GEOTECHNICAL COVENANT

MINISTER OF TRANSPORTATION

FB 22628
FB 22629

Land Title Act
Form C FB022629
(Section 133(1))
Province of
British Columbia

GENERAL INSTRUMENT - PART 1 (This area for Land Title Office use) Page 1 of 33 pages

1. **Application:** (Name, address, phone number and signature of applicant, applicant's solicitor or agent)

HOBBS HARGRAVE, Barristers & Solicitors,
301 Franklyn Street, Nanaimo, B.C. V9R 2X5
Tel: (250) 753-3477 File: 14594

Signature of Applicant, or Solicitor or Agent

2. **Parcel Identifier and Legal Description of Land:***

(PID)	(Legal Description)
~~003-134-792~~	~~South West Quarter, Section 8, Gabriola Island, Nanaimo District~~ SEE SCHEDULE

3. **Nature of Interest:***

Description	Document Reference	Person Entitled to Interest
Section 219 Covenant over part in Plan VIP 82760	Entire Instrument	Transferee
Priority Agreement granting Section 219 Covenant FB 22628 Priority over Mortgage EX95256 and Assignment of Rents EX95257	Page 7	Transferee

4. **Terms:** Part 2 of this instrument consists of (select one only)

(a) Filed Standard Charge Terms	| |	D.F.No.
(b) Express Charge Terms	|X|	Annexed as Part 2
(c) Release	| |	There is no Part 2 of this instrument

A selection of (a) includes any additional or modified terms referred to in Item 7 or in a schedule annexed to this instrument. If (c) is selected, the charge described in Item 3 is released or discharged as a charge on the land described in Item 2.

5. **Transferor(s):***

CENTRE STAGE HOLDINGS LTD. (Inc. No. 0204577) (as to Section 219 Covenant); and
CAREVEST CAPITAL INC. (Extra-Provincial Registration No. A-42259) (as to Priority Agreement)

6. **Transferee(s):***(including occupation(s), postal address(es) and postal code(s))

HER MAJESTY THE QUEEN, in the Right of the Province of British Columbia, as represented by the **MINISTER OF TRANSPORTATION**, having its offices at 2100 Labieux Road, Nanaimo, BC V9T 6E9

7. **ADDITIONAL OR MODIFIED TERMS:***

N/A

8. **EXECUTIONS:**** This instrument creates, assigns, modifies, enlarges, discharges or governs the priority of the interest(s) described in Item 3 and the Transferor(s) and every other signatory agree to be bound by this instrument, and acknowledge(s) receipt of a true copy of the filed standard charge terms, if any.

OFFICER SIGNATURE(S)

BASIL A. HOBBS
Barrister & Solicitor
307 FRANKLYN STREET
NANAIMO BC
V9R 2X5

EXECUTION DATE

Y	M	D
06	11	02

SIGNATURE(S)

CENTRE STAGE HOLDINGS LTD.
by its Authorized Signatory(ies).

Full Name: Glenna Borsuk

*If space insufficient, enter "SEE SCHEDULE" and attach schedule in Form E.
**If space insufficient, continue executions on additional page(s) in Form D.

OFFICER CERTIFICATION:
Your signature constitutes a representation that you are a solicitor, notary public or other person authorized by the Evidence Act, R.S.B.C., 1996 c. 124, to take affidavits for use in British Columbia and certifies the matters set out in Part 5 of the Land Title Act as they pertain to the execution of this instrument.

* If space insufficient, enter "SEE SCHEDULE" and attach schedule in Form E.
** If space insufficient, continue executions on additional page(s) in Form D.

Land Title Act
FORM D

EXECUTIONS CONTINUED

Officer Signature(s)	Y	M	D	Party(s) Signature(s)
PETER VAARTNOU Barrister & Solicitor 1212 - 1175 DOUGLAS STREET VICTORIA, B.C. V8W 2E1 382-7222	06	12	14	**CAREVEST CAPITAL INC.** by its authorized signatory(ies): Per: Jill Plasteras Director of Mortgage Investments Per:

OFFICER CERTIFICATION:
Your signature constitutes a representation that you are a solicitor, notary public or other person authorized by the Evidence Act, R.S.B.C., 1996 c. 124, to take affidavits for use in British Columbia and certifies the matters set out in Part 5 of the Land Title Act as they pertain to the execution of this instrument.

* If space insufficient, enter "SEE SCHEDULE" and attach schedule in Form E.
** If space insufficient, continue executions on additional page(s) in Form D.

2. PARCEL IDENTIFIER AND LEGAL DESCRIPTION OF LAND

(PID) (LEGAL DESCRIPTION)

___ ___ ___ Lot 1, Section 8, Gabriola Island, Nanaimo District, Plan VIP 82759
___ ___ ___ Lot 2, Section 8, Gabriola Island, Nanaimo District, Plan VIP 82759
___ ___ ___ Lot 3, Section 8, Gabriola Island, Nanaimo District, Plan VIP 82759
___ ___ ___ Lot 4, Section 8, Gabriola Island, Nanaimo District, Plan VIP 82759
___ ___ ___ Lot 5, Section 8, Gabriola Island, Nanaimo District, Plan VIP 82759
___ ___ ___ Lot 6, Section 8, Gabriola Island, Nanaimo District, Plan VIP 82759
___ ___ ___ Lot 7, Section 8, Gabriola Island, Nanaimo District, Plan VIP 82759
___ ___ ___ Lot 8, Section 8, Gabriola Island, Nanaimo District, Plan VIP 82759
___ ___ ___ Lot 9, Section 8, Gabriola Island, Nanaimo District, Plan VIP 82759

___ ___ ___ Strata Lot 1, Section 8, Gabriola Island, Nanaimo District, Strata Plan VIS 6238
___ ___ ___ Strata Lot 1, Section 8, Gabriola Island, Nanaimo District, Strata Plan VIS 6238
___ ___ ___ Strata Lot 1, Section 8, Gabriola Island, Nanaimo District, Strata Plan VIS 6238
___ ___ ___ Strata Lot 1, Section 8, Gabriola Island, Nanaimo District, Strata Plan VIS 6238

The Common Property of Strata Plan VIS 6238

CONSENT AND PRIORITY AGREEMENT
OF
CAREVEST CAPITAL INC.

Carevest Capital Inc. (the "**Chargeholder**") is the holder of a mortgage and assignment of rents registered against the lots (the "**Lots**") legally described in item 2 of the Form E to which this Agreement is attached, which mortgage and assignment of rents are registered in the Victoria Land Title Office under instrument numbers EX95256 and EX95257, respectively (collectively, the "**Charge**").

In connection with the Section 219 Covenant (the "**Covenant**") granted herein by Centre Stage Holdings Ltd. and Her Majesty The Queen In The Right of the Province of British Columbia, as represented by the Minister of Transportation (the "**Transferee**"), the Transferee requires the Chargeholder to grant the Covenant priority over the Charge.

This Consent and Priority Agreement is evidence that in consideration of payment to the Chargeholder of $1.00 by the Transferee, the Chargeholder agrees with the Transferee as follows:

1. The Chargeholder consents to the granting and registration of the Covenant and the Chargeholder agrees that the Covenant binds its interest in and to the Land.

2. The Chargeholder grants to the Transferee priority for the Covenant over the Chargeholder's right, title and interest in and to the Lots and the Chargeholder postpones the Charge, and all of its right, title and interest thereunder, to the Covenant as if the Covenant had been executed, delivered and registered prior to the execution, delivery and registration of the Charge.

As evidence of its agreement with the Transferee to be bound by this Consent and Priority Agreement, as a contract and as a deed executed and delivered under seal, the Chargeholder has executed and delivered this Agreement by executing the Land Title Act Form D to which this Agreement is attached and which forms part of this Agreement.

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TERMS OF INSTRUMENT – PART 2

SECTION 219 COVENANT – GEOTECHNICAL APPROVAL

THIS AGREEMENT dated for reference October 15, 2006 is

BETWEEN:

CENTRE STAGE HOLDINGS LTD.
A British Columbia company with offices at
12428 – 55th Avenue, Surrey, BC V3X 1B1

(the "Owner")

AND:

HER MAJESTY THE QUEEN, in the Right of
the Province of British Columbia, as represented by the
MINISTER OF TRANSPORTATION

(the **"Province"**)

GIVEN THAT:

A. The Owner is the registered owner in fee simple of the Lots in the Gabriola Island Local Trust Area, British Columbia legally described as follows:
Lots 1 to 9, Section 8, Gabriola Island, Nanaimo District, Plan VIP 82759.
and:

Strata Lots 1 to 4, Section 8, Gabriola Island, Nanaimo District, Strata Plan VIS 6238.
and:

The Common Property, Strata Plan VIS 6238

B Section 219 of the *Land Title Act* provides that a covenant in respect of the use of land or a building or that land is or is not to be built on in favour of the Crown or a municipality may be registered as a charge against title to the land; and

BC. As a condition to the Province consenting to the subdivision of the Lands the Province requires the owner to enter into this Section 219 covenant (the **"Agreement"**).

