CITY OF VANCOUVER

CITY CLERK'S DEPARTMENT
Access to Information & Privacy

File No.: 04-1000-20-2020-218

May 28, 2020

s.22(1)

Dear s.22(1)

Re: **Request for Access to Records under the Freedom of Information and Protection of Privacy Act (the "Act")**

I am responding to your request of March 31, 2020 for:

> **Geotechnical report by Thurber Engineering Ltd. regarding lands at 480 Broughton Street as part of the Coal Harbour Phase II project.**
> **Date range: January 1, 2017 to December 31, 2017.**

All responsive records are attached.

Under section 52 of the Act you may ask the Information & Privacy Commissioner to review any matter related to the City's response to your request. The Act allows you 30 business days from the date you receive this notice to request a review by writing to: Office of the Information & Privacy Commissioner, info@oipc.bc.ca or by phoning 250-387-5629.

If you request a review, please provide the Commissioner's office with: 1) the request number assigned to your request (#04-1000-20-2020-218); 2) a copy of this letter; 3) a copy of your original request for information sent to the City of Vancouver; and 4) detailed reasons or grounds on which you are seeking the review.

Please do not hesitate to contact the Freedom of Information Office at foi@vancouver.ca if you have any questions.

Yours truly,

Cobi Falconer, FOI Case Manager, for

[Signature on file]

Barbara J. Van Fraassen, BA
Director, Access to Information & Privacy

Barbara.vanfraassen@vancouver.ca
453 W. 12th Avenue Vancouver BC V5Y 1V4

*If you have any questions, please email us at foi@vancouver.ca and we will respond to you as soon as possible. Or you can call the FOI Case Manager at 604.871.6584.

Encl.

:kt

THURBER ENGINEERING LTD.

celebrating 60 YEARS

June 16, 2017 File: 17566

City of Vancouver
Vancouver City Hall
453 West 12th Avenue
Vancouver, BC
V5Y 1V4

Attention: Christiaan Iacoe, P.Ag.

GEOTECHNICAL ASSESSEMENT COAL HARBOUR PARCEL 1.5 DEVELOPMENT
480 BROUGHTON STREET, VANCOUVER, BC

Dear Christiaan:

Thurber Engineering Ltd. has completed an environmental and geotechnical investigation at 480 Broughton Street (Parcel 1.5 or Lot 12) in Vancouver, BC. This letter describes our understanding of the project, summarizes the results of our investigation and provides preliminary geotechnical comments and recommendations regarding site preparation, foundation design, and basement wall pressure design.

It is a condition of this letter that Thurber's performance of its professional services is subject to the attached Statement of Limitations and Conditions.

1. BACKGROUND

We understand the City intends to develop 480 Broughton Street as per the Proposed Mixed Use Development Plan for Coal Harbour Parcels 1.1 and 1.5, dated February 24, 1997. Phase 1 of that plan included the construction of the Coal Harbour Community Centre on Parcel 1.1 (or Lot 13), which was carried out in the late 1990s and early 2000s.

Phase 2 includes the construction of a school, daycare, and non-market housing building on Parcel 1.5 (the Site), which is currently used as a paved parking lot for the Community Centre. The construction plan includes an eight to nine-storey high building (daycare and housing) with one to two levels of below grade (school and gym).

Our scope of work was to carry out a geotechnical assessment of the Site and provide geotechnical comments and recommendations regarding site preparation and permanent design for the proposed development.

Information provided to us by the City for our review included:

- Geotechnical Report by Macleod Geotechnical Ltd. titled: *Coal Harbour Community Centre and Parkade*, dated March 4, 1998.

- Seawalk Assessment Report by WorleyParsons titled: *2012 Coal Harbour Seawalk Condition Assessment*, dated January 24, 2013.

- Structural Record Drawings S1 to S4, S10 and S11 by C.Y. Loh Associates Ltd. for the Coal Harbour Community Centre Phase 1, dated February 6, 2002.

- Report for Preliminary Development Permit Application by Henriquez Partners titled: *Proposed Mixed Use Development Coal Harbour Parcels 1.1 & 1.5 for City of Vancouver*, dated February 24, 1997.

The geotechnical report and the structural record drawings for the Coal Harbour Community Centre do not reference the version of the Vancouver Building By-laws used. However, it is likely that the 1987 by-laws were used for design. The existing community centre is supported on pile foundations. The piles comprise a combination of expanded base and timber or steel pipe. Macleod's report describes a 15 m wide densified zone along the north side of the site to reduce the potential for lateral soil movement during the design earthquake. Additionally, the piling plan shows a 10 m wide densification zone within the footprint of the existing building. These plans have been attached in Appendix B for reference. No information regarding the design of the densified zones for the Community Centre or the seawall were available to us. However, we assume that vibro-replacement (stone columns) were installed during densification.

2. PROGRAM OF WORK

2.1 Preparation for Fieldwork, and Review of Existing Information

Prior to conducting our field investigation, we reviewed information in our files as well as publicly available surficial geology maps. A BC One Call was completed to obtain underground utility information prior to starting fieldwork. Further, we reviewed background information provided by the City. Relevant test holes logs from Macleod's 1998 report have been incorporated into this letter.

2.2 Geotechnical Investigation

On April 21, 2017, Western Leakage Services Ltd. was retained by Thurber to scan each of the proposed test hole locations for underground utilities. Based on the results of the utility scan, the test hole locations were adjusted in the field to avoid a utility strike. A total of eight potential drilling locations were marked in the field.

On April 24, 2017, Thurber mobilized Sea to Sky Drilling Ltd.'s truck mounted wash bore rotary drill rig to conduct our investigation. Two wash bore rotary test holes (TH17-01 and TH17-02) were advanced to 9.8 and 12.2 m depth, respectively. Standard Penetration Tests (SPTs) were completed at 1.5 m intervals and representative disturbed samples were collected from the SPT split spoon sampler and returned to our laboratory in Vancouver for routine visual classification and moisture content testing. Both test holes were terminated 3 m below the surface of bedrock. Upon completion, the test holes were grouted and sealed in general compliance with groundwater

protection regulations. The test holes were logged in the field by an experienced Thurber engineer.

At TH17-01, we encountered poor sample recovery within the top 5.5 m of soil. Further, due to the spacing of the SPT samples, a soil layer at TH17-02 was not visually recorded. Therefore, to supplement the wash bore rotary drilling, a Thurber geotechnical engineer was on site on April 26, 2017 to log the auger holes during the environmental investigation.

2.3 Results

The results of the drilling and laboratory testing are provided on the attached test hole logs. The logs provide complete and detailed descriptions of the soil and groundwater conditions encountered during the investigation and must be used in preference to the generalized descriptions provided below.

A generalized soil stratigraphy is provided in the Table 1.

Table 1 – Soil Stratigraphy

Unit	Elevation (m)	Thickness (m)	Description
1	4.3 to -0.7	3.9 to 5.75	Sand to silty sand to gravelly (fill). - Loose to dense. - Water content varies from 9% to 31%. - SPT blow counts range from 6 to 31 blows / 300 mm.
2a	0.3 to -2.1	0.6 to 1.6	Woodwaste with trace to some silt and traces of sand and gravel. - Loose to compact / firm. - Water content varies from 189% to 373%. - SPT blow counts range from 6 to 10 blows / 300 mm.
2b	-0.7 to -7.4	0.7 to 3.7	Medium to coarse sand to silty sand to some silt and shell fragments (beach deposit). - Very loose. - Water content varies from 25% to 27%. - SPT blow count of 2 blows / 300 mm. - Not encountered in TH17-1.
4	-1.9 to -7.4	0.3 to 2.2	Silty sand to sandy silt to silt (glacial marine). - Hard. - Water content varies from 16% to 26%. - SPT blow counts of 96 blows / 300 mm.
5	-0.5 to -4.5	Not investigated	Siltstone to sandstone (bedrock). - Hard. - Water content varies from 13% to 30%. - SPT blow counts vary from 61 to >100 blows / 300 mm.

The groundwater level was measured in environmental monitoring wells on April 27, 2017 and May 3, 2017. The groundwater depth varied from 3.6 to 4.8 m. Given that the site is located adjacent to Coal Harbour, the groundwater levels are anticipated to be influenced by tide levels.

3. GEOTECHNICAL COMMENTS AND RECOMMENDATIONS

3.1 Site Preparation

Existing underground services and utilities within the proposed building footprint should be relocated or terminated at the property line. Construction would comprise excavation of fill and native soils within the building area down to proposed grades. Due to the proximity of the neighbouring community centre, road and seawall, installation of a shoring system would be required to provide temporary lateral support to the sides of the excavation.

3.2 Ground Improvement

The densification zones discussed in Macleod's report and shown on C.Y.'s drawings were likely designed to pervious by-law requirements and would not likely provide adequate lateral resistance to the liquefied soils. Therefore, to limit liquefaction and lateral movement of the underlying soils, consideration should be given to completing ground improvement. Given the presence of woodwaste and silty soil do not densify using ground improvement using techniques such as installation of stone columns. Therefore, other ground improvement methods should be investigated.

The existing densification berms are likely designed to a previous building code and the performance of the berms may not meet current code requirements. Therefore, the resistance to liquefaction and lateral movement of the existing berms during the design earthquake are not known. Given this uncertainty, the benefits of these berms should be ignored until further information is available.

