SEPA #: 2019.0345.EN0003

MITIGATED DETERMINATION OF NON-SIGNIFICANCE

Proponent:	Dennis Daly
Description of Proposal:	Nisqually Landing Apartments, 50-unit multi-family development
Location of the Proposal:	17021 103rd Avenue SE, Yelm, WA
Section/Township/Range:	Section 29 Township 17 Range 2E, W.M.
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:	November 1, 2019
Comment Deadline:	November 15, 2019
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 November 15, 2019, at 5:00 P.M. The City of Yelm will not act on this proposal prior November 15, 2019 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DO NOT PUBLISH BELOW THIS LINE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, Friday, November 7, 2019
Posted in public areas: Monday, November 4, 2019

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

ATTACHMENT

Project Number 2019.0345.EN0003

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 Environmental Checklist submitted July, 2019, prepared by the Iris Group PLLC.

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 Land Services NW, LLC showed no evidence of gophers.

D. The site is encumbered by a High Groundwater Flood Hazard Area. Compliance with the City of Yelm Critical Areas Code, Chapter 18.21 YMC provides protection to and from high groundwater flooding.

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. Stormwater facilities shall meet the minimum requirements of Section 18.21.080(G).

CITY OF YELM

ENVIRONMENTAL CHECKLIST

CITY USE ONLY
FEE: $150.00
DATE REC'D_____
BY:_____
FILE NO._____

A. BACKGROUND

1. Name of proposed project, if any:

   Nisqually Landing Apartments

2. Name of applicant:

   Dennis Daly
   C/O The Iris Group PLLC – Nick Taylor

3. Address, phone number and email address of applicant and of any other contact person:

   4160 6th Ave SE
   Suite 105
   Lacey, WA 98503
   (360) 688-1302
   ntaylor@irisgroupconsulting.com

4. Date checklist prepared:

   6/30/19

5. Agency requesting checklist:

   City of Yelm

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

   Construction in spring 2020.

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

   No

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

   Geotechnical Engineering Report prepared by GeoResources, dated 6/10/19.
   Mazama Pocket Gopher Absence Report by Land Services Northwest, dated 9/27/18.

9. 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

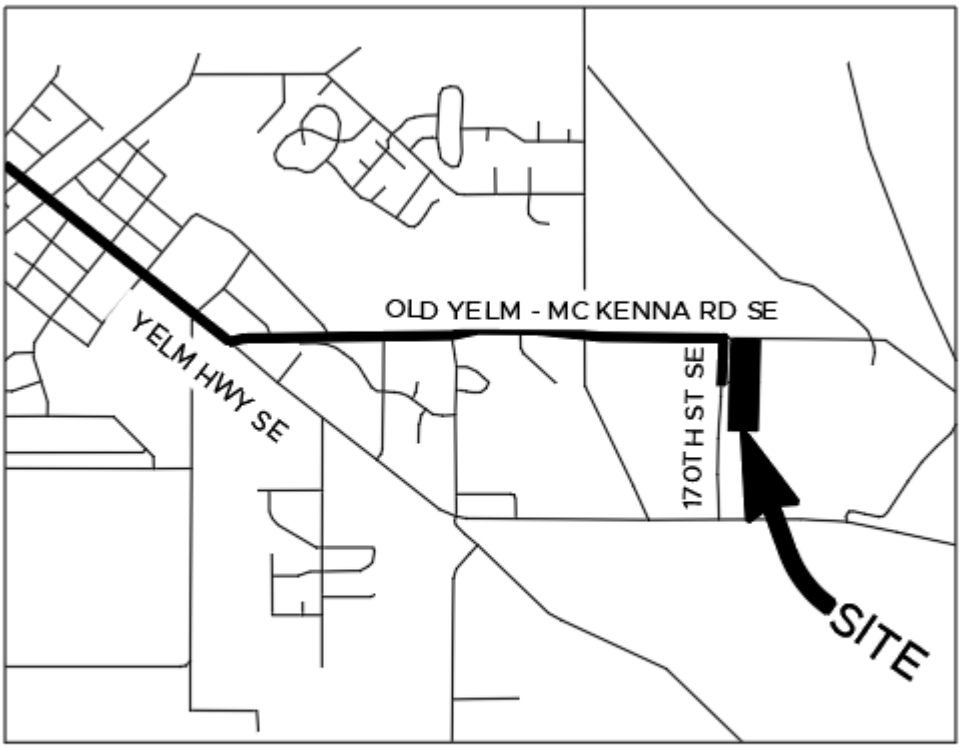
10. List any government approvals or permits that will be needed for your proposal, if known.

Land use approval, civil permits, building permit.

11. Give 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.

50-unit apartment development and associated features

12. Location of the 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. You need not duplicate maps or detailed plans submitted with any permit applications related to this checklist.



VICINITY MAP
NTS

DIRECTIONS TO SITE

1. FROM I-5 TAKE EXIT 111 FOR WA-510 E/MARVIN ROAD S TOWARD YELM
2. KEEP RIGHT AT THE FORK TO CONTINUE TOWARD GALAXY DR NE
3. TURN LEFT ONTO MARTIN WAY E
4. TURN RIGHT ONTO WA-510 E/MARTIN RD SE
5. AT THE TRAFFIC CIRCLE, TAKE THE 3RD EXIT ONTO WA-510 E
6. AT THE TRAFFIC CIRCLE, TAKE THE 1ST EXIT AND STAY ON WA-510 E
7. AT THE TRAFFIC CIRCLE, TAKE THE 2ND EXIT ONTO WA-510 E/YELM HWY SE
8. CONTINUE ON YELM HWY SE
9. MAKE A LEFT ON OLD YELM - MC KENNA RD SE
10. TURN RIGHT ON 170TH ST SE
11. DESTINATION IS ON THE LEFT

B. ENVIRONMENTAL ELEMENTS

1. **Earth**

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

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

15%

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 prime farmland.

Spanaway gravelly sandy loam.

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

No

e. Describe the purpose, type, and approximate quantities of any filling or grading proposed. Indicate source of fill.

Crushed gravel for building and parking lot base. Local source.

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

Yes. If construction stormwater pollution prevention practices are not followed there is a chance of surficial erosion.

g. About what percent of the site will be covered with impervious surfaces after project construction such as asphalt or buildings?

28% as currently shown

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

Adherence to the construction stormwater pollution prevention practices described in the Thurston County Drainage Design and Erosion Control Manual. Stormwater Management Manual for Western Washington

2. **Air**

a. What types of emissions to the air would result from the proposal (i.e., dust, automobile exhaust, odors, industrial wood smoke) during construction and when the project is completed? If any, generally describe and give approximate quantities if known.

Construction and personally owned vehicle emissions. Quantities typically associated with operation of motor vehicles.

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

None anticipated.

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

Standard motor vehicle emission control devices.

3. **Water**

a. Surface Water

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

No, however the site is adjacent to a mapped high groundwater hazard area.

2) Will the project require any work over, in, or adjacent to (within 300 feet) the described waters? If yes, please describe and attach available plans.

No.

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.

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

No

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

No

The site is encumbered by a high groundwater flood hazard area. Development shall meet the Critical areas code Chapter 18.21 YMC

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

b. Groundwater:

1) Will groundwater be withdrawn, or will water be discharged to groundwater? Give general description, purpose, and approximate quantities if known.

No

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

Nisqually River watershed.

3) Describe waste material that will be discharged into or onto the ground from septic tanks or other sources, if any (such as domestic sewage; industrial byproducts; agricultural chemicals).

None.

c. Water Runoff (including storm water):

1) Describe the source of runoff (including storm water) 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.

Post-development runoff will be collected, treated as required, and infiltrated into the ground.

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

It is possible that a hazardous material spill could combine with surface water, and possible groundwater if the spill is not appropriately managed.

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

Stormwater treatment devices. Adequate separation between infiltration surfaces and seasonally high groundwater elevation. Stormwater Management Manual for Western Washington

4. **Plants**

a. Check or circle types of vegetation found on the site:

__X__ deciduous tree: alder, maple, oak, aspen, other
__X__ evergreen tree: fir, cedar, pine, other
__X__ shrubs
__X__ grasses
__X__ pasture
_____ crops or grains
_____ wet soil plants: cattail, buttercup, bulrush, skunk cabbage, other
_____ water plants: water lily, eelgrass, milfoil, other
_____ other types of vegetation

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

Approximately 30% of existing grass and shrub cover will be removed.

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

None known.

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

Some native plants will be specified in proposed landscaping areas.

5. **Animals**

a. Circle any birds and animals that have been observed on or near the site or are known to be on or near the site:

birds: **hawk**, heron, ducks, eagle, **songbirds**, other: _____
mammals: **deer**, **bear**, elk, beaver, other: _____
fish: bass, salmon, trout, shellfish, other: _____

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

The Mazama Pocket Gopher is known to inhabit nearby sites. Reconnaissance showed no evidence

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

Do not know

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

None proposed

6. **Energy and Natural Resources**

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

Electric or natural gas will be utilized for heating

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

Not anticipated

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:

Compliance with Washington State Energy Code.

7. **Environmental Health**

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

None known

1) Describe special emergency services that might be required.

Police and fire response

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

None proposed

b. Noise

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

Traffic from Walmart Blvd SE to the West and the Walmart Store to the South.

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

Short term construction noise. Long term vehicle and residential noise.

3) Proposed measures to reduce or control noise impacts, if any:

None proposed

8. **Land and Shoreline Use**

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

The site is currently vacant.

b. Has the site been used for mineral excavation, agriculture or forestry? If so, describe.

Livestock pasture.

c. Describe any structures on the site.

Existing mobile home.

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

No proposed demolition. Mobile home to be removed

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

Moderate Density Residential

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

Moderate Density Residential, R-6

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

Not applicable.

h. Has any part of the site been classified as a "natural resource", "critical" or "environmentally sensitive" area? If so, specify.

Extremely sensitive Acquifer

A portion of the site is designated as a High Groundwater Hazard Area

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

Up to 50 families

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

None

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

Not applicable

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

Adherence to applicable zoning and development regulations

9. **Housing**

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

52 units. No specific income level identified.

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

None

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

Not applicable

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?

35' maximum building height. Exterior building materials are anticipated to be common pacific northwest-style finishes.

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

None

c. Proposed measures to reduce or control aesthetic impacts, if any:
Adherence to applicable building and development regulations

11. **Light and Glare**

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

None anticipated.

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

Not anticipated

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

Lights from the Walmart Store to the South

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

Parking lot and building lighting with full cutoff shields

12. **Recreation**

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

None known

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

No

c. Proposed measures to reduce or control impacts or provide recreation opportunities:

Designation of recreational open space

13. **Historic and Cultural Preservation**

a. Are there any places or objects listed on, or proposed for, national, state, or local preservation registers known to be on or next to the site? If so, generally describe.

None known

b. Generally describe any landmarks or evidence of historic, archeological, scientific, or cultural importance known to be on or next to the site.

None known

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

None proposed

14. **Transportation**

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

Vehicle and pedestrian access from Walmart Blvd SE

b. Is site currently served by public transit? By what means? If not, what plans exist for transit service?

No

c. How many parking spaces would the completed project have? How many would the project eliminate?

104 new parking spaces. No existing spaces eliminated 116 stalls proposed

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

No

e. Will the project 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? If known, indicate when peak volumes would occur.

21 new pm peak hour trips

Do not know trips generated or time of peak volume

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

Payment of transportation impact fees

Public Services

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

Yes; fire protection, police protection, health care, school, post office, refuse service, animal control

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

Payment of impact fees

15. **Utilities**

a. Circle utilities currently available at the site: **electricity**, **natural gas, water**, **refuse service, telephone, sanitary sewer**, septic system, other.

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.

Extension of water and sewer along Walmart Blvd SE frontage to the project site. Installation of electricity and natural gas services

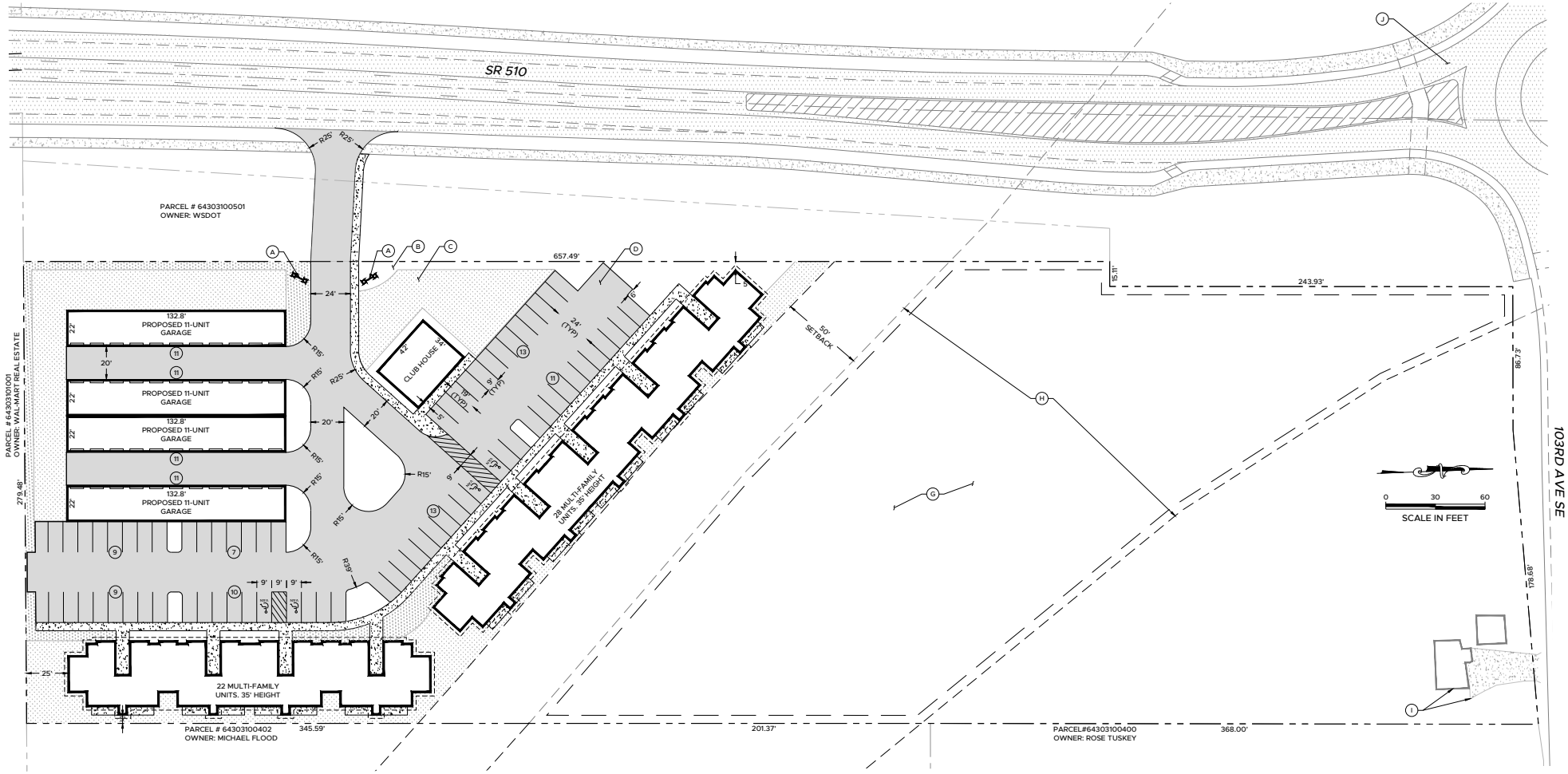
C. SIGNATURE

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

Signature:

Date Submitted:

SW 1/4 SE 1/4 SEC 29 TWN 17 RNG 2E WM



SURVEY DATA

EXISTING FEATURES ARE AS DEPICTED IN THURSTON COUNTY GEODATA. FUTURE YELM LOOP BYPASS CONFIGURATION AS PROVIDED BY WSDOT.

PARKING COUNT

PARKING LOT:	72
GARAGE STALLS:	44
TOTAL STALLS:	116

KEY NOTES

A. PROPOSED MONUMENT SIGN
B. PROPOSED LANDSCAPING (TYP)
C. PROPOSED LAWN (TYP)
D. PROPOSED ASPHALT PAVEMENT (TYP)
E. PROPOSED COMBINED RETENTION TREATMENT POND
F. PROPOSED SIDEWALK (TYP)
G. PROPOSED OPEN SPACE 72,864 SF
H. HIGH GROUNDWATER HAZARD AREA
I. EXISTING HOUSE AND DRIVEWAY TO BE REMOVED
J. FUTURE YELM LOOP BYPASS CONFIGURATION

DATE:	REVISION:	DWN. BY:	APP'D. BY:

REVIEWED BY:	NDT
DESIGNED BY:	NDT
DRAWN BY:	PCS
DATE:	10-22-2019

811 Know what's BELOW Call 811 before you dig.

10/22/19

IRISGROUP civil engineers
360-688-1302 | 420 Golf Club Rd, Suite 200, Lacey, WA 98503

NISQUALLY LANDING APARTMENTS
17021 103RD AVE SE
YELM WA, 98597

PRELIMINARY SITE PLAN

PROJ NO: DT01
DWG. NO: C-1
2 OF 5

FILE NAME:Z:\P\DT\18005 DT01\CAD\SHEET\Master Site Plan.dwg DATE/TIME:3/4/2019 1:38:43 PM

IRISGROUP
civil engineers

Nisqually Landing Apartments
Preliminary Stormwater Control Plan

Date Prepared	10/20/19
Subject Property	17021 103rd Ave SE Yelm WA, 98597 TP #: 64303100500
Applicant	Dennis Daly 8206 Baird Rd NE Olympia, WA 98516 (206) 604-6523 dtdaly1@msn.com
Reviewing Agency	City of Yelm Community Development 106 2nd St SE Yelm, WA 98597
Project Engineer	Nicholas D. Taylor, PE The Iris Group PLLC 420 Golf Club Rd SE, Suite 200 Lacey, WA 98503 (360) 688-1302 ntaylor@irisgroupconsulting.com

"I hereby certify that this Stormwater Control Plan for The Nisqually Landing Apartments has been prepared by me or under my supervision and meets minimum standards of The City of Yelm and normal standards of engineering practice. I hereby acknowledge and agree that the jurisdiction does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities designed by me."

10/20/19

Table of Contents

Appendices

Section 1 – Proposed Project Description

This Stormwater Control Plan (SCP) is associated with an administrative site plan review application for approval of a 50-unit apartment complex and associated features at 17021 103rd Ave SE, within the City of Yelm, also defined as Thurston County Tax Parcel number 64303100500. After land use approval, building and clearing/grading permits will be required for on and off-site improvements. City zoning of the project site is Medium Density Residential (R-6), in which the proposed use is a permitted use.