THIS AGREEMENT is evidence that in consideration of payment of $1.00 by the Province to the owner (the receipt of which is acknowledged by the Owner), and in consideration of the promises exchanged below, the Owner covenants and agrees with the Province in accordance with Section 219 of the *Land Title Act* as follows:

1. **No Build Covenant**

The Owner will not nor will it permit any party to develop, build or construct or place on a Lot any building structure or dwelling unit within the areas outlined in bold on a Reference Plan of Covenant over Part of Lots 1 – 9, Plan VIP 82759, and Part of Strata Lots 1-4, Plan VIS 6238, and part of the Common Property of Strata Plan VIS 6238, all of Section 8, Gabriola Island, Nanaimo District, prepared by D.G. Wallace, B.C.L.S. on the 6th day of October, 2006, a reduce copy of which is attached hereto as Schedule "A", until safe building sites have been identified by a qualified Geotechnical Engineer and approved by the Provincial Approving Officer as per the recommendations of the Golder Associates Report on Terrain Stability (dated October 20, 2006).

2. **Acknowledgement of Covenant Purpose**

The Owner acknowledges and agrees that the Lots require identification of safe building sites before the construction of any building, structure or dwelling on a Lot is commenced.

3. **Obligation**

The parties agree that this Agreement creates only contractual obligations and obligations arising out of the nature of this document as a covenant under seal. The parties agree that no tort obligations or liabilities of any kind between the parties in connection with the performance of, or any default under or in respect of, this Agreement. The intent of this section is to exclude tort liability of any kind and to limit the parties to their rights and remedies under the law of contract and under the law pertaining to covenants under seal.

4. **Indemnity**

The Owner releases, and must indemnify and save harmless, the Province, and its' respective elected and appointed officials and employees, from and against all liability, actions, causes of action, claims, damages, expenses costs, debts, demands or losses suffered or incurred by the Owner, or anyone else, arising from the granting or existence of this Agreement, from the performance by the Owner of his Agreement, or any default of the Owner under or in respect of this Agreement.

5. **No Public Law Duty**

Where Province is required or permitted by this Agreement to form an opinion, exercise a discretion, express satisfaction, make a determination or give its consent, the Owner agrees that the Province is under no public law duty of fairness or natural justice in that regard and agrees that the Province may do any of those things in the same manner as if it were a private party and not a public body.

6. **No Effect on Laws or Powers**

This Agreement does not affect or limit the discretion, rights or powers of the Province under any enactment (as defined in the *Interpretation Act*, R.S.B.C. 1996, c.238, on the reference date of this Agreement) or at common law, including in relation to the use or subdivision of the Lots.

7. **Covenants Run with the Lots**

Every obligation and covenant of the Owner in this Agreement constitutes both a contractual obligation and a covenant granted under Section 219 of the *Land Title Act* in respect of the Lots and this Agreement burdens the Lots and runs with them and binds the successors in title to the Lots. This Agreement burdens and charges all of the Lots and any parcel into which it is subdivided by any means and any parcel into which the Lots is consolidated. The Owner is only liable for breaches of this Agreement that occur in respect of a Lot while the Owner is the registered owner of that Lot.

8. **Waiver**
An alleged waiver of any breach of this Agreement is effective only if it is an express waiver in writing of the breach. A waiver of a breach of this Agreement does not operate as a waiver of any other breach of this Agreement.

9. **Severance**
If any part of this Agreement is held to be invalid, illegal or unenforceable by a court having the jurisdiction to do so, that part is to be considered to have been severed from the rest of this Agreement and the rest of this Agreement remains in force unaffected by that holding or by the severance of that part.

10. **Entire Agreement**
This Agreement is the entire agreement between the parties regarding its subject.

11. **Enurement**
This Agreement binds the parties to it and their respective successors, heirs, executors and administrators.

12. **Deed and Contract**
By executing and delivering this Agreement each of the parties intends to create both a contract and a deed executed and delivered under seal.

13. **Registration in Land Title Office**
The Owner agrees to do everything reasonably necessary, at the Owner's expense, to ensure that this Agreement is registered against title to the Lots with priority over all financial charges, liens and encumbrances registered, or the registration of which is pending, at the time of application for registration of this Agreement.

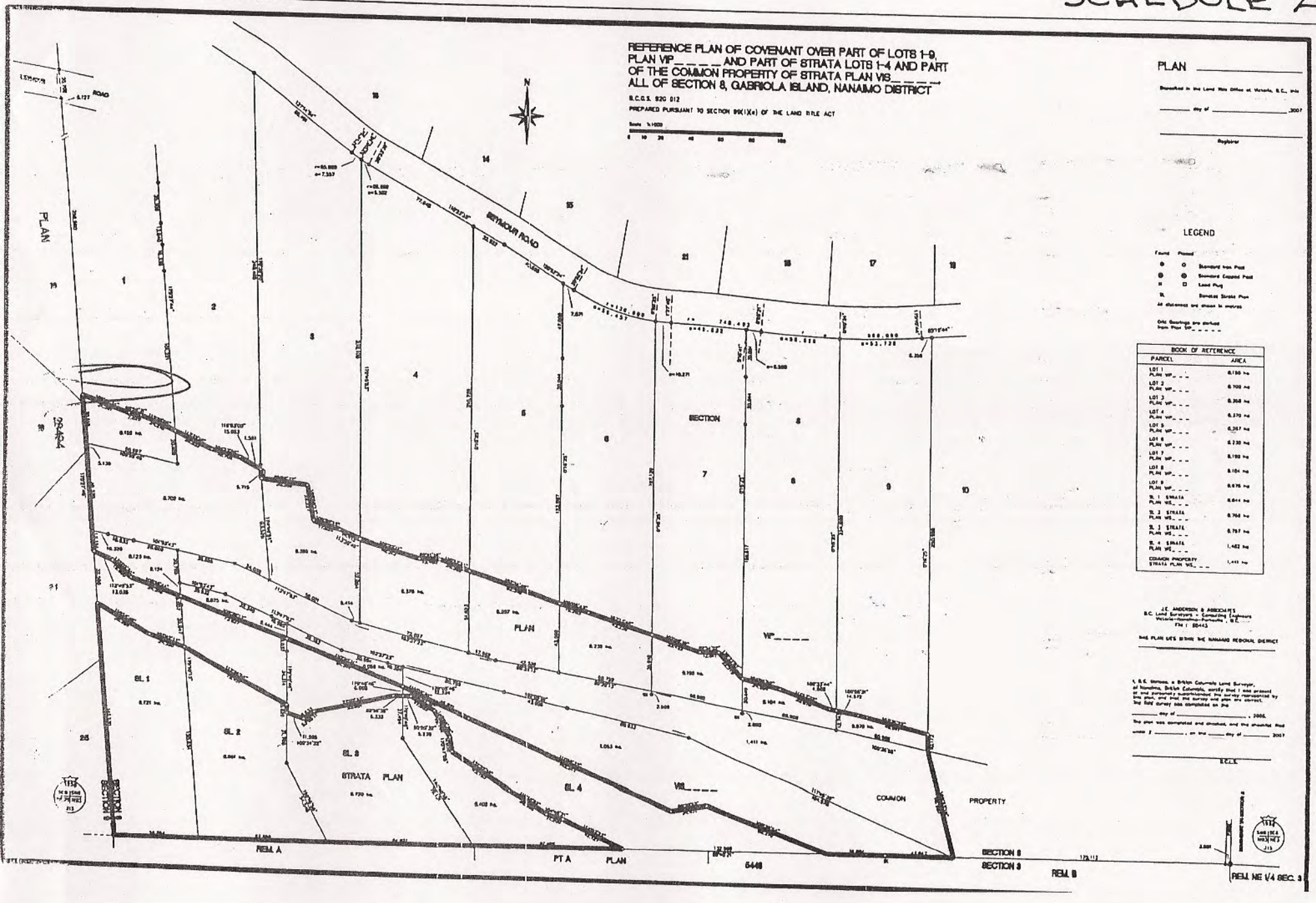
14. **Further Assurances**
The Owner must do everything reasonably necessary to give effect to the intent of this Agreement, including execution of further instruments.

