OREGON CITY

Community Development – Planning

698 Warner Parrott Road | Oregon City OR 97045
Ph (503) 722-3789 | Fax (503) 722-3880

LAND USE APPLICATION FORM

Type I (OCMC 17.50.030.A)
- ☐ Compatibility Review
- ☐ Lot Line Adjustment
- ☐ Non-Conforming Use Review
- ☒ Natural Resource (NROD) Verification
- ☐ Site Plan and Design Review
- ☐ Extension of Approval

Type II (OCMC 17.50.030.B)
- ☐ Detailed Development Review
- ☒ Geotechnical Hazards
- ☐ Minor Partition (<4 lots)
- ☐ Minor Site Plan & Design Review
- ☐ Non-Conforming Use Review
- ☐ Site Plan and Design Review
- ☐ Subdivision (4+ lots)
- ☐ Minor Variance
- ☐ Natural Resource (NROD) Review

Type III / IV (OCMC 17.50.030.C)
- ☐ Annexation
- ☐ Code Interpretation / Similar Use
- ☐ Concept Development Plan
- ☐ Conditional Use
- ☐ Comprehensive Plan Amendment (Text/Map)
- ☐ Detailed Development Plan
- ☐ Historic Review
- ☐ Municipal Code Amendment
- ☐ Variance
- ☐ Zone Change

File Number(s): _____

Proposed Land Use or Activity: Construction of a new single family residence and detached garage with second story ADU

Project Name: Schademan Residence Number of Lots Proposed (If Applicable): NA

Physical Address of Site: 5th and Apperson

Clackamas County Map and Tax Lot Number(s): 3-1E-01AA- 02602

Applicant(s):

Applicant(s) Signature: Todd L. Iselin

Applicant(s) Name Printed: Todd Iselin/ Iselin Architects PC Date: Dec 19, 2018

Mailing Address: 1307 7th St, Oregon City, OR 97045

Phone: 503.656.1942 Fax: _____ Email: todd@iselinarch.com

Property Owner(s):

Property Owner(s) Signature: Karen Schademan

Property Owner(s) Name Printed: Karen and Morris Schademan Date: Dec 19, 2018

Mailing Address: 18561 S Terry Michael Drive, Oregon City, OR 97045

Phone: 503.631.7626 Fax: _____ Email: schademan@msn.com

Representative(s):

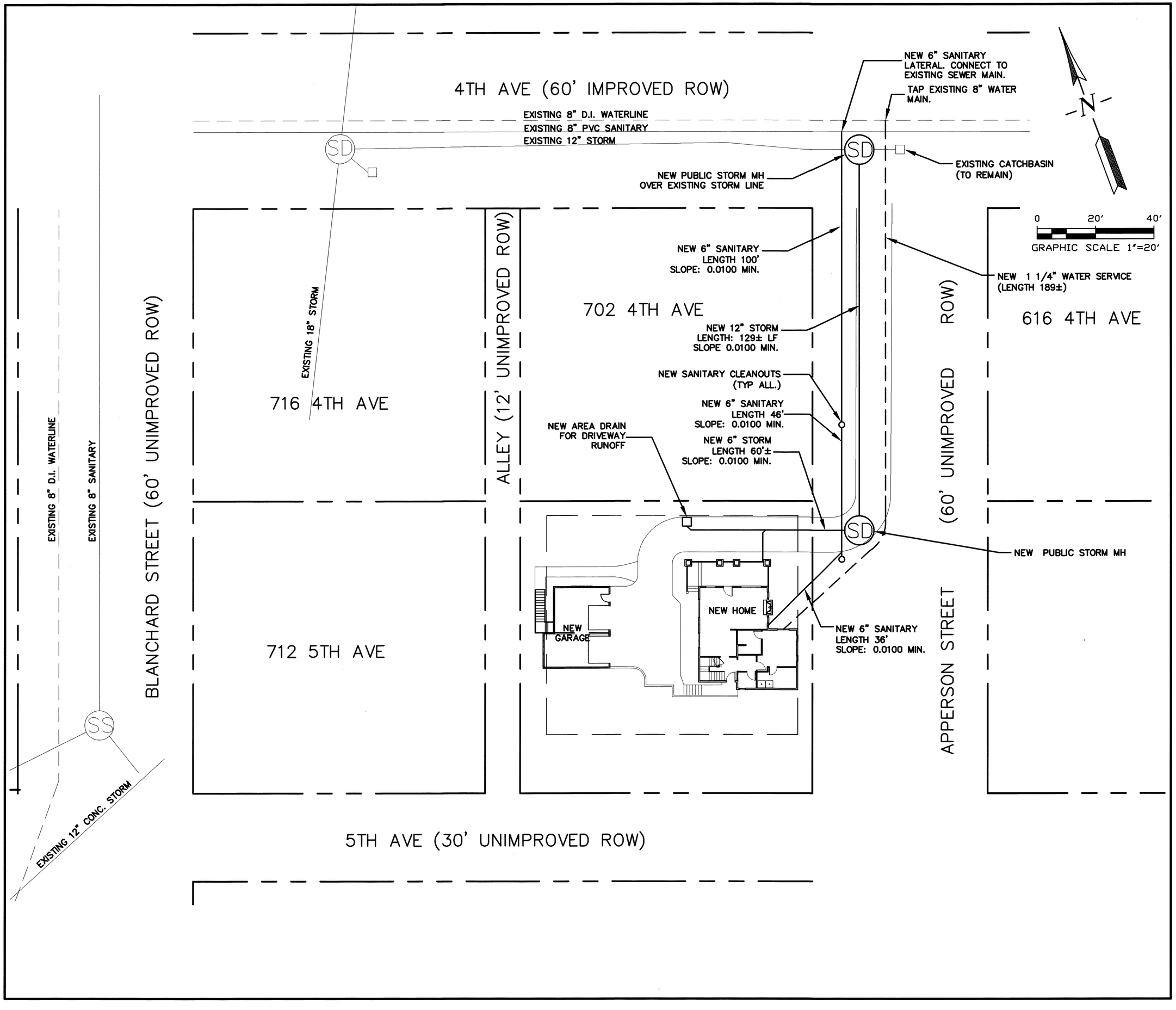
Representative(s) Signature: Todd L. Iselin

Representative (s) Name Printed: Same as applicant Date: _____

Mailing Address: _____

Phone: _____ Fax: _____ Email: _____

All signatures represented must have the full legal capacity and hereby authorize the filing of this application and certify that the information and exhibits herewith are correct and indicate the parties willingness to comply with all code requirements.



REVISIONS	BY

Schademan House

Iselin Architects, P.C.

Preliminary Utility

SISUL ENGINEERING
375 PORTLAND AVENUE
GLADSTONE, OREGON 97027
(503) 657-0188

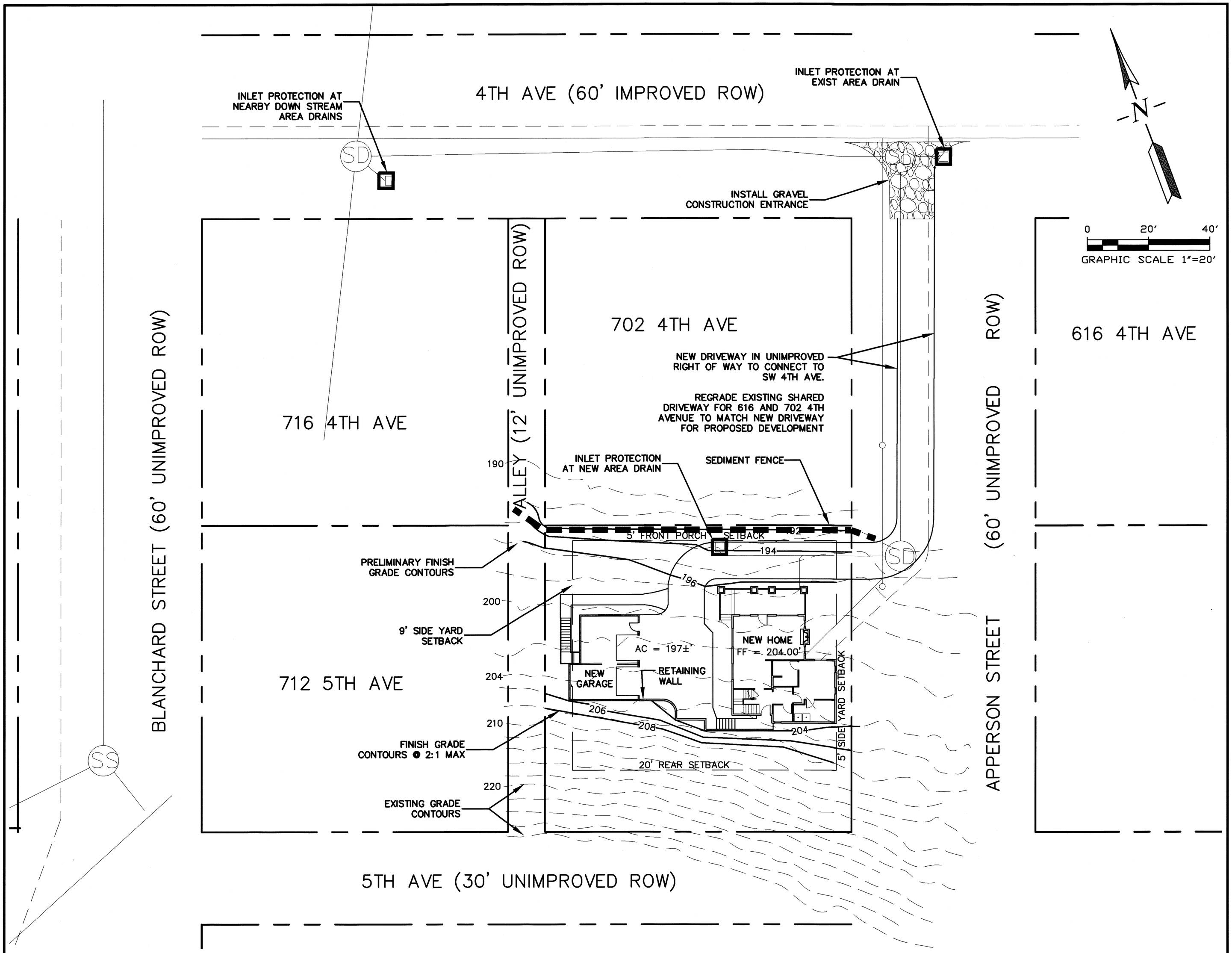
DATE 12-18-18

SCALE 1" = 20'

DRAWN JMF

JOB SGL 18-101

SHEET 1 OF 2 SHEETS



PRELIMINARY GRADING PLAN

SCALE" 1" = 20'

REVISIONS	BY

Preliminary Grading and Erosion Control

Schademan House

Iselin Architects, P.C.

ISUL ENGINEERING
375 PORTLAND AVENUE
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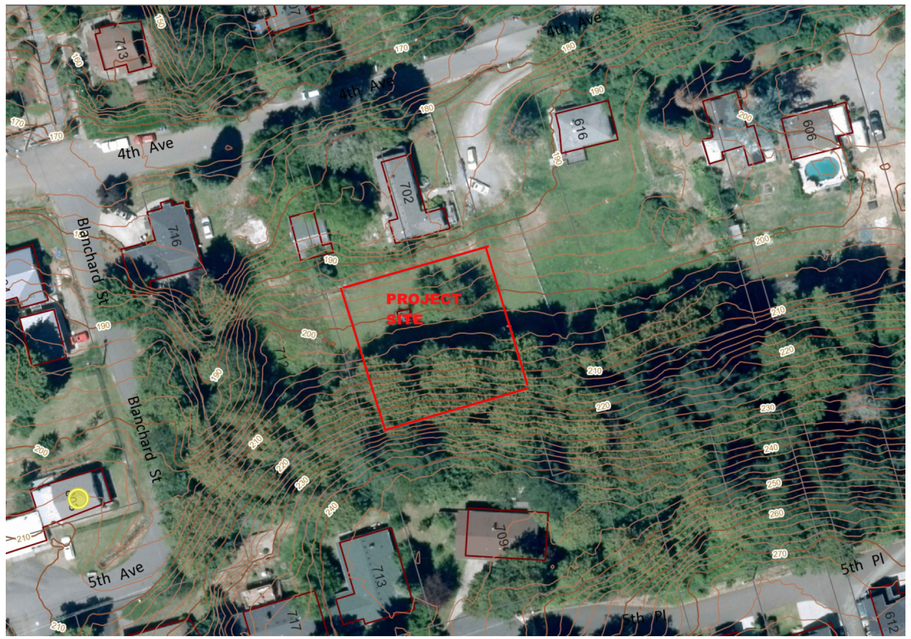
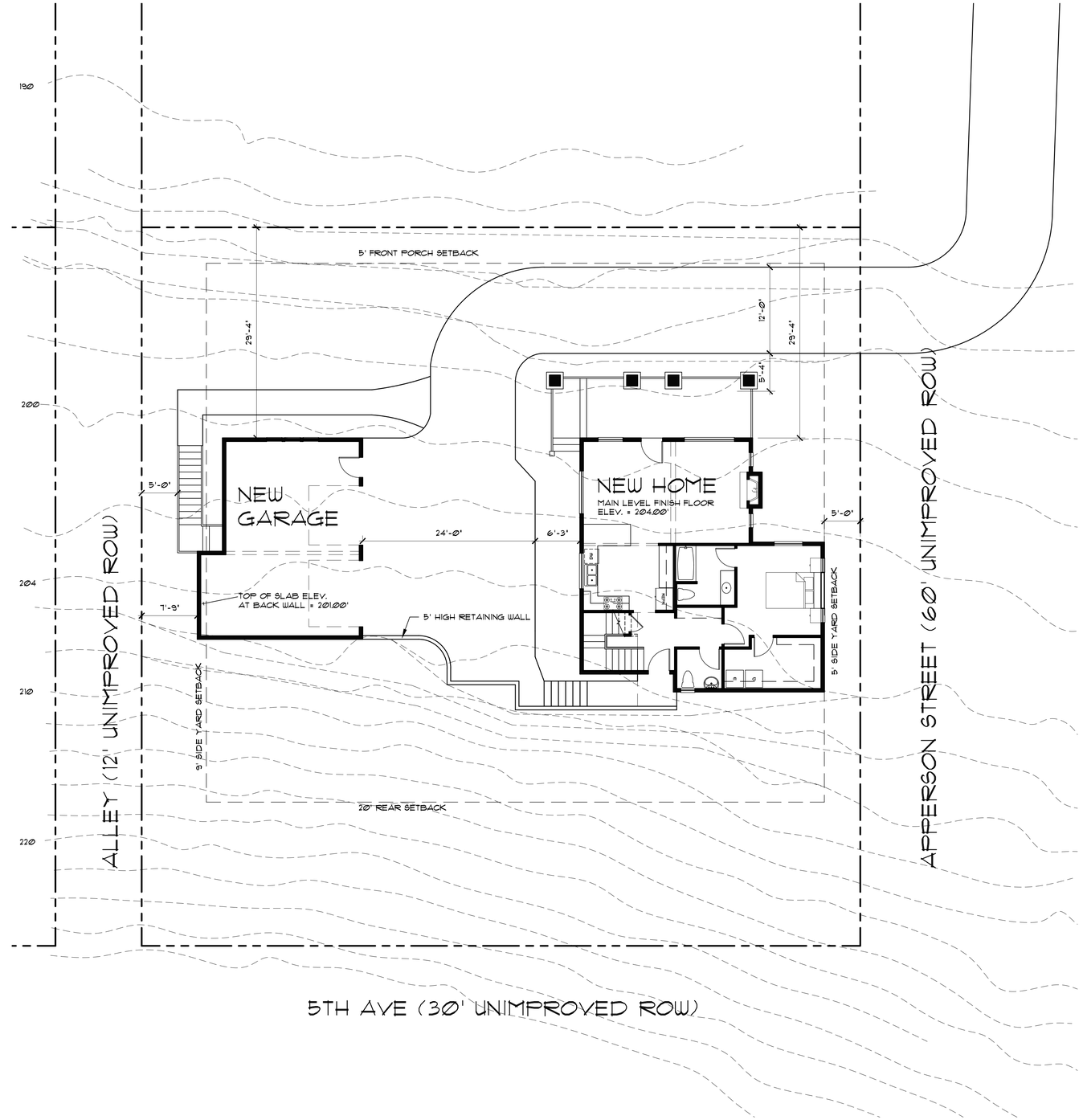


VICINITY MAP

NO SCALE



SITE PLAN

1/8" = 1'-0"

ISELIN ARCHITECTS P.C.
1307 Seventh Street
Oregon City, OR 97045
503-656-1942 ph
503-656-0658 fax
www.iselinarchitects.com

NOT FOR PRELIMINARY CONSTRUCTION

New Home and Detached Garage/ ADU for
Karen and Morris Schademan

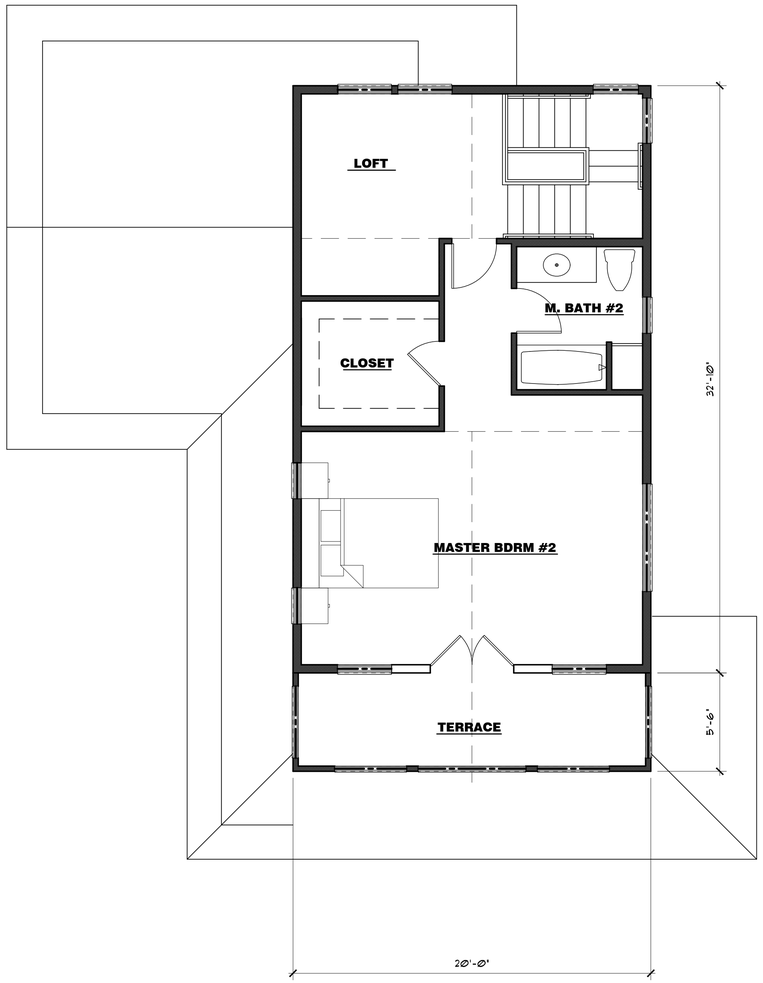
5th Ave and Apperson St
Oregon City, OR 97045

PROJ. NO. :	1773
FILE :	A-SIT
DATE :	10/29/18

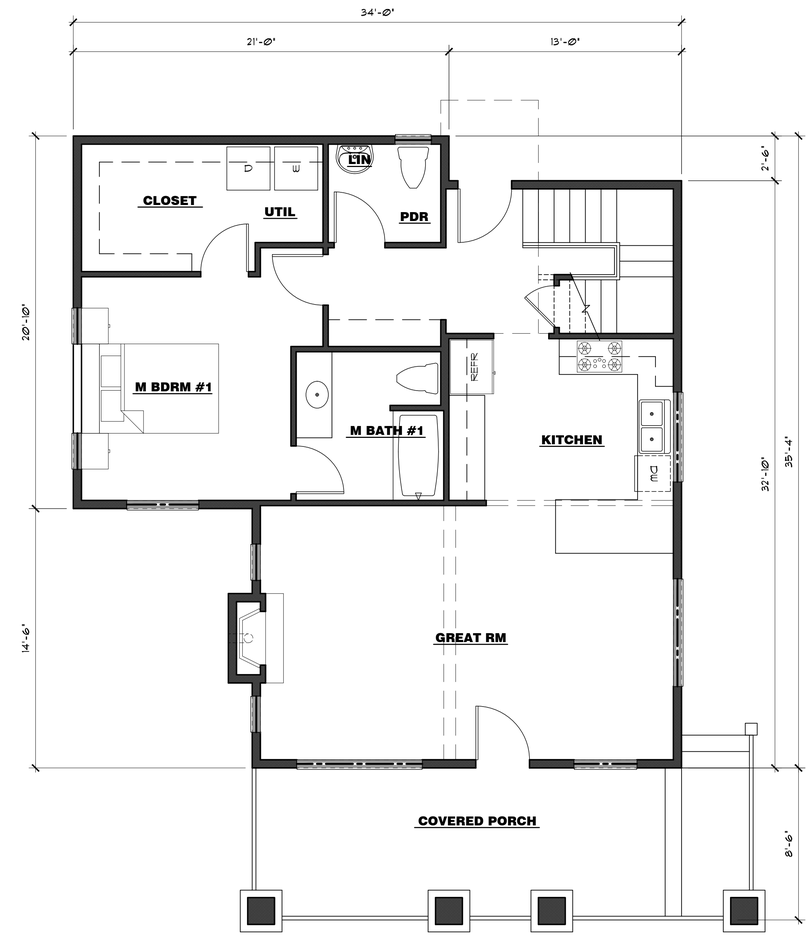
SHEET #

A1.0

SITE PLAN



UPPER LEVEL FLOOR PLAN
588 S.F.
1/4" = 1'-0"



MAIN LEVEL FLOOR PLAN
1,024 S.F.
1/4" = 1'-0"

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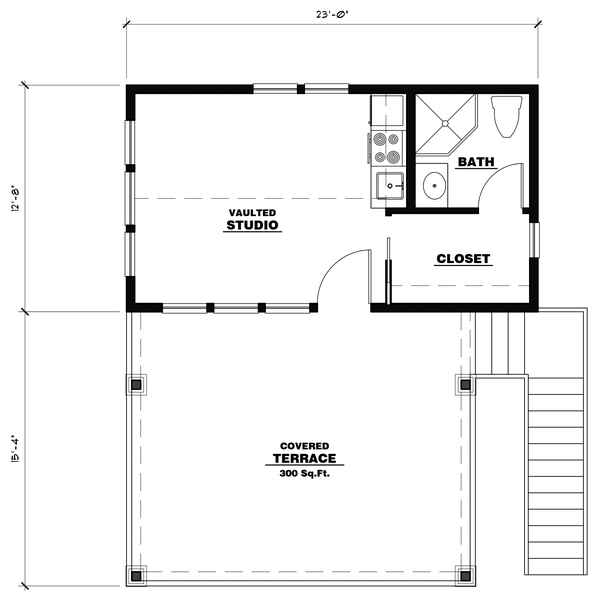
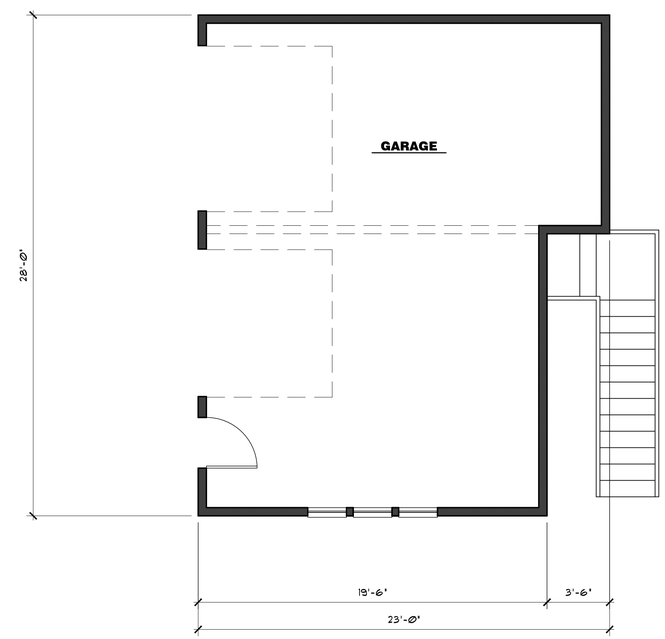
SHEET #
A1.1

PRELIM PLANS- HOUSE



UPPER LEVEL FLOOR PLAN
292 S.F.
1/4" = 1'-0"



MAIN LEVEL FLOOR PLAN
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1/4" = 1'-0"

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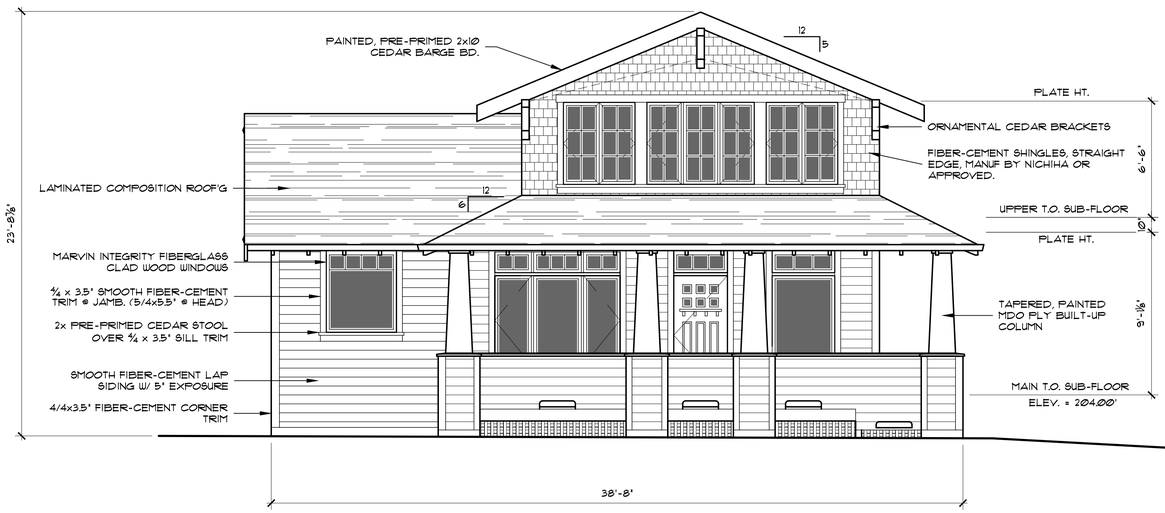
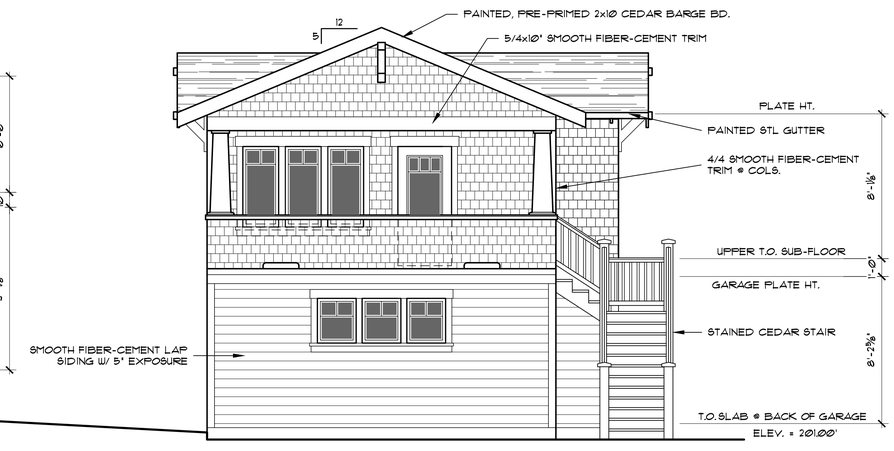
SHEET #
A1.2

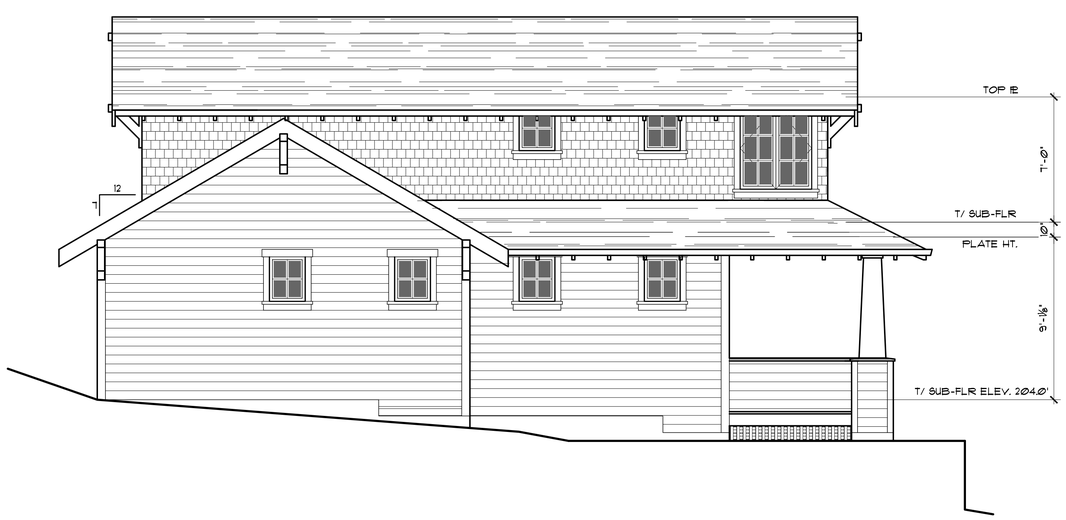
PRELIM PLANS- GARAGE



FRONT ELEVATION - HOUSE AND GARAGE
(NORTH SIDE FACING 4th AVENUE)

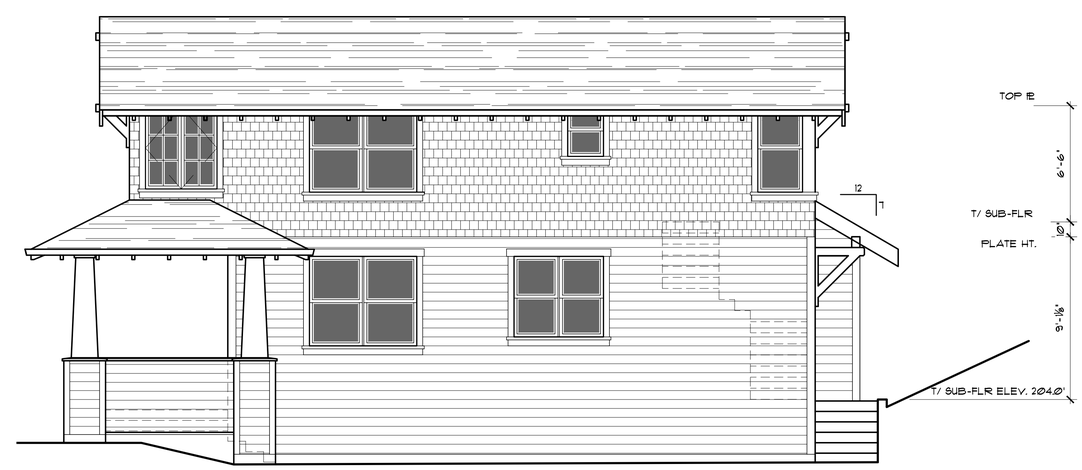
1/4" = 1'-0"





LEFT SIDE ELEVATION - HOUSE

1/4" = 1'-0"



RIGHT SIDE ELEVATION - HOUSE

1/4" = 1'-0"

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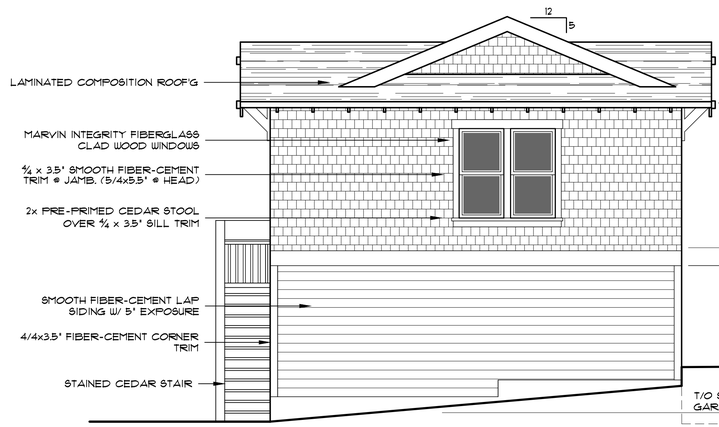
SHEET #

A2.1

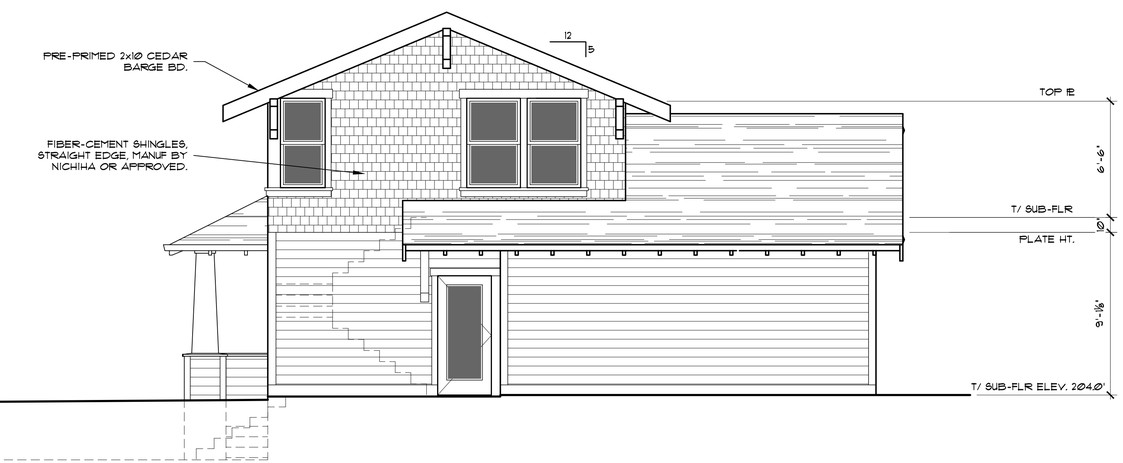
PRELIM ELEVATIONS



REAR ELEVATION - GARAGE AND HOUSE

(SOUTH SIDE FACING 5th AVENUE)

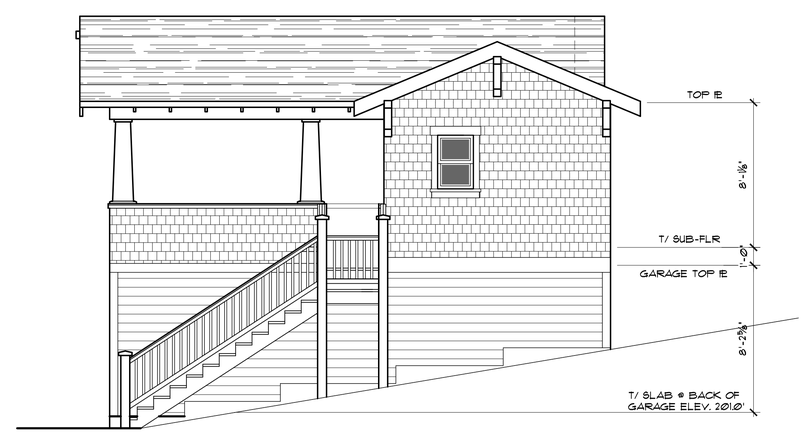
1/4" = 1'-0"



LEFT SIDE ELEVATION - GARAGE

(FACING EAST)

1/4" = 1'-0"



RIGHT SIDE ELEVATION - GARAGE

(FACING WEST)

1/4" = 1'-0"

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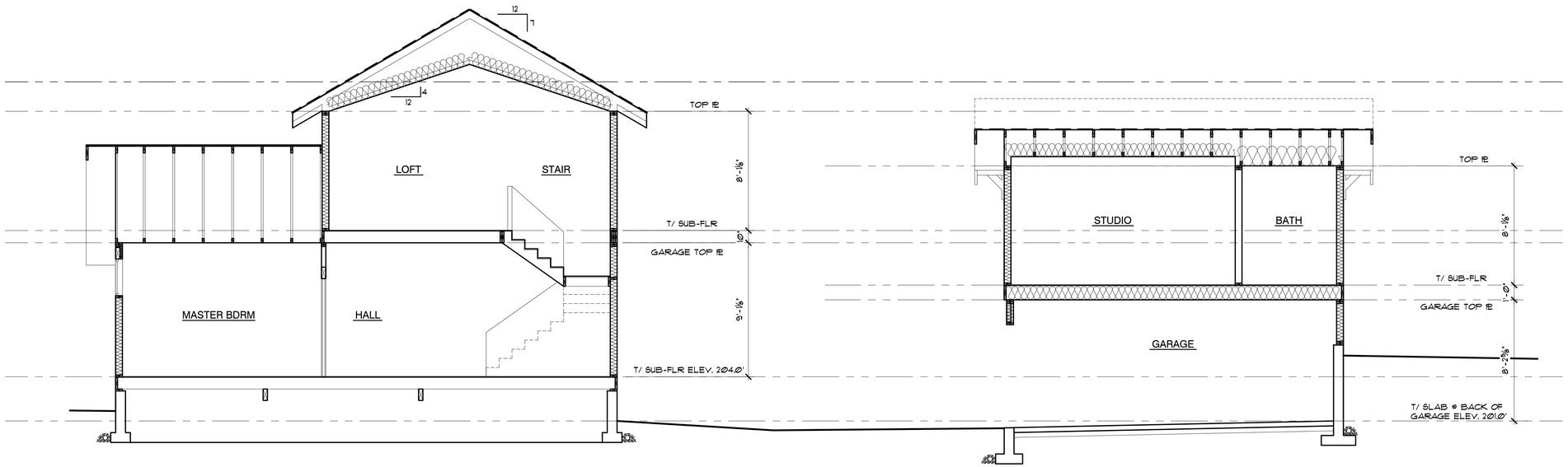
PRELIM ELEVATIONS

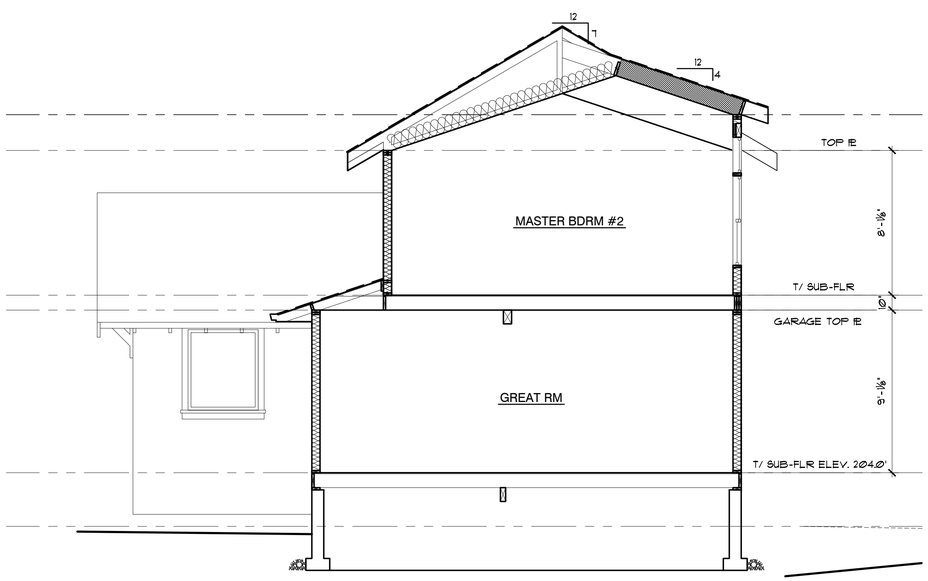


A SECTION

1/4" = 1'-0"

A SECTION

1/4" = 1'-0"



B SECTION

1/4" = 1'-0"

SECTION KEYNOTES

26. TYP PORCH / DECK FLOOR ASSEMBLY: 2x6 CEDAR DECK'G SPACED 1/8" APART OVER PT DECK JOISTS PER FRM'G PLAN.

27. TYP PORCH / DECK FLOOR ASSEMBLY: 'GACO-DECK' OR EQUAL MEMBRANE DECKING INSTALLED IN ACCORDANCE W/ MANUF INSTRUCTIONS FOR FULL WARRANTY OVER ¾" SANDED-FACE PLY OVER PT JOISTS / BEAMS PER FRM'G PLAN.

28. INSTALL ⅝" TYPE 'X' GYP BD @ GARAGE CLG UNDER HABITABLE SPACE & @ WALLS SUPPORTING FLOOR OF HABITABLE SPACE ABOVE, TYP.

29. INSTALL ⅝" TYPE 'X' GYP BD @ ENCLOSED USEABLE SPACE UNDER STAIRS, TYP.

30. 36" HIGH WALL W/ WOOD CAP. 2x4 STUDS @ 16" OC W/ ½" GYP BD EA SIDE OVER ½" PLY @ OPEN SIDE NAILED W/ 8d @ 3" OC @ PANEL EDGES & 10" OC @ FIELD. BLOCK ALL EDGES. NO HORIZ JOINTS PERMITTED.

31. 32"-34" HIGH CONT WALL-MOUNTED WOOD HANDRAIL W/ BRACKETS @ 4'-0" OC. RETURN ENDS TO WALL OR NEWEL POST.

32. 36" HIGH TRADITIONAL WOOD GUARD / HANDRAIL @ OPEN SIDE OF STAIR W/ MAX 4" OPEN'G BTWN UPRIGHTS. RETURN ENDS TO NEWEL POST.

33. TYP STAIR CONST: 1¼" PREFORMED TREADS W/ ¾" NOSING & ½" PLY RISERS ON (3) 2x12 STRINGERS. (((INSTALL FIREBLK'G @ CONCEALED SPACES BTWN STAIR STRINGERS @ TOP & BTM OF RUN))) (((INSTALL ¾" T&G PLY OVER 2x8 JOISTS @ 16" OC @ STAIR LANDING)))

34. TYP FURRED WALL ASSEMBLY: PT 2x4 STUDS @ 24" OC OVER ½" AIRSPACE. INSTALL R-15 (MIN) EPS FOAM BOARD OR MINERAL WOOL INSUL & ½" GYP BD @ INT.

35. - 40. NOT USED

41. TYP ROOF ASSEMBLY: 30 YEAR LAM COMP ROOFING OVER (2) LAYERS 15# A.S. FELT OVER 1/2" APA SPAN-RATED PLY SHTH'G.

42. TYP ROOF ASSEMBLY: PREFIN 22 GA STANDING SEAM MTL ROOFING ON 15# ROSIN COATED A.S. FELT OVER 2x NAILERS ON 15# ROSIN COATED A.S. FELT OVER ⅝" APA SPAN-RATED PLY SHTH'G.

43. INSTALL ½" APA 303-OC PLY @ EXPOSED UNDERSIDES OF ROOF IN LINE W/ ROOF SHTH'G, TYP.

44. INSTALL 1x T&G CEDAR @ EXPOSED UNDERSIDES OF ROOF IN LINE W/ ROOF SHTH'G, TYP.

45. 2x4 SOFFIT JOISTS W/ APA 303-OC PLY @ UNDERSIDE & 2" WIDE CONT SCREENED VENT, TYP.

46. 5" PREFIN STL FASCIA GUTTERS ON 2x6 PREPRIMED CEDAR FASCIA W/ 24 GA PREFIN FLASH'G @ TOP, TYP U.N.O.

47. 2x8 PREPRIMED CEDAR BARGE BD W/ 24 GA G.I. FLASH'G @ TOP.

48. INSTALL 'SIMPSON' DTC CLIPS @ 32" OC MAX FROM INT NON-BEARING WALL TOP PL TO TRUSS OR BLK'G, TYP. TOE NAILS NOT PERMITTED.

49. INSTALL MIN 'SIMPSON' H2.5 TO EA RAFTER OR TRUSS @ BEARING WALLS, TYP. REFER TO ROOF FRM'G PLAN OR TRUSS MANUF DWGS FOR OTHER REQ'D FASTENERS.

50. MANUF ROOF TRUSSES PER ROOF FRM'G PLAN. MANUF TO PROVIDE CALCS & SHOP DWGS BY REGISTERED STRUCTURAL ENG'R FOR ARCHITECT'S REVIEW & APPROVAL PRIOR TO FABRICATION.

51. RAFTERS PER FRM'G PLANS.

52. R-38 ATTIC INSUL W/ VAPOR BARRIER IN DIRECT CONTACT W/ GYP BD CLG, TYP U.N.O.

53. R-38C COMPACT BATT INSUL W/ VAPOR BARRIER IN DIRECT CONTACT W/ GYP BD CLG, TYP U.N.O.

54. RIGID MOISTURE-RESISTANT INSUL BAFFLES WHERE REQ'D.

55. 2x BLK'G W/ 2"ϕ SCREENED VENTS @ EA RAFTER OR TRUSS SPACE, TYP.

56. FULL-DEPTH (MIN R-49) AIR-IMPERMEABLE OPEN-CELL POLYURETHANE SPRAY FOAM INSUL (DEMILEC SEALECTION 'AGRIBALANCE' OR APPROVED EQUAL) @ VAULTED CLGS. SCRAPE SMOOTH @ UNDERSIDE FOR GYP BD INSTALLATION.

57. ROOF FRAMED OVER ROOF BELOW @ SLOPE TRANSITION OVER SOLID BLK'G. RUN SHTH'G @ LOWER ROOF CONT & PROVIDE VENTING @ OVERFRAMED ROOF AREA.

58. 2x CLG JOISTS PER PLANS. LAP NAIL TO RAFTERS.

59. TYP UPPER LEVEL FLOOR ASSEMBLY: ½" PARTICLE BD UNDERLAYMENT OVER ¾" T&G PLY SUBFLOOR ON FLOOR JOISTS PER FRM'G PLAN. INSTALL ½" GYP CLG BD @ UNDERSIDE. OMIT UNDERLAYMENT @ AREAS TO RECEIVE CERAMIC OR STONE TILE, HARDWOOD OR SHEET VINYL. INSTALL ½" CEMENT BACKER UNITS @ AREAS TO RECEIVE TILE, OR ½" SANDED FACE PLY UNDERLAYMENT @ AREAS TO RECEIVE SHEET VINYL.

60. TYP EXT HDR: 4x10 #1 DF-L, U.N.O. (REF FRM'G PLANS). FILL CAVITY W/ RIGID INSUL.

61. TYP EXT WALL ASSEMBLY: SIDING OVER FORTIFIBER 'HYDRO TEX' (OR EQUAL) WEATHER-RESISTIVE BARRIER OVER 15/32" APA SPAN-RATED SHTH'G ON 2x6 STUDS @ 16" OC, U.N.O. INSTALL ½" GYP BD @ INT. INSTALL R-21 BATT INSUL @ CONDITIONED SPACES.

62. TYP EXT WALL ASSEMBLY: CEMENT STUCCO SIDING ON METAL LATH W/ CONTROL JOINTS @ FLOOR LINE & @ 12'-0" O.C. MAX EA WAY, OVER FORTIFIBER 'HYDRO TEX' (OR EQUAL) WEATHER-RESISTIVE BARRIER OVER 15/32" APA SPAN-RATED PLY SHTH'G ON 2x6 STUDS @ 16" OC, U.N.O. INSTALL ½" GYP BD OR CEMENT STUCCO @ INT, & U.N.O. INSTALL R-21 BATT INSUL W/ VAPOR BARRIER @ INTERIOR @ CONDITIONED SPACES.

63. TYP INT HDR: 4x10 #1 DF-L, U.N.O. (REF FRM'G PLANS). NON-BEARING HDRS MAY BE FRAMED W/ CRIPPLES.

64. TYP INT WALL ASSEMBLY: ½" GYP BD EA SIDE OF 2x4 STUDS @ 16" OC, U.N.O.

65. ½" GYP BD @ CLG, TYP U.N.O.

66. INSTALL PAN FLASHING @ WINDOWS, TYP: 'JAMSILL' OR EQUAL. REF DTL XX/XX.

67. INSTALL FIREBLK'G @ CLG & FLOOR LEVELS, HORIZONTALLY @ INTERVALS NOT EXCEEDING 10'-0", & @ INTERCONNECTIONS BTWN CONCEALED HORIZ & VERTICAL SPACES, SUCH AS @ SOFFITS OR PORCH ROOFS, TYP.

68. - 70. NOT USED

71. TYP MAIN LEVEL FLOOR ASSEMBLY: ½" PARTICLE BD UNDERLAYMENT OVER ¾" T&G PLY SUB-FLOOR ON FLOOR JOISTS/BMS PER FRM'G PLAN, U.N.O. OMIT UNDERLAYMENT @ AREAS TO RECEIVE CERAMIC OR STONE TILE, HARDWOOD OR SHEET VINYL. INSTALL ½" CEMENT BACKER UNITS @ AREAS TO RECEIVE TILE, OR ½" SANDED-FACE PLY UNDERLAYMENT @ AREAS TO RECEIVE SHEET VINYL. MIN DIST BTWN GRADE & UNDERSIDE OF FLOOR FRM'G TO BE 18", TYP.

72. TYP MAIN LEVEL FLOOR ASSEMBLY: ½" PARTICLE BD UNDERLAYMT OVER 2x6 T&G DECKING ON 4x10 BMS ON 4x4 (OR 4x6 @ BM SPLICES) POST ON 55# A.S. FELT ON 18"ϕ x 8" CONC FTG, TYP U.N.O. OMIT UNDERLAYMT @ AREAS TO RECEIVE CERAMIC OR STONE TILE, HDWD OR SHEET VINYL. INSTALL ½" CEMENT BACKER UNITS @ AREAS TO RECEIVE TILE, OR ½" SANDED FACE PLY UNDERLAYMT @ AREAS TO RECEIVE SHEET VINYL. MIN DIST BTWN GRADE & UNDERSIDE OF FLOOR FRM'G TO BE 18", TYP.

73. 4x4 POST (OR 4x6 @ BM SPLICES) ON 55# A.S. FELT ON 24"ϕ x 10" CONC FTG, TYP U.N.O.

74. R-30 UNDERFLOOR INSUL W/ VAPOR BARRIER HELD TIGHT TO UNDERSIDE OF SUBFLOOR.

75. TYP LIVING AREA SLAB-ON-GRADE ASSEMBLY: 4" CONC SLAB OVER MIN 2" SAND BED ON 'FORTIFIBER' MOISTOP VAPOR BARRIER (OR EQUAL) OVER MIN 4" COMPACTED CRUSHED ROCK ¾"-0. INSTALL 2" RIGID UNDER-SLAB INSUL (R-15 MIN) FOR 2' @ PERIM, TYP.

76. TYP GARAGE & PATIO SLAB-ON-GRADE ASSEMBLY: 4" CONC SLAB (PATIO SLAB FINISH AS SPECIFIED BY OWNER) OVER MIN 4" COMPACTED CRUSHED ROCK ¾"-0 W/ CONTROL JOINTS @ 11'-0" OC MAX. SLOPE ⅛" PER FOOT TO GARAGE DOOR OPENING.

77. PT 2x SILL W/ PDR DRIVEN FASTENERS @ 12" OC TYP @ SLAB @ NON-BEARING WALLS.

78. TYP THICKENED SLAB ASSEMBLY (U.N.O.): 16" x 8" W/ (2) #4 CONT. INSTALL ½"ϕ A. BOLTS @ 4'-0" OC MAX (U.N.O.). SEE FLOOR PLAN FOR DOOR & OPENING LOCATIONS.

79. TYP PERIM FDN: 8" CONC FDN WALL W/ (1) #4 CONT @ TOP OF WALL, #4 @ 32" OC VERT & ½"ϕ x 7" MIN EMBED A. BOLTS @ 48" OC (U.N.O.) W/ LBP⅝ WASHERS ON 16" x 8" CONC FTG W/ (2) #4 CONT BEARING ON FIRM, UNDISTURBED SOIL. NO MORE THAN 30" OF UNBALANCED BACKFILL PERMITTED. MIN DIST BTWN FIN GRADE & BTM OF FTG TO BE 18", TYP // IF WE HAVE STRUCT ENGINEER'S DWGS -- REF XX/XX FOR WALLS W/ MORE THAN 30" OF UNBALANCED BACKFILL. REF SHEARWALL & HOLDOWN SCHEDULES FOR A. BOLT SIZE, SPACING & EMBEDMENT @ SHEARWALLS. REF XX/XX FOR FTG STEP.

