GEOPACIFIC
VANCOUVER KAMLOOPS CALGARY

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New Commons Developments
304-134 Abbott Street
Vancouver, B.C.
V6B 2K4

January 19th, 2020
File: 18407

Attention: Aida Kudic

Re: Geotechnical Investigation Report: Proposed Residential Development
409 Porlier Pass Road, Galiano Island, B.C.

1.0 INTRODUCTION

We understand that a new residential development is proposed for the above referenced site on Galiano Island. Based on a preliminary site schematic provided by Mobius Architecture, dated October 29th, 2020, the proposed development will consist of 20 residential units, distributed between two triplex buildings, one sixplex building and one eightplex building constructed at grade.

We expect wood framed construction above grade and reinforced concrete for foundations. We would anticipate structural loading to be relatively light.

This report presents our recommendations for the design and construction of the proposed development and temporary excavations, based on our field investigation and experience in the immediate area. This report has been prepared exclusively for our client, for their use, the use of others on the design team as well as for the Capital Regional District (CRD) in the development and permitting process.

2.0 SITE DESCRIPTION

The site is located northwest of the Porlier Pass-Georgeson Bay-Sturdies Bay Road intersection on Galiano Island, B.C. The site is currently unimproved and is bounded by Porlier Pass Road to the north, Georgeson Bay Road to the south, and forested property to the east and west. The site is irregular in shape, with an approximate area of 10 acres. The has been roughly graded, with 4 terraced lots excavated into the bedrock, as shown on the preliminary topographic profile provided by Mobius Architecture. The terraced lots step down from northwest to southeast with an elevation difference of about 12 metres between the upper lot and the lower lot, over a horizontal distance of about 115 metres. The average gradient on site is approximately 10%.

The location of the site as well as existing on-site improvements are shown on the attached plan, drawing No. 18407-01, following the text of this report.

The preliminary site schematic/topographic profile provided by Mobius Architecture, dated October 29th, 2020 is provided in Appendix B following the text of this report.

3.0 FIELD INVESTIGATION

GeoPacific completed an investigation of the soil conditions at the site on January 12th, 2020 using a small tracked excavator supplied and operated by Treeline Contracting of Galiano Island, B.C. At that time, a total of eight test pits were excavated to depths of up to 1.5 m below grade or effective refusal. The test pits were logged in the field by a member of our technical staff and backfilled immediately upon completion of

logging and sampling. The detailed test pit logs are presented in Appendix A, following the text of this report.

The approximate locations of the test pits completed by GeoPacific are shown on our Drawing No. 18407-01, following the text of this report. All depths are referenced from the existing ground surface at the test pit locations.

4.0 SUBSURFACE CONDITIONS

4.1 Published Geology

According to "Northern Vancouver Island - Geology" – (Map 2013-NVI-1-1) published by Geoscience BC, the region is understood to be underlain by the Nanaimo Group, consisting of "boulder, cobble and pebble conglomerate, coarse to fine sandstone, siltstone, shale and coal" and Quaternary Cover, consisting of "alluvium, glaciofluvial gravels and sand and till".

4.2 Soil Conditions

A general description of the soils encountered at the site during our investigation is provided below. For specific subsurface soil descriptions at each test hole location, please review our test hole logs in Appendix A, following this report.

TOPSOIL/SILTY SAND LOAM

Organic topsoil, followed by silty sand loam was noted at the surface of all test hole locations. The silty sand is generally loose, fine-grained, moist and reddish-orange in colour. An approximately 1.50 m layer of loose to compact silty sand fill was noted at test hole locations TP21-03 and TP21-08, respectively.

WEATHERED SANDSTONE BEDROCK

Weathered sandstone bedrock was encountered at all test hole locations beneath the topsoil/silty sand loam. Depths to bedrock varied across the site, generally ranging between 0.6 and 1.5 m below grade.

For specific soil descriptions at each of our test hole locations, refer to our test hole logs in Appendix A of this report.

4.2 Groundwater Conditions

The static groundwater table was not encountered during our investigation, and is expected to be well below the proposed development grades. Perched groundwater was also not encountered during our investigation, however perched groundwater should be expected to form within the topsoil/silty sand overlying the weathered sandstone. We expect any groundwater seepage flows could be controlled using conventional sumps and sump pumps.