15. This is the Instrument creating the condition or covenant entered into under Section 219 of the *Land Title Act* by the registered owner referred to herein and shown on the print of the plan annexed hereto and initialed by me.

_____
Approving Officer
Ministry of Transportation

As evidence of their agreement to be bound by the above terms, the parties each have executed and delivered this Agreement under seal by executing Part 1 of the *Land Title Act* Form C or Form D's to which this Agreement is attached and which form part of this Agreement.

SCHEDULE "A"


REFERENCE PLAN OF COVENANT OVER PART OF LOTS 1-9, PLAN VIP_____ AND PART OF STRATA LOTS 1-4 AND PART OF THE COMMON PROPERTY OF STRATA PLAN VIS_____ ALL OF SECTION 8, GABRIOLA ISLAND, NANAIMO DISTRICT
B.C.G.S. 92G 012
PREPARED PURSUANT TO SECTION 99(1)(e) OF THE LAND TITLE ACT
PLAN _____
LEGEND
BOOK OF REFERENCE
PARCEL
AREA
SEYMOUR ROAD
SECTION 8
PLAN VIP_____
PLAN VIS_____
SL. 1
SL. 2
SL. 3
SL. 4
STRATA PLAN
COMMON PROPERTY
REM. A
PT A PLAN 6448
SECTION 8
SECTION 9
REM. B
REM. NE 1/4 SEC. 9

Golder Associates Ltd.

2640 Douglas Street
Victoria, British Columbia, Canada V8T 4M1
Telephone 250-881-7372
Fax 250-881-7470

REPORT ON

GEOTECHNICAL HAZARD ASSESSMENT
PROPOSED SUBDIVISION
GABRIOLA ISLAND

Submitted to:

Centre Stage Holdings
12428 55 Avenue
Surrey, BC V3X 3B1

DISTRIBUTION:

2 Copies - Centre Stage Holdings
2 Copies - Golder Associates Ltd.

October 20, 2006

05-1414-089-2000

Golder Associates Ltd.

2640 Douglas Street
Victoria, British Columbia, Canada V8T 4M1
Telephone 250-881-7372
Fax 250-881-7470

October 20, 2006

05-1414-089-2000

Centre Stage Holdings Ltd.
12428 55 Ave
Surrey, B.C. V3X 3B1

Attention: Mr. Don Gatley,

RE: GEOTECHNICAL HAZARD ASSESSMENT
PROPOSED SUBDIVISION GABRIOLA ISLAND

Dear Sir:

As requested, Golder Associates Ltd. (Golder) carried out a geotechnical hazard assessment for Phase 1 of a proposed rural subdivision application on the Southwest ¼ section of Section 8 of the Gabriola Island Nanaimo District. Phase 2 of the development will occur on the Northeast ¼ of Section 3 except Parcel A (DD773261). The purpose of the assessment was to determine the potential presence of geotechnical hazards on and/or immediately adjacent to the site and determine if safe building envelopes exist for residential development on the various lots proposed for the site.

We base the assessment on information obtained from historical air photos, review of the subdivision map and field observations within and adjacent to the proposed subdivision. This report provides a preliminary assessment (zoning) of potential landslide hazards on the subject property, in this case rockfall from a series of sandstone and conglomerate bluffs and associated colluvial (talus) slopes. No channelized landslide hazards (e.g., debris flows) were identified on site. The report identifies areas where geotechnical setbacks should be designated along the tops of the main bluffs and along the tops of longer mixed bedrock and colluvial slopes, or below designated rockfall hazard zones, to define safe building envelopes. Detailed geotechnical assessments are required if residential construction is proposed within recommended the safe building envelope setbacks.

The report does not specifically address geotechnical conditions or construction issues associated with localized bluffs generally less than 5 metres high or short (5 – 20 metre long) colluvial slopes associated with those smaller bluffs. Additional geotechnical inspection/assessment of these localized areas may be called for by the building inspector at the time of building permit application for individual lot development. The report also does not address geotechnical conditions or construction issues related to foundation design.

This report follows an earlier evaluation of the possible effects of logging on slope stability on the steeper slopes within the property and recommendations related to forest harvesting practices that was carried out by Golder (see Golder, 18 January, 2006) and draws on some of the information in that earlier report.

The scope of work is limited to geomorphologic and geotechnical issues associated with rural subdivision development. The work undertaken was limited to review of readily available site information, air photo interpretation, visual inspection of the site and examination of exposed soil and bedrock conditions. Subsurface geotechnical investigations were not carried out for this project. This assessment does not include any investigation, testing, or assessment of the potential presence or effect of soil or groundwater contamination at the site or the provision of bioscience services.

This report should be interpreted and used in accordance with the limitations and considerations set out in *'Important Information and Limitations of this Report'*, which appears following the text. The reader's attention is specifically drawn to this information as it is essential that it is followed for the proper use and interpretation of this letter report. Section 2.3 (Methods) outlines additional limitations.

1.0 LOCATION

The proposed subdivision is located on a generally south-facing slope on the southwest side of Gabriola Island above False Narrows. The area is accessible from Seymour Road at the west end of the property. We have attached a not-to-scale 1:3000 scale copy of the subdivision map (Figure 1) to this report showing the proposed subdivision produced by J.E. Anderson and Associates.

2.0 WORK CARRIED OUT

The assessment included a desk review of background materials, foot and vehicle traverses and observations within the proposed subdivision, qualitative analysis of the field observations and report preparation.

2.1 Desk Review

The desk review included inspection of the preliminary subdivision plans, the topographical, geological and soils maps for the area. A series of historical air photos dating from the early 1960's were reviewed to check for the presence of air photo visible landslides or other landforms and terrain features that might indicate the presence of unstable or potentially unstable slopes.

The preparation of this report involved review of the following information:

- J.E. Anderson & Associates (REA) subdivision maps, scale 1:3000. File 85443 dated 21 December, 2005 and 31 August 2006.
- Soils map for Gabriola Island, scale 1:20,000, from Soil Survey Report 43. Soils of the Gulf Islands of British Columbia. Volume 4 Soils of Gabriola Island and lesser islands. 1990. British Columbia Soil Survey. Research Branch, Agriculture Canada. Authors: E.A. Kenney, L.J.P. van Vliet, and A.J. Green.
- A recent (circa 2005) colour orthophoto plotted at an approximate scale of 1:10,000, source unknown, provided by Centre Stage Holdings Ltd.
- Geological Survey of Canada Open File 463 Geology of Vancouver Island, J.E. Muller, 1977.
- Terrain Stability Assessment, Proposed Subdivision Gabriola Island, report by Golder Associates Ltd., 18 January 2006.

The air photos reviewed are listed in Table 2.1

Table 2.1. Air photo list

Year/Date	Flight line	Frame numbers
pre-1960	BC1437	24-26
pre-1960	BC1499	5-6
15 June 1962	BC5046	24-25
1967	15BC5261	90-92
30 June 1972	BC7407	47-49
30 June 1972	BC7409	134-136
22 July 1975	BC7754	290-293
July 1980	BCC249	204-205
1991	BCB91021	129-132, 68-

2.2 Site Reconnaissance

As part of Golder's original terrain stability assessment work, Mr. Terry Rollerson, P. Geo (Golder) made a preliminary site visit lasting about 2 hours on December 6, 2005, accompanied by Mr. Vanstone and Mr. Don Gatley of Centre Stage Holdings Ltd. A second visit of about 7 hours to inspect the steeper slopes within the subdivision area was made on December 29, 2005 with Mr. David Vanstone of Centre Stage Holdings Ltd. These traverses are described in Golder (January 18, 2006).

As part of the current scope of work, additional site visits by Mr. Rollerson were made in July 2006. These site visits occurred on July 11, 12, 13, and on July 15 – 27. Mr. Jeff Fillipone, P. Geo., (Golder) and Mr. Thor Simrose (Thor Simrose Contracting) accompanied Mr. Rollerson on July 12, 2006. Mr. Fillipone, Mr. Rollerson and Mr. Gatley also visited the property to inspect specific steep slope sites on August 2, 2006. The total cumulative field time for these visits amounted to about 40 hours including visits to both the Southwest ¼ section of Section 8 and the Northeast ¼ of Section 3 except Parcel A (DD773261), which will be proposed for development at a later date.

