SEPA #: 2019.0058

MITIGATED DETERMINATION OF NON-SIGNIFICANCE

Proponent:	C&E Developments
Description of Proposal:	Wyndstone Apartments, 75-unit multi-family development
Location of the Proposal:	15025 Tahoma Blvd. SE SE, Yelm, WA
Section/Township/Range:	Section 24 Township 17N Range 1E, W.M.
Tax Parcel Number:	21724420300
Threshold Determination:	The City of Yelm as lead agency for this action has determined that this proposal does not have a probable significant adverse impact on the environment. Therefore, an environmental impact statement (EIS) will not be required under RCW 43.21C.030(2)(c). This decision was made after review of a completed environmental checklist and other information on file with the lead agency. This information is available to the public on request.
Mitigating Measures:	See Attachment A
Lead agency:	City of Yelm
Responsible Official:	Grant Beck, Community Development Director
Date of Issue:	January 17, 2020
Comment Deadline:	January 31, 2020
Appeal Deadline:	There is no local administrative appeal of a MDNS

Grant Beck, Community Development Director

This Mitigated Determination of Non-Significance (MDNS) is issued pursuant to Washington Administrative Code 197-11-340 (2). Comments must be submitted to Grant Beck, Community Development Department, at City of Yelm, 106 2nd Street SE, Yelm, WA 98597, by January 31, 2020, at 5:00 P.M. The City of Yelm will not act on this proposal prior January 31, 2020 at 5:00 P.M. Full documents may be viewed on the City website at www.yelmwa.gov.

DO NOT PUBLISH BELOW THIS LINE

Published: Nisqually Valley News, Thursday, January 23, 2020
Posted in public areas: Friday, January 17, 2020

Copies to: All agencies/citizens on SEPA mailing list
Dept. of Ecology w/checklist

ATTACHMENT

Project Number 2019.0058

Findings of Fact

A. This Mitigated Determination of Non Significance is based on the project as proposed and the impacts and potential mitigation measures reflected in the following documents:
   - Environmental Checklist dated November 12, 2019, prepared by CES NW, Inc.
   - Preliminary Storm Drainage and Erosion & Sediment Control Report, dated November 2019, prepared by CES NW, Inc.
   - Traffic Assessment, dated November 7, 2019, prepared by Heath & Associates, Inc
   - Prairie Habitat Recon, dated September 5, 2019, prepared by Key Environmental Services, LLC.

B. The City of Yelm is identified as a Critical Aquifer Recharge Area, a designated environmentally sensitive area. Potential Impacts to groundwater quality and quantity will be mitigated through measures that meet or exceed the standards in the Stormwater Management Manual for Western Washington, as published by the Washington State Department of Ecology.

C. The Mazama Pocket Gopher has been listed as a threatened species by the Washington Department of Fish and Wildlife since at least 2008. Yelm has protected this species through the implementation of the Critical Areas Code. In April, 2014, the U.S. Fish and Wildlife Service listed the Yelm subspecies of the Mazama Pocket Gopher as threatened under the Endangered Species Act. While the City of Yelm is not responsible for implementation or enforcement of the Endangered Species Act, it consults with the Service and provides notice to applicants that the pocket gopher is a federally protected species and a permit from the U.S. Fish and Wildlife Service may be required.

   Soil suitability maps show that the site has a preferred soils for gopher habitat. A report issued by Key Environmental Solutions, LLC showed no evidence of gophers.

Mitigation Measures

1. A final drainage report meeting the minimum requirements of the Stormwater Management Manual for Western Washington, as published by the Washington State Department of Ecology shall be submitted with civil plan submission.
2. Compliance with Yelm's requirements under the Critical Areas Code does not ensure compliance with the provisions of the Endangered Species Act. The applicant should contact the US Fish and Wildlife Service with any questions about compliance with Federal standards for threatened species if, at any time, evidence of Priority Habitat Species or Mazama Pocket Gopher is found.

CITY OF YELM

ENVIRONMENTAL CHECKLIST

Action: _____

Receipt: _____

Received By: _____

Date: _____

I. INTRODUCTION INFORMATION

Name of Proposal (if applicable):
Wyndstone Apartments

Applicant: **C & E Developments, LLC**

Address: **PO Box 2983,**
Yelm, WA 98597

Phone: **(360) 400-0432**

Agent: **Craig Deaver – CES NW, Inc.**

Address: **429 – 29th Street NE, Suite D**
Puyallup, WA 98372

Phone: **(253) 848-4282**

Location of Project: **City of Yelm, Washington**

Address: **15025 Tahoma Boulevard SE, Yelm, WA 98597**
See Appendix for Vicinity Map.

Section: **24** Quarter: **SE** Township: **17N** Range: **01E**

Tax Parcel Number(s): **21724420300**

Date Checklist Prepared: **November 12, 2019**

A. BACKGROUND

1. Proposed timing or schedule (including phasing, if applicable):

   Gain administrative site plan approval in Winter 2020, construction permit issuance in Spring 2020, complete site construction and begin building construction upon site construction completion.

2. Do you have any plans for future additions, expansion, or further activity related to or connected with this proposal? If yes, explain:

   Yes, the project proposes to complete the development in two phases. Phase one will include all civil work and Buildings 3 and 4 (36-units). Phase two will consist of Buildings 1 and 2 (39-units). The total development will be comprised of 75-units.

3. List any environmental information you know about that has been prepared, or will be prepared, directly related to this proposal.

   A Geotechnical and Stormwater Investigation were completed by Insight Geologic, Inc. on July 12, 2019 and a Parcel Prairie Habitat Critical Area Recon was completed by Key Environmental Solutions, LLC on September 5, 2019. They are included with the Administrative Site Plan Review Application.

4. Do you know whether applications are pending for governmental approvals of other proposals directly affecting the property covered by your proposal? If yes, explain:

   No, there are no other pending governmental approvals.

5. List any government approvals or permits that will be needed for your proposal, if known.

   Administrative Site Plan approval, SEPA Threshold determination, Site development permit, water permits, sewer permits, and building permits.

6. Give a brief, complete description of your proposal, including the proposed uses and the size of the project and site. There are several questions later in this checklist that ask you to describe certain aspects of your proposal. You do not need to repeat those answers on this page.

   The proposal is to develop the property into 75-unit multi-family

development. There are no existing structures on-site. The development will be designed to City of Yelm standards and to blend in with the surrounding neighborhoods. City of Yelm Water and Sanitary Sewer will serve the site.

7. Location of proposal. Give sufficient information for a person to understand the precise location of your proposed project, including a street address, if any, and section, township, and range, if known. If a proposal would occur over a range of area, provide the range or boundaries of the site(s). Provide a legal description, site plan, vicinity map, and topographic map, if reasonably available. While you should submit any plans required by the agency, you are not required to duplicate maps or detailed plans submitted with any permit applications related to this checklist.

From Interstate 5 (I-5) south, take exit 116 for Mounts Rd told Old Nisqually. Turn left onto Mounts Rd SW/Nisqually Rd SW/Old Pacific Highway SE. Turn left onto Reservation Rd SE. At the traffic circle, take the second exit onto WA-510 E. At the second traffic circle, take the second exit onto WA-510 E. Merge on to WA-510 E. Turn right onto Tahoma Boulevard Southeast. The destination will be on your left.

Section: **24** Quarter: **SE** Township: **17N** Range: **01E**

B. ENVIRONMENTAL IMPACTS

1. EARTH

a. General description of the site (circle one): flat, rolling, hilly, steep slopes, mountainous, other_____:

The site is generally flat with areas of low to moderate slopes.

b. What is the steepest slope on the site (approximate percent slope)?

The steepest on the site is approximately 10%.

c. What general types of soils are found on the site (for example, clay, sand, gravel, peat, muck)? If you know the classification of agricultural soils, specify them and note any agricultural land of long-term commercial significance and whether the proposal results in removing any of these soils.

The soil at the site is identified by the USDA Natural Resource Conservation Service (NRCS) map of Thurston County, Washington as Nisqually loamy fine sand and Spanaway gravelly sandy loam.

See Appendix for the Soils Map and Description.

d. Are there surface indications or history of unstable soils in the immediate vicinity? If so, describe.

No. There are no known unstable soils or a history of unstable soils in the immediate vicinity.

e. Describe the purpose, type, total area, and approximate quantities and total affected area of any filling, excavation, and grading proposed. Indicate source of fill.

The site will be designed to balance cut and fill quantities to the greatest extent possible. Grading plans were prepared by a licensed professional engineer and submitted to the City of Yelm for review and approval. It is estimated that approximately 11,000 cubic yards of total cut and 10,000 cubic yards of total fill will be required during construction of the proposed project.

f. Could erosion occur because of clearing, construction, or use? If so, generally describe.

Yes, if vegetation is cleared during wet weather, there is a potential for erosion to occur. During construction, the developer will utilize Best Management Practices (BMPs) for wet weather.

g. About what percent of the site will be covered with impervious surfaces after project construction (for example, asphalt, or buildings)?

Approximately 35% of the site will be covered with impervious surfaces. This area includes the proposed parking lots, sidewalks, and roof area within the site boundary.

h. Proposed measures to reduce or control erosion, or other impacts to the earth, if any:

As part of the grading plan, a temporary erosion and sedimentation control plan will be prepared for approval by City of Yelm. Erosion control features will be installed prior to construction and maintained until the threat of erosion ceases to exist. The developer will obtain a National Pollutant Discharge Elimination System Permit (NPDES) and perform routine site monitoring and reporting to the Department of Ecology under the NPDES permit.

2. AIR

a. What types of emissions to the air would result from the proposal during construction, operation, and maintenance when the project is completed? If any, generally describe and give approximate quantities if known.

The grading activities proposed at the site will cause dust particulate to be emitted to the air. Vehicles and equipment used during construction can be a potential source of emissions. When the project is complete, the site may be the source of vehicle emissions from vehicles using the site. However, quantities are unknown.

b. Are there any off-site sources of emissions or odor that may affect your proposal? If so, generally describe.

Vehicles using the surrounding street system can be a source of emissions or odor. However, it is not anticipated these off-site vehicle sources of emissions will affect this proposal. There are no other known sources of odor or emissions in the vicinity.

c. Proposed measures to reduce or control emissions or other impacts to air, if any:

Unwanted dust particulate can be controlled to a certain extent by the application of water before and during grading activities. It is assumed the construction vehicles used will be equipped with factory-installed mufflers and spark arresters that would control excessive emissions. There are no measures proposed to control emissions because of vehicles using the site after construction.

3. WATER

a. Surface Water:

1. Is there any surface water body on or in the immediate vicinity of the site (including year-round and seasonal streams, saltwater, lakes, ponds, wetlands)? If yes, describe type and provide names. If appropriate, state what stream or river it flows into.

   There are no surface water bodies located on or within 200 feet of the site.

2. Will the project require any work over, in, or adjacent to (within 200 feet) the described waters? If yes, please describe and attach available plans for this work.

   No, there are no onsite or adjacent surface water bodies.

   Correct

3. Estimate the amount of fill and dredge material that would be placed in or removed from surface water or wetlands and indicate the area of the site that would be affected. Indicate the source of fill material.

   None anticipated.

4. Will the proposal require surface water withdrawals or diversions? Give general description, purpose, and approximate quantities if known.

   The project does not include any surface water withdrawals or diversions.

5. Does the proposal lie within a 100-year floodplain? If so, note location on the site plan.

   Correct

   No, the site does not lie within the 100-year floodplain.

6. Does the proposal involve any discharges of waste materials to surface waters? If so, describe the type of waste and anticipated volume of discharge.

   No, the proposal does not include discharges of waste materials.

b. Ground Water:

1. Will ground water be withdrawn from a well for drinking water or other purposes? If so, give a general description of the well, proposed uses and approximate quantities withdrawn from the well. Will water be discharged to groundwater? Give general description, purpose, and approximate quantities if known.

   There will be no groundwater withdrawals.

2. Describe the underlying aquifer with regard to quality and quantity, sensitivity, protection, recharge areas, etc.

   Thurston County has the Critical Aquifer Recharge Area listed as a both a CARA Geological Category 1 and CARA Category Code 1.

3. Describe waste material that will be discharged into the ground from septic tanks or other sources, if any (for example: Domestic sewage; industrial, containing the following chemicals . . .; agricultural; etc.). Describe the general size of the system, the number of such systems, the number of houses to be served (if applicable), or the number of animals or humans the system(s) is/are expected to serve.

   No waste material will be discharged into the ground. The project proposes to connect to the City of Yelm's Sanitary Sewer system.

c. Water Runoff (including stormwater):

1. Describe the source of runoff (including stormwater) and method of collection and disposal, if any (include quantities, if known). Where will this water flow? Will this water flow into other waters? If so, describe.

   The primary source of runoff will be from stormwater. Minimal water runoff is anticipated to occur because of landscape watering and other maintenance activities. The project site uses a cartridge filter structure and an infiltration gallery to infiltrate and treat stormwater runoff.

2. Could waste materials enter ground or surface waters? If so, generally describe.

Generally, a project of this type and size would provide areas of landscaping. If chemicals or fertilizers that are used to maintain these areas are not handled properly, it is possible they could enter ground or surface waters. To our knowledge, there are no other known sources of contaminants associated with this proposal.

3. Does the proposal alter or otherwise affect drainage patterns in the vicinity of the site? If so, describe.

The proposed multifamily development's stormwater design will maintain natural drainage patterns per City of Yelm design standards.

d. Proposed measures to reduce or control surface, ground, and runoff water impacts, if any:

The primary source of runoff will be from stormwater. Minimal water runoff is anticipated to occur because of landscape watering and other maintenance activities. The project site uses a cartridge filter structure and an infiltration gallery to infiltrate and treat stormwater runoff.

Most current SWMMWW

4. PLANTS

a. Check the type(s) of vegetation found on the site:

__X__ Deciduous tree
__X__ Evergreen tree
__X__ Shrubs
__X__ Grass
_____ Pasture
_____ Crop or grain
_____ Orchards, vineyards or other permanent crops
_____ Wet soil plants:
_____ Water plants:
_____ Other types of vegetation:

b. What kind and amount of vegetation will be removed or altered?

The developer will remove the vegetation during site development. The clearing limits will be shown on the engineering plans submitted to the City of Yelm for review.

Landscaping will be provided throughout the multi-family development and street trees will be provided along the onsite roadway extension.

c. List threatened and endangered species known to be on or near the site.

To our knowledge, there are no threatened or endangered plant species on or near the site. No threaten or endangered species are noted on the Washington State Fish and Wildlife (WDFW) Priority Species and Habitat interactive map. See Appendix VI for the WDFW map.

d. Proposed landscaping, use of native plants, or other measures to preserve or enhance vegetation on the site, if any:

Landscaping will incorporate native plant species in accordance with City of Yelm Code.

e. List all noxious weeds and invasive species known to be on or near the site.

Yes, there appears to be blackberry bushes scattered throughout the site and on adjacent properties. The total site coverage is not known at this time.

5. ANIMALS

a. List any birds and other animals, which have been observed on or near the site or are known to be on or near the site. Examples include:

_X_ Birds: **songbirds, crows**
_X_ Mammals: **field mice, squirrels, deer**
____ Fish: **None**

b. List any threatened and endangered species known to be on or near the site.

No Effect Letter attached

To our knowledge, there are no threatened or endangered animal species on or near the site. No threaten or endangered species are noted on the Washington State Fish and Wildlife (WDFW) Priority Species and Habitat interactive map. See Appendix VI for the WDFW map.

c. Is the site part of a migration route? If so, explain.

No, not to our knowledge.

d. Proposed measures to preserve or enhance wildlife, if any:

The project is a multi-family residential development. No measures are proposed.

e. List any invasive animal species known to be on or near the site.

None known.

6. ENERGY AND NATURAL RESOURCES

a. What kinds of energy (electric, natural gas, oil, wood stove, solar) will be used to meet the completed project's energy needs? Describe whether it will be used for heating, manufacturing, etc.

The primary energy source required to meet the energy needs of the development is electricity. Sufficient amounts of which would be used to maintain a comfortable lifestyle and environment. A combination of electricity and gas would be used to for heating and lighting purposes.

b. Would your project affect the potential use of solar energy by adjacent properties? If so, generally describe.

No, the existing adjacent properties are single-family lots or undeveloped. The largest impact to placing solar panels is the existing home locations on the adjacent parcels.

c. What kinds of energy conservation features are included in the plans of this proposal? List other proposed measures to reduce or control energy impacts, if any:

The homebuilder will build the proposed multi-family homes using energy efficient materials based on current industry standards for home building.

7. ENVIRONMENTAL HEALTH

a. Are there any environmental health hazards, including exposure to toxic chemicals, risk of fire and explosion, spill, or hazardous waste that could occur because of this proposal? If so, describe.

Typically, a residential development is not a source of

environmental health hazards. During construction of the proposed project, it is possible that a spill related to construction activity or equipment may occur. Once the plat has been constructed, the risk of fire is always present within a residential development.

1) Describe any known or possible contamination at the site from present or past uses.

   No known possible contamination at the site from present or past uses.

2) Describe existing hazardous chemicals/conditions that might affect project development and design. This includes underground hazardous liquid and gas transmission pipelines located within the project area and in the vicinity.

   There are no known hazardous chemicals/conditions that might affect the project development and design.

3) Describe any toxic or hazardous chemicals that might be stored, used, or produced during the project's development or construction, or at any time during the operating life of the project.

   During construction, typical materials for construction oil, petroleum or grease may be used and stored on-site and properly disposed of in accordance with the required stormwater pollution prevention plan. No chemicals will be produced.

4) Describe special emergency services that might be required.

   While not anticipated to occur, the services of the local emergency service providers may be required at some time.

5) Proposed measures to reduce or control environmental health hazards, if any:

   None are proposed.

b. Noise

1) What types of noise exist in the area, which may affect your project (for example: traffic, equipment, operation, other)?

Noise exists from the neighboring single-family parcels and adjacent street system. However, it is not anticipated that the noise will adversely affect the proposed project.

2. What types and levels of noise would be created by or associated with the project on a short-term or long-term basis (for example: traffic, construction operation, other)? Indicate what hours noise would come from the site.

During the short-term, construction activity at the project site will vary considerably as the construction progresses. In addition, because the noise produced on the site depends on the equipment being used, the noise would vary from day to day. Maximum construction noise levels can be expected to range from 65 to 89 dBA with an average value of approximately 85 dBA. Minimum noise levels can be expected to have a wider range of 57 to 88 dBA with an average value of 78 dBA (based on a construction activity noise model, described in *Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances*). Noise associated with construction operations on the site will occur roughly between the hours of 7:00 a.m. to 6:00 p.m., Monday through Friday. Long-term noise impacts will result from vehicles using the site and noises typical to a multi-family residential development.

3. Proposed measure to reduce or control noise impacts, if any:

Noise impacts associated with the construction phases of the project will be limited in duration. To mitigate general noise impacts during the grading phase, measures such as using and regularly maintaining efficient mufflers and quieting devices on all construction equipment and vehicles can be anticipated. No measures to mitigate noise impacts during the building phase are proposed. Construction hours will be limited to the normal workday, 7:00 a.m. to 6:00 p.m.

8. LAND AND SHORELINE USE

a. What is the current use of the site and adjacent properties? Will

the proposal affect current land uses on nearby or adjacent properties? If so, describe.

North: Tahoma Boulevard SE with a large lot single-family residence beyond it
West: developed single-family lots
East: large lot single-family residence
South: large vacant lot

b. Has the project site been used as working farmlands or working forest lands? If so, describe. How much agricultural or forest land of long-term commercial significance will be converted to other uses as a result of the proposal, if any? If resource lands have not been designated, how many acres in farmland or forest land tax status will be converted to nonfarm or non-forest use?

No, not to our knowledge.

1) Will the proposal affect or be affected by surrounding working farm or forest land normal business operations, such as oversize equipment access, the application of pesticides, tilling and harvesting? If so, how:

To our knowledge, the adjacent parcels are not used for agriculture or forestry.

c. Describe any structures on the site.

The parcel is currently vacant.

d. Will any structures be demolished? If so, what?

No, the parcel is vacant.

e. What is the current zoning classification of the site?

The site is currently zoned R-16 – High Density Residential.

Please see the zoning map in the appendix for clarification of zoning.

f. What is the current comprehensive plan designation of the site?

The current comprehensive plan designation is High Density Residential.

g. If applicable, what is the current shoreline master program designation of the site?

Project is not in an area designate as a shoreline, does not apply.

h. Has any part of the site been classified as a critical area by the city or county? If so, specify.

Yes, according to Thurston County GIS the site is within a critical aquifer recharge area and has a possibility of pocket gophers. A pocket gopher study has been completed and submitted with the administrative site plan application.

Correct

i. Approximately how many people would reside or work in the completed project?

The proposed plat will provide 75 units and housing for approximately 225 residents.

j. Approximately how many people would the completed project displace?

None, there are no existing structures onsite.

k. Proposed measures to avoid or reduce displacement impacts, if any:

None at this time.

l. Proposed measures to ensure the proposal is compatible with existing and projected land uses and plans, if any:

The proposed residential plat is adjacent to single-family residential uses. The site is currently zoned R-16 – High Density Residential.

m. Proposed measures to ensure the proposal is compatible with nearby agricultural and forestlands of long-term commercial significance, if any:

To our knowledge, the adjacent parcels are not used for agricultural or forest lands.

9. HOUSING

a. Approximately how many units would be provided, if any? Indicate whether high, middle, or low-income housing.

This development anticipates creating 75 new multi-family units. It is assumed the units will be in the middle income range.

b. Approximately how many units, if any, would be eliminated? Indicate whether high, middle, or low-income housing.

None, there are no existing units.

c. Proposed measures to reduce or control housing impacts, if any:

None are proposed.

10. AESTHETICS

a. What is the tallest height of any proposed structure(s), not including antennas; what is the principal exterior building material(s) proposed?

Maximum building height is 35 feet.

b. What views in the immediate vicinity would be altered or obstructed?

No views in the immediate vicinity would be altered or obstructed. The view of the site, of course, will be altered to that of a multi-family housing development.

c. Proposed measures to reduce or control aesthetic impacts, if any:

The proposed multi-family development will include architecturally compatible buildings. After construction, the development will have landscaping.

11. LIGHT AND GLARE

a. What type of light or glare will the proposal produce? What time of day would it mainly occur?

Light and glare will result from reflective surfaces, exterior building lights, and streetlights. Interior lighting may be noticeable. The occurrence of light impacts are anticipated

from dusk to dawn.

b. Could light or glare from the finished project be a safety hazard, interfere with views, or affect wildlife?

It is highly unlikely that glare or light from the project site will interfere with views or affect wildlife. Streetlights and other outdoor lighting are intended to promote safety rather than create a safety hazard.

c. What existing off-site sources of light or glare may affect your proposal?

Off-site sources of light or glare that may be noticeable would be the result from reflective surfaces, exterior building lights, streetlights and interior lighting from surrounding neighborhoods. The occurrence of light impacts are anticipated from dusk to dawn and are not anticipated to affect the project.

d. Proposed measures to reduce or control light and glare impacts, if any:

The exterior building lights and streetlights will be of low intensity, typically used for safety and security purposes.

12. RECREATION

a. What designated and informal recreational opportunities are in the immediate vicinity?

There are several designated and informal recreational opportunities within the immediate vicinity of the proposed site. Some of these opportunities within approximately 4 miles include: Longmire Community Park, Cochrane Memorial Park, McKenna Park, Yelm City Park, Yelm Skate Park, Yelm-Tenino Trail, and Tahoma Valley Golf Course.

b. Would the proposed project displace any existing recreational uses? If so, describe.

No, the project will not displace any recreational opportunities.

c. Proposed measures to reduce or control impacts on recreation, including recreation opportunities to be provided by the project or

application, if any:

Passive and active recreational opportunities will be provided within the project's proposed open space.

13. HISTORIC AND CULTURAL PRESERVATION

a. Are there any buildings, structures, or sites, located on or near the site that are over 45 years old listed in or eligible for listing in national, state, or local preservation registers located on or near the site? If so, specifically describe.

No, there are no known sites in the vicinity eligible for or listed in the Washington Information System for Architectural and Archaeological Records Data (WISAARD).

b. Are there any landmarks, features or other evidence of Indian or historic use or occupation? This may include human burials or old cemeteries. Are there any material evidence, artifacts, or areas of cultural importance on or near the site? Please list any professional studies conducted at the site to identify such resources.

To our knowledge, there are none.

c. Describe the methods used to assess the potential impacts to cultural and historic resources on or near the project site. Examples include consultation with tribes and the department of archeology and historic preservation, archaeological surveys, historic maps, GIS data, etc.

No formal studies have been conducted to assess cultural or historic resources associated with the site.

d. Proposed measures to avoid, minimize, or compensate for loss, changes to, and disturbance to resources. Please include plans for the above and any permits that may be required.

There are no measures proposed to reduce or control impacts. However, if objects are unearthed during site work that may be culturally significant, the Washington State Office of Archaeology and Historic Preservation will be notified.

14. TRANSPORTATION

a. Identify public streets and highways serving the site and describe proposed access to the existing street system. Show on site plans, if any:

The project site is located near the intersection of Tahoma Boulevard SE and Berry Valley Drive SE. Access will be provided from Tahoma Boulevard SE.

See Appendix for Vicinity Map.

b. Is the site or affected geographic area currently serviced by public transit? If so, generally describe. If not, what is the approximate distance to the nearest transit stop?

No, the site is not directly served by public transit. An Intercity Transit bus stop currently exists approximately 0.6 miles to the northeast along W Yelm Ave.

c. How many additional parking spaces would the completed project or non-project proposal have? How many would the project eliminate?

The project will provide 16 garage parking spaces, 145 on-site stalls, and 46 street stalls for a total of 207 parking stalls. No parking will be eliminated with this proposal.

d. Will the proposal require any new improvements to existing roads, streets, pedestrian, bicycle or state transportation facilities, not including driveways? If so, generally describe (indicate whether public or private).

ADA accessible ramps will be provided at the intersection of the proposed public local access residential roadway and Tahoma Boulevard SE. As part of the site improvements Durant St SE will be realigned to the project's western boundary line.

e. Will the project or proposal use (or occur in the immediate vicinity of) water, rail, or air transportation? If so, generally describe.

No.

f. How many vehicular trips per day would be generated by the completed project or proposal? If known, indicate when peak volumes would occur and what percentage of the volume would

be trucks (such as commercial and non-passenger vehicles). What data or transportation models were used to make these estimates?

According to the Traffic Assessment completed by Heath & Associates, Inc. on November 7, 2019 the project is estimated to generate approximately 549 trips per day.

g. Will the proposal interfere with, affect or be affected by the movement of agricultural and forest products on roads or streets in the area? If so generally describe.

No.

h. Proposed measures to reduce or control transportation impacts, if any:

Traffic Facility Charges

None are proposed.

15. PUBLIC SERVICES

a. Would the project result in an increased need for public services (for example: fire protection, police protection, public transit, health care, schools, other)? If so, generally describe.

Yes. Whenever a residential development is constructed, the need for public services, such as police and fire protection, increases. Yelm Community Schools District, Yelm Police Department, and SE Thurston Fire Authority serve the site.

b. Proposed measures to reduce or control direct impacts on public services, if any:

Impacts will be controlled by the increase in tax base and tax assessments paid to the public services as well as impact fees.

16. UTILITIES

a. Circle utilities currently available at the site: **Adjacent to the proposed plat are electricity**, **water, refuse service**, **telephone and cable.**

b. Describe the utilities that are proposed for the project, the utility providing the service, and the general construction activities on

the site or in the immediate vicinity, which might be needed.

The proposed plat anticipates using the following utilities:

Electricity: ..... Puget Sound Energy
Water:..... City of Yelm
Sanitary sewer:..... City of Yelm
Refuse service: ..... LeMay Pacific Disposal
Telephone / cable / internet: ..... Comcast / Dish
Gas: ..... Puget Sound Energy
Stormwater:..... ~~City of Yelm~~
Private

SIGNATURES

The above answers are true and complete to the best of my knowledge. I understand that the lead agency is relying on them to make its decision.

Signature: _____

Name of Signee: Craig Deaver

Position and Agency/Organization: _____

Principal at CES NW, Inc.

Date Submitted: 11/12/2019

APPENDIX

Table of Contents

EXHIBIT

CITY OF YELM
ENVIRONMENTAL CHECKLIST

for

Wyndstone

November 12, 2019

Prepared For:
C & E Developments, LLC
PO Box 2983,
Yelm, WA 98597

Prepared By:
Daniel Smith, P.E.
Savannah Hutchins
06164.2

Zoning Map

February, 2017

City of Yelm

Zoning Designation

- C-1 Commercial
- C-2 Heavy Commercial
- C-3 Large Lot Commercial
- CBD Central Business District
- I Industrial
- ID Insitutional District
- MPC Master Planned Community
- P/OS Parks/Open Space
- R-4 Low Density Residential
- R-6 Moderate Density Residential
- R-16 High Density Residential
- SR 510 Yelm Loop
- City Limits
- Urban Growth Area
- JBLM Large Caliber Weapons - Peak Noise
- JBLM Large Caliber Noise Zone I
- JBLM Large Caliber Noise Zone II

The information and data presented on this map are for informational purposes only and must be confirmed.

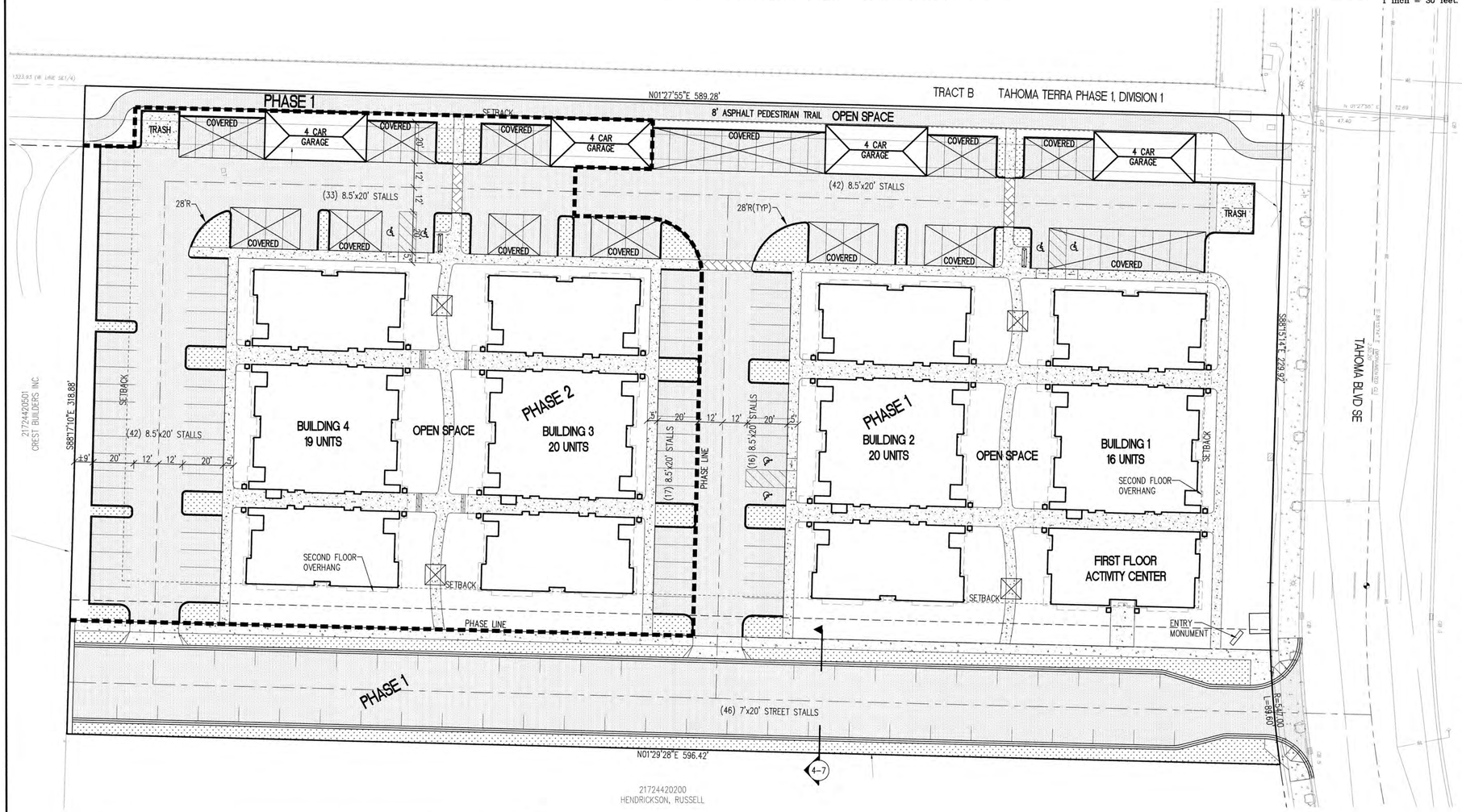
Data Source:

Thurston GeoData Center
929 Lakeridge Dr SW
Suite 216
Olympia, WA 98502
360.754.4594
www.geodata.org

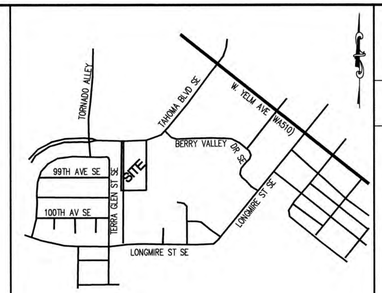
City of Yelm
Community Development Dept.
105 Yelm Ave W
Yelm, WA 98597
360.458.3835
www.ci.yelm.wa.us

WYNDSTONE MULTI-FAMILY

A PORTION OF NW 1/4 OF THE SE 1/4, SEC. 24, TWP.17N, RNG.1E
WILLAMETTE MERIDIAN, YELM, WASHINGTON



30 0 15 30 60
1 inch = 30 feet.



VICINITY MAP
NTS

PARCEL NUMBER
21724420300

SITE ADDRESS
15025 TAHOMA BOULEVARD SOUTHEAST
YELM, WA 98597

LEGAL DESCRIPTION
PARCEL NO. 21724420300; 15025 TAHOMA BLVD SE PARCEL A OF CITY OF YELM BOUNDARY LINE ADJUSTMENT NO. BLA 140153 YL AS RECORDED JULY 18, 2014 UNDER AUDITOR'S FILE NO. 4400621. IN THURSTON COUNTY, WASHINGTON.

VERTICAL DATUM
NAVD 88
ONSITE BENCHMARK: TOP OF CONC, SE CORNER OF POWER VAULT ELEV = 346.55

PRIMARY BENCHMARK CONTROL FROM THURSTON COUNTY GPS CONTROL NO. 1252AZ 2" SURFACE BRASS DISK IN WSDOT CASE MON AT INT TAHOMA BLVD SE AND SW BERRY VALLEY RD NAVD 88 ELEV = 340.02

BASIS OF BEARINGS
MONUMENTS AND CORNERS FOUND AS SET PER PLAT OF TAHOMA TERRA PHASE ONE, DIV 1, AFN 3830707. CALC. POSITION OF WEST LINE OF NW1/4 OF SE 1/4 OF SECTION 24.

SURVEY BY
E. TRUE & ASSOC.
P.O. BOX 908
YELM, WA. 98597
(360) 458-2894

PROJECT STATISTICS

GENERAL STATISTICS

GROSS SITE AREA:	203,322 S.F.(4.67 AC.)
TAHOMA BLVD S.E. R.O.W.:	15,146 S.F.(0.35 AC.)
56' R.O.W. DEDICATION:	33,197 S.F.(0.76 AC.)
NET SITE AREA:	154,979 S.F.(3.56 AC.)

DENSITY

EXISTING ZONING:	R16-HIGH DENSITY
MIN. UNITS REQUIRED:	8 UNITS PER GROSS ACRE
MAX UNITS ALLOWED:	16 UNITS PER GROSS ACRE
TOTAL UNITS ALLOWED:	4.67 AC X 16=74.7 UNITS
TOTAL UNITS SHOWN:	75 UNITS

SETBACKS

ARTERIAL SETBACK:	35'
SIDE SETBACK:	10'
REAR SETBACK:	25'
FLANKING SIDE SETBACK:	20'

PARKING

PARKING REQ.: 2 STALL PER UNITS X 75=150 STALLS

GARAGE PARKING:	16 STALLS
ONSITE PARKING:	145 STALLS
STREET PARKING:	46 STALLS
TOTAL PARKING:	207 STALLS

OPEN SPACE

OPEN SPACE REQUIRED:
GROSS AREA 203,322 S.F. x 10%=20,332 S.F.

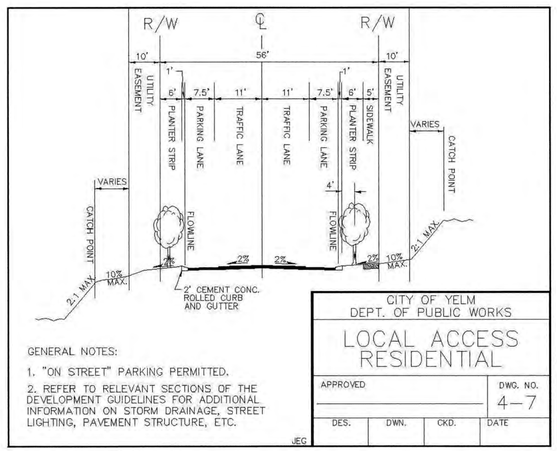
RECREATION PROVIDED:	20,281 .S.F.
PARKING OPEN SPACE PROVIDED:	4,167 .S.F.
TOTAL OPEN SPACE:	24,448 .S.F.

PHASE 1 STATISTICS

PHASE AREA:	113,631 S.F.(2.61 AC.)
56' R.O.W. DEDICATION:	33,197 S.F.(0.76 AC.)
NET AREA:	80,434 S.F.(1.85 AC.)
TOTAL NUMBER UNITS:	36 UNITS
PARKING REQ.:	2 STALL PER UNITS X 36=72 STALLS
GARAGE PARKING:	8 STALLS
ONSITE PARKING:	53 STALLS
STREET PARKING:	46 STALLS
TOTAL PARKING:	107 STALLS

PHASE 2 STATISTICS

NET AREA:	74,545 S.F.(1.71 AC.)
TOTAL NUMBER UNITS:	39 UNITS
PARKING REQ.:	2 STALL PER UNITS X 39=78 STALLS
GARAGE PARKING:	8 STALLS
ONSITE PARKING:	92 STALLS
TOTAL PARKING:	100 STALLS



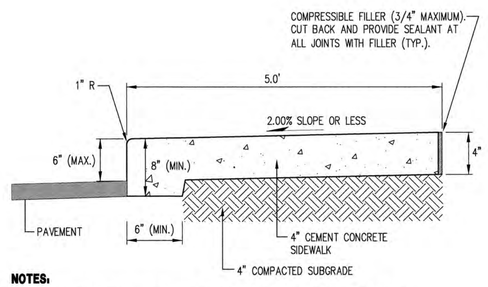
GENERAL NOTES:

1. "ON STREET" PARKING PERMITTED.
2. REFER TO RELEVANT SECTIONS OF THE DEVELOPMENT GUIDELINES FOR ADDITIONAL INFORMATION ON STORM DRAINAGE, STREET LIGHTING, PAVEMENT STRUCTURE, ETC.

JEG

CITY OF YELM
DEPT. OF PUBLIC WORKS
LOCAL ACCESS RESIDENTIAL

APPROVED	DWG. NO. 4-7
DES.	DWN. CKD. DATE



NOTES:

1. COMPACTION FOR CONCRETE CURB AND SIDEWALK TO BE 95% OF MAXIMUM DENSITY.
2. EXPANSION JOINTS SHALL BE 20' O.C. WITH 1/4" TOOLED JOINTS @ 5' O.C..
3. PROVIDE A LIGHT BROOM FINISH.

INTEGRAL CURB AND SIDEWALK
N.T.S.

SHEET INDEX

FEATURES CONTAINED IN THIS DRAWING, INCLUDING BUT NOT LIMITED TO, BOUNDARY, RIGHT-OF-WAY, EASEMENT, PARCEL LINES, BEARINGS, DISTANCES, WETLANDS AND BUFFERS, WERE DERIVED FROM PUBLIC RECORDS OR ACQUIRED FROM AUTOCAD DRAWINGS SUPPLIED BY OTHERS.

DANIEL PAUL SMITH
STATE OF WASHINGTON
47023
REGISTERED
PROFESSIONAL ENGINEER
11-20-19

No.	Revision:	Int.	Date:

C.E.S. NW INC.
CIVIL ENGINEERING & SURVEYING
429 - 29TH ST. NE, SUITE D
PUYALLUP, WA 98372
PH: (253) 848-4282
ceservices@cesnwinc.com

Project: **WYNDSTONE MULTI-FAMILY**
PRELIMINARY SITE PLAN

Client:

Designed: DPS
Drawn: MRL
Checked: CAD

Scale: 1"=30'
Date: 11.20.19
Job No.: 06164

Sheet No.:
SITE1
1 of 2 Sheets

Soil Map—Thurston County Area, Washington

Map Scale: 1:1,100 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 15 30 60 90

Feet: 0 50 100 200 300

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 1:24,000.