5.0 DISCUSSION

5.1 General

Based on preliminary information provided to us, the proposed development will consist of 20 residential units, distributed between two triplex buildings, one sixplex building and one eightplex building constructed at grade.

We have no detailed structural information at present, however we anticipate loading to be light, in the range of 1,000 kN and 100 kN/m on columns and walls respectively. Slab on grade loading is expected to be relatively light.

We expect wood framed construction above grade and reinforced concrete for foundations. Based on the anticipated foundation elevations and observed ground conditions, we expect that the buildings can be supported on conventional spread and strip footings founded on weathered sandstone bedrock, as described in Section 4.2.

To accommodate the proposed structures, we anticipate that temporary excavation depths will be 0.5 to 1.5 m below the current grades. Therefore, no special excavation measures are anticipated. Our design recommendations for temporary excavations are provided in Section 6.6.

The subsurface soils are not expected to be prone to liquefaction or other forms of ground softening under the design earthquake defined under the 2018 British Columbia Building Code.

We confirm, from a geotechnical point of view, that the proposed development is feasible provided that the recommendations outlined in the following sections are incorporated into the overall design and construction.

6.0 RECOMMENDATIONS

6.1 Site Preparation

Prior to construction of foundations and floor slabs, all unsuitable materials including vegetation, topsoil, fill, organic material, debris, and loose or otherwise disturbed soils must be removed to expose a subgrade of weathered sandstone bedrock. Some localized over excavation may be required in areas with loose to compact topsoil/silty sand.

Should grade reinstatement be required, we recommend the use of engineered fill. "Engineered Fill" is defined as clean sand to sand and gravel containing silt and clay less than 5 % by weight, compacted in 300 mm loose lifts to a minimum of 95% Modified Proctor maximum dry density at a moisture content that is within 2% of optimum for compaction.

The geotechnical engineer shall be contacted for the review of stripping and engineered fill placement and compaction.

6.2 Foundations and Bearing Capacity

Footings which are founded on *weathered sandstone bedrock* can be designed for a Serviceability Limit States (SLS) bearing pressure of 250 kPa. Factored ultimate limit state (ULS) bearing pressures, for transient loads such as those induced by wind and earthquakes, may be taken as 1.5 x the SLS bearing pressures provided above. Typically, in this type of bedrock, a level building pad is excavated or blasted, and the recovered rock is used to shape the pad.

Irrespective of the allowable bearing pressures given, pad footings should not be less than 600 mm by 600 mm and strip footings should not be less than 450 mm in width. Foundations should also be buried a minimum of 460 mm below the surface for frost protection.

Post construction settlement of foundations designed as recommended should be less than 25 mm total and 20 mm over a 10 m differential.

The exposed subgrade soils should be protected by lean mix concrete to preserve its bearing qualities and that it remains free of ponded water prior to pouring concrete for footings. Any softened, disturbed, or otherwise unsuitable subgrade should be removed and replaced with engineered fill.

Foundation subgrades must be inspected by GeoPacific prior to footing construction.

6.3 Seismic Design of Foundations

Based on the anticipated subsurface conditions, we recommend that the building be designed in accordance with Site Class B (Bedrock) spectral parameters as defined in Table 4.1.8.4.A of the 2018 British Columbia Building Code (BCBC). According to Natural Resource Canada, peak ground acceleration on firm ground for the approximate site location is 0.48 g.

The soils beyond the depth of foundations are not considered prone to ground liquefaction or other forms of ground softening caused by earthquake induced ground motions.

6.4 Slab-On-Grade Floors

In order to provide suitable support for slab-on-grade floors we recommend that any fill placed under the slab should be "engineered fill" as described in Section 6.1 above.

The floor slab should be directly underlain by a minimum of 150 mm of 19 mm clear crushed gravel fill to inhibit upward migration of moisture beneath the slab. The crushed gravel fill should be compacted to a minimum of 95% of the ASTM D1557 (Modified Proctor) maximum dry density at a moisture content that is within 2% of optimum for compaction. A moisture barrier should be installed directly beneath the slab directly above the free draining granular material.

The GeoPacific shall be contacted for the review of the slab subgrade and under slab materials and compaction.

6.5 Site and Foundation Drainage Systems

For slab on grade construction, a perimeter drainage system intended to control subsurface groundwater is not required provided that slab elevations are at least 100 mm above surrounding parking and landscape grades.

