District of West Vancouver

Development Variance Permit No. 20-020

Current Owner(s): Wenbo Wu and Tongxi Zhang

This Development Variance Permit applies to:

Civic Address: 4428 Ross Crescent

Legal Description: 002-741-121
Lot 9, Block 1, District Lot 582, Plan 4725
(the “Lands”)

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1. For the purposes of this Development Variance Permit, the Lands shall be developed in substantial compliance with the drawings approved by Council, attached as Schedule A, and specifically in compliance with the regulations and variances listed hereunder.

2. Zoning Bylaw No. 4662, 2010 is varied and supplemented for this development proposal in accordance with the following regulations:
   (a) Section 120.17 (Average Grade Calculation for Building and Structure Height) is varied to calculate maximum building height using the flood construction level at 5.26 m as average grade.
   (b) Section 130.1 (2) (c) (Highest Building Face Envelope) is varied to allow maximum highest building face to be calculated using the flood construction level at 5.26 m as average grade.
   (c) Section 120.22 (Retaining Wall Grade Line and Buildup of Grade) are varied to allow retaining wall heights as shown in Schedule A.

3. The proposed structures, retaining walls and site landscaping must be constructed and finished in substantial compliance with attached Schedule “A”.

4. Prior to issuance of a Building Permit, a section 219 covenant, in accordance with the Land Titles Act and to the satisfaction of the District of West Vancouver, shall be registered against the certificate of title for the Lands certifying that the land will be used in accordance with the conditions specified in the report attached to this permit as Schedule B.

5. Prior to the issuance of a Building Permit and as security for the due and proper completion of the landscaping as set forth in Section 3 of this Development Variance Permit, the Owner shall:

   (a) provide a landscape cost estimate consistent with the landscape plan in Schedule A acceptable to Director of Planning and Development Services;

   (b) provide security in the amount of 125% of the landscape cost estimate to the District in the form of cash or an unconditional, irrevocable auto-renewing letter of credit issued by a Canadian chartered bank or credit union; and

   (c) maintain the security for a minimum of one year after completion of the landscaping, and not prior to the date on which the District authorizes in writing the release of the security.

6. Prior to issuance of an Occupancy Permit, the applicant must complete the following:

   (a) Provide the District Facilities Department an "as-built" BCLS Survey to capture all foreshore infrastructure south of the site; and

   (b) Initiate a new foreshore encroachment agreement with the District.

7. This Development Variance Permit lapses if construction has not substantially started, with respect to this permit under an issued Building Permit, within 24 months of issuance.

THE COUNCIL OF WEST VANCOUVER APPROVED THIS PERMIT BY RESOLUTION PASSED ON SEPTEMBER 13, 2021.

M Booth

MAYOR

~~MUNICIPAL CLERK~~
DEPUTY CORPORATE OFFICER
Pascal Cuk

FOR THE PURPOSES OF SECTION 7, THIS PERMIT IS ISSUED ON SEPTEMBER 13, 2021.

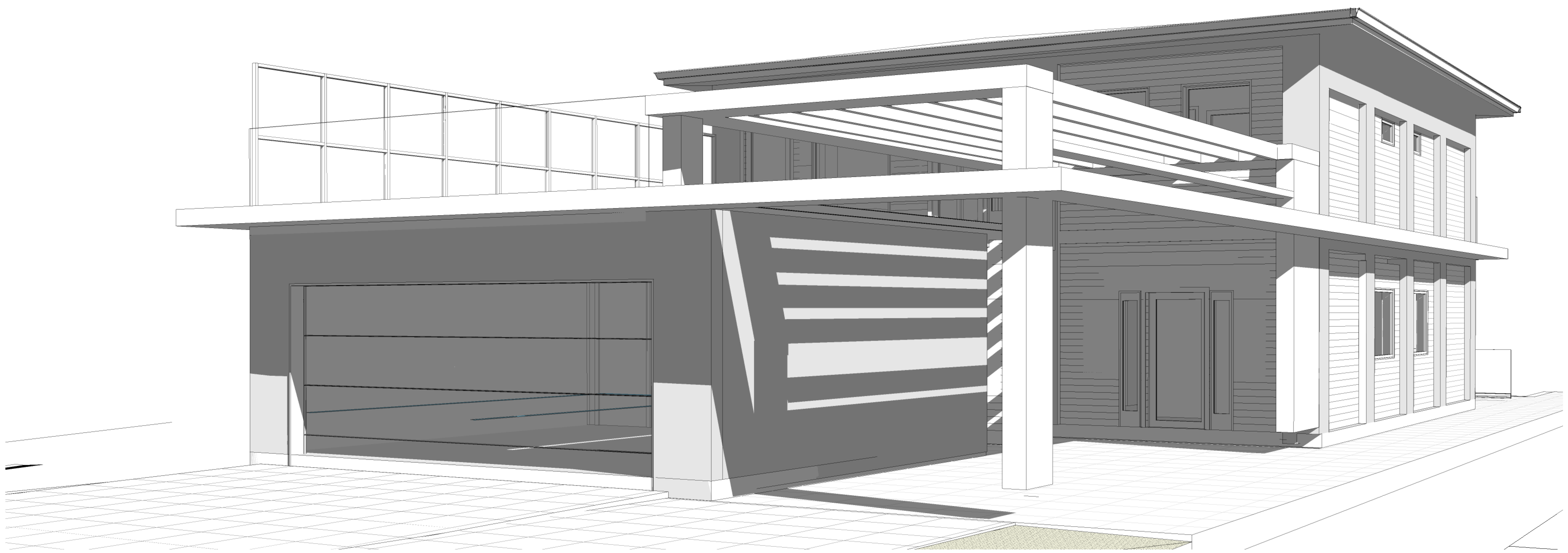
Schedules:

A – Development Plans for 4428 Ross Crescent prepared by Farzin Yadegari Architect and pmg landscape architects dated November 2020.

B – Flood Hazard Assessment for 4428 Ross Crescent prepared by NHC dated December 20, 2018 (Updated December 14, 2020) along with addendum letter from NHC dated May 13, 2021.

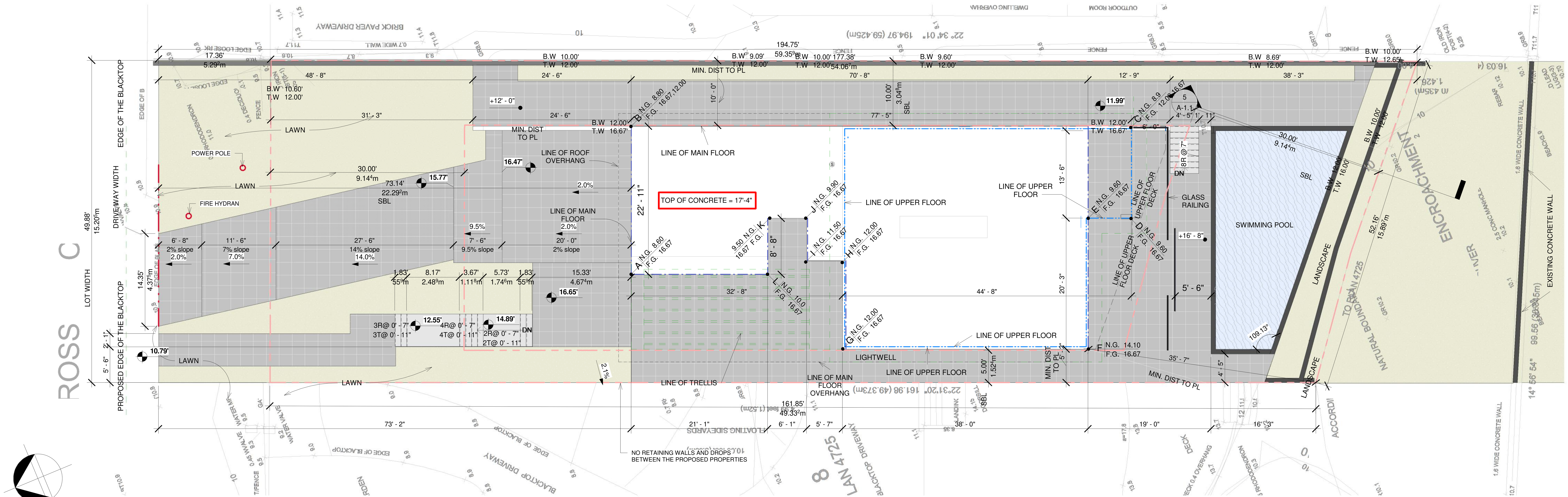
Schedule A

4428 ROSS



FARZIN
YADEGARI
ARCHITECT INC.
100 2240 CHIPPENDALE ROAD
WEST VANCOUVER, B.C. V7S 3J5
T 778 340 4142 WWW.FYARCH.CA

NOVEMBER 2020



1 SITE PLAN
1/8" = 1'-0"

4428 ROSS

4430/9 Ross Crescent, West Vancouver, BC V7W 1B2, Canada
Legal Address: Lot: 9 Block: 1 District Lot: 582 Plan: 4725
Folio: 04-0337-001 PID: 002-741-121

DESCRIBTION	IMPERIAL	METRIC
ZONE	RS4	
LOT WIDTH	50	15
LOT AREA	8440	784
UPPER FLOOR AREA	1340	124
MAIN FLOOR AREA (GARAGE INCLUDED)	1895	176
GRAND TOTAL FLOOR AREA	3235	301
GARAGE AREA (DETACHED)	0	0
GARAGE AREA (ATTACHED)	473	44
PART OF GARAGE FOR FAR.	33	3
MAIN FLOOR AREA (GARAGE EXCLUDED)	1422	132

UPPER FLOOR GRADE	27.20	8.29
MAIN FLOOR GRADE	17.33	5.28

ALLOWED (FSR) = 0.35 x Lot Area	2954	390
PROVIDED FSR AREA	2762	257
PROVIDED FSR %	32.73%	
ALLOWED- PROVIDED (FSR) =	192	18

LOWEST AVEARGE GRADE	10.23	3.12

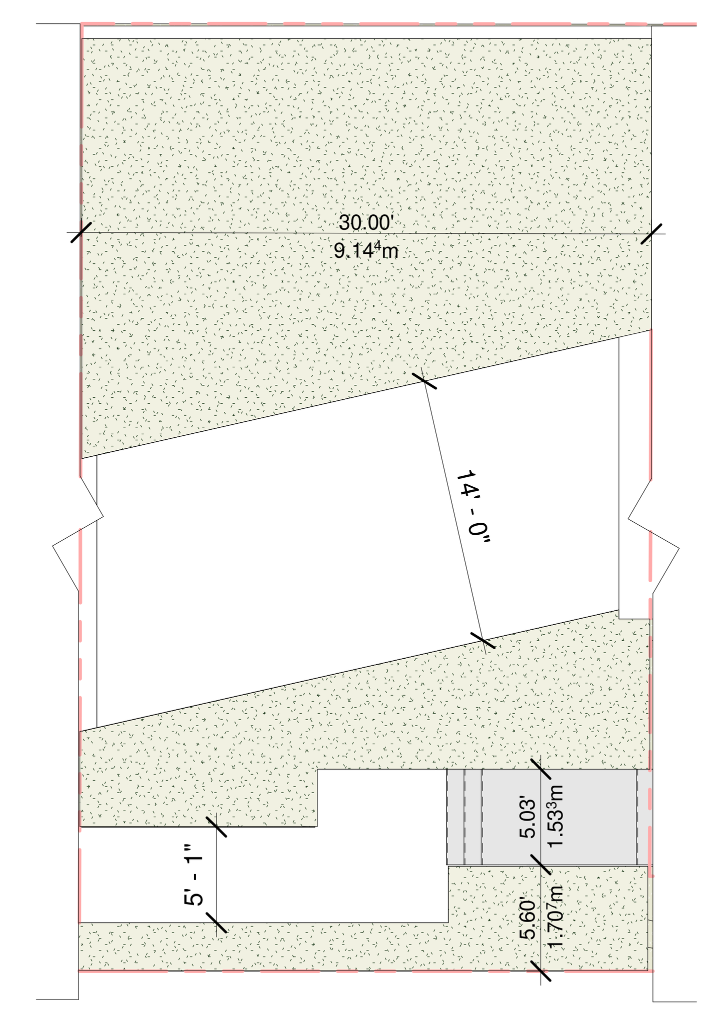
ALLOWED SITE COVERAGE = 0.30 x Lot Area	2532	235
PROVIDED SITE COVERAGE AREA	2290	213
PROVIDED SITE COVERAGE%	27.13%	

CALCULATION OF NATURAL GRADE

AVERAGE NATURAL GRADE ELEVATION					10.23
				240.00	2455.62
AB	(8.60 +	9.00) /2=	8.80 ×	21.91 =	192.81
BC	(9.00 +	9.20) /2=	9.10 ×	77.40 =	704.34
CD	(9.20 +	9.60) /2=	9.40 ×	14.23 =	133.76
DE	(9.60 +	9.70) /2=	9.65 ×	6.63 =	63.98
EF	(9.70 +	13.50) /2=	11.60 ×	20.28 =	235.25
FG	(13.50 +	12.10) /2=	12.80 ×	38.07 =	487.30
GH	(12.10 +	12.00) /2=	12.05 ×	13.44 =	161.95
HI	(12.00 +	11.50) /2=	11.75 ×	5.67 =	66.62
IJ	(11.50 +	9.90) /2=	10.70 ×	6.68 =	71.48
JK	(9.90 +	9.50) /2=	9.70 ×	5.79 =	56.16
KL	(9.50 +	10.00) /2=	9.75 ×	8.67 =	84.53
LA	(10.00 +	8.60) /2=	9.30 ×	21.23 =	197.44

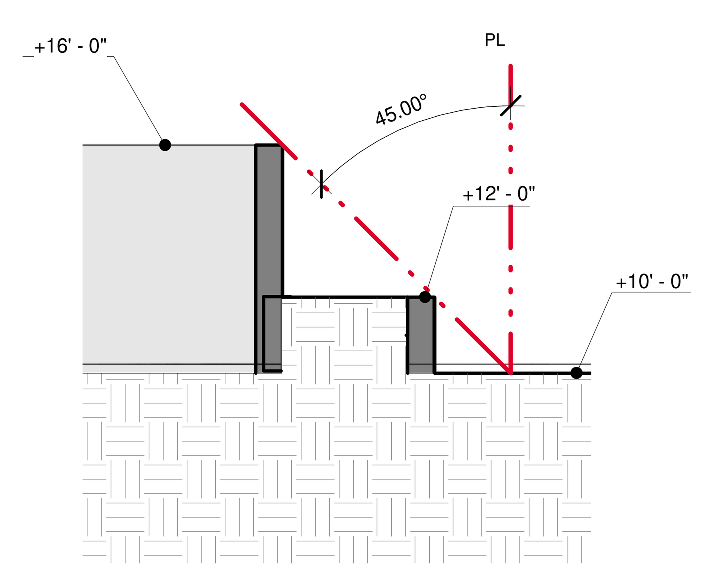
CALCULATION OF FINISHED GRADE

AVERAGE FINISHED GRADE ELEVATION					15.16
				240.00	3639.34
AB	(16.67 +	16.67) /2=	16.67 ×	21.91 =	365.24
BC	(12.00 +	12.00) /2=	12.00 ×	77.40 =	928.80
CD	(16.67 +	16.67) /2=	16.67 ×	14.23 =	237.21
DE	(16.67 +	16.67) /2=	16.67 ×	6.63 =	110.52
EF	(16.67 +	16.67) /2=	16.67 ×	20.28 =	338.07
FG	(16.67 +	16.67) /2=	16.67 ×	38.07 =	634.63
GH	(16.67 +	16.67) /2=	16.67 ×	13.44 =	224.04
HI	(16.67 +	16.67) /2=	16.67 ×	5.67 =	94.52
IJ	(16.67 +	16.67) /2=	16.67 ×	6.68 =	111.36
JK	(16.67 +	16.67) /2=	16.67 ×	5.79 =	96.52
KL	(16.67 +	16.67) /2=	16.67 ×	8.67 =	144.53
LA	(16.67 +	16.67) /2=	16.67 ×	21.23 =	353.90

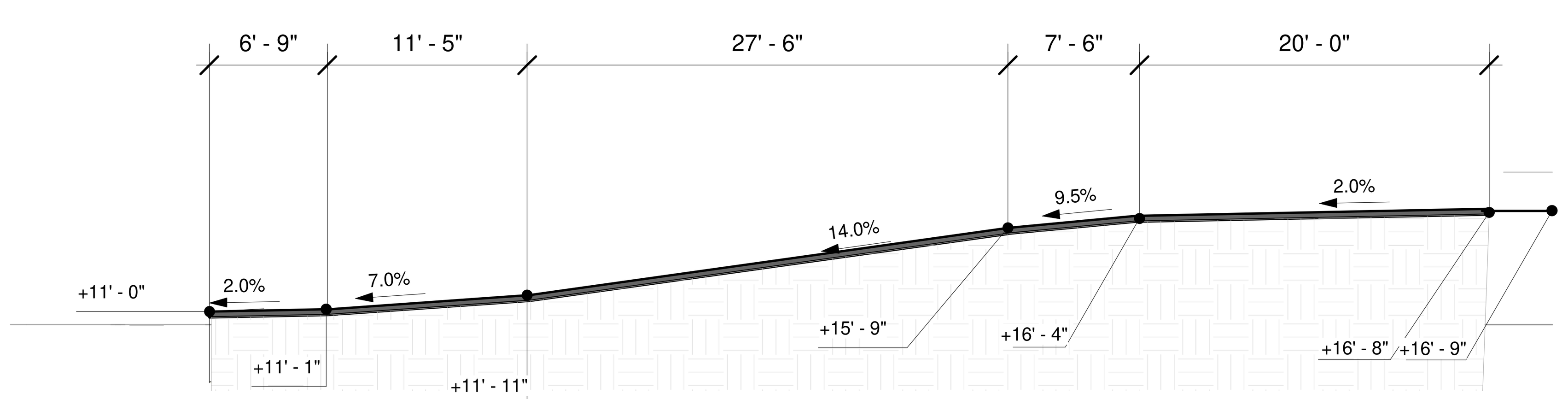


FRONT YARD PAVED AREA =626/1491SQFT=42%<50%

2 FRONT YARD PAVED AREA CALCULATION
1/8" = 1'-0"



5 RETAINING WALLS AT SOUTH PL (THE SECTION IS PERPENDICULAR TO PL)
1/4" = 1'-0"



3 DRIVEWAY PROFILE
1/8" = 1'-0"

FARZIN YADEGARI ARCHITECT INC.
100 2240 CHIPPENDALE ROAD
WEST VANCOUVER, B.C. V7S 3J5
T 778 340 4142 WWW.FYARCH.CA

No.	.	Date
1	CITY COMMENTS	May 22nd
2	BASEMENT REMOVED	JUL 25TH
3	HEIGHT CHANGE	MARCH 20
4	CITY REVIEW	NOV 20
5	PLANNING COMMENT	MAY 2021

PROJECT:
4428 ROSS

DRAWN BY: F.Y. A.A.

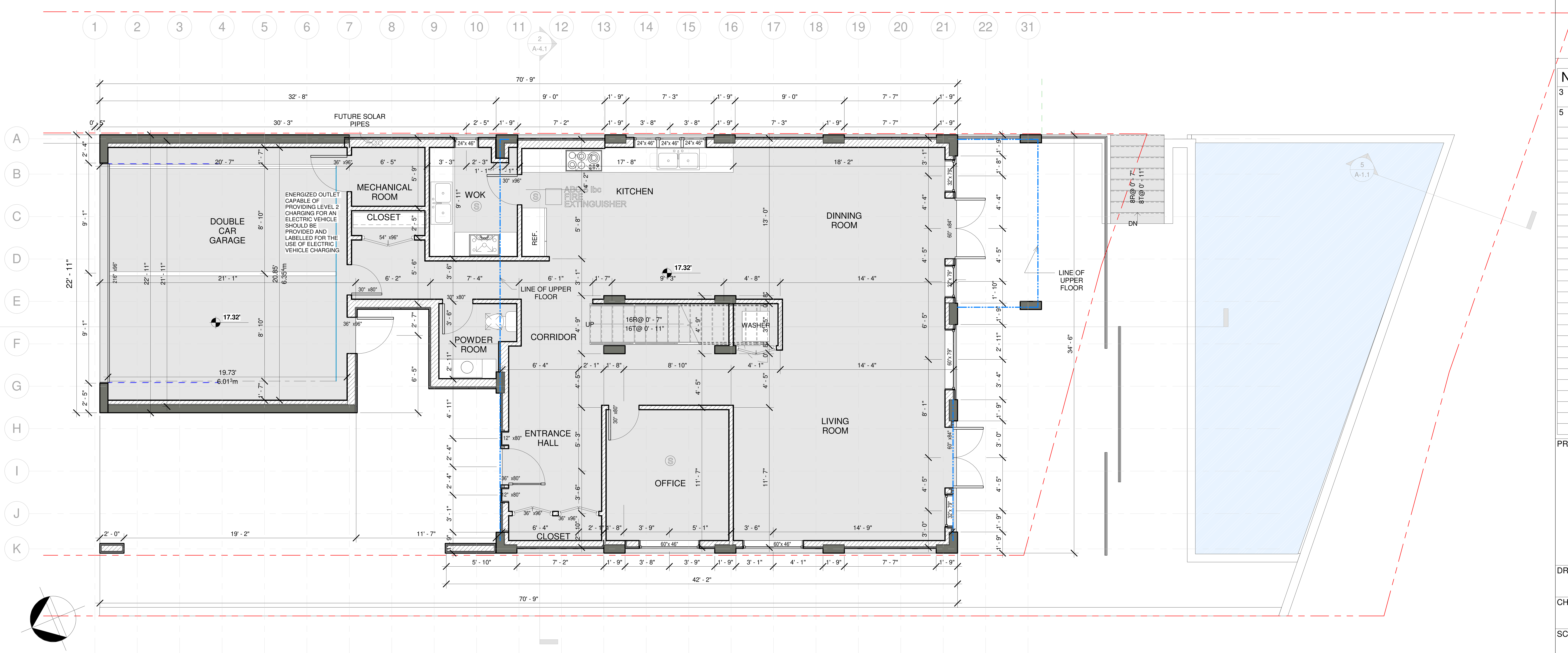
CHECKED BY: Checker

SCALE: As indicated

DATE: JUNE 2019

TITLE: SITE PLAN

SHEET NO: A-1.1



2 MAIN FLOOR
1/4" = 1'-0"

FARZIN YADEGARI ARCHITECT INC.
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T 778 340 4142 WWW.FYARCH.CA

No.	.	Date
3	HEIGHT CHANGE	MARCH 20
5	PLANNING COMMENT	MAY 2021

PROJECT:

4428 ROSS

DRAWN BY: F.Y. A.A.