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: Thurston County Area, Washington
Survey Area Data: Version 13, Sep 16, 2019

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

Date(s) aerial images were photographed: Mar 29, 2016—Oct 10, 2016

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
74	Nisqually loamy fine sand, 3 to 15 percent slopes	0.6	13.7%
110	Spanaway gravelly sandy loam, 0 to 3 percent slopes	3.2	76.0%
111	Spanaway gravelly sandy loam, 3 to 15 percent slopes	0.4	10.3%
Totals for Area of Interest		**4.2**	**100.0%**

Thurston County Area, Washington

74—Nisqually loamy fine sand, 3 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2ndc9
Elevation: 160 to 1,310 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 degrees F
Frost-free period: 150 to 200 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Nisqually and similar soils: 85 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nisqually

Setting

Landform: Terraces
Parent material: Sandy glacial outwash

Typical profile

H1 - 0 to 5 inches: loamy fine sand
H2 - 5 to 31 inches: loamy fine sand
H3 - 31 to 60 inches: loamy sand

Properties and qualities

Slope: 3 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 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 4.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: A
Forage suitability group: Droughty Soils (G002XS401WA)
Hydric soil rating: No

Minor Components

Yelm

Percent of map unit: 3 percent
Hydric soil rating: No

Norma

Percent of map unit: 2 percent
Landform: Depressions
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Thurston County Area, Washington
Survey Area Data: Version 13, Sep 16, 2019

Thurston County Area, Washington

110—Spanaway gravelly sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2ndb6
Elevation: 330 to 1,310 feet
Mean annual precipitation: 35 to 65 inches
Mean annual air temperature: 50 degrees F
Frost-free period: 150 to 200 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Spanaway and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Spanaway

Setting

Landform: Terraces, outwash plains
Parent material: Volcanic ash over gravelly outwash

Typical profile

H1 - 0 to 15 inches: gravelly sandy loam
H2 - 15 to 20 inches: very gravelly loam
H3 - 20 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 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 3.8 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Forage suitability group: Droughty Soils (G002XS401WA)
Hydric soil rating: No

Data Source Information

Soil Survey Area: Thurston County Area, Washington
Survey Area Data: Version 13, Sep 16, 2019

Thurston County Area, Washington

111—Spanaway gravelly sandy loam, 3 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2ndb7
Elevation: 330 to 1,310 feet
Mean annual precipitation: 35 to 65 inches
Mean annual air temperature: 50 degrees F
Frost-free period: 150 to 200 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Spanaway and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Spanaway

Setting

Landform: Outwash plains, terraces
Parent material: Volcanic ash over gravelly outwash

Typical profile

H1 - 0 to 15 inches: gravelly sandy loam
H2 - 15 to 20 inches: very gravelly sandy loam
H3 - 20 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 3 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 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 3.8 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Forage suitability group: Droughty Soils (G002XS401WA)
Hydric soil rating: No

Data Source Information

Soil Survey Area: Thurston County Area, Washington
Survey Area Data: Version 13, Sep 16, 2019

Wyndstone Aerial

Legend

- Parcel Boundaries
- Roads - Major
  - Major Roads
  - Ramp
  - I 5; US 101
- Roads (Large Scale)
- Railroads
- County Border

Scale 1: 2,684

0 100 200

Feet

Map Created Using GeoData Public Website

Published: 10/4/2019

Note:

THURSTON COUNTY
WASHINGTON
SINCE 1852

Thurston County GeoData Center

LEGAL DESCRIPTION OF THE PARCEL FOR WYNDSTONE SEPA APPLICATION.

PETERSON BROTHERS LLC, A WASHINGTON LIMITED LIABILITY COMPANY

THE LAND REFERRED TO HEREIN BELOW IS SITUATED IN THE COUNTY OF THURSTON, STATE OF WA, AND IS DESCRIBED AS FOLLOWS:

PARCEL A OF BOUNDARY LINE ADJUSTMENT NO. BLA-14-0153-YL, AS RECORDED JULY 18, 2014 UNDER AUDITOR'S FILE NO. 4400621.

SITUATE IN THE COUNTY OF THURSTON, STATE OF WASHINGTON.

21724420300

15025 Tahoma Blvd SE
Yelm, Washington 98597

WASHINGTON DEPARTMENT OF FISH AND WILDLIFE
PRIORITY HABITATS AND SPECIES REPORT

SOURCE DATASET: PHSPlusPublic
REPORT DATE: 10/04/2019 1.35

Query ID: P191004133440

Common Name	Site Name	Priority Area	Accuracy	Federal Status	Sensitive Data	Source Entity
Scientific Name	Source Dataset	Occurrence Type		State Status	Resolution	Geometry Type
	Source Record	More Information (URL)		PHS Listing Status		
Notes	Source Date	Mgmt Recommendations				

WDFW Test Map

October 4, 2019

PHS Report Clip Area

PT

LN

POLY

AS MAPPED

SECTION

QTR-TWP

TOWNSHIP

1:19,842

0 0.15 0.3 0.6 mi

0 0.275 0.55 1.1 km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Key Environmental Solutions, LLC.

September 5, 2019

City of Yelm
Community Development
Attn: Tami Merriman, Associate Planner
106 2nd St SE
Yelm, WA 98597

Re: Peterson Brothers LLC.. Parcel Prairie Habitat Critical Area Recon and ESA No Effect Letter, Thurston County Parcel #21724420300. Located at 15025 Tahoma Boulevard SE, Yelm, Washington, Section 24, Township 17 North, Range 01 East, W.M., and in accordance with the *Thurston County Critical Areas Ordinance Title 24.03 (Definitions), Interim Prairie Ordinance 14542, WDFW Management Recommendations for Washington Priority Habitats Oregon White Oak Woodlands and WDFW Habitat Management Recommendations for the Mazama Pocket Gophers and following the 2018 USFWS Mazama Pocket Gopher Screening Protocol.*

Dear Ms. Merriman,

Key Environmental Solutions, LLC. (KES) has completed a Prairie Habitat Area Recon on the above referenced parcel located at 15025 Tahoma Boulevard SE, Yelm, Thurston County, Washington. Fieldwork was conducted on June 11, 2019 and July 11, 2019.

Project Description and Findings

The parcel was reviewed and are approximately 4.31 acres located in eastern Thurston County, in the city of Yelm. Parcel 21724420300 is currently undeveloped. The parcel was reviewed for prairie habitat and Mazama Pocket Gophers. When the site is developed with multi-family apartment units, there will be not any "Take" of any state or federally listed species. There will be "**No Effect**" on prairie habitat, Mazama Pocket Gophers or any other critical areas or buffer impacted.

KES reviewed Washington Department of Fish and Wildlife's (WDFW) Priority Habitat Species (PHS) lists and maps and no listed species were found to occur onsite. Adjacent areas were also looked at for any critical areas or listed species, and none were found to occur.

Vegetation on the parcel consists of:

Common Name	***Sc. Name***	**Status**	**Notes**
alder	*Alnus rubra*	FAC	
Black hawthorn	*Crataegus douglasii*	FAC	
Canada thistle	*Cirsium arvense*	FACU	
common dandelion	*Taraxacum officinale*	FACU	
common vetch	*Vicia sativa*	FAC	
cut-leaf blackberry	*Rubus laciniatus*	FACU	
curly dock	*Rumex crispus*	FAC	
Douglas fir	*Pseudotsuga menziesii*	FACU	
fireweed	*Epilobium angustifolium*	FACU	
hairy cat's ear	*Hypochaeris radicata*	FACU	
Himalayan blackberry	*Rubus armenicus*	FACU	
Indian plum	*Oemleria cerasiformis*	FACU	
Juniper haircap moss	*Polytrichum juniperinum*	FACU	Dense
klamath weed	*Hypericum perforatum*	FACU	
meadow fescue	*Festuca pratensis*	FACU	
Lotus tree	*Ziziphus lotus*	UPL	
orchardgrass	*Dactylis glomerata*	FACU	
various orchard trees			
Oregon white oak	*Quercus garryana*	UPL	Only 3, all smaller than ½" diameter
Oregon grape	*Mahonia nervosa*	FACU	
pepper weed	*Lepidium latifolium*	FACU	
plantain	*Plantago lanceolata*	FAC	
red clover	*Trifolium prartense*	FACU	
Red elderberry	*Sambucus racemosa*	FACU	
Roemer's fescue	*Festuca roemeri*	FACU	
Robert geranium	*Geranium robertianum*	FACU	
Scotch broom	*Cytisus scoparius*	FACU	
serviceberry	*Amelanchier alnifolia*	FACU	
sheep sorrel	*Rumex acetosella*	FACU	
Snowberry	*Symphoricarpos albus*	FACU	
tree-of-heaven	*Ailanthus altissima*	UPL	

The project area was required to be reviewed due to the presence of prairie soils. KES reviewed the Natural Resource Conservation Service Soils (NRCS) maps and verified that prairie soils did not exist in the project area.

Soil Types	Prairie Soil
Spanaway gravelly sandy loam, 0 to 3 % slopes	Yes
Spanaway gravelly sandy loam, 3 to 15% slopes	Yes

Nisqually loamy fine sand, 3 to 15% slopes	Yes

Mapped prairie soils do not necessarily mean that the area is a prairie –vegetation, landuse, development, and historical land practices may have changed the soil conditions. Current site conditions may or may not accurately reflect mapped soils. Conversely, prairies may be found in areas where the soils are not mapped as prairie soils.

Federal ESA Species, Habitats and No Effect

There are no Federal ESA species or habitats that exist within the parcel. There will be "No Effect" and/or "No Take" from the proposed project.

Historically, the parcel was part of a large farm. In 1990 aerial, this section was still a Douglas fir stand.

KES has performed two site visits as required. KES determined that parcel does not meet the definition of prairie from USFWS and that there has been no Mazama Gopher occurrence found on adjacent parcels or anywhere in the vicinity.

There is a new subdivision directly to the west and to the north the new high school road has recently been constructed.

It is KES's professional opinion that development of this parcel with multi-family apartment units, will not impact any prairie species or any other critical areas and should be permitted. KES concurs with the proposed site plan.

Looking east.

Looking south.

Looking west across parcel.

Looking south across parcel.

Looking north across parcel.

Looking east across parcel.

Looking SE at test pits.

Looking east across parcel.

Professional Standard of Care:

Please be advised that KES personnel has provided professional services that are in accordance with the degree of care and skill generally accepted in the performance of this environmental evaluation. Fish and Wildlife Habitat Assessments together with wetland delineations, mitigation plans, classifications, ratings, streamtyping, riparian planting plans, ordinary high water line determinations, fish removal and other critical area analysis should be reviewed and approved by the agency with permitting authority and potentially other agencies with regulatory authority prior to extensive site design or development. No warranties are expressed or implied by this assessment until approved by the appropriate resource and permitting agency.

The findings expressed in this report are based on field investigations, best available data, best available science, and our professional judgement. The services described in this report were performed consistent with generally accepted professional consulting principles and practices.

The services performed were consistent with our agreement with our client. Key Environmental Solutions, LLC, (KES) is not responsible for the impacts of any changes in environmental standards, practices, or regulations after the date of this report. KES does not warrant the accuracy of supplemental information incorporated in this report that was supplied by others.

Thank you for the opportunity to evaluate this project and please contact us if you have any questions regarding this information, our findings, conclusions, or recommendations at (360) 942-3184 or (360) 562-5763.

Sincerely,

Key McMurry

Owner/Professional Stream and Wildlife Biologist, PWS

Soils

Legend

Gopher Indicator Soils

- HIGH
- MEDIUM
- LOW

Soils (USDA)

- Alderwood gravelly sandy loam, 0 to 3% slopes
- Alderwood gravelly sandy loam, 15 to 30% slopes
- Alderwood gravelly sandy loam, 3 to 15% slopes
- Alderwood gravelly sandy loam, 30 to 50% slopes
- Baldhill very stony sandy loam, 0 to 3% slopes
- Baldhill very stony sandy loam, 15 to 30% slopes
- Baldhill very stony sandy loam, 3 to 15% slopes
- Baldhill very stony sandy loam, 30 to 50% slopes
- Baumgard loam, 10 to 40% slopes
- Baumgard loam, 40 to 65% slopes
- Baumgard-Pheeney Comples, 40 to 65% slopes
- Baumgard-Pheeney complex, 10 to 40% slopes
- Baumgard-Rock outcrop complex, 40 to 65% slopes
- Bellingham silty clay loam
- Boisfort silt loam, 20 to 40% slopes
- Boisfort silt loam, 5 to 20% slopes
- Bunker gravelly silt loam, 30 to 65% slopes
- Bunker gravelly silt loam, 5 to 30% slopes

Scale 1: 2,028

0 100 200

Feet

Map Created Using GeoData Public Website

Published: 5/24/2019

Note:

THURSTON COUNTY
WASHINGTON
SINCE 1852

Thurston County GeoData Center

Sample Mazama Pocket Gopher Screening Field Form

Site Visit Date: June 11, 2019

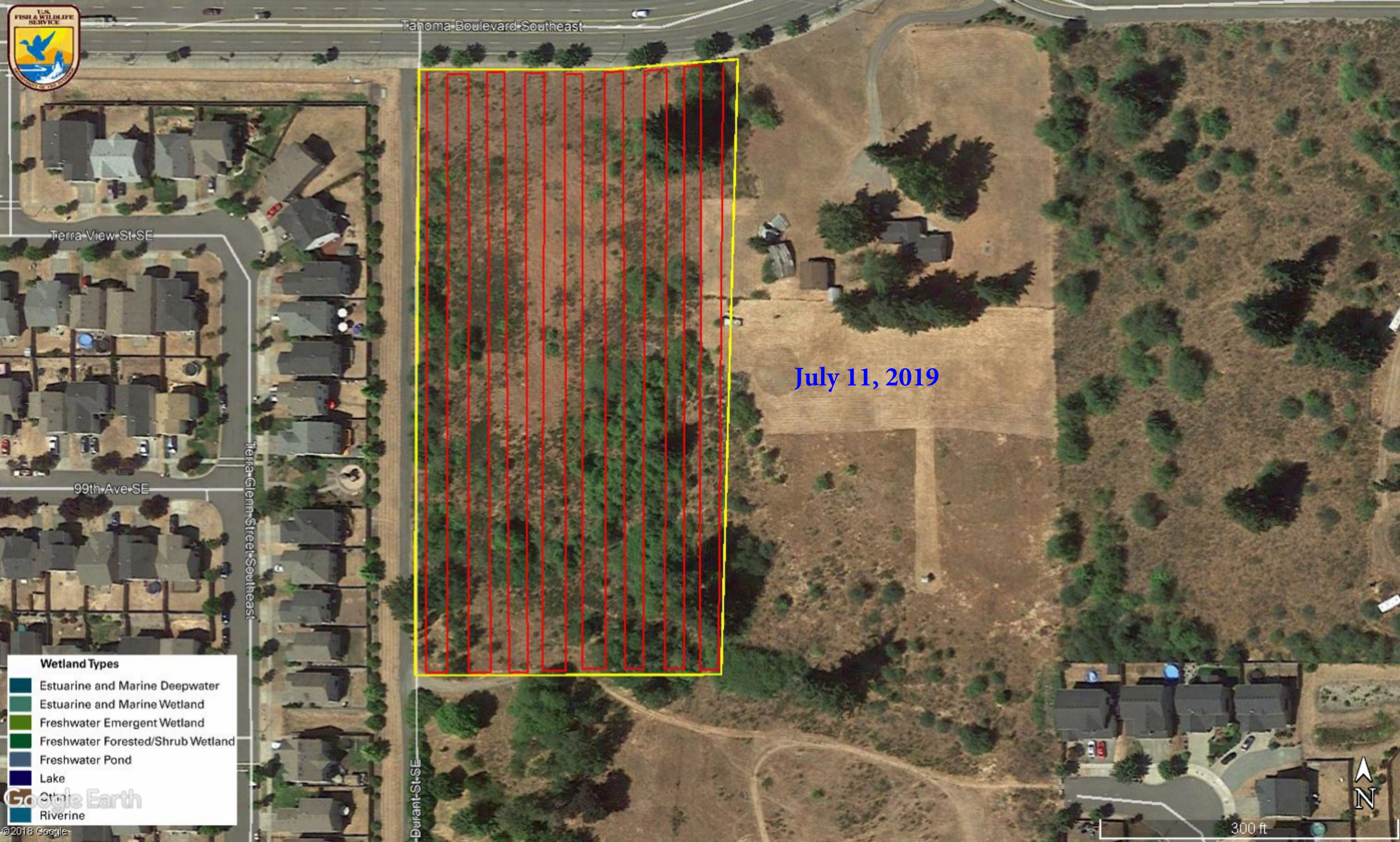
If 2nd or 3rd site visit, date(s) of previous visits: _____

Site Information	Parcel #: 21724420300 Site/Landowner: Peterson Brothers LLC. Mapped soil types [close-up soil map with site outlined is attached x] More preferred: High-Nisqually loamy fine sand, 3 to 15%, slopes Less preferred: Medium-Spanaway gravelly sandy loam, 0 to 3%, slopes Spanaway gravelly sandy loam, 3 to 15%, slopes Within 600' of known MPG occurrence? Yes (distance in ft) _____ No X [Copy that includes date of info. retrieval is attached ____]
How were the data collected? (circle the method for each)	Transect: GPS Aerial Mounds: GPS Aerial What portion of MPG mounds observed were recorded in GPS or drawn on map? None All Most Some Notes:
Field team names: (Note who filled out form and others conducting screening)	Key McMurry, Key Environmental Solutions, LLC.
Others onsite (name/affiliation)	
Site visit # (CIRCLE all that apply) Request mowing to enable screening of all or a portion of the site?	1st 2nd 3rd Unable to screen Yes No N/A Date last mowed: _____
Do onsite conditions throughout the entire parcel preclude the need for MPG surveys? (CIRCLE and DESCRIBE)	Yes No Dense woody cover (trees/shrubs) that appears to preclude any MPG use Impervious Compacted Graveled Flooded Slope Other _____ Notes:
Describe ground visibility for mound detection: (CIRCLE and DESCRIBE)	Poor Fair Good Notes:

Notes:

Sample Mazama Pocket Gopher Screening Field Form

	MPG Mounds	Indeterminate	Mole Mounds
Quantify or describe amount of MPG mounds and approx. # of mounds or groups of mounds (specify whether count is individual mounds or groups)	N/A	N/A	0
	No MPG mounds observed (CIRCLE)		
Does woody vegetation onsite match aerial photo? (CIRCLE and DESCRIBE)	**Yes** No – describe differences and show on parcel map/aerial:		
What portion of the property was screened? (CIRCLE and DESCRIBE)	**All** Part - describe and show on parcel map/aerial:		
Notes			
Team reviewed and agreed to data recorded on form? (CIRCLE, and EXPLAIN if "No")	**Yes** No Reviewed by: KM ____ ____ ____ ____ **Notes:**		


Tahoma Boulevard Southeast
Terra View St SE
99th Ave SE
Terra Glenn Street Southeast
Durant St SE
July 11, 2019
Wetland Types
Estuarine and Marine Deepwater
Estuarine and Marine Wetland
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Other
Riverine
Google Earth
©2018 Google
N
300 ft

Sample Mazama Pocket Gopher Screening Field Form

Site Visit Date: July 11, 2019

If 2nd or 3rd site visit, date(s) of previous visits: June 11, 2019

Site Information	Parcel #: 21724420300 Site/Landowner: Peterson Brothers LLC. Mapped soil types [close-up soil map with site outlined is attached x] More preferred: High-Nisqually loamy fine sand, 3 to 15%, slopes Less preferred: Medium-Spanaway gravelly sandy loam, 0 to 3%, slopes Spanaway gravelly sandy loam, 3 to 15%, slopes Within 600' of known MPG occurrence? Yes (distance in ft) _____ No X [Copy that includes date of info. retrieval is attached ____]	
How were the data collected? (circle the method for each)	Transect: GPS Aerial Mounds: GPS Aerial What portion of MPG mounds observed were recorded in GPS or drawn on map? None All Most Some Notes:	
Field team names: (Note who filled out form and others conducting screening)	Key McMurry, Key Environmental Solutions, LLC.	
Others onsite (name/affiliation)		
Site visit # (CIRCLE all that apply) Request mowing to enable screening of all or a portion of the site?	1st 2nd 3rd Unable to screen Yes No N/A Date last mowed:_____	Notes:
Do onsite conditions throughout the entire parcel preclude the need for MPG surveys? (CIRCLE and DESCRIBE)	Yes No Dense woody cover (trees/shrubs) that appears to preclude any MPG use Impervious Compacted Graveled Flooded Slope Other_____ Notes:	
Describe ground visibility for mound detection: (CIRCLE and DESCRIBE)	Poor Fair Good Notes:	

Sample Mazama Pocket Gopher Screening Field Form

	MPG Mounds	Indeterminate	Mole Mounds
Quantify or describe amount of MPG mounds and approx. # of mounds or groups of mounds (specify whether count is individual mounds or groups)	N/A	N/A	0
	No MPG mounds observed (CIRCLE)		
Does woody vegetation onsite match aerial photo? (CIRCLE and DESCRIBE)	**Yes** No – describe differences and show on parcel map/aerial:		
What portion of the property was screened? (CIRCLE and DESCRIBE)	**All** Part - describe and show on parcel map/aerial:		
Notes			
Team reviewed and agreed to data recorded on form? (CIRCLE, and EXPLAIN if "No")	**Yes** No Reviewed by: KM ____ ____ ____ ____ **Notes:**		

U.S. FISH & WILDLIFE SERVICE

oma Boulevard Southeast

Terra View St SE

99th Ave SE

Terra Glenn Street Southeast

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July 11, 2019

Wetland Types

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- Lake
- Other
- Riverine

Google Earth

N

300 ft

INSIGHT GEOLOGIC, INC.

July 12, 2019

C & E Developments LLC
PO Box 2983
Yelm, Washington 98597
Attention: Casey Peterson

Report
Geotechnical and Stormwater Investigation
Wyndstone Development
Proposed Multi-Family Residential
15025 Tahoma Boulevard SE
Yelm, Washington
Project No. 1142-001-01

INTRODUCTION

Insight Geologic is pleased to present our report of subsurface conditions at the location of your proposed Wyndstone multi-family residential development to be located at 15025 Tahoma Boulevard SE in Yelm, Washington. The location of the site is shown relative to surrounding physical features in the Vicinity Map, Figure 1. The site of the proposed project consists of a single parcel of property (Thurston County Tax Parcel No. 21724420300), comprising approximately 4.3 acres.

The project will include four, multi-family, multi-story residential buildings with appurtenant parking and drive areas. Stormwater runoff from roads and parking areas is to be infiltrated to the subsurface in the northern portion of the property.

SCOPE OF SERVICES

The objective of our services was to evaluate subsurface conditions on the property as a basis for evaluating suitability of the soils for the proposed building and parking areas, as well as evaluating the soils for stormwater infiltration. Our specific scope of services included the following tasks:

Stormwater Investigation

1. Provided for the location of subsurface utilities on the site. We conducted this task by notifying the “One Call” system.
2. Conducted a site reconnaissance to evaluate and mark proposed boring locations at the site and for truck-mounted drilling rig access.
3. Drilled two (2) borings in the location of the proposed stormwater disposal structure at the site using a truck-mounted drilling rig.

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4. Installed one (1), 2-inch diameter monitoring well, constructed of PVC casing. The well was finished inside a locking steel cover installed flush with the surrounding grade.
5. Collected soil samples continuously during drilling to the full depth of the borings.
6. Maintained logs of the soils encountered in the boreholes and provided well construction details. Soils were described in general accordance with the Unified Soil Classification System and presented on the field logs.
7. Conducted an evaluation of stormwater infiltration rates using the detailed method outlined in Ecology's 2014 Stormwater Management Manual, as adopted by the City of Yelm, and provide a design infiltration rate for stormwater infiltration.

Geotechnical Investigation

8. Excavated a series of six (6) exploratory test pits across the project site using a small, track-mounted excavator. The test pits were excavated to depths of between approximately 6 to 8 feet below ground surface (bgs) across the site.
9. Collected representative soil samples from the test pits for possible laboratory analysis.
10. Logged the soils exposed in the test pits in general accordance with ASTM D2487-06.
11. Provided for laboratory testing of seven (7) soil samples for gradation analyses to evaluate bearing capacity and for stormwater infiltration calculations.
12. Prepared a report summarizing our field activities including our recommendations for site preparation and grading, bearing capacity, seismic class, temporary and final cut slopes, earth pressures, and suitability of the on-site soils for use as fill.

FINDINGS

Surface Conditions

The project site is a rectangular shaped parcel situated at an elevation of approximately 340 to 350 feet above mean sea level (MSL) and is currently occupied by a single-family residence. The property is bounded by Tahoma Boulevard SE to the north, Durant Street SE to the west, and residential properties to the south and east. The site gently slopes down to the north with an elevation drop of 10 feet across the site. The subject site is vegetated with grasses, scotch broom, and isolated stands of low growing trees and other shrubs.

Geology

Based on our review of available published geologic maps, Vashon age glacial recessional outwash gravel deposits underlie the project site. This material is described as poorly-sorted gravel and sand. This material was deposited by outwash rivers during the waning stages of the most recent glacial period in the Puget Sound region and is not glacially consolidated.

Subsurface Explorations

We explored subsurface conditions at the site on June 10 and June 14, 2019 by excavating six test pits and advancing two borings in the locations as shown on the Site Plan, Figure 2. The test pits were excavated by Insight Geologic using a track-mounted excavator. The exploratory borings were

completed by Holocene Drilling using a truck-mounted hollow stem auger drill rig. A geologist from Insight Geologic monitored the explorations and maintained a log of the conditions encountered. The test pits were completed to depths of 6 to 8 feet bgs, and the borings were completed to depths of between 23 and 36.5 feet bgs. The soils were visually classified in general accordance with the system described in ASTM D2487-06. A copy of the explorations is contained in Attachment A.

Soil Conditions

The explorations were generally consistent across the site. Underlying approximately 6 inches of sod, we generally encountered between 1.5 to 2 feet of dark brown, poorly- to well-graded gravel and sand with cobbles and varying levels of silt and organics (GP-GM, GP), in a loose and moist condition. Underlying the dark brown unit, we encountered brown poorly- to well-graded gravels with cobbles and varying percentages of sand (GP, GW) to poorly graded sands with gravels and cobbles and varying percentages of silt (SP, SP-SM), in a loose to very dense and moist to wet condition to the base of the explorations. In general, soils increased in compaction with depth.

The soils encountered are consistent with Nisqually loamy fine sand and Spanaway gravelly sandy loam, which are mapped for the area. In general, the Nisqually loamy fine sand is mapped along the north quarter of the site, while the Spanaway gravelly sandy loam is mapped on the remainder of the property. These soils are generally formed from sandy and gravely glacial outwash and generally has restrictive layers occurring greater than 7 feet below grade. Percolation is generally high, with rates between 1.98 and 5.95 inches per hour, according to the U.S. Department of Agriculture Soil Survey.

Groundwater Conditions

Groundwater was encountered in boring MW-1 at a depth of 32 feet bgs. Groundwater was not encountered in any of the remaining explorations completed on-site. The explorations were completed during the summer season at a time that generally correlates to a lower groundwater elevation. In addition, no evidence of high groundwater was encountered within the explorations at the site.

Laboratory Testing

We selected seven soil samples for gradation analyses in general accordance with ASTM D422 to define soil class and obtain parameters for stormwater infiltration calculations. Our laboratory test results are provided in Attachment B.

STORMWATER INFILTRATION

We completed a stormwater infiltration rate evaluation in general accordance with the Washington State Department of Ecology Stormwater Manual for Western Washington (2014 Manual) as adopted by the City of Yelm. For the purposes of this evaluation, we selected Method 3 “Soil Grain Size Analysis Method”. The 2014 Manual utilizes the relationship between the D_{10}, D_{60}, and D_{90} results of the ASTM grain-size distribution analyses, along with site specific correction factors to estimate long-term design infiltration rates of each infiltration facility.

Based on our gradation analyses, we estimate that the long-term design infiltration rate (F_{design}) for the proposed stormwater infiltration is between 1.6 and 20 inches per hour, after applying the appropriate correction factors. The range of infiltration rate is the result of varying percentages of fines in the soil

profile. Our calculations assume that the stormwater infiltration will occur at a depth of at least 3 feet bgs or below the upper gravel with sand and silt unit. Changes to these infiltration rates are possible depending on the depth to groundwater during winter months. For the purposes of stormwater infiltration on this project, we recommend using an infiltration rate of 2.9 inches per hour for the pond area and 5 inches per hour for roof downspouts in the central portion of the site.

Table 1. Design Infiltration Rates – Detailed Method

Exploration	Unit	Depth Range (feet)	D_{10} Value	D_{60} Value	D_{90} Value	Long Term Design Infiltration Rate (Inches per hour)
TP-2	GW	3.0 – 8.0	7.9	44	130	20
TP-5	SP	2.0 – 8.0	0.31	3.2	51	1.6
MW-1	GP	25.0 – 26.5	0.35	14	30	2.9
MW-1	GW	30.0 – 31.5	0.26	8.5	18	
B-1	SP-SM	10.0 – 11.5	0.14	2.1	25	

SEISMIC DESIGN CONSIDERATIONS

General

We understand that seismic design will likely be performed using the 2015 IBC standards. The following parameters may be used in computing seismic base shear forces:

Table 2. 2015 IBC Seismic Design Parameters

Spectral Response Accel. at Short Periods (S_S) = 1.25
Spectral Response Accel. at 1 Second Periods (S_1) = 0.50
Site Class = D
Site Coefficient (F_A) = 1.0
Site Coefficient (F_V) = 1.5

A full report for the seismic design parameters is presented in Attachment C.

Ground Rupture

Because of the location of the site with respect to the nearest known active crustal faults, and the presence of a relatively thick layer of glacial outwash deposits, it is our opinion that the risk of ground rupture at the site due to surface faulting is low.

Soil Liquefaction

Liquefaction refers to a condition where vibration or shaking of the ground, usually from earthquake forces, results in the development of excess pore water pressures in saturated soils, and a subsequent loss of stiffness in the soil occurs. Liquefaction also causes a temporary reduction of soil shear strength and bearing capacity, which can cause settlement of the ground surface above the liquefied

soil layers. In general, soils that are most susceptible to liquefaction include saturated, loose to medium dense, clean to silty sands and non-plastic silts within 50 feet of ground surface.

Based on our review of the *Liquefaction Susceptibility Map of Thurston County (Palmer, 2004)*, the project site is identified to have a very low potential risk for soil liquefaction. Based on our experience with detailed seismic studies in the Yelm area, including areas that are mapped within the same recessional outwash soil deposits as the project site, we concur with the reviewed map. It is our opinion that there is a low risk for soil liquefaction at the site.

Seismic Compression

Seismic compression is defined as the accrual of contractive volumetric strains in unsaturated soils during strong shaking from earthquakes (Stewart et al., 2004). Loose to medium dense clean sands and non-plastic silts are particularly prone to seismic compression settlement. Seismic compression settlement is most prevalent on slopes, but it can also occur on flat ground. It is our opinion that the upper 15 feet of the soil profile at the site has a moderate risk for seismic compression settlement.

Seismic Settlement Discussion

Based on the materials encountered in our explorations, it is our preliminary opinion that seismic settlements (liquefaction-induced plus seismic compression) could potentially total a few inches at the site as the result of an IBC design level earthquake. We are available upon request to perform deep subsurface explorations and detailed seismic settlement estimates during the design phase.

Seismic Slope Instability

The maximum inclination of the site is approximately 2 percent and we did not observe signs of slope instability during our site work. In our opinion, there is a very low risk of seismic slope instability at the project site under current conditions.

Lateral Spreading

Lateral spreading involves the lateral displacement of surficial blocks of non-liquefied soil when an underlying soil layer liquefies. Lateral spreading generally develops in areas where sloping ground or large grade changes are present. Based on our limited understanding of the subsurface conditions at the site, it is our opinion that there is a low risk for the development of lateral spreading as a result of an IBC design level earthquake.

CONCLUSIONS AND RECOMMENDATIONS

General

Based on the results of our subsurface explorations and engineering analyses, it is our opinion that the proposed development is feasible from a geotechnical standpoint. We recommend that the proposed structures be supported on shallow concrete foundations that are designed using an allowable soil bearing capacity of 2,500 pounds per square foot (psf).

The soils encountered in our explorations are typically in a loose condition near ground surface. To limit the potential for structure settlement, we recommend that shallow foundations and slabs-on-grade be established on a minimum 1-foot thick layer of structural fill. Depending on final grading plans and

the time of year earthwork is performed; it could be practical to reuse the on-site soils as structural fill under the foundations/slabs.

Stormwater infiltration at the site is feasible. We propose a design infiltration rate of 2.9 inches per hour for the stormwater infiltration systems, based on the assumption that stormwater infiltration will occur within the clean gravels and sands below a depth of about 3 feet bgs. This value is based on an idealized soil column located in the area of the proposed stormwater infiltration trench on the north side of the site. It may be possible to increase the infiltration rate with additional testing such as a Pilot Infiltration Test in the location of the proposed infiltration facility.

Alternatively, based on the U.S. Department of Agriculture Soil Survey map, areas of increased infiltration may be present within the Spanaway gravelly sandy loam mapped on the southern portions of the site. Additional evaluation of this area at depth would be required for a more detailed analysis.

Earthwork

General

We anticipate that site development earthwork will include removing the existing vegetation, stripping sod/topsoil materials, preparing subgrades, excavating for utility trenches, and placing and compacting structural fill. We expect that the majority of site grading can be accomplished with conventional earthmoving equipment in proper working order.

Our explorations did not encounter appreciable amounts of debris or unsuitable soils associated with past site development. Still, it is possible that concrete slabs, abandoned utility lines or other development features could be encountered during construction. The contractor should be prepared to deal with these conditions.

Clearing and Stripping

Clearing and stripping should consist of removing surface and subsurface deleterious materials including sod/topsoil, trees, brush, debris and other unsuitable loose/soft or organic materials. Stripping and clearing should extend at least 5 feet beyond all structures and areas to receive structural fill.

We estimate that a stripping depth of about 0.5 feet will be required to remove the sod encountered in several of our explorations. Deeper stripping depths may be required if additional unsuitable soils are exposed during stripping operations. We recommend that trees be removed by overturning so that the majority of roots are also removed. Depressions created by tree or stump removal should be backfilled with structural fill and properly compacted.

Subgrade Preparation

After stripping and excavating to the proposed subgrade elevation, and before placing structural fill or foundation concrete, the exposed subgrade should be thoroughly compacted to a firm and unyielding condition. The exposed subgrade should then be proof-rolled using loaded, rubber-tired heavy equipment. We recommend that Insight Geologic be retained to observe the proof-rolling prior to placement of structural fill or foundation concrete. Areas of limited access that cannot be proof-rolled

can be evaluated using a steel probe rod. If soft or otherwise unsuitable areas are revealed during proof-rolling or probing, that cannot be compacted to a stable and uniformly firm condition, we generally recommend that: 1) the subgrade soils be scarified (e.g., with a ripper or farmer's disc), aerated and recompacted; or 2) the unsuitable soils be overexcavated and replaced with structural fill.

Temporary Excavations and Groundwater Handling

Excavations deeper than 4 feet should be shored or laid back at a stable slope if workers are required to enter. Shoring and temporary slope inclinations must conform to the provisions of Title 296 Washington Administrative Code (WAC), Part N, "Excavation, Trenching and Shoring." Regardless of the soil type encountered in the excavation, shoring, trench boxes or sloped sidewalls were required under the Washington Industrial Safety and Health Act (WISHA). The contract documents should specify that the contractor is responsible for selecting excavation and dewatering methods, monitoring the excavations for safety and providing shoring, as required, to protect personnel and structures.

In general, temporary cut slopes should be inclined no steeper than about 1.5H:1V (horizontal: vertical). This guideline assumes that all surface loads are kept at a minimum distance of at least one-half the depth of the cut away from the top of the slope, and that significant seepage is not present on the slope face. Flatter cut slopes were necessary where significant seepage occurs or if large voids are created during excavation. Some sloughing and raveling of cut slopes should be expected. Temporary covering with heavy plastic sheeting should be used to protect slopes during periods of wet weather.

We anticipate that if perched groundwater is encountered during construction can be handled adequately with sumps, pumps, and/or diversion ditches. Groundwater handling needs will generally be lower during the late summer and early fall months. We recommend that the contractor performing the work be made responsible for controlling and collecting groundwater encountered during construction.

Permanent Slopes

We do not anticipate that permanent slopes will be utilized for the proposed project. If permanent slopes are necessary, we recommend the slopes be constructed at a maximum inclination of 2H:1V. Where 2H:1V permanent slopes are not feasible, protective facings and/or retaining structures should be considered.

To achieve uniform compaction, we recommend that fill slopes be overbuilt and subsequently cut back to expose well-compacted fill. Fill placement on slopes should be benched into the slope face and include keyways. The configuration of the bench and keyway depends on the equipment being used. Bench excavations should be level and extend into the slope face. We recommend that a vertical cut of about 3 feet be maintained for benched excavations. Keyways should be about 1-1/2 times the width of the equipment used for grading or compaction.

Erosion Control

We anticipate that erosion control measures such as silt fences, straw bales and sand bags will generally be adequate during development. Temporary erosion control should be provided during

construction activities and until permanent erosion control measures are functional. Surface water runoff should be properly contained and channeled using drainage ditches, berms, swales, and tightlines, and should not discharge onto sloped areas. Any disturbed sloped areas should be protected with a temporary covering until new vegetation can take effect. Jute or coconut fiber matting, excelsior matting or clear plastic sheeting is suitable for this purpose. Graded or disturbed slopes should be tracked in-place with the equipment running perpendicular to the slope contours so that the track marks provide a texture to help resist erosion. Ultimately, erosion control measures should be in accordance with local regulations and should be clearly described on project plans.

Wet Weather Earthwork

Some of the near surface soils contain up to about 7 percent fines. When the moisture content of the soil is more than a few percent above the optimum moisture content, the soil will become unstable and it may become difficult or impossible to meet the required compaction criteria. Disturbance of near surface soils should be expected if earthwork is completed during periods of wet weather.

The wet weather season in this area generally begins in October and continues through May. However, periods of wet weather may occur during any month of the year. If wet weather earthwork is unavoidable, we recommend that:

- The ground surface is sloped so that surface water is collected and directed away from the work area to an approved collection/dispersion point.
- Earthwork activities not take place during periods of heavy precipitation.
- Slopes with exposed soil be covered with plastic sheeting or otherwise protected from erosion.
- Measures are taken to prevent on-site soil and soil stockpiles from becoming wet or unstable. Sealing the surficial soil by rolling with a smooth-drum roller prior to periods of precipitation should reduce the extent that the soil becomes wet or unstable.
- Construction traffic is restricted to specific areas of the site, preferably areas that are surfaced with materials not susceptible to wet weather disturbance.
- A minimum 1-foot thick layer of 4- to 6-inch quarry spalls is used in high traffic areas of the site to protect the subgrade soil from disturbance.
- Contingencies are included in the project schedule and budget to allow for the above elements.

Structural Fill Materials

General

Material used for structural fill should be free of debris, organic material and rock fragments larger than 3 inches. The workability of material for use as structural fill will depend on the gradation and moisture content of the soil. As the amount of fines increases, soil becomes increasingly more sensitive to small changes in moisture content and adequate compaction becomes more difficult or impossible to achieve.

On-Site Soil

We anticipate that the majority of the on-site soils encountered during construction will consist of gravels, cobbles and sands, located at or near the surface of the site. It is our opinion, that this material is a suitable source for structural fill during a significant portion of the year. On-site materials used as structural fill should be free of roots, organic matter and other deleterious materials and particles larger than 3 inches in diameter. Significant quantities of material greater than 3 inches in diameter were observed during our site explorations. This material will cause significand difficulties in soil grading and compaction efforts. We recommend that the material greater than 3 inches in diameter be screened and removed or crushed for reuse on-site.

Select Granular Fill

Select granular fill should consist of imported, well-graded sand and gravel or crushed rock with a maximum particle size of 3 inches and less than 5 percent passing a U.S. Standard No. 200 sieve based on the minus ¾-inch fraction. Organic matter, debris or other deleterious material should not be present. In our experience, "gravel borrow" as described in Section 9-03.14(1) of the 2018 WSDOT Standard Specifications is typically a suitable source for select granular fill during periods of wet weather, provided that the percent passing a U.S. Standard No. 200 sieve is less than 5 percent based on the minus ¾-inch fraction.

Structural Fill Placement and Compaction

General

Structural fill should be placed on an approved subgrade that consists of uniformly firm and unyielding inorganic native soils or compacted structural fill. Structural fill should be compacted at a moisture content near optimum. The optimum moisture content varies with the soil gradation and should be evaluated during construction.

Structural fill should be placed in uniform, horizontal lifts and uniformly densified with vibratory compaction equipment. The maximum lift thickness will vary depending on the material and compaction equipment used, but should generally not exceed the loose thicknesses provided on Table 3. Structural fill materials should be compacted in accordance with the compaction criteria provided in Table 4.

Table 3. Recommended Uncompacted Lift Thickness

Compaction Equipment	Recommended Uncompacted Fill Thickness (inches)	
	Granular Materials Maximum Particle Size ≤ 1 1/2 inch	Granular Materials Maximum Particle Size > 1 1/2 inch
Hand Tools (Plate Compactors and Jumping Jacks)	4 – 8	Not Recommended
Rubber-tire Equipment	10 – 12	6 – 8
Light Roller	10 – 12	8 – 10
Heavy Roller	12 – 18	12 – 16
Hoe Pack Equipment	18 – 24	12 – 16

Note: The above table is intended to serve as a guideline and should not be included in the project specifications.

Table 4. Recommended Compaction Criteria in Structural Fill Zones

Fill Type	Percent Maximum Dry Density Determined by ASTM Test Method D 1557 at ±3% of Optimum Moisture		
	0 to 2 Feet Below Subgrade	> 2 Feet Below Subgrade	Pipe Zone
Imported or On-site Granular, Maximum Particle Size < 1-1/4-inch	95	95	-----
Imported or On-site Granular, Maximum Particle Size >1-1/4-inch	N/A (Proof-roll)	N/A (Proof-roll)	-----
Trench Backfill[1]	95	92	90

Note: [1]Trench backfill above the pipe zone in nonstructural areas should be compacted to at least 85 percent.

Shallow Foundation Support

General

We recommend that the proposed structures be founded on continuous wall or isolated column footings, bearing on a minimum 1-foot thick overexcavation and replacement with compacted structural fill where underlying soils are not able to be compacted as structural fill. The structural fill zone should extend to a horizontal distance equal to the overexcavation depth on each side of the footing. The actual overexcavation depth will vary, depending on the conditions encountered.