80. INSTALL PT 2x6 MUDSILL @ OUTSIDE FACE OF FDN WALL OVER FIBERGLASS REINFORCED SILL SEALER. MIN (2) A. BOLTS REQ'D FOR ANY LENGTH OF MUDSILL. WHERE FLOOR JOISTS ARE HUNG FROM PLATE INSTALL 2x8 MUDSILL @ INSIDE FACE OF FDN WALL & PROVIDE PT 1x NAILER @ OUTSIDE FACE.

81. CONT 4"ϕ PERF FDN DRAIN WRAPPED W/ FILTER FABRIC SET IN CLEAN, FREE-DRAINING MATERIAL. PIPE TO COUNTY STANDARD SOAKAGE TRENCHES / COUNTY APPROVED DRYWELL / TIE TO EXIST'G SYSTEM.

82. COVER FLOOR OF CRAWLSPACE W/ 6 MIL CROSS-LAMINATED POLY VAPOR BARRIER. EXTEND UP FDN WALL 12" & LAP SEAMS 12".

83. SLOPE FIN GRADE AWAY FROM FDN MIN 6" IN FIRST 10'-0", TYP.

84. SLOPE CRAWL SPACE TO DRAIN & PROVIDE LOW POINT FTG DRAIN.

85. MIN DIST BTWN SIDING & FIN GRADE TO BE 8", TYP.

86. 2x6 PONY WALL ON 16" x 8" x CONT CONC FTG W/ (2) #4 CONT & ½"ϕ x 10" A. BOLTS W/ LBP⅝ WASHERS @ 48" OC, U.N.O.

87. - 90. NOT USED

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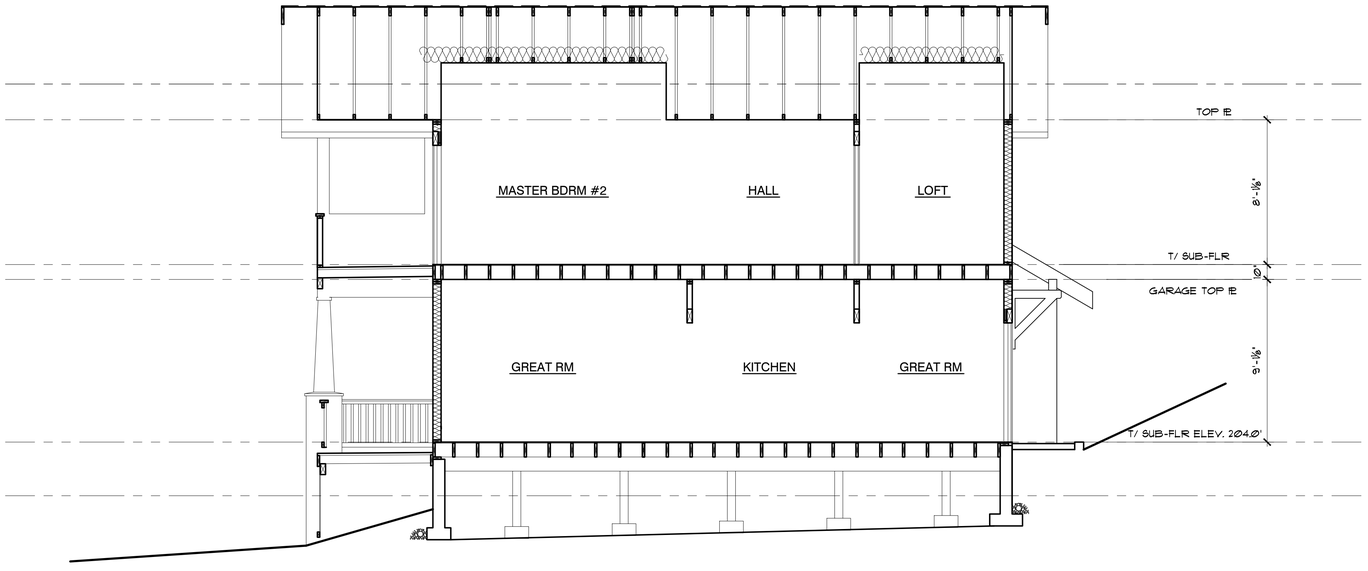
A3.1

SECTIONS & KEYNOTES



C SECTION

1/4" = 1'-0"

ISELIN
ARCHITECTS
P.C.
1307 Seventh Street
Oregon City, OR 97045
503-656-1942 ph
503-656-0658 fax
www.iselinarchitects.com

NOT FOR PRELIMINARY CONSTRUCTION

New Home and Detached Garage/ ADU for
Karen and Morris Schademan

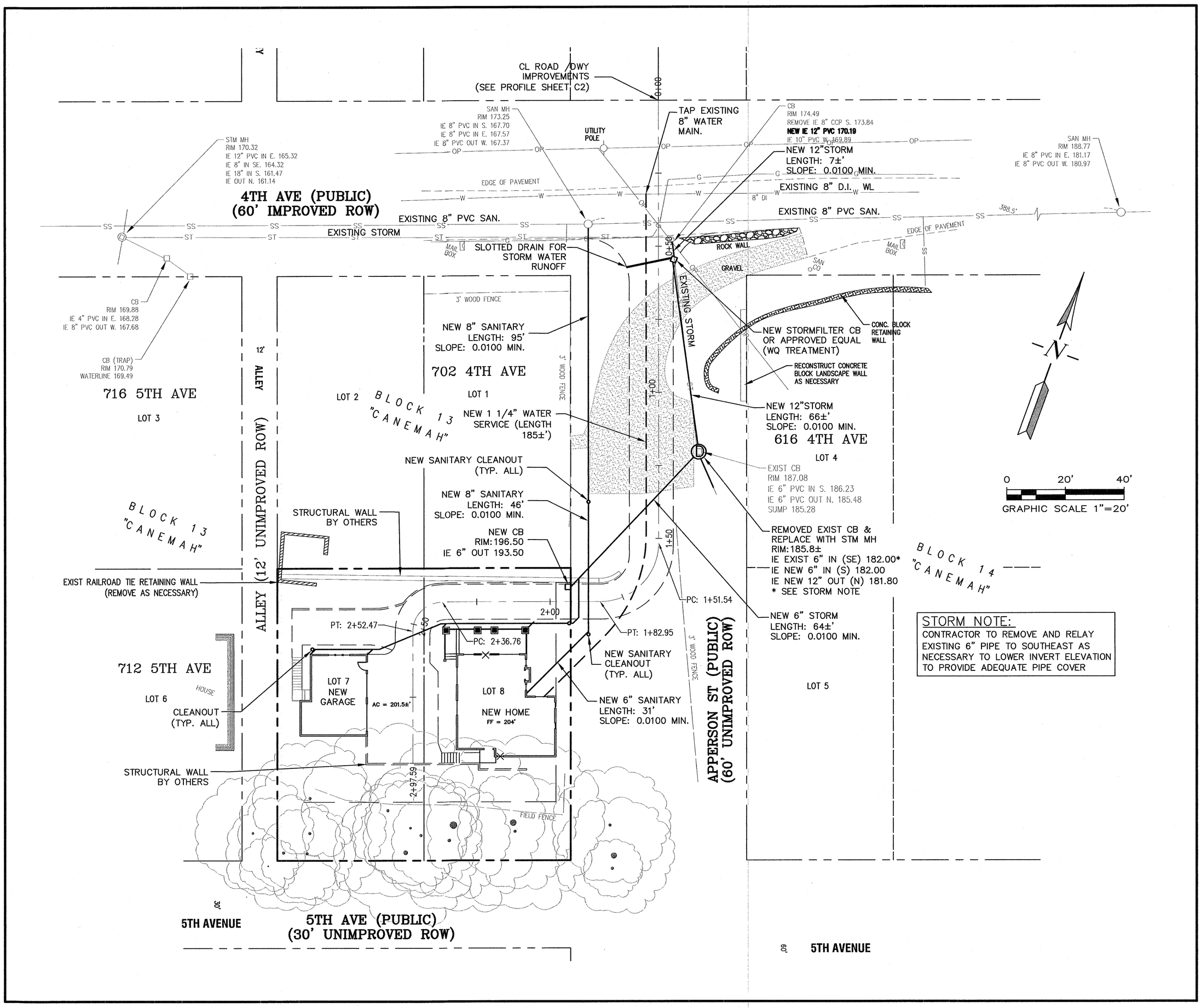
5th Ave and Apperson St
Oregon City, OR 97045

PROJ. NO. :	1773
FILE :	A-SEC
DATE :	10/29/18

SHEET #

A3.2

SECTIONS & KEYNOTES



REVISIONS	BY
5-22-19 O.C. LETTER	JMF
5-30-19 O.C. MEETING	JMF

Schademan House

Iselin Architects, P.C.

Option 1 Preliminary Utility & Site Plan

SISUL ENGINEERING
375 PORTLAND AVENUE
GLADSTONE, OREGON 97027
(503) 657-0188

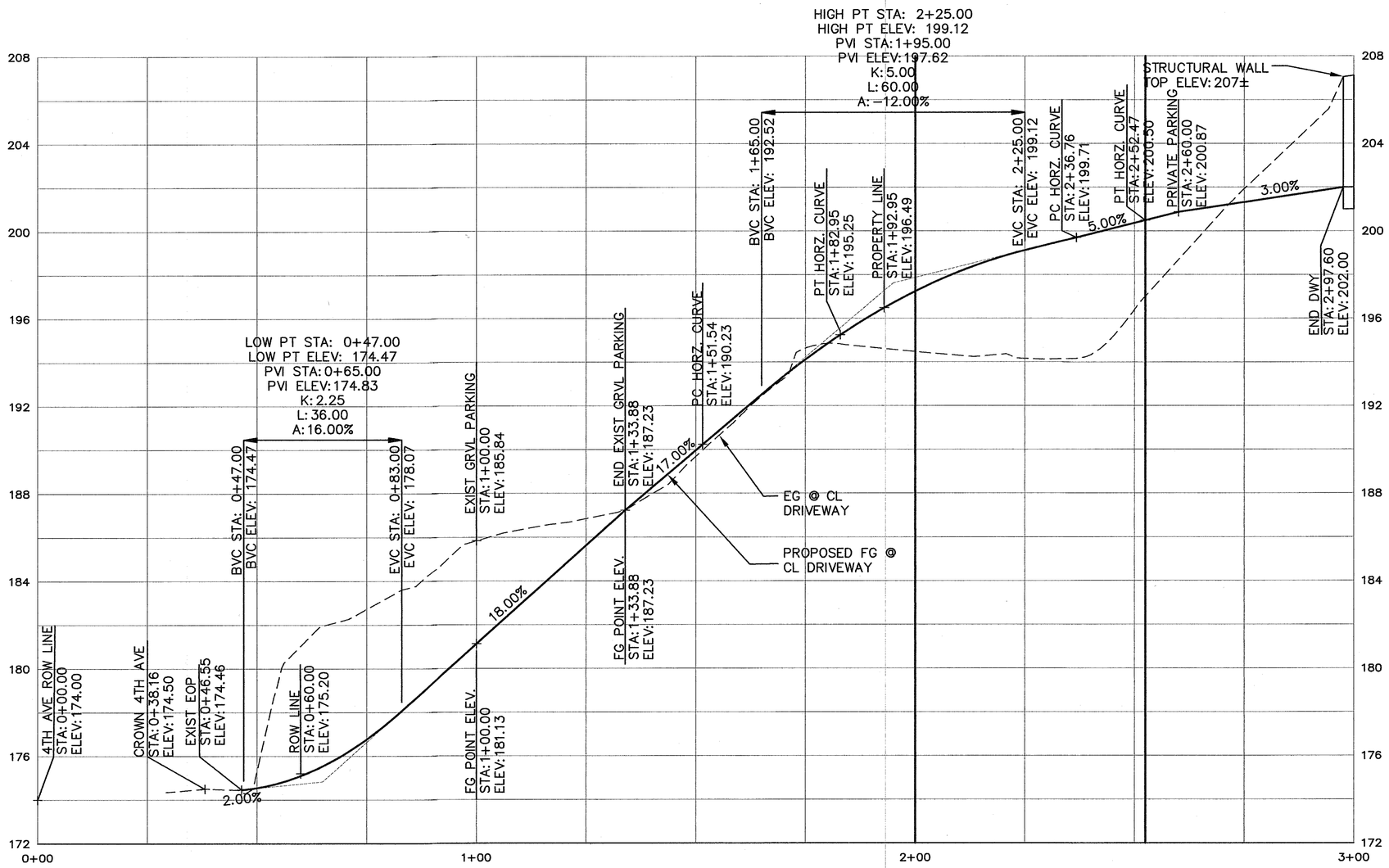
DATE 12-18-19

SCALE 1" = 20'

DRAWN JMF

JOB SGL 18-101

SHEET 1 OF 6 SHEETS



REVISED DWY

HORIZONTAL SCALE: 1"=20'
VERTICAL SCALE: 1"=4'

REVISIONS	BY
5-22-19 O.C. LETTER	JMF
5-30-19 O.C. MEETING	JMF

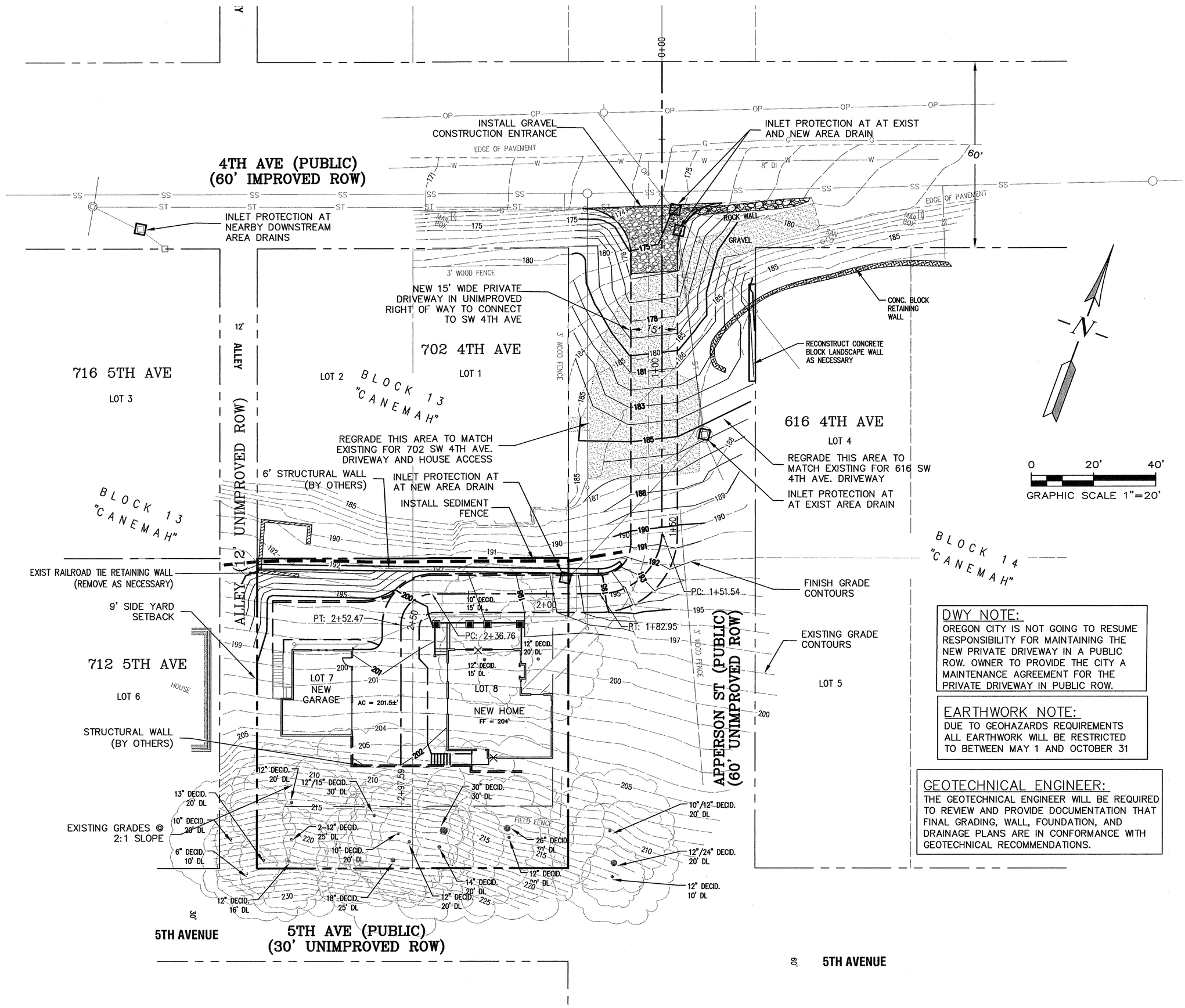
Option 1
Preliminary Dwy Profile

Schademan House

Iselin Architects, P.C.

ISUL ENGINEERING
375 PORTLAND AVENUE
GLADSTONE, OREGON 97027
(503) 657-0188

DATE 12-18-19
SCALE 1" = 20'
DRAWN JMF
JOB SGL 18-101
SHEET 2
OF 6 SHEETS



DWY NOTE:
OREGON CITY IS NOT GOING TO RESUME RESPONSIBILITY FOR MAINTAINING THE NEW PRIVATE DRIVEWAY IN A PUBLIC ROW. OWNER TO PROVIDE THE CITY A MAINTENANCE AGREEMENT FOR THE PRIVATE DRIVEWAY IN PUBLIC ROW.

EARTHWORK NOTE:
DUE TO GEOHAZARDS REQUIREMENTS ALL EARTHWORK WILL BE RESTRICTED TO BETWEEN MAY 1 AND OCTOBER 31

GEOTECHNICAL ENGINEER:
THE GEOTECHNICAL ENGINEER WILL BE REQUIRED TO REVIEW AND PROVIDE DOCUMENTATION THAT FINAL GRADING, WALL, FOUNDATION, AND DRAINAGE PLANS ARE IN CONFORMANCE WITH GEOTECHNICAL RECOMMENDATIONS.

REVISIONS	BY
5-22-19 O.C. LETTER	JMF
5-30-19 O.C. MEETING	JMF

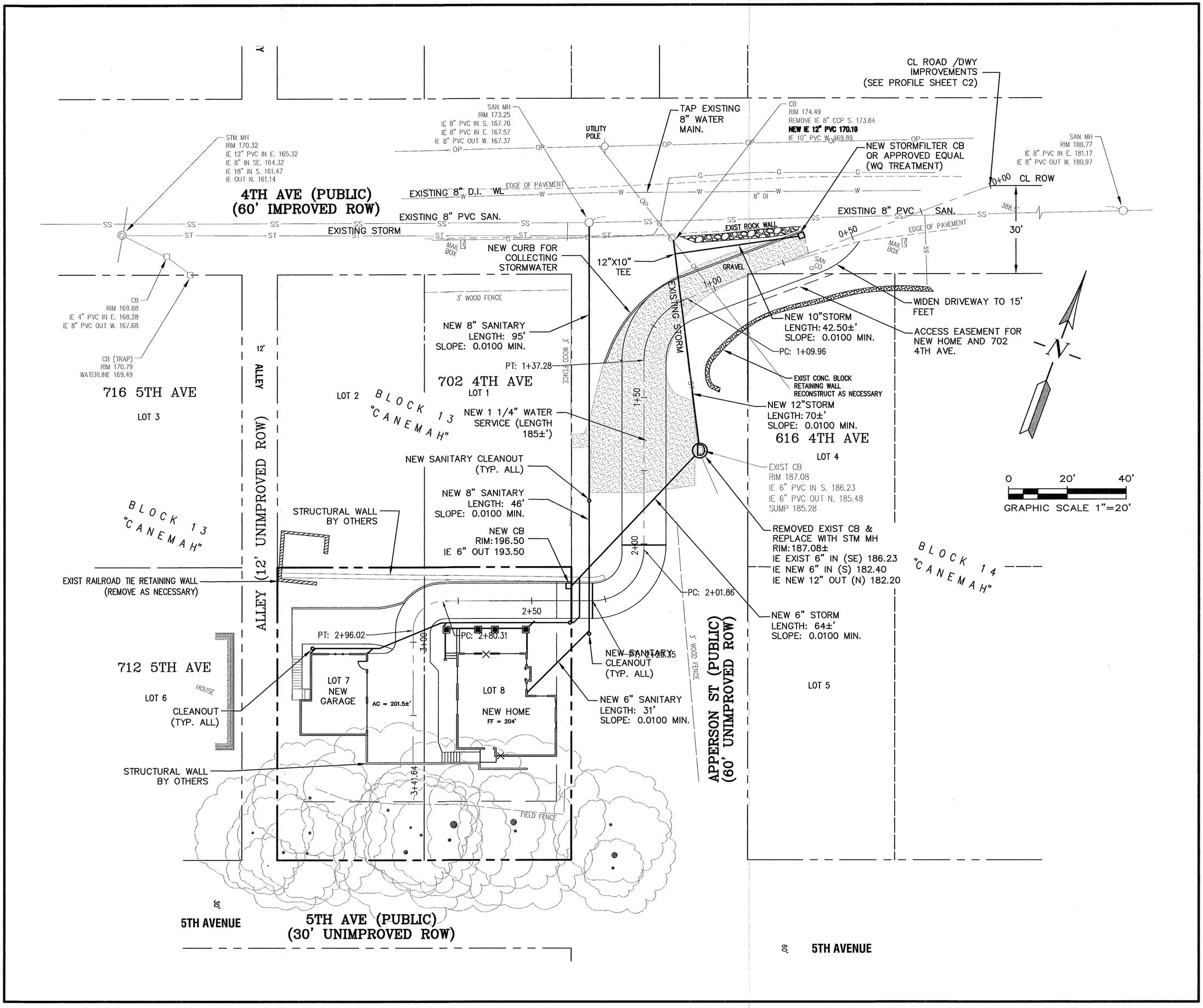
Schademan House

Iselin Architects, P.C.

Option 1
Preliminary Grading

SISUL ENGINEERING
375 PORTLAND AVENUE
GLADSTONE, OREGON 97027
(503) 657-0188

DATE 12-18-19
SCALE 1" = 20'
DRAWN JMF
JOB SGL 18-101
SHEET 3
OF 6 SHEETS



REVISIONS	BY
5-22-19 O.C. LETTER	JMF
5-30-19 O.C. MEETING	JMF

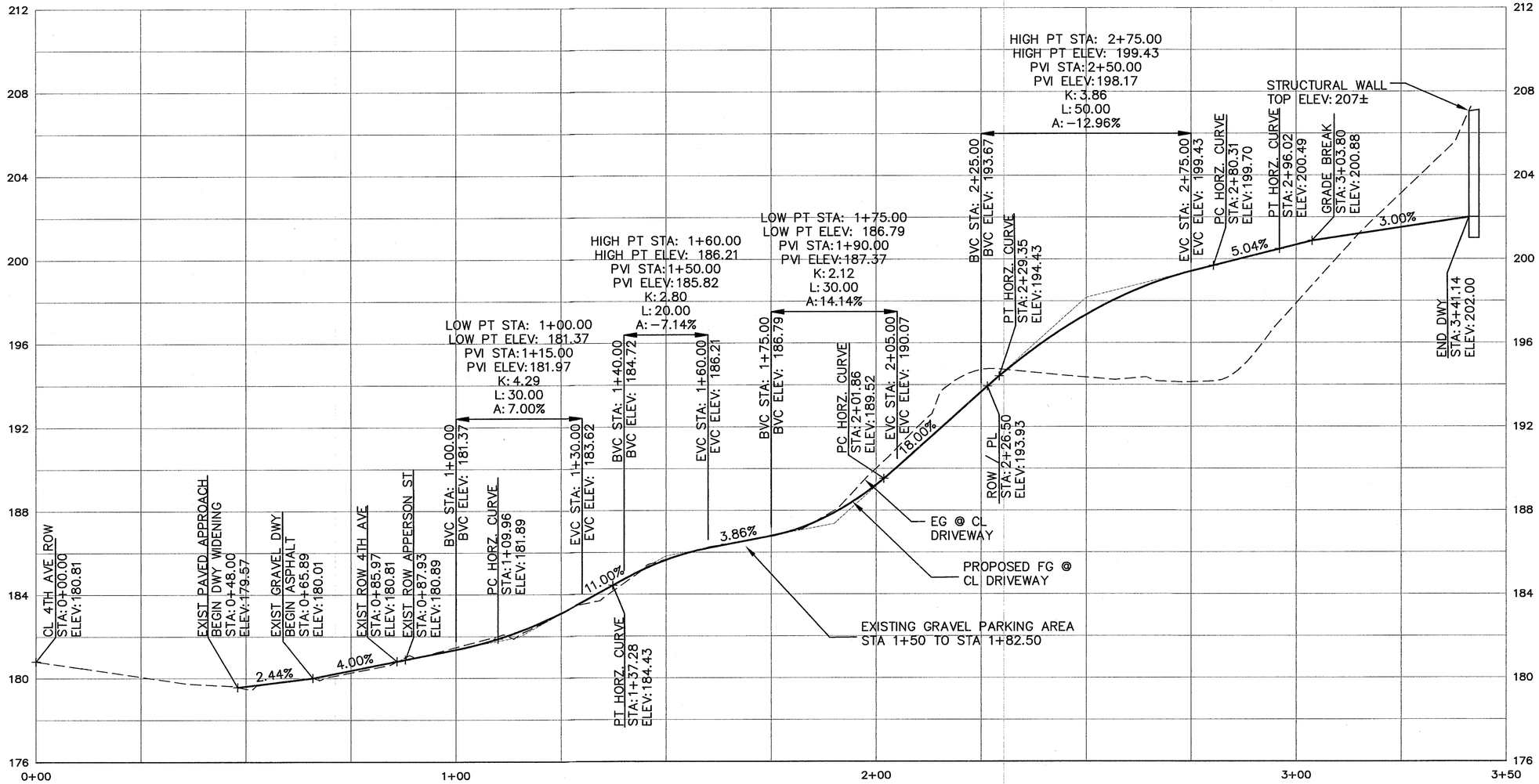
Schademan House

Iselin Architects, P.C.

Option 2
Preliminary Utility & Site Plan

ISUL ENGINEERING
375 PORTLAND AVENUE
GLADSTONE, OREGON 97027
(503) 657-0188

DATE 12-18-19
SCALE 1" = 20'
DRAWN JMF
JOB SGL 18-101
SHEET 4 OF 6 SHEETS



EXISTING DWY EXTENSION - OPTION 2

HORIZONTAL SCALE: 1"=20'
VERTICAL SCALE: 1"=4'

REVISIONS	BY
5-22-19 O.C. LETTER	JMF

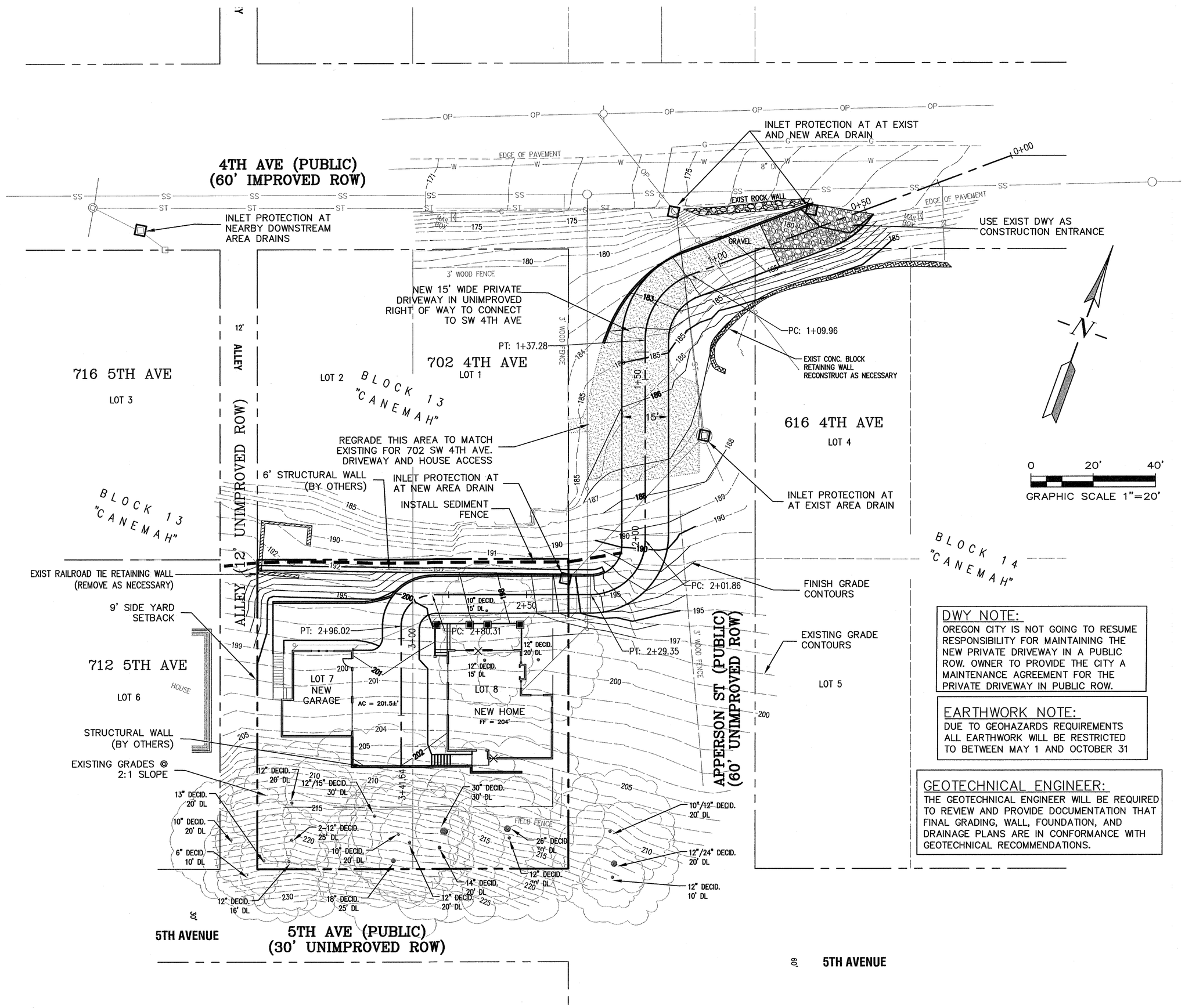
Schademan House

Iselin Architects, P.C.

Option 2
Preliminary Dwy
Profile

SISUL ENGINEERING
375 PORTLAND AVENUE
GLADSTONE, OREGON 97027
(503) 657-0188

DATE 12-18-19
SCALE 1" = 20'
DRAWN JMF
JOB SGL 18-101
SHEET 5
OF 6 SHEETS



DWY NOTE:
OREGON CITY IS NOT GOING TO RESUME RESPONSIBILITY FOR MAINTAINING THE NEW PRIVATE DRIVEWAY IN A PUBLIC ROW. OWNER TO PROVIDE THE CITY A MAINTENANCE AGREEMENT FOR THE PRIVATE DRIVEWAY IN PUBLIC ROW.

EARTHWORK NOTE:
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GEOTECHNICAL ENGINEER:
THE GEOTECHNICAL ENGINEER WILL BE REQUIRED TO REVIEW AND PROVIDE DOCUMENTATION THAT FINAL GRADING, WALL, FOUNDATION, AND DRAINAGE PLANS ARE IN CONFORMANCE WITH GEOTECHNICAL RECOMMENDATIONS.

REVISIONS	BY
5-22-19 O.C. LETTER	JMF
5-30-19 O.C. MEETING	JMF

Schademan House

Iselin Architects, P.C.

Option 2
Preliminary Grading

SISUL ENGINEERING
375 PORTLAND AVENUE
GLADSTONE, OREGON 97027
(503) 657-0188

DATE 12-18-19
SCALE 1" = 20'
DRAWN JMF
JOB SGL 18-101
SHEET 6
OF 6 SHEETS

Geologic Hazard Review
For
New Single Family Residence

at
5th and Apperson
Parcel No 3-1E-01AA-02602
Oregon City, Oregon

Dec 19, 2018

Planning Department
City of Oregon City
698 Warner Parrott Rd
Oregon City, OR 97045

ISELIN ARCHITECTS, P.C.
1307 Seventh Street Oregon City, OR 97045 p: 503-656-1942 f: 503-656-0658

Project Summary:

The proposed development consists of constructing a new 1,612 square foot single family home (1024 square foot footprint) and a detached 588 square foot garage with a 292 square foot second story accessory dwelling unit on a vacant parcel.

The site has NROD, Geohazard and Historic Review overlays. A concurrent NROD review application is being submitted for the project and historic review approval has been previously granted.

Chapter 17.44 - US—GEOLOGIC HAZARDS[21]

17.44.010 - Intent and purpose.

The intent and purpose of the provisions of this chapter are:

A. To ensure that activities in geologic hazard areas are designed based on detailed knowledge of site conditions in order to reduce the risk of private and public losses;

B. To establish standards and requirements for the use of lands within geologic hazard areas;

C. To provide safeguards to prevent undue hazards to property, the environment, and public health, welfare, and safety in connection with use of lands within geologic hazard areas;

D. To mitigate risk associated with geologic hazard areas, not to act as a guarantee that the hazard risk will be eliminated, nor as a guarantee that there is a higher hazard risk at any location. Unless otherwise provided, the geologic hazards regulations are in addition to generally applicable standards provided elsewhere in the Oregon City Municipal Code.

This application for Geologic Hazard Review is intended to ensure that the proposed development on the site is safe and all risks for this property and neighboring properties are properly mitigated.

17.44.025 - When required; regulated activities; permit and approval requirements.

No person shall engage in any of the following regulated activities within the adopted Oregon City Geologic Hazards Overlay Zone as defined in section 17.04.515 of the Oregon City Municipal Code without first obtaining permits or approvals as required by this chapter:

A. Installation or construction of an accessory structure greater than 500 square feet in area;

This application is for construction of a new home greater than 500 s.f. and requires approval per OCMC 17.04.

B. Development of land, construction, reconstruction, structural alteration, relocation or enlargement of any building or structure for which permission is required pursuant to the Oregon City Municipal Code;

This application is for construction of a new home greater than 500 s.f. and requires approval per OCMC 17.04.

C. Tree removal on slopes greater than 25 percent where canopy area removal exceeds 25 percent of the lot.

This application requires approval of 9 trees for the proposed development. Refer to attached arborist report.

D. Excavation which exceeds two feet in depth, or which involves twenty-five or more cubic yards of volume;

The construction of this new home and driveway as proposed will require excavations up to 6' deep and require the removal of approximately 200 cu yds of material.

The requirements of this chapter are in addition to other provisions of the Oregon City Municipal Code. Where the provisions of this chapter conflict with other provisions of the Oregon City Municipal Code, the provisions that are the more restrictive of regulated development activity shall govern.

17.44.030 - Procedures.

No building or site development permit or other authorization for development shall be issued until the plans and other documents required by this chapter have been reviewed and found by the review authority to comply with the requirements of this chapter.

A. Where the development is part of a land use permit application, review shall occur in the manner established in Chapter 17.50 for review of land use decisions.

B. Where the development is part of a limited land use permit application, review shall occur in the manner established in Chapter 17.50 for review of limited land use decisions.

C. Where the development is solely part of a grading permit or building permit, the city engineer may allow review to occur in the manner established in Title 15, Chapters 15.04 and 15.48 if the application meets Section 17.44.060 development standards.

D. For any other proposed development not otherwise subject to review as a land use or limited land use permit application, review shall occur in the manner established in Chapter 17.50 for limited land use decisions.

This application is being sought in conjunction with a building permit application for a single family residence. No new lots are being created as part of this application. A Type II review approval is being sought for the geologic Hazard overlay zone.

17.44.035 - Exemptions.

The following activities, and persons engaging in same, are EXEMPT from the provisions of this chapter.

A. An excavation which is less than two feet in depth, or which involves less than twenty-five cubic yards of volume;

B. A fill which does not exceed two feet in depth or twenty-five cubic yards of volume;

C. Structural alteration of any structure of less than five hundred square feet that does not involve grading as defined in this chapter;

D. Installation, construction, reconstruction, or replacement of utility lines in city right-of-way, or public easement, not including electric substations;

E. The removal or control of noxious vegetation;

F. Emergency actions which must be undertaken immediately to prevent an imminent threat to public health or safety, or prevent imminent danger to public or private property. The person undertaking emergency action shall notify the building official on all regulated activities associated with any building permit or city engineer/public works director on all others within one working day following the commencement of the emergency activity. If the city engineer/public works director or building official determine that the action or part of the action taken is beyond the scope of allowed emergency action, enforcement action may be taken.

This proposal exceeds any listed above for exemptions and none are being requested.

17.44.050 - Development—Application requirements and review procedures and approvals.

Except as provided by subsection B. of this section, the following requirements apply to all development proposals subject to this chapter:

A. A geological assessment and geotechnical report that specifically includes, but is not limited to:

1. Comprehensive information and data regarding the nature and distribution of underlying geology, the physical and chemical properties of existing soils and groundwater; an opinion of site geologic stability, and conclusions regarding the effect of geologic conditions on the proposed development. In addition to any field reconnaissance or subsurface investigation performed for the site, the following resources, as a minimum, shall be reviewed to obtain this information and data:

    a. The State of Oregon Department of Geology and Mineral Industries (DOGAMI) in Bulletin 99, Geology and Geological Hazards of North Clackamas County, Oregon (1979), or in any subsequent DOGAMI mapping for the Oregon City area;

    b. Portland State University study entitled "Environmental Assessment of Newell Creek Canyon, Oregon City, Oregon" (1992);

    c. Portland State University study, "Landslides in the Portland, Oregon, Metropolitan Area Resulting from the Storm of February 1996: Inventory Map, Database and Evaluation" (Burns and others, 1998);

    d. DOGAMI Open File Report O-06-27, "Map of Landslide Geomorphology of Oregon City, Oregon, and Vicinity Interpreted from LIDAR Imagery and Aerial Photographs" (Madin and Burns, 2006);

    e. "Preliminary Geologic Map of the Oregon City Quadrangle, Clackamas County, Oregon" (Madin, in press);

2. Information and recommendations regarding existing local drainage, proposed permit activity impacts on local drainage, and mitigation to address adverse impacts;

3. Comprehensive information about site topography;

4. Opinion as to the adequacy of the proposed development from an engineering standpoint;

5. Opinion as to the extent that instability on adjacent properties may adversely affect the project;

6. Description of the field investigation and findings, including logs of subsurface conditions and laboratory testing results;

7. Conclusions regarding the effect of geologic conditions on the proposed development, tree removal, or grading activity;

8. Specific requirements and recommendations for plan modification, corrective grading, and special techniques and systems to facilitate a safe and stable site;

9. Recommendations and types of considerations as appropriate for the type of proposed development:

    a. General earthwork considerations, including recommendations for temporary and permanent cut and fill slopes and placement of structural fill;

    b. Location of residence on lot;

    c. Building setbacks from slopes;

    d. Erosion control techniques applicable to the site;

    e. Surface drainage control to mitigate existing and potential geologic hazards;

f. Subdrainage and/or management of groundwater seepage;

g. Foundations;

h. Embedded/retaining walls;

i. Management of surface water and irrigation water; and

j. Impact of the development on the slope stability of the lot and the adjacent properties.

Refer to geotechnical report prepared by Redmond Geotechnical Services and Supplemental letter dated April 19, 2018.

10. Scaled drawings that describe topography and proposed site work, including:

    a. Natural physical features, topography at two or ten-foot contour intervals locations of all test excavations or borings, watercourses both perennial and intermittent, ravines and all existing and manmade structures or features all fully dimensioned, trees six-inch caliper or greater measured four feet from ground level, rock outcroppings and drainage facilities;

    b. All of the features and detail required for the site plan above, but reflecting preliminary finished grades and indicating in cubic yards whether and to what extent there will be a net increase or loss of soil.

    c. A cross-section diagram, indicating depth, extent and approximate volume of all excavation and fills.

Refer to architectural and civil drawings for existing topography and proposed grading.

[11.] For properties greater than one acre, a preliminary hydrology report, prepared by a suitably qualified and experienced hydrology expert, addressing the effect upon the watershed in which the proposed development is located; the effect upon the immediate area's stormwater drainage pattern of flow, the impact of the proposed development upon downstream areas and upon wetlands and water resources; and the effect upon the groundwater supply.

The site is less than 1 acre in area. Criterion does not apply.

B. Review procedures and approvals require the following:

1. Examination to ensure that:

    a. Required application requirements are completed;

    b. Geologic assessment and geotechnical report procedures and assumptions are generally accepted; and

    c. All conclusions and recommendations are supported and reasonable.

2. Conclusions and recommendations stated in an approved assessment or report shall then be directly incorporated as permit conditions or provide the basis for conditions of approval for the regulated activity.

3. All geologic assessments and geotechnical reports shall be reviewed by an engineer certified for expertise in geology or geologic engineering and geotechnical engineering, respectively, as determined by the city. The city will prepare a list of prequalified

consultants for this purpose. The cost of review by independent review shall be paid by the applicant.

The applicant is requesting the City review the submitted information and approve it with appropriate conditions so ground disturbing activity can be completed during this calendar year.

B. The city engineer may waive one or more requirements of subsections A and B of this section if the city engineer determines that site conditions, size or type or development of grading requirements do not warrant such detailed information. If one or more requirements are waived, the city engineer shall, in the staff report or decision, identify the waived provision(s), explain the reasons for the waiver, and state that the waiver may be challenged on appeal and may be denied by a subsequent review authority.

No waiver of any requirements is requested for this application.

17.44.060 - Development standards.

Notwithstanding any contrary dimensional or density requirements of the underlying zone, the following standards shall apply to the review of any development proposal subject to this chapter. Requirements of this chapter are in addition to other provision of the Oregon City Municipal Code. Where provision of this chapter conflict with other provision of the Oregon City Municipal Code, the provisions that are more restrictive of regulated development activity shall govern.

A. All developments shall be designed to avoid unnecessary disturbance of natural topography, vegetation and soils. To the maximum extent practicable as determined by the review authority, tree and ground cover removal and fill and grading for residential development on individual lots shall be confined to building footprints and driveways, to areas required for utility easements and for slope easements for road construction, and to areas of geotechnical remediation.

The proposed development has been designed to minimize the disturbance area of the site while allowing the construction of a new single family detached home with garage and vehicle maneuvering area on this sloping uphill site. The siting and design of the home has also been required to take the historic overlay district into consideration.

B. All grading, drainage improvements, or other land disturbances shall only occur from May 1 to October 31. Erosion control measures shall be installed and functional prior to any disturbances. The city engineer may allow grading, drainage improvements or other land disturbances to begin before May 1 (but no earlier than March 16) and end after October 31 (but no later than November 30), based upon weather conditions and in consultation with the project geotechnical engineer. The modification of dates shall be the minimum necessary, based upon the evidence provided by the applicant, to accomplish the necessary project goals. Temporary protective fencing shall be established around all trees and vegetation designed for protection prior to the commencement of grading or other soil disturbance.

All grading and ground disturbing activities are planned to occur from May 1 to October 31. All erosion control measures will be installed and inspected prior to beginning work and temporary tree protection fencing installed per the attached arborist report.

C. Designs shall minimize the number and size of cuts and fills.

The proposed design limits the proposed development to the relatively level lower portion of the site. Development of this portion of the site minimizes cut and fill on the site and disturbing the steeper portion of the sits.

D. Cut and fill slopes, such as those for a street, driveway accesses, or yard area, greater than seven feet in height (as measured vertically) shall be terraced. Faces on a terraced section shall not exceed five feet. Terrace widths shall be a minimum of three feet and shall be vegetated. Total cut and fill slopes shall not exceed a vertical height of fifteen feet. Except in connection with geotechnical remediation plans approved in accordance with the chapter, cuts shall not remove the toe of any slope that contains a known landslide or is greater than twenty-five percent slope. The top of cut or fill slopes not utilizing structural retaining walls shall be located a minimum of one-half the height of the cut slope from the nearest property line.

Cut slopes are proposed to be less than seven feet in height to avoid terracing. Proposed cuts at the toe of the slope are not in a known landslide hazard location and will be in accordance with the recommendations from the attached geotechnical remediation plans included in this report.

E. Any structural fill shall be designed by a suitably qualified and experienced civil or geotechnical engineer licensed in Oregon in accordance with standard engineering practice. The applicant's engineer shall certify that the fill has been constructed as designed in accordance with the provisions of this chapter.

No structural fill is proposed for this project.

F. Retaining walls shall be constructed in accordance with the Oregon Structural Specialty Code adopted by the State of Oregon.

Proposed retaining walls are all designed per OSSC requirements.

G. Roads shall be the minimum width necessary to provide safe vehicle and emergency access, minimize cut and fill and provide positive drainage control. The review authority may grant a variance from the city's required road standards upon findings that the variance would provide safe vehicle and emergency access and is necessary to comply with the purpose and policy of this chapter.

No new roads are proposed as part of this project.

H. Density shall be determined as follows:

1. For those areas with slopes less than twenty-five percent between grade breaks, the allowed density shall be that permitted by the underlying zoning district;
2. For those areas with slopes of twenty-five to thirty-five percent between grade breaks, the density shall not exceed two dwelling units per acre except as otherwise provided in subsection I of this section;
3. For those areas with slopes over thirty-five percent between grade breaks, development shall be prohibited except as otherwise provided in subsection I.4. of this section.

Project does not create any new lots. Criteria do not apply.

I. For properties with slopes of twenty-five to thirty-five percent between grade breaks:

1. For those portions of the property with slopes of twenty-five to thirty-five percent, the maximum residential density shall be limited to two dwelling units per acre; provided, however, that where the entire site is less than one-half acre in size, a single dwelling shall

be allowed on a lot or parcel existing as of January 1, 1994 and meeting the minimum lot size requirements of the underlying zone;

This lot is less than 1 acre and was existing prior to Jan 1, 1994. A single dwelling unit is proposed.

2. An individual lot or parcel with slopes between twenty-five and thirty-five percent shall have no more than fifty percent or four thousand square feet of the surface area, whichever is smaller, graded or stripped of vegetation or covered with structures or impermeable surfaces.

The proposed new home and site improvements will involve approximately 3,703 s.f. (37% of site area) be covered with structures or impermeable surfaces.

3. No cut into a slope of twenty-five to thirty-five percent for the placement of a housing unit shall exceed a maximum vertical height of fifteen feet for the individual lot or parcel.

The proposed new home will be sited so that there will be less than 10' of fall through the building envelope. The average existing slope of the area with the proposed home and garage is less than 20%

4. For those portions of the property with slopes over thirty-five percent between grade breaks:

   a. Notwithstanding any other city land use regulation, development other than roads, utilities, public facilities and geotechnical remediation shall be prohibited; provided, however, that the review authority may allow development upon such portions of land upon demonstration by an applicant that failure to permit development would deprive the property owner of all economically beneficial use of the property. This determination shall be made considering the entire parcel in question and contiguous parcels in common ownership on or after January 1, 1994, not just the portion where development is otherwise prohibited by this chapter. Where this showing can be made on residentially zoned land, development shall be allowed and limited to one single-family residence. Any development approved under this chapter shall be subject to compliance with all other applicable city requirements as well as any applicable state, federal or other requirements;

No portion of the site with slopes greater than 25% slope are proposed to be developed in any way.

   b. To the maximum extent practicable as determined by the review authority, the applicant shall avoid locating roads, utilities, and public facilities on or across slopes exceeding thirty-five percent.

No new roads or public infrastructure is proposed. Criterion does not apply.

J. The geotechnical engineer of record shall review final grading, drainage, and foundation plans and specifications and confirm in writing that they are in conformance with the recommendations provided in their report.

The geotechnical engineer of record has reviewed final drainage and foundation plans and provided the attached supplemental letter stating proposed work is in conformance with his recommendations.

K. At the city's discretion, peer review shall be required for the geotechnical evaluation/investigation report submitted for the development and/or lot plans. The peer

reviewer shall be selected by the city. The applicant's geotechnical engineer shall respond to written comments provided by the city's peer reviewer prior to issuance of building permit.

The applicant's geotechnical engineer will respond to any questions or comments from the City's peer reviewer.

L. The review authority shall determine whether the proposed methods of rendering a known or potential hazard site safe for construction, including proposed geotechnical remediation methods, are feasible and adequate to prevent landslides or damage to property and safety. The review authority shall consult with the city's geotechnical engineer in making this determination. Costs for such consultation shall be paid by the applicant. The review authority may allow development in a known or potential hazard area as provided in this chapter if specific findings are made that the specific provisions in the design of the proposed development will prevent landslides or damage. The review authority may impose any conditions, including limits on type or intensity of land use, which it determines are necessary to assure that landslides or property damage will not occur.

The applicant shall pay the City for all review costs associated with the geotechnical review.

17.44.070 - Access to property.

A. Shared private driveways may be required if the city engineer or principal planner determines that their use will result in safer location of the driveway and lesser amounts of land coverage than would result if separate private driveways are used.

The driveway for the new home will utilize a previously graded section of the unimproved Apperson St right of way for access rather than taking access from the unimproved 5th St right of way which would require extensive grading and vegetation removal. The detached garage/ accessory dwelling structure location has been sited to allow for adequate parking on the site and to enable vehicular maneuvering on site to avoid backing movements onto 4th St.

C. Innovations in driveway design and road construction shall be permitted in order to keep grading and cuts or fills to a minimum and to achieve the purpose and policy of this chapter.

Utilizing the existing unimproved right of way for vehicular access to the site will significantly decrease the grading and vegetation removal on the steeply sloping portion of the site required to access the site from the unimproved 5th St right of way.

D. Points of access to arterials and collectors shall be minimized.

Access is limited to the site to a single proposed driveway off the unimproved Apperson St right of way.

E. The city engineer or principal planner shall verify that adequate emergency services can be provided to the site.

The home is close enough to 4th Ave to allow emergency services. Large emergency vehicles will not be able to easily negotiate the proposed private driveway.

17.44.080 - Utilities.

All new service utilities, both on-site and off-site, shall be placed underground and under roadbeds where practicable. Every effort shall be made to minimize the impact of utility construction. Underground utilities require the geologic hazards permitting and review prescribed herein.

All new utilities to serve the project will be underground and will be constructed in accordance with the recommendations of the geotechnical engineer.

17.44.090 - Stormwater drainage.

The applicant shall submit a permanent and complete stormwater control plan. The program shall include, but not be limited to the following items as appropriate: curbs, gutters, inlets, catch basins, detention facilities and stabilized outfalls. Detention facilities shall be designed to city standards as set out in the city's drainage master plan and design standards. The review authority may impose conditions to ensure that waters are drained from the development so as to limit degradation of water quality consistent with Oregon City's Title III section of the Oregon City Municipal Code Chapter 17.49 and the Oregon City Public Works Stormwater Management Design Manual and Standards Plan or other adopted standards subsequently adopted by the city commission. Drainage design shall be approved by the city engineer before construction, including grading or other soil disturbance, has begun.

Stomwater water quality and detention will be provided on site and has been designed to current LID standards adopted by the City.

17.44.100 - Construction standards.

During construction on land subject to this chapter, the following standards shall be implemented by the developer:

A. All development activity shall minimize vegetation removal and soil disturbance and shall provide positive erosion prevention measures in conformance with OCMC Chapter 17.47—Erosion and Sediment Control.

Soil disturbance will be limited to the minimum necessary to construction activities and erosion and sediment control will be in place prior to start of construction. A large portion of the site will be fenced off for tree preservation during construction to provide additional protection of vegetation.

B. No grading, clearing or excavation of any land shall be initiated prior to approval of the grading plan, except that the city engineer shall authorize the site access, brush to be cleared and the location of the test pit digging prior to approval of such plan to the extent needed to complete preliminary and final engineering and surveying. The grading plan shall be approved by the city engineer as part of the city's review under this chapter. The developer shall be responsible for the proper execution of the approved grading plan.

No site work will be undertaken prior to approval of grading plan by the City.

C. Measures shall be taken to protect against landslides, mudflows, soil slump and erosion. Such measures shall include sediment fences, straw bales, erosion blankets, temporary sedimentation ponds, interceptor dikes and swales, undisturbed buffers, grooving and stair stepping, check dams, etc. The applicant shall comply with the measures described in the Oregon City Public Works Standards for Erosion and Sedimentation Control (Ordinance 99-1013).

