



**BOARD OF VARIANCE MEETING
OF THE VILLAGE OF LIONS BAY
AUGUST 30, 2023 AT 6:00PM.
AT 400 CENTRE RD. LIONS BAY, BC AND
VIA ZOOM VIDEO CONFERENCE**

Link to join meeting: <https://us02web.zoom.us/j/85791525700>
To join via phone, dial 778-907-2071 - Meeting ID: 857 9152 5700

AGENDA

1. Call to Order

2. Appointment of the Chair

THAT Morgan Gatto be appointed as the Chair of the Board of Variance Committee.

3. Approval of the Agenda

THAT the August 30, 2023 Board of Variance agenda be approved, as presented.

4. Approval of the Minutes

A. Board of Variance Meeting – February 8, 2023 (*page 2*)
THAT the February 8, 2023 Board of Variance Meeting minutes be approved as circulated.

5. Public Comments

6. New Business – Applications to be heard

(page 4)

- 1) Civic Address:** 340 Bayview Road, Lions Bay, BC
- Legal Description:** Lot 7 Block 9 DL 1575 Plan NWP13432
- Owner:** Christine and Sara Livingstone
- Request:** To change the front yard setback from 7.5 meters to 5.2 meters to accommodate a garage in the front yard.

(page 15)

- 2) Civic Address:** 26 Brunswick Beach Road, Lions Bay, BC
- Legal Description:** Lot H Block 19 DL 1815 Plan 18523
- Owner:** Robert Smith, Jing Chen, Simon Smith, Sarah Smith
- Request:** A relaxation of the building height for the Roof Mean Elevation. The roof mean elevation is requested to go from 29’6 3/8” (9.0m) to a new variance of 31’7” (9.64m) mean elevation for the pitch roof (a total of 2.1’ over height). The roof elevation is to be 3/12 pitch, no greater.

7. Public Questions & Comments

8. Adjournment



THE MUNICIPALITY OF THE VILLAGE OF LIONS BAY

BOARD OF VARIANCE MEETING OF THE VILLAGE OF LIONS BAY HELD ON WEDNESDAY, FEBRUARY 8, 2023, at 6:00 PM AT 400 CENTRE ROAD, LIONS BAY, BC AND VIA ZOOM VIDEOCONFERENCE

MINUTES

In Attendance:

Board of Variance: Morgan Gatto (Chair)
Scott Gordon
David Lee

Staff:

Public: 0

Applicants: James Mole, owner

1. Call to Order

Morgan Gatto called the meeting to order at 6:00 p.m.

2. Approval of the Agenda

Moved/Seconded

THAT the February 8, 2023 Board of Variance agenda be approved, as presented.

CARRIED

3. New Business – Applications to be Heard

- 1) **Civic Address:** 385 Timbertop Drive, Lions Bay, BC
- Legal Description:** Plan 14997, DL 2985, Lot 42
- Owner:** James Mole & Anna McCulloch
- Request:** Approval sought for rear yard setback in the northwest corner from 7.50 meters to 3.80 meters and height from 7.50 meters to 9.44 meters (30' 11")

4. Public Questions and Comments

A. James Mole, Owner, advised:

- Due to the steepness and topography of the property, there is only one reasonable location on the property for a structure.

- Neighbours from adjacent properties have not had any opposition, and there have been no additional comments from neighbours.

Decision

After considering the facts before it, the Board of Variance determined that the requested variance was to be approved.

Moved/Seconded

- 1) THAT the Board of Variance approves the rear yard setback in the northwest corner from 7.50 meters to 3.80 meters and height from 7.50 meters to 9.44 meters (30' 11"), for 385 Timbertop Drive, Lions Bay, BC

CARRIED

5. Adjournment

Moved/Seconded

THAT the meeting be adjourned.

CARRIED
(6:10 p.m.)

Chair

Corporate Officer

Date Approved:	
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Schedule "A"

**Village of Lions Bay
Board of Variance Application Form**

I hereby apply for a hearing before the Board of Variance for:

LAND SUBJECT OF THE APPLICATION
Street Address: 340 Bayview Road, Lions Bay, BC
Legal Description: Lot 7, Block 9, DL 1575, Plan NWP13432
Zoning: RS1
OWNER/CONTACT
INFORMATION Full Name(s) of Property Owner(s): Christine and Sara Livingstone
Full Name of Owner's Authorized Representative (if applicable): Kaitlynd Lewis
Address to Which Notices Should be Mailed: [REDACTED]
Daytime Phone # of Owner or Authorized Representative: [REDACTED]
Name of Person Who Will Represent Applicant at the Hearing: Kaitlynd Lewis/Gino Di Francesco
TYPE OF APPLICATION (Complete Applicable Section)
A. VARIANCE OF BYLAW RESPECTING SITING, SIZE OR DIMENSION OF A BUILDING OR STRUCTURE [s.540(a)(i)]
Bylaw Name/Number & Section(s) from which relief is sought: Siting 7.5.1
Variance From (current requirement): 7.5m (25'-0")
To (new requirement requested): 5.2m (17'-0")
B. EXEMPTION FROM PROHIBITION OF A STRUCTURAL ALTERATION OR ADDITION TO A BUILDING OR STRUCTURE WITH A NON-CONFORMING USE [s.540(c) and s.531(1)]
Bylaw Name/Number & Section(s) Which Previously Permitted Use:
Bylaw Name/Number & Section(s) Which Resulted in Legal Non-Conforming Status:

Continuing Non-Conforming Use:
Structural Alteration or Addition Desired:
<i>Note: If alteration or addition will result in a structure contrary to current bylaw siting, size or dimension requirements, also complete Section A.</i>
C. APPEAL OF BUILDING INSPECTOR'S DETERMINATION OF DAMAGE TO NON-CONFORMING BUILDING [s.532(1) and s.544]
Date of Building Inspector's Determination (application must be filed within 30 days):
Summary of Building Inspector's Determination (copy attached):
Determination Requested of Board:
D. EXEMPTION TO RELIEVE HARDSHIP FROM EARLY TERMINATION OF LAND USE CONTRACT [s.543]
Bylaw Name(s)/Number(s) & Section(s) from which relief is sought:
Variance From (current requirement):
To (new requirement requested):
STATEMENT OF HARDSHIP (not required for Type C applicants)
<p>I allege that compliance with either the bylaw or section 531(1) [strike one] would cause me hardship by:</p> <p>There is limited to no safe street parking. The home is on the west side of the street with no street shoulder or sidewalk, and around a blind corner. Due to the terrain and elevations the proposed is the only useful location for a garage to accommodate parking.</p>
(attach additional pages if necessary)
TIME REQUIRED TO COMPLETE
Respecting Type A or B applications, the Board may specify a time for completion of the construction of the Building or Structure permitted by the minor variance or exemption, after

which the permission or exemption would terminate. If your application is permitted, when do you expect to complete the work?

ADDITIONAL INFORMATION/REASONS SUPPORTING THE APPLICATION

(Attach additional pages if required)

ATTACHMENTS

Fee and Title Documents:

- A Non-refundable application fee of \$500.00 (cash or cheque), payable to the Village of Lions Bay.
- A Title Search Print dated within 30 days of the application and copies of all registered non-financial encumbrances noted thereon.

Drawings Which May be Required:

- X A site plan showing the location of all Buildings and Structures, or proposed Buildings or Structures, on the subject property, preferably prepared and signed by a BC Land Surveyor A floor plan (for existing and proposed Buildings) showing space uses and door and window locations, preferably certified by an architect or structural engineer.
- X A Building or Structure elevation plan preferably certified by an architect or structural engineer, including original and proposed alterations to site levels, if applicable.

Other Documents Which May be Required:

- A geotechnical engineer’s report with respect to drainage, topography, and other geotechnical considerations.
- Explanatory materials and such other additional information as may be advisable in support of the application (eg: photographs, letters of support, etc.)

The Village Building Department may have some of the documents noted above – check first before ordering new. Further information may be required to enable the Board of Variance members to visualize the proposal and its relationship to the surrounding area. Approval, if given by the Board, is for the plans submitted. Changes to plans after the Board’s decision will require a new application.

SIGNED BY ALL OWNERS ON TITLE ON March 3, 2023 :
(month) (day) (year)


 - 


Note: Decisions of the Board of Variance regarding Type A, B or D applications are FINAL, other than an appeal to the BC Supreme Court in respect of procedure under the *Judicial Review Procedure Act*. Decisions regarding Type C applications may be appealed by the applicant or the Village of Lions Bay to the BC Supreme Court. Information in this application is subject to the *Freedom of Information and Protection of Privacy Act*.

IMPORTANT INFORMATION

On finding hardship, the Board may order a minor variance or exemption if it would not:

- (a) result in inappropriate development of the site;
- (b) adversely affect the natural environment;
- (c) substantially affect the use and enjoyment of adjacent land;
- (d) vary permitted uses and densities under the applicable bylaw; or
- (e) defeat the intent of the bylaw.

An order of the Board must not:

- (a) be in conflict with a registered *Land Title Act* Covenant;
- (b) deal with a matter covered in a land use contract or permit;
- (c) deal with a phased development agreement;
- (d) deal with a floodplain specification under the *Local Government Act*; or
- (e) apply to a heritage property.

PLAN OF LOT 7, BLOCK 9, DISTRICT LOT 1575, PLAN 13432

P.I.D. 008-625-913

SCALE 1 INCH = 8 FEET

SEA TO SKY HIGHWAY



BENCH MARK
TOP OF SPIKE IN BLACKTOP
ELEVATION 338.54 FEET



ELEVATIONS
ELEVATIONS ARE TO GEODETIC DATUM, (CVD28GVRD)
ELEVATIONS ARE DERIVED FROM DUAL FREQUENCY RTK GNSS OBSERVATIONS TO VANCOUVER ACP 1 (GCM875864)
BENCH MARK SET: TOP OF SPIKE IN BLACKTOP LOCATED AS SHOWN ON THIS PLAN
ELEVATION 338.54 FEET

CERTIFIED CORRECT THIS 16TH DAY OF SEPTEMBER, 2022
ADDED SOUND WALLS
THIS 30TH DAY OF SEPTEMBER, 2022. FB.2522 p.24 - 26

NOTE:
LOT DIMENSIONS AND AREA DERIVED FROM FIELD SURVEY AND LAND TITLE OFFICE RECORDS

NOTE:
LAND HEREIN WITHIN BUILDING SCHEME, SEE 595337L
FOR RESTRICTIVE COVENANT 530525M, SEE 625312L
FOR COVENANT IN FAVOUR OF THE VILLAGE OF LIONS BAY, SEE BW490105.
SECTION 219 LAND TITLE ACT

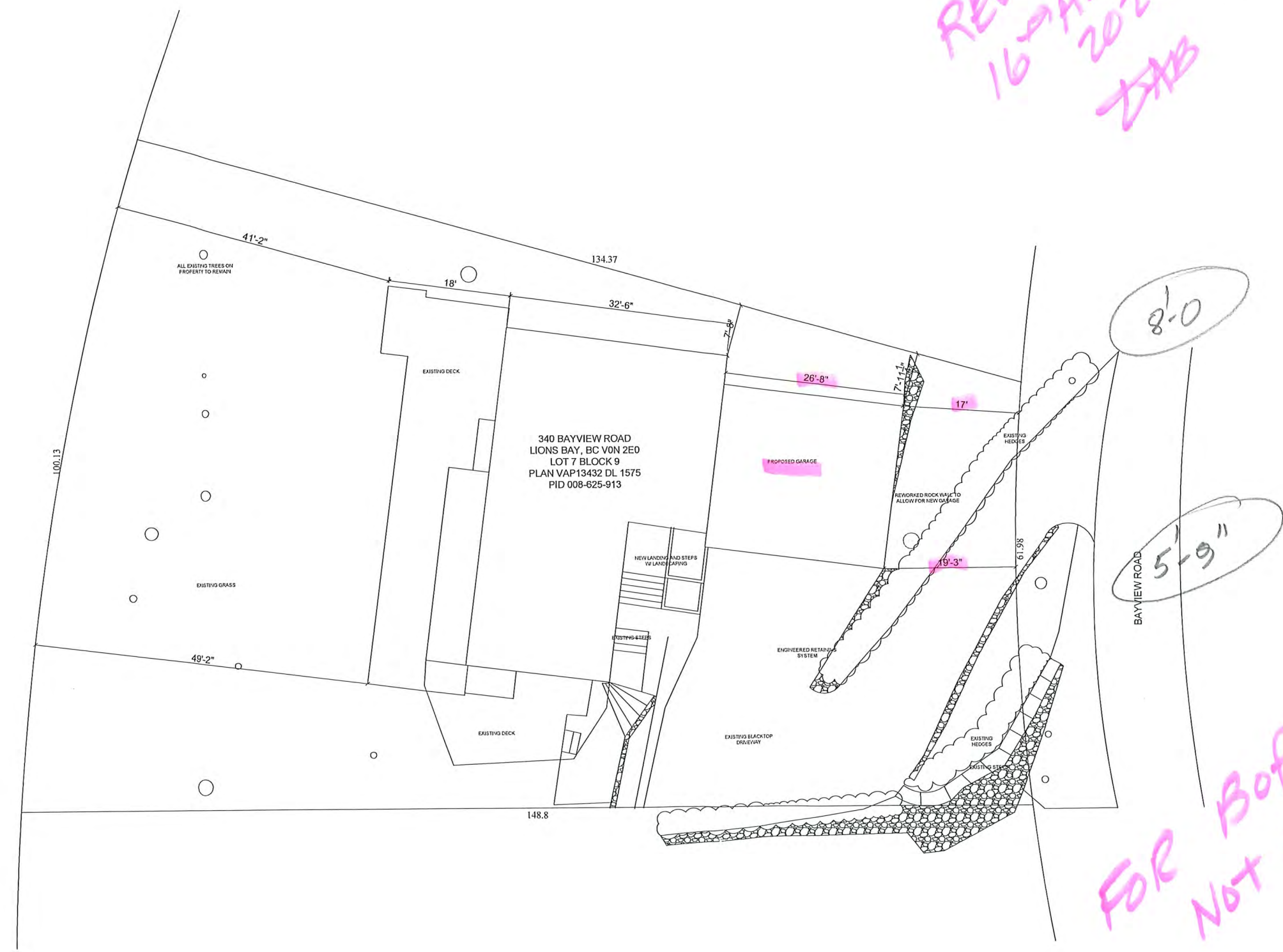
THIS DOCUMENT IS NOT VALID UNLESS
ORIGINALLY SIGNED AND SEALED
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HOBBS, WINTER & MACDONALD
B.C. LAND SURVEYORS
113-828 HARBOURSIDE DRIVE,
NORTH VANCOUVER, B.C., V7P 3R9
TEL 604-986-1371 FAX 604-986-5204
EMAIL: admin@hwmsurveyors.com

340 BAYVIEW ROAD
FB.2791 p.47 - 59 M3425-14-A LIONS BAY

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 This plan and design are, and at all times remain the exclusive property of the RJR Construction Management Ltd. and cannot be used or produced without written consent. Written dimensions shall have precedence over scaled dimensions. Contractors shall verify and be responsible for all dimensions and conditions on the job. This office shall be informed of any variation from the dimensions and conditions on the drawing.

REVIEWED
 16 AUGUST
 2023
 ZAB



A
A100 PROPOSED SITE PLAN
 SCALE: 1/8" = 1'-0"

REV.	DATE	DESCRIPTION

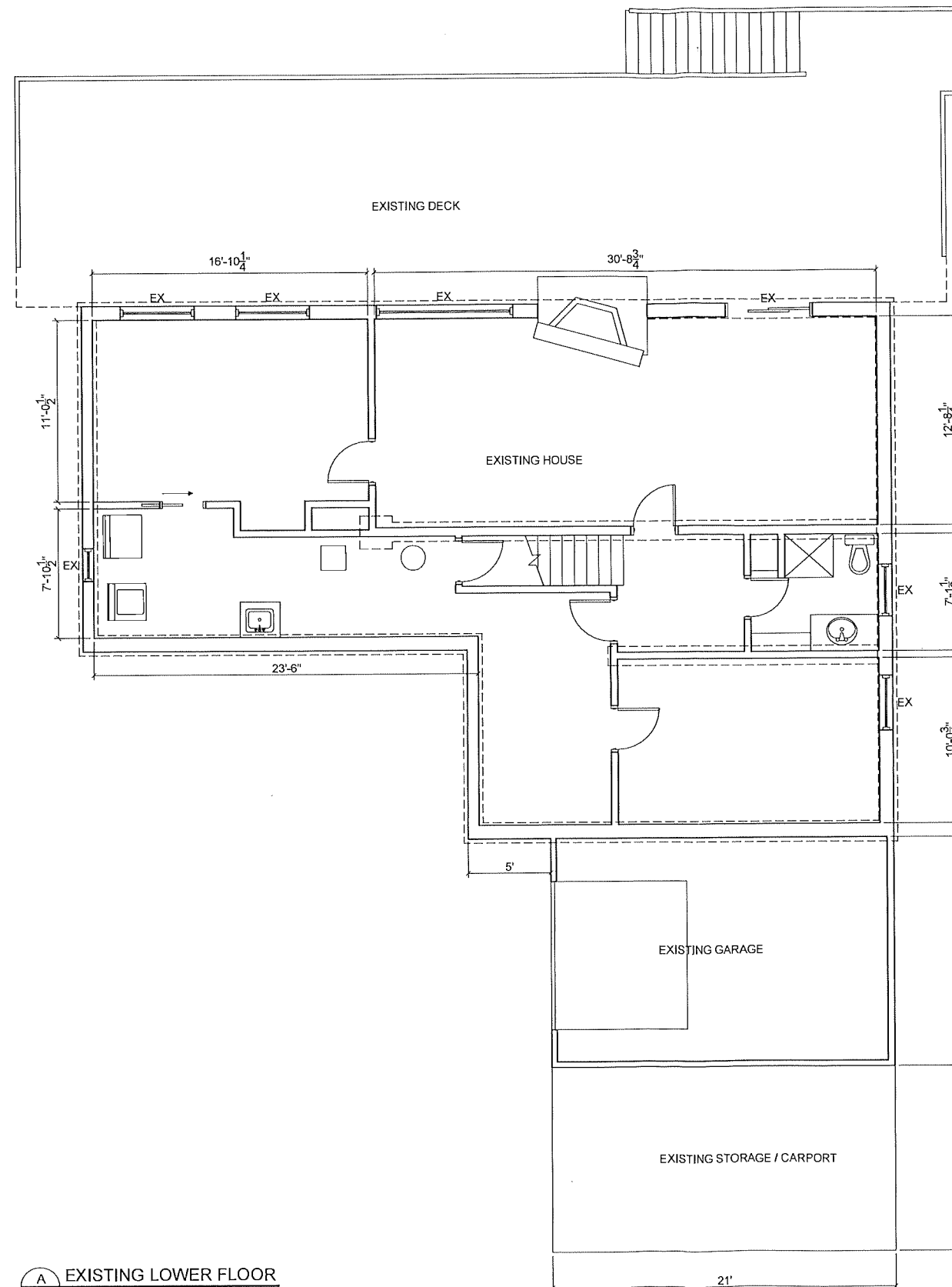


UNIT 119-3989 HENNING DRIVE
 BURNABY, B.C. V5C 6P8
 PH 604 254-1760
 FAX 604 254 4960

FOR BOFV APPROVAL ONLY
 NOT A B/P.

PROJECT Livingstone Residence	
ADDRESS 340 Bayview Road, Lions Bay, BC	
SCALE AS NOTED	DRAWN BY K.L.
DATE March 6, 2023	CHECKED BY
DRAWING TITLE SITE PLAN	
PROJECT NO 340	DWG. No. A100

This plan and design are, and at all times remain the exclusive property of the RJR construction Management Ltd. and cannot be used or produced without written consent. Written dimensions shall have precedence over scaled dimensions. Contractors shall verify and be responsible for all dimensions and conditions on the job. This office shall be informed of any variation from the dimensions and conditions on the drawing.