All drains should be designed to prevent migration of fines and should be hydraulically connected to the under-slab fill to ensure that water pressures cannot develop beneath the slab.

6.6 Temporary Excavations

We estimate that excavation depths will range from 0.5 to 1.5 m below existing grade. We expect that any temporary excavations would be sloped where possible. Our recommended temporary slope cut angles are provided in Table 1 below.

Table 1: Recommended Maximum Temporary Cut Slope Angle

Material	Slope Angle (V:H)
Topsoil/Silty Sand	1:1
Weathered Sandstone	4:2

Excavations in excess of 1.2 metres in height, requiring man-entry, require inspection by a professional engineer in accordance with Worker's Compensation Board (WCB) guidelines.

Some seepage into excavations from surficial fills should be expected. We envisage that groundwater inflows can generally be controlled with conventional sumps and sump pumps.

6.7 Utility Design and Installation

Site utilities will be required beneath the slabs-on-grade. The design of these systems must consider the locations and elevations of the foundations. The service trenches and excavations required for the installation of the underground pipes, vaults and/or manholes must be located outside of a 1.5:1 (H:V) slope measured downward from the edge of adjacent foundations.

All excavations and trenches must conform to the latest Occupational Health and Safety Regulation supplied by the Worker Compensation Board of British Columbia. Any excavation in excess of 1.2 m in depth requiring worker entry must be reviewed by a professional geotechnical engineer.

All excavations and trenching must conform to the latest WorkSafeBC requirements.

6.8 On-Site Roads and Parking

The recommended pavement thickness for the proposed roads and parking lots within the development are shown in Table 1 below.

Table 1: Recommended Minimum Pavement Structure

Material	Thickness (mm)
Asphaltic Concrete	75
Crushed gravel base course – 19 mm minus	100
Clean sand and gravel sub-base course, well graded – 75 mm minus	200

Asphalt can be reduced to 65 mm in parking areas to be occupied by automobiles and light trucks only. The base and sub-base should also be compacted to the specifications outlined in section 6.1.

Density testing should be conducted on the subbase and base materials and reviewed by the geotechnical engineer.

6.9 Slope Stability

As mentioned above, the site slopes gradually from northwest to southeast across the site, with an average gradient of about 10%. No steep slopes are located within or near the site, and the site is underlain by competent weathered sandstone bedrock. We confirm from a geotechnical standpoint that all slopes on the site are stable, and the proposed development is not expected to impact the stability of slopes onsite.

7.0 DESIGN REVIEWS AND CONSTRUCTION REVIEWS

As required for Municipal "Letters of Assurance", GeoPacific Consultants Ltd. will carry out sufficient field reviews during construction to ensure that the geotechnical design recommendations contained within this report have been adequately communicated to the design team and to the contractors implementing the design. These field reviews are not carried out for the benefit of the contractors and therefore do not in any way effect the contractors' obligations to perform under the terms of his/her contract.

It is the contractors' responsibility to advise GeoPacific Consultants Ltd. (a minimum of 48 hours in advance) that a field review is required. Field reviews are normally required at the time of the following activities:

1. Site Stripping/Excavation	Review of temporary slopes and soil conditions.
3. Engineered Fill	Review of materials and compaction degree.
4. Foundation	Review of foundation subgrade.
5. Slab-on Grade	Review of under slab fill materials and compaction.

It is critical that these reviews are carried out to ensure that our intentions have been adequately communicated. It is also critical that contractors working on the site view this document in advance of any work being carried out so that they become familiar with the sensitive aspects of the works proposed. It is the responsibility of the developer to notify GeoPacific Consultants Ltd. when conditions or situations not outlined within this document are encountered.

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 development. The report remains the property of GeoPacific Consultants Ltd. and unauthorized use of, or duplication of this report is prohibited.

We are pleased to be of assistance to you on this project and we trust that our comments and recommendations are both helpful and sufficient for your current purposes. If you would like further details or would like clarification of any of the above, please do not hesitate to call.

For:
GeoPacific Consultants Ltd.