Erosion and sediment control measures shall be in place prior to any soil disturbing activities.

D. All disturbed vegetation shall be replanted with suitable vegetation upon completion of the grading of the steep slope area.

All disturbed vegetation will be replanted with non-invasive vegetation suitable for the site.

E. Existing vegetative cover shall be maintained to the maximum extent practicable. No grading, compaction or change in ground elevation, soil hydrology and/or site drainage shall be permitted within the drip line of trees designated for protection, unless approved by the city.

The site will be cleared of invasive plant species and non-invasive plants will be maintained to the extent possible. Fencing will be installed at tree preservation areas during construction to ensure minimal disturbance of site.

F. Existing perennial and intermittent watercourses shall not be disturbed unless specifically authorized by the review authority. This includes physical impacts to the stream course as well as siltation and erosion impacts.

No existing perennial or intermittent watercourses exist on the site. Downstream watercourses will be protected from siltation and erosion from the construction site as required.

G. All soil erosion and sediment control measures shall be maintained during construction and for one year after development is completed, or until soils are stabilized by revegetation or other measures to the satisfaction of the city engineer. Such maintenance shall be the responsibility of the developer. If erosion or sediment control measures are not being properly maintained or are not functioning properly due to faulty installation or neglect, the City may order work to be stopped. (Ord. 03-1014, Att. B3 (part), 2003: Ord. 94-1001 §2(part), 1994)

All erosion and sediment control measures will be maintained during construction and for 1 year after completion to allow for new plantings to be established to prevent erosion.

H. All newly created lots, either by subdivision or partition, shall contain building envelopes with a slope of thirty-five percent or less.

No new lots are proposed as part of this development. Criterion does not apply.

I. The applicant's geotechnical engineer shall provide special inspection during construction to confirm that the subsurface conditions and assumptions made as part of their geotechnical evaluation/investigation are appropriate. This will allow for timely design changes if site conditions are encountered that are different from those anticipated.

The Owner will retain the geotechnical engineer to provide special inspection during construction to verify all site conditions are as anticipated.

J. Prior to issuing an occupancy permit, the geotechnical engineer shall prepare a summary letter stating that the soils- and foundation-related project elements were accomplished in substantial conformance with their recommendations.

The geotechnical engineer will provide a summary letter prior to occupancy being approved by the City.

17.44.110 - Approval of development.

The city engineer shall review the application and verify, based on the applicant's materials and the land use record, whether the proposed development constitutes a hazard to life, property, natural resources or public facilities. If, in the city engineer's opinion, a particular development poses such a hazard, the city engineer shall recommend to the review authority permit conditions designed to reduce or eliminate the hazard. These conditions may include, but are not limited to, prohibitions on construction activities between November 1st and March 31st.

The applicant will comply with the City Engineers recommendation to reduce or eliminate any hazardous conditions.

17.44.120 - Liability.

Approval of an application for development on land subject to this chapter shall not imply any liability on the part of the city for any subsequent damage due to earth slides. Prior to the issuance of a building permit, a waiver of damages and an indemnity and hold harmless agreement shall be required which releases the city from all liability for any damages resulting from the development approved by the city's decision.

The Owner agrees to hold the City harmless from any liability or damages resulting from development approved by the City..

17.44.130 - Compliance.

Nothing contained in this chapter shall relieve the developer of the duty to comply with any other provision of law. In the case of a conflict, the more restrictive regulation shall apply.

The Owner/ developer will comply with all provisions of the law and comform with the most restrictive provisions if conflicts exist.

17.44.140 - Appeal.

The review authority's decision may be appealed in the manner set forth in Chapter 17.50.

REDMOND GEOTECHNICAL SERVICES

Geotechnical Investigation

and

Geologic Landslide Hazard Assessment

Proposed Schaderman Single-Family Residential Home Site

Tax Lot No. 2602

5th Avenue and Apperson Street

Oregon City (Clackamas County), Oregon

for

Iselin Architects

Project No. 1477.006.G
April 19, 2018

REDMOND GEOTECHNICAL SERVICES

April 19, 2018

Mr. Todd Iselin
Iselin Architects
1307 Seventh Street
Oregon City, Oregon 97045

Dear Mr. Iselin:

Re: Geotechnical Investigation and Geologic Landslide Hazard Assessment, Proposed Schaderman Single-Family Residential Home Site, Tax Lot No. 2602, 5th Avenue and Apperson Street, Oregon City (Clackamas County), Oregon

Submitted herewith is our report entitled "Geotechnical Investigation and Geologic Landslide Hazard Assessment, Proposed Schaderman Single-Family Residential Home Site, Tax Lot No. 2602, 5th Avenue and Apperson Street, Oregon City (Clackamas County), Oregon". The scope of our services was outlined in our formal proposal to Mr. Todd Iselin dated January 30, 2018. Written authorization of our services was provided by Mr. Todd Iselin on January 31, 2018.

During the course of our investigation, we have kept you and/or others advised of our schedule and preliminary findings. We appreciate the opportunity to assist you with this phase of the project. Should you have any questions regarding this report, please do not hesitate to call.

Sincerely,

Daniel M. Redmond, P.E., G.E.
President/Principal Engineer

REGISTERED PROFESSIONAL ENGINEER 12309 OREGON July 15, 1983 DANIEL M. REDMOND

Exp. 12-31-18

PO Box 20547 • Portland, Oregon 97294 • Fax 503/286-7176 • Phone 503/285-0598

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Figure No. 1 - Site Vicinity Map
Figure No. 2 - Site Exploration Plan
Figure No. 3 - Typical Fill Slope Detail
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APPENDIX A

Test Pit Logs and Laboratory Data

APPENDIX B

Geologic Landslide Hazard Study

GEOTECHNICAL INVESTIGATION AND GEOLOGIC HAZARD ASSESSMENT PROPOSED SCHADERMAN SINGLE-FAMILY RESIDENTIAL HOME SITE TAX LOT NO. 2602 5TH AVENUE AND APPERSON STREET OREGON CITY (CLACKAMAS COUNTY) OREGON

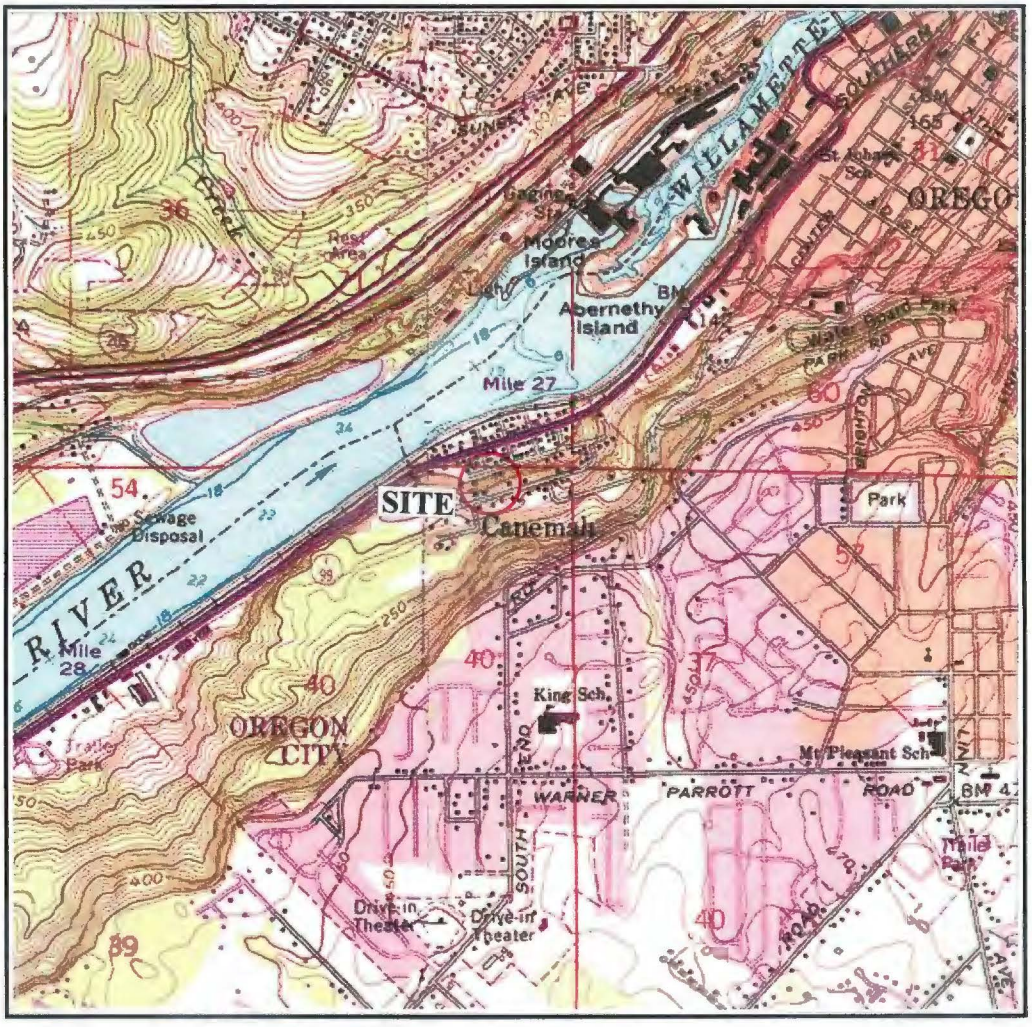
INTRODUCTION

Redmond Geotechnical Services, LLC is please to submit to you the results of our Geotechnical Investigation and Geologic Landslide Hazard Assessment at the site of the proposed new single-family residential home located to the northwest of the intersection of 5th Avenue and Apperson Street in Oregon City (Clackamas County), Oregon. The general location of the subject site is shown on the Site Vicinity Map, Figure No. 1. The purpose of our geotechnical investigation and geologic landslide hazard study services at this time was to explore the existing subsurface soils and/or groundwater conditions across the subject site and to evaluate any potential concerns with regard to past and/or current landslide activity at the site as well as to develop and/or provide appropriate geotechnical design and construction recommendations for the proposed new single-family residential development project.

PROJECT DESCRIPTION

We understand that present plans are to develop the subject property into a new single-family residential home. Based on a review of the proposed site development plan, we understand that the proposed new residential project will consist of the construction of a new single-family residential home with a main (ground floor) footprint of about 1,030 square feet (see Site Exploration Plan, Figure No. 2). The new residential home is anticipated to be a two-story structure constructed with wood framing and a raised wooden post and beam floor system. Additionally, we understand that development of the site will also include the construction of a two-story wood-frame detached garage which will have a main (ground) floor footprint of approximately 560 square feet. Support of the new residential and/or detached garage structure is anticipated to consist primarily of conventional shallow strip (continuous) footings although some individual (column) footings may also be required. Structural loading information, although unavailable at this time, is anticipated to be fairly typical and light for this type of wood-frame single-family residential structure and is expected to result in maximum dead plus live continuous (strip) and individual (column) footing loads on the order of about 1.5 to 2.5 kips per lineal foot (klf) and 10 to 30 kips, respectively.

Although a site grading plan is not available at this time, we understand that only minor cuts and/or fills are presently planned for the residential project. In general, relatively minor cuts and/or fills (i.e., 5-feet or less) will be required across the proposed residential home site.



OREGON CITY QUADRANGLE
OREGON–CLACKAMAS CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
SE/4 OREGON CITY 15' QUADRANGLE

SCALE 1:24 000

1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929
DEPTH CURVES AND SOUNDINGS IN FEET—DATUM IS MEAN LOWER LOW WATER BELOW LOCKS AND IS 50 FEET ABOVE MEAN SEA LEVEL ABOVE LOCKS
(COLUMBIA RIVER AND WILLAMETTE RIVER DATA)

SITE VICINITY MAP

Project No. 1477.006.G	**TAX LOT NO. 2602** **5TH AVE & APPERSON STREET**	Figure No. 1

In this regard, due to the existing sloping site and/or finish grades as well as the proposed use of a raised wooden post and beam floor system, the proposed new single-family residential structure will not likely include the construction of any partial below grade floor(s) and/or retaining wall(s). However, due to the anticipated use of a concrete slab-on-grade floor within the proposed detached garage, we anticipate that a small concrete retaining wall may be required along the side and/or easterly upslope portion of the garage structure.

Other associated site improvements for the project will include construction of a new gravel and/or paved private access drive extending eastward off of 5th Avenue. Additionally, the project will include the construction of new underground utility services.

SCOPE OF WORK

The purpose of our geotechnical and/or geologic studies was to evaluate the overall subsurface soil and/or groundwater conditions underlying the subject site with regard to the proposed new single-family residential development and construction at the site and any associated impacts or concerns with respect to existing and/or previous landslide activity at the site as well as provide appropriate geotechnical design and construction recommendations for the project. Specifically, our geotechnical investigation and landslide hazard study performed as a collaboration with Northwest Geological Services, Inc. (NWGS, Inc.) included the following scope of work items:

1. Review of available and relevant geologic and/or geotechnical investigation reports for the subject site and/or area .

2. A detailed field reconnaissance and subsurface exploration program of the soil and ground water conditions underlying the site by means of three (3) exploratory test pit excavations. The exploratory test pits were excavated to depths ranging from about four (4) to seven (7) feet beneath existing site grades at the approximate locations as shown on the Site Exploration Plan, Figure No. 2.

3. Laboratory testing to evaluate and identify pertinent physical and engineering properties of the subsurface soils encountered relative to the planned site development and construction at the site. The laboratory testing program included tests to help evaluate the natural (field) moisture content and dry density, maximum dry density and optimum moisture content, gradational characteristics and Atterberg Limits tests.

4. A literature review and engineering evaluation and assessment of the regional seismicity to evaluate the potential ground motion hazard(s) at the subject site. The evaluation and assessment included a review of the regional earthquake history and sources such as potential seismic sources, maximum credible earthquakes, and reoccurrence intervals as well as a discussion of the possible ground response to the selected design earthquake(s), fault rupture, landsliding, liquefaction, and tsunami and seiche flooding.

5. Engineering analyses utilizing the field and laboratory data as a basis for furnishing recommendations for foundation support of the proposed new residential and/or detached garage structure(s). Recommendations include maximum design allowable contact bearing pressure(s), depth of footing embedment, estimates of foundation settlement, lateral soil resistance, and foundation subgrade preparation. Additionally, construction and/or permanent subsurface water drainage considerations have also been prepared. Further, our report includes recommendations regarding site preparation, placement and compaction of structural fill materials, suitability of the on-site soils for use as structural fill, criteria for import fill materials, and preparation of foundation, pavement and/or floor slab subgrades.

SITE CONDITIONS

Site Geology

The subject site and/or area is underlain by highly weathered Basalt bedrock deposits and/or residual soils of the Columbia River Basalt formation. A more detailed description of the site geology across and/or beneath the site is presented in the Geologic Hazard Study in Appendix B.

Surface Conditions

The subject proposed new residential development property consists of Tax Lot No. 2602 which is a rectangular shaped (100 feet by 100 feet) tax lot encompassing a plan area of approximately 0.23 acres. The proposed residential development property is roughly located to the north of 5th Avenue and/or west of the intersection with Apperson Street. The subject site is unimproved and consists of existing open land. Surface vegetation across the site generally consists of a moderate growth of grass, weeds and brush as well as several to numerous small to large sized trees.

Topographically, the subject site is characterized as moderately sloping terrain (i.e., 25 to 35 percent) descending downward towards the north/northeast with overall topographic relief across the entire site estimated at about thirty-five (35) feet and ranges from a low about Elevation 185 feet near the northeasterly corner of the subject site to a high of about Elevation 220 near the southwesterly portion of the site.

Subsurface Soil Conditions

Our understanding of the subsurface soil conditions underlying the site was developed by means of three (3) exploratory test pits excavated to depths ranging from about four (4) to seven (7) feet beneath existing site grades on March 2, 2018 with a John Deere track-mounted excavator. The location of the exploratory test pits were located in the field by marking off distances from existing and/or known site features and are shown in relation to the proposed new residential structure and/or site improvements on the Site Exploration Plan, Figure No. 2. Detailed logs of the test pit explorations, presenting conditions encountered at each location explored, are presented in the Appendix, Figure No's. A-4 and A-5.

The exploratory test pit excavations were observed by staff from Redmond Geotechnical Services, LLC who logged each of the test pit explorations and obtained representative samples of the subsurface soils encountered across the site. Additionally, the elevation of the exploratory test pit excavations were referenced from the proposed Site Development Plan prepared by Iselin Architects and should be considered as approximate. All subsurface soils encountered at the site and/or within the exploratory test pit excavations were logged and classified in general conformance with the Unified Soil Classification System (USCS) which is outlined on Figure No. A-3.

The test pit explorations revealed that the subject site is underlain by native soil deposits comprised of highly weathered bedrock and/or residual soils composed of a surficial layer of dark brown, wet, very soft, highly organic, clayey, sandy silt topsoil materials to depths of about 12 inches. These surficial topsoil materials were inturn underlain by medium to reddish-brown, very moist to wet, soft to medium stiff becoming stiff at depth, clayey, sandy silt to a depth of about three (3) to five (5) feet beneath the existing site and/or surface grades. These upper clayey, sandy silt subgrade soils contain some rock fragments and are best characterized by relatively low to moderate strength and moderate compressibility. These upper clayey, sandy silt to silty sand subgrade soils were inturn underlain by gray-brown to dark gray-brown, damp, medium dense to dense, moderately weathered and fractured Basalt bedrock deposits to the maximum depth explored of about seven (7) feet beneath the existing site and/or surface grades. These moderately weathered and fractured Basalt bedrock deposits are best characterized by relatively moderate to high strength and low to very low compressibility.

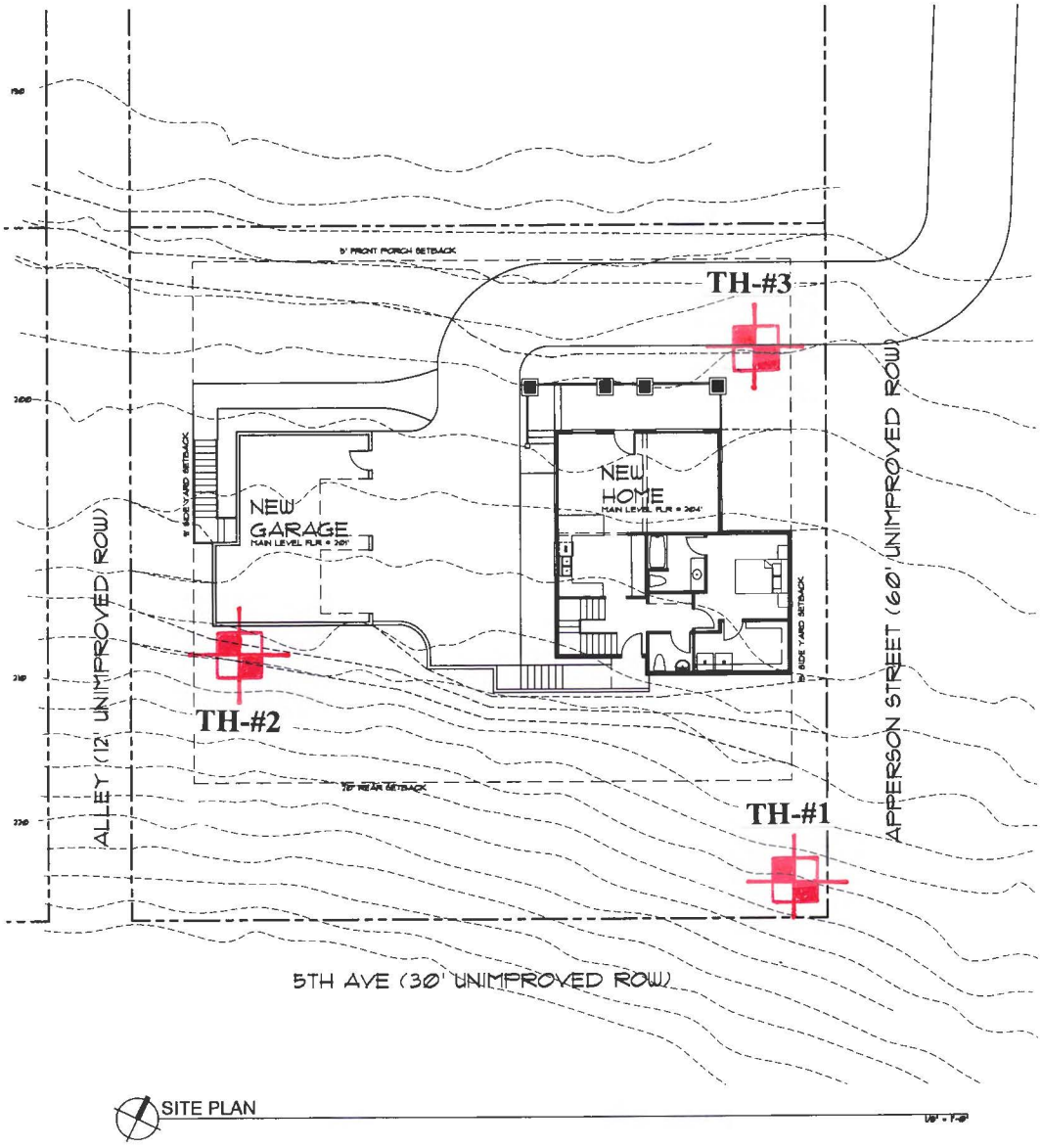
Groundwater

Groundwater was generally not encountered within any of the exploratory test pit explorations (TH-#1 through TH-#3) at the time of excavation to depths of at least seven (7) feet beneath existing surface grades. However, an existing seasonal drainage basin and/or feature is located to the east/northeast of the subject property. Additionally, although ponding of surface water was generally not present across the site at the time of our field work, the presence of the clayey, sandy silt soils beneath the site is generally believed to be associated with very low infiltration rates of the area.

In this regard, although groundwater elevations at the site may fluctuate seasonally in accordance with rainfall conditions and/or associated with runoff of the westerly drainage basin as well as changes in site utilization, we are generally of the opinion that the static water levels and/or surface water ponding not observed during our recent field exploration work generally reflect a low seasonal groundwater level(s) at and/or beneath the site.

LABORATORY TESTING

Representative samples of the on-site subsurface soils were collected at selected depths and intervals from various test pit excavations and returned to our laboratory for further examination and testing and/or to aid in the classification of the subsurface soils as well as to help evaluate and identify their engineering strength and compressibility characteristics.



LEGEND

TH-#3 Indicates approximate location of exploratory test hole

SITE EXPLORATION PLAN

Project No. 1477.006.G	**TAX LOT NO. 2602** **5TH AVE & APPERSON STREET**	Figure No. 2

The laboratory testing consisted of visual and textural sample inspection, moisture content and dry density determinations, maximum dry density and optimum moisture content, gradation analyses and Atterberg Limits tests. Results of the various laboratory tests are presented in the Appendix, Figure No's. A-6 through A-8.

SEISMICITY AND EARTHQUAKE SOURCES

The seismicity of the southwest Washington and northwest Oregon area, and hence the potential for ground shaking, is controlled by three separate fault mechanisms. These include the Cascadia Subduction Zone (CSZ), the mid-depth intraplate zone, and the relatively shallow crustal zone. Descriptions of these potential earthquake sources are presented below.

The CSZ is located offshore and extends from northern California to British Columbia. Within this zone, the oceanic Juan de Fuca Plate is being subducted beneath the continental North American Plate to the east. The interface between these two plates is located at a depth of approximately 15 to 20 kilometers (km). The seismicity of the CSZ is subject to several uncertainties, including the maximum earthquake magnitude and the recurrence intervals associated with various magnitude earthquakes. Anecdotal evidence of previous CSZ earthquakes has been observed within coastal marshes along the Washington and Oregon coastlines. Sequences of interlayered peat and sands have been interpreted to be the result of large Subduction zone earthquakes occurring at intervals on the order of 300 to 500 years, with the most recent event taking place approximately 300 years ago. A study by Geomatrix (1995) and/or USGS (2008) suggests that the maximum earthquake associated with the CSZ is moment magnitude (Mw) 8 to 9. This is based on an empirical expression relating moment magnitude to the area of fault rupture derived from earthquakes that have occurred within Subduction zones in other parts of the world. An Mw 9 earthquake would involve a rupture of the entire CSZ. As discussed by Geomatrix (1995) this has not occurred in other subduction zones that have exhibited much higher levels of historical seismicity than the CSZ. However, the 2008 USGS report has assigned a probability of 0.67 for a Mw 9 earthquake and a probability of 0.33 for a Mw 8.3 earthquake. For the purpose of this study an earthquake of Mw 9.0 was assumed to occur within the CSZ.

The intraplate zone encompasses the portion of the subducting Juan de Fuca Plate located at a depth of approximately 30 to 50 km below western Washington and western Oregon. Very low levels of seismicity have been observed within the intraplate zone in western Oregon and western Washington. However, much higher levels of seismicity within this zone have been recorded in Washington and California. Several reasons for this seismic quiescence were suggested in the Geomatrix (1995) study and include changes in the direction of Subduction between Oregon, Washington, and British Columbia as well as the effects of volcanic activity along the Cascade Range. Historical activity associated with the intraplate zone includes the 1949 Olympia magnitude 7.1 and the 1965 Puget Sound magnitude 6.5 earthquakes. Based on the data presented within the Geomatrix (1995) report, an earthquake of magnitude 7.25 has been chosen to represent the seismic potential of the intraplate zone.

The third source of seismicity that can result in ground shaking within the Vancouver and southwest Washington area is near-surface crustal earthquakes occurring within the North American Plate. The historical seismicity of crustal earthquakes in this area is higher than the seismicity associated with the CSZ and the intraplate zone. The 1993 Scotts Mills (magnitude 5.6) and Klamath Falls (magnitude 6.0), Oregon earthquakes were crustal earthquakes.

Liquefaction

Seismic induced soil liquefaction is a phenomenon in which lose, granular soils and some silty soils, located below the water table, develop high pore water pressures and lose strength due to ground vibrations induced by earthquakes. Soil liquefaction can result in lateral flow of material into river channels, ground settlements and increased lateral and uplift pressures on underground structures. Buildings supported on soils that have liquefied often settle and tilt and may displace laterally. Soils located above the ground water table cannot liquefy, but granular soils located above the water table may settle during the earthquake shaking.

Our review of the subsurface soil test pit logs from our exploratory field explorations (TH-#1 through TH-#3) and laboratory test results indicate that the site is generally underlain by medium stiff to stiff, clayey, sandy silt subgrade soils and/or medium dense to dense and moderately weathered and fractured basalt bedrock deposits to depths of at least 7.0 feet beneath existing site grades. Additionally, groundwater was generally not encountered within any of the exploratory test pit excavations (TH-#1 through TH-#3) at the site during our field exploration work to depths of at least 7.0 feet.

As such, due to the medium stiff to stiff and/or cohesive nature of the clayey, sandy silt subgrade soils and/or the medium dense to dense characteristics of the slightly weathered and fractured basalt bedrock deposits beneath the site, it is our opinion that the native clayey, sandy silt to silty sand subgrade soils and/or moderately weathered and fractured basalt bedrock deposits located beneath the subject site have a very low potential for liquefaction during the design earthquake motions previously described.

Landslides

Although the subject property is located within a large ancient landslide deposit, no active landslides were observed or are known to be present on the subject site. Additionally, development of the subject site into the planned residential home site does not appear to present a potential and/or serious geologic and/or landslide hazard risk provided that the site grading and development activities conform with the recommendations presented within this report. A more detailed assessment of the potential landslide hazard of the subject site is presented in the Geologic Hazard Study in Appendix B.

Surface Rupture

Although the site is generally located within a region of the country known for seismic activity, no known faults exist on and/or immediately adjacent to the subject site. As such, the risk of surface rupture due to faulting is considered negligible.

Tsunami and Seiche

A tsunami, or seismic sea wave, is produced when a major fault under the ocean floor moves vertically and shifts the water column above it. A seiche is a periodic oscillation of a body of water resulting in changing water levels, sometimes caused by an earthquake. Tsunami and seiche are not considered a potential hazard at this site because the site is not near to the coast and/or there are no adjacent significant bodies of water.

Flooding and Erosion

Stream flooding is a potential hazard that should be considered in lowland areas of Clackamas County and Oregon City. The FEMA (Federal Emergency Management Agency) flood maps should be reviewed as part of the design for the proposed new residential structures and site improvements. Elevations of structures on the site should be designed based upon consultants reports, FEMA (Federal Emergency Management Agency), and Clackamas County requirements for the 100-year flood levels of any nearby creeks, streams and/or drainage basins.

CONCLUSIONS AND RECOMMENDATIONS

General

Based on the results of our field explorations, laboratory testing, and engineering analyses, it is our opinion that the site is presently stable and generally suitable for the proposed new Schaderman single-family residential development and its associated site improvements provided that the recommendations contained within this report are properly incorporated into the design and construction of the project.

The primary features of concern at the site are 1) the presence of moisture sensitive clayey, sandy silt subgrade soils across the site, 2) the presence of moderately sloping site conditions across the subject site, and 3) the relatively low infiltration rates anticipated within the near surface clayey, sandy silt subgrade soils.

With regard to the moisture sensitive clayey, sandy silt subgrade soils, we are generally of the opinion that all site grading and earthwork activities be scheduled for the drier summer months which is typically June through September.

In regards to the moderately sloping site conditions across the proposed new residential home site, we are of the opinion that site grading and/or structural fill placement should be minimized where possible and should generally limit cuts and/or fills to about five (5) feet or less unless approved by the Geotechnical Engineer. Additionally, where existing site slopes and/or surface grades exceed about 20 percent (1V:5H), proper benching and keying of all fills into the natural site slopes may be required.

With regard to the relatively low infiltration rates anticipated within the clayey, sandy silt subgrade soils beneath the site, we generally do not recommend any concentrated storm water infiltration within structural and/or embankment fills. However, some limited storm water infiltration may be feasible if diffused within the lower northerly portion of the residential lot and/or area of the site where the existing and/or finish slope gradients are no steeper than about 20 percent (1V:5H). In this regard, we recommend that all proposed storm water detention and/or infiltration systems for the project be reviewed and approved by Redmond Geotechnical Services, LLC.

The following sections of this report provide specific recommendations regarding subgrade preparation and grading as well as foundation and floor slab design and construction for the new Schaderman single-family residential development project.

Site Preparation

As an initial step in site preparation, we recommend that the proposed new residential building site and/or lot as well as any associated structural and/or site improvement area(s) be stripped and cleared of any existing improvements, any existing unsuitable and/or undocumented fill materials, surface debris, existing vegetation, topsoil materials, and/or any other deleterious materials present at the time of construction. In general, we envision that the site stripping to remove existing vegetation and topsoil materials will generally be about 12 inches. However, localized areas requiring deeper removals, such as any existing undocumented and/or unsuitable fill materials as well as old tree stump areas, may be encountered and should be evaluated at the time of construction by the Geotechnical Engineer. The stripped and cleared materials should be properly disposed of as they are generally considered unsuitable for use/reuse as fill materials.

Following the completion of the site stripping and clearing work and prior to the placement of any required structural fill materials and/or structural improvements, the exposed subgrade soils within the planned structural improvement area(s) should be inspected and approved by the Geotechnical Engineer. Areas found to be soft or otherwise unsuitable should be over-excavated and removed or scarified and recompacted as structural fill. During wet and/or inclement weather conditions, proof rolling and/or scarification and re-compaction may not be appropriate.

The on-site native clayey, sandy silt to silty sand subgrade soil materials are generally considered suitable for use/reuse as structural fill materials provided that they are free of organic materials, debris, and rock fragments in excess of about 6 inches in dimension. However, if site grading is performed during wet or inclement weather conditions, the use of some of the on-site native soil materials which contain significant silt and clay sized particles will be difficult at best.

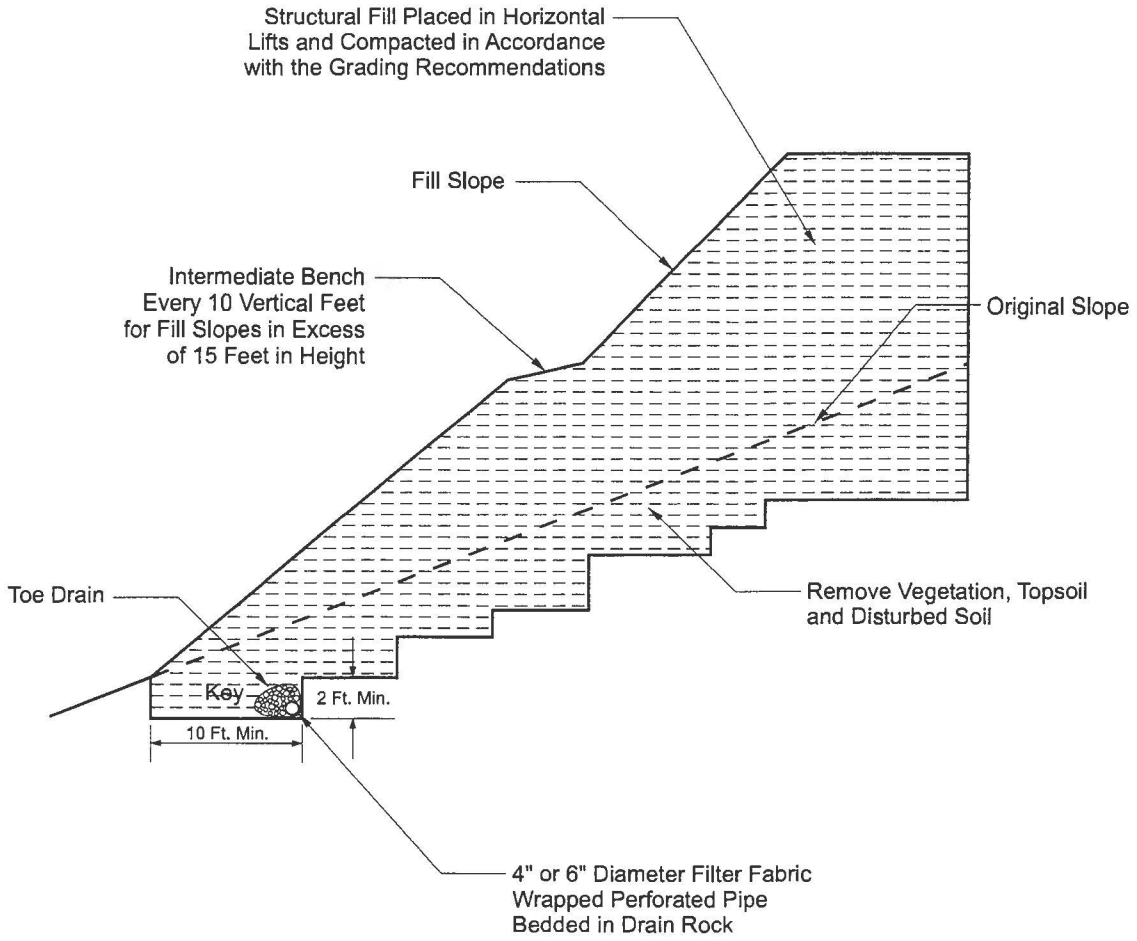
In this regard, during wet or inclement weather conditions, we recommend that an import structural fill material be utilized which should consist of a free-draining (clean) granular fill (sand & gravel) containing no more than about 5 percent fines. Representative samples of the materials which are to be used as structural fill materials should be submitted to the Geotechnical Engineer and/or laboratory for approval and determination of the maximum dry density and optimum moisture content for compaction.

In general, all site earthwork and grading activities should be scheduled for the drier summer months (June through September) if possible. However, if wet weather site preparation and grading is required, it is generally recommended that the stripping of topsoil materials be accomplished with a tracked excavator utilizing a large smooth-toothed bucket working from areas yet to be excavated. Additionally, the loading of strippings into trucks and/or protection of moisture sensitive subgrade soils will also be required during wet weather grading and construction. In this regard, we recommend that areas in which construction equipment will be traveling be protected by covering the exposed subgrade soils with a woven geotextile fabric such as Mirafi FW404 followed by at least 12 inches or more of crushed aggregate base rock. Further, the geotextile fabric should have a minimum Mullen burst strength of at least 250 pounds per square inch for puncture resistance and an apparent opening size (AOS) between the U.S. Standard No. 70 and No. 100 sieves.

All structural fill materials placed within the new building and/or pavement areas should be moistened or dried as necessary to near (within 3 percent) optimum moisture conditions and compacted by mechanical means to a minimum of 92 percent of the maximum dry density as determined by the ASTM D-1557 (AASHTO T-180) test procedures. Structural fill materials should be placed in lifts (layers) such that when compacted do not exceed about 8 inches. Additionally, all fill materials placed within three (3) lineal feet of the perimeter (limits) of the proposed residential or detached garage structure and/or access drive should be considered structural fill. Additionally, due to the sloping site conditions, we recommend that all structural fill materials planned in areas where existing surface and/or slope gradients exceed about 20 percent (1V:5H) be properly benched and/or keyed into the native (natural) slope subgrade soils. In general, a bench width of between eight (8) and ten (10) feet and a keyway depth of between one (1) and two (2) feet is generally recommended. However, the actual bench width and keyway depth should be determined at the time of construction by the Geotechnical Engineer. Further, all fill slopes should be constructed with a finish slope surface gradient no steeper than about 2H:1V. A typical fill slope detail can be provided upon request. All aspects of the site grading, including a review of the proposed site grading plan(s), should be approved and/or monitored by a representative of Redmond Geotechnical Services, LLC.

Foundation Support

Based on the results of our investigation, it is our opinion that the site of the proposed new residential development is suitable for support of the two-story wood-frame residential structure and detached garage provided that the following foundation design recommendations are followed. The following sections of this report present specific foundation design and construction recommendations for the planned new residential and/or garage structure(s).



TYPICAL FILL SLOPE DETAIL

Project No. 1477.006.G	**TAX LOT NO. 2602** **5TH AVE & APPERSON STREET**	Figure No. 3

Shallow Foundations

In general, conventional shallow continuous (strip) footings and individual (spread) column footings may be supported by approved native (untreated) sandy silt to silty sand subgrade soil materials and/or sandy silt to silty sand structural fill soils based on an allowable contact bearing pressure of about 2,000 pounds per square foot (psf). This recommended allowable contact bearing pressure is intended for dead loads and sustained live loads and may be increased by one-third for the total of all loads including short-term wind or seismic loads. In general, continuous strip footings should have a minimum width of at least 16 inches and be embedded at least 18 inches below the lowest adjacent finish grade (includes frost protection). Individual column footings (where required) should be embedded at least 18 inches below grade and have a minimum width of at least 24 inches. Additionally, we recommend that all downslope footings for the proposed new single-family residential structure as well as the proposed detached garage be sufficiently embedded such that at least eight (8) feet is developed between the face of the existing and/or finish slope face and the outer bearing edge of the footing element. Further, if foundation excavation and construction work is planned to be performed during wet and/or inclement weather conditions, we recommend that a 3- to 4-inch layer of compacted crushed rock be used to help protect the exposed foundation bearing surfaces until the placement of concrete.

Total and differential settlements of foundations constructed as recommended above and supported by approved native subgrade soils or by properly compacted structural fill materials are expected to be well within the tolerable limits for this type of lightly loaded wood-frame structure and should generally be less than about 1-inch and 1/2-inch, respectively.

Allowable lateral frictional resistance between the base of the footing element and the supporting subgrade bearing soil can be expressed as the applied vertical load multiplied by a coefficient of friction of 0.30 and 0.45 for native silty subgrade soils and/or import gravel fill materials, respectively. In addition, lateral loads may be resisted by passive earth pressures on footings poured "neat" against in-situ (native) subgrade soils or properly backfilled with structural fill materials based on an equivalent fluid density of 250 pounds per cubic foot (pcf). This recommended value includes a factor of safety of approximately 1.5 which is appropriate due to the amount of movement required to develop full passive resistance.

Floor Slab Support

In order to provide uniform subgrade reaction beneath concrete slab-on-grade floors, we recommend that the floor slab area be underlain by a minimum of 6 inches of free-draining (less than 5 percent passing the No. 200 sieve), well-graded, crushed rock. The crushed rock should help provide a capillary break to prevent migration of moisture through the slab. However, additional moisture protection can be provided by using a 10-mil polyolefin geo-membrane sheet such as StegoWrap.

The base course materials should be compacted to at least 95 percent of the maximum dry density as determined by the ASTM D-1557 (AASHTO T-180) test procedures. Where floor slab subgrade materials are undisturbed, firm and stable and where the underslab aggregate base rock section has been prepared and compacted as recommended above, we recommend that a modulus of subgrade reaction of 150 pci be used for design.

Retaining/Below Grade Walls

Retaining and/or below grade walls should be designed to resist lateral earth pressures imposed by native soils or granular backfill materials as well as any adjacent surcharge loads. For walls which are unrestrained at the top and free to rotate about their base, we recommend that active earth pressures be computed on the basis of the following equivalent fluid densities:

Non-Restrained Retaining Wall Pressure Design Recommendations

Slope Backfill (Horizontal/Vertical)	Equivalent Fluid Density/Silt (pcf)	Equivalent Fluid Density/Gravel (pcf)
Level	35	30
3H:1V	60	50
2H:1V	90	80

For walls which are fully restrained at the top and prevented from rotation about their base, we recommend that at-rest earth pressures be computed on the basis of the following equivalent fluid densities:

Restrained Retaining Wall Pressure Design Recommendations

Slope Backfill (Horizontal/Vertical)	Equivalent Fluid Density/Silt (pcf)	Equivalent Fluid Density/Gravel (pcf)
Level	45	35
3H:1V	65	60
2H:1V	95	90

The above recommended values assume that the walls will be adequately drained to prevent the buildup of hydrostatic pressures. Where wall drainage will not be present and/or if adjacent surcharge loading is present, the above recommended values will be significantly higher.

Backfill materials behind walls should be compacted to 90 percent of the maximum dry density as determined by the ASTM D-1557 (AASHTO T-180) test procedures. Special care should be taken to avoid over-compaction near the walls which could result in higher lateral earth pressures than those indicated herein. In areas within three (3) to five (5) feet behind walls, we recommend the use of hand-operated compaction equipment.

Pavements

Flexible pavement design for the proposed private access drive for the single-family residential project was determined on the basis of projected (anticipated) traffic volume and loading conditions relative to an assumed subgrade "R"-value characteristic. Based on an assumed subgrade "R"-value of 30 and using the design procedures contained within the AASHTO 1993 Design of Pavement Structures Manual, a Structural Number (SN) of 2.5 was determined. In this regard, we recommend the following flexible pavement section for the construction of new private access drive:

Material Type	Pavement Section (inches)
Asphaltic Concrete	3.0
Aggregate Base Rock	8.0

Wet Weather Grading and Soft Spot Mitigation

Construction of the proposed new private access drive is generally recommended during dry weather. However, during wet weather grading and construction, excavation to subgrade can proceed during periods of light to moderate rainfall provided that the subgrade remains covered with aggregate. A total aggregate thickness of 12-inches or more may be necessary to protect the subgrade soils from heavy construction traffic. Construction traffic should not be allowed directly on the exposed subgrade but only atop a sufficient compacted base rock thickness to help mitigate subgrade pumping. If the subgrade becomes wet and pumps, no construction traffic shall be allowed on the access drive alignment. Positive site drainage away from the street shall be maintained if site paving will not occur before the on-set of the wet season.

Depending on the timing for the project, any soft subgrade found during proof-rolling or by visual observations can either be removed and replaced with properly dried and compacted fill soils or removed and replaced with compacted crushed aggregate. However, and where approved by the Geotechnical Engineer, the soft area may be covered with a bi-axial geogrid and covered with compacted crushed aggregate.

Soil Shrink-Swell and Frost Heave

The results of the laboratory tests indicate that the native subgrade soils possess a low expansion potential. As such, the exposed subgrade soils should not be allowed to completely dry and should be moistened to near optimum moisture content (plus or minus 3 percent) at the time of the placement of the crushed aggregate base rock materials. Additionally, exposure of the subgrade soils to freezing weather may result in frost heave and softening of the subgrade. As such, all subgrade soils exposed to freezing weather should be evaluated and approved by the Geotechnical Engineer prior to the placement of the crushed aggregate base rock materials.

Excavation/Slopes

Temporary excavations of up to about five (5) feet in depth may be constructed and/or excavated with inclinations of at least 1 to 1 (horizontal to vertical) or properly braced/shored. Where excavations are planned to exceed about five (5) feet, this office should be consulted. All shoring systems and/or temporary excavation bracing for the project should be the responsibility of the excavation contractor. Permanent cut and/or slopes should be constructed no steeper than about 2H to 1V unless approved by the Geotechnical Engineer.

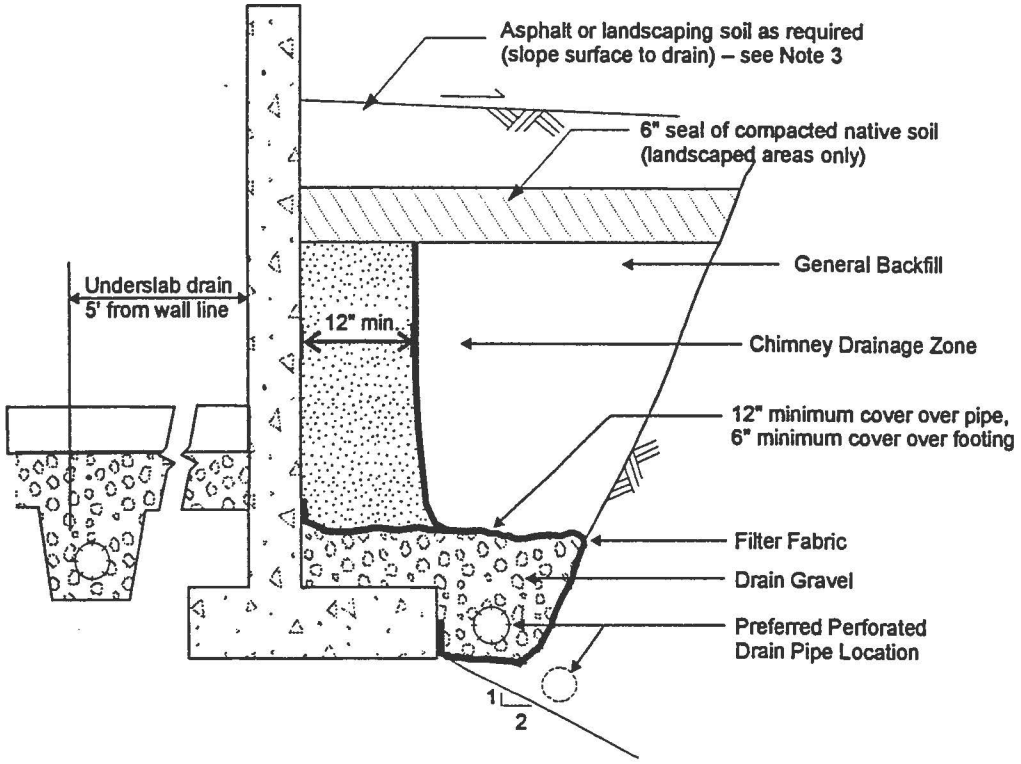
Depending on the time of year in which trench excavations occur, trench dewatering may be required in order to maintain dry working conditions if the invert elevations of the proposed utilities are located at and/or below the groundwater level. If groundwater is encountered during utility excavation work, we recommend placing trench stabilization materials along the base of the excavation. Trench stabilization materials should consist of 1-foot of well-graded gravel, crushed gravel, or crushed rock with a maximum particle size of 4 inches and less than 5 percent fines passing the No. 200 sieve. The material should be free of organic matter and other deleterious material and placed in a single lift and compacted until well keyed.

Surface Drainage/Groundwater

We recommend that positive measures be taken to properly finish grade the site so that drainage waters from the residential structure and landscaping areas as well as adjacent properties or buildings are directed away from the new residential structure foundations and/or floor slabs. All roof drainage should be directed into conduits that carry runoff water away from the residential and/or garage structure(s) to a suitable outfall. Roof downspouts should not be connected to foundation drains. A minimum ground slope of about 2 percent is generally recommended in unpaved areas around the proposed new residential structure and/or detached garage.

Groundwater was not encountered at the site in any of the exploratory test pits (TH-#1 through TH-#3) at the time of excavation to depths of at least 7 feet beneath existing site grades. Additionally, surface water ponding was not observed at the site during our field exploration work. However, an existing seasonal drainage basin feature is located to the east/northeast of the subject property. Further, groundwater elevations in the area and/or across the subject property may fluctuate seasonally and may temporarily pond/perch near the ground surface during periods of prolonged rainfall.

As such, based on our current understand of the possible site grading required to bring the subject site and/or residential building pad to finish design grade(s), we are of the opinion that an underslab drainage system is generally not required for the proposed single-family residential structure. However, a perimeter foundation drain is recommended for any perimeter footings and/or below grade retaining walls. A typical recommended perimeter footing/retaining wall drain detail is shown on Figure No. 4.



SCHEMATIC - NOT TO SCALE

NOTES:

1. Filter Fabric to be non-woven geotextile (Amoco 4545, Mirafi 140N, or equivalent)
2. Lay perforated drain pipe on minimum 0.5% gradient, widening excavation as required. Maintain pipe above 2:1 slope, as shown.
3. All-granular backfill is recommended for support of slabs, pavements, etc. (see text for structural fill).
4. Drain gravel to be clean, washed ¾" to 1½" gravel.
5. General backfill to be on-site gravels, or ¾""-0 or 1½"-0 crushed rock compacted to 92% Modified Proctor (AASHTO T-180).
6. Chimney drainage zone to be 12" wide (minimum) zone of clean washed, medium to coarse sand or drain gravel if protected with filter fabric. Alternatively, prefabricated drainage structures (Miradrain 6000 or similar) may be used.

PERIMETER FOOTING/RETAINING WALL DRAIN DETAIL

Project No. 1477.006.G	**TAX LOT NO. 2602** **5TH AVE & APPERSON STREET**	Figure No. 4

Further, due to the relatively low infiltration rates of the near surface clayey, sandy silt subgrade soils as well as the moisture sensitivity of the site to disposal of storm water in a relatively concentrated area, we are generally of the opinion that storm water detention and/or disposal systems should not be utilized within the residential lot and/or around the proposed residential structure unless it consists of a diffusion type system approved by the Geotechnical Engineer.

Seismic Design Considerations

Structures at the site should be designed to resist earthquake loading in accordance with the methodology described in the latest edition (2014) of the State of Oregon Structural Specialty Code (OSSC) and/or Amendments to the 2015 International Building Code (IBC). The maximum considered earthquake ground motion for short period and 1.0 period spectral response may be determined from the Oregon Structural Specialty Code and/or from the National Earthquake Hazard Reduction Program (NEHRP) "Recommended Provisions for Seismic Regulations for New Buildings and Other Structures" published by the Building Seismic Safety Council. We recommend Site Class "C" be used for design. Using this information, the structural engineer can select the appropriate site coefficient values (F_a and F_v) from the 2015 IBC to determine the maximum considered earthquake spectral response acceleration for the project. However, we have assumed the following response spectrum for the project:

Table 1. Recommended Seismic Design Parameters

Site Class	S_S	S_1	Fa	Fv	S_{MS}	S_{M1}	S_{DS}	S_{D1}
C	0.933	0.403	1.027	1.397	0.958	0.563	0.639	0.375

Notes: 1. S_S and S_1 were established based on the USGS 2015 mapped maximum considered earthquake spectral acceleration maps for 2% probability of exceedence in 50 years.

2. Fa and Fv were established based on IBC 2015 tables using the selected S_S and S_1 values.

CONSTRUCTION MONITORING AND TESTING

We recommend that **Redmond Geotechnical Services, LLC** be retained to provide construction monitoring and testing services during all earthwork operations for the proposed new residential project. The purpose of our monitoring services would be to confirm that the site conditions reported herein are as anticipated, provide field recommendations as required based on the actual conditions encountered, document the activities of the grading contractor and assess his/her compliance with the project specifications and recommendations. It is important that our representative meet with the contractor prior to any site grading to help establish a plan that will minimize costly over-excavation and site preparation work. Of primary importance will be observations made during site preparation and stripping, structural fill placement, footing excavations and construction as well as retaining wall backfill.