We recommend that a representative from Insight Geologic observe the foundation surfaces before overexcavation, and before placing structural fill in overexcavations. This representative should confirm that adequate bearing surfaces have been prepared and that the soil conditions are as anticipated. Unsuitable foundation bearing soils should be recompacted or removed and replaced with compacted structural fill, as recommended by the geotechnical engineer.

Bearing Capacity and Footing Dimensions

We recommend an allowable soil bearing pressure of 2,500 psf for shallow foundations that are supported as recommended. This allowable bearing pressure applies to long-term dead and live loads exclusive of the weight of the footing and any overlying backfill. The allowable soil bearing pressure can be increased by one-third when considering total loads, including transient loads such as those induced by wind and seismic forces.

We recommend a minimum width of 18 inches for continuous wall footings and 2 feet for isolated column footings. For settlement considerations, we have assumed a maximum width of 4 feet for continuous wall footings and 6 feet for isolated column footings.

Perimeter footings should be embedded at least 12 inches below the lowest adjacent grade where the ground is flat. Interior footings should be embedded a minimum of 6 inches below the nearest adjacent grade.

Settlement

We estimate that total settlement of footings that are designed and constructed as recommended should be less than 1 inch. We estimate that differential settlements should be ½ inch or less between

comparably loaded isolated footings or along 50 feet of continuous footing. We anticipate that the settlement will occur essentially as loads are applied during construction.

Lateral Load Resistance

Lateral loads on shallow foundation elements may be resisted by passive resistance on the sides of footings and by friction on the base of footings. Passive resistance may be estimated using an equivalent fluid density of 303 pounds per cubic foot (pcf), assuming that the footings are backfilled with structural fill. Frictional resistance may be estimated using 0.25 for the coefficient of base friction.

The lateral resistance values provided above incorporate a factor of safety of 1.5. The passive earth pressure and friction components can be combined, provided that the passive component does not exceed two-thirds of the total. The top foot of soil should be neglected when calculating passive resistance, unless the foundation perimeter area is covered by a slab-on-grade or pavement.

Slabs-On-Grade

Slabs-on-grade should be established on a minimum 1-foot thick section of structural fill extending to an approved bearing surface. A modulus of vertical subgrade reaction (subgrade modulus) can be used to design slabs-on-grade. The subgrade modulus varies based on the dimensions of the slab and the magnitude of applied loads on the slab surface; slabs with larger dimensions and loads are influenced by soils to a greater depth. We recommend a modulus value of 300 pounds per cubic inch (pci) for design of on-grade floor slabs with floor loads up to 500 psf. We are available to provide alternate subgrade modulus recommendations during design, based on specific loading information.

We recommend that slabs-on-grade in interior spaces be underlain by a minimum 4-inch thick capillary break layer to reduce the potential for moisture migration into the slab. The capillary break material should consist of a well-graded sand and gravel or crushed rock containing less than 5 percent fines based on the fraction passing the ¾-inch sieve. The 4-inch thick capillary break layer can be included when calculating the minimum 1-foot thick structural fill section beneath the slab. If dry slabs are required (e.g., where adhesives are used to anchor carpet or tile to the slab), a waterproofing liner should be placed below the slab to act as a vapor barrier.

Subsurface Drainage

It is our opinion that foundation footing drains and underslab drains are likely unnecessary for the proposed structures. The majority of subsurface site soils are well draining and it is unlikely that subsurface drains would produce water. The soils are suitable for roof runoff drywells and should be classified as Group A for the purposes of design.

Conventional Retaining Walls

General

We do not anticipate that retaining walls will be utilized for the proposed project. We should be contacted during the design phase to review retaining wall plans and provide supplemental recommendations, if needed.

Drainage

Positive drainage is imperative behind any retaining structure. This can be accomplished by using a zone of free-draining material behind the wall with perforated pipes to collect water seepage. The drainage material should consist of coarse sand and gravel containing less than 5 percent fines based on the fraction of material passing the ¾-inch sieve. The wall drainage zone should extend horizontally at least 12 inches from the back of the wall. If a stacked block wall is constructed, we recommend that a barrier such as a non-woven geotextile filter fabric be placed against the back of the wall to prevent loss of the drainage material through the wall joints.

A perforated smooth-walled rigid PVC pipe, having a minimum diameter of 4 inches, should be placed at the bottom of the drainage zone along the entire length of the wall. Drainpipes should discharge to a tightline leading to an appropriate collection and disposal system. An adequate number of cleanouts should be incorporated into the design of the drains in order to provide access for regular maintenance. Roof downspouts, perimeter drains or other types of drainage systems should not be connected to retaining wall drain systems.

Design Parameters

We recommend an active lateral earth pressure of 37 pcf (equivalent fluid density) for a level backfill condition. This assumes that the top of the wall is not structurally restrained and is free to rotate. For restrained walls that are fixed against rotation (at-rest condition), an equivalent fluid density of 56 pcf can be used for the level backfill condition. For seismic conditions, we recommend a uniform lateral pressure of 14H psf (where H is the height of the wall) be added to the lateral pressures. This seismic pressure assumes a peak ground acceleration of 0.32 g. Note that if the retaining system is designed as a braced system but is expected to yield a small amount during a seismic event, the active earth pressure condition may be assumed and combined with the seismic surcharge.

The recommended earth pressure values do not include the effects of surcharges from surface loads or structures. If vehicles were operated within one-half the height of the wall, a traffic surcharge should be added to the wall pressure. The traffic surcharge can be approximated by the equivalent weight of an additional 2 feet of backfill behind the wall. Other surcharge loads, such as construction equipment, staging areas and stockpiled fill, should be considered on a case-by-case basis.

DOCUMENT REVIEW AND CONSTRUCTION OBSERVATION

We recommend that we be retained to review the portions of the plans and specifications that pertain to earthwork construction and stormwater infiltration. We recommend that monitoring, testing and consultation be performed during construction to confirm that the conditions encountered are consistent with our explorations and our stated design assumptions. Insight Geologic would be pleased to provide these services upon request.

REFERENCES

International Code Council, International Building Code, 2015.

Seismic Compression of As-compacted Fill Soils with Variable Levels of Fines Content and Fines Plasticity, Department of Civil and Environmental Engineering, University of California, Los Angeles, July 2004.

Washington State Department of Transportation (WSDOT), Standard Specifications for Road, Bridge and Municipal Construction Manual, 2018.

Washington State Department of Ecology (WSDOE), Stormwater Management Manual of Western Washington, 2014.

LIMITATIONS

We have prepared this geotechnical and stormwater investigation report for the exclusive use of C & E Developments LLC and their authorized agents, for the proposed development located at 15025 Tahoma Boulevard SE in Yelm, Washington.

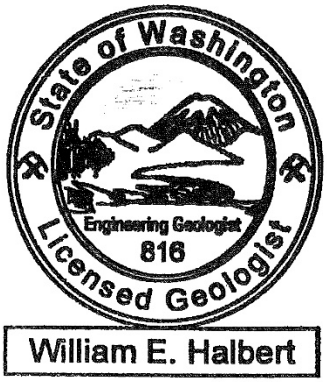
Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in the field of geotechnical engineering in this area at the time this report was prepared. No warranty or other conditions, expressed or implied, should be understood.

Please refer to Attachment D titled "Report Limitations and Guidelines for Use" for additional information pertaining to use of this report.

We appreciate the opportunity to be of service to you on this project. Please contact us if you have questions or require additional information.

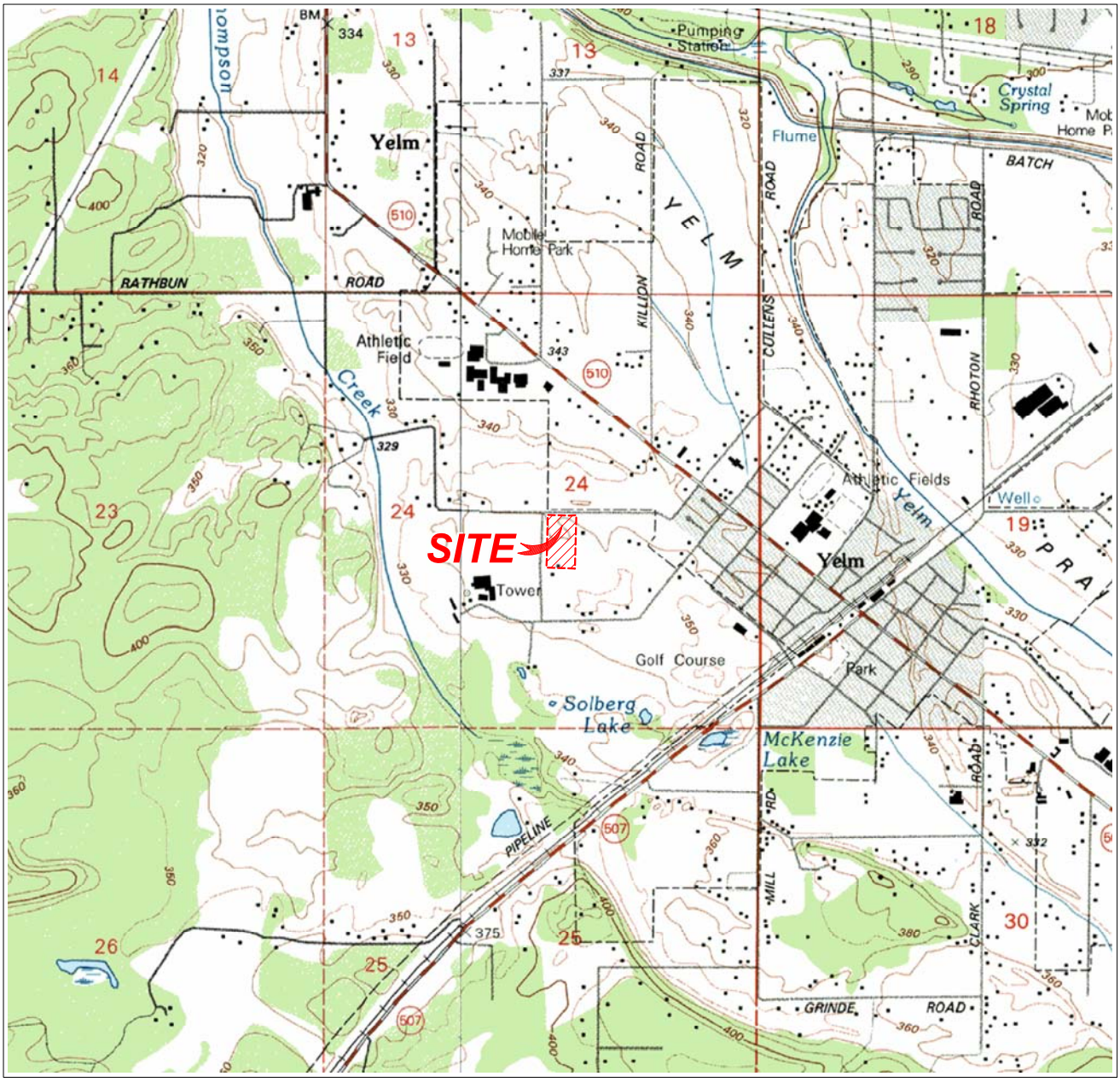
Respectfully Submitted,
INSIGHT GEOLOGIC, INC.

William E. Halbert, L.E.G., L.HG.
Principal



Attachments

FIGURES



Source: Terrain Navigator Image (c)

MC KENNA, WASHINGTON
7.5 MINUTE QUADRANGLE
Year 1990

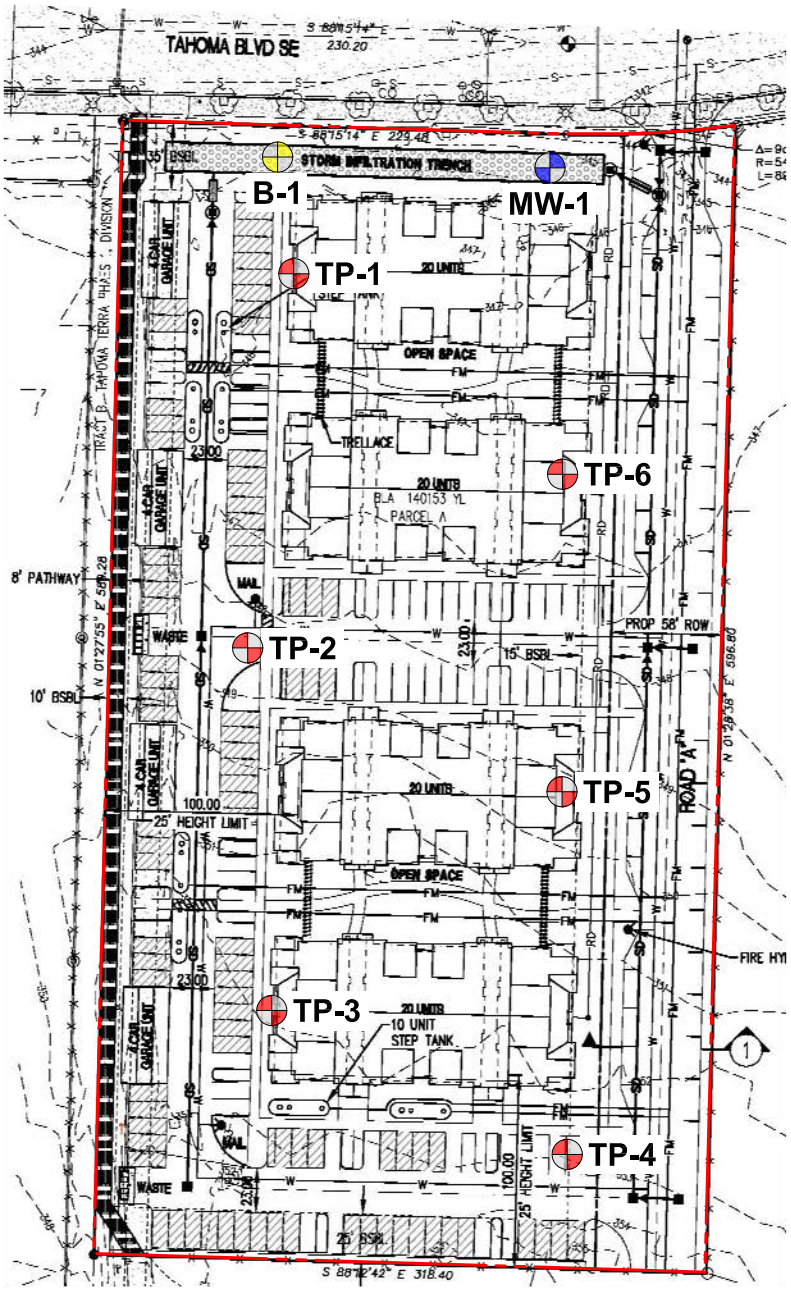
SCALE: 1: 24000

WYNDSTONE

YELM, WASHINGTON

INSIGHT GEOLOGIC, INC.

Figure 1
Vicinity Map



SOURCE: C.E.S. NW INC.

LEGEND:

- **B-1** APPROXIMATE BORING LOCATION
- **TP-1** APPROXIMATE TEST PIT LOCATION
- **MW-1** APPROXIMATE MONITORING WELL LOCATION
- APPROXIMATE PROJECT BOUNDARY

SCALE: 1" = 100'

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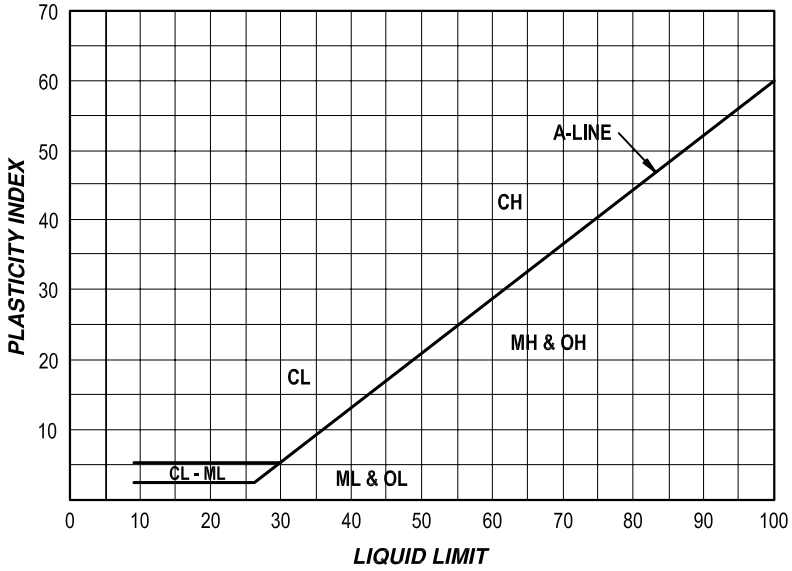
Figure 2
Site Plan

ATTACHMENT A
EXPLORATION LOGS

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS	GROUP NAME
COARSE GRAINED SOILS (MORE THAN 50% RETAINED ON NO. 200 SIEVE)	GRAVEL AND GRAVELLY SOILS (MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE)	CLEAN GRAVEL <5% FINES	GW	WELL-GRADED GRAVEL, FINE TO COARSE GRAVEL
			GP	POORLY GRADED GRAVEL
		GRAVEL WITH FINES >12% FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SAND AND SANDY SOILS (MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE)	CLEAN SAND <5% FINES	SW	WELL-GRADED SAND, FINE TO COARSE SAND
			SP	POORLY GRADED SAND
		SAND WITH FINES >12% FINES	SM	SILTY SAND
			SC	CLAYEY SAND
FINE GRAINED SOILS (MORE THAN 50% PASSING NO. 200 SIEVE)	SILTS AND CLAYS (LIQUID LIMIT LESS THAN 50)	INORGANIC	ML	SILT
			CL	CLAY
		ORGANIC	OL	ORGANIC SILT, ORGANIC CLAY
	SILTS AND CLAYS (LIQUID LIMIT 50 OR MORE)	INORGANIC	MH	SILT OF HIGH PLASTICITY, ELASTIC SILT
			CH	CLAY OF HIGH PLASTICITY, FAT CLAY
		ORGANIC	OH	ORGANIC CLAY, ORGANIC SILT
HIGHLY ORGANIC SOILS			PT	PEAT



SOIL MOISTURE MODIFIERS:
DRY - ABSENCE OF MOISTURE, DUSTY, DRY TO THE TOUCH
MOIST - DAMP, BUT NO VISIBLE WATER
WET - VISIBLE FREE WATER OR SATURATED, USUALLY SOIL IS OBTAINED BELOW WATER TABLE

ADDITIONAL MATERIAL SYMBOLS

SYMBOLS	TYPICAL DESCRIPTION
CC	CEMENT CONCRETE
AC	ASPHALT CONCRETE
CR	CRUSHED ROCK / QUARRY SPALLS
TS	TOPSOIL/SOD/DUFF

GROUNDWATER EXPLORATION SYMBOLS

- MEASURED GROUNDWATER LEVEL IN EXPLORATION, WELL, OR PIEZOMETER
- GROUNDWATER OBSERVED AT TIME OF EXPLORATION
- PERCHED WATER OBSERVED AT TIME OF EXPLORATION
- MEASURED FREE PRODUCT IN WELL OR PIEZOMETER

STRATIGRAPHIC CONTACT

- APPROXIMATE CONTACT BETWEEN SOIL STRATA OR GEOLOGIC UNIT
- APPROXIMATE LOCATION OF SOIL STRATA CHANGE WITHIN GEOLOGIC SOIL UNIT
- APPROXIMATE GRADUAL CHANGE BETWEEN SOIL STRATA OR GEOLOGIC SOIL UNIT
- APPROXIMATE GRADUAL CHANGE OF SOIL STRATA WITHIN GEOLOGIC SOIL UNIT

LABORATORY / FIELD TEST CLASSIFICATIONS

- **%F** PERECENT FINES
- **AL** ATTERBERG LIMITS
- **CA** CHEMICAL ANALYSIS
- **CP** LABORATORY COMPACTION TEST
- **CS** CONSOLIDATION TEST
- **DS** DIRECT SHEAR
- **HA** HYDROMETER ANALYSIS
- **MC** MOISTURE CONTENT
- **MD** MOISTURE CONTENT AND DRY DENSITY
- **OC** ORGANIC COMPOUND
- **PM** PERMEABILITY OR HYDRAULIC CONDUCTIVITY
- **PP** POCKET PENETROMETER
- **SA** SIEVE ANALYSIS
- **TX** TRIAXIAL COMPRESSION
- **UC** UNCONFINED COMPRESSION
- **VS** VANE SHEAR

SAMPLER SYMBOLS

- 2.4 INCH I.D. SPLIT BARREL
- DIRECT-PUSH
- STANDARD PENETRATION TEST
- SHELBY TUBE
- PISTON
- BULK OR GRAB

SHEEN CLASSIFICATIONS

- **NS** NO VISIBLE SHEEN
- **SS** SLIGHT SHEEN
- **MS** MODERATE SHEEN
- **HS** HEAVY SHEEN
- **NT** NOT TESTED

TP-1

DEPTH (FT)	U.S.C.S.	LITHOLOGY	SOIL DESCRIPTION	REMARKS AND LABORATORY TEST RESULTS
0	TS		Sod	
1	GP-GM		Dark brown fine to coarse gravel with fine to coarse sand, trace silt, fine roots, loose, moist	
3	GP		Brown fine to coarse gravel with fine to coarse sand, loose, moist	
8			Groundwater not encountered	
10				

LEGEND:

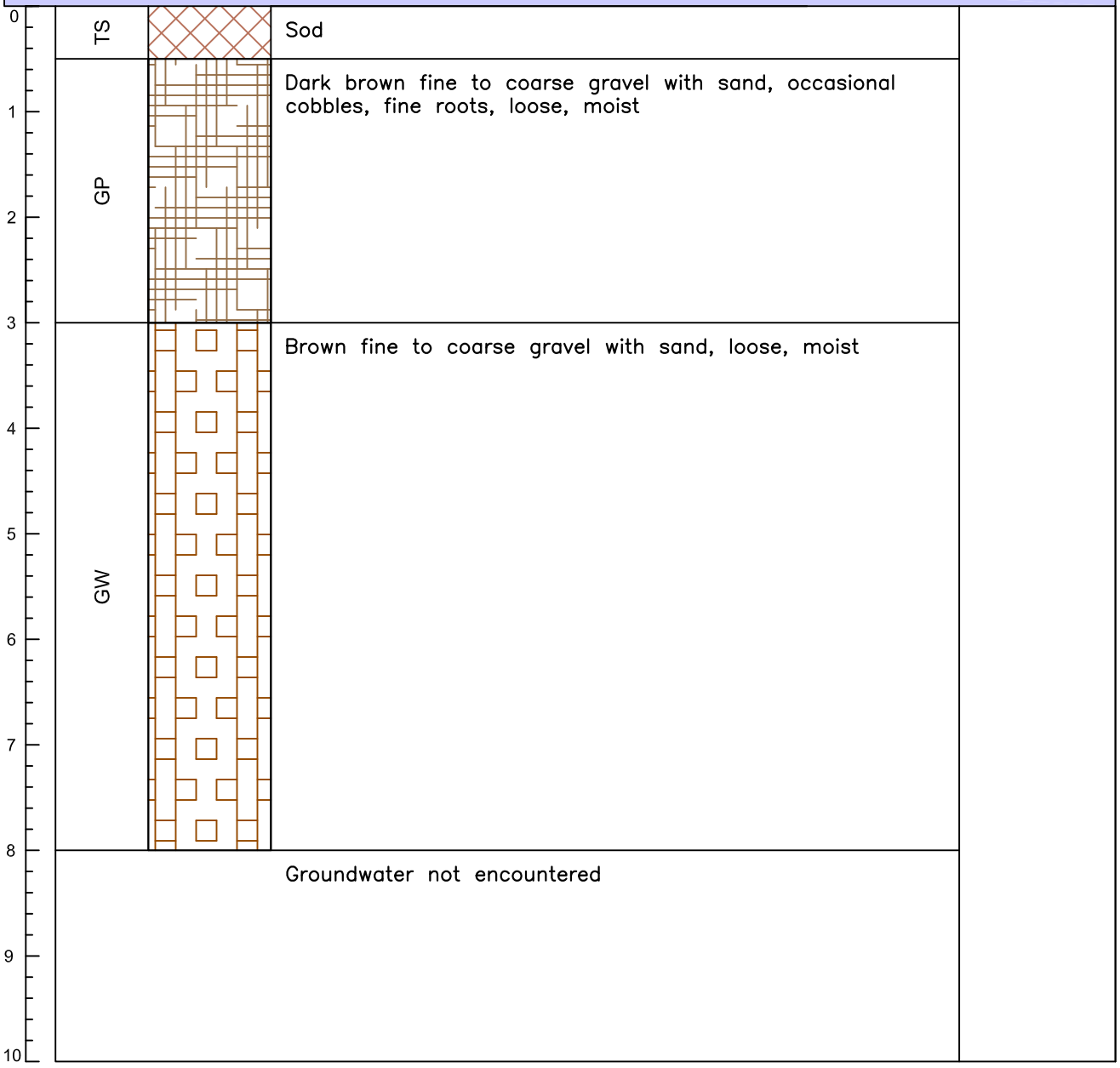
PROJECT NO.: 1142-001-01
DATE: JUNE 10, 2019
TOTAL DEPTH: 8 FEET
DRILLING EQUIPMENT: EXCAVATOR
LOGGED BY: KEVIN VANDEHEY

WYNDSTONE
YELM, WASHINGTON

INSIGHT GEOLOGIC, INC.

Exploration Log TP-1

TP-2



LEGEND:

PROJECT NO.: 1142-001-01
DATE: JUNE 10, 2019
TOTAL DEPTH: 8 FEET
DRILLING EQUIPMENT: EXCAVATOR
LOGGED BY: KEVIN VANDEHEY

WYNDSTONE
YELM, WASHINGTON

INSIGHT GEOLOGIC, INC.

Exploration Log TP-2

TP-3

DEPTH (FT)	U.S.C.S.	LITHOLOGY	SOIL DESCRIPTION	REMARKS AND LABORATORY TEST RESULTS
0	TS		Sod	
1	GP-GM		Dark brown fine to coarse gravel with fine to coarse sand and silt, occasional cobbles, fine roots, loose, moist	
2	GP		Brown fine to coarse gravel with fine to coarse sand, occasional cobbles, loose, moist	
3				
4				
5				
6				
7				
8			Groundwater not encountered	
9				
10				

LEGEND:

PROJECT NO.: 1142-001-01
DATE: JUNE 10, 2019
TOTAL DEPTH: 8 FEET
DRILLING EQUIPMENT: EXCAVATOR
LOGGED BY: KEVIN VANDEHEY

WYNDSTONE
YELM, WASHINGTON

INSIGHT GEOLOGIC, INC.

Exploration Log TP-3

TP-4

DEPTH (FT)	U.S.C.S.	LITHOLOGY	SOIL DESCRIPTION	REMARKS AND LABORATORY TEST RESULTS
0	TS		Sod	
1	GP-GM		Dark brown fine to coarse gravel with fine to coarse sand and silt, occasional cobbles, fine roots, loose, moist	
2	GP		Brown fine to coarse gravel with cobbles, occasional boulders, dense, moist	
3				
4				
5				
6			Groundwater not encountered	
7				
8				
9				
10				

LEGEND:

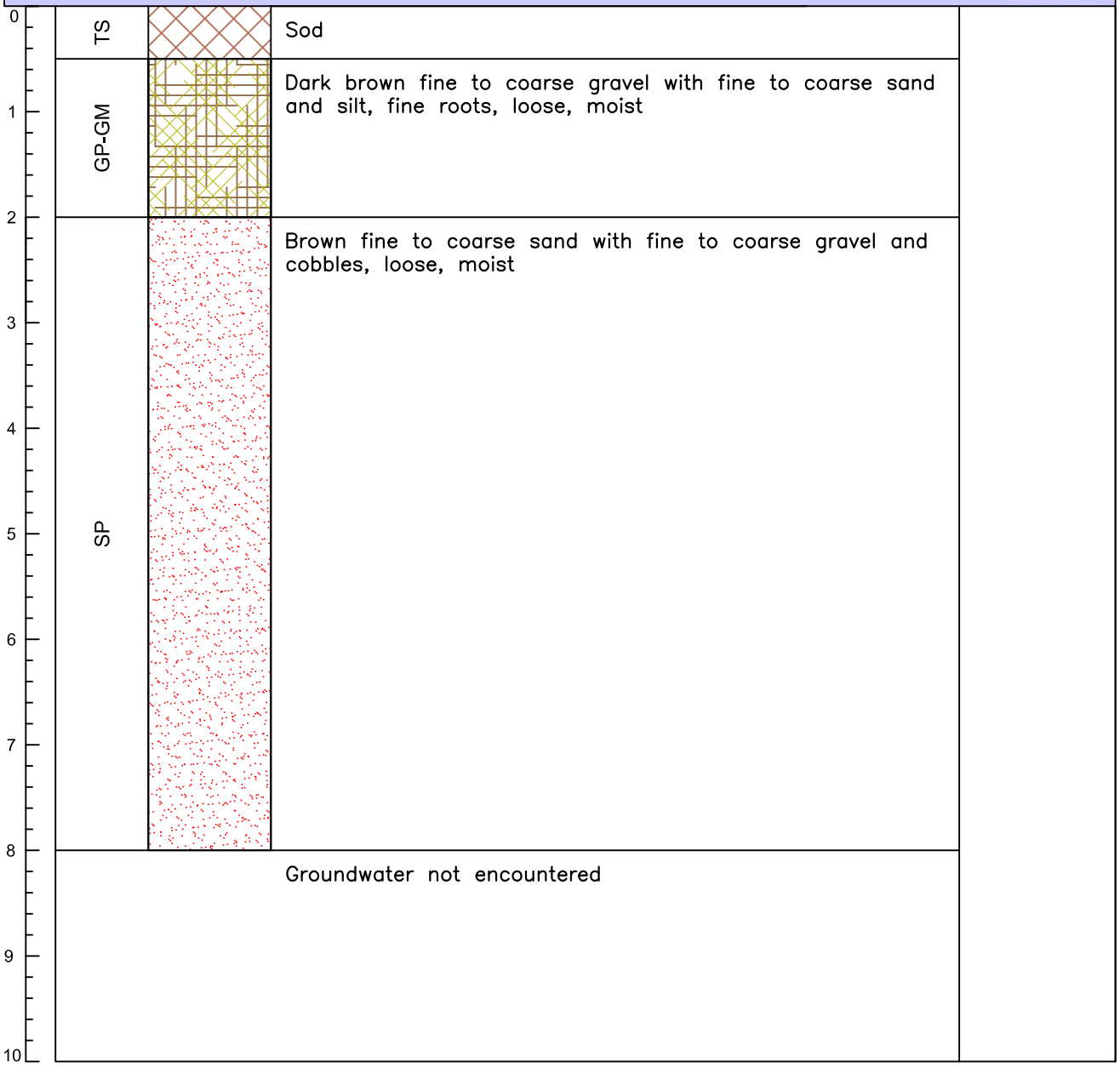
PROJECT NO.: 1142-001-01
DATE: JUNE 10, 2019
TOTAL DEPTH: 6 FEET
DRILLING EQUIPMENT: EXCAVATOR
LOGGED BY: KEVIN VANDEHEY

WYNDSTONE
YELM, WASHINGTON

INSIGHT GEOLOGIC, INC.

Exploration Log TP-4

TP-5



LEGEND:

PROJECT NO.: 1142-001-01
DATE: JUNE 10, 2019
TOTAL DEPTH: 8 FEET
DRILLING EQUIPMENT: EXCAVATOR
LOGGED BY: KEVIN VANDEHEY

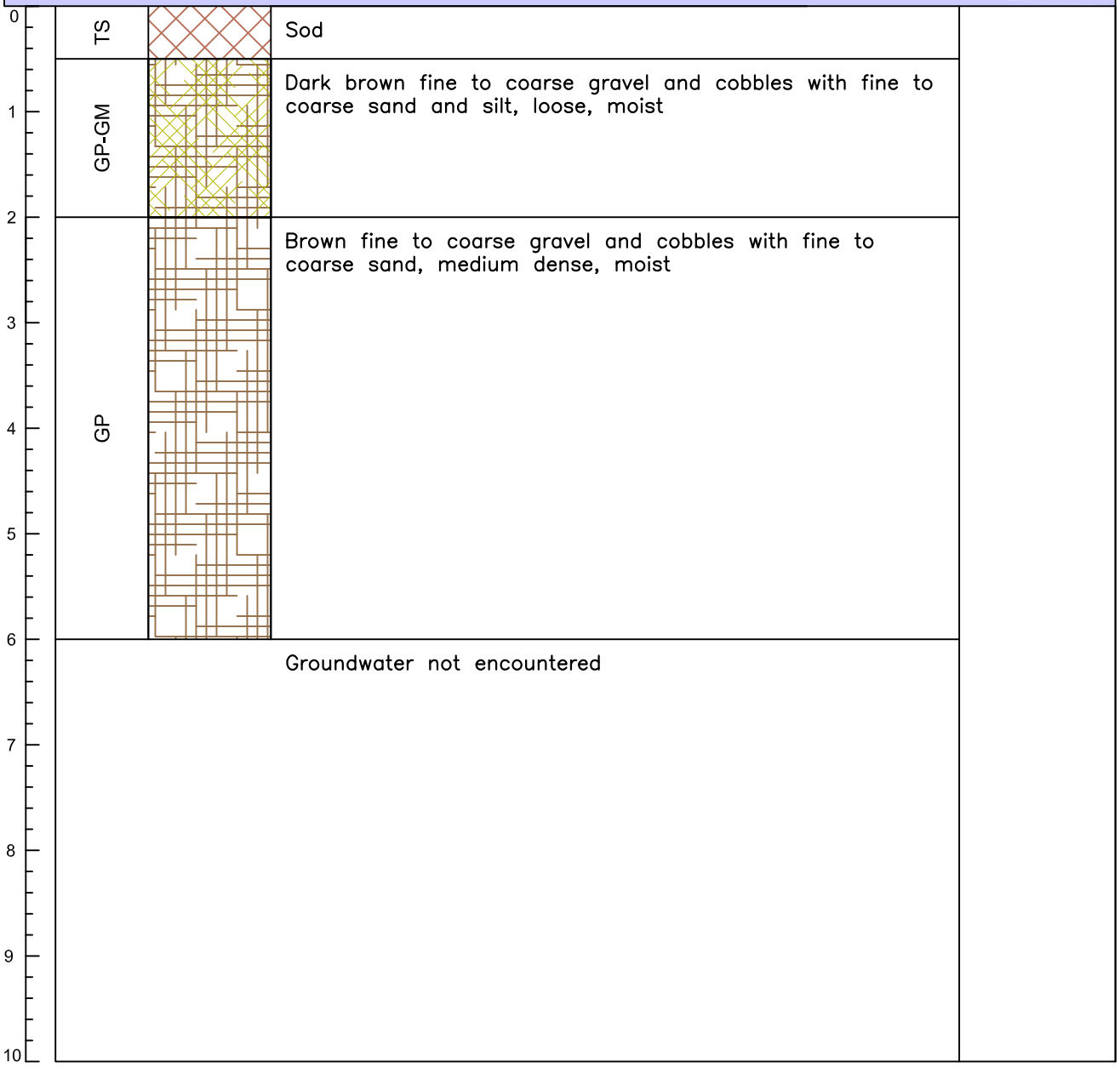
WYNDSTONE

YELM, WASHINGTON

INSIGHT GEOLOGIC, INC.

Exploration Log TP-5

TP-6



LEGEND:

PROJECT NO.: 1142-001-01
DATE: JUNE 10, 2019
TOTAL DEPTH: 6 FEET
DRILLING EQUIPMENT: EXCAVATOR
LOGGED BY: KEVIN VANDEHEY

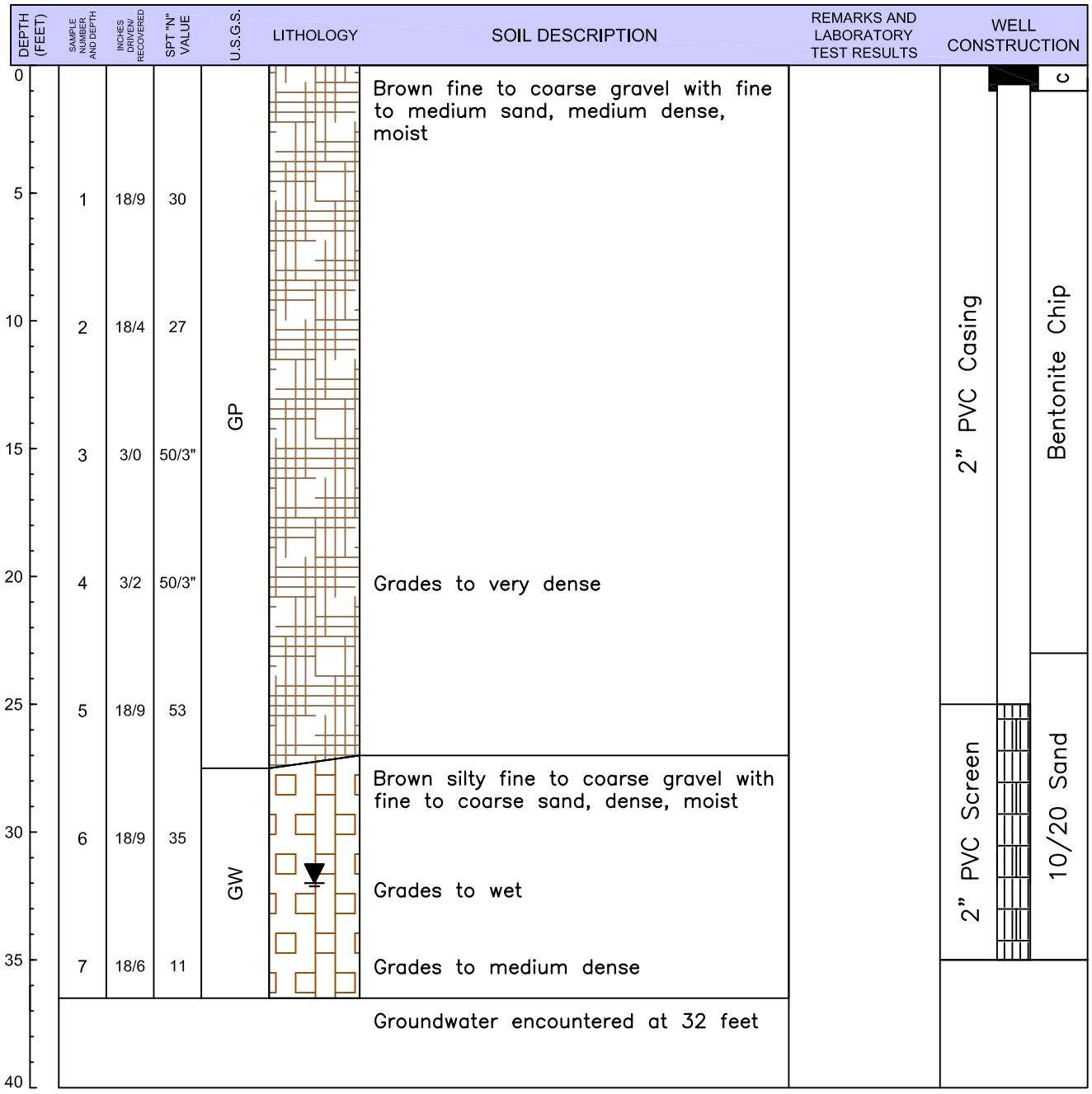
WYNDSTONE

YELM, WASHINGTON

INSIGHT GEOLOGIC, INC.

Exploration Log TP-6

MW-1



LEGEND:

PROJECT NO.: 1142-001-01
DATE: JUNE 14, 2019
TOTAL DEPTH: 36.5 FEET
DOE WELL NO.: BLT-736
DRILLING CONTRACTOR: HOLOCENE
DRILLING EQUIPMENT: B-58
DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: ANDREW JOHNSON

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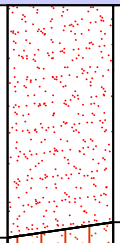
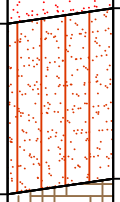
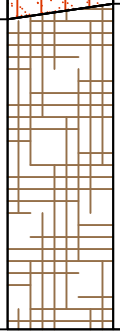
YELM, WASHINGTON

INSIGHT GEOLOGIC, INC.

Exploration Log MW-1

B-1

DEPTH (FEET)	SAMPLE NUMBER AND DEPTH	INCHES DRIVEN / RECOVERED	SPT "N" VALUE	U.S.G.S.	LITHOLOGY	SOIL DESCRIPTION	REMARKS AND LABORATORY TEST RESULTS
0				SP		Brown fine to coarse sand with fine to coarse gravel, medium dense, moist	
5	1	18/10	26				
				SP-SM		Brown fine to coarse sand with fine to coarse gravel and silt, occasional cobbles, dense, moist	
10	2	18/12	48				
				GP		Brown fine to coarse gravel with fine to coarse sand, dense, moist	
15	3	7/3	50/1"				
20	4	12/4	50/6"				
	5	6/0	50/6"				
25						Groundwater not encountered	
30							
35							
40							

LEGEND:

PROJECT NO.: 1142-001-01
DATE: JUNE 14, 2019
TOTAL DEPTH: 23 FEET
DRILLING CONTRACTOR: HOLOCENE
DRILLING EQUIPMENT: B-58
DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: ANDREW JOHNSON

WYNDSTONE
YELM, WASHINGTON

INSIGHT GEOLOGIC, INC.