CHECKED BY: Checker

SCALE: 1/4" = 1'-0"

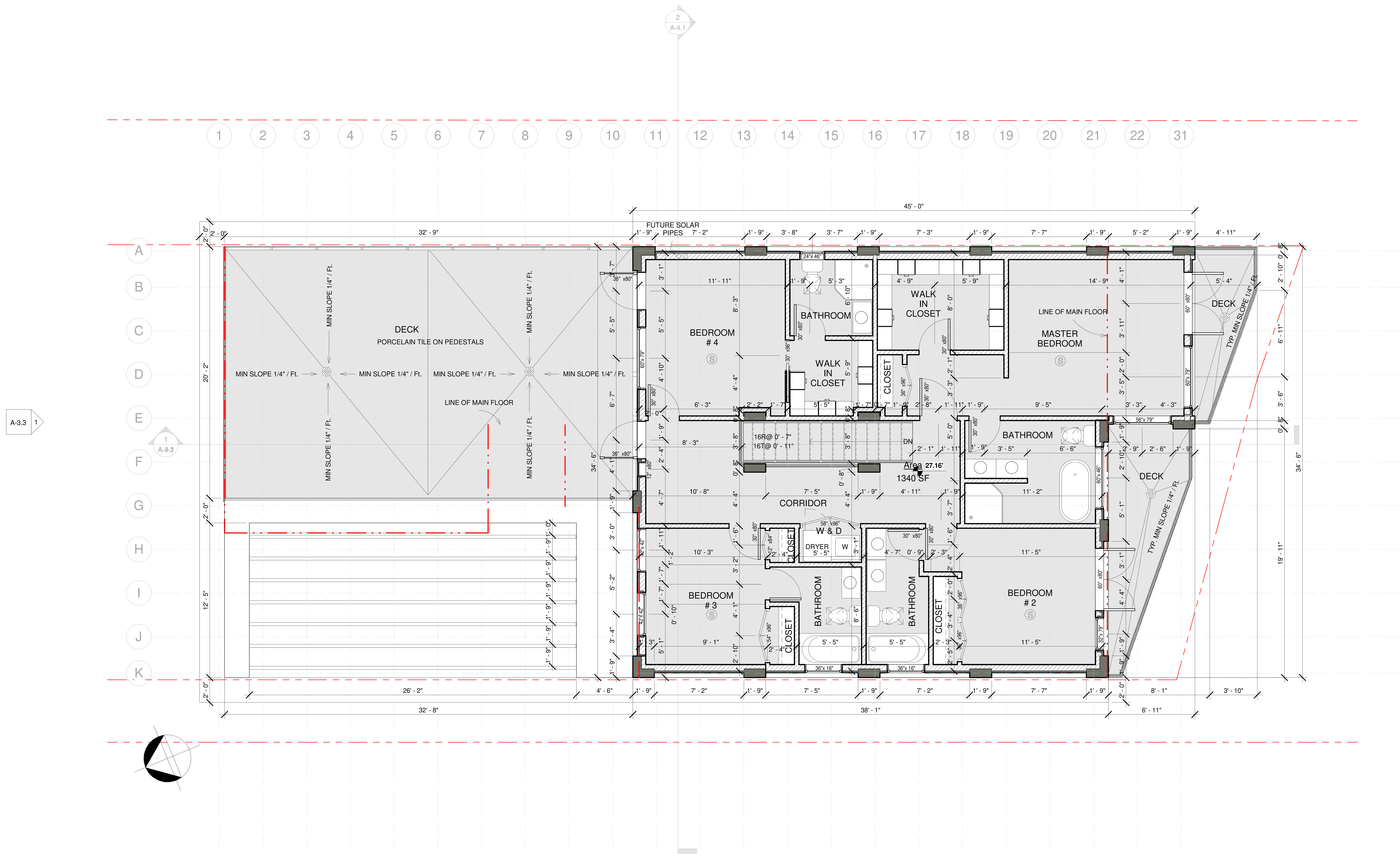
DATE: JUNE 2019

TITLE:

MAIN FLOOR PLAN

SHEET NO:

A-2.1



① UPPER FLOOR
1/4" = 1'-0"

FARZIN YADEGARI ARCHITECT INC.
100 2240 CHIPPENDALE ROAD
WEST VANCOUVER, B.C. V7S 3J5
T 778 340 4142 WWW.FYARCH.CA

No.	.	Date
5	PLANNING COMMENT	MAY 2021

PROJECT:

4428 ROSS

DRAWN BY: F.Y. A.A.

CHECKED BY: Checker

SCALE: 1/4" = 1'-0"

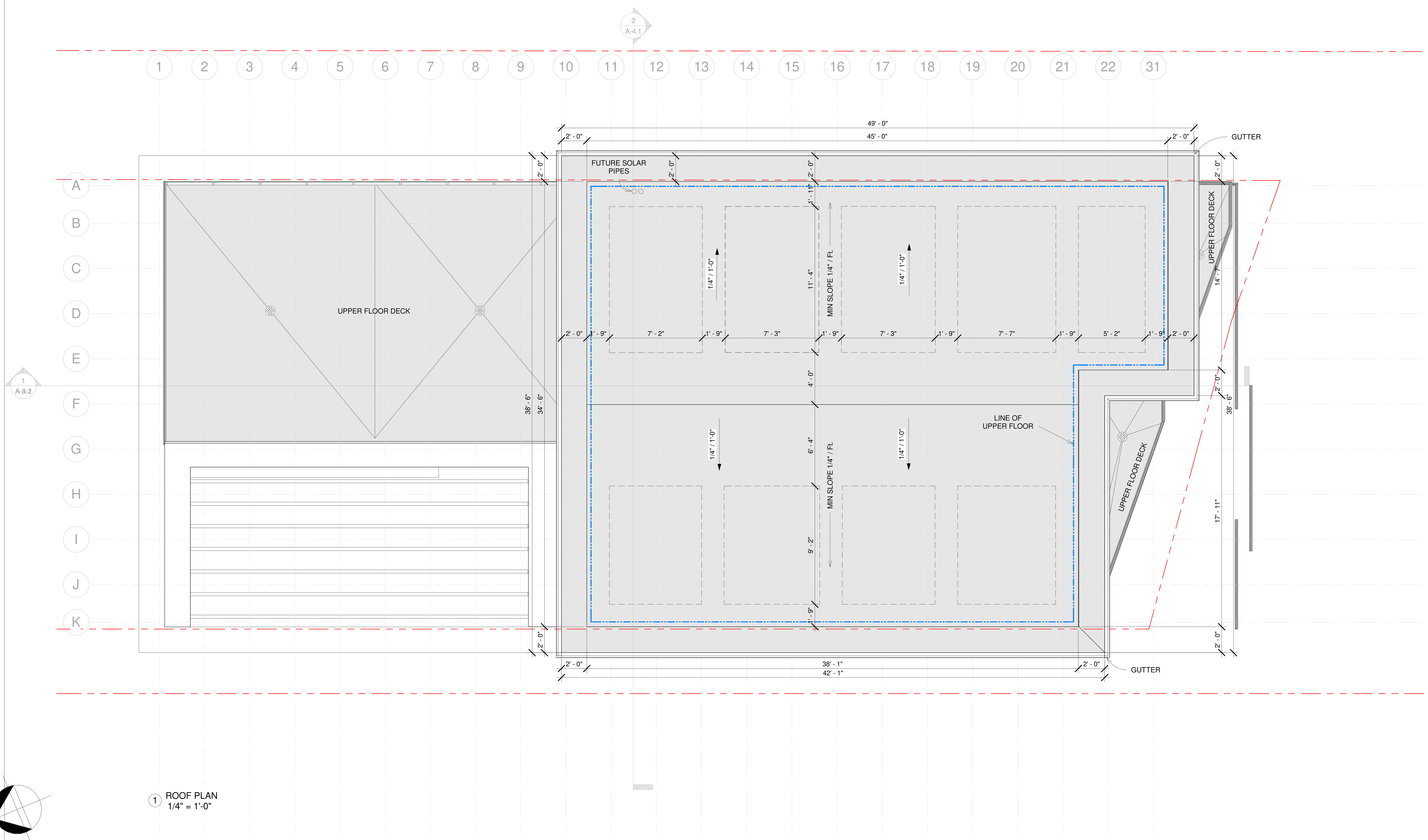
DATE: JUNE 2019

TITLE:

UPPER FLOOR PLAN

SHEET NO:

A-2.2



1 ROOF PLAN
1/4" = 1'-0"

FARZIN YADEGARI ARCHITECT INC.
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T 778 340 4142 WWW.FYARCH.CA

No.	.	Date
5	PLANNING COMMENT	MAY 2021

PROJECT:

4428 ROSS

DRAWN BY: F.Y. A.A.

CHECKED BY: Checker

SCALE: 1/4" = 1'-0"

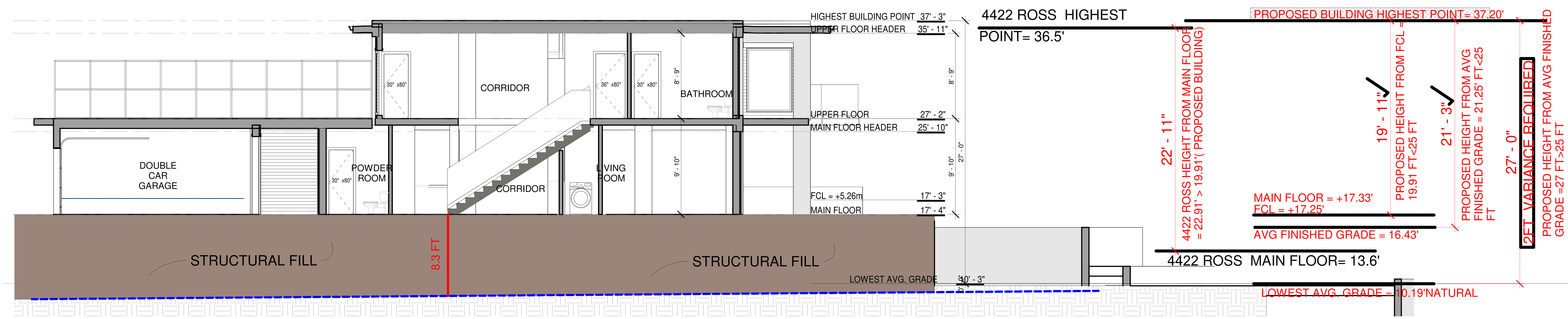
DATE: JUNE 2019

TITLE:

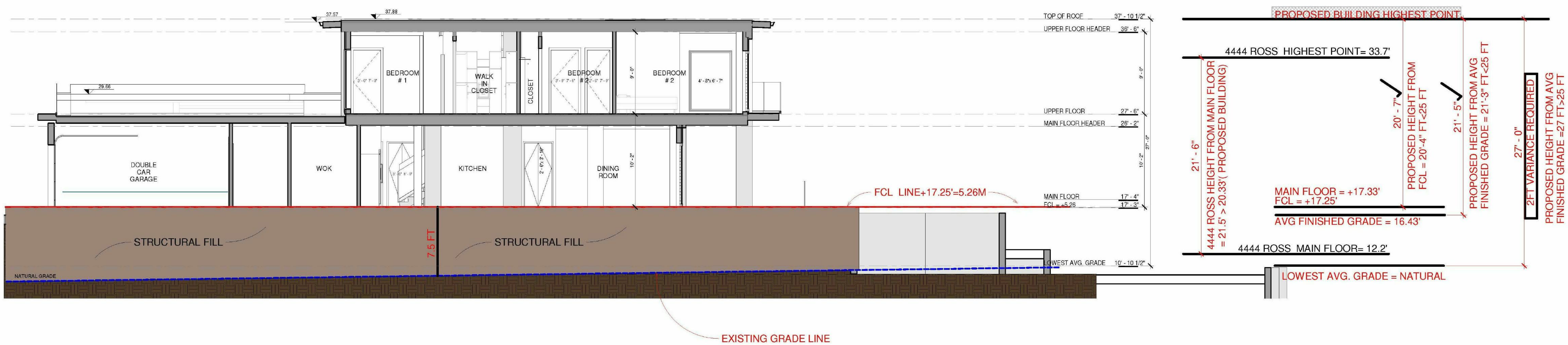
ROOF PLAN

SHEET NO:

A-2.3



4428 ROSS LONGITUDINAL SECTION AND VARIANCE RATIONALE



4430 ROSS LONGITUDINAL SECTION AND VARIANCE RATIONALE

FARZIN YADEGARI ARCHITECT INC.
100 2240 CHIPPENDALE ROAD
WEST VANCOUVER, B.C. V7S 3J5
T 778 340 4142 WWW.FYARCH.CA

No.	.	Date
1	CITY COMMENTS	May 22nd
2	BASEMENT REMOVED	JUL 25TH
4	CITY REVIEW	NOV 20
5	PLANNING COMMENT	MAY 2021

PROJECT:

4428 ROSS
4430 ROSS

DRAWN BY: F.Y. A.A.

CHECKED BY: Checker

SCALE: 3/16" = 1'-0"

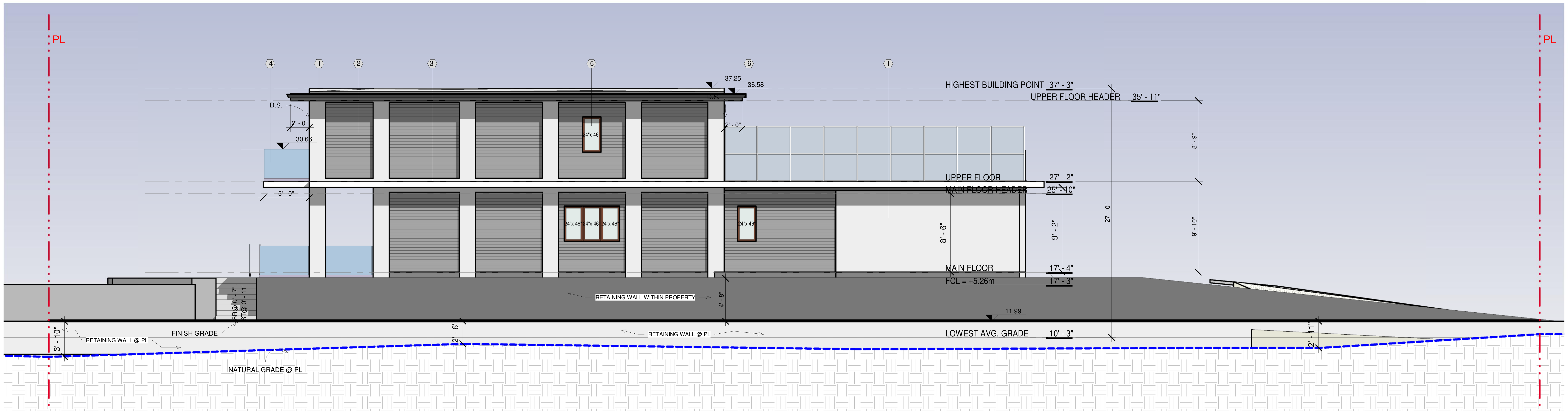
DATE: JUNE 2019

TITLE:

TYPICAL SECTIONS

SHEET NO:

A-3-2



1 EAST ELEVATION
3/16" = 1'-0"

MATERIAL LEGEND:

1-EXPOSED CONCRETE- ELASTOMERIC PAINT- WHITE HERON
2-CEMENTITIOUS PLANK- SLATE GRAY
3-ALUMINUM CLADDING- BONE WHITE
4- FRAMELESS GLASS RAILING
5-VINYL WINDOWS-WHITE
6-ALUMINUM GLADDING COVERING STRUCTURAL ELEMENTS- CHESTNUT
7-ALUMINUM FLASHING-SLATE GRAY MATCH COLOR

UNPROTECTED OPENING AREA/EXPOSING BUILDING FACE=38/1139=
3.33%<15.22% (COMPLIES BCBC 2018 TABLE 3.2.3.1-D) LD=1.52m

2 EAST ELEVATION SPATIAL SEPARATION
3/16" = 1'-0"

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No.	.	Date
3	HEIGHT CHANGE	MARCH 20
5	PLANNING COMMENT	MAY 2021

PROJECT:

4428 ROSS

DRAWN BY: F.Y. A.A.

CHECKED BY: Checker

SCALE: 3/16" = 1'-0"

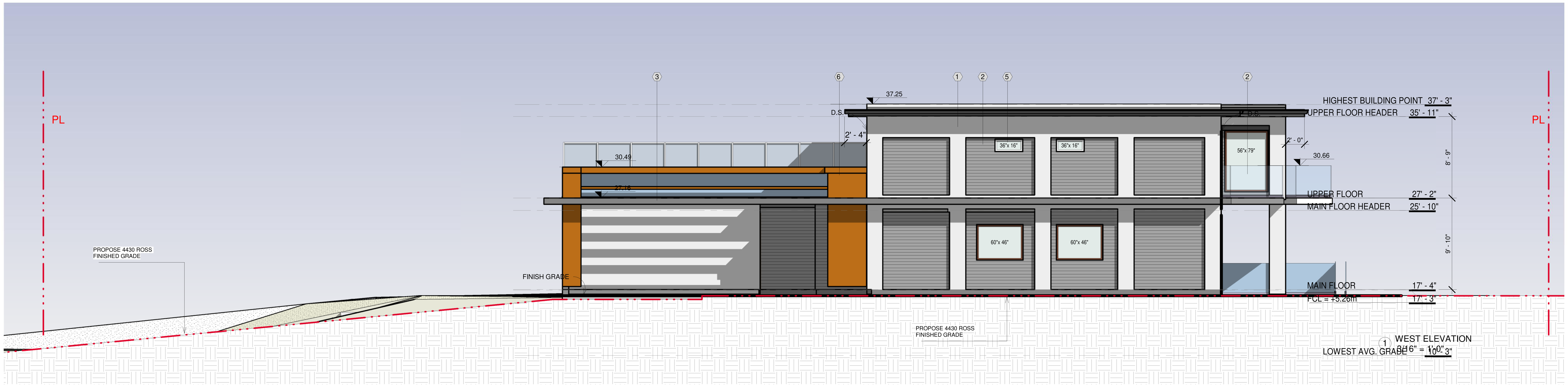
DATE: JUNE 2019

TITLE:

EAST ELEVATION

SHEET NO:

A-3.1



WEST ELEVATION
3/16" = 1'-0"

MATERIAL LEGEND:

1-EXPOSED CONCRETE- ELASTOMERIC PAINT- WHITE HERON
2-CEMENTITIOUS PLANK- SLATE GRAY
3-ALUMINUM CLADDING- BONE WHITE
4- FRAMELESS GLASS RAILING
5-VINYL WINDOWS-WHITE
6-ALUMINUM GLADDING COVERING STRUCTURAL ELEMENTS- CHESTNUT
7-ALUMINUM FLASHING-SLATE GRAY MATCH COLOR

UNPROTECTED OPENING AREA/EXPOSING BUILDING FACE=67/1147=6%<26.55%
(COMPLIES BCBC 2018 TABLE 3.2.3.1-D) LD=3.10m

WEST ELEVATION SPATIAL SEPARATION
3/16" = 1'-0"

FARZIN YADEGARI ARCHITECT INC.
100 2240 CHIPPENDALE ROAD WEST VANCOUVER, B.C. V7S 3J5
T 778 340 4142 WWW.FYARCH.CA

No.	.	Date
3	HEIGHT CHANGE	MARCH 20
5	PLANNING COMMENT	MAY 2021

PROJECT: 4428 ROSS

DRAWN BY: F.Y. A.A.

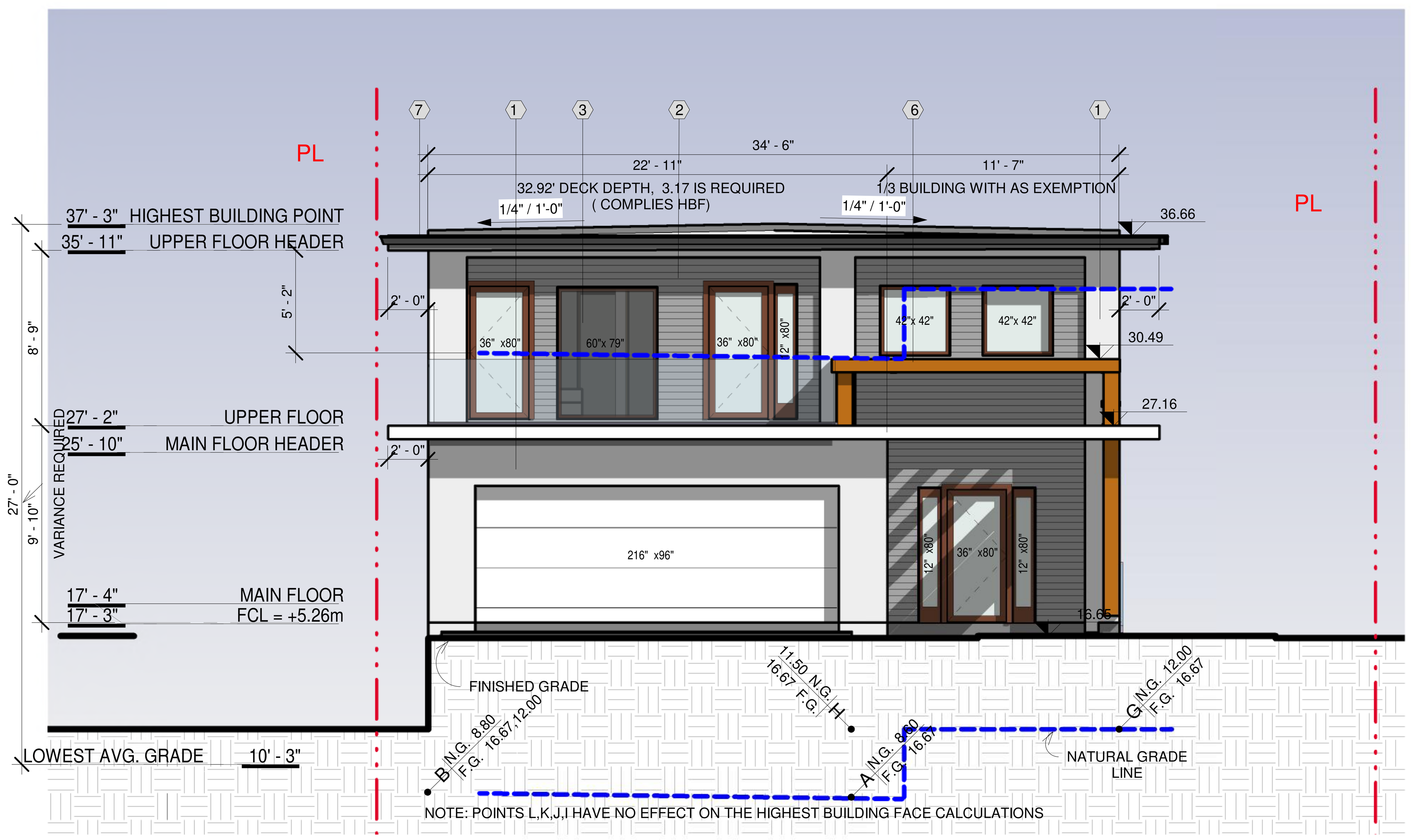
CHECKED BY: A.A

SCALE: 3/16" = 1'-0"