A
A101 EXISTING LOWER FLOOR
SCALE: 1/4" = 1'-0"

LEGEND

NEW WALLS	—————
EXISTING WALLS TO BE DEMOLISHED	- - - - -
EXISTING WALLS	=====

REV.	DATE	DESCRIPTION



UNIT 119-3989 HENNING DRIVE
BURNABY, B.C. V5C 6P8
PH 604 254-1760
FAX 604 254 4960

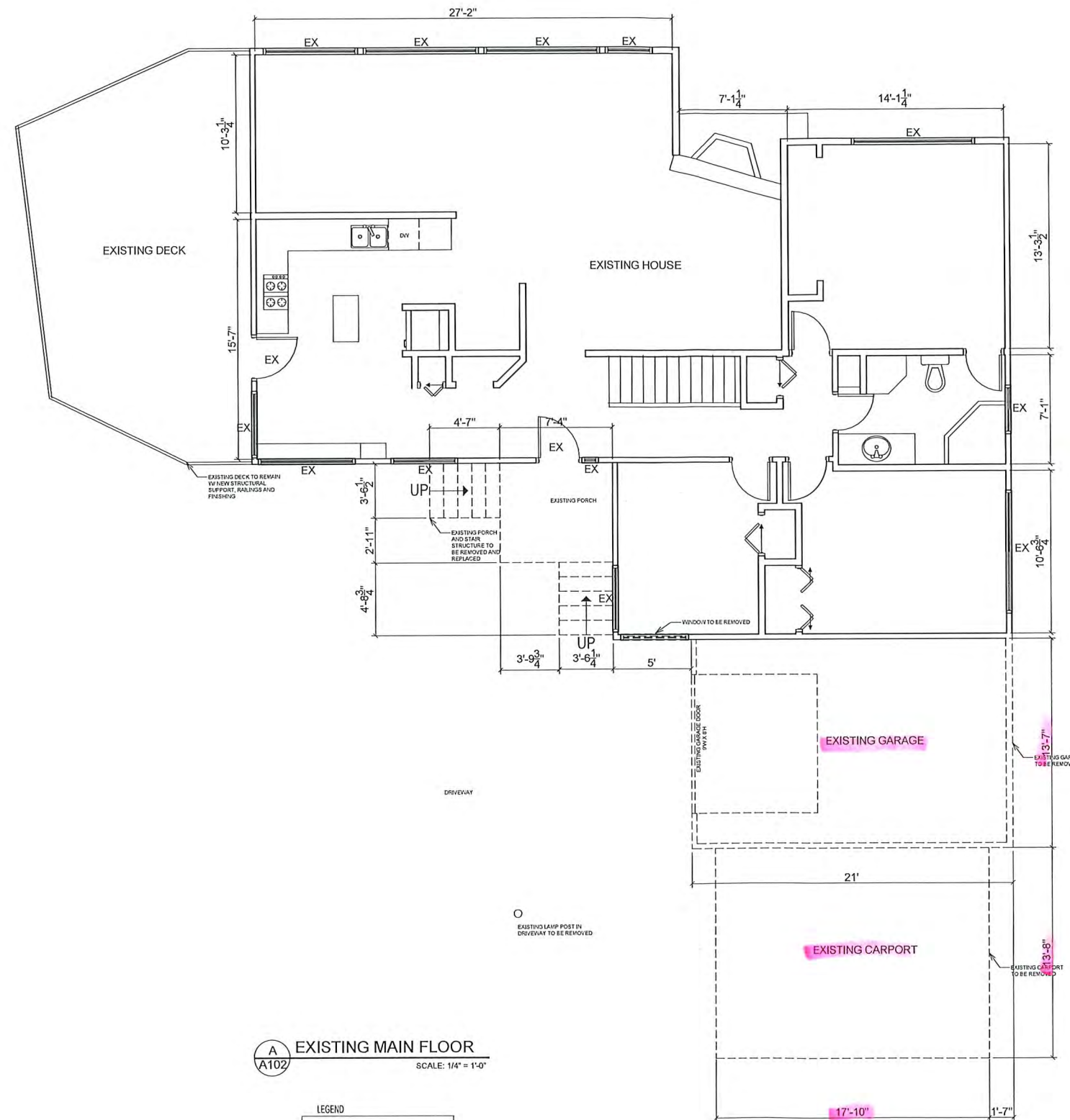
PROJECT
Livingstone Residence
ADDRESS
**340 Bayview Road,
Lions Bay, BC**

SCALE AS NOTED	DRAWN BY K.L.
DATE March 6, 2023	CHECKED BY

DRAWING TITLE
EXISTING FLOOR PLANS

PROJECT NO 340	DWG. No. A101
--------------------------	-------------------------

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27'3"

REV.	DATE	DESCRIPTION



UNIT 119-3989 HENNING DRIVE
 BURNABY, B.C. V5C 6P8
 PH 604 254-1760
 FAX 604 254 4960

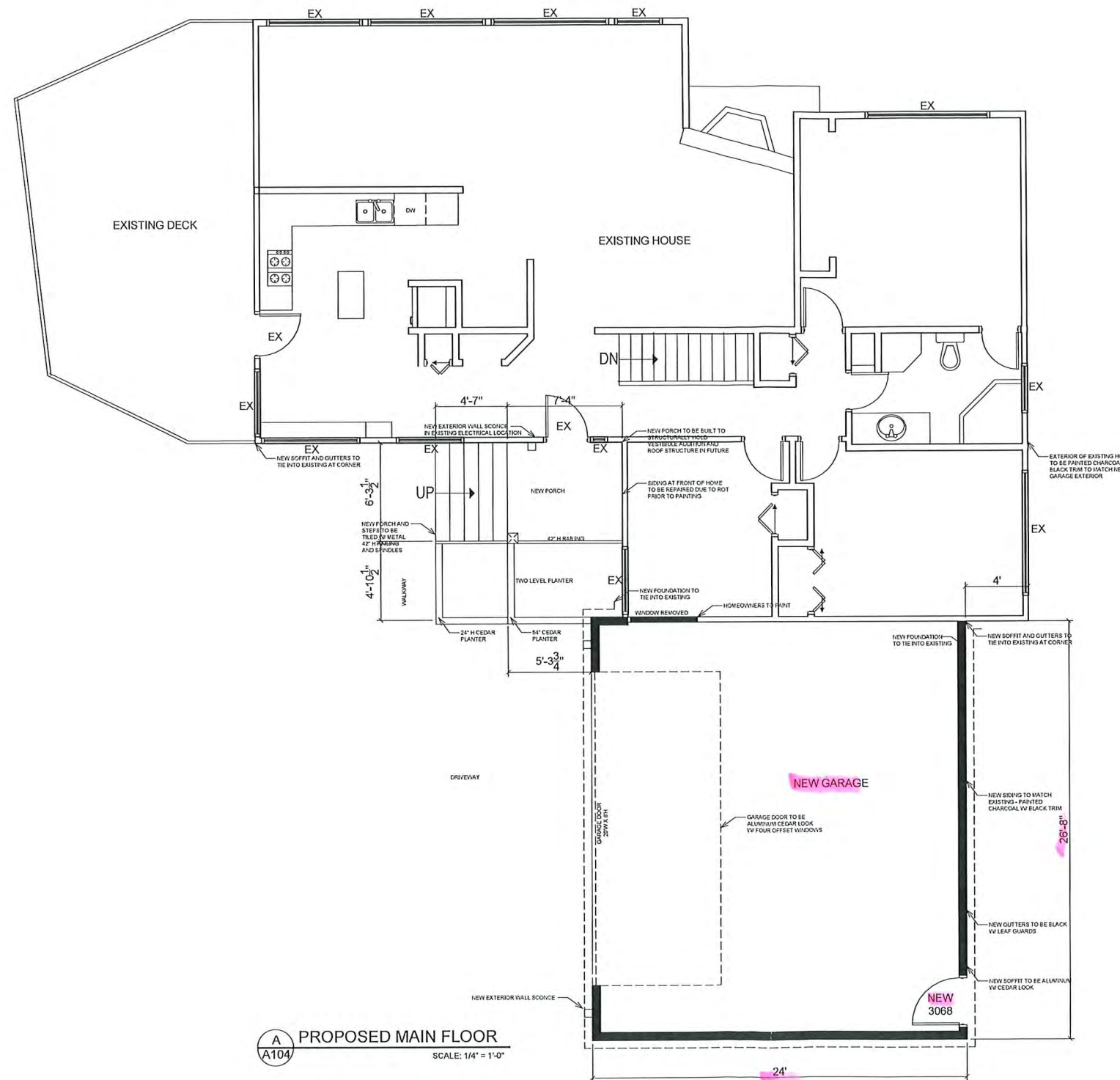
PROJECT
Livingstone Residence
 ADDRESS
340 Bayview Road, Lions Bay, BC

SCALE AS NOTED DRAWN BY K.L.
 DATE March 6, 2023 CHECKED BY

DRAWING TITLE
EXISTING FLOOR PLANS

PROJECT NO **340** DWG. No. **A102**

This plan and design are, and at all times remain the exclusive property of the RJR construction Management Ltd. and cannot be used or produced without written consent. Written dimensions shall have precedence over scaled dimensions. Contractors shall verify and be responsible for all dimensions and conditions on the job. This office shall be informed of any variation from the dimensions and conditions on the drawing.



REV.	DATE	DESCRIPTION



UNIT 119-3989 HENNING DRIVE
 BURNABY, B.C. V5C 6P8
 PH 604 254-1760
 FAX 604 254 4960

PROJECT
Livingstone Residence
 ADDRESS
**340 Bayview Road,
 Lions Bay, BC**

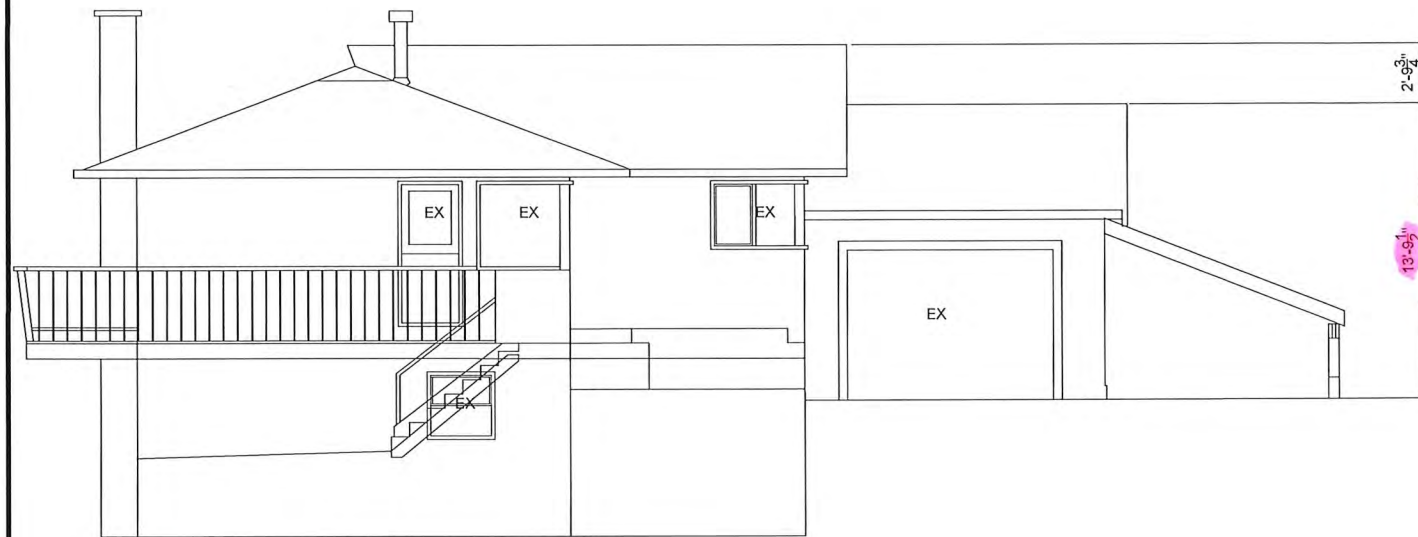
SCALE AS NOTED DRAWN BY K.L.
 DATE March 6, 2023 CHECKED BY

DRAWING TITLE
PROPOSED FLOOR PLANS

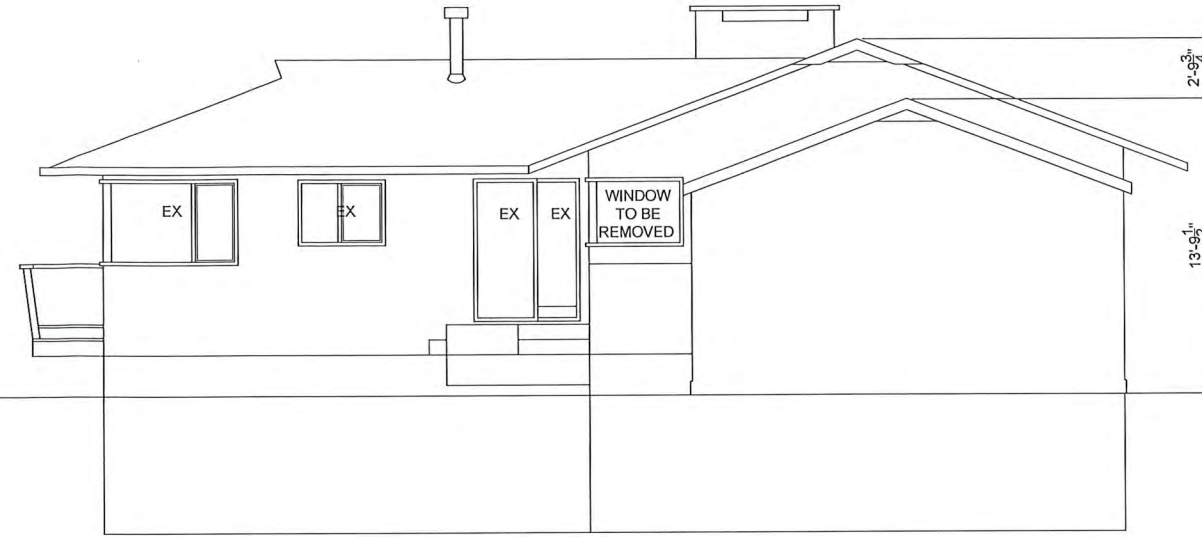
PROJECT NO **340** DWG. No. **A104**

This plan and design are, and at all times remain the exclusive property of the RJR Construction Management Ltd. and cannot be used or produced without written consent. Written dimensions shall have precedence over scaled dimensions. Contractors shall verify and be responsible for all dimensions and conditions on the job. This office shall be informed of any variation from the dimensions and conditions on the drawing.

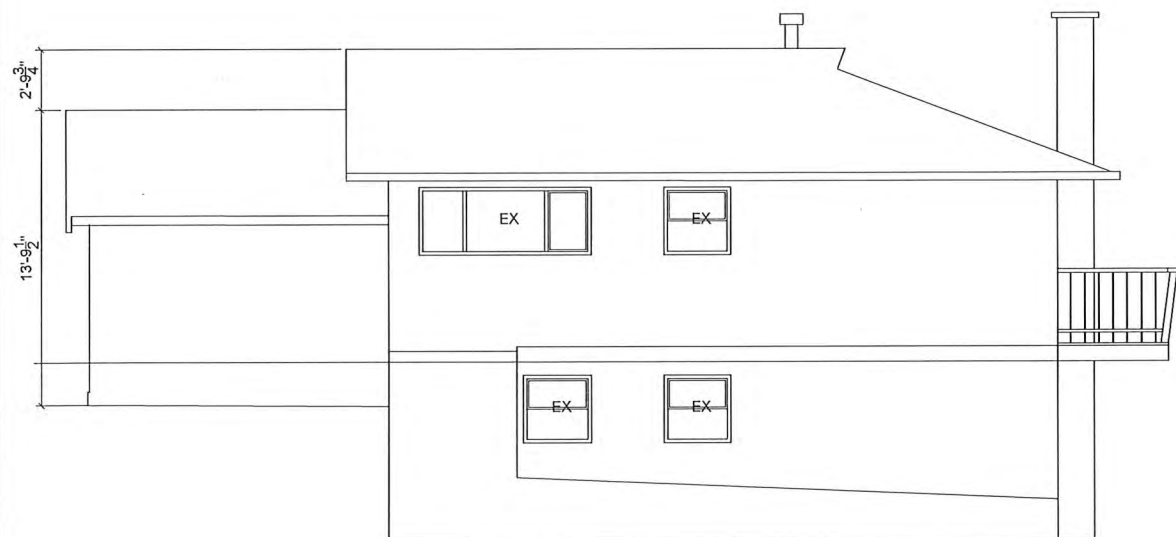
REV. DATE DESCRIPTION



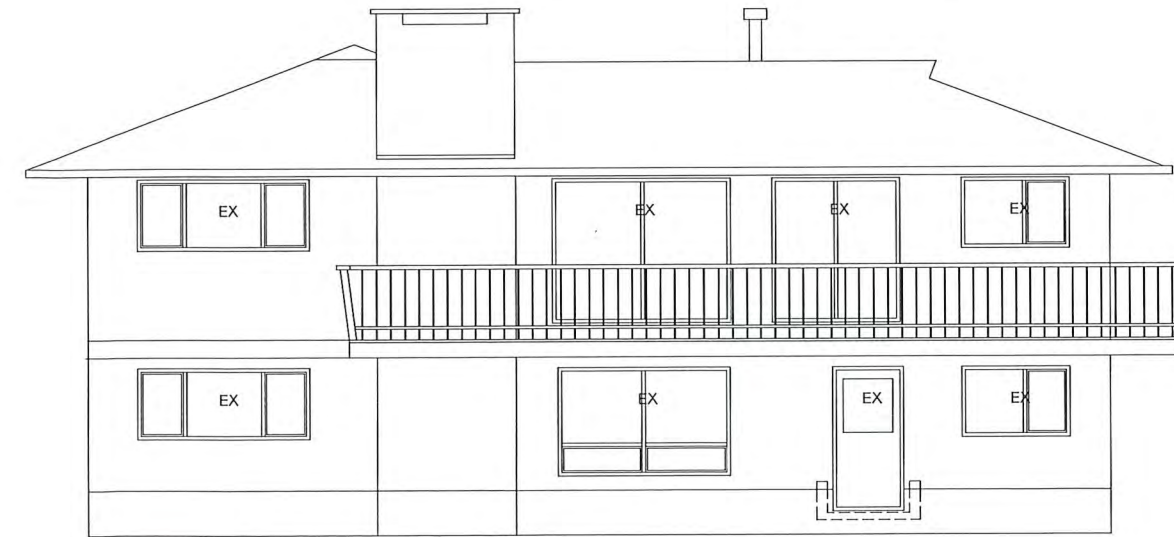
A EXISTING LEFT ELEVATION
A105 SCALE: 1/4" = 1'-0"



B EXISTING FRONT ELEVATION
A105 SCALE: 1/4" = 1'-0"



C EXISTING RIGHT ELEVATION
A105 SCALE: 1/4" = 1'-0"



D EXISTING REAR ELEVATION
A105 SCALE: 1/4" = 1'-0"



UNIT 119-3989 HENNING DRIVE
BURNABY, B.C. V5C 6P8
PH 604 254-1760
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PROJECT
Livingstone Residence
ADDRESS
**340 Bayview Road,
Lions Bay, BC**

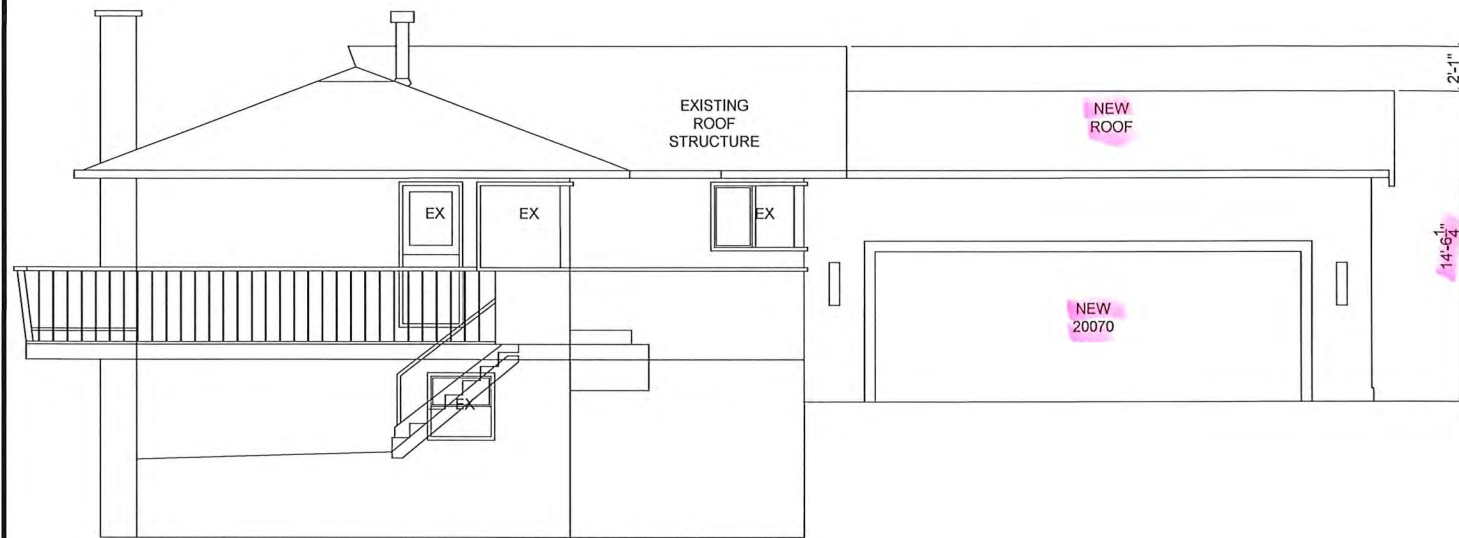
SCALE AS NOTED DRAWN BY K.L.
DATE March 6, 2023 CHECKED BY

DRAWING TITLE
EXISTING ELEVATIONS

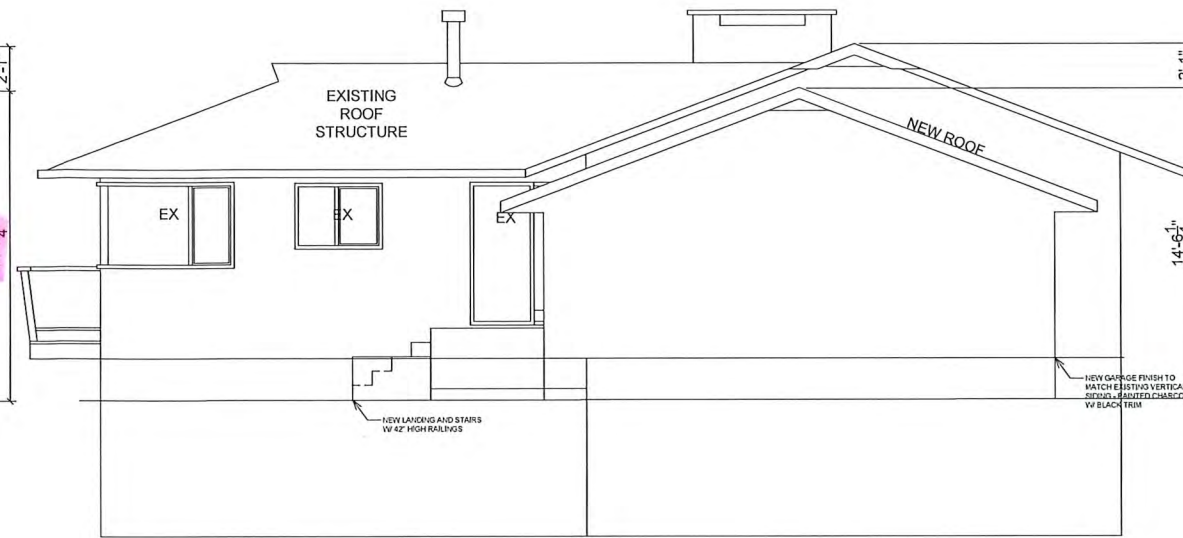
PROJECT NO **340** DWG. No. **A105**

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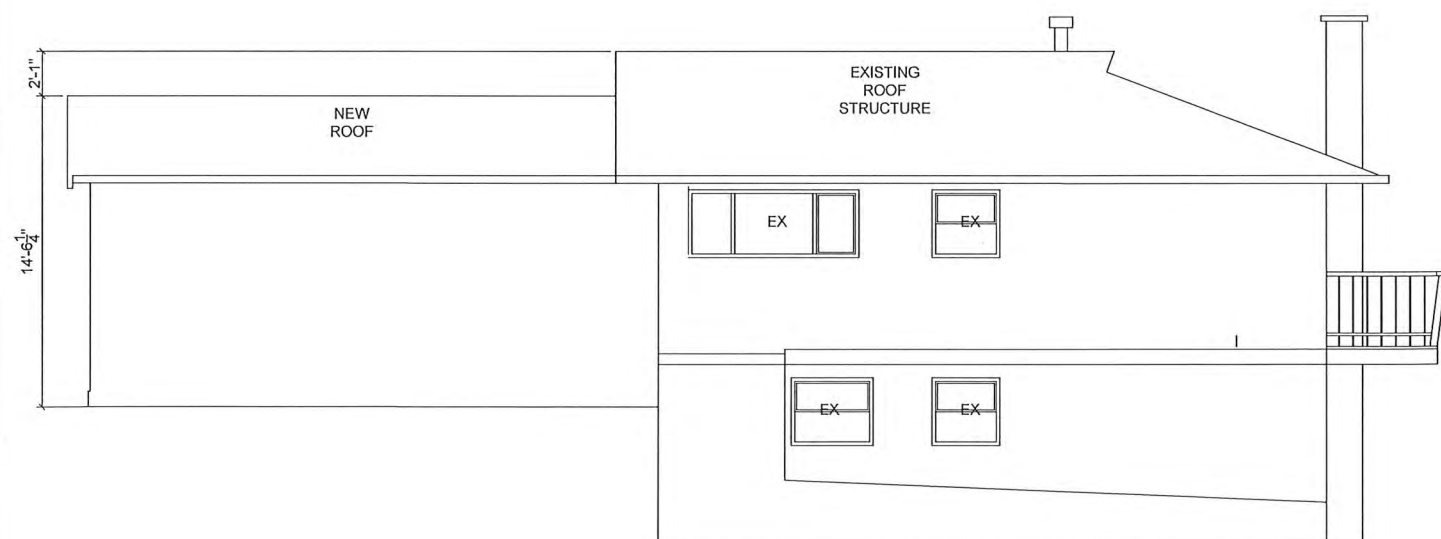
REV.	DATE	DESCRIPTION



