DGI

Date: Dec 8, 2004
Project No: B53

EMBASSY DEVELOPMENT CORPORATION
#204-4430 Halifax Street
Burnaby, B.C.
V5C 5R4

Attn: **Mr. Ryan Bosa, President**

Re: **Proposed High-rise Development**
Royal Avenue
New Westminster, B.C.

Dear Sir:

As requested, Davies Geotechnical Inc. has completed a geotechnical investigation at the site of the proposed hi-rise development to be located at the southeast corner of the intersection of Royal Avenue and Merivale Street, within the City of New Westminster, B.C.

The purpose of our investigation was to gather site-specific information regarding subsurface soil and groundwater conditions in order to provide recommendations regarding the following: site preparation, excavation design, dewatering, foundation design, seismic design, permanent drainage, and basement wall design.

The results of the investigation and the aforementioned recommendations are presented within this report.

Attached to the end of this report are the following:

- Figure 1: Borehole Location Plan
- Borehole Logs
- Figure 2: Subsoil Section Looking East
- Figure 3: Lateral Earth Pressure for Basement Design.

1.0 SITE DESCRIPTION

The property is identified as Parcel A Plan LMP 4158 and is bounded to the north by Royal Avenue, the south by St Agnes Street and Cunningham Street, the west by Merivale Street, and the east by St Mary's Street. At the time of our investigation the site was occupied by St Mary's Hospital. The locations of the existing structures on site are shown on Figure 1 attached to this report.

Review of the site survey plan provided by Bennet Surveys dated June 22, 2004 indicates that site grades dip relatively steeply down from northwest to southeast with elevation ranging from 208 feet at the northwest corner of the site to 167 feet at the southeast corner of the site.

2.0 PROPOSED DEVELOPMENT

Review of preliminary architectural plans prepared by Arc Design International Corp. indicated that the proposed development will consist of several key elements as follows:

- Two 32 storey towers.
- Townhouse and apartment structures surrounding the hi-rises.
- An apartment building located on the eastern portion of the site.

Three to four levels of parking will be provided with the underground parking fully buried below grade along the north side (e.g. Royal Avenue) and day lighting at grade along the south boundary (St Agnes Street and Cunningham Street).

Preliminary architectural drawings indicate that the top of slab elevation for the lowest level will range from 171.5 feet to 172.5 feet.

3.0 SITE INVESTIGATION

Davies Geotechnical Inc. completed a preliminary site investigation on November 23, 2004. This work involved the completion of 5 Becker boreholes (BOH), 1 Becker Denseness Test (BDT), and the installation of 4 piezometers. The boreholes were completed to depths ranging from 10 feet to 30 feet below the finished floor slab elevations equivalent to depths ranging from 30 feet to 50 feet below existing grade.

The approximate locations of the boreholes are shown on Figure 1 (Site Plan) attached to this report.

The drilling was completed using a Becker Hammer drill rig provided by SDS Drilling. The Becker Hammer drilling involved driving a 6 $_{5/8}$ inch diameter double walled casing into the ground using a 180 Linkbelt diesel hammer delivering 8000 ft-lb of energy. The open-ended holes (BOH), which were completed for the purpose of sampling, involved

use of an open-ended casing. During driving air was forced down between the annulus of the two casings and was returned through the centre of the inner casing bringing samples of the soil to the surface. Grab samples of the soils were retrieved from a cyclone at regular depth intervals. Closed ended Becker Hammer drill holes (BDT) were also completed in order to measure the relative consistency of the subsoils. The number of blows required to drive the casing each foot are considered BDT "N" values and are comparable to SPT "N_{60}" values up to depths of 50 feet below grade.

The details regarding the piezometer installations are presented on the borehole logs attached to this report.

All test holes were logged and sampled by qualified personnel from Davies Geotechnical Inc. Representative samples of the subsoils encountered were returned to our laboratory for further classification and moisture content testing.

4.0 RESULTS

4.1 Site Geology

Review of the Geologic Survey of Canada map 1484 A indicates that the site is located in an area underlain by Vashon drift and Capilano sediments (VC), which are glacial drift, including lodgment and minor flow till, lenses and inter-beds of glacio-fluvial sands. These soils are typically overconsolidated and consequently can be characterized as having high strength and being relatively incompressible.