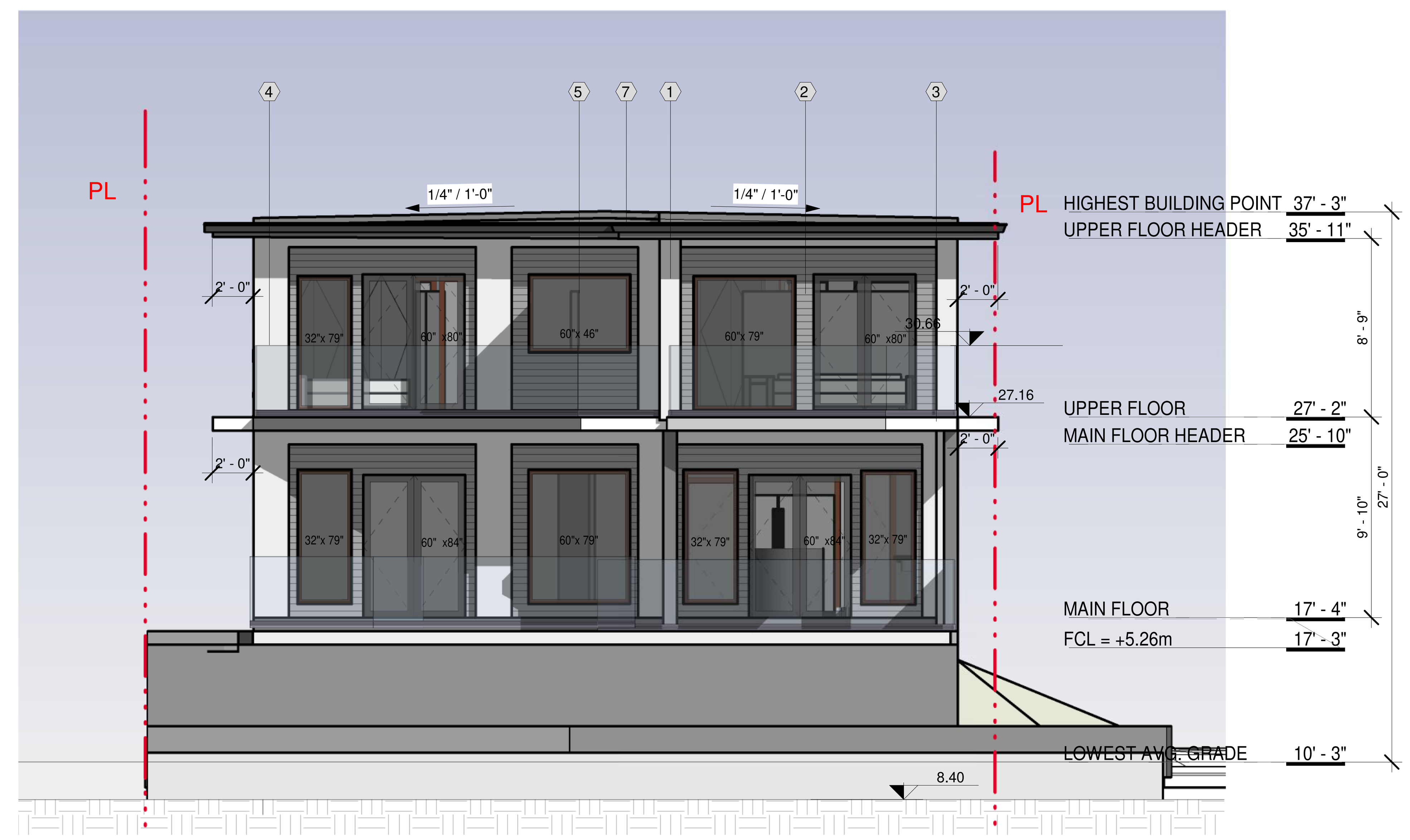
DATE: JUNE 2019

TITLE: WEST ELEVATION

SHEET NO: A-3.2



1 NORTH ELEVATION
3/16" = 1'-0"



2 SOUTH ELEVATION
3/16" = 1'-0"

MATERIAL LEGEND:

1-EXPOSED CONCRETE- ELASTOMERIC PAINT- WHITE HERON
2-CEMENTITIOUS PLANK- SLATE GRAY
3-ALUMINUM CLADDING- BONE WHITE
4- FRAMELESS GLASS RAILING
5-VINYL WINDOWS-WHITE
6-ALUMINUM GLADDING COVERING STRUCTURAL ELEMENTS- CHESTNUT
7-ALUMINUM FLASHING-SLATE GRAY MATCH COLOR

FARZIN YADEGARI ARCHITECT INC.
100 2240 CHIPPENDALE ROAD
WEST VANCOUVER, B.C. V7S 3J5
T 778 340 4142 WWW.FYARCH.CA

No.	.	Date
2	BASEMENT REMOVED	JUL 25TH
3	HEIGHT CHANGE	MARCH 20
5	PLANNING COMMENT	MAY 2021

PROJECT:

4428 ROSS

DRAWN BY: F.Y. A.A.

CHECKED BY: Checker

SCALE: 3/16" = 1'-0"

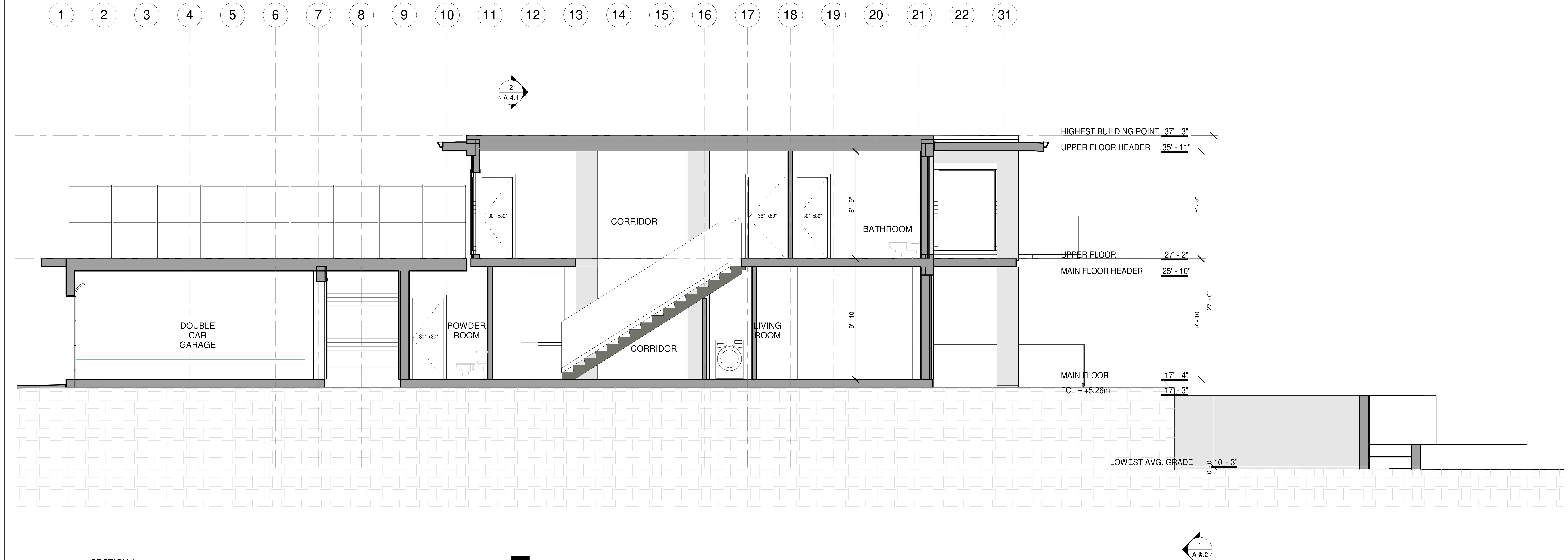
DATE: JUNE 2019

TITLE:

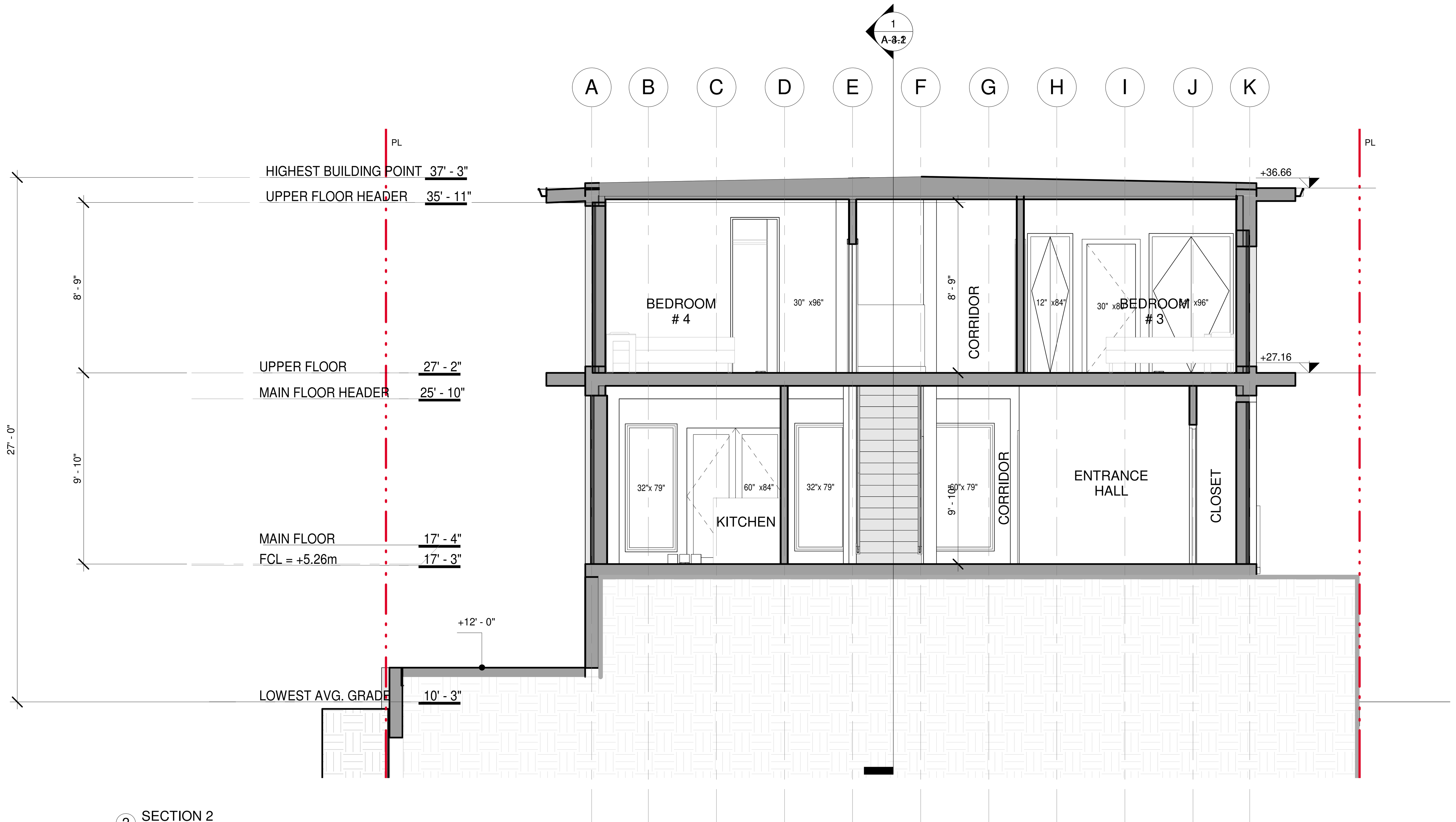
NORTH & SOUTH ELEVATION

SHEET NO:

A-3.3



1 SECTION 1
1/4" = 1'-0"



2 SECTION 2
1/4" = 1'-0"

FARZIN YADEGARI ARCHITECT INC.
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No.	.	Date
1	CITY COMMENTS	May 22nd
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3	HEIGHT CHANGE	MARCH 20
5	PLANNING COMMENT	MAY 2021

PROJECT:

4428 ROSS

DRAWN BY: F.Y. A.A.

CHECKED BY: Checker

SCALE: 1/4" = 1'-0"

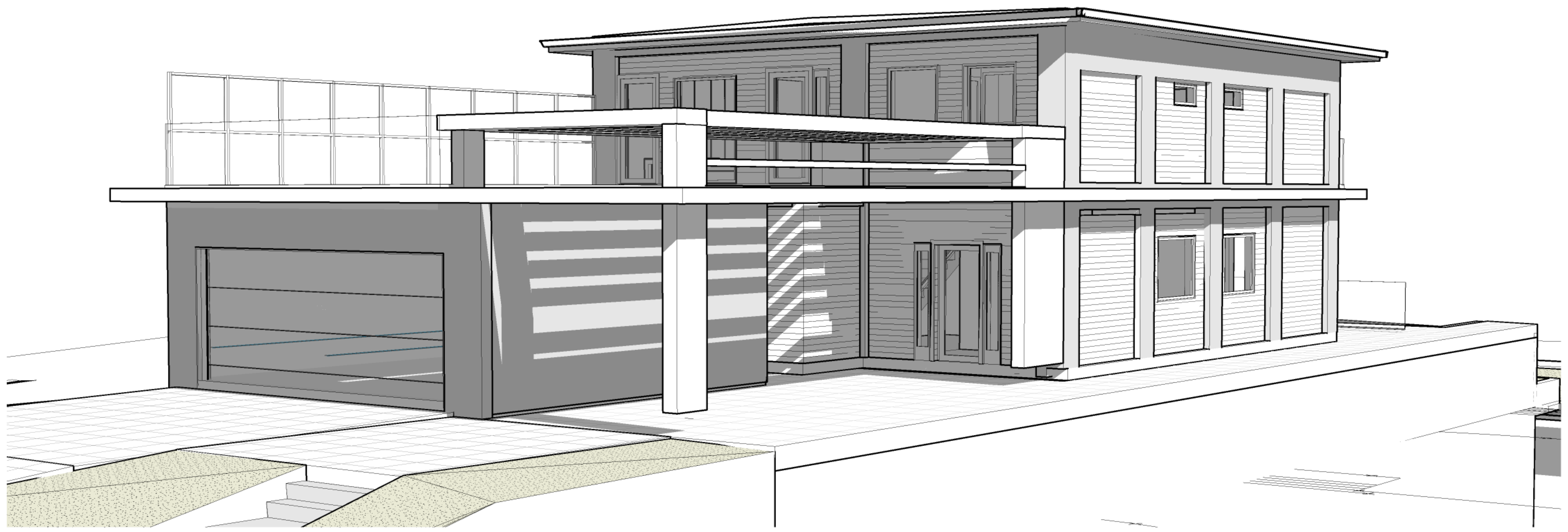
DATE: JUNE 2019

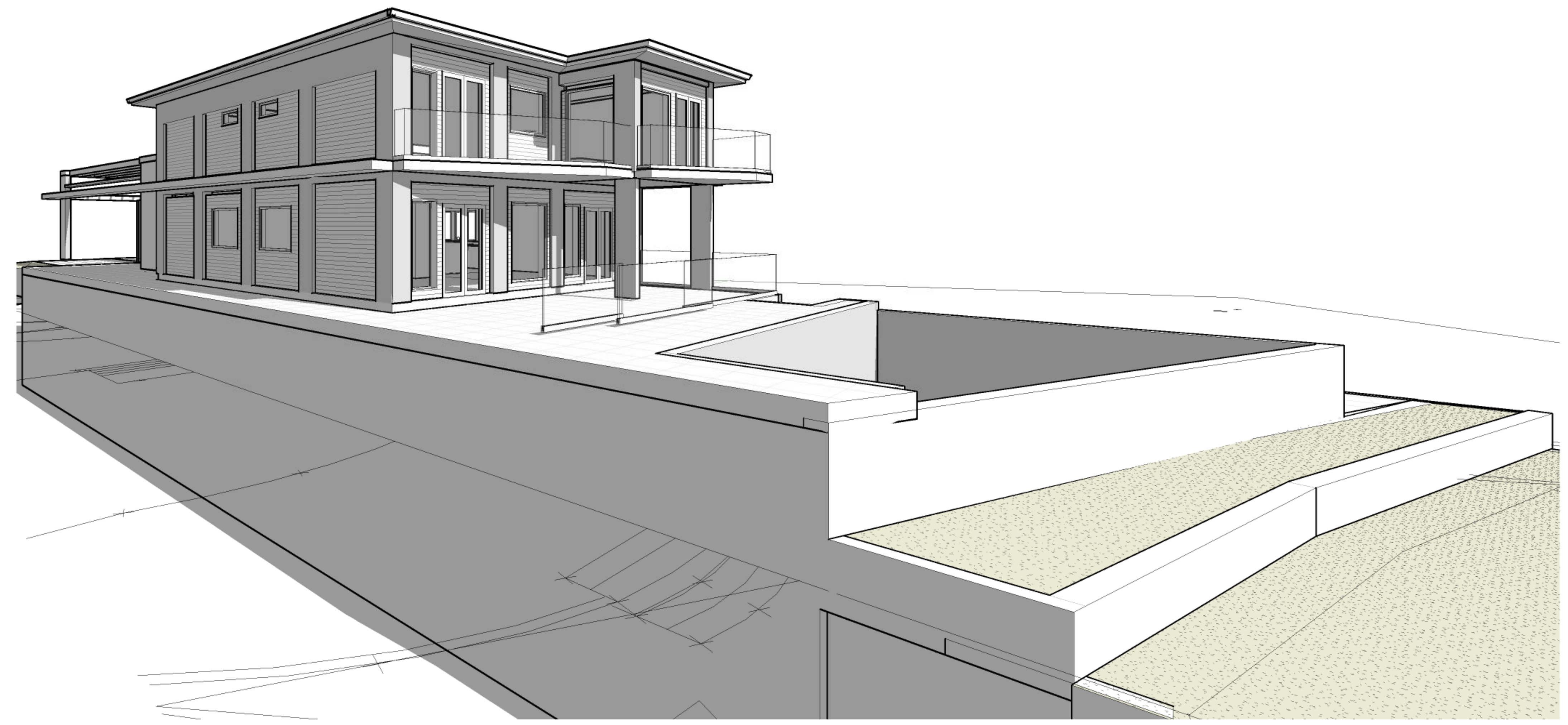
TITLE:

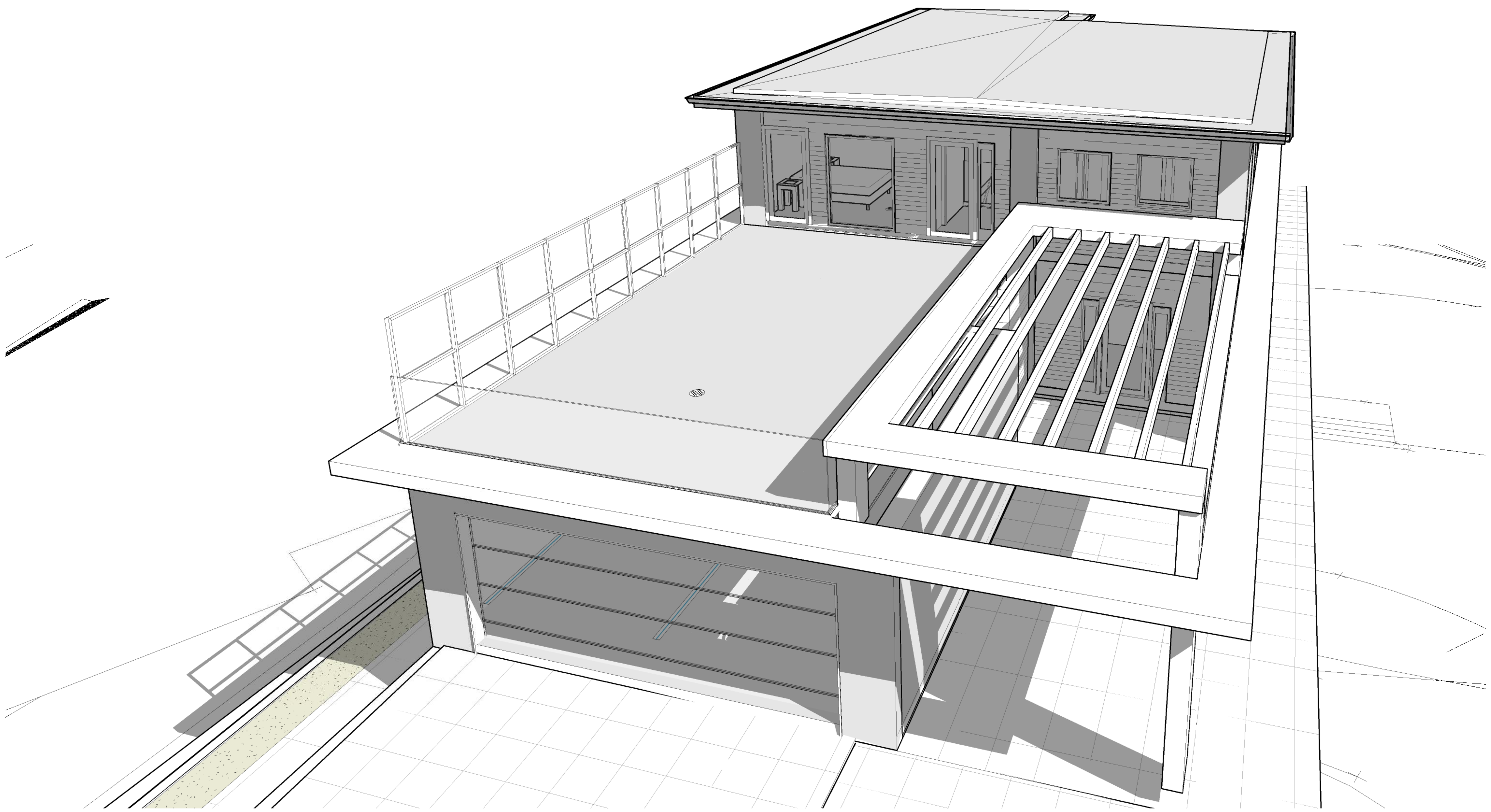
SECTIONS

SHEET NO:

A-4.1







FARZIN
YADEGARI
ARCHITECT INC.
100 2240 CHIPPENDALE ROAD
WEST VANCOUVER, B.C. V7S 3J5
T 778 340 4142 WWW.FYARCH.CA

No.	.	Date
5	PLANNING COMMENT	MAY 2021

PROJECT:

4428 ROSS

DRAWN BY: F.Y. A.A.