Exploration Log B-1

ATTACHMENT B
LABORATORY ANALYSES RESULTS

Gradation Analysis Summary Data

Job Name: Wyndstone
Job Number: 1142-001-01
Date Tested: 7/1/19
Tested By: Kevin Vandehey

Sample Location: TP-2
Sample Name: TP-2 0.5'-3.0'
Depth: 0.5 - 3 Feet

Moisture Content (%) 4.3%

Sieve Size	Percent Passing
3.0 in. (75.0)	100.0
1.5 in. (37.5)	51.9
3/4 in. (19.0)	31.3
3/8 in. (9.5-mm)	24.9
No. 4 (4.75-mm)	21.6
No. 10 (2.00-mm)	18.8
No. 20 (.850-mm)	15.9
No. 40 (.425-mm)	11.9
No. 60 (.250-mm)	8.6
No. 100 (.150-mm)	6.1
No. 200 (.075-mm)	4.5

Size Fraction	Percent by Weight
Coarse Gravel	68.7
Fine Gravel	9.7
Coarse Sand	2.8
Medium Sand	6.9
Fine Sand	7.4
Fines	4.5
Total	**100.0**

LL	- -
PL	- -
PI	- -
D_{10}	0.31
D_{30}	17.00
D_{60}	41.00
D_{90}	65.00
Cc	22.74
Cu	132.26

ASTM Classification
Group Name: **Poorly Graded Gravel with Sand**
Symbol: **GP**

INSIGHT GEOLOGIC, INC.

Gradation Analysis Summary Data

Job Name: Wyndstone
Job Number: 1142-001-01
Date Tested: 7/1/19
Tested By: Kevin Vandehey

Sample Location: TP-2
Sample Name: TP-2 3.0'-8.0'
Depth: 3 - 8 Feet

Moisture Content (%) 1.2%

Sieve Size	Percent Passing
3.0 in. (75.0)	64.7
1.5 in. (37.5)	57.3
3/4 in. (19.0)	27.3
3/8 in. (9.5-mm)	12.4
No. 4 (4.75-mm)	6.0
No. 10 (2.00-mm)	2.8
No. 20 (.850-mm)	1.7
No. 40 (.425-mm)	0.9
No. 60 (.250-mm)	0.5
No. 100 (.150-mm)	0.3
No. 200 (.075-mm)	0.2

Size Fraction	Percent by Weight
Coarse Gravel	72.7
Fine Gravel	21.2
Coarse Sand	3.2
Medium Sand	1.8
Fine Sand	0.7
Fines	0.2
Total	**100.0**

LL	- -
PL	- -
PI	- -
D_{10}	7.90
D_{30}	20.50
D_{60}	44.00
D_{90}	130.00
Cc	1.21
Cu	5.57

ASTM Classification
Group Name: **Well Graded Gravel**
Symbol: **GW**

INSIGHT GEOLOGIC, INC.

Gradation Analysis Summary Data

Job Name: Wyndstone
Job Number: 1142-001-01
Date Tested: 7/1/19
Tested By: Kevin Vandehey

Sample Location: TP-5
Sample Name: TP-5 0.5'-2.0'
Depth: 0.5 - 2 Feet

Moisture Content (%) 7.0%

Sieve Size	Percent Passing
3.0 in. (75.0)	100.0
1.5 in. (37.5)	67.9
3/4 in. (19.0)	52.7
3/8 in. (9.5-mm)	42.9
No. 4 (4.75-mm)	37.2
No. 10 (2.00-mm)	32.3
No. 20 (.850-mm)	26.6
No. 40 (.425-mm)	16.7
No. 60 (.250-mm)	11.5
No. 100 (.150-mm)	9.2
No. 200 (.075-mm)	7.2

Size Fraction	Percent by Weight
Coarse Gravel	47.3
Fine Gravel	15.5
Coarse Sand	4.9
Medium Sand	15.6
Fine Sand	9.5
Fines	7.2
Total	**100.0**

LL	- -
PL	- -
PI	- -
D_{10}	0.18
D_{30}	1.40
D_{60}	28.00
D_{90}	60.00
Cc	0.39
Cu	155.56

ASTM Classification
Group Name: **Poorly Graded Gravel with Sand and Silt**
Symbol: **GP-GM**

INSIGHT GEOLOGIC, INC.

Gradation Analysis Summary Data

Job Name: Wyndstone
Job Number: 1142-001-01
Date Tested: 7/1/19
Tested By: Kevin Vandehey

Sample Location: TP-5
Sample Name: TP-5 2.0'-8.0'
Depth: 2 - 8 Feet

Moisture Content (%) 4.9%

Sieve Size	Percent Passing
3.0 in. (75.0)	100.0
1.5 in. (37.5)	81.7
3/4 in. (19.0)	68.7
3/8 in. (9.5-mm)	64.5
No. 4 (4.75-mm)	61.4
No. 10 (2.00-mm)	57.7
No. 20 (.850-mm)	48.6
No. 40 (.425-mm)	18.5
No. 60 (.250-mm)	5.2
No. 100 (.150-mm)	2.6
No. 200 (.075-mm)	1.5

Size Fraction	Percent by Weight
Coarse Gravel	31.3
Fine Gravel	7.3
Coarse Sand	3.7
Medium Sand	39.1
Fine Sand	17.1
Fines	1.5
Total	**100.0**

LL	- -
PL	- -
PI	- -
D_{10}	0.31
D_{30}	0.55
D_{60}	3.20
D_{90}	51.00
Cc	0.30
Cu	10.32

ASTM Classification
Group Name: **Poorly Graded Sand with Gravel**
Symbol: **SP**

INSIGHT GEOLOGIC, INC.

Gradation Analysis Summary Data

Job Name: Wyndstone
Job Number: 1142-001-01
Date Tested: 7/1/19
Tested By: Kevin Vandehey

Sample Location: MW-1
Sample Name: MW-1 25.0'-26.5'
Depth: 25 - 26.5 Feet

Moisture Content (%) 4.5%

Sieve Size	Percent Passing
3.0 in. (75.0)	100.0
1.5 in. (37.5)	100.0
3/4 in. (19.0)	69.1
3/8 in. (9.5-mm)	53.5
No. 4 (4.75-mm)	43.6
No. 10 (2.00-mm)	32.3
No. 20 (.850-mm)	20.3
No. 40 (.425-mm)	11.9
No. 60 (.250-mm)	7.6
No. 100 (.150-mm)	5.3
No. 200 (.075-mm)	3.3

Size Fraction	Percent by Weight
Coarse Gravel	30.9
Fine Gravel	25.5
Coarse Sand	11.3
Medium Sand	20.4
Fine Sand	8.6
Fines	3.3
Total	**100.0**

LL	- -
PL	- -
PI	- -
D_{10}	0.35
D_{30}	1.70
D_{60}	14.00
D_{90}	30.00
Cc	0.59
Cu	40.00

ASTM Classification
Group Name: **Poorly Graded Gravel with Sand**
Symbol: **GP**

INSIGHT GEOLOGIC, INC.

Gradation Analysis Summary Data

Job Name: Wyndstone
Job Number: 1142-001-01
Date Tested: 7/1/19
Tested By: Kevin Vandehey

Sample Location: MW-1
Sample Name: MW-1 30.0'-31.5'
Depth: 30 - 31.5 Feet

Moisture Content (%) 6.7%

Sieve Size	Percent Passing
3.0 in. (75.0)	100.0
1.5 in. (37.5)	100.0
3/4 in. (19.0)	92.1
3/8 in. (9.5-mm)	64.1
No. 4 (4.75-mm)	44.3
No. 10 (2.00-mm)	31.1
No. 20 (.850-mm)	19.9
No. 40 (.425-mm)	13.2
No. 60 (.250-mm)	9.4
No. 100 (.150-mm)	6.5
No. 200 (.075-mm)	3.9

Size Fraction	Percent by Weight
Coarse Gravel	7.9
Fine Gravel	47.8
Coarse Sand	13.2
Medium Sand	17.9
Fine Sand	9.3
Fines	3.9
Total	**100.0**

LL	- -
PL	- -
PI	- -
D_{10}	0.26
D_{30}	1.80
D_{60}	8.50
D_{90}	18.00
Cc	1.47
Cu	32.69

ASTM Classification
Group Name: **Well Graded Gravel with Sand**
Symbol: **GW**

INSIGHT GEOLOGIC, INC.

Gradation Analysis Summary Data

Job Name: Wyndstone
Job Number: 1142-001-01
Date Tested: 7/1/19
Tested By: Kevin Vandehey

Sample Location: B-1
Sample Name: B-1 10.0'-11.5'
Depth: 10 - 11.5 Feet

Moisture Content (%) 3.9%

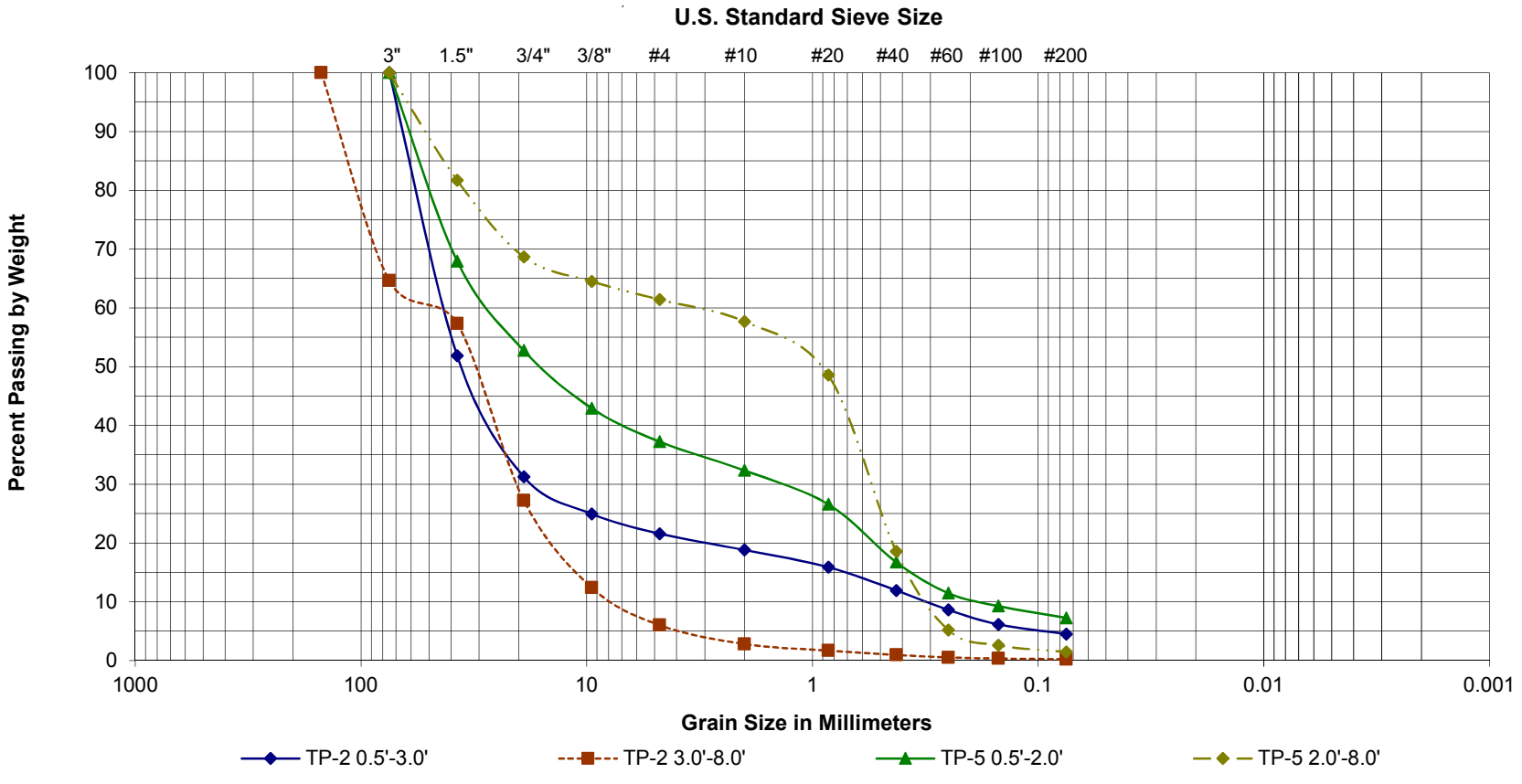
Sieve Size	Percent Passing
3.0 in. (75.0)	100.0
1.5 in. (37.5)	100.0
3/4 in. (19.0)	85.0
3/8 in. (9.5-mm)	77.6
No. 4 (4.75-mm)	72.3
No. 10 (2.00-mm)	58.7
No. 20 (.850-mm)	42.5
No. 40 (.425-mm)	27.6
No. 60 (.250-mm)	17.2
No. 100 (.150-mm)	10.6
No. 200 (.075-mm)	5.3

Size Fraction	Percent by Weight
Coarse Gravel	15.0
Fine Gravel	12.7
Coarse Sand	13.7
Medium Sand	31.1
Fine Sand	22.3
Fines	5.3
Total	**100.0**

LL	- -
PL	- -
PI	- -
D_{10}	0.14
D_{30}	0.47
D_{60}	2.10
D_{90}	25.00
Cc	0.75
Cu	15.00

ASTM Classification
Group Name: **Poorly Graded Sand with Gravel and Silt**
Symbol: **SP-SM**

INSIGHT GEOLOGIC, INC.



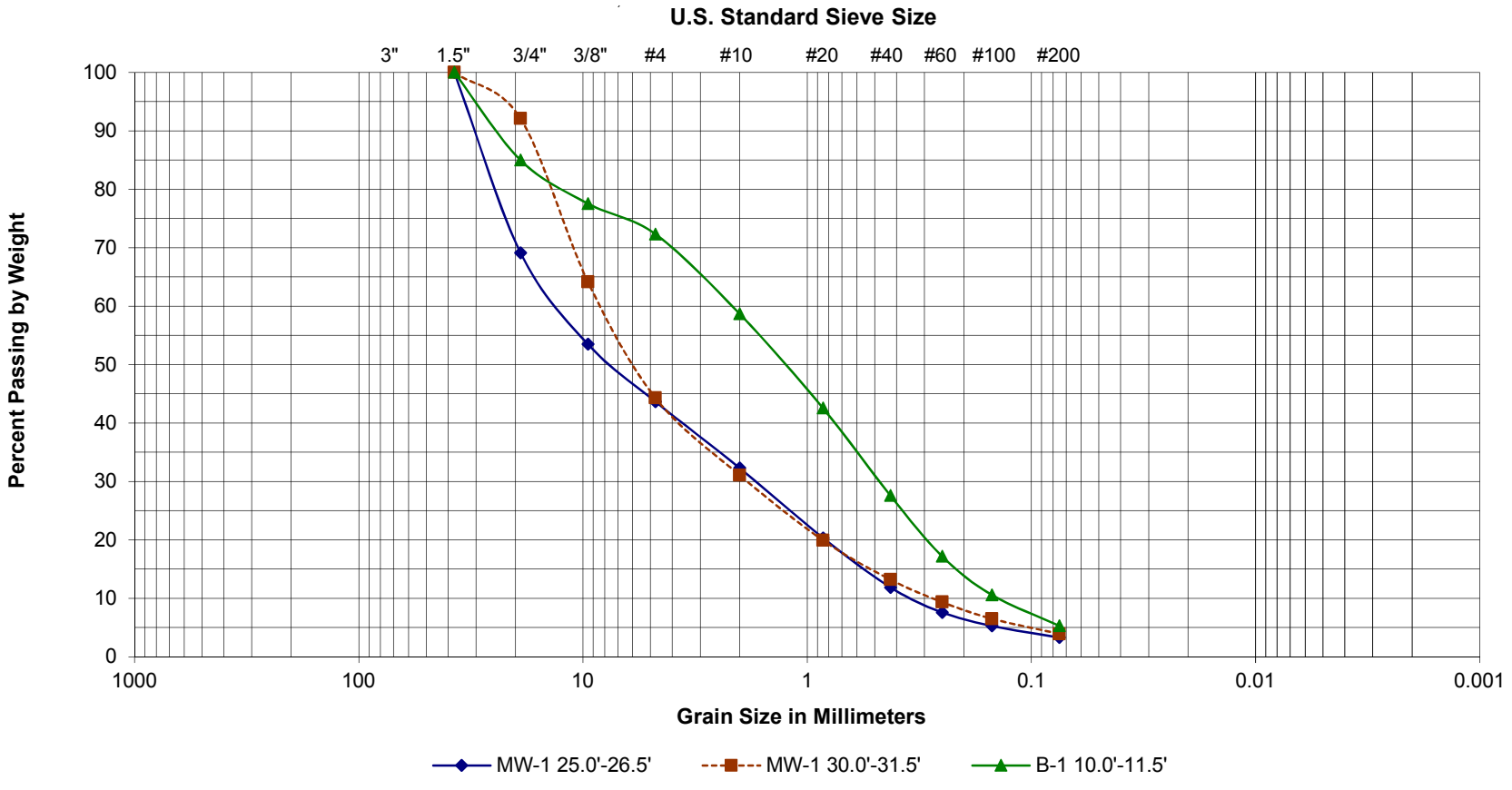
COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

WYNDSTONE

YELM, WASHINGTON

INSIGHT GEOLOGIC, INC.

Graph 1
Gradation Analysis Results



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

WYNDSTONE

YELM, WASHINGTON

INSIGHT GEOLOGIC, INC.

Graph 2
Gradation Analysis Results

ATTACHMENT C
SIESMIC DESIGN PARAMETERS

Hazards by Location

Search Information

Coordinates: 46.94455144795768, -122.62151451110839

Elevation: 350 ft

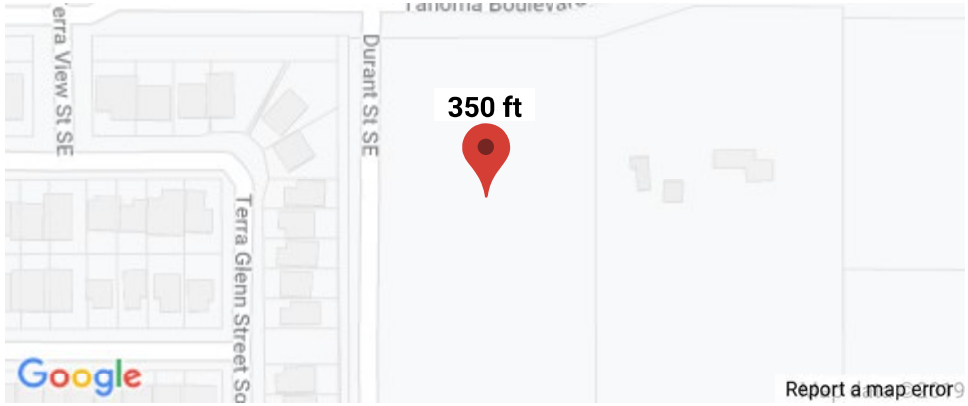
Timestamp: 2019-07-10T17:29:07.126Z

Hazard Type: Seismic

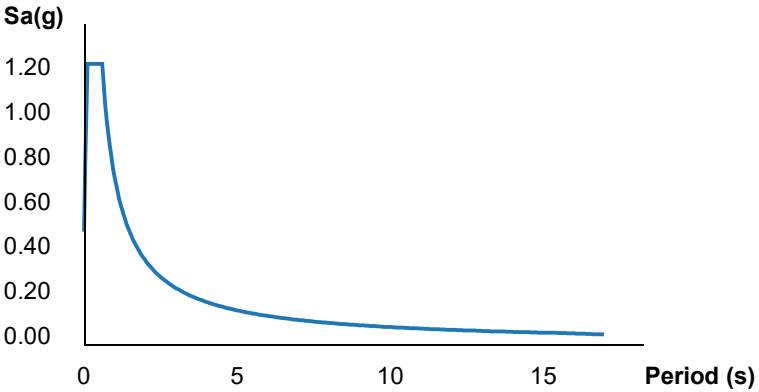
Reference Document: IBC-2015

Risk Category: IV

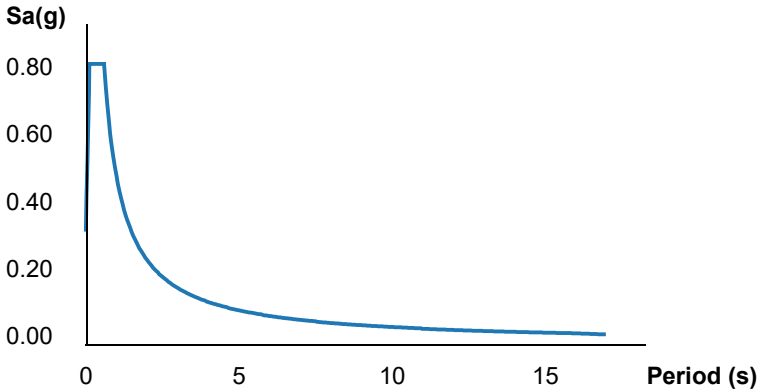
Site Class: D



MCER Horizontal Response Spectrum



Design Horizontal Response Spectrum



Basic Parameters

Name	Value	Description
S_S	1.251	MCE_R ground motion (period=0.2s)
S_1	0.499	MCE_R ground motion (period=1.0s)
S_{MS}	1.251	Site-modified spectral acceleration value
S_{M1}	0.749	Site-modified spectral acceleration value
S_{DS}	0.834	Numeric seismic design value at 0.2s SA
S_{D1}	0.5	Numeric seismic design value at 1.0s SA

ATTACHMENT D

REPORT LIMITATIONS AND GUIDELINES FOR USE

ATTACHMENT D

REPORT LIMITATIONS AND GUIDELINES FOR USE[1]

This attachment provides information to help you manage your risks with respect to the use of this report.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES, PERSONS AND PROJECTS

This report has been prepared for the exclusive use of C & E Developments LLC (Client) and their authorized agents. This report may be made available to regulatory agencies for review. This report is not intended for use by others, and the information contained herein is not applicable to other sites.

Insight Geologic Inc. structures our services to meet the specific needs of our clients. For example, a geotechnical or geologic study conducted for a civil engineer or architect may not fulfill the needs of a construction contractor or even another civil engineer or architect that are involved in the same project. Because each geotechnical or geologic study is unique, each geotechnical engineering or geologic report is unique, prepared solely for the specific client and project site. Our report is prepared for the exclusive use of our Client. No other party may rely on the product of our services unless we agree in advance to such reliance in writing. This is to provide our firm with reasonable protection against open-ended liability claims by third parties with whom there would otherwise be no contractual limits to their actions. Within the limitations of scope, schedule and budget, our services have been executed in accordance with our Agreement with the Client and generally accepted geotechnical practices in this area at the time this report was prepared. This report should not be applied for any purpose or project except the one originally contemplated.

A GEOTECHNICAL ENGINEERING OR GEOLOGIC REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

Insight Geologic, Inc. considered a number of unique, project-specific factors when establishing the scope of services for this project and report. Unless Insight Geologic specifically indicates otherwise, do not rely on this report if it was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

For example, changes that can affect the applicability of this report include those that affect:

- the function of the proposed structure;
- elevation, configuration, location, orientation or weight of the proposed structure;
- composition of the design team; or
- project ownership.

If important changes are made after the date of this report, Insight Geologic should be given the opportunity to review our interpretations and recommendations and provide written modifications or confirmation, as appropriate.

---

[1] Developed based on material provided by ASFE, Professional Firms Practicing in the Geosciences; www.asfe.org .

SUBSURFACE CONDITIONS CAN CHANGE

This geotechnical or geologic report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by manmade events such as construction on or adjacent to the site, or by natural events such as floods, earthquakes, slope instability or ground water fluctuations. Always contact Insight Geologic before applying a report to determine if it remains applicable.

MOST GEOTECHNICAL AND GEOLOGIC FINDINGS ARE PROFESSIONAL OPINIONS

Our interpretations of subsurface conditions are based on field observations from widely spaced sampling locations at the site. Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Insight Geologic reviewed field and laboratory data and then applied our professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ, sometimes significantly, from those indicated in this report. Our report, conclusions and interpretations should not be construed as a warranty of the subsurface conditions.

GEOTECHNICAL ENGINEERING REPORT RECOMMENDATIONS ARE NOT FINAL

Do not over-rely on the preliminary construction recommendations included in this report. These recommendations are not final, because they were developed principally from Insight Geologic's professional judgment and opinion. Insight Geologic's recommendations can be finalized only by observing actual subsurface conditions revealed during construction. Insight Geologic cannot assume responsibility or liability for this report's recommendations if we do not perform construction observation.

Sufficient monitoring, testing and consultation by Insight Geologic should be provided during construction to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes should the conditions revealed during the work differ from those anticipated, and to evaluate whether or not earthwork activities are completed in accordance with our recommendations. Retaining Insight Geologic for construction observation for this project is the most effective method of managing the risks associated with unanticipated conditions.

A GEOTECHNICAL ENGINEERING OR GEOLOGIC REPORT COULD BE SUBJECT TO MISINTERPRETATION

Misinterpretation of this report by other design team members can result in costly problems. You could lower that risk by having Insight Geologic confer with appropriate members of the design team after submitting the report. Also retain Insight Geologic to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering or geologic report. Reduce that risk by having Insight Geologic participate in pre-bid and pre-construction conferences, and by providing construction observation.

DO NOT REDRAW THE EXPLORATION LOGS

Geotechnical engineers and geologists prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a

geotechnical engineering or geologic report should never be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, but recognize that separating logs from the report can elevate risk.

GIVE CONTRACTORS A COMPLETE REPORT AND GUIDANCE

Some owners and design professionals believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering or geologic report, but preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with Insight Geologic and/or to conduct additional study to obtain the specific types of information they need or prefer. A pre-bid conference can also be valuable. Be sure contractors have sufficient time to perform additional study. Only then might an owner be in a position to give contractors the best information available, while requiring them to at least share the financial responsibilities stemming from unanticipated conditions. Further, a contingency for unanticipated conditions should be included in your project budget and schedule.

CONTRACTORS ARE RESPONSIBLE FOR SITE SAFETY ON THEIR OWN CONSTRUCTION PROJECTS

Our geotechnical recommendations are not intended to direct the contractor’s procedures, methods, schedule or management of the work site. The contractor is solely responsible for job site safety and for managing construction operations to minimize risks to on-site personnel and to adjacent properties.

READ THESE PROVISIONS CLOSELY

Some clients, design professionals and contractors may not recognize that the geoscience practices (geotechnical engineering or geology) are far less exact than other engineering and natural science disciplines. This lack of understanding can create unrealistic expectations that could lead to disappointments, claims and disputes. Insight Geologic includes these explanatory “limitations” provisions in our reports to help reduce such risks. Please confer with Insight Geologic if you are unclear how these “Report Limitations and Guidelines for Use” apply to your project or site.

GEOTECHNICAL, GEOLOGIC AND ENVIRONMENTAL REPORTS SHOULD NOT BE INTERCHANGED

The equipment, techniques and personnel used to perform an environmental study differ significantly from those used to perform a geotechnical or geologic study and vice versa. For that reason, a geotechnical engineering or geologic report does not usually relate any environmental findings, conclusions or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. Similarly, environmental reports are not used to address geotechnical or geologic concerns regarding a specific project.

PRELIMINARY
STORM DRAINAGE AND EROSION & SEDIMENTATION CONTROL REPORT

FOR

Wyndstone
Yelm, Washington

November 2019

Prepared for:

C & E Developments, LLC
PO Box 2983
Yelm, WA 98597

Prepared by:

Daniel P. Smith, PE, Project Manager

Approved By:

Craig Deaver, Principal

REPORT #06164.0

"I hereby state that this Preliminary Drainage and Erosion/Sediment Control Plan for Wyndstone has been prepared by me or under my supervision and meets the standard of care and expertise which is usual and customary in this community of professional engineers. I understand that Pierce County does not and will not assume liability for the sufficiency, suitability or performance of drainage facilities prepared by me."

This analysis is based on data and records either supplied to, or obtained by, C.E.S. NW, Inc. These documents are referenced within the text of the analysis. The analysis has been prepared utilizing procedures and practices within the standard accepted practices of the industry.

TABLE OF CONTENTS

STORM DRAINAGE

1. Project Overview

This preliminary report accompanies the site plan for the Wyndstone project as submitted to the City of Yelm for site plan review. Pursuant to City of Yelm Municipal Code (YMC) 13.16.060 the methodology and design criteria for the project are established by the Department of Ecology's 2014 Stormwater Management Manual (Manual). Project information and the analysis used for sizing of the stormwater facilities as provided to the City are included within.

The Wyndstone project consists of 75 multifamily units across four building situated on parcel # 21724420300 totaling approximately 4.67 acres. The proposed project is made up of a rectangular shaped parcel of land located at the intersection of Tahoma Blvd and Durant Street, Yelm, Washington. The site is currently surrounded by Tahoma Blvd to the north, single family homes and Durant Street to the west, and vacant parcels to the south and east. A vicinity map is provided in **Appendix "A"** for reference.

Land Use Application – Site Plan Review
Address – 15025 Tahoma Blvd SE Yelm, WA 98597
Parcel Numbers – 21724420300
Zoning – R16-High Density
Legal Description – Parcel No. 21724420300; 15025 Tahoma Blvd. SE parcel a of City of Yelm boundary line adjustment no. BLA 140153 YL as recorded July 18, 2014 under Auditor's File No. 4400621. In Thurston County, Washington.

It is proposed that the Wyndstone project will be constructed in two separate phases with Buildings 1 and 2 and their associated parking constructed in Phase I, and Buildings 3 and 4 with the remaining parking constructed in Phase II. A new public roadway extension is proposed as part of Phase I and will extend the full length of the eastern boundary line. An infiltration trench is proposed to fully infiltrate runoff from both phases with a FloGard Perk Filter vault upstream that provides basic runoff treatment. Both facilities are sized with the WWHM modeling program and are proposed north of Building 1 and are constructed as part of Phase I. Detailed sizing calculations are provided in Section 4 of this report.

The project proposes more than 5,000 sq.ft. of new effective impervious surfaces; therefore, according to Figure 2.2 from Volume I of the Manual the project must meet all minimum requirements. The following is a discussion of each minimum requirement:

Minimum Requirement #1: Preparation of Stormwater Site Plans: The stormwater site plan has been prepared and is summarized within this preliminary drainage report.

Minimum Requirement #2: Construction Stormwater Pollution Prevention: A preliminary erosion control report that addresses SWPPP elements 1-13 is included in Section 5.

Minimum Requirement #3: Source Control of Pollution: A Source Control manual will be included as part of the Operations and Maintenance Manual prepared as part of the final engineering documents.

Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls: The site is tributary to a single threshold discharge area that flows into Tahoma Blvd SE and the groundwater table. Runoff in Tahoma Blvd SE is tributary to an infiltration gallery located approximately 300-feet east of the site along the south side of the roadway. A detailed downstream analysis is provided in Section 3 of this report.

Minimum Requirement #5: Onsite Stormwater Management: The project fully infiltrates its runoff with an infiltration trench. Runoff that is fully infiltrated exceeds the LID Performance Standard; therefore, onsite stormwater management BMPs are not necessary. Soil amendments per BMP T51.3 is required for all new landscaped areas.

Minimum Requirement #6: Runoff Treatment: This project proposes more than 5,000 square feet of pollution generating surfaces; therefore, minimum requirement #6 is applicable to this project. A FloGard Perk Filter vault provides basic runoff treatment upstream of the infiltration trench. Sizing calculations are provided in Section 4 of this report.

Minimum Requirement #7: Flow Control: The project discharges to a single threshold discharge area and exceeds flow control thresholds; therefore, an infiltration trench is proposed to fully infiltrate the runoff from both phases. Sizing calculations are provided in Section 4 of this report.

Minimum Requirement #8: Wetland Protection: This requirement is not applicable to this project since there are no existing wetlands onsite or adjacent to the site.

Minimum Requirement #10: Basin/Watershed Planning: The project site exists within Nisqually River Basin WRIA 11. Runoff from the proposed improvements will be fully infiltrated with the proposed infiltration trench; therefore, concerns to the watershed are mitigated.

Minimum Requirement #11: Operation and Maintenance: An Operations and Maintenance Manual will be prepared as part of the final engineering documents.

2. Existing Conditions Summary

The proposed project is comprised of one 4.67 acre parcel that is predominantly pasture and brush with several scattered trees. Durant Street, an existing roadway, runs along the west boundary of the site. The site is relatively flat sloping north towards Tahoma Blvd with slopes between 2 – 10%.

According to the Soil Survey of Thurston County, Washington, prepared by the United States Department of Agriculture, the site's soils is composed of Nisqually loamy fine sand (74) and Spanaway gravelly sandy loam (110 & 111), which are a Type A soils having low erosion potential, and high infiltration potential. A description of these soils and a copy of the soil map for this project site is included within **Appendix "A"**. A geotechnical engineer's report and subsequent memo, dated July 12, 2019 and July 26, 2019 respectively, has been prepared by Insight Geologic Inc. They discovered the site is underline by recessional outwash gravels, and in their July 26th memo, they provide a design infiltration rate of 31 inches per hour near the proposed infiltration trench. This rate was determined using a Large Scale Pilot Infiltration Test. A copy of their report and memo is provided in **Appendix "D"**.

According to FIRM Panel 53067C0353E the site is located within Zone X. This zone is considered outside of a known flood plain. A copy of the FIRM Panel 53067C0353E can be found within **Appendix "B".**

3. Offsite Analysis

The site controls its runoff with an infiltration trench located on the north side of proposed Building 1. The trench fully infiltrates runoff from the site improvements to the groundwater table up to the 100 year stormwater event as modeled by the WWHM computer program. The site has little to no runoff from offsite properties. In the case of an overflow event runoff from

the site will discharge to the public closed conveyance system in Tahoma Blvd SE. From here the runoff continues east within the public conveyance system for approximately 300-feet where it is infiltrated in a 5-foot deep rock infiltration gallery along the south side of Tahoma Blvd. SE. This is the conclusion of the offsite drainage path. A downstream drainage map is included in **Appendix "B".**

4. Permanent Stormwater Control Plans

Existing Site Hydrology

Approximately 4.345-acres of the existing site is being developed as part of the Wyndstone project. The existing site coverage includes 0.164-acres of pavement along Durant St SE and the remaining 4.181-acres is pasture. The existing site hydrology is analyzed for the purpose of determining flow control thresholds.

The existing site's flow frequencies are summarized below:

2-year 0.060-cfs
10-year 0.106-cfs
50-year 0.160-cfs
100-year 0.187-cfs

A Pre-developed Drainage Basin map is included in **Appendix "B".**

Developed Site Hydrology

The Wyndstone project will constructed four multi-family building, parking lots and associated utilities between two phases. Durant St SE will be realigned along the project's western boundary line and a new public roadway will be constructed along the eastern boundary line. Runoff from both phases and the new public roadway is controlled with a 15-foot wide by 200-foot long by 4.5-foot deep infiltration trench located north of Building 1. A Perk Filter treatment device is upstream of the infiltration trench to provide basic runoff treatment. Durant St SE is tributary to Tahoma Blvd SE and is considered a bypass basin which does not exceed flow control thresholds. The post developed drainage basins are summarized Table 4.1 below:

Sub-Basin	Land-use	WWHM Description	Area (acre)
Onsite A	Yards, Landscaping, Planters	A, Lawn, Flat	0.679
Onsite B	Streets, Sidewalks, and Parking Lot	Roads, Mod	1.795
Onsite C	Roof Tops	Roof Tops, Flat	1.470
Bypass A	Streets and Sidewalks (Durant Street SE/Intersection Road A and Tahoma Blvd SE)	Roads, Flat	0.146
Bypass B	Landscaping	A, Lawn, Mod	0.255
Total			**4.345**

Table 4.1 – Post Developed Basin Summary

The flow frequencies of the onsite basins tributary to the infiltration trench are summarized below:

2-year.....1.265-cfs

10-year.....2.072-cfs

50-year.....2.873-cfs

100-year.....3.243-cfs

The flow frequencies of the bypass basins are summarized below:

2-year.....0.055-cfs

10-year.....0.096-cfs

50-year.....0.141-cfs

100-year.....0.164-cfs

Each basin is depicted on the Post Developed Drainage basin map included in Appendix "B".

Facility Sizing

Runoff from the onsite basin is controlled with a 15-foot wide by 200-foot long by 4.5-foot deep infiltration trench with two twelve inch dispersal pipes. A FloGard Perk Filter is sized to provide basic runoff treatment upstream of the trench. The bypass area is tributary to the existing public drainage system in Tahoma Blvd SE.

Flow Control

As calculated by the WWHM computer program the infiltration trench is sized to fully infiltrate runoff from the site through the 100-year storm event. The trench is modeled as a trap pond to determine the required storage. The model requires 3,675 cubic-feet of storage while 3,736 cubic-feet is provided.

V_{trench} = (175-feet * 4.5-feet * 15-feet – V_{pipe})*n + V_{pipe}

$V_{pipe} = 2*L*\pi r^2 = *(0.5')$

n = drain rock void ratio = 0.30

L = length of pipe = 175-feet

r = 0.5-feet

V_{pipe} = 274.89 cubic-feet

V_{trench} = (175-feet * 4.5-feet * 15-feet – 274.89-cf)*0.30 + 274.89-cf = **3,736 cubic-feet provided.** WWHM computer results are provided in **Appendix "C".**

The bypass area is allowed to flow downstream of the onsite improvements. The bypass area includes portions of the intersection of the new roadway and Tahoma Blvd SE, the realignment of Durant Street SE and some landscape areas along Tahoma Blvd SE. These areas are analyzed to demonstrate that they do not exceed flow control thresholds from minimum requirement #7. The bypass basin includes 6,360 sq.ft. of impervious area, 0.26-acres of new landscaped areas, and a decrease of the 100-year storm event by 0.02-cfs; therefore, flow control is not necessary. WWHM computational results are provided in **Appendix "C".**

Water Quality

An 8-foot by 9-foot FloGard Perk Filter vault is sized to provide basic runoff treatment upstream of the infiltration trench. The Department of Ecology (EYC) has provided a General Use Level Designation (GULD) with a treatment flow rate of 6.8 gpm/cartridge for a 12-inch cartridge and 10.2 gpm/cartridge for an 18-inch cartridge. According to the GULD Perk Filters are sized with the off-line water quality flow rate as calculated by the WWHM computer program (0.298-cfs). Copies of the GULD and of the WWHM results are provided in **Appendix "C".** The vault treats runoff with eight (8) 12-inch and 18-inch filter stacks. Each stack provides a combined treatment flow rate of 17 gpm/stack. The required number of stacks is calculated as follows:

N_{stack} = 449[gpm/cfs]*Q_{treat}[cfs]/17[gpm/stack] = 449[gpm/cfs]*0.298[cfs]/17[gpm/stack] = 7.9 stacks; therefore, use **8 stacks.**

Conveyance Calculations

The project collect runoff with the use of catch basins within the proposed parking lot and roadway as part of a closed conveyance network. This network will be designed to convey a 25-year storm event without surcharging during the 100-year storm event. A sizing analysis will be provided in the final engineering report.

5. Construction Stormwater Pollution Prevention Plan

The minimum requirements for erosion and sediment control are defined Volume II of the Manual. Volume II outlines 13 Erosion and Sediment Control requirements. The Temporary Erosion and Sediment Control Plan provides the design and locations of BMPs to control erosion and sediment.

Requirement No. 1: Preserve Vegetation/Mark Clearing Limits - The project proposes to clear areas onsite. Clearing limits are to be staked by a professional land surveyor as shown on the approved plans. Clearing shall remain within these limits.

Requirement No. 2: Establish Construction Access - A construction entrance (BMP C105) is proposed to protect Tahoma Blvd SE from sediment. Adjacent paved surfaces must be cleaned daily, or if deemed necessary, more frequently.

Requirement No. 3: Control Flow Rates - The project will clear approximately 4.67 acres to construct the site improvements. The project will mitigate runoff with cover measures (BMP C120 and C121), silt fences (BMP C233) interceptor swales (BMP C200), check dams (BMP C207), and a temporary sediment pond (BMP C241).

Requirement No. 4: Install Sediment Controls - The project proposes silt fences (BMP C233) and interceptor swales (BMP C200) around the perimeter of the site and a temporary sediment pond to trap sediment onsite.

Requirement No. 5: Stabilize Soils - The project will stabilize exposed soils with the use of cover measures. These cover measures are mulching, temporary seeding, and plastic sheeting (BMP C120, C121, C123).

Requirement No.6: Protect Slopes - Just like stabilizing the exposed soils the project's exposed slopes will be controlled with the same covering measures (BMP C120, C121, and BMP C123).

Requirement No. 7: Protect Drain Inlets - Existing offsite drain inlets and proposed drain inlets will be protected from sediment with the use of bag filters (BMP C220).

Requirement No. 8: Stabilization of Channels and Outlets - There are no proposed or exiting channels and outlets that need protection onsite or offsite.

Requirement No. 9: Control Pollutants - The project will require earth moving equipment. When vehicles are stored onsite care needs to be taken to make sure that any fluid leaks are contained with drip pans and the fluids are disposed of properly. All spills need to be cleaned up immediately as per the Department of Ecology (EYC) and City of Yelm Standards.

Requirement No. 10: Control Dewatering - This project proposal includes dewatering with the use of a temporary sediment pond (BMP C241). Runoff and seepage should be collected and conveyed to the temporary sediment pond for sediment removal. Water should be collected and conveyed with the use of interceptor swales (BMP C200) or by pumping directly to the temporary sediment pond.

Requirement No. 11: Maintain BMPs - The proposed BMPs need to be maintained as per the approved plans notes and specifications. In general, when sediment accumulation has reached 1/3 of the treatment device or one (1) foot of depth it should be removed. Also, if there is a major storm event then the proposed BMPs should be checked and cleaned appropriately. If the sediment removed from these devices is approved by a geotechnical engineer, they can be stabilized onsite. If not, they must be removed as per the EYC and the City's requirements.

Requirement No. 12: Manage the Project - A construction sequence is provided on the plans. This construction sequence needs to be followed to ensure that sediment is not deposited downstream. The City and the Project Engineer needs to inspect the erosion control BMPs after installation and during construction. The contractor is to employ a Certified Erosion and Sediment Control Lead (CESL, BMP C160) as described by the State to help manage and inspect the erosion control devices. Detailed descriptions of each BMP listed above can be found in Volume 2 of the Stormwater Management Manual for Western Washington, 2014.