4.2 Soil Conditions

Summaries of the subsurface conditions at each borehole location are shown on the borehole logs attached to the end of this report. Review of the borehole logs indicates that subsurface conditions are relatively consistent across the site and conform to the known geology of the area and can be summarized as follows:

Soil Unit	Description	Soil Characteristics
1	Fill – generally consisting of brown Sand with varying amounts of gravel. The thickness of this layer appears to range from 3 to 5 feet.	BDT results range from 8 to 20 plus indicating that the fill is loose to medium dense.
2	Brown / grey Fine Sand, trace silt to silty, interbedded sandy Silt layers	BDT results are in excess of 30 blows per foot indicating that these soils are dense.
3	Grey fine Sand, trace silt / silty fine Sand / Occasional sandy Silt and Silt layers, Interlayered with till-like silty Sand some gravel.	BDT results are in excess of 30 blows per foot indicating that these soils is dense to very dense

4.3 Groundwater

Groundwater levels were measured in the open boreholes and the standpipe piezometers on November 24, 2004. The results of this monitoring are summarized on Table 1 below.

Table 1 – Groundwater Levels

Borehole #	Depth (ft)	Elevation (ft)
1 – P 1	7	186
1 – P 2	7	186
1 - P 3	7.5	185.5
2	3	182
3	3	171
4	3	169
5 – P 4	21	185

The three piezometers installed within BOH -1 at differing elevations are similar and consequently it is inferred that groundwater conditions are hydrostatic (no indication of artesian).

Interpretation of the available groundwater monitoring data suggests that the groundwater elevations dips slightly from west to east and dips from north to south.

5.0 DESIGN CONSIDERATIONS

The results of the preliminary site investigation indicate that the soils at the site generally consist of glacio-fluvial dense to very dense fine Sand and silty Sand with interbeds of very dense till-like soils. These soils typically have high shear strength and consequently are suitable to provide support for the proposed towers and other structures bearing on conventional strip and spread foundations.

Measured water levels at the site are above the proposed slab elevations and consequently use of temporary dewatering will be required to complete the excavation work as well as the use of permanent dewatering to maintain a dry building.

6.0 RECOMMENDATIONS

6.1 Site Preparation

The first stage of site work will involve the demolition of the existing hospital structures and associated infrastructure and utilities.

The top of slab elevations for level 1 ranges from 171.5 feet to 172. 5 feet and encompass the entire site area. Review of existing site grades around the perimeter of the site indicates that excavation depths will range from 38 feet at the northwest corner to 15 feet at the northeast corner (along Royal Avenue), and 9 to 10 feet along Cunningham Street.

In view of the depths of the proposed excavation and the proximity of the proposed building to the property lines vertical shoring will be required for the majority of the site perimeter. The soils encountered at the site generally consist of dense fine Sand with silty Sand and sandy Silt interbeds. Based upon previous experience with other projects of similar soil conditions the proposed excavation can be supported using conventional means involving shotcreted tied back with soil anchors.

The soils within the bulk excavation depth generally consist of fine sand, silty Sand, sandy Silt are highly susceptible to piping and erosion when exposed to seepage forces. Since the proposed excavation extends below the water table use of permanent dewatering will be necessary to draw water levels down below the base of the excavation. Use of face saving measures such as miro-drain and the use of horizontal drains installed in the shored face will likely be required.

Details regarding the excavation and shoring requirements can be provided in the form of an excavation design and specification presented under a separate cover.

6.2 Temporary Dewatering

Water levels measured at the site at the time of investigation (November 2004) indicate that a groundwater table exists ranges in elevation from 170 feet at the southeast corner to 185 feet at the northwest corner. The majority of the proposed building will be founded below this groundwater table and consequently use of temporary dewatering will be required in order to complete the bulk excavation. This temporary dewatering system will likely consist of a network of pumped wells installed at 50 feet to 100 feet on center.

Additional site investigation and pump testing will be necessary in order to prepare the design for the temporary dewatering system.

6.3 Foundation Design

Review of the borehole information indicates that dense to very dense native soils will be encountered at bulk excavation level over the majority of the site area, with the exception of the southern boundary where these dense soils were encountered 7 feet to 10 feet below design floor slab elevation.

For the purposes of preliminary foundation design we assume that all footings will be founded on the very dense native soils. The following allowable bearing pressures may be used for foundation design:

- Pad footings Qa = 8000 p.s.f. (D.L.+L.L.) for width greater than 4 feet
- Pad footings Qa = 5000 p.s.f. (D.L.+L.L.) for width less than 4 feet
- Strip footings Qa =4000 p.s.f. (D.L.+L.L.)

Higher bearing pressures may be acceptable for specific foundations subject to a review by the geotechnical engineer.

6.4 Seismic Design Parameters

The site is located in a seismically active area specified as Zone 4 by the National Building Code of Canada. The design earthquake for this Zone is a magnitude 7 event with a 10 percent possibility of exceedence in 50 years or a 475-year return period.

Given the nature of the dense till at the site, according to the Table 4.1.9.1.C of NBCC of 1998, the foundation factor F = 1.0 is appropriate for seismic design.