CLOSURE AND LIMITATIONS

This report is intended for the exclusive use of the addressee and/or their representative(s) to use to design and construct the proposed new single-family residential and/or detached garage structure(s) and their associated site improvements described herein as well as to prepare any related construction documents. The conclusions and recommendations contained in this report are based on site conditions as they presently exist and assume that the explorations are representative of the subsurface conditions between the explorations and/or at other locations across the study area. The data, analyses, and recommendations herein may not be appropriate for other structures and/or purposes. We recommend that parties contemplating other structures and/or purposes contact our office. In the absence of our written approval, we make no representation and assume no responsibility to other parties regarding this report. Additionally, the above recommendations are contingent on Redmond Geotechnical Services, LLC being retained to provide all site inspections and constriction monitoring services for this project. Redmond Geotechnical Services, LLC will not assume any responsibility and/or liability for any engineering judgment, inspection and/or testing services performed by others.

It is the owners/developers responsibility for insuring that the project designers and/or contractors involved with this project implement our recommendations into the final design plans, specifications and/or construction activities for the project. Further, in order to avoid delays during construction, we recommend that the final design plans and specifications for the project be reviewed by our office to evaluate as to whether our recommendations have been properly interpreted and incorporated into the project.

If during any future site grading and construction, subsurface conditions different from those encountered in the explorations are observed or appear to be present beneath excavations, we should be advised immediately so that we may review these conditions and evaluate whether modifications of the design criteria are required. We also should be advised if significant modifications of the proposed site development are anticipated so that we may review our conclusions and recommendations.

LEVEL OF CARE

The services performed by the Geotechnical Engineer for this project have been conducted with that level of care and skill ordinarily exercised by members of the profession currently practicing in the area under similar budget and time restraints. No warranty or other conditions, either expressed or implied, is made.

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Appendix "A"

Test Pit Logs and Laboratory Test Data

APPENDIX

FIELD EXPLORATIONS AND LABORATORY TESTING

FIELD EXPLORATION

Subsurface conditions at the site were explored by excavating three (3) exploratory test pits (TH-#1 through TH-#3) on March 2, 2018. The approximate location of the test pit explorations are shown in relation to the proposed new residential and/or detached garage structure(s) and the associated site improvements on the Site Exploration Plan, Figure No. 2.

The test pits were excavated using track-mounted excavating equipment in general conformance with ASTM Methods in Vol. 4.08, D-1586-94 and D-1587-83. The test pits were excavated to depths ranging from about 4.0 to 7.0 feet beneath existing site grades. Detailed logs of the test pits are presented on the Log of Test Pits, Figure No's. A-4 and A-5. The soils were classified in accordance with the Unified Soil Classification System (USCS), which is outlined on Figure No. A-3.

The exploration program was coordinated by a field engineer who monitored the excavating and exploration activity, obtained representative samples of the subsurface soils encountered, classified the soils by visual and textural examination, and maintained continuous logs of the subsurface conditions. Disturbed and/or undisturbed samples of the subsurface soils were obtained at appropriate depths and/or intervals and placed in plastic bags and/or with a thin walled ring sample.

Groundwater was not encountered in any of the exploratory test pits (TH-#1 through TH-#3) at the time of excavating to depths of at least 7.0 feet beneath existing surface grades.

LABORATORY TESTING

Pertinent physical and engineering characteristics of the soils encountered during our subsurface investigation were evaluated by a laboratory testing program to be used as a basis for selection of soil design parameters and for correlation purposes. Selected tests were conducted on representative soil samples. The program consisted of tests to evaluate the existing (in-situ) moisture-density, maximum dry density and optimum moisture content, gradational characteristics and Atterberg Limits tests.

Dry Density and Moisture Content Determinations

Density and moisture content determinations were performed on both disturbed and relatively undisturbed samples from the test pit explorations in general conformance with ASTM Vol. 4.08 Part D-216. The results of these tests were used to calculate existing overburden pressures and to correlate strength and compressibility characteristics of the soils. Test results are shown on the test pit logs at the appropriate sample depths.

Maximum Dry Density

One (1) Maximum Dry Density and Optimum Moisture Content test was performed on a representative samples of the near surface clayey, sandy silt to silty sand subgrade soils in accordance with ASTM Vol. 4.08 Part D-1557. The test results were conducted to help establish various engineering and/or strength properties. The test results are presented on Figure No. A-6.

Atterberg Limits

One (1) Liquid Limit (LL) and Plastic Limit (PL) test was performed on a representative sample of the sandy, clayey silt subgrade soils in accordance with ASTM Vol. 4.08 Part D-4318-85. These tests were conducted to facilitate classification of the soils and for correlation purposes. The test results appear on Figure No. A-7.

Gradation Analysis

One (1) Gradation analyses was performed on a representative sample of the subsurface soils in accordance with ASTM Vol. 4.08 Part D-422. The test results were used to classify the soil in accordance with the Unified Soil Classification System (USCS). The test results are shown graphically on Figure No. A-8.

The following figures are attached and complete the Appendix:

Figure No. A-3	Key To Exploratory Test Pit Logs
Figure No's. A-4 and A-5	Log of Test Pits
Figure No. A-6	Maximum Density Test Results
Figure No. A-7	Atterberg Limits Test Results
Figure No. A-8	Gradation Test Results

PRIMARY DIVISIONS			GROUP SYMBOL	SECONDARY DIVISIONS
COARSE GRAINED SOILS MORE THAN HALF OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVELS MORE THAN HALF OF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS (LESS THAN 5% FINES)	GW	Well graded gravels, gravel-sand mixtures, little or no fines.
			GP	Poorly graded gravels or gravel-sand mixtures, little or no fines.
		GRAVEL WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines.
			GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines.
	SANDS MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS (LESS THAN 5% FINES)	SW	Well graded sands, gravelly sands, little or no fines.
			SP	Poorly graded sands or gravelly sands, little or no fines.
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures, non-plastic fines.
			SC	Clayey sands, sand-clay mixtures, plastic fines.
FINE GRAINED SOILS MORE THAN HALF OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS LIQUID LIMIT IS LESS THAN 50%		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL	Organic silts and organic silty clays of low plasticity.
	SILTS AND CLAYS LIQUID LIMIT IS GREATER THAN 50%		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS			Pt	Peat and other highly organic soils.

DEFINITION OF TERMS

U.S. STANDARD SERIES SIEVE: 200, 40, 10, 4

CLEAR SQUARE SIEVE OPENINGS: 3/4", 3", 12"

SILTS AND CLAYS	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

GRAIN SIZES

SANDS, GRAVELS AND NON-PLASTIC SILTS	BLOWS/FOOT†
VERY LOOSE	0 - 4
LOOSE	4 - 10
MEDIUM DENSE	10 - 30
DENSE	30 - 50
VERY DENSE	OVER 50

RELATIVE DENSITY

CLAYS AND PLASTIC SILTS	STRENGTH‡	BLOWS/FOOT†
VERY SOFT	0 - 1/4	0 - 2
SOFT	1/4 - 1/2	2 - 4
FIRM	1/2 - 1	4 - 8
STIFF	1 - 2	8 - 16
VERY STIFF	2 - 4	16 - 32
HARD	OVER 4	OVER 32

CONSISTENCY

†Number of blows of 140 pound hammer falling 30 inches to drive a 2 inch O.D. (1-3/8 inch I.D.) split spoon (ASTM D-1586).

‡Unconfined compressive strength in tons/sq. ft. as determined by laboratory testing or approximated by the standard penetration test (ASTM D-1586), pocket penetrometer, torvane, or visual observation.

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KEY TO EXPLORATORY TEST PIT LOGS
Unified Soil Classification System (ASTM D-2487)

TL 2602, 5TH AVE & APPERSON ST
Oregon City, Oregon

PROJECT NO.	DATE	
1477.006.G	4/19/18	Figure A-3

BACKHOE COMPANY: Jim Smith Excavating BUCKET SIZE: 24 inches DATE: 3/02/18

DEPTH (FEET)	BAG SAMPLE	DENSITY TEST	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
						TEST PIT NO. TH-#1 ELEVATION 214'±
0					ML	Dark brown, wet, very soft, highly organic, sandy, clayey SILT (Topsoil)
	X			28.8	ML	Medium to reddish-brown, very moist to wet, soft to medium stiff, clayey, sandy SILT with occasional rock fragments
	X			27.2		
5					RK	Gray-brown, damp, medium dense to dense, moderately weathered and fractured BASALT bedrock
						Total Depth = 7.0 feet No groundwater encountered at time of excavation
10						
15						
						TEST PIT NO. TH-#2 ELEVATION 208'±
0					ML	Dark brown, wet, very soft, highly organic, sandy, clayey SILT (Topsoil)
	X			29.4	ML	Medium to reddish-brown, very moist to wet, soft to medium stiff, clayey, sandy SILT with occasional rock fragments
5	X				RK	Gray-brown, damp, medium dense to dense, moderately weathered and fractured BASALT bedrock
						Total Depth = 6.0 feet No groundwater encountered at time of exploration
10						
15						

LOG OF TEST PITS

PROJECT NO. 1477.006.G | TL 2602, 5TH AVE & APPERSON ST | FIGURE NO. A-4

BACKHOE COMPANY: Jim Smith Excavating BUCKET SIZE: 24 inches DATE: 3/02/18

DEPTH (FEET)	BAG SAMPLE	DENSITY TEST	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION TEST PIT NO. TH-#3 ELEVATION 198'±
0					ML	Dark brown, wet, very soft, highly organic, sandy, clayey SILT (Topsoil)
					ML	Medium brown, very moist to wet, soft to medium stiff, clayey, sandy SILT
5					RK	Dark gray-brown, damp, medium dense to dense, moderately weathered and fractured BASALT bedrock
10						Total Depth = 4.0 feet No groundwater encountered at time of exploration
15						

						TEST PIT NO. ELEVATION
0						
5						
10						
15						

LOG OF TEST PITS

PROJECT NO. 1477.006.G | TL 2602, 5TH AVE & APPERSON ST | FIGURE NO. A-5

MAXIMUM DENSITY TEST RESULTS

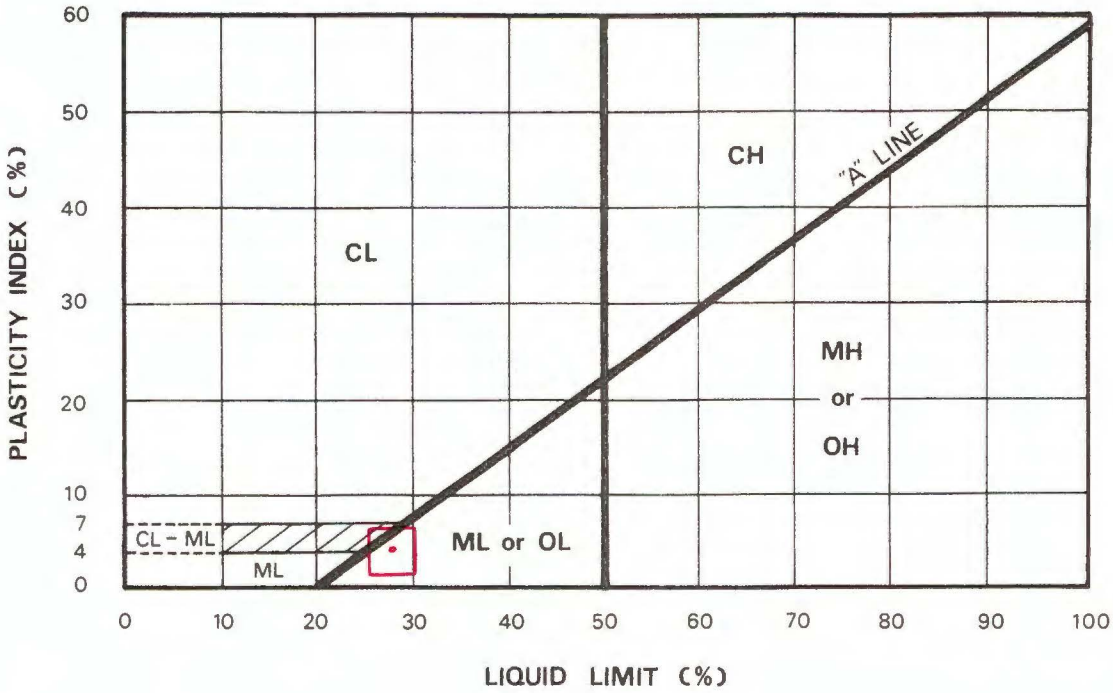
SAMPLE LOCATION	SOIL DESCRIPTION	MAXIMUM DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)
TH-#1 @ 2.0'	Medium to reddish-brown, clayey, sandy SILT (ML)	111.0	15.0

EXPANSION INDEX TEST RESULTS

SAMPLE LOCATION	INITIAL MOISTURE (%)	COMPACTED DRY DENSITY (pcf)	FINAL MOISTURE (%)	VOLUMETRIC SWELL (%)	EXPANSION INDEX	EXPANSIVE CLASS.

MAXIMUM DENSITY & EXPANSION INDEX TEST RESULTS

PROJECT NO.: 1477.006.G	TL 2602, 5th ave & APPERSON ST	FIGURE NO.: A-6



KEY SYMBOL	BORING NO.	SAMPLE DEPTH (feet)	NATURAL WATER CONTENT %	LIQUID LIMIT %	PLASTICITY INDEX %	PASSING NO. 200 SIEVE %	LIQUIDITY INDEX	UNIFIED SOIL CLASSIFICATION SYMBOL
⊡	TH-#1	2.0	28.8	28.8	4.2	73.1		ML

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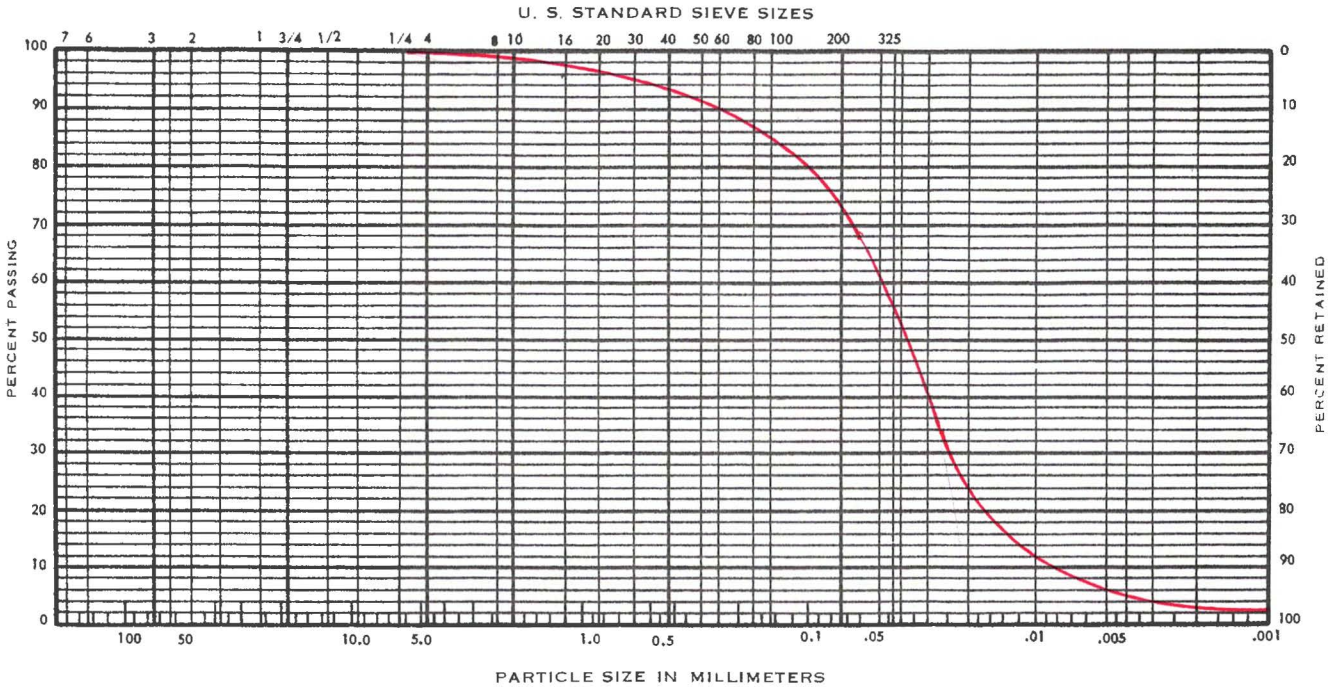
PLASTICITY CHART AND DATA

TL 2602, 5TH AVE & APPERSON ST
oregon City, Oregon

PROJECT NO.	DATE	
1477.006.G	4/19/18	Figure A-7

UNIFIED SOIL CLASSIFICATION SYSTEM

(ASTM D 422-72)



COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

KEY SYMBOL	BORING NO.	SAMPLE DEPTH (feet)	ELEV. (feet)	UNIFIED SOIL CLASSIFICATION SYMBOL	SAMPLE DESCRIPTION
—	TH-#1	2.0		ML	Medium to reddish-brown, clayey, sandy SILT

REDMOND GEOTECHNICAL SERVICES
PO BOX 20547 • PORTLAND, OREGON 97294

GRADATION TEST DATA

TL 2602, 5TH AVE & APPERSON ST
Oregon City, Oregon

PROJECT NO.	DATE	FIGURE
1477.006.G	4/19/18	A-8

Appendix "B"

Geologic Hazard Assessment

NORTHWEST GEOLOGICAL SERVICES, INC.
Consulting Geologists and Hydrogeologists
2505 N.E. 42nd Avenue, Portland, Oregon 97213-1201
503-249-1093 nwgeological@gmail.com

Redmond Geotechnical Services **22 March 2018**
P. O. Box 20547
Portland, OR 97294
Attention: Dan Redmond

Geologic Hazard Assessment
Block 13, TL 2602 Canemah
700 Block 4th Street
Oregon City, Oregon

Dan:

The purpose of this letter is to present Northwest Geological Services, Inc. (NGS) Landslide Hazard Study for the above referenced property. Work was done as per your email of 26 January 2018. Figures 1 and 2 show the location of the site about ¼ miles south of the Willamette River.

We understand that our services are in support of your client's efforts to develop the property for a residential dwelling. Our study is intended to meet Oregon City Chapter 17.44 US Geologic Hazards Development Permit requirements for the Engineering Geology portions of a Type II land use application and for subsequent building permits.

SUMMARY OF CONCLUSIONS

The Missoula floods intensely scoured the site area below about elevation 400 ft. That scour accounts for the thin overburden soil, minor topographic irregularities and locally steep slopes in the site area. The detailed topographic survey of the site, the geologic reconnaissance, test pits and studies of nearby sites reveal that the site is underlain by competent bedrock with relatively thin soils. No evidence of slope failure is apparent at or near the site. In our opinion the proposed development can be accomplished without adverse affect on the site area slope stability.

Water from the slope uphill passes through the site soils. Surface or ground water that is collected or intercepted by footings, structures, pavements, fills, etc., should not be disposed in a concentrated area. Soil and rock properties indicate that diffusion in the unimproved Apperson St right-of-way or disposal to a storm sewer may be viable alternatives.[1]

We recommend review of site grading or other earthworks, footings, foundations and drainage -- as well as plans for any such work -- by a qualified geotechnical engineer.

1. SCOPE OF STUDY

State hazard maps indicate the site may be[2] located on an inactive, rotational, bedrock landslide. However, neither hazard from rapidly-moving landslides, nor more than low-moderate hazards from earthquakes are indicated. Additionally, geologic mapping indicates that two historic slope failures have occurred along the slopes above South End Rd, south of the site. Thus, the scope of our studies included the following engineering geologic tasks:

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[1] The City disposes storm water from 4th Ave and 5th Pl. to infiltration trenches and storm sewers (Figures 3 and 11).

[2] Inferred from LIDAR with "Moderate" confidence by Madin & Burns (2006) but not field checked by them.

- Obtain and review historic aerial photographs, imagery and LIDAR of the site;
- Review previous geologic investigations of the site area, including those required by the City;
- Conduct a geologic reconnaissance of the site and adjacent area;
- Observe test pit explorations conducted by Redmond Geotechnical Services;
- Review the preliminary plans for the proposed development; and
- Prepare this letter describing our work, findings and recommendations.

2. SITE SETTING

2.1 Location

The site is located at the southwest end of the Canemah District, in Oregon City, Oregon. Assessor's maps show it as TL 2602 NE 1/4 NE 1/4 Section 1, T3S/R1E Willamette Meridian in Donation Land Claim 40 (Figures 1 and 2). The site comprises Parcels 7 and 8 of Block 13 of the historic Canemah District. The site is accessed from Fourth Ave and the unimproved right of way of Apperson St (Figures 3 and 4). The site is bounded on the north by TLs 2600 and 2601, on the south and east by the unimproved rights-of-way of 5th Ave and Apperson St, respectively. TLs 2700 and 3500 are across an alleyway to the west.

2.2 Physiography

As shown on Figures 1, 3 and 4, the site lies at elevation ~190' to 225' about halfway up the slope from the Willamette River to the upland plateau south of Oregon City. The site is near the southwest margin of the Canemah District (Figures 2 and 3) and was platted and developed before 1900 (see Section 2.3). Grading for construction of streets and building sites for development modified the natural hillside extensively.

Regional geologic mapping indicates the bedrock is Miocene age basalt that is mantled by thin surficial soils. Younger rocks occur south of the site (Figure 5). As discussed in Section 4, the site was intensely scoured by multiple catastrophic Missoula floods towards the end of the last Ice Age.

Topographic mapping and LIDAR (Figures 3and 6) show Canemah is a series or alternating benches[3] and moderate to steep slopes. The stepped topography was formed as the Willamette River cut through the conglomerate and lava flows forming the south end of the Tualatin Hills. The catastrophic Missoula Floods[4] repeatedly scoured the canyon walls (see Section 4), enhancing the benched nature of the topography by scouring away most soil and colluvial deposits.

Detailed topographic mapping of the site (Figure 4) shows natural slopes range from moderate (~20%) up to relatively steep (~80%-90). The slope along 4th St north of the site is partially supported by a stone wall. The slope along the south 1/3 of the site and south of the site up to SW 5th Ave is steep, but relatively smooth and regular (Figure 4).

Most of the site is grass and forb covered. The slope south of the site is shaded by immature firs, false cedar, Red Alder and Maples (Figure 9). The conifers are straight and erect. Ground cover of ivy and berries mantle the slope and patches of understory maple and scrub occur locally.

[3] Benches generally eroded into soft zones at the tops or bottoms of resistant units; in this area Wanapum flows of Columbia River Basalt (Tgsb, Twfg, Twfs) and cemented conglomerate and sandstone lenses in the Troutdale Formation (Ttg).

[4] From ~70,000 – 13,000 years ago (Waitt, 1981; Minervini & others, 2003).

2.3 Historical Development of the Site and Area

We looked for evidence of landslides on historic aerial photographs[5] and maps. The maps include USGS quadrangles, City GIS data and NOAA LIDAR. The USGS maps were published in 1904, 1951, 1961 and 1990. Lowest return LIDAR was used by the City GIS to derive the elevation contours on Figure 3. (We also reviewed the raw LIDAR imagery for this report.)

The 1910 Sanborn map show the house at 710 4th Ave was built immediately north of the site. It also shows houses present at 716 and 909 4th Ave, as well as at 803 5th Ave west of the site (see Figure 3 for locations). These houses are all still there. The historic aerial photographs show the site mostly cleared from the 1950s through the 1960s. The 1952 photos show houses present on the lots NW, N and NE of the site. The site was apparently the back yard for the residence at 710 4th St. 1970 and later photos show the treed area along the 5th St right-of-way progressively spread north onto the steep slope in the south 1/3 of the site.

No slope failures are apparent on the aerial photos. The historic topo maps also show no indication of slope failure. Several new residences have been built nearby, including on the lot west of the site. It was cleared and a residence was built (712 4th Ave) in late 2017. Additionally, there was recent construction at 804 4th Ave, and 602, 612, 620, 628 and 708 5th place, all in the last 10 years and all with no reported stability problems.[6]

3. GOVERNMENT HAZARD ESTIMATES

Schlicker and Finlayson (1979) mapped the site as an area of moderate slope with "landslide topography". This interpretation was based on the USGS 7.5" Quadrangle map, aerial photo interpretation and limited field checking. Three fairly recent DOGAMI studies include the site (Madin & Burns, 2006; Burns & Mickelson, 2010; Madin, 2009). The first two of these studies relied on interpretation of LIDAR and aerial photographs. The most detailed study by Madin (2009) is shown on Figure 5 (left panel). Madin relied on the two other studies, LIDAR, previous geologic mapping and limited field checking.

Madin and Burns (2006) and Burns and Mickelson (2010) inferred from the LIDAR and aerial photos that the site is on a "moderate confidence" prehistoric landslide. Neither study included field checking the interpreted landslides. Madin (2009) shows the site as in a Quaternary landslide (i.e., not recent) with the same extent as the earlier DOGAMI studies. Madin did limited field checking, including the basalt outcrops along South End Rd, south of the site. However, his database (Madin, 2009, Appendix A) indicates he did not examine the LIDAR interpreted landslide surrounding the site. Madin (2009) contains the following warning:

NOTICE

> The Oregon Department of Geology and Mineral Industries is publishing this map because the subject matter is consistent with the mission of the Department. The map is not intended to be used for site-specific planning. The map cannot serve as a substitute for site-specific investigations by qualified practitioners. Site-specific data may give results that differ from those shown on the map. The views and conclusions contained in this document are those of the author and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government

[5] Aerial photographs examined from our files include photos taken in 1952, 1960, 1970, 1986 and 2008. Photos examined from the City GIS were taken in 1994, and 2000 - 2016.

[6] The city did not provide landslide hazard studies for any of these sites at the pre-App conference.

SLIDO[7] compiles available landslide information in one place (Figure 6). Potential and known hazards can be mapped onto base maps of LIDAR (Figure 6, top), aerial photos (Figure 6, bottom) or a roadmap (Figure 6, center), providing better location information for landslide features than the published maps. Figure 6 also shows the two historic rockfalls (Hofmeister, 2000) on South End Rd, south of the site. The SLIDO site also compiles landslide susceptibility information. SLIDO shows the site in an area of potentially "High" landslide susceptibility. Typically, that rating is applied to areas shown by SLIDO as mapped landslide areas. All of the SLIDO maps carry the following disclaimer:

> "For general information only; not to be used for planning purposes.
> http://www.oregongeology.org/slido"

4. AREA GEOLOGY

4.1 Previous Studies of the Site Area Geology

The geology of the site area (Figure 5) has been mapped by several geologists (Treasher, 1942; Trimble, 1963; Schlicker & Finlayson, 1979; Madin, 2009; Ma & others, 2012).[8] Kienle (1971) mapped individual basalt flows exposed along the Willamette River, Hwy 99E and the SPRR tracks and correlated them with Columbia River Basalt flows in the Columbia Gorge and east of the Cascades.

All studies agree that the site area is underlain by the regionally extensive Columbia River Basalt which extends to depths of several hundred feet in the site area. The Columbia River Basalt is overlain by the sedimentary strata of the Troutdale Formation. These strata are in turn overlain by the Boring Lava, well exposed along South End Rd, south of the site. Strata dip gently to the SW at about 1º to 2º. The nearest major fault is the Bolton fault, about 1¼ miles NE. That fault extends NW-SE, parallel to the Willamette River, from Portland to Oregon City (Beeson and others, 1989; Liberty and others, 2002).

Figure 7 shows the geology along a cross section from McLoughlin Blvd SSE through the site to the cliffs above South End Rd (Section B-B' on Figures 2 and 5). As discussed in Section 5, the geologic cross section is based partly on mapping described above and updated for this report. Updates include basalt flow identifications from Kienle (1971)[9] and pertinent site-specific hazard studies in the Canemah area (NGS, 1993, 2004b, 2016, 2017) where individual basalt flows were identified.

As noted, none of the pre-2000s geologic maps indicate that landslides have affected the site. However, Schlicker and Finlayson (1979) did map "landslide topography" in the NW ¼ of 3S/2E-1 (i.e., in the site area). They also identified the site area as one of thin soils. They noted that in such areas, septic systems and utility excavation could be a problem.

Madin's (2009) interpretation of two large, overlapping, prehistoric landslides in the site area is based on only on physiography. The steep concave cliff along South End Rd is typical of the geomorphology of a headscarp. And the benched terrain could be indicative of internal scarps of a large slide mass. None of the DOGAMI reports actually field checked the landslide interpretation.

Our field work in the area indicates that there are no massive landslide deposits below the assumed headscarp above South End Rd. Reconnaissance of the slope below South End Rd (NGS, 1993)

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[7] Statewide Landslide Information Layer Oregon: http://www.oregongeology.org/slido/index.html.

[8] The most comprehensive geologic maps are by Trimble, 1963, and, Schlicker and Finlayson's, 1979, Bulletin 99. Although, Madin's (2009) Geology Map covers the area, features are not referenced to culture or coordinates, so it is very difficult to use. Also, it is mostly a compilation of earlier mapping with limited new mapping and spot checking. Burns and Mikelson (2010) and Madin & Burns (2006) are remote interpretation of LIDAR and aerial photographs rather than on the ground geologic studies such as those by Treasher, Trimble or Schlicker & Finlayson. Ma & others, 2012, was simply a compilation and reinterpretation of previous work by others.

[9] Kienle (1971) used petrology, paleomagnetism and chemical analyses to prove that the flows at Canemah were identical to the Columbia River Basalt Gingko flow and other Frenchman Springs flows in the Columbia Gorge and east of the Cascades.

found talus with local angular boulders up to 8 ft across. South End Rd was built before 1914. It was cut into the talus / colluvium as much as possible to avoid rock cuts. Side cast fills from the construction and subsequent widening have destabilized the slope below the road, resulting in occasional local fill failures. Additionally, removal of talus destabilized the rock and/or colluvial slopes above the road resulting in rockfalls (Hofmeister, 2000; Madin, 2009). These are surficial failures and have not affected the site. Also, reconnaissance and test pits at two separate sites within Madin's "landslide" (NGS, 2004b, 2016 & 2017) found thin colluvium overlying in-place bedrock rather than landslide debris.

Krager (2015) found basalt in two test pits immediately west of the site. He had refusal with the excavator in the basalt at 3 and 5 ft depth, but did not identify which basalt flow was encountered. Instead Krager assumed Madin's (2009) landslide interpretation was correct. Similarly, PBS (2007, 2014) found basalt at shallow depths on TL 300 in Block 17 site. But -like Krager- PBS didn't identify which basalt flow was encountered and assumed Madin's (2009) landslide interpretation of the LIDAR was correct.

In summary, NGS (1993, 2004b, 2016 & 2017) identified the basalt flows on three Canemah properties, including the subject site (Figure 2) and found in place basalt and/or sandstone bedrock. At all three sites the bedrock was overlain by only a few feet of colluvium with no landslide deposits encountered.

4.2 Effect of Missoula Floods

The Missoula Floods drastically modified the landscape below 400 ft elevation (Minervini and others, 2003). The floods both scoured the land and, locally, deposited extensive glaciofluvial sediments. In main-channel areas flood velocities were many feet per second (Waitt, 1985) the scour was severe and deep, bedrock was scoured and plucked, and the sediments deposited are usually coarse grained. In backwater areas the floods scoured away soils and weathered rocks and deposited in their place a mantle of fine-grained sediment, generally referred to as the Willamette Silt.

The site is in the canyon of the Willamette River's narrow channel through the south end of the Tualatin Mountains. Almost all of the Missoula flood waters that poured into Willamette Valley passed through this gap, so the scour from the rising floods was particularly severe. The site is also just downstream of the of the confluence of the Tualatin with the Willamette. The combined flow of the receding floods was aimed at the south bank of the Willamette from Canemah south to about river-mile 29 (just past lower left of Figure 1). So, the area was thoroughly scoured several times. Minervini & others (2003) estimated that at least 20 of the Missoula Floods rose to more than 200 ft in this area. They also estimate that 10 or more rose to over 260 ft[10], with a few extending to 400 ft. As noted, Waitt (1985) estimated flood velocities of several meters/second.

5. SITE GEOL0GY

5.1 Site Area Reconnaissance

Reconnaissance of the site and site area was conducted on 2 March 2018. The area reconnaissance covered the west end of the Canemah District and the slope to the south. We found the site and area to be underlain by at least flows of Frenchman Springs member of the Columbia River Basalt.[11] The basalt flows are exposed in roadcuts along Fourth and Fifth Avenues south of the site, along Highway 99 north and south of the Canemah District, and along the SPRR tracks above the Willamette River.

[10] As noted, site elevation is ~192 to 228 ft (Figure 4).

[11] Kienle (1971) found that the flows are of the Frenchman Springs Basalt Member of the Late Yakima Basalt. The flows are now grouped with the Wanapum Formation of the Columbia River Basalt Group. These flows are shown on Figure 7 as the Gingko basalt (Twfg) and Sand Hollow basalt (Twfs) and are about 12-14 million years in age.

The basalt is usually dark grey to black and hard (RH-4)[12] where fresh. It is jointed in large columns and/or irregular, interlocking blocks. The bottom of the lowest Frenchman Springs flow is along the SPRR at about elevation 70 ft.

Several hundred feet of older, Grande Ronde Basalt flows (Tgsb on Figure 7) underlie the 250+ feet of Frenchman Springs flows at the site. These older flows appear to dip northeast (Kienle, 1971).[13] However, the younger Frenchman Springs basalt flows appear to be nearly horizontal at the site or dip slightly SW. The upper surface of the basalt is irregular because it was eroded by the same streams that deposited the overlaying Troutdale Formation. The top of the basalt is at about elevation 280 ft S of the site (NGS, 2004b) and about 250 along South End Rd ENE of the site (Madin, 2009).[14] The vesicular flow top of the Sand Hollow flow is exposed on 5th Pl SSE of the site (Figures 3, 7 and 8).

The Troutdale formation extends uphill from the basalt to the Boring Lava (Figure 5, right). The contact is buried by colluvium (NGS, 1994, 2004b). Thickness appears to range from 100 up to 200 ft in the site area. Troutdale silty sandstone and pebbly sandstone are exposed along South End Rd. north-east of the site. Similar strata are inferred to underlay the slope south and uphill of 5th Pl. based on rounded Troutdale type cobbles and pebbles in the site colluvium (NGS, 2004b). Usually, the Troutdale siltstones and silty sandstones are weathered to a depth of many feet. However, the weathered material appears to have been mostly removed by the Missoula floods in the site area.

The Boring Lava consists of one or two flows of grey, hard (RH-4) olivine basaltic andesite. The Boring flows are basaltic andesite, and distinct from the local Columbia River Basalt (Figure 8, lower left). Cuts along South End Road south of the site provide a good section of the Boring Lava (Figure 8, right center). The near-vertical cuts reveal it to be columnar jointed to blocky jointed and show that it will stand in steep cuts for many decades. However, the exposed face of the basalt is susceptible to frost wedging and topple failures. These processes can cause significant rockfalls from steep faces of the basalt such as the two historic road cut slides (rockfalls) shown on Figure 6.

5.2 Site Explorations

Site slopes are gentle except in the south 1/3 of the lot (Figures 4 and 9, upper). Three test pits were excavated on TL 2602 to explore site conditions (Figure 9, upper). Figure 4 shows location of the three test pits and graphic logs are on Figure 10. The test pits were located to explore conditions at the uphill limit of the site (TP-1), where a cut or wall will be needed for the garage (TP-2) and above the existing cut for the neighbor's residence (TP-3). The cuts, fills and retaining walls for the road and residence will be the only significant earthworks for site development (Figure 4).

Test pits TP-1, -2 and -3 found Frenchman Springs basalt bedrock at depths of 5, 3 and 2.5 ft, respectively. The basalt is medium hard to hard, red brown to black gray, dense to vesicular, severely to slightly weathered BASALT bedrock. The basalt was overlain by 2.5 to 5 ft of colluvium (Qc). In TP-2 and -3 the colluvium was covered by about 0.5 ft of organic topsoil. Discrete topsoil was not present in TP-1 which was located in the cleared right-of-way for Apperson St.

The basalt in TP-3 was highly vesicular and contained abundant clusters of feldspar crystals (glomerocrysts) typical of the Gingko flows. The basalt in TP-1 and -2 contained rare, small crystals of feldspar (microphenocrysts) up to about 2 mm long. These are typical of the upper Frenchman Springs flows, particularly the Sand Hollow flows that are known to overlay the Gingko. Many of the vesicles were flattened in the basalt from TP-2 and a few pipe vesicles were also present. Flattened and pipe

[12] Panama Canal Scale of rock hardness: 1 = soft, 2 = medium, 3 = medium hard and 4 = hard.

[13] Where they are exposed below the Falls viewpoint along the railroad tracks adjacent to the Willamette River.

[14] Schlicker and Finlayson (1979) mapped Troutdale extending down to about elevation 210 ft. However, RGS's TP-1 and TP-2 found basalt bedrock so the Troutdale must be higher.

vesicles are typical of the bottoms of lava flows. Consequently we interpret the south part of the site to be underlain by the base of a Sand Hollow basalt flow and the north part to be underlain by the top of a Gingko basalt flow as shown on Figure 7.

5.3 Surface Water / Natural Resources Overlay (NROD)

We observed no areas of standing water (lakes, ponds) or drainage ways (streams, rills) at the site. Oregon City GIS shows the nearest watercourse to be a drainage – locally known as Coffee Creek - along the west side of lot west of the site (Figures 3 and 11).

Coffee Creek[15] is partially channelized and has been incorporated into the City storm drainage system (Figures 3 and 11). The drainage is too small to show on the USGS (2014) topographic map. In spite of the small size and interconnection with the storm sewer system, the City NROD extends along it. The NROD reaches east and SE from the creek/storm sewer to and across most of the site.

Our reconnaissance, review of topography and City utilities maps indicate there is no direct surface drainage from the site to Coffee Creek. Instead, most surface water infiltrates into the colluvium and thence by vadose or saturated flow downhill through the colluvium. A small percentage recharges aquifers in the bedrock basalt flows. What little surface runoff exits the site is intercepted by the impervious pavement of 4th Ave where it drains to the 12" 4th Ave storm sewer. That pipe connects to the storm sewer in Coffee Creek at the intersection of 4th Ave and Blanchard St. Note also that the City routes much of the intercepted runoff in the area to buried infiltration structures along the streets or to Coffee Creek.

In summary, stormwater is captured uphill and downhill of TL 2602 and routed into the soil or to the storm sewer. There is no surface discharge to the to the NROD-protected drainage west of the site. However, surface runoff from the site that reaches 4th Ave is directed to Coffee Creek as is that from all other residences uphill of 4th Ave.

5.4 Ground Water Observations

No ground water was found in the test pits on 2 March 2018. We found locally moist soils during the reconnaissance. However, we found no seeps or springs, in spite of recent precipitation.

6. INTERPRETATION OF SITE CONDITIONS

Review of aerial photos and topographic maps indicates that, historically, the site has been a normal hillside location with no obvious problems. Several residences on adjacent and nearby properties are 80 to over 100 years old and show no visible signs of damage from slope failure. Conifer trees near the site are generally straight and erect with only the minor pistol butting typical of slow soil creep. Nearby pavements are generally smooth and free of cracks or offsets from slope failure.

We previously discussed (NGS, 2004b, 2016 & 2017) the simple and logical explanation for a lack of landslide deposits below an apparent landslide scarp. First, the current gentle to steep basalt slopes shown on the cross section (Figure 7) are obviously stable. Likewise, the bench above 5th Pl underlain by the Sand Hollow basalt also is in place and stable as is the Troutdale formation slope above the bench. Only the steep colluvial / talus slope below the Boring lava might be remnant of an ancient, surficial landslide. In our experience, only the downcutting of the Willamette River over millennia or submersion during the Missoula Floods more than 13,000 years ago would destabilize the slope. Either process would also remove all or most deposits of such slope failures.

[15] We surmise the name derives from the color of the creek's wet season flow.

However, we favor Missoula floods as an explanation. The entire area below about elevation 400 ft was intensely scoured several times by the Missoula floods (Waitt, 1985; Minervini & others, 2003; Burns & Coe, 2012). In our opinion the multiple scour events easily account for the thin overburden soil, minor topographic irregularities and general lack of landslide deposits, as well as for the relatively steep slopes left at the edges of some basalt flows.

As noted previously, soils in the test pits were moist. Soils uphill of the test pits were also moist during our reconnaissance. Based on the site vegetation and slope, it does not have standing water at any time. However, the soil is thin on the slope uphill of the site and the slope extends up to the unimproved 5th Ave right-of-way. Consequently some runoff from the slope must cross the site during precipitation. We suspect that the soil develops a transient zone of saturation above the bedrock during intense or prolonged storm events.

The closest potentially active fault is the Bolton Fault located about 1 ¼ NE of the site (Beeson and others, 1989; Liberty and others, 2002). NGS (1994; 2004a) estimated the fault could produce an Mw = 6.8 earthquake at relatively shallow depths.

7. CONCLUSIONS AND RECOMMENDATIONS

The bedrock slopes at the site appear stable. The colluvium also appears stable under present conditions. Based on the typical rock and soil properties and the plan for proposed cuts, fills and retaining walls (Figure 4) it, is our opinion that the site can be developed without creating any slope stability problems. However, the footing design for the wall and excavation plan for the cuts and fills should be reviewed by a qualified professional. We also recommend that the excavations for the work be inspected by a qualified professional prior to placing fills or drainage blanket material.

Some water will move across the site slopes during storms as noted previously. In our opinion this will not be a problem as long as the water that is intercepted by improvements (e.g., street, footing drains, roofs and pavements) is dispersed across the slopes. It should not be discharged to a concentrated or a few small areas such as dry wells, particularly to the area above the house north of the site. Alternatively, runoff can be sent to the existing storm sewer in 4th or to an infiltration structure constructed along the adjacent unimproved street right-of-way (Figures 3 and 5). Regardless of the choice (all are viable in our opinion), the plan should be reviewed by a qualified professional.

Excavation of some rock may be required to meet the planned footing elevations. The plans for this work should be reviewed by a qualified professional. Also, excavations for footings or structures should be inspected by the project geotechnical engineer or their qualified representative. We recognize that development plans may change as development proceeds. In our opinion, there are many ways that the subject site could be developed without creating slope hazards. Regardless of what actual changes are made from the plan shown on Figure 4, we recommend that the final plans for footings, foundations, cuts, fills or other earthworks, and drainage be reviewed by the appropriate qualified professional engineers.

8. CLOSURE

This report has been prepared exclusively for the use of the owner for specific application to this proposed project alone (i.e., as shown on Figure 6). Changes to the project that involve the extent and/or depth of fills or excavations should be submitted for our review and for review by the geotechnical engineer.

Our services have been executed in accordance with generally accepted engineering geologic practices in this area at the time this report was prepared. We caution that only limited subsurface

explorations were conducted. Thus, site conditions may vary from those inferred herein from the test pits and natural exposures. If such variation is found you should contact us to review the conditions found.

The conclusions and recommendations herein apply only to this specific project or to one of substantially the same scope and extent at this site. Conclusions and recommendations should be updated if the proposed scope is not completed within three years of the date of this report.

We thank you for the opportunity to assist you with your property development. Please contact me if you have questions about the report.

Yours very truly,
Northwest Geological Services, Inc.

Clive F. (Rick) Kienle, Jr.
Vice President

Reference NGS 235.89-2

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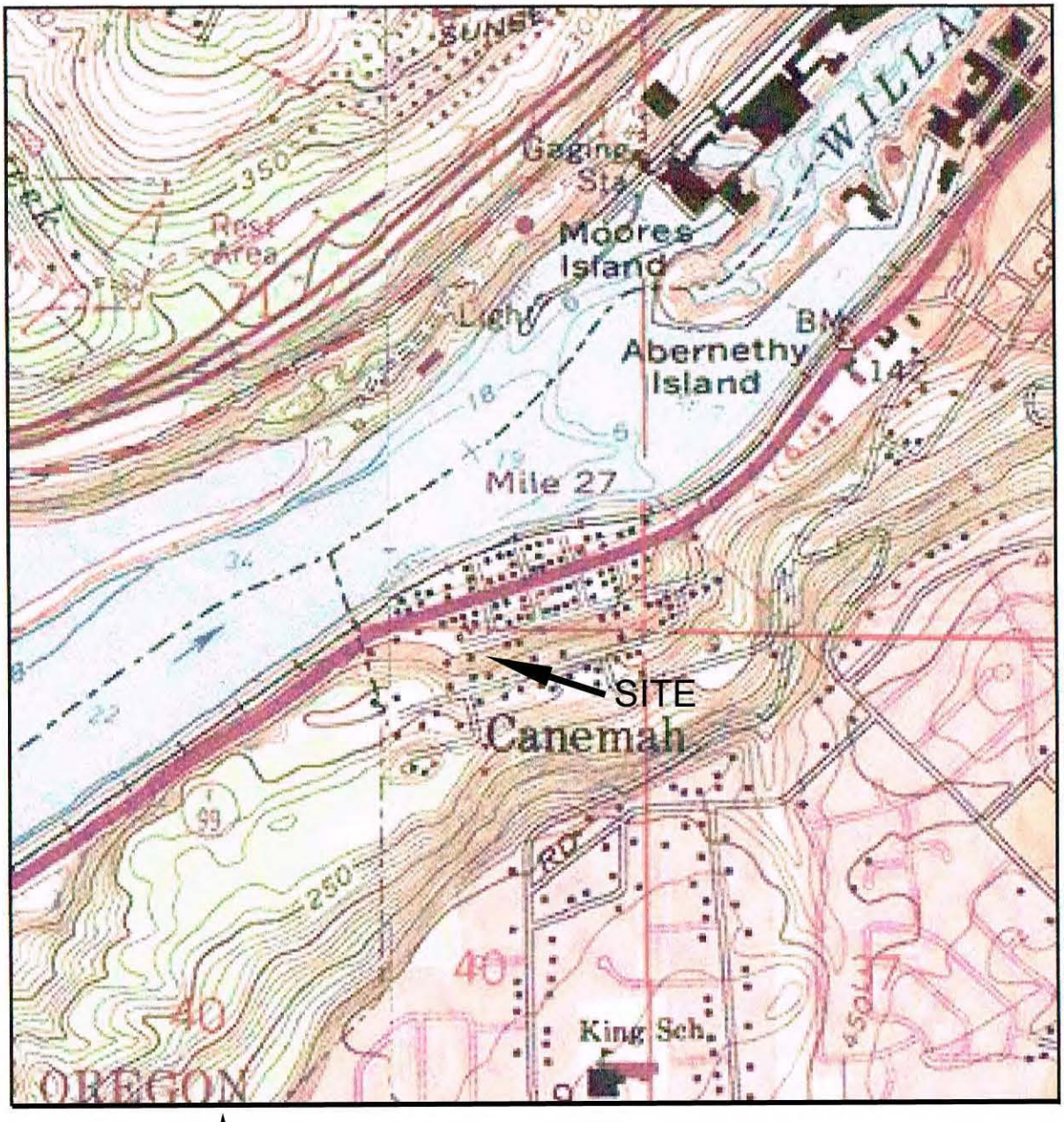


1000 ft

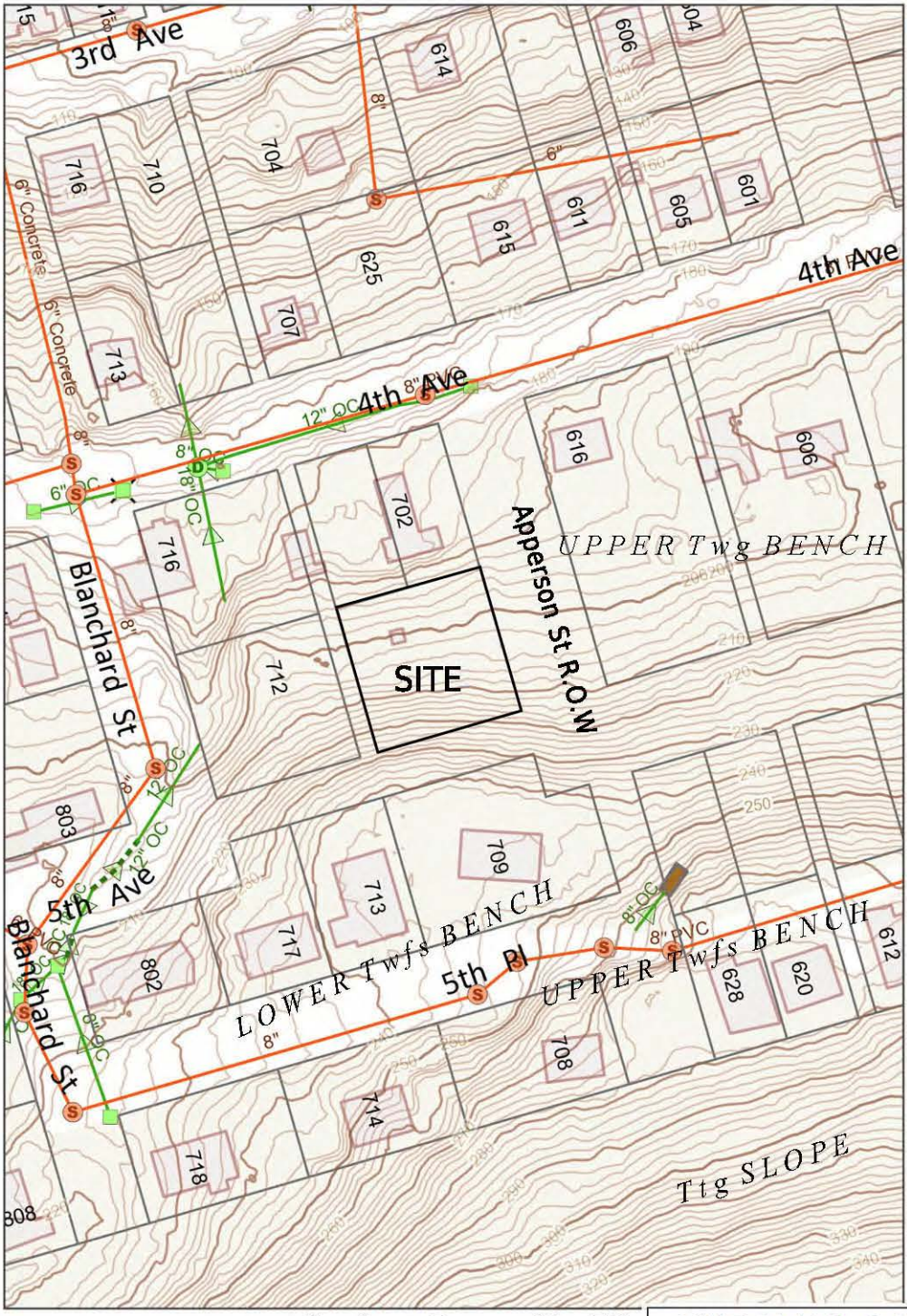
N

Image from USGS Camas and Oregon City 7.5" Quadrangles

3S/1E-1AA Block 13 TL2602, Canemah		
Oregon City, Oregon		
Landslide Hazard Study		
Site Location Map		
NGS, Inc.	March 2018	**Figure 1**

3S/1E-1AA Block 13 TL2602, Canemah		
Oregon City, Oregon		
Landslide Hazard Study		
2016 Air Photo & Nearby Study Locations		
NGS, Inc.	March 2018	**Figure 2**

Site Area Topography and Sewer Utilities



Legend

Contours (2ft)
- 10 foot
- 2 foot

Contours (10ft)
- 50 foot
- 10 foot

Building Outlines

Taxlots

Sewer Structures

Sewer Pipes
- Gravity Line
- Force Main
- Outfall

Storm Structures
- Manhole
- Inlet
- Outlet

Storm Conduits
- Pipe
- Culvert
- Ditch
- Detention Tank
- Flow Arrows

Storm Ponds
- Pond
- Swale
- Man-Made Wetland

Overview Map

The City of Oregon City makes no representations, express or implied, as to the accuracy, completeness and timeliness of the information displayed. This map is not suitable for legal, engineering, surveying or navigation purposes. Notification of any errors is appreciated.