This SCP was prepared in accordance with the 2012 Stormwater Management Manual for Western Washington (SMMWW) with 2014 amendments. Discussion of how the project will meet all applicable Minimum Requirements is provided below. A portion of the project site is within a High Groundwater Hazard Area and is thusly subject to the requirements of Yelm Municipal Code section 18.21.080.

Minimum Requirements

Per SMMWW Volume 1, figure 2.4.1, of which an annotated version is provided as *Appendix A* to this report, all nine Minimum Requirements apply to the new and replaced hard surfaces, as well as converted vegetation areas.

MR #1 – Preparation of Drainage Control Plans

Preparation of this SCP meets the intent of Minimum Requirement #1.

MR #2 – Construction Stormwater Pollution Prevention (SWPP) Thresholds

As this SCP has been prepared preliminarily for land use application, a SWPP plan has not yet been prepared. It is understood that an approved SWPP plan will be necessary for issuance of civil construction permits, and thusly a SWPP plan will be prepared as part of the future civil permit application, showing how the project will meet the thirteen required SWPP elements. As there is currently no anticipated discharge from the site, it is anticipated that the project will not be required to obtain coverage under the Washington State Construction Stormwater General Permit.

MR #3 – Source Control of Pollution

A Pollution Source Control Program (PSCP) will be developed specifically for this project at the time of future permit application.

MR #4 – Preservation of Natural Drainage Systems and Outfalls

In the existing condition there is no outfall at which concentrated flow enters or leaves the site, except for in the emergency overflow condition, which would result in overflow discharge to the high groundwater hazard area. As the in-situ soils are well drained significant runoff from the site does not appear to occur in the natural condition. In the proposed condition runoff from basins A, B, D, E, and F will be infiltrated onsite, which mimics the natural drainage and infiltration pattern.

There is little to no offsite run-on to the development area. Existing relatively flat grades also limit offsite run-on from the undeveloped property to the East.

MR #5 – Onsite Stormwater Management

SMMWW Volume I, figure 2.5.1, as annotated and provided in *Appendix A,* was used to identify and select Best Management Practices (BMPs) for management of stormwater.

The flow chart in figure 2.5.1 indicates that because the project is required to meet all Minimum Requirements, it is also required to meet the Low Impact Development (LID) Performance Standard.

Basins

Basin A encompasses the eastern apartment building and associated parking lot. Basin B encompasses the western apartment building and associated parking lot. Basin C includes the pervious areas east and north of the project site. Basin D includes the eastern covered parking buildings and associated driveway. Basin E includes the western covered parking buildings and associated driveway. Basin F encompasses main driveway and entrance to the development. Refer to the Basin Map included as *Appendix B*.

Conveyance

The only conveyance piping will be the emergency overflow catch basins and piping, and it will consist of double-walled high-density polyethylene pipe sized to convey the 100-year event flow. Conveyance calculations will be provided within the Final Stormwater Control Plan, which will be produced and submitted at the time of civil permit application.

MR #6 – Runoff Treatment

Treatment of runoff from pollution-generating surfaces will be accomplished with a 6" ASTM-C33 sand layer below the proposed pervious pavement, which will be used in all parking and driving areas onsite.

MR #7 – Flow Control

Flow control for all basins is unnecessary due to the rapid infiltration rate of in-situ soils. See *Appendix D* for the Western Washington Hydrology Model (WWHM) output indicating that all runoff will be infiltrated with no storage required beyond that which will be provided by the base course layer of the pervious pavement section as well as the pervious pavement itself.

MR #8 – Wetlands Protection

As this project does not discharge into a wetland, Minimum Requirement #8 is not applicable to this project.

MR #9 – Operation and Maintenance

A Stormwater Facility Maintenance Program consistent with the provisions of SMMWW Volume IV will be provided for the proposed stormwater facilities at the time of civil permit application and will be contained within the Final Stormwater Control Plan.

Section 2 – Existing Conditions

The site is generally rectangular in shape, measures approximately 265 to 285 feet wide (east to west) by 900 to 915 feet deep (north to south) and encompasses about 5.62 acres. The site is bounded by Walmart Boulevard Southeast to the West, 103rd Avenue Southeast to the North, Walmart to the South, and pasture to the East. The site generally slopes down from the Southwest and Northeast to a shallow drainage that runs from Southeast to Northwest through the central portion of the site. The bottom of the drainage gently slopes down to the Northwest at approximately 1 percent or less. The upper, Northeastern portion of the site slopes down to the Southwest at approximately 8 to 16 percent before flattening out to 1 percent or less through the central drainage. The southwestern portion of the site slopes up from the drainage at approximately 4 to 5 percent before flattening out to 1 percent or less in the southwestern corner of the site. The total topographic relief across the site is on the order of 18 feet and is depicted on the Stormwater Site Plan.

Vegetation across the site generally consists of unmaintained grass and scotch broom. The northeastern portion of the site is vegetated with a moderate stand of fir trees with a sparse to moderate understory of small deciduous trees and native and invasive plants and shrubs. No areas of surficial erosion, standing water, seeps, springs, or deep-seated slope movement was observed during site reconnaissance.

Section 3 – Soils Investigation

The USDA Natural Resource Conservation Service (NRCS) Web Soil Survey maps the site as being underlain by Spanaway gravelly sandy loam (110 and 113) soils. The Spanaway soils are derived from volcanic ash over gravelly outwash, have a "slight" erosion hazard when exposed, and are included in hydrologic soils group A. The 110 soils form on slopes of 0 to 3 percent, while the 113 soils form on slopes of 3 to 15 percent. The Washington Geologic Information Portal maps the site as being underlain by continental glacial outwash, gravel (Qgog). These soils were generally deposited during the most recent Vashon Stade of the Fraser Glaciation, some 12,000 to 15,000 years ago. The recessional outwash soils consist of a poorly sorted, lightly stratified mixture of sand and gravel that may contain localized deposits of clay and silt that were deposited by meltwater streams emanating from the retreating continental ice mass. The recessional outwash deposits are considered normally consolidated and offer moderate strength and compressibility characteristics, where undisturbed. Refer to the project geotechnical report for further detail of existing soil characteristics.

Groundwater

Based on 2018/2019 wet season monitoring, the project geotechnical report indicates that the seasonally high groundwater level is approximately 12 feet below existing grades. However, the City of Yelm has indicated that the based flood elevation in this area has been recorded at 339' or 340', which in the City of Yelm's opinion means that the seasonally high groundwater level is 339' or 340'. As depicted in the preliminary grading and drainage plan included with this report there are no locations onsite where the bottom of the 18" pervious pavement section would be lower than elevation 346', which is 6' above the "record high groundwater level" in accordance with the SWMMWW's groundwater separation requirement.

Section 4 – Wells and Septic Systems

There is one existing well and one existing septic system serving the single-family residence at the northeast corner of the subject property. Existing wells and septic systems are also known to exist within 200' of property boundaries.

Section 5 – Fuel Tanks

There is no indication of existing above or below grade fuel tanks on the property.

Section 6 – Subbasin Description

There is no off-site drainage tributary to the project. Thurston County GIS data indicates that a high groundwater hazard area exists at the upper central portion of the site. See *Appendix F* for a depiction of the approximate location of this area. There are no proposed stormwater facilities within the high groundwater hazard area, and there is no proposed development within 50' of the high groundwater hazard area. In the event of catastrophic failure of the onsite pervious pavement section, stormwater would flow to the emergency overflow catch basins and to the high groundwater hazard area.

Section 7 – Floodplain Analysis

FEMA does not list the site as being within a flood zone. Thurston County GIS data indicates that a high groundwater hazard area exists at the upper central portion of the site. See *Appendix F* for a depiction of the approximate location of this area.

Section 8 – Aesthetic Considerations for Facilities

The proposed facilities will be below grade and not visible.

Section 9 – Facility Selection and Sizing

Roof and sidewalk runoff from stormwater in basins A, B, D, E, and F will be conveyed to the respective pervious pavement areas within each of those basins. Confirmation of the adequacy of the pervious pavement section for infiltration of the tributary roof and sidewalk runoff is included the Western Washington Hydrology Model (WWHM) output provided in *Appendix D.* The design infiltration rate used for sizing is 30 in/hr, which is the recommended design infiltration rate provided in the project geotechnical engineering report, included as *Appendix E* to this report.

Basins

Tabulation of basin areas, as used for modeling, is included in *Table 1* below. Visual depiction of the basins is provided in *Appendix B – Basin Map.*

Basin	Roof	Lawn	Pervious Pavement	Sidewalk	Tributary to
A	0.17 AC	0.07 AC	0.25 AC	0.06 AC	Pervious Pavement
B	0.25 AC	0.10 AC	0..31 AC	0.09 AC	Pervious Pavement
C	0 AC	0.56 AC	0 AC	0 AC	High Groundwater Hazard Area
D	0.13 AC	0 AC	0.06 AC	0 AC	Pervious Pavement
E	0.13 AC	0 AC	0.06 AC	0 AC	Pervious Pavement
F	0 AC	0.03 AC	0.11 AC	0.01 AC	Pervious Pavement

Table 1 – Surface Coverage

Section 10 – Conveyance System Analysis

Subgrade conveyance for the emergency overflow drainage system will consist of double-walled high-density polyethylene pipe sized to convey the 100-year event flow. Conveyance calculations will be provided within the Final Stormwater Control Plan, which will be produced and submitted at the time of civil permit application.

Section 11 – Offsite Analysis & Mitigation

This section is not applicable as stormwater will not be discharged to an offsite conveyance. However, in the event of catastrophic failure of the pervious pavement section, stormwater would flow overland to the onsite high groundwater hazard area.

Section 12 – Utilities

All proposed utilities will be installed in accordance with applicable code and required separation will be provided. Water will be supplied by the main in SR 510, which will be extended to the site as part of this project. Sanitary sewer will be provided by the force main line in SR 510, which will be extended to the site as part of this project.

Franchise utilities will be provided from the SR 510 property frontage. There are no anticipated utility conflicts with the proposed stormwater system.

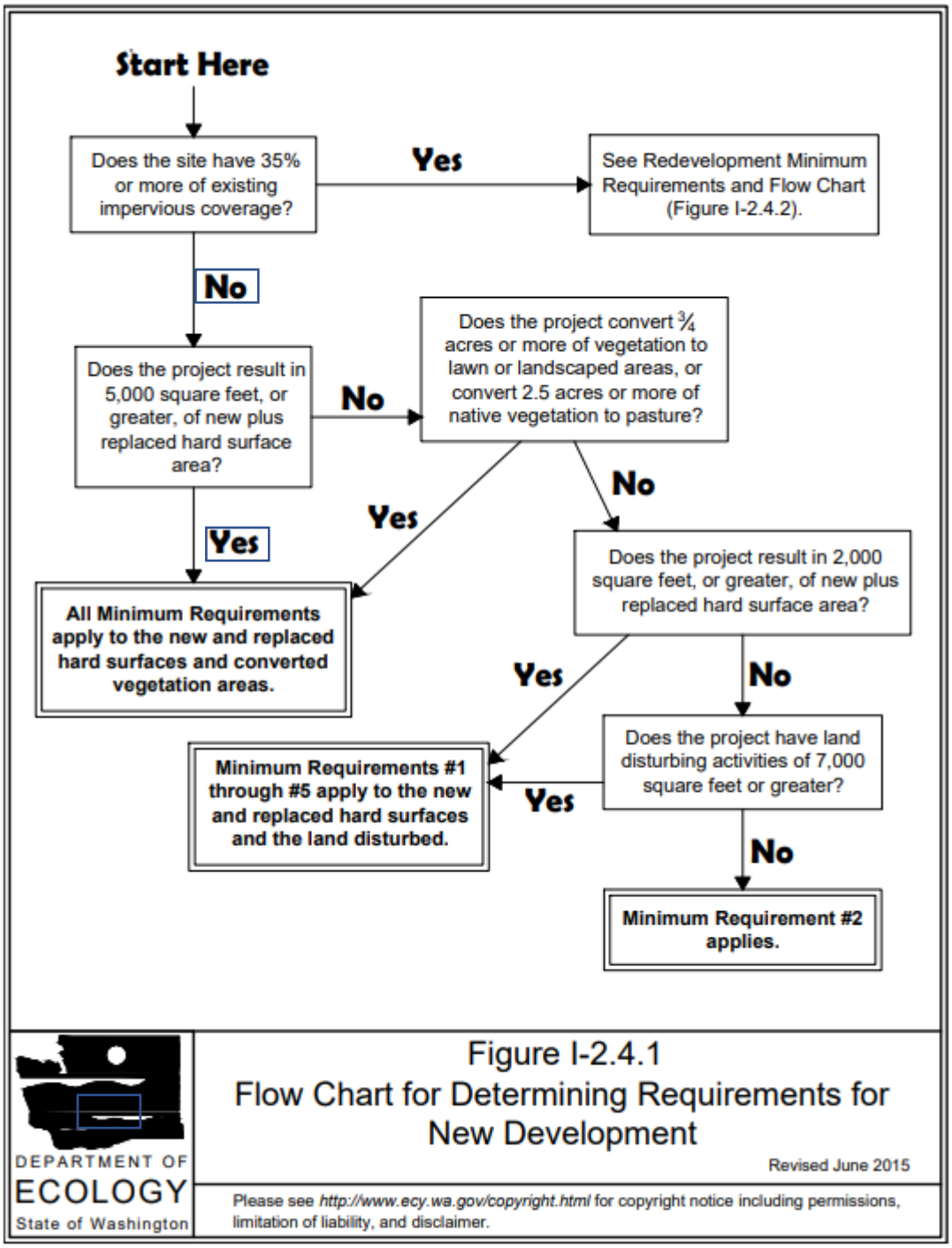
Section 13 – Covenants, Dedications, Easements, Agreements

There are no proposed onsite facilities that would require covenants, dedications, easements, or agreements.

Section 14 – Other Permits or Conditions Placed on the Project

Civil permits will be required for the project. There are currently no known conditions of approval.

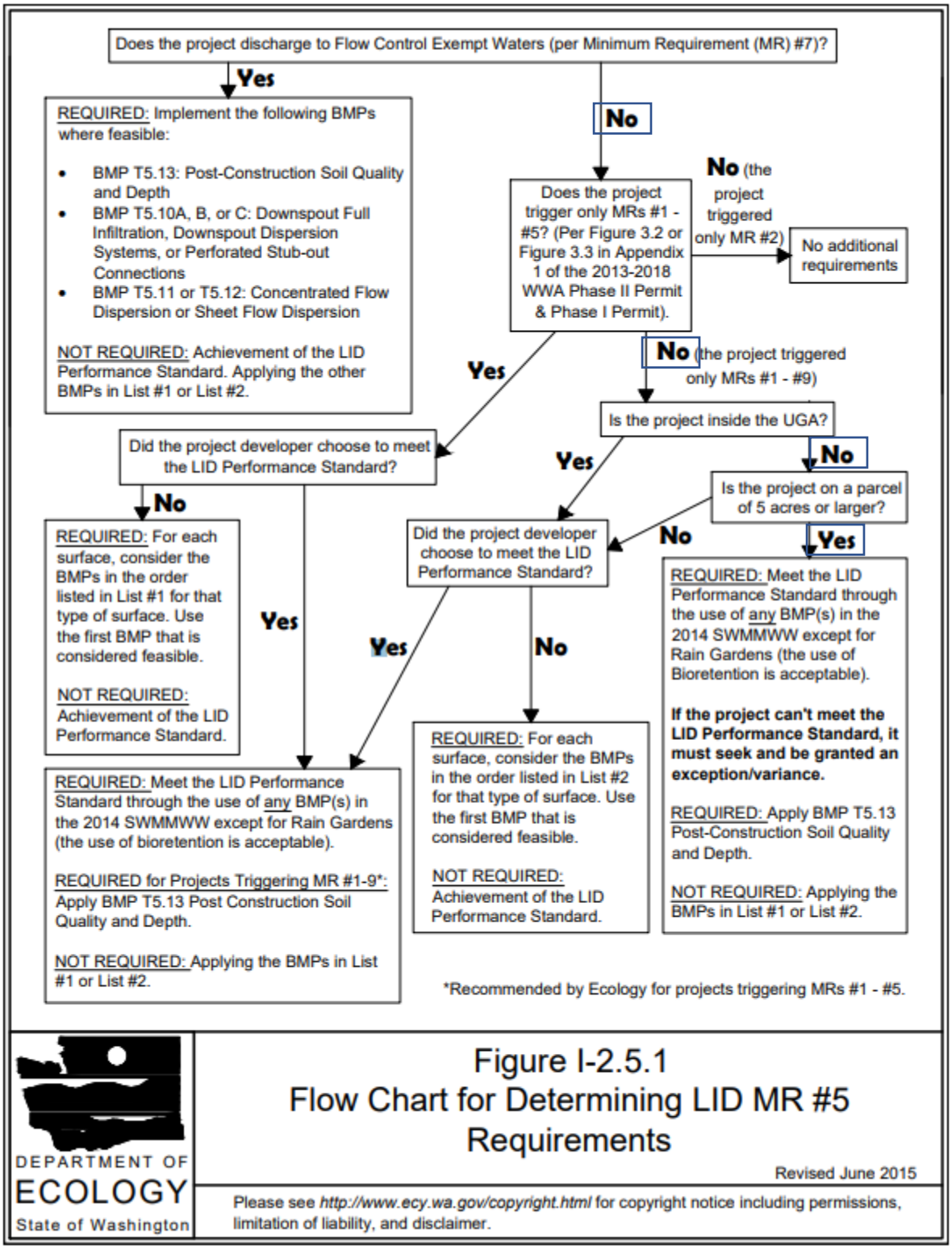
Appendix A



DEPARTMENT OF ECOLOGY
State of Washington

Figure I-2.4.1
Flow Chart for Determining Requirements for New Development

Revised June 2015

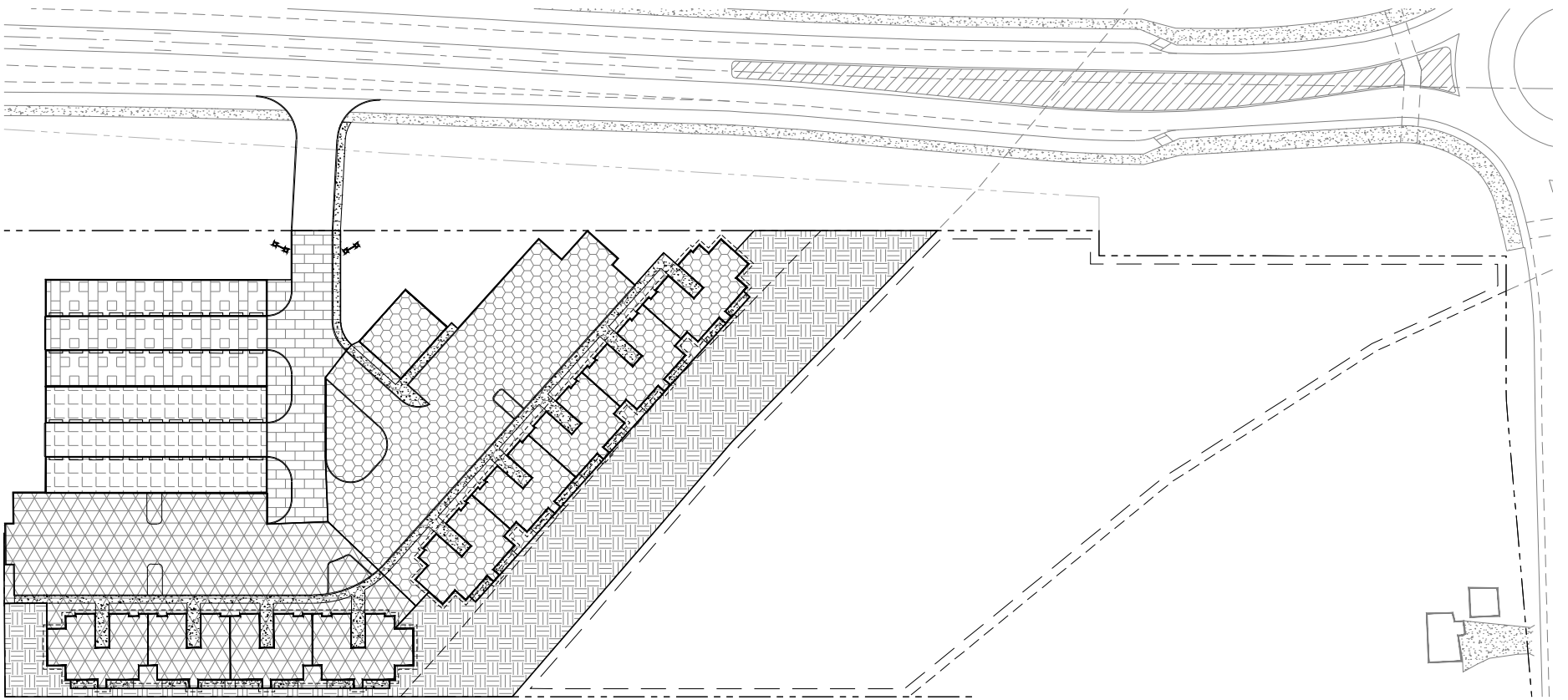


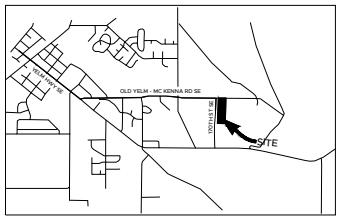
DEPARTMENT OF ECOLOGY
State of Washington