CHECKED BY: Checker

SCALE:

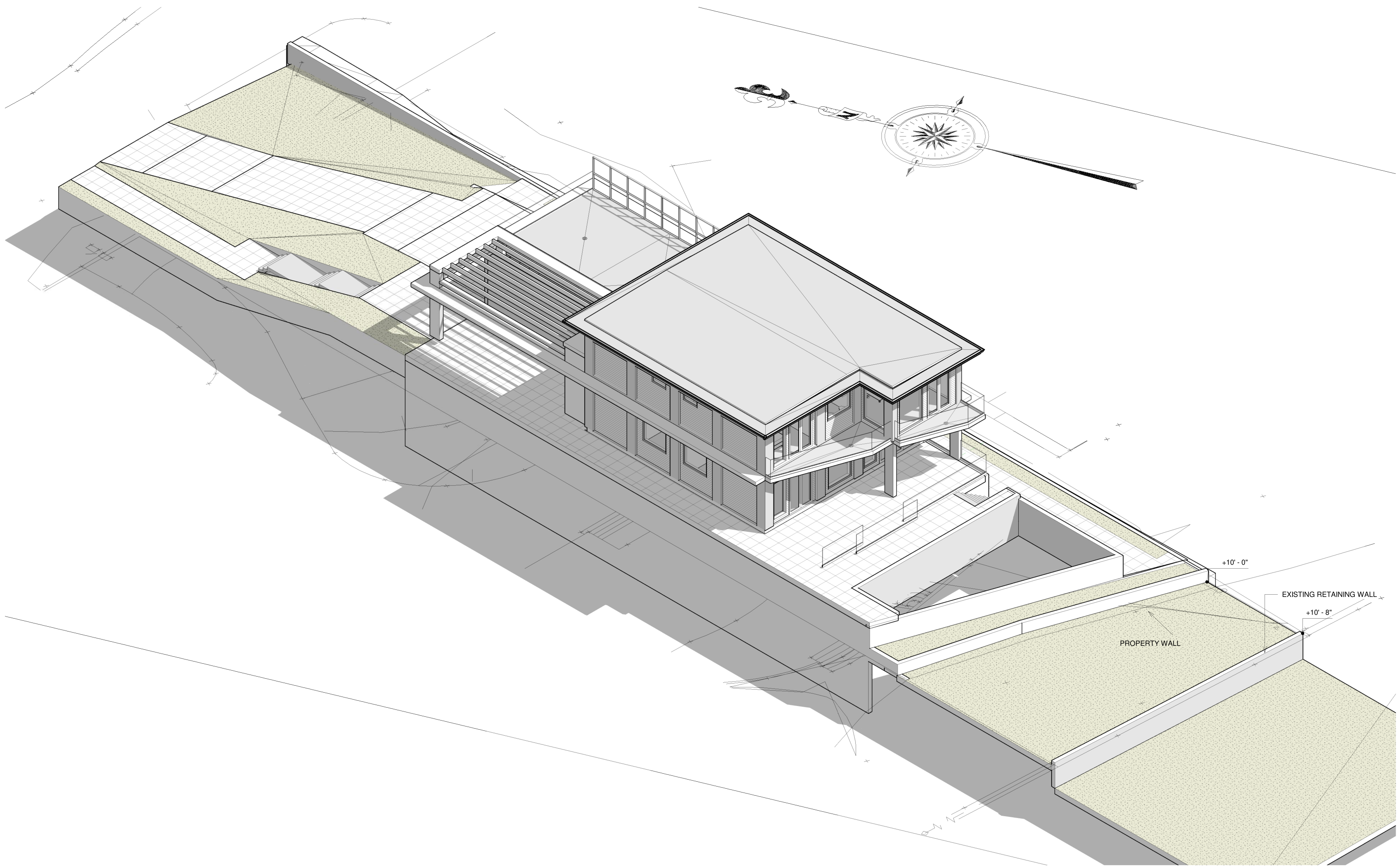
DATE: JUNE 2019

TITLE:

PERSPECTIVE2

SHEET NO:

A-5.2



1 AXONOMETRIC DRAWING

FARZIN YADEGARI ARCHITECT INC.
100 2240 CHIPPENDALE ROAD
WEST VANCOUVER, B.C. V7S 3J5
T 778 340 4142 WWW.FYARCH.CA

No.	.	Date
5	PLANNING COMMENT	MAY 2021

PROJECT:

4428 ROSS

DRAWN BY: F.Y. A.A.

CHECKED BY: F.Y.

SCALE:

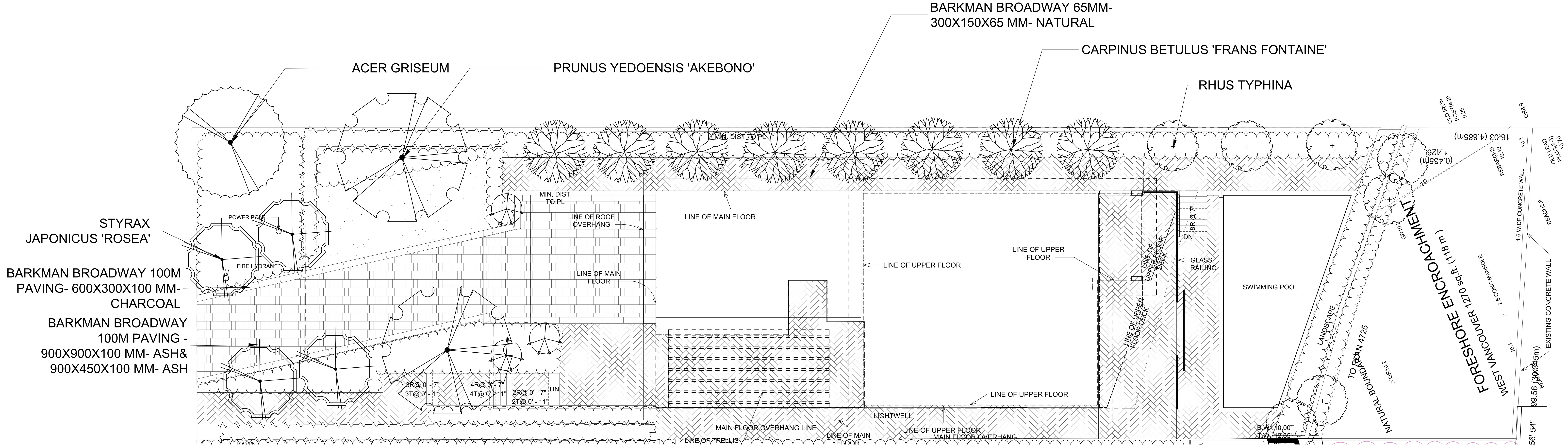
DATE: JUNE 2019

TITLE:

AXONOMETRIC

SHEET NO:

A-5.3



PLANT SCHEDULE	STREET NUMBER- 4428	PMG PROJECT NUMBER: 20-041		
KEY	QTY	BOTANICAL NAME	COMMON NAME	PLANTED SIZE / REMARKS
TREE				
	1	ACER GRISEUM	PAPERBARK MAPLE	6CM CAL; 1.8M STD; B&B
	8	CARPINUS BETULUS 'FRANS FONTAINE'	PYRAMIDAL EUROPEAN HORNBEAM	6CM CAL; 1.8M STDB&B
	3	CEDRUS DEODORA BLUE HEAVEN	DWARF HIMALAYAN CEDAR	1.5M HT; B&B
	2	PRUNUS YEDOENSIS 'AKEBONO'	DAYBREAK CHERRY	6CM CAL; B&B
	7	RHUS TYPHINA	STAGHORN SUMAC	2M HT; B&B; WELL BRANCHED 3 STEM OR MORE
	4	STYRAX JAPONICUS 'ROSEA'	PINK FLOWERED JAPANESE SNOWBELL	5CM CAL; B&B

NOTES: * PLANT SIZES IN THIS LIST ARE SPECIFIED ACCORDING TO THE BC LANDSCAPE STANDARD AND CANADIAN LANDSCAPE STANDARD, LATEST EDITION. CONTAINER SIZES SPECIFIED AS PER CNLA STANDARD. BOTH PLANT SIZE AND CONTAINER SIZE ARE THE MINIMUM ACCEPTABLE SIZES. * REFER TO SPECIFICATIONS FOR DEFINED CONTAINER MEASUREMENTS AND OTHER PLANT MATERIAL REQUIREMENTS. * SEARCH AND REVIEW: MAKE PLANT MATERIAL AVAILABLE FOR OPTIONAL REVIEW BY LANDSCAPE ARCHITECT AT SOURCE OF SUPPLY. AREA OF SEARCH TO INCLUDE LOWER MAINLAND AND FRASER VALLEY. * SUBSTITUTIONS: OBTAIN WRITTEN APPROVAL FROM THE LANDSCAPE ARCHITECT PRIOR TO MAKING ANY SUBSTITUTIONS TO THE SPECIFIED MATERIAL. UNAPPROVED SUBSTITUTIONS WILL BE REJECTED. ALLOW A MINIMUM OF FIVE DAYS PRIOR TO DELIVERY FOR REQUEST TO SUBSTITUTE. SUBSTITUTIONS ARE SUBJECT TO BC LANDSCAPE STANDARD AND CANADIAN LANDSCAPE STANDARD - DEFINITION OF CONDITIONS OF AVAILABILITY. * ALL LANDSCAPE MATERIAL AND WORKMANSHIP MUST MEET OR EXCEED BC LANDSCAPE STANDARD AND CANADIAN LANDSCAPE STANDARD LATEST EDITION. * ALL PLANT MATERIAL MUST BE PROVIDED FROM CERTIFIED DISEASE FREE NURSERY. * BIO-SOLIDS NOT PERMITTED IN GROWING MEDIUM UNLESS AUTHORIZED BY LANDSCAPE ARCHITECT.

pmg LANDSCAPE ARCHITECTS
Suite C100 - 4185 Still Creek Drive
Burnaby, British Columbia, V5C 6G9
p: 604 294-0011 ; f: 604 294-0022

SEAL:

NO.	DATE	REVISION DESCRIPTION	DR.
1	20.12.04	NEW SITE PLAN	JH

CLIENT: TOP VISION DEVELOPMENTS INC.
WITH: FARZIN YADEGARI ARCHITECT INC.

PROJECT:

SPENCER RESIDENCE

4428 ROSS CRESCENT
WEST VANCOUVER, BC

DRAWING TITLE:

LANDSCAPE PLAN

DATE: 20.MAR.25
SCALE: 1/ 8"=1'0"
DRAWN: DD
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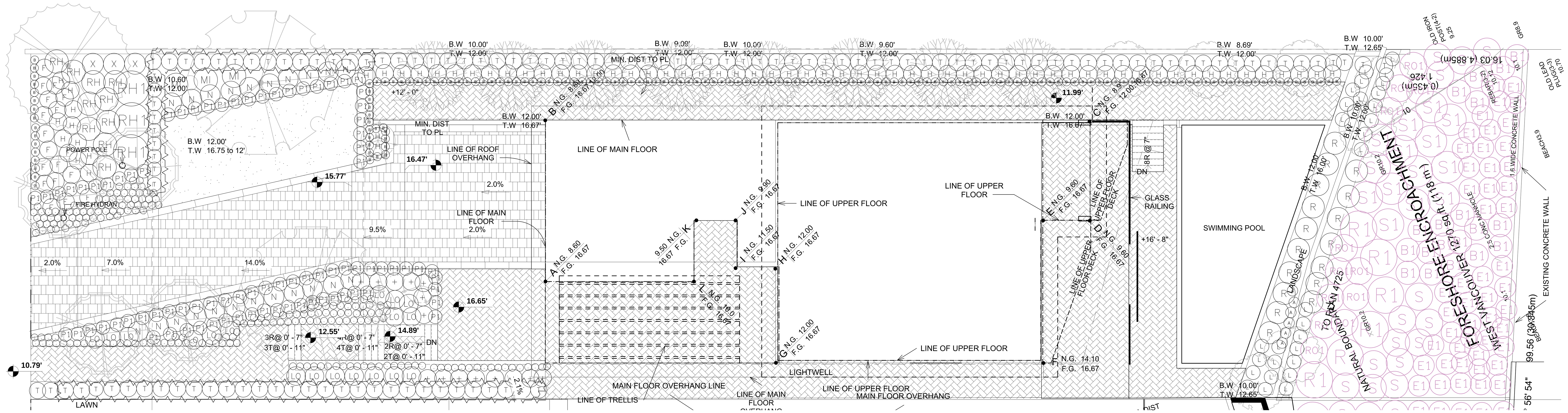
DRAWING NUMBER: **L1** OF 4

20041-1.ZIP

PMG PROJECT NUMBER: 20-041



PLANT SCHEDULE

STREET NUMBER- 4428

PMG PROJECT NUMBER: 20-041

KEY	QTY	BOTANICAL NAME	COMMON NAME	PLANTED SIZE / REMARKS
SHRUB				
B	152	BUXUS SEMPERVIRENS 'SUFFRUTICOSA'	DWARF BOXWOOD	#1 POT;15CM
LO	18	LOROPETALUM CHINENSIS `JAZZ HANDS'	CHINESE FRINGE FLOWER	#2 POT; 30CM
+	15	NANDINA DOMESTICA 'FIREPOWER'	FIREPOWER HEAVENLY BAMBOO	#2 POT; 40CM
N	22	NANDINA DOMESTICA 'PLUM PASSION'	HEAVENLY BAMBOO; PURPLE-RED NEW GROWTH	#3 POT; 50CM
X	3	PRUNUS LUSITANICA	PORTUGESE LAUREL	1M HT.
RH1	3	RHODODENDRON 'ANNA ROSE WHITNEY'	RHODODENDRON	#3 POT; 50CM
RH	10	RHODODENDRON 'CYNTHIA'	RHODODENDRON; ROSY CRIMSON	#3 POT; 50CM;
R	17	ROSA NUTKANA	NOOTKA ROSE	2 POT; 40CM
T	117	THUJA OCCIDENTALIS 'SMARAGD'	EMERALD GREEN CEDAR	1.5M HT; B&B
GRASS				
	208	CAREX OSHIMENSIS	JAPANESE SEDGE	#1 POT
L	31	LEYMUS MOLLIS	DUNEGRASS	#1 POT
P1	82	PENNISETUM SETACEUM 'RUBRUM'	PURPLE FOUNTAIN GRASS	#1 POT
PERENNIAL				
F	18	FUCHSIA M. `DAVID'	HARDY FUSCHIA	15 CM POT
H	68	HOSTA 'KROSSA REGAL'	HOSTA; LARGE; GREY-BLUE	#2 POT; 1-2 EYE
GC				
A	6	ARCTOSTAPHYLOS UVA-URSI	KINNICKINICK	#1 POT; 20CM
SHRUB				
T	117	THUJA OCCIDENTALIS 'SMARAGD'	EMERALD GREEN CEDAR	1.5M HT; B&B

NOTES: * PLANT SIZES IN THIS LIST ARE SPECIFIED ACCORDING TO THE BC LANDSCAPE STANDARD AND CANADIAN LANDSCAPE STANDARD, LATEST EDITION. CONTAINER SIZES SPECIFIED AS PER CNLA STANDARD. BOTH PLANT SIZE AND CONTAINER SIZE ARE THE MINIMUM ACCEPTABLE SIZES. * REFER TO SPECIFICATIONS FOR DEFINED CONTAINER MEASUREMENTS AND OTHER PLANT MATERIAL REQUIREMENTS. * SEARCH AND REVIEW: MAKE PLANT MATERIAL AVAILABLE FOR OPTIONAL REVIEW BY LANDSCAPE ARCHITECT AT SOURCE OF SUPPLY. AREA OF SEARCH TO INCLUDE LOWER MAINLAND AND FRASER VALLEY. * SUBSTITUTIONS: OBTAIN WRITTEN APPROVAL FROM THE LANDSCAPE ARCHITECT PRIOR TO MAKING ANY SUBSTITUTIONS TO THE SPECIFIED MATERIAL. UNAPPROVED SUBSTITUTIONS WILL BE REJECTED. ALLOW A MINIMUM OF FIVE DAYS PRIOR TO DELIVERY FOR REQUEST TO SUBSTITUTE. SUBSTITUTIONS ARE SUBJECT TO BC LANDSCAPE STANDARD AND CANADIAN LANDSCAPE STANDARD - DEFINITION OF CONDITIONS OF AVAILABILITY. * ALL LANDSCAPE MATERIAL AND WORKMANSHIP MUST MEET OR EXCEED BC LANDSCAPE STANDARD AND CANADIAN LANDSCAPE STANDARD LATEST EDITION. * ALL PLANT MATERIAL MUST BE PROVIDED FROM CERTIFIED DISEASE FREE NURSERY. * BIO-SOLIDS NOT PERMITTED IN GROWING MEDIUM UNLESS AUTHORIZED BY LANDSCAPE ARCHITECT.

PLANT SCHEDULE- FORESHORE AREA-4428

PMG PROJECT NUMBER: 20-041

KEY	QTY	BOTANICAL NAME	COMMON NAME	PLANTED SIZE / REMARKS
SHRUB				
R1	6	CORNUS SERICEA	RED OSIER DOGWOOD	#3 POT; 80CM
E1	49	ELYMUS CANADENSIS	CANADA WILD EYE	#1 POT; 30CM
S1	14	ROSA PISOCARPA	CLUSTER ROSE	#3 POT; 60CM
RO1	12	ROSA RUGOSA	RUGOSA ROSE	#3 POT; 50CM
B1	20	RUBUS PARVIFLORUS	THIMBLEBERRY	#1 POT; 30CM
S	14	RUBUS SPECTABILIS	SALMONBERRY	#3 POT; 50CM

NOTES: * PLANT SIZES IN THIS LIST ARE SPECIFIED ACCORDING TO THE BC LANDSCAPE STANDARD AND CANADIAN LANDSCAPE STANDARD, LATEST EDITION. CONTAINER SIZES SPECIFIED AS PER CNLA STANDARD. BOTH PLANT SIZE AND CONTAINER SIZE ARE THE MINIMUM ACCEPTABLE SIZES. * REFER TO SPECIFICATIONS FOR DEFINED CONTAINER MEASUREMENTS AND OTHER PLANT MATERIAL REQUIREMENTS. * SEARCH AND REVIEW: MAKE PLANT MATERIAL AVAILABLE FOR OPTIONAL REVIEW BY LANDSCAPE ARCHITECT AT SOURCE OF SUPPLY. AREA OF SEARCH TO INCLUDE LOWER MAINLAND AND FRASER VALLEY. * SUBSTITUTIONS: OBTAIN WRITTEN APPROVAL FROM THE LANDSCAPE ARCHITECT PRIOR TO MAKING ANY SUBSTITUTIONS TO THE SPECIFIED MATERIAL. UNAPPROVED SUBSTITUTIONS WILL BE REJECTED. ALLOW A MINIMUM OF FIVE DAYS PRIOR TO DELIVERY FOR REQUEST TO SUBSTITUTE. SUBSTITUTIONS ARE SUBJECT TO BC LANDSCAPE STANDARD AND CANADIAN LANDSCAPE STANDARD - DEFINITION OF CONDITIONS OF AVAILABILITY. * ALL LANDSCAPE MATERIAL AND WORKMANSHIP MUST MEET OR EXCEED BC LANDSCAPE STANDARD AND CANADIAN LANDSCAPE STANDARD LATEST EDITION. * ALL PLANT MATERIAL MUST BE PROVIDED FROM CERTIFIED DISEASE FREE NURSERY. * BIO-SOLIDS NOT PERMITTED IN GROWING MEDIUM UNLESS AUTHORIZED BY LANDSCAPE ARCHITECT.

pmg LANDSCAPE ARCHITECTS
Suite C100 - 4185 Still Creek Drive
Burnaby, British Columbia, V5C 6G9
p: 604 294-0011 ; f: 604 294-0022

SEAL:

NO.	DATE	REVISION DESCRIPTION	DR.
1	20.12.04	NEW SITE PLAN	JH

CLIENT: TOP VISION DEVELOPMENTS INC.
WITH: FARZIN YADEGARI ARCHITECT INC.

PROJECT:

SPENCER RESIDENCE

4428 ROSS CRESCENT
WEST VANCOUVER, BC

DRAWING TITLE:

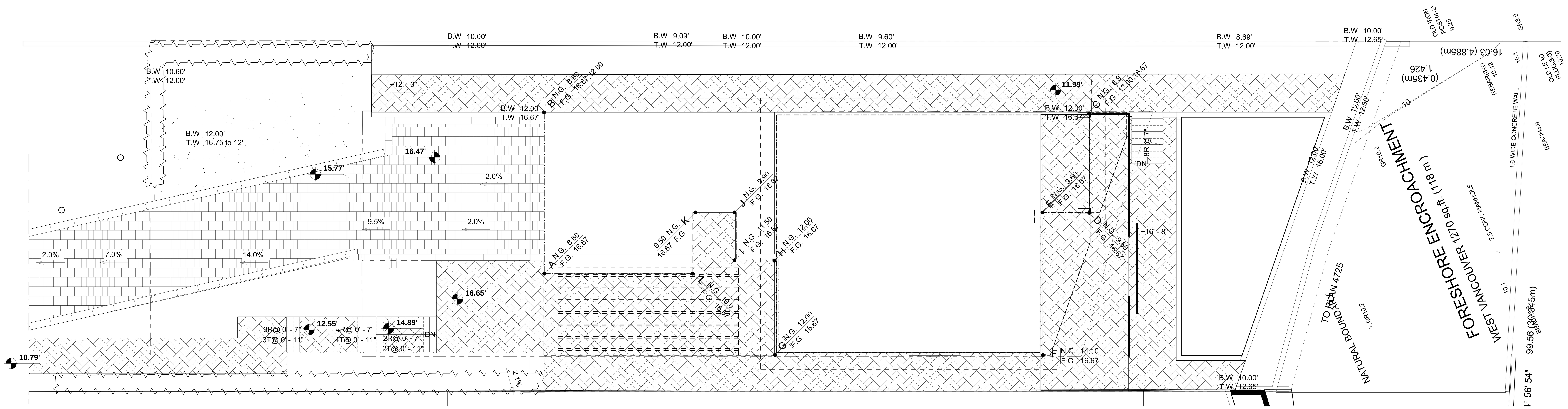
SHRUB PLAN

DATE: 20.MAR.25
SCALE: 1/ 8"=1'0"
DRAWN: DD
DESIGN: DD
CHK'D: PCM

DRAWING NUMBER: **L2** OF 4

20041-1.ZIP

PMG PROJECT NUMBER: 20-041



pmg
LANDSCAPE ARCHITECTS
Suite C100 - 4185 Still Creek Drive
Burnaby, British Columbia, V5C 6G9
p: 604 294-0011 ; f: 604 294-0022

SEAL:

NO.	DATE	REVISION DESCRIPTION	DR.
1	20.12.04	NEW SITE PLAN	JH

CLIENT: TOP VISION DEVELOPMENTS INC.
WITH: FARZIN YADEGARI ARCHITECT INC.