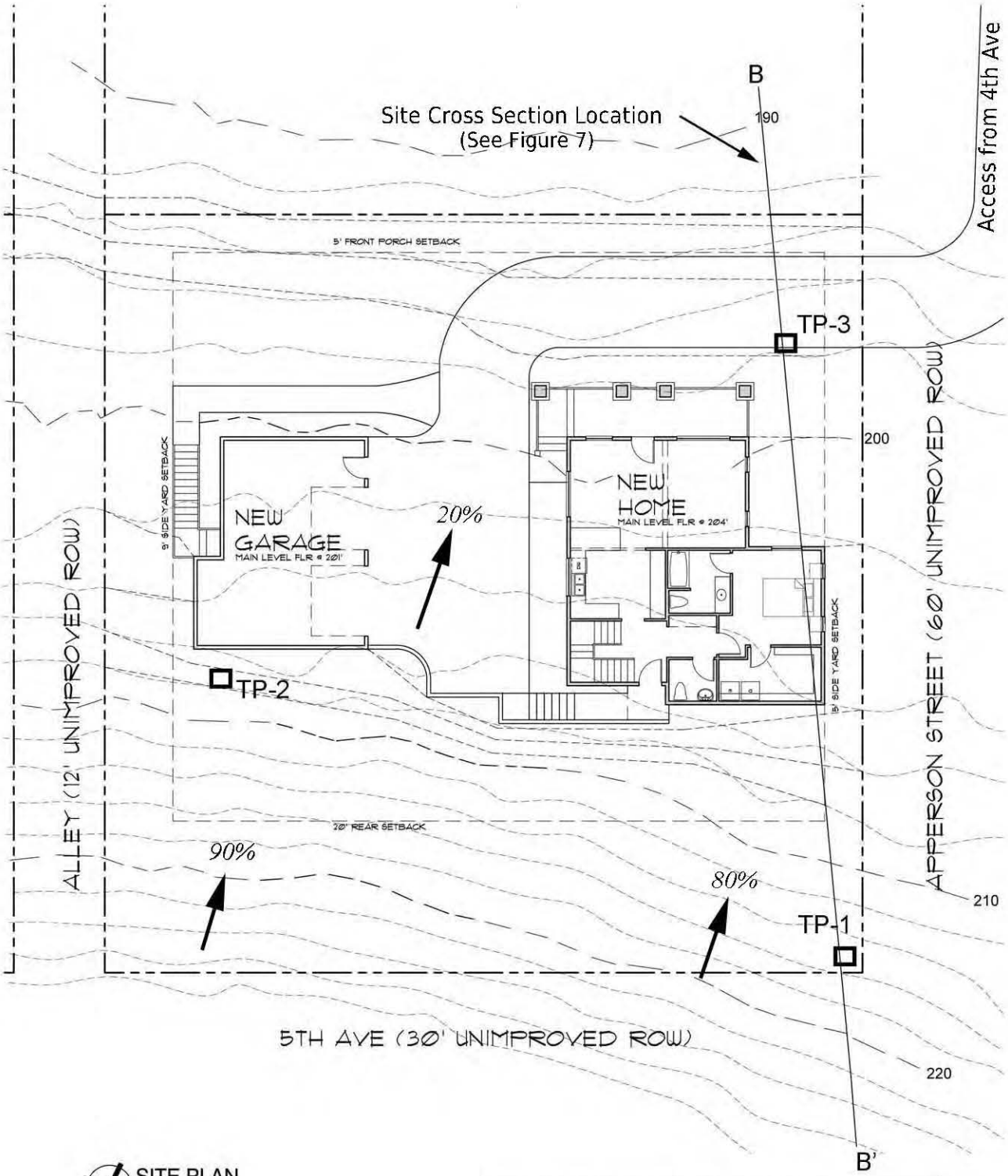
Map from Oregon City GIS

N

0 100 Feet

Map created 3/13/2018

3S/1E-1AA Block 13 TL2602, Canemah		
Oregon City, Oregon		
Landslide Hazard Study		
Site Area Topography & Sewers		
NGS, Inc.	March 2018	**Figure 3**

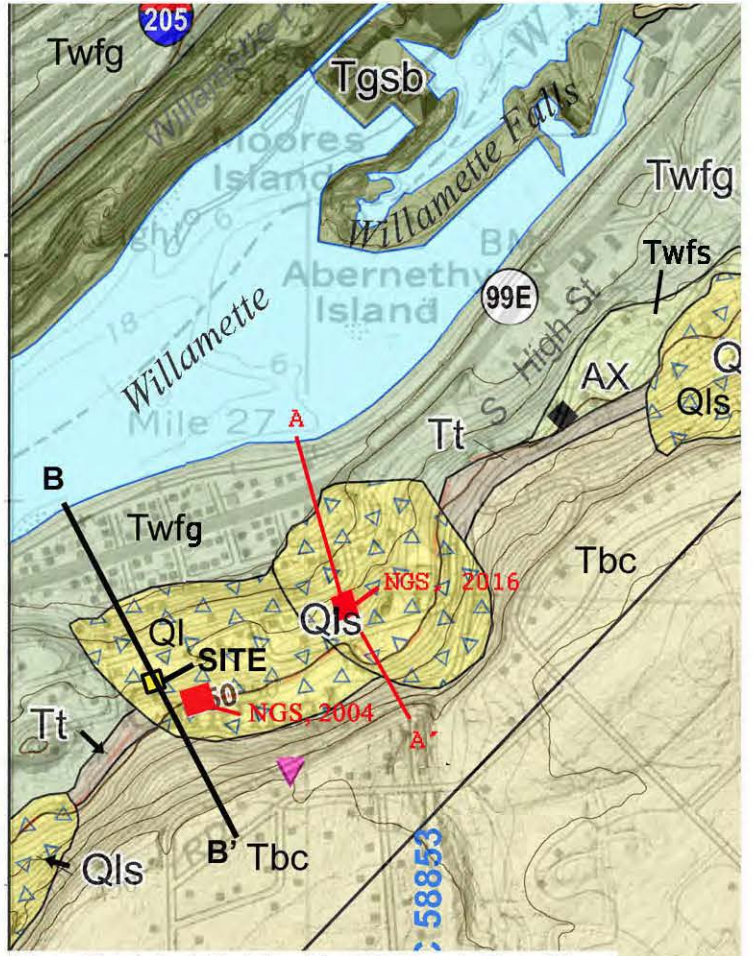


SITE PLAN

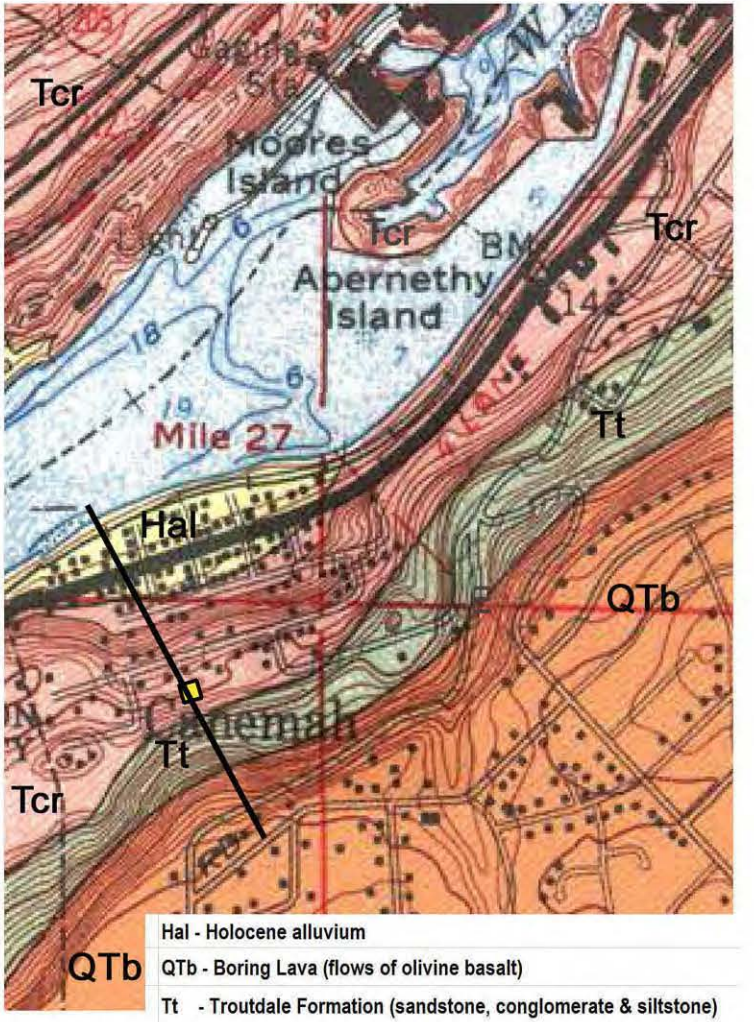
20 ft

3S/1E-1AA Block 13 TL2602, Canemah Oregon City, Oregon		
Landslide Hazard Study Proposed Site Plan & Test Pit Locations		
NGS, Inc.	March 2018	**Figure 4**

Madin, 2009 (GMS-119)



Schlicker & Finlayson, 1979 (Bull 99)



Qls - prehistoric landslide, inferred from LIDAR, moderate confidence

Tbc - Basalt of Canemah, Pliocene Boring Lava

Tt - Troutdale Formation, Pliocene sandstone and conglomerate

Twfs - Sand Hollow flows, Miocene Wanapum Basalt

Twfg - Gingko flows, Miocene Wanupum Basalt

Tgsb - Sentinel Bluff flows, Miocene Grande Ronde Basalt

Rockfall from Hofmeister (2000)

Sample Site (Madin, 2009)

N

1000 ft

Hal - Holocene alluvium

QTb - Boring Lava (flows of olivine basalt)

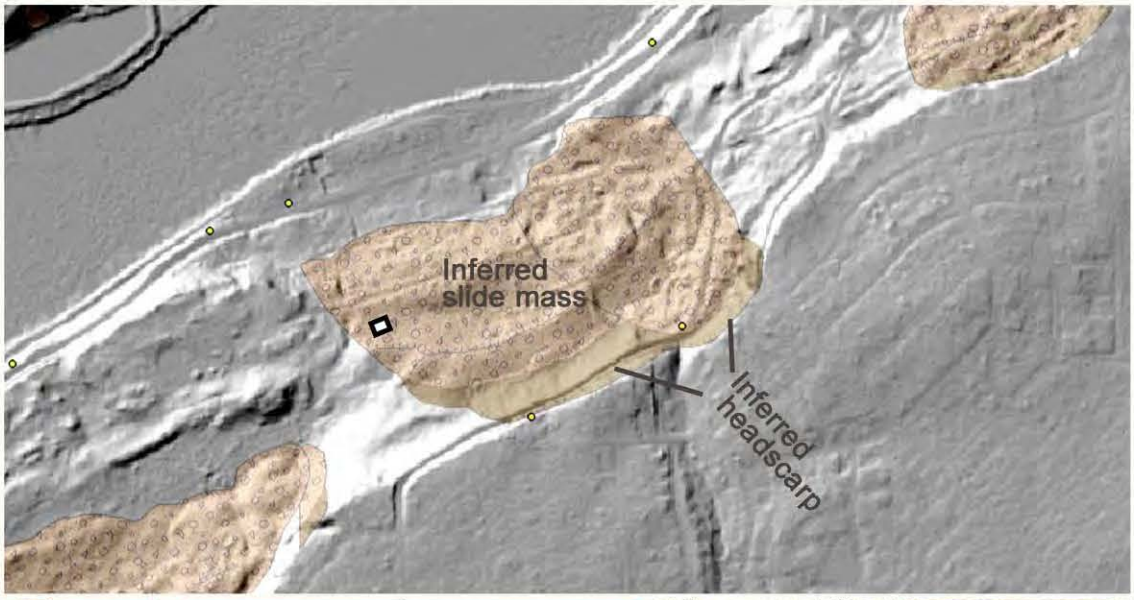
Tt - Troutdale Formation (sandstone, conglomerate & siltstone)

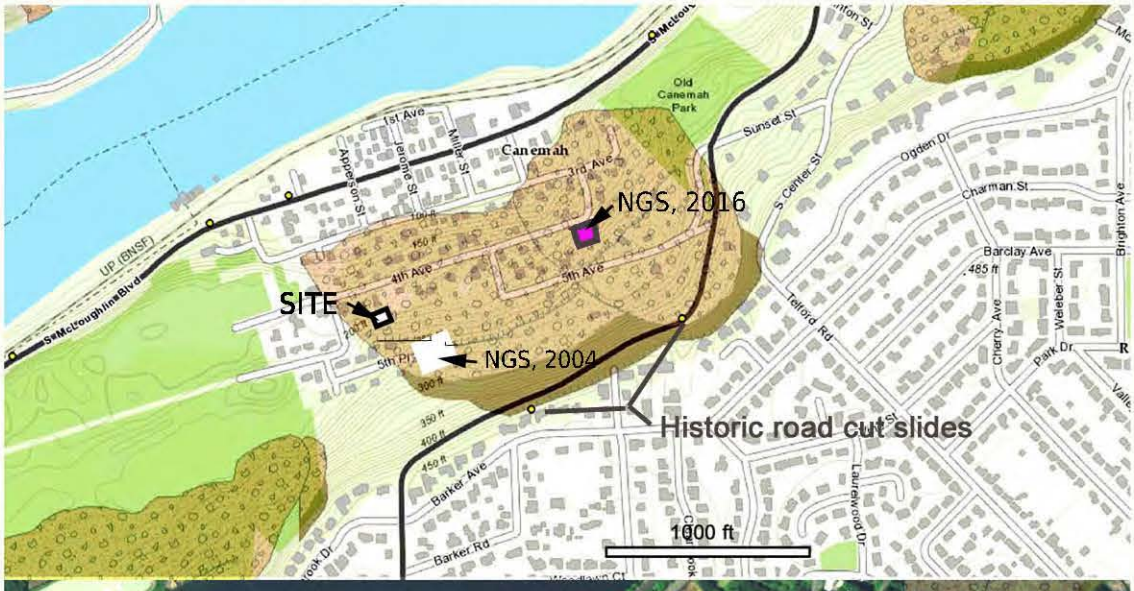
Tcr - Columbia River Basalt (basalt with intercalated soils)

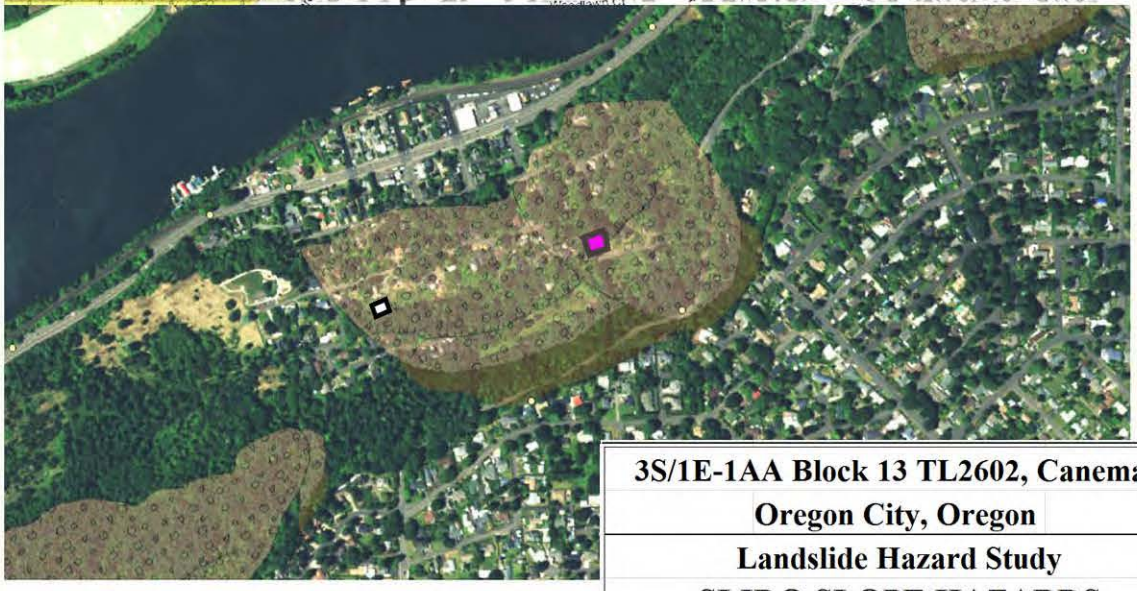
B--B' Geologic Cross Section

Notes:
1. Tgsb exposed below RR tracks at low water (Kienle, 1971) but not shown by Madin (2009).
2. Twfs exposed in test pits at the site, in cuts along 5th Place south of the site and test pits for NGS, 2004 & 2016 (see Figure 2).

3S/1E-1AA Block 13 TL2602, Canemah		
Oregon City, Oregon		
Landslide Hazard Study		
DOGAMI Geologic Maps		
NGS, Inc.	March 2018	**Figure 5**







Maps from:
http://www.oregongeology.org/sub/slido/.

3S/1E-1AA Block 13 TL2602, Canemah		
Oregon City, Oregon		
Landslide Hazard Study		
SLIDO SLOPE HAZARDS		
NGS, Inc.	March 2018	**Figure 6**

LEGEND

Qc – Holocene colluvium: medium stiff to stiff red brown sandy SILT, trace clay, basalt fragments, rare rounded gravel, damp, grades down into decomposed basalt.

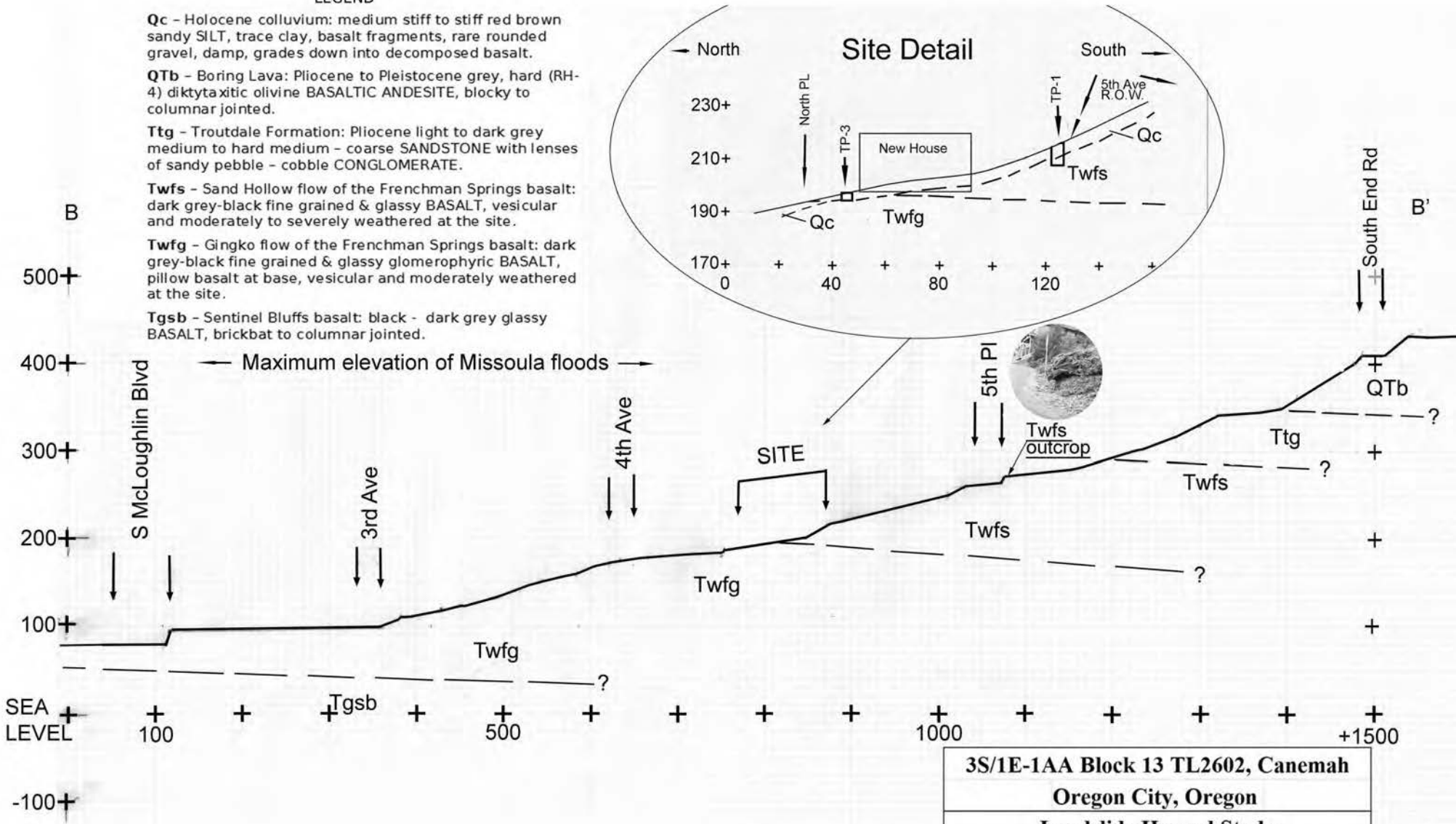
QTb – Boring Lava: Pliocene to Pleistocene grey, hard (RH-4) diktytaxitic olivine BASALTIC ANDESITE, blocky to columnar jointed.

Ttg – Troutdale Formation: Pliocene light to dark grey medium to hard medium – coarse SANDSTONE with lenses of sandy pebble – cobble CONGLOMERATE.

Twfs – Sand Hollow flow of the Frenchman Springs basalt: dark grey-black fine grained & glassy BASALT, vesicular and moderately to severely weathered at the site.

Twfg – Gingko flow of the Frenchman Springs basalt: dark grey-black fine grained & glassy glomerophyric BASALT, pillow basalt at base, vesicular and moderately weathered at the site.

Tgsb – Sentinel Bluffs basalt: black - dark grey glassy BASALT, brickbat to columnar jointed.



3S/1E-1AA Block 13 TL2602, Canemah Oregon City, Oregon		
Landslide Hazard Study		
Area & Site Geologic Cross Sections		
NGS, Inc.	March 2018	**Figure 7**

Samples of black fine grained and glassy Sand Hollow (Twfs) basalt from outcrop (top photo) and of grey basaltic andesite Boring Lava (QTb) from along South End Rd (center right photo).

Top: Looking east at Sand Hollow basalt (Twfs) exposed at entrance to driveway for 708 5th Pl ~ one block SSE of the site. Test pit (NGS, 2004) confirm this basalt flow extends east along 5th PL. This in-place bedrock is within the area shown as Quaternary landslide (Qls) by Madin (2009) and as Troutdale formation by Schlicker & Finlayson (1979).

Above: Sample location of Boring Lava (QTb) at cliff base, south side of South End Rd, south of the site.

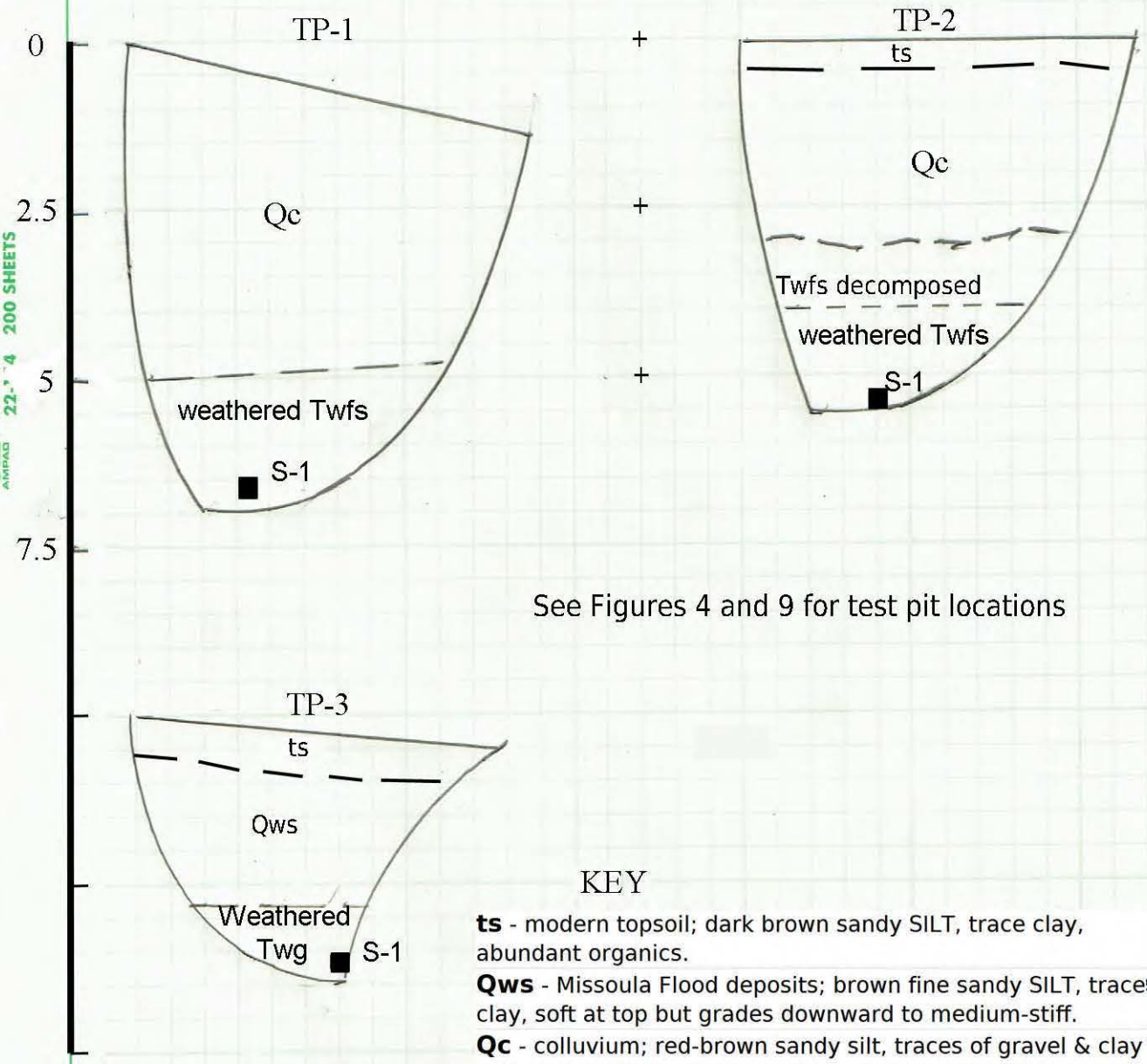
3S/1E-1AA Block 13 TL2602, Canemah		
Oregon City, Oregon		
Landslide Hazard Study		
Basalt Bedrock South of Site		
NGS, Inc.	March 2018	**Figure 8**

Panorama of site looking S (left) to NE (right). House on TL 3500 behind tree (center, right). Note TP-1 and -3 locations at left and right, respectively.

Far Left: Fine-grained and vesicular flow top of Gingko flow (Twfg) from ~3 ft depth in TP-3. Large white patches are clusters of plagioclase feldspar (glomerocrysts). The glomerocrysts are characteristic of the Gingko flows but absent in the other Frenchman Springs flows.

Near Left: Fine grained to glassey vesicular base of the Sand Hollow flow (Twfs). Samples from TP-1 @ 6.5 ft (above ruler) and TP-2 @5.5 ft (below ruler).

3S/1E-1AA Block 13 TL2602, Canemah		
Oregon City, Oregon		
Landslide Hazard Study		
SITE PHOTOGRAPHS		
NGS, Inc.	March 2018	**Figure 9**



See Figures 4 and 9 for test pit locations

KEY

ts - modern topsoil; dark brown sandy SILT, trace clay, abundant organics.

Qws - Missoula Flood deposits; brown fine sandy SILT, traces clay, soft at top but grades downward to medium-stiff.

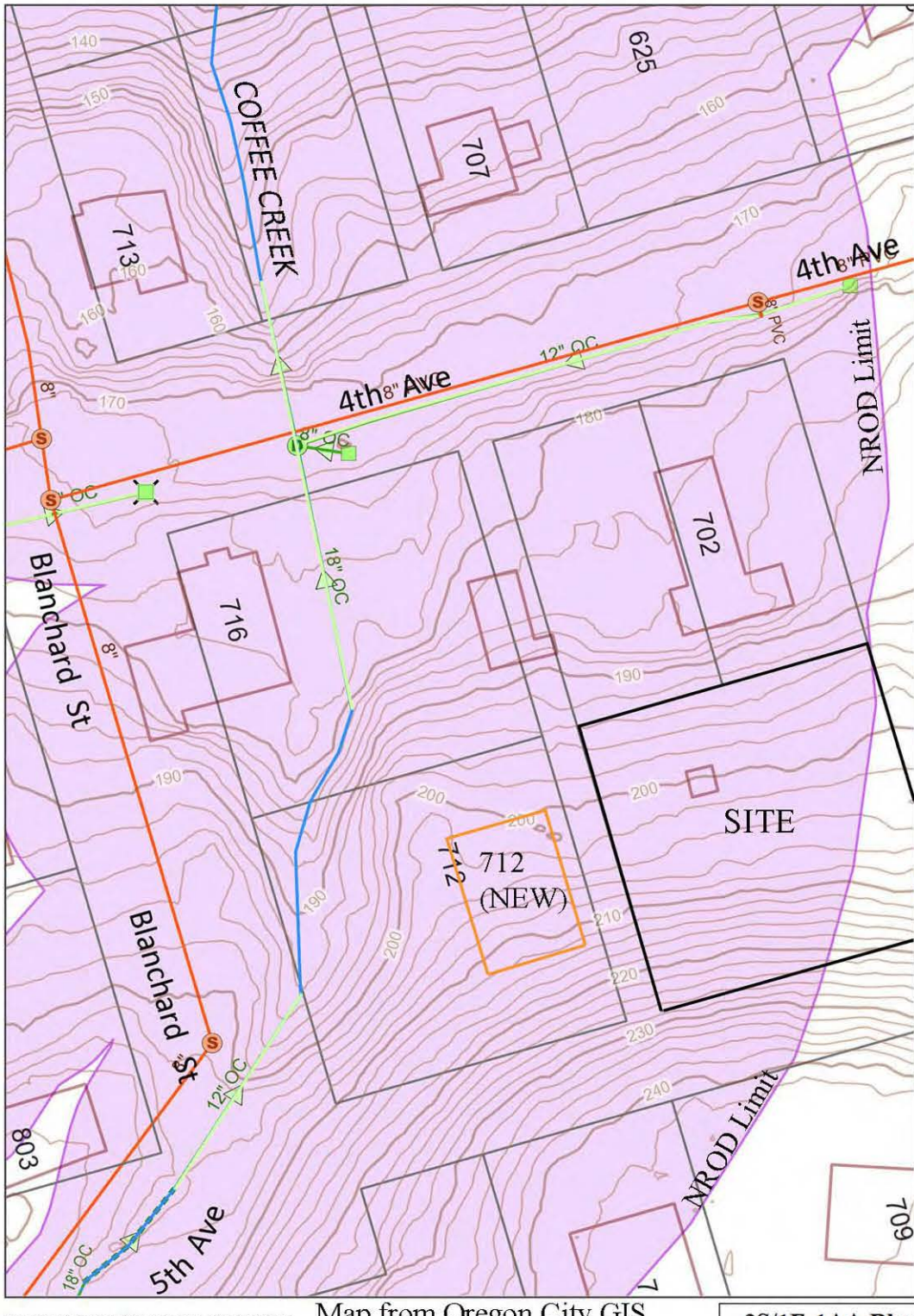
Qc - colluvium; red-brown sandy silt, traces of gravel & clay and rare small boulders, medium at top grading downward to stiff.

Twfs - Sand Hollow flow; dark grey fine grained to glassy vesicular basalt, rare small feldspar phenocrysts, weathered, except top foot severely weathered to decomposed to hard brown and tan gritty clayey SILT.

Twg - Gingko flow; dark grey glassy vesicular basalt, abundant glomerocrysts of feldspar, moderately weathered.

3S/1E-1AA Block 13 TL2602, Canemah		
Oregon City, Oregon		
Landslide Hazard Study		
Site Test Pits		
NGS, Inc.	March 2018	**Figure 10**

Oregon City NROD Map



Legend

- Streams
  - Above Ground
  - Below Ground
- Contours (2ft) - 1:3,600 and clc
  - 10 foot
  - 2 foot
- Building Outlines - 1:3,600 and
- Taxlots
- Sewer Structures (City Owned)
- Sewer Pipes (City Owned)
  - Gravity Line
  - Force Main
  - Outfall
- Storm Structures (City Owned)
  - Manhole
  - Inlet
  - Outlet
- Storm Conduits (City Owned)
  - Pipe
  - Culvert
  - Ditch
  - Detention Tank
- Flow Arrows
- Storm Ponds
  - Pond
  - Swale
  - Man-Made Wetland
- NROD - Natural Resource

The City of Oregon City makes no representations, express or implied, as to the accuracy, completeness and timeliness of the information displayed. This map is not suitable for legal, engineering, surveying or navigation purposes. Notification of any errors is appreciated.

Map from Oregon City GIS

N

0 50 Feet

Map created 3/15/2018

3S/1E-1AA Block 13 TL2602, Canemah		
Oregon City, Oregon		
Landslide Hazard Study		
NROD MAP		
NGS, Inc.	March 2018	**Figure 11**

Schademan House

Oregon City, OR

Architect: Iselin Architects

J.O. SGL 18-101

May 31, 2019

PRELIMINARY STORM DRAIN CALCULATIONS

REGISTERED PROFESSIONAL ENGINEER
OREGON
JAMES M. FOX

EXPIRES: 12/31/19
72761 PE

SISUL ENGINEERING

A Division of Sisul Enterprises, Inc.

375 Portland Avenue

Gladstone, OR 97027

phone: (503) 657-0188

fax: (503) 657-5779

Narrative:

The project site is a vacant residential lot that will be transformed into a new single-family home with a detached garage located on lots 7 and 8 of block 13 of the old historic Canemah district (Tax lot 2602 of T3 1E Sec. 01AA). The project site is the second tax lot south of 4th Avenue on the east side of Apperson Street (unimproved). In the current condition, the site is steeply to moderately sloped with vegetation consisting primarily of grass and trees.

For the developed conditions we are proposing a new 15-foot wide private driveway in a public right of way. From the Apperson right of way the private drive width will be reduced to 12-feet-wide as it extends into the site along the northern property line. The driveway will than turn south and open up into small area designed for vehicle maneuvers. On the west side of the open area will be a detached garage on the east side will be the proposed house. Structural walls will be necessary for private grading and perhaps the public right of way depending upon the driveway grading option used.

In the public right of way, the City has currently left two option for the15-foot wide driveway. Option 1 is to extend a driveway directly into the site from SW 4th Avenue. This option would require driveway grades of 18 percent and still produce significant cuts that would affect driveway grades at 616 & 702 SW 4th Avenue.

The second option is to extend an existing driveway pending an access easement from 616 SW 4th Avenue and approval form a transportation engineer. For this option to work the existing driveway would need to be widened to 15 feet and extended to our project site. This option would protect an existing rock wall and not affect driveway grades of 616 & 702 SW 4th Avenue

Stormwater Approach:

For stormwater treatment we are proposing to provide water quality treatment through an approved mechanical device. For stormwater detention we are proposing a fee in lieu of an infiltration or retention system.

Looking at Oregon City's stormwater management hierarchy found under section 2.2.4.1 of "Stormwater and Grading Design Standards" all sites are to provide or justify why surface infiltration or onsite retention of a 10-year storm event is not feasible. Our site is located in geohazard location that limits stormwater options. The geotechnical report dated April 19, 2018 provided by Redmond Geotechnical Service, indicates concerns regarding infiltration or cuts that exceed 5 feet.

The geotechnical report also anticipated low infiltration rates and limited stormwater facilities to the lower northerly portion of the site where slopes are below 20 percent. New stormwater facilities would require a Geotechnical review and approval. Our sites exiting slopes at the northerly portion of the site are in

the range of 30 percent exceeding the allowed slope range. In addition, there is an existing and proposed house immediately downstream of our site whose foundation may be affected by stormwater infiltration. Infiltration or retention facilities do not appear feasible for our site.

The second aspect of the Oregon City's stormwater hierarchy is onsite stormwater management facilities, or the use of onsite stormwater management facilities to meet the water quality and flow control standards. A mechanical device can be provided for onsite water quality treatment but would not capture the additional stormwater runoff from the private driveway in the public right of way. A second mechanical device would still be need for the public right of way. We are proposing to place one mechanical water quality treatment device in the right of way at the downhill side of the selected driveway option.

A retention facility would require geotechnical approval and still be presented with sites slope issues complied with cut and fill restraints noted earlier under the 1st tier of the hierarchy.

The last hierarchy tier before fee in lieu is discharging to an offsite or regional facility. Our site is located in close proximity to the Willamette River with no regional stormwater facility downstream of our site within in the existing drainage patterns. This portion of the Canemah District is partially developed and contains steep slopes without a good location to add a new regional facility.

Stormwater flow collected in Apperson right of way will pe piped 160 feet west in 4th Avenue before discharging towards south towards the Willamette river into and open drainageway that flows between existing developed lots. Offsite regional facilities don't appear reasonable in this case.

Water Quality Requirements:

WQ, 24-hour storm event must be designed to capture and treat 80 percent of the average annual runoff volume.

Site Conditions & Design Values:

Proposed Area:

Total Onsite Area = 9,999 sf or 0.23 acres
Pervious Area = 5661, sf or 0.13 acres
Impervious Area = 4,338 sf or 0.10 acres

Total Offsite Area = 7,964 sf or 0.18 acres (Apperson Street)
Pervious Area = 5,791 sf or 0.13 acres
**Impervious Area = 2,565 sf or 0.05 acres

Total Impervious Area = 6,903 sf or 0.16 acres

**offsite impervious area may vary depending upon driveway option. For preliminary calculations option 2 is used which would produce a greater impervious area if counting redevelopment area of existing driveway. Driveway option 1 is calculated at 2,185 sf or 0.05 acres or 380 sf less.

Existing Use: The site is currently undeveloped and appears as a back yard for neighboring tax lot.

Soil Type: This site has one soil type as identified by (Soil Survey Clackamas County Area, Oregon) (See Soil Survey Attachments)

Saum silt loam 78B -- Hydrologic Group 'C'
Xerochrepts rock outcrop 93E-- Hydrologic Group 'C'

For additional soil information see provided NRCS soil printouts and the geotechnical report.

Runoff Curve Numbers: (per Table 3.5.2B, King County Washington Surface Design Manual)

Impervious Area - Hydrologic Group 'C' => 98

Rainfall Distribution: (per section 4-2, City of Oregon City Stormwater and Grading Design Standards)

WQ, 24-hour duration STD SCS Type 1A Storm => 1.0 inches

Time of Concentration – Post Developed: (Design Values per Table 3.5.2C King County Washington Surface Design Manual)

Since a large portion of the site is impervious, with steep slopes the minimum time of concentration of 5 minutes will be used. Tc = 5 minutes

Post Developed Hydrographs:

The post developed hydrographs will be generated using the Santa Barbara Urban Hydrograph (SBUH) Method. (KING COUNTY DEPARTMENT OF PUBLIC WORKS Surface Water Management Division, HYDROGRAPH PROGRAMS Version 4.20)

WQ Runoff Rate – Post Development

```
-----------------------------------------------------------------------
******************** S.C.S. TYPE-1A DISTRIBUTION ********************
*********   1-YEAR  24-HOUR STORM  ****  1.00" TOTAL PRECIP. *********

-----------------------------------------------------------------------
ENTER: A(PERV), CN(PERV), A(IMPERV), CN(IMPERV), TC FOR BASIN NO.  1
0,0,.16,98,5
```

```
DATA PRINT-OUT:

  AREA(ACRES)     PERVIOUS     IMPERVIOUS    TC(MINUTES)
                  A     CN     A     CN
       .2         .0    .0     .2   98.0         5.0

  PEAK-Q(CFS)    T-PEAK(HRS)     VOL(CU-FT)
      .04           7.67            459

ENTER [d:][path]filename[.ext] FOR STORAGE OF COMPUTED HYDROGRAPH:
18101wq
```

Water Quality Sizing:

The proposed mechanical device was chosen from City of Portland approved list, that per my understanding City of Oregon City will accept. On the plans we select a Stormfilter catchbasin or approved equal. For further information see the attached approval sheets and data printout in the supporting data.

The mechanical device will be sized based upon the water quality storm events volume. Per the calculations above the water quality storm event will be 459 cubic feet and produce a water quality flow rate of 0.3 cfs.

Water Quality Flow (WQF):

$$WQF = \frac{WQV\ (cu.\ ft)}{4\ (hours)} = \frac{4594\ (cu.\ ft.)}{14{,}400\ (s)} = 0.032\ cfs$$

A Stormfilter catchbasin with a ZPG cartridge can treat from 5-11.3 gallons per minute depending upon the cartridge depth. For preliminary calculations we will use an 18" cartridge with 7.5 gallon per minute treatment rate.

Cartrige Treatment rate = 7.5 gpm or 0.0167 cfs.

Number of Cartridges = 0.32 cfs / 0.0167 cfs = 1.9 cartridges = 2cartridges

Therefore, a Stormfilter Catchbains with 2- 18" cartridges can be used to provide water quality treatment.

SUPPORTING DATA PAGES

3. *Minimize Soil Compaction*

   Required actions: Avoid any construction activity that could cause soil compaction in areas designated for stormwater management facilities to preserve filtration and infiltration characteristics of the soil. Also avoid soil compaction in vegetated buffers, and mitigation and/or re-vegetation areas. Delineate these areas on the Preliminary Site Plan and protect during construction with orange construction fencing.

4. *Minimize Imperviousness*

   Required actions: Document the proposed impervious areas for the site. Consider the use of impervious area reduction strategies, such as porous pavement and/or green roofs, to reduce the net impervious area proposed for the site. Impervious area reduction strategies will reduce the impervious area requiring stormwater management facilities. Identify proposed impervious area reduction methods and show them on the Preliminary Site Plan.

2.2.4 Stormwater Management Strategy

Given suitable site and soil conditions, the City requires that the stormwater management strategy prioritize infiltration of stormwater runoff to the maximum extent practicable (MEP) to recharge groundwater and mimic pre-development hydrologic conditions. A geotechnical report is required to document onsite infiltration conditions in order to determine the appropriate stormwater management strategy.

Figure 2-2 shows the City's Stormwater Management Hierarchy that should be used in selecting the proposed stormwater management strategy. Applicants must demonstrate that the strategies higher on the hierarchy are not feasible before selecting a lower level strategy for stormwater management.

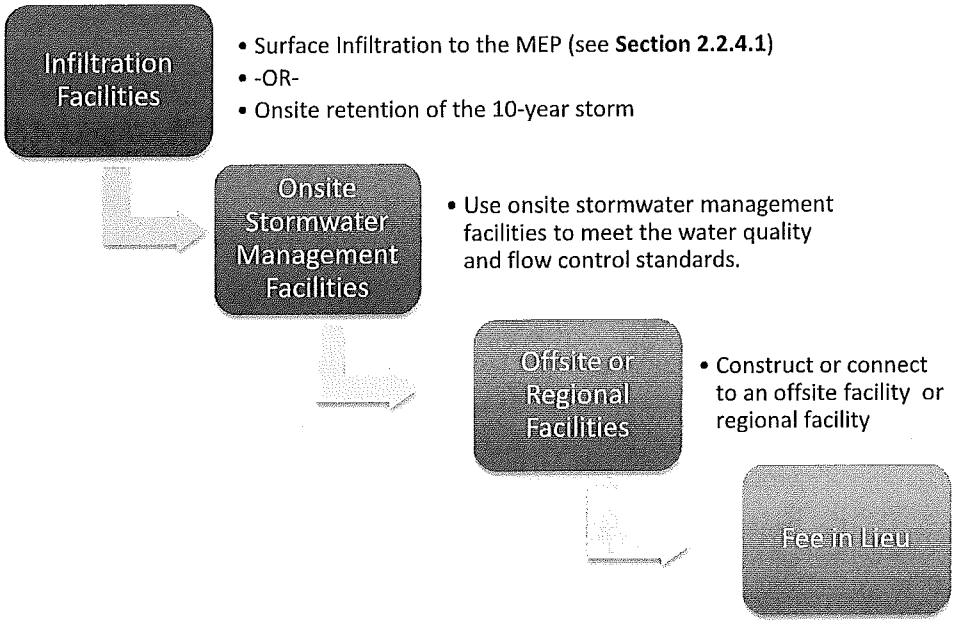


Figure 2-2. Stormwater Management Strategy Heirarchy

After selecting a stormwater management strategy, applicants should indicate which stormwater management facilities are proposed for the site based on the results of the site assessment and planning process. The BMP Sizing Tool should be used to determine preliminary sizes for stormwater management facilities and the BMP Sizing Tool report should be included as part of the application. All proposed stormwater management facilities should be shown on the Preliminary Site Plan.

2.2.4.1 Infiltration to the MEP

The applicant must identify and select the strategy that will be used to infiltrate to the MEP and manage stormwater runoff to meet the water quality and flow control standards in **Chapter 4**. Two options exist under the infiltration strategy:

- **Surface infiltration facilities to the MEP** – Check this option if vegetated, surface facilities will be utilized to the MEP to address the water quality and flow control standards. Facilities must be sized according to the design requirements in **Chapter 4**, using either the BMP Sizing Tool or the Engineered Method. When site constraints restrict the area available for stormwater management facilities, an infiltration facility with a surface area equivalent to 10 percent of the total new plus replaced impervious area of the site will be considered the MEP. Approved stormwater management facilities are defined in **Chapter 4**.

  -OR-

- **Onsite retention of the 10-year design storm** – Check this option if infiltration facilities will be used to retain and infiltrate all stormwater runoff onsite up to and including the 10-year storm. Infiltration of the full 10-year design storm is assumed to satisfy both water quality and flow control requirements of **Chapter 4**.

2.2.4.2 Onsite Stormwater Management

When limiting conditions restrict the use of surface infiltration, the stormwater management strategy shall use onsite filtration or lined stormwater management facilities to meet the water quality and flow control standards in **Chapter 4**. Facilities must be sized according to the design requirements in **Chapter 4**, utilizing either the BMP Sizing Tool or the Engineered Method.

A geotechnical report is not required to document limiting conditions, but approval from the City is required to install lined and/or underground facilities in place of low-impact development facilities.

Limiting conditions may include the following:

A. Stormwater management facilities would be located on fill.

B. Site areas include steep slopes (>25 percent) and/or geologic hazard zone designations (per OCMC 17.44). A geotechnical engineering or geologist report and City approval is required for infiltration facilities on moderate slopes of 10 to 25 percent.

C. Sites in areas of seasonal high groundwater table. For site planning submittal, sites with jurisdictional wetlands or FEMA floodplains may be required to perform a seasonal high groundwater table assessment and determine that the seasonal groundwater table is at least 12 inches below the proposed bottom elevation of stormwater infiltration facilities.

Map Scale: 1:499 if printed on A portrait (8.5" x 11") sheet.

Meters: 0 5 10 20 30

Feet: 0 20 40 80 120

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Clackamas County Area, Oregon
Survey Area Data: Version 14, Sep 18, 2018

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 26, 2014—Sep 5, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
78D	Saum silt loam, 15 to 30 percent slopes	0.1	17.5%
93E	Xerochrepts-Rock outcrop complex, moderately steep	0.4	82.5%
Totals for Area of Interest		**0.5**	**100.0%**

Clackamas County Area, Oregon

93E—Xerochrepts-Rock outcrop complex, moderately steep

Map Unit Setting

National map unit symbol: 2282
Elevation: 100 to 500 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

Xerochrepts and similar soils: 60 percent
Rock outcrop: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Xerochrepts

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from andesite and/or basalt

Typical profile

H1 - 0 to 26 inches: gravelly loam
H2 - 26 to 30 inches: unweathered bedrock

Properties and qualities

Slope: 0 to 30 percent
Depth to restrictive feature: 10 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Hydric soil rating: No

Description of Rock Outcrop

Typical profile

R - 0 to 60 inches: unweathered bedrock

Properties and qualities

Slope: 0 to 30 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Data Source Information

Soil Survey Area: Clackamas County Area, Oregon
Survey Area Data: Version 14, Sep 18, 2018

Clackamas County Area, Oregon

78D—Saum silt loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2273
Elevation: 250 to 800 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Saum and similar soils: 80 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Saum

Setting

Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Material silty and colluvium

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 26 inches: silty clay loam
H3 - 26 to 50 inches: gravelly silty clay loam
H4 - 50 to 54 inches: unweathered bedrock

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: 40 to 60 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.4 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Forage suitability group: Well Drained > 15% Slopes (G002XY001OR)

Hydric soil rating: No

Data Source Information

Soil Survey Area: Clackamas County Area, Oregon
Survey Area Data: Version 14, Sep 18, 2018

ENVIRONMENTAL SERVICES
CITY OF PORTLAND
working for clean rivers

Approved Manufactured Stormwater Treatment Technologies (MSTTs)

February 25, 2019

The City of Portland has approved the 7 manufactured stormwater treatment technologies listed below. Designers may use these technologies to meet Portland's water quality treatment standard under the Performance Approach, as outlined in the SWMM. The listed technologies have been through Washington's Department of Ecology (DOE) Technology Assessment Protocol (TAPE)[1] program and have received DOE's General Use Level Designation (GULD) for Basic Treatment/TSS removal. Based on that designation and the supporting data, the City of Portland has reviewed and approved the technologies for use in Portland.

Designers should consult the Conditions of Approval for each technology, which apply to both public and private applications. Designers should determine which technology best fits their site conditions, project goals, and long-term maintenance requirements. Not all technologies will be appropriate for every site or project.

For City-owned systems, including projects in the right-of-way, BES approves the selected technology and configuration based on project circumstances and City preferences. BES typically requires pretreatment for City-owned MSTTs.

Manufacturer	Device Name	DOE Treatment Type[2]	Conditions
BaySaver Technologies	BayFilter using Enhanced Media Cartridges (EMC)	Basic Treatment Phosphorus Treatment	Conditions of Approval
Contech Engineered Solutions, LLC	Filterra Bioretention Systems	Basic Treatment Enhanced Treatment Phosphorus Treatment Oil Treatment	Conditions of Approval.
Contech Engineered Solutions, LLC	StormFilter with ZPG Media	Basic Treatment	Conditions of Approval

[1] Washington DOE Emerging Technologies Website

[2] The Portland SWMM regulates only for TSS removal, which is met by the WA DOE standard for Basic Treatment. Other treatment designations approved by WA DOE are included for reference only.

Manufacturer	Device Name	DOE Treatment Type[2]	Conditions
Contech Engineered Solutions, LLC	StormFilter with PhosphoSorb Media	Basic Treatment Phosphorus Treatment	Conditions of Approval
Modular Wetland Systems	MWS Linear	Basic Treatment Enhanced Treatment Phosphorus Treatment	Conditions of Approval
Oldcastle Infrastructure	BioPod Biofilter System with StormMix Media	Basic Treatment Enhanced Treatment Phosphorus Treatment	Conditions of Approval
Oldcastle Infrastructure	PerkFilter Media Filtration Device (using ZPC Filter Media)	Basic Treatment Phosphorus Treatment	Conditions of Approval

CITY OF PORTLAND
ENVIRONMENTAL SERVICES

1120 SW Fifth Avenue, Room 1000, Portland, Oregon 97204 ▪ Nick Fish, Commissioner ▪ Michael Jordan, Director

February 2019

Stormwater Management Manual
Approved Manufactured Stormwater Treatment Technology

Contech Stormwater Management StormFilter™ with ZPG Filter Media

City of Portland Decision:
The Contech Stormwater Management StormFilter with ZPG Filter Media meets Portland's pollution reduction requirements, per the requirements of the 2016 Stormwater Management Manual, and is approved for use in the City of Portland with the following conditions.

Background:
As part of the application process, Contech Engineered Solutions submitted the Washington State Department of Ecology (DOE) Technology Assessment Protocol (TAPE) Technology Evaluation Report, including all appendices and performance monitoring data, to demonstrate that the StormFilter with ZPG meets the City of Portland's pollution reduction requirements.

Contech gave a technical presentation to City staff, Portland State University students and faculty, and the public on March 13, 2017. The presentation was followed by a technical interview with the City of Portland review committee to discuss water quality performance, maintenance, and overall use in the public right-of-way.

The City of Portland contracted with Portland State University's Department of Civil and Environmental Engineering (PSU) to provide a third-party review of the submitted water quality performance data. PSU analyzed the provided data and found that the Contech StormFilter with ZPG meets the pollution reduction requirements of the 2016 Portland SWMM.

Additional information is available online for this system, including:

- Contech StormFilter product website
- WA DOE General Use Level Designation (GULD) for Basic Treatment (TSS removal) for the StormFilter with ZPG media at 1 gpm/sq ft of surface area.

The City of Portland complies with all non-discrimination laws including Title VI (Civil Rights) and Title II (ADA).
To request a translation, accommodation or additional information, please call 503-823-7740, or use City TTY 503-823-6868, or Oregon Relay Service: 711.

Conditions of Use:

1. All configuration options for the Contech StormFilter with ZPG are approved for TSS removal. Selection of a specific configuration is the responsibility of the project designer.