Requirement No. 13: Manage the Project - LID BMPs such as soil amendments and an infiltration trench are proposed as part of this project. The areas subject to soil amendments and infiltration trench should not be re-compacted during construction of each building to protect these BMPs.

6. Special Reports and Studies

A geotechnical engineer's report and subsequent memo, dated July 12, 2019 and July 26, 2019 respectively, has been prepared by Insight Geologic Inc. Copies of these reports are included in **Appendix "D".**

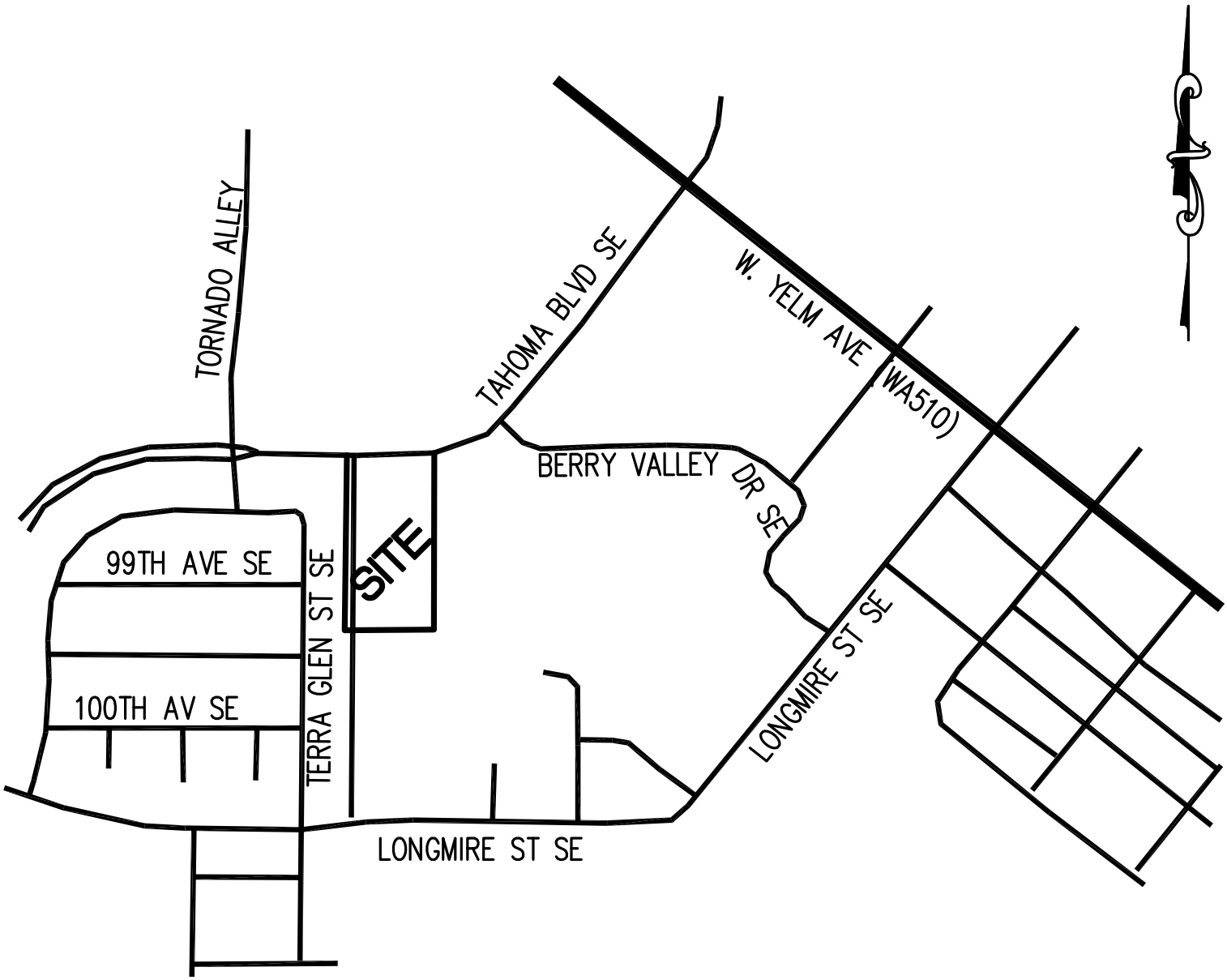
7. Other Permits

Other permits are required including:

- Site plan and SEPA review;
- Site development and clear and grading permits;
- Sanitary sewer permit;
- Water main extension and DEA.

APPENDIX A

General Exhibits



VICINITY MAP

NTS

Map Scale: 1:1,090 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 15 30 60 90

Feet: 0 50 100 200 300

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 1:24,000.

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: Thurston County Area, Washington
Survey Area Data: Version 13, Sep 16, 2019

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

Date(s) aerial images were photographed: Mar 29, 2016—Oct 10, 2016

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
74	Nisqually loamy fine sand, 3 to 15 percent slopes	0.7	15.1%
110	Spanaway gravelly sandy loam, 0 to 3 percent slopes	3.3	75.3%
111	Spanaway gravelly sandy loam, 3 to 15 percent slopes	0.4	9.5%
Totals for Area of Interest		**4.4**	**100.0%**

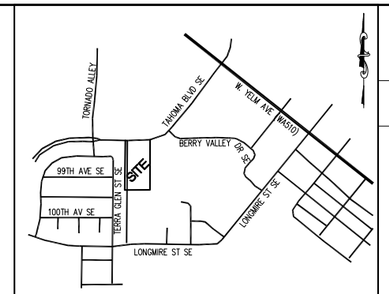
APPENDIX B

Basin Exhibits

WYNDSTONE MULTI-FAMILY

A PORTION OF NW 1/4 OF THE SE 1/4, SEC. 24, TWP.17N, RNG.1E
WILLAMETTE MERIDIAN, YELM, WASHINGTON

30 0 15 30 60
1 inch = 30 feet.



VICINITY MAP
NTS

PRE-DEVELOPED BASIN:
EXISTING SITE COVERAGE INCLUDES 0.164-ACRES OF PAVEMENT ALONG DURANT ST SE AND THE REMAINING 4.181-ACRES IS PASTURE

No.	Revision:	Int.	Date:

C.E.S. NW INC.
CIVIL ENGINEERING & SURVEYING
420 - 29TH ST. NE, SUITE D
PUYALLUP, WA. 98372
PH: (253) 848-4282
cesenw@comcast.com

Project: **WYNDSTONE MULTI-FAMILY**
PRE-DEVELOPED BASIN MAP

Client:

Designed:	DPS
Drawn:	MRL
Checked:	CAD
Scale:	1"=30'
Date:	11.19.19
Job No.:	06164

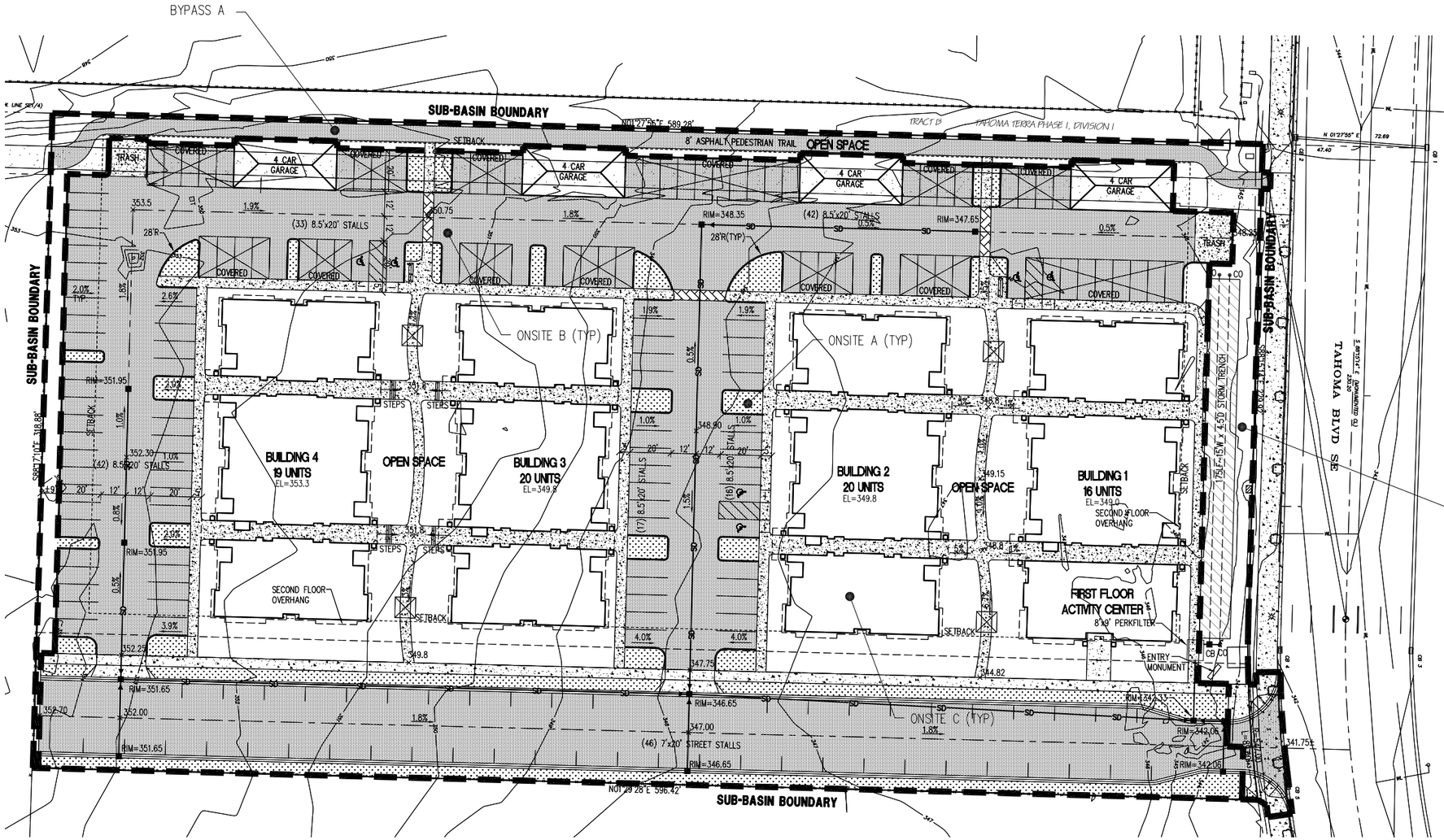
Sheet No.:
B1
1 of 2 Sheets

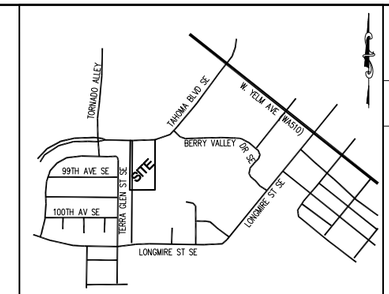
FEATURES CONTAINED IN THIS DRAWING, INCLUDING BUT NOT LIMITED TO, BOUNDARY, RIGHT-OF-WAY, EASEMENT, PARCEL LINES, BEARINGS, DISTANCES, WETLANDS AND BUFFERS, WERE DERIVED FROM PUBLIC RECORDS OR ACQUIRED FROM AUTOCAD DRAWINGS SUPPLIED BY OTHERS.

WYNDSTONE MULTI-FAMILY

A PORTION OF NW 1/4 OF THE SE 1/4, SEC. 24, TWP.17N, RNG.1E
WILLAMETTE MERIDIAN, YELM, WASHINGTON

30 0 15 30 60
1 inch = 30 feet.





VICINITY MAP
NTS

Sub-Basin	Land-use	WWHM Description	Area (acre)
Onsite A	Yards, Landscaping, Planters	A, Lawn, Flat	0.679
Onsite B	Streets, Sidewalks, and Parking Lot	Roads, Mod	1.795
Onsite C	Roof Tops	Roof Tops, Flat	1.470
Bypass A	Streets and Sidewalks (Durant Street SE/Intersection Road A and Tahoma Blvd SE)	Roads, Flat	0.146
Bypass B	Landscaping	A, Lawn, Mod	0.255
Total			**4.345**

POST DEVELOPED BASIN SUMMARY

FEATURES CONTAINED IN THIS DRAWING, INCLUDING BUT NOT LIMITED TO, BOUNDARY, RIGHT-OF-WAY, EASEMENT, PARCEL LINES, BEARINGS, DISTANCES, WETLANDS AND BUFFERS, WERE DERIVED FROM PUBLIC RECORDS OR ACQUIRED FROM AUTOCAD DRAWINGS SUPPLIED BY OTHERS.

No.	Revision:	Int.	Date:

C.E.S. NW INC.
CIVIL ENGINEERING & SURVEYING
429 - 29TH ST. NE, SUITE D
PUYALLUP, WA 98372
PH: (253) 848-4282
cesenw@comcast.net

Project: **WYNDSTONE MULTI-FAMILY**
POST DEVELOPED BASIN MAP

Client:

Designed: DPS
Drawn: MRL
Checked: CAD

Scale: 1"=30'
Date: 11.13.19
Job No.: 06164

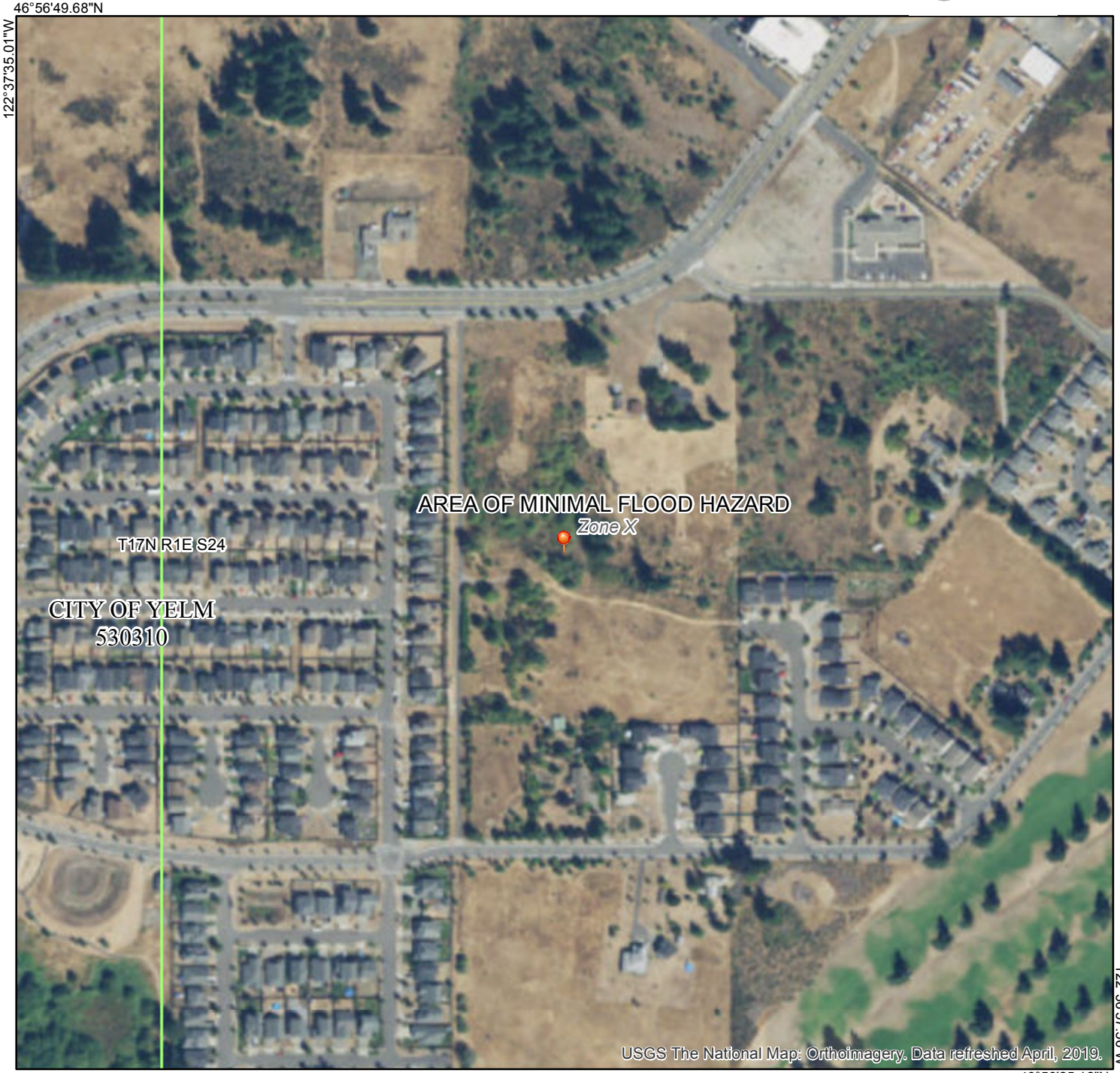
Sheet No.:
B2
2 of 2 Sheets

National Flood Hazard Layer FIRMette

FEMA

46°56'49.68"N

122°37'35.01"W



122°36'57.56"W

46°56'25.12"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/13/2019 at 11:36:26 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

SEC 13 & 24 T 17 N, R 1 E, W.M.

PROPOSED TEMPORARY CONSTRUCTION EASEMENT

SCALE IN FEET
0 10 20 40

TAHOMA BLVD

DURANT ST.

S 88°14'31" E 3500

33+00 34+00 35+00 36+00 37+00 38+00 39+00

STA 33+70.28
BEGIN PROJECT

VERTICAL DATUM
NGVD 29

BASIS OF BEARING:
NAD83/91 BASED ON THURSTON
COUNTY SECTION DATA

STA 36+05, 32.08' LT
CB TYPE 1

134 LF OF 12" DIAM. SCH. A
STORM PIPE AT 0.56%

STA 37+50, 32.08' LT
CB TYPE 1

153 LF OF 12" DIAM. SCH. A
STORM PIPE AT 0.56%

MATCH LINE 39+00

88 LF OF 12" DIAM. SCH. A
STORM PIPE AT 0.68%

STA 38+32, 32.08' RT
CB TYPE 1

PC = 35+99.85

77 LF OF 12" DIAM. SCH. A
STORM PIPE AT 0.52%

STA 37+50, 32.08' RT
CB TYPE 1

STA 36+05, 32.08' RT
CB TYPE 1

STA 36+77.5, 32.08' RT
CB TYPE 1

77 LF OF 12" DIAM. SCH. A
STORM PIPE AT 0.52%

88 LF OF 12" DIAM. SCH. A
STORM PIPE AT 0.68%

STA 38+05, 42' RT
CB TYPE 2-48" DIAM. WITH
SOLID METAL COVER AND 2"
PERF. AT BOTTOM OF STRUCTURE

ROCK GALLERY
110'L x 9'W O.C. 9' RT
FROM FACE OF CURB

Gutter Flow

Closed Conveyance Flow

Rock Gallery

STA 36+05, 42' RT
CB TYPE 2-48" DIAM.
WITH SOLID METAL COVER AND 2"
PERF. AT BOTTOM OF STRUCTURE
RIM=337.58
IE=332.11

STA 38+32, 32.08' RT
CB TYPE 1
RIM=336.66
IE=333.60

STA 36+05, 32.08' RT
CB TYPE 1
RIM=337.46
IE=334.60

STA 36+05, 32.08' LT/RT
CB TYPE 1
RIM=337.84
LEFT IE=335.74
RIGHT IE=335.00

STA 37+50, 32.08' LT/RT
CB TYPE 1
RIM=337.09
LEFT IE=334.99
RIGHT IE=334.20

-0.5226%

STA 38+31
EXIST. TEL., RT

STA 38+63
PROP. STEP, LT

STA 38+75
PROP. WATER, LT

STA 38+88
EXIST. TEL, RT

134 LF OF 12" DIAM. SCH. A
STORM PIPE AT 0.56% LT

153 LF OF 12" DIAM. SCH. A
STORM PIPE AT 0.56% LT

88 LF OF 12" DIAM. SCH. A
STORM PIPE AT 0.68% RT

77 LF OF 12" DIAM. SCH. A
STORM PIPE AT 0.52% RT

77 LF OF 12" DIAM. SCH. A
STORM PIPE AT 0.52% RT

88 LF OF 12" DIAM. SCH. A
STORM PIPE AT 0.68% RT

110 LF OF 12" DIAM.
UNDERDRAIN PIPE AT 0.5%

ROCK GALLERY
FROM STA 38+05, 42' RT
TO STA 39+06.47, 42' RT
TOP EL=334.30
BOTTOM EL.=329.30

342 340 338 336 334 332 330 228 226

339.67 339.41 339.15 338.89 338.63 338.37 338.11 337.85 337.58 337.32 337.06

		DATE
DESIGNED BY:	K. ZAYAS	04/06
ENTERED BY:	C. LOWE	04/06
CHECKED BY:		
PROJ. ENGR.:	S. HELLER	04/06

REVISIONS

NO.	DATE	
1	02/08/07	CHANGE ORDER #2

DWG#: Change Order 2-D5042-001.dwg Xref: z-24x36b, rcprf002, se_kz, 03/06/07 09:50 shauna

CONTRACT NO.

KAREN MERCEDES ZAYAS
STATE OF WASHINGTON
20070
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES

SKILLINGS CONNOLLY
5016 Lacey Boulevard SE, Lacey, Washington 98503
(360) 491-3399 (800) 454-7545 Fax (360) 491-3857

SR 510/TAHOMA BLVD. LID NO. 2 - PHASE I

YELM WA

DRAINAGE PLAN AND PROFILE
(NORTHWEST AND SOUTHEAST)
CHANGE ORDER #2

JOB NUMBER 05042
DR-1
SHEET 14 OF 54 SHEETS

APPENDIX C

Storm Water Calculations

WWHM2012
PROJECT REPORT

Project Name: 06164.2
Site Name: Wynstone
Site Address:
City : Yelm, WA
Report Date: 11/19/2019
Gage : Eaton Creek
Data Start : 1955/10/01
Data End : 2011/09/30
Precip Scale: 0.86
Version Date: 2019/06/06
Version : 4.2.16

Low Flow Threshold for POC 1 : 50 Percent of the 2 Year

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Pasture, Flat	4.181
Pervious Total	4.181

Impervious Land Use	acre
ROADS FLAT	0.164
Impervious Total	0.164
Basin Total	4.345

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Lawn, Flat	.679
Pervious Total	0.679

Impervious Land Use	acre
ROADS MOD	1.795
ROOF TOPS FLAT	1.47
Impervious Total	3.265
Basin Total	3.944

Element Flows To:

Surface	Interflow	Groundwater
Trapezoidal Pond 1	Trapezoidal Pond 1	

Name : Trapezoidal Pond 1
Bottom Length: 175.00 ft.
Bottom Width: 15.00 ft.
Depth: 4.5 ft.
Volume at riser head: 0.0844 acre-feet.
Infiltration On
Infiltration rate: 30
Infiltration safety factor: 1
Total Volume Infiltrated (ac-ft.): 514.389
Total Volume Through Riser (ac-ft.): 0
Total Volume Through Facility (ac-ft.): 514.389
Percent Infiltrated: 100
Total Precip Applied to Facility: 0
Total Evap From Facility: 0
Side slope 1: 0 To 1
Side slope 2: 0 To 1
Side slope 3: 0 To 1
Side slope 4: 0 To 1
Discharge Structure
Riser Height: 1.4 ft.
Riser Diameter: 18 in.

Element Flows To:

Outlet 1	Outlet 2

Pond Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.060	0.000	0.000	0.000
0.0500	0.060	0.003	0.000	1.822
0.1000	0.060	0.006	0.000	1.822

0.1500	0.060	0.009	0.000	1.822
0.2000	0.060	0.012	0.000	1.822
0.2500	0.060	0.015	0.000	1.822
0.3000	0.060	0.018	0.000	1.822
0.3500	0.060	0.021	0.000	1.822
0.4000	0.060	0.024	0.000	1.822
0.4500	0.060	0.027	0.000	1.822
0.5000	0.060	0.030	0.000	1.822
0.5500	0.060	0.033	0.000	1.822
0.6000	0.060	0.036	0.000	1.822
0.6500	0.060	0.039	0.000	1.822
0.7000	0.060	0.042	0.000	1.822
0.7500	0.060	0.045	0.000	1.822
0.8000	0.060	0.048	0.000	1.822
0.8500	0.060	0.051	0.000	1.822
0.9000	0.060	0.054	0.000	1.822
0.9500	0.060	0.057	0.000	1.822
1.0000	0.060	0.060	0.000	1.822
1.0500	0.060	0.063	0.000	1.822
1.1000	0.060	0.066	0.000	1.822
1.1500	0.060	0.069	0.000	1.822
1.2000	0.060	0.072	0.000	1.822
1.2500	0.060	0.075	0.000	1.822
1.3000	0.060	0.078	0.000	1.822
1.3500	0.060	0.081	0.000	1.822
1.4000	0.060	0.084	0.000	1.822
1.4500	0.060	0.087	0.177	1.822
1.5000	0.060	0.090	0.502	1.822
1.5500	0.060	0.093	0.919	1.822
1.6000	0.060	0.096	1.404	1.822
1.6500	0.060	0.099	1.938	1.822
1.7000	0.060	0.102	2.501	1.822
1.7500	0.060	0.105	3.072	1.822
1.8000	0.060	0.108	3.632	1.822
1.8500	0.060	0.111	4.160	1.822
1.9000	0.060	0.114	4.639	1.822
1.9500	0.060	0.117	5.055	1.822
2.0000	0.060	0.120	5.401	1.822
2.0500	0.060	0.123	5.676	1.822
2.1000	0.060	0.126	5.892	1.822
2.1500	0.060	0.129	6.137	1.822
2.2000	0.060	0.132	6.338	1.822
2.2500	0.060	0.135	6.533	1.822
2.3000	0.060	0.138	6.723	1.822
2.3500	0.060	0.141	6.907	1.822
2.4000	0.060	0.144	7.086	1.822
2.4500	0.060	0.147	7.261	1.822
2.5000	0.060	0.150	7.432	1.822
2.5500	0.060	0.153	7.599	1.822
2.6000	0.060	0.156	7.763	1.822
2.6500	0.060	0.159	7.923	1.822
2.7000	0.060	0.162	8.080	1.822
2.7500	0.060	0.165	8.234	1.822
2.8000	0.060	0.168	8.385	1.822
2.8500	0.060	0.171	8.533	1.822
2.9000	0.060	0.174	8.679	1.822
2.9500	0.060	0.177	8.822	1.822

3.0000	0.060	0.180	8.964	1.822
3.0500	0.060	0.183	9.103	1.822
3.1000	0.060	0.186	9.239	1.822
3.1500	0.060	0.189	9.374	1.822
3.2000	0.060	0.192	9.507	1.822
3.2500	0.060	0.195	9.638	1.822
3.3000	0.060	0.198	9.768	1.822
3.3500	0.060	0.201	9.896	1.822
3.4000	0.060	0.204	10.02	1.822
3.4500	0.060	0.207	10.14	1.822
3.5000	0.060	0.210	10.27	1.822
3.5500	0.060	0.213	10.39	1.822
3.6000	0.060	0.216	10.51	1.822
3.6500	0.060	0.220	10.63	1.822
3.7000	0.060	0.223	10.74	1.822
3.7500	0.060	0.226	10.86	1.822
3.8000	0.060	0.229	10.97	1.822
3.8500	0.060	0.232	11.09	1.822
3.9000	0.060	0.235	11.20	1.822
3.9500	0.060	0.238	11.31	1.822
4.0000	0.060	0.241	11.42	1.822
4.0500	0.060	0.244	11.53	1.822
4.1000	0.060	0.247	11.64	1.822
4.1500	0.060	0.250	11.75	1.822
4.2000	0.060	0.253	11.85	1.822
4.2500	0.060	0.256	11.96	1.822
4.3000	0.060	0.259	12.06	1.822
4.3500	0.060	0.262	12.17	1.822
4.4000	0.060	0.265	12.27	1.822
4.4500	0.060	0.268	12.37	1.822
4.5000	0.060	0.271	12.47	1.822
4.5500	0.060	0.274	12.57	1.822

Name : Bypass
Bypass: Yes

GroundWater: No

Pervious Land Use	**acre**
A B, Lawn, Mod	**.255**
Pervious Total	**0.255**

Impervious Land Use	**acre**
ROADS FLAT	**0.146**
Impervious Total	**0.146**
Basin Total	**0.401**

Element Flows To:

Surface	**Interflow**	**Groundwater**

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:4.181
Total Impervious Area:0.164

Mitigated Landuse Totals for POC #1
Total Pervious Area:0.934
Total Impervious Area:3.411

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.060353
5 year	0.086237
10 year	0.106391
25 year	0.135569
50 year	0.16019
100 year	0.187449

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.054723
5 year	0.078546
10 year	0.096397
25 year	0.121415
50 year	0.141903
100 year	0.164034

Stream Protection Duration
Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1956	0.090	0.054
1957	0.081	0.093
1958	0.042	0.040
1959	0.055	0.049
1960	0.065	0.057
1961	0.056	0.053
1962	0.068	0.060
1963	0.103	0.118
1964	0.058	0.051
1965	0.058	0.059
1966	0.041	0.037
1967	0.053	0.048
1968	0.046	0.042
1969	0.040	0.036

1970	0.044	0.039
1971	0.077	0.043
1972	0.221	0.099
1973	0.053	0.045
1974	0.075	0.065
1975	0.051	0.046
1976	0.054	0.052
1977	0.078	0.069
1978	0.068	0.071
1979	0.075	0.066
1980	0.050	0.046
1981	0.105	0.141
1982	0.103	0.092
1983	0.103	0.092
1984	0.063	0.057
1985	0.051	0.043
1986	0.057	0.058
1987	0.066	0.066
1988	0.034	0.028
1989	0.107	0.105
1990	0.049	0.044
1991	0.188	0.179
1992	0.063	0.058
1993	0.129	0.115
1994	0.064	0.056
1995	0.087	0.075
1996	0.080	0.064
1997	0.042	0.039
1998	0.085	0.103
1999	0.054	0.049
2000	0.043	0.035
2001	0.041	0.035
2002	0.032	0.028
2003	0.067	0.057
2004	0.072	0.064
2005	0.045	0.040
2006	0.037	0.030
2007	0.065	0.073
2008	0.041	0.035
2009	0.048	0.041
2010	0.081	0.069
2011	0.038	0.034

Stream Protection Duration
Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.2207	0.1791
2	0.1884	0.1406
3	0.1288	0.1184
4	0.1066	0.1146
5	0.1050	0.1049
6	0.1034	0.1035
7	0.1034	0.0986
8	0.1032	0.0927
9	0.0900	0.0920
10	0.0870	0.0920

11	0.0846	0.0751
12	0.0811	0.0730
13	0.0808	0.0713
14	0.0796	0.0691
15	0.0776	0.0690
16	0.0766	0.0665
17	0.0752	0.0656
18	0.0747	0.0645
19	0.0717	0.0641
20	0.0681	0.0638
21	0.0677	0.0603
22	0.0668	0.0589
23	0.0657	0.0584
24	0.0653	0.0579
25	0.0646	0.0574
26	0.0636	0.0570
27	0.0631	0.0568
28	0.0629	0.0563
29	0.0576	0.0536
30	0.0575	0.0529
31	0.0567	0.0524
32	0.0564	0.0513
33	0.0550	0.0489
34	0.0535	0.0486
35	0.0535	0.0479
36	0.0529	0.0457
37	0.0528	0.0455
38	0.0513	0.0447
39	0.0506	0.0436
40	0.0502	0.0434
41	0.0489	0.0429
42	0.0480	0.0424
43	0.0459	0.0413
44	0.0447	0.0399
45	0.0440	0.0396
46	0.0428	0.0392
47	0.0424	0.0385
48	0.0416	0.0367
49	0.0412	0.0362
50	0.0410	0.0355
51	0.0409	0.0353
52	0.0401	0.0350
53	0.0383	0.0343
54	0.0367	0.0302
55	0.0337	0.0284
56	0.0316	0.0276

Stream Protection Duration
POC #1
The Facility FAILED

Facility FAILED duration standard for 1+ flows.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0302	2013	1175	58	Pass
0.0315	1696	981	57	Pass

0.0328	1438	860	59	Pass
0.0341	1230	746	60	Pass
0.0354	1061	638	60	Pass
0.0367	909	552	60	Pass
0.0381	797	485	60	Pass
0.0394	683	416	60	Pass
0.0407	606	368	60	Pass
0.0420	517	328	63	Pass
0.0433	465	288	61	Pass
0.0446	394	261	66	Pass
0.0459	351	231	65	Pass
0.0472	317	209	65	Pass
0.0486	285	188	65	Pass
0.0499	265	165	62	Pass
0.0512	233	144	61	Pass
0.0525	208	127	61	Pass
0.0538	194	106	54	Pass
0.0551	172	92	53	Pass
0.0564	156	85	54	Pass
0.0578	135	76	56	Pass
0.0591	124	68	54	Pass
0.0604	113	57	50	Pass
0.0617	101	53	52	Pass
0.0630	84	51	60	Pass
0.0643	78	48	61	Pass
0.0656	71	41	57	Pass
0.0669	64	39	60	Pass
0.0683	56	33	58	Pass
0.0696	48	30	62	Pass
0.0709	46	28	60	Pass
0.0722	41	27	65	Pass
0.0735	40	25	62	Pass
0.0748	37	24	64	Pass
0.0761	36	23	63	Pass
0.0775	33	23	69	Pass
0.0788	27	22	81	Pass
0.0801	25	22	88	Pass
0.0814	23	21	91	Pass
0.0827	22	21	95	Pass
0.0840	20	21	104	Pass
0.0853	19	20	105	Pass
0.0866	18	19	105	Pass
0.0880	16	18	112	Fail
0.0893	16	18	112	Fail
0.0906	15	17	113	Fail
0.0919	15	17	113	Fail
0.0932	15	14	93	Pass
0.0945	15	14	93	Pass
0.0958	15	13	86	Pass
0.0972	15	13	86	Pass
0.0985	15	13	86	Pass
0.0998	13	12	92	Pass
0.1011	13	11	84	Pass
0.1024	13	10	76	Pass
0.1037	10	9	90	Pass
0.1050	10	6	60	Pass
0.1063	8	6	75	Pass

0.1077	7	6	85	Pass
0.1090	7	6	85	Pass
0.1103	7	5	71	Pass
0.1116	7	5	71	Pass
0.1129	7	4	57	Pass
0.1142	6	4	66	Pass
0.1155	5	3	60	Pass
0.1169	5	3	60	Pass
0.1182	4	3	75	Pass
0.1195	4	2	50	Pass
0.1208	4	2	50	Pass
0.1221	4	2	50	Pass
0.1234	3	2	66	Pass
0.1247	3	2	66	Pass
0.1260	3	2	66	Pass
0.1274	3	2	66	Pass
0.1287	3	2	66	Pass
0.1300	2	2	100	Pass
0.1313	2	2	100	Pass
0.1326	2	2	100	Pass
0.1339	2	2	100	Pass
0.1352	2	2	100	Pass
0.1366	2	2	100	Pass
0.1379	2	2	100	Pass
0.1392	2	2	100	Pass
0.1405	2	2	100	Pass
0.1418	2	1	50	Pass
0.1431	2	1	50	Pass
0.1444	2	1	50	Pass
0.1457	2	1	50	Pass
0.1471	2	1	50	Pass
0.1484	2	1	50	Pass
0.1497	2	1	50	Pass
0.1510	2	1	50	Pass
0.1523	2	1	50	Pass
0.1536	2	1	50	Pass
0.1549	2	1	50	Pass
0.1563	2	1	50	Pass
0.1576	2	1	50	Pass
0.1589	2	1	50	Pass
0.1602	2	1	50	Pass

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.

Perlnd and Implnd Changes

No changes have been made.

WWHM2012
PROJECT REPORT

Project Name: 06164.2 treatment
Site Name: Wynstone
Site Address:
City : Yelm, WA
Report Date: 11/18/2019
Gage : Eaton Creek
Data Start : 1955/10/01
Data End : 2011/09/30
Precip Scale: 0.86
Version Date: 2019/06/06
Version : 4.2.16

Low Flow Threshold for POC 1 : 50 Percent of the 2 Year

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Predev
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Pasture, Mod	4.181
Pervious Total	4.181

Impervious Land Use	acre
ROADS MOD	0.164
Impervious Total	0.164
Basin Total	4.345

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Lawn, Flat	.679
Pervious Total	0.679

Impervious Land Use	acre
ROADS MOD	1.795
ROOF TOPS FLAT	1.47
Impervious Total	3.265
Basin Total	3.944

Element Flows To:
Surface Interflow Groundwater

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:4.181
Total Impervious Area:0.164

Mitigated Landuse Totals for POC #1
Total Pervious Area:0.679
Total Impervious Area:3.265

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.072804
5 year	0.10711
10 year	0.134432
25 year	0.17473
50 year	0.209303
100 year	0.248089

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	1.26489
5 year	1.736823
10 year	2.071518
25 year	2.520101
50 year	2.873195

100 year 3.242738

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0.433 **acre-feet**
On-line facility target flow: 0.5251 **cfs.**
Adjusted for 15 min: 0.5251 **cfs.**
Off-line facility target flow: 0.2977 **cfs.**
Adjusted for 15 min: 0.2977 **cfs.**

POC #2 was not reported because POC must exist in both scenarios and both scenarios must have been run.**Perlnd and Implnd Changes**
No changes have been made.

WASHINGTON STATE DEPARTMENT OF ECOLOGY

August 2018

GENERAL USE LEVEL DESIGNATION FOR BASIC AND PHOSPHORUS TREATMENT

For

Kristar/Oldcastle Precast, Inc. FloGard Perk Filter™ (using ZPC Filter Media)

Ecology's Decision:

Based on Kristar/Oldcastle's application submissions, including the Draft Technical Evaluation Report, dated April 2010, Ecology hereby issues the following use level designations:

1. **General use level designation (GULD) for the Perk Filter™ for basic treatment:**
   - **Using a zeolite-perlite-carbon (ZPC) filter media as specified by Kristar/Oldcastle.**
   - **Sized at hydraulic loading rate of no more than 1.5 gpm/ft^2 of media surface area, per Table 1.**

Table 1. Design Flowrate per Cartridge

Effective Cartridge Height (inches)	12	18
Cartridge Flowrate (gpm/cartridge)	6.8	10.2

2. **General use level designation (GULD) for the Perk Filter™ for phosphorus treatment:**
   - **Using a zeolite-perlite-carbon (ZPC) filter media as specified by Kristar/Oldcastle.**
   - **Sized at hydraulic loading rate of no more than 1.5 gpm/ft^2 of media surface area, per Table 1.**

3. **Ecology approves Perk Filter™ units for treatment at the hydraulic loading rates shown in Table 1, and sized based on the water quality design flow rate for an off-line system. The internal weir in the inlet chamber functions as a bypass to route flow in excess of the water quality design flow rate around the treatment chamber. Calculate the water quality design flow rate using the following procedures:**

   - **Western Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using the latest version of the Western Washington Hydrology Model or other Ecology-approved continuous runoff model.**

- **Eastern Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using one of the three methods described in Chapter 2.2.5 of the Stormwater Management Manual for Eastern Washington (SWMMEW) or local manual.**

- **Entire State: For treatment installed downstream of detention, the water quality design flow rate is the full 2-year release rate of the detention facility.**

4. **These General Use Level Designations have no expiration date but may be revoked or amended by Ecology, and are subject to the conditions specified below.**

<u>Ecology's Conditions of Use:</u>

Perk Filter™ units shall comply with the following conditions:

1. **Design, assemble, install, operate, and maintain Perk Filter™ units in accordance with Kristar/Oldcastle's applicable manuals and documents and the Ecology Decision.**

2. **Each site plan must undergo Kristar/Oldcastle review and approval before site installation. This ensures that site grading and slope are appropriate for use of a Perk Filter™ unit.**

3. **Perk Filter™media shall conform to the specifications submitted to, and approved by, Ecology.**

4. **Maintenance: The required maintenance interval for stormwater treatment devices is often dependent upon the degree of pollutant loading from a particular drainage basin. Therefore, Ecology does not endorse or recommend a "one size fits all" maintenance cycle for a particular model/size of manufactured filter treatment device.**

- **Typically, Kristar/Oldcastle designs PerkFilter systems for a target filter media replacement interval of 12 months. Maintenance includes removing accumulated sediment from the vault, and replacing spent cartridges with recharged cartridges.**
- **Indications of the need for maintenance include effluent flow decreasing to below the design flow rate, as indicated by the scumline above the shoulder of the cartridge.**
- **Owners/operators must inspect PerkFilter for a minimum of twelve months from the start of post-construction operation to determine site-specific maintenance schedules and requirements. You must conduct inspections monthly during the wet season, and every other month during the dry season. (According to the SWMMWW, the wet season in western Washington is October 1 to April 30. According to SWMMEW, the wet season in eastern Washington is October 1 to June 30). After the first year of operation, owners/operators must conduct inspections based on the findings during the first year of inspections.**

- **Conduct inspections by qualified personnel, follow manufacturer's guidelines, and use methods capable of determining either a decrease in treated effluent flowrate and/or a decrease in pollutant removal ability.**
- **When inspections are performed, the following findings typically serve as maintenance triggers:**
    - **Accumulated vault sediment depths exceed an average of 2 inches, or**
    - **Accumulated sediment depths on the tops of the cartridges exceed an average of 0.5 inches, or**
    - **Standing water remains in the vault between rain events, or**
    - **Bypass occurs during storms smaller than the design storm.**
- **Note: If excessive floatables (trash and debris) are present, perform a minor maintenance consisting of gross solids removal, not cartridge replacement.**

5. Discharges from the Perk Filter™ units shall not cause or contribute to water quality standards violations in receiving waters.

Applicant: Kristar/Oldcastle Precast, Inc.