A fifty percent increase in allowable bearing pressure for seismic load condition is considered acceptable with a reduction in safety factor on the ultimate bearing pressure.

6.5 Permanent Drainage

Use of a permanent dewatering system will be required in order to maintain a dry building envelope. We anticipate that this system will comprise of a network of passive wells installed beneath the building that are connected to a network of sub floor drains.

Detailed recommendations regarding permanent dewatering and drainage design can be provided once additional site investigation and testing are completed.

6.6 Basement Wall Design

The basement walls will have to be designed to resist the applicable lateral pressures associated with earth pressures, compaction loads, surface surcharges and seismic loads.

Attached to this report is a lateral earth pressure diagram for both the static and static plus seismic load cases (Fig.2).

6.7 Building Perimeter Drainage

We recommend that all basement structures be provided with a perimeter drain system and drainage blanket. The drainage system should consist of a 100 mm diameter perforated pipe surrounded by at least 150 mm of drain gravel. The drain should then be connected to a suitable gravity discharge or pumped sump. A sub floor drainage system consisting of a network of perforated drains installed within gravel filled trenches

beneath the floor slab will also be required.

6.8 Perimeter Backfill

Perimeter backfill should consist of clean sand or sand and gravel with less than 5% passing through the #200 sieve. Backfill should be placed in lifts not exceeding 300 mm in thickness and should be compacted to at least 95% of Modified Proctor Maximum Dry Density. Consideration may be given to the use of bird's eye gravel backfill provided that it is placed in lifts and compacted using a concrete vibrator.

7.0 CLOSURE

Davies Geotechnical Inc. has completed a preliminary geotechnical investigation at the site of the proposed hi-rise development at Royal Avenue in New Westminster, B.C.

The results of the preliminary investigation indicate that dense soils were encountered close to existing grade across the entire site. Consequently the proposed hi-rise towers and other structures can be founded on conventional strip and spread foundations.

The proposed basement will be founded at elevation ranging from 171 feet to 172 feet and consequently will be founded below the measured water table at the site (with elevation ranging from 185 feet to 170 feet). Consequently use of temporary dewatering will be required to complete the bulk excavation.

Permanent dewatering will be required beneath the proposed building in order to maintain a dry basement and to eliminate uplift forces on the parking slab.

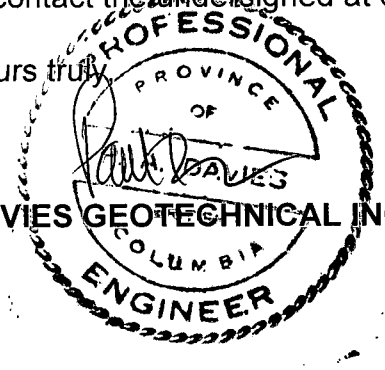
Additional site investigation involving the installation of monitoring wells and well pump tests will be required in order to provide detailed recommendations regarding temporary and permanent dewatering requirements at the site.

Periodic reviews of the site conditions and construction should be completed by the geotechnical engineer in order to confirm that the site conditions are compatible with the design and the work is completed in general conformance with the project specifications.

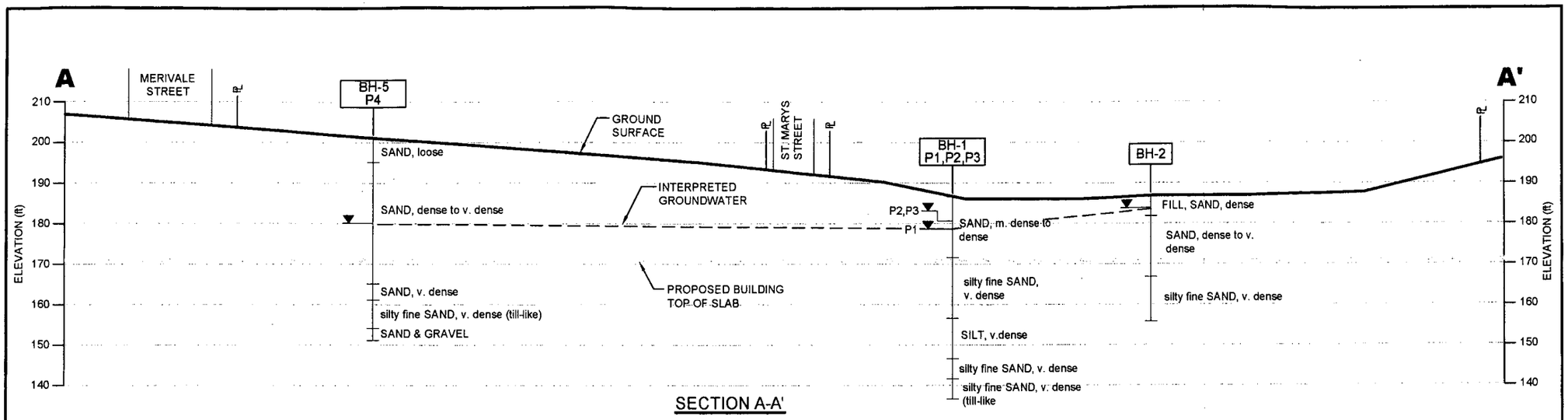
The information provided in this report is intended for the purposes of preliminary design and should not be incorporated directly into specifications without approval by Davies Geotechnical Inc.