The foot traverses within the subdivision concentrated on the steeper sections of the property including a series of steep sandstone and conglomerate bluffs, moderately to steeply sloping colluvial slopes intermixed with the bluffs and colluvial (talus) aprons formed at the base of the bluffs. These traverses ran roughly east south east to east along the tops and bases of each of the main bedrock bluffs and along the bases of the dominant talus slopes. Limited foot and vehicle traverses were made on the gently and moderately sloping portions of the property.

2.3 General Assessment Methods

The geotechnical hazard assessment in large part follows the methodology outlined in the "Guidelines for Legislated Landslide Assessments for Proposed Residential Development in British Columbia" (Association of British Columbia Professional Engineers and Geoscientists [APEGBC], 2006), but also takes direction from the "Guidelines for Terrain Stability Assessments in the Forest Sector" (APEGBC, 2003).

The field reconnaissance included a visual assessment of terrain features including surficial material and bedrock conditions, surface water conditions, vegetation, slope gradients and geomorphic processes encountered during our traverses through the property. Our assessment of the surficial material and bedrock conditions is based on visual examination of natural bedrock outcrops, natural surficial material and soil

exposures and exposures along existing roads within the property. Our field observations reference lot numbers and topographic features. Much of the terminology used in this report to describe surficial materials (soils), slope processes and slope gradients follows Howes and Kenk, 1997. Basic measurements were made using clinometer, steel tape or hip chain, hand held laser rangefinder and geologic compass. In the assessment of geotechnical hazards no detailed slope stability analyses or subsurface investigations have been carried out.

2.4 Fragmental Rockfall Hazard Assessment Methodology

Fragmental rockfall is characterized by the detachment of individual rock fragments from a steep rock slope and their gravitational downhill transport. There is evidence of previous fragmental rockfall from the steep sandstone and conglomerate bluffs on the property. Boulders of sandstone and conglomerate, 1 to 20 cubic metres in size, that appear to be derived from fragmental rockfall are located on the talus slopes and for a short distance out onto level or gently sloping areas beyond the lower edges of the talus slopes. On most bluffs there are potentially unstable blocks or slabs of sandstone or conglomerate. These blocks range in size from about 0.5 to 20+ cubic metres. Ongoing physical/chemical weathering processes will continue to loosen and detach these blocks from the bluffs. Similarly, ground shaking during seismic events may also result in future rockfall. Consequently, rockfall will continue to occur on these slopes and occasional blocks will likely travel downslope beyond the lower edges of the existing talus slopes.

Estimates of potential future rockfall runout distances are based on assessment of the distribution and extent of existing rockfall debris. There are at least two empirical methods that can be used to estimate rockfall runout distances and define rockfall hazard zones.

The rockfall runout method used for this study is described in Evans and Hungr (1993). Their study focused on 15 rockfall sites located in mountainous terrain in the southern interior of BC and coastal BC. The method relies on the determination of a "minimum rockfall shadow angle" defined as the angle between the top of the talus slope and the maximum limit of the rockfall shadow. The "rockfall shadow" is an area of scattered boulders located on level to gently sloping ground that extends beyond the lower edge of the talus slope. These boulders likely bounce and/or roll across the slopes beyond the lower edge of the main talus slope. Evans and Hungr found a minimum rockfall shadow angle of 27.5 degrees to be a reasonable first approximation of rockfall shadow limits. The method provides a maximum probable runout distance, which has not been exceeded

at any of the 15 rockfall sites studied by Evans and Hungr and which does not require the determination of individual rockfall initiation and termination points.

A second empirical method, "rockfall fahrboschung" for estimating rockfall runout is dependent on the determination of the initiation and terminal points for individual rockfall events (see the description of a study by Onofri and Candian, 1971, in Evans and Hungr). The rockfall fahrboschung is the angle between the highest point on a rockfall source scar and the stopping point of the longest runout boulder for that particular rockfall. Onofri and Candian found this relationship to range from 28.4 to 40.7 degrees. Correlation of rockfall source scars with associated rockfall fragments, however, is not viable unless both the rockfall and the source scars are distinct and fresh (there are very few sites like this on Gabriola). Consequently, this approach was not suitable for the current study.

Measurements of minimum rockfall shadow angles were made at a number of locations on the Gabriola site to confirm/compare with the Evans and Hungr 27.5 degrees minimum rockfall shadow angle. In the case of the subject property (and possibly elsewhere on Gabriola) the minimum rockfall shadow angles measured were consistently about 22 degrees. Consequently, a "Gabriola specific" minimum rockfall shadow angle of 22 degrees was adopted and applied to all determinations of rockfall shadow (hazard) zones where the slopes at the toe of the talus were relatively level. Minimum rockfall shadow angle lines were located (flagged) in the field by Golder and then ground surveyed by REA. The minimum rockfall shadow angle line is identified on the subdivision map (line A-A9). Steel survey pins placed by REA identify the intersection of the minimum rockfall shadow line with each respective property line.

We did observe local areas where the hillsides were gently to moderately sloping rather than level at the toe of a talus slope (or mixed colluvial and rock outcrop slope). In these cases rockfall runout distances did not necessarily conform to the local 22 degree minimum rockfall shadow angle relationship. At times individual rockfall fragments on these slopes appear to travel well beyond the point defined by the 22 degree, minimum rockfall shadow angle. In these cases, we carried out an extensive search of the slopes below the bluffs/talus to identify possible rockfall fragments with which to define a maximum rockfall shadow (runout) limit. These sites were restricted to the lower slopes of the southwest ¼ of Section 8 (the southern slopes of strata lots SL1 to SL4). On these hillsides the observed rockfall appeared to stop on slopes ranging from 11 to 17 degrees (20 to 30 percent, consequently a 11 degree (20 percent) slope angle limit was adopted to define the likely limit of maximum rockfall runout on these specific hillsides. For the purposes of this subdivision application the 11 degree slope angle delimited rockfall shadow hazard line below strata lots SL1 to SL4 is defined as the lower (southern)

property boundary, but in some circumstances fragmental rockfall runout distances could extend beyond this boundary. For example, the top of a 5 to 10 metre high interbedded sandstone and conglomerate bluff runs along, or a short distance below the lower property boundary, at the southern limit of strata lots SL1, SL2 and SL3. A rockfall shadow hazard line was not determined for potential rockfall from this bluff or for rocks that could potentially be generated from or roll over the top of this bluff as it lies well outside any potential building envelopes within the current development.

For both rockfall shadow hazard line determination methods, the rockfall shadow line should define an approximate 1:10,000 probability of an individual rockfall reaching the defined rockfall shadow line within a single year. This probability is based on the assumption that it is about 10,000 years since glacial ice left the area, the visible talus and individual rockfall fragments will have accumulated since that time.

In the case of both methods for determination of the rockfall shadow hazard line used on the Gabriola site an additional 10 metre setback from this line is recommended to define a "safe" building envelope boundary. If a property owner wishes relaxation of the rockfall shadow hazard line or of the building envelope setback distance so that they can build closer to the toe of a rockfall prone slope then a detailed geotechnical evaluation of potential rockfall runout distances and/or protective (mitigative) measures should be undertaken.

Limitations of the approach: Preliminary clearing and road construction and previous logging activity may have altered the location of occasional rockfall fragments so that in some cases the location of specific fragments may not represent original rockfall runout locations. Similarly, some slopes below bluffs and talus slopes are composed of till containing some moderately large rock fragments consisting of a variety of lithologies. Some of these fragments are sandstone. Due to the rounded nature of the edges of some local sandstone outcrops/bluffs and some of the rockfall fragments from these bluffs it is not always possible to distinguish individual rockfall fragments from rocks derived from the till. In cases where it was not possible to distinguish culturally moved rocks or rocks derived from till from rockfall fragments we assumed that the fragments were rockfall. This approach may lead to locally conservative estimates of rockfall runout distances.

2.5 Bluff Top and Steep Slope Assessment Methodology

The second part of the geotechnical hazards assessment involved evaluation of stability conditions along the tops of the higher sandstone bluffs and longer mixed colluvial and bedrock slopes that directly abut proposed building sites.

Most bluffs/scarps less than about 5 metres high and mixed colluvial and bedrock slopes steeper than about 30 degrees and 5 to 20 metres in downslope extent that occur locally within the subdivision are not specifically included in this assessment. It is unlikely that these slopes pose a significant landslide hazard. It is possible that site specific geotechnical inspection may be called for by the building inspector at the time of building permit application for individual lot development to assess these localized areas. There are localized, short blocky colluvial (talus) slopes associated with some of these smaller bedrock bluffs/scarps indicating that fragmental rockfall has occasionally occurred along these slopes. The runout distances for this type of rockfall appear to be limited to a few metres.