Ground improvement using deep soil mixing could be considered to limit soil liquefaction/lateral movement of soil. Additionally, consideration could be given to supporting the portions of the building on top of the improved soil mass. For preliminary design, the deep soil mixing should be located along the north side of the of the building and return along a portion of the west side of the building/site. The mixing should extent down to Units 4 or 5 and have a lateral width of between 0.7 and 1 times the depth from the underside of foundation to the top of the competent soil. The actual length and width of the improved soil mass can be refined during the detailed design stage.

3.3 Foundation Design

Conceptual design drawings for the proposed development by Henriquez Partners show that the lowest floor level at El. 0.987 m. The proposed structure could be supported on a combination of spread footings and deep foundations (piles) bearing on Units 4 or 5. The test hole logs show that the top surface of Units 4 and 5 (foundation soil), slopes from south to north and varies from about El. -0.5 to -1.9 m. However, it is not clear if the original design will be revised.

The test hole logs show that the site is underlain by fill of varying density/consistency over woodwaste and loose sand to sandy silt to silt (beach or bottom deposits). These deposits will not provide adequate support for the proposed building foundations unless they are improved by soil mixing. Footings or piles should be founded on the underlying till-like soil and bedrock (Units 4 and 5).

Foundations for the proposed structure could include one of the following options. Option 1, support the southern portion of the proposed structure on spread footings bearing on Units 4 and 5. At a given distance, the foundation would transition to large diameter drilled shafts/pile foundations. This assumes that no ground improvement will be completed to limit liquefaction and lateral spread of the underlying soils during the seismic event.

Option 2, as above, at the southern end of the building, the building could be supported on spread footings bearing on Units 4 or 5. At the north end of the building improve the soil mass (as described in Section 3.2) to limit the effects of liquefaction and lateral movement of soil. Foundations for the north end of the building could possibly be supported on the improved soil mass. To provide foundation support between the spread footings at the south and the improved soil mass to the north, small diameter steel pipe piles could be used.

3.4 Spread Footings

Where depth to foundation soils (Units 4 or 5) is relatively shallow, portions of the building could be supported on spread footings. For Ultimate Limit State design, a factored bearing resistance of 900 kPa with a geotechnical foundation factor, $\Phi = 0.5$ may be used for foundation design. This assumes that the bearing soils will comprise undisturbed glacial marine till-like soil (Unit 4) or bedrock (Unit 5). When the excavation down to foundation soil is impractical, pile supported foundations should be considered.

3.5 Deep Foundations / Piles

As described in Section 3.3, portions of the proposed structure could be supported on deep foundations (steel pipe piles or shafts) that extend down into Units 4 or 5. The piles would likely be required to be drilled into the soil to achieve the required axial and lateral resistance. In Option 1, it is assumed that no measures would be completed to limit liquefaction/lateral movement of soil. For this option, consideration should be given to installing large diameter (say 1.5 to 2 m) piles to resist inertial loads and kinematic soil movement during the design seismic event.

In Option 2, if a ground improvement measures are completed, small diameter (say, 610 mm) steel pipe piles could be installed (drilled in) between the improved soil mass and the spread footings (to the south) to provide foundation support for the structure.

During the detailed design stage and when design loads are available, the pile size and axial compression resistance could be provided. It is not known if tension resistance will be required from the piles. However, this can be reviewed during the detailed design stage.

3.6 Seismic Considerations

The existing community centre was likely designed to the 1987 Vancouver Building By-laws. The proposed structure will likely be designed to the 2014 Vancouver Building By-laws. The structural engineer should assess if a structural separation between the existing and the proposed structure will be required as the two structures would likely respond differently during a seismic event.

3.6.1 Site Class

For spread footings bearing on the till-like soil or bedrock, Site Class C would be suitable for foundations design. Site Class F, would be suitable for pile foundations at this location. For Site Class F, a site specific response analysis should be completed during the detailed design phase of the project. The structural engineer should assess the potential challenges associated with a structure that is partially supported on spread footings and on piles.

3.6.2 Liquefaction

The test hole logs show that the north end of the site is underlain by loose to dense sand to silty sand (fill) and soft / very loose silt to silty sand and sand (beach deposits). These deposits are likely susceptible to seismically induced liquefaction or strain softening. During the design seismic event, these soils will likely experience strength loss and which would result in settlement of the ground surface and lateral movement of the soil. Estimates of post liquefaction settlements and lateral flow slide should be addressed during the detailed design stage.

3.7 Basement Wall Design

In Appendix C of the Macleod report is a letter discussing flood potential for the Community Centre. Groundwater levels are reported to vary from El. 0 to 1.5 m along the north side and greater than El. 2.0 m on the south side of the existing building.

The groundwater level fluctuations are not known at this site. Therefore, we have assumed that the basement walls will likely be affected by hydrostatic pressure (groundwater or tidal action) depending on final design depth of the building. Therefore, consideration should be given to waterproofing or tanking the basement to reduce the likelihood of infiltration of water and to resist hydrostatic pressure or the installation of a pumping / permanent drainage system. However, if the groundwater level is determined to be lower than the underside of proposed floor elevation tanking of the basement would not be required and groundwater seepage could likely be managed with pumped sumps.

3.8 Backfill

Perimeter backfill adjacent to City of Vancouver property should be in completed in general compliance with the City of Vancouver's Street Restoration Manual.

3.9 Construction

It is anticipated that temporary shoring will be required to provide lateral support to the sides of the excavation. Temporary shoring systems could comprise the installation of sheet piles, jet grout columns, secant piles, etc. that are embedded into the underlying till-like soil or bedrock. The benefits of these systems are that they can provide a cut-off to reduce the likelihood of migration of groundwater into the excavation. Additionally, installation of dewatering wells may also be required to lower the groundwater table or reduce infiltration into the excavation.

These are temporary construction issues and are typically the responsibility of the general contractor.

3.10 Key Considerations for Next Phase

a. The lateral extent and an understanding of the seawalk and the community centre densification berm should be investigated. This information may be available from exp Services Inc. (formerly Macleod Geotechnical Ltd.).

b. Long term monitoring of the groundwater level to gain further understanding of the groundwater regime. Installation of additional groundwater monitoring wells may be required.

c. For Site Class F, a Site Specific Ground Response Analysis should be completed to provide input for structural design.

d. Detailed assessment of liquefaction and lateral spreading (lateral loads) during the seismic event. This may include development of numerical model.

THURBER

60 YEARS

4. CLOSURE

As required by By-Law 17 of the BC Professional Engineers and Geoscientist Act, we inform you that we carry Professional Liability Insurance.

We trust that this information is sufficient for your needs. Should you require clarification of any item or additional information, please contact us at your convenience.

Yours truly,
Thurber Engineering Ltd.
David Regehr, P.Eng.
Review Principal

Simon Paxton, EIT
Project Engineer

Gunther Yip, P.Eng.
Project Manager

Statement of Limitations and Conditions

Appendix A:
Test Hole Location Plan
Elevation Looking East
Test Hole Logs
Symbols and Terms

Appendix B:
Test Hole Logs (by Others)
Structural Record Drawings (by C.Y. Loh Associates Ltd.)

THURBER

STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

5. INTERPRETATION OF THE REPORT

a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.

d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

THURBER

APPENDIX A

Plotted: June 6, 2017

LEGEND:
- TEST HOLE
- TEST HOLE (BY OTHERS)
- PROPERTY LINE

NOTES:
1. BASE PLAN TAKEN FROM CITY OF VANCOUVER'S OPEN DATABASE (2015 AERIAL SHOWN).
2. TEST HOLE LOCATIONS ARE APPROXIMATE.

THURBER ENGINEERING LTD.

