City of West Linn
Planning & Development • 22500 Salamo Rd #1000 • West Linn, Oregon 97068
Telephone 503.656.4211 • Fax 503.656.4106 • westlinnoregon.gov

DEVELOPMENT REVIEW APPLICATION

For Office Use Only		
STAFF CONTACT: Darren Wyss	PROJECT NO(S).: WA-18-03	
NON-REFUNDABLE FEE(S): 2850	REFUNDABLE DEPOSIT(S):	TOTAL: 2850

Type of Review (Please check all that apply):

- ☐ Annexation (ANX)
- ☐ Appeal and Review (AP) *
- ☐ Conditional Use (CUP)
- ☐ Design Review (DR)
- ☐ Easement Vacation
- ☐ Extraterritorial Ext. of Utilities
- ☐ Final Plat or Plan (FP)
- ☐ Flood Management Area
- ☐ Hillside Protection & Erosion Control
- ☐ Historic Review
- ☐ Legislative Plan or Change
- ☐ Lot Line Adjustment (LLA) */**
- ☐ Minor Partition (MIP) (Preliminary Plat or Plan)
- ☐ Non-Conforming Lots, Uses & Structures
- ☐ Planned Unit Development (PUD)
- ☐ Pre-Application Conference (PA) */**
- ☐ Street Vacation
- ☐ Subdivision (SUB)
- ☐ Temporary Uses *
- ☐ Time Extension *
- ☐ Variance (VAR)
- ☐ Water Resource Area Protection/Single Lot (WAP)
- ☒ Water Resource Area Protection/Wetland (WAP)
- ☐ Willamette & Tualatin River Greenway (WRG)
- ☐ Zone Change

Home Occupation, Pre-Application, Sidewalk Use, Sign Review Permit, and Temporary Sign Permit applications require different or additional application forms, available on the City website or at City Hall.

Site Location/Address:

19738 Wildwood Dr.

Assessor's Map No.: 2-1E-23AC
Tax Lot(s): 9004
Total Land Area: 10000 sq ft

Brief Description of Proposal:

New Home

Applicant Name: (please print) Max Eckelman
Address: 509 Washington st.
City State Zip: Oregon City OR 97045
Phone: 503-572-0239
Email: max@eckwork.com

Owner Name (required): (please print) Max Eckelman
Address: 509 Washington St.
City State Zip: Oregon City OR 97045
Phone: ~~503-572-0239~~
Email: max@eckwork.com

Consultant Name: (please print)
Address:
City State Zip:
Phone:
Email:

RECEIVED
JUL 18 2018
PLANNING & BUILDING
CITY OF WEST LINN

1. All application fees are non-refundable (excluding deposit). **Any overruns to deposit will result in additional billing.**
2. The owner/applicant or their representative should be present at all public hearings.
3. A denial or approval may be reversed on appeal. No permit will be in effect until the appeal period has expired.
4. **Three (3) complete hard-copy sets (single sided) of application materials must be submitted with this application. One (1) complete set of digital application materials must also be submitted on CD in PDF format. If large sets of plans are required in application please submit only two sets.**

* No CD required / ** Only one hard-copy set needed

The undersigned property owner(s) hereby authorizes the filing of this application, and authorizes on site review by authorized staff. I hereby agree to comply with all code requirements applicable to my application. Acceptance of this application does not infer a complete submittal. All amendments to the Community Development Code and to other regulations adopted after the application is approved shall be enforced where applicable. Approved applications and subsequent development is not vested under the provisions in place at the time of the initial application.

Applicant's signature — Date: 7/19/18
Owner's signature ***(required)*** — Date: 7/19/18

AKS ENGINEERING & FORESTRY

BEND, OR
3052 NW Merchant Way, Suite 100
Bend, OR 97703
(503) 317-8429

KEIZER, OR
4300 Cherry Avenue NE
Keizer, OR 97303
(503) 400-6028

TUALATIN, OR
12965 SW Herman Road, Suite 100
Tualatin, OR 97062
(503) 563-6151

VANCOUVER, WA
9600 NE 126th Avenue, Suite 2520
Vancouver, WA 98682
(360) 882-0419

www.aks-eng.com

Wildwood Drive Natural Resource Assessment

Date:	7/23/2018
To:	City of West Linn Planning Department
From:	Stacey Reed, PWS, Senior Wetland Scientist
Project:	19738 Wildwood Drive Single Family Residence on Lot of Record
Subject:	WRA Permit and Hardship Variance
Site Location:	T2S, R1E, Section 23AC, Tax Lot 9004 West Linn, Clackamas County, Oregon

Introduction

AKS Engineering & Forestry, LLC (AKS) conducted a natural resource assessment for 19738 Wildwood Drive, West Linn, Clackamas County, Oregon (Tax Lot 9004 of Assessor's Tax Map 2S 1E 23AC). The study area is shown on attached Figures 1-2. An unnamed tributary to Robin Creek is mapped on the City of West Linn's Water Resource Area (WRA) map flowing northeasterly through the northwest corner of the site. The tributary is located at the bottom of a ravine with no distinct top of slope for at least 150 feet, requiring a 200 foot wide WRA buffer. The WRA buffer consumes the entire site.

This memorandum describes the results of the natural resource assessment and requests a hardship variance approval for a single-family home within the outer edges of the WRA buffer. This memo documents the project meets all of the hardship provisions described in Section 32.110 of City of West Linn Community Development Code (CDC) Chapter 32 Water Resource Area Protection.

Existing Conditions and Background Mapping

The project site consists of an undeveloped property located within the Hidden Springs residential neighborhood of West Linn. The project site is generally dominated with Douglas fir (*Pseudotsuga menziesii*), bigleaf maple (*Acer macrophyllum*), red alder (*Alnus rubra*), and pineland swordfern (*Polystichum munitum*) with Himalayan blackberry (*Rubus armeniacus*) along the edges near Wildwood Drive. The topography on the site slopes northerly toward the tributary that flows through the northern portion of the site. Topography is steep, with greater than 25 percent slopes throughout.

According to the Natural Resources Conservation Service (NRCS) soil survey map for Clackamas County, Oregon Area soil survey and the Clackamas County hydric soil list Saum silt loam with 30%-60% slopes are mapped extending throughout the entire site (Figures 3). Saum silt loams are not listed as hydric, nor do they have any hydric inclusions.

The City of West Linn has an Oregon Department of State Lands (DSL) approved Local Wetland Inventory (LWI) map (Figure 4). The LWI map has an unnamed drainage mapped within the project site. Our study confirmed a portion of the drainage is located within the site. According to the City's WRA map, an unnamed tributary to Robin Creek is mapped in the northwest portion of the site (Figure 5). According to the WRA map, no Significant Riparian Corridors are mapped on the site.

On-Site Protected Water Resource

AKS Senior Wetland Scientist, Stacey Reed, PWS, conducted site visits on May 9 and 14, 2018 to evaluate site conditions and determine whether the flow regime within the on-site portions of the tributary was ephemeral or intermittent. The channel daylights approximately 50 feet off-site to the west from a large diameter culvert that passes flow under Wildwood Drive. On-site, the channel is narrow averaging approximately 3 foot wide channel bed with 1 foot tall banks. The dominant streambed substrate is silt loam with scattered gravels and cobbles. The on-site portion of the channel contained approximately 1/2-inch deep continuous flow during the May 9, 2018 site visit. However, according to the National Weather Service (NWS) Portland station, approximately 0.25-inch of rainfall was received within the 3 days prior to the May 9, 2018 site visit. Therefore, a follow up site visit was conducted a week later on May 14, 2018. The on-site upper portions of the channel were dry (lacked flow) during the May 14, 2018 site visit, but the lower half of the channel contained approximately ¼-inch deep continuous flow. Since portions of the channel still contained flow, we determined the on-site portions of the channel to be intermittent. Intermittent drainages mapped on West Linn's WRA map are considered a Protected Water Feature requiring a WRA buffer.

The ordinary high water mark (OHWM) for the on-site portion of drainage was professionally land surveyed by Andy Paris and Associates, Inc. The Existing Conditions Map depicting the surveyed water boundaries and adjacent topography is included as Figure 6. Representative site photographs are attached for reference.

Extent of the Water Resource Area (WRA)

The slopes within the first 50 feet from the OHWM of the tributary are greater than 25%, with no distinct top of bank until Wildwood Drive. Therefore, according to Table 32-2 *Required Width of WRA* of Chapter 32.030 of the City's CDC, the width of a WRA for the on-site tributary extends 200 feet, which consumes the entire site (0.24 acres of on-site WRA). The extent of WRA and slope measurements are shown on the attached Existing Conditions Map (Figure 6).

Existing Conditions of the WRA

The existing condition of the on-site WRA was determined based on the presence of native vegetation, water features, and slope, consistent with CDC Section 32.050.F. The existing condition of the on-site WRA was determined to be in *good* condition due to having a dense native tree canopy and native understory. The entire site is under native tree canopy (red alder, bigleaf maple, and Douglas-fir trees). The understory was primarily dominated by pineland sword fern and vine maple, generally lacking any non-native invasive plants. Only a few Himalayan blackberry thickets were observed near the edge of the property, near Wildwood Drive.

Hardship Provision Compliance

The project will consist of a single-family 3-story home within WRA. No impacts will occur within the Water Resource (drainage). The total area of the home is +/-3,000 square feet, with each story +/-1,000 square feet. The home is situated as far away from the on-site drainage as possible, near the top of the slope adjacent to Wildwood Drive. A geotechnical investigation was completed to confirm slope stability for the project. The geotechnical report prepared by H.G. Schlicker & Associates is attached. The site plan figures are included as Figures 7 and 7A. Figure 7 shows the full build out of the bottom story, along with the location for the fireplace. Figure 7A shows site erosion and control measures (construction management plan per Section 32.050.G)

Stormwater Management: According to the attached Geotech report, stormwater collected from roof drains, footing drains, and impervious surfaces on the site can be collected and directed downslope via a pipe to discharge into a riprap energy dissipation pad above the OHWM of the tributary. To minimize disturbance within the WRA, we recommend laying the pipe above ground, stapled with #3 rebar to secure the pipe to the ground surface. The area north of the house is shaded; therefore, minimal sunlight damage is expected due to exposed pipe. The riprap

energy dissipation pad will be approximately 10 square feet (5 foot by 5 foot) and will be placed within the WRA, at least 5 feet upslope from the OHWM of the drainage (approximate location shown on attached Figure 7). The location of the energy dissipater is not expected to have an erosive effect on the tributary or diminish the stability of the slope. According to Table 32-1 of West Linn CDC, the energy dissipater can occur within the WRA if no reasonable alternative exists. Since the entire site is within WRA, there are no alternatives to avoiding impact. Impacts to WRA have been minimized by proposing above ground pipe and not trenching to install buried pipe. Due to steep slopes and low permeability, the Geotech report does not recommend on-site water quality treatment.

Tree Preservation: Figure 6 illustrates the surveyed location of all trees on the site. Figure 7A illustrates planned tree removal and preservation. A total of only 8 trees will be removed from the site for the project. The project preserves 9 trees, including the larger diameter trees on the site. The trees to be removed are smaller diameter, with the largest being a 12-inch diameter Douglas fir and a 15-inch diameter bigleaf maple. Of the 8 trees to be removed, only 2 bigleaf maple trees with greater than 12-inch DBH will be removed.

The project site is an established lot of record with the Assessor's office before January 1, 2006, meeting the hardship provision criteria under CDC 32.110.A.

The project will only require a total of 2,510 square feet of maximum disturbed area (MDA), consisting of home, deck, driveway and energy dissipation pad, meeting the hardship provision criteria under CDC 32.110.B.

Impact Evaluation Per CDC 32.110.C.

The entire site is located with WRA buffer. Therefore, impacts to WRA are unavoidable. The project consists of relatively small impact to the buffer, resulting in under 5,000 square feet of MDA (impervious surfaces). The MDA encroachment is the least amount of square footage necessary to develop a single-family home compatible with the surrounding neighborhood. Therefore, the project meets criteria listed under CDC 32.110.C.1.

The home is approximately 85 feet from the edge of the drainage (at closest extent), and avoids impacts to the drainage. The home will not have a functional loss on the intermittent drainage. An 85 foot wide protective buffer between the home and the seasonal drainage is adequate to protect the stream functions. A total of 9 trees and dense native vegetation will remain between the home and the drainage; therefore, the project meets criteria listed under CDC 32.110.C.2.

The development will occur greater than 15 feet from the water resource, meeting criteria listed under CDC 32.110.C.3.

The access driveway is approximately 17-feet wide, with the home being situated as close to Wildwood Drive as possible; therefore, the project meets criteria listed under CDC 32.110.C.4.

Temporary disturbed areas (TDA) adjacent to the development area will be restored to pre-construction conditions and planted with native pineland sword fern.

Mitigation

The project results in a total of 2,510 square feet of MDA. Permanent encroachment will be mitigated off-site through payment in lieu to the City of West Linn Parks Department. The remaining portions of the on-site WRA can be described as being in *good* condition. There are no non-native invasive plants to remove within remaining WRA and no opportunity to install additional plants as the remaining WRA is densely vegetated with native

pineland sword fern and dense canopy of bigleaf maple trees. Off-site mitigation is the most practical approach for this project.

According to Section 32.090, off-site mitigation is allowed if there is not sufficient on-site area. According to Section 32.090.C, off-site mitigation ratios are 2:1; therefore, the project requires 5,020 square feet of off-site credits.