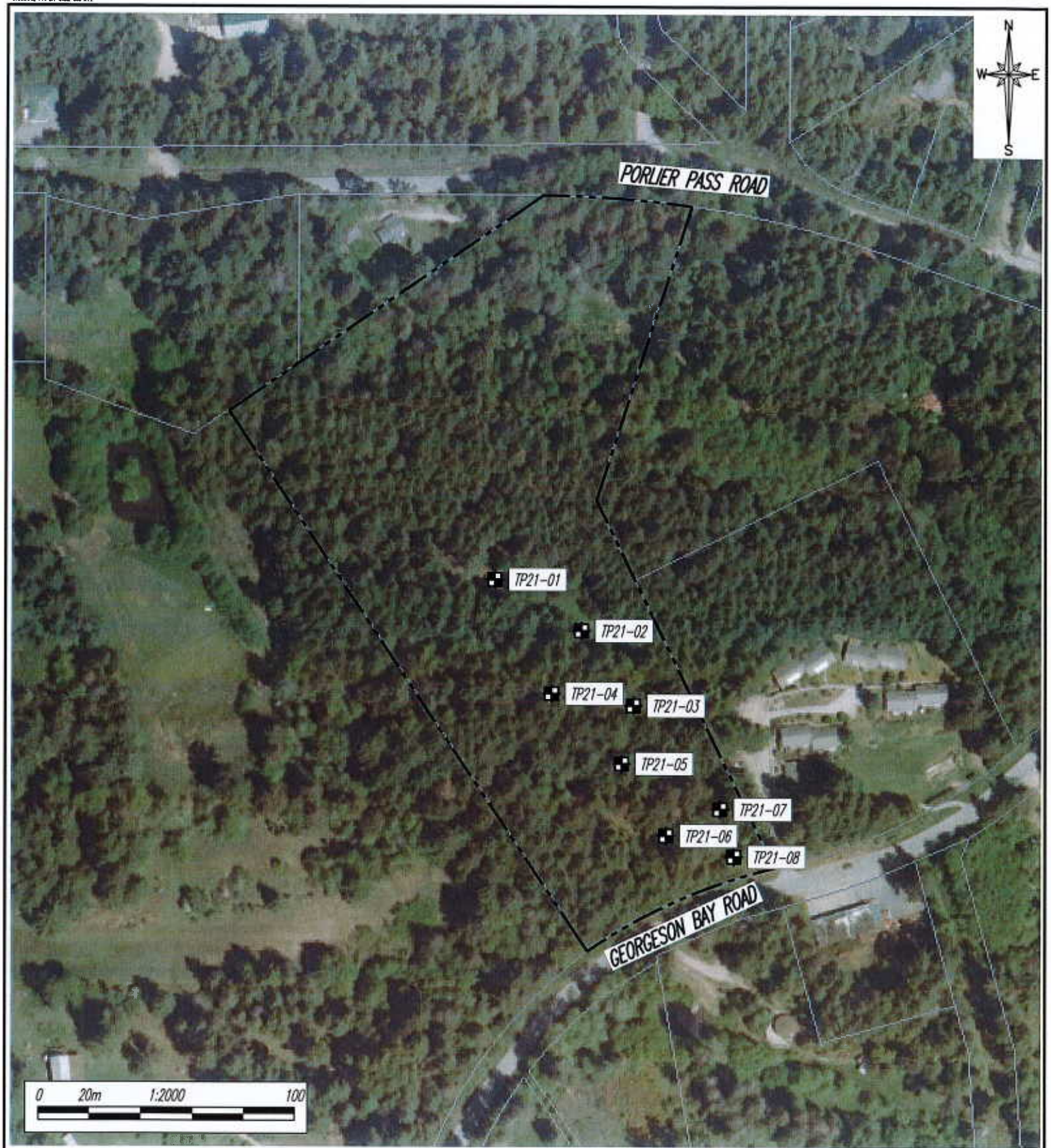
Reviewed By:

JAN 2 0 2021

James Carson, B.A.Sc., E.I.T.
Project Manager

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

ORIGINAL PAPER SIZE 8.5"x11"



LEGEND:

TP19-# – TEST PIT (TP) LOCATION

SITE PLAN

1:2000

*TEST LOCATIONS ARE APPROXIMATE

REVISIONS:
A.
B.
C.