CLIENT: CITY OF VANCOUVER

TEST HOLE LOCATION PLAN

480 BROUGHTON STREET VANCOUVER B.C.

DESIGNED	DRAWN	APPROVED
SMP	MOM	
DATE	SCALE	
06/06/17	1:500	
PROJECT No.	DWG. No.	REV.
17566	1	0

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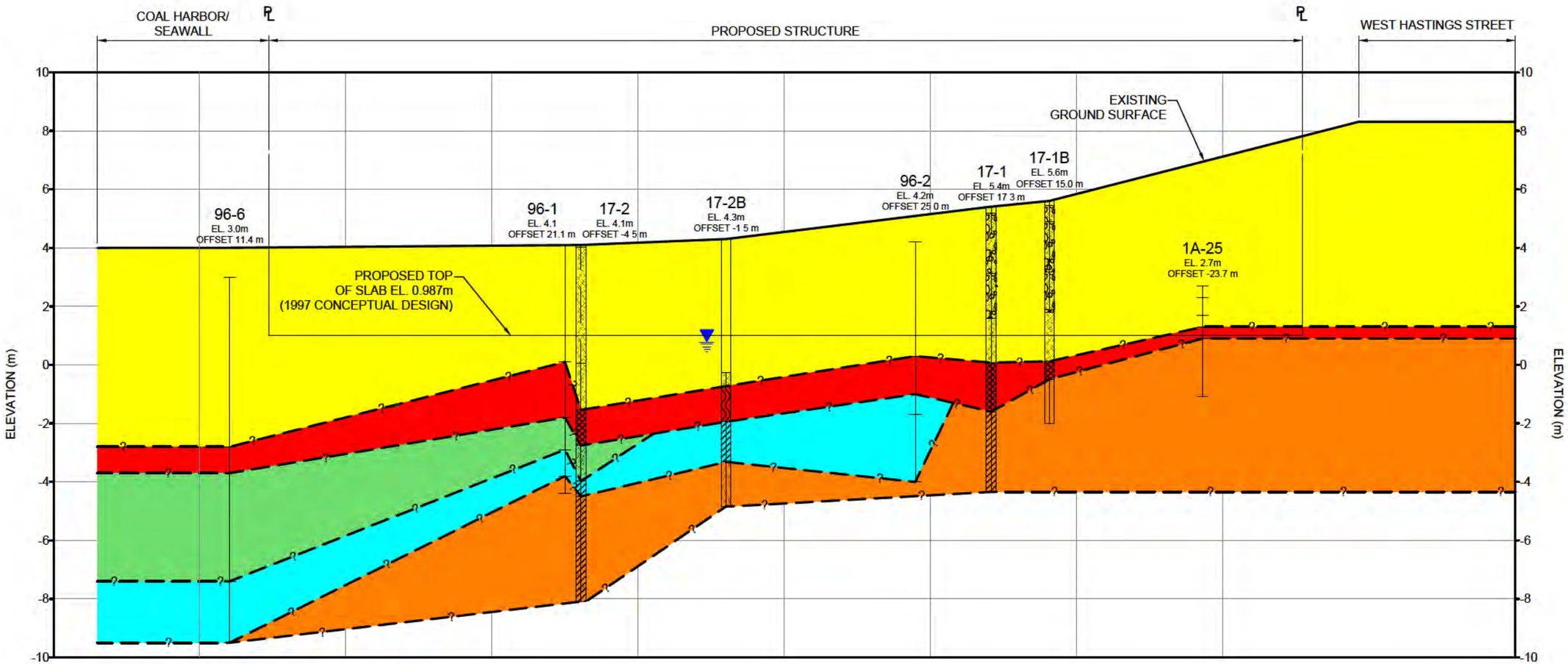
CANCEL PRINTS BEARING EARLIER NUMBER

Plotted: June 14, 2017



HORIZONTAL SCALE 0 5 10 15m

VERTICAL SCALE 0 2.5 5.0 7.5m

LEGEND:

- FILL
- SILTSTONE / SANDSTONE (BEDROCK)
- WOODWASTE
- SILTY SAND TO SAND
- SILT TO SILTY SAND / SANDY SILT (TILL-LIKE)
- WATER LEVEL

THURBER ENGINEERING LTD.

480 BROUGHTON STREET VANCOUVER B.C.

CLIENT: CITY OF VANCOUVER

ELEVATION LOOKING EAST

DESIGNED	DRAWN	APPROVED
GTY	NAK	

DATE	SCALE
08/06/17	H=1:300 V=1:150

PROJECT No.	DWG. No.	REV.
17566	2	0

CANCEL PRINTS BEARING EARLIER NUMBER

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Sheet 1 of 2

LOG OF TEST HOLE

TEST HOLE NO. **17-1**

LOCATION: See Dwg. 17566-1

TOP OF HOLE ELEV: 5.4 m (est.)
METHOD: Mud Rotary
DRILLING CO.: Sea to Sky Drilling Services Ltd.
INSPECTOR: SMP

THURBER

CLIENT: City of Vancouver
PROJECT: 480 Broughton Street

DATE: April 24, 2017
FILE NO.: 17566

PENETRATION (blows/300 mm) | WATER CONTENT (%): ○ Disturbed ● Undisturbed | WATER LEVEL: Plastic Limit — Liquid Limit | SAMPLES: ◧ Disturbed ■ Undisturbed ☒ No Recovery | UNDRAINED SHEAR STRENGTH (kPa): ◆ Peak ◇ Residual ◆ Remolded | GRAIN SIZE (%): ▲ Passing #200 sieve △ Passing #4 sieve | SOIL HEADSPACE READING (ppm): ■ GASTECH reading ⊠ PID reading

DEPTH (m)	COMMENTS		SOILS DESCRIPTION	ELEVATION (m)
0			GRASS and TOPSOIL (150 mm).	5
1		SM	Compact to loose, brown to grey, moist SAND with some silt and gravel and traces of clay, organics and coal (FILL).	4
2				
3	Driller noted a change in soil at 2.3 m depth based on drill action. Mostly smooth drilling, occasional grinding sound on rocks	SM	Dense. brown to grey, moist, silty SAND with some gravel and a trace of clay (FILL).	3
4				2
5	Water El. measured April 27, 2017 from TH17-01DM Water El. measured May 3, 2017 from TH17-01DM	SM	Loose, grey, wet, sitly SAND with traces of clay and organics (FILL).	1
6	189 ○ Drill return lost at 6.1 m depth	WOOD	Loose, brown, moist WOODWASTE with some silt and traces of sand and gravel (FILL).	0 -1
7	Hard drilling below 7.0 m depth SPT refusal. 100 blows for 150 mm of penetration	CL/ML	Hard, grey to brown, moist SILT with some clay and traces of organics and oxidation (SILTSTONE).	-2
8				-3
9	SPT refusal. 50 blows for 75 mm of penetration	CL		-4
10	SPT refusal. 100 blows for 300 mm of penetration	CL/ML	End of test hole at required depth.	

LOG OF TEST HOLE 17566.GPJ PRACTICE MARLON.GDT 5/18/17- THURBER BC NEW.GLB

Sheet 2 of 2

LOG OF TEST HOLE

TEST HOLE NO. **17-1**

LOCATION: See Dwg. 17566-1

TOP OF HOLE ELEV: 5.4 m (est.)
METHOD: Mud Rotary
DRILLING CO.: Sea to Sky Drilling Services Ltd.
INSPECTOR: SMP

THURBER

CLIENT: City of Vancouver
PROJECT: 480 Broughton Street

DATE: April 24, 2017
FILE NO.: 17566

PENETRATION (blows/300 mm) | WATER CONTENT (%): ○ Disturbed ● Undisturbed | WATER LEVEL: Plastic Limit — Liquid Limit | SAMPLES: ◧ Disturbed ■ Undisturbed ☒ No Recovery | UNDRAINED SHEAR STRENGTH (kPa): ◆ Peak ◇ Residual ◆ Remolded | GRAIN SIZE (%): ▲ Passing #200 sieve △ Passing #4 sieve | SOIL HEADSPACE READING (ppm): ■ GASTECH reading ⊠ PID reading

DEPTH (m)	10 20 30 40 50 60 70 80 90 100	COMMENTS	SOILS DESCRIPTION	ELEVATION (m)
10			Test hole grouted to 3.8 m depth. Bentonite chips and cuttings to surface.	-5
11				-6
12				-7
13				-8
14				-9
15				-10
16				-11
17				-12
18				-13
19				-14
20				

LOG OF TEST HOLE 17566.GPJ PRACTICE MARLON.GDT 5/18/17- THURBER BC NEW.GLB

Sheet 1 of 1

LOG OF TEST HOLE

TEST HOLE NO. **17-1B**

LOCATION: See Dwg. 17566-1

TOP OF HOLE ELEV: 5.6 m (est.)
METHOD: SSA
DRILLING CO.: On-Track Drilling Inc.
INSPECTOR: SMP

THURBER

CLIENT: City of Vancouver
PROJECT: 480 Broughton Street

DATE: April 24, 2017
FILE NO.: 17566

PENETRATION (blows/300 mm) | WATER CONTENT (%): ○ Disturbed ● Undisturbed | WATER LEVEL: Plastic Limit — Liquid Limit | SAMPLES: ◧ Disturbed ■ Undisturbed ☒ No Recovery | UNDRAINED SHEAR STRENGTH (kPa): ◆ Peak ◇ Residual ◆ Remolded | GRAIN SIZE (%): ▲ Passing #200 sieve △ Passing #4 sieve | SOIL HEADSPACE READING (ppm): ■ GASTECH reading ⊠ PID reading

DEPTH (m)	COMMENTS		SOILS DESCRIPTION	ELEVATION (m)
0			GRASS and TOPSOIL (150 mm).	
		SM	Grey, moist, gravelly SAND with some silt (FILL).	5
1		SM	Brown, moist, gravelly SAND with some silt (FILL).	
2				4
		SM/GM	- moist to wet below 2.1 m depth	
		SM	Grey, moist, gravelly SAND with some silt (FILL).	3
3				
		SM	- some gravel and organics and a trace of oxidation below 3.4 m depth	2
4		SP-SM	Grey, moist SAND with traces of silt and gravel (FILL).	
				1
5			- moist to wet below 4.9 m depth	
		SP-SM		
	213	WOOD	Brown, moist WOODWASTE with traces of silt, clay and organics (FILL).	0
6			Blue to grey, dry SILT with traces of clay and oxidation (SILTSTONE).	
				-1
7	Hard drilling below 7.0 m depth	ML		
				-2
8			End of hole at required depth. No water was observed upon completion of drilling. Hole stayed open to 4.4 m depth.	
				-3
9				
				-4
10				

LOG OF TEST HOLE 17566.GPJ PRACTICE MARLON.GDT 5/18/17- THURBER BC NEW.GLB

Sheet 1 of 2

LOG OF TEST HOLE

TEST HOLE NO. **17-2**

LOCATION: See Dwg. 17566-1

CLIENT: City of Vancouver
PROJECT: 480 Broughton Street

TOP OF HOLE ELEV: 4.1 m (est.)
METHOD: Mud Rotary
DRILLING CO.: Sea to Sky Drilling Services Ltd.
INSPECTOR: SMP