The tops of bedrock bluffs generally higher than 5 metres and the tops of colluvial or mixed colluvial and bedrock outcrop slopes equal to or steeper than about 30 degrees and with a downslope extent generally greater than 20 metres, that occur in proximity to the more significant bedrock bluffs were traversed and flagged. These flag lines were then ground surveyed by REA and are identified on the subdivision map (lines B-B9and C-C9). Steel survey pins placed by REA identify the intersection of the top of bluff or top of steep slope line with each respective property line. The "top of bluff" line was defined as the top of a clearly defined vertical or near vertical bedrock (bluff) surface or the first strong, visible structure (e.g., joint surface) back from the top edge of the bluff if there was no clearly defined bluff edge. The top of bluff line was placed behind (upslope of) any obviously detached blocks or indentations along the top of the bluff. In a few cases, a significant joint trace running parallel or sub-parallel to the main bluff surface, which was visibly associated with detached slabs or blocks on the bluff face was projected across soil slopes behind the main bluff face where there was no visible surface expression of the joint surface and flagged as the bluff top line. In these cases the "bluff top line" may be located a few metres back from (upslope of) the apparent bluff top.

In the case of colluvial or mixed colluvial and rock outcrop slopes the "top of steep slope" line was placed along the most obvious break or change in slope at the top of the 30 degree (58 percent) or steeper than 30 degree slope. In most cases this change in slope is obvious, but in some cases it is indeterminate. In these indeterminate cases, a conservative judgment defines the "top of steep slope" line.

The dominant bedrock joint orientations (strike direction and dip angle) and characteristics along the bedrock bluffs were measured and recorded. Approximate bluff heights were determined with a hand held laser rangefinder. Clinometer and hip chain slope traverses were carried out on each dominant hillslope morphology to provide data for simple cross-section profiles.

Horizontal setback distances from the bluff and colluvial "top of slope" lines to define preliminary "safe" building envelopes for individual lots within the subdivision were developed for each significant bluff, colluvial or mixed colluvial and bedrock slope type. If a property owner wishes relaxation of the top of bluff/slope setback distance so that they can build closer to the top edge of a bluff or steep colluvial slope then a detailed geotechnical investigation should be undertaken. The setback distances from the top of each sandstone bluff are based on a 1:1 relationship to estimated bluff height, unless bedrock structure indicated that a greater or lesser distance was appropriate (i.e., for bluffs equal to or less than 5 metres high the horizontal setback distance was set at 5 metres and for bluffs between 5 and 10 metres high the horizontal setback distance was set at 10 metres). In the case of steep, mixed colluvial and bedrock slopes the horizontal setback distance was set at 5 metres based on field observations that bedrock occurs at shallow depths (i.e., 1 to 2 metres) on most of these slopes.

The top of bluff setback is set to minimize the chance that a building foundation could be affected by or trigger a fragmental rockfall event. The top of steep colluvial slope setback is set to minimize the chance that a building foundation or fill might surcharge the slope sufficiently to initiate failure of the slope.

A "top of bluff" line and building envelope setback was not determined or surveyed for the 5 to 10 metre high conglomerate and sandstone bluff that runs along the lower property boundary of strata lots SL1, SL2 and SL3 as these areas fall within the preliminary rockfall shadow zone on the southern portions of strata lots SL1 to SL4.

Setbacks for slope stability and rockfall hazard are not specified for the less than 5-metre high bedrock outcrops and short, steep (less than 30 degrees and less than 20 metres long) colluvial or talus slopes that occur locally within the subdivision. It is our understanding that most of these sites occur at locations where residential construction is unlikely. A site-specific geotechnical evaluation should occur if residential construction is proposed in such areas.

3.0 GENERAL SITE CONDITIONS AND BACKGROUND

3.1 Terrain and Soils

Colluvial veneers and blankets[1], and long, linear sandstone and conglomerate bluffs form the steeper, south-southeast facing portions of the property.

[1] Veneers are generally less than 1 metre deep and blankets are greater than 1 metre deep (Howes and Kenk, 1997).

Horizontal setback distances from the bluff and colluvial "top of slope" lines to define preliminary "safe" building envelopes for individual lots within the subdivision were developed for each significant bluff, colluvial or mixed colluvial and bedrock slope type. If a property owner wishes relaxation of the top of bluff/slope setback distance so that they can build closer to the top edge of a bluff or steep colluvial slope then a detailed geotechnical investigation should be undertaken. The setback distances from the top of each sandstone bluff are based on a 1:1 relationship to estimated bluff height, unless bedrock structure indicated that a greater or lesser distance was appropriate (i.e., for bluffs equal to or less than 5 metres high the horizontal setback distance was set at 5 metres and for bluffs between 5 and 10 metres high the horizontal setback distance was set at 10 metres). In the case of steep, mixed colluvial and bedrock slopes the horizontal setback distance was set at 5 metres based on field observations that bedrock occurs at shallow depths (i.e., 1 to 2 metres) on most of these slopes.

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[1] Veneers are generally less than 1 metre deep and blankets are greater than 1 metre deep (Howes and Kenk, 1997).

The dominant sandstone bluff and talus slope in the southwest ¼ of section 8 generally trends east-southeast through the lower (southern) portions of lots 1 to 5. A mixed colluvial and exposed bedrock slope continues south southeast through the lower (southern) portions of lots 6 to 12 and the upper slopes of strata lot 4. There is a low, discontinuous (5 to 10 metre high) bluff and talus slope that runs east southeast though the middle sections of strata lots SL1 to SL4. A 5 to 10 metre high bluff runs along or below the lower property line in the vicinity of strata lots SL1 to SL3. Morainal materials (till) occur locally on the moderately sloping mid slopes on the southern and northern portions of this ¼ section.

The steeper slopes are dominated by Saturna soils and exposed bedrock. Saturna soils are well- to rapidly-drained forest soils developed in shallow morainal deposits (till) or weathered sandstones and/or conglomerates on gently to moderately sloping surfaces and in colluvial materials derived from the sandstone and conglomerate on steeper surfaces (BC Soil Survey, 1990). Qualicum soils developed in gravely to sandy glaciofluvial, fluvial or marine deposits and Baynes soils developed variously in sandy fluvial, marine or eolian deposits may occur locally, most likely along the gentle slopes on the northern margin of the property where shallow glaciofluvial or marine beach gravels occur. Brigantine soils, which are imperfectly- to poorly-drained soils developed from sandy to loamy sandy fluvial and marine deposits, may occur locally in gently sloping to depressional areas within portions of lots 2 to 12.

Gently dipping sandstones and limited areas of conglomerate bedrock of the Upper Cretaceous Gabriola Formation of the Nanaimo Group underlie the entire property. Where exposed in higher vertical outcrops these rocks exhibit localized vertical and moderately to steeply dipping, south-facing joint or exfoliation surfaces. The bedding planes in the sandstones vary from horizontal to surfaces that dip gently out of or into the slope. The conglomerates are generally massive, but can be weakly bedded or jointed locally. These joint and exfoliation surfaces appear to control the periodic but localized rockfall that is evident on the rock bluffs throughout the property.

There was no visible evidence of natural or logging related shallow landslide (e.g., debris slide, debris avalanche) activity visible on any of the areas of the property visited in the field. There is evidence of ongoing rockfall[2] activity on the sandstone and conglomerate bluffs. There was no apparent evidence of recent shallow landslides on the historical air photos reviewed as part of this assessment. There was no evidence of large-scale, deep-seated landsides on these slopes. Soil creep is likely present on the steeper colluvial

[2] The term landslides encompasses the term rockfall, but within the context of this report rockfall is considered separate from other types of landslides and the term landslide should be interpreted as referring to debris slides, debris avalanches and similar events and not rockfall.

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slopes and there is some evidence for this in the presence of locally curved stems of some conifers on these slopes.

3.2 Timber Removal

Some localized timber harvesting has taken place on the property in the last year in the form of both small patch cuts and selective removal of individual trees. Future timber removal on the property will likely follow a similar pattern. The clearing of trees is done to create views and building sites. Ground-based yarding using skidder or hoe forwarding systems and hand felling will predominate. There is no sign of instability or significant surface erosion resulting from this harvesting.