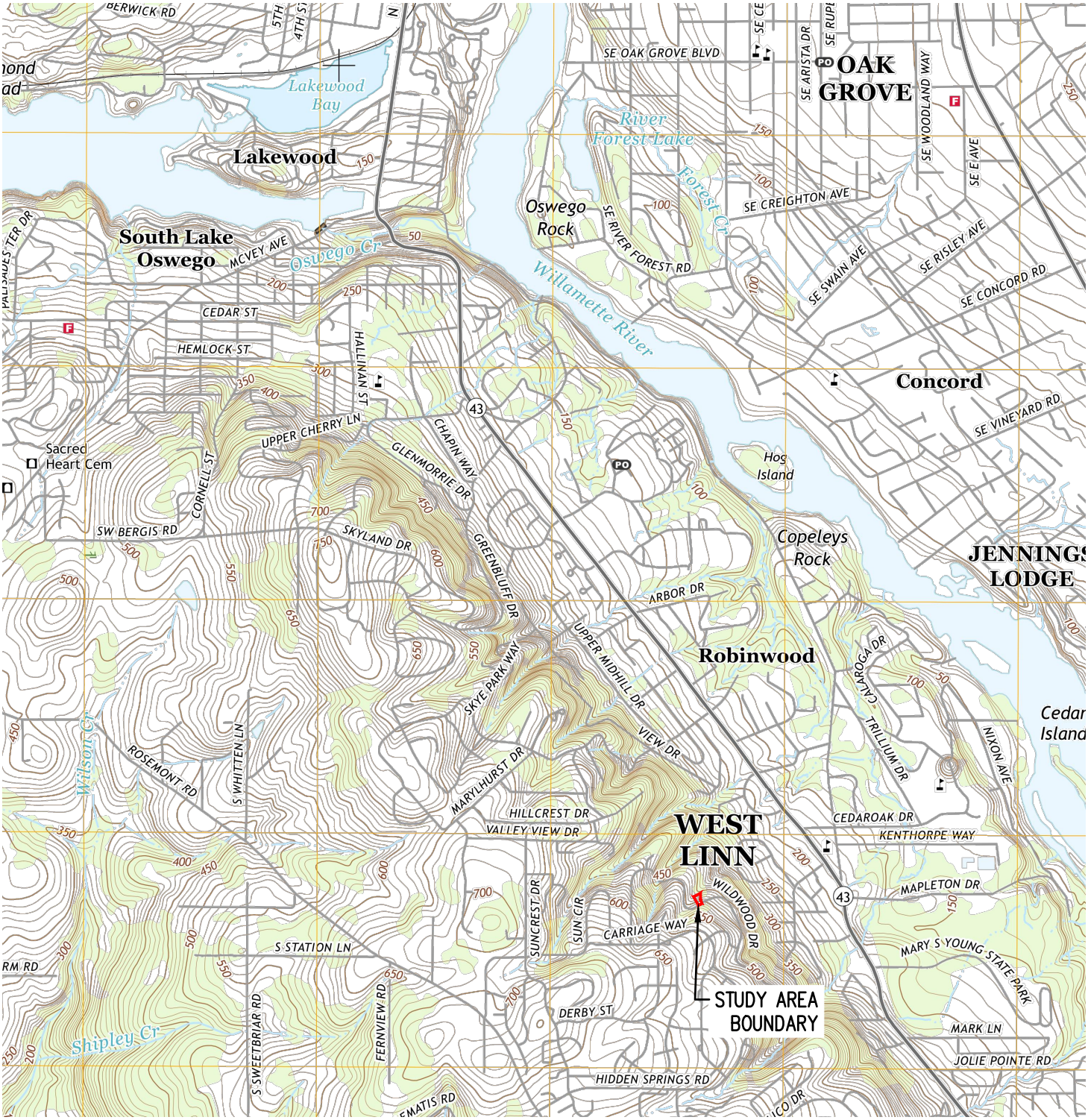
Please do not hesitate to contact me regarding this memorandum.

Stacey Reed

Stacey Reed, PWS
Senior Wetland Scientist

List of Figures
Figure 1. USGS Vicinity Map
Figure 2. Tax Map (2S 1E 23AC)
Figure 3. NRCS Soil Survey Map
Figure 4. Local Wetland Inventory (LWI) Map
Figure 5. West Linn Water Resource Area (WRA) Map
Figure 6. Existing Conditions Map
Figure 7 and 7A. Site and Erosion Control Figures

List of Attachments
Representative Site Photographs
Geotech Report prepared by H.G. Schlicker & Associates



USGS 7.5' TOPOGRAPHIC SERIES
QUADRANGLE: LAKE OSWEGO, OR (2017)

N

SCALE: 1"= 2000 FEET

2000 0 800 1200 1600 2000

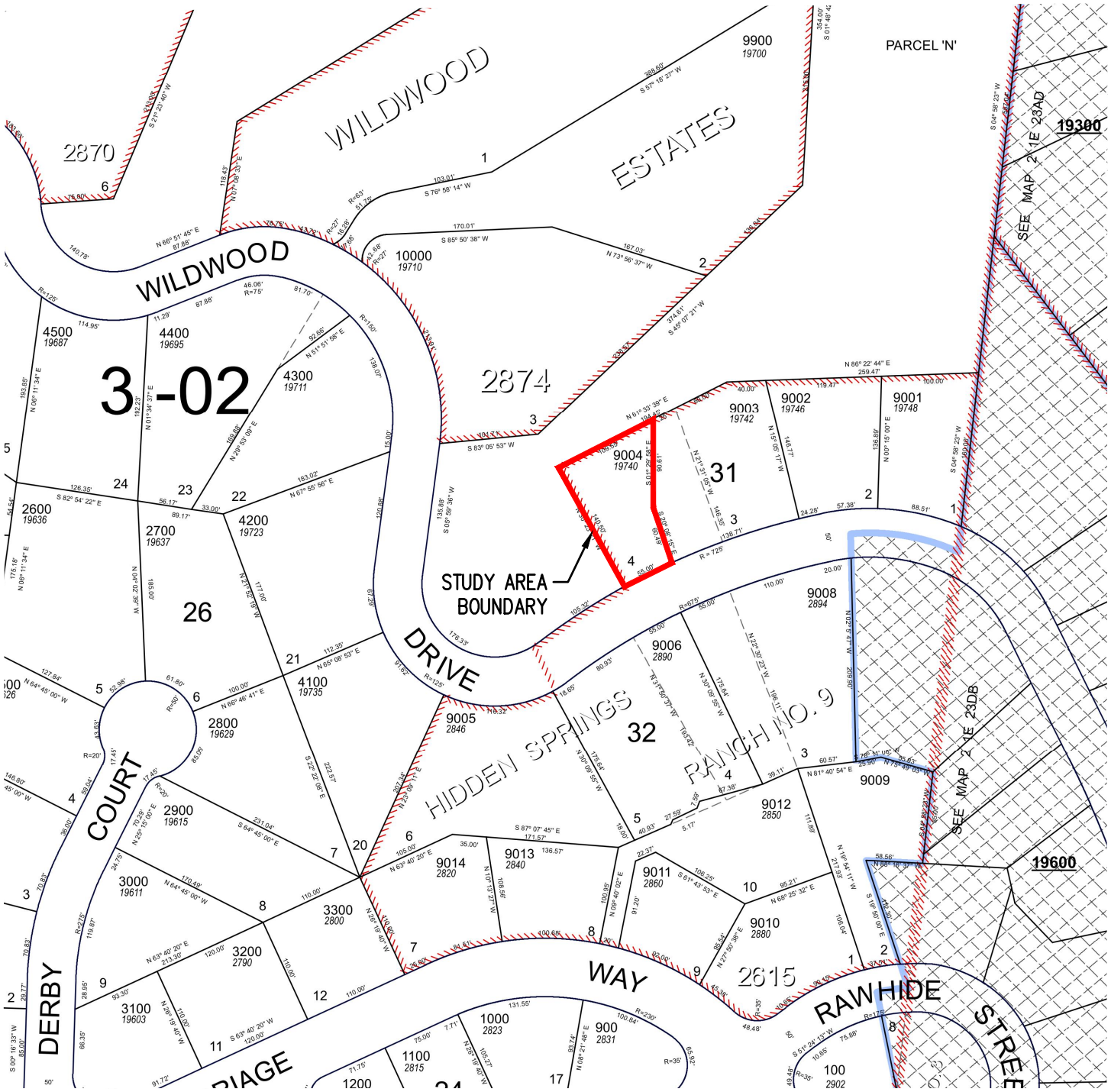
DATE: 06/22/2018

USGS VICINITY MAP
WILDWOOD DRIVE WEST LINN NATURAL RESOURCE ASSESSMENT MEMO

FIGURE 1

AKS ENGINEERING & FORESTRY, LLC
12965 SW HERMAN RD SUITE 100
TUALATIN, OR 97062 www.aks-eng.com
PHONE: 503.563.6151 FAX: 503.563.6152

DRWN: KMK
CHKD: HS
AKS JOB: 6786



CLACKAMAS COUNTY
TAX LOT 9004
TAX MAP 2 1 E 23AC

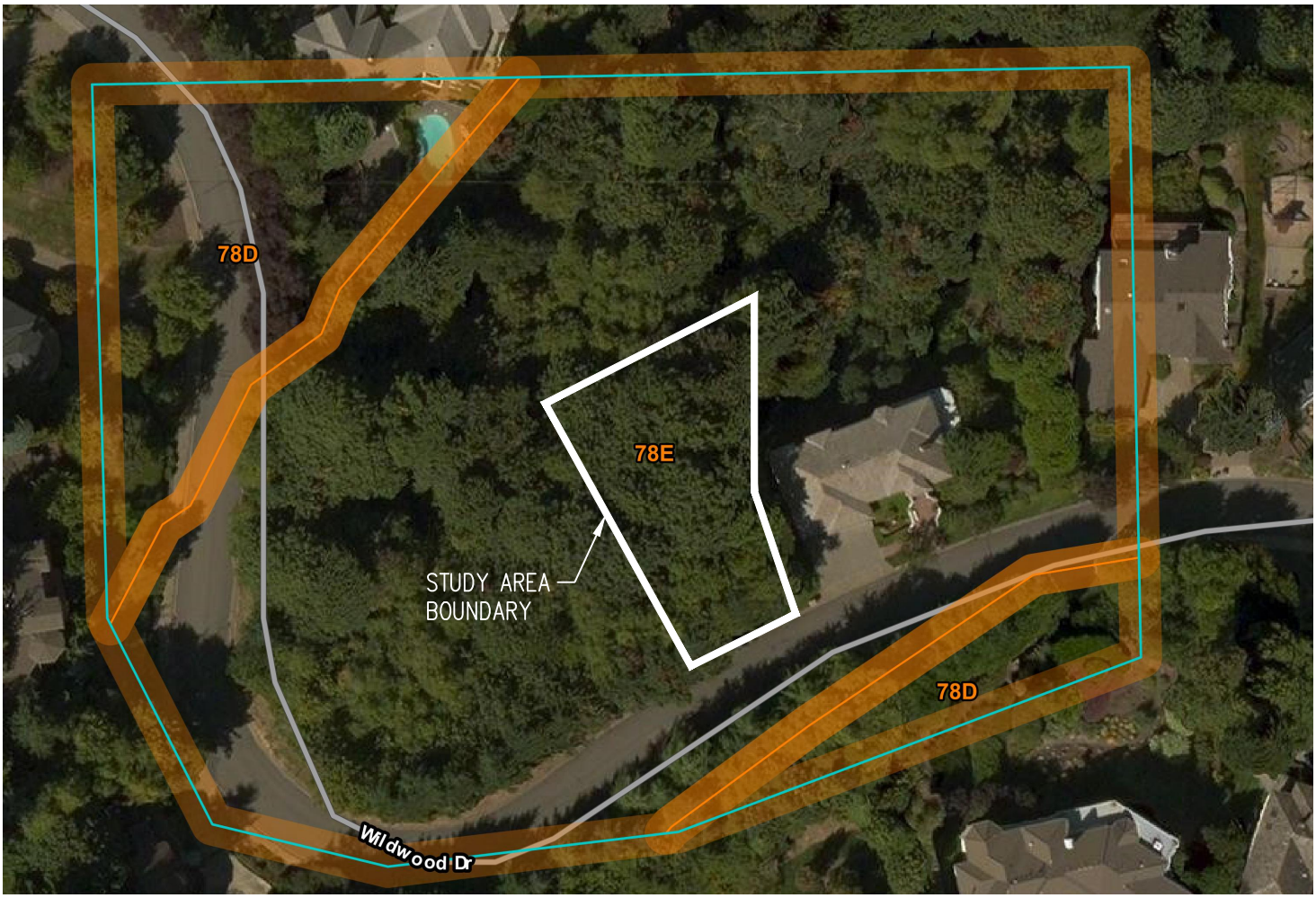
N

SCALE: 1"=150 FEET

150 0 60 90 120 150

DATE: 06/22/2018

TAX MAP (MAP 2 1E 23AC) WILDWOOD DRIVE WEST LINN NATURAL RESOURCE ASSESSMENT MEMO	FIGURE 2
AKS ENGINEERING & FORESTRY, LLC 12965 SW HERMAN RD SUITE 100 TUALATIN, OR 97062 www.aks-eng.com PHONE: 503.563.6151 FAX: 503.563.6152	DRWN: KMK CHKD: HS AKS JOB: 6786



MAP UNIT SYMBOL	MAP UNIT NAME
78E	SAUM SILT LOAM, 30% TO 60% SLOPES; NON-HYDRIC

NRCS WEB SOIL SURVEY FOR
CLACKAMAS COUNTY

N

SCALE: 1"= 80 FEET

80 0 32 48 64 80

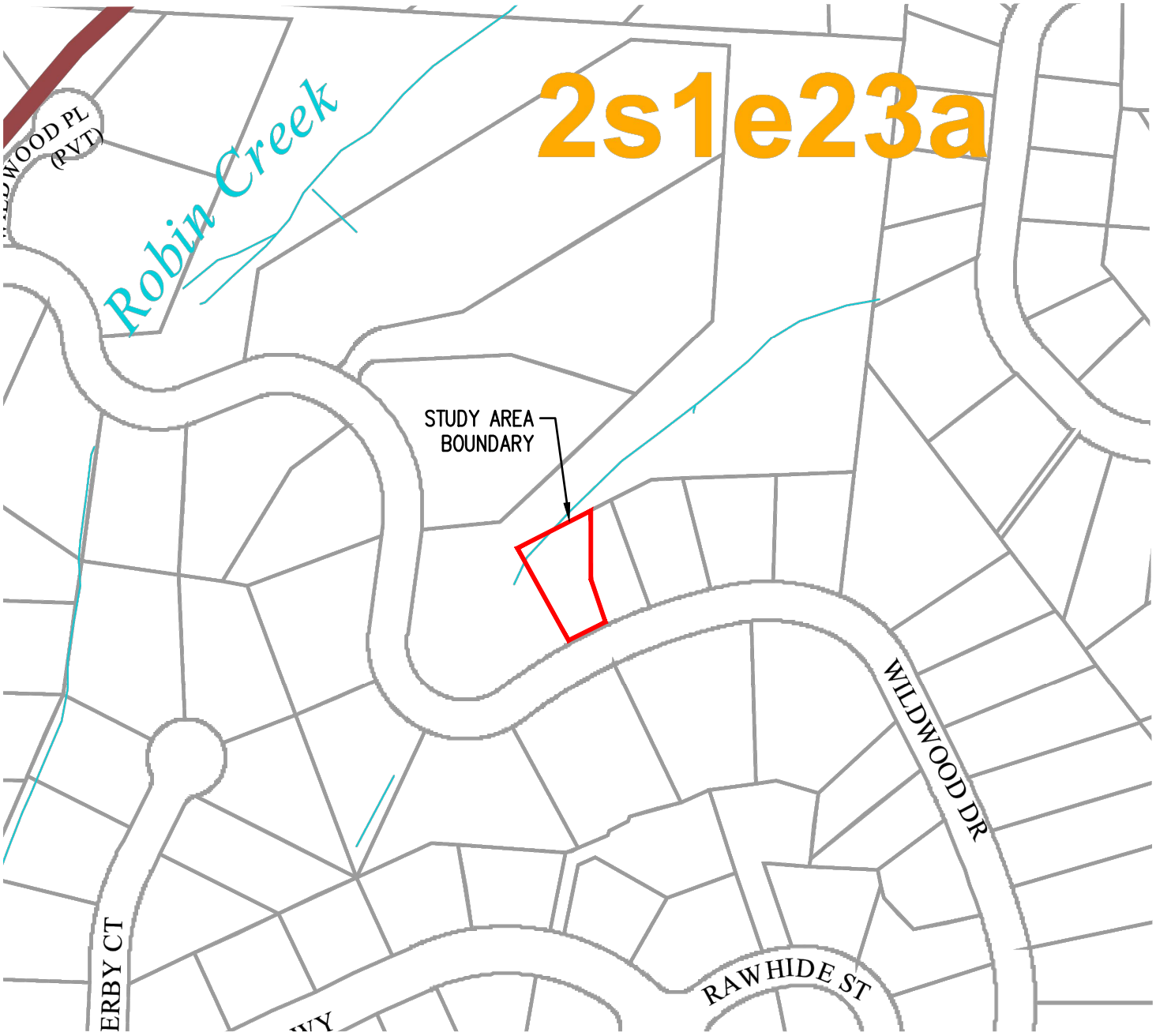
DATE: 06/22/2018

NRCS SOIL SURVEY MAP
WILDWOOD DRIVE WEST LINN NATURAL RESOURCE ASSESSMENT MEMO

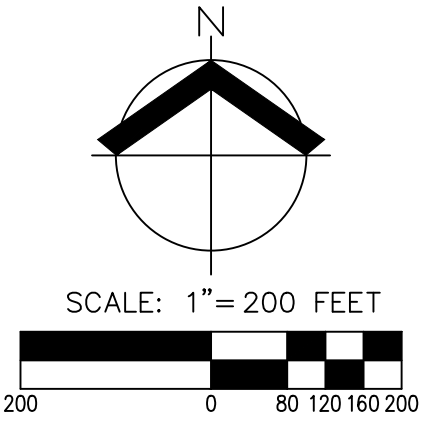
FIGURE 3

AKS ENGINEERING & FORESTRY, LLC
12965 SW HERMAN RD SUITE 100
TUALATIN, OR 97062 www.aks-eng.com
PHONE: 503.563.6151 FAX: 503.563.6152