THURBER

DATE: April 24, 2017
FILE NO.: 17566

PENETRATION (blows/300 mm) | WATER CONTENT (%): ○ Disturbed ● Undisturbed | WATER LEVEL: Plastic Limit — Liquid Limit | SAMPLES: ◧ Disturbed ■ Undisturbed ☒ No Recovery | UNDRAINED SHEAR STRENGTH (kPa): ◆ Peak ◇ Residual ◆ Remolded | GRAIN SIZE (%): ▲ Passing #200 sieve △ Passing #4 sieve | SOIL HEADSPACE READING (ppm): ■ GASTECH reading ☒ PID reading

DEPTH (m)	COMMENTS		SOILS DESCRIPTION	ELEVATION (m)
0		GP-GM	GRASS and TOPSOIL (75 mm). Loose to compact, brown, moist SAND with some silt and a trace of gravel and organics (FILL).	4
1		SM		3
2				2
3		SM		1
4		SP-SM / SM		0
5	Hydrocarbon-like odour between 4.1 and 5.6 m depth		Loose, grey to brown, moist SAND with some silt and traces of gravel, organics and zones of grey silt (FILL).	-1
6	373 Driller noted wood at 5.6 m depth based on drill action	WOOD	Compact, brown, wet WOODWASTE with traces of sand and silt (FILL).	-2
7		SM	Very loose, grey, wet, silty SAND with some silt, shell fragments and a trace of organics.	-3
8	Driller noted a change in soil at 6.6 m depth based on drill action		Stiff, brown, moist, clayey SILT with traces of sand and oxidation.	-4
9	104	CL / ML / ML	Hard, grey, sandy SILT with some clay and occasional grey and black lenses (interbedded SILTSTONE and SANDSTONE)	-5
10				

LOG OF TEST HOLE 17566.GPJ PRACTICE MARLON.GDT 5/18/17- THURBER BC NEW.GLB

Sheet 2 of 2

LOG OF TEST HOLE

TEST HOLE NO. 17-2

LOCATION: See Dwg. 17566-1

CLIENT: City of Vancouver
PROJECT: 480 Broughton Street

TOP OF HOLE ELEV: 4.1 m (est.)
METHOD: Mud Rotary
DRILLING CO.: Sea to Sky Drilling Services Ltd.
INSPECTOR: SMP

THURBER

DATE: April 24, 2017
FILE NO.: 17566

PENETRATION (blows/300 mm) | WATER CONTENT (%): ○ Disturbed ● Undisturbed | WATER LEVEL: Plastic Limit — Liquid Limit | SAMPLES: ◧ Disturbed ■ Undisturbed ☒ No Recovery | UNDRAINED SHEAR STRENGTH (kPa): ◆ Peak ◇ Residual ◆ Remolded | GRAIN SIZE (%): ▲ Passing #200 sieve △ Passing #4 sieve | SOIL HEADSPACE READING (ppm): ■ GASTECH reading ⊠ PID reading

DEPTH (m)	COMMENTS		SOILS DESCRIPTION	ELEVATION (m)
10	SPT refusal. 50 blows for 125 mm of penetration	ML	Hard, grey, sandy SILT with some clay and occasional grey and black lenses (interbedded SILTSTONE and SANDSTONE)	-6
11				-7
12	SPT refusal. 100 blows for 200 mm of penetration	SP-SM	- 5 mm thick seam of coal at 11.7 m depth	-8
13			End of hole at required depth. Test hole grouted to 2.1 m depth. Bentonite chips and cuttings to surface.	-9
14				-10
15				-11
16				-12
17				-13
18				-14
19				-15
20				

LOG OF TEST HOLE 17566.GPJ PRACTICE MARLON.GDT 5/18/17- THURBER BC NEW.GLB

Sheet 1 of 1

LOG OF TEST HOLE

TEST HOLE NO. **17-2B**

LOCATION: See Dwg. 17566-1

TOP OF HOLE ELEV: 4.3 m (est.)
METHOD: SSA
DRILLING CO.: On-Track Drilling Inc.
INSPECTOR: SMP

THURBER

CLIENT: City of Vancouver
PROJECT: 480 Broughton Street

DATE: April 26, 2017
FILE NO.: 17566

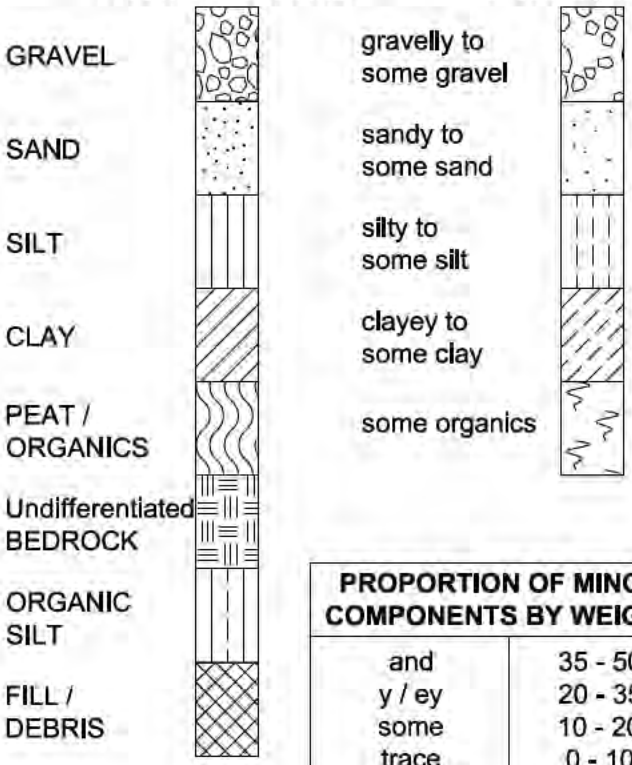
PENETRATION (blows/300 mm) | WATER CONTENT (%): ○ Disturbed ● Undisturbed | WATER LEVEL: Plastic Limit — Liquid Limit | SAMPLES: ◧ Disturbed ■ Undisturbed ☒ No Recovery | UNDRAINED SHEAR STRENGTH (kPa): ◆ Peak ◇ Residual ◆ Remolded | GRAIN SIZE (%): ▲ Passing #200 sieve △ Passing #4 sieve | SOIL HEADSPACE READING (ppm): ■ GASTECH reading ⊠ PID reading

DEPTH (m)	COMMENTS	SOILS DESCRIPTION	ELEVATION (m)
0		Soil not logged between 0 and 4.6 m depth.	4
1			3
2			2
3	Water El. measured on April 27, 2017 Water El. measured on May 3, 2017 Water El. measured at time of drilling		1
4			0
5	357 ○ Soil consistency inferred	SM Grey, wet, SAND with some silt and traces of gravel and organics (FILL). PT Firm, brown, moist, WOODWASTE (FILL).	-1
6			-2
7	Hard drilling below 7.3 m depth	ML Very stiff to hard, brown, moist SILT with some clay and traces of sand and oxidation.	-3
8		ML Grey, moist, sandy SILT with traces of clay, organics and siltstone fragments (WEATHERED BEDROCK).	-4
9			
10		End of test hole at required depth. Test hole stayed open to 6.7 m depth. Water was observed at 3.7 m depth upon completion of drilling.	-5

LOG OF TEST HOLE 17566.GPJ PRACTICE MARLON.GDT 5/18/17- THURBER BC NEW.GLB

SYMBOLS AND TERMS
FOR SOIL DESCRIPTION AND TEST HOLE LOGS

BASIC SOIL SYMBOLS



SYMBOL VARIATIONS - EXAMPLES[1]

DENSITY OF GRANULAR SOILS	
Description	SPT N[5][6]
Very Loose	0 - 4
Loose	4 - 10
Compact	10 - 30
Dense	30 - 50
Very Dense	> 50

PROPORTION OF MINOR COMPONENTS BY WEIGHT[2]	
and	35 - 50%
y / ey	20 - 35%
some	10 - 20%
trace	0 - 10%

CONSISTENCY OF COHESIVE SOILS	
Description	Undrained Shear Strength (kPa)[6]
Very Soft	< 12
Soft	12 - 25
Firm	25 - 50
Stiff	50 - 100
Very Stiff	100 - 200
Hard	> 200

PENETRATION TESTS	
Dynamic Cone Penetration	
Standard Penetration	
Becker Closed Casing	
Becker Open Casing	
Bounce Chamber Pressure	

CLASSIFICATION BY PARTICLE SIZE				
		Size Range[6]		
			U.S. Standard Sieve Size	
Name		(mm)[3]	Retained	Passing
Boulders		> 200	8 inch	-
Cobbles		75 - 200	3 inch	8 inch
Gravel:	coarse	19 - 75	0.75 inch	3 inch
	fine	5 - 19	No. 4	0.75 inch
Sand:	coarse	2 - 5	No. 10	No. 4
	medium	0.4 - 2	No. 40	No. 10
	fine	0.075 - 0.4	No. 200	No. 40
Fines (Silt or Clay)[4]		< 0.075	-	No. 200

(1) Only selected examples of the possible variations or combinations of the basic symbols are illustrated.
(2) Example: SAND, silty, trace of gravel = sand with 20 to 35% silt and up to 10% gravel, by dry weight. Percentages of secondary materials are estimates based on visual and tactile assessment of samples.
(3) Approximate metric conversion.
(4) Fines are classified as silt or clay on the basis of Atterberg limits.
(5) SPT N values on test hole logs are uncorrected field values.
(6) Reference Canadian Foundation Engineering Manual 4th Edition, 2006.