We trust that the information provided within this report meets your requirements at this time. If you have any questions or require additional information, please do not hesitate to contact the undersigned at 604-291-2201.

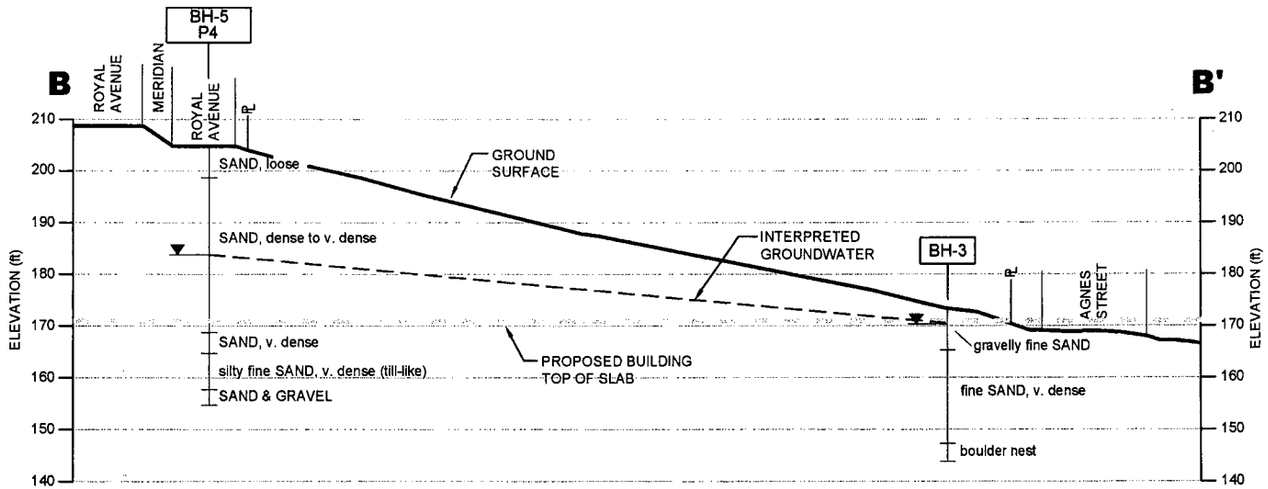
Yours truly,



DAVIES GEOTECHNICAL INC.



SECTION A-A'



SECTION B-B'

NOTE: SECTIONS A-A' AND B-B' HAVE BEEN EXAGGERATED 2x VERTICALLY FOR SOIL INTERPRETATION CLARITY.

0' 25' 50' 75'
1" = 50' (HORIZONTAL SCALE)

0' 10' 20' 30'
1" = 25' (VERTICAL SCALE)

Davies Geotechnical Inc.
Unit #3 -5707 Sidley Street, Burnaby, B.C. V5H 5E6
Tel 604-291-2201 Fax. 604-291-2274