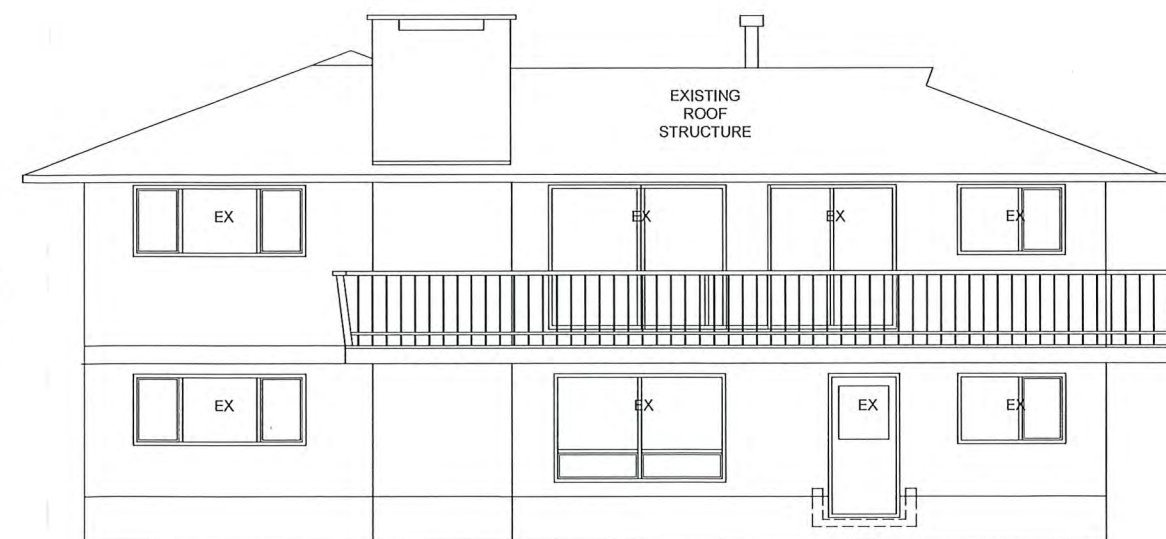
A PROPOSED LEFT ELEVATION
A106 SCALE: 1/4" = 1'-0"



B PROPOSED FRONT ELEVATION
A106 SCALE: 1/4" = 1'-0"



C PROPOSED RIGHT ELEVATION
A106 SCALE: 1/4" = 1'-0"



D PROPOSED REAR ELEVATION
A106 SCALE: 1/4" = 1'-0"



UNIT 119-3989 HENNING DRIVE
BURNABY, B.C. V5C 6P8
PH 604 254-1760
FAX 604 254 4960

PROJECT
Livingstone Residence
ADDRESS
**340 Bayview Road,
Lions Bay, BC**

SCALE AS NOTED DRAWN BY K.L.
DATE March 6, 2023 CHECKED BY

DRAWING TITLE
PROPOSED ELEVATIONS

PROJECT NO **340** DWG. No. **A106**



Schedule "A"

**Village of Lions Bay
Board of Variance Application Form**

I hereby apply for a hearing before the Board of Variance for:

LAND SUBJECT OF THE APPLICATION	
Street Address:	26 Brunswick Beach Road, Lions Bay
Legal Description:	LOT H BLOCK 19 DISTRICT LOT 1815 PLAN 18523
Zoning:	RS-1 Brunswick beach overlay area
OWNER/CONTACT INFORMATION	
Full Name(s) of Property Owner(s):	Robert Smith/Jing Chen/Simon Smith/Sarah Smith
Full Name of Owner's Authorized Representative (if applicable):	RODRIGO MUNGUIA
Address to Which Notices Should be Mailed:	[REDACTED]
Daytime Phone # of Owner or Authorized Representative:	[REDACTED]
Name of Person Who Will Represent Applicant at the Hearing:	Robert Smith/Jing Chen/Rodrigo Munguia
TYPE OF APPLICATION (Complete Applicable Section)	
A. VARIANCE OF BYLAW RESPECTING SITING, SIZE OR DIMENSION OF A BUILDING OR STRUCTURE [s.540(a)(i)]	
Bylaw Name/Number & Section(s) from which relief is sought:	7.6.8.1
Variance From (current requirement):	29'-6 3/8" (9.0 m) - <u>Roof Mean Elevation</u>
To (new requirement requested):	31'-7" (9.64 m) - <u>Roof Mean Elevation</u>
B. EXEMPTION FROM PROHIBITION OF A STRUCTURAL ALTERATION OR ADDITION TO A BUILDING OR STRUCTURE WITH A NON-CONFORMING USE [s.540(c) and s.531(1)]	
Bylaw Name/Number & Section(s) Which Previously Permitted Use:	
Bylaw Name/Number & Section(s) Which Resulted in Legal Non-Conforming Status:	

BRUNSWICK BEACH ZONING BYLAW

1/3 PITCH ROOF

Continuing Non-Conforming Use:
Structural Alteration or Addition Desired:
<i>Note: If alteration or addition will result in a structure contrary to current bylaw siting, size or dimension requirements, also complete Section A.</i>
C. APPEAL OF BUILDING INSPECTOR'S DETERMINATION OF DAMAGE TO NON-CONFORMING BUILDING [s.532(1) and s.544]
Date of Building Inspector's Determination (application must be filed within 30 days):
Summary of Building Inspector's Determination (copy attached):
Determination Requested of Board:
D. EXEMPTION TO RELIEVE HARDSHIP FROM EARLY TERMINATION OF LAND USE CONTRACT [s.543]
Bylaw Name(s)/Number(s) & Section(s) from which relief is sought:
Variance From (current requirement):
To (new requirement requested):
STATEMENT OF HARDSHIP (not required for Type C applicants)
I allege that compliance with either the bylaw or section 531(1) [strike one] would cause me hardship by: Please see the letter attached to this application with the name - Lions Bay - Board of Variance Supplement to Schedule A1 - Jan 15 2023
(attach additional pages if necessary)
TIME REQUIRED TO COMPLETE
Respecting Type A or B applications, the Board may specify a time for completion of the construction of the Building or Structure permitted by the minor variance or exemption, after

which the permission or exemption would terminate. If your application is permitted, when do you expect to complete the work?

ADDITIONAL INFORMATION/REASONS SUPPORTING THE APPLICATION

(Attach additional pages if required)

ATTACHMENTS

Fee and Title Documents:

- A Non-refundable application fee of \$500.00 (cash or cheque), payable to the Village of Lions Bay.
- A Title Search Print dated within 30 days of the application and copies of all registered non-financial encumbrances noted thereon.

Drawings Which May be Required:

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SIGNED BY ALL OWNERS ON TITLE ON January 8, 2023 :

[Redacted Signature Area]

Robert Smith Sarah Smith Jing Chen Robert Smith
Note: Decisions of the Board of Variance regarding Type A, B or D applications are FINAL, other than an appeal to the BC Supreme Court in respect of procedure under the *Judicial Review Procedure Act*. Decisions regarding Type C applications may be appealed by the applicant or the Village of Lions Bay to the BC Supreme Court. Information in this application is subject to the *Freedom of Information and Protection of Privacy Act*.

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- (c) substantially affect the use and enjoyment of adjacent land;
- (d) vary permitted uses and densities under the applicable bylaw; or
- (e) defeat the intent of the bylaw.

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- (b) deal with a matter covered in a land use contract or permit;
- (c) deal with a phased development agreement;
- (d) deal with a floodplain specification under the *Local Government Act*; or
- (e) apply to a heritage property.

Attachment to Schedule A

Village of Lions Bay Board of Variance Application Form: Statement of Hardship

Re: #26 Brunswick Beach Road (LOT H BLOCK 19 DISTRICT LOT 1815 PLAN 18523)
Application for Height Variance

The 6.1 m Flood Construction Level (FCL), which is 9 feet 8 inches above the property's average grade, is impacting the design of the livable area of the house because the main habitable (living) areas can only start at/above the FCL. As such, the first habitable space would need to be raised to the second-floor level.

This would cause the mean elevation of the roof to be raised because—to have sufficient space for a multi-generational family—we need habitable space on two floors, currently the second and third-floor levels.

Lions Bay has enforced the FCL standard/code, and we support this building code as it is for the property's inhabitants' future safety and the property's long-term protection. This building code safety measure, along with the seawall we will also build on behalf of Lions Bay on the ocean side of the Esplanade, will not only protect our property and house, but the land around it and lower areas of BBO located east of #26 (properties #27, #25, #23 and possibly others).

However, without the 2' height variance we are requesting (vs. the 9' 8" taken away from us), we would also lose the third-floor level as livable/habitable space, forcing all living areas, e.g., kitchen, living and dining areas, three bedrooms, bathrooms, storage, and mechanical and electrical rooms, to be above the FCL and located on the second-floor level alone.

Not receiving the height variance would reduce the maximum allowable density (FSR) of Lot H (#26) from the currently allowable 3,657 square feet to a habitable space on one level of approximately 1,387 square feet, which is only 37.9% of the allowable FSR.

This will negatively affect the use of our family home and the land/property value of Lot H and numerous other properties in the BBO. Land on which you can only build 1,387 square feet of livable/habitable space—ten feet above ground level—is a lot less valuable than land on which you can build a 3,657 square feet home.

We would suffer a significant economic loss, along with our dream of building our multi-generational family home on #26.

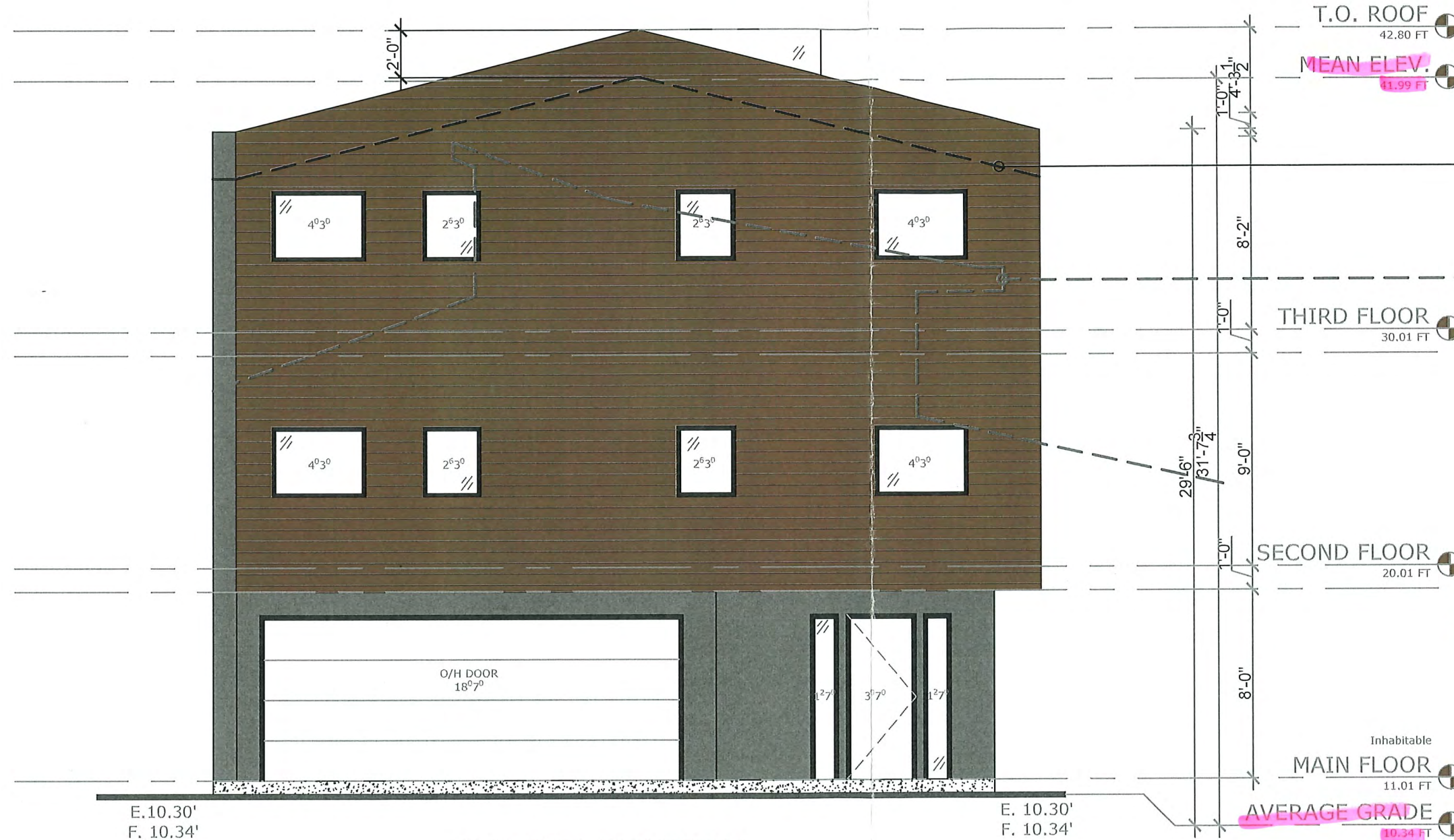
For the Board's reference, we have consulted with the owners of #27 Brunswick Beach Rd. and #24 Brunswick Beach Rd., and both now fully support our height variance design/application.

We hope to receive approval for the height variance, so we can start building our family home at #26 Brunswick Beach Road soon.

Sincerely,

Robert Smith, Jing (Cathy) Chen, Simon Smith, and Sarah Smith

per Brunswick Beach Zoning Bylaw



** 6.1m **
Reviewed TAB

EAST ELEVATION

SCALE 3/16" = 1'-0"

STREETSCAPE COMPARISON

- BOB V ONLY.

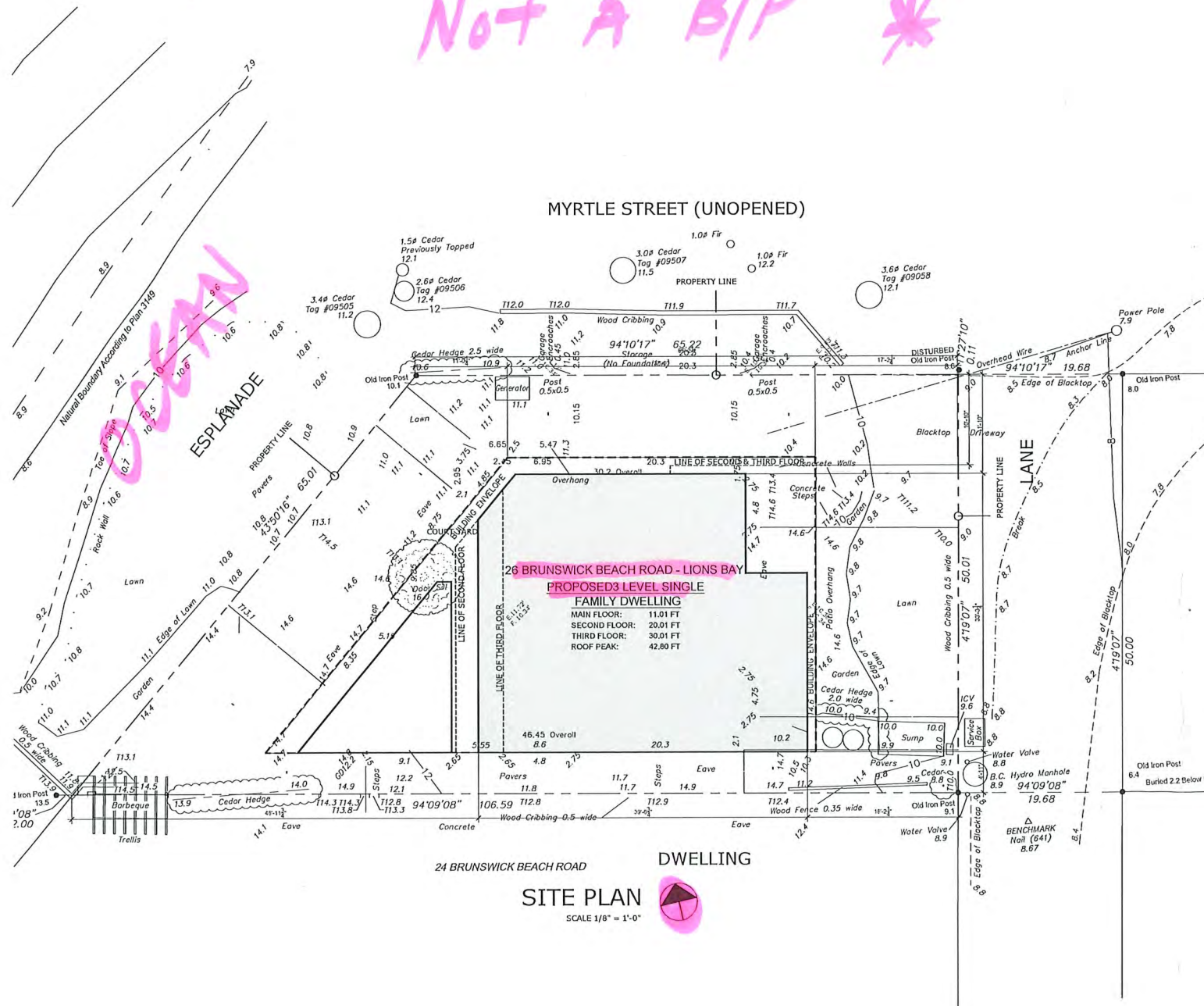
RECEIVED
JAN 20 2023

PROJECT STATISTICS:

CIVIL ADDRESS:
26 BRUNSWICK BEACH ROAD, LIONS BAY, B.C.
LEGAL ADDRESS:
LOT "H" BLOCK 19 DISTRICT LOT 1815 GROUP 1,
NWD, PLAN 18523
PID:
007-146-825
ZONING:
RS-1 BRUNSWICK BEACH OVERLAY AREA

LOT DEPTH (AVERAGE):
85.91 FT [26.18M]
LOT WIDTH :
50.01 FT [15.24M]
LOT AREA:
4297 SQ.FT [399.20M2]
BUILDING FOOT PRINT:
1217 SQ.FT [113.06M2]
TOTAL PARCEL COVERAGE:
1217 SQ.FT [28.3%]

** FOR BOFV ONLY
NOT A B/P **



RS-1 BRUNSWICK BEACH - ZONING

PERMITTED	PROPOSED
<u>7.1.1(a) OUTRIGHT APPROVAL USE</u>	
SINGLE DETACHED DWELLING	SINGLE DETACHED DWELLING
<u>7.6.1(b) MAX DENSITY</u>	
FAR 0.25 + 240M2 = 3657.59 SQ.FT. [339.8M2]	3384.52 SQ.FT [314.43 M2]
MAIN FLOOR SECOND FLOOR THIRD FLOOR GARAGE	722.12 SQ.FT [67.87 M2] (EXCL. ELEVATOR SHAFT 38 SQ.FT) 1387.34 SQ.FT [128.89 M2] (EXCL. ELEVATOR SHAFT 38 SQ.FT) 1227.00 SQ.FT [113.99 M2] (EXCL. ELEVATOR SHAFT 38 SQ.FT) 48.06 SQ.FT [4.46 M2]
<u>7.6.1(c) PARCEL COVERAGE</u> <i>Brunswick Beach Zoning</i>	
12.5% + 180M2 = 2474.63 SQ.FT. [229.9M2]	2360.57 SQ.FT. [219.30 M2]
<u>7.6.1(e) MAX GARAGE EXCLUDED FROM FAR</u>	
430.56 SQ.FT. [40M2]	448.06 SQ.FT. [4.46 M2]
<u>7.6.2(b) FRONT SETBACK</u>	
THE LESSER OF 7.5 METRES OR 20 PERCENT OF THE PARCEL DEPTH, TO A MINIMUM OF 4.5 METRES FROM ANY OTHER FRONT PARCEL LINE; 24' - 7 5/16" [7.5M] > 20% OF 85' - 10 15/16" = 17' - 2 3/16" FT [5.24M]	18' - 2 1/4" [5.24 M]
<u>7.6.2(a) REAR SETBACK</u>	
14' - 9 1/8" [4.5M]	14' - 9 1/8" [4.5 M]
<u>7.6.2(d) INTERIOR SIDE YARD SETBACK</u>	
4' - 11 1/16" [1.5M]	4' - 11 1/16" [1.5 M]
<u>7.6.2(e) EXTERIOR SIDE YARD SETBACK</u>	
9' - 10 1/16" [3.0M]	9' - 10 1/16" [3.0 M]
<u>7.6.8.1 MAX BUILDING HEIGHT</u>	
29' - 6 3/8" FT [9.0M] (ROOF MEAN Elevation @40' - 0 1/2" [12.21 M])	39' - 2" [11.94M] (ROOF MEAN ELEVATION @41' - 11 3/4" [12.80 M])
<u>4.19.2 MIN BUILDING ELEVATION</u>	
a) 0.7 METRE ABOVE 200 YEAR FLOOD LEVEL, WHICH LEVEL HAS BEEN ESTABLISHED BY THE MINISTRY OF ENVIRONMENT. b) 3.1 METRES ABOVE THE NATURAL BOUNDARY OF A WATERCOURSE WHERE THE 200 YEAR FLOOD LEVEL HAS NOT BEEN ESTABLISHED; AND c) 1.6 METRES ABOVE THE NATURAL BOUNDARY OF THE SEA.	<i>* SEE'S NHC REPORT PAGE 20 AND 21 Reviewed DAB 15th AUGUST 2023</i>