Figure I-2.5.1
Flow Chart for Determining LID MR #5 Requirements

Revised June 2015

Appendix B





VICINITY MAP
NTS

0 30 60
SCALE IN FEET

BASIN AREA	ROOF	PERVIOUS	PERVIOUS PAVEMENT	SIDEWALK
A:	0.17 ACRE	0.07 ACRE	0.25 ACRE	0.06 ACRE
B:	0.25 ACRE	0.10 ACRE	0.31 ACRE	0.09 ACRE
C:	0 ACRE	0.56 ACRE	0 ACRE	0 ACRE
D:	0.13 ACRE	0 ACRE	0.06 ACRE	0 ACRE
E:	0.13 ACRE	0 ACRE	0.06 ACRE	0 ACRE
F:	0 ACRE	0.03 ACRE	0.11 ACRE	0.01 ACRE

DATE:	REVISION:	DWN. BY:	APP'D. BY:

REVIEWED BY: NDT
DESIGNED BY: PCS
DRAWN BY: PCS
DATE: 10-21-2019

811 Know what's BELOW Call 811 before you dig.

10/21/19

IRISGROUP civil engineers
360-688-1302 | 420 Golf Club Rd, Suite 200, Lacey, WA 98503

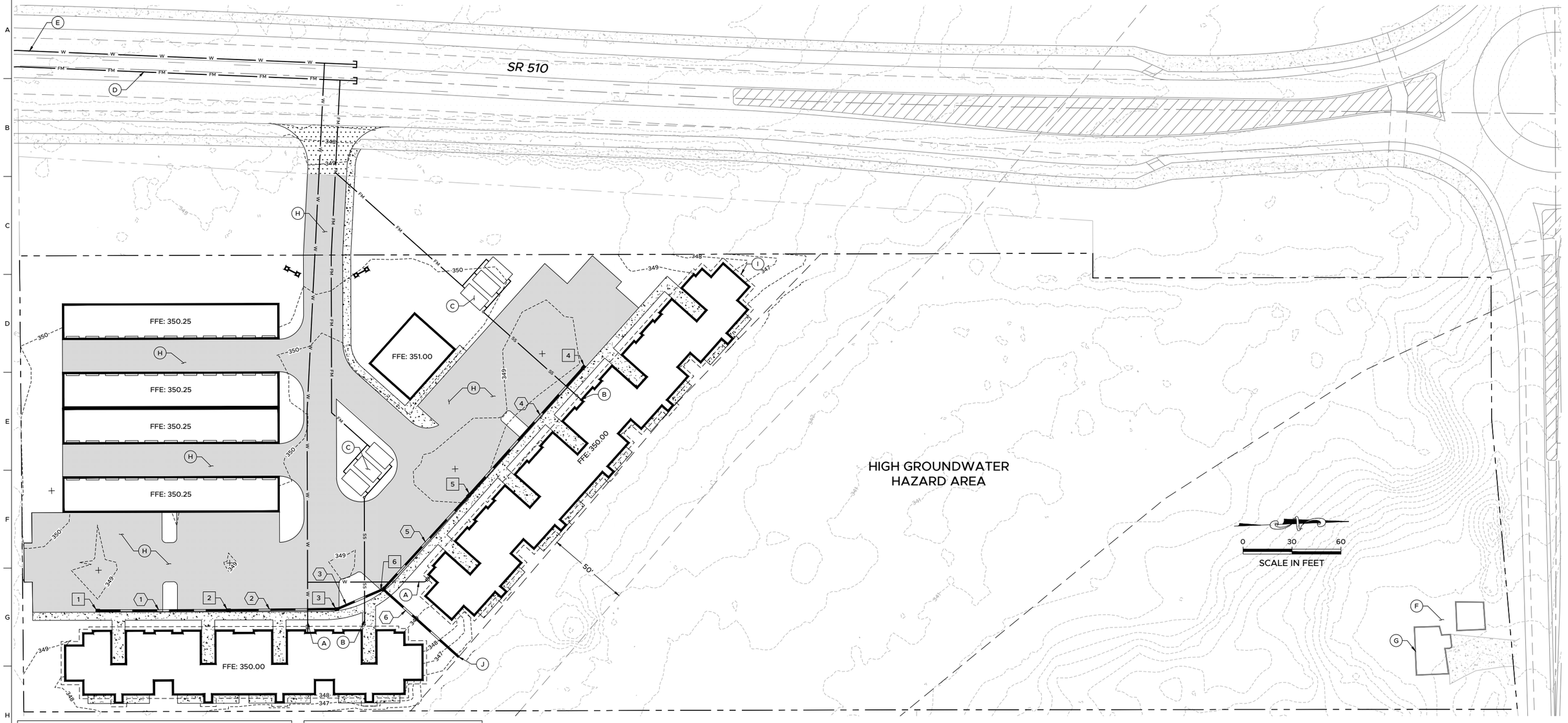
NISQUALLY LANDING APARTMENTS
17021 103RD AVE SE
YELM WA, 98597

BASIN MAP

PROJ. NO: DT01
DWG. NO:
OF

Appendix C

SW 1/4 SE 1/4 SEC 29 TWN 17 RNG 2E WM



OVERFLOW STRUCTURE TABLE

NAME	RIM ELEVATION	INVERTS	NORTHING	EASTING
1	349.04	12" IE:345.04(N)	591165.3530	1121360.5677
2	349.12	12" IE:344.64(S) 12" IE:344.64(N)	591245.4806	1121363.6541
3	349.10	12" IE:344.31(S) 12" IE:344.31(N)	591311.8922	1121365.6060
4	349.02	12" IE:345.02(SE)	591468.8434	1121223.6862
5	348.96	12" IE:344.49(NW) 12" IE:344.49(SE)	591395.3509	1121299.3715
6	349.07	12" IE:344.10(S) 12" IE:344.10(NW) 12" IE:344.10(NE)	591340.6214	1121354.5866

OVERFLOW PIPE TABLE

NAME	SIZE	LENGTH	GRADE (FT/FT)
1	12"	80'	0.005
2	12"	66'	0.005
3	12"	31'	0.007
4	12"	105'	0.005
5	12"	78'	0.005
6	12"	62'	0.005

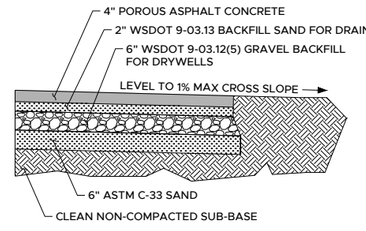
POROUS ASPHALT
(1/2" PG 70-22)

AGGREGATE TO BE 1/2" CRUSHED ROCK MEETING THE FOLLOWING GRADATION

US STANDARD SIEVE	PERCENT PASSING
1/2	100
#4	92-98
#8	12-18
#16	7-13
#30	0-5
#200	0-3

PROPORTIONS

5.5% TO 6.0%



1 NOT TO SCALE

PERVIOUS ASPHALT PAVEMENT SECTION DETAIL

NOTES:

1. POROUS ASPHALT PAVEMENT TO BE INSTALLED AFTER THE SITE HAS BEEN STABILIZED.
2. LOOSE MATERIAL IS TO BE REMOVED AND ANY SOFT AREAS ARE TO BE OVER EXCAVATED AND BROUGHT BACK TO GRADE WITH GRAVEL BACKFILL FOR DRYWELLS.
3. PLACE 8 INCHES MIN, QUARRY SPALLS OVER PERMEABLE SURFACE AREA TO PROVIDE TEMPORARY CONSTRUCTION ACCESS. EXCAVATE TO SUBGRADE ONLY AFTER SITE IS STABILIZED, CONSTRUCTION ACCESS IS NO LONGER NEEDED AND THE FINAL ROAD SECTION IS THE BE CONSTRUCTED.
4. SUBGRADE IS TO BE COMPACTED TO THE MINIMUM NECESSARY FOR STRUCTURAL STABILITY, USE STATIC DUAL WHEEL SMALL MECHANICAL ROLLERS OR PLATE VIBRATION MACHINES FOR COMPACTION. HEAVY EQUIPMENT OR TRUCK TRAFFIC IS NOT ALLOWED ON SUBGRADE.

KEY NOTES

- A: 1" WATER SERVICE
- B: GRAVITY SEWER CONNECTION TO BUILDING DRAIN
- C: PROPOSED STEP SYSTEM (6) 6,000 GALLON TANKS
- D: PROPOSED SANITARY SEWER FORCE MAIN EXTENSION TO SITE
- E: PROPOSED WATER MAIN EXTENSION TO SITE
- F: LOCATION OF EXISTING SEPTIC SYSTEM AND WELL HEAD UNKNOWN
- G: EXISTING SINGLE FAMILY RESIDENCE
- H: PERVIOUS ASPHALT PAVEMENT PER DETAIL 1/C-2
- I: PROPOSED ROOF OVERHANG (TYP)
- J: EMERGENCY OVERFLOW DISCHARGE

DATE:	REVISION:	DWN. BY:	APP'D. BY:

REVIEWED BY: NDT
DESIGNED BY: PCS
DRAWN BY: PCS
DATE: 10-22-2019

Know what's BELOW
Call 811 before you dig.

NICHOLAS DAVID TAYLOR
STATE OF WASHINGTON
46113
REGISTERED
PROFESSIONAL ENGINEER
10/22/19

IRISGROUP
civil engineers
360-688-1302 | 420 Golf Club Rd, Suite 200, Lacey, WA 98503

NISQUALLY LANDING APARTMENTS
17021 103RD AVE SE
YELM WA, 98597

PRELIMINARY GRADING, DRAINAGE, AND UTILITY PLAN

PROJ. NO: DT01
DWG. NO: C-2
3 OF 5

Appendix D

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	Nisqually Landing Apartments
Site Name:	
Site Address:	
City:	
Report Date:	10/21/2019
Gage:	Lake Lawrence
Data Start:	1955/10/01
Data End:	2008/09/30
Timestep:	15 Minute
Precip Scale:	0.857
Version Date:	2018/10/10
Version:	4.2.16

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data

Predeveloped Land Use

Storage Roofs (2)

Bypass:	No
Impervious Land Use	acre
ROOF TOPS FLAT LAT	0.133
Element Flows To:	
Outlet 1	Outlet 2
Permeable Pavement 1	

Mitigated Land Use

A Roof and Walk

Bypass:	No
Impervious Land Use	acre
ROOF TOPS FLAT LAT	0.23

Element Flows To:

Outlet 1	Outlet 2
A	

B Roof and Walk

Bypass:	No
Impervious Land Use	acre
ROOF TOPS FLAT LAT	0.34

Element Flows To:

Outlet 1	Outlet 2
B	

D Roof and Walk

Bypass:	No
Impervious Land Use	acre
ROOF TOPS FLAT LAT	0.13

Element Flows To:

Outlet 1	Outlet 2
D	

E Roof and Walk

Bypass:	No
Impervious Land Use	acre
ROOF TOPS FLAT LAT	0.13

Element Flows To:

Outlet 1	Outlet 2
E	

F Roof and Walk

Bypass:	No
Impervious Land Use	acre
ROOF TOPS FLAT LAT	0.01

Element Flows To:

Outlet 1	Outlet 2
F	

A Lawn

Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Lawn, Flat	.07

Element Flows To:

Surface	Interflow	Groundwater
A	A	

B Lawn

Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Lawn, Flat	.1

Element Flows To:

Surface	Interflow	Groundwater
B	B	

F Roof and Walk

Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Lawn, Flat	.03

Element Flows To:

Surface	Interflow	Groundwater
F	F	

Routing Elements
Predeveloped Routing

Permeable Pavement 1

Pavement Area:0.0606 acre.Pavement Length:132.00 ft.

Pavement Width:	20.00 ft.
	Pavement slope 1:0 To 1
Pavement thickness:	0.3333
Pour Space of Pavement:	0.16
Material thickness of second layer:	0.5
Pour Space of material for second layer:	0.3
Material thickness of third layer:	0.5
Pour Space of material for third layer:	0.2
Infiltration On	
Infiltration rate:	30
Infiltration safety factor:	1
Total Volume Infiltrated (ac-ft.):	36.491
Total Volume Through Riser (ac-ft.):	0
Total Volume Through Facility (ac-ft.):	36.491
Percent Infiltrated:	100
Total Precip Applied to Facility:	0
Total Evap From Facility:	0.718

Element Flows To:
Outlet 1 Outlet 2

Permeable Pavement Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.060	0.000	0.000	0.000
0.0148	0.060	0.000	0.000	1.833
0.0296	0.060	0.000	0.000	1.833
0.0444	0.060	0.000	0.000	1.833
0.0593	0.060	0.000	0.000	1.833
0.0741	0.060	0.000	0.000	1.833
0.0889	0.060	0.001	0.000	1.833
0.1037	0.060	0.001	0.000	1.833
0.1185	0.060	0.001	0.000	1.833
0.1333	0.060	0.001	0.000	1.833
0.1481	0.060	0.001	0.000	1.833
0.1630	0.060	0.002	0.000	1.833
0.1778	0.060	0.002	0.000	1.833
0.1926	0.060	0.002	0.000	1.833
0.2074	0.060	0.002	0.000	1.833
0.2222	0.060	0.002	0.000	1.833
0.2370	0.060	0.002	0.000	1.833
0.2518	0.060	0.003	0.000	1.833
0.2667	0.060	0.003	0.000	1.833
0.2815	0.060	0.003	0.000	1.833
0.2963	0.060	0.003	0.000	1.833
0.3111	0.060	0.003	0.000	1.833
0.3259	0.060	0.004	0.000	1.833
0.3407	0.060	0.004	0.000	1.833
0.3555	0.060	0.004	0.000	1.833
0.3704	0.060	0.004	0.000	1.833
0.3852	0.060	0.004	0.000	1.833

0.4000	0.060	0.004	0.000	1.833
0.4148	0.060	0.005	0.000	1.833
0.4296	0.060	0.005	0.000	1.833
0.4444	0.060	0.005	0.000	1.833
0.4592	0.060	0.005	0.000	1.833
0.4741	0.060	0.005	0.000	1.833
0.4889	0.060	0.005	0.000	1.833
0.5037	0.060	0.006	0.000	1.833
0.5185	0.060	0.006	0.000	1.833
0.5333	0.060	0.006	0.000	1.833
0.5481	0.060	0.007	0.000	1.833
0.5629	0.060	0.007	0.000	1.833
0.5778	0.060	0.007	0.000	1.833
0.5926	0.060	0.007	0.000	1.833
0.6074	0.060	0.008	0.000	1.833
0.6222	0.060	0.008	0.000	1.833
0.6370	0.060	0.008	0.000	1.833
0.6518	0.060	0.008	0.000	1.833
0.6666	0.060	0.009	0.000	1.833
0.6815	0.060	0.009	0.000	1.833
0.6963	0.060	0.009	0.000	1.833
0.7111	0.060	0.010	0.000	1.833
0.7259	0.060	0.010	0.000	1.833
0.7407	0.060	0.010	0.000	1.833
0.7555	0.060	0.010	0.000	1.833
0.7704	0.060	0.011	0.000	1.833
0.7852	0.060	0.011	0.000	1.833
0.8000	0.060	0.011	0.000	1.833
0.8148	0.060	0.011	0.000	1.833
0.8296	0.060	0.012	0.000	1.833
0.8444	0.060	0.012	0.000	1.833
0.8592	0.060	0.012	0.000	1.833
0.8741	0.060	0.012	0.000	1.833
0.8889	0.060	0.013	0.000	1.833
0.9037	0.060	0.013	0.000	1.833
0.9185	0.060	0.013	0.000	1.833
0.9333	0.060	0.014	0.000	1.833
0.9481	0.060	0.014	0.000	1.833
0.9629	0.060	0.014	0.000	1.833
0.9778	0.060	0.014	0.000	1.833
0.9926	0.060	0.015	0.000	1.833
1.0074	0.060	0.015	0.000	1.833
1.0222	0.060	0.015	0.000	1.833
1.0370	0.060	0.015	0.000	1.833
1.0518	0.060	0.015	0.000	1.833
1.0666	0.060	0.015	0.000	1.833
1.0815	0.060	0.015	0.000	1.833
1.0963	0.060	0.016	0.000	1.833
1.1111	0.060	0.016	0.000	1.833
1.1259	0.060	0.016	0.000	1.833
1.1407	0.060	0.016	0.000	1.833
1.1555	0.060	0.016	0.000	1.833
1.1703	0.060	0.016	0.000	1.833
1.1852	0.060	0.017	0.000	1.833
1.2000	0.060	0.017	0.000	1.833
1.2148	0.060	0.017	0.000	1.833
1.2296	0.060	0.017	0.000	1.833
1.2444	0.060	0.017	0.000	1.833