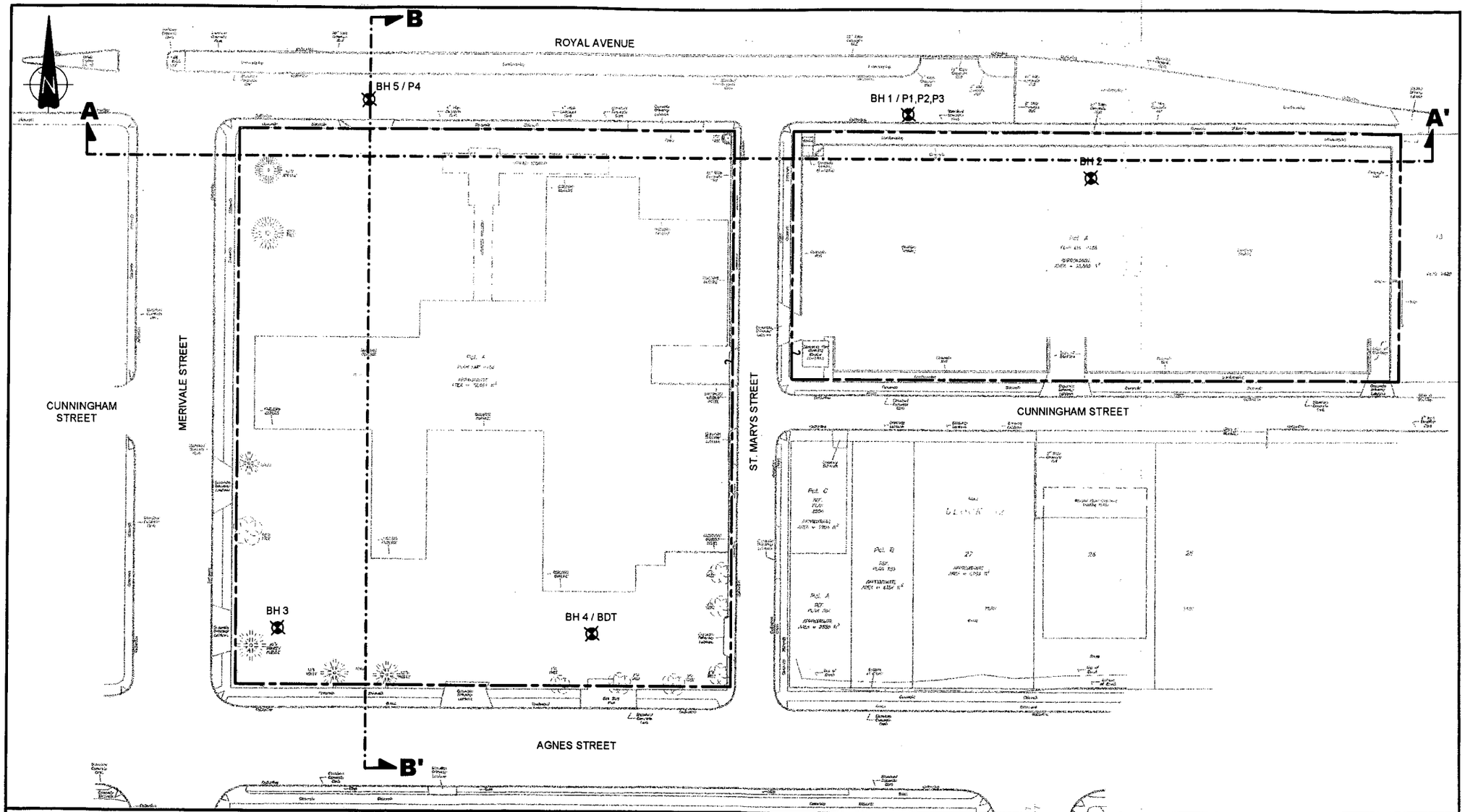
Client
EMBASSY DEVELOPMENTS CORPORATION

DWN BY:	PD
CHK'D BY:	PD
APP.	PD
SCALE	AS SHOWN

PROJECT
ST. MARY'S
ROYAL AVENUE, NEW WESTMINISTER

TITLE
GEOTECHNICAL SECTIONS
A-A AND B-B'

DATE:	DEC. 2004
PROJECT NO:	
REV. NO.:	0
FIGURE No.	FIGURE 2



NOTE:
BASEPLAN PROVIDED BY BENNETT & ASSOCIATES, DRAWING 30568-2, DATE JUNE 22, 2004.

0' 25' 50' 75'
1" = 50'

Davies Geotechnical Inc.
Unit #3 -5707 Sidley Street, Burnaby, B.C. V5H 5E6
Tel 604-291-2201 Fax. 604-291-2274

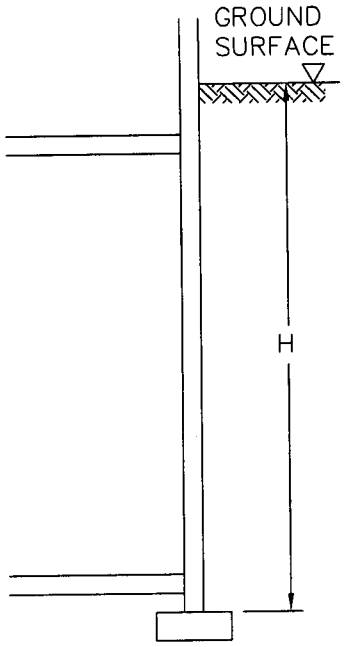
Client
EMBASSY DEVELOPMENTS CORPORATION

DWN BY:	PD
CHK'D BY:	PD
APP.	PD
SCALE	AS SHOWN

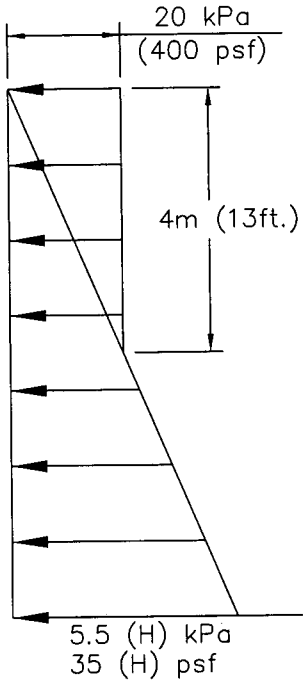
PROJECT
ST. MARY'S
ROYAL AVENUE, NEW WESTMINISTER