PROJECT:

SPENCER RESIDENCE

4428 ROSS CRESCENT
WEST VANCOUVER, BC

DRAWING TITLE:

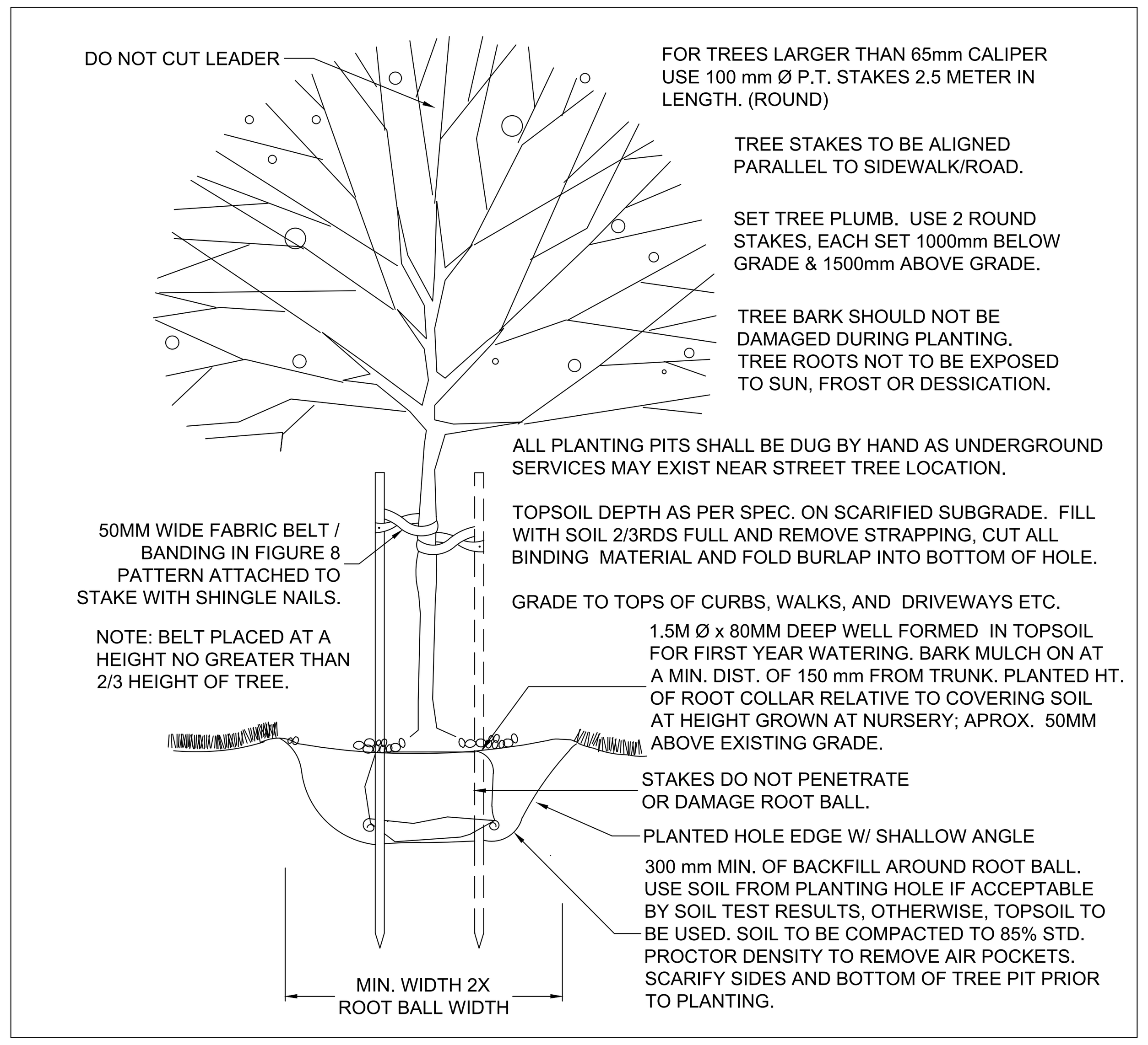
GRADING PLAN

DATE: 20.MAR.25
SCALE: 1/ 8"=1'0"
DRAWN: DD
DESIGN: DD
CHK'D: PCM

DRAWING NUMBER:
L3
OF 4

20041-1.ZIP

PMG PROJECT NUMBER: **20-041**



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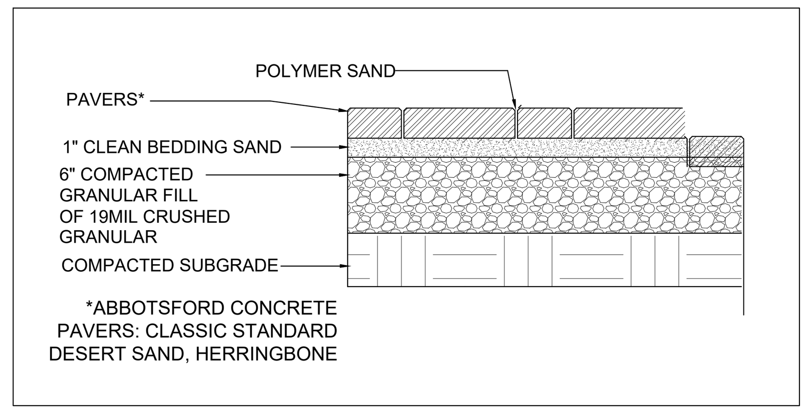

3 PAVERS ON GRADE
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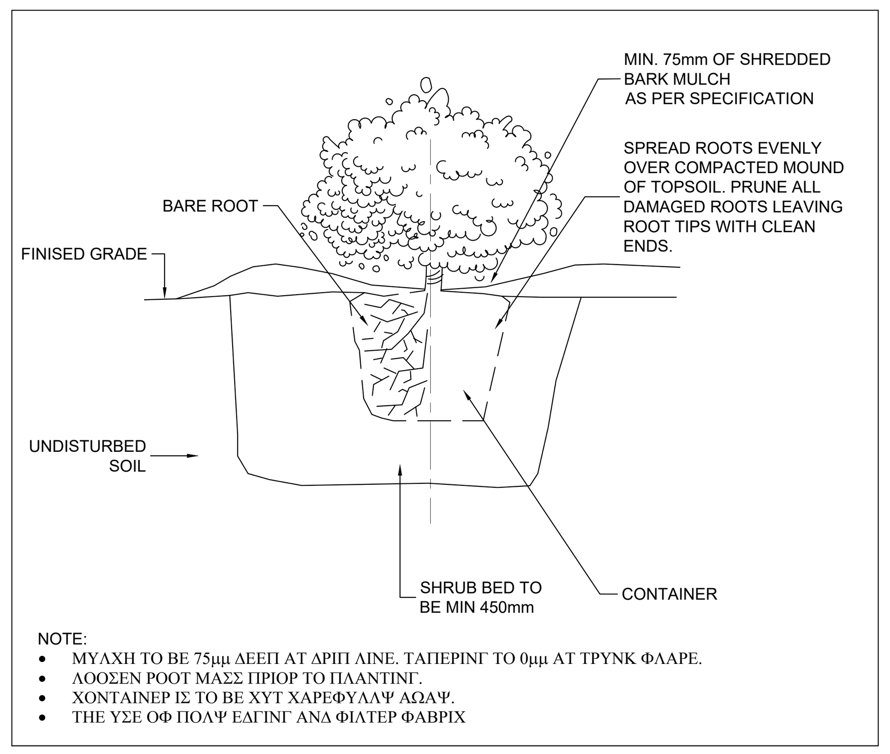

2 BARE ROOT/CONTAINER SHRUB PLANTING
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pmg LANDSCAPE ARCHITECTS
Suite C100 - 4185 Still Creek Drive
Burnaby, British Columbia, V5C 6G9
p: 604 294-0011 ; f: 604 294-0022

SEAL:

NO.	DATE	REVISION DESCRIPTION	DR.
1	20.12.04	NEW SITE PLAN	JH

CLIENT: TOP VISION DEVELOPMENTS INC.
WITH: FARZIN YADEGARI ARCHITECT INC.

PROJECT:

SPENCER RESIDENCE

4428 ROSS CRESCENT
WEST VANCOUVER, BC

DRAWING TITLE:

DETAIL PLAN

DATE: 20.MAR.25
SCALE: 1/ 8"=1'0"
DRAWN: DD
DESIGN: DD
CHK'D: PCM

DRAWING NUMBER:
L4
OF 4

20041-1.ZIP

PMG PROJECT NUMBER: **20-041**

nhc
northwest hydraulic consultants ltd

SCHEDULE B

NHC Ref. No. 3004331
2018 December 20
Updated 2020 December 14

TONG XI ZHANG
张彤曦, 13811969587@163.com

Care of:

Peter Yang Personal Real Estate Corporation
Lions Gate Realty
#202-1555 Marine Dr, West Vancouver, BC
Attn: Peter Yang
Via: peteryang1818@yahoo.ca

Farzin Yadegari Architect Inc.
100- 2240 Chippendale Rd.
West Vancouver, BC V7S 3J5
Attn: Farzin Yadegari, Architect AIBC
Via: farzin@fyarch.ca

Re: Flood Hazard Assessment
4428 Ross Crescent, West Vancouver, BC

Dear Mr. Zhang,

This letter report summarizes the flood hazard assessment (FHA) study conducted by Northwest Hydraulic Consultants Ltd. (NHC) in support of future building permit for the proposed development of 4428 Ross Crescent, District of West Vancouver (DWV), British Columbia. This assessment was initially prepared prior to development of plans for the building or landscape. The report was subsequently updated following receipt of such drawings provided by Farzin Yadegari Architect Inc. dated 2019 May 22 and then again 2020 December 14.

1 INTRODUCTION

A single-family home is being proposed for 4428 Ross Crescent (Parcel E, District Lot 555). The property is located on the north shore of Burrard Inlet within the DWV. A number of creeks flow down from the steep slopes of the coastal North Shore mountains to outlet to Burrard Inlet near the project site; specifically, Claymore Creek, Willow Creek, Cypress Creeks (**Figure 1**). The property is potentially at risk to coastal flood hazards from Burrard Inlet as well as riverine flood hazards from the adjacent creeks. NHC has conducted a flood hazard assessment to identify and assess these hazards. This report presents this assessment, the findings, and recommended measures to mitigate the hazard.

The objective of this assessment is to identify and evaluate the flood hazards that may affect the safe development and use of the property with respect to the proposed development and decide if development is possible to an acceptable safety threshold, either without or with mitigation. The currently accepted safety threshold in British Columbia is 0.5% annual exceedance probability (AEP) up to the year 2100. The 0.5% AEP event is often referred to as the 200-year event as such an event is expected, on average, to occur or be exceeded, once every 200 years.

The report has been structured by presenting referenced guidelines, site observations, coastal assessment, riverine assessment, and concluding with findings and recommendations.

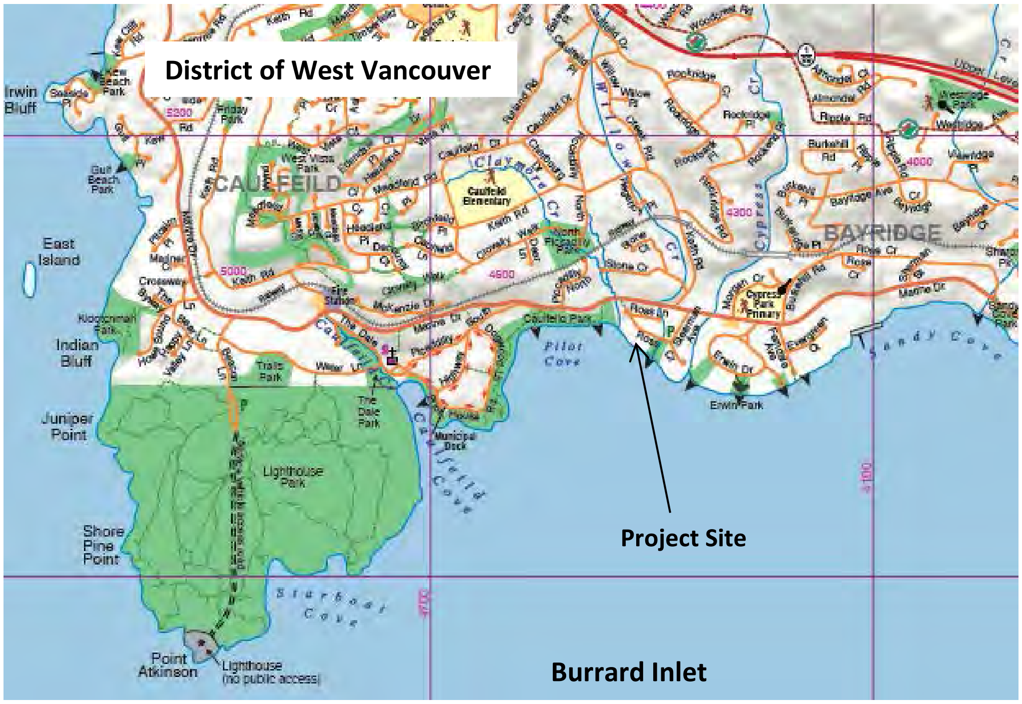

Figure 1. Project site location (DWV Map, 2018)

2 REFERENCED GUIDELINES

The following guidelines and regulations have been reviewed as part of our investigation of the possible hydrotechnical hazards that could threaten the study property.

- Professional Practice Guidelines – Legislated Flood Assessments in a Changing Climate in BC (EGBC, 2018)
- Flood Hazard Area Land Use Management Guidelines (BCMFLNRD, 2018)
- Coastal Floodplain Mapping – Guidelines and Specifications (BC MFLNRO, 2011)
- Climate Change Adaptation Guidelines for Sea Dikes and Coastal Flood Hazard Land Use – Guidelines for Management of Coastal Flood Hazard Land Use (BCMoE, 2011)
- Climate Change Adaptation Guidelines for Sea Dikes and Coastal Flood Hazard Land Use – Draft Policy Discussion Paper (BCMoE, 2011)

DWV requires all applicants applying after January 1, 2018, for a building permit to construct buildings in coastal areas, obtain a site specific FHA.

3 SITE DESCRIPTION

A site investigation was conducted 2018 October 15th by NHC to assess the current site conditions. The property is located along the southeast facing shoreline of Pilot Cove. Erwin Park, the point flanking the east side of the cove, provides shelter from the east; Point Atkinson, the western point, provides shelter from the north and west; leaving exposure across English Bay from the south and across the Straight of Georgia from the southwest. The property currently is grass surface yard at an elevation of roughly 2.8 to 3.4 m (GD) with a roughly 2 m high vertical concrete wall (with parapet) at its boundary with Burrard Inlet. From the wall a gravel and cobble beach slope down at roughly 8% slope (12.5H:1V). This extends across Pilot Cove and roughly 100 m into Burrard Inlet, where the slope increases, reaching a depth from roughly 15 m to 100 m (**Photo 1 to 3**).

Most adjacent properties are protected with similar sized concrete sea walls; however, some properties have retained a more natural shoreline; flatter slope, wood debris, boulders, gravel, and shoreline planting. Wood debris and sorting of beach substrate along the beach provide evidence of wave action at the site and how it varies further along the shore of the cove. No signs of exposed foundations, overhanging banks, or conversely buried shoreline was evident. Without such evidence or an extensive comparison of past surveys, assessment of long-term beach degradation or aggradation is difficult to verify. However, increased armouring of upstream channels and shoreline, and the addition of debris barriers at nearby culverts, are expected to have reduced sediment supply to the beach; and is likely to have resulted in either coarsening of the beach or degradation.

From east to west Cypress Creek, Willow Creek, and Claymore Creek (also referred to as Piccadilly Creek) flow north to south entering Burrard Inlet east (Cypress and Willow Creek) and west (Claymore Creek) of the property.

Cypress Creek (**Figure B.1** in **Appendix B**) is the largest nearby creek; located 160 m east of the property. Its channel is the most defined due to its much larger watershed and resulting greater flow. Flow is confined within a channel of relatively high banks. The channel transitions from roughly 15% grade upstream of the railway crossing (480 m upstream) to 5% at the Marine Drive crossing (200 m upstream), and roughly 2% as it approaches Burrard Inlet. The closest crossing, Marine Drive, is provided by a clear span bridge. The deep open channel at this crossing reduces the probability of debris blockages, and overland flooding impacting the site from this creek.

Willow Creek (**Figure B.2** in **Appendix B**), an order of magnitude smaller than Cypress Creek, is located 50 m east of the project site. Extensive and frequent overland flooding has been reported by neighbours interviewed at the time of site inspection; the flooding appears likely to have occurred from this creek. Willow Creek flow is conveyed from upstream of Marine Drive through to Ross Crescent within a 1.2 m diameter concrete culvert; approximately 270 m long. A debris trash rack structure was recently installed at the upstream end of the culvert, likely in response to the recent flooding. Despite this recent work, the culvert appears to be substantially full of fine sediment reducing its capacity. Sediment from Willow Creek has formed a point bar that extends into Burrard Inlet and bends north towards the project site from the right side of the channel's outlet (as facing downstream).

Claymore Creek (**Figure B.3** in **Appendix B**), the smallest of the three creeks, enters Pilot Cove at its northeast corner, 60 m northwest of the project site. The creek has a relatively small watershed and equally small constructed channel with limited flow capacity. Low lying banks appear easily overtopped. The slope of this creek is more than 5% upstream of Marine Drive and flattens to 3 to 5% just upstream of Ross Crescent, and to about 1% near its outlet at Burrard Inlet.

Photo 1. Towards site from beach

Photo 2. Southeast towards outlet of Willow Creek from top of concrete wall.

Photo 3. Potential scour near the wall, looking west of the property

Photo 4. Potential scour near the wall, looking east of the property

4 COASTAL FLOOD HAZARD ANALYSIS

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 hydraulic forces or wood debris. Flood inundation is the focus of this coastal assessment. Other coastal hazards are of less concern for this assessment based on initial review; that is:

- Overflow and spray can be assessed and addressed through site drainage design follow site design.
- Shoreline erosion appears to be adequately addressed with the existing wall based on the site inspection. Typical residence set back minimums of 15 m is expected to be more than adequate

to detect and address any changes in shoreline erosion before such process is expected to impact the residence.

- Although no riprap or other armouring appears present at the toe, there was no sign of scour undermining the structure.
- Evidence of shoreline aggradation or degradation was not identified during the site inspection. Aggradation may occur as a result of beach nourishment projects, as have occurred further east in West Vancouver. Such projects are not expected to negatively affect the project site. More likely, is degradation of the beach resulting from armouring of upstream channels and installation of debris barriers in the upper watersheds of Willow, Cypress, or Claymore Creek. Such works could result in degradation, which could undermine and fail the existing seawall or lead to larger waves reaching the project site resulting in increased inundation, erosion, and scour. Due to recent additions of a debris barrier on Willow Creek, the property owner should consider monitoring beach levels through survey of the beach or marking of the seawall. Shoreline degradation can be addressed if detected.

Canadian Hydrographic Service Chart 3495 present the local tides. Flood inundation can be substantially greater than the normal range of tides due to storm surge, wave effects, and long- term changes in global and local sea level.

Table 1. Water elevations at Point Atkinson.

Sea State	Tide Elevation (m Geodetic Datum)
Higher High Water, Large Tide (HHWLT)	2.0
Higher High Water, Mean Tide (HHWMT)	1.3
Mean Water Level (MWL)	0.0
Lower Low Water, Mean Tide (LLWMT)	-2.0
Lower Low Water, Large Tide (LLWLT)	-3.1

4.1 Coastal Flood Level

To reduce the likelihood of damage from coastal flood inundation, the coastal flood level is assessed and used to derive a minimum construction level – the flood construction level (FCL) – for homes and commercial buildings within the area potentially at risk. The design event for flood hazard assessments for single family homes in British Columbia is typically the 200-year event, that is an event with an annual exceedance probability of 0.5% (EGBC, 2018).

The initial Climate Change Adaptation Guidelines for Sea Dikes and Coastal Flood Hazard Land Use (MOE, 2011a), presented a single approach for assessing coastal inundation; a combined approach, that is based on the combined effects of tide, storm surge, wave run-up, and sea level rise (SLR). This approach generally results in conservative calculation of a design flood level, as it is often applied ignoring the probability of the various design events cooccurring (the probability that a 200-year storm surge co-occurs during HHWLT and 200-year wave event is closer to a 4000-year event, AEP of 0.025%, instead of 200-year event, AEP of 0.5%). Subsequent revisions to the guidelines acknowledge this, through presenting an alternative joint probability (also referred to as probabilistic) approach as well as suggesting a reduced freeboard be used when using the combined approach. For this assessment a joint probability approach has been applied, with the components of the assessment presented in the following subsections.

4.1.1 Joint Occurrence of Storm Surge and Tides

NHC has assessed the joint probability of storm surge and tides by conducting a frequency analysis on the local water levels (Point Atkinson) to calculate a joint probability 200-year water level of El. 2.89 m.

4.1.2 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 such as home development are considered to have a service life of 100-years or less, resulting in designs often considering projections to the year-2100. The BC Provincial Sea Dike Guidelines (MOE, 2011a) recommends that sea level rise (SLR) associated with global climate change will result in a base water level 1 m above that seen in the year 2000 by the year 2100. The rate of SLR is projected to increase as the climate warms (**Figure 2**.). Therefore, any increase incorporated in the past 18 years is expected to be minimal, and 1 m is to be added for projection from current to year 2100.

Predicted changes in storm intensity and frequency over the next 82 years, which could influence storm surge and wave effects, are highly variable and inconclusive. Such influence has not been incorporated in this analysis.

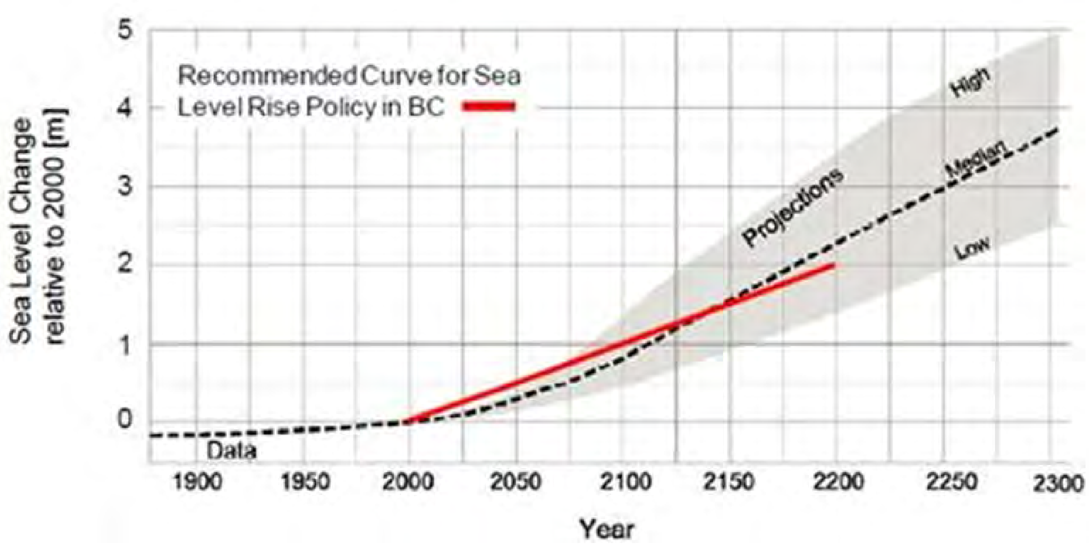

Figure 2. Projected climate change (MOE, 2011).

The recommended SLR for planning and design in BC was based on 2008 study by Fisheries and Oceans Canada (DFO) and MOE (Bomhold, 2008 and Thomson, et. al., 2008). The authors of those works acknowledge the design SLR for BC is greater than the global mean SLR projected by the IPCC AR4 (2007) for the year 2100 (roughly 40 cm greater). However, more recent studies, such as IPCC AR5 (2014), suggests global mean SLR of up to 1.0 m or more by the year 2100. These values were based on the Paris Accord being adopted adhered to.

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 orders of magnitude larger than the 1 m. Recent changes in estimates of global mean SLR to the year 2100 or 2200 have not yet been addressed in the context of coastal BC, but based on recent conversations with FLNRORD, the province is amidst a study of SLR to update the 2011 design values. This study is not expected to be complete until April 2019.

Despite the 1 m adopted by this flood hazard assessment, residents along the coast should therefore be aware that SLR could be substantially greater over the next 100-years, which may require raising, reconstruction, or relocation.

4.1.3 Local Subsidence

In addition to a rising sea, movement of the ground down (subsidence) or up (uplift) will influence the local sea level. Provincial guidelines for local subsidence suggest a rate of -1.3 mm/yr for Point Atkinson; the negative stating that the ground is experiencing uplift. However, a more specific data source suggests that subsidence for this location is on the order of 1.5 mm/yr; **Figure 3** (Lambert et. al., 2008). To the year 2100, this translates to a lowering of 0.12 m, resulting in an additional localized SLR of 0.12 m.

