GEOPACIFIC
VANCOUVER KAMLOOPS CALGARY

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Champion Development Group Inc.
75 West 3rd Avenue
Vancouver, B.C.
V5Y 3T8

June 6, 2017
File: 14947

Attention: Gregory Chan

Re: Geotechnical Investigation Report: Proposed Mixed Use Development
57 Lakewood Drive, Vancouver, B.C.

1.0 INTRODUCTION

We understand that a mixed-use development is proposed for the above referenced site. The proposed development will comprise of up to 7 stories of above grade structure constructed over two levels of below grade parking with an anticipated excavation depth of up to 9 m. We understand that the construction will be of reinforced concrete and that the proposed structure will be constructed close to property lines on all sides.

This report has been prepared exclusively for Champion Development Group Inc. for their use, the use of others on their design and construction team and in the development and permitting process. This report presents the results of an investigation of the soil conditions at the proposed development site and also makes recommendations for the design and construction of the proposed structure and foundation.

2.0 SITE DESCRIPTION

The site is located at the southwest corner of the intersection of Dundas Street and Lakewood Drive. The site is rectangular in shape, measuring approximately 60 m in the east-west direction and 38 m in the north-south direction. The site slopes gradually down from the southeast with an approximate 4 m grade differential between the southeast corner and the northwest corner.

The site is bounded to the west by a commercial property, to the north by Dundas Street, to the east by Lakewood Drive and to the south by a laneway.

The site is currently occupied on the eastern half by a warehouse structure with storage and parking to the west.

The location of the site is shown on our Drawing No. 14947-1, following the text of this report.

3.0 FIELD INVESTIGATION

GeoPacific Consultants Ltd. Conducted a geotechnical investigation at the site on May 12, 2017. A total of four augured test holes were advanced using the subcontracted services of Southlands Drilling Ltd. of Delta, BC. The test holes were advanced to depths of up to 12.0 m below the existing site grades and were logged by a technician from our office. Two Dynamic Cone Penetration Tests (DCPTs) were advanced within

BEDROCK (Sandstone)

Sandstone was observed in two of our test holes at depths between 6.4 and 7.3 m below existing grade. The sandstone was observed to be weathered at the interface with the glacial till becoming harder within the first metre of drilling. The cuttings were grey, medium to fine grained sand. A sample of the sandstone near the interface with the overlying till layer was observed to have a moisture content of 9.5%.

Heavily cemented and extremely hard zones of sandstone, commonly referred to as "floaters" may be encountered within the sandstone. Floaters may require splitting or blasting to facilitate their removal.

4.2 Groundwater Conditions

Groundwater was not observed within the test holes. The static groundwater table is expected to be quite deep in this area. However, we expect that perched groundwater may be encountered at the surface of the glacial till, particularly during the wetter winter and spring months.

5.0 DISCUSSION

5.1 General

The preliminary design information suggests that the building will be founded approximately 9 m below existing site grades. At that depth, we would expect foundations would consist of conventional strip and pad footings bearing on bedrock or very dense glacial till.

The subsurface soils are not expected to be prone to liquefaction or other forms of ground softening under the design earthquake defined under the 2014 Vancouver Building Bylaw.

We confirm from a geotechnical point of view that the proposed development is feasible provided the following recommendations are implemented in the design and construction of the development.

6.0 RECOMMENDATIONS

6.1 Site Preparation for Building

Prior to construction of foundations and floor slabs, all vegetation, topsoil, fill, organic material, debris, refuse and loose or otherwise disturbed soils must be removed from the construction areas to expose a subgrade of *dense to very dense unweathered Glacial Till or Sandstone Bedrock.* Stripping depths will likely be governed by slab and footing elevations, rather than soil conditions.

It is very important that the stripped subgrade should be blinded and protected by lean mix concrete to preserve their bearing qualities and that it remain dry and free of ponded water prior to pouring concrete for footings. Any soften, disturbed subgrade should be removed under a review of GeoPacific, and replaced with lean mix concrete beneath the foundations.

