Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

#### This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmationdependent recommendations if you fail to retain that engineer to perform construction observation*.

#### This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnicalengineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

#### **Give Constructors a Complete Report and Guidance**

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

#### **Read Responsibility Provisions Closely**

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

#### **Geoenvironmental Concerns Are Not Covered**

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnicalengineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.* 

## Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, *proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration*. Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. *Geotechnical engineers are not buildingenvelope or mold specialists*.



Telephone: 301/565-2733 e-mail: info@geoprofessional.org www.geoprofessional.org

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