TITLE
GENERAL SITE AND
BOREHOLE LOCATION PLAN

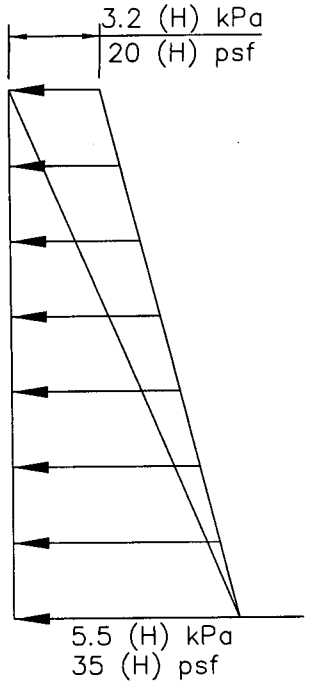
DATE:	DEC. 2004
PROJECT NO:	
REV. NO.:	0
FIGURE No.	FIGURE 1



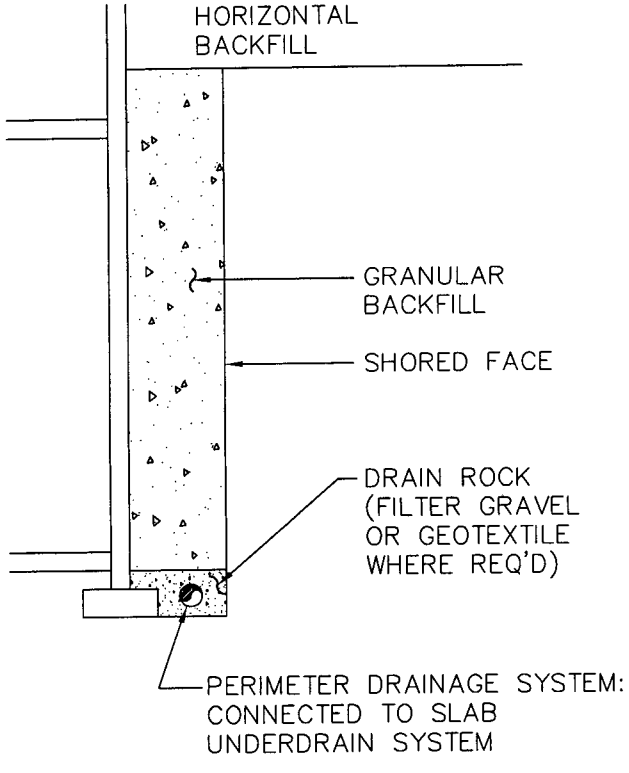
TYPICAL BASEMENT WALL



STATIC LOAD



SEISMIC+STATIC LOAD



NOTES:

GRANULAR BACKFILL AS PER CITY STANDARDS

- ALL METRIC UNITS IN (m) AND (kPa)
- ALL IMPERIAL UNITS IN (ft.) AND (psf)
- ABOVE SKETCHES ARE NOT TO SCALE

EMBASSY DEVELOPMENT CORP.	Davies Geotechnical Inc.	
PROPOSED HIGHRISES ROYAL AVE, NEW WESTMINSTER	LATERAL PRESSURE FOR BASEMENT WALL DESIGN	Dwg by: PD | Date: 02/11/04 Dwg: B53

TEST HOLE LOG - BH-1

SAMPLE DATA
WEIGHT HAMMER
HEIGHT DROP

ELEV. COLLAR : 194 ft
ELEV. GROUND

BOH-1

COHESION - KPa
100 200 300 400
● FIELD VANE ▲ LAB VANE ■ UNCONF.