1.2592	0.060	0.017	0.000	1.833
1.2740	0.060	0.017	0.000	1.833
1.2889	0.060	0.018	0.000	1.833
1.3037	0.060	0.018	0.000	1.833
1.3185	0.060	0.018	0.000	1.833
1.3333	0.060	0.018	0.000	1.833

Mitigated Routing

A

Pavement Area:0.0700 acre.Pavement Length:1.00 ft.
Pavement Width: 3049.00 ft.
Pavement slope 1:0 To 1
Pavement thickness: 0.3333
Pour Space of Pavement: 0.16
Material thickness of second layer: 0.5
Pour Space of material for second layer: 0.3
Material thickness of third layer: 0.5
Pour Space of material for third layer: 0.2
Infiltration On
Infiltration rate: 30
Infiltration safety factor: 1
Total Volume Infiltrated (ac-ft.): 48.578
Total Volume Through Riser (ac-ft.): 0
Total Volume Through Facility (ac-ft.): 48.578
Percent Infiltrated: 100
Total Precip Applied to Facility: 0
Total Evap From Facility: 0.846
Element Flows To:
Outlet 1 Outlet 2

Permeable Pavement Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.070	0.000	0.000	0.000
0.0148	0.070	0.000	0.000	2.117
0.0296	0.070	0.000	0.000	2.117
0.0444	0.070	0.000	0.000	2.117
0.0593	0.070	0.000	0.000	2.117
0.0741	0.070	0.001	0.000	2.117
0.0889	0.070	0.001	0.000	2.117
0.1037	0.070	0.001	0.000	2.117
0.1185	0.070	0.001	0.000	2.117
0.1333	0.070	0.001	0.000	2.117
0.1481	0.070	0.002	0.000	2.117
0.1630	0.070	0.002	0.000	2.117
0.1778	0.070	0.002	0.000	2.117
0.1926	0.070	0.002	0.000	2.117
0.2074	0.070	0.002	0.000	2.117
0.2222	0.070	0.003	0.000	2.117
0.2370	0.070	0.003	0.000	2.117
0.2518	0.070	0.003	0.000	2.117
0.2667	0.070	0.003	0.000	2.117
0.2815	0.070	0.003	0.000	2.117
0.2963	0.070	0.004	0.000	2.117
0.3111	0.070	0.004	0.000	2.117
0.3259	0.070	0.004	0.000	2.117
0.3407	0.070	0.004	0.000	2.117
0.3555	0.070	0.005	0.000	2.117
0.3704	0.070	0.005	0.000	2.117
0.3852	0.070	0.005	0.000	2.117
0.4000	0.070	0.005	0.000	2.117
0.4148	0.070	0.005	0.000	2.117

0.4296	0.070	0.006	0.000	2.117
0.4444	0.070	0.006	0.000	2.117
0.4592	0.070	0.006	0.000	2.117
0.4741	0.070	0.006	0.000	2.117
0.4889	0.070	0.006	0.000	2.117
0.5037	0.070	0.007	0.000	2.117
0.5185	0.070	0.007	0.000	2.117
0.5333	0.070	0.007	0.000	2.117
0.5481	0.070	0.008	0.000	2.117
0.5629	0.070	0.008	0.000	2.117
0.5778	0.070	0.008	0.000	2.117
0.5926	0.070	0.009	0.000	2.117
0.6074	0.070	0.009	0.000	2.117
0.6222	0.070	0.009	0.000	2.117
0.6370	0.070	0.010	0.000	2.117
0.6518	0.070	0.010	0.000	2.117
0.6666	0.070	0.010	0.000	2.117
0.6815	0.070	0.010	0.000	2.117
0.6963	0.070	0.011	0.000	2.117
0.7111	0.070	0.011	0.000	2.117
0.7259	0.070	0.011	0.000	2.117
0.7407	0.070	0.012	0.000	2.117
0.7555	0.070	0.012	0.000	2.117
0.7704	0.070	0.012	0.000	2.117
0.7852	0.070	0.013	0.000	2.117
0.8000	0.070	0.013	0.000	2.117
0.8148	0.070	0.013	0.000	2.117
0.8296	0.070	0.014	0.000	2.117
0.8444	0.070	0.014	0.000	2.117
0.8592	0.070	0.014	0.000	2.117
0.8741	0.070	0.014	0.000	2.117
0.8889	0.070	0.015	0.000	2.117
0.9037	0.070	0.015	0.000	2.117
0.9185	0.070	0.015	0.000	2.117
0.9333	0.070	0.016	0.000	2.117
0.9481	0.070	0.016	0.000	2.117
0.9629	0.070	0.016	0.000	2.117
0.9778	0.070	0.017	0.000	2.117
0.9926	0.070	0.017	0.000	2.117
1.0074	0.070	0.017	0.000	2.117
1.0222	0.070	0.017	0.000	2.117
1.0370	0.070	0.017	0.000	2.117
1.0518	0.070	0.018	0.000	2.117
1.0666	0.070	0.018	0.000	2.117
1.0815	0.070	0.018	0.000	2.117
1.0963	0.070	0.018	0.000	2.117
1.1111	0.070	0.018	0.000	2.117
1.1259	0.070	0.018	0.000	2.117
1.1407	0.070	0.019	0.000	2.117
1.1555	0.070	0.019	0.000	2.117
1.1703	0.070	0.019	0.000	2.117
1.1852	0.070	0.019	0.000	2.117
1.2000	0.070	0.019	0.000	2.117
1.2148	0.070	0.019	0.000	2.117
1.2296	0.070	0.020	0.000	2.117
1.2444	0.070	0.020	0.000	2.117
1.2592	0.070	0.020	0.000	2.117
1.2740	0.070	0.020	0.000	2.117

1.2889	0.070	0.020	0.000	2.117
1.3037	0.070	0.020	0.000	2.117
1.3185	0.070	0.021	0.000	2.117
1.3333	0.070	0.021	0.000	2.117

B

Pavement Area:0.3100 acre.Pavement Length:1.00 ft.

Pavement Width:	13503.00 ft.
	Pavement slope 1:0 To 1
Pavement thickness:	0.3333
Pour Space of Pavement:	0.16
Material thickness of second layer:	0.5
Pour Space of material for second layer:	0.3
Material thickness of third layer:	0.5
Pour Space of material for third layer:	0.2
Infiltration On	
Infiltration rate:	30
Infiltration safety factor:	1
Total Volume Infiltrated (ac-ft.):	109.005
Total Volume Through Riser (ac-ft.):	0
Total Volume Through Facility (ac-ft.):	109.005
Percent Infiltrated:	100
Total Precip Applied to Facility:	0
Total Evap From Facility:	3.037
Element Flows To:	
Outlet 1	Outlet 2

Permeable Pavement Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.310	0.000	0.000	0.000
0.0148	0.310	0.000	0.000	9.377
0.0296	0.310	0.001	0.000	9.377
0.0444	0.310	0.002	0.000	9.377
0.0593	0.310	0.003	0.000	9.377
0.0741	0.310	0.004	0.000	9.377
0.0889	0.310	0.005	0.000	9.377
0.1037	0.310	0.006	0.000	9.377
0.1185	0.310	0.007	0.000	9.377
0.1333	0.310	0.008	0.000	9.377
0.1481	0.310	0.009	0.000	9.377
0.1630	0.310	0.010	0.000	9.377
0.1778	0.310	0.011	0.000	9.377
0.1926	0.310	0.011	0.000	9.377
0.2074	0.310	0.012	0.000	9.377
0.2222	0.310	0.013	0.000	9.377
0.2370	0.310	0.014	0.000	9.377
0.2518	0.310	0.015	0.000	9.377
0.2667	0.310	0.016	0.000	9.377
0.2815	0.310	0.017	0.000	9.377
0.2963	0.310	0.018	0.000	9.377
0.3111	0.310	0.019	0.000	9.377
0.3259	0.310	0.020	0.000	9.377
0.3407	0.310	0.021	0.000	9.377
0.3555	0.310	0.022	0.000	9.377
0.3704	0.310	0.023	0.000	9.377
0.3852	0.310	0.023	0.000	9.377
0.4000	0.310	0.024	0.000	9.377
0.4148	0.310	0.025	0.000	9.377
0.4296	0.310	0.026	0.000	9.377
0.4444	0.310	0.027	0.000	9.377

0.4592	0.310	0.028	0.000	9.377
0.4741	0.310	0.029	0.000	9.377
0.4889	0.310	0.030	0.000	9.377
0.5037	0.310	0.031	0.000	9.377
0.5185	0.310	0.033	0.000	9.377
0.5333	0.310	0.034	0.000	9.377
0.5481	0.310	0.035	0.000	9.377
0.5629	0.310	0.037	0.000	9.377
0.5778	0.310	0.038	0.000	9.377
0.5926	0.310	0.040	0.000	9.377
0.6074	0.310	0.041	0.000	9.377
0.6222	0.310	0.042	0.000	9.377
0.6370	0.310	0.044	0.000	9.377
0.6518	0.310	0.045	0.000	9.377
0.6666	0.310	0.046	0.000	9.377
0.6815	0.310	0.048	0.000	9.377
0.6963	0.310	0.049	0.000	9.377
0.7111	0.310	0.051	0.000	9.377
0.7259	0.310	0.052	0.000	9.377
0.7407	0.310	0.053	0.000	9.377
0.7555	0.310	0.055	0.000	9.377
0.7704	0.310	0.056	0.000	9.377
0.7852	0.310	0.057	0.000	9.377
0.8000	0.310	0.059	0.000	9.377
0.8148	0.310	0.060	0.000	9.377
0.8296	0.310	0.062	0.000	9.377
0.8444	0.310	0.063	0.000	9.377
0.8592	0.310	0.064	0.000	9.377
0.8741	0.310	0.066	0.000	9.377
0.8889	0.310	0.067	0.000	9.377
0.9037	0.310	0.068	0.000	9.377
0.9185	0.310	0.070	0.000	9.377
0.9333	0.310	0.071	0.000	9.377
0.9481	0.310	0.073	0.000	9.377
0.9629	0.310	0.074	0.000	9.377
0.9778	0.310	0.075	0.000	9.377
0.9926	0.310	0.077	0.000	9.377
1.0074	0.310	0.077	0.000	9.377
1.0222	0.310	0.078	0.000	9.377
1.0370	0.310	0.079	0.000	9.377
1.0518	0.310	0.080	0.000	9.377
1.0666	0.310	0.080	0.000	9.377
1.0815	0.310	0.081	0.000	9.377
1.0963	0.310	0.082	0.000	9.377
1.1111	0.310	0.083	0.000	9.377
1.1259	0.310	0.083	0.000	9.377
1.1407	0.310	0.084	0.000	9.377
1.1555	0.310	0.085	0.000	9.377
1.1703	0.310	0.086	0.000	9.377
1.1852	0.310	0.086	0.000	9.377
1.2000	0.310	0.087	0.000	9.377
1.2148	0.310	0.088	0.000	9.377
1.2296	0.310	0.088	0.000	9.377
1.2444	0.310	0.089	0.000	9.377
1.2592	0.310	0.090	0.000	9.377
1.2740	0.310	0.091	0.000	9.377
1.2889	0.310	0.091	0.000	9.377
1.3037	0.310	0.092	0.000	9.377

1.3185	0.310	0.093	0.000	9.377
1.3333	0.310	0.094	0.000	9.377

D

Pavement Area:0.0600 acre.Pavement Length:1.00 ft.

Pavement Width:	2613.00 ft.
	Pavement slope 1:0 To 1
Pavement thickness:	0.3333
Pour Space of Pavement:	0.16
Material thickness of second layer:	0.5
Pour Space of material for second layer:	0.3
Material thickness of third layer:	0.5
Pour Space of material for third layer:	0.2
Infiltration On	
Infiltration rate:	30
Infiltration safety factor:	1
Total Volume Infiltrated (ac-ft.):	29.391
Total Volume Through Riser (ac-ft.):	0
Total Volume Through Facility (ac-ft.):	29.391
Percent Infiltrated:	100
Total Precip Applied to Facility:	0
Total Evap From Facility:	0.666
Element Flows To:	
Outlet 1	Outlet 2

Permeable Pavement Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.060	0.000	0.000	0.000
0.0148	0.060	0.000	0.000	1.814
0.0296	0.060	0.000	0.000	1.814
0.0444	0.060	0.000	0.000	1.814
0.0593	0.060	0.000	0.000	1.814
0.0741	0.060	0.000	0.000	1.814
0.0889	0.060	0.001	0.000	1.814
0.1037	0.060	0.001	0.000	1.814
0.1185	0.060	0.001	0.000	1.814
0.1333	0.060	0.001	0.000	1.814
0.1481	0.060	0.001	0.000	1.814
0.1630	0.060	0.002	0.000	1.814
0.1778	0.060	0.002	0.000	1.814
0.1926	0.060	0.002	0.000	1.814
0.2074	0.060	0.002	0.000	1.814
0.2222	0.060	0.002	0.000	1.814
0.2370	0.060	0.002	0.000	1.814
0.2518	0.060	0.003	0.000	1.814
0.2667	0.060	0.003	0.000	1.814
0.2815	0.060	0.003	0.000	1.814
0.2963	0.060	0.003	0.000	1.814
0.3111	0.060	0.003	0.000	1.814
0.3259	0.060	0.003	0.000	1.814
0.3407	0.060	0.004	0.000	1.814
0.3555	0.060	0.004	0.000	1.814
0.3704	0.060	0.004	0.000	1.814
0.3852	0.060	0.004	0.000	1.814
0.4000	0.060	0.004	0.000	1.814
0.4148	0.060	0.005	0.000	1.814
0.4296	0.060	0.005	0.000	1.814
0.4444	0.060	0.005	0.000	1.814

0.4592	0.060	0.005	0.000	1.814
0.4741	0.060	0.005	0.000	1.814
0.4889	0.060	0.005	0.000	1.814
0.5037	0.060	0.006	0.000	1.814
0.5185	0.060	0.006	0.000	1.814
0.5333	0.060	0.006	0.000	1.814
0.5481	0.060	0.006	0.000	1.814
0.5629	0.060	0.007	0.000	1.814
0.5778	0.060	0.007	0.000	1.814
0.5926	0.060	0.007	0.000	1.814
0.6074	0.060	0.008	0.000	1.814
0.6222	0.060	0.008	0.000	1.814
0.6370	0.060	0.008	0.000	1.814
0.6518	0.060	0.008	0.000	1.814
0.6666	0.060	0.009	0.000	1.814
0.6815	0.060	0.009	0.000	1.814
0.6963	0.060	0.009	0.000	1.814
0.7111	0.060	0.009	0.000	1.814
0.7259	0.060	0.010	0.000	1.814
0.7407	0.060	0.010	0.000	1.814
0.7555	0.060	0.010	0.000	1.814
0.7704	0.060	0.010	0.000	1.814
0.7852	0.060	0.011	0.000	1.814
0.8000	0.060	0.011	0.000	1.814
0.8148	0.060	0.011	0.000	1.814
0.8296	0.060	0.012	0.000	1.814
0.8444	0.060	0.012	0.000	1.814
0.8592	0.060	0.012	0.000	1.814
0.8741	0.060	0.012	0.000	1.814
0.8889	0.060	0.013	0.000	1.814
0.9037	0.060	0.013	0.000	1.814
0.9185	0.060	0.013	0.000	1.814
0.9333	0.060	0.013	0.000	1.814
0.9481	0.060	0.014	0.000	1.814
0.9629	0.060	0.014	0.000	1.814
0.9778	0.060	0.014	0.000	1.814
0.9926	0.060	0.014	0.000	1.814
1.0074	0.060	0.015	0.000	1.814
1.0222	0.060	0.015	0.000	1.814
1.0370	0.060	0.015	0.000	1.814
1.0518	0.060	0.015	0.000	1.814
1.0666	0.060	0.015	0.000	1.814
1.0815	0.060	0.015	0.000	1.814
1.0963	0.060	0.015	0.000	1.814
1.1111	0.060	0.016	0.000	1.814
1.1259	0.060	0.016	0.000	1.814
1.1407	0.060	0.016	0.000	1.814
1.1555	0.060	0.016	0.000	1.814
1.1703	0.060	0.016	0.000	1.814
1.1852	0.060	0.016	0.000	1.814
1.2000	0.060	0.016	0.000	1.814
1.2148	0.060	0.017	0.000	1.814
1.2296	0.060	0.017	0.000	1.814
1.2444	0.060	0.017	0.000	1.814
1.2592	0.060	0.017	0.000	1.814
1.2740	0.060	0.017	0.000	1.814
1.2889	0.060	0.017	0.000	1.814
1.3037	0.060	0.017	0.000	1.814

1.3185	0.060	0.018	0.000	1.814
1.3333	0.060	0.018	0.000	1.814

E

Pavement Area:0.0600 acre.Pavement Length:1.00 ft.