The property has been harvested twice before and all or part of the property burned during a wildfire in the late 1940's (D. Vanstone, pers. comm., December 2005). There is no visible sign of landslide activity associated with those events. The last time the property was harvested, was in the late 1980's or in 1990. Most of the second growth timber on the steeper slopes was not harvested at that time, nor were the slopes within strata lots SL1 to SL4.

3.3 Seismicity

The proposed subdivision is located within Seismic Zone 4 (on a scale of 0 to 6) of the current British Columbia and National Building Codes. The spectral acceleration associated with a Cascadia Subduction Zone earthquake having a 2 percent probability of exceedence in 50 years, ranges between about 0.18g and 1.03g with a peak ground acceleration of 0.51g for firm ground conditions[3]. For a 10 percent probability of exceedence in 50 years, the spectral acceleration ranges between 0.09g and 0.54g with a peak ground acceleration of 0.27g. The Cascadia Subduction Zone earthquakes are not reflected on NBC maps. A Cascadia Subduction Zone earthquake could result in Zone 6 velocities being exceeded on Southern Vancouver Island.

It should be noted that the National Building Code of Canada has recently been revised (NBBCC 2005) and is recommending that buildings be designed to a 1:2,475 year seismic event (2 percent in 50 year probability of exceedence or 0.000404 per annum) with greatly increased design accelerations. We expect this new code to become compulsory once the new BC Building Code is completed, which will likely be in early 2007.

[3] Values derived from the Natural Resources Canada Earth Sciences Sector web site which provides interpolated 2005 National Building Code of Canada seismic hazard values for specified sites: http://earthquakescanada.nrcan.gc.ca/hazard/interpolator/index_e.php

4.0 GEOTECHNICAL HAZARD ASSESSMENT

4.1 Terrain Descriptions, Terrain Stability Interpretations and Geotechnical Recommendations

The following descriptions are of the slopes within the property traversed or inspected to evaluate geotechnical hazards. The spatial distribution of the terrain types described below corresponds to the lots outlined on the property map (Figure 1) attached to this report. This map identifies the steep slope and rockfall hazard zones described below.

Lots 1 to 4

The steep, south-facing slopes that form the southern portion of lots 1 to 4 include an upper, relatively low sandstone bluff (ranging from about 3 to 8 metres high) and a lower sandstone bluff (about 5 to 10 metres high) separated by a moderately steeply sloping, relatively planar hillside mantled with shallow (0.1 to 1.0 metre deep), well-to rapidly-drained, rubbly colluvial veneers (i.e., Saturna soils). The upper bluff is present only on lots 1 and 2, and half the distance across the south-facing slope of lot 3 and is highest near the lot 1-2 property line. The slope angles on the sandstone bluffs range from 35 to 90 degrees. Locally there are small overhangs. Slope angles on the colluvial slopes between and adjacent to the rock bluffs range from 24 to 29 degrees. The sandstones are relatively massive with infrequent bedding planes which can be horizontal but which also dip gently into the slope. There are occasional near-vertical joints, spaced roughly 3 to 5 metres apart, striking generally north-south and strong, steeply sloping joints and/or exfoliation surfaces that parallel the slope striking at about 110 degrees and dipping at about 70 degrees to the southwest (see Table 4.1). The joint surface striking at 110 degrees controls the orientation of both the small, upper bluff and the higher, lower bluff. This 110 degree striking joint has apertures ranging from 0.05 to 0.5 metres where it defines detached or partially detached blocks and slabs of rock along the face of the upper bluff.

There is evidence of limited natural rockfall (blocks up to 1 metre in diameter and 2 to 3 metres long) along the upper bluff and also evidence of considerable natural rockfall (blocks 0.5 to 2+ metres in diameter are present) from the lower bluff. There is however, no evidence of very recent rockfall. The rockfall from the lower bluff forms an extensive, well-to rapidly-drained, blocky rubbly colluvial (talus) apron along the base of the bluff. Slope angles on the colluvial apron range from 31 to 37 degrees (60 to 75 percent). The colluvial apron extends from the western edge of lot 1 part way along the base of lot 5. An existing road runs along the base of the talus slope. There is no

visible evidence of landslide activity following earlier timber harvesting on any of these slopes.

The north-facing slopes of these four lots are composed of well-drained morainal and weathered bedrock blankets and veneers that cover low, rounded, east-west trending sandstone ridges and swales. These slopes are generally gently to moderately sloping (less than 26 degrees or 49 percent). Areas of moderately steep to steeply sloping terrain (greater than 26 degrees) consisting of steep (60 to 80 degree) bedrock outcrops less than 5 metres high and colluvial slopes less than 20 metres long are present locally.

The recommended building envelope setback is 10 metres north from the "top of bluff" line on lots 1 and 2 due to the presence of an overhang and partially detached blocks and slabs of sandstone. The building envelope setback for lot 3 is located 5 metres north of the top of bluff line as there are no obvious detached blocks along the upper bluff surface except for a single block at the east end of the bluff. The top of bluff line for lot 3 runs north and then west in the middle of the lot to define additional short steep slopes. The setback along the south-facing upper colluvial slope of lot 4 is set at 5 metres.

Table 4.1 Joint Orientations Lots 1 to 3

Joint	Dip direction (°)	Dip angle (°)	Persistence	Shape	Roughness	Joint spacing (m)
1	0-10	5-15	continuous	wavy	smooth to rough	0.5-3
2	110	70	continuous	planar to wavy	smooth to rough	3-4
3	205-210	45-80	continuous	wavy	rough	2-3
4	210	30-50	discontinuous	planar	rough	0.5-3

Lot 5

The mid and upper slopes of the steeper hillside on the southern portion of this lot are mantled with well-to rapidly drained rubbly colluvial veneers interrupted locally by small, irregular to rounded sandstone outcrops and scarps. A low 1 to 2 metre high bedrock scarp is present near the top of the slope and a 2 to 3 metre high, near-vertical sandstone bluff is present about two-thirds of the way down the slope. A rubbly colluvial apron is present along the lower portion of the slope below the lower rock bluff. Slope angles on the upper colluvial slope range from 17 to 35 degrees but locally can reach 42 degrees near small sandstone outcrops and scarps. The exposed scarp surfaces are joint controlled and strike at about 110 degrees. The slope gradients on the colluvial

apron at the base of the slope range from 31 to 35 degrees (60 to 70 percent). These slopes are relatively uniform (smooth) but can be irregular where bedrock is near or at the surface. The hillside is generally planar. There is no evidence of previous natural or harvest related landslide activity on these slopes.

The north-facing slope of this lot is dominated by well-drained morainal blankets and veneers and veneers of weathered bedrock that cover one or two low, glacially modified ridges. These slopes are generally gently to moderately sloping (less than 26 degrees). Areas of moderately steep to steeply sloping terrain (greater than 26 degrees) consisting of steep bedrock outcrops less than 5 metres high and colluvial slopes less than 20 metres long occur locally.

The recommended "top of steep slope" building envelope setback on the south-facing slope of this lot is 5 metres.

Lots 6 to 9

The south-facing hillside that forms the southern portions of these lots is dominated by shallow, well-to rapidly-drained colluvial veneers. Small, irregular to rounded sandstone outcrops and scarps occur locally. These slopes are uniform and generally planar. Slope angles on these south-facing slopes range from 29 to 30 degrees in lot 6, 33 to 35 degrees with minor areas of 42 degrees in lot 7, 29 to 35 degrees in lot 8 and 24 to 30 degrees in lot 9. There is no visible evidence of previous landslide activity on these slopes. There may be minor natural rockfall from time to time from the small rock outcrops on these slopes.

A broad, gently-sloping, east-southeast trending ridge crest separates the southern from the northern slopes of these lots. The ridge and north-facing portions of these lots are mantled with veneers of morainal materials and weathered bedrock. The north-facing portions of these lots have slope angles ranging from 3 to 11 degrees, but locally can reach 30 to 35 degrees on short steeper colluvial slope segments and 70 to 80 degrees on low bedrock scarps. The bedrock scarps and colluvial slopes are located along the edges of shallow swales that trend east-southeast through these lots. The swales range from about 5 to 10 metres deep. These north-facing slopes are uniform to benchy and generally planar to locally convex.

The recommended building envelope setback from the "top of steep slope" line on the south-facing slopes of these lots is set at 5 metres.