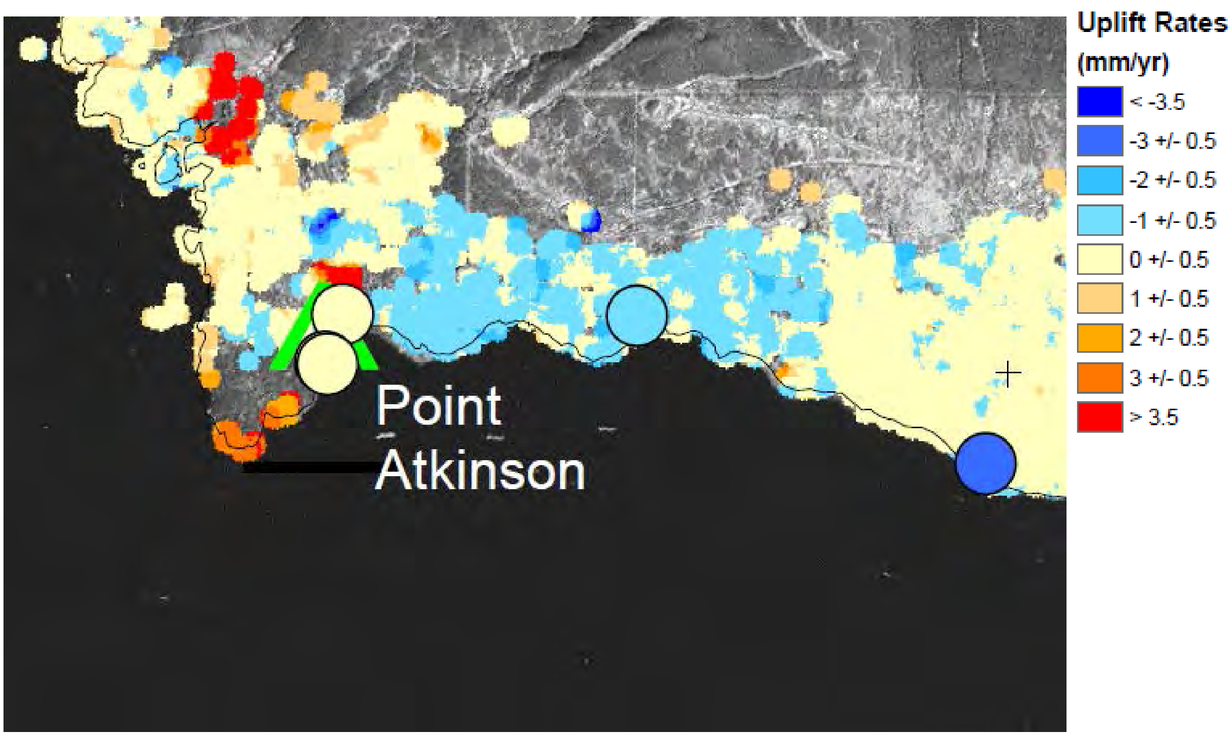

Figure 3. Local subsidence, shown as rate of uplift (Lambert et. al., 2008).

4.1.4 Wind Analysis

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

There is one Meteorological Service of Canada (MSC) station in the vicinity of the study area that has a long-term record suitable for analysis: Point Atkinson (1.8 km southwest of the study area). Twenty years of hourly wind data was used for the study, as summarized in **Table 2**.

Table 2. Point Atkinson station information.

Station	Station ID	Station Location	Period
Point Atkinson	1106200	480768 E 5464953 N	1997–2018

*No data is available for the period between 1959 and 1961.

The local wind climate can be visualized using a wind rose plot, utilizing arrows at the cardinal and inter-cardinal compass points to show the direction from which the winds blow and the magnitude and frequency for a given period. Wind rose showing the direction and magnitude of the winds at Point Atkinson is shown in **Figure 4.**

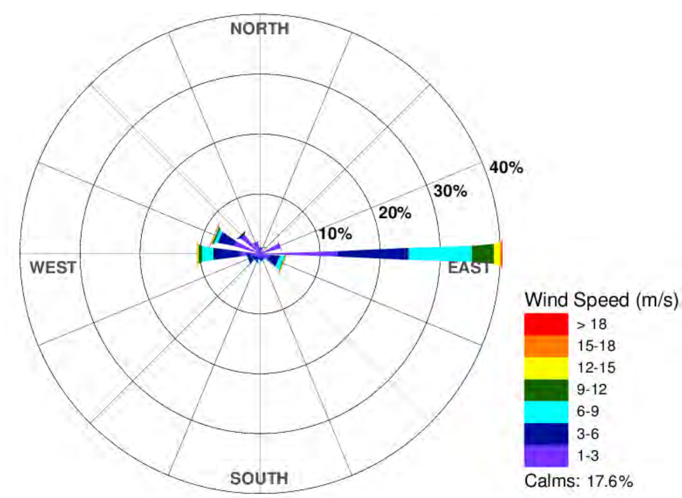

Figure 4. Wind rose based on data from Point Atkinson.

The wind rose shows that wind experienced at Point Atkinson is most frequently from the east and secondly from the west. Frequency analysis was conducted on the Point Atkinson data to obtain the wind speed for the design easterly and westerly storm events. The results are summarized in **Table 3** with the westerly winds being slightly faster than from the east for the same return frequency.

Table 3. Design wind speeds – Point Atkinson.

Event	Easterly		Westerly	
	Speed (m/s)	Speed (km/hr)	Speed (m/s)	Speed (km/hr)
1-in-5 year	20.4	73	21.0	76
1-in-10 year	20.9	75	22.3	80
1-in-50 year	22.2	80	25.2	91

For this study, the 50-year storm events were used for the flood hazard assessment. Discussion on the selection of this AEP for the assessment is provided in the section presenting summation of the FCL.

4.1.5 Wave Analysis

A nearshore wave model (Simulating Waves Nearshore or SWAN) of the Strait of Georgia and Burrard Inlet was developed to model wave generation and propagation from deep water into coastal areas and shorelines. SWAN incorporates physical processes such as wave propagation, wave generation by wind, white-capping, shoaling, wave breaking, bottom friction, sub-sea obstacles, wave setup and wave-wave interactions in its computations. SWAN version 41.20 was used for this study.

Two models were used for the analysis: a fine grid model of the approaches at Burrard Inlet was nested in a coarse grid model of the Strait of Georgia. The coarse grid measures about 113 km southwest to northeast, and 253 km northwest to southeast, with each grid cell measuring 500 m by 500 m. The fine grid measures about 9 km east to west, and 8 km north to south, with each grid cell measuring 50 m by 50 m. The model's bathymetric grids were generated from digitized Canadian Hydrographic Charts and NOAA 3 arc-second resolution data.

The 50-year event (2% AEP) for each design wind directions (westerly and easterly) were used to drive the SWAN model. For each event, a spatially varying Strait of Georgia wind field was developed and applied to both the coarse and fine grid models. The regional wind stations used to generate the spatially varying wind field are presented in **Table 4**. The SWAN model was used to simulate wave generation and transformation for the events. This resulted in a calculated wave climate near the project site.

Table 4. Regional wind data sources.

Station	Station ID	Period	Location
Entrance Island	EC ID 1022689	1994 – 2018 (Present)	49°12'31.195" N 123°48'38.001" W
Ballenas Island	EC ID 1020590	1994 – 2018 (Present)	49°21'01.000" N 124°09'37.000" W
Nanaimo Airport	EC ID 1025370	1954 – 2013	49°03'16.000" N 123°52'12.000" W
Nanaimo Airport	EC ID 1025365	2014 – 2018 (Present)	49°03'16.000" N 123°52'12.000" W
Sandheads CS	EC ID 1107010	1994 – 2018 (Present)	49°06'21.225" N 123°18'12.123" W
Saturna Island CS	EC ID 1017101	1994 – 2018 (Present)	48°47'02.067" N 123°02'41.082" W
Sisters Island	EC ID 2027403	1995 – 2018 (Present)	49°29'11.800" N 124°26'05.800" W
Victoria Int'l Airport	EC ID 1018620	1953 – 2013	48°38'50.010" N 123°25'33.000" W
Victoria Int'l Airport	EC ID 1018621	2013 – 2018 (Present)	48°38'50.000" N 123°25'33.000" W
Kelp Reefs	EC ID 1013998	1997 – 2018 (Present)	48°32'51.700" N 123°14'13.320" W
Halibut Bank	C46146	1992 – 2018 (Present)	49°20'24.000" N 123°43'48.000" W
Sentry Shoal	C46131	1992 – 2018 (Present)	49°54'36.000" N 124°59'24.000" W
Pat Bay	C46134	2001 – 2016	48°38'60.000" N 123°30'00.000" W

The model results showing the 50-year waves from the west and east are presented in **Figure 5** and **Figure 6** and **Table 5**. Wave height is shown by colour shading, wave direction and relative heights are shown by vectors. The largest deep water waves are from the west, as expected, due to the longer fetch (37 km versus 7 km from the east) and higher wind speed. Despite that largest waves to reach the project site are from the east. The design significant wave height and mean wave period at the study area are from the east at 1.5 m and 3.9 seconds respectively.

Table 5. Simulation results of design waves near project site

Event	Easterly		Westerly	
	Hs (m)	T (s)	Hs (m)	T (s)
1-in-50 year	1.5	3.9	1.1	3.3

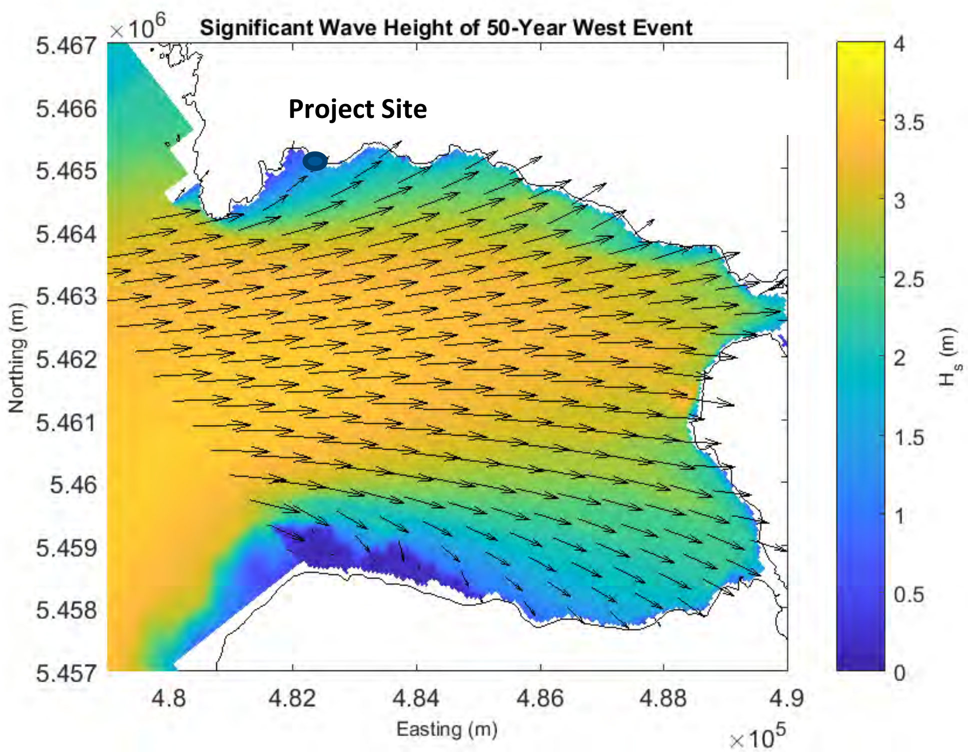

Figure 5. Significant wave height (Hs) and direction for simulated 50-year westerly event.

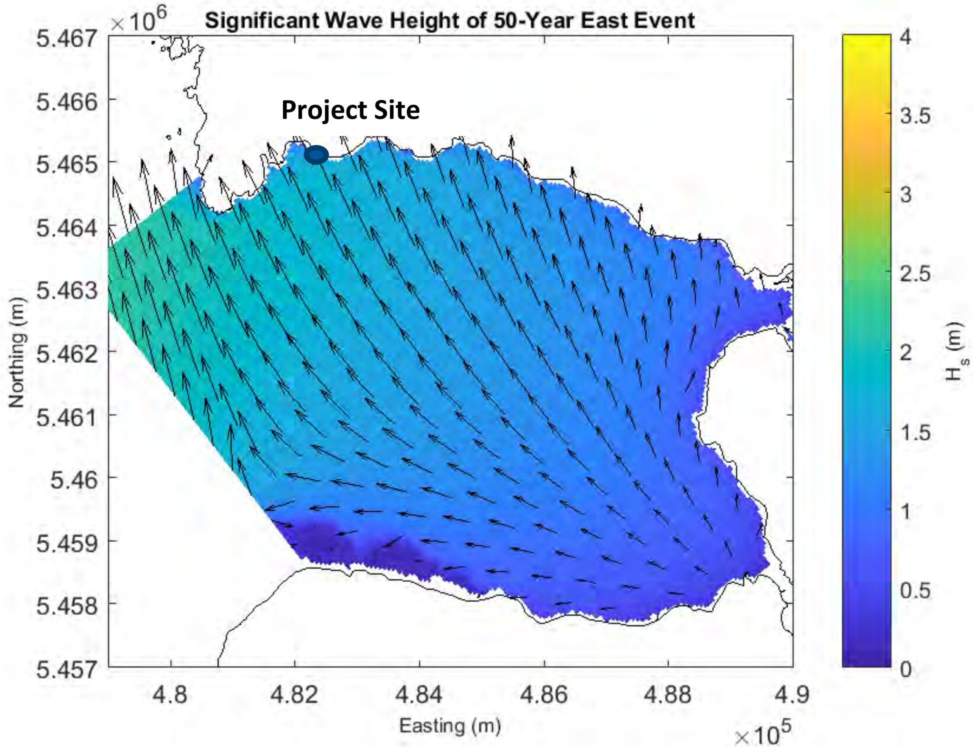

Figure 6. Significant wave height (Hs) and direction for simulated 50-year easterly event.

4.1.6 Wave Effect

The BC Provincial Sea Dike Guidelines (MOE, 2011a) accept the use of a few criteria for calculation of the wave run-up component for design elevation. For this study, the 2% exceedance level was adopted, that is the run-up from a wave with a height that is expected to be exceeded by 2% of the waves occurring during a design event.

Wave run-up was initially estimated using methods described in EurOtop (2016); based on incoming wave height, wave periods, wave angle of approach to shoreline, water depth, and shoreline slope and elevation. The shoreline was initially evaluated based on a gradual sloping shoreline from the beach to the house. This resulted in a wave run-up of 0.65 m during future design water level.

Based on current design drawings (FYA, 2020 November), discussions with the architect, and site inspection, the shoreline embankment is expected to be as describe below from water to land:

El. -5 to 0.8 m	Cobble, gravel, sand beach at 8% slope (existing)
El. 0.8 to 3.05 m	Concrete wall with parapet (existing)
El. 3.05 to 3.31 m	Landscaped terrace, 4 to 10 m wide (proposed)
El. 3.31 to 3.70 m	Concrete wall (proposed)
El. 3.70 m	Terrace feature, 1.2 m wide (proposed)
El. 3.70 to 4.92 m	Concrete wall (proposed)
El. 4.92 m	Swimming pool, 2.3 to 5.5 m wide (proposed)
El. 5.10 m	Landscaped lawn, 5.8 to 6.0 m wide (proposed)

El. 5.28 m Main floor (proposed)

The shoreline embankment can be classified as a composite steep-fronted structure. It has a number of complicating features with respect to wave run-up; such as, a series of walls and terraces, the swimming pool, and the set back of the house. As a simplification, run-up was initially assessed assuming a vertical wall from the beach to the crest of the embankment (El. 4.9 m). Water depth was considered both under current and future conditions (i.e. SLR and subsidence).

From the initial assessment, run-up and spray are expected to overtop the crest of the embankment under both the current and future water levels. Average overtopping volume during the design event is expected to be on the order of 11 l/s/m, and peak overtopping volume could be up to 20 times this value. Such overtopping is expected to bring both saltwater, sediment, and large wood debris over the embankment, and potentially into the pool during the design event.

Despite this initial assessment of the currently proposed shoreline embankment, a number of approaches can be applied to reduce the overtopping volume and limit the potential damage from debris; such as:

- Construction of a berm seaward of the existing concrete seawall. In is envisioned that this berm could be constructed of cobble and boulders. It would reduce the vulnerability to beach degradation and toe scour and absorb wave energy before it reaches the embankment. Design of such a structure should be done in consultation with shoreline biologist to minimize negative impacts of the structure and potentially incorporate habitat features, such as boulder complexes or intertidal benches.
- Construction of a structure to force breaking seaward of the embankment crest. Potentially, this could be achieved by increasing the height of the berm suggested in the previous paragraph or increasing the height of the existing seawall. To ensure effectiveness the distance between top of embankment and such a seaward structure is expected to be a minimum of 2 to 6 m (current distance is 2.4 m between the existing and proposed seaward).
- Addition of a parapet (or bullnose) on the top of the seawall could limit overtopping and spray. Such a structure should be designed by a coastal engineer to ensure elevation, angle, and extent are appropriate.
- Addition of a wall located on the landscaped lawn between the house and the shoreline.
- Use of the proposed pool as a stilling basin for overtopping waves during extreme events. The pool is expected to dissipate the energy of overtopping waves.
- Provision for temporary seawall structure on top of the proposed embankment crest. When constructing the seawall along the pools edge, provisions could be made that allow additional seawall to be bolted to this wall. This temporary structure is expected to only be required in fall and winter months when tides are highest and storms generally most intense.

Previous versions of this assessment considered a gradually sloping shoreline. The allowance for run-up based on that assessment was 0.65 m. This included consideration of half the calculated run-up for the FCL as per provincial guidelines (2011b). For a vertical wall breakwater, the run-up could be substantially higher than 0.65 m. To address this a detailed wave effects assessment was conducted (NHC, 2019). This assessment included simulation of wave run-up using the SWASH (Simulating Waves till Shore) model. A number of potential solutions were developed to maintain the reduced wave effects. The approach selected by the design team is to use the following:

- barrier between the pool and the residence with a crest elevation of 5.4 m or greater (barrier has been proposed to limit wave run-up and control access to the pool).
- erosion resistant materials (i.e. paving) for the ground between the barrier and the pool.

The barrier is shown on the current drawing set (Farzin Yadegari Architect Inc., 2020 November).

4.1.7 Flood Construction Level

The coastal FCL is based on the joint effects of tide, storm surge, wave run-up, and sea level rise (SLR). A joint probabilistic approach has been applied to storm surge and tides, however wave effects have been calculated independently and are to be added in development of the FCL. To account for the additional decrease in probability that an extreme wave event from the east simultaneously occurs during the 200-year high water event, a 50-year wave event was selected for this analysis. In addition, 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 Provincial Climate Change Adaptation Guideline (MOE, 2011b) is 0.6 m when using a joint probability approach.

The following table (**Table 6**) summarizes the resulting FCL for the current condition and that predicted for the year 2100.

Table 6. Flood construction levels.

FCL Input	Year 2018 Elevation (m)	Year 2100 Elevation (m)
Tide + storm surge (joint probability)	2.89	2.89
+ wave effect	0.65	0.65
+ Design sea level rise (to year 2100)	0	1.0
+ Subsidence (to year 2100)	0	0.12
Coastal flood level	3.54	4.66
+ Freeboard (m)	0.6	0.6
Flood construction level	4.14	**5.26**

4.2 Tsunami Hazard

In addition to wave and storm events, high water and coastal property inundation can 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 tsunami events generally are a result of earthquakes that produce substantial vertical movement of the sea floor in sufficiently shallow water.

Assessment of tsunami hazards are beyond the scope of this project, however previous studies suggest that the tsunami wave height reaching Vancouver Harbour would be roughly 10% of the tsunami wave height observed at Tofino on the west coast of Vancouver Island (Spaeth and Berkman, 1967) and that run up from a tsunami is expected to be less than 2 m on the North Shore from a tsunamis originating from the Pacific Ocean (Clague et al. 2005). Such an event would be extremely large on the west coast of Vancouver Island assuming the attenuation through the strait is roughly 10%.

The expected maximum tsunami run-up of less than 2 m would be for events far less frequent that the 200-year event, and when added to mean water high high tide (MWHHT), sea level rise, and subsidence, is still below the coastal derived FCL minus freeboard (El. 4.42 m versus El. 4.66 m).

5 RIVERINE FLOOD HAZARD ASSESSMENT

This riverine assessment considers flood hazards from Willow Creek, Claymore Creek and Cypress Creek. Historical flooding has been reported for the area resulting from Willow Creek and Claymore Creek (Vancouver Sun, 2016) and possibly also Cypress Creek (North Shore News, 2016). The Pacific Stream Keepers Federation also reported the occurrence of flooding in 1975 and 1983. Recently, the District of West Vancouver updated the inlet of the Willow Creek at Keith Road by adding a trash racks to intercept debris prior to culvert blockage.

All three creeks are not expected to impose substantial hydrotechnical hazards on the site other than flood inundation. That is, avulsion, channel migration, scour, and erosion risk has not been further investigated. Exposed soils or steep slopes towards Burrard Inlet could suffer erosion during a riverine flood event, but such conditions are not expected for this site.

5.1 Riverine Flood Inundation

5.1.1 Hydrology

The Cypress Creek watershed is gauged; Willow Creek and Claymore Creek are not gauged and have no record of water level or discharge. Cypress Creek gauge data is available for only six years, which is not adequate for performing a reliable peak flow analysis. Therefore, flow was estimated using a regional analysis based on the long term data record from MacKay Creek (WSC 08GA061, 1970-2012) and through use of the Rational method. Results from the regional analysis were transposed between sites using the equation $Q_1/Q_2 = (A_1/A_2)^n$; where *Q* is discharge, *A* is contributing watershed area, and *n* is a scaling factor estimated as 0.75 as per Eaton et al (2002). Results of the analysis are shown in the following table (**Table 7**).

To account for climate change, changes rainfall intensity was investigated using an IDF-CC tool (intensity-duration-frequency climate-change). This suggested an increase in precipitation intensity of 13% to 30% for the 200-year event to the year 2100. The impact to flow may be variable due to changes in snow-pack, timing of events, and ground cover. However, adoption of 30% increase was assumed for this analysis to remain conservative.

Table 7. Design flows.

Variable	McKay	Claymore	Willow	Cypress
Watershed area (km^2)	3.6	0.6	0.9	11.8
2-year flow (m^3/s)	5.6	1.5	2.0	13.6
5-year flow (m^3/s)	8.0	2.1	2.8	19.5
10-year flow (m^3/s)	9.9	2.6	3.5	24.2
20-year flow (m^3/s)	11.9	3.1	4.2	29.0
50-year flow (m^3/s)	15.4	4.0	5.4	37.4
100-year flow (m^3/s)	17.7	4.6	6.3	43.2
200-year flow (m^3/s)	20.3	5.3	7.2	49.4
Year 2100, 200-year flow	26.4	6.9	9.3	64.2

5.1.2 Hydraulic Analysis

To predict flood levels resulting from 200-year flows (0.5% AEP) with allowance for climate change, a one-dimensional hydraulic model was constructed using US Army Corps of Engineers' HEC-RAS software based on sections and slopes surveyed in the field. The model including Marine Drive, Ross Crescent, and the properties between Ross Crescent and Burrard Inlet with a simplified geometry, to simply evaluate if overflow flood depth near the subject property is greater or near that predicted from coastal flooding. The tested scenarios included blockage of the three creeks at culvert entrances and within the open channels.