THURBER

THURBER

BOREHOLE No. 96 - 01

LOCATION: SEE TEST HOLE LOCATION PLAN

GROUND SURFACE ELEVATION: 3.8 m (approx.)
(geodetic)

WATER TABLE ELEVATION: (approx.)
(at time of investigation)

EQUIPMENT: Sonic Drill Rig
4 inch inside diameter casing .

● Grab samples from core.

depth, ft.	depth, m.	elevation (m)	symbol	SOIL DESCRIPTION	sample no.	water content, %	
0	0	3.8					
	1		●	**silty SAND / sandy SILT** **trace to some gravel** **grey / brown**	**S1**		
5	2						
			●	**reddish brown sand**	**S2**		
10	3			**(FILL)**			
	4	-0.2					
			●		**S3**		
15	5			**Woodwaste, reddish-brown** **shredded and pieces of wood**			**- hole sloughed at 18.5 ft**
			●		**S4**		
20	6	-2.1	●	**medium to coarse SAND**	**S5**		**- old beach ? – 8.7% Passing No200 Sieve**
			●	**- trace silt - contains shells**	**S6**		
	7	-3.2	●		**S9**	23.5	
25			●	**12 " grey silty SAND / sandy SILT over weathered brown SILTSTONE**	**S7**	23.2	**- weathered till - like soil**
	8	-4.1	●	**grey SILTSTONE**	**S8**	15.3	**- drilling got harder at 24 ft**
		-4.7					
30	9			**Bottom of Hole At 28 ft**			
	10						
35	11						
	12						
40	13						
45	14						
	15						
50							
	16						

MARATHON DEVELOPMENTS	MACLEOD GEOTECHNICAL LTD.		1451 Marine Drive West Vancouver, B.C. V7T 1B8
COAL HARBOUR PARK AND COMMUNITY CENTER	BOREHOLE LOG No. BH - 96 - 01	JOB No. X 29	Date: Nov, 1996
		Page: 1/1	By: PD
			Dwg.: BH 96-01

BOREHOLE No. 96 - 02

LOCATION: SEE TEST HOLE LOCATION PLAN

GROUND SURFACE ELEVATION: 4.3 m (approx.)
(geodetic)

WATER TABLE ELEVATION: (approx.)
(at time of investigation)

EQUIPMENT: Sonic Drill Rig
4 inch inside diameter casing .

● Grab samples from core.

depth, ft.	depth, m.	elevation (m)	symbol	SOIL DESCRIPTION	sample no.	water content, %	
0	0	4.2					
			●	**silty SAND / sandy SILT**	S1		
5	1			**trace gravel to gravelly**			
				grey / brown			
	2		●	**occasional piece of wood**	S2		
				till - like			
10	3			**medium to coarse sand with sandstone chunks**			
			●	**(FILL)**	S3		
	4	0.3					
15				**Woodwaste redish - brown**			
	5		●	**shredded wood and pieces**	S4		**- hydrogen sulphide smell ?**
		-1.0					
			●	**grey SAND, trace silt some shells**	S5		**- old beach ?**
20	6	-1.7	●		S6	20.0	**- drilling more difficult at 20 ft**
				12 " grey / green sandy SILT (till - like)			
	7		●	**overlying ;**	S7		
				grey SILTSTONE			
25		-3.6	●		S8		
	8			**Bottom of Hole At 25.5 ft**			
	9						
30							
	10						
35							
	11						
	12						
40							
	13						
45							
	14						
	15						
50							
	16						

MARATHON DEVELOPMENTS	MACLEOD GEOTECHNICAL LTD.	1451 Marine Drive West Vancouver, B.C. V7T 1B8	
COAL HARBOUR PARK AND COMMUNITY CENTER	BOREHOLE LOG No. BH - 96 - 02	JOB No. X 29	Date: Nov, 1996
		Page: 1/1	By: PD
			Dwg.: BH 96-02

BOREHOLE No. 96 - 06

LOCATION: SEE TEST HOLE LOCATION PLAN

GROUND SURFACE ELEVATION: 3.0 m (approx.)
(geodetic)

WATER TABLE ELEVATION: (approx.)
(at time of investigation)

EQUIPMENT: Sonic Drill Rig
4 inch inside diameter casing .

● Grab samples from core.

depth, ft.	depth, m.	elevation (m)	symbol	SOIL DESCRIPTION	sample no.	water content, %	
0	0	3.0					
				silty SAND / sandy SILT **grey - brown** **old concrete** **sand and gravel** **occasional pod of organics** **(FILL)**			
20	6	-2.8		**shredded wood waste and soil** **black, oily, hydrocarbon smell**			**- old pilings ?**
		-3.7		**grey medium SAND** **trace silty, occasional silty lense** **some shells**			**- blockage during drilling elevation of top of beach ???** **- old beach ?**
35	11	-7.4		**grey / green silty SAND / sandy SILT** **trace to some gravel** **TILL- LIKE**			**- firmer at 34 ft**
40	12	-9.5		**Bottom Of Hole At 41 ft**			
50	16						

MARATHON DEVELOPMENTS	MACLEOD GEOTECHNICAL LTD.	1451 Marine Drive West Vancouver, B.C. V7T 1B8	
COAL HARBOUR PARK AND COMMUNITY CENTER	BOREHOLE LOG No. BH - 96 - 06	JOB No. X 29	Date: Nov, 1996
		Page: 1/1	By: PD
			Dwg.: BH 96-06

PROJECT: 912-1035B

RECORD OF BOREHOLE 91-103

SHEET 1 OF 1

LOCATION: COAL HARBOUR

BORING DATE: OCT. 15-16/91

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3M	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m; SHEAR STRENGTH Cu, kPa; natV. + Q. ●; rem.V. ⊕ U. ○	HYDRAULIC CONDUCTIVITY, k, cm/s; WATER CONTENT, PERCENT Wp W Wl	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	MAYHEW 1000 FOUNDEX	0.07m ASPHALT		2.5 0.00	1	50 DO	9				
1											
2		Loose to compact brown sand, silt and gravel, some cobbles, small boulders and bricks, trace wood organics. (FILL)			2	50 DO	4				
3											
4					3	50 DO	9				
5											
6				-3.28 5.79	4	50 DO	23				
7		Soft to stiff grey SILT, some silty sand layers/pockets, trace clay and shells, some to trace gravel.			5	50 DO	4		○		
8					6	50 DO	PH				
9		Dense grey silty SAND, some gravel. (TILL)		-6.09 8.50	7	50 DO	96	-6	○		
10											
11		Very dense weakly cemented silty SAND, occasional horizontal silt partings. (Weakly cemented SANDSTONE?)		-8.13 10.62	8	50 DO	102		○		
12				-9.65							
13		Very hard dark grey laminated SILT/clayey SILT. Occasional thin brown organic partings. (Weakly cemented SILTSTONE?)		12.14	9	50 DO	61		○		
14											
15		End of Borehole		-12.42 14.98	10	50 DO	110		○		
16											
17											
18											
19											
20											

SHEAR STRENGTH Cu, kPa: 20 40 60 80

WATER CONTENT, PERCENT: Wp W Wl; 20 40 60 80

15 ◆ 5 PERCENT AXIAL STRAIN AT FAILURE

DEPTH SCALE

LOGGED: L.W.

CHECKED: N.W.

Golder Associates

04.11

Ph 1B

BORE HOLE LOG

CLIENT: Marathon Realty Company Limited
JOB NO: 5-061-04.11
SITE LOCATION: Coal Harbour, Vancouver, B.C.

Hole : BH 1A-25
Date : 92/06/03
Datum : ground surface +2.7m ±

NORECOL SUPERVISOR: S. Day
CONTRACTOR: Sonic Drilling
EQUIPMENT TYPE: Sonic Rig

DEPTH metres	SOIL DESCRIPTION	SAMPLE INT	SAMPLE NAME	OTHER
	Surface Conditions: Asphalt (15cm)			
0.0	Light grey sandy gravel, black staining, loose, dry, no odour		32501	
			32502	
1.0	Yellow sand with sandy silt inclusions, orange mottles, loose, damp, no odour		32503	
	Grey yellow sand, damp			
	Wood pieces, moist, hydrogen sulfide odour		10.9m	
2.0				
	Grey sandstone, saturated, mottled and stained yellow near top		32504	
3.0				
	E. O. H.			
4.0				
5.0				
6.0				
7.0				
8.0				

A0 066 001/05

GENERAL NOTES

1. This structure has been designed in accordance with the Vancouver Building By-Law 6134 including the design for seismic forces.

2. Read structural drawings together with architectural, mechanical and other drawings for detail dimensions, locations of door and window openings, duct work, recesses, inserts and other items. In the event of discrepancies between drawings, the more stringent requirements shall be followed.

3. See Architectural, Landscape, Mechanical and Electrical drawings for depressions, pads, curbs, trenches in slabs etc.

4. Verify all dimensions and examine site conditions prior to fabrication of all items to ensure correct fit.

5. For conditions not explicitly shown, contractor shall request clarifications from the engineer before proceeding with the work.

6. Provide adequate shoring or bracing during construction to resist all forces including forces such as wind, seismic and unbalanced forces due to construction sequence.