- BOFV ONLY -



101-173 Forester Street,
North Vancouver V7H A06
P. 604 396 6002
www.trimstudio.ca
info@trimstudio.ca

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NO :	DATE :	REVISION :

PROJECT:
26 BRUNSWICK BEACH ROAD, LIONS BAY BC

DRAWING TITLE:
SITE PLAN

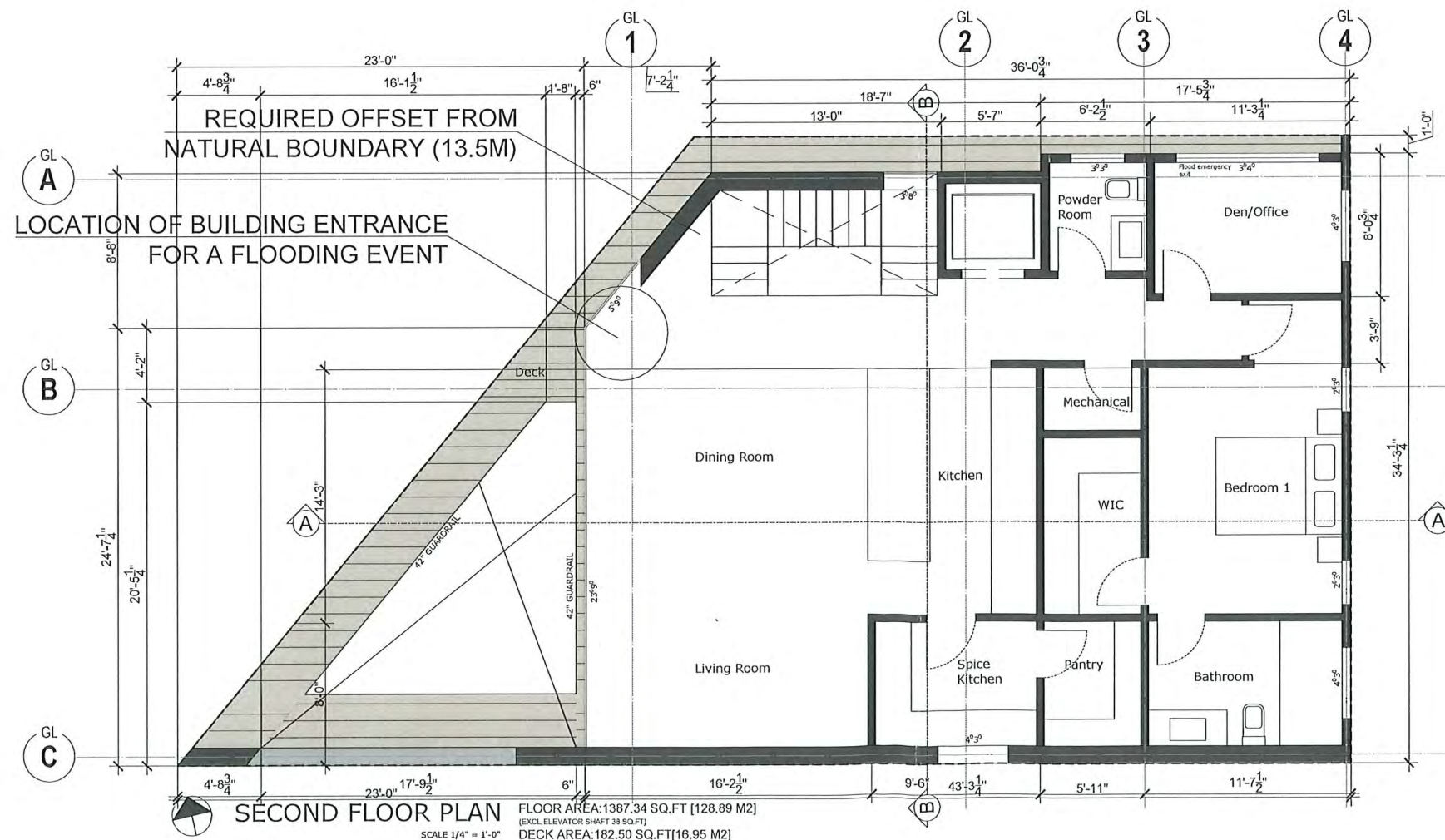
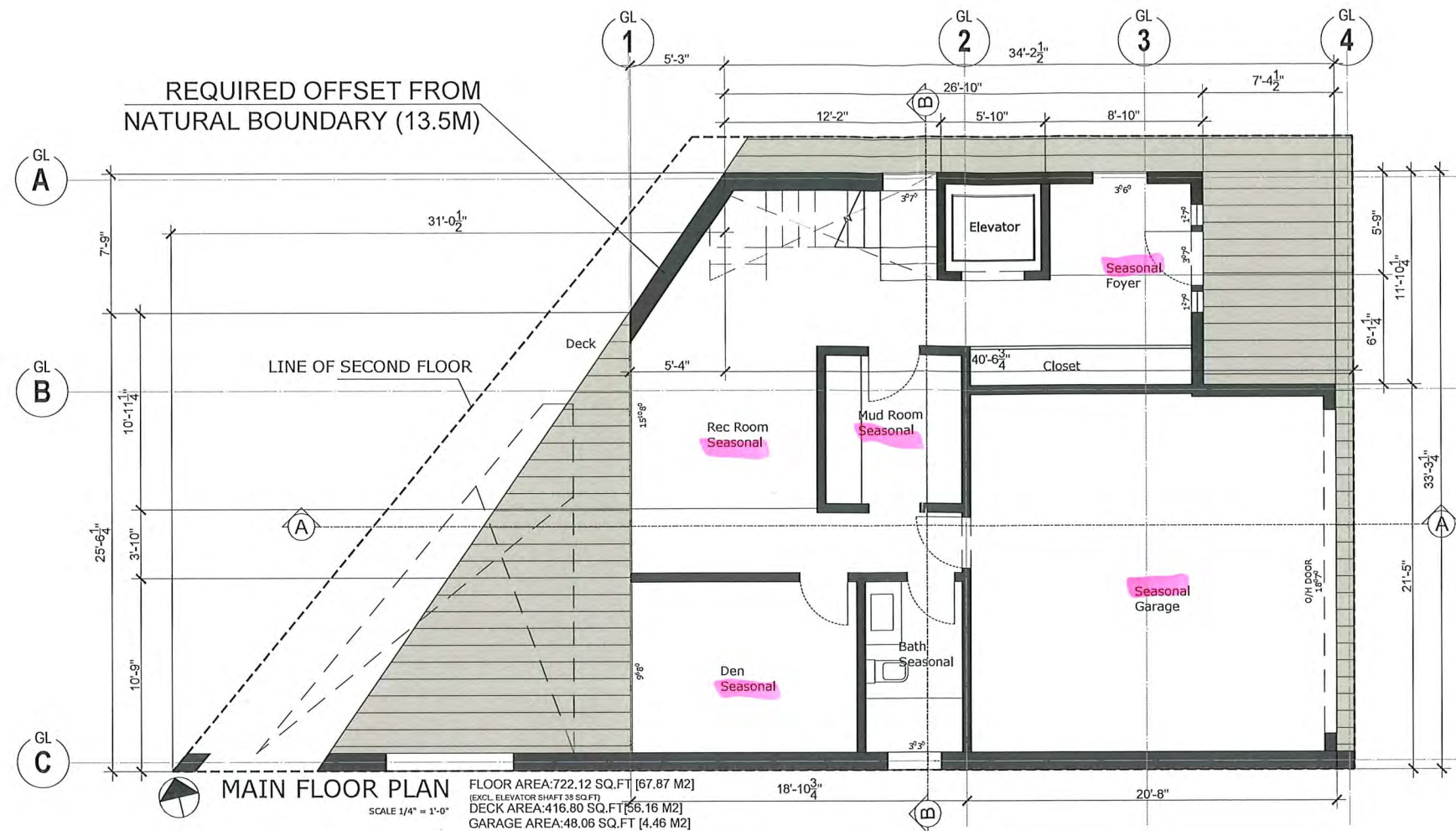
DATE	MARCH, 2022
SCALE	1/4" = 1'-0"
DRAWN BY	R.M.
CHECKED BY	N.B.
PROJECT NO.	DRAWING NO.
	A1

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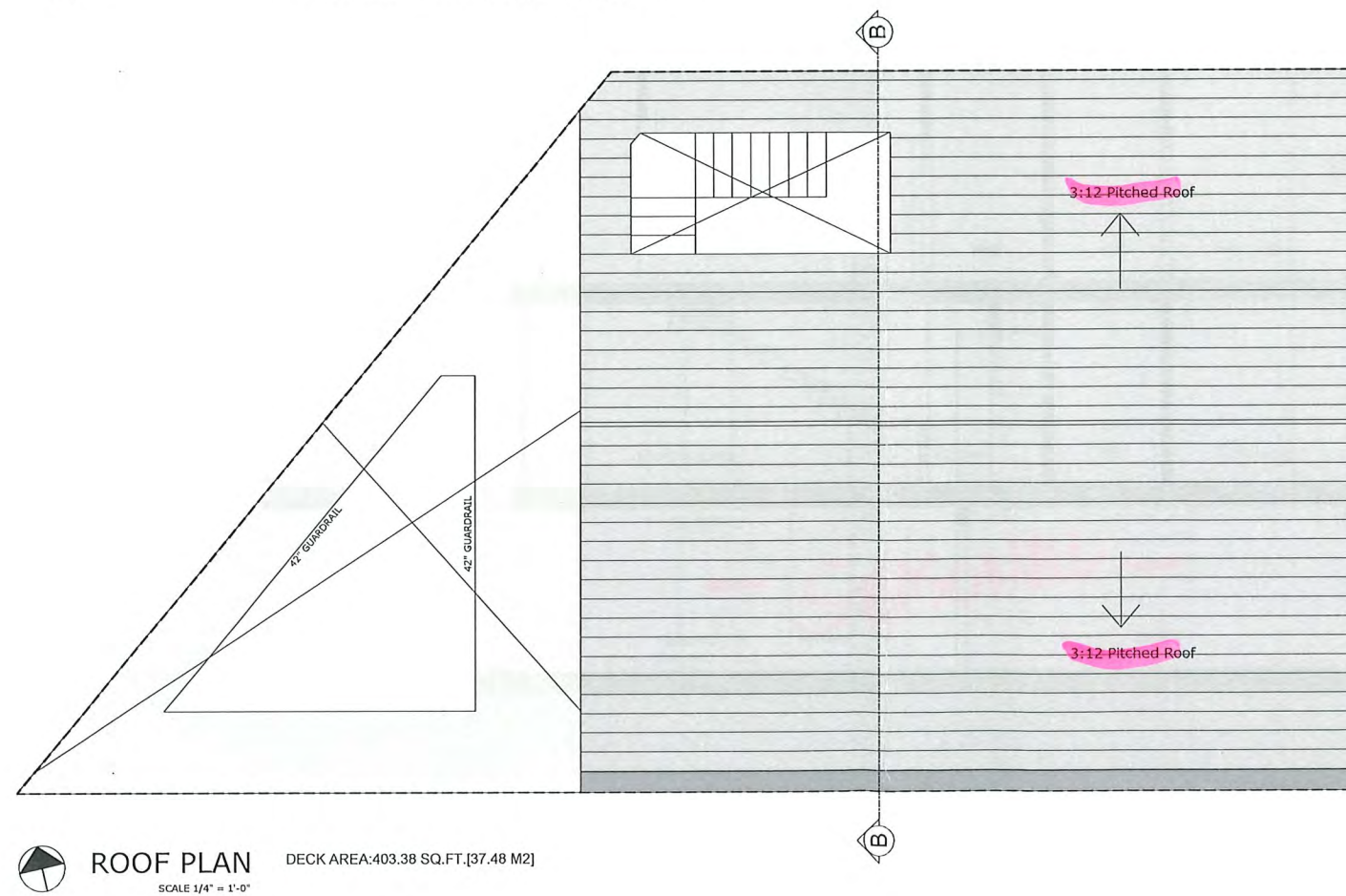
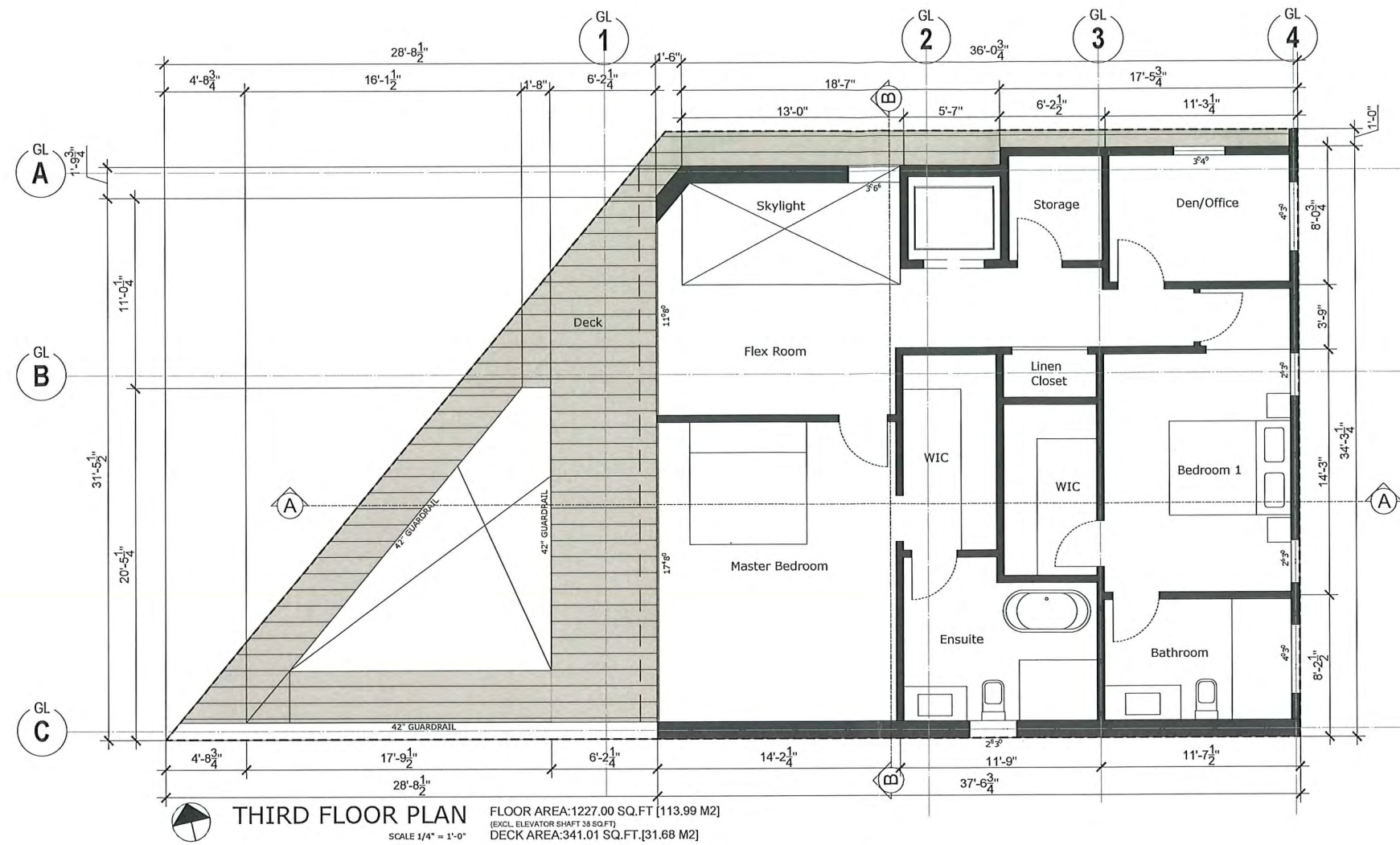


NO :	DATE :	REVISION :
REVISION NO :		
PROJECT :		
26 BRUNSWICK BEACH ROAD, LIONS BAY BC		
DRAWING TITLE :		
MAIN FLOOR PLAN & SECOND FLOOR PLAN		
DATE	MARCH, 2022	
SCALE	1/4" = 1'-0"	
DRAWN BY	H.T	
CHECKED BY	N.B	
PROJECT NO.		DRAWING NO.
		A2

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design studio

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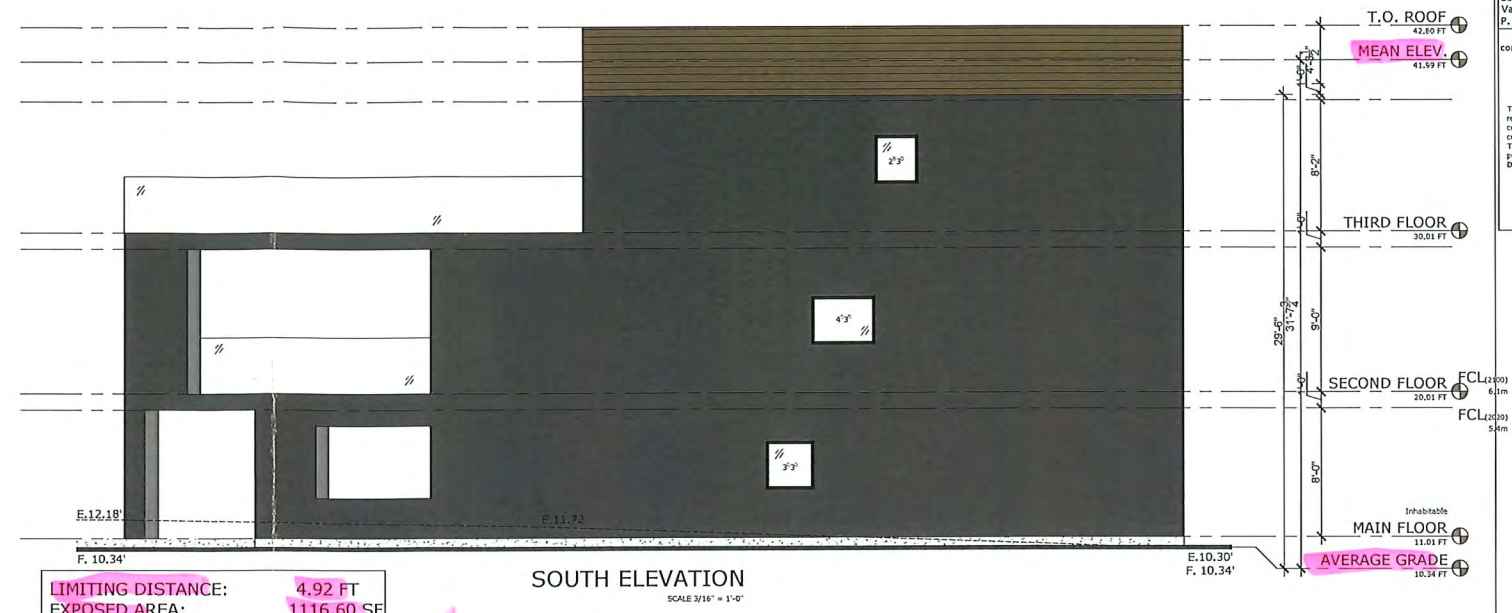
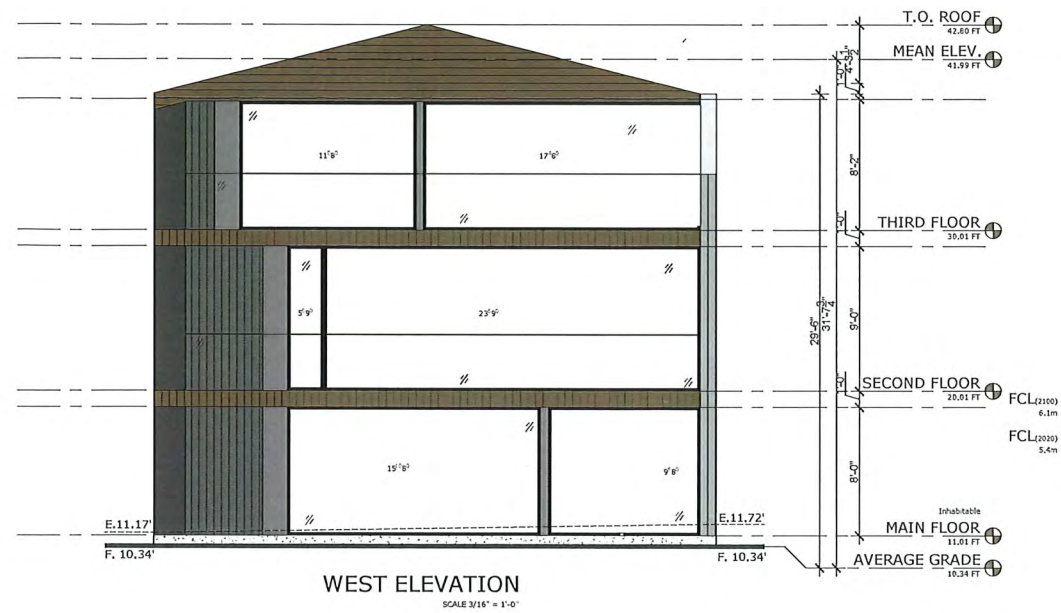


NO.:	DATE:	REVISION:
REVISION NO.:		
PROJECT:		
26 BRUNSWICK BEACH ROAD, LIONS BAY BC		
DRAWING TITLE:		
THIRD FLOOR PLAN & ROOF PLAN		
DATE	MARCH, 2022	
SCALE	1/4" = 1'-0"	
DRAWN BY	H.T	
CHECKED BY	N.B	
PROJECT NO.	DRAWING NO.	
	A3	