Any grade reinstatement beneath building foundations must be done with lean mix concrete. Any lean mix concrete placed should have an unconfined compressive strength of at least 5 MPa at 28 days.

hydraulically connected to the perimeter drainage system to facilitate the removal of any water which accumulates under the slab. Elevator pits and sumps may be tanked rather than lowering the perimeter drainage system in these areas.

The geotechnical engineer shall be contacted for the review of the slab subgrade and underslab materials and compaction.

6.4 Foundation Drainage

A perimeter drainage system will be required for the below grade structure to prevent the development of water pressure on the foundation walls and the basement floor slabs. Groundwater flows are expected to be relatively light. Flow rates should be confirmed at the time of construction by the mechanical designer. Preliminary design can be based on 30 litres / min for the entire site.

6.5 Temporary Excavation, Shoring and Underpinning

Shoring will be required around the perimeter of the site in order to construct the proposed below grade portion of the structure. It is our opinion that the natural soils are sufficiently strong that vertical cuts may be supported with the use of an anchored shotcrete shoring system.

This is the most appropriate method for this site and it is typically the most economical method of shored excavation. Furthermore, we expect the use of conventional anchors is feasible for the majority of the site. However, hollow core (self-drilling) anchors should be anticipated in sandy zones within the till. Underpinning will be required beneath the neighbouring building to the west.

Our observations during our site investigation as well as our experience in this area indicate that cobbles and boulders may be present within the native soils. Cobbles and small boulders can typically be removed with conventional excavation equipment. However, large boulders may require splitting / blasting to facilitate their removal from the site.

Some ground movements should be expected during installation of the shoring system. Based on the soil conditions identified in the test holes and our experience with similar sites, we expect movements of up to about 10 mm at face of excavation, decreasing to 3 mm at 3 m back of the excavation face.

Light to moderate perched groundwater water flows should be expected although we expect that inflows could be handled with conventional sumps and sump pumps.

Shoring and underpinning installation requires review at the time of tie back anchor installations and trimming of panels, prior to shotcrete applications and during tensioning of the tie back anchors.

Temporary cut slopes in excess of 1.2 m in height require inspection by a professional engineer in accordance with WorkSafe B.C. guidelines.

The geotechnical engineer shall be contacted for the review of shoring installation and temporary excavations.

6.6 Earth Pressures on Foundation Walls

Earth pressures against the foundation walls are dependent on factors such as, available lateral restraint

8.0 CLOSURE

This report has been prepared exclusively for our Client for the purpose of providing geotechnical recommendations for the design and construction of the proposed residential development, temporary excavations and related earthworks. The report remains the property of GeoPacific Consultants Ltd. and unauthorised use of, or duplication of, this report is prohibited.

We are pleased to assist you with this project and we trust that this information is helpful and sufficient for your purposes at this time. Should you require any further details or if you would like clarification of any of the above, please do not hesitate to call or contact us.

For:

GeoPacific Consultants Ltd.