DRWN: KMK
CHKD: HS
AKS JOB: 6786



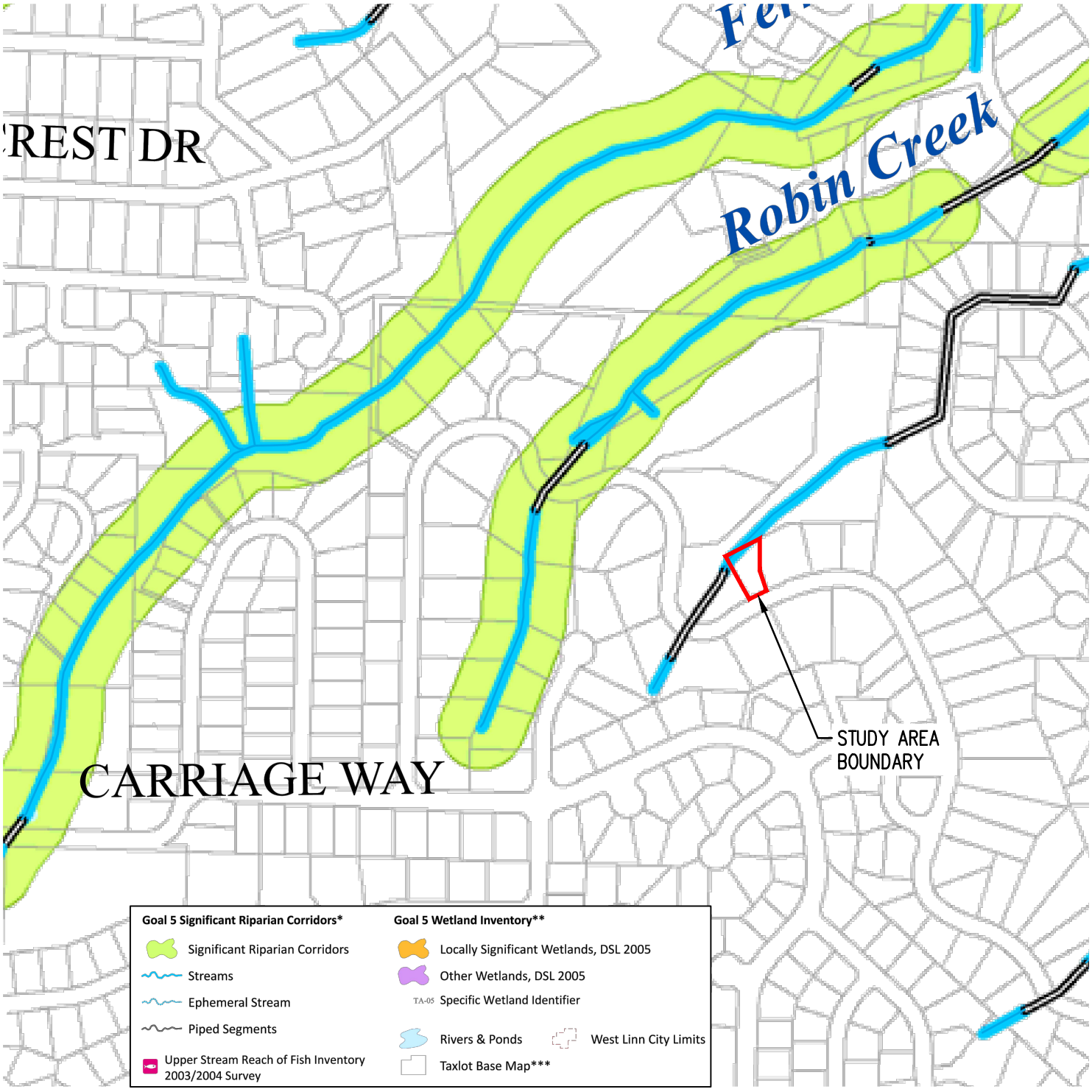
CITY OF WEST LINN
LOCAL WETLAND INVENTORY (2004)



DATE: 06/22/2018

LOCAL WETLAND INVENTORY MAP WILDWOOD DRIVE WEST LINN NATURAL RESOURCE ASSESSMENT MEMO	FIGURE 4
AKS ENGINEERING & FORESTRY, LLC 12965 SW HERMAN RD SUITE 100 TUALATIN, OR 97062 www.aks-eng.com PHONE: 503.563.6151 FAX: 503.563.6152	DRWN: KMK CHKD: HS AKS JOB: 6786

DWG: 6786 NRA FIGURES 1-4 | FIGURE 4



WEST LINN PLANNING DEPARTMENT AND GIS
(MAY, 2014)

N

SCALE: 1"= 400 FEET

400 0 160 240 320 400

DATE: 07/17/2018

WEST LINN WATER RESOURCE AREA (WRA) MAP
WILDWOOD DRIVE WEST LINN NATURAL RESOURCE ASSESSMENT MEMO

FIGURE 5

AKS ENGINEERING & FORESTRY, LLC
12965 SW HERMAN RD SUITE 100
TUALATIN, OR 97062 www.aks-eng.com
PHONE: 503.563.6151 FAX: 503.563.6152

DRWN: JRI
CHKD: SAR
AKS JOB: 6786

TITLE NOTE:

1. THIS SURVEY DOES NOT CONSTITUTE A TITLE SEARCH BY SURVEYOR. THERE MAY EXIST EASEMENTS, CONDITIONS, OR RESTRICTIONS THAT COULD AFFECT THE TITLE OF THIS PROPERTY. NO ATTEMPT HAS BEEN MADE IN THIS SURVEY TO SHOW SUCH MATTERS THAT MAY AFFECT TITLE.

TOPOGRAPHIC SURVEY

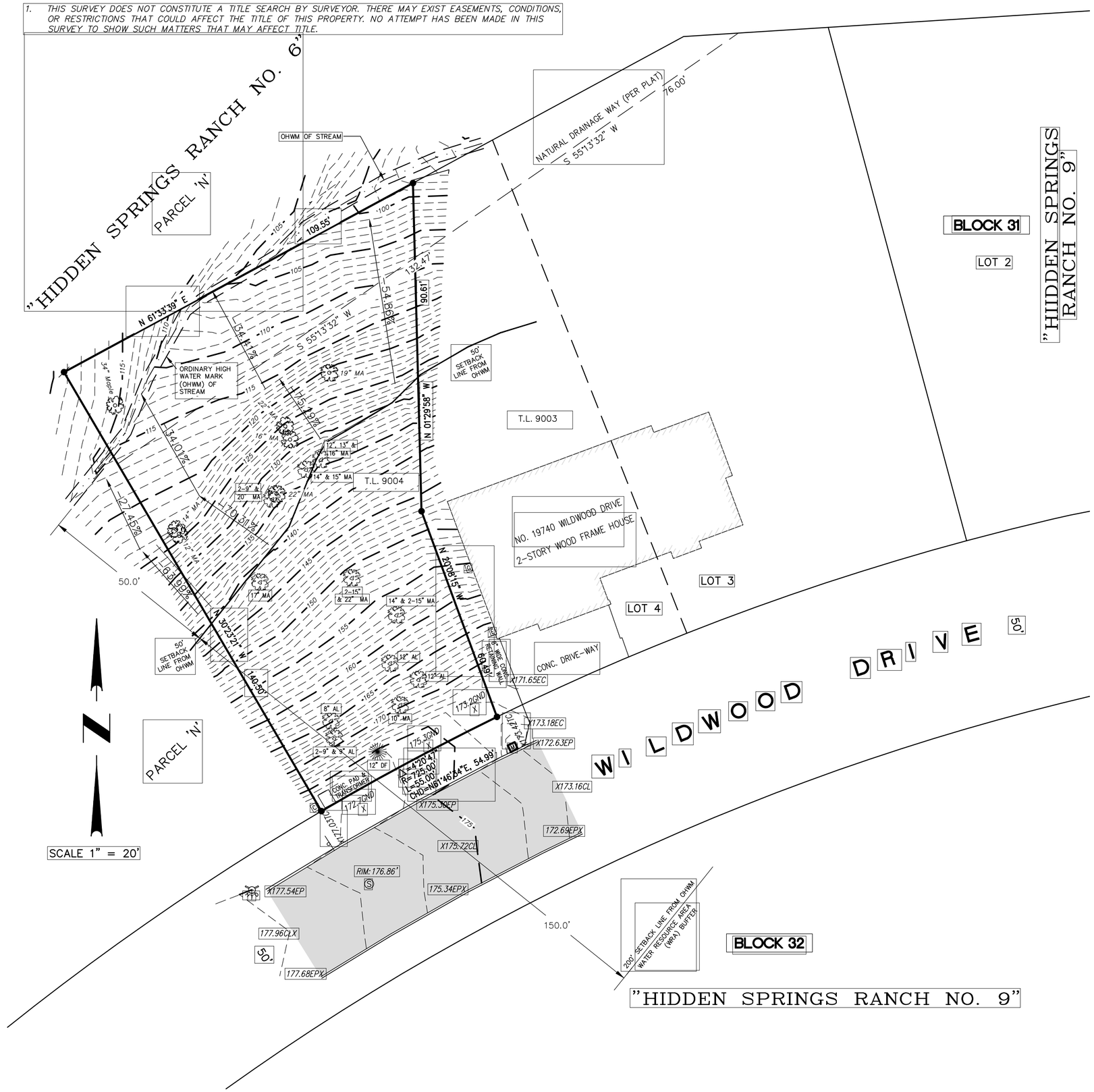
FOR:

MAX ECKELMAN

BEING A PORTION OF LOT 4, BLOCK 31, "HIDDEN SPRINGS RANCH NO. 9"

IN THE NE 1/4 SEC. 23, T.2S., R.1E., W.M.
CITY OF WEST LINN
CLACKAMAS COUNTY, OREGON

JULY 11, 2018 MAP 2 1E 23AC



LEGEND:

FOUND 5/8" IRON ROD WITH YELLOW PLASTIC CAP STAMPED: "ANDY PARIS & ASSOC, INC."	DF DOUGLAS FIR TREE
FOUND 5/8" I.R. (SMOOTH) W/YPC "LS 937" PER PLAT OF "HIDDEN SPRINGS RANCH NO. 9"	AL ALDER TREE
	MA MAPLE TREE
(S) SANITARY SEWER MANHOLE	000.00FFX SPOT ELEVATION TOP OF CURB
FIRE HYDRANT	000.00GNDX SPOT ELEVATION GROUND
(M) MAILBOX IN BRICK COLUMN	000.00EPX SPOT ELEVATION EDGE OF PAVEMENT
(E) ELECTRIC METER	000.00CLX SPOT ELEVATION CENTER OF ROAD
(G) GAS METER	CONC. VERTICAL CURB (UNLESS OTHERWISE NOTED)
(C) CABLE PEDESTAL	
ROAD SIGN	ASPHALT
DECIDUOUS TREE AS NOTED	
CONIFEROUS TREE AS NOTED	

NOTES:

1. ELEVATIONS ARE ON AN ASSUMED DATUM..
2. THE BOUNDARIES AS SHOWN ON THIS MAP ARE BASED ON RECORD DATA AND FOUND MONUMENTS. THIS MAP DOES NOT REPRESENT A SURVEY TO BE RECORDED, BUT WAS DONE FOR SITE/TOPO INFORMATION ONLY.
3. THIS SURVEY IS MADE FOR THE ORIGINAL PURCHASER OF THE SURVEY ONLY. ANDY PARIS & ASSOCIATES, INC. ASSUMES NO LIABILITY FOR INFORMATION SHOWN HEREON TO ANY OTHER INSTITUTIONS OR SUBSEQUENT PURCHASERS OF THE PROPERTY.
4. SURVEY IS VALID ONLY IF PRINT HAS SEAL AND SIGNATURE OF SURVEYOR.
5. THE LOCATION AND OR EXISTENCE OF UTILITY SERVICE LINES AS SHOWN ON THIS MAP ARE BASED ON FIELD OBSERVATION ONLY. THERE MAY EXIST ADDITIONAL SERVICE LINES NOT SHOWN ON THIS SURVEY.
6. SUBSURFACE AND ENVIRONMENTAL CONDITIONS WERE NOT EXAMINED OR CONSIDERED AS A PART OF THIS SURVEY. NO STATEMENT IS MADE CONCERNING THE EXISTENCE OF UNDERGROUND OR OVERHEAD CONTAINERS OR FACILITIES THAT MAY AFFECT THE USE OR DEVELOPMENT OF THIS TRACT.
7. THIS SURVEY DOES NOT CONSTITUTE A TITLE SEARCH BY SURVEYOR. THERE MAY EXIST EASEMENTS, CONDITIONS, OR RESTRICTIONS THAT COULD AFFECT THE TITLE OF THIS PROPERTY. NO ATTEMPT HAS BEEN MADE IN THIS SURVEY TO SHOW SUCH MATTERS THAT MAY AFFECT TITLE.