Pavement Width:	2613.00 ft.
	Pavement slope 1:0 To 1
Pavement thickness:	0.3333
Pour Space of Pavement:	0.16
Material thickness of second layer:	0.5
Pour Space of material for second layer:	0.3
Material thickness of third layer:	0.5
Pour Space of material for third layer:	0.2
Infiltration On	
Infiltration rate:	30
Infiltration safety factor:	1
Total Volume Infiltrated (ac-ft.):	29.391
Total Volume Through Riser (ac-ft.):	0
Total Volume Through Facility (ac-ft.):	29.391
Percent Infiltrated:	100
Total Precip Applied to Facility:	0
Total Evap From Facility:	0.666

Element Flows To:

Outlet 1 Outlet 2

Permeable Pavement Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.060	0.000	0.000	0.000
0.0148	0.060	0.000	0.000	1.814
0.0296	0.060	0.000	0.000	1.814
0.0444	0.060	0.000	0.000	1.814
0.0593	0.060	0.000	0.000	1.814
0.0741	0.060	0.000	0.000	1.814
0.0889	0.060	0.001	0.000	1.814
0.1037	0.060	0.001	0.000	1.814
0.1185	0.060	0.001	0.000	1.814
0.1333	0.060	0.001	0.000	1.814
0.1481	0.060	0.001	0.000	1.814
0.1630	0.060	0.002	0.000	1.814
0.1778	0.060	0.002	0.000	1.814
0.1926	0.060	0.002	0.000	1.814
0.2074	0.060	0.002	0.000	1.814
0.2222	0.060	0.002	0.000	1.814
0.2370	0.060	0.002	0.000	1.814
0.2518	0.060	0.003	0.000	1.814
0.2667	0.060	0.003	0.000	1.814
0.2815	0.060	0.003	0.000	1.814
0.2963	0.060	0.003	0.000	1.814
0.3111	0.060	0.003	0.000	1.814
0.3259	0.060	0.003	0.000	1.814
0.3407	0.060	0.004	0.000	1.814
0.3555	0.060	0.004	0.000	1.814
0.3704	0.060	0.004	0.000	1.814
0.3852	0.060	0.004	0.000	1.814
0.4000	0.060	0.004	0.000	1.814
0.4148	0.060	0.005	0.000	1.814
0.4296	0.060	0.005	0.000	1.814
0.4444	0.060	0.005	0.000	1.814

0.4592	0.060	0.005	0.000	1.814
0.4741	0.060	0.005	0.000	1.814
0.4889	0.060	0.005	0.000	1.814
0.5037	0.060	0.006	0.000	1.814
0.5185	0.060	0.006	0.000	1.814
0.5333	0.060	0.006	0.000	1.814
0.5481	0.060	0.006	0.000	1.814
0.5629	0.060	0.007	0.000	1.814
0.5778	0.060	0.007	0.000	1.814
0.5926	0.060	0.007	0.000	1.814
0.6074	0.060	0.008	0.000	1.814
0.6222	0.060	0.008	0.000	1.814
0.6370	0.060	0.008	0.000	1.814
0.6518	0.060	0.008	0.000	1.814
0.6666	0.060	0.009	0.000	1.814
0.6815	0.060	0.009	0.000	1.814
0.6963	0.060	0.009	0.000	1.814
0.7111	0.060	0.009	0.000	1.814
0.7259	0.060	0.010	0.000	1.814
0.7407	0.060	0.010	0.000	1.814
0.7555	0.060	0.010	0.000	1.814
0.7704	0.060	0.010	0.000	1.814
0.7852	0.060	0.011	0.000	1.814
0.8000	0.060	0.011	0.000	1.814
0.8148	0.060	0.011	0.000	1.814
0.8296	0.060	0.012	0.000	1.814
0.8444	0.060	0.012	0.000	1.814
0.8592	0.060	0.012	0.000	1.814
0.8741	0.060	0.012	0.000	1.814
0.8889	0.060	0.013	0.000	1.814
0.9037	0.060	0.013	0.000	1.814
0.9185	0.060	0.013	0.000	1.814
0.9333	0.060	0.013	0.000	1.814
0.9481	0.060	0.014	0.000	1.814
0.9629	0.060	0.014	0.000	1.814
0.9778	0.060	0.014	0.000	1.814
0.9926	0.060	0.014	0.000	1.814
1.0074	0.060	0.015	0.000	1.814
1.0222	0.060	0.015	0.000	1.814
1.0370	0.060	0.015	0.000	1.814
1.0518	0.060	0.015	0.000	1.814
1.0666	0.060	0.015	0.000	1.814
1.0815	0.060	0.015	0.000	1.814
1.0963	0.060	0.015	0.000	1.814
1.1111	0.060	0.016	0.000	1.814
1.1259	0.060	0.016	0.000	1.814
1.1407	0.060	0.016	0.000	1.814
1.1555	0.060	0.016	0.000	1.814
1.1703	0.060	0.016	0.000	1.814
1.1852	0.060	0.016	0.000	1.814
1.2000	0.060	0.016	0.000	1.814
1.2148	0.060	0.017	0.000	1.814
1.2296	0.060	0.017	0.000	1.814
1.2444	0.060	0.017	0.000	1.814
1.2592	0.060	0.017	0.000	1.814
1.2740	0.060	0.017	0.000	1.814
1.2889	0.060	0.017	0.000	1.814
1.3037	0.060	0.017	0.000	1.814

1.3185	0.060	0.018	0.000	1.814
1.3333	0.060	0.018	0.000	1.814

F

Pavement Area:0.1100 acre.Pavement Length:1.00 ft.
Pavement Width: 4791.00 ft.
Pavement slope 1:0 To 1
Pavement thickness: 0.3333
Pour Space of Pavement: 0.16
Material thickness of second layer: 0.5
Pour Space of material for second layer: 0.3
Material thickness of third layer: 0.5
Pour Space of material for third layer: 0.2
Infiltration On
Infiltration rate: 30
Infiltration safety factor: 1
Total Volume Infiltrated (ac-ft.): 17.582
Total Volume Through Riser (ac-ft.): 0
Total Volume Through Facility (ac-ft.): 17.582
Percent Infiltrated: 100
Total Precip Applied to Facility: 0
Total Evap From Facility: 0.857
Element Flows To:
Outlet 1 Outlet 2

Permeable Pavement Hydraulic Table

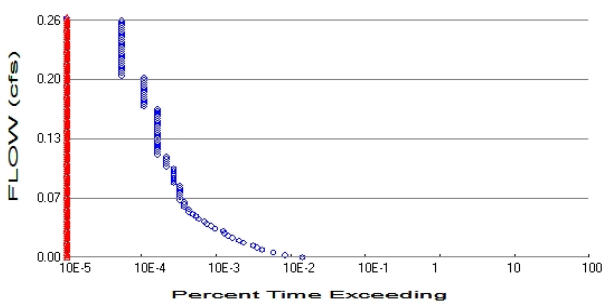
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.110	0.000	0.000	0.000
0.0148	0.110	0.000	0.000	3.327
0.0296	0.110	0.000	0.000	3.327
0.0444	0.110	0.001	0.000	3.327
0.0593	0.110	0.001	0.000	3.327
0.0741	0.110	0.001	0.000	3.327
0.0889	0.110	0.002	0.000	3.327
0.1037	0.110	0.002	0.000	3.327
0.1185	0.110	0.002	0.000	3.327
0.1333	0.110	0.002	0.000	3.327
0.1481	0.110	0.003	0.000	3.327
0.1630	0.110	0.003	0.000	3.327
0.1778	0.110	0.003	0.000	3.327
0.1926	0.110	0.004	0.000	3.327
0.2074	0.110	0.004	0.000	3.327
0.2222	0.110	0.004	0.000	3.327
0.2370	0.110	0.005	0.000	3.327
0.2518	0.110	0.005	0.000	3.327
0.2667	0.110	0.005	0.000	3.327
0.2815	0.110	0.006	0.000	3.327
0.2963	0.110	0.006	0.000	3.327
0.3111	0.110	0.006	0.000	3.327
0.3259	0.110	0.007	0.000	3.327
0.3407	0.110	0.007	0.000	3.327
0.3555	0.110	0.007	0.000	3.327
0.3704	0.110	0.008	0.000	3.327
0.3852	0.110	0.008	0.000	3.327
0.4000	0.110	0.008	0.000	3.327
0.4148	0.110	0.009	0.000	3.327
0.4296	0.110	0.009	0.000	3.327
0.4444	0.110	0.009	0.000	3.327

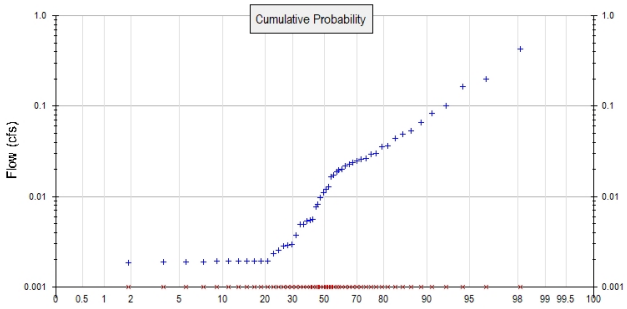
0.4592	0.110	0.010	0.000	3.327
0.4741	0.110	0.010	0.000	3.327
0.4889	0.110	0.010	0.000	3.327
0.5037	0.110	0.011	0.000	3.327
0.5185	0.110	0.011	0.000	3.327
0.5333	0.110	0.012	0.000	3.327
0.5481	0.110	0.012	0.000	3.327
0.5629	0.110	0.013	0.000	3.327
0.5778	0.110	0.013	0.000	3.327
0.5926	0.110	0.014	0.000	3.327
0.6074	0.110	0.014	0.000	3.327
0.6222	0.110	0.015	0.000	3.327
0.6370	0.110	0.015	0.000	3.327
0.6518	0.110	0.016	0.000	3.327
0.6666	0.110	0.016	0.000	3.327
0.6815	0.110	0.017	0.000	3.327
0.6963	0.110	0.017	0.000	3.327
0.7111	0.110	0.018	0.000	3.327
0.7259	0.110	0.018	0.000	3.327
0.7407	0.110	0.019	0.000	3.327
0.7555	0.110	0.019	0.000	3.327
0.7704	0.110	0.020	0.000	3.327
0.7852	0.110	0.020	0.000	3.327
0.8000	0.110	0.021	0.000	3.327
0.8148	0.110	0.021	0.000	3.327
0.8296	0.110	0.022	0.000	3.327
0.8444	0.110	0.022	0.000	3.327
0.8592	0.110	0.023	0.000	3.327
0.8741	0.110	0.023	0.000	3.327
0.8889	0.110	0.024	0.000	3.327
0.9037	0.110	0.024	0.000	3.327
0.9185	0.110	0.024	0.000	3.327
0.9333	0.110	0.025	0.000	3.327
0.9481	0.110	0.025	0.000	3.327
0.9629	0.110	0.026	0.000	3.327
0.9778	0.110	0.026	0.000	3.327
0.9926	0.110	0.027	0.000	3.327
1.0074	0.110	0.027	0.000	3.327
1.0222	0.110	0.027	0.000	3.327
1.0370	0.110	0.028	0.000	3.327
1.0518	0.110	0.028	0.000	3.327
1.0666	0.110	0.028	0.000	3.327
1.0815	0.110	0.028	0.000	3.327
1.0963	0.110	0.029	0.000	3.327
1.1111	0.110	0.029	0.000	3.327
1.1259	0.110	0.029	0.000	3.327
1.1407	0.110	0.030	0.000	3.327
1.1555	0.110	0.030	0.000	3.327
1.1703	0.110	0.030	0.000	3.327
1.1852	0.110	0.030	0.000	3.327
1.2000	0.110	0.031	0.000	3.327
1.2148	0.110	0.031	0.000	3.327
1.2296	0.110	0.031	0.000	3.327
1.2444	0.110	0.031	0.000	3.327
1.2592	0.110	0.032	0.000	3.327
1.2740	0.110	0.032	0.000	3.327
1.2889	0.110	0.032	0.000	3.327
1.3037	0.110	0.032	0.000	3.327

1.3185	0.110	0.033	0.000	3.327
1.3333	0.110	0.033	0.000	3.327

Analysis Results

POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0
Total Impervious Area: 0.193606

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.2
Total Impervious Area: 1.449939

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.009839
5 year	0.034876
10 year	0.070466
25 year	0.154073
50 year	0.260018
100 year	0.421423

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0
5 year	0
10 year	0
25 year	0
50 year	0
100 year	0

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1956	0.024	0.000
1957	0.030	0.000
1958	0.011	0.000
1959	0.010	0.000
1960	0.005	0.000
1961	0.016	0.000
1962	0.002	0.000
1963	0.035	0.000
1964	0.008	0.000
1965	0.017	0.000

1966	0.002	0.000
1967	0.012	0.000
1968	0.003	0.000
1969	0.002	0.000
1970	0.003	0.000
1971	0.029	0.000
1972	0.053	0.000
1973	0.004	0.000
1974	0.013	0.000
1975	0.003	0.000
1976	0.008	0.000
1977	0.002	0.000
1978	0.022	0.000
1979	0.002	0.000
1980	0.005	0.000
1981	0.027	0.000
1982	0.020	0.000
1983	0.005	0.000
1984	0.005	0.000
1985	0.002	0.000
1986	0.025	0.000
1987	0.023	0.000
1988	0.002	0.000
1989	0.002	0.000
1990	0.101	0.000
1991	0.036	0.000
1992	0.002	0.000
1993	0.002	0.000
1994	0.002	0.000
1995	0.026	0.000
1996	0.049	0.000
1997	0.044	0.000
1998	0.066	0.000
1999	0.002	0.000
2000	0.006	0.000
2001	0.002	0.000
2002	0.019	0.000
2003	0.003	0.000
2004	0.426	0.000
2005	0.199	0.000
2006	0.166	0.000
2007	0.083	0.000
2008	0.020	0.000

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.4255	0.0000
2	0.1988	0.0000
3	0.1660	0.0000
4	0.1009	0.0000
5	0.0834	0.0000
6	0.0660	0.0000
7	0.0530	0.0000
8	0.0486	0.0000
9	0.0444	0.0000
10	0.0365	0.0000
11	0.0353	0.0000

12	0.0300	0.0000
13	0.0294	0.0000
14	0.0265	0.0000
15	0.0260	0.0000
16	0.0248	0.0000
17	0.0239	0.0000
18	0.0229	0.0000
19	0.0217	0.0000
20	0.0200	0.0000
21	0.0196	0.0000
22	0.0187	0.0000
23	0.0171	0.0000
24	0.0165	0.0000
25	0.0127	0.0000
26	0.0121	0.0000
27	0.0111	0.0000
28	0.0096	0.0000
29	0.0081	0.0000
30	0.0078	0.0000
31	0.0055	0.0000
32	0.0054	0.0000
33	0.0054	0.0000
34	0.0050	0.0000
35	0.0049	0.0000
36	0.0037	0.0000
37	0.0030	0.0000
38	0.0029	0.0000
39	0.0028	0.0000
40	0.0025	0.0000
41	0.0023	0.0000
42	0.0019	0.0000
43	0.0019	0.0000
44	0.0019	0.0000
45	0.0019	0.0000
46	0.0019	0.0000
47	0.0019	0.0000
48	0.0019	0.0000
49	0.0019	0.0000
50	0.0019	0.0000
51	0.0019	0.0000
52	0.0018	0.0000
53	0.0018	0.0000

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0049	265	0	0	Pass
0.0075	157	0	0	Pass
0.0101	108	0	0	Pass
0.0126	77	0	0	Pass
0.0152	65	0	0	Pass
0.0178	58	0	0	Pass
0.0204	43	0	0	Pass
0.0230	38	0	0	Pass
0.0255	31	0	0	Pass
0.0281	27	0	0	Pass
0.0307	24	0	0	Pass
0.0333	23	0	0	Pass
0.0358	18	0	0	Pass
0.0384	16	0	0	Pass
0.0410	14	0	0	Pass
0.0436	13	0	0	Pass
0.0461	11	0	0	Pass
0.0487	10	0	0	Pass
0.0513	9	0	0	Pass
0.0539	8	0	0	Pass
0.0565	8	0	0	Pass
0.0590	7	0	0	Pass
0.0616	7	0	0	Pass
0.0642	7	0	0	Pass
0.0668	6	0	0	Pass
0.0693	6	0	0	Pass
0.0719	6	0	0	Pass
0.0745	6	0	0	Pass
0.0771	6	0	0	Pass
0.0796	6	0	0	Pass
0.0822	6	0	0	Pass
0.0848	5	0	0	Pass
0.0874	5	0	0	Pass
0.0900	5	0	0	Pass
0.0925	5	0	0	Pass
0.0951	5	0	0	Pass
0.0977	5	0	0	Pass
0.1003	5	0	0	Pass
0.1028	4	0	0	Pass
0.1054	4	0	0	Pass
0.1080	4	0	0	Pass
0.1106	4	0	0	Pass
0.1131	4	0	0	Pass
0.1157	3	0	0	Pass
0.1183	3	0	0	Pass
0.1209	3	0	0	Pass
0.1235	3	0	0	Pass
0.1260	3	0	0	Pass
0.1286	3	0	0	Pass
0.1312	3	0	0	Pass
0.1338	3	0	0	Pass
0.1363	3	0	0	Pass
0.1389	3	0	0	Pass

0.1415	3	0	0	Pass
0.1441	3	0	0	Pass
0.1466	3	0	0	Pass
0.1492	3	0	0	Pass
0.1518	3	0	0	Pass
0.1544	3	0	0	Pass
0.1569	3	0	0	Pass
0.1595	3	0	0	Pass
0.1621	3	0	0	Pass
0.1647	3	0	0	Pass
0.1673	2	0	0	Pass
0.1698	2	0	0	Pass
0.1724	2	0	0	Pass
0.1750	2	0	0	Pass
0.1776	2	0	0	Pass
0.1801	2	0	0	Pass
0.1827	2	0	0	Pass
0.1853	2	0	0	Pass
0.1879	2	0	0	Pass
0.1904	2	0	0	Pass
0.1930	2	0	0	Pass
0.1956	2	0	0	Pass
0.1982	2	0	0	Pass
0.2008	1	0	0	Pass
0.2033	1	0	0	Pass
0.2059	1	0	0	Pass
0.2085	1	0	0	Pass
0.2111	1	0	0	Pass
0.2136	1	0	0	Pass
0.2162	1	0	0	Pass
0.2188	1	0	0	Pass
0.2214	1	0	0	Pass
0.2239	1	0	0	Pass
0.2265	1	0	0	Pass
0.2291	1	0	0	Pass
0.2317	1	0	0	Pass
0.2343	1	0	0	Pass
0.2368	1	0	0	Pass
0.2394	1	0	0	Pass
0.2420	1	0	0	Pass
0.2446	1	0	0	Pass
0.2471	1	0	0	Pass
0.2497	1	0	0	Pass
0.2523	1	0	0	Pass
0.2549	1	0	0	Pass
0.2574	1	0	0	Pass
0.2600	1	0	0	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
A POC	☐	44.21			☐	100.00			
B POC	☐	99.19			☐	100.00			
D POC	☐	26.75			☐	100.00			
E POC	☐	26.75			☐	100.00			
F POC	☐	16.00			☐	100.00			
Total Volume Infiltrated		212.89	0.00	0.00		100.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Passed