7. Observe and enforce all construction safety measures required by the Vancouver Building By-Law 6134, Part 8 and the Worker's Compensation Board of British Columbia. Employ a qualified professional specialty Engineer registered in British Columbia for the design of all false work and temporary support of all structural elements, earth banks, roads, etc. It is the sole responsibility of the Contractor to ensure that no part of the work is subjected to a load which will endanger the safety of the building or workers. Use temporary bracing where necessary to support all loads to which structure may be subjected, including erection equipment and construction operations.

8. INSPECTION

   Provide a minimum of 24 hours notice to the Engineer for routine inspections of:

   piles, prior to forming for pile caps or foundations
   reinforcing steel, prior to each concrete pour
   masonry, before each grout pour
   structural steel, prior to application of steel decking and before concealment
   steel studs, prior to application of sheathing
   steel deck, before placing reinforcement or concrete
   steel deck, before placing concrete

   The Contractor is responsible for pre-inspecting the work and confirm completeness prior to inspection by the Engineer.

9. DESIGN LIVE LOADS

Snow Load Values	Ss = 1.6 kPa Sr = 0.3 kPa
Basic roof snow load	1.58 kPa
(plus additional snow build-up where applicable)	
Roof live load	4.8 kPa
Interior slabs	4.8 kPa
Community Centre ground floor, gym level floor	4.8 kPa
Ramp, loading and ground level turn around for vehicles	12.0 kPa
Parking levels except as above	2.4 kPa
Mechanical rooms	3.6 kPa
Corridors, exits and stairs	4.8 kPa
For soil loads on suspended slabs see drawing S6	
Basic wind pressure (1:30 probability)	0.55 kPa

Seismic Factors:
Za = 4 Zv = 4 v = 0.2
I = 1 R = 2 F = 1.3

10. FOUNDATIONS

Foundation design based on the geotechnical report prepared by MacLeod Geotechnical Dated March 4, 1998 (File Number: X29-C).

Allowable soil bearing pressure for spread footings: 500 kPa
Refer to geotechnical report for type and anticipated depths of bearing stratum.
Lateral earth pressure on basement walls: Equivalent fluid pressure of 5.5 kN/m^3 but not less than 20 kPa for first 4000 below grade

Minimum depth of footings for frost cover to underside of footings: 600 mm

At changes of depths of foundations, slope footing at 1.5H:1V maximum.

At locations where spread footings are used in place of short piles, soil conditions must be inspected by the Geotechnical Engineer to verify the conditions and confirm the allowable soil bearing pressure after excavation and prior to construction of form work for footings and walls.

Protect native soils from softening and frost. Remove all softened or frost damaged soils prior to placing of reinforcement and concrete.
Provide adequate means of removing water from excavations and trenches. Excavations to be free of water prior to and during concrete placement.

Compact fills in maximum lifts and to densities as noted in the geotechnical report or as directed by the Geotechnical Engineer and test for compaction at sufficient intervals to verify conformance.

Provide a minimum of 150mm of well graded sand and gravel below all interior and exterior slabs on grade on prepared sub-base.

Do not back fill behind basement walls until a minimum of 7 days after the completion of interior floor systems unless walls are adequately braced.

Do not back fill behind cantilever retaining walls until concrete has attained 28 day compressive strength. Back fill both sides of retaining walls simultaneously until lower soil level is reached.

11. PILES (GENERAL)

Base tender on number of piles shown, with length calculated from cut-off elevation to tip elevation shown on drawings. In tender, provide a unit price for changes to aggregate pile lengths per metre.

For further details of piles and driving, refer to the geotechnical report and pile specifications.

The Geotechnical Engineer retained by the Owner will provide continuous full-time inspection of the pile driving. Provide a minimum of 48 hours notice to the Geotechnical Engineer for inspection of the piles and driving operation.

12. TIMBER/STEEL PIPE PILES

Treated timber piles: to conform to CSA CAN3-O56-M79, with minimum 300mm diameter at butt, minimum 250mm at tip. Treat piles to CAN/CSA O80-Series-M89 with 100% creosote oil to obtain a minimum net retention of 160 kg/m^3 and a minimum penetration of 20mm.

Steel pipe piles: 219s x 8.18mm c/w 20mm tip plate, filled with concrete.
r/w 4-15m vertical, 10M ties @ 200 o/c full length.

The tip of all timber piles is to be fitted with a steel drive shoe.

Timber/Steel Pipe Pile Capacity: 180 kN

13. EXPANDED BASE CONCRETE PILES

Install expanded base concrete piles under the continuous inspection of the Geotechnical Engineer. Piles to penetrate a minimum of 0.5 metres into the dense till or bedrock which underly the compressible layers but total length of piles not to be less than 3m.

Pile size	Compression Capacity	Vertical Reinforcement
500 mm shaft dia	1080 kN	6-25M full length

Tension on tension piles (as shown) 300 kN

Provide D11.5 @ 80 spiral ties for all vertical pile reinforcement.
No splices are permitted in reinforcement for concrete piles.

14. CONCRETE

Provide concrete and perform work to CSA A23.1-94. Test concrete to CSA A23.2-94. Testing of concrete to be performed by an independent testing agency approved by the Engineer and retained by the Contractor.

Cast a set of 3 cylinders from each day's pour for 7 day and 28 day tests. Cast an extra 2 cylinders from suspended slab and beam pours for field curing and testing to determine strength of concrete prior to stripping forms.

Properties of Mixes:

Mix / Use	Strength	Slump	Air	Aggregate	Class	SP
A Lean Concrete	20 MPa	100+/-30	-	20 mm	—	opt
B Pile caps and grade beams.	30 MPa	80+/-20	3-5%	20 mm	—	opt
C Parking slabs, walls and columns. Ramp slab, walls, sidewalk and roof slab.	35 MPa	80+/-20	5-8%	20 mm*	C-1	yes
D Gym floor, other fully interior floor slabs of community centre	30 MPa	80+/-20	-	20 mm*	—	yes
E Exterior concrete including: sidewalks not cast integrally with structure, curbs, planters, landscape walls and features. Roof level slabs. Multipurpose floor and all other concrete not specifically listed.	32 MPa	80+/-20	5-8%	20 mm	C-2	opt
F Concrete topping on Steel deck and on Precast Concrete	25 MPa	80+/-20	-	20 mm	—	opt
G Masonry Grout	20 MPa	150+/-50	-	10 mm	—	opt
H Concrete expanded base piles - refer to specification section 02385						
J Concrete fill in steel pipe piles	30 MPa	80+/-20	-	20 mm	—	opt

Mix notes:

Strength = Minimum compressive strength at 28 days (MPa)
Slump = Slump, +/- 20mm, as measured before addition of superplasticizer. Contractor to make slump tests from each truck of concrete. Reject concrete with non-conforming slump.
Aggregate = Nominal size of coarse aggregate (mm)
" = Use 10mm aggregate in walls with congested reinforcement
Air = Entrained air. Air entraining admixtures to conform to CSA CAN3-A266.2-M78. Contractor to make air content tests from each truck of concrete.
# = provide 5-8% for concrete exposed to weather
SP = Superplasticizer:
yes = mandatory use
opt = may be used at Contractor's discretion where needed to improve workability
Class = Exposure Class. Mix design to meet or exceed requirements of exposure class in accordance with CSA A23.2-94

Cement: type 10 (normal) portland cement to CAN/CSA-A5-93.

Calcium chloride: not permitted
Other admixtures: to CSA CAN3-A266.2-M78 with the prior approval of the Engineer.

Grout (for steel plate/concrete connections and where shown): non-shrink, nonferrous, premixed grout developing a minimum compressive strengths of 30 MPa at 3 days, and 55 MPa at 28 days.

Bonding Agent: Sternson Bonding Agent ST-433. Apply bonding agent in accordance with manufacturer's written instructions to all faces of existing concrete at interface with new cast-in-place concrete.

Floor Hardener: dry-shake applied hardener, Mastercron by Master Builders applied in strict accordance with manufacturer's written instructions. Apply to parking slab on grade and other locations where specified by the Architect.

Concrete anchors and inserts: Use Hilti HSL, HVA and other anchors and inserts in strict accordance with manufacturers instructions where shown or required. No substitutions permitted without the prior written consent of the Engineer.

The Contractor shall be responsible for design of all formwork, falsework and temporary shoring. Use mechanical vibrators throughout to compact concrete. Use keyed construction joints. Check all applicable drawings for locations of block-outs, anchors and embedded inserts before concrete is placed.
No conduit, boxes or other inserts are permitted in columns without the prior written approval of the Engineer. Forms and reinforcing steel must be inspected by the Engineer before concrete is placed.

Do not remove forms for foundations, pile caps and walls until a minimum of 24 hours after concrete is placed and the concrete has attained a strength of at least 10 MPa. Forms for suspended slabs may be removed and reshoring installed after the concrete has attained at least two-thirds of the specified strength. Reshoring to remain in place until concrete has developed full specified strength. Strength of concrete at time of stripping forms to be determined by testing field cured concrete cylinders, at the contractor's expense.

15. PRECAST CONCRETE

The precast prestressed units shall be supplied and erected by an experienced plant manufacturer in accordance with the specifications of the Canadian Prestressed Institute. Design of the precast units to be performed by a Professional Engineer registered in British Columbia retained by the supplier for the loads indicated, in accordance with CSA A23.4-94 and the Vancouver Building By-Law 6134. Configuration and exact shape of unit to conform to the manufacturer's forms and plant within the limitations shown on the drawings. Depth of units to conform to the structural drawings.