2. Use of a Contech StormFilter with ZPG does not exempt a project or site from required flow control requirements, operations and maintenance requirements, or other applicable requirements of the SWMM.

3. For use in the public right-of-way, the following conditions must be met:
   - Units must meet City of Portland street design requirements, including but not limited to H-20 vehicle load rating, non-slip surface, and American with Disabilities Act tolerances specific to surface grates or vault lids.

   - The O&M Plan must call for an assessment during the two-year warranty period of project-specific maintenance requirements and frequencies.

4. Contech-certified providers should be utilized for activation, inspection and maintenance of the system, unless otherwise trained and certified by the manufacturer.

Project Designer Responsibilities:

1. Ensuring that the Conditions of Use are met.

2. Ensuring that the project meets all applicable requirements of the Portland SWMM, including the Stormwater Infiltration and Discharge Hierarchy.

3. Ensuring that the design and installation of the units are appropriate for the project goals, site conditions, long-term maintenance requirements, and any other site-specific design requirements on private property or for use in the public right-of-way.

4. Sizing units to meet the current Portland SWMM presumptive design approach and pollution reduction requirements. The pollution reduction capacity is flow-based and assumes a treatment flow intensity of 0.19 inches per hour, 5 minute time of concentration, and a 0.90 runoff coefficient using the Rational Method with treatment rates based upon WA GULD approved flow rates, in lieu of the manufacturer's standard flow rate. The treatment capacities for Contech StormFilter units with ZPG, based on those assumptions, are provided in Table 1. For sites with different times of concentration, different rainfall intensities may be appropriate. See SWMM Chapter 1.3.4, page 1-40 for additional information.

Table 1. Contech StormFilter with ZPG Sizing to Meet City of Portland Pollution Reduction Requirements

Cartridge Size/Stack Configuration	Cartridge Design Flow Rate (gpm/ cartridge stack)	Maximum Drainage Area (acres/ cartridge stack)	Maximum Drainage Area (square feet/ cartridge stack
12	5	0.065	2838
18	7.5	0.098	4257
27	11.3	0.147	6413

5. Each site plan must undergo Contech review before the City of Portland can approve the unit(s) for site installation. A letter certifying the project has been designed to the manufacturer's specification must be submitted to BES prior to the appropriate design milestone. For public improvements, including public works permits, the letter must be submitted to BES prior to 60% plan review. For installation on private property, the letter must be submitted prior to building permit plan approval. The project designer is highly encouraged to work with Contech prior to the appropriate review milestone to maximize placement and performance of the unit(s).

6. If the project designer wishes to vary from these conditions of approval, the project designer must use the Performance Design Approach.

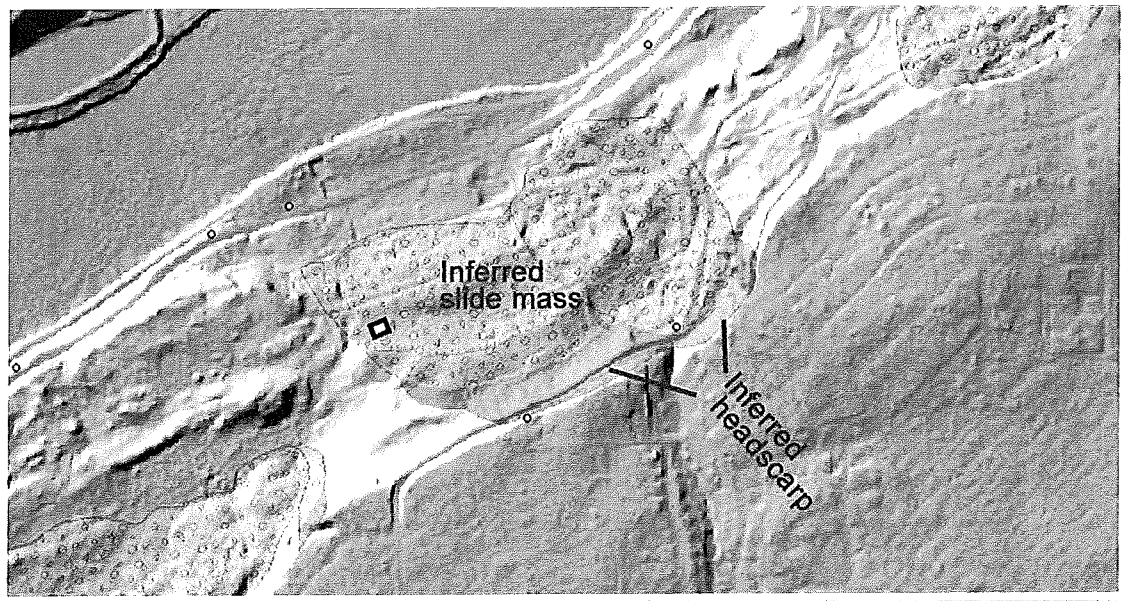
General Conditions:

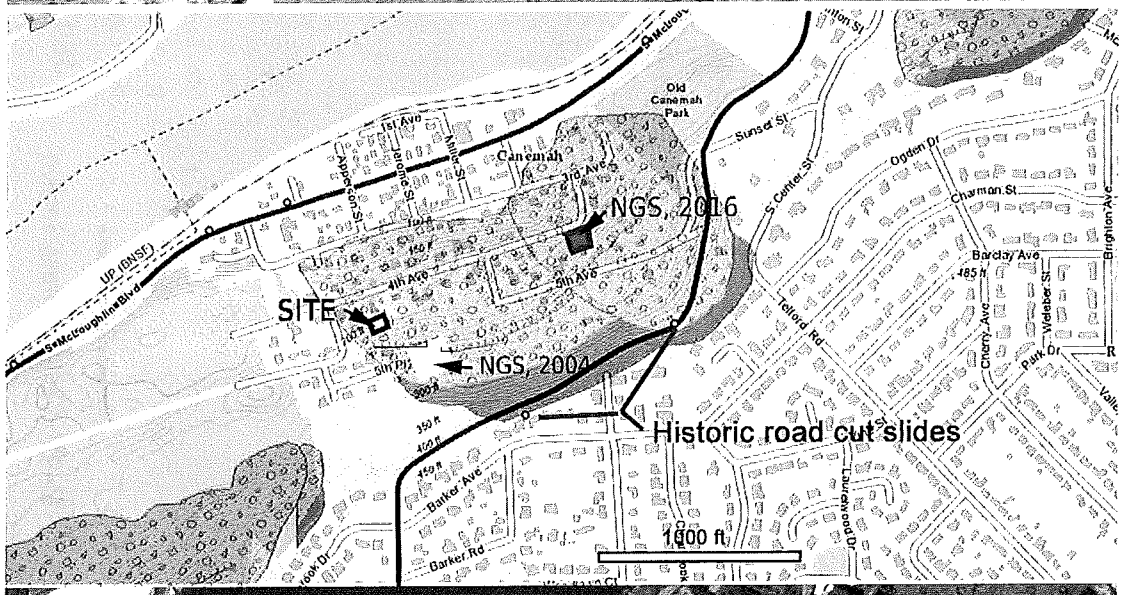
1. BES may at any time suspend or revoke approval if the performance of the technology does not meet performance criteria, if there are changes to the TAPE certification, or the performance criteria change due to local, state, or federal pollution reduction standards.

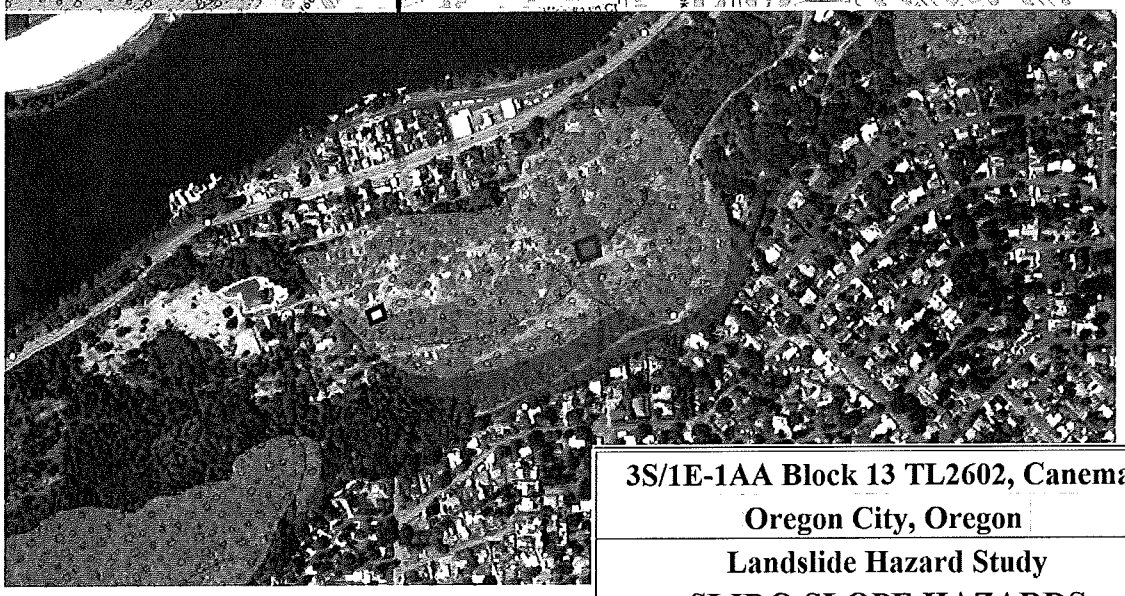
2. If any changes, updates, or revisions have occurred to the StormFilter with ZPG, the applicant must obtain WA DOE TAPE GULD certification and re-apply following submission guidelines in effect at the time of application.

Document Updates:

Date	Action
August 2017	The device was approved for use in the City of Portland.
July 2018	Removed the 3-yr expiration date on BES' approval, per a change in BES policy.
February 2019	Removed "Cartridges per Impervious Acre" from Table 1 due to the potential for associated rounding errors.



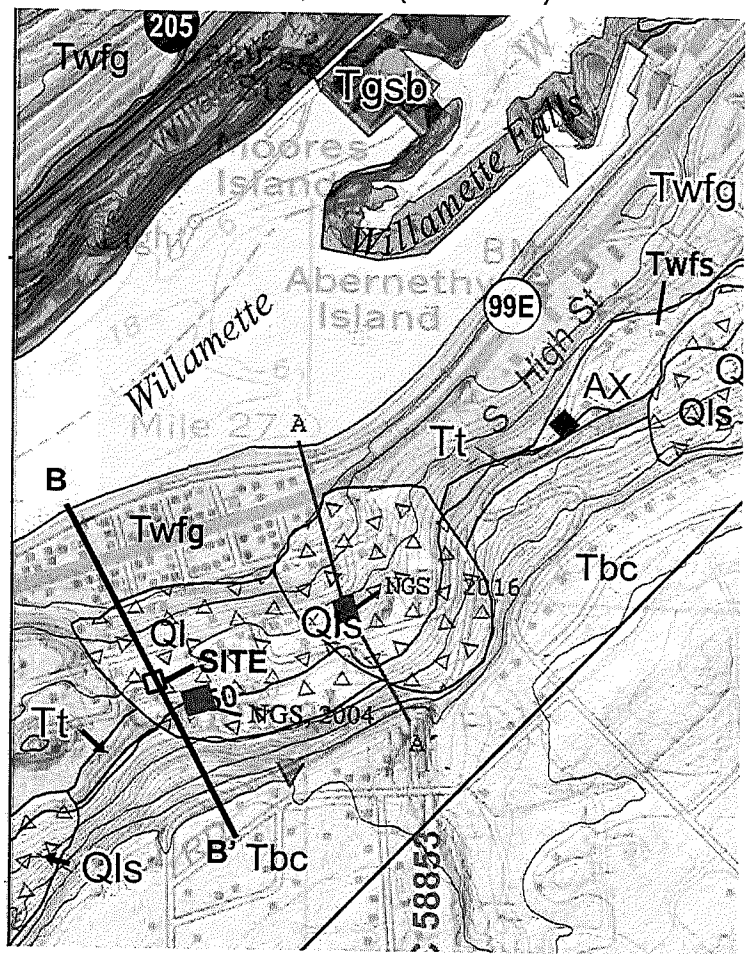




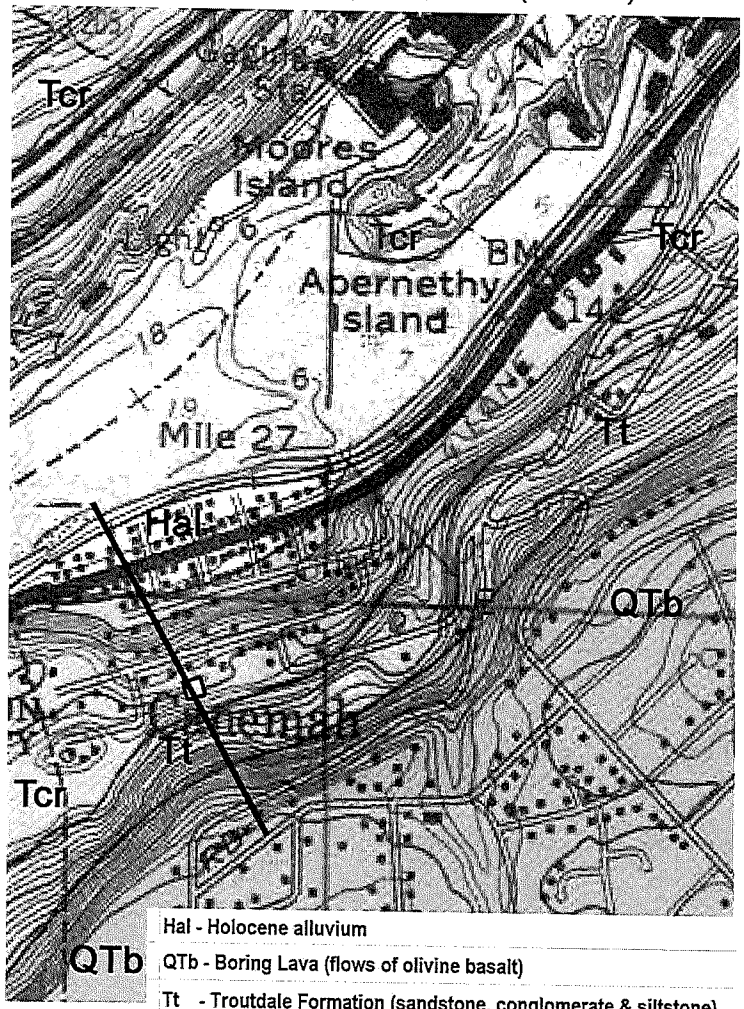
Maps from:
http://www.oregongeology.org/sub/slido/.

3S/1E-1AA Block 13 TL2602, Canemah Oregon City, Oregon		
Landslide Hazard Study **SLIDO SLOPE HAZARDS**		
NGS, Inc.	March 2018	**Figure 6**

Madin, 2009 (GMS-119)



Schlicker & Finlayson, 1979 (Bull 99)



Qls - prehistoric landslide, inferred from LIDAR, moderate confidence

Tbc - Basalt of Canemah, Pliocene Boring Lava

Tt - Troutdale Formation, Pliocene sandstone and conglomerate

Twfs - Sand Hollow flows, Miocene Wanapum Basalt

Twfg - Gingko flows, Miocene Wanupum Basalt

Tgsb - Sentinel Bluff flows, Miocene Grande Ronde Basalt

Rockfall from Hofmeister (2000)

Sample Site (Madin, 2009)

N

1000 ft

Hal - Holocene alluvium

QTb - Boring Lava (flows of olivine basalt)

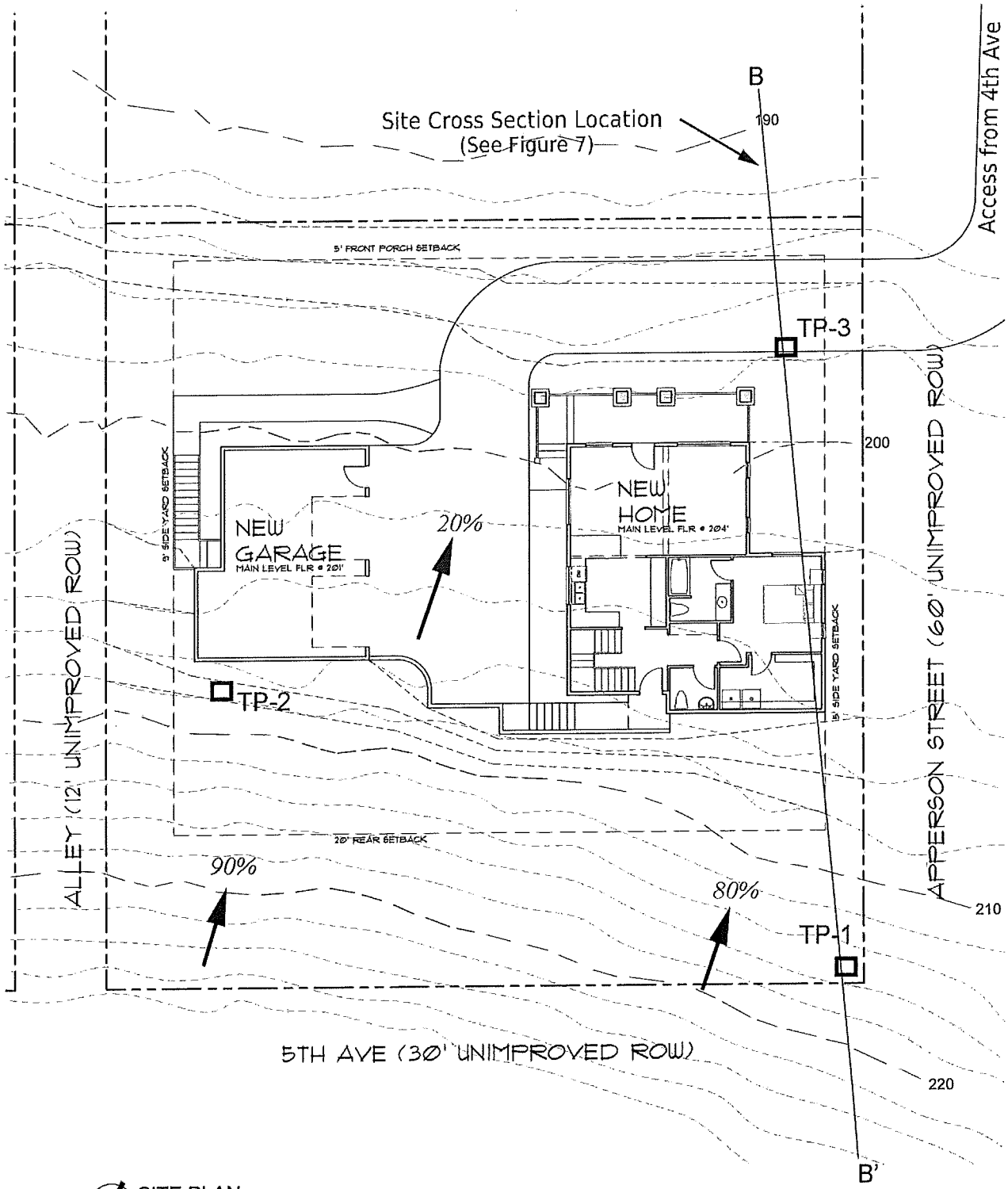
Tt - Troutdale Formation (sandstone, conglomerate & siltstone)

Tcr - Columbia River Basalt (basalt with intercalated soils)

B--B' Geologic Cross Section

Notes:
1. Tgsb exposed below RR tracks at low water (Kienle, 1971) but not shown by Madin (2009).
2. Twfs exposed in test pits at the site, in cuts along 5th Place south of the site and test pits for NGS, 2004 & 2016 (see Figure 2).

3S/1E-1AA Block 13 TL2602, Canemah		
Oregon City, Oregon		
Landslide Hazard Study		
DOGAMI Geologic Maps		
NGS, Inc.	March 2018	**Figure 5**

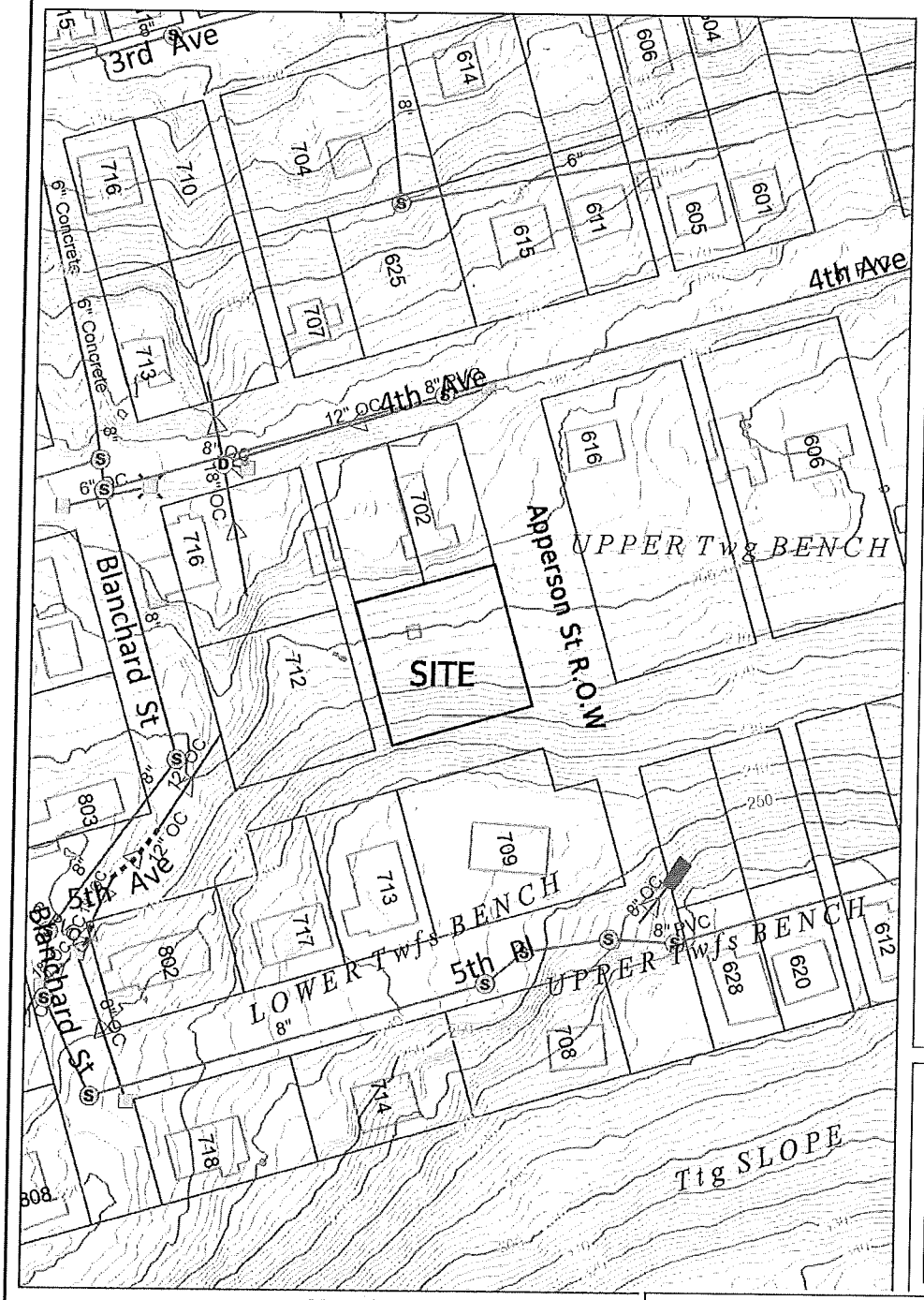


SITE PLAN

20 ft

3S/1E-1AA Block 13 TL2602, Canemah Oregon City, Oregon		
Landslide Hazard Study Proposed Site Plan & Test Pit Locations		
NGS, Inc.	March 2018	**Figure 4**

Site Area Topography and Sewer Utilities



Legend

Contours (2ft)
- 10 foot
- 2 foot

Contours (10ft)
- 50 foot
- 10 foot

Building Outlines
Taxlots
Sewer Structures

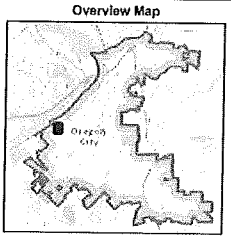
Sewer Pipes
- Gravity Line
- Force Main
- Outfall

Storm Structures
- Manhole
- Inlet
- Outlet

Storm Conduits
- Pipe
- Culvert
- Ditch
- Detention Tank
- Flow Arrows

Storm Ponds
- Pond
- Swale
- Man-Made Wetland

Overview Map



The City of Oregon City makes no representations, express or implied, as to the accuracy, completeness and timeliness of the information displayed. This map is not suitable for legal, engineering, surveying or navigation purposes. Notification of any errors is appreciated.

Map from Oregon City GIS

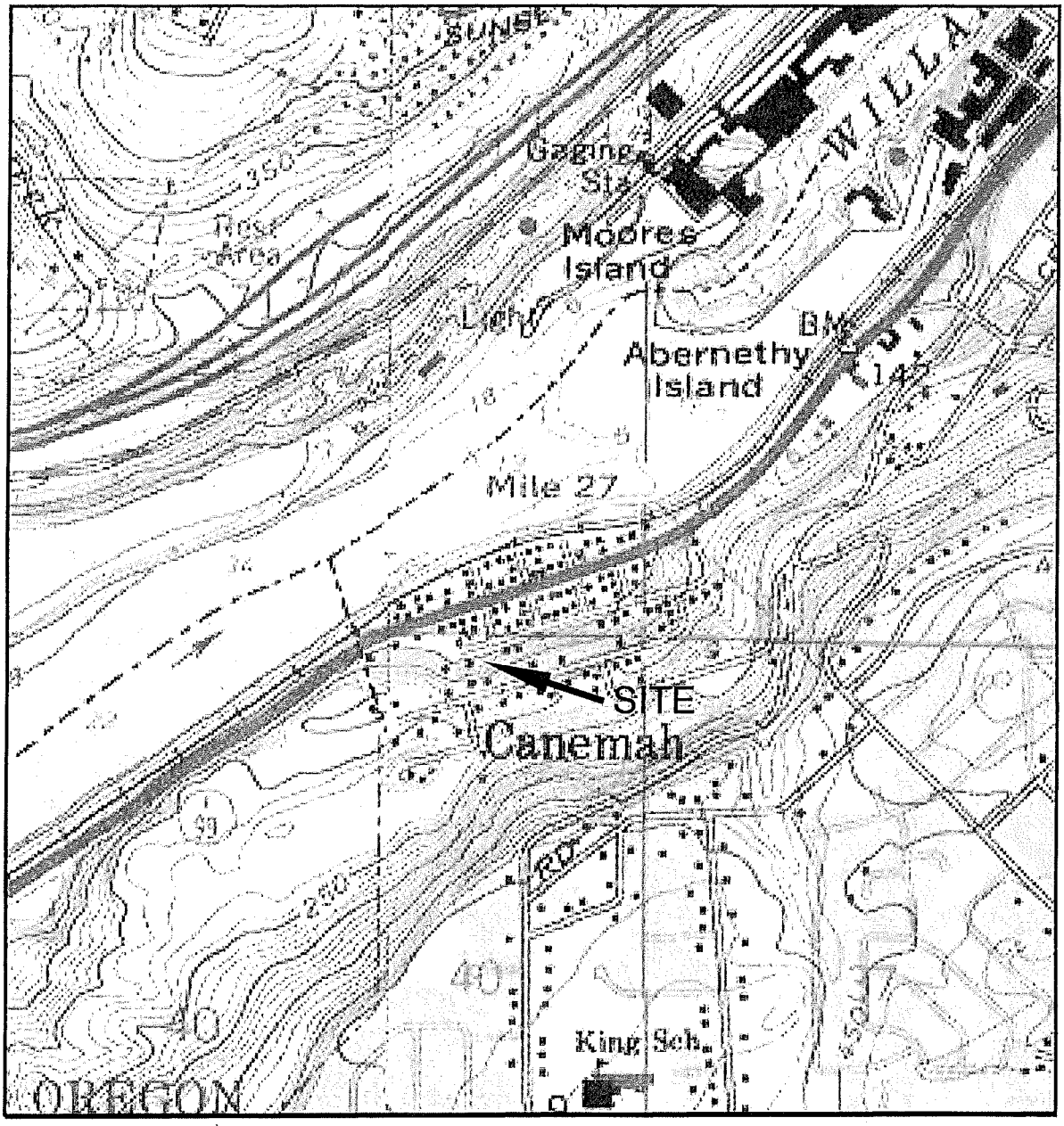
N

0 100 Feet

Map created 3/13/2018

3S/1E-1AA Block 13 TL2602, Canemah Oregon City, Oregon		
Landslide Hazard Study Site Area Topography & Sewers		
NGS, Inc.	March 2018	Figure 3

3S/1E-1AA Block 13 TL2602, Canemah Oregon City, Oregon		
Landslide Hazard Study 2016 Air Photo & Nearby Study Locations		
NGS, Inc.	March 2018	**Figure 2**



1000 ft

N

Image from USGS Camas and Oregon City 7.5" Quadrangles

3S/1E-1AA Block 13 TL2602, Canemah Oregon City, Oregon		
Landslide Hazard Study Site Location Map		
NGS, Inc.	March 2018	**Figure 1**

NGS, 2017, Response to Foundation Engineering Review of 16 December 2016 Geologic Hazard Assessment Block 17, TL 300 Canemah, Oregon City, Oregon, Northwest Geological Services, Inc letter-report dated 7 August 2017 to Redmond Geotechnical Services.

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Madin, I.P., 2009, Geologic Map of the Oregon City 7.5′ Quadrangle, Clackamas County, Oregon, Oregon Dept. of Geology and Mineral Industries Geologic Map GMS-119.

Minervini, J. M., O'Connor, J. E. and R.E. Wells, 2003, Maps Showing Inundation Depths, Ice-Rafted Erratics, and Sedimentary Facies of Late Pleistocene Missoula Floods In The Willamette Valley, Oregon, U.S. Geological Survey Open File Report 03-408.

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NGS, Inc, 2004b, Landslide Hazard Study, Block 52, Canemah, Oregon City, Oregon, Northwest Geological Services, Inc. report dated 10 May 2004 to John Carson c/o Kabik, Inc.

NGS, 2016, Geologic Hazard Assessment Block 17, TL 300 Canemah, Oregon City, Oregon, Northwest Geological Services, Inc letter-report dated 19 December 2016 to Redmond Geotechnical Services.

explorations were conducted. Thus, site conditions may vary from those inferred herein from the test pits and natural exposures. If such variation is found you should contact us to review the conditions found.

The conclusions and recommendations herein apply only to this specific project or to one of substantially the same scope and extent at this site. Conclusions and recommendations should be updated if the proposed scope is not completed within three years of the date of this report.

We thank you for the opportunity to assist you with your property development. Please contact me if you have questions about the report.

Yours very truly,
Northwest Geological Services, Inc.

Clive F. (Rick) Kienle, Jr.
Vice President

Reference NGS 235.89-2

However, we favor Missoula floods as an explanation. The entire area below about elevation 400 ft was intensely scoured several times by the Missoula floods (Waitt, 1985; Minervini & others, 2003; Burns & Coe, 2012). In our opinion the multiple scour events easily account for the thin overburden soil, minor topographic irregularities and general lack of landslide deposits, as well as for the relatively steep slopes left at the edges of some basalt flows.

As noted previously, soils in the test pits were moist. Soils uphill of the test pits were also moist during our reconnaissance. Based on the site vegetation and slope, it does not have standing water at any time. However, the soil is thin on the slope uphill of the site and the slope extends up to the unimproved 5th Ave right-of-way. Consequently some runoff from the slope must cross the site during precipitation. We suspect that the soil develops a transient zone of saturation above the bedrock during intense or prolonged storm events.

The closest potentially active fault is the Bolton Fault located about 1 ¼ NE of the site (Beeson and others, 1989; Liberty and others, 2002). NGS (1994; 2004a) estimated the fault could produce an Mw = 6.8 earthquake at relatively shallow depths.

7. CONCLUSIONS AND RECOMMENDATIONS

The bedrock slopes at the site appear stable. The colluvium also appears stable under present conditions. Based on the typical rock and soil properties and the plan for proposed cuts, fills and retaining walls (Figure 4) it, is our opinion that the site can be developed without creating any slope stability problems. However, the footing design for the wall and excavation plan for the cuts and fills should be reviewed by a qualified professional. We also recommend that the excavations for the work be inspected by a qualified professional prior to placing fills or drainage blanket material.

Some water will move across the site slopes during storms as noted previously. In our opinion this will not be a problem as long as the water that is intercepted by improvements (e.g., street, footing drains, roofs and pavements) is dispersed across the slopes. It should not be discharged to a concentrated or a few small areas such as dry wells, particularly to the area above the house north of the site. Alternatively, runoff can be sent to the existing storm sewer in 4th or to an infiltration structure constructed along the adjacent unimproved street right-of-way (Figures 3 and 5). Regardless of the choice (all are viable in our opinion), the plan should be reviewed by a qualified professional.

Excavation of some rock may be required to meet the planned footing elevations. The plans for this work should be reviewed by a qualified professional. Also, excavations for footings or structures should be inspected by the project geotechnical engineer or their qualified representative. We recognize that development plans may change as development proceeds. In our opinion, there are many ways that the subject site could be developed without creating slope hazards. Regardless of what actual changes are made from the plan shown on Figure 4, we recommend that the final plans for footings, foundations, cuts, fills or other earthworks, and drainage be reviewed by the appropriate qualified professional engineers.

8. CLOSURE

This report has been prepared exclusively for the use of the owner for specific application to this proposed project alone (i.e., as shown on Figure 6). Changes to the project that involve the extent and/or depth of fills or excavations should be submitted for our review and for review by the geotechnical engineer.

Our services have been executed in accordance with generally accepted engineering geologic practices in this area at the time this report was prepared. We caution that only limited subsurface

vesicles are typical of the bottoms of lava flows. Consequently we interpret the south part of the site to be underlain by the base of a Sand Hollow basalt flow and the north part to be underlain by the top of a Gingko basalt flow as shown on Figure 7.

5.3 Surface Water / Natural Resources Overlay (NROD)

We observed no areas of standing water (lakes, ponds) or drainage ways (streams, rills) at the site. Oregon City GIS shows the nearest watercourse to be a drainage – locally known as Coffee Creek - along the west side of lot west of the site (Figures 3 and 11).

Coffee Creek[15] is partially channelized and has been incorporated into the City storm drainage system (Figures 3 and 11). The drainage is too small to show on the USGS (2014) topographic map. In spite of the small size and interconnection with the storm sewer system, the City NROD extends along it. The NROD reaches east and SE from the creek/storm sewer to and across most of the site.

Our reconnaissance, review of topography and City utilities maps indicate there is no direct surface drainage from the site to Coffee Creek. Instead, most surface water infiltrates into the colluvium and thence by vadose or saturated flow downhill through the colluvium. A small percentage recharges aquifers in the bedrock basalt flows. What little surface runoff exits the site is intercepted by the impervious pavement of 4th Ave where it drains to the 12" 4th Ave storm sewer. That pipe connects to the storm sewer in Coffee Creek at the intersection of 4th Ave and Blanchard St. Note also that the City routes much of the intercepted runoff in the area to buried infiltration structures along the streets or to Coffee Creek.

In summary, stormwater is captured uphill and downhill of TL 2602 and routed into the soil or to the storm sewer. There is no surface discharge to the to the NROD-protected drainage west of the site. However, surface runoff from the site that reaches 4th Ave is directed to Coffee Creek as is that from all other residences uphill of 4th Ave.

5.4 Ground Water Observations

No ground water was found in the test pits on 2 March 2018. We found locally moist soils during the reconnaissance. However, we found no seeps or springs, in spite of recent precipitation.

6. INTERPRETATION OF SITE CONDITIONS

Review of aerial photos and topographic maps indicates that, historically, the site has been a normal hillside location with no obvious problems. Several residences on adjacent and nearby properties are 80 to over 100 years old and show no visible signs of damage from slope failure. Conifer trees near the site are generally straight and erect with only the minor pistol butting typical of slow soil creep. Nearby pavements are generally smooth and free of cracks or offsets from slope failure.

We previously discussed (NGS, 2004b, 2016 & 2017) the simple and logical explanation for a lack of landslide deposits below an apparent landslide scarp. First, the current gentle to steep basalt slopes shown on the cross section (Figure 7) are obviously stable. Likewise, the bench above 5th Pl underlain by the Sand Hollow basalt also is in place and stable as is the Troutdale formation slope above the bench. Only the steep colluvial / talus slope below the Boring lava might be remnant of an ancient, surficial landslide. In our experience, only the downcutting of the Willamette River over millennia or submersion during the Missoula Floods more than 13,000 years ago would destabilize the slope. Either process would also remove all or most deposits of such slope failures.

[15] We surmise the name derives from the color of the creek's wet season flow.

The basalt is usually dark grey to black and hard (RH-4)[12] where fresh. It is jointed in large columns and/or irregular, interlocking blocks. The bottom of the lowest Frenchman Springs flow is along the SPRR at about elevation 70 ft.

Several hundred feet of older, Grande Ronde Basalt flows (Tgsb on Figure 7) underlie the 250+ feet of Frenchman Springs flows at the site. These older flows appear to dip northeast (Kienle, 1971).[13] However, the younger Frenchman Springs basalt flows appear to be nearly horizontal at the site or dip slightly SW. The upper surface of the basalt is irregular because it was eroded by the same streams that deposited the overlaying Troutdale Formation. The top of the basalt is at about elevation 280 ft S of the site (NGS, 2004b) and about 250 along South End Rd ENE of the site (Madin, 2009).[14] The vesicular flow top of the Sand Hollow flow is exposed on 5th Pl SSE of the site (Figures 3, 7 and 8).

The Troutdale formation extends uphill from the basalt to the Boring Lava (Figure 5, right). The contact is buried by colluvium (NGS, 1994, 2004b). Thickness appears to range from 100 up to 200 ft in the site area. Troutdale silty sandstone and pebbly sandstone are exposed along South End Rd. northeast of the site. Similar strata are inferred to underlay the slope south and uphill of 5th Pl. based on rounded Troutdale type cobbles and pebbles in the site colluvium (NGS, 2004b). Usually, the Troutdale siltstones and silty sandstones are weathered to a depth of many feet. However, the weathered material appears to have been mostly removed by the Missoula floods in the site area.

The Boring Lava consists of one or two flows of grey, hard (RH-4) olivine basaltic andesite. The Boring flows are basaltic andesite, and distinct from the local Columbia River Basalt (Figure 8, lower left). Cuts along South End Road south of the site provide a good section of the Boring Lava (Figure 8, right center). The near-vertical cuts reveal it to be columnar jointed to blocky jointed and show that it will stand in steep cuts for many decades. However, the exposed face of the basalt is susceptible to frost wedging and topple failures. These processes can cause significant rockfalls from steep faces of the basalt such as the two historic road cut slides (rockfalls) shown on Figure 6.

5.2 Site Explorations

Site slopes are gentle except in the south 1/3 of the lot (Figures 4 and 9, upper). Three test pits were excavated on TL 2602 to explore site conditions (Figure 9, upper). Figure 4 shows location of the three test pits and graphic logs are on Figure 10. The test pits were located to explore conditions at the uphill limit of the site (TP-1), where a cut or wall will be needed for the garage (TP-2) and above the existing cut for the neighbor's residence (TP-3). The cuts, fills and retaining walls for the road and residence will be the only significant earthworks for site development (Figure 4).

Test pits TP-1, -2 and -3 found Frenchman Springs basalt bedrock at depths of 5, 3 and 2.5 ft, respectively. The basalt is medium hard to hard, red brown to black gray, dense to vesicular, severely to slightly weathered BASALT bedrock. The basalt was overlain by 2.5 to 5 ft of colluvium (Qc). In TP-2 and -3 the colluvium was covered by about 0.5 ft of organic topsoil. Discrete topsoil was not present in TP-1 which was located in the cleared right-of-way for Apperson St.

The basalt in TP-3 was highly vesicular and contained abundant clusters of feldspar crystals (glomerocrysts) typical of the Gingko flows. The basalt in TP-1 and -2 contained rare, small crystals of feldspar (microphenocrysts) up to about 2 mm long. These are typical of the upper Frenchman Springs flows, particularly the Sand Hollow flows that are known to overlay the Gingko. Many of the vesicles were flattened in the basalt from TP-2 and a few pipe vesicles were also present. Flattened and pipe

[12] Panama Canal Scale of rock hardness: 1 = soft, 2 = medium, 3 = medium hard and 4 = hard.

[13] Where they are exposed below the Falls viewpoint along the railroad tracks adjacent to the Willamette River.

[14] Schlicker and Finlayson (1979) mapped Troutdale extending down to about elevation 210 ft. However, RGS's TP-1 and TP-2 found basalt bedrock so the Troutdale must be higher.

found talus with local angular boulders up to 8 ft across. South End Rd was built before 1914. It was cut into the talus / colluvium as much as possible to avoid rock cuts. Side cast fills from the construction and subsequent widening have destabilized the slope below the road, resulting in occasional local fill failures. Additionally, removal of talus destabilized the rock and/or colluvial slopes above the road resulting in rockfalls (Hofmeister, 2000; Madin, 2009). These are surficial failures and have not affected the site. Also, reconnaissance and test pits at two separate sites within Madin's "landslide" (NGS, 2004b, 2016 & 2017) found thin colluvium overlying in-place bedrock rather than landslide debris.

Krager (2015) found basalt in two test pits immediately west of the site. He had refusal with the excavator in the basalt at 3 and 5 ft depth, but did not identify which basalt flow was encountered. Instead Krager assumed Madin's (2009) landslide interpretation was correct. Similarly, PBS (2007, 2014) found basalt at shallow depths on TL 300 in Block 17 site. But -like Krager- PBS didn't identify which basalt flow was encountered and assumed Madin's (2009) landslide interpretation of the LIDAR was correct.

In summary, NGS (1993, 2004b, 2016 & 2017) identified the basalt flows on three Canemah properties, including the subject site (Figure 2) and found in place basalt and/or sandstone bedrock. At all three sites the bedrock was overlain by only a few feet of colluvium with no landslide deposits encountered.

4.2 Effect of Missoula Floods

The Missoula Floods drastically modified the landscape below 400 ft elevation (Minervini and others, 2003). The floods both scoured the land and, locally, deposited extensive glaciofluvial sediments. In main-channel areas flood velocities were many feet per second (Waitt, 1985) the scour was severe and deep, bedrock was scoured and plucked, and the sediments deposited are usually coarse grained. In backwater areas the floods scoured away soils and weathered rocks and deposited in their place a mantle of fine-grained sediment, generally referred to as the Willamette Silt.

The site is in the canyon of the Willamette River's narrow channel through the south end of the Tualatin Mountains. Almost all of the Missoula flood waters that poured into Willamette Valley passed through this gap, so the scour from the rising floods was particularly severe. The site is also just downstream of the of the confluence of the Tualatin with the Willamette. The combined flow of the receding floods was aimed at the south bank of the Willamette from Canemah south to about river-mile 29 (just past lower left of Figure 1). So, the area was thoroughly scoured several times. Minervini & others (2003) estimated that at least 20 of the Missoula Floods rose to more than 200 ft in this area. They also estimate that 10 or more rose to over 260 ft[10], with a few extending to 400 ft. As noted, Waitt (1985) estimated flood velocities of several meters/second.

5. SITE GEOL0GY

5.1 Site Area Reconnaissance

Reconnaissance of the site and site area was conducted on 2 March 2018. The area reconnaissance covered the west end of the Canemah District and the slope to the south. We found the site and area to be underlain by at least flows of Frenchman Springs member of the Columbia River Basalt.[11] The basalt flows are exposed in roadcuts along Fourth and Fifth Avenues south of the site, along Highway 99 north and south of the Canemah District, and along the SPRR tracks above the Willamette River.

[10] As noted, site elevation is ~192 to 228 ft (Figure 4).

[11] Kienle (1971) found that the flows are of the Frenchman Springs Basalt Member of the Late Yakima Basalt. The flows are now grouped with the Wanapum Formation of the Columbia River Basalt Group. These flows are shown on Figure 7 as the Gingko basalt (Twfg) and Sand Hollow basalt (Twfs) and are about 12-14 million years in age.

SLIDO[7] compiles available landslide information in one place (Figure 6). Potential and known hazards can be mapped onto base maps of LIDAR (Figure 6, top), aerial photos (Figure 6, bottom) or a roadmap (Figure 6, center), providing better location information for landslide features than the published maps. Figure 6 also shows the two historic rockfalls (Hofmeister, 2000) on South End Rd, south of the site. The SLIDO site also compiles landslide susceptibility information. SLIDO shows the site in an area of potentially "High" landslide susceptibility. Typically, that rating is applied to areas shown by SLIDO as mapped landslide areas. All of the SLIDO maps carry the following disclaimer:

> "For general information only; not to be used for planning purposes.
> http://www.oregongeology.org/slido"

4. AREA GEOLOGY

4.1 Previous Studies of the Site Area Geology

The geology of the site area (Figure 5) has been mapped by several geologists (Treasher, 1942; Trimble, 1963; Schlicker & Finlayson, 1979; Madin, 2009; Ma & others, 2012).[8] Kienle (1971) mapped individual basalt flows exposed along the Willamette River, Hwy 99E and the SPRR tracks and correlated them with Columbia River Basalt flows in the Columbia Gorge and east of the Cascades.

All studies agree that the site area is underlain by the regionally extensive Columbia River Basalt which extends to depths of several hundred feet in the site area. The Columbia River Basalt is overlain by the sedimentary strata of the Troutdale Formation. These strata are in turn overlain by the Boring Lava, well exposed along South End Rd, south of the site. Strata dip gently to the SW at about 1° to 2°. The nearest major fault is the Bolton fault, about 1¼ miles NE. That fault extends NW-SE, parallel to the Willamette River, from Portland to Oregon City (Beeson and others, 1989; Liberty and others, 2002).

Figure 7 shows the geology along a cross section from McLoughlin Blvd SSE through the site to the cliffs above South End Rd (Section B-B' on Figures 2 and 5). As discussed in Section 5, the geologic cross section is based partly on mapping described above and updated for this report. Updates include basalt flow identifications from Kienle (1971)[9] and pertinent site-specific hazard studies in the Canemah area (NGS, 1993, 2004b, 2016, 2017) where individual basalt flows were identified.

As noted, none of the pre-2000s geologic maps indicate that landslides have affected the site. However, Schlicker and Finlayson (1979) did map "landslide topography" in the NW ¼ of 3S/2E-1 (i.e., in the site area). They also identified the site area as one of thin soils. They noted that in such areas, septic systems and utility excavation could be a problem.

Madin's (2009) interpretation of two large, overlapping, prehistoric landslides in the site area is based on only on physiography. The steep concave cliff along South End Rd is typical of the geomorphology of a headscarp. And the benched terrain could be indicative of internal scarps of a large slide mass. None of the DOGAMI reports actually field checked the landslide interpretation.

Our field work in the area indicates that there are no massive landslide deposits below the assumed headscarp above South End Rd. Reconnaissance of the slope below South End Rd (NGS, 1993)

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[7] Statewide Landslide Information Layer Oregon: http://www.oregongeology.org/slido/index.html.

[8] The most comprehensive geologic maps are by Trimble, 1963, and, Schlicker and Finlayson's, 1979, Bulletin 99. Although, Madin's (2009) Geology Map covers the area, features are not referenced to culture or coordinates, so it is very difficult to use. Also, it is mostly a compilation of earlier mapping with limited new mapping and spot checking. Burns and Mikelson (2010) and Madin & Burns (2006) are remote interpretation of LIDAR and aerial photographs rather than on the ground geologic studies such as those by Treasher, Trimble or Schlicker & Finlayson. Ma & others, 2012, was simply a compilation and reinterpretation of previous work by others.

[9] Kienle (1971) used petrology, paleomagnetism and chemical analyses to prove that the flows at Canemah were identical to the Columbia River Basalt Gingko flow and other Frenchman Springs flows in the Columbia Gorge and east of the Cascades.

2.3 Historical Development of the Site and Area

We looked for evidence of landslides on historic aerial photographs[5] and maps. The maps include USGS quadrangles, City GIS data and NOAA LIDAR. The USGS maps were published in 1904, 1951, 1961 and 1990. Lowest return LIDAR was used by the City GIS to derive the elevation contours on Figure 3. (We also reviewed the raw LIDAR imagery for this report.)

The 1910 Sanborn map show the house at 710 4th Ave was built immediately north of the site. It also shows houses present at 716 and 909 4th Ave, as well as at 803 5th Ave west of the site (see Figure 3 for locations). These houses are all still there. The historic aerial photographs show the site mostly cleared from the 1950s through the 1960s. The 1952 photos show houses present on the lots NW, N and NE of the site. The site was apparently the back yard for the residence at 710 4th St. 1970 and later photos show the treed area along the 5th St right-of-way progressively spread north onto the steep slope in the south 1/3 of the site.

No slope failures are apparent on the aerial photos. The historic topo maps also show no indication of slope failure. Several new residences have been built nearby, including on the lot west of the site. It was cleared and a residence was built (712 4th Ave) in late 2017. Additionally, there was recent construction at 804 4th Ave, and 602, 612, 620, 628 and 708 5th place, all in the last 10 years and all with no reported stability problems.[6]

3. GOVERNMENT HAZARD ESTIMATES

Schlicker and Finlayson (1979) mapped the site as an area of moderate slope with "landslide topography". This interpretation was based on the USGS 7.5" Quadrangle map, aerial photo interpretation and limited field checking. Three fairly recent DOGAMI studies include the site (Madin & Burns, 2006; Burns & Mickelson, 2010; Madin, 2009). The first two of these studies relied on interpretation of LIDAR and aerial photographs. The most detailed study by Madin (2009) is shown on Figure 5 (left panel). Madin relied on the two other studies, LIDAR, previous geologic mapping and limited field checking.

Madin and Burns (2006) and Burns and Mickelson (2010) inferred from the LIDAR and aerial photos that the site is on a "moderate confidence" prehistoric landslide. Neither study included field checking the interpreted landslides. Madin (2009) shows the site as in a Quaternary landslide (i.e., not recent) with the same extent as the earlier DOGAMI studies. Madin did limited field checking, including the basalt outcrops along South End Rd, south of the site. However, his database (Madin, 2009, Appendix A) indicates he did not examine the LIDAR interpreted landslide surrounding the site. Madin (2009) contains the following warning:

NOTICE

> The Oregon Department of Geology and Mineral Industries is publishing this map because the subject matter is consistent with the mission of the Department. The map is not intended to be used for site-specific planning. The map cannot serve as a substitute for site-specific investigations by qualified practitioners. Site-specific data may give results that differ from those shown on the map. The views and conclusions contained in this document are those of the author and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government

[5] Aerial photographs examined from our files include photos taken in 1952, 1960, 1970, 1986 and 2008. Photos examined from the City GIS were taken in 1994, and 2000 - 2016.

[6] The city did not provide landslide hazard studies for any of these sites at the pre-App conference.

- Obtain and review historic aerial photographs, imagery and LIDAR of the site;
- Review previous geologic investigations of the site area, including those required by the City;
- Conduct a geologic reconnaissance of the site and adjacent area;
- Observe test pit explorations conducted by Redmond Geotechnical Services;
- Review the preliminary plans for the proposed development; and
- Prepare this letter describing our work, findings and recommendations.

2. SITE SETTING

2.1 Location

The site is located at the southwest end of the Canemah District, in Oregon City, Oregon. Assessor's maps show it as TL 2602 NE 1/4 NE 1/4 Section 1, T3S/R1E Willamette Meridian in Donation Land Claim 40 (Figures 1 and 2). The site comprises Parcels 7 and 8 of Block 13 of the historic Canemah District. The site is accessed from Fourth Ave and the unimproved right of way of Apperson St (Figures 3 and 4). The site is bounded on the north by TLs 2600 and 2601, on the south and east by the unimproved rights-of-way of 5th Ave and Apperson St, respectively. TLs 2700 and 3500 are across an alleyway to the west.

2.2 Physiography

As shown on Figures 1, 3 and 4, the site lies at elevation ~190' to 225' about halfway up the slope from the Willamette River to the upland plateau south of Oregon City. The site is near the southwest margin of the Canemah District (Figures 2 and 3) and was platted and developed before 1900 (see Section 2.3). Grading for construction of streets and building sites for development modified the natural hillside extensively.