FILE NO.: 18407

DWG. NO.: 18407-01

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DATE: JANUARY 19, 2021		
DRAWN BY: N.K.	APPROVED BY: M.J.K.	REVIEWED BY: J.C.
SCALE: AS SHOWN		

PROPOSED RESIDENTIAL DEVELOPMENT

407 PORLIER PASS ROAD, GALIANO ISLAND, B.C.

TEST PIT LOCATION PLAN

APPENDIX A – TEST PIT LOGS

Test Pit Log: TP21-01

File: 18407
Project: Residential Development
Client: New Common Developments
Site Location: 409 Porlier Pass Road

GEOPACIFIC CONSULTANTS
215 - 1200 West 73rd Avenue, Vancouver, BC, V6P 6G5
Tel: 604-439-0922 Fax:604-439-9189

INFERRED PROFILE						
Depth	Symbol	SOIL DESCRIPTION	Depth/Elev (ft)	Moisture Content (%)	Groundwater	Remarks
ft / m		Ground Surface				
0		***TOPSOIL/SILTY SAND LOAM*** 200 mm of TOPSOIL over loose SILTY SAND LOAM, moist, redish-orange	1.0			
1		***SANDSTONE / SILTSTONE*** Fractured / weathered SANDSTONE / SILTSTONE bedrock, dry, tan-brown	2.0			
2		End of Test Pit				Excavator refusal at 0.6 m
3						
1						
4						
5						
6						

Logged: BSS
Method: Mini Excavator
Date: 2021-01-12

Datum: Ground Elevation
Figure Number: A.01

Test Pit Log: TP21-02

File: 18407
Project: Residential Development
Client: New Common Developments
Site Location: 409 Porlier Pass Road

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INFERRED PROFILE

Depth (ft / m)	Symbol	SOIL DESCRIPTION	Depth/Elev (ft)	Moisture Content (%)	Groundwater	Remarks
0 / 0		Ground Surface				
		TOPSOIL/SILTY SAND LOAM 200 mm of TOPSOIL over loose SILTY SAND LOAM, moist, redish-orange	1.0			
1		***SANDSTONE / SILTSTONE*** Fractured / weathered SANDSTONE / SILTSTONE bedrock, dry, tan-brown	2.0			
2		End of Test Pit				Excavator refusal at 0.6 m
3 / 1						
4						
5						
6						

Logged: BSS
Method: Mini Excavator
Date: 2021-01-12

Datum: Ground Elevation
Figure Number: A.02

Test Pit Log: TP21-03

File: 18407
Project: Residential Development
Client: New Common Developments
Site Location: 409 Porlier Pass Road

GEOPACIFIC CONSULTANTS
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Depth (ft / m)	Symbol	SOIL DESCRIPTION	Depth/Elev (ft)	Moisture Content (%)	Groundwater	Remarks
0 / 0		Ground Surface				
		TOPSOIL/SILTY SAND LOAM 200 mm TOPSOIL over loose SILTY SAND LOAM, moist, redish-orange	1.0			
1		***SANDY SILT*** Dense to very dense SANDY SILT, till-like, moist, tan-brown	4.0			
4		***SANDSTONE / SILTSTONE*** Fractured / weathered SANDSTONE / SILTSTONE bedrock, dry, tan-brown	5.0			
5		End of Test Pit				Excavator refusal at 1.5 m
6						
1						

Logged: BSS
Method: Mini Excavator
Date: 2021-01-12

Datum: Ground Elevation
Figure Number: A.03

Test Pit Log: TP21-04

File: 18407
Project: Residential Development
Client: New Common Developments
Site Location: 409 Porlier Pass Road

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Depth (ft / m)	Symbol	SOIL DESCRIPTION	Depth/Elev (ft)	Moisture Content (%)	Groundwater	Remarks
0 / 0		Ground Surface				
		TOPSOIL/SILTY SAND LOAM 200 mm of TOPSOIL over loose SILTY SAND LOAM, moist, redish-orange	1.0			
1		***SANDY SILT*** Dense to very dense SANDY SILT, till-like, moist, tan-brown	3.0			
3 / 1		***SANDSTONE / SILTSTONE*** Fractured / weathered SANDSTONE / SILTSTONE bedrock, dry, tan-brown	4.0			
4		End of Test Pit				
5						Excavator refusal at 1.2 m
6						