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

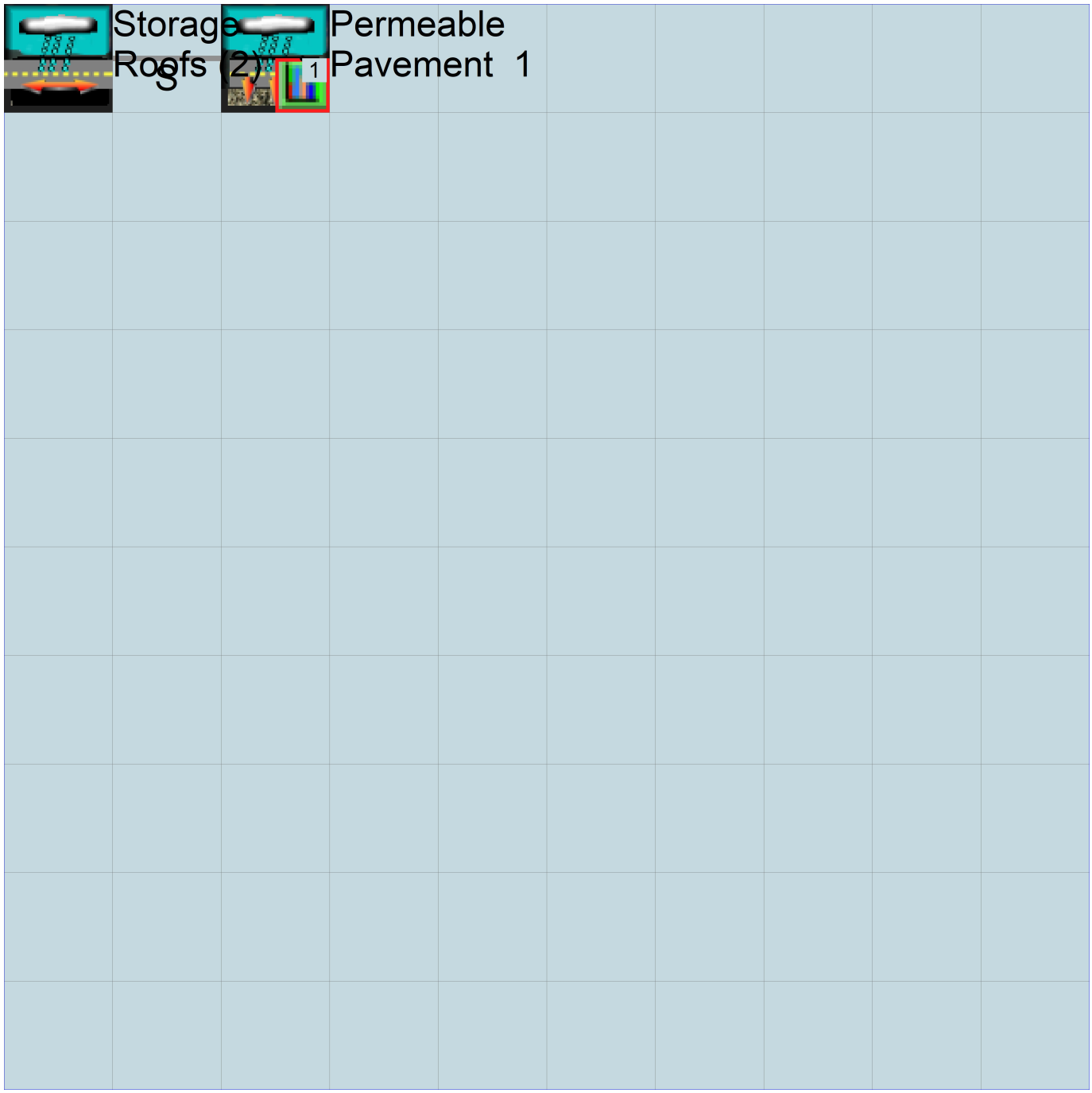
No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix

Predeveloped Schematic



Mitigated Schematic

Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2008 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   DT01 - pervious test.wdm
MESSU       25   PreDT01 - pervious test.MES
            27   PreDT01 - pervious test.L61
            28   PreDT01 - pervious test.L62
            30   POCDT01 - pervious test1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND       4
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                   MAX                     1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                       in  out           ***
    4     A/B, Pasture, Flat      1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    4         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
    4         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    4         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    4               0         5       1.5       400      0.05       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    4              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    4          0.15       0.5       0.3         0       0.7       0.4
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
    4              0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                      in  out           ***
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
  END IWAT-STATE1
```

```
END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND   4                       2.39     COPY   501     12
PERLND   4                       2.39     COPY   501     13

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                       in  out                              ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                  ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *      *  *  *  *  *        ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><--------><--------> ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                     ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><---><---><---><---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    0.857          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    0.857          IMPLND   1 999 EXTNL  PREC
```

```
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2008 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   DT01 - pervious test.wdm
MESSU       25   MitDT01 - pervious test.MES
            27   MitDT01 - pervious test.L61
            28   MitDT01 - pervious test.L62
            30   POCDT01 - pervious test1.dat
END FILES

OPN SEQUENCE
    INGRP               INDELT 00:15
      IMPLND      36
      IMPLND      37
      IMPLND      38
      IMPLND      39
      IMPLND      40
      PERLND      41
      PERLND      42
      PERLND      43
      IMPLND      29
      RCHRES       1
      IMPLND      34
      RCHRES       2
      IMPLND      22
      RCHRES       3
      IMPLND      25
      RCHRES       4
      IMPLND      35
      RCHRES       5
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        D                           MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
```

```
    # -  #                          User  t-series Engl Metr ***
                                        in  out           ***
   41     A/B, Lawn, Flat          1    1    1    1   27    0
   42     A/B, Lawn, Flat          1    1    1    1   27    0
   43     A/B, Lawn, Flat          1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   41         0    0    1    0    0    0    0    0    0    0    0    0
   42         0    0    1    0    0    0    0    0    0    0    0    0
   43         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   41         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   42         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   43         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   41         0    0    0    0    0    0    0    0    0    0    0
   42         0    0    0    0    0    0    0    0    0    0    0
   43         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   41              0         5       0.8       400      0.05       0.3     0.996
   42              0         5       0.8       400      0.05       0.3     0.996
   43              0         5       0.8       400      0.05       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   41              0         0         2         2         0         0         0
   42              0         0         2         2         0         0         0
   43              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                          ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   41            0.1       0.5      0.25         0       0.7      0.25
   42            0.1       0.5      0.25         0       0.7      0.25
   43            0.1       0.5      0.25         0       0.7      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS       AGWS      GWVS
   41              0         0         0         0         3          1         0
   42              0         0         0         0         3          1         0
   43              0         0         0         0         3          1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
```

```
                                     in  out           ***
 36     ROOF TOPS/FLAT LAT      1    1    1   27    0
 37     ROOF TOPS/FLAT LAT      1    1    1   27    0
 38     ROOF TOPS/FLAT LAT      1    1    1   27    0
 39     ROOF TOPS/FLAT LAT      1    1    1   27    0
 40     ROOF TOPS/FLAT LAT      1    1    1   27    0
 29      Porous Pavement        1    1    1   27    0
 34      Porous Pavement        1    1    1   27    0
 22      Porous Pavement        1    1    1   27    0
 25      Porous Pavement        1    1    1   27    0
 35      Porous Pavement        1    1    1   27    0
END GEN-INFO
*** Section IWATER***

ACTIVITY
  <PLS > ************* Active Sections ****************************
  # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
 36         0    0    1    0    0    0
 37         0    0    1    0    0    0
 38         0    0    1    0    0    0
 39         0    0    1    0    0    0
 40         0    0    1    0    0    0
 29         0    0    1    0    0    0
 34         0    0    1    0    0    0
 22         0    0    1    0    0    0
 25         0    0    1    0    0    0
 35         0    0    1    0    0    0
END ACTIVITY

PRINT-INFO
  <ILS > ******** Print-flags ******** PIVL  PYR
  # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
 36         0    0    4    0    0    0    1    9
 37         0    0    4    0    0    0    1    9
 38         0    0    4    0    0    0    1    9
 39         0    0    4    0    0    0    1    9
 40         0    0    4    0    0    0    1    9
 29         0    0    4    0    0    0    1    9
 34         0    0    4    0    0    0    1    9
 22         0    0    4    0    0    0    1    9
 25         0    0    4    0    0    0    1    9
 35         0    0    4    0    0    0    1    9
END PRINT-INFO

IWAT-PARM1
  <PLS >  IWATER variable monthly parameter value flags  ***
  # -  # CSNO RTOP  VRS  VNN RTLI     ***
 36         0    0    0    0    0
 37         0    0    0    0    0
 38         0    0    0    0    0
 39         0    0    0    0    0
 40         0    0    0    0    0
 29         0    0    0    0    0
 34         0    0    0    0    0
 22         0    0    0    0    0
 25         0    0    0    0    0
 35         0    0    0    0    0
END IWAT-PARM1

IWAT-PARM2
  <PLS >       IWATER input info: Part 2         ***
  # -  # ***  LSUR     SLSUR      NSUR     RETSC
 36          400      0.01       0.1       0.1
 37          400      0.01       0.1       0.1
 38          400      0.01       0.1       0.1
 39          400      0.01       0.1       0.1
 40          400      0.01       0.1       0.1
 29          400      0.01       0.1       0.1
 34          400      0.01       0.1       0.1
 22          400      0.01       0.1       0.1
```

```
   25            400      0.01       0.1       0.1
   35            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
   36              0         0
   37              0         0
   38              0         0
   39              0         0
   40              0         0
   29              0         0
   34              0         0
   22              0         0
   25              0         0
   35              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
   36              0         0
   37              0         0
   38              0         0
   39              0         0
   40              0         0
   29              0         0
   34              0         0
   22              0         0
   25              0         0
   35              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
B Roof and Walk***
IMPLND  37                      1.0968     IMPLND  25     53
IMPLND  22                        0.07     RCHRES   3      5
IMPLND  25                        0.31     RCHRES   4      5
A Lawn***
PERLND  41                      1.0001     IMPLND  22     54
PERLND  41                      1.0001     IMPLND  22     55
B Lawn***
PERLND  42                      0.3226     IMPLND  25     54
PERLND  42                      0.3226     IMPLND  25     55
F Roof and Walk***
PERLND  43                      0.2728     IMPLND  35     54
PERLND  43                      0.2728     IMPLND  35     55
A Roof and Walk***
IMPLND  36                      3.2859     IMPLND  22     53
IMPLND  34                        0.06     RCHRES   2      5
IMPLND  29                        0.06     RCHRES   1      5
IMPLND  35                        0.11     RCHRES   5      5
D Roof and Walk***
IMPLND  38                      2.1672     IMPLND  29     53
E Roof and Walk***
IMPLND  39                      2.1672     IMPLND  34     53
F Roof and Walk***
IMPLND  40                      0.0909     IMPLND  35     53

******Routing******
IMPLND  36                        0.23     COPY     1     15
IMPLND  37                        0.34     COPY     1     15
IMPLND  38                        0.13     COPY     1     15
IMPLND  39                        0.13     COPY     1     15
IMPLND  40                        0.01     COPY     1     15
```

```
PERLND  41                        0.07     COPY     1     12
PERLND  41                        0.07     COPY     1     13
PERLND  42                         0.1     COPY     1     12
PERLND  42                         0.1     COPY     1     13
PERLND  43                        0.03     COPY     1     12
PERLND  43                        0.03     COPY     1     13
RCHRES   3                           1     COPY   501     17
RCHRES   4                           1     COPY   501     17
RCHRES   1                           1     COPY   501     17
RCHRES   2                           1     COPY   501     17
RCHRES   5                           1     COPY   501     17
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<----------------><---> User T-series  Engl Metr LKFG             ***
                                       in  out                              ***
    1     D                      2    1    1    1   28    0    1
    2     E                      2    1    1    1   28    0    1
    3     A                      2    1    1    1   28    0    1
    4     B                      2    1    1    1   28    0    1
    5     F                      2    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
    2         1    0    0    0    0    0    0    0    0    0
    3         1    0    0    0    0    0    0    0    0    0
    4         1    0    0    0    0    0    0    0    0    0
    5         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
    2         4    0    0    0    0    0    0    0    0    0    1    9
    3         4    0    0    0    0    0    0    0    0    0    1    9
    4         4    0    0    0    0    0    0    0    0    0    1    9
    5         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                  ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
           FG FG FG FG  possible  exit  *** possible  exit      possible  exit
            *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
    1       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    2       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    3       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    4       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    5       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
```

```
    # -  #    FTABNO       LEN      DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><--------><--------> ***
    1              1      0.01       0.0       0.0       0.5       0.0
    2              2      0.01       0.0       0.0       0.5       0.0
    3              3      0.01       0.0       0.0       0.5       0.0
    4              4      0.01       0.0       0.0       0.5       0.0
    5              5      0.01       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                         ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    3            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    4            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    5            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      3
   91    5
     Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)     (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.069995  0.000000  0.000000  0.000000
  0.014814  0.069995  0.000207  0.000000  2.117361
  0.029629  0.069995  0.000415  0.000000  2.117361
  0.044443  0.069995  0.000622  0.000000  2.117361
  0.059258  0.069995  0.000830  0.000000  2.117361
  0.074072  0.069995  0.001037  0.000000  2.117361
  0.088887  0.069995  0.001244  0.000000  2.117361
  0.103701  0.069995  0.001452  0.000000  2.117361
  0.118516  0.069995  0.001659  0.000000  2.117361
  0.133330  0.069995  0.001866  0.000000  2.117361
  0.148144  0.069995  0.002074  0.000000  2.117361
  0.162959  0.069995  0.002281  0.000000  2.117361
  0.177773  0.069995  0.002489  0.000000  2.117361
  0.192588  0.069995  0.002696  0.000000  2.117361
  0.207402  0.069995  0.002903  0.000000  2.117361
  0.222217  0.069995  0.003111  0.000000  2.117361
  0.237031  0.069995  0.003318  0.000000  2.117361
  0.251846  0.069995  0.003526  0.000000  2.117361
  0.266660  0.069995  0.003733  0.000000  2.117361
  0.281474  0.069995  0.003940  0.000000  2.117361
  0.296289  0.069995  0.004148  0.000000  2.117361
  0.311103  0.069995  0.004355  0.000000  2.117361
  0.325918  0.069995  0.004563  0.000000  2.117361
  0.340732  0.069995  0.004770  0.000000  2.117361
  0.355547  0.069995  0.004977  0.000000  2.117361
  0.370361  0.069995  0.005185  0.000000  2.117361
  0.385176  0.069995  0.005392  0.000000  2.117361
  0.399990  0.069995  0.005599  0.000000  2.117361
  0.414804  0.069995  0.005807  0.000000  2.117361
  0.429619  0.069995  0.006014  0.000000  2.117361
  0.444433  0.069995  0.006222  0.000000  2.117361
  0.459248  0.069995  0.006429  0.000000  2.117361
  0.474062  0.069995  0.006636  0.000000  2.117361
  0.488877  0.069995  0.006844  0.000000  2.117361
  0.503691  0.069995  0.007155  0.000000  2.117361
  0.518506  0.069995  0.007466  0.000000  2.117361
  0.533320  0.069995  0.007777  0.000000  2.117361
  0.548134  0.069995  0.008088  0.000000  2.117361
  0.562949  0.069995  0.008399  0.000000  2.117361
  0.577763  0.069995  0.008710  0.000000  2.117361
  0.592578  0.069995  0.009021  0.000000  2.117361
  0.607392  0.069995  0.009332  0.000000  2.117361
```