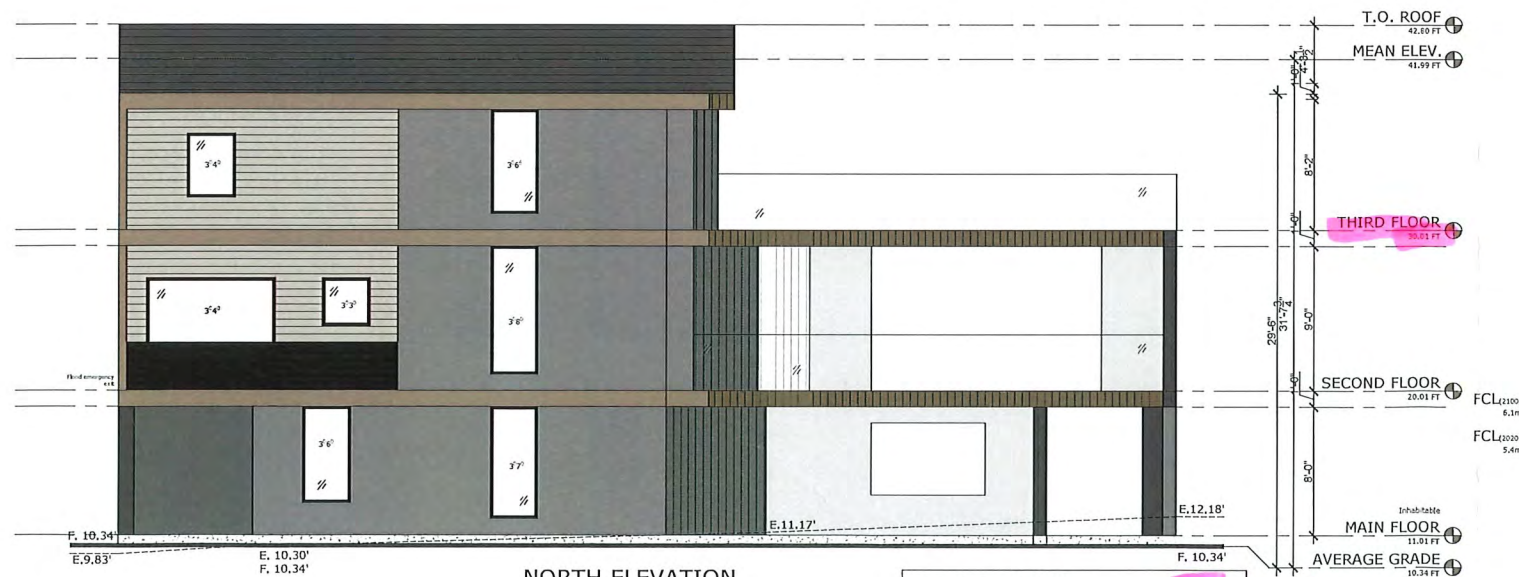
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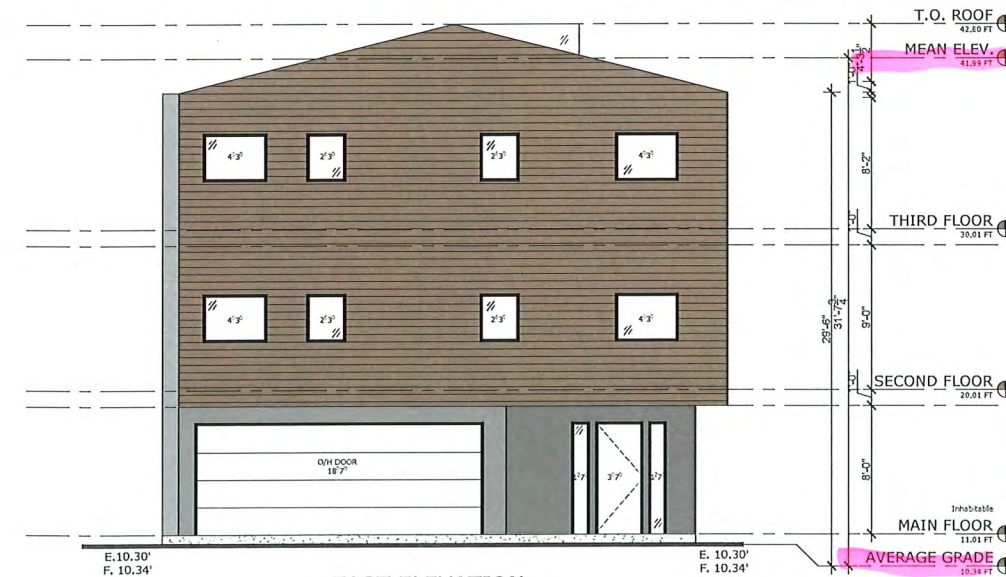
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LIMITING DISTANCE: 4.92 FT
EXPOSED AREA: 1116.60 SF
MAX UPO (7%): 78.16 SF
PROPOSED UPO: 29.00 SF



















LIMITING DISTANCE: 10.83 FT
EXPOSED AREA: 1119.60 SF
MAX UPO (10.6%): 118.68 SF
PROPOSED UPO: 115.50 SF



NO:	DATE:	REVISION:
REVISION NO:		
PROJECT:		
26 BRUNSWICK BEACH ROAD, LIONS BAY BC		
DRAWING TITLE:		
NORTH ELEVATION & EAST ELEVATION		
DATE:	MARCH, 2022	
SCALE:	3/16" = 1'-0"	
DRAWN BY:	HT	
CHECKED BY:	N.B	
PROJECT NO.	DRAWING NO.	
	A5	

	MARCH 21.	JUNE 21.	SEPTEMBER 21.	DECEMBER 21.
9:00:00 AM				
12:00:00 PM				
3:00:00 PM				
6:00:00 PM				

TITLE: Proposed House Shadow Analysis (Roof Peak at 40.80').(As per zoning bylaw 9m max height)		DESIGNER: EWAN DESIGN+CONSTRUCT INC 3993 Henning Drive, BURNABY, BC, V5C 6P7 TEL: 604 324 3185 / 604 338 8127 email: info@ewandc.com	
PROJECT USE:	ADDRESS: 26 Brunswick Beach Road, Lions Bay, BC	SCALE:	

	MARCH 21.	JUNE 21.	SEPTEMBER 21.	DECEMBER 21.
9:00:00 AM				
12:00:00 PM				
3:00:00 PM				
6:00:00 PM				

PROJECT USE:	TITLE: Proposed House Shadow Analysis (Roof Peak at 42.80').(Max height 9.61m roof peak)	DESIGNER:	EWAN DESIGN+CONSTRUCT INC 3993 Henning Drive, BURNABY, BC, V5C 6P7 TEL: 604 324 3185 / 604 338 8127 email: info@ewandc.com
ADDRESS:	26 Brunswick Beach Road, Lions Bay, BC	SCALE:	

NHC Ref. No. 3006207

2021 February 26

**Interex Management Ltd.**

8419 Laurel Street

Vancouver, BC

V6P 3V4

Attention: Mr. Ken Wong

Re: Flood Hazard Assessment**26 Brunswick Beach Road, Village of Lions Bay, BC**

This letter report summarizes the flood hazard assessment (FHA) conducted by Northwest Hydraulic Consultants Ltd. (NHC) in support of the future building permit for the proposed 26 Brunswick Beach Road development located within the Village of Lions Bay (Lot 'H', Block 19, District Lot 1815, Group 1, New Westminster District, Plan 18523).

A sealed copy of this letter was submitted on January 12, 2021 which was revised in response to additional architectural information provided by Interex Management Ltd.

This assessment considers preliminary general building plans provided by Interex Management Ltd., which indicate that the ground in front (seaward) of the proposed dwelling will remain at the existing elevation following construction. Raising the ground elevation, changing the building design, and/or constructing shoreline protection structures would require a reassessment of the FCL as such modification influences wave runup.

1 Introduction

A principal dwelling is being proposed for 26 Brunswick Beach Road to replace an existing dwelling on the property. The waterfront property is located on Brunswick Beach in Howe Sound within the Village of Lions Bay (**Figure 1**). The property is located on the northern side of the point and is mainly exposed to northerly waves and is relatively sheltered from southerly waves. The property is potentially at risk from coastal flood hazards from Howe Sound during northerly wind events occurring at high water levels. Because of its relative distance from major creeks and topography of the area, the risk of flood hazard from the nearby creeks is considered to be low, and was therefore not assessed.

The objective of this assessment is to identify and evaluate the flood hazards that may affect the safe development and use of the property. The currently accepted safety threshold in British Columbia is an event with 0.5% annual exceedance probability (AEP) up to the year 2100. Such event is often referred to as the 200-year event.

It is NHC's understanding that the design of the new dwelling is currently underway and requires results of this assessment as input.

This report presents the findings of an assessment performed by NHC of flood hazards from Howe Sound, accompanied with recommended measures for mitigation. The report has been structured as follows: the pertinent guidelines and references are described first, followed by site observations and coastal flood hazard assessment, and concludes with findings and recommendations.



Figure 1 Satellite imagery of project site.
Source: Google Earth, image taken on August 24, 2019

1.1 Existing FHA Requirements

The Village of Lions Bay requires all applicants for a building permit provide an assessment of flood risk and appropriate minimum flood construction levels (Village of Lions Bay Bylaw No. 431).

According to Village of Lions Bay Bylaw No. 520 Section 4.19, no building or structure shall be constructed, erected, or placed:

1. *Within 15 metres of the natural boundary of a watercourse;*
2. *On ground surface less than:*
 - a. *0.7 metres above the 200-year flood level, which level has been established by the Ministry of Environment;*
 - b. *3.1 metres above the natural boundary of a water course where the 200-year flood level has not been established; and*
 - c. *1.6 metres above the natural boundary of the sea.*

Professional obligations require that a site-specific FHA report that confirms the land may be used safely for the use intended must:

- Be prepared in accordance with the most recent edition of the Professional Practice Guidelines – Legislated Flood Assessments in a Changing Climate in BC published by Engineers and Geoscientists of BC (EGBC, 2018), and
- Identify all floor areas proposed to be constructed below the 4.5 m Canadian Geodetic Vertical Datum and specify use of these areas, as applicable.

1.2 Referenced Guidelines

The following guidelines and regulations were reviewed as part of our investigation of the possible flood hazards incident on the property under study:

- Professional Practice Guidelines – Legislated Flood Assessments in a Changing Climate in BC (EGBC, 2018)
- Flood Hazard Area Land Use Management Guidelines – Sea level rise amendment (BCMFLNRD, 2018)
- Climate Change Adaptation Guidelines for Sea Dikes and Coastal Flood Hazard Land Use – Draft Policy Discussion Paper (BC Ministry of Environment, 2011a)
- Coastal Floodplain Mapping – Guidelines and Specifications (BC Ministry of Environment, 2011b), and
- Climate Change Adaptation Guidelines for Sea Dikes and Coastal Flood Hazard Land Use – Guidelines for Management of Coastal Flood Hazard Land Use (BC Ministry of Environment, 2011c).
- Flood Hazard Area Land Use Management Guidelines (MWLAP, 2004)

2 Site Description

The following site description is based on the survey data (Chapman Land Surveying Ltd. attached as **Appendix B**) and a site inspection. It was clarified that the vertical datum of the provided survey is the Canadian Geodetic Vertical Datum of 2013 (CGVD2013)¹. The site inspection was conducted on Nov. 10, 2020 by Philippe St-Germain, P.Eng. of NHC to examine the shoreline and to identify the condition of surrounding areas. The weather throughout the site inspection was calm. The water level was approximately -0.5 m at the time of the site inspection; this and all elevations in this document are reported with respect to CGVD2013 unless otherwise stated. The local conversion from CGVD2013 to chart datum (CD) is +2.94 m.

¹ NHC, 2020. Email communication between Philippe St-Germain (pstgermain@nhcweb.com) and Ken Wong (ken20.interex@gmail.com) on January 7, 2021.

The property is bounded by the sea to the west and an asphalted lane to Brunswick Road to the east. The shoreline in front of the property consist of a pebble beach with coarse sand. This pebble beach is uniformly sloped at approximately 5H:1V (**Figure 2**). The upper portion of the beach is mainly composed of pebbles forming a small berm (**Figure 3**). Large wood logs are present at the top of the beach slope in front of the property as well as in front of the two adjacent properties. Typical riparian vegetation begins directly behind the logs located towards the northern limit of the property (**Figure 3**), and which corresponds to an elevation of approximately 2.9 m. There is a large rocky headland directly south of the property (**Figure 2**).

The seaward limit of the property is located landward of an approximately 9 m wide and relatively levelled esplanade mostly covered with grass (see legal survey provided in **Appendix B**). According to the legal survey the seaward limit of the esplanade consists of the natural boundary. The property itself is mainly flat with ground elevations varying from approximately 3.0 to 3.3 m along its perimeter. The elevation of the ground behind the property is lower (**Figure 4**), as the center elevation of the asphalted lane is approximately 2.5 m.

The shoreline north of the property has a milder slope and becomes mainly composed of cobbles as one moves further north (**Figure 5**). The properties along this portion of the shoreline have vertical seawalls of varying construction type, with some of them showing signs of erosion (**Figure 6**).



Figure 2. Pebble beach in front of property looking south. Property under study located behind cedar tree on the left of the photograph.



Figure 3. Pebble beach in front of property looking north. Property under study located on the right of the photograph.



Figure 4. Lower elevation asphalted lane on the landside of the property (looking northeast).



Figure 5. Character of shoreline north of property under study.

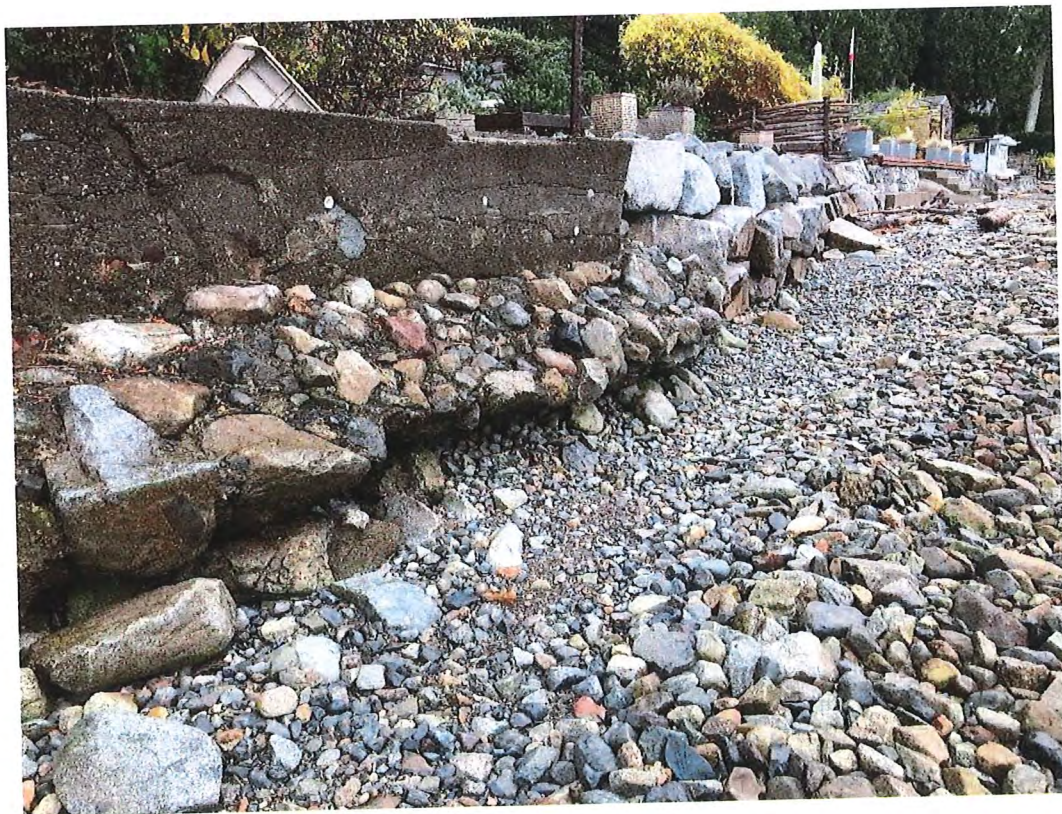


Figure 6. Signs of erosion at toe of seawall located along shoreline to the north.

3 Fluvial Flood Hazards

The property is located at considerable distance away from the closest major creeks, which are Magnesia Creek over 300 m to the north and Alberta Creek over 1 km to the south. No outfalls suggesting water channelling were observed along the shoreline directly north of the property and assessment of land topography in Google Earth did not suggest the presence of any sizable creeks in the vicinity of the property. Accordingly, the risk from creek flooding is deemed low and no further analysis is warranted.

4 Coastal Geomorphic Hazards

The site inspection did not reveal existing signs of shoreline erosion at the property. Observations made during NHC's site visit suggest that there is a potential for the accretion of beach material directly in front of the property. This is in agreement with the sediment deprived shoreline to the north of the property in conjunction with the presence of a rocky headland directly south of the property, which may help to retain sediments transported southwards due to the prevailing northerly storm conditions. Prevailing storm conditions are further discussed in **Section 5.1.5** of this letter report.

Comparison of satellite images available in Google Earth from 2003 to 2019 did not reveal noticeable changes in the position of the shoreline in front of the property, although this comparison is limited to the relatively low resolution of the satellites imagery available in Google Earth. Historically, it is possible that any trends in the position of the shoreline was affected by the gradual construction of seawall structures to the north of the property, as these structures interrupts the sediment supply that may have been provided by the previously natural shoreline. It is not anticipated that analysis of historical air photo extending further back in time would reveal further information on the sediment transport processes expected to be currently occurring on site. For this reasons such analysis is not warranted.

Overall, the erosion hazards are deemed low for the site and the shoreline in front of the property currently appears stable. However, the stability and position of the shoreline may be affected as sea level rises, potentially with re-shaping of the cross shore profile and position of the beach berm, although the prediction of any changes would require additional assessment of shoreline geomorphology.

5 Coastal Flood Hazards

Coastal flood hazards are primarily dictated by flood inundation, but can include overflow and spray, shoreline erosion and scour, beach degradation and aggradation, or physical loading from hydrodynamic forces or debris impact entrained in wave runup. Physical loading is not investigated as part of this assessment as plans for the structures are not available at the time of study.

Canadian Tide and Current Tables (2019, Volume 5) present tides at Point Atkinson, which is 15 km south of the study site (**Table 1**). Despite the higher high water large tide (HHWLT) level being lower than the property, storm surge, wave effects and long-term changes in global and local sea level could result in substantially higher coastal flood levels. Therefore, these effects are analyzed in the following sections.

Table 1. Tidal levels at Point Atkinson

Tidal Level	Meters with Respect to CGVD2013	Metres with Respect to CD
Higher High Water, Large Tide (HHWLT)	2.1	5.0
Higher High Water, Mean Tide (HHWMT)	1.6	4.5
Mean Water Level (MWL)	0.0	2.9
Lower Low Water, Mean Tide (LLWMT)	-1.7	1.2
Lower Low Water, Large Tide (LLWLT)	-2.8	0.1

5.1 Coastal Flood Inundation Hazard

To reduce the likelihood of damage from coastal flood inundation, the coastal flood level was assessed and used to derive a minimum construction level for habitable floors– the flood construction level (FCL). The FCL provides a mitigation measure to limit the likelihood of flooding for developments located along the coast.

According to MWLAP (2004), habitable area is defined as any room or space within a building or structure that is or can be used for human occupancy, commercial sales, or storage of goods, possessions or equipment (including furnaces) which would be subject to damage if flooded. It is recommended that a restrictive covenant be associated with the property to limit the use of any space below the FCL.

The FCL is generally based on an event with an AEP of 0.5% (200-year event). In addition, due to global climate change related sea-level rise, future conditions are considered up to the expected life of the project; often up to the year 2100 (roughly 80 years from present).

The BC Ministry of Environment’s Climate Change Adaptation Guidelines for Sea Dikes and Coastal Flood Hazard Land Use (BC Ministry of Environment, 2011b) and the BC Ministry of Forests, Natural Resource Operations and Rural Development’s amendment of the Flood Hazard Area Land Use Management Guidelines (BCMFLNRD, 2018) present two approaches for determining the 200-year FCL: 1) *combined* method and 2) *probabilistic* method. The components used in determining the FCL using each method are illustrated in **Figure 7** and **Figure 8**.



NHC Ref. No. 3006207

2021 February 26

Interex Management Ltd.

8419 Laurel Street
Vancouver, BC
V6P 3V4

Attention: Mr. Ken Wong

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¹ NHC, 2020. Email communication between Philippe St-Germain (pstgermain@nhcweb.com) and Ken Wong (ken20.interex@gmail.com) on January 7, 2021.

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The seaward limit of the property is located landward of an approximately 9 m wide and relatively levelled esplanade mostly covered with grass (see legal survey provided in **Appendix B**). According to the legal survey the seaward limit of the esplanade consists of the natural boundary. The property itself is mainly flat with ground elevations varying from approximately 3.0 to 3.3 m along its perimeter. The elevation of the ground behind the property is lower (**Figure 4**), as the center elevation of the asphalted lane is approximately 2.5 m.

The shoreline north of the property has a milder slope and becomes mainly composed of cobbles as one moves further north (**Figure 5**). The properties along this portion of the shoreline have vertical seawalls of varying construction type, with some of them showing signs of erosion (**Figure 6**).



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Figure 3. Pebble beach in front of property looking north. Property under study located on the right of the photograph.



Figure 4. Lower elevation asphalted lane on the landside of the property (looking northeast).



Figure 5. Character of shoreline north of property under study.



Figure 6. Signs of erosion at toe of seawall located along shoreline to the north.

3 Fluvial Flood Hazards

The property is located at considerable distance away from the closest major creeks, which are Magnesia Creek over 300 m to the north and Alberta Creek over 1 km to the south. No outfalls suggesting water channelling were observed along the shoreline directly north of the property and assessment of land topography in Google Earth did not suggest the presence of any sizable creeks in the vicinity of the property. Accordingly, the risk from creek flooding is deemed low and no further analysis is warranted.

4 Coastal Geomorphic Hazards

The site inspection did not reveal existing signs of shoreline erosion at the property. Observations made during NHC's site visit suggest that there is a potential for the accretion of beach material directly in front of the property. This is in agreement with the sediment deprived shoreline to the north of the property in conjunction with the presence of a rocky headland directly south of the property, which may help to retain sediments transported southwards due to the prevailing northerly storm conditions. Prevailing storm conditions are further discussed in **Section 5.1.5** of this letter report.

Comparison of satellite images available in Google Earth from 2003 to 2019 did not reveal noticeable changes in the position of the shoreline in front of the property, although this comparison is limited to the relatively low resolution of the satellites imagery available in Google Earth. Historically, it is possible that any trends in the position of the shoreline was affected by the gradual construction of seawall structures to the north of the property, as these structures interrupts the sediment supply that may have been provided by the previously natural shoreline. It is not anticipated that analysis of historical air photo extending further back in time would reveal further information on the sediment transport processes expected to be currently occurring on site. For this reasons such analysis is not warranted.