Logged: BSS
Method: Mini Excavator
Date: 2021-01-12

Datum: Ground Elevation
Figure Number: A.04

Test Pit Log: TP21-05

File: 18407
Project: Residential Development
Client: New Common Developments
Site Location: 409 Porlier Pass Road

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INFERRED PROFILE

Depth (ft / m)	Symbol	SOIL DESCRIPTION	Depth/Elev (ft)	Moisture Content (%)	Groundwater	Remarks
0 / 0		Ground Surface				
		TOPSOIL/SILTY SAND LOAM 200 mm of TOPSOIL over loose SILTY SAND LOAM, moist, redish-orange	1.5			
		SANDY SILT Dense to very dense SANDY SILT, till-like, moist, tan-brown	2.5			
		SANDSTONE / SILTSTONE Fractured / weathered SANDSTONE / SILTSTONE bedrock, dry, tan-brown	4.0			
		End of Test Pit				Excavator refusal at 1.2 m

1 m
2 ft
3 m
4 ft
5 m
6 ft

Logged: BSS
Method: Mini Excavator
Date: 2021-01-12

Datum: Ground Elevation
Figure Number: A.05

Test Pit Log: TP21-06

File: 18407
Project: Residential Development
Client: New Common Developments
Site Location: 409 Porlier Pass Road

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INFERRED PROFILE				Moisture Content (%)	Groundwater	Remarks
Depth (ft / m)	Symbol	SOIL DESCRIPTION	Depth/Elev (ft)			
0 / 0		Ground Surface				
		TOPSOIL/SILTY SAND LOAM 200 mm of TOPSOIL over loose SILTY SAND LOAM, moist, redish-orange	1.5			
		SANDSTONE / SILTSTONE Fractured / weathered SANDSTONE / SILTSTONE bedrock, dry, tan-brown	3.0			
3 / 1		End of Test Pit				Excavator refusal at 0.9 m
4						
5						
6						

Logged: BSS
Method: Mini Excavator
Date: 2021-01-12

Datum: Ground Elevation
Figure Number: A.06

Test Pit Log: TP21-07

File: 18407
Project: Residential Development
Client: New Common Developments
Site Location: 409 Porlier Pass Road

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INFERRED PROFILE

Depth (ft / m)	Symbol	SOIL DESCRIPTION	Depth/Elev (ft)	Moisture Content (%)	Groundwater	Remarks
0 / 0		Ground Surface				
		TOPSOIL/SILTY SAND LOAM 200 mm of TOPSOIL over loose SILTY SAND LOAM, moist, redish-orange	1.5			
		SANDY SILT Dense to very dense SANDY SILT, till-like, moist, tan-brown	2.5			
		SANDSTONE / SILTSTONE Fractured / weathered SANDSTONE / SILTSTONE bedrock, dry, tan-brown	4.0			
		End of Test Pit				Excavator refusal at 1.2 m

Logged: BSS
Method: Mini Excavator
Date: 2021-01-12

Datum: Ground Elevation
Figure Number: A.07

Test Pit Log: TP21-08

File: 18407
Project: Residential Development
Client: New Common Developments
Site Location: 409 Porlier Pass Road