Applicant's Address: 5331 SW Macadam Avenue
Suite 376
Portland, OR 97239

Application Documents:

- Perk Filter™ Final Report, prepared by: Office of Water Programs, California State University, Sacramento (September 2007)
- Verification Phase of Perk Filter™ Tests with Zeolite-Perlite-Carbon Media and Zeolite-Carbon Media (August 2007)
- Quality Assurance Project Plan KriStar Perk Filter™ Stormwater Treatment Performance Monitoring Project, October 2008 Draft
- Technical Evaluation Report Volume 1: KriStar Perk Filter™ Stormwater Treatment System Performance Monitoring, April 2010
- Technical Evaluation Report Volume 2 - Appendices: KriStar Perk Filter™ Stormwater Treatment System Performance Monitoring, April 2010.

Applicant's Use Level Request:

- General use level designation as a basic and Phosphorus treatment device in accordance with Ecology's *Guidance for Evaluating Emerging Stormwater Treatment Technologies Technology Assessment Protocol – Ecology (TAPE) January 2011 Revision*.

Applicant's Performance Claims:

- Capability to remove 80% of total suspended solids from stormwater runoff from sites with influent concentrations between 100 mg/L and 200 mg/L and provide effluent concentrations of 20 mg/L or less with influent concentrations less than 100 mg/L given a typical particle size distribution.
- Capability to remove 50% of Total Phosphorus from stormwater runoff from sites with influent concentrations between 0.1 mg/l and 0.5 mg/l.

Findings of Fact:

- Based on laboratory testing at a flowrate of 12 GPM per filter, the Perk Filter™ containing ZPC media had an average total suspended solids removal efficiency of 82% using Sil-Co-Sil 106 with an average influent concentration of 102 mg/L and zero initial sediment loading.

- Based on field-testing at a flowrate of 0.57 GPM/inch of cartridge height (17.25 inch diameter cartridge) (1.5 gpm per sq ft filter surface area), the Perk Filter™ containing ZPC media had an average total suspended solids removal efficiency of 82.4% for an influent concentration between 20 mg/L and 200 mg/l. The Perk Filter™ containing ZPC media had an average removal efficiency of 85.2% for an influent concentration between 100 mg/l and 200 mg/l. Removal rates fell over time and dropped below 80% after approximately 10 months.

- Based on field testing at a flowrate of 0.57 GPM/inch of cartridge height (17.25 inch diameter cartridge) (1.5 gpm per sq ft filter surface area), the Perk Filter™ containing ZPC media had an average total Phosphorus removal efficiency of 62.4% for an influent concentration between 0.1 mg/L and 0.5 mg/l. Removal rates tended to remain relatively constant during the 10 months of monitoring.

- Field Testing indicates that sediment accumulation in the Sediment Gallery during the 10 months of sampling was within the available volume for sediment. Thus, maintenance at a 6-month frequency (vacuuming of sediment from Inlet Gallery) as suggested by the manufacturer is sufficient.

- Filter flows during bypass events utilize the full 30-inch height of the filter. Without bypass, an unknown amount of filter is used. Comparing the flow through the filter during bypass events with the design flow rate shows that the Kristar/Oldcastle system falls below the design flow rate after approximately 10 months of operation.

- Percent removal of TSS falls below 80% after approximately 10 months. There are earlier data points below 80% but these are from low influent concentration storms

Other Perk Filter™ Related Issues to be Addressed By the Company:

1. Kristar/Oldcastle may perform additional monitoring to better determine the maintenance frequency for the filters with respect to design flow rate and Total Suspended Solids removal. Presentation of additional data may result in a modification to the requirements in this Use Level designation document.

Technology Description: Download at www.kristar.com

Contact Information:

Applicant: Jay Holtz, P.E.
Engineering Manager
Kristar/Oldcastle Precast, Inc.
5331 SW Macadam Avenue
Suite 376
Portland, OR 97239
(971) 271-0796
jay.holtz@oldcastle.com

Applicant website: www.kristar.com

Ecology web link: http://www.ecy.wa.gov/programs/wq/stormwater/newtech/index.html

Ecology: Douglas C. Howie, P.E.
Department of Ecology
Water Quality Program
(360) 407-6444
douglas.howie@ecy.wa.gov

Revision History

Date	Revision
March 2008	Original Draft use-level-designation document
June 2010	Revise Use Level to General
January 2013	Modified Design Storm Description, added Revision Table, formatted document to match Ecology standard
May 2014	Revised Company name and contact information
June 2016	Designated device for off-line sizing
August 2018	Revised Address and phone number for Oldcastle

APPENDIX D

Geotechncial Engineer's Reports

INSIGHT GEOLOGIC, INC.

July 12, 2019

C & E Developments LLC
PO Box 2983
Yelm, Washington 98597
Attention: Casey Peterson

Report
Geotechnical and Stormwater Investigation
Wyndstone Development
Proposed Multi-Family Residential
15025 Tahoma Boulevard SE
Yelm, Washington
Project No. 1142-001-01

INTRODUCTION

Insight Geologic is pleased to present our report of subsurface conditions at the location of your proposed Wyndstone multi-family residential development to be located at 15025 Tahoma Boulevard SE in Yelm, Washington. The location of the site is shown relative to surrounding physical features in the Vicinity Map, Figure 1. The site of the proposed project consists of a single parcel of property (Thurston County Tax Parcel No. 21724420300), comprising approximately 4.3 acres.

The project will include four, multi-family, multi-story residential buildings with appurtenant parking and drive areas. Stormwater runoff from roads and parking areas is to be infiltrated to the subsurface in the northern portion of the property.

SCOPE OF SERVICES

The objective of our services was to evaluate subsurface conditions on the property as a basis for evaluating suitability of the soils for the proposed building and parking areas, as well as evaluating the soils for stormwater infiltration. Our specific scope of services included the following tasks:

Stormwater Investigation

1. Provided for the location of subsurface utilities on the site. We conducted this task by notifying the “One Call” system.
2. Conducted a site reconnaissance to evaluate and mark proposed boring locations at the site and for truck-mounted drilling rig access.
3. Drilled two (2) borings in the location of the proposed stormwater disposal structure at the site using a truck-mounted drilling rig.

1015 East 4th Avenue, Olympia, Washington 98506
Phone: 360.754.2128 Fax: 360.754.9299

4. Installed one (1), 2-inch diameter monitoring well, constructed of PVC casing. The well was finished inside a locking steel cover installed flush with the surrounding grade.
5. Collected soil samples continuously during drilling to the full depth of the borings.
6. Maintained logs of the soils encountered in the boreholes and provided well construction details. Soils were described in general accordance with the Unified Soil Classification System and presented on the field logs.
7. Conducted an evaluation of stormwater infiltration rates using the detailed method outlined in Ecology's 2014 Stormwater Management Manual, as adopted by the City of Yelm, and provide a design infiltration rate for stormwater infiltration.

Geotechnical Investigation

8. Excavated a series of six (6) exploratory test pits across the project site using a small, track-mounted excavator. The test pits were excavated to depths of between approximately 6 to 8 feet below ground surface (bgs) across the site.
9. Collected representative soil samples from the test pits for possible laboratory analysis.
10. Logged the soils exposed in the test pits in general accordance with ASTM D2487-06.
11. Provided for laboratory testing of seven (7) soil samples for gradation analyses to evaluate bearing capacity and for stormwater infiltration calculations.
12. Prepared a report summarizing our field activities including our recommendations for site preparation and grading, bearing capacity, seismic class, temporary and final cut slopes, earth pressures, and suitability of the on-site soils for use as fill.

FINDINGS

Surface Conditions

The project site is a rectangular shaped parcel situated at an elevation of approximately 340 to 350 feet above mean sea level (MSL) and is currently occupied by a single-family residence. The property is bounded by Tahoma Boulevard SE to the north, Durant Street SE to the west, and residential properties to the south and east. The site gently slopes down to the north with an elevation drop of 10 feet across the site. The subject site is vegetated with grasses, scotch broom, and isolated stands of low growing trees and other shrubs.

Geology

Based on our review of available published geologic maps, Vashon age glacial recessional outwash gravel deposits underlie the project site. This material is described as poorly-sorted gravel and sand. This material was deposited by outwash rivers during the waning stages of the most recent glacial period in the Puget Sound region and is not glacially consolidated.

Subsurface Explorations

We explored subsurface conditions at the site on June 10 and June 14, 2019 by excavating six test pits and advancing two borings in the locations as shown on the Site Plan, Figure 2. The test pits were excavated by Insight Geologic using a track-mounted excavator. The exploratory borings were

completed by Holocene Drilling using a truck-mounted hollow stem auger drill rig. A geologist from Insight Geologic monitored the explorations and maintained a log of the conditions encountered. The test pits were completed to depths of 6 to 8 feet bgs, and the borings were completed to depths of between 23 and 36.5 feet bgs. The soils were visually classified in general accordance with the system described in ASTM D2487-06. A copy of the explorations is contained in Attachment A.

Soil Conditions

The explorations were generally consistent across the site. Underlying approximately 6 inches of sod, we generally encountered between 1.5 to 2 feet of dark brown, poorly- to well-graded gravel and sand with cobbles and varying levels of silt and organics (GP-GM, GP), in a loose and moist condition. Underlying the dark brown unit, we encountered brown poorly- to well-graded gravels with cobbles and varying percentages of sand (GP, GW) to poorly graded sands with gravels and cobbles and varying percentages of silt (SP, SP-SM), in a loose to very dense and moist to wet condition to the base of the explorations. In general, soils increased in compaction with depth.

The soils encountered are consistent with Nisqually loamy fine sand and Spanaway gravelly sandy loam, which are mapped for the area. In general, the Nisqually loamy fine sand is mapped along the north quarter of the site, while the Spanaway gravelly sandy loam is mapped on the remainder of the property. These soils are generally formed from sandy and gravely glacial outwash and generally has restrictive layers occurring greater than 7 feet below grade. Percolation is generally high, with rates between 1.98 and 5.95 inches per hour, according to the U.S. Department of Agriculture Soil Survey.

Groundwater Conditions

Groundwater was encountered in boring MW-1 at a depth of 32 feet bgs. Groundwater was not encountered in any of the remaining explorations completed on-site. The explorations were completed during the summer season at a time that generally correlates to a lower groundwater elevation. In addition, no evidence of high groundwater was encountered within the explorations at the site.

Laboratory Testing

We selected seven soil samples for gradation analyses in general accordance with ASTM D422 to define soil class and obtain parameters for stormwater infiltration calculations. Our laboratory test results are provided in Attachment B.

STORMWATER INFILTRATION

We completed a stormwater infiltration rate evaluation in general accordance with the Washington State Department of Ecology Stormwater Manual for Western Washington (2014 Manual) as adopted by the City of Yelm. For the purposes of this evaluation, we selected Method 3 “Soil Grain Size Analysis Method”. The 2014 Manual utilizes the relationship between the D_{10}, D_{60}, and D_{90} results of the ASTM grain-size distribution analyses, along with site specific correction factors to estimate long-term design infiltration rates of each infiltration facility.

Based on our gradation analyses, we estimate that the long-term design infiltration rate (F_{design}) for the proposed stormwater infiltration is between 1.6 and 20 inches per hour, after applying the appropriate correction factors. The range of infiltration rate is the result of varying percentages of fines in the soil

profile. Our calculations assume that the stormwater infiltration will occur at a depth of at least 3 feet bgs or below the upper gravel with sand and silt unit. Changes to these infiltration rates are possible depending on the depth to groundwater during winter months. For the purposes of stormwater infiltration on this project, we recommend using an infiltration rate of 2.9 inches per hour for the pond area and 5 inches per hour for roof downspouts in the central portion of the site.

Table 1. Design Infiltration Rates – Detailed Method

Exploration	Unit	Depth Range (feet)	D_{10} Value	D_{60} Value	D_{90} Value	Long Term Design Infiltration Rate (Inches per hour)
TP-2	GW	3.0 – 8.0	7.9	44	130	20
TP-5	SP	2.0 – 8.0	0.31	3.2	51	1.6
MW-1	GP	25.0 – 26.5	0.35	14	30	2.9
MW-1	GW	30.0 – 31.5	0.26	8.5	18	
B-1	SP-SM	10.0 – 11.5	0.14	2.1	25	

SEISMIC DESIGN CONSIDERATIONS

General

We understand that seismic design will likely be performed using the 2015 IBC standards. The following parameters may be used in computing seismic base shear forces:

Table 2. 2015 IBC Seismic Design Parameters

Spectral Response Accel. at Short Periods (S_S) = 1.25
Spectral Response Accel. at 1 Second Periods (S_1) = 0.50
Site Class = D
Site Coefficient (F_A) = 1.0
Site Coefficient (F_V) = 1.5

A full report for the seismic design parameters is presented in Attachment C.

Ground Rupture

Because of the location of the site with respect to the nearest known active crustal faults, and the presence of a relatively thick layer of glacial outwash deposits, it is our opinion that the risk of ground rupture at the site due to surface faulting is low.

Soil Liquefaction

Liquefaction refers to a condition where vibration or shaking of the ground, usually from earthquake forces, results in the development of excess pore water pressures in saturated soils, and a subsequent loss of stiffness in the soil occurs. Liquefaction also causes a temporary reduction of soil shear strength and bearing capacity, which can cause settlement of the ground surface above the liquefied

soil layers. In general, soils that are most susceptible to liquefaction include saturated, loose to medium dense, clean to silty sands and non-plastic silts within 50 feet of ground surface.

Based on our review of the *Liquefaction Susceptibility Map of Thurston County (Palmer, 2004)*, the project site is identified to have a very low potential risk for soil liquefaction. Based on our experience with detailed seismic studies in the Yelm area, including areas that are mapped within the same recessional outwash soil deposits as the project site, we concur with the reviewed map. It is our opinion that there is a low risk for soil liquefaction at the site.

Seismic Compression

Seismic compression is defined as the accrual of contractive volumetric strains in unsaturated soils during strong shaking from earthquakes (Stewart et al., 2004). Loose to medium dense clean sands and non-plastic silts are particularly prone to seismic compression settlement. Seismic compression settlement is most prevalent on slopes, but it can also occur on flat ground. It is our opinion that the upper 15 feet of the soil profile at the site has a moderate risk for seismic compression settlement.

Seismic Settlement Discussion

Based on the materials encountered in our explorations, it is our preliminary opinion that seismic settlements (liquefaction-induced plus seismic compression) could potentially total a few inches at the site as the result of an IBC design level earthquake. We are available upon request to perform deep subsurface explorations and detailed seismic settlement estimates during the design phase.

Seismic Slope Instability

The maximum inclination of the site is approximately 2 percent and we did not observe signs of slope instability during our site work. In our opinion, there is a very low risk of seismic slope instability at the project site under current conditions.

Lateral Spreading

Lateral spreading involves the lateral displacement of surficial blocks of non-liquefied soil when an underlying soil layer liquefies. Lateral spreading generally develops in areas where sloping ground or large grade changes are present. Based on our limited understanding of the subsurface conditions at the site, it is our opinion that there is a low risk for the development of lateral spreading as a result of an IBC design level earthquake.

CONCLUSIONS AND RECOMMENDATIONS

General

Based on the results of our subsurface explorations and engineering analyses, it is our opinion that the proposed development is feasible from a geotechnical standpoint. We recommend that the proposed structures be supported on shallow concrete foundations that are designed using an allowable soil bearing capacity of 2,500 pounds per square foot (psf).

The soils encountered in our explorations are typically in a loose condition near ground surface. To limit the potential for structure settlement, we recommend that shallow foundations and slabs-on-grade be established on a minimum 1-foot thick layer of structural fill. Depending on final grading plans and

the time of year earthwork is performed; it could be practical to reuse the on-site soils as structural fill under the foundations/slabs.

Stormwater infiltration at the site is feasible. We propose a design infiltration rate of 2.9 inches per hour for the stormwater infiltration systems, based on the assumption that stormwater infiltration will occur within the clean gravels and sands below a depth of about 3 feet bgs. This value is based on an idealized soil column located in the area of the proposed stormwater infiltration trench on the north side of the site. It may be possible to increase the infiltration rate with additional testing such as a Pilot Infiltration Test in the location of the proposed infiltration facility.

Alternatively, based on the U.S. Department of Agriculture Soil Survey map, areas of increased infiltration may be present within the Spanaway gravelly sandy loam mapped on the southern portions of the site. Additional evaluation of this area at depth would be required for a more detailed analysis.

Earthwork

General

We anticipate that site development earthwork will include removing the existing vegetation, stripping sod/topsoil materials, preparing subgrades, excavating for utility trenches, and placing and compacting structural fill. We expect that the majority of site grading can be accomplished with conventional earthmoving equipment in proper working order.

Our explorations did not encounter appreciable amounts of debris or unsuitable soils associated with past site development. Still, it is possible that concrete slabs, abandoned utility lines or other development features could be encountered during construction. The contractor should be prepared to deal with these conditions.

Clearing and Stripping

Clearing and stripping should consist of removing surface and subsurface deleterious materials including sod/topsoil, trees, brush, debris and other unsuitable loose/soft or organic materials. Stripping and clearing should extend at least 5 feet beyond all structures and areas to receive structural fill.

We estimate that a stripping depth of about 0.5 feet will be required to remove the sod encountered in several of our explorations. Deeper stripping depths may be required if additional unsuitable soils are exposed during stripping operations. We recommend that trees be removed by overturning so that the majority of roots are also removed. Depressions created by tree or stump removal should be backfilled with structural fill and properly compacted.

Subgrade Preparation

After stripping and excavating to the proposed subgrade elevation, and before placing structural fill or foundation concrete, the exposed subgrade should be thoroughly compacted to a firm and unyielding condition. The exposed subgrade should then be proof-rolled using loaded, rubber-tired heavy equipment. We recommend that Insight Geologic be retained to observe the proof-rolling prior to placement of structural fill or foundation concrete. Areas of limited access that cannot be proof-rolled

can be evaluated using a steel probe rod. If soft or otherwise unsuitable areas are revealed during proof-rolling or probing, that cannot be compacted to a stable and uniformly firm condition, we generally recommend that: 1) the subgrade soils be scarified (e.g., with a ripper or farmer's disc), aerated and recompacted; or 2) the unsuitable soils be overexcavated and replaced with structural fill.

Temporary Excavations and Groundwater Handling

Excavations deeper than 4 feet should be shored or laid back at a stable slope if workers are required to enter. Shoring and temporary slope inclinations must conform to the provisions of Title 296 Washington Administrative Code (WAC), Part N, "Excavation, Trenching and Shoring." Regardless of the soil type encountered in the excavation, shoring, trench boxes or sloped sidewalls were required under the Washington Industrial Safety and Health Act (WISHA). The contract documents should specify that the contractor is responsible for selecting excavation and dewatering methods, monitoring the excavations for safety and providing shoring, as required, to protect personnel and structures.

In general, temporary cut slopes should be inclined no steeper than about 1.5H:1V (horizontal: vertical). This guideline assumes that all surface loads are kept at a minimum distance of at least one-half the depth of the cut away from the top of the slope, and that significant seepage is not present on the slope face. Flatter cut slopes were necessary where significant seepage occurs or if large voids are created during excavation. Some sloughing and raveling of cut slopes should be expected. Temporary covering with heavy plastic sheeting should be used to protect slopes during periods of wet weather.

We anticipate that if perched groundwater is encountered during construction can be handled adequately with sumps, pumps, and/or diversion ditches. Groundwater handling needs will generally be lower during the late summer and early fall months. We recommend that the contractor performing the work be made responsible for controlling and collecting groundwater encountered during construction.

Permanent Slopes

We do not anticipate that permanent slopes will be utilized for the proposed project. If permanent slopes are necessary, we recommend the slopes be constructed at a maximum inclination of 2H:1V. Where 2H:1V permanent slopes are not feasible, protective facings and/or retaining structures should be considered.

To achieve uniform compaction, we recommend that fill slopes be overbuilt and subsequently cut back to expose well-compacted fill. Fill placement on slopes should be benched into the slope face and include keyways. The configuration of the bench and keyway depends on the equipment being used. Bench excavations should be level and extend into the slope face. We recommend that a vertical cut of about 3 feet be maintained for benched excavations. Keyways should be about 1-1/2 times the width of the equipment used for grading or compaction.

Erosion Control

We anticipate that erosion control measures such as silt fences, straw bales and sand bags will generally be adequate during development. Temporary erosion control should be provided during

construction activities and until permanent erosion control measures are functional. Surface water runoff should be properly contained and channeled using drainage ditches, berms, swales, and tightlines, and should not discharge onto sloped areas. Any disturbed sloped areas should be protected with a temporary covering until new vegetation can take effect. Jute or coconut fiber matting, excelsior matting or clear plastic sheeting is suitable for this purpose. Graded or disturbed slopes should be tracked in-place with the equipment running perpendicular to the slope contours so that the track marks provide a texture to help resist erosion. Ultimately, erosion control measures should be in accordance with local regulations and should be clearly described on project plans.

Wet Weather Earthwork

Some of the near surface soils contain up to about 7 percent fines. When the moisture content of the soil is more than a few percent above the optimum moisture content, the soil will become unstable and it may become difficult or impossible to meet the required compaction criteria. Disturbance of near surface soils should be expected if earthwork is completed during periods of wet weather.

The wet weather season in this area generally begins in October and continues through May. However, periods of wet weather may occur during any month of the year. If wet weather earthwork is unavoidable, we recommend that:

- The ground surface is sloped so that surface water is collected and directed away from the work area to an approved collection/dispersion point.
- Earthwork activities not take place during periods of heavy precipitation.
- Slopes with exposed soil be covered with plastic sheeting or otherwise protected from erosion.
- Measures are taken to prevent on-site soil and soil stockpiles from becoming wet or unstable. Sealing the surficial soil by rolling with a smooth-drum roller prior to periods of precipitation should reduce the extent that the soil becomes wet or unstable.
- Construction traffic is restricted to specific areas of the site, preferably areas that are surfaced with materials not susceptible to wet weather disturbance.
- A minimum 1-foot thick layer of 4- to 6-inch quarry spalls is used in high traffic areas of the site to protect the subgrade soil from disturbance.
- Contingencies are included in the project schedule and budget to allow for the above elements.

Structural Fill Materials

General

Material used for structural fill should be free of debris, organic material and rock fragments larger than 3 inches. The workability of material for use as structural fill will depend on the gradation and moisture content of the soil. As the amount of fines increases, soil becomes increasingly more sensitive to small changes in moisture content and adequate compaction becomes more difficult or impossible to achieve.

On-Site Soil

We anticipate that the majority of the on-site soils encountered during construction will consist of gravels, cobbles and sands, located at or near the surface of the site. It is our opinion, that this material is a suitable source for structural fill during a significant portion of the year. On-site materials used as structural fill should be free of roots, organic matter and other deleterious materials and particles larger than 3 inches in diameter. Significant quantities of material greater than 3 inches in diameter were observed during our site explorations. This material will cause significand difficulties in soil grading and compaction efforts. We recommend that the material greater than 3 inches in diameter be screened and removed or crushed for reuse on-site.

Select Granular Fill

Select granular fill should consist of imported, well-graded sand and gravel or crushed rock with a maximum particle size of 3 inches and less than 5 percent passing a U.S. Standard No. 200 sieve based on the minus ¾-inch fraction. Organic matter, debris or other deleterious material should not be present. In our experience, "gravel borrow" as described in Section 9-03.14(1) of the 2018 WSDOT Standard Specifications is typically a suitable source for select granular fill during periods of wet weather, provided that the percent passing a U.S. Standard No. 200 sieve is less than 5 percent based on the minus ¾-inch fraction.

Structural Fill Placement and Compaction

General

Structural fill should be placed on an approved subgrade that consists of uniformly firm and unyielding inorganic native soils or compacted structural fill. Structural fill should be compacted at a moisture content near optimum. The optimum moisture content varies with the soil gradation and should be evaluated during construction.

Structural fill should be placed in uniform, horizontal lifts and uniformly densified with vibratory compaction equipment. The maximum lift thickness will vary depending on the material and compaction equipment used, but should generally not exceed the loose thicknesses provided on Table 3. Structural fill materials should be compacted in accordance with the compaction criteria provided in Table 4.

Table 3. Recommended Uncompacted Lift Thickness

Compaction Equipment	Recommended Uncompacted Fill Thickness (inches)	
	Granular Materials Maximum Particle Size ≤ 1 1/2 inch	Granular Materials Maximum Particle Size > 1 1/2 inch
Hand Tools (Plate Compactors and Jumping Jacks)	4 – 8	Not Recommended
Rubber-tire Equipment	10 – 12	6 – 8
Light Roller	10 – 12	8 – 10
Heavy Roller	12 – 18	12 – 16
Hoe Pack Equipment	18 – 24	12 – 16

Note: The above table is intended to serve as a guideline and should not be included in the project specifications.

Table 4. Recommended Compaction Criteria in Structural Fill Zones

Fill Type	Percent Maximum Dry Density Determined by ASTM Test Method D 1557 at ±3% of Optimum Moisture		
	0 to 2 Feet Below Subgrade	> 2 Feet Below Subgrade	Pipe Zone
Imported or On-site Granular, Maximum Particle Size < 1-1/4-inch	95	95	-----
Imported or On-site Granular, Maximum Particle Size >1-1/4-inch	N/A (Proof-roll)	N/A (Proof-roll)	-----
Trench Backfill[1]	95	92	90

Note: [1]Trench backfill above the pipe zone in nonstructural areas should be compacted to at least 85 percent.

Shallow Foundation Support

General

We recommend that the proposed structures be founded on continuous wall or isolated column footings, bearing on a minimum 1-foot thick overexcavation and replacement with compacted structural fill where underlying soils are not able to be compacted as structural fill. The structural fill zone should extend to a horizontal distance equal to the overexcavation depth on each side of the footing. The actual overexcavation depth will vary, depending on the conditions encountered.

We recommend that a representative from Insight Geologic observe the foundation surfaces before overexcavation, and before placing structural fill in overexcavations. This representative should confirm that adequate bearing surfaces have been prepared and that the soil conditions are as anticipated. Unsuitable foundation bearing soils should be recompacted or removed and replaced with compacted structural fill, as recommended by the geotechnical engineer.

Bearing Capacity and Footing Dimensions

We recommend an allowable soil bearing pressure of 2,500 psf for shallow foundations that are supported as recommended. This allowable bearing pressure applies to long-term dead and live loads exclusive of the weight of the footing and any overlying backfill. The allowable soil bearing pressure can be increased by one-third when considering total loads, including transient loads such as those induced by wind and seismic forces.

We recommend a minimum width of 18 inches for continuous wall footings and 2 feet for isolated column footings. For settlement considerations, we have assumed a maximum width of 4 feet for continuous wall footings and 6 feet for isolated column footings.

Perimeter footings should be embedded at least 12 inches below the lowest adjacent grade where the ground is flat. Interior footings should be embedded a minimum of 6 inches below the nearest adjacent grade.

Settlement

We estimate that total settlement of footings that are designed and constructed as recommended should be less than 1 inch. We estimate that differential settlements should be ½ inch or less between

comparably loaded isolated footings or along 50 feet of continuous footing. We anticipate that the settlement will occur essentially as loads are applied during construction.

Lateral Load Resistance

Lateral loads on shallow foundation elements may be resisted by passive resistance on the sides of footings and by friction on the base of footings. Passive resistance may be estimated using an equivalent fluid density of 303 pounds per cubic foot (pcf), assuming that the footings are backfilled with structural fill. Frictional resistance may be estimated using 0.25 for the coefficient of base friction.

The lateral resistance values provided above incorporate a factor of safety of 1.5. The passive earth pressure and friction components can be combined, provided that the passive component does not exceed two-thirds of the total. The top foot of soil should be neglected when calculating passive resistance, unless the foundation perimeter area is covered by a slab-on-grade or pavement.

Slabs-On-Grade

Slabs-on-grade should be established on a minimum 1-foot thick section of structural fill extending to an approved bearing surface. A modulus of vertical subgrade reaction (subgrade modulus) can be used to design slabs-on-grade. The subgrade modulus varies based on the dimensions of the slab and the magnitude of applied loads on the slab surface; slabs with larger dimensions and loads are influenced by soils to a greater depth. We recommend a modulus value of 300 pounds per cubic inch (pci) for design of on-grade floor slabs with floor loads up to 500 psf. We are available to provide alternate subgrade modulus recommendations during design, based on specific loading information.

We recommend that slabs-on-grade in interior spaces be underlain by a minimum 4-inch thick capillary break layer to reduce the potential for moisture migration into the slab. The capillary break material should consist of a well-graded sand and gravel or crushed rock containing less than 5 percent fines based on the fraction passing the ¾-inch sieve. The 4-inch thick capillary break layer can be included when calculating the minimum 1-foot thick structural fill section beneath the slab. If dry slabs are required (e.g., where adhesives are used to anchor carpet or tile to the slab), a waterproofing liner should be placed below the slab to act as a vapor barrier.

Subsurface Drainage

It is our opinion that foundation footing drains and underslab drains are likely unnecessary for the proposed structures. The majority of subsurface site soils are well draining and it is unlikely that subsurface drains would produce water. The soils are suitable for roof runoff drywells and should be classified as Group A for the purposes of design.

Conventional Retaining Walls

General

We do not anticipate that retaining walls will be utilized for the proposed project. We should be contacted during the design phase to review retaining wall plans and provide supplemental recommendations, if needed.

Drainage

Positive drainage is imperative behind any retaining structure. This can be accomplished by using a zone of free-draining material behind the wall with perforated pipes to collect water seepage. The drainage material should consist of coarse sand and gravel containing less than 5 percent fines based on the fraction of material passing the ¾-inch sieve. The wall drainage zone should extend horizontally at least 12 inches from the back of the wall. If a stacked block wall is constructed, we recommend that a barrier such as a non-woven geotextile filter fabric be placed against the back of the wall to prevent loss of the drainage material through the wall joints.

A perforated smooth-walled rigid PVC pipe, having a minimum diameter of 4 inches, should be placed at the bottom of the drainage zone along the entire length of the wall. Drainpipes should discharge to a tightline leading to an appropriate collection and disposal system. An adequate number of cleanouts should be incorporated into the design of the drains in order to provide access for regular maintenance. Roof downspouts, perimeter drains or other types of drainage systems should not be connected to retaining wall drain systems.

Design Parameters

We recommend an active lateral earth pressure of 37 pcf (equivalent fluid density) for a level backfill condition. This assumes that the top of the wall is not structurally restrained and is free to rotate. For restrained walls that are fixed against rotation (at-rest condition), an equivalent fluid density of 56 pcf can be used for the level backfill condition. For seismic conditions, we recommend a uniform lateral pressure of 14H psf (where H is the height of the wall) be added to the lateral pressures. This seismic pressure assumes a peak ground acceleration of 0.32 g. Note that if the retaining system is designed as a braced system but is expected to yield a small amount during a seismic event, the active earth pressure condition may be assumed and combined with the seismic surcharge.

The recommended earth pressure values do not include the effects of surcharges from surface loads or structures. If vehicles were operated within one-half the height of the wall, a traffic surcharge should be added to the wall pressure. The traffic surcharge can be approximated by the equivalent weight of an additional 2 feet of backfill behind the wall. Other surcharge loads, such as construction equipment, staging areas and stockpiled fill, should be considered on a case-by-case basis.

DOCUMENT REVIEW AND CONSTRUCTION OBSERVATION

We recommend that we be retained to review the portions of the plans and specifications that pertain to earthwork construction and stormwater infiltration. We recommend that monitoring, testing and consultation be performed during construction to confirm that the conditions encountered are consistent with our explorations and our stated design assumptions. Insight Geologic would be pleased to provide these services upon request.

REFERENCES

International Code Council, International Building Code, 2015.

Seismic Compression of As-compacted Fill Soils with Variable Levels of Fines Content and Fines Plasticity, Department of Civil and Environmental Engineering, University of California, Los Angeles, July 2004.

Washington State Department of Transportation (WSDOT), Standard Specifications for Road, Bridge and Municipal Construction Manual, 2018.

Washington State Department of Ecology (WSDOE), Stormwater Management Manual of Western Washington, 2014.

LIMITATIONS

We have prepared this geotechnical and stormwater investigation report for the exclusive use of C & E Developments LLC and their authorized agents, for the proposed development located at 15025 Tahoma Boulevard SE in Yelm, Washington.

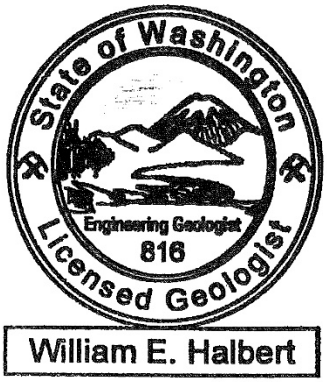
Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in the field of geotechnical engineering in this area at the time this report was prepared. No warranty or other conditions, expressed or implied, should be understood.

Please refer to Attachment D titled "Report Limitations and Guidelines for Use" for additional information pertaining to use of this report.

We appreciate the opportunity to be of service to you on this project. Please contact us if you have questions or require additional information.

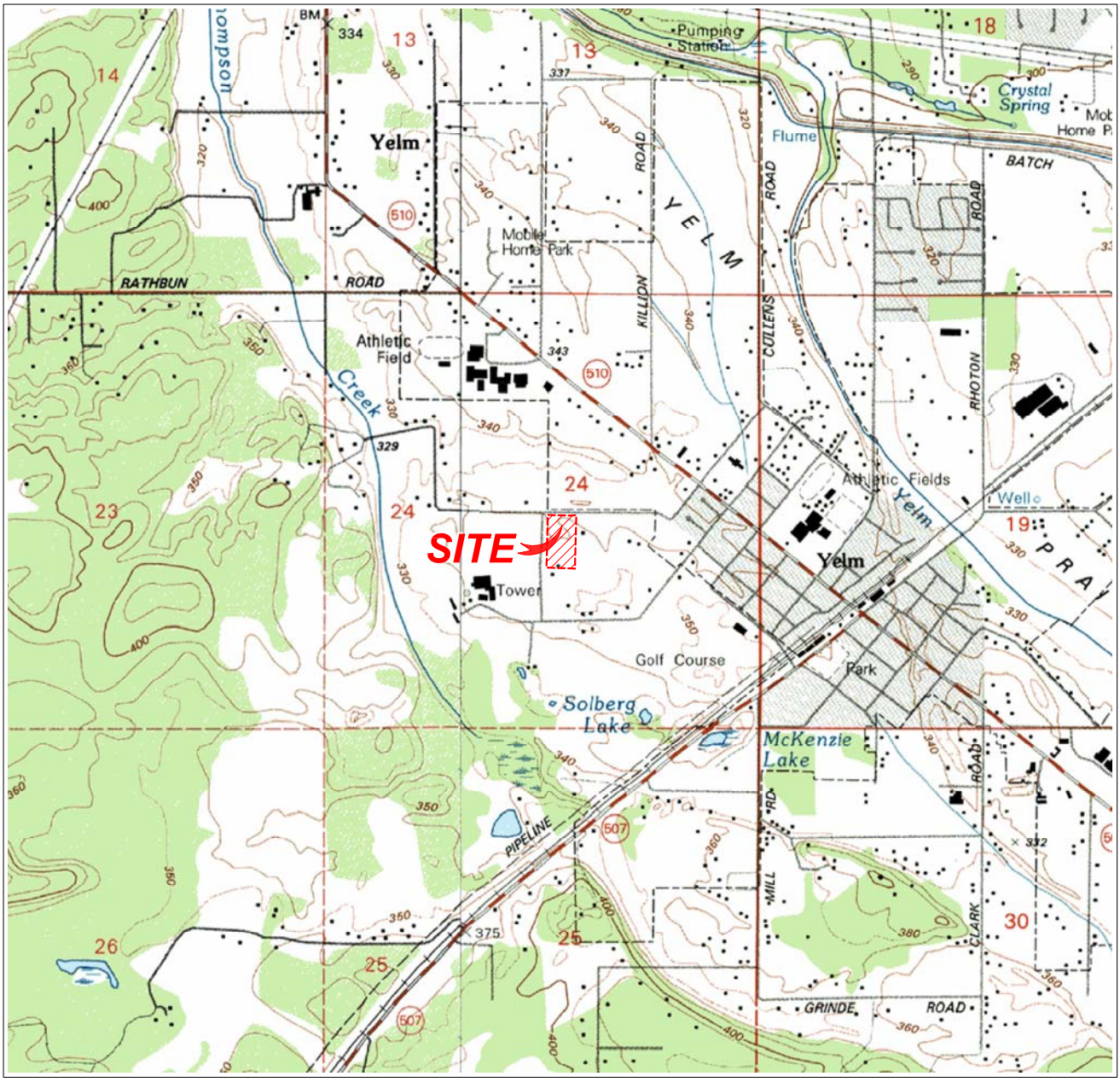
Respectfully Submitted,
INSIGHT GEOLOGIC, INC.

William E. Halbert, L.E.G., L.HG.
Principal



Attachments

FIGURES



Source: Terrain Navigator Image (c)

MC KENNA, WASHINGTON
7.5 MINUTE QUADRANGLE
Year 1990

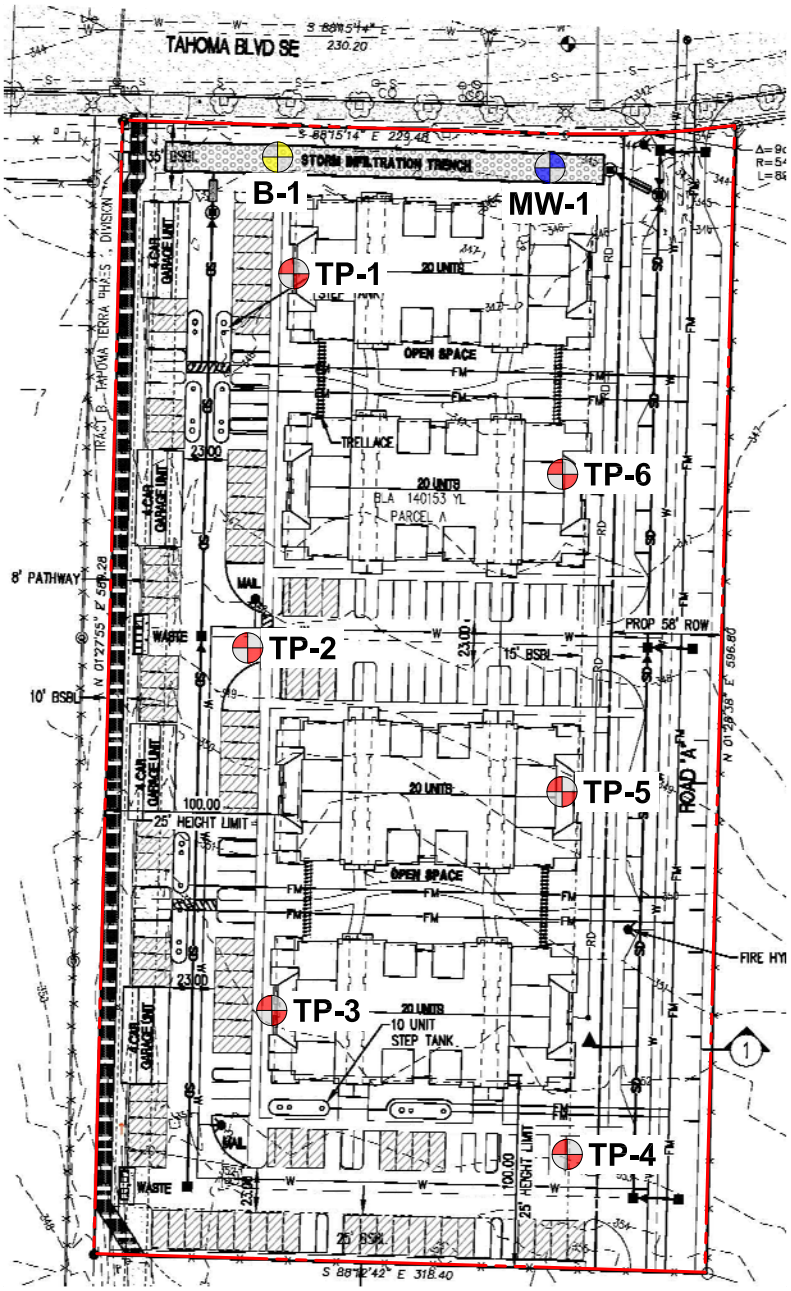
SCALE: 1: 24000

WYNDSTONE

YELM, WASHINGTON

INSIGHT GEOLOGIC, INC.

Figure 1
Vicinity Map



SOURCE: C.E.S. NW INC.