Regional geologic mapping indicates the bedrock is Miocene age basalt that is mantled by thin surficial soils. Younger rocks occur south of the site (Figure 5). As discussed in Section 4, the site was intensely scoured by multiple catastrophic Missoula floods towards the end of the last Ice Age.

Topographic mapping and LIDAR (Figures 3and 6) show Canemah is a series or alternating benches[3] and moderate to steep slopes. The stepped topography was formed as the Willamette River cut through the conglomerate and lava flows forming the south end of the Tualatin Hills. The catastrophic Missoula Floods[4] repeatedly scoured the canyon walls (see Section 4), enhancing the benched nature of the topography by scouring away most soil and colluvial deposits.

Detailed topographic mapping of the site (Figure 4) shows natural slopes range from moderate (~20%) up to relatively steep (~80%-90). The slope along 4th St north of the site is partially supported by a stone wall. The slope along the south 1/3 of the site and south of the site up to SW 5th Ave is steep, but relatively smooth and regular (Figure 4).

Most of the site is grass and forb covered. The slope south of the site is shaded by immature firs, false cedar, Red Alder and Maples (Figure 9). The conifers are straight and erect. Ground cover of ivy and berries mantle the slope and patches of understory maple and scrub occur locally.

[3] Benches generally eroded into soft zones at the tops or bottoms of resistant units; in this area Wanapum flows of Columbia River Basalt (Tgsb, Twfg, Twfs) and cemented conglomerate and sandstone lenses in the Troutdale Formation (Ttg).

[4] From ~70,000 – 13,000 years ago (Waitt, 1981; Minervini & others, 2003).

NORTHWEST GEOLOGICAL SERVICES, INC.
Consulting Geologists and Hydrogeologists
2505 N.E. 42nd Avenue, Portland, Oregon 97213-1201
503-249-1093 nwgeological@gmail.com

Redmond Geotechnical Services
P. O. Box 20547
Portland, OR 97294
Attention: Dan Redmond

22 March 2018

Geologic Hazard Assessment
Block 13, TL 2602 Canemah
700 Block 4th Street
Oregon City, Oregon

Dan:

The purpose of this letter is to present Northwest Geological Services, Inc. (NGS) Landslide Hazard Study for the above referenced property. Work was done as per your email of 26 January 2018. Figures 1 and 2 show the location of the site about ¼ miles south of the Willamette River.

We understand that our services are in support of your client's efforts to develop the property for a residential dwelling. Our study is intended to meet Oregon City Chapter 17.44 US Geologic Hazards Development Permit requirements for the Engineering Geology portions of a Type II land use application and for subsequent building permits.

SUMMARY OF CONCLUSIONS

The Missoula floods intensely scoured the site area below about elevation 400 ft. That scour accounts for the thin overburden soil, minor topographic irregularities and locally steep slopes in the site area. The detailed topographic survey of the site, the geologic reconnaissance, test pits and studies of nearby sites reveal that the site is underlain by competent bedrock with relatively thin soils. No evidence of slope failure is apparent at or near the site. In our opinion the proposed development can be accomplished without adverse affect on the site area slope stability.

Water from the slope uphill passes through the site soils. Surface or ground water that is collected or intercepted by footings, structures, pavements, fills, etc., should not be disposed in a concentrated area. Soil and rock properties indicate that diffusion in the unimproved Apperson St right-of-way or disposal to a storm sewer may be viable alternatives.[1]

We recommend review of site grading or other earthworks, footings, foundations and drainage -- as well as plans for any such work -- by a qualified geotechnical engineer.

1. SCOPE OF STUDY

State hazard maps indicate the site may be[2] located on an inactive, rotational, bedrock landslide. However, neither hazard from rapidly-moving landslides, nor more than low-moderate hazards from earthquakes are indicated. Additionally, geologic mapping indicates that two historic slope failures have occurred along the slopes above South End Rd, south of the site. Thus, the scope of our studies included the following engineering geologic tasks:

[1] The City disposes storm water from 4th Ave and 5th Pl. to infiltration trenches and storm sewers (Figures 3 and 11).

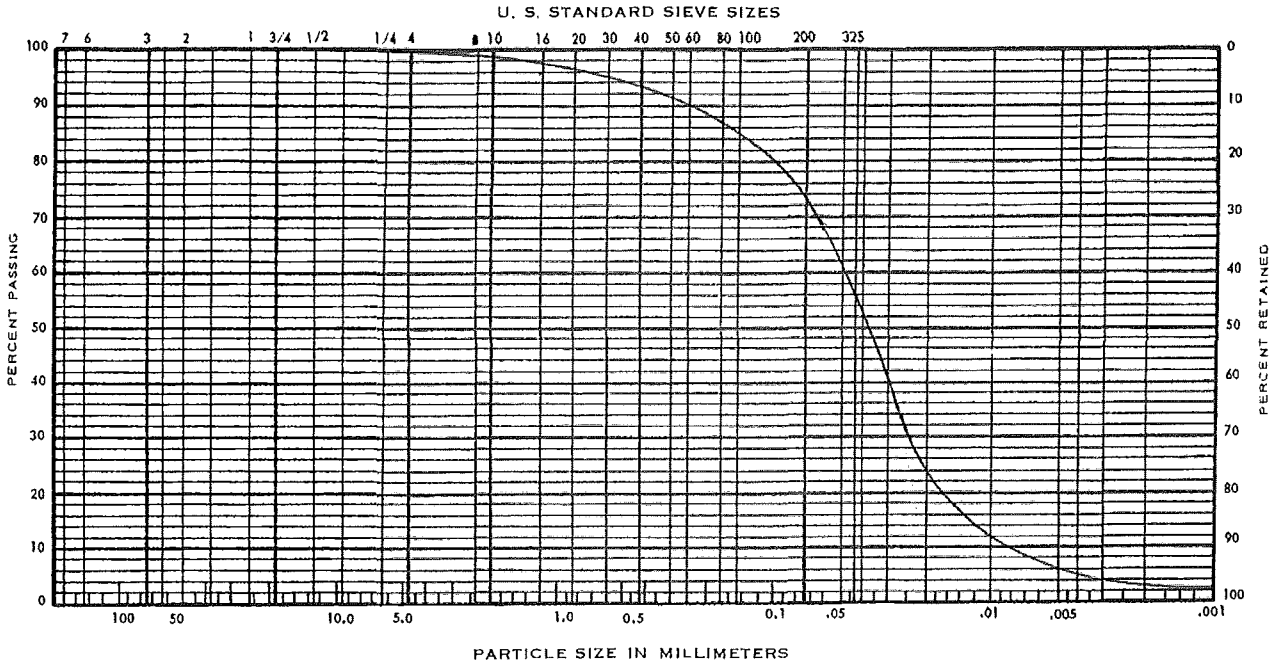
[2] Inferred from LIDAR with "Moderate" confidence by Madin & Burns (2006) but not field checked by them.

Appendix "B"

Geologic Hazard Assessment

UNIFIED SOIL CLASSIFICATION SYSTEM

(ASTM D 422-72)



COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

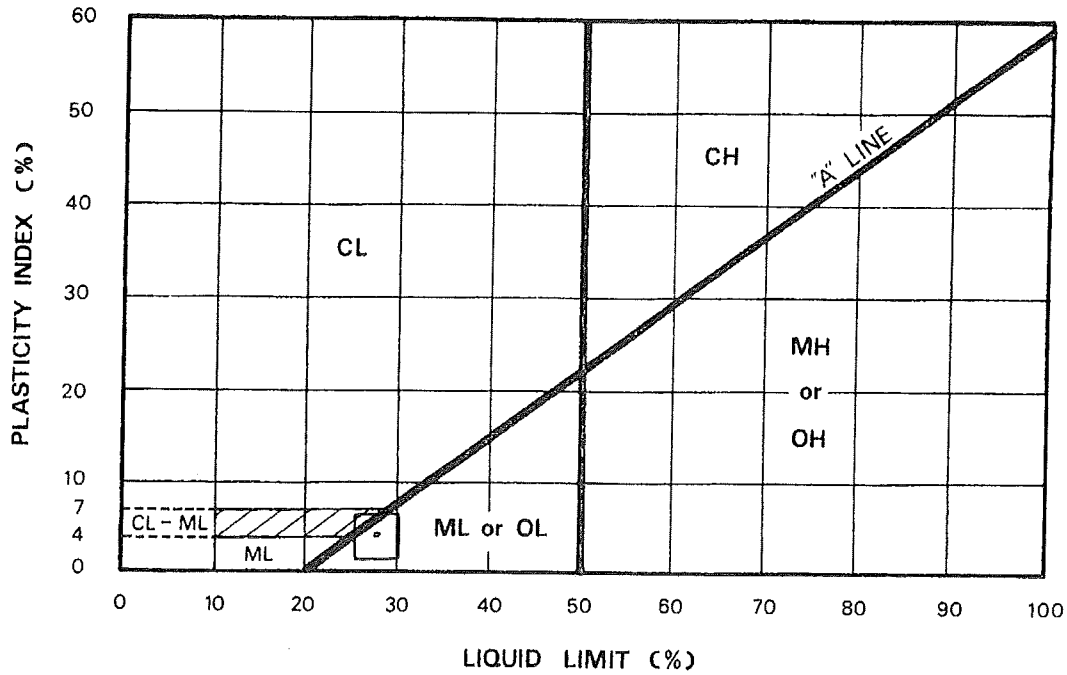
KEY SYMBOL	BORING NO.	SAMPLE DEPTH (feet)	ELEV. (feet)	UNIFIED SOIL CLASSIFICATION SYMBOL	SAMPLE DESCRIPTION
——	TH-#1	2.0		ML	Medium to reddish-brown, clayey, sandy SILT

REDMOND GEOTECHNICAL SERVICES
PO BOX 20547 • PORTLAND, OREGON 97294

GRADATION TEST DATA

TL 2602, 5TH AVE & APPERSON ST
Oregon City, Oregon

PROJECT NO.	DATE	FIGURE
1477.006.G	4/19/18	A-8



KEY SYMBOL	BORING NO.	SAMPLE DEPTH (feet)	NATURAL WATER CONTENT %	LIQUID LIMIT %	PLASTICITY INDEX %	PASSING NO. 200 SIEVE %	LIQUIDITY INDEX	UNIFIED SOIL CLASSIFICATION SYMBOL
▪	TH-#1	2.0	28.8	28.8	4.2	73.1		ML

REDMOND GEOTECHNICAL SERVICES
PO BOX 20547 • PORTLAND, OREGON 97294

PLASTICITY CHART AND DATA

TL 2602, 5TH AVE & APPERSON ST
oregon City, Oregon

PROJECT NO.	DATE	
1477.006.G	4/19/18	Figure A-7

MAXIMUM DENSITY TEST RESULTS

SAMPLE LOCATION	SOIL DESCRIPTION	MAXIMUM DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)
TH-#1 @ 2.0'	Medium to reddish-brown, clayey, sandy SILT (ML)	111.0	15.0

EXPANSION INDEX TEST RESULTS

SAMPLE LOCATION	INITIAL MOISTURE (%)	COMPACTED DRY DENSITY (pcf)	FINAL MOISTURE (%)	VOLUMETRIC SWELL (%)	EXPANSION INDEX	EXPANSIVE CLASS.

MAXIMUM DENSITY & EXPANSION INDEX TEST RESULTS

PROJECT NO.: 1477.006.G | TL 2602, 5th ave & APPERSON ST | FIGURE NO.: A-6

BACKHOE COMPANY: Jim Smith Excavating BUCKET SIZE: 24 inches DATE: 3/02/18

DEPTH (FEET)	BAG SAMPLE	DENSITY TEST	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION TEST PIT NO. TH-#3 ELEVATION 198'±
0					ML	Dark brown, wet, very soft, highly organic, sandy, clayey SILT (Topsoil)
					ML	Medium brown, very moist to wet, soft to medium stiff, clayey, sandy SILT
5					RK	Dark gray-brown, damp, medium dense to dense, moderately weathered and fractured BASALT bedrock
10						Total Depth = 4.0 feet No groundwater encountered at time of exploration
15						

						TEST PIT NO. ELEVATION
0						
5						
10						
15						

LOG OF TEST PITS

PROJECT NO. 1477.006.G | TL 2602, 5TH AVE & APPERSON ST | FIGURE NO. A-5

REDMOND GEOTECHNICAL SERVICES

BACKHOE COMPANY: Jim Smith Excavating BUCKET SIZE: 24 inches DATE: 3/02/18

DEPTH (FEET)	BAG SAMPLE	DENSITY TEST	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
						TEST PIT NO. TH-#1 ELEVATION 214'±
0					ML	Dark brown, wet, very soft, highly organic, sandy, clayey SILT (Topsoil)
	X			28.8	ML	Medium to reddish-brown, very moist to wet, soft to medium stiff, clayey, sandy SILT with occasional rock fragments
	X			27.2		
5					RK	Gray-brown, damp, medium dense to dense, moderately weathered and fractured BASALT bedrock
						Total Depth = 7.0 feet No groundwater encountered at time of excavation
10						
15						
						TEST PIT NO. TH-#2 ELEVATION 208'±
0					ML	Dark brown, wet, very soft, highly organic, sandy, clayey SILT (Topsoil)
	X			29.4	ML	Medium to reddish-brown, very moist to wet, soft to medium stiff, clayey, sandy SILT with occasional rock fragments
5	X				RK	Gray-brown, damp, medium dense to dense, moderately weathered and fractured BASALT bedrock
						Total Depth = 6.0 feet No groundwater encountered at time of exploration
10						
15						

LOG OF TEST PITS

PROJECT NO. 1477.006.G | TL 2602, 5TH AVE & APPERSON ST | FIGURE NO. A-4

PRIMARY DIVISIONS			GROUP SYMBOL	SECONDARY DIVISIONS
COARSE GRAINED SOILS MORE THAN HALF OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVELS MORE THAN HALF OF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS (LESS THAN 5% FINES)	GW	Well graded gravels, gravel-sand mixtures, little or no fines.
			GP	Poorly graded gravels or gravel-sand mixtures, little or no fines.
		GRAVEL WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines.
			GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines.
	SANDS MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS (LESS THAN 5% FINES)	SW	Well graded sands, gravelly sands, little or no fines.
			SP	Poorly graded sands or gravelly sands, little or no fines.
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures, non-plastic fines.
			SC	Clayey sands, sand-clay mixtures, plastic fines.
FINE GRAINED SOILS MORE THAN HALF OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS LIQUID LIMIT IS LESS THAN 50%		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL	Organic silts and organic silty clays of low plasticity.
	SILTS AND CLAYS LIQUID LIMIT IS GREATER THAN 50%		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS			Pt	Peat and other highly organic soils.

DEFINITION OF TERMS

	U.S. STANDARD SERIES SIEVE 200	40	10	4	CLEAR SQUARE SIEVE OPENINGS 3/4"	3"	12"
SILTS AND CLAYS	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

GRAIN SIZES

SANDS, GRAVELS AND NON-PLASTIC SILTS	BLOWS/FOOT†
VERY LOOSE	0 - 4
LOOSE	4 - 10
MEDIUM DENSE	10 - 30
DENSE	30 - 50
VERY DENSE	OVER 50

RELATIVE DENSITY

CLAYS AND PLASTIC SILTS	STRENGTH‡	BLOWS/FOOT†
VERY SOFT	0 - 1/4	0 - 2
SOFT	1/4 - 1/2	2 - 4
FIRM	1/2 - 1	4 - 8
STIFF	1 - 2	8 - 16
VERY STIFF	2 - 4	16 - 32
HARD	OVER 4	OVER 32

CONSISTENCY

†Number of blows of 140 pound hammer falling 30 inches to drive a 2 inch O.D. (1-3/8 inch I.D.) split spoon (ASTM D-1586).

‡Unconfined compressive strength in tons/sq. ft. as determined by laboratory testing or approximated by the standard penetration test (ASTM D-1586), pocket penetrometer, torvane, or visual observation.

REDMOND GEOTECHNICAL SERVICES
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KEY TO EXPLORATORY TEST PIT LOGS
Unified Soil Classification System (ASTM D-2487)

TL 2602, 5TH AVE & APPERSON ST
Oregon City, Oregon

PROJECT NO.	DATE	
1477.006.G	4/19/18	Figure A-3

Maximum Dry Density

One (1) Maximum Dry Density and Optimum Moisture Content test was performed on a representative samples of the near surface clayey, sandy silt to silty sand subgrade soils in accordance with ASTM Vol. 4.08 Part D-1557. The test results were conducted to help establish various engineering and/or strength properties. The test results are presented on Figure No. A-6.

Atterberg Limits

One (1) Liquid Limit (LL) and Plastic Limit (PL) test was performed on a representative sample of the sandy, clayey silt subgrade soils in accordance with ASTM Vol. 4.08 Part D-4318-85. These tests were conducted to facilitate classification of the soils and for correlation purposes. The test results appear on Figure No. A-7.

Gradation Analysis

One (1) Gradation analyses was performed on a representative sample of the subsurface soils in accordance with ASTM Vol. 4.08 Part D-422. The test results were used to classify the soil in accordance with the Unified Soil Classification System (USCS). The test results are shown graphically on Figure No. A-8.

The following figures are attached and complete the Appendix:

Figure No. A-3	Key To Exploratory Test Pit Logs
Figure No's. A-4 and A-5	Log of Test Pits
Figure No. A-6	Maximum Density Test Results
Figure No. A-7	Atterberg Limits Test Results
Figure No. A-8	Gradation Test Results

APPENDIX

FIELD EXPLORATIONS AND LABORATORY TESTING

FIELD EXPLORATION

Subsurface conditions at the site were explored by excavating three (3) exploratory test pits (TH-#1 through TH-#3) on March 2, 2018. The approximate location of the test pit explorations are shown in relation to the proposed new residential and/or detached garage structure(s) and the associated site improvements on the Site Exploration Plan, Figure No. 2.

The test pits were excavated using track-mounted excavating equipment in general conformance with ASTM Methods in Vol. 4.08, D-1586-94 and D-1587-83. The test pits were excavated to depths ranging from about 4.0 to 7.0 feet beneath existing site grades. Detailed logs of the test pits are presented on the Log of Test Pits, Figure No's. A-4 and A-5. The soils were classified in accordance with the Unified Soil Classification System (USCS), which is outlined on Figure No. A-3.

The exploration program was coordinated by a field engineer who monitored the excavating and exploration activity, obtained representative samples of the subsurface soils encountered, classified the soils by visual and textural examination, and maintained continuous logs of the subsurface conditions. Disturbed and/or undisturbed samples of the subsurface soils were obtained at appropriate depths and/or intervals and placed in plastic bags and/or with a thin walled ring sample.

Groundwater was not encountered in any of the exploratory test pits (TH-#1 through TH-#3) at the time of excavating to depths of at least 7.0 feet beneath existing surface grades.

LABORATORY TESTING

Pertinent physical and engineering characteristics of the soils encountered during our subsurface investigation were evaluated by a laboratory testing program to be used as a basis for selection of soil design parameters and for correlation purposes. Selected tests were conducted on representative soil samples. The program consisted of tests to evaluate the existing (in-situ) moisture-density, maximum dry density and optimum moisture content, gradational characteristics and Atterberg Limits tests.

Dry Density and Moisture Content Determinations

Density and moisture content determinations were performed on both disturbed and relatively undisturbed samples from the test pit explorations in general conformance with ASTM Vol. 4.08 Part D-216. The results of these tests were used to calculate existing overburden pressures and to correlate strength and compressibility characteristics of the soils. Test results are shown on the test pit logs at the appropriate sample depths.

Appendix "A"

Test Pit Logs and Laboratory Test Data

Geologic Map Series (GMS-49), Map of Oregon Seismicity, 1841-1986 dated 1986.

Geologic Map Series (GMS-119), Geologic Map of the Oregon City 7.5 Quadrangle, Clackamas County, Oregon dated 2009.

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CLOSURE AND LIMITATIONS

This report is intended for the exclusive use of the addressee and/or their representative(s) to use to design and construct the proposed new single-family residential and/or detached garage structure(s) and their associated site improvements described herein as well as to prepare any related construction documents. The conclusions and recommendations contained in this report are based on site conditions as they presently exist and assume that the explorations are representative of the subsurface conditions between the explorations and/or at other locations across the study area. The data, analyses, and recommendations herein may not be appropriate for other structures and/or purposes. We recommend that parties contemplating other structures and/or purposes contact our office. In the absence of our written approval, we make no representation and assume no responsibility to other parties regarding this report. Additionally, the above recommendations are contingent on Redmond Geotechnical Services, LLC being retained to provide all site inspections and constriction monitoring services for this project. Redmond Geotechnical Services, LLC will not assume any responsibility and/or liability for any engineering judgment, inspection and/or testing services performed by others.

It is the owners/developers responsibility for insuring that the project designers and/or contractors involved with this project implement our recommendations into the final design plans, specifications and/or construction activities for the project. Further, in order to avoid delays during construction, we recommend that the final design plans and specifications for the project be reviewed by our office to evaluate as to whether our recommendations have been properly interpreted and incorporated into the project.

If during any future site grading and construction, subsurface conditions different from those encountered in the explorations are observed or appear to be present beneath excavations, we should be advised immediately so that we may review these conditions and evaluate whether modifications of the design criteria are required. We also should be advised if significant modifications of the proposed site development are anticipated so that we may review our conclusions and recommendations.

LEVEL OF CARE

The services performed by the Geotechnical Engineer for this project have been conducted with that level of care and skill ordinarily exercised by members of the profession currently practicing in the area under similar budget and time restraints. No warranty or other conditions, either expressed or implied, is made.

Further, due to the relatively low infiltration rates of the near surface clayey, sandy silt subgrade soils as well as the moisture sensitivity of the site to disposal of storm water in a relatively concentrated area, we are generally of the opinion that storm water detention and/or disposal systems should not be utilized within the residential lot and/or around the proposed residential structure unless it consists of a diffusion type system approved by the Geotechnical Engineer.

Seismic Design Considerations

Structures at the site should be designed to resist earthquake loading in accordance with the methodology described in the latest edition (2014) of the State of Oregon Structural Specialty Code (OSSC) and/or Amendments to the 2015 International Building Code (IBC). The maximum considered earthquake ground motion for short period and 1.0 period spectral response may be determined from the Oregon Structural Specialty Code and/or from the National Earthquake Hazard Reduction Program (NEHRP) "Recommended Provisions for Seismic Regulations for New Buildings and Other Structures" published by the Building Seismic Safety Council. We recommend Site Class "C" be used for design. Using this information, the structural engineer can select the appropriate site coefficient values (F_a and F_v) from the 2015 IBC to determine the maximum considered earthquake spectral response acceleration for the project. However, we have assumed the following response spectrum for the project:

Table 1. Recommended Seismic Design Parameters

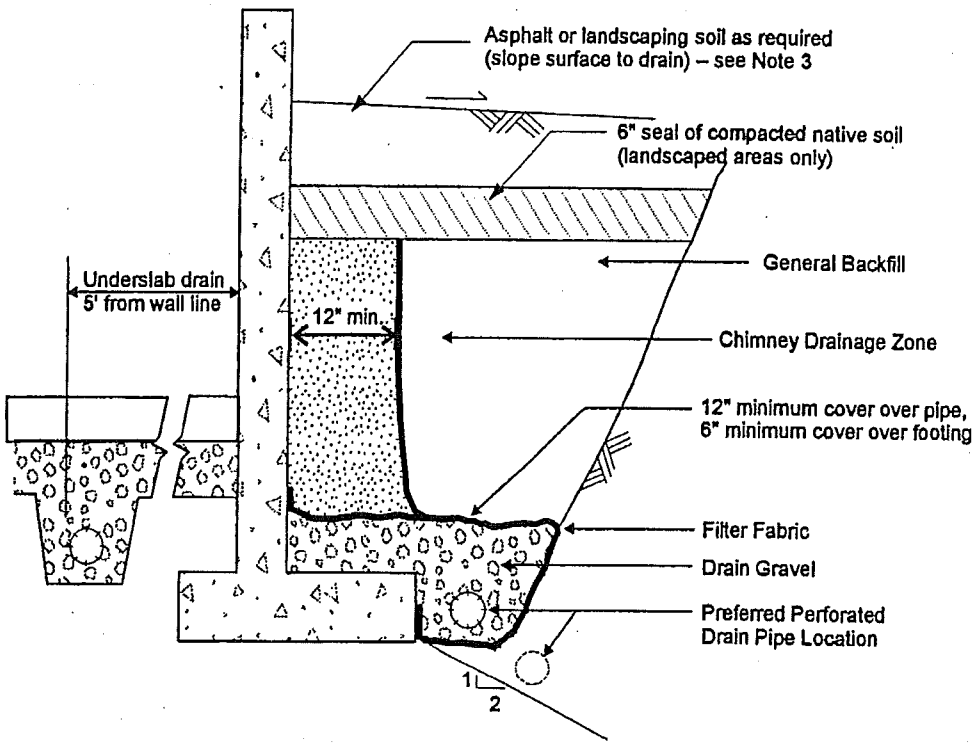
Site Class	S_S	S_1	F_a	F_v	S_{MS}	S_{M1}	S_{DS}	S_{D1}
C	0.933	0.403	1.027	1.397	0.958	0.563	0.639	0.375

Notes: 1. S_S and S_1 were established based on the USGS 2015 mapped maximum considered earthquake spectral acceleration maps for 2% probability of exceedence in 50 years.

2. Fa and Fv were established based on IBC 2015 tables using the selected S_S and S_1 values.

CONSTRUCTION MONITORING AND TESTING

We recommend that **Redmond Geotechnical Services, LLC** be retained to provide construction monitoring and testing services during all earthwork operations for the proposed new residential project. The purpose of our monitoring services would be to confirm that the site conditions reported herein are as anticipated, provide field recommendations as required based on the actual conditions encountered, document the activities of the grading contractor and assess his/her compliance with the project specifications and recommendations. It is important that our representative meet with the contractor prior to any site grading to help establish a plan that will minimize costly over-excavation and site preparation work. Of primary importance will be observations made during site preparation and stripping, structural fill placement, footing excavations and construction as well as retaining wall backfill.



SCHEMATIC - NOT TO SCALE

NOTES:

1. Filter Fabric to be non-woven geotextile (Amoco 4545, Mirafi 140N, or equivalent)
2. Lay perforated drain pipe on minimum 0.5% gradient, widening excavation as required. Maintain pipe above 2:1 slope, as shown.
3. All-granular backfill is recommended for support of slabs, pavements, etc. (see text for structural fill).
4. Drain gravel to be clean, washed ¾" to 1½" gravel.
5. General backfill to be on-site gravels, or ¾""-0 or 1½"-0 crushed rock compacted to 92% Modified Proctor (AASHTO T-180).
6. Chimney drainage zone to be 12" wide (minimum) zone of clean washed, medium to coarse sand or drain gravel if protected with filter fabric. Alternatively, prefabricated drainage structures (Miradrain 6000 or similar) may be used.

PERIMETER FOOTING/RETAINING WALL DRAIN DETAIL		
Project No. 1477.006.G	TAX LOT NO. 2602 5TH AVE & APPERSON STREET	Figure No. 4

Excavation/Slopes

Temporary excavations of up to about five (5) feet in depth may be constructed and/or excavated with inclinations of at least 1 to 1 (horizontal to vertical) or properly braced/shored. Where excavations are planned to exceed about five (5) feet, this office should be consulted. All shoring systems and/or temporary excavation bracing for the project should be the responsibility of the excavation contractor. Permanent cut and/or slopes should be constructed no steeper than about 2H to 1V unless approved by the Geotechnical Engineer.

Depending on the time of year in which trench excavations occur, trench dewatering may be required in order to maintain dry working conditions if the invert elevations of the proposed utilities are located at and/or below the groundwater level. If groundwater is encountered during utility excavation work, we recommend placing trench stabilization materials along the base of the excavation. Trench stabilization materials should consist of 1-foot of well-graded gravel, crushed gravel, or crushed rock with a maximum particle size of 4 inches and less than 5 percent fines passing the No. 200 sieve. The material should be free of organic matter and other deleterious material and placed in a single lift and compacted until well keyed.

Surface Drainage/Groundwater

We recommend that positive measures be taken to properly finish grade the site so that drainage waters from the residential structure and landscaping areas as well as adjacent properties or buildings are directed away from the new residential structure foundations and/or floor slabs. All roof drainage should be directed into conduits that carry runoff water away from the residential and/or garage structure(s) to a suitable outfall. Roof downspouts should not be connected to foundation drains. A minimum ground slope of about 2 percent is generally recommended in unpaved areas around the proposed new residential structure and/or detached garage.

Groundwater was not encountered at the site in any of the exploratory test pits (TH-#1 through TH-#3) at the time of excavation to depths of at least 7 feet beneath existing site grades. Additionally, surface water ponding was not observed at the site during our field exploration work. However, an existing seasonal drainage basin feature is located to the east/northeast of the subject property. Further, groundwater elevations in the area and/or across the subject property may fluctuate seasonally and may temporarily pond/perch near the ground surface during periods of prolonged rainfall.

As such, based on our current understand of the possible site grading required to bring the subject site and/or residential building pad to finish design grade(s), we are of the opinion that an underslab drainage system is generally not required for the proposed single-family residential structure. However, a perimeter foundation drain is recommended for any perimeter footings and/or below grade retaining walls. A typical recommended perimeter footing/retaining wall drain detail is shown on Figure No. 4.

Pavements

Flexible pavement design for the proposed private access drive for the single-family residential project was determined on the basis of projected (anticipated) traffic volume and loading conditions relative to an assumed subgrade "R"-value characteristic. Based on an assumed subgrade "R"-value of 30 and using the design procedures contained within the AASHTO 1993 Design of Pavement Structures Manual, a Structural Number (SN) of 2.5 was determined. In this regard, we recommend the following flexible pavement section for the construction of new private access drive:

Material Type	Pavement Section (inches)
Asphaltic Concrete	3.0
Aggregate Base Rock	8.0

Wet Weather Grading and Soft Spot Mitigation

Construction of the proposed new private access drive is generally recommended during dry weather. However, during wet weather grading and construction, excavation to subgrade can proceed during periods of light to moderate rainfall provided that the subgrade remains covered with aggregate. A total aggregate thickness of 12-inches or more may be necessary to protect the subgrade soils from heavy construction traffic. Construction traffic should not be allowed directly on the exposed subgrade but only atop a sufficient compacted base rock thickness to help mitigate subgrade pumping. If the subgrade becomes wet and pumps, no construction traffic shall be allowed on the access drive alignment. Positive site drainage away from the street shall be maintained if site paving will not occur before the on-set of the wet season.

Depending on the timing for the project, any soft subgrade found during proof-rolling or by visual observations can either be removed and replaced with properly dried and compacted fill soils or removed and replaced with compacted crushed aggregate. However, and where approved by the Geotechnical Engineer, the soft area may be covered with a bi-axial geogrid and covered with compacted crushed aggregate.

Soil Shrink-Swell and Frost Heave

The results of the laboratory tests indicate that the native subgrade soils possess a low expansion potential. As such, the exposed subgrade soils should not be allowed to completely dry and should be moistened to near optimum moisture content (plus or minus 3 percent) at the time of the placement of the crushed aggregate base rock materials. Additionally, exposure of the subgrade soils to freezing weather may result in frost heave and softening of the subgrade. As such, all subgrade soils exposed to freezing weather should be evaluated and approved by the Geotechnical Engineer prior to the placement of the crushed aggregate base rock materials.

The base course materials should be compacted to at least 95 percent of the maximum dry density as determined by the ASTM D-1557 (AASHTO T-180) test procedures. Where floor slab subgrade materials are undisturbed, firm and stable and where the underslab aggregate base rock section has been prepared and compacted as recommended above, we recommend that a modulus of subgrade reaction of 150 pci be used for design.

Retaining/Below Grade Walls

Retaining and/or below grade walls should be designed to resist lateral earth pressures imposed by native soils or granular backfill materials as well as any adjacent surcharge loads. For walls which are unrestrained at the top and free to rotate about their base, we recommend that active earth pressures be computed on the basis of the following equivalent fluid densities:

Non-Restrained Retaining Wall Pressure Design Recommendations

Slope Backfill (Horizontal/Vertical)	Equivalent Fluid Density/Silt (pcf)	Equivalent Fluid Density/Gravel (pcf)
Level	35	30
3H:1V	60	50
2H:1V	90	80

For walls which are fully restrained at the top and prevented from rotation about their base, we recommend that at-rest earth pressures be computed on the basis of the following equivalent fluid densities:

Restrained Retaining Wall Pressure Design Recommendations

Slope Backfill (Horizontal/Vertical)	Equivalent Fluid Density/Silt (pcf)	Equivalent Fluid Density/Gravel (pcf)
Level	45	35
3H:1V	65	60
2H:1V	95	90

The above recommended values assume that the walls will be adequately drained to prevent the buildup of hydrostatic pressures. Where wall drainage will not be present and/or if adjacent surcharge loading is present, the above recommended values will be significantly higher.

Backfill materials behind walls should be compacted to 90 percent of the maximum dry density as determined by the ASTM D-1557 (AASHTO T-180) test procedures. Special care should be taken to avoid over-compaction near the walls which could result in higher lateral earth pressures than those indicated herein. In areas within three (3) to five (5) feet behind walls, we recommend the use of hand-operated compaction equipment.

Shallow Foundations

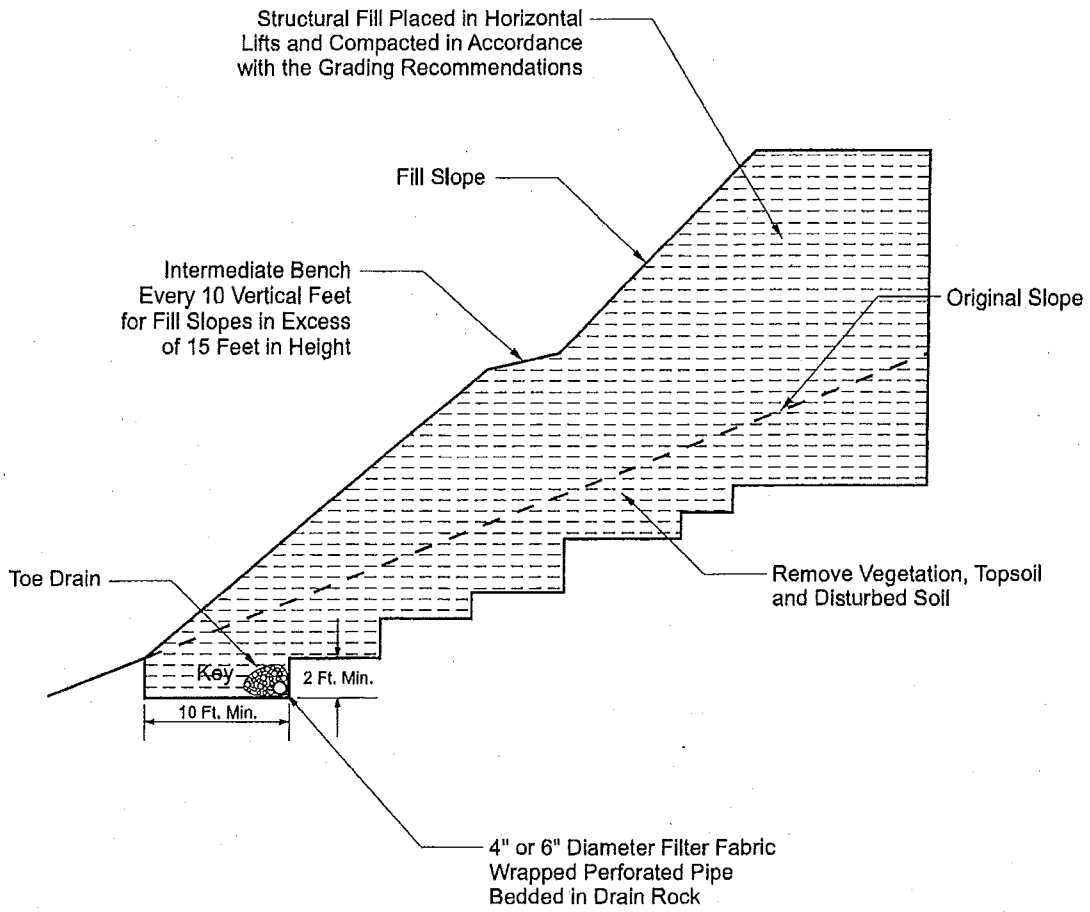
In general, conventional shallow continuous (strip) footings and individual (spread) column footings may be supported by approved native (untreated) sandy silt to silty sand subgrade soil materials and/or sandy silt to silty sand structural fill soils based on an allowable contact bearing pressure of about 2,000 pounds per square foot (psf). This recommended allowable contact bearing pressure is intended for dead loads and sustained live loads and may be increased by one-third for the total of all loads including short-term wind or seismic loads. In general, continuous strip footings should have a minimum width of at least 16 inches and be embedded at least 18 inches below the lowest adjacent finish grade (includes frost protection). Individual column footings (where required) should be embedded at least 18 inches below grade and have a minimum width of at least 24 inches. Additionally, we recommend that all downslope footings for the proposed new single-family residential structure as well as the proposed detached garage be sufficiently embedded such that at least eight (8) feet is developed between the face of the existing and/or finish slope face and the outer bearing edge of the footing element. Further, if foundation excavation and construction work is planned to be performed during wet and/or inclement weather conditions, we recommend that a 3- to 4-inch layer of compacted crushed rock be used to help protect the exposed foundation bearing surfaces until the placement of concrete.

Total and differential settlements of foundations constructed as recommended above and supported by approved native subgrade soils or by properly compacted structural fill materials are expected to be well within the tolerable limits for this type of lightly loaded wood-frame structure and should generally be less than about 1-inch and 1/2-inch, respectively.

Allowable lateral frictional resistance between the base of the footing element and the supporting subgrade bearing soil can be expressed as the applied vertical load multiplied by a coefficient of friction of 0.30 and 0.45 for native silty subgrade soils and/or import gravel fill materials, respectively. In addition, lateral loads may be resisted by passive earth pressures on footings poured "neat" against in-situ (native) subgrade soils or properly backfilled with structural fill materials based on an equivalent fluid density of 250 pounds per cubic foot (pcf). This recommended value includes a factor of safety of approximately 1.5 which is appropriate due to the amount of movement required to develop full passive resistance.

Floor Slab Support

In order to provide uniform subgrade reaction beneath concrete slab-on-grade floors, we recommend that the floor slab area be underlain by a minimum of 6 inches of free-draining (less than 5 percent passing the No. 200 sieve), well-graded, crushed rock. The crushed rock should help provide a capillary break to prevent migration of moisture through the slab. However, additional moisture protection can be provided by using a 10-mil polyolefin geo-membrane sheet such as StegoWrap.



TYPICAL FILL SLOPE DETAIL

Project No. 1477.006.G	**TAX LOT NO. 2602** **5TH AVE & APPERSON STREET**	Figure No. 3

In this regard, during wet or inclement weather conditions, we recommend that an import structural fill material be utilized which should consist of a free-draining (clean) granular fill (sand & gravel) containing no more than about 5 percent fines. Representative samples of the materials which are to be used as structural fill materials should be submitted to the Geotechnical Engineer and/or laboratory for approval and determination of the maximum dry density and optimum moisture content for compaction.

In general, all site earthwork and grading activities should be scheduled for the drier summer months (June through September) if possible. However, if wet weather site preparation and grading is required, it is generally recommended that the stripping of topsoil materials be accomplished with a tracked excavator utilizing a large smooth-toothed bucket working from areas yet to be excavated. Additionally, the loading of strippings into trucks and/or protection of moisture sensitive subgrade soils will also be required during wet weather grading and construction. In this regard, we recommend that areas in which construction equipment will be traveling be protected by covering the exposed subgrade soils with a woven geotextile fabric such as Mirafi FW404 followed by at least 12 inches or more of crushed aggregate base rock. Further, the geotextile fabric should have a minimum Mullen burst strength of at least 250 pounds per square inch for puncture resistance and an apparent opening size (AOS) between the U.S. Standard No. 70 and No. 100 sieves.

All structural fill materials placed within the new building and/or pavement areas should be moistened or dried as necessary to near (within 3 percent) optimum moisture conditions and compacted by mechanical means to a minimum of 92 percent of the maximum dry density as determined by the ASTM D-1557 (AASHTO T-180) test procedures. Structural fill materials should be placed in lifts (layers) such that when compacted do not exceed about 8 inches. Additionally, all fill materials placed within three (3) lineal feet of the perimeter (limits) of the proposed residential or detached garage structure and/or access drive should be considered structural fill. Additionally, due to the sloping site conditions, we recommend that all structural fill materials planned in areas where existing surface and/or slope gradients exceed about 20 percent (1V:5H) be properly benched and/or keyed into the native (natural) slope subgrade soils. In general, a bench width of between eight (8) and ten (10) feet and a keyway depth of between one (1) and two (2) feet is generally recommended. However, the actual bench width and keyway depth should be determined at the time of construction by the Geotechnical Engineer. Further, all fill slopes should be constructed with a finish slope surface gradient no steeper than about 2H:1V. A typical fill slope detail can be provided upon request. All aspects of the site grading, including a review of the proposed site grading plan(s), should be approved and/or monitored by a representative of Redmond Geotechnical Services, LLC.

Foundation Support

Based on the results of our investigation, it is our opinion that the site of the proposed new residential development is suitable for support of the two-story wood-frame residential structure and detached garage provided that the following foundation design recommendations are followed. The following sections of this report present specific foundation design and construction recommendations for the planned new residential and/or garage structure(s).

In regards to the moderately sloping site conditions across the proposed new residential home site, we are of the opinion that site grading and/or structural fill placement should be minimized where possible and should generally limit cuts and/or fills to about five (5) feet or less unless approved by the Geotechnical Engineer. Additionally, where existing site slopes and/or surface grades exceed about 20 percent (1V:5H), proper benching and keying of all fills into the natural site slopes may be required.

With regard to the relatively low infiltration rates anticipated within the clayey, sandy silt subgrade soils beneath the site, we generally do not recommend any concentrated storm water infiltration within structural and/or embankment fills. However, some limited storm water infiltration may be feasible if diffused within the lower northerly portion of the residential lot and/or area of the site where the existing and/or finish slope gradients are no steeper than about 20 percent (1V:5H). In this regard, we recommend that all proposed storm water detention and/or infiltration systems for the project be reviewed and approved by Redmond Geotechnical Services, LLC.

The following sections of this report provide specific recommendations regarding subgrade preparation and grading as well as foundation and floor slab design and construction for the new Schaderman single-family residential development project.

Site Preparation

As an initial step in site preparation, we recommend that the proposed new residential building site and/or lot as well as any associated structural and/or site improvement area(s) be stripped and cleared of any existing improvements, any existing unsuitable and/or undocumented fill materials, surface debris, existing vegetation, topsoil materials, and/or any other deleterious materials present at the time of construction. In general, we envision that the site stripping to remove existing vegetation and topsoil materials will generally be about 12 inches. However, localized areas requiring deeper removals, such as any existing undocumented and/or unsuitable fill materials as well as old tree stump areas, may be encountered and should be evaluated at the time of construction by the Geotechnical Engineer. The stripped and cleared materials should be properly disposed of as they are generally considered unsuitable for use/reuse as fill materials.

Following the completion of the site stripping and clearing work and prior to the placement of any required structural fill materials and/or structural improvements, the exposed subgrade soils within the planned structural improvement area(s) should be inspected and approved by the Geotechnical Engineer. Areas found to be soft or otherwise unsuitable should be over-excavated and removed or scarified and recompacted as structural fill. During wet and/or inclement weather conditions, proof rolling and/or scarification and re-compaction may not be appropriate.

The on-site native clayey, sandy silt to silty sand subgrade soil materials are generally considered suitable for use/reuse as structural fill materials provided that they are free of organic materials, debris, and rock fragments in excess of about 6 inches in dimension. However, if site grading is performed during wet or inclement weather conditions, the use of some of the on-site native soil materials which contain significant silt and clay sized particles will be difficult at best.

Surface Rupture

Although the site is generally located within a region of the country known for seismic activity, no known faults exist on and/or immediately adjacent to the subject site. As such, the risk of surface rupture due to faulting is considered negligible.

Tsunami and Seiche

A tsunami, or seismic sea wave, is produced when a major fault under the ocean floor moves vertically and shifts the water column above it. A seiche is a periodic oscillation of a body of water resulting in changing water levels, sometimes caused by an earthquake. Tsunami and seiche are not considered a potential hazard at this site because the site is not near to the coast and/or there are no adjacent significant bodies of water.

Flooding and Erosion

Stream flooding is a potential hazard that should be considered in lowland areas of Clackamas County and Oregon City. The FEMA (Federal Emergency Management Agency) flood maps should be reviewed as part of the design for the proposed new residential structures and site improvements. Elevations of structures on the site should be designed based upon consultants reports, FEMA (Federal Emergency Management Agency), and Clackamas County requirements for the 100-year flood levels of any nearby creeks, streams and/or drainage basins.

CONCLUSIONS AND RECOMMENDATIONS

General

Based on the results of our field explorations, laboratory testing, and engineering analyses, it is our opinion that the site is presently stable and generally suitable for the proposed new Schaderman single-family residential development and its associated site improvements provided that the recommendations contained within this report are properly incorporated into the design and construction of the project.

The primary features of concern at the site are 1) the presence of moisture sensitive clayey, sandy silt subgrade soils across the site, 2) the presence of moderately sloping site conditions across the subject site, and 3) the relatively low infiltration rates anticipated within the near surface clayey, sandy silt subgrade soils.

With regard to the moisture sensitive clayey, sandy silt subgrade soils, we are generally of the opinion that all site grading and earthwork activities be scheduled for the drier summer months which is typically June through September.

The third source of seismicity that can result in ground shaking within the Vancouver and southwest Washington area is near-surface crustal earthquakes occurring within the North American Plate. The historical seismicity of crustal earthquakes in this area is higher than the seismicity associated with the CSZ and the intraplate zone. The 1993 Scotts Mills (magnitude 5.6) and Klamath Falls (magnitude 6.0), Oregon earthquakes were crustal earthquakes.

Liquefaction

Seismic induced soil liquefaction is a phenomenon in which lose, granular soils and some silty soils, located below the water table, develop high pore water pressures and lose strength due to ground vibrations induced by earthquakes. Soil liquefaction can result in lateral flow of material into river channels, ground settlements and increased lateral and uplift pressures on underground structures. Buildings supported on soils that have liquefied often settle and tilt and may displace laterally. Soils located above the ground water table cannot liquefy, but granular soils located above the water table may settle during the earthquake shaking.

Our review of the subsurface soil test pit logs from our exploratory field explorations (TH-#1 through TH-#3) and laboratory test results indicate that the site is generally underlain by medium stiff to stiff, clayey, sandy silt subgrade soils and/or medium dense to dense and moderately weathered and fractured basalt bedrock deposits to depths of at least 7.0 feet beneath existing site grades. Additionally, groundwater was generally not encountered within any of the exploratory test pit excavations (TH-#1 through TH-#3) at the site during our field exploration work to depths of at least 7.0 feet.

As such, due to the medium stiff to stiff and/or cohesive nature of the clayey, sandy silt subgrade soils and/or the medium dense to dense characteristics of the slightly weathered and fractured basalt bedrock deposits beneath the site, it is our opinion that the native clayey, sandy silt to silty sand subgrade soils and/or moderately weathered and fractured basalt bedrock deposits located beneath the subject site have a very low potential for liquefaction during the design earthquake motions previously described.

Landslides

Although the subject property is located within a large ancient landslide deposit, no active landslides were observed or are known to be present on the subject site. Additionally, development of the subject site into the planned residential home site does not appear to present a potential and/or serious geologic and/or landslide hazard risk provided that the site grading and development activities conform with the recommendations presented within this report. A more detailed assessment of the potential landslide hazard of the subject site is presented in the Geologic Hazard Study in Appendix B.

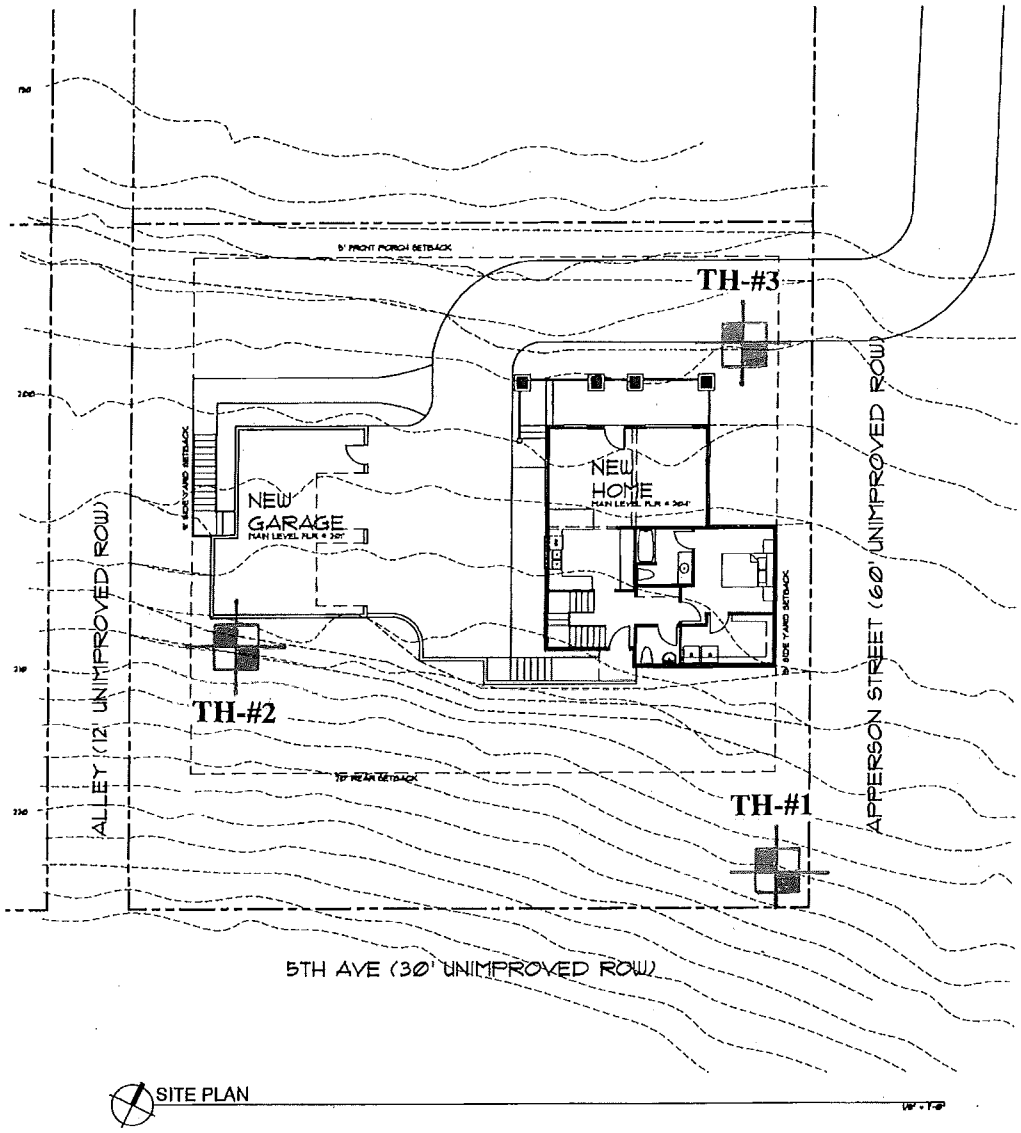
The laboratory testing consisted of visual and textural sample inspection, moisture content and dry density determinations, maximum dry density and optimum moisture content, gradation analyses and Atterberg Limits tests. Results of the various laboratory tests are presented in the Appendix, Figure No's. A-6 through A-8.

SEISMICITY AND EARTHQUAKE SOURCES

The seismicity of the southwest Washington and northwest Oregon area, and hence the potential for ground shaking, is controlled by three separate fault mechanisms. These include the Cascadia Subduction Zone (CSZ), the mid-depth intraplate zone, and the relatively shallow crustal zone. Descriptions of these potential earthquake sources are presented below.