Concrete for units to be normal weight (2400 kg/m^3). Precast concrete units shall be cast in smooth steel forms, free from ragged edges, patchwork, fins, excessive form oil and other irregularities. Top of units to have a rough surface to accept topping.

Cover to reinforcement for concrete to conform to CSA A23.1-94. All exposed hardware for precast units to be primed except where field welded. Touch up field welds and unpainted steel with 2 coats of approved paint after installation and after welding has been inspected.

Submit shop drawings to the Engineer for review prior to fabrication. All shop drawings to be signed and sealed by the Professional Engineer responsible for the design of the units.

Loading for precast floor tees (superimposed, unfactored): Live Load 4.8 kpa

Superimposed Dead load: See roof loading diagram on S6.

16. REINFORCING STEEL

Use new deformed reinforcing bars conforming to CAN/CSA G30.18-M92, grade 400W unless noted. Welded wire fabric to CSA G30.5-M1983(R1991). Place reinforcing steel to CSA A23.1-94

Clear cover to reinforcement (unless noted otherwise):

50mm expanded base concrete piles
75mm surfaces of concrete cast against the ground
50mm formed surfaces exposed to earth or weather, sides of pilecaps
40mm concrete fill in steel pipe piles
40mm to stirrups in beams and slabbands
40mm to outside of ties in columns, interior faces of walls in parkade
25mm surfaces of slabs and interior surfaces of walls except at parkade
40mm top surfaces of slabs at parkade and ramp
30mm bottom surfaces of slabs at parkade and ramp
30mm exterior faces of walls

Splice reinforcement as follows (unless noted otherwise):

Bar size	10M	15M	20M	25M	30M	35M	
Lap splice	450	670	890	1330	1670	1950 mm	uncoated
	580	870	1160	1820	2180	2550 mm	epoxy coated

Welded wire mesh: 300 mm
Ladder reinforcement for masonry walls: 300 mm
Stagger vertical and horizontal splices in adjacent bars in walls, grade beams, and continuous bars in beams.

All concrete to be reinforced. Reinforcement for slabs, walls, curbs, planters, architectural concrete and other concrete not explicitly detailed:

wall or slab thickness	horizontal wall reinf.	vertical wall reinf.	slab reinf.
180mm or less	10M @ 200	10M @ 200	10M @ 300 EW BOT
200mm to 300mm	15M @ 300 EF	15M @ 300 EF	15M @ 400 T&B EW

Irregularly shaped concrete elements : 15M @ 200 each way placed 40mm from each surface and 1-15m at each corner.
For other thicknesses, reinforcement to be proportional to the above.

In addition to reinforcement shown on plans and details, provide:
Corner bars to match horizontal wall reinforcement at wall intersections.
Dowels, hooked one end, in footings, pile caps, foundation walls and slabs to match vertical reinforcement in supported elements including: concrete wall, masonry wall, column and to match zone reinforcement.
Two 15M bars at the ends of walls.
Two 15M top bars continuous at all free edges of suspended slabs, stagger lap splices.
Two 15M bars around all wall and slab openings, extending 600mm beyond edges.
Two 15M x 1500 mm long diagonal bars at corners of wall and slab openings and steps in walls.

Do not cut slab reinforcement at openings, spread reinforcement around openings.
Provide nonferrous slab bolsters to adequately raise reinforcement to proper level and all necessary carry bars required to maintain reinforcement in position.

⚠ ~~Provide 5000 kg of 15M or larger reinforcing bars, bent or straight to be used at the direction of the Engineer. Carry bars to maintain proper height of bars are not to be taken from this reinforcement.~~ DELETED

17. MASONRY

Masonry design and construction to CSA S304.1-94.
Concrete unit masonry conforming to CSA A165-Series-94.
standard units: type H/15 MPa(net area)/A/W
Use metric block sizes and running bond throughout.
Mortar: to CSA A179-94 type "S" proportioned by volume.
Grout: coarse grout to CSA A179-94.
Grout all cells containing reinforcing steel or steel inserts, top two courses of walls, lintels and foundation walls.

Reinforcing steel: deformed bars to CAN/CSA G30.18-M92, grade 400W.
Joint reinforcing: 3.66 mm ladder type to ASTM A82 and ASTM 185 for weld and shear strengths. Sized to suit block width.
Minimum reinforcement for walls (u.n.o.):
Vertical: 1-15M @ 800mm
Horizontal: 1-20M @ 1200mm
Ladder reinforcement: @ 600mm starting 400mm from bottom of wall.

Unless noted otherwise, provide:
Dowels into footing or suspended slab at bottom and top of wall to match vertical wall reinforcement.
Corner bars to match all horizontal wall reinforcement.
One 20M horizontal in top two courses of all walls and in top course of parapet walls.
One 20M in horizontal courses containing steel inserts, joist pockets, etc., extending at least 600mm each side of insert or pocket.
One 15M vertical at ends of walls and at wall intersections.
One 20M around openings, extending 200mm beyond corners.
Two 10M continuous (stagger lap splices) at top of all planter walls & curbs

Partition walls: Provide L102x102x8x200 mm long brackets each side of new partition walls at maximum spacing of 1200mm centres fastened to structure above with two 16mm diameter Hilti Kwik Bolts in each angle. For special details of continuous channel over walls above change rooms, see structural drawing S4 and architectural details.

18. STRUCTURAL STEEL

Structural steel to conform to CAN/CSA G40.21-M92 u.n.o.
HSS shapes: grade 350W, class C
W shapes: grade 350W
C, S, L, plates and other sections: grade 300W
Pipe sections: to ASTM A53 grade B, min. yield strength 241 MPa

Round bars for hangers and bracing, to CAN/CSA G40.21-M92 , grade 260W min
Reinforcing bars welded to structural steel shapes: to CAN/CSA G30.18-M92 grade 400W.
Bolts, nuts and washers: to ASTM A325, minimum size 3/4"
Anchor bolts, nuts and washers: to ASTM A307 u.n.o.
Headed studs: weldable mild steel conforming to CSA S16.1-94 and CSA A23.3-94, Appendix H, minimum size 20mm diameter u.n.o.
Clevises and turnbuckles: Except where detailed otherwise, clevises, turnbuckles and accessories to be as listed in A.I.S.C Manual of Steel Construction, Eighth Edition, galvanized. Clevises to be fit with maximum size pin to suit clevis number and with stainless steel cotter pin.

Substitution of members shown on drawings may be permitted with the prior approval of the Engineer, provided the substituted member has equal or higher strength and rigidity. Cost for any substitutions to be included in the contract price.

All steel (except steel embedded in concrete, 50mm around field welded joints, galvanized items and when fireproofed) to receive one coat of approved shop primer after fabrication. Touch up unpainted steel and steel around field welds with one coat of approved paint after erection. At field welds, remove paint prior to welding and touch up same day with primer to prevent staining to exposed concrete. All exterior steel for canopies and other elements to be hot-dip galvanized except where stainless steel is shown.

Structural steel fabricator to be certified by the Canadian Welding Bureau to CSA W47.1-92, Division 2.1 or Division 1.

Unless detailed, all structural steel connections to be designed by a Professional Engineer registered in British Columbia retained by the steel fabricator to Vancouver Building By-Law 6134 for 75% of the total uniform load capacity of the member or for force shown. Shop drawings to be sealed by the Professional Engineer responsible for the detail design.

The Contractor shall be responsible for the supervision of the fabrication of the structural steel. A Professional Engineer or testing agency, retained by the steel fabricator is required to submit a letter prior to the review of shop drawings stating that he will be responsible for inspecting and testing the welds for the structural steel. Refer to specifications.

Perimeter Deck Angle: Provide a continuous angle or bent plate L76x76x6.4 mm around perimeter of all steel deck except where other sizes detailed.

19. STEEL DECK

Fabricate and install steel deck in accordance with CSA S136-94 and the Canadian Sheet Steel Building Institute Standards. Steel deck shall be roll-formed flat metal conforming to ASTM A446. Use high-bond type deck for decking with concrete topping, for composite action with a wipe-coat. Roof deck to have a G90 zinc coating.

Install deck continuous minimum three spans where possible unless pre-approved.
Weld deck through the low rib to supporting structural steel members by means of 20 mm diameter fusion welds at 300mm o/c. Form end laps over supports overlapped not less than 75 mm. Weld deck to supports along perimeter and intermediate supports at maximum 300mm centres. Fasten side laps by mechanical methods at 600mm o.c. Paint all deck welds with approved zinc-rich paint. The deck erector shall install headed studs onto beams through deck in the field or shall coordinate with steel fabricator to have studs shop installed and deck cut around studs in field to suit.

The deck erector shall cut all openings in the steel deck. Reinforce all openings between 150 mm and 450 mm square with L76x76x6.4 each side perpendicular to flutes and extending two flutes each side of opening. Openings larger than 450 mm square to be framed by structural steel fabricator between adjacent support members.

Submit shop drawings to the Engineer for review prior to fabrication. Show deck size, layout, fastening conditions and allowable loading for spans shown. Shop drawings to be sealed by the Professional Engineer registered in British Columbia who is responsible for the steel deck design.