```
0.622207  0.069995  0.009644  0.000000  2.117361
0.637021  0.069995  0.009955  0.000000  2.117361
0.651836  0.069995  0.010266  0.000000  2.117361
0.666650  0.069995  0.010577  0.000000  2.117361
0.681464  0.069995  0.010888  0.000000  2.117361
0.696279  0.069995  0.011199  0.000000  2.117361
0.711093  0.069995  0.011510  0.000000  2.117361
0.725908  0.069995  0.011821  0.000000  2.117361
0.740722  0.069995  0.012132  0.000000  2.117361
0.755537  0.069995  0.012443  0.000000  2.117361
0.770351  0.069995  0.012754  0.000000  2.117361
0.785166  0.069995  0.013065  0.000000  2.117361
0.799980  0.069995  0.013377  0.000000  2.117361
0.814794  0.069995  0.013688  0.000000  2.117361
0.829609  0.069995  0.013999  0.000000  2.117361
0.844423  0.069995  0.014310  0.000000  2.117361
0.859238  0.069995  0.014621  0.000000  2.117361
0.874052  0.069995  0.014932  0.000000  2.117361
0.888867  0.069995  0.015243  0.000000  2.117361
0.903681  0.069995  0.015554  0.000000  2.117361
0.918496  0.069995  0.015865  0.000000  2.117361
0.933310  0.069995  0.016176  0.000000  2.117361
0.948124  0.069995  0.016487  0.000000  2.117361
0.962939  0.069995  0.016798  0.000000  2.117361
0.977753  0.069995  0.017110  0.000000  2.117361
0.992568  0.069995  0.017421  0.000000  2.117361
1.007382  0.069995  0.017587  0.000000  2.117361
1.022197  0.069995  0.017752  0.000000  2.117361
1.037011  0.069995  0.017918  0.000000  2.117361
1.051826  0.069995  0.018084  0.000000  2.117361
1.066640  0.069995  0.018250  0.000000  2.117361
1.081454  0.069995  0.018416  0.000000  2.117361
1.096269  0.069995  0.018582  0.000000  2.117361
1.111083  0.069995  0.018748  0.000000  2.117361
1.125898  0.069995  0.018914  0.000000  2.117361
1.140712  0.069995  0.019080  0.000000  2.117361
1.155527  0.069995  0.019246  0.000000  2.117361
1.170341  0.069995  0.019412  0.000000  2.117361
1.185156  0.069995  0.019577  0.000000  2.117361
1.199970  0.069995  0.019743  0.000000  2.117361
1.214784  0.069995  0.019909  0.000000  2.117361
1.229599  0.069995  0.020075  0.000000  2.117361
1.244413  0.069995  0.020241  0.000000  2.117361
1.259228  0.069995  0.020407  0.000000  2.117361
1.274042  0.069995  0.020573  0.000000  2.117361
1.288857  0.069995  0.020739  0.000000  2.117361
1.303671  0.069995  0.020905  0.000000  2.117361
1.318486  0.069995  0.021071  0.000000  2.117361
1.333300  0.069995  0.021237  0.000000  2.117361
END FTABLE  3
FTABLE      4
 91    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)     (cfs)   (ft/sec)    (Minutes)***
0.000000  0.309986  0.000000  0.000000  0.000000
0.014814  0.309986  0.000918  0.000000  9.377083
0.029629  0.309986  0.001837  0.000000  9.377083
0.044443  0.309986  0.002755  0.000000  9.377083
0.059258  0.309986  0.003674  0.000000  9.377083
0.074072  0.309986  0.004592  0.000000  9.377083
0.088887  0.309986  0.005511  0.000000  9.377083
0.103701  0.309986  0.006429  0.000000  9.377083
0.118516  0.309986  0.007348  0.000000  9.377083
0.133330  0.309986  0.008266  0.000000  9.377083
0.148144  0.309986  0.009185  0.000000  9.377083
0.162959  0.309986  0.010103  0.000000  9.377083
0.177773  0.309986  0.011021  0.000000  9.377083
0.192588  0.309986  0.011940  0.000000  9.377083
0.207402  0.309986  0.012858  0.000000  9.377083
0.222217  0.309986  0.013777  0.000000  9.377083
```

0.237031	0.309986	0.014695	0.000000	9.377083
0.251846	0.309986	0.015614	0.000000	9.377083
0.266660	0.309986	0.016532	0.000000	9.377083
0.281474	0.309986	0.017451	0.000000	9.377083
0.296289	0.309986	0.018369	0.000000	9.377083
0.311103	0.309986	0.019288	0.000000	9.377083
0.325918	0.309986	0.020206	0.000000	9.377083
0.340732	0.309986	0.021124	0.000000	9.377083
0.355547	0.309986	0.022043	0.000000	9.377083
0.370361	0.309986	0.022961	0.000000	9.377083
0.385176	0.309986	0.023880	0.000000	9.377083
0.399990	0.309986	0.024798	0.000000	9.377083
0.414804	0.309986	0.025717	0.000000	9.377083
0.429619	0.309986	0.026635	0.000000	9.377083
0.444433	0.309986	0.027554	0.000000	9.377083
0.459248	0.309986	0.028472	0.000000	9.377083
0.474062	0.309986	0.029391	0.000000	9.377083
0.488877	0.309986	0.030309	0.000000	9.377083
0.503691	0.309986	0.031687	0.000000	9.377083
0.518506	0.309986	0.033064	0.000000	9.377083
0.533320	0.309986	0.034442	0.000000	9.377083
0.548134	0.309986	0.035820	0.000000	9.377083
0.562949	0.309986	0.037197	0.000000	9.377083
0.577763	0.309986	0.038575	0.000000	9.377083
0.592578	0.309986	0.039953	0.000000	9.377083
0.607392	0.309986	0.041330	0.000000	9.377083
0.622207	0.309986	0.042708	0.000000	9.377083
0.637021	0.309986	0.044086	0.000000	9.377083
0.651836	0.309986	0.045464	0.000000	9.377083
0.666650	0.309986	0.046841	0.000000	9.377083
0.681464	0.309986	0.048219	0.000000	9.377083
0.696279	0.309986	0.049597	0.000000	9.377083
0.711093	0.309986	0.050974	0.000000	9.377083
0.725908	0.309986	0.052352	0.000000	9.377083
0.740722	0.309986	0.053730	0.000000	9.377083
0.755537	0.309986	0.055107	0.000000	9.377083
0.770351	0.309986	0.056485	0.000000	9.377083
0.785166	0.309986	0.057863	0.000000	9.377083
0.799980	0.309986	0.059240	0.000000	9.377083
0.814794	0.309986	0.060618	0.000000	9.377083
0.829609	0.309986	0.061996	0.000000	9.377083
0.844423	0.309986	0.063373	0.000000	9.377083
0.859238	0.309986	0.064751	0.000000	9.377083
0.874052	0.309986	0.066129	0.000000	9.377083
0.888867	0.309986	0.067506	0.000000	9.377083
0.903681	0.309986	0.068884	0.000000	9.377083
0.918496	0.309986	0.070262	0.000000	9.377083
0.933310	0.309986	0.071639	0.000000	9.377083
0.948124	0.309986	0.073017	0.000000	9.377083
0.962939	0.309986	0.074395	0.000000	9.377083
0.977753	0.309986	0.075773	0.000000	9.377083
0.992568	0.309986	0.077150	0.000000	9.377083
1.007382	0.309986	0.077885	0.000000	9.377083
1.022197	0.309986	0.078620	0.000000	9.377083
1.037011	0.309986	0.079354	0.000000	9.377083
1.051826	0.309986	0.080089	0.000000	9.377083
1.066640	0.309986	0.080824	0.000000	9.377083
1.081454	0.309986	0.081559	0.000000	9.377083
1.096269	0.309986	0.082294	0.000000	9.377083
1.111083	0.309986	0.083028	0.000000	9.377083
1.125898	0.309986	0.083763	0.000000	9.377083
1.140712	0.309986	0.084498	0.000000	9.377083
1.155527	0.309986	0.085233	0.000000	9.377083
1.170341	0.309986	0.085967	0.000000	9.377083
1.185156	0.309986	0.086702	0.000000	9.377083
1.199970	0.309986	0.087437	0.000000	9.377083
1.214784	0.309986	0.088172	0.000000	9.377083
1.229599	0.309986	0.088906	0.000000	9.377083
1.244413	0.309986	0.089641	0.000000	9.377083
1.259228	0.309986	0.090376	0.000000	9.377083

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1.274042  0.309986  0.091111  0.000000  9.377083
1.288857  0.309986  0.091845  0.000000  9.377083
1.303671  0.309986  0.092580  0.000000  9.377083
1.318486  0.309986  0.093315  0.000000  9.377083
1.333300  0.309986  0.094050  0.000000  9.377083
END FTABLE  4
FTABLE      1
 91    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)     (cfs)   (ft/sec)    (Minutes)***
0.000000  0.059986  0.000000  0.000000  0.000000
0.014814  0.059986  0.000178  0.000000  1.814583
0.029629  0.059986  0.000355  0.000000  1.814583
0.044443  0.059986  0.000533  0.000000  1.814583
0.059258  0.059986  0.000711  0.000000  1.814583
0.074072  0.059986  0.000889  0.000000  1.814583
0.088887  0.059986  0.001066  0.000000  1.814583
0.103701  0.059986  0.001244  0.000000  1.814583
0.118516  0.059986  0.001422  0.000000  1.814583
0.133330  0.059986  0.001600  0.000000  1.814583
0.148144  0.059986  0.001777  0.000000  1.814583
0.162959  0.059986  0.001955  0.000000  1.814583
0.177773  0.059986  0.002133  0.000000  1.814583
0.192588  0.059986  0.002311  0.000000  1.814583
0.207402  0.059986  0.002488  0.000000  1.814583
0.222217  0.059986  0.002666  0.000000  1.814583
0.237031  0.059986  0.002844  0.000000  1.814583
0.251846  0.059986  0.003021  0.000000  1.814583
0.266660  0.059986  0.003199  0.000000  1.814583
0.281474  0.059986  0.003377  0.000000  1.814583
0.296289  0.059986  0.003555  0.000000  1.814583
0.311103  0.059986  0.003732  0.000000  1.814583
0.325918  0.059986  0.003910  0.000000  1.814583
0.340732  0.059986  0.004088  0.000000  1.814583
0.355547  0.059986  0.004266  0.000000  1.814583
0.370361  0.059986  0.004443  0.000000  1.814583
0.385176  0.059986  0.004621  0.000000  1.814583
0.399990  0.059986  0.004799  0.000000  1.814583
0.414804  0.059986  0.004977  0.000000  1.814583
0.429619  0.059986  0.005154  0.000000  1.814583
0.444433  0.059986  0.005332  0.000000  1.814583
0.459248  0.059986  0.005510  0.000000  1.814583
0.474062  0.059986  0.005687  0.000000  1.814583
0.488877  0.059986  0.005865  0.000000  1.814583
0.503691  0.059986  0.006132  0.000000  1.814583
0.518506  0.059986  0.006398  0.000000  1.814583
0.533320  0.059986  0.006665  0.000000  1.814583
0.548134  0.059986  0.006932  0.000000  1.814583
0.562949  0.059986  0.007198  0.000000  1.814583
0.577763  0.059986  0.007465  0.000000  1.814583
0.592578  0.059986  0.007731  0.000000  1.814583
0.607392  0.059986  0.007998  0.000000  1.814583
0.622207  0.059986  0.008265  0.000000  1.814583
0.637021  0.059986  0.008531  0.000000  1.814583
0.651836  0.059986  0.008798  0.000000  1.814583
0.666650  0.059986  0.009064  0.000000  1.814583
0.681464  0.059986  0.009331  0.000000  1.814583
0.696279  0.059986  0.009598  0.000000  1.814583
0.711093  0.059986  0.009864  0.000000  1.814583
0.725908  0.059986  0.010131  0.000000  1.814583
0.740722  0.059986  0.010397  0.000000  1.814583
0.755537  0.059986  0.010664  0.000000  1.814583
0.770351  0.059986  0.010931  0.000000  1.814583
0.785166  0.059986  0.011197  0.000000  1.814583
0.799980  0.059986  0.011464  0.000000  1.814583
0.814794  0.059986  0.011730  0.000000  1.814583
0.829609  0.059986  0.011997  0.000000  1.814583
0.844423  0.059986  0.012264  0.000000  1.814583
0.859238  0.059986  0.012530  0.000000  1.814583
0.874052  0.059986  0.012797  0.000000  1.814583
```

```
0.888867  0.059986  0.013063  0.000000  1.814583
0.903681  0.059986  0.013330  0.000000  1.814583
0.918496  0.059986  0.013597  0.000000  1.814583
0.933310  0.059986  0.013863  0.000000  1.814583
0.948124  0.059986  0.014130  0.000000  1.814583
0.962939  0.059986  0.014396  0.000000  1.814583
0.977753  0.059986  0.014663  0.000000  1.814583
0.992568  0.059986  0.014930  0.000000  1.814583
1.007382  0.059986  0.015072  0.000000  1.814583
1.022197  0.059986  0.015214  0.000000  1.814583
1.037011  0.059986  0.015356  0.000000  1.814583
1.051826  0.059986  0.015498  0.000000  1.814583
1.066640  0.059986  0.015640  0.000000  1.814583
1.081454  0.059986  0.015783  0.000000  1.814583
1.096269  0.059986  0.015925  0.000000  1.814583
1.111083  0.059986  0.016067  0.000000  1.814583
1.125898  0.059986  0.016209  0.000000  1.814583
1.140712  0.059986  0.016351  0.000000  1.814583
1.155527  0.059986  0.016494  0.000000  1.814583
1.170341  0.059986  0.016636  0.000000  1.814583
1.185156  0.059986  0.016778  0.000000  1.814583
1.199970  0.059986  0.016920  0.000000  1.814583
1.214784  0.059986  0.017062  0.000000  1.814583
1.229599  0.059986  0.017205  0.000000  1.814583
1.244413  0.059986  0.017347  0.000000  1.814583
1.259228  0.059986  0.017489  0.000000  1.814583
1.274042  0.059986  0.017631  0.000000  1.814583
1.288857  0.059986  0.017773  0.000000  1.814583
1.303671  0.059986  0.017915  0.000000  1.814583
1.318486  0.059986  0.018058  0.000000  1.814583
1.333300  0.059986  0.018200  0.000000  1.814583
END FTABLE  1
FTABLE      2
 91    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.059986  0.000000  0.000000  0.000000
0.014814  0.059986  0.000178  0.000000  1.814583
0.029629  0.059986  0.000355  0.000000  1.814583
0.044443  0.059986  0.000533  0.000000  1.814583
0.059258  0.059986  0.000711  0.000000  1.814583
0.074072  0.059986  0.000889  0.000000  1.814583
0.088887  0.059986  0.001066  0.000000  1.814583
0.103701  0.059986  0.001244  0.000000  1.814583
0.118516  0.059986  0.001422  0.000000  1.814583
0.133330  0.059986  0.001600  0.000000  1.814583
0.148144  0.059986  0.001777  0.000000  1.814583
0.162959  0.059986  0.001955  0.000000  1.814583
0.177773  0.059986  0.002133  0.000000  1.814583
0.192588  0.059986  0.002311  0.000000  1.814583
0.207402  0.059986  0.002488  0.000000  1.814583
0.222217  0.059986  0.002666  0.000000  1.814583
0.237031  0.059986  0.002844  0.000000  1.814583
0.251846  0.059986  0.003021  0.000000  1.814583
0.266660  0.059986  0.003199  0.000000  1.814583
0.281474  0.059986  0.003377  0.000000  1.814583
0.296289  0.059986  0.003555  0.000000  1.814583
0.311103  0.059986  0.003732  0.000000  1.814583
0.325918  0.059986  0.003910  0.000000  1.814583
0.340732  0.059986  0.004088  0.000000  1.814583
0.355547  0.059986  0.004266  0.000000  1.814583
0.370361  0.059986  0.004443  0.000000  1.814583
0.385176  0.059986  0.004621  0.000000  1.814583
0.399990  0.059986  0.004799  0.000000  1.814583
0.414804  0.059986  0.004977  0.000000  1.814583
0.429619  0.059986  0.005154  0.000000  1.814583
0.444433  0.059986  0.005332  0.000000  1.814583
0.459248  0.059986  0.005510  0.000000  1.814583
0.474062  0.059986  0.005687  0.000000  1.814583
0.488877  0.059986  0.005865  0.000000  1.814583
```

```
0.503691  0.059986  0.006132  0.000000  1.814583
0.518506  0.059986  0.006398  0.000000  1.814583
0.533320  0.059986  0.006665  0.000000  1.814583
0.548134  0.059986  0.006932  0.000000  1.814583
0.562949  0.059986  0.007198  0.000000  1.814583
0.577763  0.059986  0.007465  0.000000  1.814583
0.592578  0.059986  0.007731  0.000000  1.814583
0.607392  0.059986  0.007998  0.000000  1.814583
0.622207  0.059986  0.008265  0.000000  1.814583
0.637021  0.059986  0.008531  0.000000  1.814583
0.651836  0.059986  0.008798  0.000000  1.814583
0.666650  0.059986  0.009064  0.000000  1.814583
0.681464  0.059986  0.009331  0.000000  1.814583
0.696279  0.059986  0.009598  0.000000  1.814583
0.711093  0.059986  0.009864  0.000000  1.814583
0.725908  0.059986  0.010131  0.000000  1.814583
0.740722  0.059986  0.010397  0.000000  1.814583
0.755537  0.059986  0.010664  0.000000  1.814583
0.770351  0.059986  0.010931  0.000000  1.814583
0.785166  0.059986  0.011197  0.000000  1.814583
0.799980  0.059986  0.011464  0.000000  1.814583
0.814794  0.059986  0.011730  0.000000  1.814583
0.829609  0.059986  0.011997  0.000000  1.814583
0.844423  0.059986  0.012264  0.000000  1.814583
0.859238  0.059986  0.012530  0.000000  1.814583
0.874052  0.059986  0.012797  0.000000  1.814583
0.888867  0.059986  0.013063  0.000000  1.814583
0.903681  0.059986  0.013330  0.000000  1.814583
0.918496  0.059986  0.013597  0.000000  1.814583
0.933310  0.059986  0.013863  0.000000  1.814583
0.948124  0.059986  0.014130  0.000000  1.814583
0.962939  0.059986  0.014396  0.000000  1.814583
0.977753  0.059986  0.014663  0.000000  1.814583
0.992568  0.059986  0.014930  0.000000  1.814583
1.007382  0.059986  0.015072  0.000000  1.814583
1.022197  0.059986  0.015214  0.000000  1.814583
1.037011  0.059986  0.015356  0.000000  1.814583
1.051826  0.059986  0.015498  0.000000  1.814583
1.066640  0.059986  0.015640  0.000000  1.814583
1.081454  0.059986  0.015783  0.000000  1.814583
1.096269  0.059986  0.015925  0.000000  1.814583
1.111083  0.059986  0.016067  0.000000  1.814583
1.125898  0.059986  0.016209  0.000000  1.814583
1.140712  0.059986  0.016351  0.000000  1.814583
1.155527  0.059986  0.016494  0.000000  1.814583
1.170341  0.059986  0.016636  0.000000  1.814583
1.185156  0.059986  0.016778  0.000000  1.814583
1.199970  0.059986  0.016920  0.000000  1.814583
1.214784  0.059986  0.017062  0.000000  1.814583
1.229599  0.059986  0.017205  0.000000  1.814583
1.244413  0.059986  0.017347  0.000000  1.814583
1.259228  0.059986  0.017489  0.000000  1.814583
1.274042  0.059986  0.017631  0.000000  1.814583
1.288857  0.059986  0.017773  0.000000  1.814583
1.303671  0.059986  0.017915  0.000000  1.814583
1.318486  0.059986  0.018058  0.000000  1.814583
1.333300  0.059986  0.018200  0.000000  1.814583
END FTABLE  2
FTABLE      5
 91    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.109986  0.000000  0.000000  0.000000
0.014814  0.109986  0.000326  0.000000  3.327083
0.029629  0.109986  0.000652  0.000000  3.327083
0.044443  0.109986  0.000978  0.000000  3.327083
0.059258  0.109986  0.001304  0.000000  3.327083
0.074072  0.109986  0.001629  0.000000  3.327083
0.088887  0.109986  0.001955  0.000000  3.327083
0.103701  0.109986  0.002281  0.000000  3.327083
```

0.118516	0.109986	0.002607	0.000000	3.327083
0.133330	0.109986	0.002933	0.000000	3.327083
0.148144	0.109986	0.003259	0.000000	3.327083
0.162959	0.109986	0.003585	0.000000	3.327083
0.177773	0.109986	0.003911	0.000000	3.327083
0.192588	0.109986	0.004236	0.000000	3.327083
0.207402	0.109986	0.004562	0.000000	3.327083
0.222217	0.109986	0.004888	0.000000	3.327083
0.237031	0.109986	0.005214	0.000000	3.327083
0.251846	0.109986	0.005540	0.000000	3.327083
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0.281474	0.109986	0.006192	0.000000	3.327083
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0.325918	0.109986	0.007169	0.000000	3.327083
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1.051826	0.109986	0.028416	0.000000	3.327083
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1.081454	0.109986	0.028938	0.000000	3.327083
1.096269	0.109986	0.029199	0.000000	3.327083
1.111083	0.109986	0.029459	0.000000	3.327083
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1.140712	0.109986	0.029981	0.000000	3.327083

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  1.155527  0.109986  0.030241  0.000000  3.327083
  1.170341  0.109986  0.030502  0.000000  3.327083
  1.185156  0.109986  0.030763  0.000000  3.327083
  1.199970  0.109986  0.031023  0.000000  3.327083
  1.214784  0.109986  0.031284  0.000000  3.327083
  1.229599  0.109986  0.031545  0.000000  3.327083
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  1.318486  0.109986  0.033109  0.000000  3.327083
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END FTABLES

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<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    0.857          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    0.857          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           RCHRES   1     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.76           RCHRES   2     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.76           RCHRES   3     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.76           RCHRES   4     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.76           RCHRES   5     EXTNL  POTEV

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15

  MASS-LINK       17
RCHRES     OFLOW  OVOL   1                 COPY           INPUT  MEAN
  END MASS-LINK   17

  MASS-LINK       53
IMPLND     IWATER SURO                     IMPLND         EXTNL  SURLI
  END MASS-LINK   53

  MASS-LINK       54
PERLND     PWATER SURO                     IMPLND         EXTNL  SURLI
  END MASS-LINK   54

  MASS-LINK       55
```

```
PERLND     PWATER IFWO                    IMPLND         EXTNL  SURLI
  END MASS-LINK   55

END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

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Appendix E

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June 10, 2019

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Geotechnical Engineering Report
Proposed Multi-Family Residential Development
17021 – 103rd Avenue Southeast
Yelm, Washington
PN: 64303100500
Doc ID: IrisGroup.103rdAveSE.RG

INTRODUCTION

This geotechnical engineering report summarizes our site observations, subsurface explorations, laboratory testing, and engineering analyses, and provides geotechnical recommendations and design criteria for the proposed multi-family residential development to be constructed at 17021 – 103rd Avenue Southeast in Yelm, Washington. The general location of the site is shown on the attached Site Location Map, Figure 1.