Lots 10 to 12

These lots comprise the gently to moderately sloping terrain at the east end of the row of lots from lot 1 to lot 12. Well-drained morainal and weathered bedrock veneers and blankets dominate these slopes. The same broad, gently-sloping, east southeast trending ridge crest that is found in lots 5 to 9 separates the longer northern slope from the shorter southern slopes of lots 10 to 12. The slope angles on the southern portion of the slope generally range from 3 to 9 degrees. These slopes are generally planar and uniform. The northern portions of these lots have slope angles ranging from 3 to 17 degrees and locally near the lot 9/10 boundary can reach 30 to 35 degrees on short steeper slope segments. The northern slopes of these lots range from uniform to benchy and generally planar to locally convex. There are no geotechnical setbacks recommended for lots 10 to 12.

Strata Lots SL1 and SL2

The upper portion of these lots (above top of bluff line C-C9) are either level or gently sloping and mantled with well-drained morainal materials or veneers of weathered bedrock. The mid and lower, south-facing slopes of these lots contain two short steep slopes separated by gently to moderately sloping terrain mantled with weathered bedrock and morainal materials.

The upper of the two steep slopes within these two lots is composed of a 2 to 8 metre high sandstone bluff and a small blocky rubbly talus slope that runs along the base of the bluff. The bluff ends within SL2 and the higher portion of the bluff is within SL1. Slope angles on the sandstone bluff range from 39 degrees (80 percent) to 90 degrees and the slope angles on the talus slope at the base of the bluff range from 27 to 31 degrees (50 to 60 percent). Below the talus slope the terrain is stepped or benchy and slope angles range from 2 to 27 degrees (5 to 50 percent). Portions of the bluff are relatively competent but there are areas where several large partially detached blocks of sandstone are stacked on top of each other. The dominant joint surface that controls the orientation of the bluff strikes at approximately 110 degrees and dips at about 80 degrees to the southwest. The joints within the bluff are described in Table 4.2. The bedding planes within this bluff dip gently north into the slope. Rockfall from this bluff is generally contained on a near-level step or bench located about 10 metres downslope of the bottom of the bluff, however there may be potential for individual rockfall fragments to roll further downslope.

The lower steep slope is composed of a 5 to 10 metre high, discontinuous sandstone and conglomerate bluff and a well-to rapidly-drained, blocky rubbly colluvial apron located along the base of the rock bluff. This slope also extends across a portion of the lower

slope of strata lot SL 3. Slope angles on the lower bluff range from 39 to 90 degrees and are 27 to 35 degrees on the colluvial apron. Bedding and joint geometry in these bluffs is similar to those described for the bluffs in lots 1 and 2. The main face of the bluff strikes at about 110 degrees. The rockfall shadow of the lower bluff extends out to the lower property pin in the southwest corner of the property. There is no visible evidence of previous natural or harvest related landslide activity on these slopes.

The rockfall hazard line A-A9 defines the edge of the minimum rockfall shadow angle line along the base of the slope above these lots. The recommended building envelope setback distance is 10 metres south of the rockfall shadow line.

The building envelope setback distance is set 10 metres back from the top of bluff line along the top of the upper bluff (i.e., 10 metres north of the top of bluff line) within strata lots SL1 and SL2. This setback distance is based on the height of the bluff and on the joint orientations visible along the south face of the bluff.

The rockfall hazard zone below the upper bluff slope is considered to extend downslope to the lower property boundary, as there are no extensive areas of level terrain within these two lots that will with certainty contain the rockfall from the upper bluff. A top of bluff line and building envelope setback was not defined for the lower bluff as it is within the potential rockfall hazard zone of the upper bluff.

Further geotechnical investigation and analyses to evaluate rockfall runout or mitigative works would be required if residential construction was considered on the lower slopes of these lots. Similarly, any relaxation of the top of bluff line C-C9 or the rockfall hazard line A-A9 would require further geotechnical investigation.

Table 4.2 Joint Orientations Strata Lots SL1 and SL2

Joint	Dip direction (°)	Dip angle (°)	Persistence	Shape	Roughness	Joint spacing (m)
1	200	70	continuous	wavy	rough	2-3
2	210	24	discontinuous	wavy	rough	-
3	190	16	continuous	wavy	rough	1-3
4	125	90	discontinuous	planar	rough	0.5-5
5	115	44-50	discontinuous	irregular	rough	2-6
6	275	50	discontinuous	wavy	rough	5+
7	280-290	34-50	discontinuous	wavy	rough	1-2

Lots SL3 and SL4

The upper surface of strata lots SL3 and SL 4 above the top of steep slope/top of bluff line C-C9 is generally level to gently sloping. A small wetland is present on the eastern side of strata lot SL 4. The slopes above and east of the wetland are composed of mixed colluvial materials and small bedrock outcrops or scarps. There is a small talus apron along the base of this slope immediately upslope of the wetland. Slope angles on the mixed colluvial and bedrock slope range from 22 to 24 degrees on the upper portion of the slope (below the strata road) and 39 to 42 degrees on the lower portion of this slope. Slope angles are near vertical on some of the small bedrock scarps. There is potential for rockfall from these steeper slopes and from the steeper south-facing slopes in lots 3 though 9 above the strata road and potentially from the fill slope of the strata road. Rockfall hazard line A-A9 defines the minimum rockfall shadow angle line for this area. A building envelope setback 10 metres south of this rockfall hazard line is recommended in this area.

The slopes immediately below "top of steep slope/top of bluff" line C-C9 comprise 5 to 10 metre high sandstone bluffs along portions of the southern boundary of SL4 and steep colluvial slopes with minor bedrock outcrops for the remainder of SL4 and SL3. The mixed colluvial and bedrock slopes range from 5 to 15 metres in length. Portions of these slopes have slope angles less than 30 degrees, but these areas are included for purposes of defining a continuous top of steep slope line. A building envelope setback of 5 metres north of this line is recommended unless detailed geotechnical investigations indicate that this setback distance can be relaxed.

The slopes on the lower portions of strata lots SL3 and SL4 are composed of well-drained, blankets and veneers of morainal materials and weathered bedrock. Slope angles range from 3 to 27 degrees. The slope morphology ranges from uniform to benchy. These slopes extend down to the lower property boundary, and like the lower slopes of strata lots SL1 and SL2 are considered to be within the rockfall shadow of the bluffs and steeper colluvial slopes defined by the top of bluff line C-C9.

Lots 13 to 20 and adjacent slopes

Most of the northern portion of the subdivision (north of Seymour Road) consists of gently sloping terrain (slopes less than 15 degrees or 27 percent). Lots 13 to 19 occupy a broad, low ridge that trends generally east-southeast. The northern portions of lots 13 to 19 and the slopes of lot 20, north of these lots, have generally north–facing aspects. The southern portions of lots 13 to 19 slope gently to the south. Locally within lots 13 to 17 there are small areas of moderately sloping terrain (slopes of 16 to 25 degrees) along the

slopes of a shallow swale immediately south of the ridge crest, but these areas are restricted in extent and the slopes are relatively short (i.e., 5 to 20 metres long). The entire area is mantled with well-drained morainal blankets and veneers and locally by veneers and blankets of weathered bedrock. Very minor areas of shallow, gravely, glaciofluvial or marine (beach) deposits are present on very gently sloping terrain near the northern boundary of lot 20 There are several large, isolated, 2 to 3 metre high sandstone blocks located on the south-facing slopes just north of Seymour Road. There are no visible geotechnical hazards on these slopes. As such, it is our professional opinion that the gently sloping terrain within lots 13 to 20 is suitable for residential construction.

5.0 SUMMARY CONCLUSIONS AND RECOMMENDATIONS

The lack of evidence of large scale, deep-seated landslides on these slopes indicates that the probability of large-scale, deep-seated landslides is very low under current (and previous post-glacial) climatic and physical conditions. The lack of evidence of such activity since the end of the Fraser Glaciation in this area about 10,000 years ago, suggests an annual probability of occurrence of such events of less than 1:10,000.

A significant seismic event, such as that having a 10 percent probability of occurrence in 50 years (i.e., 1:475-year event), could result in localized landslides on the steeper slopes within the subdivision. However, considering that there have been many such events over the last approximately 10,000 years since deglaciation in this area, without obvious signs of significant landslide activity, we consider the likelihood of a seismically induced landslide on these slopes to be low (i.e., less than 1:10,000 annually). With respect to rockfall, there certainly exists a possibility that seismic activity has and could result in rockfall activity. It is our professional opinion that the rockfall runout hazard limits established for the property will suffice for rockfall generated by seismic activity as well as rockfall resulting from physical and chemical weathering.