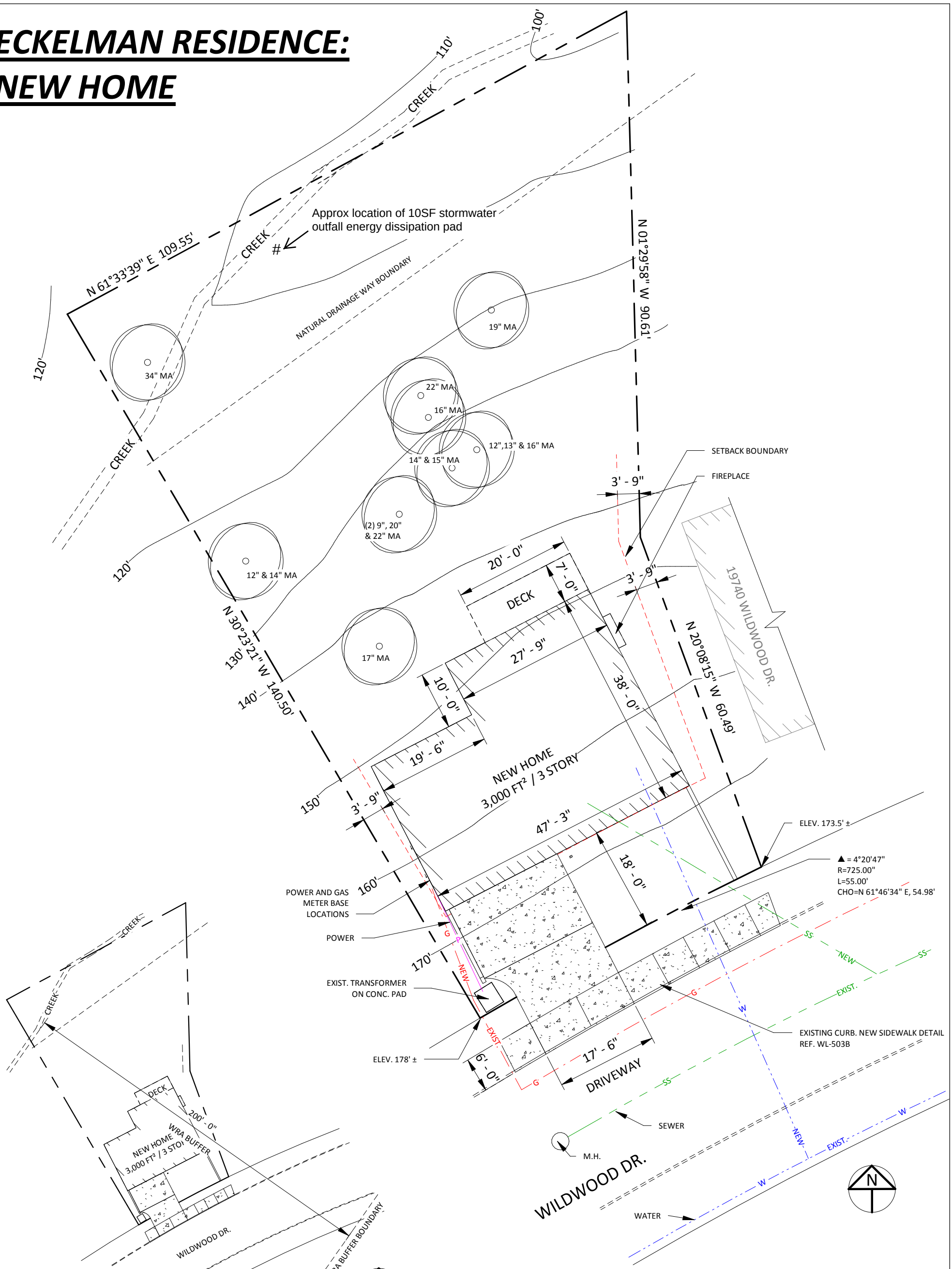
REGISTERED PROFESSIONAL LAND SURVEYOR
OREGON
JANUARY 15, 1987
HAROLD P. SALO
2264
EXPIRES: JUNE 30, 2020

SINCE 1952
ANDY PARIS AND ASSOCIATES, INC.
PROFESSIONAL LAND SURVEYORS
16057 BOONES FERRY ROAD
LAKE OSWEGO, OREGON 97035
PH: 503-636-3341
www.andyparis.com

PROJECT: 18134
DRAWING: 18134TP1.DWG
DRAFTED: AH 07/11/18

FIGURE 6 EXISTING CONDITIONS

ECKELMAN RESIDENCE:
NEW HOME



1 SITE PLAN
1/16" = 1'-0"

2 WRA BUFFER ZONE
1" = 50'-0"

PERMANENT DISTURBANCE AREA WITHIN WRA BUFFER ZONE: 2,510 FT²
(BUILDING FOOTPRINT, CONCRETE DRIVEWAY AREA, NEWLY GRADED LANDSCAPED AREA, ETC.)

APPLICANT:
MAX ECKELMAN
509 WASHINGTON ST.
OREGON CITY, OR 97045
(503) 572-0239

ECKELMAN
GARY ECKELMAN, ARCHITECT
4529 SE 67TH AVE. PORTLAND, OR 97206
P. (503) 572-1247

ECKELMAN - NEW SINGLE FAMILY HOME
19738 WILDWOOD DR, WEST
LINN, OR 97068

WRA - SITE PLAN FIGURE 7

Project number	18-102
Date	7/12/2018
Drawn by	CE
Checked by	GE

A1

Scale As indicated
7/12/2018 3:33:55 PM

EROSION CONTROL / TREE PROTECTION NOTES:

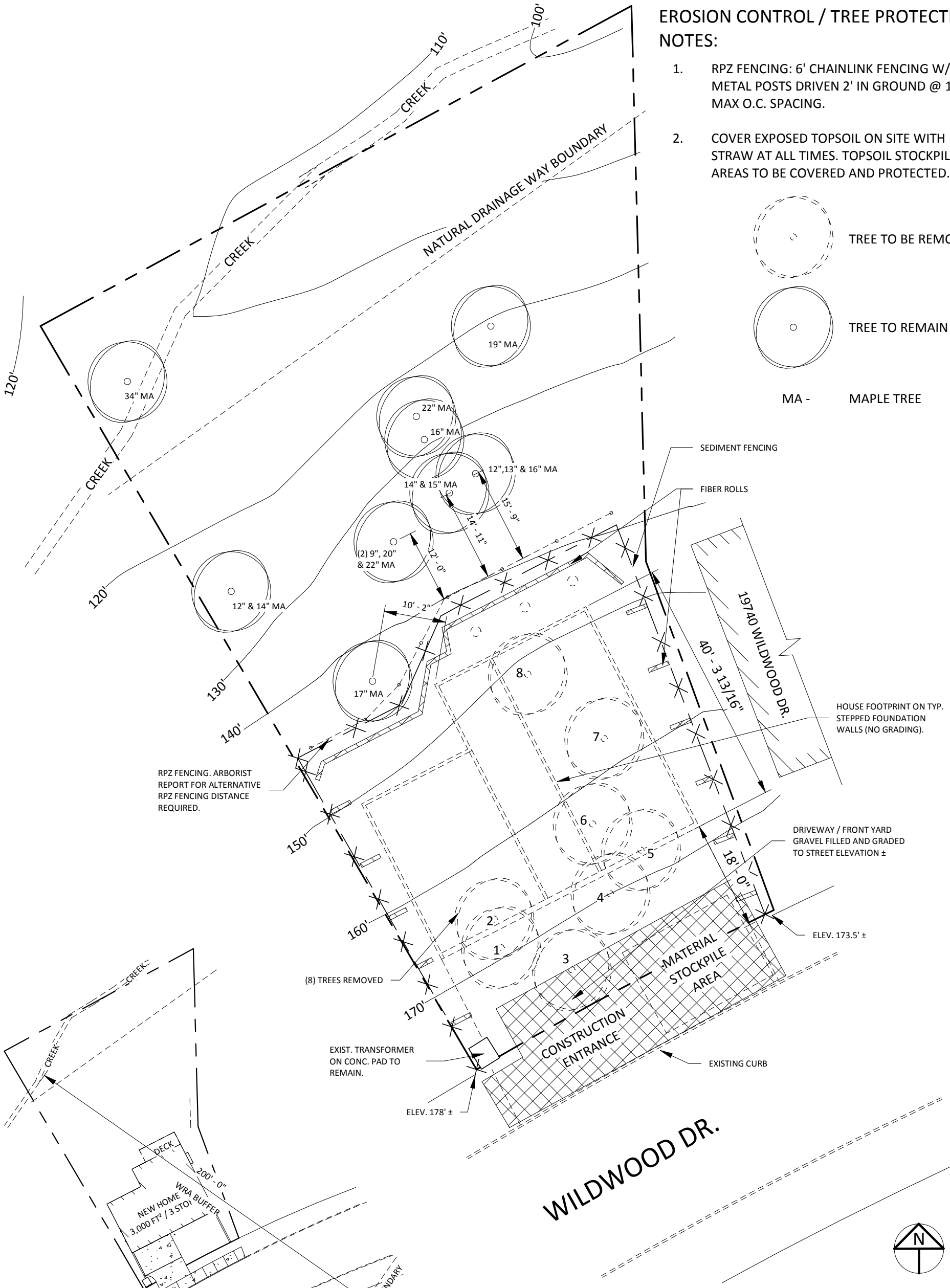
1. RPZ FENCING: 6' CHAINLINK FENCING W/ 8' METAL POSTS DRIVEN 2' IN GROUND @ 10' MAX O.C. SPACING.

2. COVER EXPOSED TOPSOIL ON SITE WITH STRAW AT ALL TIMES. TOPSOIL STOCKPILE AREAS TO BE COVERED AND PROTECTED.

TREE TO BE REMOVED

TREE TO REMAIN

MA - MAPLE TREE



1 EROSION/TREE PLAN
1/16" = 1'-0"

2 WRA BUFFER ZONE
1" = 50'-0"

PERMANENT DISTURBANCE AREA WITHIN WRA BUFFER ZONE: 2,510 FT²
(BUILDING FOOTPRINT, CONCRETE DRIVEWAY AREA, NEWLY GRADED LANDSCAPED AREA, ETC.)

APPLICANT:

MAX ECKELMAN
509 WASHINGTON ST.
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ECKELMAN
GARY ECKELMAN, ARCHITECT
4529 SE 67TH AVE. PORTLAND, OR 97206
P. (503) 572-1247

ECKELMAN - NEW SINGLE FAMILY HOME

19738 WILDWOOD DR, WEST LINN, OR 97068

WRA - EROSION/TREE PLAN

FIGURE 7A

Project number	18-102
Date	7/12/2018
Drawn by	CE
Checked by	GE

A2

Scale As indicated

7/12/2018 3:33:55 PM

Photos taken by Stacey Reed on May 14, 2018

Photo A. View of property from Wildwood Drive.

Photo B. View northeast of good condition Water Resource Area (WRA).

Photo B. View of on site portion of drainage.

Photo D. View south of steep slopes adjacent to drainage.

Geologic Hazards and
Geotechnical Investigation
Tax Lot 9004, Map 2-1E-23AC
19738 Wildwood Drive
West Linn, Oregon

Prepared for:
Mr. Max Eckelman
Eckelman Construction LLC.
4529 S.E. 67th Avenue
Portland, Oregon 97206

Project #Y184154

July 19, 2018

H.G. Schlicker & Associates, Inc.

H.G. Schlicker & Associates, Inc.
607 Main Street, Suite 200 • Oregon City, Oregon 97045
(503) 655-8113 • FAX (503) 655-8173

Project #Y184154

July 19, 2018

To: **Mr. Max Eckelman**
Eckelman Construction LLC.
4529 S.E. 67th Avenue
Portland, Oregon 97206

Subject: **Geologic Hazards and**
Geotechnical Investigation
Tax Lot 9004, Map 2-1E-23AC
19738 Wildwood Drive
West Linn, Oregon

Dear Mr. Eckelman:

The accompanying report presents the results of our geologic hazards and geotechnical investigation for the above subject site.

After you have reviewed our report, we would be pleased to discuss it and to answer any questions you might have.

This opportunity to be of service is sincerely appreciated. If we can be of any further assistance, please contact us.

H.G. SCHLICKER & ASSOCIATES, INC.

J. Douglas Gless, MSc, RG, CEG, LHG
President/Principal Engineering Geologist

JDG:mgb

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

FIGURES

APPENDICES

H.G. Schlicker & Associates, Inc.
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Project #Y184154 July 19, 2018

To: **Mr. Max Eckelman**
Eckelman Construction LLC.
4529 S.E. 67th Avenue
Portland, Oregon 97206

Subject: **Geologic Hazards and**
Geotechnical Investigation
Tax Lot 9004, Map 2-1E-23AC
19738 Wildwood Drive
West Linn, Oregon

Dear Mr. Eckelman:

1.0 Introduction and General Information

At your request and authorization, a representative of H.G. Schlicker and Associates, Inc. (HGSA) visited the subject site on June 6, 2018 to complete a geologic hazards and geotechnical investigation of Tax Lot 9004, Map 2-1E-23AC, located at 19738 Wildwood Drive, West Linn, Oregon (Figures 1 and 2; Appendix A). It is our understanding that you are are planning to construct a new home on the property.

This report addresses the engineering geology and geologic hazards at the site with respect to constructing a home. The scope of our work consisted of a site visit, site observations and measurements, hand augered borings, a slope profile, limited review of the geologic literature, interpretation of topographic maps, lidar and stereo aerial photographs, and preparation of this report which provides our findings, conclusions, and recommendations.

2.0 Site Description

The site is located on a northwest facing hillside in West Linn, Oregon (Figures 1 and 2; Appendix A). The site consists of a vacant 0.24-acre lot approximately 140 feet deep, southeast to northwest, and 55 to 109 feet wide, southwest to northeast (Figure 2). The lot is bound to the south by Wildwood Drive, to the east by an existing home, and to the north and west by Wildwood Open Space.

The site generally slopes down to the north from 20 to 40 degrees. Uncontrolled fill, landscape and construction-related debris, including large pieces of concrete and bricks as much as 6 feet thick were observed near the top of the slope near the southern portion of the site. Cracks on the asphalt surface of Wildwood Drive were observed near the site. The site is vegetated with evergreen and deciduous trees, ferns, ivy, and other brush.

Wildwood Open Space and a tributary of Robin Creek occupy the northern portion of the site. The banks of the creek were heavily vegetated and in places overgrown to the point of obscuring the creek bed. The areas of exposed creek bed were lined with rock fragments. Debris was observed in the creek including a section of metal pipe and a tire.