Overall, the erosion hazards are deemed low for the site and the shoreline in front of the property currently appears stable. However, the stability and position of the shoreline may be affected as sea level rises, potentially with re-shaping of the cross shore profile and position of the beach berm, although the prediction of any changes would require additional assessment of shoreline geomorphology.

5 Coastal Flood Hazards

Coastal flood hazards are primarily dictated by flood inundation, but can include overflow and spray, shoreline erosion and scour, beach degradation and aggradation, or physical loading from hydrodynamic forces or debris impact entrained in wave runup. Physical loading is not investigated as part of this assessment as plans for the structures are not available at the time of study.

Canadian Tide and Current Tables (2019, Volume 5) present tides at Point Atkinson, which is 15 km south of the study site (**Table 1**). Despite the higher high water large tide (HHWLT) level being lower than the property, storm surge, wave effects and long-term changes in global and local sea level could result in substantially higher coastal flood levels. Therefore, these effects are analyzed in the following sections.

Table 1. Tidal levels at Point Atkinson

Tidal Level	Meters with Respect to CGVD2013	Metres with Respect to CD
Higher High Water, Large Tide (HHWLT)	2.1	5.0
Higher High Water, Mean Tide (HHWMT)	1.6	4.5
Mean Water Level (MWL)	0.0	2.9
Lower Low Water, Mean Tide (LLWMT)	-1.7	1.2
Lower Low Water, Large Tide (LLWLT)	-2.8	0.1

5.1 Coastal Flood Inundation Hazard

To reduce the likelihood of damage from coastal flood inundation, the coastal flood level was assessed and used to derive a minimum construction level for habitable floors– the flood construction level (FCL). The FCL provides a mitigation measure to limit the likelihood of flooding for developments located along the coast.

According to MWLAP (2004), habitable area is defined as any room or space within a building or structure that is or can be used for human occupancy, commercial sales, or storage of goods, possessions or equipment (including furnaces) which would be subject to damage if flooded. It is recommended that a restrictive covenant be associated with the property to limit the use of any space below the FCL.

The FCL is generally based on an event with an AEP of 0.5% (200-year event). In addition, due to global climate change related sea-level rise, future conditions are considered up to the expected life of the project; often up to the year 2100 (roughly 80 years from present).

The BC Ministry of Environment’s Climate Change Adaptation Guidelines for Sea Dikes and Coastal Flood Hazard Land Use (BC Ministry of Environment, 2011b) and the BC Ministry of Forests, Natural Resource Operations and Rural Development’s amendment of the Flood Hazard Area Land Use Management Guidelines (BCMFLNRD, 2018) present two approaches for determining the 200-year FCL: 1) *combined* method and 2) *probabilistic* method. The components used in determining the FCL using each method are illustrated in **Figure 7** and **Figure 8**.

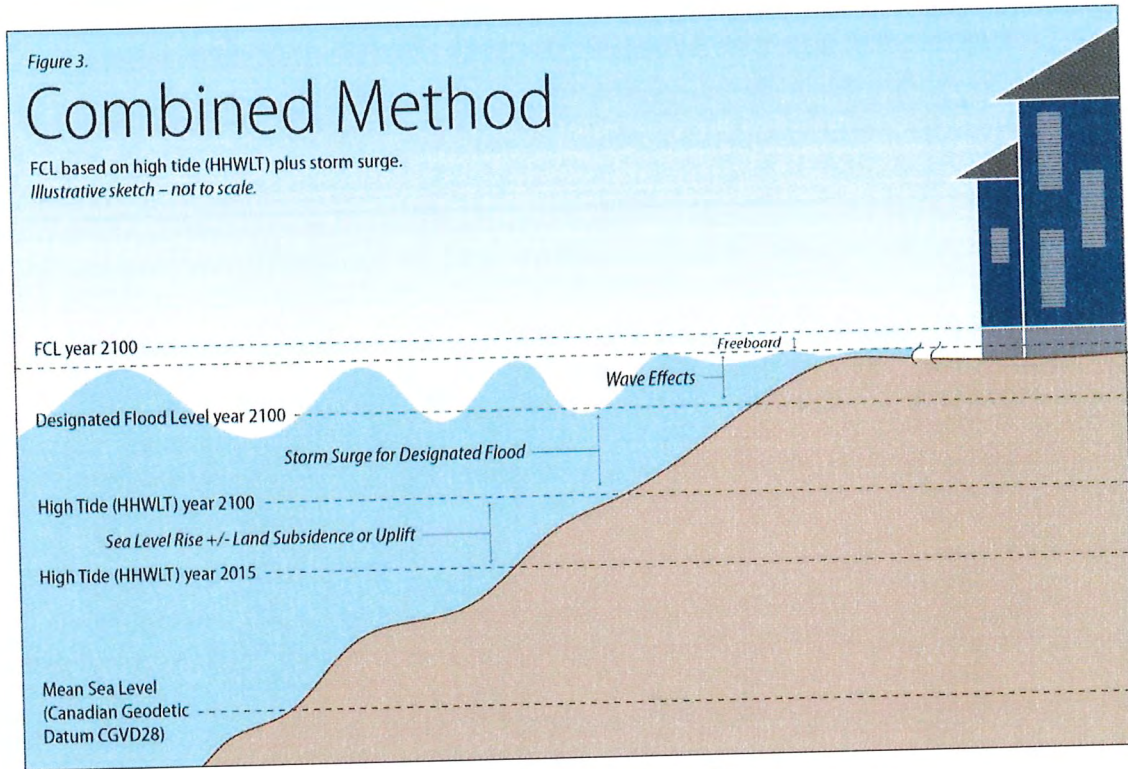


Figure 7. FCL based on combined method (BCMFLNRD, 2018)

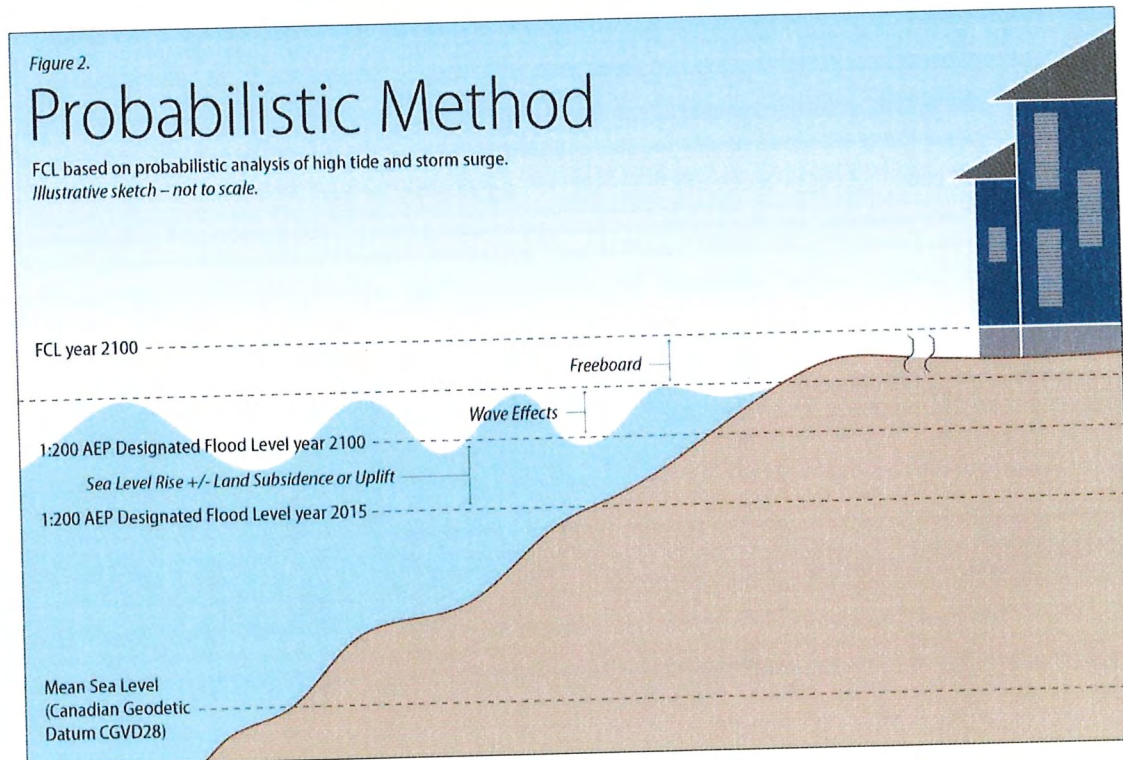


Figure 8. FCL based on probabilistic analysis (BCMFLNRD, 2018)

The combined method is the addition of independent effects of tide, storm surge, and wave run-up, and sea level rise (SLR). This deterministic approach generally results in conservative calculation of a design flood level, as it is applied neglecting the probability of the various design events occurring simultaneously. This is particularly relevant for the fully independent variables of tide and storm surge. For example, the AEP that a 200-year storm surge occurs during HHWLT and 200-year wave event is less than 0.025%; substantially less than the design AEP of 0.5%.

For this assessment a probabilistic approach has been applied, considering the joint probability of tide and storm surge coinciding. This method provides an estimate with an AEP closer to the design AEP of 0.5%.

The coastal FCL using the probabilistic approach is the sum of:

- 0.5% AEP water level as determined by probabilistic analyses of tides and storm surge (the joint probability piece)
 - Allowances for future sea level rise (SLR) to the year 2100
 - Allowance for regional uplift or subsidence to the year 2100
 - Estimated wave effects associated with the designated storm with an 0.5% AEP, and
 - Freeboard.
- } Designated Flood Level

Each of these components are described in the following sections.

Potential changes in storm intensity and frequency over the next 80 years due to climate change could influence storm surge and wave effects. However, predicted changes in storm intensity and frequency are highly variable and inconclusive and therefore have not been incorporated in this analysis.

5.1.1 Joint Occurrence of Storm Surge and Tides

Coastal flood levels for the 0.5% AEP were developed by applying the Empirical Simulation Technique (EST) on the long term observed data (66 years) at Point Atkinson (NHC, 2008). The EST method is recommended by the Coastal Hydraulics Laboratory (of the US Army Corps of Engineers) and Federal Emergency Management Agency (of United States Department of Homeland Security) technical documentation for frequency related studies. The analysis determined that the 0.5% AEP water level at Point Atkinson is at an elevation of 3.1 m (CGVD2013).

5.1.2 Sea Level Rise

Global climate change is expected to result in increased sea levels resulting from melting of global ice and increased ocean volume due to rising water temperature. Typically, projects are considered to have a service life of 80 years, resulting in designs often considering projections to the year-2100.

The BC Provincial Sea Dike Guidelines (BC Ministry of Environment, 2011c) recommend that SLR associated with global climate change will result, by the year 2100, in a base water level 1.0 m above that seen in the year 2000. The rate of SLR is projected to increase as the climate warms (Figure 9). Therefore, any increase incorporated in the past 20 years is expected to be minimal and hence ignored.

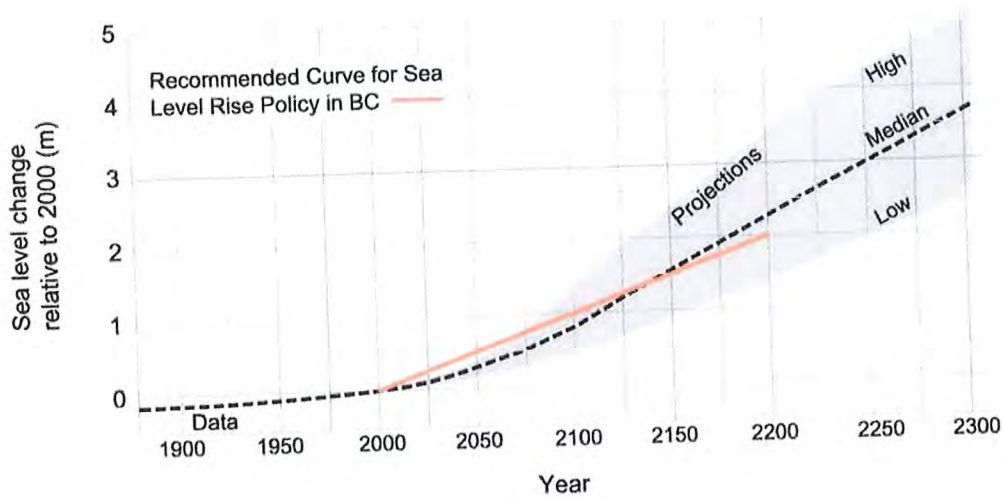


Figure 9. Projected climate change (BC Ministry of Environment, 2011c)

Note that the recommended SLR for planning and design in British Columbia is based on a 2008 study by Fisheries and Oceans Canada (Thomson *et al.*, 2008) and MOE (Bornhold, 2008). The authors of those works acknowledge the design SLR for British Columbia is greater than the global mean SLR projected by the IPCC AR4 (2007) for the year 2100 (roughly 0.4 m greater). However, more recent studies, such as IPCC AR5 (2014), suggests global mean SLR of up to 1 m or more by the year 2100. These predictions were based on the Paris Accord being adopted and adhered to. Higher estimates of global mean SLR are associated with higher emission (or business as usual) scenarios.

Other studies have investigated the potential effect of a collapse of the Antarctic ice sheet and have shown that such an event would result in far greater SLR, with estimates that are orders of magnitude larger than the 1 to 2 m projected over the next 80 to 180 years. Recent changes in estimates of global mean SLR to the year 2100 or 2200 have not yet been addressed in the context of coastal British Columbia, but based on recent conversations with FLNRORD, the province is amidst a study of SLR to update the 2011 design values although NHC is not aware of when this study will be finalized.

5.1.3 Local Subsidence

Vertical movement of the earth surface occurs within coastal BC for a variety of geological reasons. Land is either static, experiencing uplift (rising), or experiencing subsidence (lowering). In addition to a rising sea, land movement will influence the local relative sea level. Provincial guidelines (BC Ministry of Environment, 2011c) recommends an uplift of 1.3 ± 0.2 mm/year at Point Atkinson. To the year 2100, this translates to a rise of 0.1 m.

This uplift is however neglected because movement of the earth can vary over short distances and in that context the site is considered to far from Point Atkinson to rely on this reduction of SLR. Detailed information on earth movement specific to Howe Sound is not available. Neglecting the uplift is conservative considering that it would lower the FCL.

5.1.4 Designated Flood Level

Table 2 summarizes the resulting designated flood level (still water) for the current condition and that predicted for the Year 2100. The latter exceeds the property's ground elevation without the influence of wave effects.

Table 2. Designated flood level

Parameter	Year 2020 Elevation (m)	Year 2100 Elevation (m)
Tide + storm surge (joint probability, CGVD2013)	3.1	3.1
+ Design sea level rise	0.0	1.0
+ Subsidence	0.0	0.0
Designated Flood Level (CGVD2013)	3.1	4.1

5.1.5 Wave Effect Assessment

Since there is no comprehensive measurement of waves in the vicinity of the study site, a high-level wind and wave analysis was conducted to determine the incident wave climate. The wave climate allows one to determine the wave height at the site which is used to perform the flood hazard assessment.

Wind Analysis

There is one Meteorological Service of Canada (MSC) station in the vicinity of the study area that has a long-term record suitable for wind analysis: Howe Sound - Pam Rocks. The station is located on a rocky islet approximately 4.3 km to the northwest of the project site and 2.7 km south of Anvil Island. Twenty-five years of hourly wind data was used for the study, as summarized in **Table 3**.

Table 3. Pam Rocks station information

Station	Station ID	Station Location	Period of Record
Pam Rocks	10459NN	478310E 5481735 N	1994–2019

The local wind climate can be visualized using a wind rose plot. The plot presents arrows at the cardinal and inter-cardinal compass points to show the direction from which the winds blow, along with associated magnitude and frequency. A wind rose showing the frequency of direction and magnitude of winds at Pam Rocks is shown in **Figure 10**.

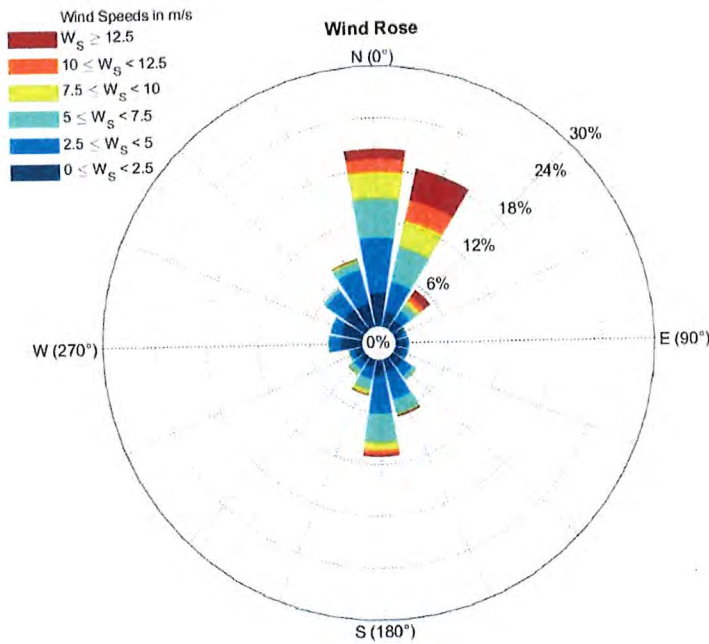


Figure 10. Wind rose for Pam Rocks meteorological station

The wind rose shows that wind experienced at Pam Rocks is most frequently from the north and secondly from the south. As expected, given the orientation of the mountains alongside of Howe Sound, wind from east and west is less frequent and milder. The property under study is mainly exposed to northerly storms and is relatively sheltered from southerly storms. Accordingly, winds that are of concern for this study are winds from the northerly sector. Extreme value frequency analysis was conducted on the wind data from this sector to obtain the wind speed for the designated (0.5% AEP) northerly storm. The results are summarized in **Table 4**.

Table 4. Design wind speeds based on Pam Rocks data

Event	Northerly Sector	
	Speed (m/s)	Speed (km/hr)
20% AEP	26.7	96.1
10% AEP	28.4	102.2
5% AEP	30.1	108.4
2% AEP	32.3	116.3
1% AEP	34.0	122.4
0.5% AEP	35.6	128.2

Both (BC Ministry of Environment, 2011a) and (BCMFLNRD, 2018) guidelines suggest that the wave effects are to be based on the 0.5% AEP storm in conjunction with the 0.5% AEP water level.

Incident Wave Height

Figure 11 shows the open water exposure of the project site. The property is exposed to open water fetch from the north and northwest. Given the similar length of the fetches, the fetch from the northwest is technically more adverse for the project site as the property's water front is facing that direction. However, since winds from that direction measured at Pam Rock are less frequent are generally milder in comparison to the winds from the north, winds coming from the north direction are considered for this assessment.

The property is relatively sheltered from southerly waves as the property is located on the northern side of the point and is mainly exposed to northerly and westerly waves. Waves coming from the south can reach the property shoreline although such waves will be attenuated as they diffract around the point just south of the property (**Figure 1**).

A coarse wave model of the Strait of Georgia was employed to estimate offshore wave conditions incident to the site to capture presence of islands and constrictions within Howe Sound. Results shown in **Figure 12** suggest a significant wave height of $H_s = 2.2$ m approaching the site from the north-northwest direction with a peak wave period of $T_p = 5.4$ sec. The significant wave height corresponds to the mean height of the highest 1/3 of the waves in a storm.