LEGEND:

- **B-1** APPROXIMATE BORING LOCATION
- **TP-1** APPROXIMATE TEST PIT LOCATION
- **MW-1** APPROXIMATE MONITORING WELL LOCATION
- APPROXIMATE PROJECT BOUNDARY

SCALE: 1" = 100'

WYNDSTONE

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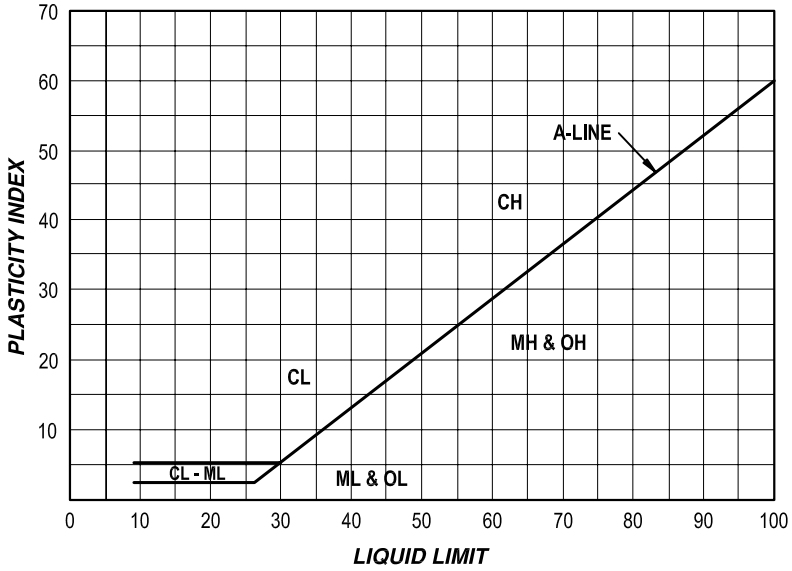
Figure 2
Site Plan

ATTACHMENT A
EXPLORATION LOGS

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS	GROUP NAME
COARSE GRAINED SOILS (MORE THAN 50% RETAINED ON NO. 200 SIEVE)	GRAVEL AND GRAVELLY SOILS (MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE)	CLEAN GRAVEL <5% FINES	GW	WELL-GRADED GRAVEL, FINE TO COARSE GRAVEL
			GP	POORLY GRADED GRAVEL
		GRAVEL WITH FINES >12% FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SAND AND SANDY SOILS (MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE)	CLEAN SAND <5% FINES	SW	WELL-GRADED SAND, FINE TO COARSE SAND
			SP	POORLY GRADED SAND
		SAND WITH FINES >12% FINES	SM	SILTY SAND
			SC	CLAYEY SAND
FINE GRAINED SOILS (MORE THAN 50% PASSING NO. 200 SIEVE)	SILTS AND CLAYS (LIQUID LIMIT LESS THAN 50)	INORGANIC	ML	SILT
			CL	CLAY
		ORGANIC	OL	ORGANIC SILT, ORGANIC CLAY
	SILTS AND CLAYS (LIQUID LIMIT 50 OR MORE)	INORGANIC	MH	SILT OF HIGH PLASTICITY, ELASTIC SILT
			CH	CLAY OF HIGH PLASTICITY, FAT CLAY
		ORGANIC	OH	ORGANIC CLAY, ORGANIC SILT
HIGHLY ORGANIC SOILS			PT	PEAT



SOIL MOISTURE MODIFIERS:
DRY - ABSENCE OF MOISTURE, DUSTY, DRY TO THE TOUCH
MOIST - DAMP, BUT NO VISIBLE WATER
WET - VISIBLE FREE WATER OR SATURATED, USUALLY SOIL IS OBTAINED BELOW WATER TABLE

ADDITIONAL MATERIAL SYMBOLS

SYMBOLS	TYPICAL DESCRIPTION
CC	CEMENT CONCRETE
AC	ASPHALT CONCRETE
CR	CRUSHED ROCK / QUARRY SPALLS
TS	TOPSOIL/SOD/DUFF

GROUNDWATER EXPLORATION SYMBOLS

- MEASURED GROUNDWATER LEVEL IN EXPLORATION, WELL, OR PIEZOMETER
- GROUNDWATER OBSERVED AT TIME OF EXPLORATION
- PERCHED WATER OBSERVED AT TIME OF EXPLORATION
- MEASURED FREE PRODUCT IN WELL OR PIEZOMETER

STRATIGRAPHIC CONTACT

- APPROXIMATE CONTACT BETWEEN SOIL STRATA OR GEOLOGIC UNIT
- APPROXIMATE LOCATION OF SOIL STRATA CHANGE WITHIN GEOLOGIC SOIL UNIT
- APPROXIMATE GRADUAL CHANGE BETWEEN SOIL STRATA OR GEOLOGIC SOIL UNIT
- APPROXIMATE GRADUAL CHANGE OF SOIL STRATA WITHIN GEOLOGIC SOIL UNIT

LABORATORY / FIELD TEST CLASSIFICATIONS

- **%F** PERECENT FINES
- **AL** ATTERBERG LIMITS
- **CA** CHEMICAL ANALYSIS
- **CP** LABORATORY COMPACTION TEST
- **CS** CONSOLIDATION TEST
- **DS** DIRECT SHEAR
- **HA** HYDROMETER ANALYSIS
- **MC** MOISTURE CONTENT
- **MD** MOISTURE CONTENT AND DRY DENSITY
- **OC** ORGANIC COMPOUND
- **PM** PERMEABILITY OR HYDRAULIC CONDUCTIVITY
- **PP** POCKET PENETROMETER
- **SA** SIEVE ANALYSIS
- **TX** TRIAXIAL COMPRESSION
- **UC** UNCONFINED COMPRESSION
- **VS** VANE SHEAR

SAMPLER SYMBOLS

- 2.4 INCH I.D. SPLIT BARREL
- DIRECT-PUSH
- STANDARD PENETRATION TEST
- SHELBY TUBE
- PISTON
- BULK OR GRAB

SHEEN CLASSIFICATIONS

- **NS** NO VISIBLE SHEEN
- **SS** SLIGHT SHEEN
- **MS** MODERATE SHEEN
- **HS** HEAVY SHEEN
- **NT** NOT TESTED

TP-1

DEPTH (FT)	U.S.C.S.	LITHOLOGY	SOIL DESCRIPTION	REMARKS AND LABORATORY TEST RESULTS
0	TS		Sod	
1	GP-GM		Dark brown fine to coarse gravel with fine to coarse sand, trace silt, fine roots, loose, moist	
2				
3	GP		Brown fine to coarse gravel with fine to coarse sand, loose, moist	
4				
5				
6				
7				
8			Groundwater not encountered	
9				
10				

LEGEND:

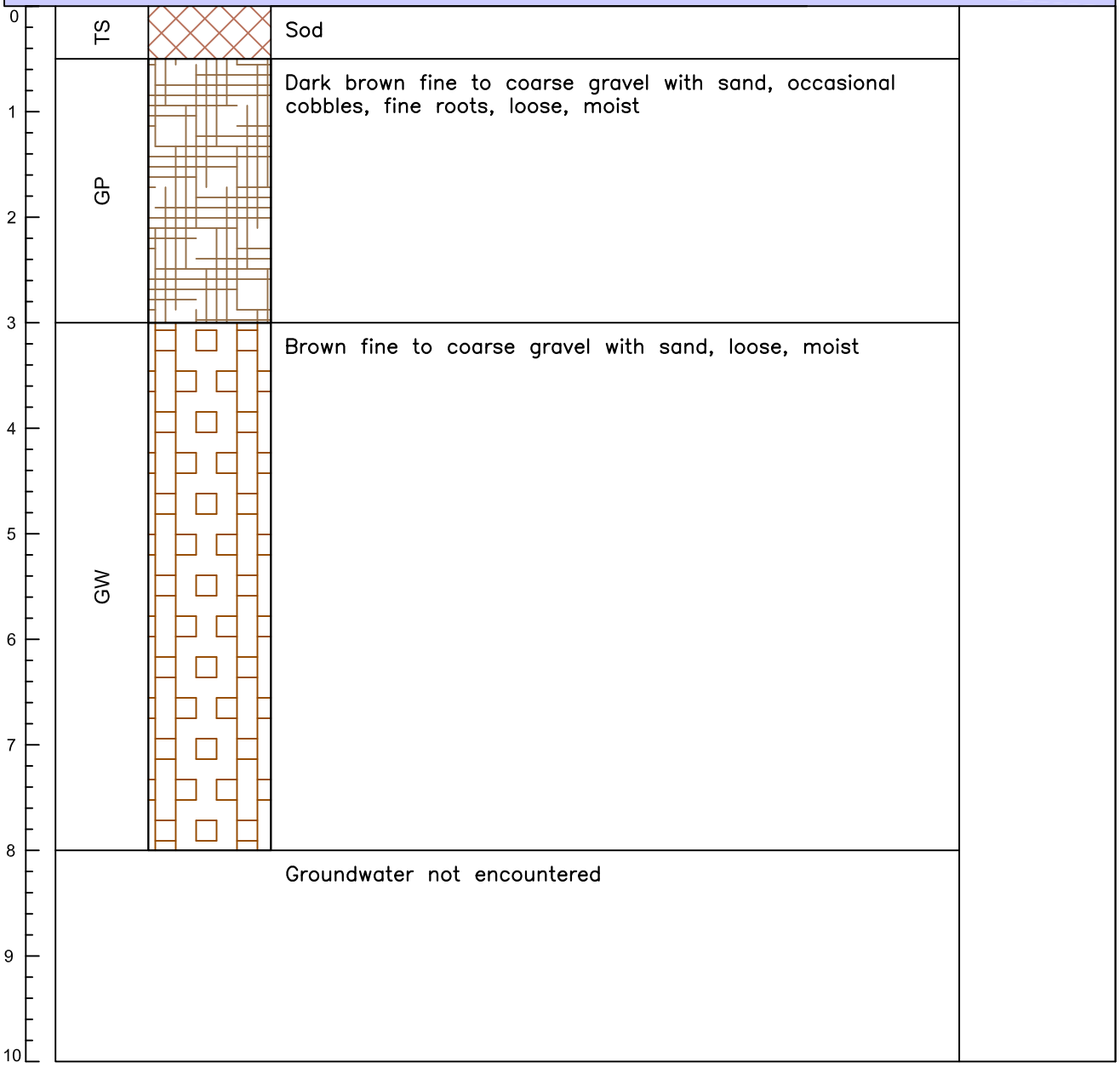
PROJECT NO.: 1142-001-01
DATE: JUNE 10, 2019
TOTAL DEPTH: 8 FEET
DRILLING EQUIPMENT: EXCAVATOR
LOGGED BY: KEVIN VANDEHEY

WYNDSTONE
YELM, WASHINGTON

INSIGHT GEOLOGIC, INC.

Exploration Log TP-1

TP-2



LEGEND:

PROJECT NO.: 1142-001-01
DATE: JUNE 10, 2019
TOTAL DEPTH: 8 FEET
DRILLING EQUIPMENT: EXCAVATOR
LOGGED BY: KEVIN VANDEHEY

WYNDSTONE
YELM, WASHINGTON

INSIGHT GEOLOGIC, INC.

Exploration Log TP-2

TP-3

DEPTH (FT)	U.S.C.S.	LITHOLOGY	SOIL DESCRIPTION	REMARKS AND LABORATORY TEST RESULTS
0	TS		Sod	
1	GP-GM		Dark brown fine to coarse gravel with fine to coarse sand and silt, occasional cobbles, fine roots, loose, moist	
2	GP		Brown fine to coarse gravel with fine to coarse sand, occasional cobbles, loose, moist	
8			Groundwater not encountered	
10				

LEGEND:

PROJECT NO.: 1142-001-01
DATE: JUNE 10, 2019
TOTAL DEPTH: 8 FEET
DRILLING EQUIPMENT: EXCAVATOR
LOGGED BY: KEVIN VANDEHEY

WYNDSTONE
YELM, WASHINGTON

INSIGHT GEOLOGIC, INC.

Exploration Log TP-3

TP-4

DEPTH (FT)	U.S.C.S.	LITHOLOGY	SOIL DESCRIPTION	REMARKS AND LABORATORY TEST RESULTS
0	TS		Sod	
1	GP-GM		Dark brown fine to coarse gravel with fine to coarse sand and silt, occasional cobbles, fine roots, loose, moist	
2	GP		Brown fine to coarse gravel with cobbles, occasional boulders, dense, moist	
6			Groundwater not encountered	
10				

LEGEND:

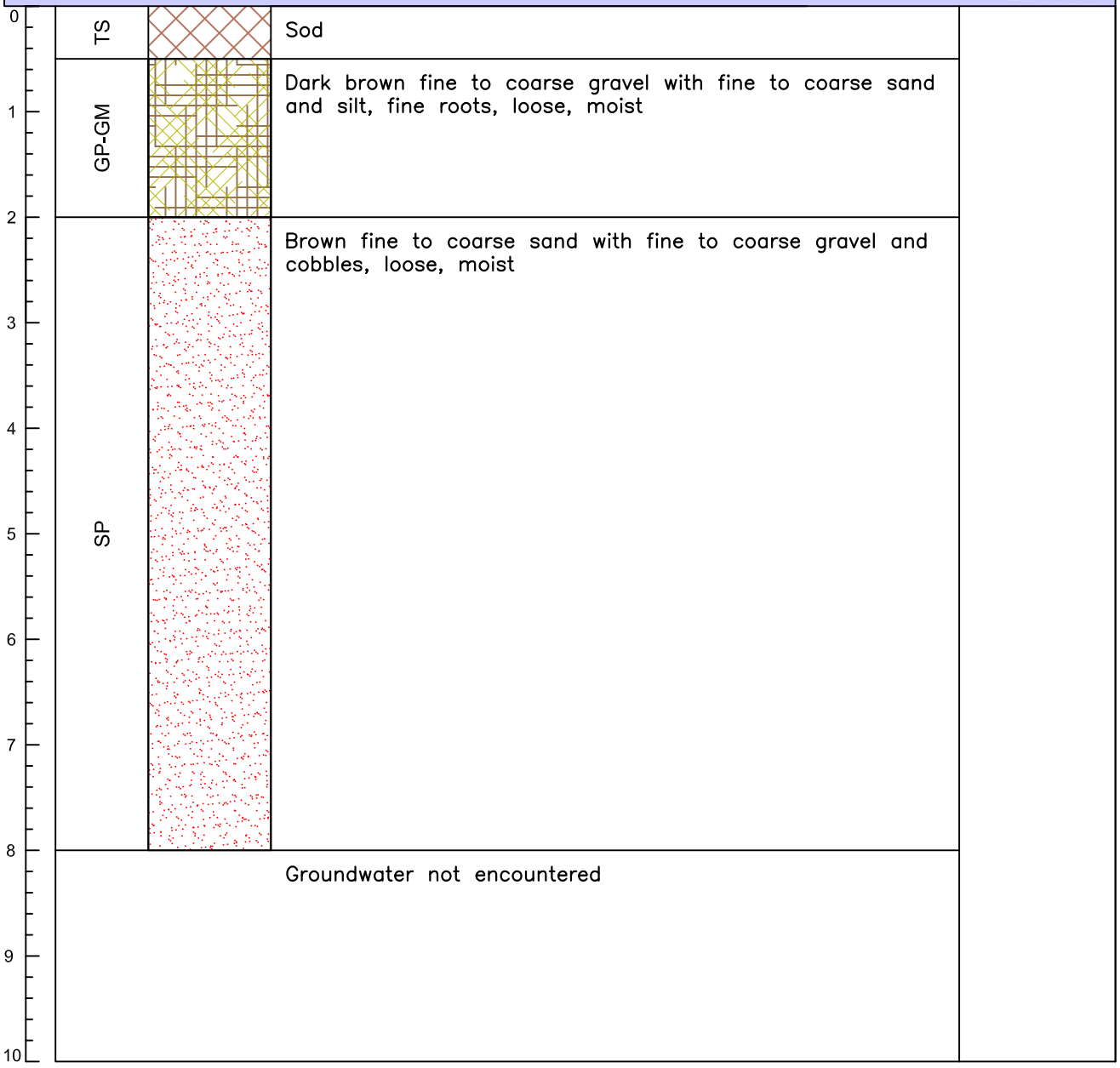
PROJECT NO.: 1142-001-01
DATE: JUNE 10, 2019
TOTAL DEPTH: 6 FEET
DRILLING EQUIPMENT: EXCAVATOR
LOGGED BY: KEVIN VANDEHEY

WYNDSTONE
YELM, WASHINGTON

INSIGHT GEOLOGIC, INC.

Exploration Log TP-4

TP-5



LEGEND:

PROJECT NO.: 1142-001-01
DATE: JUNE 10, 2019
TOTAL DEPTH: 8 FEET
DRILLING EQUIPMENT: EXCAVATOR
LOGGED BY: KEVIN VANDEHEY

WYNDSTONE
YELM, WASHINGTON

INSIGHT GEOLOGIC, INC.

Exploration Log TP-5

TP-6

DEPTH (FT)	U.S.C.S.	LITHOLOGY	SOIL DESCRIPTION	REMARKS AND LABORATORY TEST RESULTS
0	TS		Sod	
1	GP-GM		Dark brown fine to coarse gravel and cobbles with fine to coarse sand and silt, loose, moist	
2	GP		Brown fine to coarse gravel and cobbles with fine to coarse sand, medium dense, moist	
6			Groundwater not encountered	
10				

LEGEND:

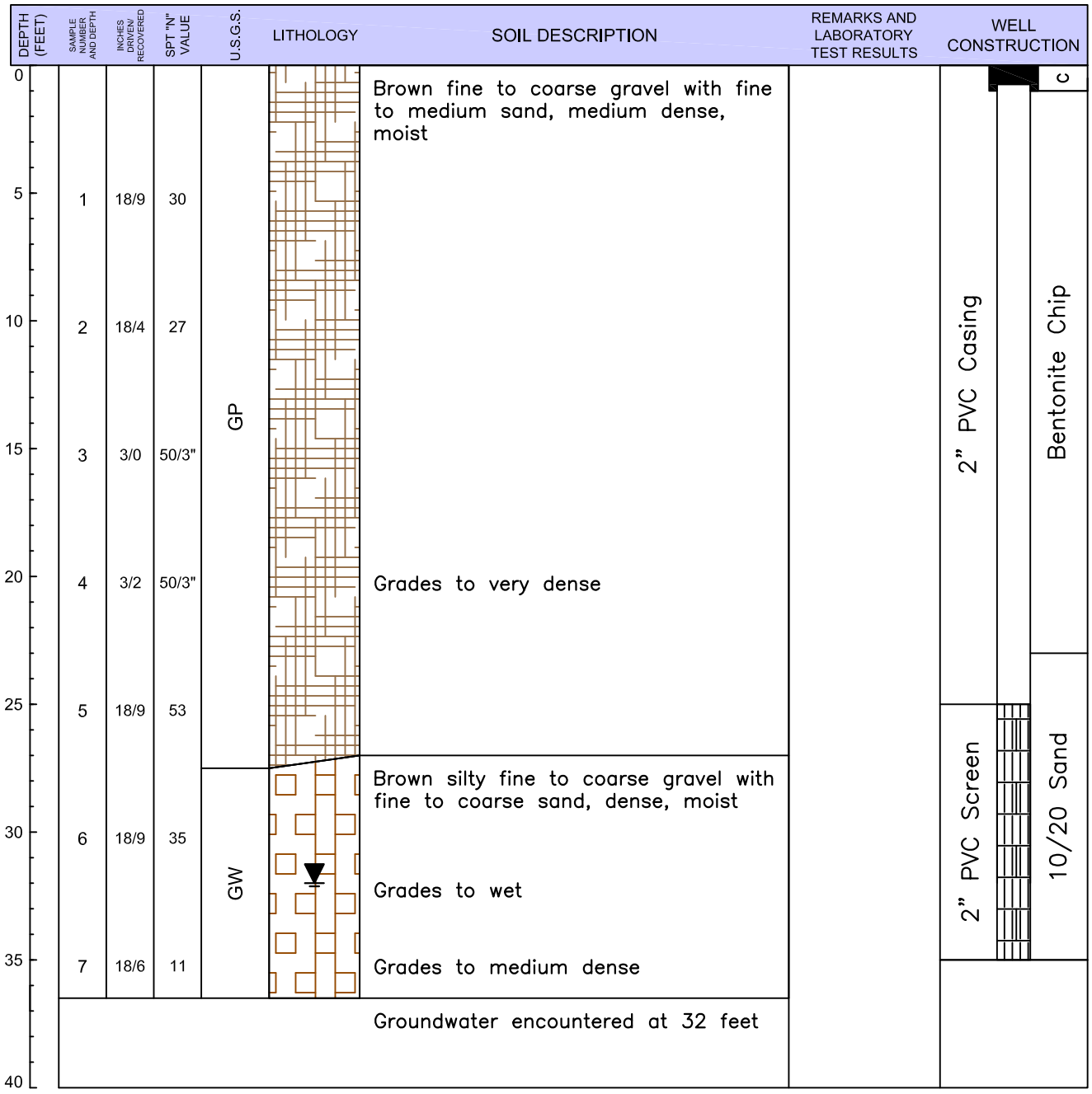
PROJECT NO.: 1142-001-01
DATE: JUNE 10, 2019
TOTAL DEPTH: 6 FEET
DRILLING EQUIPMENT: EXCAVATOR
LOGGED BY: KEVIN VANDEHEY

WYNDSTONE
YELM, WASHINGTON

INSIGHT GEOLOGIC, INC.

Exploration Log TP-6

MW-1



LEGEND:

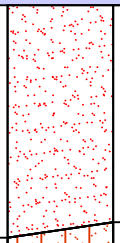
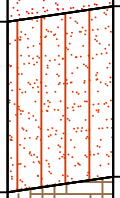
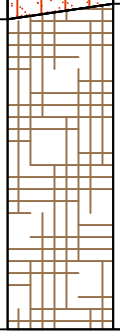
PROJECT NO.: 1142-001-01
DATE: JUNE 14, 2019
TOTAL DEPTH: 36.5 FEET
DOE WELL NO.: BLT-736
DRILLING CONTRACTOR: HOLOCENE
DRILLING EQUIPMENT: B-58
DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: ANDREW JOHNSON

WYNDSTONE
YELM, WASHINGTON

INSIGHT GEOLOGIC, INC.

Exploration Log MW-1

B-1

DEPTH (FEET)	SAMPLE NUMBER AND DEPTH	INCHES DRIVEN/ RECOVERED	SPT "N" VALUE	U.S.G.S.	LITHOLOGY	SOIL DESCRIPTION	REMARKS AND LABORATORY TEST RESULTS
0				SP		Brown fine to coarse sand with fine to coarse gravel, medium dense, moist	
5	1	18/10	26				
				SP-SM		Brown fine to coarse sand with fine to coarse gravel and silt, occasional cobbles, dense, moist	
10	2	18/12	48				
				GP		Brown fine to coarse gravel with fine to coarse sand, dense, moist	
15	3	7/3	50/1"				
20	4	12/4	50/6"				
	5	6/0	50/6"				
25						Groundwater not encountered	
30							
35							
40							

LEGEND:

PROJECT NO.: 1142-001-01
DATE: JUNE 14, 2019
TOTAL DEPTH: 23 FEET
DRILLING CONTRACTOR: HOLOCENE
DRILLING EQUIPMENT: B-58
DRILLING METHOD: HOLLOW STEM AUGER
LOGGED BY: ANDREW JOHNSON

WYNDSTONE
YELM, WASHINGTON

INSIGHT GEOLOGIC, INC.

Exploration Log B-1

ATTACHMENT B
LABORATORY ANALYSES RESULTS

Gradation Analysis Summary Data

Job Name: Wyndstone
Job Number: 1142-001-01
Date Tested: 7/1/19
Tested By: Kevin Vandehey

Sample Location: TP-2
Sample Name: TP-2 0.5'-3.0'
Depth: 0.5 - 3 Feet

Moisture Content (%) 4.3%

Sieve Size	Percent Passing
3.0 in. (75.0)	100.0
1.5 in. (37.5)	51.9
3/4 in. (19.0)	31.3
3/8 in. (9.5-mm)	24.9
No. 4 (4.75-mm)	21.6
No. 10 (2.00-mm)	18.8
No. 20 (.850-mm)	15.9
No. 40 (.425-mm)	11.9
No. 60 (.250-mm)	8.6
No. 100 (.150-mm)	6.1
No. 200 (.075-mm)	4.5

Size Fraction	Percent by Weight
Coarse Gravel	68.7
Fine Gravel	9.7
Coarse Sand	2.8
Medium Sand	6.9
Fine Sand	7.4
Fines	4.5
Total	**100.0**

LL	- -
PL	- -
PI	- -
D_{10}	0.31
D_{30}	17.00
D_{60}	41.00
D_{90}	65.00
Cc	22.74
Cu	132.26

ASTM Classification
Group Name: **Poorly Graded Gravel with Sand**
Symbol: **GP**

INSIGHT GEOLOGIC, INC.

Gradation Analysis Summary Data

Job Name: Wyndstone
Job Number: 1142-001-01
Date Tested: 7/1/19
Tested By: Kevin Vandehey

Sample Location: TP-2
Sample Name: TP-2 3.0'-8.0'
Depth: 3 - 8 Feet

Moisture Content (%) 1.2%

Sieve Size	Percent Passing
3.0 in. (75.0)	64.7
1.5 in. (37.5)	57.3
3/4 in. (19.0)	27.3
3/8 in. (9.5-mm)	12.4
No. 4 (4.75-mm)	6.0
No. 10 (2.00-mm)	2.8
No. 20 (.850-mm)	1.7
No. 40 (.425-mm)	0.9
No. 60 (.250-mm)	0.5
No. 100 (.150-mm)	0.3
No. 200 (.075-mm)	0.2

Size Fraction	Percent by Weight
Coarse Gravel	72.7
Fine Gravel	21.2
Coarse Sand	3.2
Medium Sand	1.8
Fine Sand	0.7
Fines	0.2
Total	**100.0**

LL	- -
PL	- -
PI	- -
D_{10}	7.90
D_{30}	20.50
D_{60}	44.00
D_{90}	130.00
Cc	1.21
Cu	5.57

ASTM Classification
Group Name: **Well Graded Gravel**
Symbol: **GW**

INSIGHT GEOLOGIC, INC.

Gradation Analysis Summary Data

Job Name: Wyndstone
Job Number: 1142-001-01
Date Tested: 7/1/19
Tested By: Kevin Vandehey

Sample Location: TP-5
Sample Name: TP-5 0.5'-2.0'
Depth: 0.5 - 2 Feet

Moisture Content (%) 7.0%

Sieve Size	Percent Passing
3.0 in. (75.0)	100.0
1.5 in. (37.5)	67.9
3/4 in. (19.0)	52.7
3/8 in. (9.5-mm)	42.9
No. 4 (4.75-mm)	37.2
No. 10 (2.00-mm)	32.3
No. 20 (.850-mm)	26.6
No. 40 (.425-mm)	16.7
No. 60 (.250-mm)	11.5
No. 100 (.150-mm)	9.2
No. 200 (.075-mm)	7.2

Size Fraction	Percent by Weight
Coarse Gravel	47.3
Fine Gravel	15.5
Coarse Sand	4.9
Medium Sand	15.6
Fine Sand	9.5
Fines	7.2
Total	**100.0**

LL	- -
PL	- -
PI	- -
D_{10}	0.18
D_{30}	1.40
D_{60}	28.00
D_{90}	60.00
Cc	0.39
Cu	155.56

ASTM Classification
Group Name: **Poorly Graded Gravel with Sand and Silt**
Symbol: **GP-GM**

INSIGHT GEOLOGIC, INC.

Gradation Analysis Summary Data

Job Name: Wyndstone
Job Number: 1142-001-01
Date Tested: 7/1/19
Tested By: Kevin Vandehey

Sample Location: TP-5
Sample Name: TP-5 2.0'-8.0'
Depth: 2 - 8 Feet

Moisture Content (%) 4.9%

Sieve Size	Percent Passing
3.0 in. (75.0)	100.0
1.5 in. (37.5)	81.7
3/4 in. (19.0)	68.7
3/8 in. (9.5-mm)	64.5
No. 4 (4.75-mm)	61.4
No. 10 (2.00-mm)	57.7
No. 20 (.850-mm)	48.6
No. 40 (.425-mm)	18.5
No. 60 (.250-mm)	5.2
No. 100 (.150-mm)	2.6
No. 200 (.075-mm)	1.5

Size Fraction	Percent by Weight
Coarse Gravel	31.3
Fine Gravel	7.3
Coarse Sand	3.7
Medium Sand	39.1
Fine Sand	17.1
Fines	1.5
Total	**100.0**

LL	- -
PL	- -
PI	- -
D_{10}	0.31
D_{30}	0.55
D_{60}	3.20
D_{90}	51.00
Cc	0.30
Cu	10.32

ASTM Classification
Group Name: **Poorly Graded Sand with Gravel**
Symbol: **SP**

INSIGHT GEOLOGIC, INC.

Gradation Analysis Summary Data

Job Name: Wyndstone
Job Number: 1142-001-01
Date Tested: 7/1/19
Tested By: Kevin Vandehey

Sample Location: MW-1
Sample Name: MW-1 25.0'-26.5'
Depth: 25 - 26.5 Feet

Moisture Content (%) 4.5%

Sieve Size	Percent Passing
3.0 in. (75.0)	100.0
1.5 in. (37.5)	100.0
3/4 in. (19.0)	69.1
3/8 in. (9.5-mm)	53.5
No. 4 (4.75-mm)	43.6
No. 10 (2.00-mm)	32.3
No. 20 (.850-mm)	20.3
No. 40 (.425-mm)	11.9
No. 60 (.250-mm)	7.6
No. 100 (.150-mm)	5.3
No. 200 (.075-mm)	3.3

Size Fraction	Percent by Weight
Coarse Gravel	30.9
Fine Gravel	25.5
Coarse Sand	11.3
Medium Sand	20.4
Fine Sand	8.6
Fines	3.3
Total	**100.0**

LL	- -
PL	- -
PI	- -
D_{10}	0.35
D_{30}	1.70
D_{60}	14.00
D_{90}	30.00
Cc	0.59
Cu	40.00

ASTM Classification
Group Name: **Poorly Graded Gravel with Sand**
Symbol: **GP**

INSIGHT GEOLOGIC, INC.

Gradation Analysis Summary Data

Job Name: Wyndstone
Job Number: 1142-001-01
Date Tested: 7/1/19
Tested By: Kevin Vandehey

Sample Location: MW-1
Sample Name: MW-1 30.0'-31.5'
Depth: 30 - 31.5 Feet

Moisture Content (%) 6.7%

Sieve Size	Percent Passing
3.0 in. (75.0)	100.0
1.5 in. (37.5)	100.0
3/4 in. (19.0)	92.1
3/8 in. (9.5-mm)	64.1
No. 4 (4.75-mm)	44.3
No. 10 (2.00-mm)	31.1
No. 20 (.850-mm)	19.9
No. 40 (.425-mm)	13.2
No. 60 (.250-mm)	9.4
No. 100 (.150-mm)	6.5
No. 200 (.075-mm)	3.9

Size Fraction	Percent by Weight
Coarse Gravel	7.9
Fine Gravel	47.8
Coarse Sand	13.2
Medium Sand	17.9
Fine Sand	9.3
Fines	3.9
Total	**100.0**

LL	- -
PL	- -
PI	- -
D_{10}	0.26
D_{30}	1.80
D_{60}	8.50
D_{90}	18.00
Cc	1.47
Cu	32.69

ASTM Classification
Group Name: **Well Graded Gravel with Sand**
Symbol: **GW**

INSIGHT GEOLOGIC, INC.

Gradation Analysis Summary Data

Job Name: Wyndstone
Job Number: 1142-001-01
Date Tested: 7/1/19
Tested By: Kevin Vandehey

Sample Location: B-1
Sample Name: B-1 10.0'-11.5'
Depth: 10 - 11.5 Feet

Moisture Content (%) 3.9%

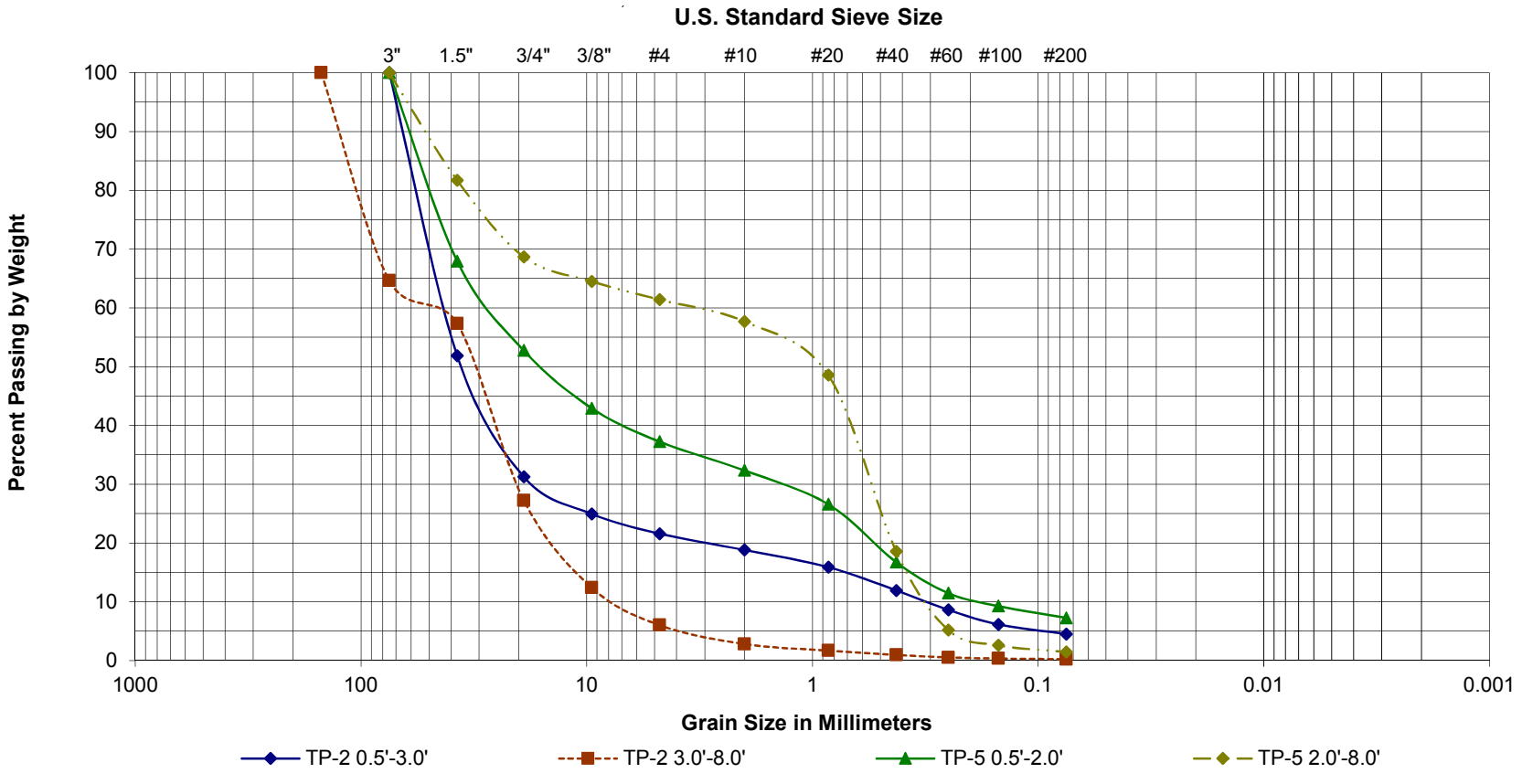
Sieve Size	Percent Passing
3.0 in. (75.0)	100.0
1.5 in. (37.5)	100.0
3/4 in. (19.0)	85.0
3/8 in. (9.5-mm)	77.6
No. 4 (4.75-mm)	72.3
No. 10 (2.00-mm)	58.7
No. 20 (.850-mm)	42.5
No. 40 (.425-mm)	27.6
No. 60 (.250-mm)	17.2
No. 100 (.150-mm)	10.6
No. 200 (.075-mm)	5.3

Size Fraction	Percent by Weight
Coarse Gravel	15.0
Fine Gravel	12.7
Coarse Sand	13.7
Medium Sand	31.1
Fine Sand	22.3
Fines	5.3
Total	**100.0**

LL	- -
PL	- -
PI	- -
D_{10}	0.14
D_{30}	0.47
D_{60}	2.10
D_{90}	25.00
Cc	0.75
Cu	15.00

ASTM Classification
Group Name: **Poorly Graded Sand with Gravel and Silt**
Symbol: **SP-SM**

INSIGHT GEOLOGIC, INC.



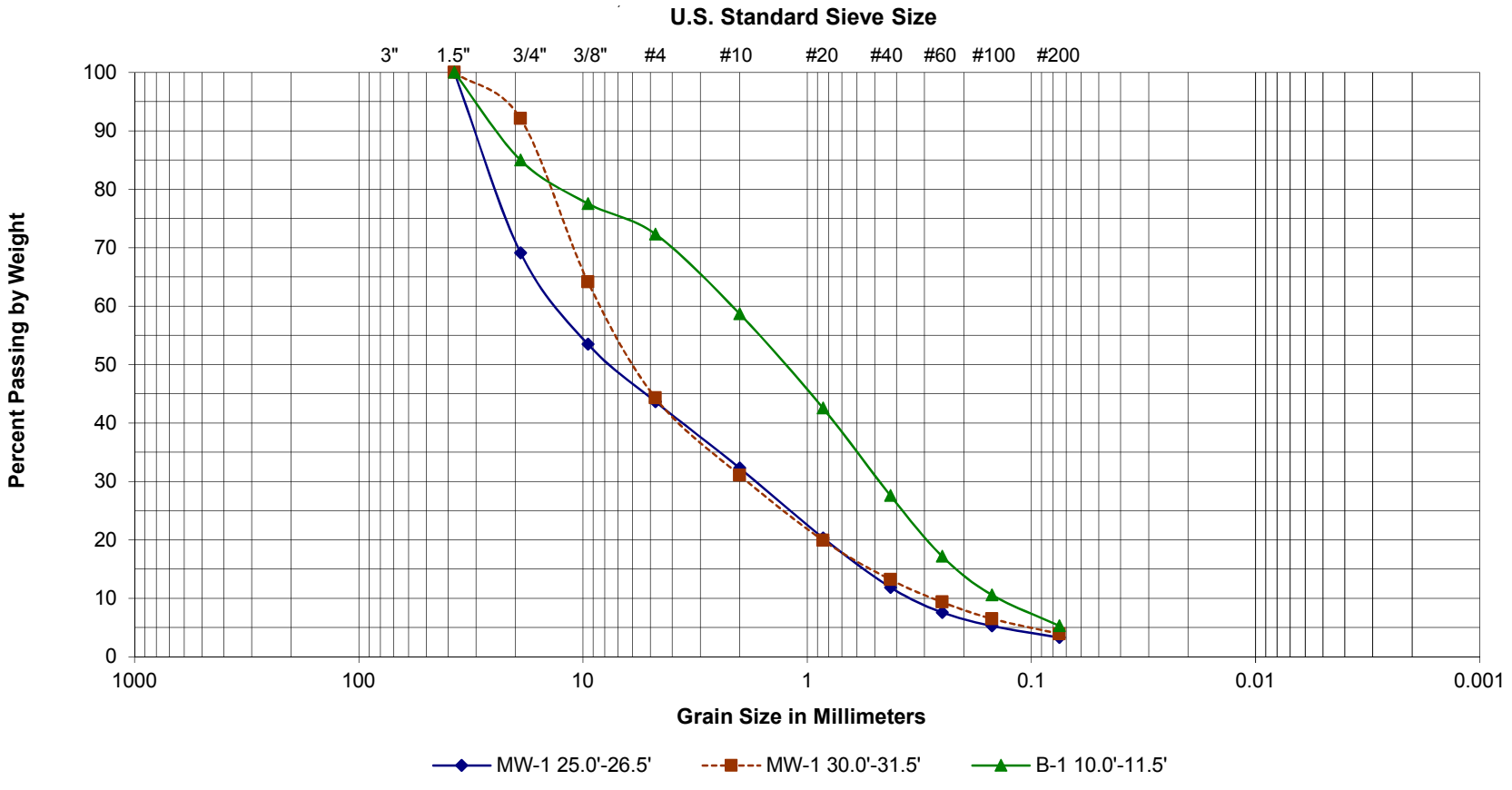
COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

WYNDSTONE

YELM, WASHINGTON

INSIGHT GEOLOGIC, INC.

Graph 1
Gradation Analysis Results



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

WYNDSTONE

YELM, WASHINGTON

INSIGHT GEOLOGIC, INC.

Graph 2
Gradation Analysis Results

ATTACHMENT C
SIESMIC DESIGN PARAMETERS

Hazards by Location

Search Information

Coordinates: 46.94455144795768, -122.62151451110839

Elevation: 350 ft

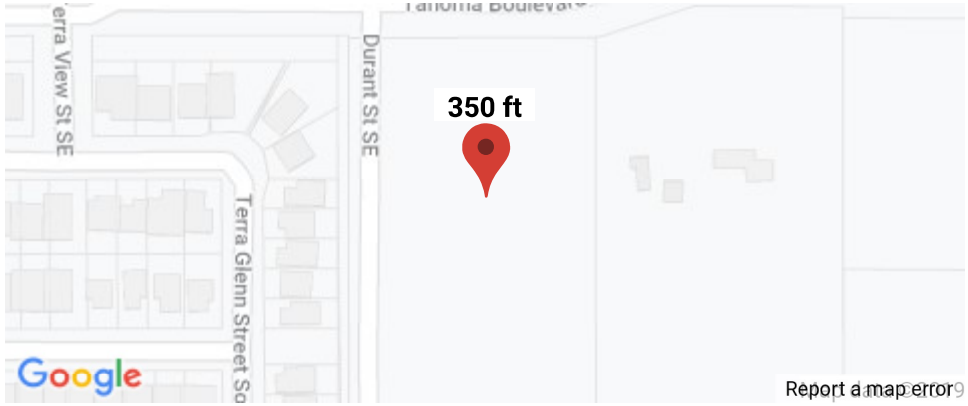
Timestamp: 2019-07-10T17:29:07.126Z

Hazard Type: Seismic

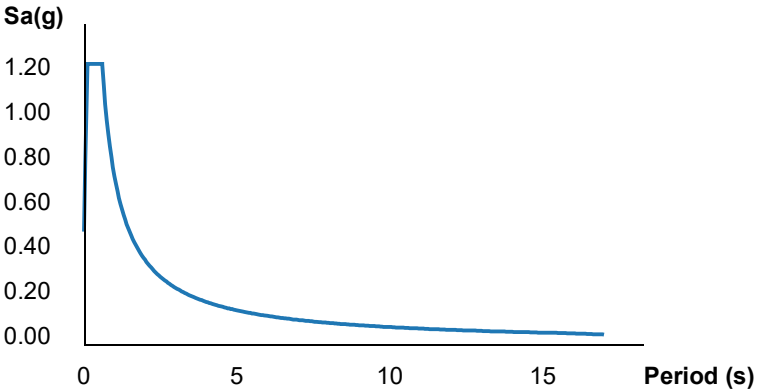
Reference Document: IBC-2015

Risk Category: IV

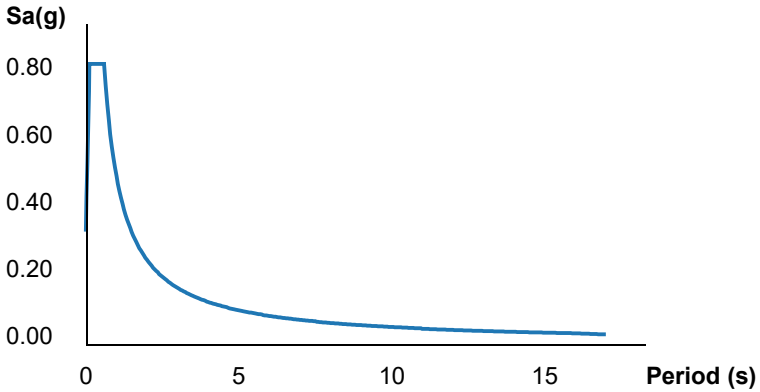
Site Class: D



MCER Horizontal Response Spectrum



Design Horizontal Response Spectrum



Basic Parameters

Name	Value	Description
S_S	1.251	MCE_R ground motion (period=0.2s)
S_1	0.499	MCE_R ground motion (period=1.0s)
S_{MS}	1.251	Site-modified spectral acceleration value
S_{M1}	0.749	Site-modified spectral acceleration value
S_{DS}	0.834	Numeric seismic design value at 0.2s SA
S_{D1}	0.5	Numeric seismic design value at 1.0s SA

ATTACHMENT D
REPORT LIMITATIONS AND GUIDELINES FOR USE

ATTACHMENT D

REPORT LIMITATIONS AND GUIDELINES FOR USE[1]

This attachment provides information to help you manage your risks with respect to the use of this report.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES, PERSONS AND PROJECTS

This report has been prepared for the exclusive use of C & E Developments LLC (Client) and their authorized agents. This report may be made available to regulatory agencies for review. This report is not intended for use by others, and the information contained herein is not applicable to other sites.