The CSZ is located offshore and extends from northern California to British Columbia. Within this zone, the oceanic Juan de Fuca Plate is being subducted beneath the continental North American Plate to the east. The interface between these two plates is located at a depth of approximately 15 to 20 kilometers (km). The seismicity of the CSZ is subject to several uncertainties, including the maximum earthquake magnitude and the recurrence intervals associated with various magnitude earthquakes. Anecdotal evidence of previous CSZ earthquakes has been observed within coastal marshes along the Washington and Oregon coastlines. Sequences of interlayered peat and sands have been interpreted to be the result of large Subduction zone earthquakes occurring at intervals on the order of 300 to 500 years, with the most recent event taking place approximately 300 years ago. A study by Geomatrix (1995) and/or USGS (2008) suggests that the maximum earthquake associated with the CSZ is moment magnitude (Mw) 8 to 9. This is based on an empirical expression relating moment magnitude to the area of fault rupture derived from earthquakes that have occurred within Subduction zones in other parts of the world. An Mw 9 earthquake would involve a rupture of the entire CSZ. As discussed by Geomatrix (1995) this has not occurred in other subduction zones that have exhibited much higher levels of historical seismicity than the CSZ. However, the 2008 USGS report has assigned a probability of 0.67 for a Mw 9 earthquake and a probability of 0.33 for a Mw 8.3 earthquake. For the purpose of this study an earthquake of Mw 9.0 was assumed to occur within the CSZ.

The intraplate zone encompasses the portion of the subducting Juan de Fuca Plate located at a depth of approximately 30 to 50 km below western Washington and western Oregon. Very low levels of seismicity have been observed within the intraplate zone in western Oregon and western Washington. However, much higher levels of seismicity within this zone have been recorded in Washington and California. Several reasons for this seismic quiescence were suggested in the Geomatrix (1995) study and include changes in the direction of Subduction between Oregon, Washington, and British Columbia as well as the effects of volcanic activity along the Cascade Range. Historical activity associated with the intraplate zone includes the 1949 Olympia magnitude 7.1 and the 1965 Puget Sound magnitude 6.5 earthquakes. Based on the data presented within the Geomatrix (1995) report, an earthquake of magnitude 7.25 has been chosen to represent the seismic potential of the intraplate zone.



LEGEND

TH-#3 Indicates approximate location of exploratory test hole

SITE EXPLORATION PLAN		
Project No. 1477.006.G	**TAX LOT NO. 2602** **5TH AVE & APPERSON STREET**	Figure No. 2

The exploratory test pit excavations were observed by staff from Redmond Geotechnical Services, LLC who logged each of the test pit explorations and obtained representative samples of the subsurface soils encountered across the site. Additionally, the elevation of the exploratory test pit excavations were referenced from the proposed Site Development Plan prepared by Iselin Architects and should be considered as approximate. All subsurface soils encountered at the site and/or within the exploratory test pit excavations were logged and classified in general conformance with the Unified Soil Classification System (USCS) which is outlined on Figure No. A-3.

The test pit explorations revealed that the subject site is underlain by native soil deposits comprised of highly weathered bedrock and/or residual soils composed of a surficial layer of dark brown, wet, very soft, highly organic, clayey, sandy silt topsoil materials to depths of about 12 inches. These surficial topsoil materials were inturn underlain by medium to reddish-brown, very moist to wet, soft to medium stiff becoming stiff at depth, clayey, sandy silt to a depth of about three (3) to five (5) feet beneath the existing site and/or surface grades. These upper clayey, sandy silt subgrade soils contain some rock fragments and are best characterized by relatively low to moderate strength and moderate compressibility. These upper clayey, sandy silt to silty sand subgrade soils were inturn underlain by gray-brown to dark gray-brown, damp, medium dense to dense, moderately weathered and fractured Basalt bedrock deposits to the maximum depth explored of about seven (7) feet beneath the existing site and/or surface grades. These moderately weathered and fractured Basalt bedrock deposits are best characterized by relatively moderate to high strength and low to very low compressibility.

Groundwater

Groundwater was generally not encountered within any of the exploratory test pit explorations (TH-#1 through TH-#3) at the time of excavation to depths of at least seven (7) feet beneath existing surface grades. However, an existing seasonal drainage basin and/or feature is located to the east/northeast of the subject property. Additionally, although ponding of surface water was generally not present across the site at the time of our field work, the presence of the clayey, sandy silt soils beneath the site is generally believed to be associated with very low infiltration rates of the area.

In this regard, although groundwater elevations at the site may fluctuate seasonally in accordance with rainfall conditions and/or associated with runoff of the westerly drainage basin as well as changes in site utilization, we are generally of the opinion that the static water levels and/or surface water ponding not observed during our recent field exploration work generally reflect a low seasonal groundwater level(s) at and/or beneath the site.

LABORATORY TESTING

Representative samples of the on-site subsurface soils were collected at selected depths and intervals from various test pit excavations and returned to our laboratory for further examination and testing and/or to aid in the classification of the subsurface soils as well as to help evaluate and identify their engineering strength and compressibility characteristics.

5. Engineering analyses utilizing the field and laboratory data as a basis for furnishing recommendations for foundation support of the proposed new residential and/or detached garage structure(s). Recommendations include maximum design allowable contact bearing pressure(s), depth of footing embedment, estimates of foundation settlement, lateral soil resistance, and foundation subgrade preparation. Additionally, construction and/or permanent subsurface water drainage considerations have also been prepared. Further, our report includes recommendations regarding site preparation, placement and compaction of structural fill materials, suitability of the on-site soils for use as structural fill, criteria for import fill materials, and preparation of foundation, pavement and/or floor slab subgrades.

SITE CONDITIONS

Site Geology

The subject site and/or area is underlain by highly weathered Basalt bedrock deposits and/or residual soils of the Columbia River Basalt formation. A more detailed description of the site geology across and/or beneath the site is presented in the Geologic Hazard Study in Appendix B.

Surface Conditions

The subject proposed new residential development property consists of Tax Lot No. 2602 which is a rectangular shaped (100 feet by 100 feet) tax lot encompassing a plan area of approximately 0.23 acres. The proposed residential development property is roughly located to the north of 5th Avenue and/or west of the intersection with Apperson Street. The subject site is unimproved and consists of existing open land. Surface vegetation across the site generally consists of a moderate growth of grass, weeds and brush as well as several to numerous small to large sized trees.

Topographically, the subject site is characterized as moderately sloping terrain (i.e., 25 to 35 percent) descending downward towards the north/northeast with overall topographic relief across the entire site estimated at about thirty-five (35) feet and ranges from a low about Elevation 185 feet near the northeasterly corner of the subject site to a high of about Elevation 220 near the southwesterly portion of the site.

Subsurface Soil Conditions

Our understanding of the subsurface soil conditions underlying the site was developed by means of three (3) exploratory test pits excavated to depths ranging from about four (4) to seven (7) feet beneath existing site grades on March 2, 2018 with a John Deere track-mounted excavator. The location of the exploratory test pits were located in the field by marking off distances from existing and/or known site features and are shown in relation to the proposed new residential structure and/or site improvements on the Site Exploration Plan, Figure No. 2. Detailed logs of the test pit explorations, presenting conditions encountered at each location explored, are presented in the Appendix, Figure No's. A-4 and A-5.

In this regard, due to the existing sloping site and/or finish grades as well as the proposed use of a raised wooden post and beam floor system, the proposed new single-family residential structure will not likely include the construction of any partial below grade floor(s) and/or retaining wall(s). However, due to the anticipated use of a concrete slab-on-grade floor within the proposed detached garage, we anticipate that a small concrete retaining wall may be required along the side and/or easterly upslope portion of the garage structure.

Other associated site improvements for the project will include construction of a new gravel and/or paved private access drive extending eastward off of 5th Avenue. Additionally, the project will include the construction of new underground utility services.

SCOPE OF WORK

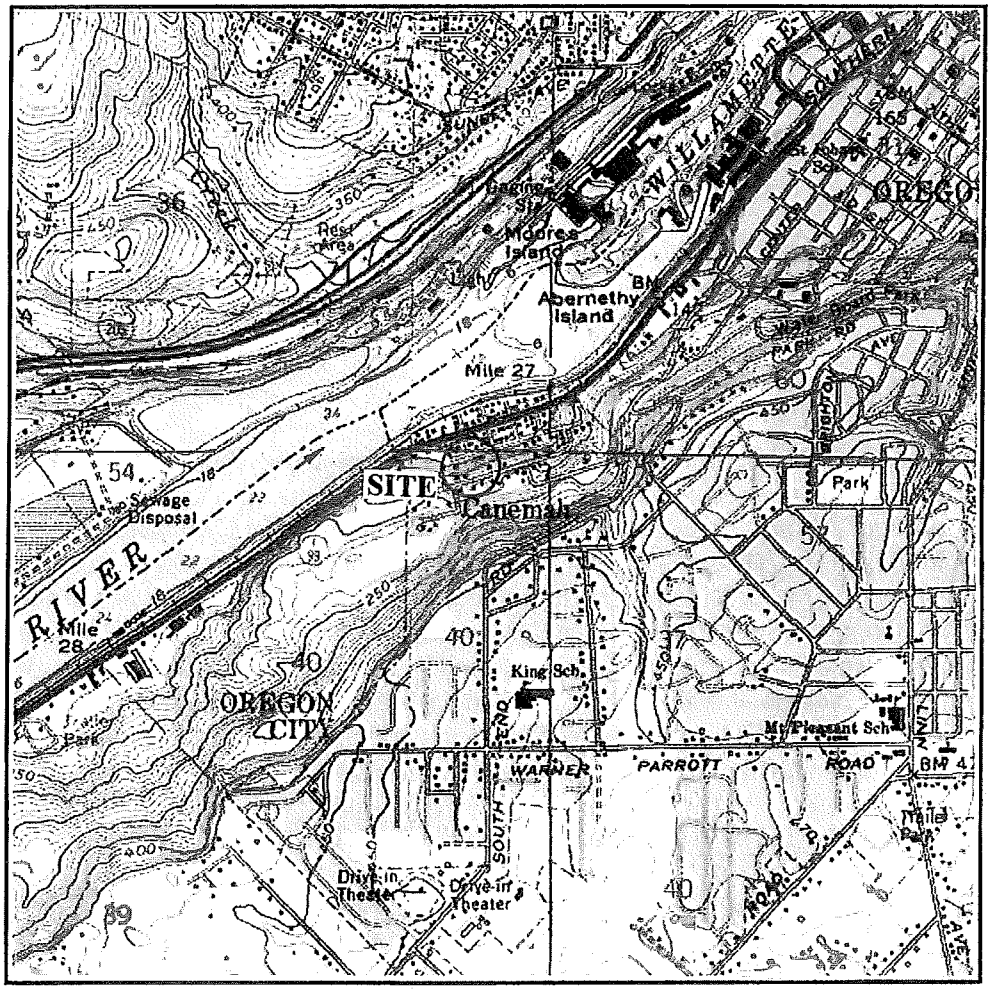
The purpose of our geotechnical and/or geologic studies was to evaluate the overall subsurface soil and/or groundwater conditions underlying the subject site with regard to the proposed new single-family residential development and construction at the site and any associated impacts or concerns with respect to existing and/or previous landslide activity at the site as well as provide appropriate geotechnical design and construction recommendations for the project. Specifically, our geotechnical investigation and landslide hazard study performed as a collaboration with Northwest Geological Services, Inc. (NWGS, Inc.) included the following scope of work items:

1. Review of available and relevant geologic and/or geotechnical investigation reports for the subject site and/or area .

2. A detailed field reconnaissance and subsurface exploration program of the soil and ground water conditions underlying the site by means of three (3) exploratory test pit excavations. The exploratory test pits were excavated to depths ranging from about four (4) to seven (7) feet beneath existing site grades at the approximate locations as shown on the Site Exploration Plan, Figure No. 2.

3. Laboratory testing to evaluate and identify pertinent physical and engineering properties of the subsurface soils encountered relative to the planned site development and construction at the site. The laboratory testing program included tests to help evaluate the natural (field) moisture content and dry density, maximum dry density and optimum moisture content, gradational characteristics and Atterberg Limits tests.

4. A literature review and engineering evaluation and assessment of the regional seismicity to evaluate the potential ground motion hazard(s) at the subject site. The evaluation and assessment included a review of the regional earthquake history and sources such as potential seismic sources, maximum credible earthquakes, and reoccurrence intervals as well as a discussion of the possible ground response to the selected design earthquake(s), fault rupture, landsliding, liquefaction, and tsunami and seiche flooding.



OREGON CITY QUADRANGLE
OREGON–CLACKAMAS CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
SE/4 OREGON CITY 15' QUADRANGLE

SCALE 1:24 000

1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929
DEPTH CURVES AND SOUNDINGS IN FEET–DATUM IS MEAN LOWER LOW WATER BELOW LOCKS AND IS 50 FEET ABOVE MEAN SEA LEVEL ABOVE LOCKS
(COLUMBIA RIVER AND WILLAMETTE RIVER DATA)

SITE VICINITY MAP

Project No. 1477.006.G	**TAX LOT NO. 2602** **5TH AVE & APPERSON STREET**	Figure No. 1

GEOTECHNICAL INVESTIGATION AND GEOLOGIC HAZARD ASSESSMENT PROPOSED SCHADERMAN SINGLE-FAMILY RESIDENTIAL HOME SITE TAX LOT NO. 2602 5TH AVENUE AND APPERSON STREET OREGON CITY (CLACKAMAS COUNTY) OREGON

INTRODUCTION

Redmond Geotechnical Services, LLC is please to submit to you the results of our Geotechnical Investigation and Geologic Landslide Hazard Assessment at the site of the proposed new single-family residential home located to the northwest of the intersection of 5th Avenue and Apperson Street in Oregon City (Clackamas County), Oregon. The general location of the subject site is shown on the Site Vicinity Map, Figure No. 1. The purpose of our geotechnical investigation and geologic landslide hazard study services at this time was to explore the existing subsurface soils and/or groundwater conditions across the subject site and to evaluate any potential concerns with regard to past and/or current landslide activity at the site as well as to develop and/or provide appropriate geotechnical design and construction recommendations for the proposed new single-family residential development project.

PROJECT DESCRIPTION

We understand that present plans are to develop the subject property into a new single-family residential home. Based on a review of the proposed site development plan, we understand that the proposed new residential project will consist of the construction of a new single-family residential home with a main (ground floor) footprint of about 1,030 square feet (see Site Exploration Plan, Figure No. 2). The new residential home is anticipated to be a two-story structure constructed with wood framing and a raised wooden post and beam floor system. Additionally, we understand that development of the site will also include the construction of a two-story wood-frame detached garage which will have a main (ground) floor footprint of approximately 560 square feet. Support of the new residential and/or detached garage structure is anticipated to consist primarily of conventional shallow strip (continuous) footings although some individual (column) footings may also be required. Structural loading information, although unavailable at this time, is anticipated to be fairly typical and light for this type of wood-frame single-family residential structure and is expected to result in maximum dead plus live continuous (strip) and individual (column) footing loads on the order of about 1.5 to 2.5 kips per lineal foot (klf) and 10 to 30 kips, respectively.

Although a site grading plan is not available at this time, we understand that only minor cuts and/or fills are presently planned for the residential project. In general, relatively minor cuts and/or fills (i.e., 5-feet or less) will be required across the proposed residential home site.

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Test Pit Logs and Laboratory Data

APPENDIX B

Geologic Landslide Hazard Study

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REDMOND GEOTECHNICAL SERVICES

April 19, 2018

Mr. Todd Iselin
Iselin Architects
1307 Seventh Street
Oregon City, Oregon 97045

Dear Mr. Iselin:

Re: Geotechnical Investigation and Geologic Landslide Hazard Assessment, Proposed Schaderman Single-Family Residential Home Site, Tax Lot No. 2602, 5th Avenue and Apperson Street, Oregon City (Clackamas County), Oregon

Submitted herewith is our report entitled "Geotechnical Investigation and Geologic Landslide Hazard Assessment, Proposed Schaderman Single-Family Residential Home Site, Tax Lot No. 2602, 5th Avenue and Apperson Street, Oregon City (Clackamas County), Oregon". The scope of our services was outlined in our formal proposal to Mr. Todd Iselin dated January 30, 2018. Written authorization of our services was provided by Mr. Todd Iselin on January 31, 2018.

During the course of our investigation, we have kept you and/or others advised of our schedule and preliminary findings. We appreciate the opportunity to assist you with this phase of the project. Should you have any questions regarding this report, please do not hesitate to call.

Sincerely,

Daniel M. Redmond, P.E., G.E.
President/Principal Engineer

REGISTERED PROFESSIONAL ENGINEER 12309 OREGON July 15, 1983 DANIEL M. REDMOND

12-31-18

PO BOX 20547 • PORTLAND, OREGON 97294 • FAX 503/286-7176 • PHONE 503/285-0598

REDMOND GEOTECHNICAL SERVICES

Geotechnical Investigation

and

Geologic Landslide Hazard Assessment

Proposed Schaderman Single-Family Residential Home Site

Tax Lot No. 2602

5th Avenue and Apperson Street

Oregon City (Clackamas County), Oregon

for

Iselin Architects

Project No. 1477.006.G
April 19, 2018

LEGEND

Qc – Holocene colluvium: medium stiff to stiff red brown sandy SILT, trace clay, basalt fragments, rare rounded gravel, damp, grades down into decomposed basalt.

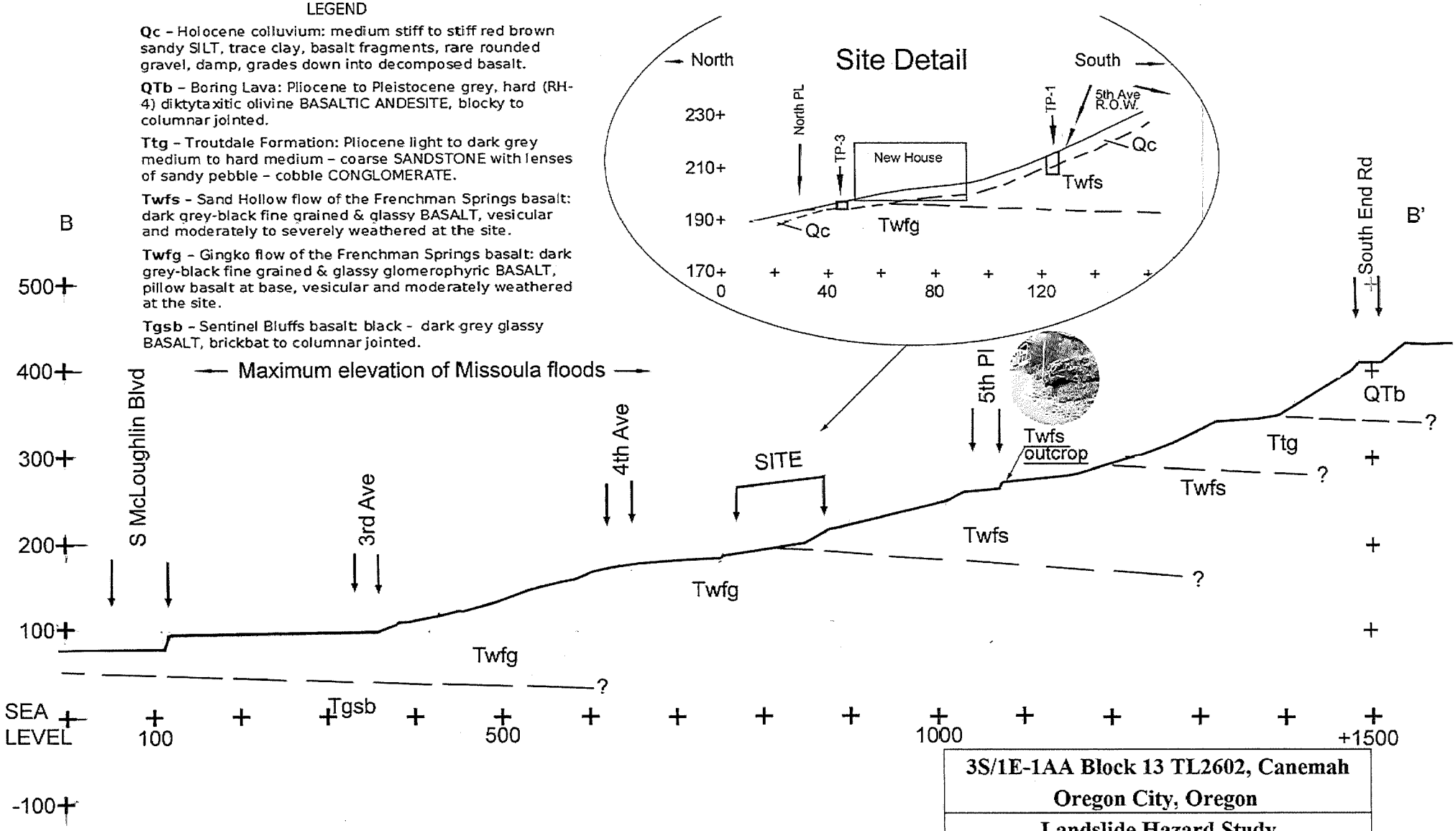
QTb – Boring Lava: Pliocene to Pleistocene grey, hard (RH-4) diktytaxitic olivine BASALTIC ANDESITE, blocky to columnar jointed.

Ttg – Troutdale Formation: Pliocene light to dark grey medium to hard medium – coarse SANDSTONE with lenses of sandy pebble – cobble CONGLOMERATE.

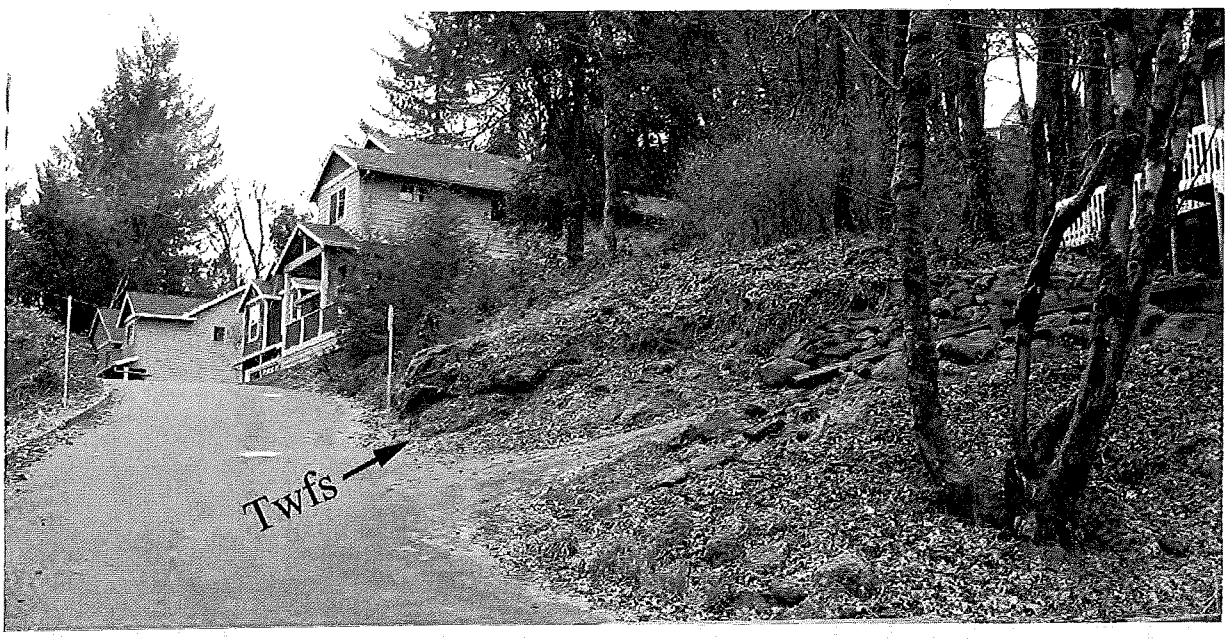
Twfs – Sand Hollow flow of the Frenchman Springs basalt: dark grey-black fine grained & glassy BASALT, vesicular and moderately to severely weathered at the site.

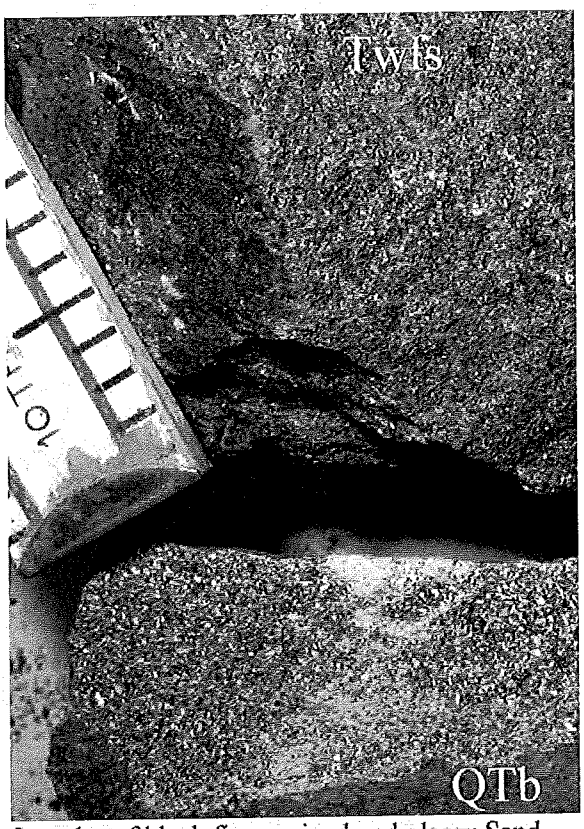
Twfg – Gingko flow of the Frenchman Springs basalt: dark grey-black fine grained & glassy glomerophyric BASALT, pillow basalt at base, vesicular and moderately weathered at the site.

Tgsb – Sentinel Bluffs basalt: black - dark grey glassy BASALT, brickbat to columnar jointed.

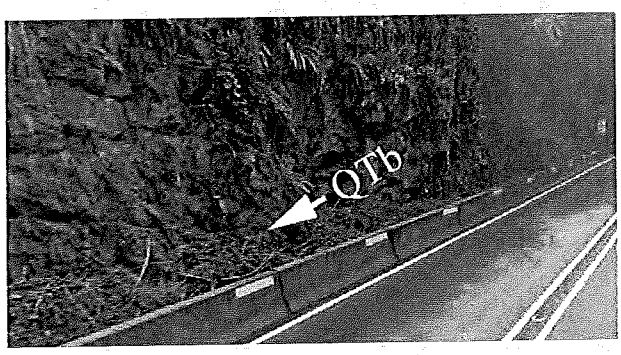


3S/1E-1AA Block 13 TL2602, Canemah Oregon City, Oregon		
Landslide Hazard Study Area & Site Geologic Cross Sections		
NGS, Inc.	March 2018	**Figure 7**





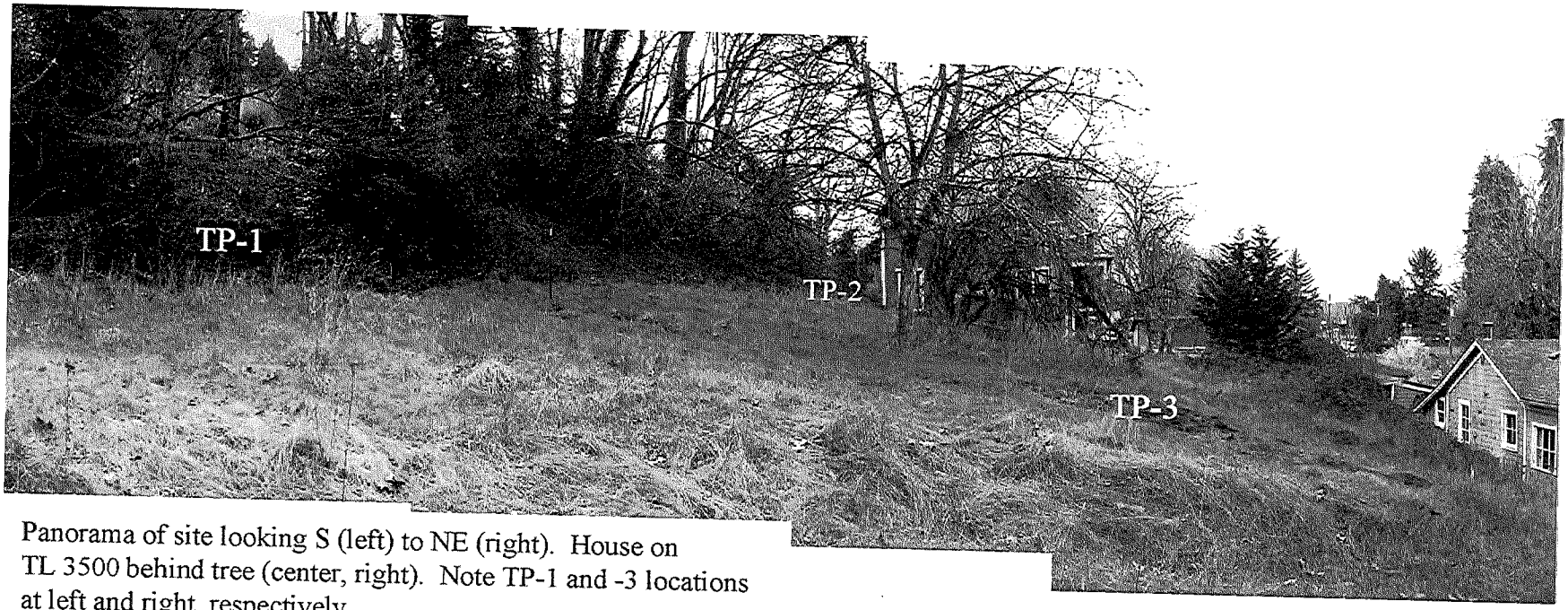
Samples of black fine grained and glassy Sand Hollow (Twfs) basalt from outcrop (top photo) and of grey basaltic andesite Boring Lava (QTb) from along South End Rd (center right photo).



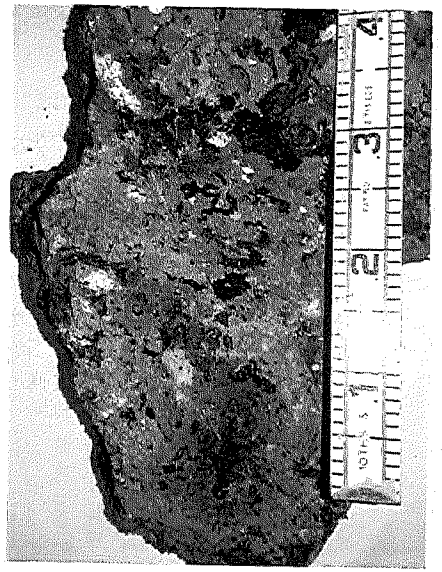
Top: Looking east at Sand Hollow basalt (Twfs) exposed at entrance to driveway for 708 5th Pl ~ one block SSE of the site. Test pit (NGS, 2004) confirm this basalt flow extends east along 5th PL. This in-place bedrock is within the area shown as Quaternary landslide (Qls) by Madin (2009) and as Troutdale formation by Schlicker & Finlayson (1979).

Above: Sample location of Boring Lava (QTb) at cliff base, south side of South End Rd, south of the site.

3S/1E-1AA Block 13 TL2602, Canemah Oregon City, Oregon		
Landslide Hazard Study Basalt Bedrock South of Site		
NGS, Inc.	March 2018	**Figure 8**



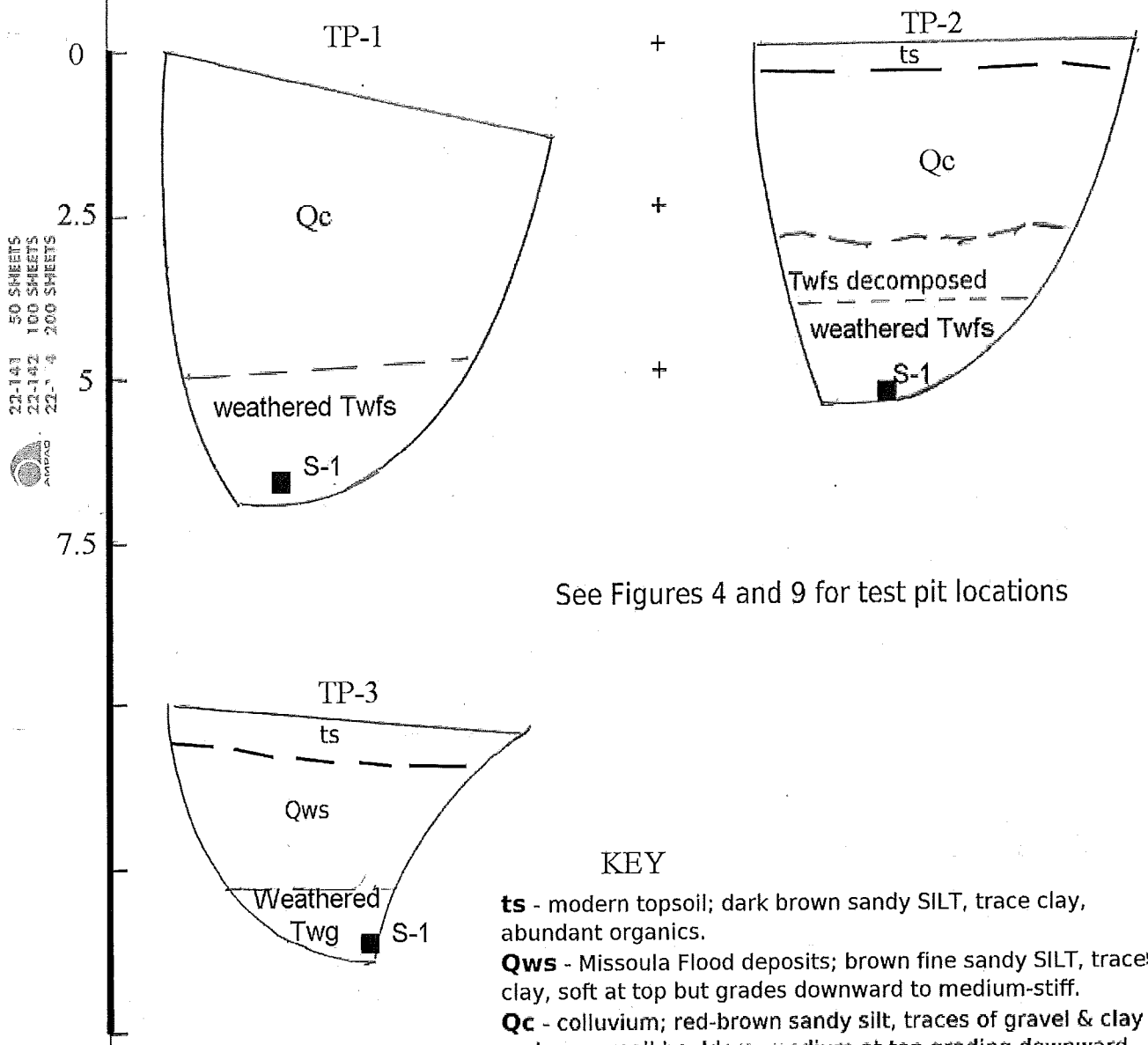
Panorama of site looking S (left) to NE (right). House on TL 3500 behind tree (center, right). Note TP-1 and -3 locations at left and right, respectively.



Far Left: Fine-grained and vesicular flow top of Gingko flow (Twfg) from ~3 ft depth in TP-3. Large white patches are clusters of plagioclase feldspar (glomerocrysts). The glomerocrysts are characteristic of the Gingko flows but absent in the other Frenchman Springs flows.

Near Left: Fine grained to glassey vesicular base of the Sand Hollow flow (Twfs). Samples from TP-1 @ 6.5 ft (above ruler) and TP-2 @5.5 ft (below ruler).

3S/1E-1AA Block 13 TL2602, Canemah Oregon City, Oregon		
Landslide Hazard Study		
SITE PHOTOGRAPHS		
NGS, Inc.	March 2018	**Figure 9**



See Figures 4 and 9 for test pit locations

KEY

ts - modern topsoil; dark brown sandy SILT, trace clay, abundant organics.

Qws - Missoula Flood deposits; brown fine sandy SILT, trace clay, soft at top but grades downward to medium-stiff.

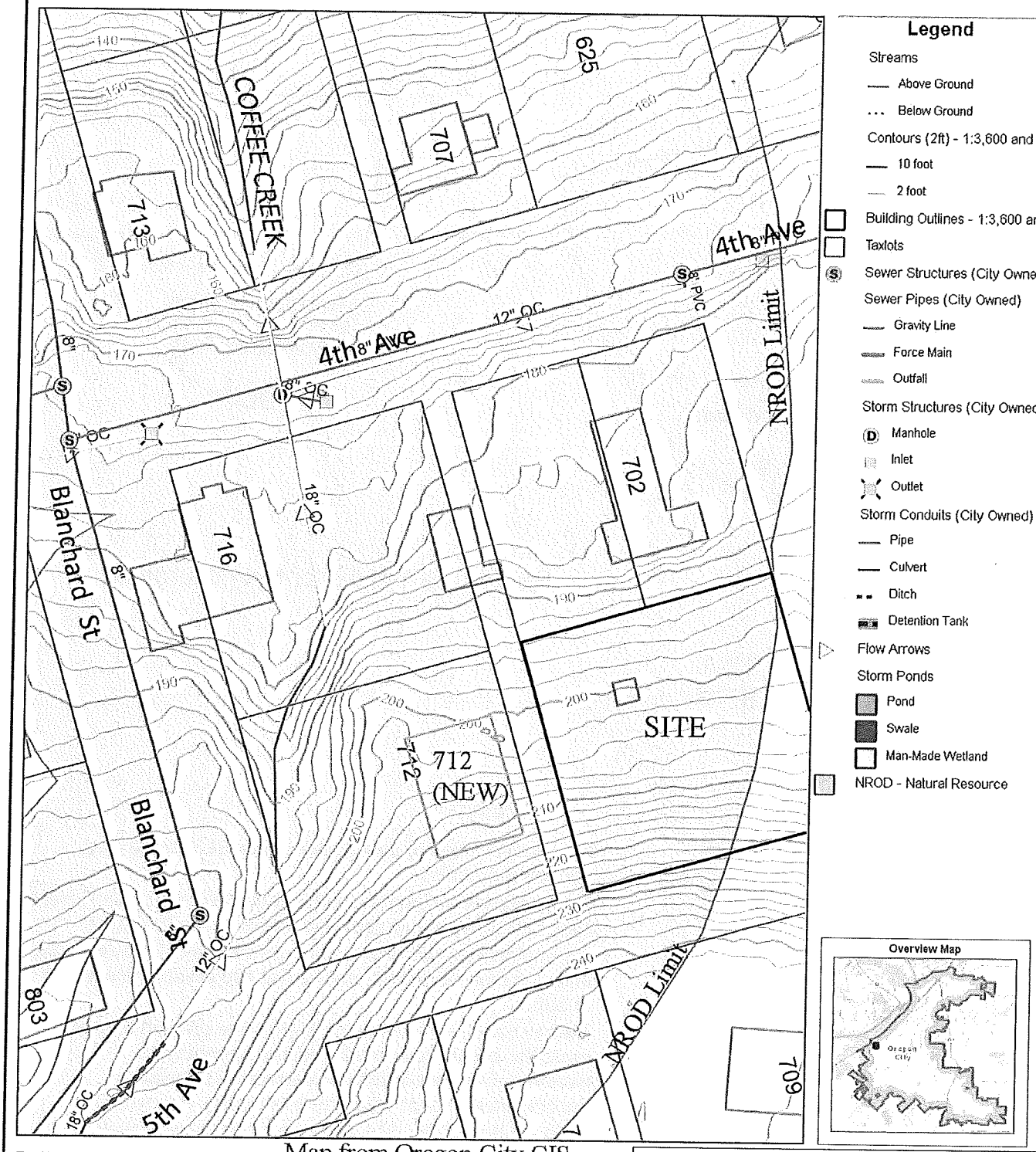
Qc - colluvium; red-brown sandy silt, traces of gravel & clay and rare small boulders, medium at top grading downward to stiff.

Twfs - Sand Hollow flow; dark grey fine grained to glassy vesicular basalt, rare small feldspar phenocrysts, weathered, except top foot severely weathered to decomposed to hard brown and tan gritty clayey SILT.

Twg - Gingko flow; dark grey glassy vesicular basalt, abundant glomerocrysts of feldspar, moderately weathered.

3S/1E-1AA Block 13 TL2602, Canemah Oregon City, Oregon		
Landslide Hazard Study Site Test Pits		
NGS, Inc.	March 2018	**Figure 10**

Oregon City NROD Map



The City of Oregon City makes no representations, express or implied, as to the accuracy, completeness and timeliness of the information displayed. This map is not suitable for legal, engineering, surveying or navigation purposes. Notification of any errors is appreciated.

Map from Oregon City GIS

N

0 50 Feet

Map created 3/15/2018

3S/1E-1AA Block 13 TL2602, Canemah Oregon City, Oregon		
Landslide Hazard Study NROD MAP		
NGS, Inc.	March 2018	Figure 11

Type 1
Natural Resource Overlay Review
For
New Single Family Residence

at
5th and Apperson
Parcel No 3-1E-01AA-02602
Oregon City, Oregon

Dec 19, 2018

Planning Department
City of Oregon City
698 Warner Parrott Rd
Oregon City, OR 97045

ISELIN ARCHITECTS, P.C.
1307 Seventh Street Oregon City, OR 97045 p: 503-656-1942 f: 503-656-0658

Project Summary:

The proposed development consists of constructing a new 1,612 square foot single family home (1024 square foot footprint) and a detached 588 square foot garage with a 292 square foot second story accessory dwelling unit on a vacant parcel.

The site has NROD, Geohazard and Historic Review overlays. A concurrent Geological review application is being submitted for the project and historic review approval has been previously granted.

The subject site is subject to the NROD overlay since it is within 200' of a protected feature. The protected feature is a small perennial non fish bearing natural stream with varying side slopes based on the NROD application approved for the Bistline Residence on adjoining Tax lots 2700 and 3500. This report was prepared on May 1, 2014 by ETC Environmental.

The proposed new home and garage are outside the NROD buffer area as previously delineated in the report referenced above. The Bistline house proposed and constructed on tax lot 3500 also completely isolates the proposed development from the protected feature. Refer to attached NROD Area plan from ETC report with proposed home and garage location on Tax Lot 2602 shown.

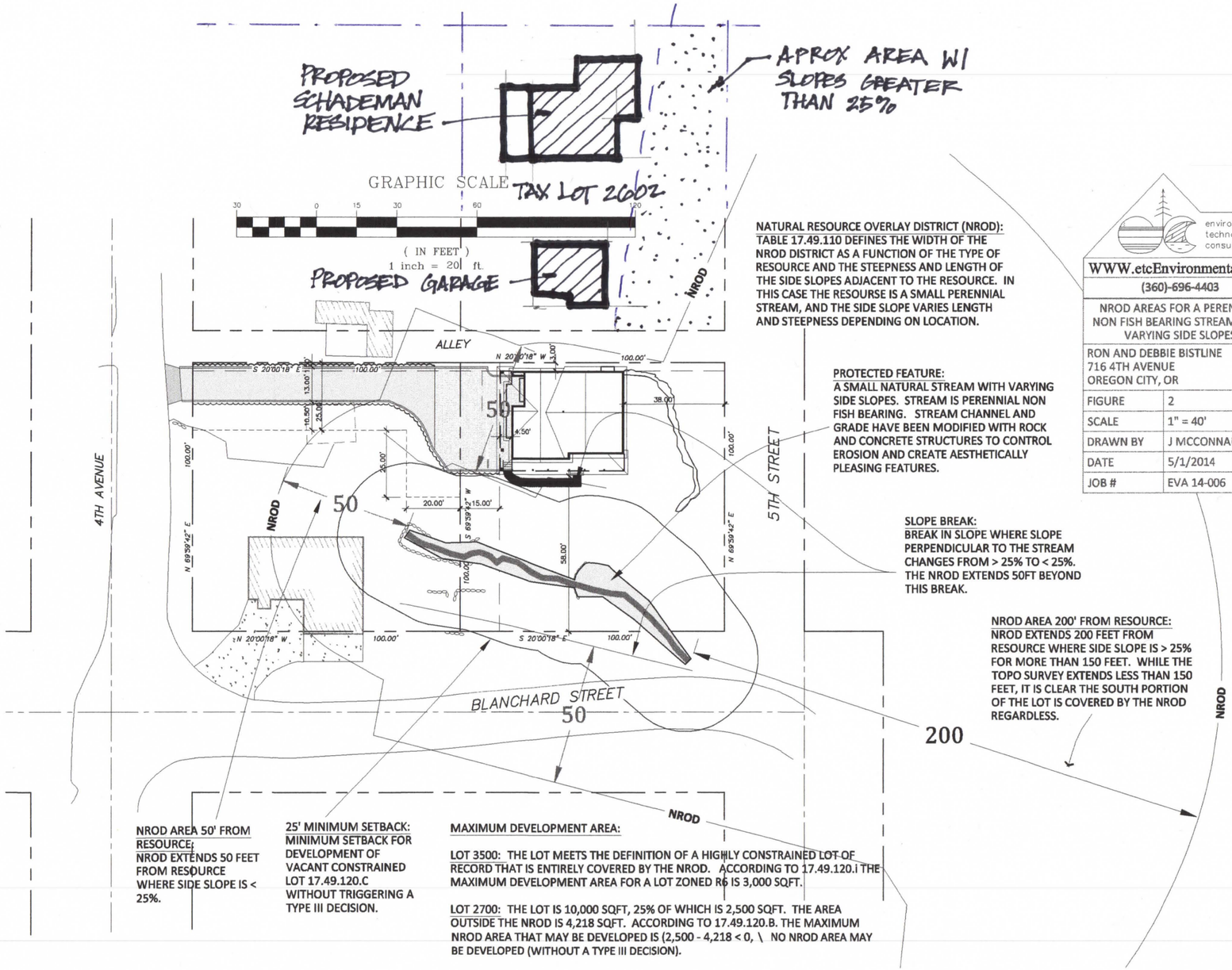
A Type 1 Natural Resource Overlay Review is requested to allow the construction of the proposed home and detached garage on this being sought.

Bistline Residence - Canemah HD

THIS INFORMATION APPLIES PRIOR TO THIS SITE:
Tax Lot 3500
T3S–R1E–01AA–TL3500
Lots 5 & 6, Block 13
SUBDIVISION: "CANEMAH"
R: C15062
ALT R00743253
JHA: City of Oregon City
97045
Zoning: R6

FOR:
Ron & Debbie Bistline
(503) 396-2316

Tax Lot 3500
DATE: 1/23/15 BILLD / GBC



NATURAL RESOURCE OVERLAY DISTRICT (NROD):
TABLE 17.49.110 DEFINES THE WIDTH OF THE NROD DISTRICT AS A FUNCTION OF THE TYPE OF RESOURCE AND THE STEEPNESS AND LENGTH OF THE SIDE SLOPES ADJACENT TO THE RESOURCE. IN THIS CASE THE RESOURSE IS A SMALL PERENNIAL STREAM, AND THE SIDE SLOPE VARIES LENGTH AND STEEPNESS DEPENDING ON LOCATION.

PROTECTED FEATURE:
A SMALL NATURAL STREAM WITH VARYING SIDE SLOPES. STREAM IS PERENNIAL NON FISH BEARING. STREAM CHANNEL AND GRADE HAVE BEEN MODIFIED WITH ROCK AND CONCRETE STRUCTURES TO CONTROL EROSION AND CREATE AESTHETICALLY PLEASING FEATURES.

SLOPE BREAK:
BREAK IN SLOPE WHERE SLOPE PERPENDICULAR TO THE STREAM CHANGES FROM > 25% TO < 25%. THE NROD EXTENDS 50FT BEYOND THIS BREAK.

NROD AREA 200' FROM RESOURCE:
NROD EXTENDS 200 FEET FROM RESOURCE WHERE SIDE SLOPE IS > 25% FOR MORE THAN 150 FEET. WHILE THE TOPO SURVEY EXTENDS LESS THAN 150 FEET, IT IS CLEAR THE SOUTH PORTION OF THE LOT IS COVERED BY THE NROD REGARDLESS.

NROD AREA 50' FROM RESOURCE:
NROD EXTENDS 50 FEET FROM RESOURCE WHERE SIDE SLOPE IS < 25%.

25' MINIMUM SETBACK:
MINIMUM SETBACK FOR DEVELOPMENT OF VACANT CONSTRAINED LOT 17.49.120.C WITHOUT TRIGGERING A TYPE III DECISION.

MAXIMUM DEVELOPMENT AREA:

LOT 3500: THE LOT MEETS THE DEFINITION OF A HIGHLY CONSTRAINED LOT OF RECORD THAT IS ENTIRELY COVERED BY THE NROD. ACCORDING TO 17.49.120.I THE MAXIMUM DEVELOPMENT AREA FOR A LOT ZONED R6 IS 3,000 SQFT.

LOT 2700: THE LOT IS 10,000 SQFT, 25% OF WHICH IS 2,500 SQFT. THE AREA OUTSIDE THE NROD IS 4,218 SQFT. ACCORDING TO 17.49.120.B. THE MAXIMUM NROD AREA THAT MAY BE DEVELOPED IS (2,500 - 4,218 < 0, \ NO NROD AREA MAY BE DEVELOPED (WITHOUT A TYPE III DECISION).

environmental technology consultants
WWW.etcEnvironmental.NET
(360)-696-4403

NROD AREAS FOR A PERENNIAL NON FISH BEARING STREAM WITH VARYING SIDE SLOPES	
RON AND DEBBIE BISTLINE 716 4TH AVENUE OREGON CITY, OR	
FIGURE	2
SCALE	1" = 40'
DRAWN BY	J MCCONNAUGHEY
DATE	5/1/2014
JOB #	EVA 14-006

SITE PLAN GENERAL NOTES

1. PROVIDE A MINIMUM 8" DEEP GRAVEL BASE FOR ALL DRIVEWAY AREAS.
2. MAXIMUM DRIVEWAY SLOPE SHOULD BE VERIFIED WITH THE BUILDING DEPARTMENT PRIOR TO CONSTRUCTION.
3. PROVIDE A MINIMUM 4" DEEP GRAVEL BASE FOR ALL SIDEWALK AND PATIO AREAS.
4. PIPE ALL STORM DRAINAGE FROM THE BUILDING TO A DISPOSAL POINT APPROVED BY THE BUILDING DEPARTMENT.
5. PROVIDE AND MAINTAIN POSITIVE DRAINAGE AWAY FROM BUILDING ON ALL SIDES.
6. THE BOUNDARY AND TOPOGRAPHY INFORMATION HAS BEEN PROVIDED TO GREGG B. CREIGHTON, ARCHITECT, P.C. BY THE CONTRACTOR, OWNER OR ENGINEERING CONSULTANT. GREGG B. CREIGHTON ARCHITECT, P.C. WILL NOT BE HELD LIABLE FOR THE ACCURACY OF THIS INFORMATION. IT IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR TO VERIFY ALL SITE CONDITIONS INCLUDING ANY FILL PLACED ON THE SITE. THE CONTRACTOR MUST INFORM THIS OFFICE OF ANY POTENTIAL FIELD MODIFICATIONS NOT SPECIFIED ON THE PLANS.
7. NON–STABILIZED FILL MUST NOT EXCEED 2:1 SLOPE
8. EXCAVATION MATERIAL REMAINING ON SITE IS TO BE CONTAINED BY AN APPROVED SEDIMENT BARRIER. THE CONTRACTOR MUST VERIFY LOCATION WITH APPROPRIATE BUILDING OFFICIAL.
9. PROTECT STOCK PILES FROM OCTOBER 1st THRU APRIL 30th PER THE EROSION CONTROL HANDBOOK.
10. NO CUTTING OR FILLING SHALL TAKE PLACE WITHIN THE DRIP LINE OF AN EXISTING TREE UNLESS THE EXCEPTION IS APPROVED BY THE BUILDING DEPT.

LEGEND
= EDGE OF PAVEMENT
= PROPERTY LINE
= POROUS ASPHALT DRIVE
= EXIST. CONCRETE SIDEWALK
= GRAVEL
= PERMEABLE PAVERS

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252 "A" Ave. Suite 300
Lake Oswego, OR 97034
(503) 635-0797
Fax: (503)635-1041
Job #: 00000

S2

CREIGHTON ARCHITECTURE IS NOT LIABLE FOR THE ACCURACY OF THE TOPOGRAPHY & UTILITY INFORMATION. IT IS THE SOLE RESPONSIBILITY OF THE BUILDER TO VERIFY ALL SITE CONDITIONS, INCLUDING ANY FILL PLACED ON THE SITE AND INFORM OWNERS OF ANY POTENTIAL FIELD MODIFICATIONS.

1-26-15 1:34pm
BISTLINE-SITE.dwg
Plotted by GregCreighton
GBC layer group : P

nrod area plan

SCALE: 1" = 20'-0"