3.0 Geologic Mapping, Investigation and Descriptions

The site lies in an area mapped as middle Miocene-aged basalt of the Columbia River Basalt Group (Schlicker and Finlayson, 1979; Beeson et al., 1989). Volcanic rocks of Columbia River Basalt Group are flood-basalt flows of variable thickness that were erupted from long linear fissures in northeastern Oregon, eastern Washington, and western Idaho. These lavas generally consist of dense, fine-grained to glassy rock in the lower portion, with a middle zone of massive columnar jointed to close cubic jointed rock and an upper zone of vesicular or scoriaceous rock which is often deeply weathered and altered to a residual clayey soil. The subject site is mapped as having middle Miocene basalt of the Sentinel Bluffs unit of the Grande Ronde Basalt; middle Miocene basalt rocks of the Winter Water unit are also mapped on the northern part of the site (Beeson et al., 1989) In the area of the site, total unit thickness of Columbia River Basalt rocks is more than 900 feet (Schlicker and Finlayson, 1979).

At the time of our site visit, we completed three hand augered borings as deep as approximately 4 feet. The approximate locations of the borings are shown in Figure 3. An engineering geologist from our office visually classified the soils encountered according to the Unified Soil Classification System (USCS) as follows:

B-1	Depth (ft.)	USCS	Description
	0 – 1.0	ML	SILT, medium brown, moist, soft, with organic matter and 0.5" > roots.
	1.0 – 1.5	ML	SILT, medium brown, moist, soft, with fragments of clayey silt.
	1.5 – 3.0	ML	CLAYEY SILT, brown, moist, soft, with reddish brown, medium stiff, clayey silt fragments.

	3.0 – 4.5	ML	CLAYEY SILT, brown, moist medium stiff, with orange stained rock fragments.
B-2	**Depth (ft.)**	**USCS**	**Description**
	0 – 1.5	ML (Disturbed)	CLAYEY SILT, red-brown, moist, medium stiff, with roots less than 0.5" diameter.
	1.5 – 3.0	ML	CLAYEY SILT, medium brown, moist, medium stiff.
B-3	**Depth (ft.)**	**USCS**	**Description**
	0 – 2.0	ML (Disturbed)	CLAYEY SILT, dark brown, moist, soft, with roots less than 0.5" diameter.
	2.0 – 3.5	ML	CLAYEY SILT, light brown, moist, medium stiff, with roots less than 0.25" diameter.

Soils encountered at the site generally consisted 2-6 feet of uncontrolled fill and debris at upper elevations near the road. Soft to medium stiff native silts are underlain at shallow depth by medium stiff silts with weathered basaltic rock fragments.

3.1 Structures

The site is located approximately 1.5 miles southwest of the Portland Hills fault, and approximately 1 mile southwest of Oatfield fault. These potentially active faults are part of the Portland Hills fault zone which also includes the East Bank fault. These faults are believed to be characterized by dextral strike-slip motion, and have a potential of generating magnitude 6.5 to 7.1 earthquakes (Geomatrix, 1995; Wong et al., 2000). The Portland Hills fault is believed to have a potential of generating a magnitude 6.6 to 7.1 earthquake, and the Oatfield fault is believed to have a potential of generating a magnitude 6.5 to 6.9 earthquake (Wong et al., 2000). The site is mapped approximately 800 feet southwest of the Bolton fault, an approximately 5-mile long, northwest striking, southwest-dipping reverse fault which trends generally along the Willamette River; the fault is part of the Portland Hills fault zone and the Portland Hills–Clackamas River structural zone (Beeson et al., 1989, Personius et al., 2003). The Bolton fault is considered to be potentially active (Wong et al., 2000; Personius et al., 2003).

Based on mapping, the subject site lies approximately 3 miles northeast of the Molalla-Canby fault. The Molalla-Canby fault is an approximately 30-mile long northwest

trending, northeast dipping fault. Delineation of the Molalla-Canby fault has been largely based on data obtained from low-altitude aeromagnetic data (Blakely et al., 1995). Although there is no definitive evidence that has established the seismic potential of this fault, seismic reflection data across the East Bank and Portland Hills faults, which the Molalla-Canby fault may be associated with, have indicated possible displacements in the last 15,000 years (Wong et al., 2000). The fault appears to deform Missoula flood deposits which were deposited approximately 15,000 years ago.

4.0 Slope Stability and Erosion

The area of the site is located on a generally northeast-sloping hillside which formed as the result of downcutting and erosion of the Willamette River (Figure 1). The site generally slopes from approximately 20 to 40 degrees toward the northwest and is located on the flanks of a small stream valley. A tributary of Robin Creek flows across the northwest corner of the site at the base of the slope (Figure 3).

DOGAMI's SLIDO-3 landslide mapping shows a southeast facing complex earth flow (Lake_Oswego_324) mapped approximately 1,100 feet northwest of the site; no other significant landslide features are mapped within a ¼ mile radius of the subject site (Burns and Duplantis, 2010; Burns and Watzig, 2014). However, the site is in area mapped with a landslide hazard of Moderate, landsliding possible, to High, landsliding likely, according to DOGAMI.

At the time of our site visit, we observed some minor signs of shallow sloughing near the top of the slope in the uncontrolled fill. Clearing and grading activity at the site could expose surface soils to surface water erosion if not mitigated. Because of the steeply sloping nature of the site, stormwater runoff from the site could cause rill erosion in areas of exposed soil.

5.0 Regional Seismic Hazards

The historical earthquake record for the Willamette Valley and Portland basin is dominated by small to moderate earthquakes and an appreciable lack of significantly large earthquakes. Most of the earthquakes which have occurred within the Portland metropolitan area and surrounding areas could not be associated with any known faults. There have been at least 17 earthquake events of Richter magnitude (M) 4 or larger which have occurred in the region in historic time, of which 6 of these events have been of magnitude (M) 5.0 and greater. The largest historic earthquakes within the region have been the 2001 Nisqually, Washington earthquake (M 6.8), the 1993 Scotts Mills earthquake (M 5.6) northeast of Salem, Oregon, the 1964 Vancouver, Washington earthquake (M 5.3), the 1962 Portland earthquake (M 5.5), and the 1961 earthquake (M 5.0) northwest of Portland. There are at least three crustal faults beneath the Portland metropolitan area which researchers believe could generate earthquakes of M 6.5 or

larger (Wong et al., 2000). These larger earthquakes may occur at an average interval of approximately 1,000 years (Bott and Wong, 1993).

Abundant evidence indicates that a series of earthquakes related to the Cascadia Subduction Zone (CSZ) have occurred along the coastline of the Pacific Northwest. Evidence suggests that there have been as many as thirteen major earthquakes, or more, in the last 7,700 years (Priest et al., 1997). These earthquakes were likely of magnitude (M) 8.0 to 9.0, and are believed to have had a mean recurrence interval of 500 to 600 years; however, some of the past earthquakes have had intervals less than 300 years (Clague et al., 2000). Evidence suggests the last major earthquake occurred in 1700 and may have been of magnitude (M) 9.0 (Clague et al., 2000). Locally, these great coastal earthquakes would likely have about the same effects as a local large earthquake, although ground shaking due to a CSZ earthquake may have a longer duration.

As noted above, faults within the Portland Fault Zone have a potential of generating magnitude 6.5 to 7.1 earthquakes (Geomatrix, 1995; Wong et al., 2000). Based on 1997 Relative Earthquake Hazard Map of the Portland Metro Region (Mabey et al., 1997), the subject site lies in an area designated as Zone A. Zone A represents areas which show the greatest hazard associated with earthquakes. The degree of relative hazard was based on the factors of ground motion amplification, liquefaction, and slope instability.

6.0 Flooding Hazards and Riparian Mapping

Based on the 2008 Flood Insurance Rate Map (FIRM, Panel #41005 C0019D) the site lies in an area rated as Zone X which is defined as an area determined to be outside the 0.2% annual chance floodplain.

The site is not mapped as lying in an area of wet soils or high water table (Schlicker and Finlayson, 1979). However, as mentioned above, the site lies on the flanks of the valley of a small, primarily stormwater fed, stream. At the time of our site visit, we observed the stream at the site, which is mapped as a tributary of Robin Creek. Stormwater runoff above the site flows downslope toward the site. The site may be subject to seasonally high groundwater. Based on mapping from the City of West Linn GIS MapOptix website, (accessed July 2018) the site is not mapped as Goal 5 Significant Riparian. However, the area immediately to the northwest of the subject site, the main branch of Robin Creek, has been mapped as Goal 5 Significant Riparian.

7.0 Climate Change

According to most of the recent scientific studies, the Earth's climate is changing as the result of human activities which are altering the chemical composition of the atmosphere through the buildup of greenhouse gases, primarily carbon dioxide, methane, nitrous oxide, and

chlorofluorocarbons (EPA, 1998). Although there are uncertainties about exactly how and when the Earth's climate will respond to enhanced concentrations of greenhouse gases, scientific observations indicate that detectable changes are under way (EPA, 1998; Church and White, 2006). Global climate change can lead to increased rainfall which can result in an increase in landslide occurrence.

8.0 Conclusions and Recommendations

The main engineering geologic concerns at the site are:

1. The hillsides in the draw above the site have the potential of generating debris slides and mudflows that could travel downslope and impact the lower elevations of the site in the immediate vicinity of the stream.

2. Uncontrolled fills up to several feet thick are present on the northern part of the site, along the north side of Wildwood Drive. These fills will need to be removed and replaced with properly compacted structural fill in order to construct the driveway.

3. Foundations can be footings stepped down the slope, grade beams supported on deep foundations such as augered or driven pile, or a daylight basement type design. Please note that prior to design of a deep foundation system, the site would need to be drilled to obtain deep subsurface information as required by the Oregon Structural Specialty Code (OSSC).

4. Stormwater discharged or concentrated on the slope has the potential to cause erosion and/or slope instability effects at the site. As discussed in Section 8.11, stormwater will need to be collected from the roof drains, impervious surfaces and flatwork, and footing drains, directed downslope in a buried pvc pipe and discharged at one or more energy dissipaters near the creek at the northwest portion of the site.

5. There is an inherent risk of earthquakes in Oregon which could cause harm and damage structures, and the subject site is located in the vicinity of Portland-area seismically active faulting. These risks must be accepted by the owners, future owners, developers, and residents of the site.

The following recommendations shall be adhered to during design and construction:

8.1 Site Preparation

A stepped foundation design would be most appropriate for the site. An HGSA representative shall observe the footing locations and foundation excavations prior to placing fill, forming and/or pouring of concrete.

Building loads may be supported on individual and continuous spread footings bearing in undisturbed, native, non-organic, firm soils or properly designed and compacted structural fill placed on these soils. All footing areas should be stripped of all organic soils, organic debris, and any existing fills. We anticipate that non-organic, firm soils will be encountered at depths of approximately 4 feet. However depths may vary substantially which will necessitate HGSA's professional site observations during excavation for the foundations. Care should be taken during excavation so that materials exposed in the excavations are not disturbed or softened. Protection of footing areas from deterioration may be necessary, and can be accomplished by placing 3 to 4 inches of well compacted crushed rock aggregate in footing and slab areas.

Any tree stumps, including the root systems, shall be removed from beneath footing, slab and pavement areas, and the resulting holes backfilled with compacted structural backfill placed in lifts not exceeding 8 inches and compacted to a dry density of at least 92 percent of the Modified Proctor maximum dry density (ASTM D1557).

8.2 Soil Bearing Capacities

Footings bearing in undisturbed, native, non-organic, firm soils or properly compacted structural fill placed on these soils may be designed for the following:

ALLOWABLE SOIL BEARING CAPACITIES	
Allowable Dead Plus Live Load Bearing Capacity [a]	2,000 psf
Passive Resistance	250 psf/ft embedment depth
Lateral Sliding Coefficient	0.35
[a] Allowable bearing capacity may be increased by one-third for short term wind or seismic loads.	

8.3 Footings

Our recommended minimum footing widths and embedment depths are as follows:

MINIMUM FOOTING WIDTHS & EMBEDMENT DEPTHS			
Number of Stories	One	Two	Three
Minimum Footing Width	18 inches	24 inches	28 inches
Minimum Exterior Footing Embedment Depth [a]	18 inches	20 inches	24 inches
Minimum Interior Footing Embedment Depth [b]	6 inches	6 inches	6 inches

[a] All footings shall be embedded as specified above, or extend below the frost line as per Table R301.2(1) of the 2014 ORSC, whichever provides greater embedment.

[b] Interior footings shall be embedded a minimum of 6 inches below the lowest adjacent finished grade, or as otherwise recommended by our firm. In general, interior footings placed on sloping or benched ground shall be embedded or set back from cut slopes in such a manner as to provide a minimum horizontal distance between the foundation component and face of the slope of one foot per every foot of elevation change.

8.4 Slabs-On-Ground

All areas beneath slabs shall be excavated a minimum of 6 inches into native, non-organic, firm soils. The exposed subgrade in the slab excavation shall be cut smooth, without loose or disturbed soil and rock remaining in the excavation.

SLABS-ON-GROUND	
Minimum thickness of 3/4 inch minus crushed rock beneath slabs	6 inches
Compaction Requirements	92% ASTM D1557, compacted in 8-inch lifts maximum

The slab excavation shall then be backfilled with a minimum of 6 inches of ¾ inch minus, clean, free-draining, crushed rock placed in 8-inch lifts maximum which are compacted to 92 percent of the Modified Proctor (ASTM D1557). Reinforcing of the slab is recommended and the slab shall be fully waterproofed in accordance with structural design considerations. An underslab drainage system is recommended for all slabs, as per the architect's recommendations. Where floor coverings are planned, slabs shall also be underlain by a suitable moisture barrier.

8.5 Retaining Walls

For static conditions free standing retaining walls shall be designed for a lateral static active earth pressure expressed as an equivalent fluid density (EFD) of 35 pounds per cubic foot, assuming level backfill. An EFD of 45 pounds per cubic foot shall be used assuming sloping backfill of 2H:1V. At-rest retaining walls shall be designed for a lateral at-rest pressure expressed as an equivalent fluid density (EFD) of 60 pounds per cubic foot, assuming level backfill behind the wall equal to a distance of at least half of the height of the wall. Walls need to be fully drained to prevent the build-up of hydrostatic pressures.

The EFDs below assume static conditions, and no surcharge loads from vehicles or structures. If surcharge loads will be applied to the retaining walls, forces on the walls resulting from these loads will need to be added to the pressures given above.

For seismic loading a unit pseudostatic force equal to 8.23 pcf $(H)^2$, where H is the height of the wall in feet, shall be added to the static lateral earth pressure. The location of the pseudostatic force can be assumed to act at a distance of 0.6H above the base of the wall.

RETAINING WALL EARTH PRESSURE PARAMETERS	
Static Case, Active Wall (level backfill/grades)	35 pcf [a]
Static Case, Active Wall (2H:1V backfill/grades)	45 pcf [a]
Static Case, At-Rest Wall (level backfill/grades)	60 pcf [a]
Seismic Loading (level backfill/grades)	8.23 pcf $(H)^2$ [b]

[a] Earth pressure expressed as an equivalent fluid density (EFD).
[b] Seismic loading expressed as a pseudostatic force, where H is the height of the wall in feet. The location of the pseudostatic force can be assumed to act at a distance of 0.6H above the base of the wall.