20. WELDING

Welding design and practice to W59-M1989.
All welding to be performed by Canadian Welding Bureau approved welders in accordance with CSA W47.1-92.

Minimum welds, except where shown or required by connection design:
Minimum leg size of welds to be 6 mm
Connections of bracing members: length of weld to develop at least 100% of the axial tension capacity of bracing members, but not less than 50mm long on each side of joint.
Other connections between members: as required by design but not less than 50mm long weld on each side of joint.
All welds between members at exterior locations to be continuous to seal joint from water penetration.

Inspection and testing of welds:
To be performed by a testing agency approved by the Engineer and paid directly by the Steel Fabricator. Refer to specification for details of testing required.

ABBREVIATIONS

&	AND	HR	HANDRAIL(ING)
@	AT	LG	LONG
AB	ANCHOR BOLT	LL	LIVE LOAD
ALT	ALTERNATE(LY)	LV	LENGTH VARIES
APPROX	APPROXIMATE(LY)	MAX	MAXIMUM
ARCH	ARCHITECT(URAL)	MECH	MECHANICAL
B TO B	BACK TO BACK	MFR	MANUFACTURER
BETW'N	BETWEEN	MIN	MINIMUM
BLDG	BUILDING	N/S	NEAR SIDE
B/L	BAYLINE	NTS	NOT TO SCALE
BLL	BOTTOM LOWER LAYER	OC	OENTRE
BUL	BOTTOM UPPER LAYER	OPNG	OPENING
B,BOT	BOTTOM	OPP	OPPOSITE
BU	BUILT UP	OWSJ	OPEN WEB STEEL JOIST
CL,℄	CENTRELINE	PERP	PERPENDICULAR
C/W	COMPLETE WITH	PL, ℻	PLATE
CC	CENTRE TO CENTRE	R	RADIUS
CJ	CONSTRUCTION JOINT	RD	ROOF DRAIN
COL	COLUMN	REINF	REINFORCEMENT
CONC	CONCRETE	REQ'D	REQUIRED
CONST	CONSTRUCTION	REV	REVISION
CONT	CONTINUOUS (LAP SPLICE)	R/W	REINFORCED WITH
CTR	CENTRE	SECT	SECTION
DET	DETAIL	SIM	SIMILAR
DIM	DIMENSION	SK	SKETCH
DL	DEAD LOAD	S.O.G.	SLAB ON GRADE
DN	DOWN	SP	SPACE(D)(S)(ING)
DO	DITTO	SPEC	SPECIFICATION
DP	DEEP	STIR(S)	STIRRUP(S)
DWGS	DRAWINGS	STL	STEEL
EA	EACH	STR	STRAIGHT, STRUCTURE(AL)
EF	EACH FACE	T	TOP
EL, ELEV	ELEVATION	T&B	TOP AND BOTTOM
EQ SP	EQUAL(LY) SPACES(D)	THK	THICK(NESS)
EW	EACH WAY	TOC	TOP OF CONCRETE
EXIST	EXISTING	TOS	TOP OF STRUCTURAL STEEL
FD	FLOOR DRAIN	TUL	TOP UPPER LAYER
FDN	FOUNDATION	TLL	TOP LOWER LAYER
FIN GR	FINISHED,FINAL GRADE	TYP	TYPICAL
FIN FL	FINISHED FLOOR	UB	U BAR
FL	FLOOR	U/S	UNDERSIDE
F/S	FAR SIDE	UNO	UNLESS NOTED OTHERWISE
GA	GAUGE	VEF	VERTICAL EACH FACE
GALV	GALVANIZED	VERT	VERTICAL
GL	GRIDLINE, BAYLINE	W	WIDE
H1E	HOOKED ONE END	/W	WITH
H2E	HOOKED TWO ENDS	WP	WORK POINT
HEF	HORIZONTAL EACH FACE	WS	WATER STOP
HORIZ	HORIZONTAL		

LEGEND

PROPERTY LINE

CW4 — CONCRETE WALL & TYPE

MW1 — MASONRY BLOCK WALL & TYPE

DUCT OR OPENING THROUGH WALL BELOW

TOP OF CONCRETE OR MASONRY WALL

FOUNDATION SLOPES DOWN IN DIRECTION SHOWN (1V:1.5H UNO)

88.585 — TOP OF CONCRETE (LEVEL SURFACES)

[88.585] — ANTICIPATED TOP OF PILE CAP ELEVATION

88.585 — SPOT ELEVATION AT TOP OF CONCRETE (SLOPING SURFACES)

FLOOR OR ROOF DRAIN

C5 — CONCRETE COLUMN IN PLAN SECTION.

T1 — TOP BEAM REINF. SEE SCHEDULE

B1 — BOT. BEAM REINF. SEE SCHEDULE

S1 — STIRRUP TYPE, SEE SCHEDULE

INDICATES EXTENT OF BARS
TOP REINFORCING
BOTTOM REINFORCING
INDICATES BARS TO CONTINUE TO EXTENTS OF ELEMENT

1 / S4 — SECTION NUMBER / DRAWING WHERE SECTION IS LOCATED

1 / S4 — DETAIL NUMBER / DRAWING WHERE DETAIL IS LOCATED

SECTION 1/20 — 1 / S4 — SECTION NUMBER / DRAWING WHERE SECTION TAKEN FROM

DETAIL 1:20 — 1 / S4 — DETAIL NUMBER / DRAWING WHERE DETAIL TAKEN FROM

PLUMBING OR OTHER OPENINGS IN SLAB

5CC — 500ø CONCRETE EXPANDED BASE PILE

3S — 300ø TIMBER PILE OR CONCRETE FILLED STEEL PIPE PILE

5CC — 500ø CONCRETE EXPANDED BASE PILE WITH TENSION

DRAWING INDEX

⚠ 02/02/06	ISSUED FOR RECORD DWGS.
98/09/04	ISSUED FOR CONSTRUCTION
⚠ 98/09/04	STRUCTURAL ADDENDA ADDED
98/06/05	ISSUED FOR TENDER
98/06/05	RE-ISSUED FOR BLDG. PERMIT
98/05/08	ISSUED FOR CLIENT REVIEW
98/04/09	ISSUED FOR BUILDING PERMIT

HENRIQUEZ · PARTNERS
Architects
Urban Designers
402 W. Pender Street
Vancouver, B.C.
V6B 1T6
Tel 604 687 5681
Fax 604 687 3030

JOB TITLE
COAL HARBOUR COMMUNITY CENTER PHASE 1

ADDRESS
500 BROUGHTON STREET, VANCOUVER, B.C.

CONSULTANT
C.Y. LOH ASSOCIATES LTD.
Consulting Structural Engineers
1863 Powell Street
Vancouver, B.C. V5L1H8
(604)254-0568

DRAWING TITLE
GENERAL NOTES

DATE	98/06/05	DRAWN	W.P.D.
SCALE	N.T.S.	CHECKED	LS
JOB NO.	9494		

S1 ⚠

066.001/05 A0

A0 066 001/05

ZONE OF SOIL DENSIFICATION
SEE DRAWINGS X29-C-G3
BY MACLEOD GEOTECHNICAL

GENERAL EXTENT OF BASEMENT

WORK POINT AT CENTRE OF PILE PC168

OUTLINE OF CRANE BASE

PT58 DELETED

CP2

PILE PLAN (A) 1:100

ESTIMATED PILE BEARING SURFACE CONTOURS FOR TENDER PURPOSES (ELEVATIONS IN METRES TO GEODETIC DATUM) TYPICAL

△ NOTES:

1. CUT-OFF ELEVATIONS OF TIMBER PILES SUPPORTING SLABS ON GRADE TO BE 300mm BELOW TOP OF SLAB TYP. U.N.O.
2. REFER TO S3 AND S4 FOR TOP OF SLAB ELEVATIONS.

02/02/08	ISSUED FOR RECORD DWGS.
△ 98/11/24	REVISED PILE DIM'S & CUT-OFF ADD CRANE PILES
98/09/04	ISSUED FOR CONSTRUCTION
△ 98/09/04	REVISED PILE DIM'S
△ 98/08/26	DIM'S AND CUT-OFFS ADDED OUTSIDE DENSIFICATION ZONE
△ 98/07/07	DENSIFICATION ZONES REVISED PILE NUMBERS ADDED
△ 98/07/03	PILE NUMBERS AND CUT-OFF ELEV. ADDED IN DENSIFICATION ZONE
△ 98/07/03	STRUCTURAL ADDENDA ADDED
98/06/05	ISSUED FOR TENDER
98/06/05	RE-ISSUED FOR BLDG. PERMIT
98/05/08	ISSUED FOR CLIENT REVIEW
98/04/09	ISSUED FOR BUILDING PERMIT

HENRIQUEZ • PARTNERS
Architects
Urban Designers

402 W. Pender Street
Vancouver, B.C.
V6B 1T6
Tel 604 687 5688
Fax 604 687 8530

JOB TITLE
COAL HARBOUR COMMUNITY CENTRE PHASE 1

ADDRESS
500 BROUGHTON STREET, VANCOUVER, B.C.

CONSULTANT
C.Y. LOH ASSOCIATES LTD.
Consulting Structural Engineers
1863 Powell Street
Vancouver, B.C. V5L1H8
(604)254-0868

DRAWING TITLE
PILING PLAN

DATE 98/06/05	DRAWN N.D.H.
SCALE 1:100	CHECKED LS
JOB NO. 9494	

S2 △

066.001/05 A0