Insight Geologic Inc. structures our services to meet the specific needs of our clients. For example, a geotechnical or geologic study conducted for a civil engineer or architect may not fulfill the needs of a construction contractor or even another civil engineer or architect that are involved in the same project. Because each geotechnical or geologic study is unique, each geotechnical engineering or geologic report is unique, prepared solely for the specific client and project site. Our report is prepared for the exclusive use of our Client. No other party may rely on the product of our services unless we agree in advance to such reliance in writing. This is to provide our firm with reasonable protection against open-ended liability claims by third parties with whom there would otherwise be no contractual limits to their actions. Within the limitations of scope, schedule and budget, our services have been executed in accordance with our Agreement with the Client and generally accepted geotechnical practices in this area at the time this report was prepared. This report should not be applied for any purpose or project except the one originally contemplated.

A GEOTECHNICAL ENGINEERING OR GEOLOGIC REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

Insight Geologic, Inc. considered a number of unique, project-specific factors when establishing the scope of services for this project and report. Unless Insight Geologic specifically indicates otherwise, do not rely on this report if it was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

For example, changes that can affect the applicability of this report include those that affect:

- the function of the proposed structure;
- elevation, configuration, location, orientation or weight of the proposed structure;
- composition of the design team; or
- project ownership.

If important changes are made after the date of this report, Insight Geologic should be given the opportunity to review our interpretations and recommendations and provide written modifications or confirmation, as appropriate.

---

[1] Developed based on material provided by ASFE, Professional Firms Practicing in the Geosciences; www.asfe.org .

SUBSURFACE CONDITIONS CAN CHANGE

This geotechnical or geologic report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by manmade events such as construction on or adjacent to the site, or by natural events such as floods, earthquakes, slope instability or ground water fluctuations. Always contact Insight Geologic before applying a report to determine if it remains applicable.

MOST GEOTECHNICAL AND GEOLOGIC FINDINGS ARE PROFESSIONAL OPINIONS

Our interpretations of subsurface conditions are based on field observations from widely spaced sampling locations at the site. Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Insight Geologic reviewed field and laboratory data and then applied our professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ, sometimes significantly, from those indicated in this report. Our report, conclusions and interpretations should not be construed as a warranty of the subsurface conditions.

GEOTECHNICAL ENGINEERING REPORT RECOMMENDATIONS ARE NOT FINAL

Do not over-rely on the preliminary construction recommendations included in this report. These recommendations are not final, because they were developed principally from Insight Geologic's professional judgment and opinion. Insight Geologic's recommendations can be finalized only by observing actual subsurface conditions revealed during construction. Insight Geologic cannot assume responsibility or liability for this report's recommendations if we do not perform construction observation.

Sufficient monitoring, testing and consultation by Insight Geologic should be provided during construction to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes should the conditions revealed during the work differ from those anticipated, and to evaluate whether or not earthwork activities are completed in accordance with our recommendations. Retaining Insight Geologic for construction observation for this project is the most effective method of managing the risks associated with unanticipated conditions.

A GEOTECHNICAL ENGINEERING OR GEOLOGIC REPORT COULD BE SUBJECT TO MISINTERPRETATION

Misinterpretation of this report by other design team members can result in costly problems. You could lower that risk by having Insight Geologic confer with appropriate members of the design team after submitting the report. Also retain Insight Geologic to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering or geologic report. Reduce that risk by having Insight Geologic participate in pre-bid and pre-construction conferences, and by providing construction observation.

DO NOT REDRAW THE EXPLORATION LOGS

Geotechnical engineers and geologists prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a

geotechnical engineering or geologic report should never be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, but recognize that separating logs from the report can elevate risk.

GIVE CONTRACTORS A COMPLETE REPORT AND GUIDANCE

Some owners and design professionals believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering or geologic report, but preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with Insight Geologic and/or to conduct additional study to obtain the specific types of information they need or prefer. A pre-bid conference can also be valuable. Be sure contractors have sufficient time to perform additional study. Only then might an owner be in a position to give contractors the best information available, while requiring them to at least share the financial responsibilities stemming from unanticipated conditions. Further, a contingency for unanticipated conditions should be included in your project budget and schedule.

CONTRACTORS ARE RESPONSIBLE FOR SITE SAFETY ON THEIR OWN CONSTRUCTION PROJECTS

Our geotechnical recommendations are not intended to direct the contractor’s procedures, methods, schedule or management of the work site. The contractor is solely responsible for job site safety and for managing construction operations to minimize risks to on-site personnel and to adjacent properties.

READ THESE PROVISIONS CLOSELY

Some clients, design professionals and contractors may not recognize that the geoscience practices (geotechnical engineering or geology) are far less exact than other engineering and natural science disciplines. This lack of understanding can create unrealistic expectations that could lead to disappointments, claims and disputes. Insight Geologic includes these explanatory “limitations” provisions in our reports to help reduce such risks. Please confer with Insight Geologic if you are unclear how these “Report Limitations and Guidelines for Use” apply to your project or site.

GEOTECHNICAL, GEOLOGIC AND ENVIRONMENTAL REPORTS SHOULD NOT BE INTERCHANGED

The equipment, techniques and personnel used to perform an environmental study differ significantly from those used to perform a geotechnical or geologic study and vice versa. For that reason, a geotechnical engineering or geologic report does not usually relate any environmental findings, conclusions or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. Similarly, environmental reports are not used to address geotechnical or geologic concerns regarding a specific project.

INSIGHT GEOLOGIC, INC.

1015 East 4th Avenue
Olympia, Washington 98506
Telephone: (360) 754-2128
Fax: (360) 754-9299

MEMORANDUM

TO: Casey Peterson

FROM: William Halbert, L.E.G., L.Hg.

DATE: July 26, 2019

PROJECT: 1142-001-02 Wyndstone Residential

SUBJECT: Supplemental Infiltration Rate Evaluation

At the request of Peterson Brothers LLC, we have conducted a supplemental evaluation for the proposed stormwater infiltration at the Wyndstone multi-family residential development to be located 15025 Tahoma Boulevard SE in Yelm, Washington.

Our previous investigations and evaluation of design stormwater infiltration rates for the project, using the "Detailed Approach" as described in the Department of Ecology's 2014 Stormwater Management Manual for Western Washington (2014 Manual), as adopted by the City of Yelm, produced artificially low infiltration rates for the site based on similar sites in the area in similar soils. It was decided that we also run a full-scale Pilot Infiltration Test (PIT) as a more realistic method of determining the infiltration rate of the soil. On July 24, 2019, we completed two stormwater infiltration rate evaluations in general accordance with the 2014 Manual consisting of full-scale PITs. The PITs were performed at the north and south side of the site at a depth of 5 feet below ground surface.

For the PITs, a 10-foot by 10-foot area was excavated to a depth of about 5 feet below ground surface. The PIT located on the north side of the site was located within the area of the proposed stormwater infiltration gallery. A second PIT was excavated on the south side of the site for comparison purposes. The base of the excavations correlated to the approximate elevation of the base of the proposed stormwater infiltration gallery. The soils exposed in the base of the excavations consisted of fine to course gravel and cobbles with sand and trace silt, which was consistent with our previous observations.

Water was added to the excavations using a water tuck provided by Peterson Brothers LLC to saturate the underlying soils. Datalogging pressure transducers were placed in the bottom of the excavations to provide a constant record of the water level during the PITs.

Despite adding approximately 4,000 gallons of water to PIT-1 at the maximum rate available to the water truck, we were unable to develop standing water in the base of the PIT excavation. Water levels were able to be maintained in in PIT-2 until the water truck was drained and then the excavation drained in approximately 15 minutes. The water levels over time for PIT-1 and PIT-2 are shown in Figure 1 and Figure 2, below. The initial infiltration rate was calculated using the fall of the water level in inches over time.

Figure 1.

PIT-1 Hydrograph

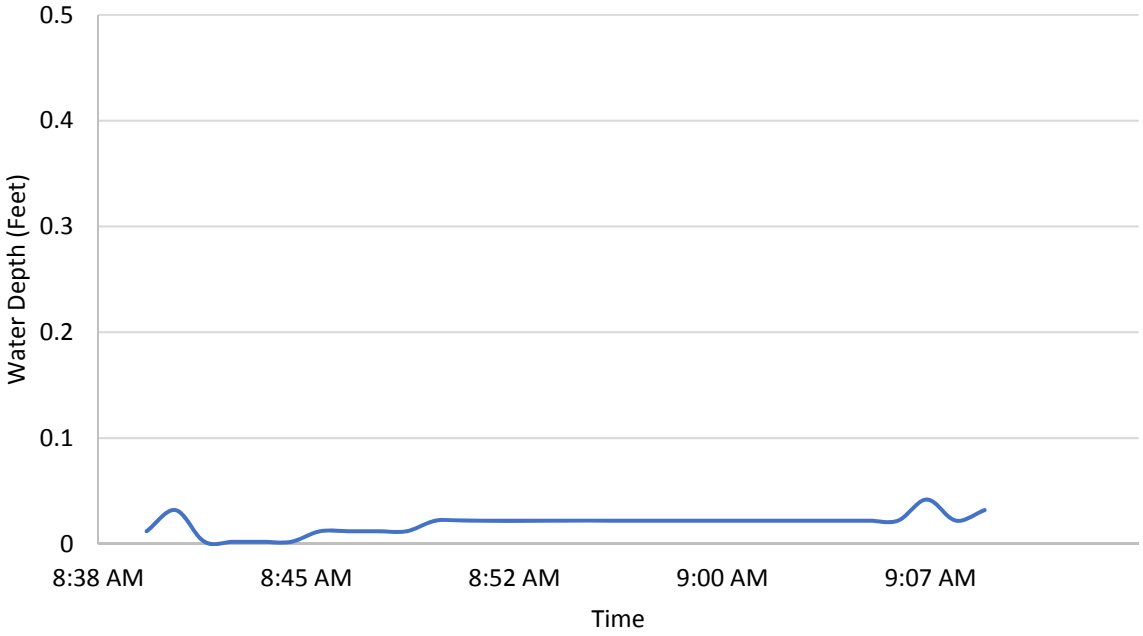
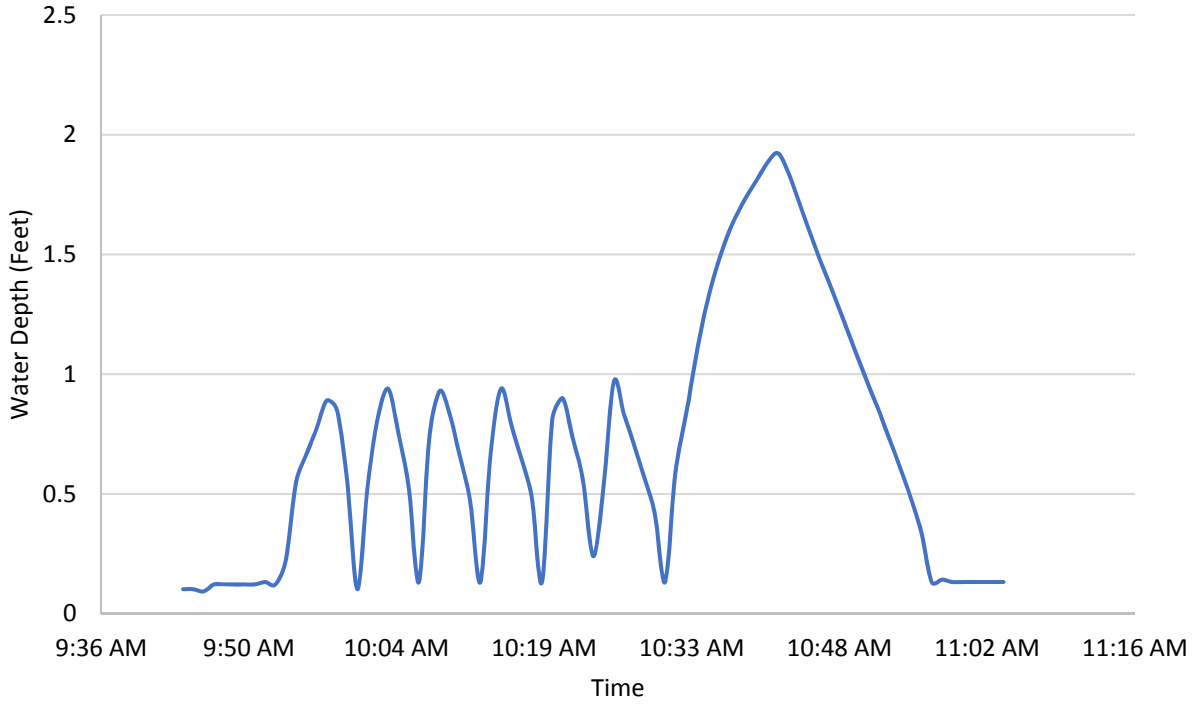


Figure 2.

PIT-2 Hydrograph



Based on the "Simple Approach" as described in the 2014 Manual, we then applied the appropriate correction factors to the initial infiltration rates which generated a design infiltration rate of between 132 and 104 inches per hour. However, as the site has a contributing area of larger than 1 acre the 2014 Manual recommends the use of the "Detailed Approach" to determine the design infiltration rate. Using the additional site-specific correction factors and depth to groundwater utilized in the Detailed Approach, the design infiltration rate is between 12.2 and 8.3 inches per hour. Based on the gravel and cobbly nature of the site and that the depth to groundwater is greater than 30 feet below ground surface, it is our opinion that the reduction in infiltration rate generated by the Detailed Approach is overly conservative as groundwater mounding is unlikely to develop in the gravel soils at the site. As a result, we have generated a discretionary correction factor of 0.4 that takes into account the corrections presented on the Detailed Approach while reducing the correction that is based on potential mounding effects of the groundwater table. Correction values are shown in Table 1, below.

Our final design infiltration rate based on these revised correction values are between **32 and 21 inches per hour**. Please note that this design infiltration rate is based on current site conditions and may be adjusted depending on significant increases in groundwater elevations during the winter groundwater monitoring period.

Table 1.

Design Infiltration Rate Calculation

PIT	Initial Infiltration Rate (in./hr.)	Testing Methodology Correction Factor	Site Variability Correction Factor	Plugging Correction Factor	Discretionary Correction Factor	Design Infiltration Rate (in./hr.)
PIT-1	132.8	0.75	0.9	0.9	0.4	32.2
PIT-2	86	0.75	0.9	0.9	0.4	20.9

We trust this meets your current requirements. Please contact us if you have questions regarding our testing.

November 7, 2019

Mr. Craig Deaver
CES NW, Inc.
429 29th Street NE, Suite D
Puyallup, WA 98372

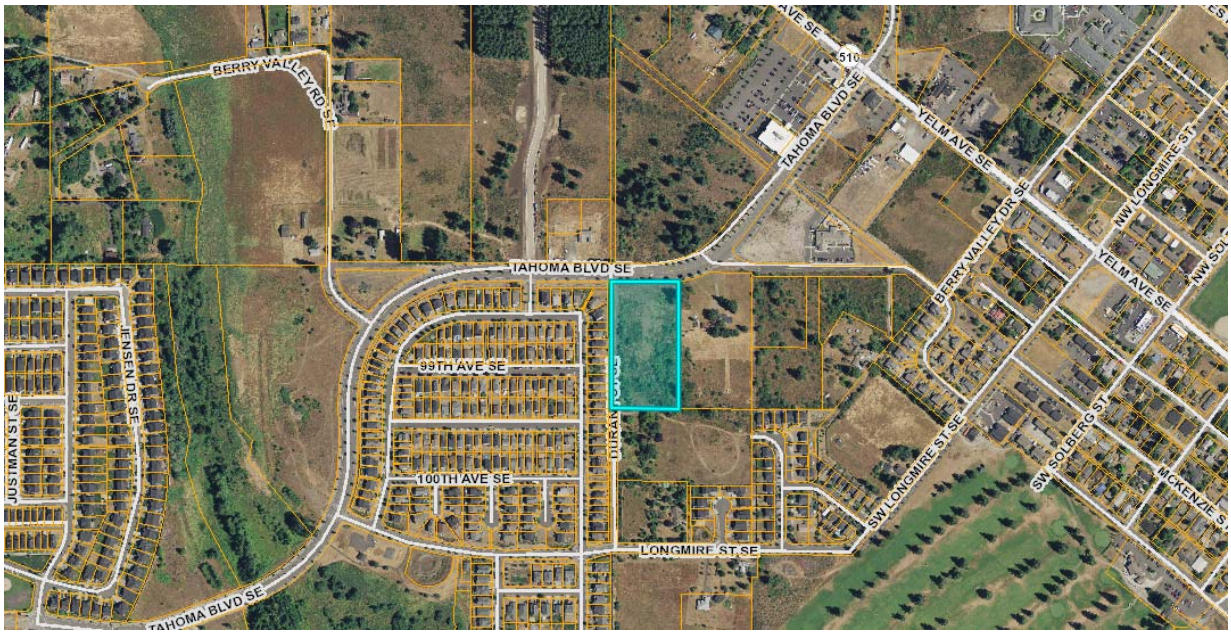
Subject: Wyndstone – Yelm Traffic Assessment

The intent of this assessment serves to provide trip generation analysis for the proposed development of 75 apartment units in the city of Yelm. The subject site is located on 4.31-acre parcel #: 21724420300. A description of the project summary is provided below.

Proposed Project

Wyndstone is a proposed apartment development comprised of 75 multi-family dwelling units located in the city of Yelm. The subject site is comprised within undeveloped 4.31-acre parcel #: 21724420300. The subject site is bordered to the west by Durant Street SE and to the north by Tahoma Boulevard SE. Nearby land use is a mixture of residential, school and undeveloped. Access to the site is proposed via one new roadway extending south from Tahoma Boulevard SE. A provided site plan illustrating the overall configuration of the project is presented in Figure 1 on the following page.

Aerial Vicinity



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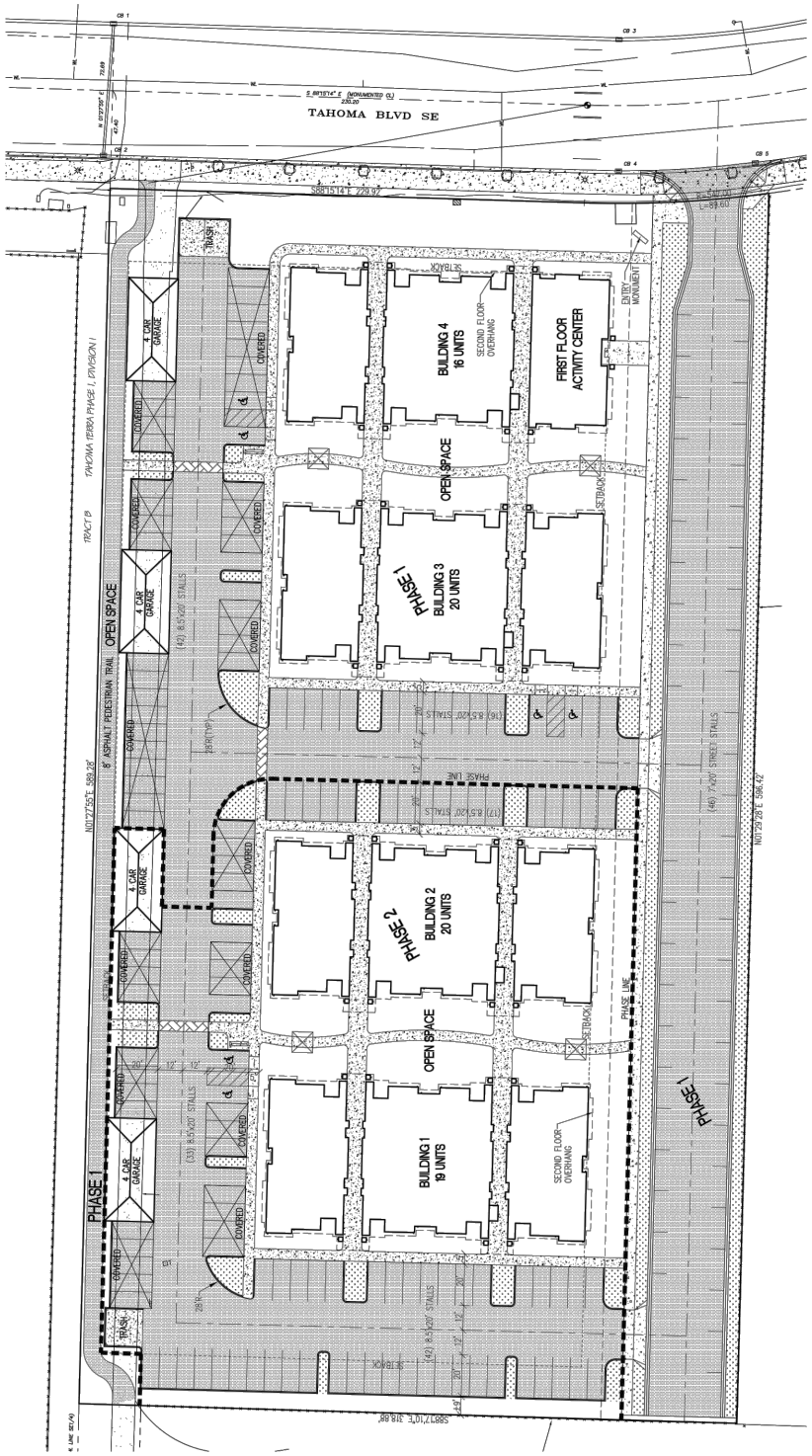


HEATH & ASSOCIATES

TRAFFIC AND CIVIL ENGINEERING

WYNDSTONE - YELM

SITE PLAN
FIGURE 1

Transit Service

A review of the Intercity Transit regional system map indicates the nearest transit route in the area is served via Route 94. Service is provided from the Olympia Transit Center to the Yelm Walmart from the hours of 5:34 AM to 9:45 PM. The nearest stop with respect to the subject site is located at the intersection of Tahoma Boulevard SE / Killion Road SE & SR-510 (~0.25 miles northeast), offering 30-minute headways during peak travel times. Limited weekend service is also provided. Refer to the Intercity Transit route schedule for more detailed information.

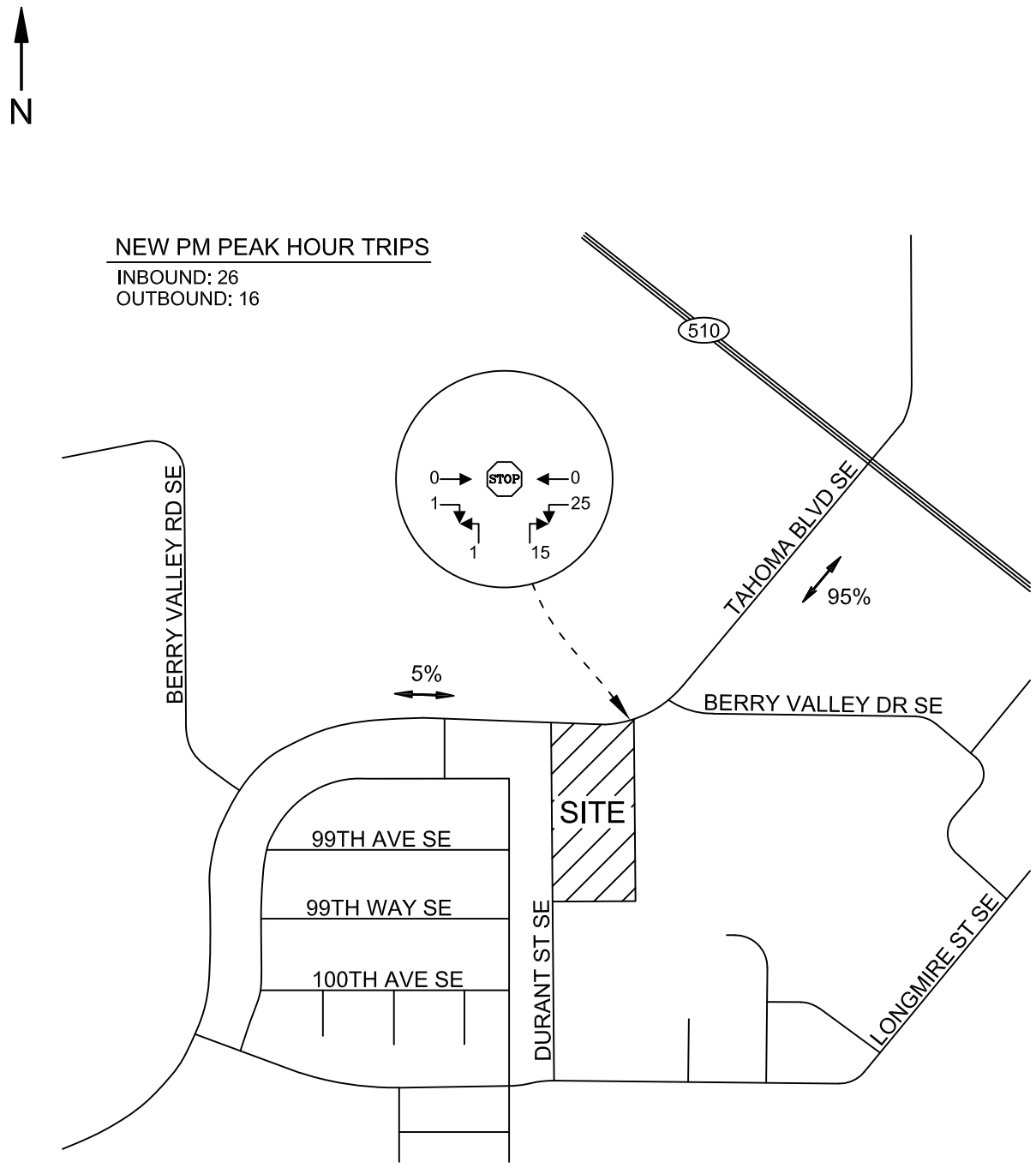
Trip Generation

Trip generation is defined by the number of vehicular movements that enter or exit a site during a particular timeframe such as a specific peak hour or an entire day. Trip generation estimates are based on data from the ITE *Trip Generation Manual,* 10th Edition. Corresponding the proposed development with ITE data, the following land use of LUC 220 – Multi-Family Low-Rise was applied. Attached to this document are excerpts from the ITE manual for the utilized land use. Table 1 below summarizes the estimated trip volumes using average rates.

Table 1: Project Trip Generation

Land Use	Dwelling Units	AWDT	AM Peak-Hour Trips			PM Peak-Hour Trips		
			In	Out	Total	In	Out	Total
Multi-Family	75	549	8	27	**35**	26	16	**42**

The proposed development of 75 multi-family units is estimated to generate 35 new AM (8 in / 27 out) and 42 new PM (26 in / 16 out) peak hour trips. Figure 2 on the following page illustrates the project's PM peak hour trip distribution and assignment with full-buildout. The main arterial route to and from the subject site is by way of Tahoma Boulevard SE.



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WYNDSTONE - YELM

PM PEAK HOUR TRIP DISTRIBUTION & ASSIGNMENT
FIGURE 2

Proposed Access

Access to the site is proposed via one new drive access off Tahoma Boulevard SE (see Figure 2). Assessments of the approximate driveway location were made to establish whether sufficient entering sight distance (ESD) is available. Based on the 35-mph speed limit of Tahoma Boulevard SE, AASHTO guidelines[1] would require 335 and 390 feet of unobstructed view for outbound right- and left-turn movements, respectively. Preliminary examinations of the proposed access point location indicate sight distance is met. While horizontal curvature occurs along Tahoma Boulevard SE to the northeast of the proposed access location, it does not impede the necessary sight lines.

Conclusion

The proposed Wyndstone development consists of 75 multi-family apartment units on parcel #: 21724420300 with a site address of 15025 Tahoma Boulevard SE. The subject site, located in the city of Yelm, is bordered to the north by Tahoma Boulevard SE and to the west by Durant Street SE. Based on ITE data, the project is anticipated to be a moderate generator of traffic with approximately 35 AM (8 in / 27 out) and 42 PM (26 in / 16 out) peak hour trips. A site plan illustrates one proposed access drive on Tahoma Boulevard SE with acceptable sight lines.

Based on the above analysis the project is subject to Traffic Impact Fees (TIF) as required by the city of Yelm. Exact fees and calculations will be determined by the City at the time of building permit issuance.

Please call if you require anything further.

Sincerely,

Gregary B. Heath, P.E., PTOE

[1] AASHTO. "A Policy on Geometric Design of Highway and Streets" 8th Edition. (2018).

Multifamily Housing (Low-Rise)
(220)

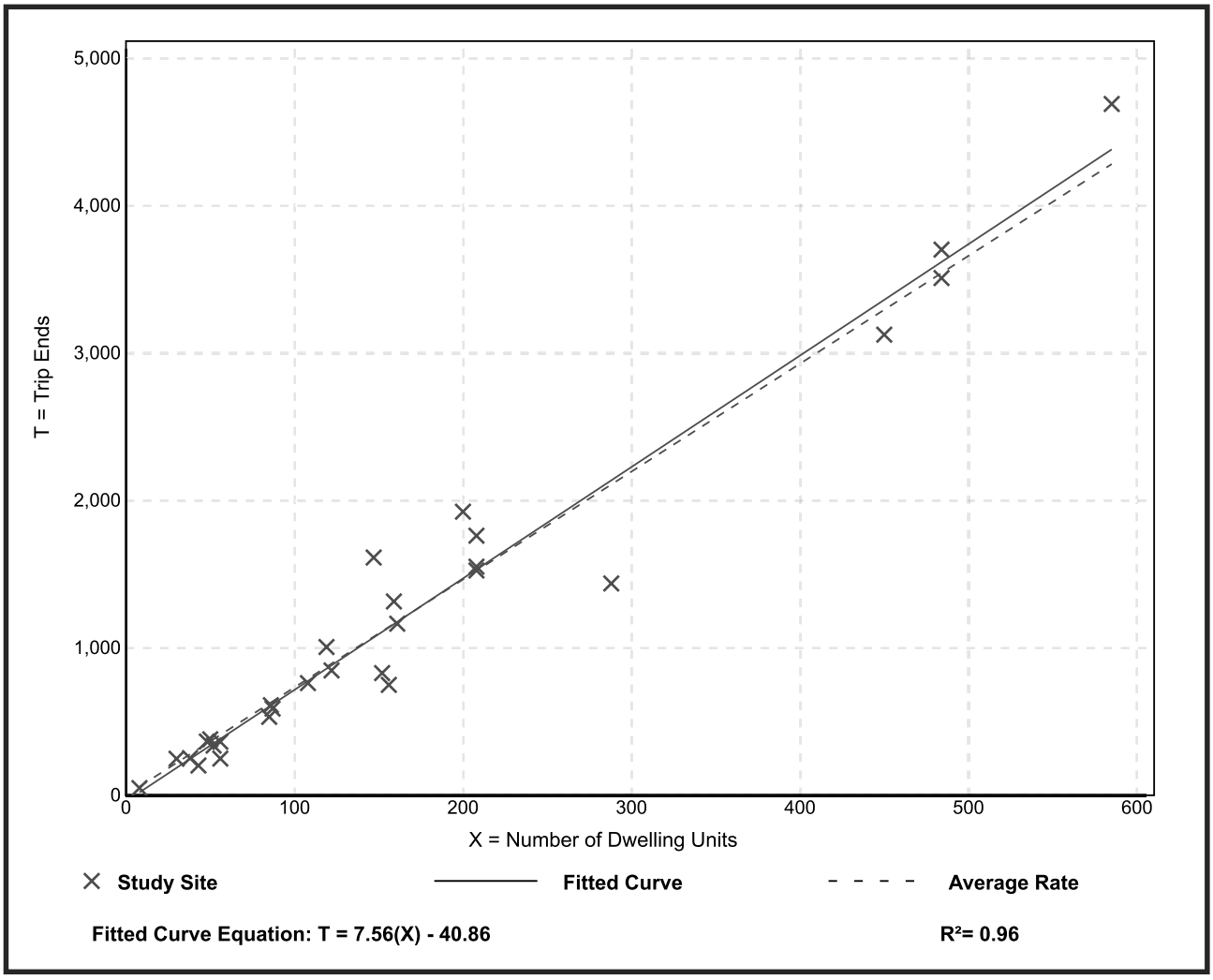
Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday**

Setting/Location: **General Urban/Suburban**
Number of Studies: 29
Avg. Num. of Dwelling Units: 168
Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
7.32	4.45 - 10.97	1.31

Data Plot and Equation



Trip Generation Manual, 10th Edition ● Institute of Transportation Engineers

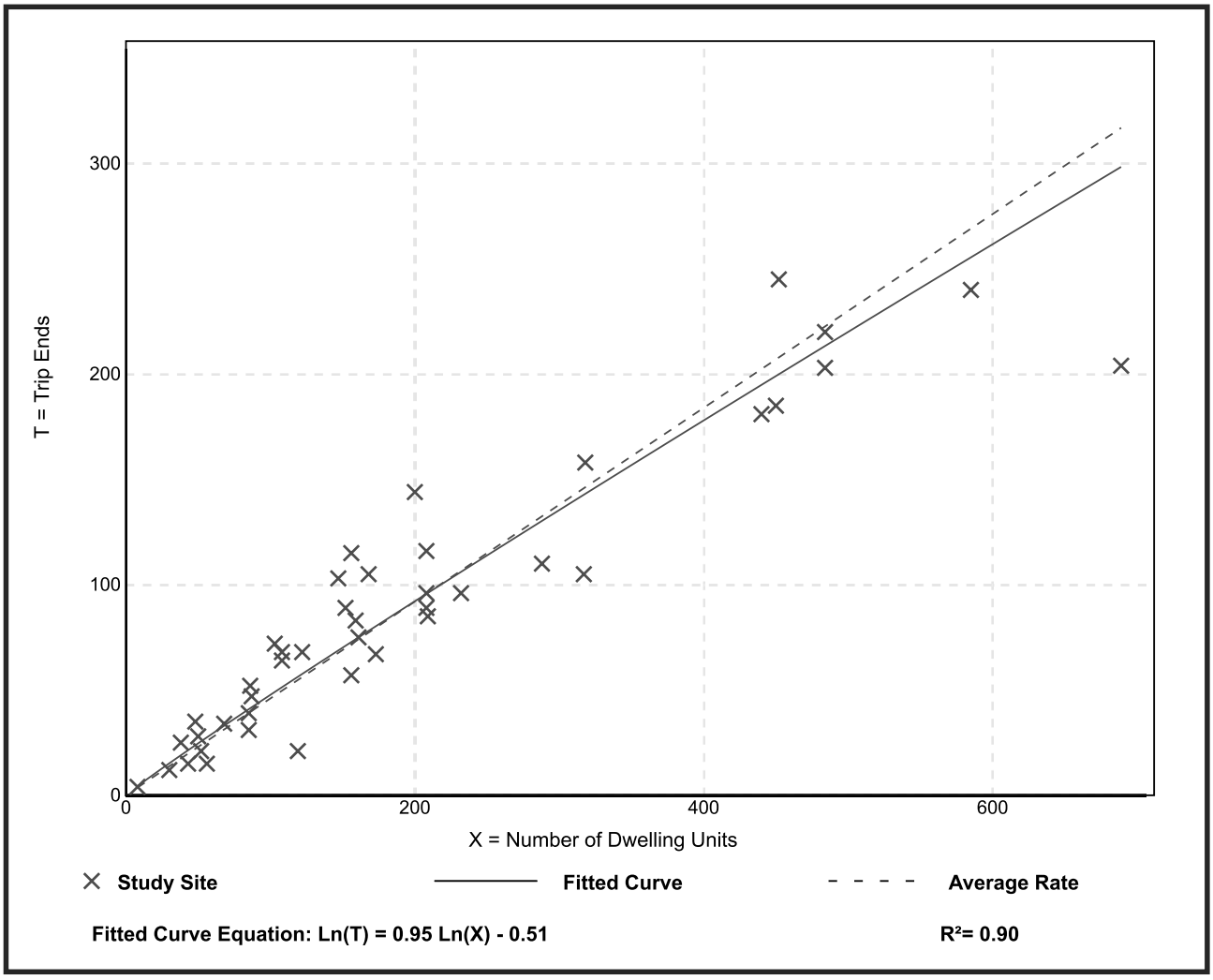
Multifamily Housing (Low-Rise)
(220)

Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.
Setting/Location: **General Urban/Suburban**
Number of Studies: 42
Avg. Num. of Dwelling Units: 199
Directional Distribution: 23% entering, 77% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.46	0.18 - 0.74	0.12

Data Plot and Equation



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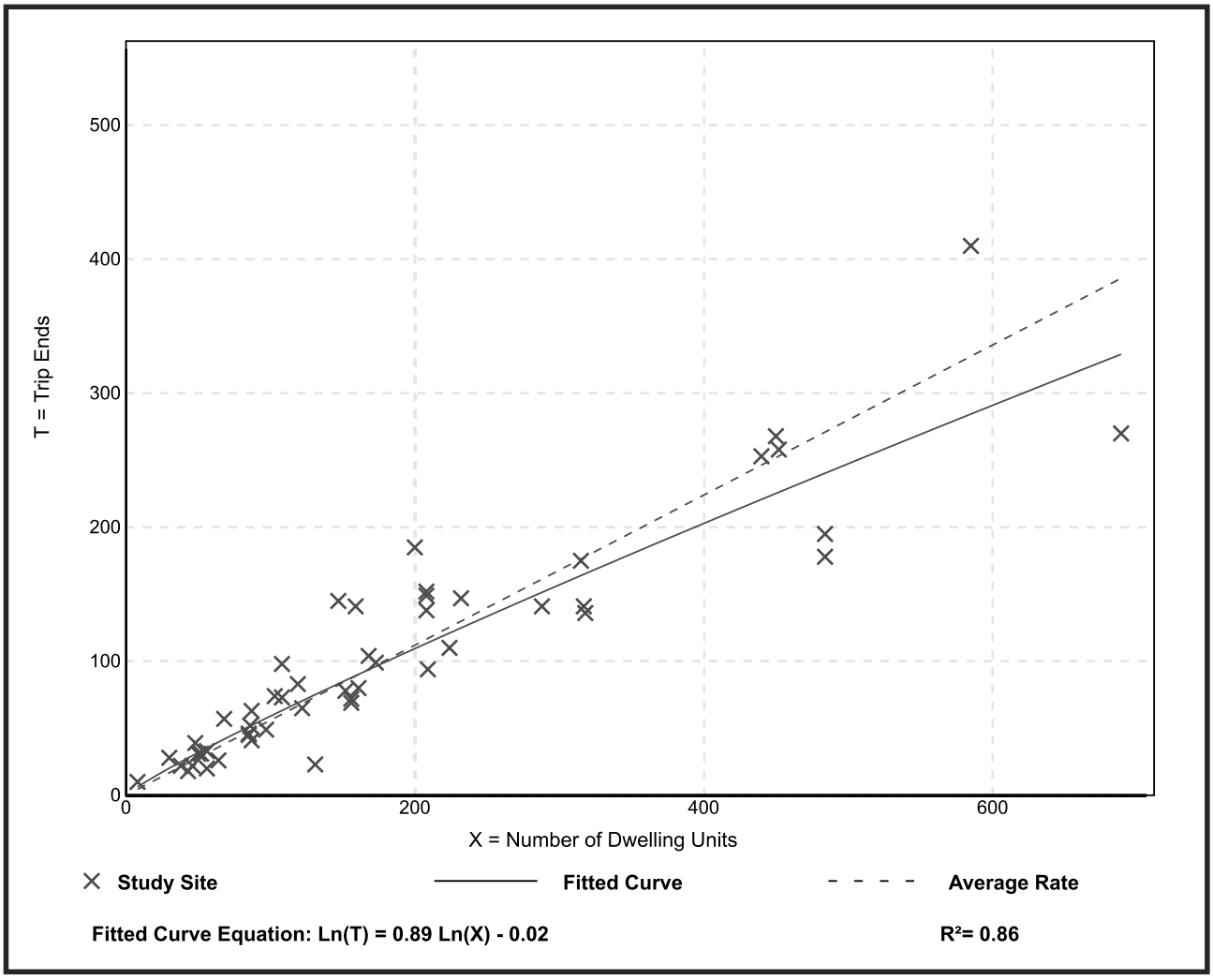
Multifamily Housing (Low-Rise)
(220)

Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.
Setting/Location: **General Urban/Suburban**
Number of Studies: 50
Avg. Num. of Dwelling Units: 187
Directional Distribution: 63% entering, 37% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.56	0.18 - 1.25	0.16

Data Plot and Equation



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