Free-draining granular backfill for walls shall be placed in 8-inch horizontal lifts and machine compacted to 92 percent of the maximum dry density as determined by ASTM D1557. Compaction within 2 feet of the wall shall be accomplished with light weight hand operated compaction equipment to avoid applying additional lateral pressure on the walls. Drainage of the retaining wall shall consist of slotted drains placed at the base of the wall on the backfilled side and backfilled with free-draining crushed rock (less than 5% passing the 200-mesh sieve using a washed sieve method) protected by non-woven filter fabric (Mirafi® 140N or equivalent) placed between the native soil and the backfill. Filter fabric protected free-draining crushed rock shall extend to within 2 feet of the ground surface behind the wall, and the filter fabric shall be overlapped at the top per the manufacturer's recommendations. All walls shall be fully drained to prevent the build-up

of hydrostatic pressures. All retaining walls shall have a minimum of 2 feet of embedment at the toe, or be designed without passive resistance. The EFDs provided above assume that free draining crushed rock will be used for the retaining wall backfill.

8.6 Seismic Requirements

The structure and all structural elements shall be designed to meet current Oregon Residential Specialty Code (ORSC) seismic requirements. Based on our knowledge of subsurface conditions at the site, and our analysis using the guidelines recommended in the ORSC, the structure shall be designed to meet the following seismic parameters:

SEISMIC DESIGN PARAMETERS	
Site Class	D
Seismic Design Category	D_1
Mapped Spectral Response Acceleration for Short Periods	S_S = 0.857 g
Site Coefficients	F_a = 1.200 F_v = 1.917
Design Spectral Response Acceleration at Short Periods	S_{DS} = 0.686 g

8.7 Structural Fills

Structural fills supporting building loads or slabs shall consist of granular material, free of organics and deleterious materials, and contain no particles greater than 1½ inches in diameter so that nuclear methods (ASTM D2922 & ASTM D3017) can be easily used for field density and moisture testing. All areas to receive fill shall be stripped of all soft soils, organic soils, organic debris, existing fill, and disturbed soils.

Proper test frequency and earthwork documentation usually requires daily observation during stripping, rough grading, and placement of structural fill. Field density testing shall generally conform to ASTM D2922 and D3017, or D1556. To minimize the number of field and laboratory tests, fill materials shall be from a single source and of a consistent character. Structural fill shall be approved and periodically observed by HGSA and tested by a qualified testing firm. Test results will need to be reviewed and approved by HGSA. We recommend that at least three density tests be performed for every 18 inches or every 200 cubic yards of fill placed, whichever requires more testing. Because testing is performed on an on-call basis, we recommend that the earthwork contractor schedule the testing. Relatively more testing is typically necessary on smaller projects.

STRUCTURAL FILL	
Compaction Requirements	92% ASTM D1557, compacted in 8-inch lifts maximum, at or near the optimum moisture content (± 2%).
Benching Requirements [a]	Slopes steeper than 5H:1V that are to receive fill shall be benched. Fills shall not be placed along slopes steeper than 3H:1V, unless approved by H.G. Schlicker & Associates, Inc.
[a] Benches shall be cut into native, non-organic, firm soils. Benches shall be a minimum of 6 feet wide with side cuts no steeper than 1H:1V and no higher than 6 feet. The lowest bench shall be keyed in a minimum of 2 feet into native, non-organic, firm soils.	

8.8 Groundwater

Groundwater may be encountered at shallow depths in excavations during the wet season. If groundwater is encountered, unwatering of the excavation is required and shall be the contractor's responsibility. This can typically be accomplished by pumping from one or more sumps, or daylighting the excavations to drain.

8.9 Erosion Control

Vegetation shall be removed only as necessary and exposed areas shall be replanted following construction. Disturbed ground surfaces exposed during the wet season (November 1 through April 30) shall be temporarily planted with grasses, or protected with erosion control blankets or hydromulch.

Temporary sediment fences shall be installed downslope of any disturbed areas of the site until permanent vegetation cover can be established (Figure 5).

Exposed sloping areas steeper than 3 horizontal to 1 vertical (3H:1V) shall be protected with a straw erosion control blanket (North American Green S150 or equivalent) to provide erosion protection until permanent vegetation can be established. Erosion control blankets shall be installed as per the manufacturer's recommendations.

8.10 Cut and Fill Slopes

Temporary unsupported cut and fill slopes less than 9 feet in height shall be sloped no steeper than 1 horizontal to 1 vertical (1H:1V). If temporary slopes greater than 9 feet high are desired, or if water seepage is encountered in cuts, our firm shall be contacted to provide additional recommendations. Temporary cuts in excess of 4 feet high and steeper than 1H:1V will likely require appropriate shoring to provide for worker safety, per OSHA regulations. Temporary cuts shall be protected from inclement weather by the use of plastic sheeting to help prevent erosion and/or failure.

TEMPORARY AND PERMANENT CUTS	
Temporary Cuts	1H:1V (maximum) [a]
Permanent Cuts	2H:1V (maximum) [a]
[a] All cuts greater than 9 feet high, or cuts where water seepage is encountered, shall be approved by a representative of H.G. Schlicker & Associates, Inc.	

If the above cut slope recommendations cannot be achieved due to construction and/or property line constraints, temporary or permanent retention of cut slopes may be required, as determined by a representative of HGSA.

Permanent unsupported cut and fill slopes shall be constructed no steeper than 2 horizontal to 1 vertical (2H:1V). Cut slopes steeper than 2H:1V shall be retained with an engineered retaining wall. Fill slopes steeper than 2H:1V shall be retained or be mechanically reinforced using geogrids, or other suitable products as approved by HGSA. Areas that slope steeper than 5H:1V and are to receive fill shall be benched. Benches shall be cut into native, non-organic, firm soil. The lowest bench shall be keyed a minimum of 2 feet into native, firm soil, and be a minimum of 6 feet wide.

8.11 Drainage

Surface water shall be diverted from building foundations and walls to approved disposal points by grading the ground surface to slope away a minimum of 2 percent for 6 feet towards a suitable gravity outlet to prevent ponding near the structures. Permanent subsurface drainage of the building perimeter is recommended to prevent extreme seasonal variation in moisture content of subgrade materials and subjection of foundations and slabs to hydrostatic pressures.

Perimeter drains shall be installed adjacent to the perimeter footings and sloped a minimum of 1.0 percent to a gravity outlet. A suitable perimeter drain system would consist of a 4-inch diameter, perforated PVC pipe (typical) embedded below and adjacent to the bottom of footings and backfilled with approved drain rock. The type of PVC pipe to be utilized may depend on building agency requirements and shall be verified prior to construction. HGSA also recommends lining the drainage trench excavation with a non-woven filter fabric which prevents undermining of foundation or slab components or any disturbance to supporting soils.

In addition to the perimeter foundation drain system, drainage of any crawlspace areas is required. Each crawlspace shall be graded to a low point for installation of a drain that is tied into the perimeter footing drain and tightlined to an approved disposal point.

All crawlspaces will need to be vented as per ORSC requirements.

On site infiltration is not recommended due to the increased risk of slope instability for the site. All roof drains shall be collected and tightlined in a separate system independent of the footing drains, or an approved backflow prevention device shall be used. All roof and footing drains shall be discharged to an approved disposal point, we recommend that energy dissipaters, such as splash blocks or a rock apron, be utilized at all pipe outfall locations. See Figure 6 for stormwater outfall design recommendations. The existing tributary of Robin Creek along the northwest portion of the site appears to be a suitable disposal point at the toe of the slope. However, the stream and areas near the disposal points should be routinely monitored for signs of erosion.

8.12 Plan Review and Site Observations

We shall be provided the opportunity to review all site development, foundation, drainage, and grading plans prior to construction to assure conformance with the intent of our recommendations (Appendix B). The plans, details and specifications shall clearly show that the above recommendations have been implemented into the design.

We shall observe the basement excavation and footing excavations prior to placing structural fill, forming and pouring concrete to assure that suitable bearing materials and recommended setbacks have been achieved (Appendix B). Please provide us with at least five (5) days' notice prior to any needed site observations. There will be additional costs for these services.

9.0 Limitations

Landsliding, erosion, storms, earthquakes and other natural events can cause severe impacts to structures built within this environment and can be detrimental to the health and welfare of those who choose to place themselves within this environment. The client is warned that, although this report is intended to identify the geologic hazards causing these risks, the scientific and engineering communities knowledge and understanding of geologic hazards processes is not complete. This report pertains to the subject site only, and is not applicable to adjacent sites nor is it valid for types of development other than that to which it refers. Geologic conditions including materials, processes and rates can change with time and therefore a review of the site and/or this report may be necessary as time passes to assure its accuracy and adequacy.

The hand augered boring logs and related information depict generalized subsurface conditions only at these specific locations and at the particular time the subsurface exploration was completed. Soil and groundwater conditions at other locations may differ from the conditions at these locations.

Our investigation was based on engineering geological reconnaissance and a limited review of published information. The information presented in this report is believed to be representative of the site. The conclusions herein are professional opinions derived in accordance with current standards of professional practice, budget and time constraints. No warranty is expressed or implied. The performance of this site during a seismic event has not been evaluated. If you would like us to do so, please contact us. This report may only be copied in its entirety.

10.0 Disclosure

H.G. Schlicker & Associates, Inc. and the undersigned Certified Engineering Geologist have no financial interest in the subject site, the project or the Client's organization.

11.0 References

Beeson, M. H., Tolan, T. L., and Madin, I. P., 1989, Geologic map of the Lake Oswego Quadrangle, Clackamas, Multnomah, and Washington Counties, Oregon: Oregon Department of Geology and Mineral Industries, Geologic Map Series, GMS-59, map.

Burns, W. J., and Duplantis, S., 2010, Overview of the landslide inventory of the Lake Oswego quadrangle, Clackamas, Multnomah, and Washington Counties, Oregon: Oregon Department of Geology and Mineral Industries, Interpretive Map Series IMS-32, map.

Burns, W. J. and Watzig, R. J., 2014, SLIDO-3.0, Statewide Landslide Information Database for Oregon, release 3.0, 35 p., maps, database.

Burns, W. J., Mickelson, K. A., and Madin, I. P., 2016, Landslide susceptibility overview map of Oregon: Oregon Department of Geology and Mineral Industries, Open-File Report O-16-02, 48 p., 1 plate.

Blakely, R. J., Wells, R. E., Yelin, T. S., Madin, I. P., and Beeson, M. H., 1995, Tectonic setting of the Portland-Vancouver area, Oregon and Washington: Constraints from low-altitude aeromagnetic data: Geologic Society of America Bulletin, v. 107, No. 9, p. 1051-1062.

Bott, D. J., and Wong, I. G., 1993, Historical earthquakes in and around Portland, Oregon: Oregon Geology, v. 55, No. 5, p. 116-122.

Church, J. A., and White, N. J., 2006, A 20th century acceleration in global sea-level rise: Geophysical Research Letters, v. 22, LO1601, 4 p.

Clague, J. J., Atwater, B. F., Wang, K., Wang, Y., and Wong, I., 2000, Penrose Conference 2000 - Great Cascadia Earthquake Tricentennial, Programs Summary and Abstracts: Oregon Department of Geology and Mineral Industries, Special Paper 33, 156 p.

EPA, 1998, Climate Change and Oregon; Environmental Protection Agency, EPA 236-98-007u, 4 p.

Geomatrix Consultants, 1995, Seismic design mapping, State of Oregon, final report: Prepared for the Oregon Department of Transportation, Project No. 2442.

Mabey, M. A., Black, G. L., Madin, I. P., Meier, D. B., Youd, T. L., Jones, C. F., and Rice, J. G.,1997, Relative earthquake hazard map of the Portland Metro region, Clackamas, Multnomah, and Washington Counties, Oregon: Oregon Department of Geology and Mineral Industries, Interpretive Map Series IMS-1, map.

Madin, I. P., and Wang, Z., 1999, Relative earthquake hazard maps for selected urban areas in western Oregon: Oregon Department of Geology and Mineral Industries, Interpretive Map Series IMS-10.

Oregon Seismic Safety Policy Advisory Commission (OSSPAC), February 2013, The Oregon Resilience Plan: Reducing Risk and Improving Recovery for the next Cascadia Earthquake and Tsunami Report to the 77th Legislative Assembly: State of Oregon Office of Emergency Management, 341 p.

OSU News and Research Communications, May 24, 2010, Odds are 1-in-3 that a huge quake will hit Northwest in next 50 years: Oregon State University, Corvallis http://oregonstate.edu/ua/ncs/archives/2010/may/odds-huge-quake-Northwest-next-50-years

Priest, G. R., Myers, E., Baptista, A. M., Fleuck, P., Wang, K., Kamphaus, R. A., and Peterson,C. D., 1997, Cascadia Subduction Zone tsunamis: Hazard mapping at Yaquina Bay, Oregon, final technical report to the National Earthquake Hazard Reduction Program: Oregon Department of Geology and Mineral Industries, Open-File Report O-97-34

Personius, S. F., Dart, R. L., Bradley, L-A, Haller, K. M., 2003, Map and data for Quaternary faults and folds in Oregon: U.S. Geological Survey, Open-File Report 03-095, 556 p., map.

Rogers, A. M., Walsh, T. J., Kockelman, J., and Priest, G. R., 1996, Earthquake hazards in the Pacific Northwest - an overview: U.S. Geological Survey, Professional Paper 1560, p. 1- 54.

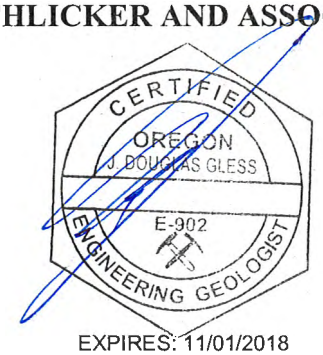
Schlicker, H. G., and Finlayson, C. T., 1979, Geology and geologic hazards of northwestern Clackamas County, Oregon: Oregon Department of Geology and Mineral Industries Bulletin 99, 79 p., maps.

Wong, I. Silva, W., Bott, J., Wright, D., Thomas, P., Gregor, N., Li, S., Mabey, M., Sojourner,A., and Wang, Y., 2000, Earthquake scenario and probabilistic ground shaking maps of the Portland, Oregon, metropolitan area: Oregon Department of Geology and Mineral Industries, IMS-16, 16 p., maps.

It has been our pleasure to serve you. If you have any questions concerning this report, or the site, please contact us.