Previous harvesting on the moderately sloping areas on this property has not resulted in visible landslide activity so timber removal for building sites, or to develop views, should result in a low likelihood of landslide activity. Similarly the likelihood of natural landslide activity should be low. Occasional post-harvest landslide activity is not unknown on similar terrain on nearby Vancouver Island, although generally in wetter climates than found on Gabriola Island. Rollerson, et al. (2002), report post-harvest landslide probabilities from southwestern Vancouver Island of about 5 percent on terrain with slope angles between 20 and 30 degrees, so landslide activity resulting from timber removal cannot be entirely discounted. If the assumption is made that harvest related landslides on Vancouver Island recur each forest rotation (e.g. every 50 years) the

post-harvest landslide rates noted above could equate to a landslide probability of 0.001 per year or 1:1000 annually on terrain with slopes between 20 and 30 degrees. As the climate at the Gabriola site is drier, the natural or harvest-related landslide probabilities on similar slopes on the Gabriola site should be less than those suggested above.

Because of the often deeply weathered, and the moderately- to well-fractured or exfoliated character of the local sandstone and conglomerate bedrock, we recommend that prior to construction for residential purposes, additional geotechnical investigation be undertaken to determine the physical characteristics of the bedrock, where bedrock is at or near surface and to provide geotechnical input to the design of appropriate foundations. Similarly, setbacks for slope stability and rockfall hazard are not specified for the less than 5-metre high bedrock outcrops and short, steep (]30 degree) colluvial or talus slopes that occur locally within the subdivision. Golder recommends a site-specific geotechnical evaluation for these hazards as well as foundation conditions if residential construction is proposed in such areas.

Avoid discharging concentrated drainage, such as from roof rainwater leaders, perimeter drains, or other sources onto moderately steeply sloping to steeply sloping areas within the subdivision as this could lead to slope failure.

Do not excavate, raise grade, create fills or spoil waste materials on moderately to steeply sloping terrain or within building envelope setback zones without the approval of a geotechnical engineer.

Should any signs of future slope instability such as landslides, tension cracks, significant surface soil erosion be observed on any of the moderately sloping to steeply sloping terrain within individual lots or within the building envelope setback zones, the owner(s) should contact a qualified geotechnical/geological engineer or engineering geologist to assess the situation.

A detailed, site specific assessment of geotechnical hazards and foundation conditions, including recommendations for suitable mitigation to protect residences from geotechnical hazards should be conducted if residential construction is proposed within any of the building (geotechnical hazard) setback zones recommended in this report, or on any of the short but moderately steep to steep bedrock or colluvial slopes within the subdivision area.

There are no apparent geotechnical hazards within the gently to moderately sloping terrain located outside the building envelope setback zones and designated geotechnical

hazard zones. Based on the level of landslide safety suggested by the Ministry of Transportation (i.e., a probability of landslide occurrence affecting the proposed development site of less than 1 in 500 years), it is our professional opinion that the slopes outside the building envelope setback zones and designated geotechnical hazard zones are safe for the use intended (i.e. construction of permanent residences) with respect to natural landslide and rockfall activity, provided the geotechnical recommendations provided in this report are followed.

6.0 CLOSURE

We trust that the information provided in this report is sufficient for your immediate needs. If you have any questions about this report, please contact us.

Yours truly,

GOLDER ASSOCIATES LTD.

Terry Rollerson, P. Geo.
Senior Geoscientist

Reviewed by:

Mark Goldbach, P.Eng,
Managing Principal and Senior Geotechnical Engineer

TPR/MGG/knb

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Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

Soil, Rock and Groundwater Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. **The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report.** The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

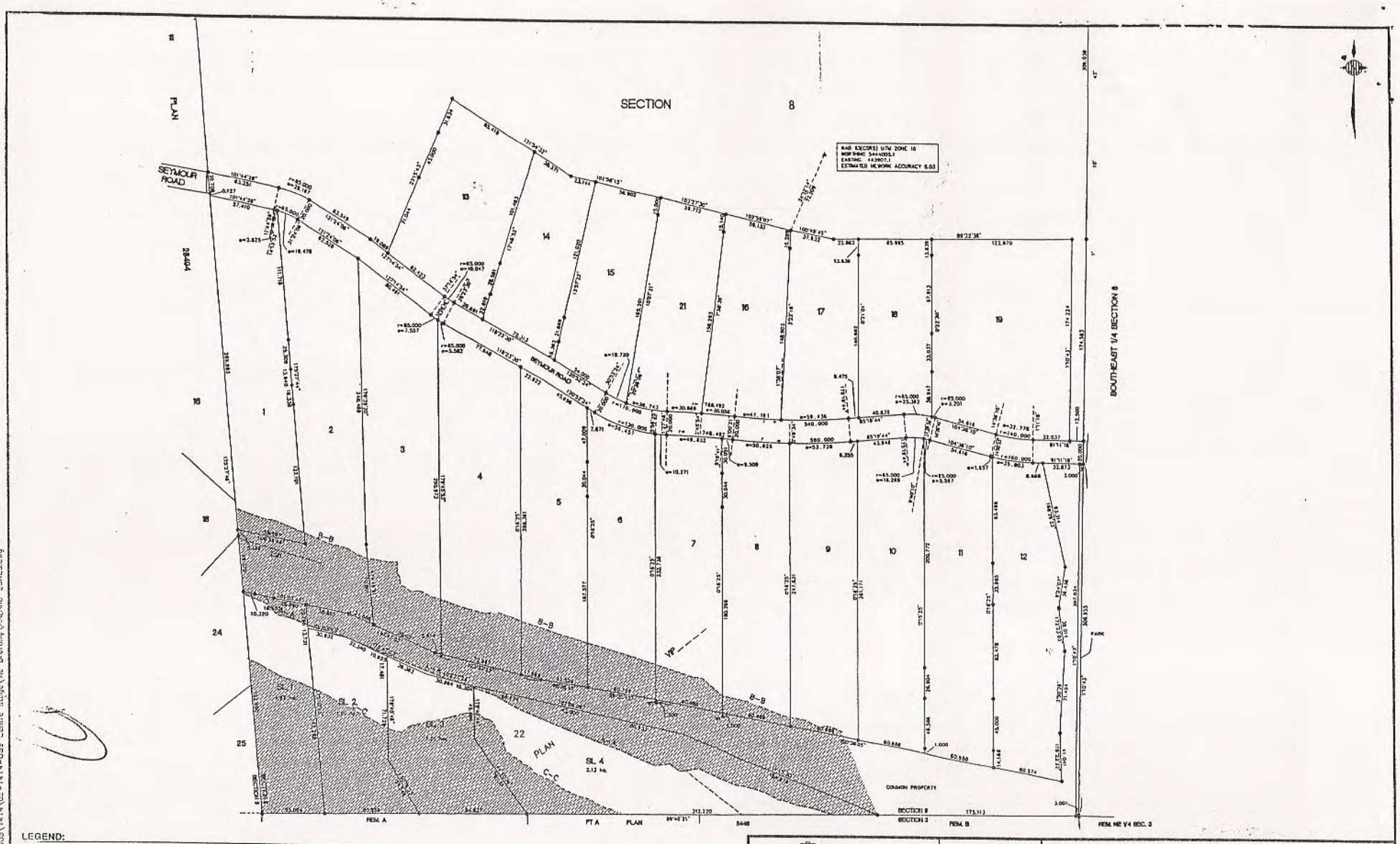
Sample Disposal: Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

Follow-Up and Construction Services: All details of the design were not known at the time of submission of Golder's report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder's report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder's report. Adequate field review, observation and testing during construction are necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, Golder's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

Changed Conditions and Drainage: Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Golder be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Golder takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.



LEGEND:

STEEP SLOPE AND ROCKFALL HAZARD ZONES IDENTIFIED BY GOLDER ASSOCIATES LTD.

REFERENCES:

BASE PLAN SUPLIED BY J.E. ANDERSON AND ASSOCIATES, "85443 safe building.dwg"

60 0 60

SCALE 1:3000 METRES

Golder Associates
Victoria, British Columbia, Canada

SCALE	AS SHOWN
DATE	19 OCT 06
DESIGN	N/A
CAD	DGM
CHECK	TR
REVIEW	
FILE No.	HAZARD ZONES.dwg
PROJECT No.	05-1414-089
REV.	

TITLE

STEEP SLOPE AND ROCKFALL HAZARD ZONES

CENTRE STAGE HOLDINGS - GABRIOLA ISLAND

FIGURE 1

PLOT DATE: October 20, 2006
FILENAME: N:\Active\2005\1414\05-1414-089 Centre Stage\Vic Drafting\HAZARD ZONES.dwg