PLASTIC LIMIT | WATER CONTENT | LIQUID LIMIT
X — — — 0 — — — X
10 30 50 70 90%

DEPTH	PEIZO. 1	PEIZO. 2	PEIZO. 3	SYMBOL	DESCRIPTION OF MATERIAL	PENETRATION RESISTANCE - BLOWS/FT. 0 25 50 75 100
(ft)/(m)						
5 ft 1.5m					Brown medium to coarse SAND, trace to some gravel, moist, medium dense to dense	
10 ft 3.0m						
15 ft 4.5m					Grey silty fine SAND, occasional gravel, moist, occasional sandy silt lense, very dense, wet @ 23'	
20 ft 6.0m						
25 ft 7.6m						
30 ft 9.1m					Grey SILT, some fine sand to sandy, trace coarse sand, trace fine sand, wet, very dense	
35 ft 10.6m						
40ft						

Davies Geotechnical Inc.
Unit #3 -5707 Sidley Street, Burnaby, B.C. V5H 5E6
Tel 604-291-2201 Fax. 604-291-2274

JOB No.: B53
PROJECT: ST. MARY'S
LOCATION: Royal Avenue, New Westminster
HOLE No.: BH-1
DATE: NOV. 25, 2004 PLATE: 1 of 2

TEST HOLE LOG - BH-1 CONT'D

SAMPLE DATA
WEIGHT HAMMER
HEIGHT DROP

ELEV. COLLAR : 194 ft
ELEV. GROUND

BOH-1

COHESION - KPa
100 200 300 400
● FIELD VANE ▲ LAB VANE ■ UNCONF.

PLASTIC LIMIT X — WATER CONTENT —0— LIQUID LIMIT —X
10 30 50 70 90%

DEPTH	PEIZO. 1	PEIZO. 2	PEIZO. 3	SYMBOL	DESCRIPTION OF MATERIAL	PENETRATION RESISTANCE - BLOWS/FT. 0 25 50 75 100
(ft)/(m)						
					Grey silty fine SAND, occasional gravel, wet, very dense	
45 ft						
1.5m						
					Grey silty fine SAND, some gravel, wet (TILL-LIKE), very dense	
50 ft						
3.0m					END OF HOLE	

Davies Geotechnical Inc.
Unit #3 -5707 Sidley Street, Burnaby, B.C. V5H 5E6
Tel 604-291-2201 Fax. 604-291-2274

JOB No.: B53
PROJECT: ST. MARY'S
LOCATION: Royal Avenue, New Westminster
HOLE No.: BH-1
DATE: NOV. 25, 2004 PLATE: 2 of 2

TEST HOLE LOG - BH-2

SAMPLE DATA
WEIGHT HAMMER
HEIGHT DROP

DEPTH | PEIZO. | BLOWS/FT | NO. | SYMBOL | DESCRIPTION OF MATERIAL

ELEV. COLLAR : 185 ft
ELEV. GROUND

BOH-2

PENETRATION RESISTANCE - BLOWS/FT.
0 25 50 75 100

COHESION - KPa
100 200 300 400
● FIELD VANE ▲ LAB VANE ■ UNCONF.

PLASTIC LIMIT | WATER CONTENT | LIQUID LIMIT
X — — 0 — — X
10 30 50 70 90%

(ft)/(m)

5 ft
1.5m

FILL, brown, gravelly, medium to coarse SAND, trace silt, dense

10 ft
3.0m

Grey fine SAND, trace to some silt, moist, dense to very dense

15 ft
4.5m

20 ft
6.0m

25 ft
7.6m

Grey silty fine SAND, moist, very dense

30 ft
9.1m

END OF HOLE

35 ft
10.6m

40ft

Davies Geotechnical Inc.
Unit #3 -5707 Sidley Street, Burnaby, B.C. V5H 5E6
Tel 604-291-2201 Fax. 604-291-2274

JOB No.: B53
PROJECT: ST. MARY'S
LOCATION: Royal Avenue, New Westminster
HOLE No.: BH-2
DATE: NOV. 25, 2004 PLATE: 1 of 1

TEST HOLE LOG - BH-3

SAMPLE DATA
WEIGHT HAMMER
HEIGHT DROP

ELEV. COLLAR : 173 ft
ELEV. GROUND

BOH-3

COHESION - KPa
100 200 300 400
● FIELD VANE ▲ LAB VANE ■ UNCONF.

PLASTIC LIMIT | WATER CONTENT | LIQUID LIMIT
X — — — 0 — — — X
10 30 50 70 90%

DEPTH	PEIZO.	BLOWS/FT	NO.	SYMBOL	DESCRIPTION OF MATERIAL	PENETRATION RESISTANCE - BLOWS/FT. 0 25 50 75 100
(ft)/(m)						
	▼				Brown gravelly fine SAND, some cobbles, wet	
5 ft 1.5m						
10 ft 3.0m					Brown/Grey fine SAND, trace to some silt, wet, very dense	
15 ft 4.5m						
20 ft 6.0m						
25 ft 7.6m					Boulder nest	
					END OF HOLE	
30 ft 9.1m						
35 ft 10.6m						
40ft						

Davies Geotechnical Inc.
Unit #3 -5707 Sidley Street, Burnaby, B.C. V5H 5E6
Tel 604-291-2201 Fax. 604-291-2274