The model results suggest Cypress Creek is not expected to impact the site; however, blockage and subsequent flooding at Claymore Creek and Willow Creek could result in overland flow depths as large as 1 to 1.5 m and velocities as high as 1 to 2 m/s. It is expected that overland flooding up to the design event will remain less then El. 4.3 m at the project site. Overland velocities could be high enough to induce erosion and scour if ground cover is not maintained (i.e. coarse gravel or cobble stones, paving, or grass).

The calculated riverine flood depth is less than that calculated for coastal flooding, therefore the coastal FCL should be adopted for site design.

6 SUMMARY AND RECOMMENDATIONS

A hydrotechnical flood hazard assessment was conducted for 4428 Ross Crescent. From this study, the following recommendations are made for safe use of the property:

1) An FCL of 5.26 m be adopted for this site, provided the barrier between the shoreline and residence is constructed to an elevation of 5.4 m or greater (as shown on current drawings).
2) Building entrances and windows to habitable space should be at or above the FCL.
3) The underside of any wooden floor system, or the top of any concrete floor system used for habitation should be above the FCL.

4) No enclosed space to be used for habitation or storage of goods that can be damaged by floodwaters should be below the FCL.

5) All main electrical and mechanical infrastructure are to be above the FCL. Any electrical supply below the FCL (i.e. outlets or lighting) should be protected by GFCI (ground fault circuit interruption) located above the FCL.

6) The residence is set back from the edge of water a minimum of 15 m. Additional set back improves options to address further increases in SLR that may occur as well as shoreline erosion if it becomes a problem in the future.

7) If the site is landscaped with isolated low lying ground between the properties boundary with Burrard Inlet and the proposed residence, than stormwater drainage is designed to accommodate potential spray and overtopping.

8) Shoreline treatment to reduce and address overtopping is designed by a coastal engineer and constructed. Any staging of treatment, that is accounting for SLR with future treatments, is defined and documented, such that future owners of the property are aware of the future requirements (potentially using a covenant to ensure knowledge transfer).

In addition, it is recommended that the property owner monitor and inspect their property for erosion and beach degradation twice a year to allow further investigation and mitigation if either become a problem in the future.

This flood hazard assessment was conducted following EGBC 2018 Class 1 flood hazard assessment guidelines. A summary of the APEGBC criteria for such an assessment is presented in **Table 8**.

Hazards other than flood hazards from the Burrard Inlet and the adjacent creeks, 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.

Table 8. Summary of EGBC typical Class 1 flood hazard assessment methods and deliverables

EGBC Flood Hazard Assessment Component	Notes
Typical hazard assessment methods and climate/environmental change considerations	
Site inspection and qualitative assessment of flood hazard	Completed by NHC 2018
Identify any very low hazard surfaces in the consultation area (i.e., river terraces)	Completed by NHC 2018
Estimate erosion rates along river banks	River erosion not applicable to site. Coastal erosion not evident.
1-D or possibly 2-D modelling, modelling of fluvial regime and future trends in river bed changes, erosion hazard maps, possibly paleoflood analysis	2-D coastal and 1-D riverine completed by NHC 2018
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)	Potential blockage of culvert or sediment deposition in the channel considered possible mechanism of the flood scenario

EGBC Flood Hazard Assessment Component	Notes
Conduct simple time series analysis of runoff data, review climate change predictions for study region, include in assessment if considered appropriate	Completed by NHC 2018, including allowance for climate change as recommended by MWLAP (2004)
Quantify erosion rates by comparative air photograph analysis	N/A – erosion risk deemed low
Typical deliverables	
Letter report or memorandum with at least water levels and consideration of scour and bank erosion	Completed
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	Flow descriptions completed. Erosion risk deemed low
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	Areas and elevations inundated during the 200-year return period design event described

7 CLOSURE

We hope this work and report meets your current needs. If you have any questions or would like to further discuss these findings, please contact Edwin Wang or Dale Muir at our North Vancouver office at (604) 980-6011 or by email (ewang@nhcweb.com | dmuir@nhcweb.com).

Sincerely,

Northwest Hydraulic Consultants Ltd.

Prepared by:

Sahar Banisoltan, PhD. EIT.
Project Engineer

Reviewed by:

PROFESSIONAL PROVINCE OF D.P. MUIR 27657 BRITISH COLUMBIA ENGINEER

2020 DEC 15

Dale Muir, P. Eng.
Principal

DISCLAIMER

This document has been prepared by Northwest Hydraulic Consultants Ltd. in accordance with generally accepted engineering practices and is intended for the exclusive use and benefit of TONG XI ZHANG , and their authorized representatives for specific application to the Flood Hazard Assessment at L4428 Ross Crescent, West Vancouver, BC.

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REFERENCES

BCMOE (2011a). "Climate Change Adaption Guidelines for Sea Dikes and Coastal Flood Hazard Land Use – Sea Dike Guidelines".

BCMOE (2011b). "Climate Change Adaption Guidelines for Sea Dikes and Coastal Flood Hazard Land Use – Draft Policy Discussion Paper".

Clague et al. (2005). Tsunami Hazard to North and West Vancouver, British Columbia. Centre for Natural Hazard Research, Simon Fraser University. 25 pp.

Coastal Floodplain Mapping – Guidelines and Specifications (BC MFLNRO, 2011)

Eaton, B., M. Church, and D. Ham. (2002) "Scaling and Regionalization of Flood Flows in British Columbia, Canada". Hydrological Processes 16:3245-3263.

Flood Hazard Area Land Use Management Guidelines (BCMFLNRD, 2018)

EGBC. (2018) Legislated Flood Assessments in a Changing Climate in BC. Version 2.0. Prepared by Engineers and Geoscientists of British Columbia, dated 2019 July 18.

EurOtop (2016). Wave Overtopping of Sea Defences and Related Structures: Assessment Manual. 2007 August.

Lambert, A., Mazzotti, S., van der Kooij, M., and Mainville, A., (2008): Subsidence and relative sea level rise in the Fraser River Delta, Greater Vancouver, British Columbia, from combined geodetic data, Geological Survey of Canada, Open File 5698, 44p.

Northwest Hydraulic Consultants (NHC). (1984). Hydraulic Design of Stable Flood Control Channels. II-Draft Guidelines for Preliminary Design. Prepared for U.S Army Corps of Engineers Seattle District.

Northwest Hydraulic Consultants (NHC). (2019). 4428 Ross Crescent, District of West Vancouver Mitigation Measures to Reduce Wave Effects – Runup Analysis. Prepared for Top Vision Development and Farzin Yadegari Architect Inc. 2019 September 10.

North Shore News (2016) "West Vancouver _flooding victims eligible for disaster relief" Retrieved on November 23, 2018 from https://www.nsnews.com/news/west-vancouver-flooding-victims-eligible-for-disaster-relief-1.2292067

Professional Practice Guidelines – Legislated Flood Assessments in a Changing Climate in BC (EGBC, 2018)

Spaeth, M. G., and Berkman, S. C. (1967). The tsunami of March 28, 1964 as recorded at tide stations.

Vancouver sun (2016) "A heavy rainstorm in Metro Vancouver overnight caused flooding and evacuations overnight Tuesday in West Vancouver." Retrieved on Nov 23, 2018 from https://vancouversun.com/news/local-news/heavy-rainstorm-causes-flooding-in-west-vancouver

The Pacific Stream keepers Federation (Not dated) Cypress Creek Watershed Profile, Retrieved on Nov 23, 2018 from https://www.pskf.ca/ecology/watershed/westvan/cypress02.htm

Appendix A
Flood Hazard and Risk Assurance Statement

FLOOD ASSURANCE STATEMENT

Note: This statement is to be read and completed in conjunction with the current Engineers and Geoscientists BC *Professional Practice Guidelines – Legislated Flood Assessments in a Changing Climate in BC* ("the guidelines") and is to be provided for flood assessments for the purposes of the *Land Title Act*, Community Charter, or the *Local Government Act*. Defined terms are capitalized; see the Defined Terms section of the guidelines for definitions.

To: The Approving Authority

District of West Vancouver

750 17th St. West Vancouver, BC, V7V 3T3

Jurisdiction and address

Date: 2018 December 20

With reference to (CHECK ONE):

- ☐ *Land Title Act* (Section 86) – Subdivision Approval
- ☐ *Local Government Act* (Division 7) – Development Permit
- ☒ Community Charter (Section 56) – Building Permit
- ☐ *Local Government Act* (Section 524) – Flood Plain Bylaw Variance
- ☐ *Local Government Act* (Section 524) – Flood Plain Bylaw Exemption

For the following property ("the Property"):

4428 Ross Cresent; Plan 4725 District Lot 582 Block 1 Lot 9

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 who fulfils the education, training, and experience requirements as outlined in the guidelines.

I have signed, sealed, and dated, and thereby certified, the attached Flood Assessment Report on the Property in accordance with the guidelines. That report and this statement must be read in conjunction with each other. In preparing that Flood Assessment Report I have:

[CHECK TO THE LEFT OF APPLICABLE ITEMS]

X 1. Consulted with representatives of the following government organizations:
District of West Vancouver

X 2. Collected and reviewed appropriate background information

___ 3. Reviewed the Proposed Development on the Property

X 4. Investigated the presence of Covenants on the Property, and reported any relevant information

X 5. Conducted field work on and, if required, beyond the Property

X 6. Reported on the results of the field work on and, if required, beyond the Property

X 7. Considered any changed conditions on and, if required, beyond the Property

8. For a Flood Hazard analysis I have:
   - X 8.1 Reviewed and characterized, if appropriate, Flood Hazard that may affect the Property
   - X 8.2 Estimated the Flood Hazard on the Property
   - X 8.3 Considered (if appropriate) the effects of climate change and land use change
   - ___ 8.4 Relied on a previous Flood Hazard Assessment (FHA) by others
   - X 8.5 Identified any potential hazards that are not addressed by the Flood Assessment Report

9. For a Flood Risk analysis I have:
   - ___ 9.1 Estimated the Flood Risk on the Property
   - ___ 9.2 Identified existing and anticipated future Elements at Risk on and, if required, beyond the Property
   - ___ 9.3 Estimated the Consequences to those Elements at Risk

10. In order to mitigate the estimated Flood Hazard for the Property, the following approach is taken:
 X 10.1 A standard-based approach
___ 10.2 A Risk-based approach
___ 10.3 The approach outlined in the guidelines, Appendix F: Flood Assessment Considerations for Development Approvals
___ 10.4 No mitigation is required because the completed flood assessment determined that the site is not subject to a Flood Hazard

11. Where the Approving Authority has adopted a specific level of Flood Hazard or Flood Risk tolerance, I have:
___ 11.1 Made a finding on the level of Flood Hazard or Flood Risk on the Property
___ 11.2 Compared the level of Flood Hazard or Flood Risk tolerance adopted by the Approving Authority with my findings
___ 11.3 Made recommendations to reduce the Flood Hazard or Flood Risk on the Property

12. Where the Approving Authority has not adopted a level of Flood Hazard or Flood Risk tolerance, I have:
 X 12.1 Described the method of Flood Hazard analysis or Flood Risk analysis used
 X 12.2 Referred to an appropriate and identified provincial or national guideline for level of Flood Hazard or Flood Risk
 X 12.3 Made a finding on the level of Flood Hazard of Flood Risk tolerance on the Property
 X 12.4 Compared the guidelines with the findings of my flood assessment
 x 12.5 Made recommendations to reduce the Flood Hazard or Flood Risk

X 13. Considered the potential for transfer of Flood Risk and the potential impacts to adjacent properties

X 14. Reported on the requirements for implementation of the mitigation recommendations, including the need for subsequent professional certifications and future inspections.

Based on my comparison between:

[CHECK ONE]

☐ The findings from the flood assessment and the adopted level of Flood Hazard or Flood Risk tolerance (item 11.2 above)

X☐ The findings from the flood assessment and the appropriate and identified provincial or national guideline for level of Flood Hazard or Flood Risk tolerance (item 12.4 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 Flood Assessment Report will "assist the local government in determining what conditions or requirements under [Section 920] subsection (7.1) it will impose in the permit".

X☐ 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.

X☐ Without any registered Covenant.

☐ For flood plain bylaw variance, as required by the *Flood Hazard Area Land Use Management Guidelines* and the *Amendment Section 3.5 and 3.6* associated with the *Local Government Act* (Section 524), "the development may occur safely".

☐ For flood plain bylaw exemption, as required by the *Local Government Act* (Section 524), "the land may be used safely for the use intended".

FLOOD ASSURANCE STATEMENT

I certify that I am a Qualified Professional as defined below.

2018-12-20
Date

Northwest Hydraulic Consultants Ltd.
Prepared by

Sahar Bani Soltan
Name (print)

Sahar Bani Saltan
Signature

30 Gostick Place
North Vancouver, BC, V7M 3G3
Address

604-980-6011
Telephone

DMUIR@NHCWEB.COM
Email

Northwest Hydraulic Consultants Ltd.
Reviewed by

Dale Muir
Name (print)

[signature]
Signature

PROFESSIONAL
PROVINCE OF
D.P. MUIR
27657
BRITISH COLUMBIA
ENGINEER
2018-12-20

(Affix PROFESSIONAL SEAL here)

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

I am a member of the firm Northwest Hydraulic Consultants Ltd.
and I sign this letter on behalf of the firm. (Name of firm)

Appendix B
Site Photos

Figure B.1. Cypress Creek (a: Marine Drive looking east, b: upstream, c: downstream)

Figure B.2. Willow Creek photos (a: new trash rack at inlet, b: culvert inlet, c: outlet)

Figure B.3. Claymore Creek inlet and outlet photos (a: Claymore Creek at Ross Crescent, b: culvert inlet, c: constructed channel, d: debris at crossing outlet)

Figure B.4. Roads near project site (a: Keith Road looking north, b: intersection of Marine Drive and Keith Road looking west, c: intersection of Marine Drive and Stearman Avenue looking southwest, d: Ross Crescent looking northwest

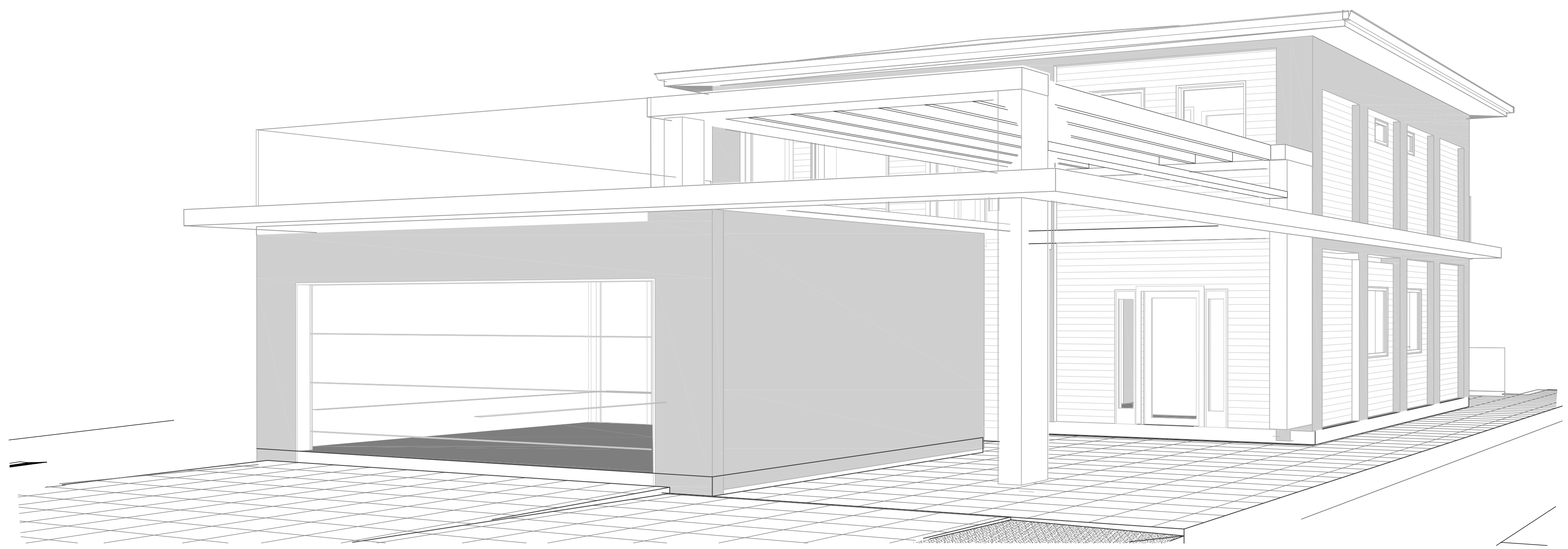
a

b

Figure B.5. Project site (a: project site looking landward (NE) , b: project site looking seaward (SW))

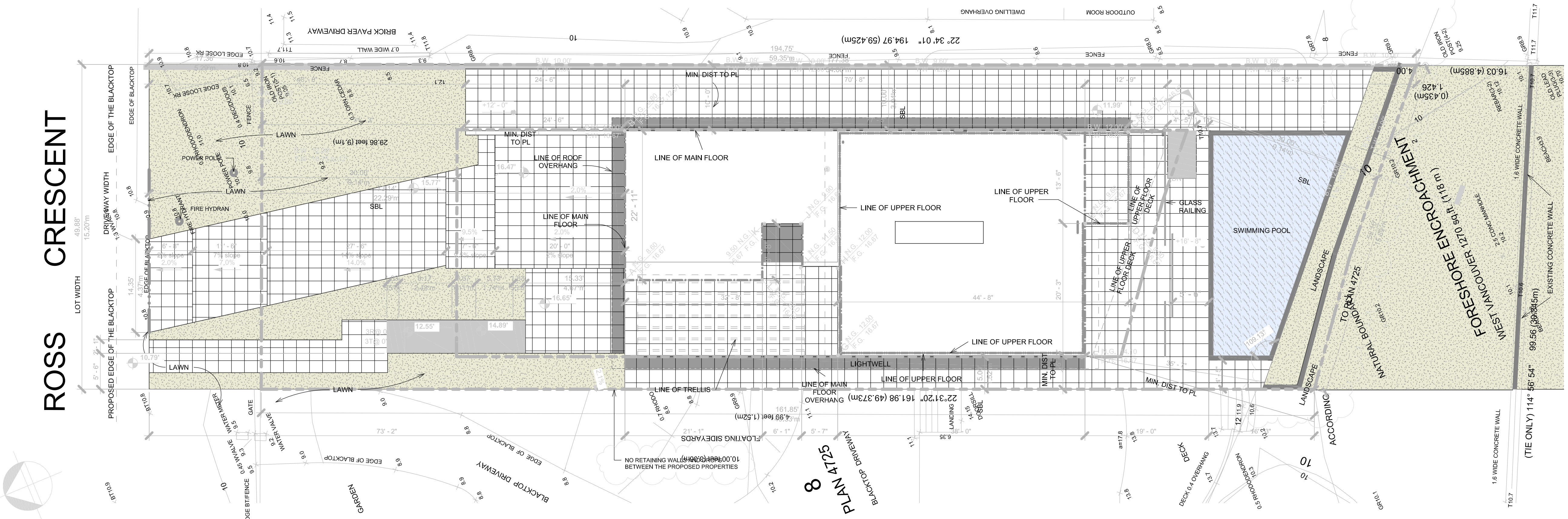
Appendix C
Reference Drawings

4428 ROSS



FARZIN
YADEGARI
ARCHITECT INC.
100 2240 CHIPPENDALE ROAD
WEST VANCOUVER, B.C. V7S 3J5
T 778 340 4142 WWW.FYARCH.CA

NOVEMBER 2020



① SITE PLAN
1/8" = 1'-0"

4428 ROSS

4430/9 Ross Crescent, West Vancouver, BC V7W 1B2, Canada
Legal Address: Lot: 9 Block: 1 District Lot: 582 Plan: 4725
Folio: 04-0337-001 PID: 002-741-121

DESCRIBTION	IMPERIAL	METRIC
ZONE	RS4	
LOT WIDTH	50	15
LOT AREA	8440	784
UPPER FLOOR AREA	1340	124
MAIN FLOOR AREA (GARAGE INCLUDED)	1895	176
GRAND TOTAL FLOOR AREA	3235	301
GARAGE AREA (DETACHED)	0	0
GARAGE AREA (ATTACHED)	473	44
PART OF GARAGE FOR FAR.	33	3
MAIN FLOOR AREA (GARAGE EXCLUDED)	1422	132

UPPER FLOOR GRADE	27.20	8.29
MAIN FLOOR GRADE	17.33	5.28

ALLOWED (FSR) = 0.35 x Lot Area	2954	390
PROVIDED FSR AREA	2762	257
PROVIDED FSR %	32.73%	
ALLOWED- PROVIDED (FSR) =	192	18

LOWEST AVEARGE GRADE	10.23	3.12

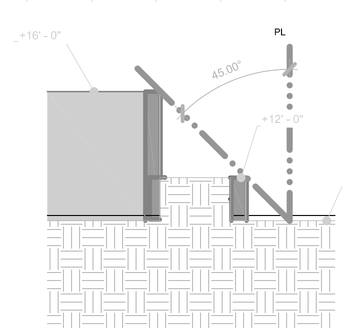
ALLOWED SITE COVERAGE = 0.30 x Lot Area	2532	235
PROVIDED SITE COVERAGE AREA	2290	213
PROVIDED SITE COVERAGE%	27.13%	

CALCULATION OF NATURAL GRADE

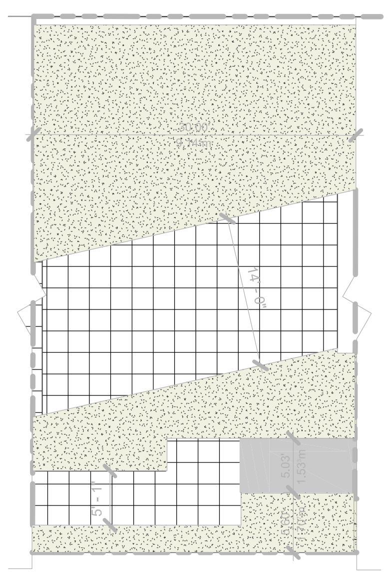
AVERAGE NATURAL GRADE ELEVATION									10.23
						240.00			2455.62
AB	(	8.60 +	9.00)	/2=	8.80 ×	21.91	=		192.81
BC	(	9.00 +	9.20)	/2=	9.10 ×	77.40	=		704.34
CD	(	9.20 +	9.60)	/2=	9.40 ×	14.23	=		133.76
DE	(	9.60 +	9.70)	/2=	9.65 ×	6.63	=		63.98
EF	(	9.70 +	13.50)	/2=	11.60 ×	20.28	=		235.25
FG	(	13.50 +	12.10)	/2=	12.80 ×	38.07	=		487.30
GH	(	12.10 +	12.00)	/2=	12.05 ×	13.44	=		161.95
HI	(	12.00 +	11.50)	/2=	11.75 ×	5.67	=		66.62
IJ	(	11.50 +	9.90)	/2=	10.70 ×	6.68	=		71.48
JK	(	9.90 +	9.50)	/2=	9.70 ×	5.79	=		56.16
KL	(	9.50 +	10.00)	/2=	9.75 ×	8.67	=		84.53
LA	(	10.00 +	8.60)	/2=	9.30 ×	21.23	=		197.44

CALCULATION OF FINISHED GRADE

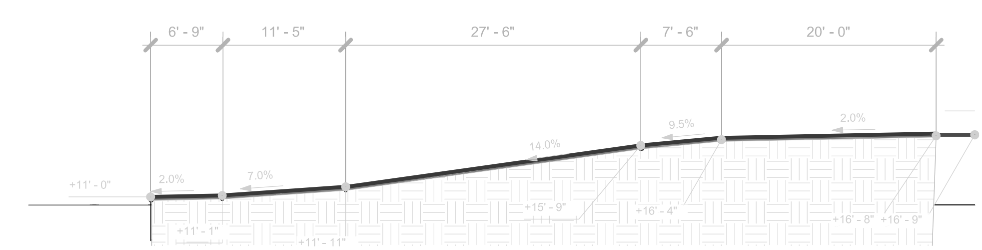
AVERAGE FINISHED GRADE ELEVATION									15.16
						240.00			3639.34
AB	(	16.67 +	16.67)	/2=	16.67 ×	21.91	=		365.24
BC	(	12.00 +	12.00)	/2=	12.00 ×	77.40	=		928.80
CD	(	16.67 +	16.67)	/2=	16.67 ×	14.23	=		237.21
DE	(	16.67 +	16.67)	/2=	16.67 ×	6.63	=		110.52
EF	(	16.67 +	16.67)	/2=	16.67 ×	20.28	=		338.07
FG	(	16.67 +	16.67)	/2=	16.67 ×	38.07	=		634.63
GH	(	16.67 +	16.67)	/2=	16.67 ×	13.44	=		224.04
HI	(	16.67 +	16.67)	/2=	16.67 ×	5.67	=		94.52
IJ	(	16.67 +	16.67)	/2=	16.67 ×	6.68	=		111.36
JK	(	16.67 +	16.67)	/2=	16.67 ×	5.79	=		96.52
KL	(	16.67 +	16.67)	/2=	16.67 ×	8.67	=		144.53
LA	(	16.67 +	16.67)	/2=	16.67 ×	21.23	=		353.90



⑤ RETAINING WALLS AT SOUTH PL
(THE SECTION IS PERPENDICULAR TO PL)
1/4" = 1'-0"



② FRONT YARD PAVED AREA CALCULATION
1/8" = 1'-0"



③ DRIVEWAY PROFILE
1/8" = 1'-0"

FARZIN YADEGARI ARCHITECT INC.
100 2245 CHIPPENDALE ROAD
WEST VANCOUVER, B.C. V7S 3J5
T 778 340 4142 WWW.FYARCH.CA

No.	.	Date
1	CITY COMMENTS	May 22nd
2	BASEMENT REMOVED	JUL 25TH
3	HEIGHT CHANGE	MARCH 20
4	CITY REVIEW	NOV 20

PROJECT: 4428 ROSS

DRAWN BY: F.Y. A.A.