Respectfully submitted,

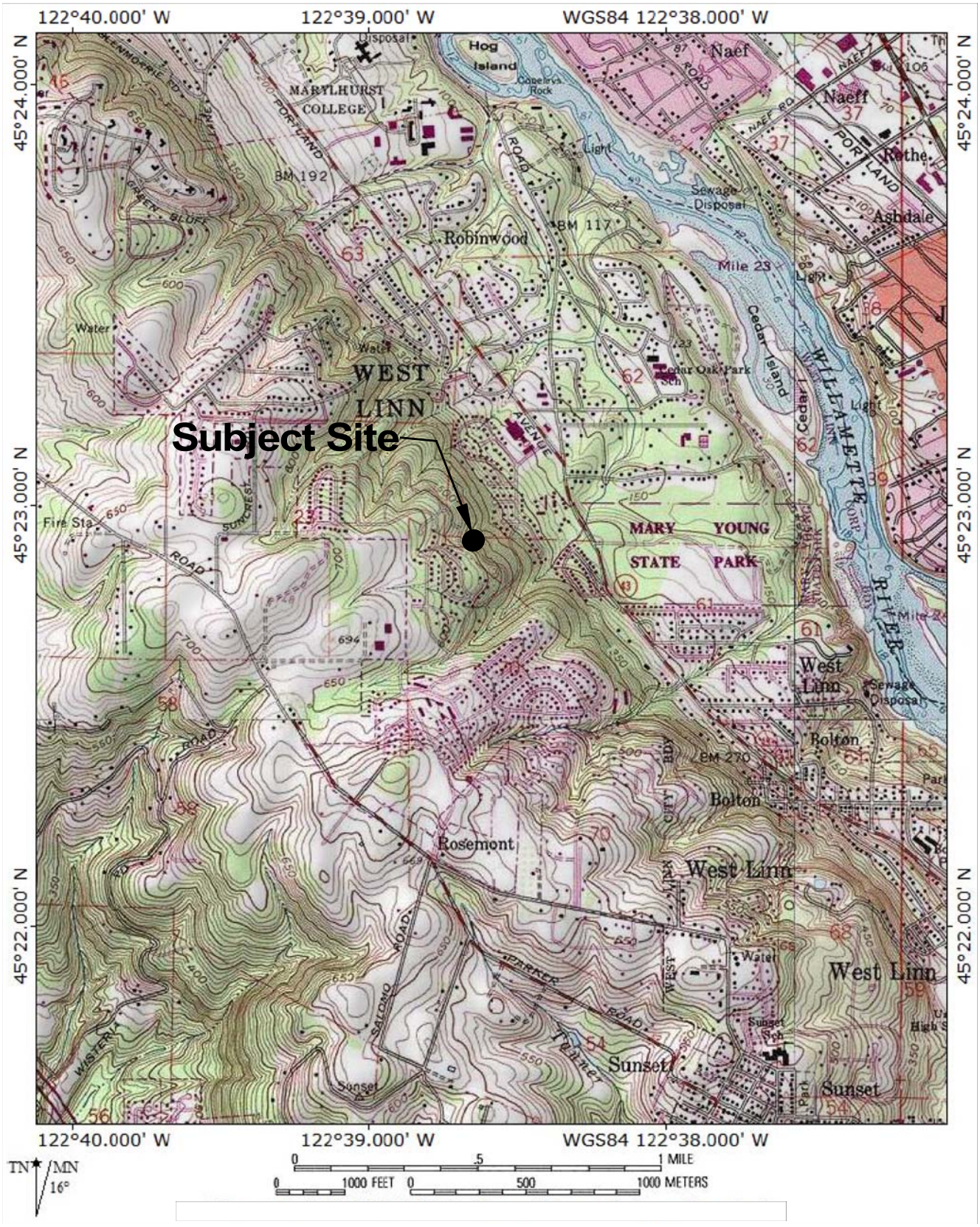
H.G. SCHLICKER AND ASSOCIATES, INC.



EXPIRES: 11/01/2018

J. Douglas Gless, MSc, RG, CEG, LHG
President/Principal Engineering Geologist

JDG:mgb



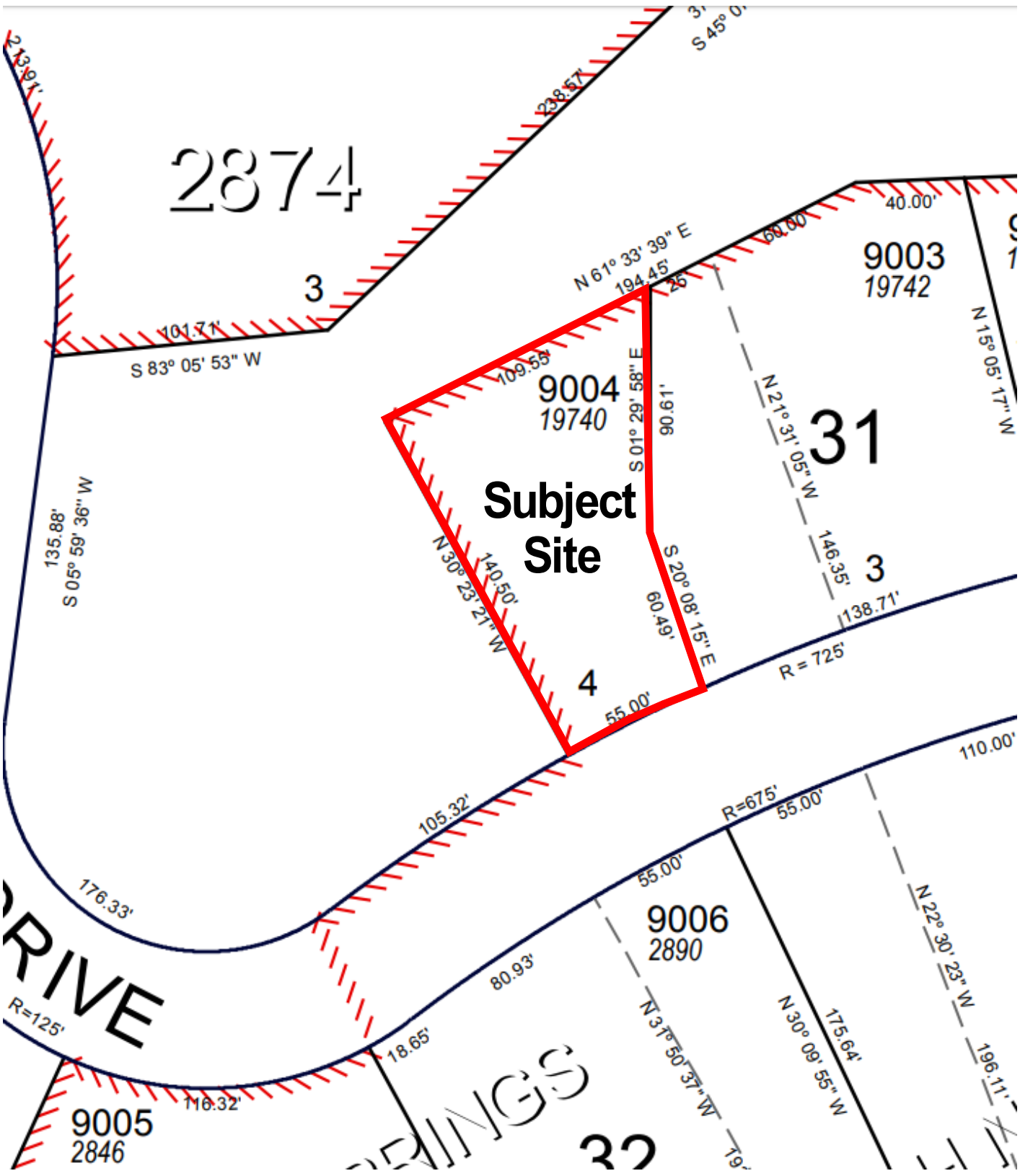
N

Date: 07/19/2018 Scale: 1" = 2,000'	**Project #Y184154**	Prepared by: MGB Approved by: JDG

Location Map
Tax Lot 9004, Map 2-1E-23AC
19738 Wildwood Drive, West Linn, Oregon

H.G. Schlicker & Associates, Inc.

Figure 1



N

Modified from the Clackamas County assessor's plat, 2-1E-23AC

All locations and dimensions are approximate.

Date: 07/19//2018	**Project #Y184154**	Prepared by: MGB
Scale: 1" = 50'		Approved by: JDG

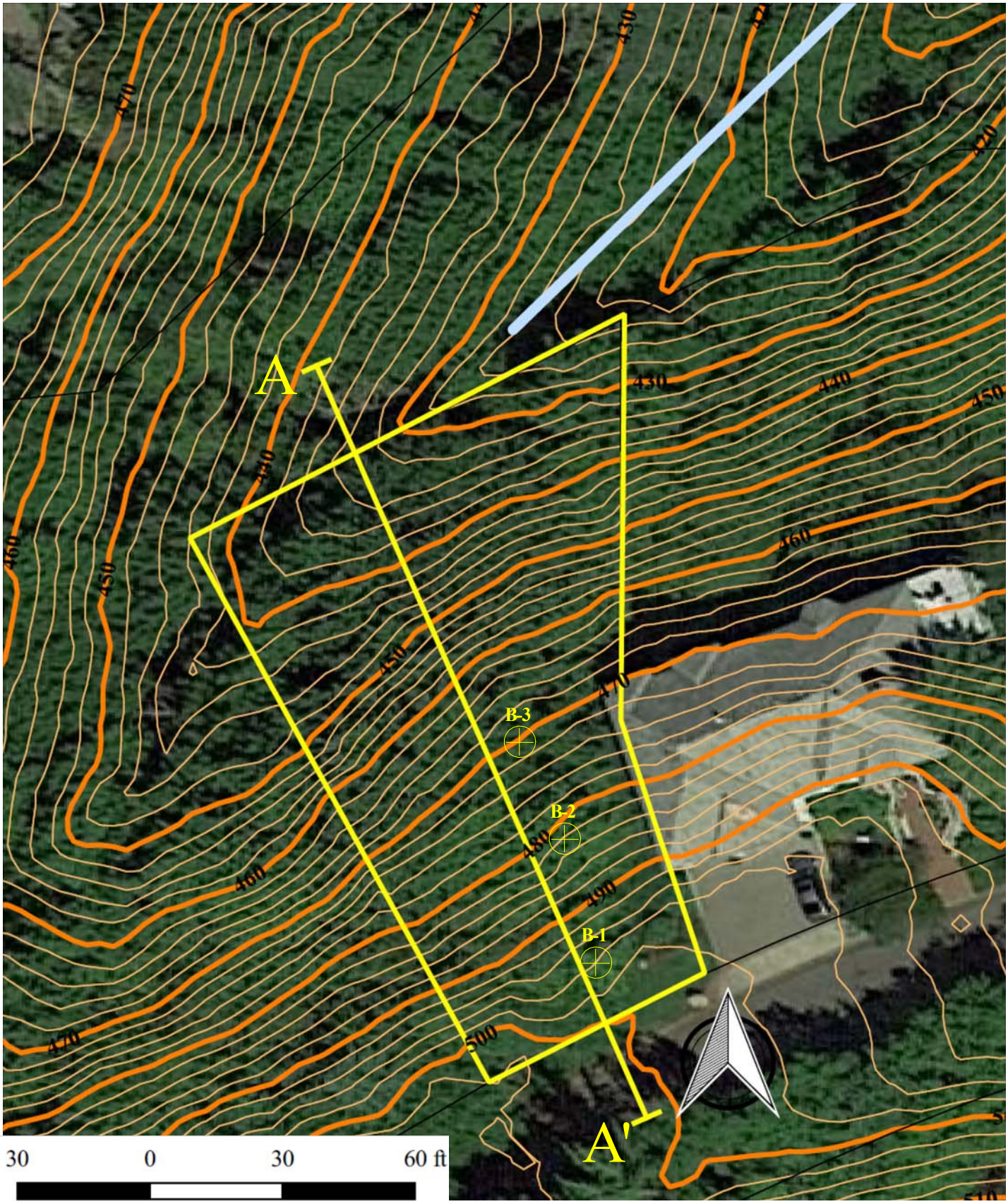
Plat Map

Tax Lot 9004, Map 2-1E-23AC

19738 Wildwood Drive, West Linn, Oregon

H.G. Schlicker & Associates, Inc.

Figure 2



B-2

= Approximate location of hand boring

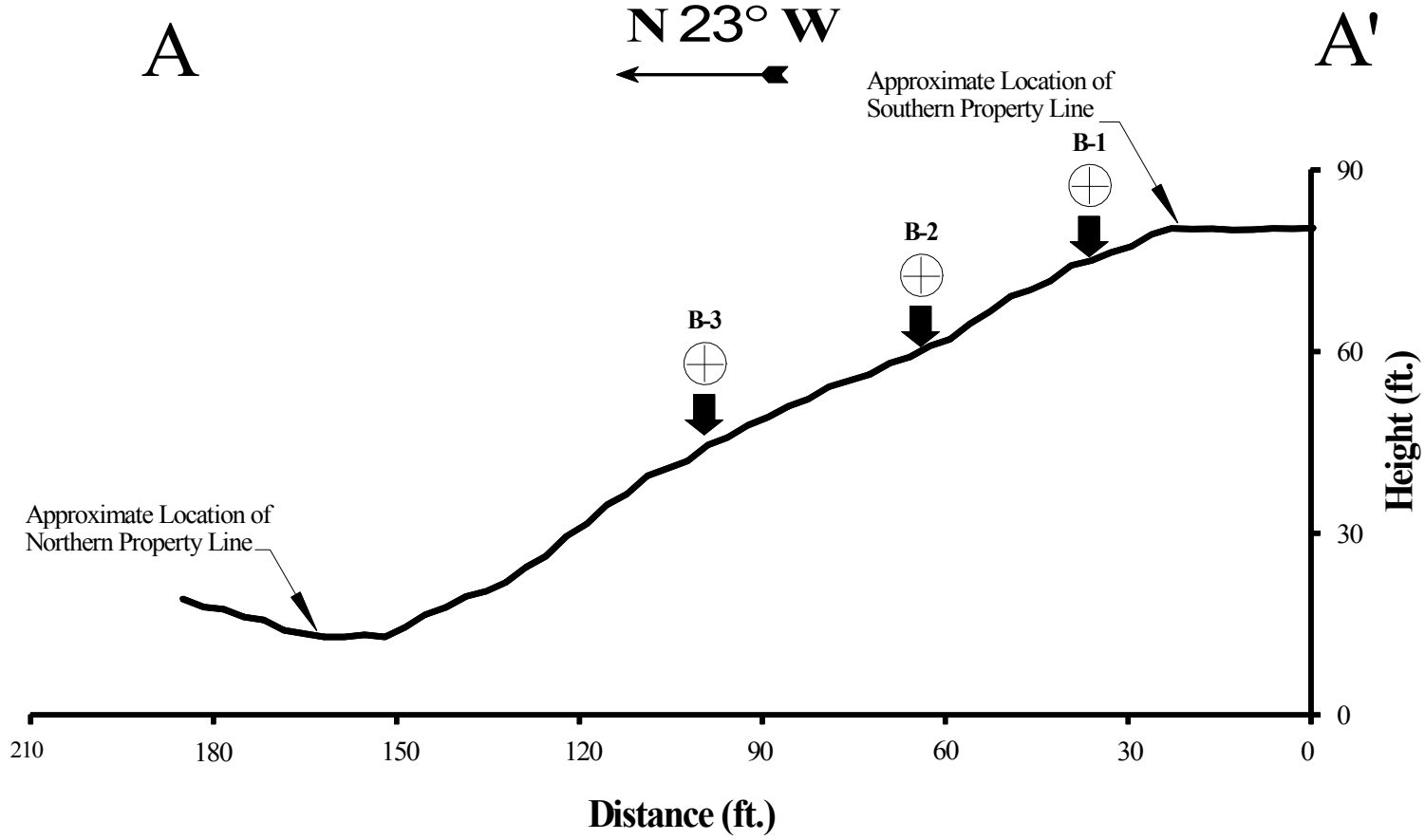
Imagery provide by GOOGLE
Topography derived from 2014 OLC METRO by DOGAMI
Streams Layer derived from Clackamas County GIS Data Portal
All locations and dimensions are approximate.