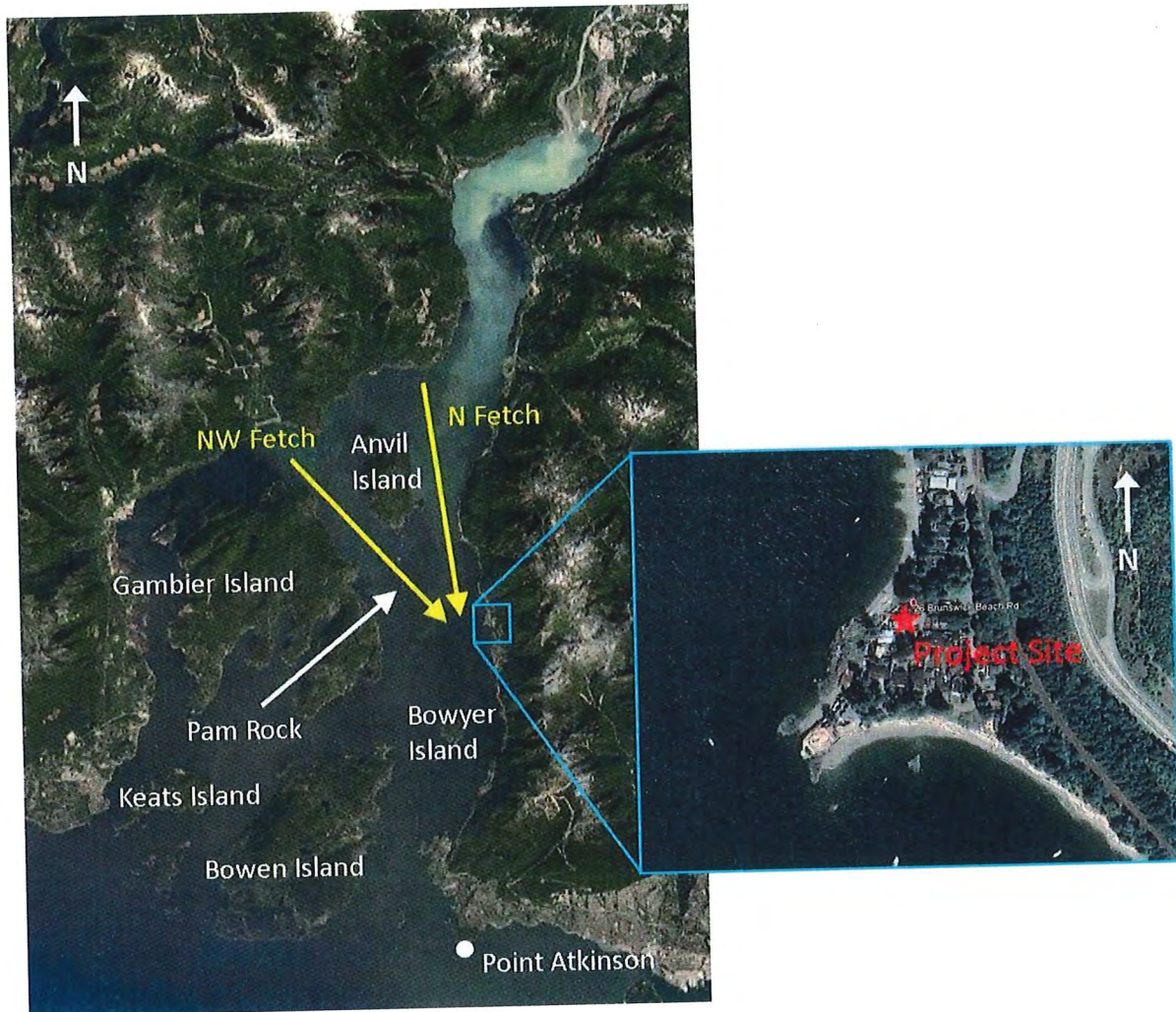


Figure 11. Site open water exposure
Source: Google Earth

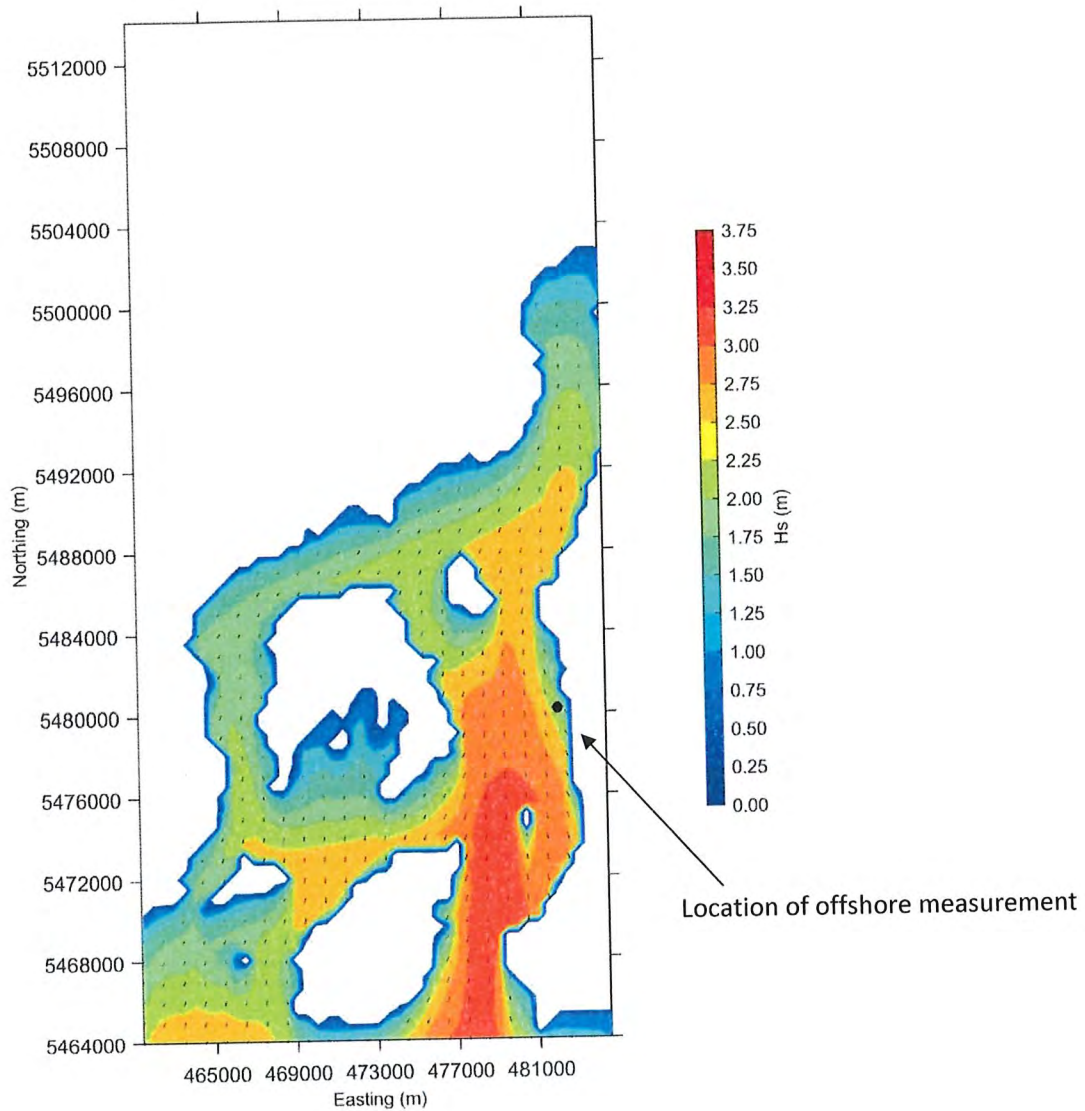


Figure 12. Wave model results for 0.5% AEP northerly winds. Wave height is shown by colour and wave direction by vectors.

Wave Effect Analysis

As waves propagate from deep water closer to the shoreline, they become affected by the shallower water depth as well as the orientation of the shoreline. Such transformation was assessed according to the method of Goda (2000) resulting in a slight height reduction from $H_s = 2.2$ m to $H_s = 2.1$ m at the lower part of the beach, which corresponds to an elevation of 0.6 m. This elevation is the lowest elevation reported on the legal survey provided in **Appendix B**.

Wave runup at the shoreline determines the extent over which waves act above a given water level. Wave runup is therefore an important parameter to determine flood inundation extents from coastal storms. The BC Provincial Sea Dike Guidelines (BC Ministry of Environment, 2011b) accept the use of a few criteria for calculation of the wave runup component for design elevation. As normally applied for runup analysis, the 2% exceedance level was adopted for this study – that is the runup from a wave with a height that is expected to be exceeded by 2% of the waves occurring during a storm.

As wave runup is affected by the type of shoreline waves interact with, assumptions are required regarding the characteristics of the future shoreline. Based on site conditions, the profile of the beach is expected to remain approximately the same as sea level rises. The current assessment of the FCL considers that the ground in front (seaward) of the proposed dwelling will remain at the existing elevation following construction.

Conceptual design details for the proposed dwelling are shown in **Figure 13**. The section shown corresponding to where the perpendicular distance between the proposed dwelling and the shoreline is minimal.

For the purpose of estimating wave runup, the site's waterfront is schematized as a 5H:1V slope representing the beach leading up to an approximately 13.5 m wide and relatively leveled area in front of a solid vertical wall (i.e., side of dwelling). The width of the levelled area corresponds to the approximately 9 m wide esplanade and an offset of 4.5 m further landward from the property line. The presence of the overhanging balcony was neglected which makes the analysis more conservative, as such construction detail prevents water from reaching higher elevations as it runs up the vertical wall.

Based on the above assumptions, the wave runup is estimated using methodology presented in EurOtop (2018), which provides technical guidance for the design and assessment of coastal structures. The specific methodology followed corresponds to the scenario of a promenade on top of a slope with a wall on the landward side. This desktop methodology was validated by means of computer simulations using the Simulating WAVes till Shore (SWASH; Zijlema et al., 2011) time-resolving model. The results are summarized in the following table.

Table 5. Wave effects

Parameter	Year 2020	Year 2100
Design Wave Height (m)	2.1	2.1
Design Wave Period (s)	5.4	5.4
Designated Flood Level (m, CGVD2013)	3.1	4.1
Wave Runup ¹ (m)	1.7	1.4

Notes:

1. Wave runup is measured from the designated flood level

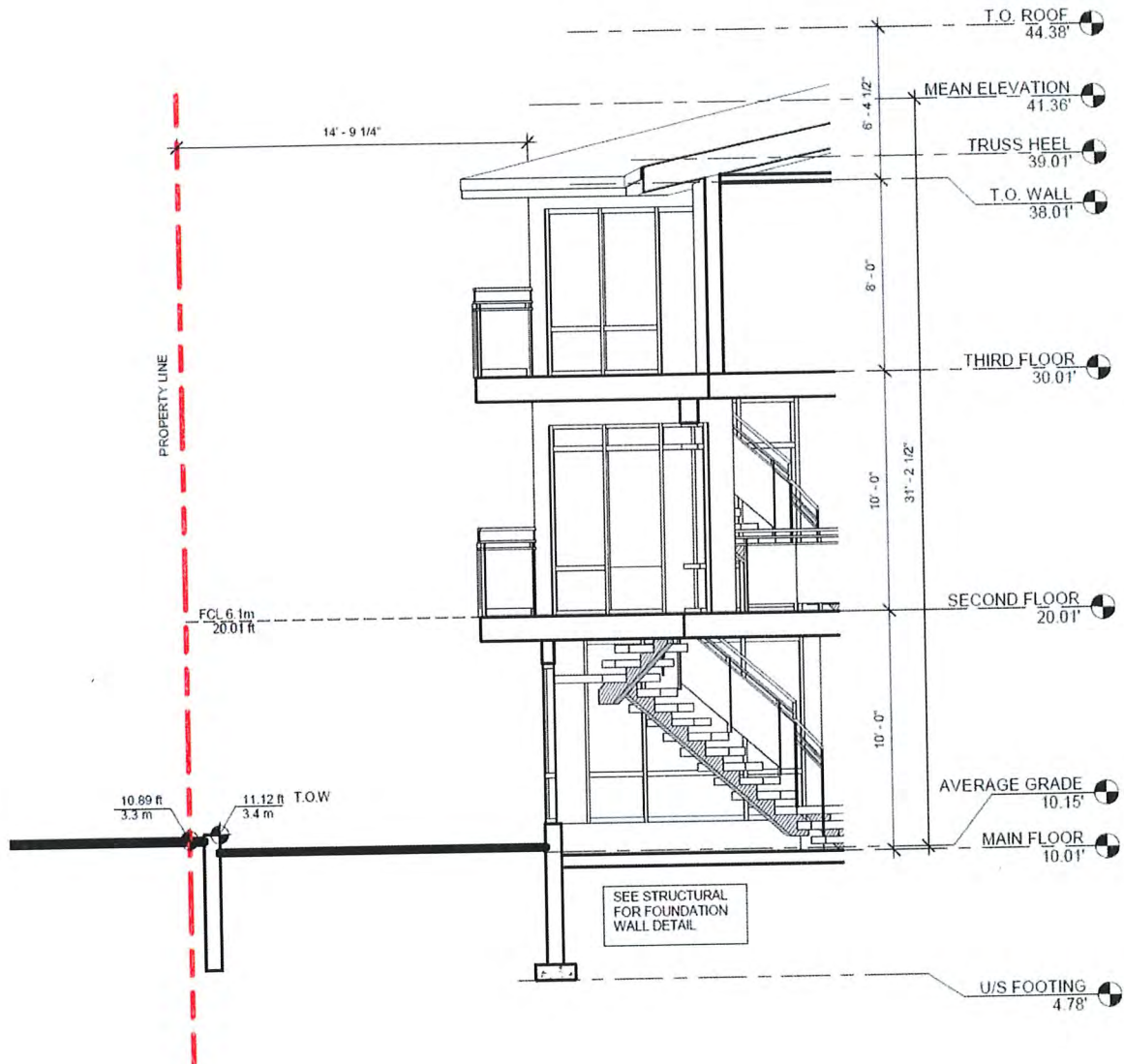


Figure 13. Conceptual design details for the seaward side of the proposed dwelling provided by Interex Management Ltd. on January 4, 2021.

5.2 Coastal Flood Construction Level

Table 6 summarizes the resulting FCL for the current condition and that predicted for the Year 2100. A freeboard is applied to account for temporal and spatial variances in wave climate and surge, as well as precision of the calculation overall. Freeboard for infrastructure according to the amendment to the provincial guidelines (BCMFLNRD, 2018) is 0.6 m when using the joint probabilistic approach.

The FCL adopted by the Village of Lions Bay is 1.6 m above the existing natural boundary of the sea, as per Bylaw No. 520 Section 4.19 2c. This is on average an elevation of 4.5 m, with the existing natural boundary interpreted as per the site topographic survey (**Appendix B**). The year 2100 FCL of 5.9 m is 1.4 m above this level.

Table 6. Coastal flood construction levels (CGVD2013)

FCL Input	Year 2020 Elevation (m)	Year 2100 Elevation (m)
Tide + storm surge (joint probability)	3.1	3.1
+ wave effect	1.7	1.4
+ Design sea level rise (to year 2100)	0.0	1.0
+ Subsidence	0.0	0.0
Coastal flood level	4.8	5.5
+ Freeboard	0.6	0.6
Flood construction level (CGVD2013)	5.4	6.1

5.3 Tsunami Hazard

In addition to wave and storm events, high water and coastal property inundation could potentially occur from a tsunami event. Previously denoted as tidal waves, the Japanese term tsunami, is now used to denote long period waves (5 to 60 minutes) that radiate out from the rapid displacement of a large volume of water. The initial displacement can result from an earthquake, landslide, volcanic eruption, glacier calving, or impact from a meteorite. However, major tsunamis generally are a result of earthquakes that produce substantial vertical movement of the sea floor.

Lions Bay can be affected by Tsunamis originating in the Pacific Ocean propagating in the Juan de Fuca Strait and the Strait of Georgia, as well as local sources in the Strait of Georgia and Howe Sound. Fisheries and Oceans Canada (DFO, n.d.) simulated a large Cascadia subduction zone tsunami, originating a few hundred kilometres offshore of Vancouver Island. This work suggested that tsunami waves propagating through the Juan de Fuca Strait and the Strait of Georgia would be approximately 0.5 m in Howe Sound. The last such large tsunami occurred in 1700 and has an average reoccurrence of 500 years. Local tsunami sources that could potentially impact the project site include a potential slump of the Fraser River delta (Rabinovich *et al.*, 2003), shallow crustal faults under the Strait of Georgia (Clague, 2005), and subaerial and submarine landslides in Howe Sound (Westmar, 2005).

In comparison to storms, the probability of a tsunami to occur and affect Howe sound is considerably small. Hence, tsunami hazard is not considered to govern the FCL for the site.

5.4 Building Setback

The provincial flood hazard area land use guideline (BCMFLNRD, 2018) recommends that the building setback should be at least the greater of 1) 15 m from the future estimated natural boundary of the sea at year 2100 and 2) landward of the location where the natural ground elevation contour is equivalent to the year 2100 FCL.

In very general terms, the natural boundary often corresponds to the limit of riparian vegetation, which in turn generally corresponds to the elevation reached by wave runup under combined storm and water level conditions expected to occur on an annual basis. At an elevation of 2.9 m, the current limit of riparian vegetation is approximately 1 m above the high water mark (HHWLT). Considering sea level rise in the future, the natural boundary is expected to move further landwards and closer to the proposed dwelling, as the property is relatively low and levelled – only approximately 0.1 to 0.4 m above the future high water mark.

A setback of 15 m from either the locations recommended by BCMFLNRD (2018) as indicated above considerably limits the development of the property, if not completely as the ground elevation of the entire property is below the 2100 FCL.

With the erosion hazard deemed low for the site, the Village of Lions Bay's bylaw requirement for a setback of 15 m from the existing natural boundary is considered safe. However the setback of the proposed dwelling is approximately 13.5 m. Accordingly, it is recommended that mitigation measures be implemented to prevent undermining of the building's foundation as a result of erosion or scour. Such measures are suggested further below.

6 Summary and Recommendations

A flood hazard assessment was conducted for the property located at 26 Brunswick Beach Road in the Village of Lions Bay. It is expected that coastal flooding originating from Howe Sound is the primary mechanism for flood hazards (i.e., in comparison to fluvial hazards). From this assessment, the hazard was characterized and the property deemed safe for use provided the following recommended mitigation measures are adhered to:

- 1) An FCL of 6.1 m (CGVD2013) is adopted for the site for long-term infrastructure (design life \geq 30 years); an FCL of 5.4 m (CGVD2013) may be adopted for short-term infrastructure (design life $<$ 30 years).
- 2) The underside of any wooden floor system, or the top of any concrete floor system used for habitation is at or above the applicable FCL.
- 3) Building entrances and windows to habitable areas are no lower than the applicable FCL. A lack of building entrances at or above the applicable FCL may complicate any emergency rescue during a flooding event and therefore poses a risk to safety.
- 4) A 13.5 m setback from the existing natural boundary is adopted for this site provided that the mitigation measures listed below in 5) are considered.

- 5) Any structure that is above ground and below the FCL or reliant on erodible soils that extend below the FCL is protected against or designed to withstand erosion from water; this could potentially be achieved through either:
 - a. Founding of structures on bedrock;
 - b. Founding of structures on supports capable to withstand exposure to at least 2 m below the adjacent ground, unless indicated otherwise by a qualified professional;
 - c. Armouring foundation to protect against erosion and scour (such armouring is to be designed by a qualified professional).
- 6) Shoreline conditions and any scour and erosion mitigation measures are inspected annually and following any large wave event occurring at high water level (waves in excess of 1 m). If substantial shoreline changes are identified, then a qualified professional is retained to provide assessment.
- 7) Any areas below the FCL, such as an underground parking or crawl space provide pedestrian exits that extend to or above the FCL and are adequate for evacuation during a flood and under lack of electrical power.
- 8) The area should be landscaped such that drainage of the ground on and surrounding the property is ensure and that ponding of water is avoided.
- 9) Main electrical switchgear (i.e., control panel, fuse, circuit breaker) is above the FCL. Any electrical supply below the FCL (i.e., lighting or electrical outlets) is protected by ground fault circuit interruption (GFCI) located above the FCL or protected through other methods approved safe up to the FCL by an qualified professional.
- 10) Mechanical equipment is above the FCL or otherwise constructed to be safe for inundation up to the FCL.
- 11) Preliminary and final building plans are formally reviewed by a qualified registered engineer to ensure they meet the recommendations presented within this FHA prior to construction.

This assessment is based on ground slopes between the beach and the house as recorded during NHC's site visit. Any changes to the shoreline and waterfront, such as construction of a seawall, infilling the yard to reduce frequency of flooding, etc. could alter the FCL and should therefore only be done in conjunction with a review by a qualified professional.

Despite the results and application of recommended mitigations, a residual flood hazard from Howe Sound still exists; that is, less frequent events (AEP <0.5%) may exceed the design values and mitigation measures presented. Furthermore, hazards other than flood hazards from Howe Sound, such as geotechnical, fire, and wildlife hazards have not been assessed as part of this assessment. Stormwater and sediment management has not been designed or assessed through this study and may also impose hazards if not adequately addressed.

This flood hazard assessment was conducted following EGBC 2018 Class 1 flood hazard assessment guidelines. A summary of the EGBC criteria for such an assessment is presented in **Table 7**.

Table 7. Summary of EGBC typical Class 1 flood hazard assessment methods and deliverables.

EGBC Flood Hazard Assessment Component	Notes
<i>Typical hazard assessment methods and climate/environmental change considerations</i>	
Site inspection and qualitative assessment of flood hazard	Completed by NHC 2020
Identify any very low hazard surfaces in the consultation area (i.e., river terraces)	Completed by NHC 2020
Estimate erosion rates along shoreline	Completed by NHC 2020
1-D or possibly 2-D modelling, modelling of fluvial regime and future trends in river bed changes, erosion hazard maps, possibly paleoflood analysis	Not Applicable
Identify upstream or downstream mass movement processes that could change flood levels (e.g., landslides leading to partial channel blockages, diverting water into opposite banks)	Not Applicable
Conduct simple time series analysis of runoff data, review climate change predictions for study region, include in assessment if considered appropriate	Climate change related to sea level rise reviewed. Analysis of runoff data not applicable.
Quantify erosion rates by comparative air photograph analysis	Analysis not performed. Current erosion risk deemed low.
<i>Typical deliverables</i>	
Letter report or memorandum with at least water levels and consideration of scour and bank erosion	Completed by NHC 2020
Cross-sections with water levels, flow velocity and qualitative description of recorded historic events, estimation of scour and erosion rates where appropriate with maps showing erosion over time	Not Applicable
Maps with area inundated at different return period, flow velocity, flow depth, delineation of areas prone to erosion and river bed elevation changes, estimates of erosion rates	Not Applicable



7 Closure

We hope this work and report meets your current needs. If you have any questions don't hesitate to contact Philippe St-Germain or Grant Lamont by phone (604-980-6011) or by email (pstgermain@nhcweb.com | glamont@nhcweb.com).

Sincerely,

Northwest Hydraulic Consultants Ltd.

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Grant Lamont, P.Eng.,
Principal

DISCLAIMER

This document has been prepared by **Northwest Hydraulic Consultants Ltd.** for the benefit of **Interex Management Ltd.** for specific application to the **flood hazard assessment for a building permit on the property located at 26 Brunswick Beach Road, Village of Lions Bay.** The information and data contained herein represent **Northwest Hydraulic Consultants Ltd.** best professional judgment in light of the knowledge and information available to **Northwest Hydraulic Consultants Ltd.** at the time of preparation, and was prepared in accordance with generally accepted engineering practices.

Except as required by law, this report and the information and data contained herein are to be treated as confidential and may be used and relied upon only by **Interex Management Ltd.** **Northwest Hydraulic Consultants Ltd.** denies any liability whatsoever to other parties who may obtain access to this report for any injury, loss or damage suffered by such parties arising from their use of, or reliance upon, this report or any of its contents.

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Appendix A
Flood Hazard and Risk Assurance Statement

APPENDIX J: FLOOD HAZARD AND RISK ASSURANCE STATEMENT

Note: This Statement is to be read and completed in conjunction with the "APEGBC Professional Practice Guidelines - Legislated Flood Assessments in a Changing Climate, March 2012 ("APEGBC Guidelines") and is to be provided for flood assessments for the purposes of the Land Title Act, Community Charter or the Local Government Act. Italicized words are defined in the APEGBC Guidelines.

To: The Approving Authority

Date: 2021-02-26

Planning and Development Services, Village of Lions Bay

PO Box 141, 400 Centre Rd, Lions Bay, V0N 2E0

Jurisdiction and address

With reference to (check one):

- Land Title Act (Section 86) – Subdivision Approval
- Local Government Act (Sections 919.1 and 920) – Development Permit
- Community Charter (Section 56) – Building Permit
- Local Government Act (Section 910) – Flood Plain Bylaw Variance
- Local Government Act (Section 910) – Flood Plain Bylaw Exemption

For the Property:

Lot 'H', Block 19, District Lot 1815, Group 1, New Westminster District, Plan 18523

Legal description and civic address of the Property

The undersigned hereby gives assurance that he/she is a *Qualified Professional* and is a *Professional Engineer* or *Professional Geoscientist*.