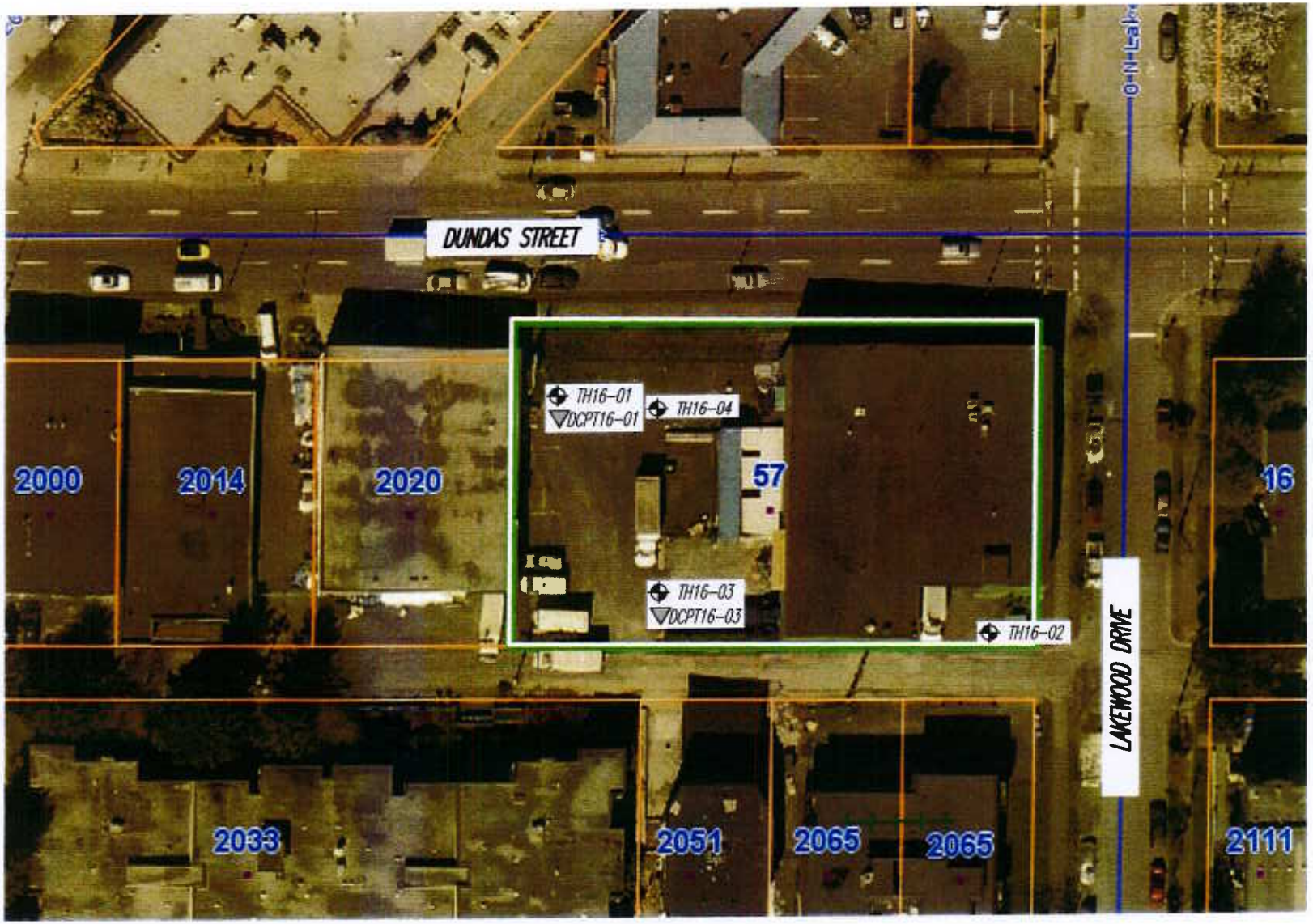
Reviewed by:



JUN 0 6 2017

Kyle Doyle, B. Eng, EIT
Geotechnical Engineer in Training

Matt Kokan, M.A.Sc., P.Eng.
Principal



LEGEND:

- TH17-# – TEST HOLE (TH) LOCATION
- DCPT17-# – DYNAMIC CONE PENETRATION TEST (DCPT) LOCATION
- SITE BOUNDARY

SITE PLAN

SCALE = 1:700

RECEIVED:

GEOPACIFIC
VANCOUVER KAMLOOPS CALGARY
1779 W. 75th Avenue
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DATE		
JUNE 04, 2017		
DESIGN BY: K.G.D	APPROVED BY: M.J.K.	DRAWN BY: M.J.K
SCALE: SEE ABOVE		

MIXED USE DEVELOPMENT

57 LAKEWOOD DRIVE, VANCOUVER, BC

TEST HOLE LOCATIONS

FILE NO.: 14947

REC. NO.: 14947-01

REVISIONS:

Appendix A – TEST HOLE DATA

Test Hole Log: TH17-01

File: 14947
Project: Mixed Use Development
Client: Champion Developments
Site Location: 57 Lakewood Drive, Vancouver, BC

GEOPACIFIC CONSULTANTS
1779 West 75th Avenue, Vancouver, BC, V6P 6P2
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INFERRED PROFILE

Depth (ft / m)	Symbol	SOIL DESCRIPTION	Depth (m)/Elev (m)	Moisture Content (%)	DCPT (blows per foot) 10 20 30 40	Groundwater / Well	Remarks
0 / 0		Ground Surface					
		FILL 4 inches of asphalt overlying dark brown, loose mixed fill.	0.0		2, 2, 3, 13, 19, >50, >50		
		SILT and SAND Mottled brown/grey, dense, silt and sand.	1.1				
		SAND Light brown, very dense, silty sand with trace gravel, wet.	2.1				
		TILL Grey, very dense, silty sand to sand with silt and gravel.		13.6%			
				12.0%			
		SANDSTONE Grey, dry sandstone.	6.4				
				9.5%			
		End of Borehole	9.1				

Logged: KGD
Method: Solid Stem Auger
Date: May 12, 2017

Datum: Existing Ground
Figure Number: A.01

Test Hole Log: TH17-02

File: 14947
Project: Mixed Use Development
Client: Champion Developments
Site Location: 57 Lakewood Drive, Vancouver, BC

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INFERRED PROFILE

Depth (ft)	Depth (m)	Symbol	SOIL DESCRIPTION	Depth (m)/Elev (m)	Moisture Content (%)	DCPT (blows per foot) 10 20 30 40	Groundwater / Well	Remarks
0	0		Ground Surface					
			FILL 4 inches of asphalt overlying compact, red brown sand with silt.	0.0				
	1		***SAND*** Light brown, compact to dense silty sand.	1.5				
	2		***SAND*** Light brown, dense, silty sand with trace gravel.		8.7%			
	3		***TILL*** Grey, very dense, silty sand to sand with silt and gravel. Between 25 - 40 feet driller reports very difficult to drill.	3.0	8.9%			
	4							
	5							
	6							
	7							
	8							
	9							
	10				12.2%			
	11							
	12				10.7%			
40			End of Borehole	12.2				