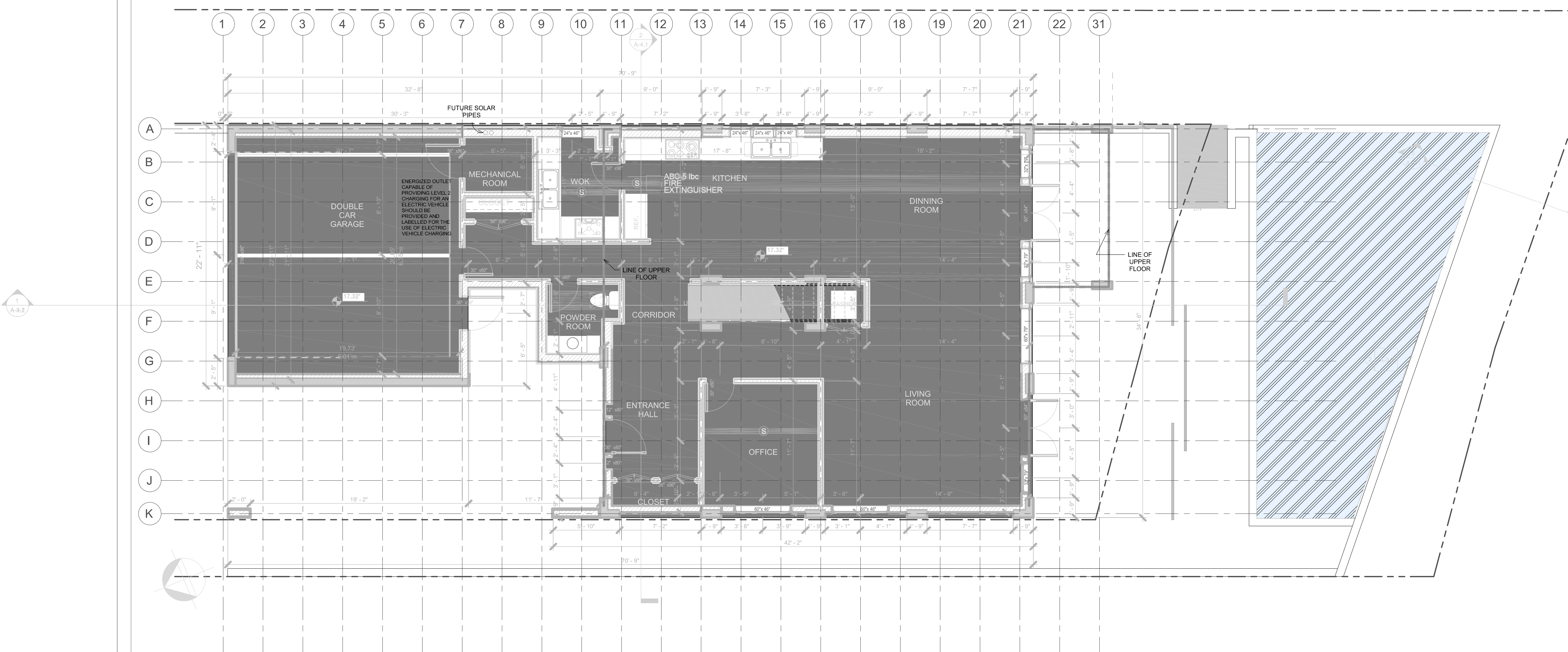
CHECKED BY: Checker

SCALE: As indicated

DATE: JUNE 2019

TITLE: SITE PLAN

SHEET NO: A-1.1



2 MAIN FLOOR
1/4" = 1'-0"

FARZIN YADEGARI ARCHITECT INC.
100 2240 CHIPPENDALE ROAD
WEST VANCOUVER, B.C. V7S 3J5
T. 778 340 4142 WWW.FYARCH.CA

No.	.	Date
3	HEIGHT CHANGE	MARCH 20

PROJECT:
4428 ROSS

DRAWN BY: F.Y. A.A.

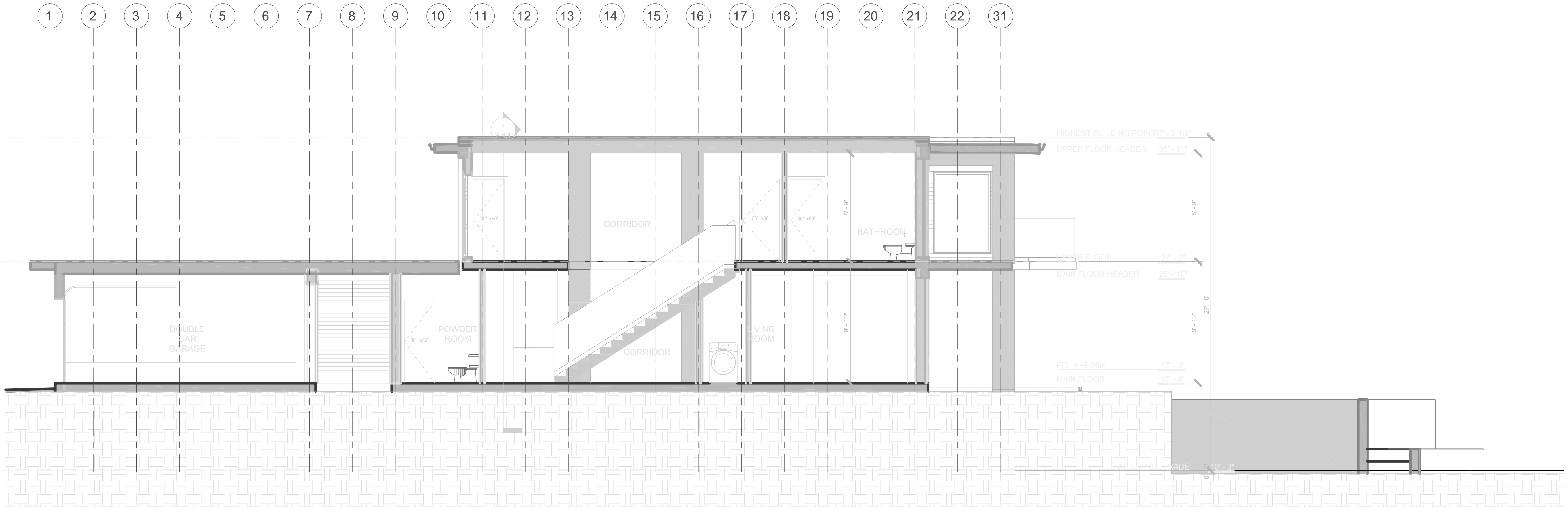
CHECKED BY: Checker

SCALE: 1/4" = 1'-0"

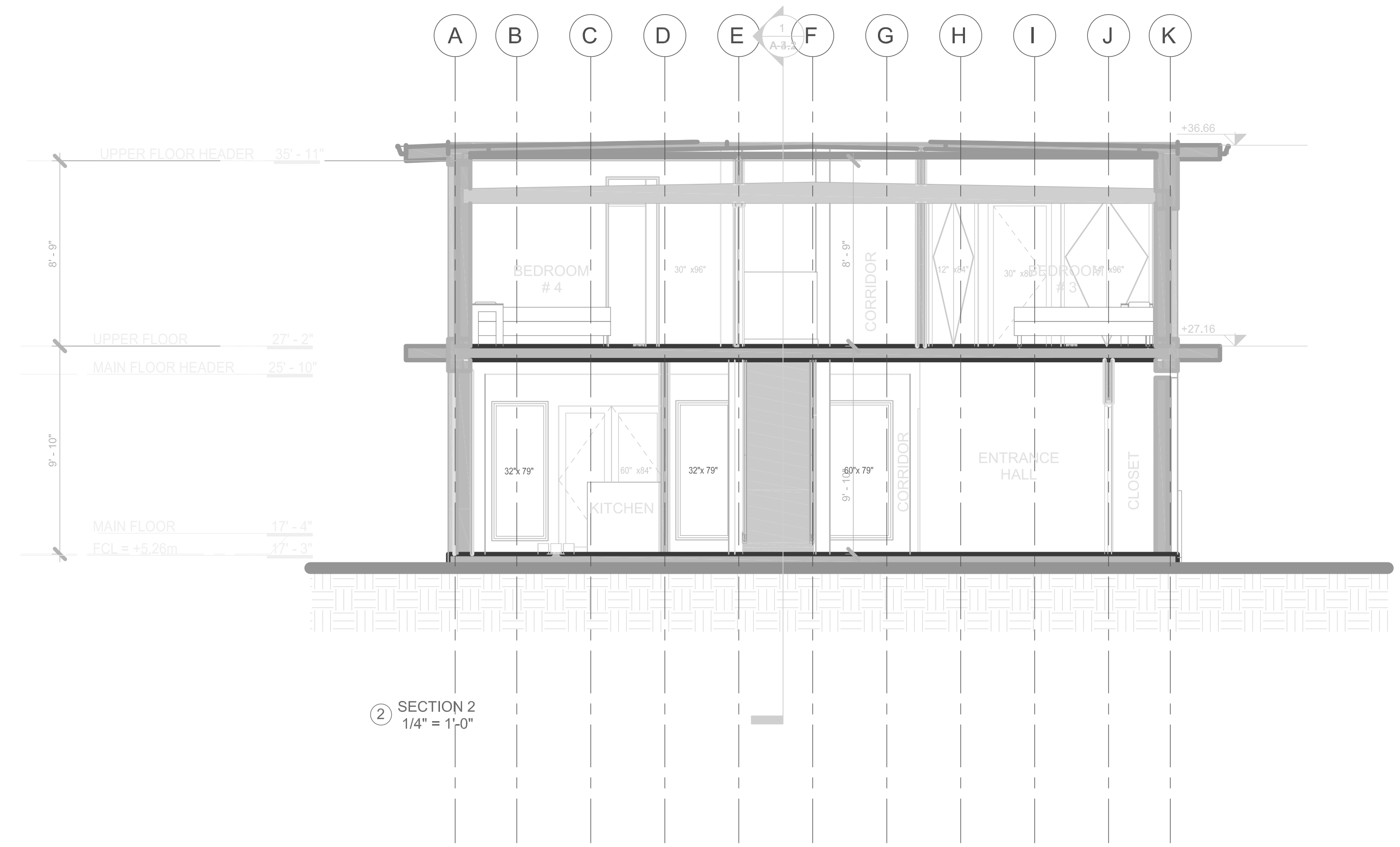
DATE: JUNE 2019

TITLE:
MAIN FLOOR PLAN

SHEET NO:
A-2.1



① SECTION 1
1/4" = 1'-0"



② SECTION 2
1/4" = 1'-0"

FARZIN YADEGARI ARCHITECT INC.
100 2245 CHIPPENDALE ROAD
WEST VANCOUVER, B.C. V7S 3J5
T 778 340 4142 WWW.FYARCH.CA

No.	.	Date
1	CITY COMMENTS	May 22nd
2	BASEMENT REMOVED	JUL 25TH
3	HEIGHT CHANGE	MARCH 20

PROJECT:
4428 ROSS

DRAWN BY: F.Y. A.A.

CHECKED BY: Checker

SCALE: 1/4" = 1'-0"

DATE: JUNE 2019

TITLE:
SECTIONS

SHEET NO:
A-4.1

nhc
northwest hydraulic consultants ltd

NHC Ref. No. 3004331
2021 May 13

Top Vision Development
150-10691 Shellbridge Way
Richmond, BC, V6X 2W8

Attn: Chris Spencer
Via: chrisspencer0125@gmail.com

Farzin Yadegari Architect Inc.
100- 2240 Chippendale Rd.
West Vancouver, BC V7S 3J5

Attn: **Farzin Yadegari, Architect**
Via: farzin@fyarch.ca

Re: 4428 Ross Crescent, District of West Vancouver
Coastal Wave Mitigation – Summary & Clarification

Introduction

This letter report is to provide additional description for recommended mitigation measures to address wave effects with respect the assessed flood hazard for the proposed redevelopment of 4428 Ross Crescent, District of West Vancouver (DWV), British Columbia, and would also apply to the similar development proposed for 4430 Ross Crescent.

Previously NHC conducted a flood hazard assessment (FHA) for this property[1] (4428 Ross Crescent) which stated a flood construction level (FCL) of El. 5.26 m (CGVD28 Datum[2]) conditional on additional mitigation measures to reduce the wave effects at the proposed house. Wave and runup modelling was conduced by NHC to confirm suitable wave mitigation measures[3]. This document has been prepared to clarify how the adopted wave mitigation measures are to work at reducing wave effect at the building. Provided below is a summary of the flood level and wave conditions from the previous reports and further description of the proposed wave barrier.

Flood Level

The coastal flood construction level (FCL) is derived from the still water level, often referred to as the designated flood level (DFL) plus the wave effects and freeboard. The DFL incorporates the combined effects of astronomical tides and concurrent atmospheric effects (e.g., storm surge) as projected to future design conditions. The future conditions include an allowance for seal level rise (SLR) and land subsidence. Error! Reference source not found. summarizes the resulting DFL for the current condition

[1] Flood Hazard Assessment, 4428 Ross Crescent, West Vancouver, BC, prepared by NHC, 2020 December 14

[2] All elevations are referenced to CGVD28 (Canadian Geodetic Vertical Datum) of 1927, unless otherwise specified.

[3] 4428 Ross Crescent, District of West Vancouver, Mitigation Measures to Reduce Wave Effects – Runup Analysis, prepared by NHC, 2019 September 10.

and that predicted for the year 2100. The freeboard is a factor of safety to account for uncertainty in the underlying data and analysis as well as temporal or spatial variations in water level. Wave effects are presented in the following subsection.

Table 1 Designated flood levels

Parameter	Year 2019 Elevation (m)	Year 2100 Elevation (m)
Tide + storm surge (joint probability)	2.89	2.89
+ Design SLR	0.00	1.00
+ Subsidence	0.00	0.12
Designated Flood Level	**2.89**	**4.01**

Wave Conditions

The 50-yr easterly wind event was used to calculate the design significant wave height and peak wave period; resulting in **1.6 m** and **4.6 seconds**. Additional modelling was conducted to simulate the runup of the design waves over the proposed shoreline. The analysis indicated that the waves would runup no higher than the proposed walls under current conditions, but by the year 2100 sea level rise is projected to enable waves to overtop the walls and flow along the patio area and reach the proposed house; under the design water level and storm conditions (**Figure 1**).

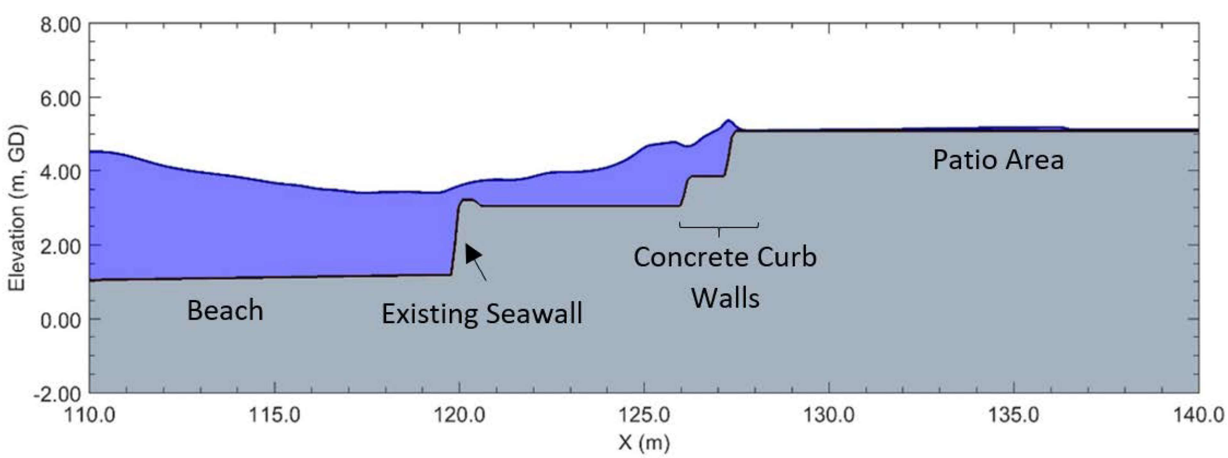


Figure 1 Simulated design wave overtopping proposed shoreline, year 2100 design water levels.

It was decided to use a barrier located between the house and pool to not only control access to the pool but also block wave runup (**Figure 2**).

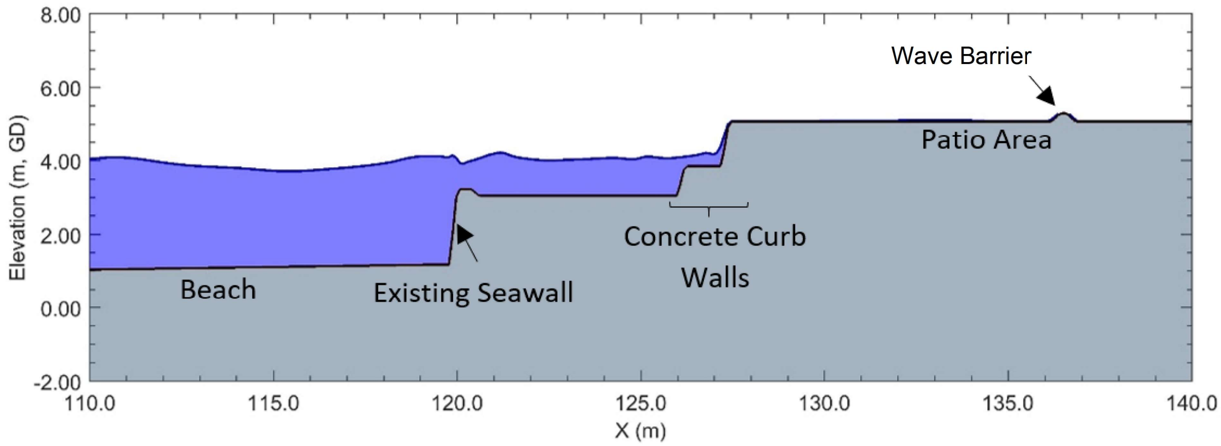


Figure 2 Simulated design wave runup blocked by wave barrier, year 2100 design water levels.

Wave Barrier

No additional barriers are required to protect the house from coastal hazards up to the design event under the current design water levels.

However, to protect the house against coastal flood inundation in the future – that is, following 0.7 to 1.0 m of sea level rise (estimated to occur over the next 50-100 years) – a barrier is required to block wave runup before it reaches the proposed house. This barrier is intended to block overtopping across the patio. Incoming waves will break at or between the seawall and curb wall with runup of water continuing over the patio area as remaining energy and momentum is dissipated. The barrier is intended to block the flow of water that remains following the breaking of the waves.

To be effective against the design event, the barrier is to be:

- Located between the pool and the house.
- Have a crest elevation of 5.4 m or greater (17’8.6”).
- Sufficiently secure to withstand loading of water up to an elevation of 5.4 m
- Provide continuous protection from coastal exposure (southwest side and southeast corner). This can be provided either as a:
    - Single solid structure,
    - Structure with a gate or other opening that can be closed, or
    - Overlapping barriers, provided the overlap is equal or greater to the distance between the barriers, the distance between the barriers is no greater than 1.2 m, and the overlap is set back a minimum of 2 m from an entrance to the house.

Despite assessment and mitigation of coastal flood hazards, the site may still be susceptible to residual risk from more extreme events occurring (beyond the standard design events) or other hazards not directly related to the coastal flood hazard (i.e. geotechnical, seismic, fire, etc.).

CLOSURE

We hope this work and report meets your current needs. If you have any questions don't hesitate to contact Dale Muir or Edwin Wang by phone **604-980-6011 o**r email (dmuir@nhcweb.com | ewang@nhcweb.com).

Sincerely,

Northwest Hydraulic Consultants Ltd.

Prepared by:

PROFESSIONAL PROVINCE OF D.P. MUIR 27657 BRITISH COLUMBIA ENGINEER

2021 MAR 31

Dale Muir, P.Eng.
Principal Engineer

Reviewed by: Edwin Wang, P.Eng.

DISCLAIMER

This document has been prepared by Northwest Hydraulic Consultants Ltd. for the benefit of Top Vision Development for specific application to the assessing wave effects reduction measures at 4428 Ross Crescent, West Vancouver. 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.

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