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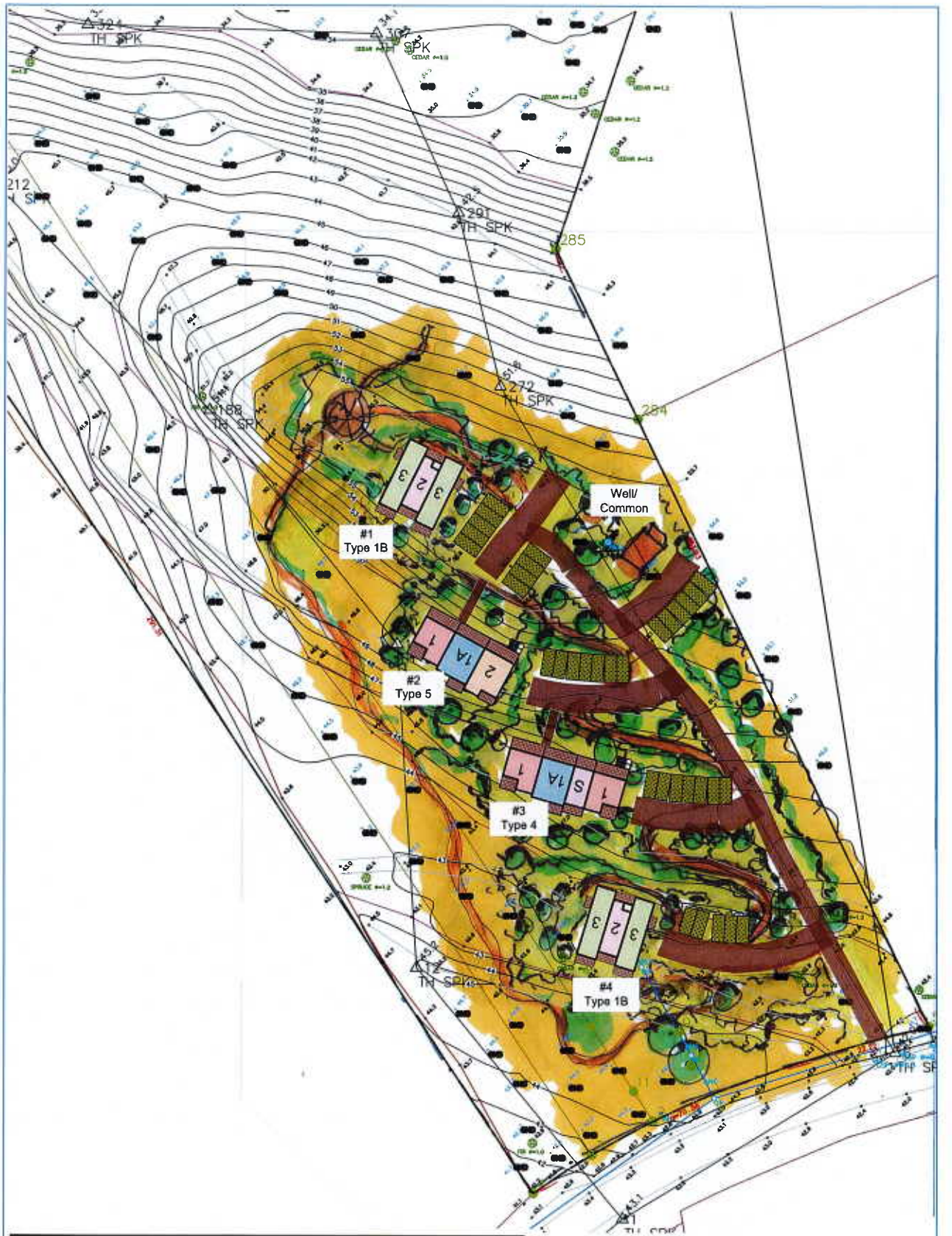
Depth (ft / m)	Symbol	SOIL DESCRIPTION	Depth/Elev (ft)	Moisture Content (%)	Groundwater	Remarks
0 / 0		Ground Surface				
		TOPSOIL/SILTY SAND LOAM 200 mm of TOPSOIL over loose SILTY SAND LOAM, moist, redish-orange	1.5			
		SANDY SILT Dense to very dense SANDY SILT, till-like, moist, tan-brown	4.0			
		SANDSTONE / SILTSTONE Fractured / weathered SANDSTONE / SILTSTONE bedrock, dry, tan-brown	5.0			
		End of Test Pit				Excavator refusal at 1.5 m

Logged: BSS
Method: Mini Excavator
Date: 2021-01-12

Datum: Ground Elevation
Figure Number: A.08

APPENDIX B-

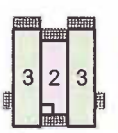
PRELIMINARY SITE SCHEMATIC



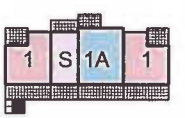
Scheme E:

Building Number	Building Type	Studio	1 bed	2 bed	3 bed
1	Type 1B			1	2
2	Type 5		4	2	
3	Type 4	2	6		
4	Type 1B			1	2
Total		2	10	4	4

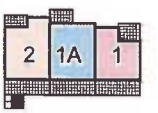
20



Type 1B
(3 Units)



Type 4
(8 Units)



Type 5
(6 Units)

Mobius ARCHITECTURE

Date: October 29, 2020
Scale: 1/64" = 1'-0"

Galiano Green

Scheme E 2.5