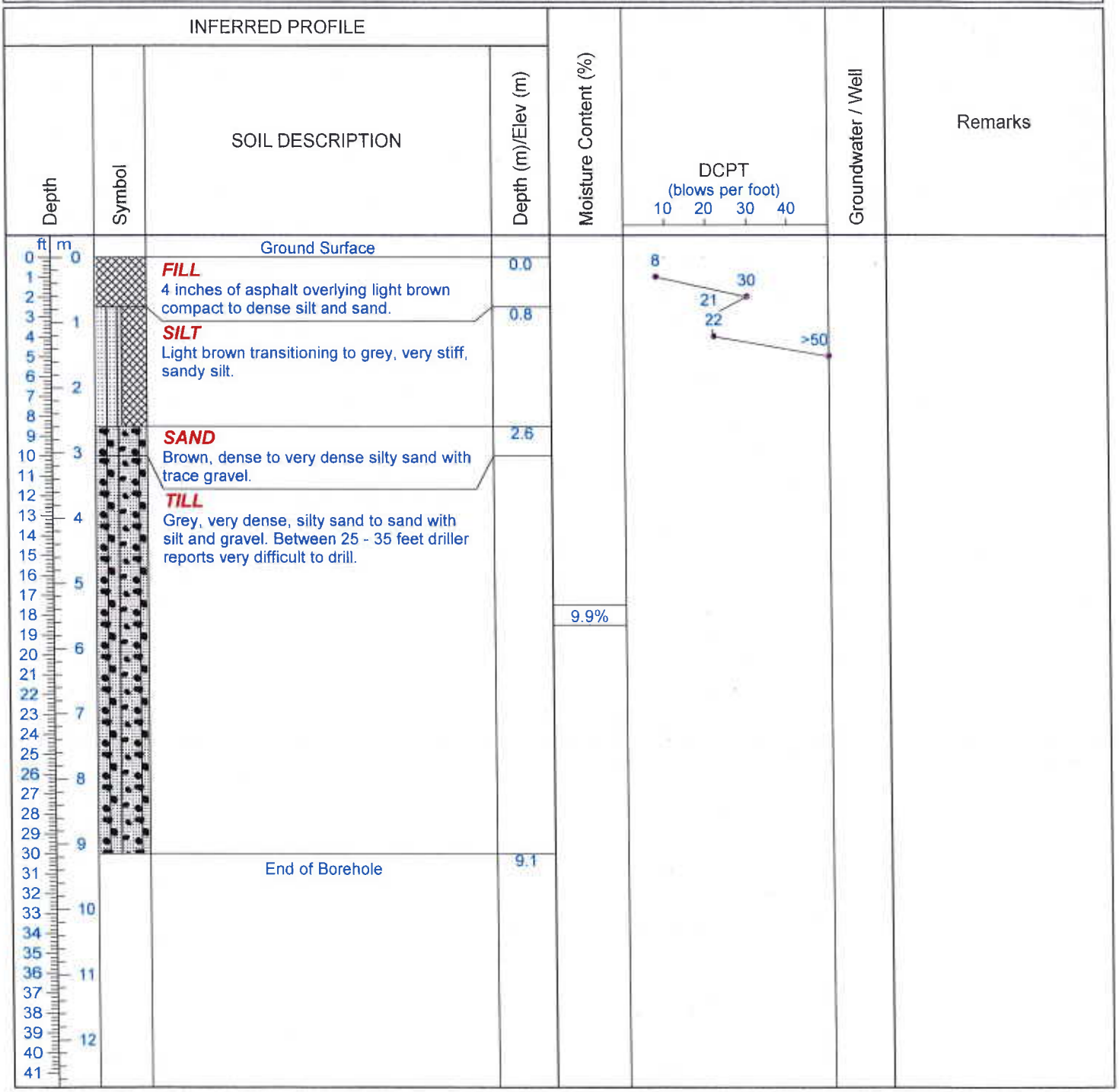
Logged: KGD
Method: Solid Stem Auger
Date: May 12, 2017

Datum: Existing Ground
Figure Number: A.02
Page: 1 of 1

Test Hole Log: TH17-03

File: 14947
Project: Mixed Use Development
Client: Champion Developments
Site Location: 57 Lakewood Drive, Vancouver, BC

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Logged: KGD
Method: Solid Stem Auger
Date: May 12, 2017

Datum: Existing Ground
Figure Number: A.03
Page: 1 of 1

Test Hole Log: TH17-04

File: 14947
Project: Mixed Use Development
Client: Champion Developments
Site Location: 57 Lakewood Drive, Vancouver, BC

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INFERRED PROFILE

Depth (ft / m)	Symbol	SOIL DESCRIPTION	Depth (m)/Elev (m)	Moisture Content (%)	DCPT (blows per foot) 10 20 30 40	Groundwater / Well	Remarks
0 / 0		Ground Surface					
0–3 / 0–1		***FILL*** 4 inches of asphalt overlying light brown compact to dense silt and sand.	0.0 – 0.6				
3–5 / 1–1.5		***SILT*** Light brown, very stiff, sandy silt.	0.6 – 1.5				
5–24 / 1.5–7.3		***TILL*** Grey, very dense, silty sand to sand with silt and gravel. Between 25 - 35 feet driller reports very difficult to drill.	1.5 – 7.3	15.7%			
24–25 / 7.3–7.6		***SANDSTONE*** Grey, medium grained sandstone.	7.3				
25 / 7.6		End of Borehole					

Logged: KGD
Method: Solid Stem Auger
Date: May 12, 2017

Datum: Existing Ground
Figure Number: A.04
Page: 1 of 1