Date: 07/18//2018	**Project #Y184154**	Prepared by: MGB
Scale: 1" = 30'		Approved by: JDG

Site Topographic Map with Profile line
Tax Lot 9004, Map 2-1E-23AC
19738 Wildwood Drive, West Linn, Oregon

H.G. Schlicker & Associates, Inc.

Figure 3



B-2 = Approximate location of hand boring

All locations and dimensions are approximate.

Date: 07/19/2018	**Project #Y184154**	Prepared by: MGB
Scale: 1" = 30'		Approved by: JDG

Slope Profile A-A'
Tax Lot 9004, Map 2-1E-23AC
19738 Wildwood Drive, West Linn, Oregon

H.G. Schlicker & Associates, Inc.

Figure 4

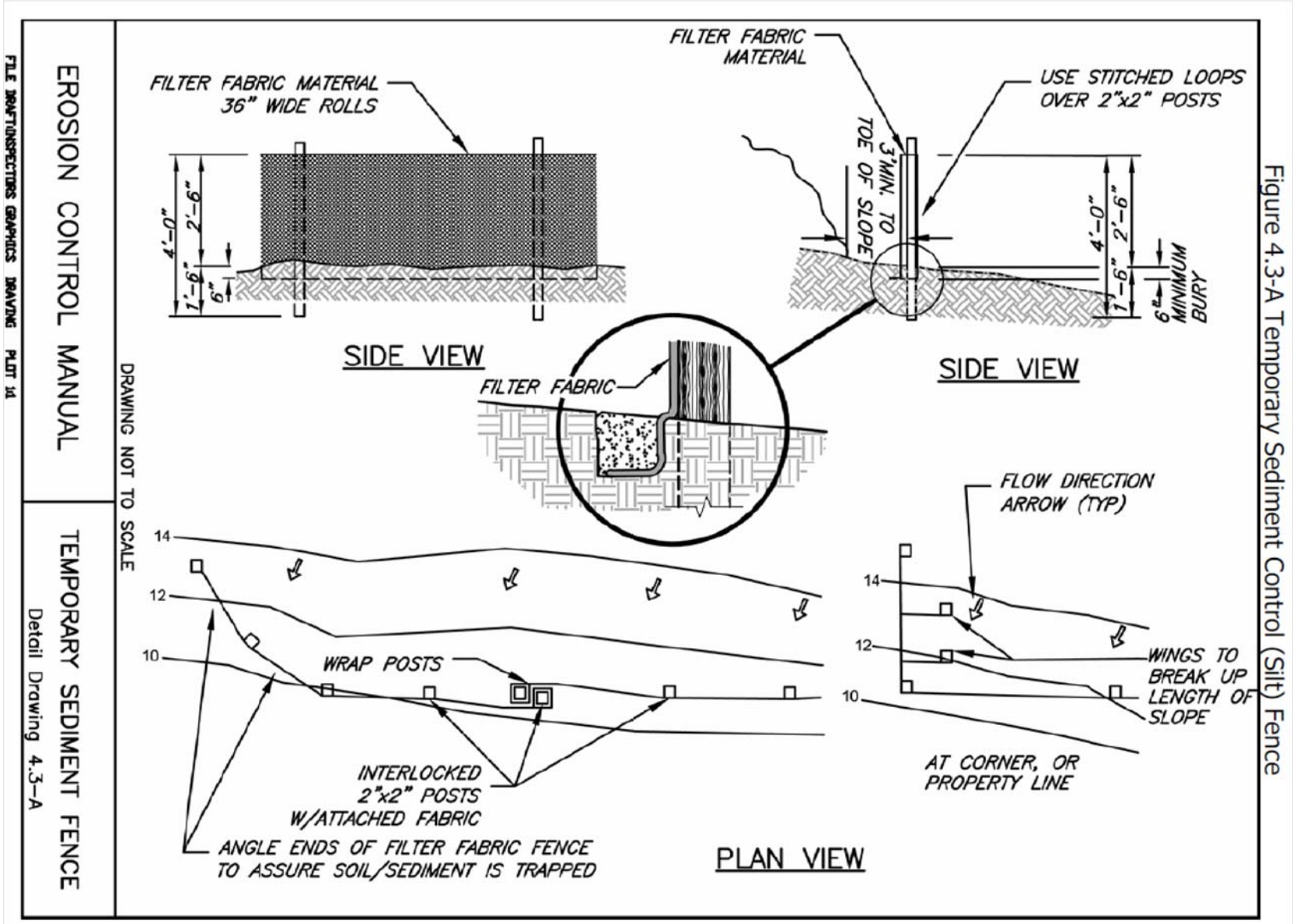


Figure 4.3-A Temporary Sediment Control (Silt) Fence

Date: 07/19/2018	**Project #Y184154**	Prepared by: MGB
Scale: As Shown		Approved by: JDG

Sediment Fence Detail

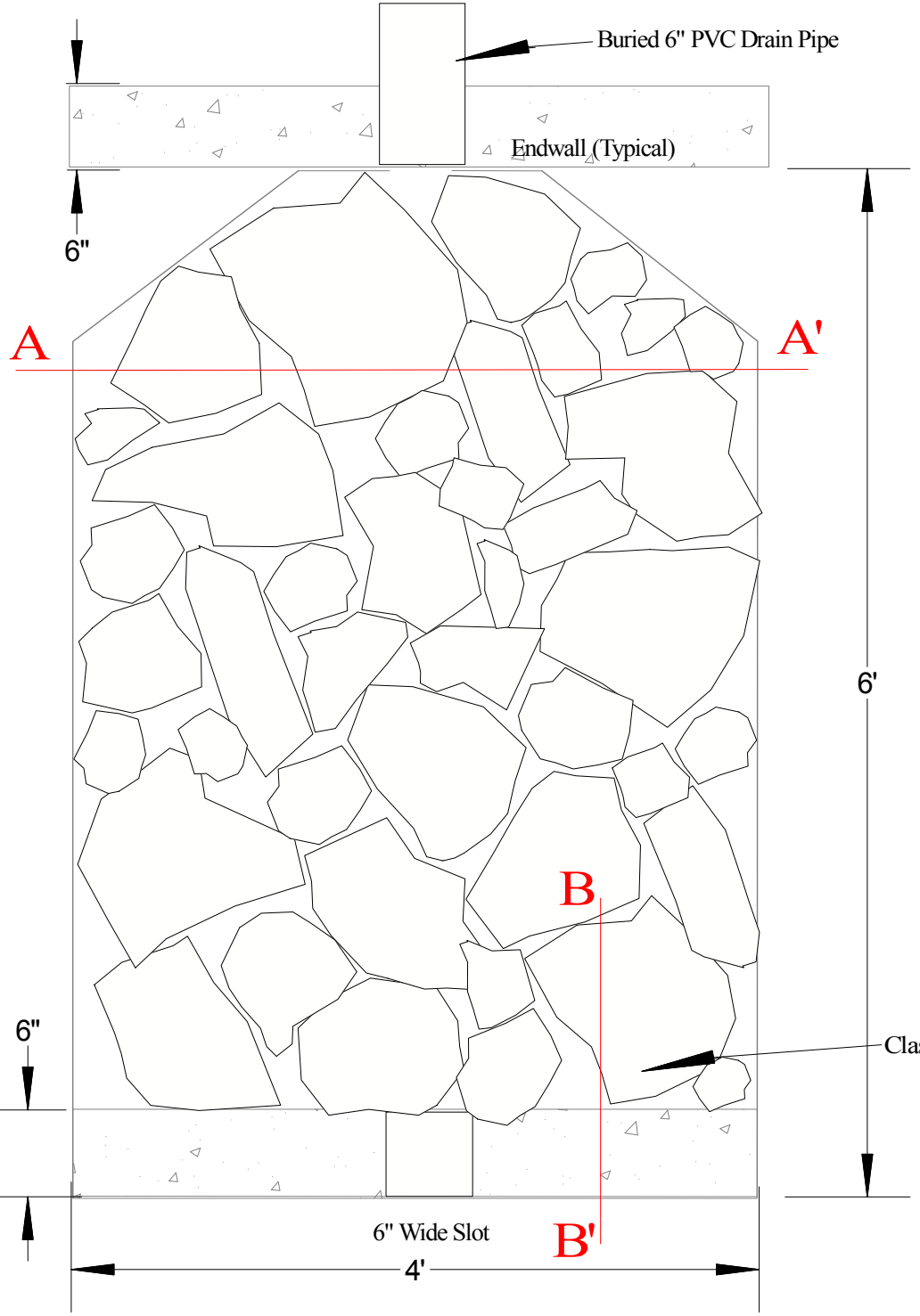
Tax Lot 9004, Map # 2-1E-23AC
19738 Wildwood Drive, West Linn, Oregon

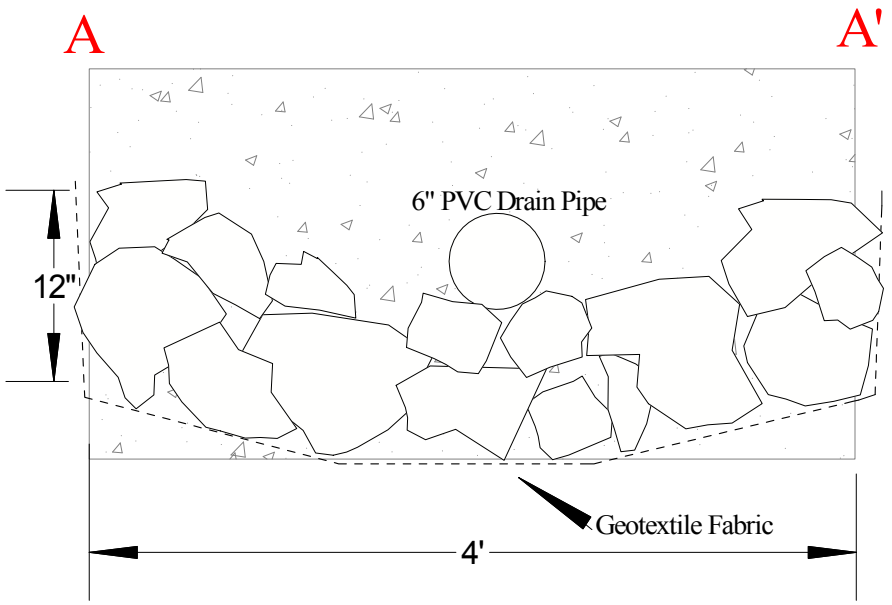
H.G. Schlicker & Associates, Inc.

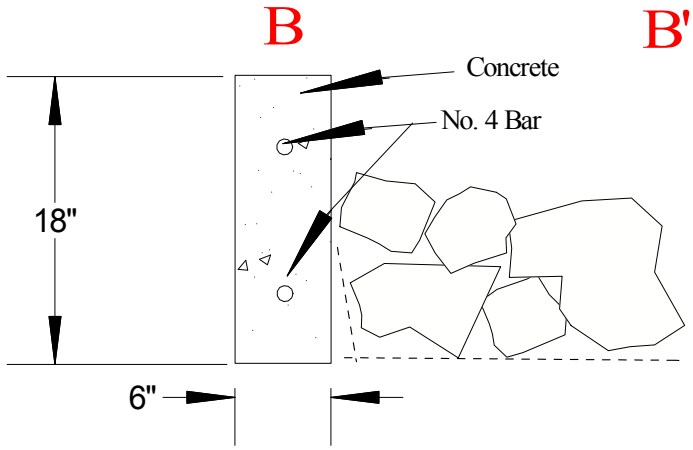
Figure 5

Drawing modified from Erosion and Sediment Control Manual,
City of Portland Bureau of Environmental Services, 2008.

Refer to Original Source for Design Criteria/ Specifications







Date: 07/19/2018	**Project #Y184154**	Prepared by: MGB
Scale: As shown		Approved by: JDG

Stormwater Outfall Detail

Tax Lot 9004, Map # 2-1E-23AC
19738 Wildwood Drive, West Linn, Oregon

H.G. Schlicker & Associates, Inc.

Figure 6

Appendix A
- Site Photographs -

Photo 1 – Northeasterly view of the site from across Wildwood Drive.


Photo 2 – Downslope view towards the tributary of Robin Creek.

Photo 3 – Southeasterly view looking upslope from the creek bed.

Photo 4 – Westerly view of the site taken at approximately midslope

Photo 5 – Downslope view of home to the west of the site.

Photo 6 – View of concrete stormwater outflow structure at head of the creek near the site.

Photo 7 – View of creek bottom near the northwest portion of the site. Note that at the time of our site visit the creek had no flowing water.

Photo 8 – Close-up view of a tire and pipe observed in the creek bottom near the site.

Photo 9 – Easterly view of the top of the slope, near the southern boundary of the site. Note that disturbed fill was observed here.

Photo 10 – Close-up view of weathered and partially buried concrete blocks observed near the southern portion of the site.

Photo 11 – Close-up view partially buried brick fragments observed near the southern portion of the site.

Photo 12 – View of cracking in surface of Wildwood Drive near site.

Appendix B
- Checklist of Recommended Plan Reviews and Site Observations -

APPENDIX B
Checklist of Recommended Plan Reviews and Site Observations
To Be Completed by a Representative of H.G. Schlicker & Associates, Inc.

Item No.	Date Done	Procedure	Timing
1*		Review site development, foundation, drainage, grading and erosion control plans.	Prior to construction.
2*		Observe foundation excavations.	Following excavation of foundations, and prior to placing fill, forming and pouring. **
3*		Review Proctor (ASTM D1557) and field density test results for all fills placed at the site.	During construction.

* There will be additional charges for these services.
** Please provide us with at least 5 days' notice prior to all site observations.