JOB No.: B53
PROJECT: ST. MARY'S
LOCATION:
HOLE No.: BH-3
DATE: NOV. 25, 2004 PLATE: 1 of 1

TEST HOLE LOG - BH-4

SAMPLE DATA
WEIGHT HAMMER
HEIGHT DROP

DEPTH	PEIZO.	BLOWS/FT	NO.	SYMBOL	DESCRIPTION OF MATERIAL
(ft)/(m)					ELEV. COLLAR : 171 ft ELEV. GROUND
5 ft 1.5m	▼				FILL - grey-brown, mottled SANDY SILT, trace gravel, moist, loose to medium, dense
10 ft 3.0m					Grey silty fine SAND/ trace sandy SILT, moist, very dense
15 ft 4.5m					
20 ft 6.0m					
25 ft 7.6m					Grey sitly fine to coarse SAND, some gravel/ gravelly medium to coarse SAND, trace silt, wet, very dense
30 ft 9.1m					END OF HOLE
35 ft 10.6m					
40ft					

BOH-4 / BDT -4

PENETRATION RESISTANCE - BLOWS/FT.
0 25 50 75 100

BDT -4

BOH -1

COHESION - KPa
100 200 300 400
● FIELD VANE ▲ LAB VANE ■ UNCONF.

PLASTIC LIMIT | WATER CONTENT | LIQUID LIMIT
X — — — 0 — — — X
10 30 50 70 90%

Davies Geotechnical Inc.
Unit #3 -5707 Sidley Street, Burnaby, B.C. V5H 5E6
Tel 604-291-2201 Fax. 604-291-2274

JOB No.: B53
PROJECT: ST. MARY'S
LOCATION: Royal Avenue, New Westminster
HOLE No.: BH-4
DATE: NOV. 25, 2004 PLATE: 1 of 1

TEST HOLE LOG - BH-5

SAMPLE DATA
WEIGHT HAMMER
HEIGHT DROP

ELEV. COLLAR : 205 ft
ELEV. GROUND

COHESION - KPa
100 200 300 400
● FIELD VANE ▲ LAB VANE ■ UNCONF.

PLASTIC LIMIT | WATER CONTENT | LIQUID LIMIT
X — — 0 — — X
10 30 50 70 90%

DEPTH	PEIZO.	BLOWS/FT	NO.	SYMBOL	DESCRIPTION OF MATERIAL	DCPT PENETRATION RESISTANCE - BLOWS/FT. 0 25 50 75 100
(ft)/(m)						
					Grey silty fine SAND, wet, loose	
5 ft 1.5m						
					Brown, gravelly medium to coarse SAND, trace silt, dense, moist	
10 ft 3.0m						
					Brown fine SAND, trace to some silt, moist, interlayered with occasional sandy silt, dense to very dense, moist	
15 ft 4.5m						
20 ft 6.0m						
25 ft 7.6m						
30 ft 9.1m						
					Grey fine SAND, trace silt, wet below 35', very dense	
35 ft 10.6m						
40ft						

Davies Geotechnical Inc.
Unit #3 -5707 Sidley Street, Burnaby, B.C. V5H 5E6
Tel 604-291-2201 Fax. 604-291-2274

JOB No.: B53
PROJECT: ST. MARY'S
LOCATION: Royal Avenue, New Westminster
HOLE No.: BH-5
DATE: NOV. 25, 2004 PLATE: 1 of 2

TEST HOLE LOG - BH-5 CONT'D

SAMPLE DATA
WEIGHT HAMMER
HEIGHT DROP

DEPTH	PEIZO.	BLOWS/FT	NO.	SYMBOL	DESCRIPTION OF MATERIAL
(ft)/(m)					ELEV. COLLAR : 205 ft ELEV. GROUND
45 ft					Grey silty fine SAND, trace gravel, wet, (TILL-LIKE), very dense
1.5m					
50 ft					Grey SAND & GRAVEL, waterbearing
3.0m					END OF HOLE

DCPT
PENETRATION RESISTANCE - BLOWS/FT.
0 25 50 75 100

COHESION - KPa
100 200 300 400
● FIELD VANE ▲ LAB VANE ■ UNCONF.

PLASTIC LIMIT X — WATER CONTENT — 0 — LIQUID LIMIT X
10 30 50 70 90%

Davies Geotechnical Inc.
Unit #3 -5707 Sidley Street, Burnaby, B.C. V5H 5E6
Tel 604-291-2201 Fax. 604-291-2274

JOB No.: B53
PROJECT: ST. MARY'S
LOCATION: Royal Avenue, New Westminster
HOLE No.: BH-5
DATE: NOV. 25, 2004 PLATE: 2 of 2