I have signed, sealed and dated, and thereby certified, the attached flood assessment report on the Property in accordance with the APEGBC Guidelines. That report must be read in conjunction with this Statement. In preparing that report I have:

Check to the left of applicable items

- 1. Collected and reviewed appropriate background information
- 2. Reviewed the proposed *residential development* on the Property
- 3. Conducted field work on and, if required, beyond the Property
- 4. Reported on the results of the field work on and, if required, beyond the Property
- 5. Considered any changed conditions on and, if required, beyond the Property
- 6. For a *flood hazard* analysis or *flood risk* analysis I have:
 - 6.1 reviewed and characterized, if appropriate, floods that may affect the Property
 - 6.2 estimated the *flood hazard* or *flood risk* on the property
 - 6.3 included (if appropriate) the effects of climate change and land use change
 - 6.4 identified existing and anticipated future *elements at risk* on and, if required, beyond the Property
 - 6.5 estimated the potential *consequences* to those *elements at risk*
- 7. Where the *Approving Authority* has adopted a specific level of *flood hazard* or *flood risk* tolerance or return period that is different from the standard 200-year return period design criteria⁽¹⁾, I have
 - 7.1 compared the level of *flood hazard* or *flood risk* tolerance adopted by the *Approving Authority* with the findings of my investigation
 - 7.2 made a finding on the level of *flood hazard* or *flood risk* tolerance on the Property based on the comparison
 - 7.3 made recommendations to reduce the *flood hazard* or *flood risk* on the Property

⁽¹⁾ *Flood Hazard Area Land Use Management Guidelines* published by the BC Ministry of Forests, Lands, and Natural Resource Operations and the 2009 publication *Subdivision Preliminary Layout Review – Natural Hazard Risk* published by the Ministry of Transportation and Public Infrastructure. It should be noted that the 200-year return period is a standard used typically for rivers and purely fluvial processes. For small creeks subject to debris floods and debris flows return periods are commonly applied that exceed 200 years. For life-threatening events including debris flows, the Ministry of Transportation and Public Infrastructure stipulates in their 2009 publication *Subdivision Preliminary Layout Review – Natural Hazard Risk* that a 10,000-year return period needs to be considered.

8. Where the *Approving Authority* has **not** adopted a level of *flood risk* or *flood hazard tolerance* I have:

NA8.1 described the method of *flood hazard analysis* or *flood risk analysis* used

NA8.2 referred to an appropriate and identified provincial or national guideline for level of *flood hazard* or *flood risk*

NA8.3 compared this guideline with the findings of my investigation

NA8.4 made a finding on the level of *flood hazard* or *flood risk* tolerance on the Property based on the comparison

NA8.5 made recommendations to reduce *flood risks*

 9. Reported on the requirements for future inspections of the Property and recommended who should conduct those inspections.

Based on my comparison between

Check one

- the findings from the investigation and the adopted level of *flood hazard* or *flood risk* tolerance (item 7.2 above)
- the appropriate and identified provincial or national guideline for level of *flood hazard* or *flood risk* tolerance (item 8.4 above)

I hereby give my assurance that, based on the conditions contained in the attached flood assessment report,

Check one

- for subdivision approval, as required by the *Land Title Act* (Section 86), "that the land may be used safely for the use intended".

Check one

- with one or more recommended registered *covenants*.
- without any registered *covenant*.

- for a development permit, as required by the *Local Government Act* (Sections 919.1 and 920), my report will "assist the local government in determining what conditions or requirements under [Section 920] subsection (7.1) it will impose in the permit".

- for a building permit, as required by the *Community Charter* (Section 56), "the land may be used safely for the use intended".

Check one

- with one or more recommended registered *covenants*.
- without any registered *covenant*.

- for flood plain bylaw variance, as required by the *Flood Hazard Area Land Use Management Guidelines* associated with the *Local Government Act* (Section 910), "the development may occur safely".

- for flood plain bylaw exemption, as required by the *Local Government Act* (Section 910), "the land may be used safely for the use intended".

Philippe St-Germain

Name (print)

2021-02-26

Date

Signature

Address

30 Gostick Place, North Vancouver, BC V7M 3G3

604-980-6011

Telephone



(Affix Professional seal here)

26-Feb.-2021

If the *Qualified Professional* is a member of a firm, complete the following.

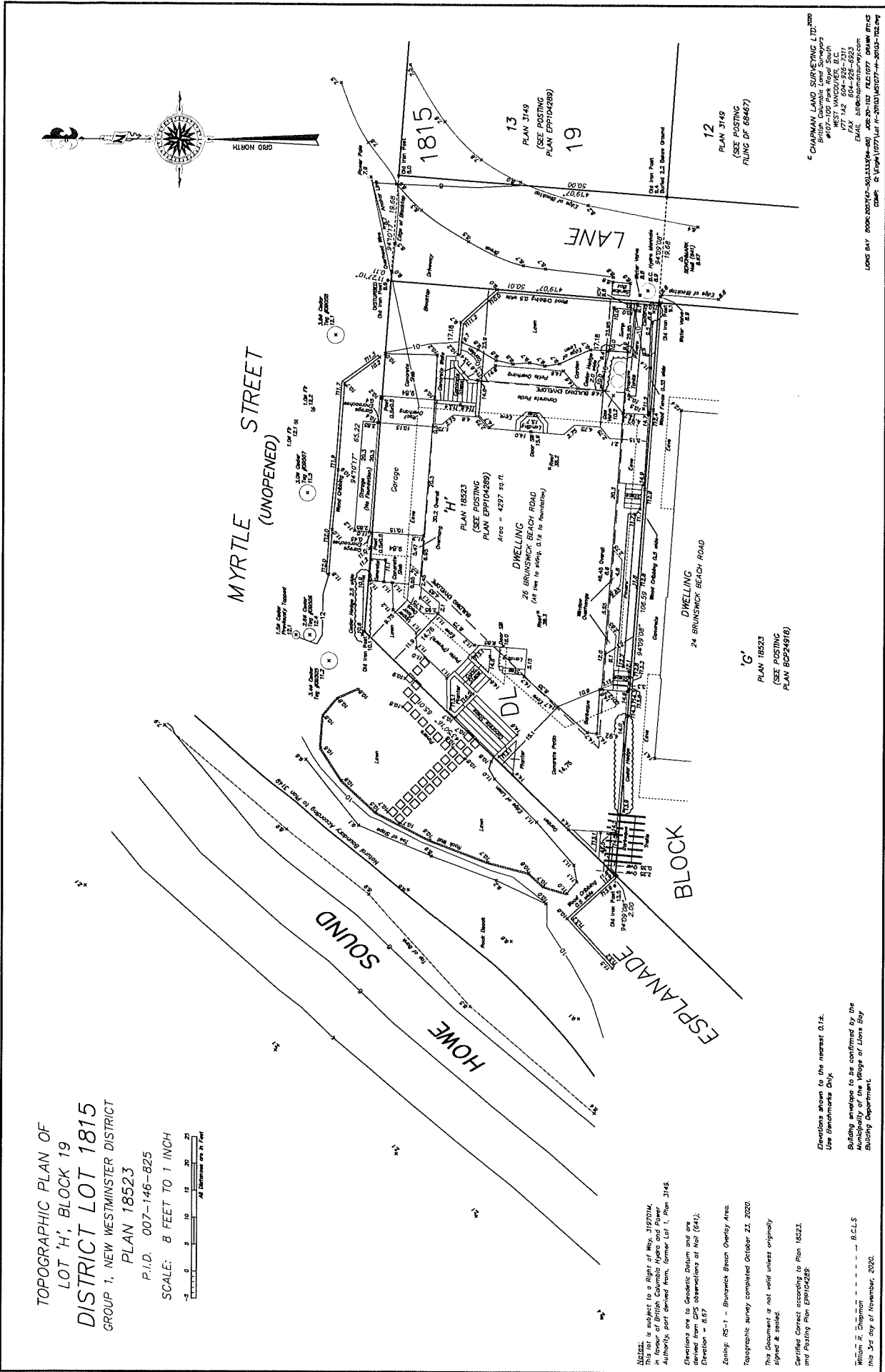
I am a member of the firm Northwest Hydraulic Consultants Ltd. (NHC)

and I sign this letter on behalf of the firm.

(Print name of firm)



Appendix B
Received Site Legal Survey





Earth & Environmental Consulting

March 30, 2022

GES Project No. 21003

Attn: Rodrigo Manguia, Trim Design

Re: **UPDATED PRELIMINARY GEOTECHNICAL REPORT
 PROPOSED SINGLE-FAMILY RESIDENTIAL DEVELOPMENT
 26 BRUNSWICK BEACH RD, LIONS BAY, BC**

1.0 Introduction

As requested, GES Geotech Inc (GES) is providing this Preliminary Geotechnical Report, as a desktop geotechnical study of the subject site. No intrusive investigation was carried out. The site will have to be raised to comply with the flood construction level (FCL), which is being developed through flood modelling and analysis by Northwest Hydraulics. At the time of writing this report we have not seen a copy of the FCL report by Northwest Hydraulics.

Ken Wong of Interex Management provided the Authorization to Proceed with this Preliminary Geotechnical Report, via a signed Agreement dated Feb 23, 2021. This report presents an update to our March 5, 2021 Preliminary Geotechnical Report, and includes a review of the February 26, 2021 Flood Hazard Assessment (FHA) report by Northwest Hydraulic Consultants Ltd (NHC Report); the latter report was prepared with the understanding that The ground in front (seaward) of the proposed dwelling will remain at the existing elevation following construction. The FHA report addressed the 1 in 200 year flood event which is the currently accepted threshold in BC.

The FHA report recommends a flood construction level (FCL) of 6.1m for the design life of the proposed SFR development, with the top of the concrete floor level and the underside of any wooden floor systems for habitation, as well as the building entrances and windows to habitable areas, to be at or above the FCL elevation. Further, the report adopts a 13.5 m setback from the natural boundary for this site, provided that the report's recommendations for mitigation measures are followed; for details of NHC's recommendations, reference should be made to the 2021 NHC Report.

2.0 Site Conditions

The subject site is located at 26 Brunswick Beach Rd in Lions Bay. The site is a "rectangular" shaped lot. The site is bounded to the west by the ocean, to the north by unoccupied land, to the east by Brunswick Beach Rd, and to the south by existing private

Rodrigo Manguia
26 Brunswick Beach Rd, Lions Bay

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GES Project No. 21003
March 30, 2022

residence; see attached Figures 1 and 2 for general site location and elevations. Site elevation is between about 6 to 7 m above sea level (ASL), and the site slopes from east to west, having a gradient of about 8%-10%.

3.0 Anticipated Subsoil Conditions

Based on our previous experience working on another property at Brunswick Beach Rd, we anticipate the subsoils to comprise of native gravels and sands with rock and boulder. Furthermore, we understand that there could be an increase in the site elevations for the main floor of the new proposed building due to requirements for flood protection anticipated as a function of climate change and climate risk management considerations; the latter recommendations are within the purview of Northwest Hydraulics.

To confirm the anticipated subsoils, the Owner may choose to excavate a test pit to depths of 3-4 m (below existing ground level) at the time that site preparation works are underway. GES would be pleased to attend site at that time to review and log the subsoils during test pitting, and subsequently, if deemed necessary, modify any of the recommendations included in this report.

Based on our previous experience, we estimate that Site Class, corresponding to the elevation of the proposed development, is Class C. We estimate the Serviceability Limit State (SLS) net allowable bearing capacity to have a minimum value of 100 kPa (~ 2,000 psf) for the native sands and gravels; this design value for net allowable bearing capacity would likely increase based on the results of an exploratory test pit investigation that would most ideally be carried out prior to commencement of construction and/or at the time of demolition of the existing house.

4.0 Conclusions and Recommendations

The recommendations presented in the following sections of this report are based on our experience with similar projects along Brunswick Beach Rd. The subsurface conditions at the site are anticipated to comprise native gravels, sands, cobbles and boulders. Further, it is expected that general site grade will be increased in elevation in order to comply with the recommendations made by Northwest Hydraulic Consultants respecting their recommended 6.1 m FCL requirements.

Accordingly, and based on our experience gained from similar sites, any conventional residential house situated within the gravel and sand deposit of the subject site can be supported on conventional shallow strip and spread footings with slab-on-grade resting on the gravel and sand deposits, accompanied with suitable provisions, provided that the recommendations made above and in the following paragraphs are adhered to.

Foundations and Floor Slabs

The proposed SFR may be supported on shallow strip and spread footings placed on undisturbed organic-free gravel and sand deposits. The footings placed on the prepared

subgrade may be designed against live and dead loads using an SLS net allowable bearing capacity of about 100 kPa (2,000 psf) for the native gravel and sand deposits. Footings designed and constructed in accordance with the recommendations discussed in the subsequent paragraphs are estimated to sustain total settlements in the order of maximum 20 mm for the proposed residential houses using a layer of 0.3 m of properly compacted $\frac{3}{4}$ " clear crushed gravel overlying the trimmed gravel and sand subgrade.

The minimum footing widths should be 450 mm (18 inches) for strip footings and 600 mm (24 inches) for spread footings. The base level of the footings should have a minimum soil cover of 0.6 m (2 ft.) for protection against frost heave. Differential settlements that occur between adjacent column footings are not expected to exceed 12.5 mm (one-half inch). Footing areas should be cleaned off of any loose or softened material prior to pouring concrete. Water should not be allowed to pond in footing subgrades. Alternatively, a minimum 50 mm (2 inches) thick skim coat of lean mix concrete should be placed over footing subgrade immediately after excavation and Subgrade Review to prevent soil degradation. Floor slabs should be structurally separate from foundations supporting walls and columns, or should be structurally designed to accommodate potential differential settlements between the slab and foundations. Floor slabs should be constructed on a well-compacted granular base layer consisting of a minimum 450 mm thick well-graded 19 mm minus sand and gravel with no more than 5% fines (passing the 75-micron sieve). The granular base layer shall be compacted to minimum 100% Standard Proctor Maximum Dry Density (SPMDD). It is recommended that site preparation and excavations for footings and slab-on-grade be reviewed in the field by GES in order to confirm the subgrade conditions and the bearing capacity value recommended above.

Structural Fill

Structural fill may be required to raise the grade or for replacing unsuitable subgrade materials. Structural fill materials should consist of clean, free draining well-graded sand and gravel materials with less than 5% fines (passing the 75-micron sieve). Structural fill should extend beyond the footing edges a distance equal to the depth of the structural fill placed below the footing and slab-on-grade. Similarly, structural fill should extend a distance equal to the depth of the structural fill below the pavement structures. The fill should be placed in maximum lifts of 150 mm (0.5 ft.) and compacted to at least 100% of its Standard Proctor Maximum Dry Density (ASTM D-698).

Seismic Considerations

Based on the subject site's latitude and longitude and as per the 2015 National Building Code of Canada for the 2% in 50 years probability of occurrence (i.e., the 1 in 2,400-yr return period), the Peak Ground Acceleration (PGA) is 0.4g.

As mentioned earlier, Soil Class for the subject property, which is underlain by native gravel and sand deposits, is estimated to be Class C.

Rodrigo Manguia
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Given the relative density and type of subsoils (i.e., native gravels and sands) that are anticipated at the subject site, the proposed site is not considered to be susceptible to liquefaction during a major seismic event; however the proximity to the prevailing groundwater level must first be determined prior to commencement of construction activities in order to confirm the above lack of concern regarding susceptibility to liquefaction. Groundwater levels are typically determined by means of a test pit investigation; see above sections for recommendations regarding the proposed test pit investigation prior to commencement of construction.

Damages due to differential lateral and vertical movements and tension cracking of the soil surface could occur after a strong magnitude earthquake. Damage to the buildings during a major earthquake will likely be mitigated if foundation footings are tied together structurally; the latter is a decision for the Project Structural Engineer of Record (SER).

Pavement Structure

Due to presence of gravel and sand deposits that are anticipated to underlie the subject site, the possibility of cracking and settlement of the pavements is very unlikely if any pavement is constructed on the native gravel and sand deposits, with the understanding that any topsoil or organic materials must first be removed off-site. In order to achieve proper construction of the pavement structure the following recommendations shall be followed:

The subgrade material shall be removed and over-excavated to allow for placement of proper competent pavement base. Native clean gravel and sand materials or other proper engineered fill can be used as pavement base followed by placement of a 30 cm layer of $\frac{3}{4}$ " minus clear crushed gravel on top of the compacted subgrade; the clear crushed gravel shall be compacted to achieve the 100% Standard Proctor Density value.

5.0 Construction Field Reviews

GES Geotech should be notified to conduct field reviews during construction. This is to confirm that the site conditions encountered are consistent with the design assumptions, and to ensure that construction is following the general intent of this report and design recommendations. It is our recommendation that field reviews shall include the following:

- Commencement of site preparation works
- Drainage system review
- Site visits and subgrade review prior to pouring concrete for the footings
- Reviewing and density testing (by others) to verify compaction of sub-base and base layers in pavement areas.

GES Geotech should be notified at least 72 hours prior to the need for a geotechnical field review and/or construction compliance testing being required.

Rodrigo Manguia
26 Brunswick Beach Rd, Lions Bay

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March 30, 2022

6.0 Limitations

The recommendations presented in this report are based on GES's interpretation and understanding of site conditions and the information provided for the proposed development. To properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the report in its entirety. We cannot be responsible for use, by any party, of portions of the report without reference to the whole report. In addition, any variations in structure locations or anticipated loading from those utilized in this report should be brought to our attention immediately; any variations in structure locations or anticipated loading may affect our recommendations.

7.0 Closure

The report has been prepared following generally accepted geotechnical engineering principles and practice. The main purpose of this report was to describe the subsurface soil and groundwater conditions and provide Updated Preliminary Geotechnical Recommendations for the construction of the proposed SFR Development. Provided the recommendations set out in this report are implemented, the development can be undertaken as proposed. This report has been completed for the exclusive use of Mr. Rodrigo Manguia as the architectural designer and agent for the project located at 26 Brunswick Beach Rd in Lions Bay, BC. Any use of the information contained in this report by third parties or for other than the intended purpose must *first* be approved in writing by GES.

We trust the information presented in this report meets your immediate requirements. Should you have any questions please do not hesitate to contact us.

Yours truly,

GES Geotech Inc – A Slate Holdings Company
EGBC Permit: 1001508

Prepared by:

Reviewed by:



Zolfaghar (Parviz) Kheyruri, MSc
Senior Geotechnical Specialist

Mahmoud Mahmoud, PhD, PEng, FEC, FGC (Hon)
President

Attach: Figures 1 & 2

ZPK/MM/sm

220330R SFR - 26 Brunswick Beach Rd, Lions Bay.docx



Figure 1: 26 Brunswick Beach Rd, Lions Bay Location of Site & Elevation

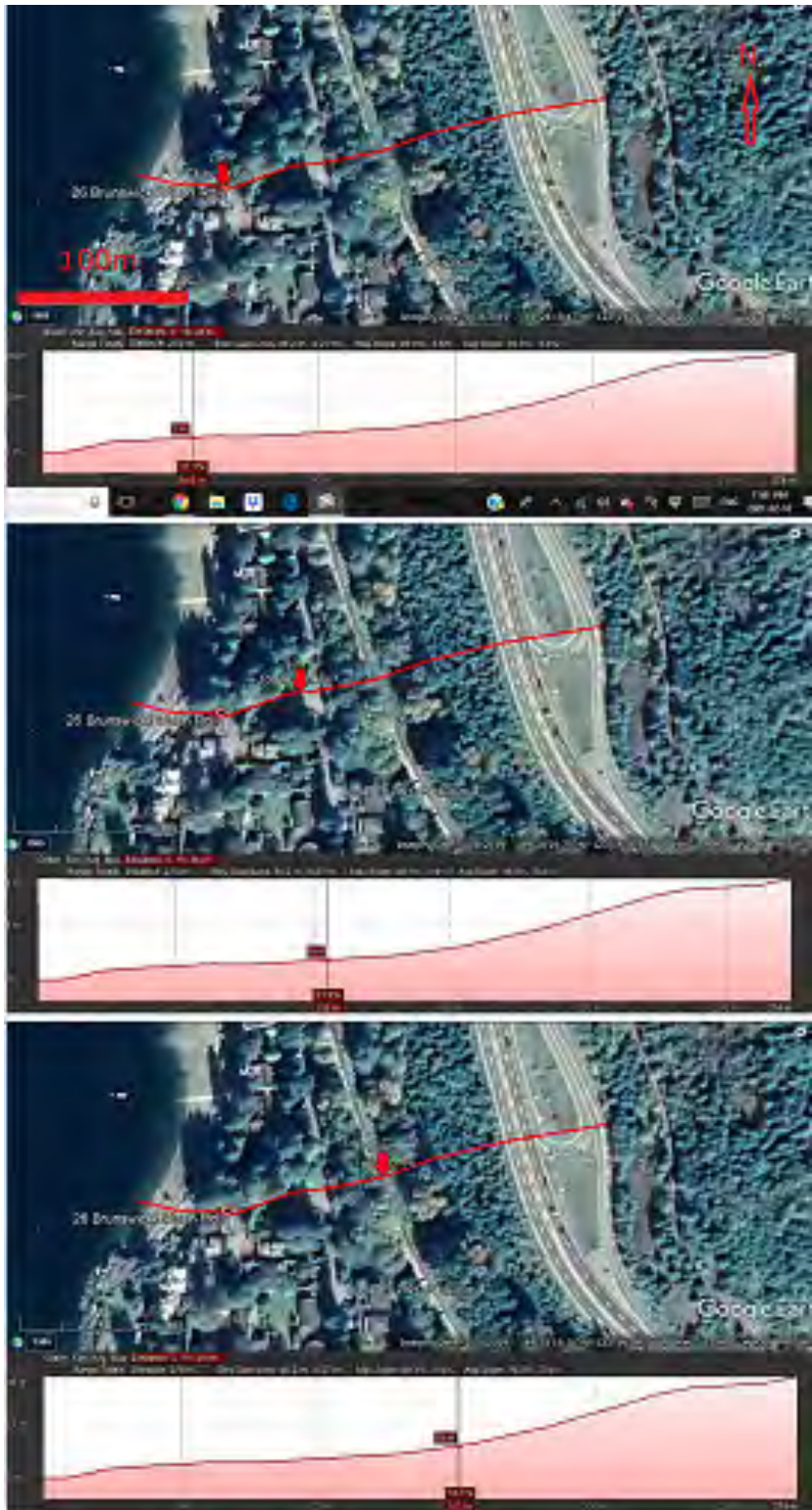


Figure 2: 26 Brunswick Beach Rd, Lions Bay Location of Site & Profile