Our understanding of the project is based on our discussions with you, our November 9 and 16, 2018 site visits, our understanding of the City of Yelm Development Codes, and our experience in the site area. We understand that the site is currently undeveloped except for a single family residence and detached garage in the north portion of the site. We further understand that you propose to construct four 3-story multi-family residential buildings in the south portion of the site, including paved access roads and parking stalls, and associated utilities. We anticipate that the new buildings will be three-story, wood framed structures supported by conventional shallow foundations with slab on grade floors. A copy of the proposed site plan has been included as Figure 2a.

We understand the City of Yelm is requiring our *Geotechnical Engineering Report* dated December 26, 2006 be updated to meet the current City of Yelm Development Codes. Additionally, the City of Yelm has adopted the 2012 Stormwater Management Manual for Western Washington with 2014 Amendments (2012 SWMMWW), and is requiring a report be prepared to address the feasibility of onsite infiltration in accordance with Volume I, Section 3.1.1.

SCOPE

The purpose of our services was to evaluate the surface and subsurface conditions across the site as a basis for providing geotechnical recommendations and design criteria for the proposed development. Specifically, the scope of services for this project included the following:

1. Reviewing existing geological, hydrogeological, and geotechnical literature for the site area;
2. Exploring the subsurface conditions by monitoring the excavation of 6 test pits at select locations across the site and by monitoring the drilling of 2 borings completed as groundwater observation wells;
3. Collecting select soil samples from the explorations and conducting 2 grain size analyses, as appropriate;
4. Describing surface and subsurface conditions, including soil type, depth to groundwater, and estimate of high groundwater;
5. Addressing the appropriate criteria for Geologic Hazards per the current City of Yelm Geologically Hazardous Areas Title 18.21;
6. Providing geotechnical conclusions and recommendations regarding seismic site class and design coefficients, seismic hazard analysis, site grading activities including; site preparation, subgrade preparation, fill placement criteria, suitability of on-site soils for use as structural fill, temporary and permanent cut and fill slopes, drainage and erosion control measures;
7. Providing conclusions regarding foundations, including shallow conventional footings, along with floor slab support and design criteria, including bearing capacity and subgrade modulus if appropriate;
8. Providing our opinion about the feasibility of onsite infiltration in accordance with the 2012 SWMMWW, including a preliminary design infiltration rate based on grain size data, as appropriate, to meet the Soils Report requirement of the 2012 SWMMWW;
9. Providing recommendations for erosion and sediment control during wet weather grading and construction; and
10. Preparing this written *Geotechnical Engineering Report* with design recommendations summarizing our site observations and conclusions, and our geotechnical recommendations and design criteria, along with the supporting data.

The above scope of work was summarized in our *Proposal for Geotechnical Engineering* Services dated September 27, 2018. We received written authorization to proceed by you on November 4, 2018

SITE CONDITIONS

Surface Conditions

The site is located at 17021 – 103rd Avenue Southeast in Yelm, Washington within an area of agricultural, residential, and commercial development. The site is generally rectangular in shape, measures approximately 265 to 285 feet wide (east to west) by 900 to 915 feet deep (north to south), and encompasses about 5.62 acres. The site is bounded by Walmart Boulevard Southeast to the west, 103rd Avenue Southeast to the north, Walmart to the south, and pasture to the east.

The site generally slopes down from the southwest and northeast to a shallow drainage that runs from southeast to northwest through the central portion of the site. The bottom of the drainage

gently slopes down to the northwest at approximately 1 percent or less. The upper, northeastern portion of the site slopes down to the southwest at approximately 8 to 16 percent before flattening out to 1 percent or less through the central drainage. The southwestern portion of the site slopes up from the drainage at approximately 4 to 5 percent before flattening out to 1 percent or less in the southwestern corner of the site. The total topographic relief across the site is on the order of 18 feet. The existing site configuration and topography is shown on the Site and Exploration Map, Figure 2b.

Vegetation across the site generally consists of unmaintained grass and scotch broom. The northeastern portion of the site is vegetated with a moderate stand of fir trees with a sparse to moderate understory of small deciduous trees and native and invasive plants and shrubs. No areas of surficial erosion, standing water, seeps, springs, or deep seated slope movement was observed during our site reconnaissance.

Site Soils

The USDA Natural Resource Conservation Service (NRCS) Web Soil Survey maps the site as being underlain by Spanaway gravelly sandy loam (110 and 113) soils. The Spanaway soils are derived from volcanic ash over gravelly outwash, have a "slight" erosion hazard when exposed, and are included in hydrologic soils group A. The 110 soils form on slopes of 0 to 3 percent, while the 113 soils form on slopes of 3 to 15 percent. A copy of the soils map for the site vicinity is provided as Figure 3.

Site Geology

The Washington Geologic Information Portal maps the site as being underlain by continental glacial outwash, gravel (Qgog). These soils were generally deposited during the most recent Vashon Stade of the Fraser Glaciation, some 12,000 to 15,000 years ago. The recessional outwash soils consist of a poorly sorted, lightly stratified mixture of sand and gravel that may contain localized deposits of clay and silt that were deposited by meltwater streams emanating from the retreating continental ice mass. The recessional outwash deposits are considered normally consolidated and offer moderate strength and compressibility characteristics, where undisturbed. An excerpt of the above reference geologic map is attached as Figure 4.

Subsurface Explorations

On November 9, 2018 a representative from GeoResources, LLC (GeoResources) visited the site and monitored the excavation of 6 test pits to depths 7½ to 9 feet below the existing ground surface. We returned to the site on November 16, 2018 to monitor the drilling of two borings to 19½ and 26½ feet below the existing ground surface. The test pits were excavated by a licensed earthwork contractor operating a track-mounted excavator and the borings were drilled by a licensed drilling contractor operating a small track-mounted drill rig, both working under contract for GeoResources.

The specific number, locations, and depths of our explorations were selected based on the configuration of the proposed development and were adjusted in the field based on site access limitations. A representative from our office continuously monitored the explorations, maintained logs of the subsurface conditions encountered, obtained representative soil samples, and observed pertinent site features. Representative soil samples obtained from the explorations were placed in sealed plastic bags and taken to our laboratory for further examination and testing as deemed necessary. The test pits were backfilled with the excavated soils and bucket tamped, but not

otherwise compacted, while the borings were backfilled with bentonite chips and abandoned by the driller in accordance with Washington State Department of Ecology requirements.

During drilling, soil samples were obtained at 2½- and 5-foot depth intervals in accordance with Standard Penetration Test (SPT) as per the test method outlined by ASTM: D1586. The SPT method consists of driving a standard 2-inch-diameter split-spoon sampler 18-inches into the soil with a 140-pound hammer. The number of blows required to drive the sampler through each 6-inch interval is counted, and the total number of blows struck during the final 12 inches is recorded as the Standard Penetration Resistance, or "SPT blow count". The resulting Standard Penetration Resistance values indicate the relative density of granular soils and the relative consistency of cohesive soils.

The subsurface explorations completed as part of this evaluation indicate the subsurface conditions at specific locations only, as actual subsurface conditions can vary across the site. Furthermore, the nature and extent of such variation would not become evident until additional explorations are performed or until construction activities have begun.

The soils encountered were visually classified in accordance with the Unified Soil Classification System (USCS) and ASTM D: 2488. The approximate locations of our explorations are indicated on the attached Site and Exploration Plan, Figures 2a and 2b. The USCS is included in Appendix A as Figure A-1, while descriptive logs of the soils encountered are included as Figures A-2 through A-5.

Subsurface Conditions

Our explorations encountered relatively uniform subsurface conditions that generally agrees with the mapped stratigraphy within the site vicinity. In general, our explorations encountered 1.5 to 3 feet of black silty gravel with sand in a medium dense, moist condition underlain by golden brown sandy gravel with cobbles and variable amounts of silt in a medium dense, moist condition that was encountered to the full depth explored. These soils appear consistent with the mapped recessional outwash.

In test pit TP-6, the upper black silty gravel was underlain by brown silty sand with boulders in a medium dense, moist conditions that was underlain by golden-brown silty gravel with sand and boulders in a medium dense, moist condition that was encountered to the full depth explored. These soils appear to be consistent with weathered recessional outwash over recessional outwash.

Laboratory Testing

Geotechnical laboratory tests were performed on select samples retrieved from the test pits to determine soil index and engineering properties encountered. Laboratory testing included visual soil classification per ASTM D: 2488, and grain size analyses per ASTM D: 422 standard procedures. The results of the laboratory tests are included in Appendix B.

Groundwater Conditions

Groundwater was not observed in any of our explorations at the time of excavation; however, groundwater was encountered in the groundwater observation wells during our wet season monitoring. Based on the High Groundwater Hazard mapping by Thurston County GeoData, we anticipate the mottling is indicative of the seasonal high levels of the regional groundwater table. We anticipate fluctuations in the local groundwater levels may occur in response to precipitation patters, off-site construction activities, and site utilization. Table 1 summarizes the approximate depths and

elevations of groundwater observed at the time of our explorations and our subsequent readings in or borings, and the High Groundwater Hazard Map is included as Figure 5.

TABLE 1
APPROXIMATE DEPTHS, AND ELEVATION OF GROUNDWATER ENCOUNTERED IN EXPLORATIONS

Exploration Number	Depth to Groundwater (feet)	Estimated Elevation of Groundwater (feet)	Date Encountered
B-1	N/E	N/E	ATD (11/16/2018)
	N/E	N/E	12/14/18
	N/E	N/E	12/26/18
	17.40	322.6	1/9/2019
	16.03	323.97	1/22/2019
	15.05	324.95	2/15/2019
	12.84	327.16	2/27/2019
	13.24	326.76	3/15/2019
	14.39	325.61	3/29/2019
	14.95	325.05	4/10/2019
	14.67	325.33	4/26/2019
B-2	N/E	N/E	ATD (11/16/2018)
	N/E	N/E	12/14/18
	N/E	N/E	12/26/18
	19.21	326.79	1/9/2019
	18.95	327.05	1/22/2019
	16.75	329.25	2/15/2019
	14.56	331.44	2/27/2019
	15.50	330.5	3/15/2019
	16.08	329.92	3/29/2019
	16.70	329.3	4/10/2019
	16.4	329.6	4/26/2019

Notes: Elevations are based on topographic information obtained from Thurston County GeoData
ATD = At time of drilling/digging
N/E: Not encountered

ENGINEERING CONCLUSIONS AND RECOMMENDATIONS

Based on the results of our data review, site reconnaissance, subsurface explorations and our experience in the area, it is our opinion that the site is suitable for the proposed multi-family residential development. Pertinent conclusions and geotechnical recommendations regarding the design and construction of the proposed development are presented below.

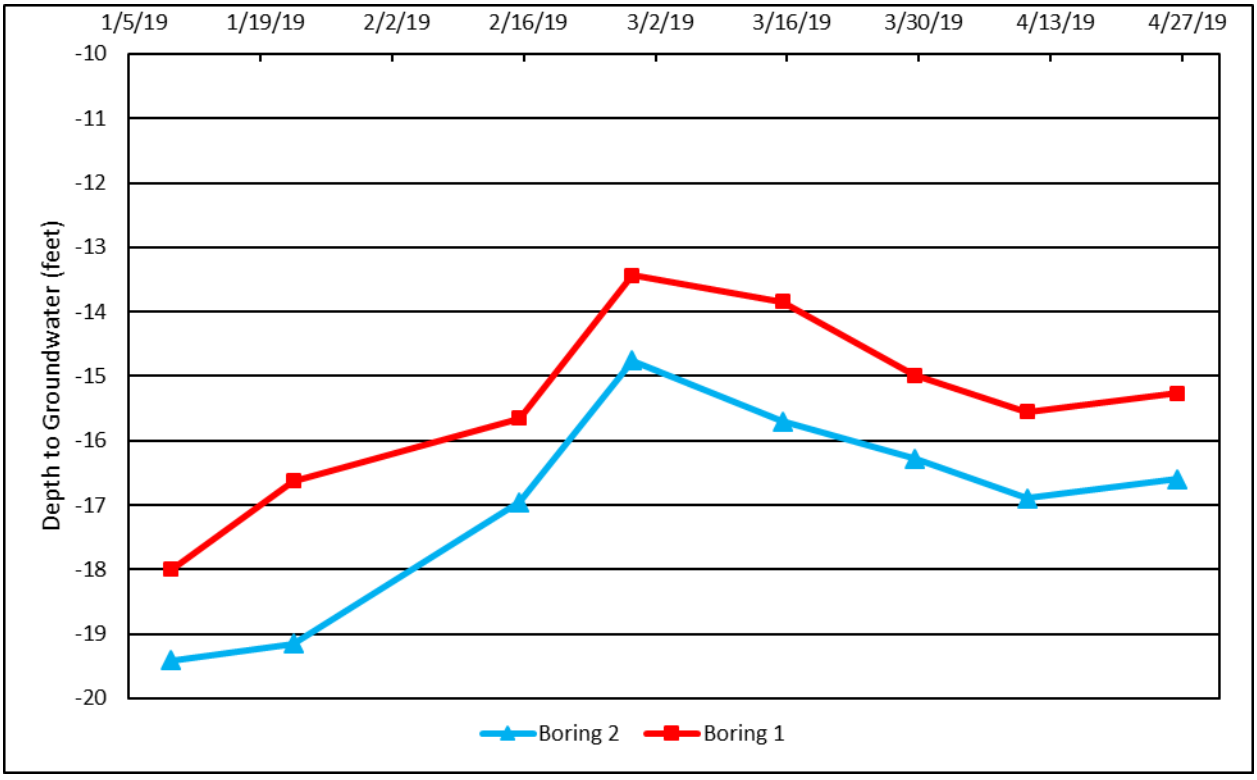
Frequently Flooded Areas YMC 18.21.080

Per the Yelm Municipal Code, Chapter 18.21.080 Frequently Flooded Areas, hall include areas identified by the Flood Insurance Rate Map(s) and areas mapped by Thurston County as high ground water flood hazard areas. The site is not mapped as a Floodway of a Flood Hazard Area by FEMA (FIRM, Panel 362 of 625). Thurston County maps the upper, central portion of the site as being a High Groundwater Hazard Area. A copy of the High Groundwater Hazard Area map for the site vicinity has been included as Figure 5.

Based on the above, the site does not trigger the performance standards for the FEMA 100-Year Floodplain; however, performance standards per the YMC 18.21.080.G should be met for High Groundwater Hazard Areas because of the mapped designation by Thurston County. Per the performance standards, development shall not be located within 50 horizontal feet or two vertical feet of the established base flood elevation, whichever is less. Additionally, the bottom of any infiltration facility for stormwater shall be located at least 6 feet above the base flood elevation.

Our two borings were installed as monitoring wells to observe the elevation of the seasonal groundwater table throughout the wet season. The results of our 2018-2019 wet season groundwater monitoring are summarized in Exhibit 1, below.

EXHIBIT 1
2018/2019 WET SEASON GROUNDWATER DEPTHS



Seismic Design

Based on our observations and the subsurface units mapped at the site, we interpret the structural site conditions to correspond to a seismic Site Class "D" in accordance with the 2015 IBC

documents and American Society of Civil Engineers (ASCE) standard 7-10 Chapter 20 Table 20.3-1. This is based on the anticipated range of SPT (Standard Penetration Test) blow counts for the soils types in the site area. These conditions were assumed to be representative for the subsurface conditions for the site in general based on our experience in the vicinity of the site.

The U.S. Geological Survey (USGS) completed probabilistic seismic hazard analyses (PSHA) for the entire country in November 1996, which were updated and republished in 2002 and 2008. The PSHA ground motion results can be obtained from the USGS 2015 IBC design. Table 2, below, summarizes the recommended design parameters.

TABLE 2
2015 IBC PARAMETERS FOR DESIGN OF SEISMIC STRUCTURES

Spectral Response Acceleration (SRA) and Site Coefficients	Short Period	1 Second Period
Mapped SRA	S_s = 1.244	S_1 = 0.494
Site Coefficients (Site Class D)	F_a = 1.003	F_v = 1.506
Maximum Considered Earthquake SRA	S_{MS} = 1.247	S_{M1} = 0.744
Design SRA	S_{DS} = 0.831	S_{D1} = 0.496

Earthquake-induced geologic hazards may include liquefaction, lateral spreading, slope instability, and ground surface fault rupture. In our opinion, the potential for liquefaction and lateral spreading is not significant because of the coarse nature of the soils encountered across the site. The ground surface at the project site is gently sloping; therefore, the potential for earthquake-induced slope instability is also low. According to the Department of Natural Resources Geologic Hazards Map, the site is not located near a known fault zone. No evidence of ground fault rupture was observed in the subsurface explorations or out site reconnaissance. Therefore, in our opinion, the potential for ground surface fault rupture is also low.

Foundation Support

Based on the subsurface soil conditions encountered across the site, we recommend that spread footings for the proposed structure be founded on the on the medium dense, golden brown recessional outwash or on appropriately prepared structural fill that extends to suitable native soils. Any areas of old debris should be removed prior to blending and recompaction. Because of the silty and organic nature of the dark brown soils, we do not recommend that footings be founded directly on the upper soils encountered across the site.

The soil at the base of the excavations should be disturbed as little as possible. All loose, soft or unsuitable material should be removed or recompacted, as appropriate. A representative from our firm should observe the foundation excavations to determine if suitable bearing surfaces have been prepared, particularly in the areas where the foundation will be situated on fill material.

We recommend a minimum width of 36 inches for isolated footings and at least 18 inches for continuous wall footings. All footing elements should be embedded at least 18 inches below grade for frost protection. Footings founded as described above on the recessional outwash or on structural fill that extends to suitable bearing soils may be designed with a maximum allowable

bearing pressure of 3,000 psf (pounds per square foot). This value is for combined dead and long-term live loads. The weight of the footing and any overlying backfill may be neglected. The allowable bearing value may be increased by one-third for transient loads such as those induced by seismic events or wind loads.

Lateral loads may be resisted by friction on the base of footings and floor slabs and as passive pressure on the sides of footings. We recommend that an allowable coefficient of friction of 0.35 be used to calculate friction between the concrete and the underlying native recessional outwash. Passive pressure may be determined using an allowable equivalent fluid density of 350 pcf (pounds per cubic foot). Factors of safety have been applied to these values.

We estimate that settlements of footings designed and constructed as recommended will be less than 1 inch, for the anticipated load conditions, with differential settlements between comparably loaded footings of ½-inch or less over a span of 50 feet. Most of the settlements should occur essentially as loads are being applied; however, disturbance of the foundation subgrade during construction could result in larger settlements than predicted.

Floor Slab Support

Slab-on-grade floors, where constructed, should be supported on the medium dense recessional outwash or on structural fill prepared as described in the "**Site Preparation**" section of this report. Any areas of old fill material should be evaluated during grading activity for suitability of structural support. Areas of significant organic debris should be removed.

We recommend that floor slabs be directly underlain by a minimum 4-inch thick capillary break that consists of clean, granular material, such as pea gravel or clean crushed rock. This layer should be placed in one lift, compacted to an unyielding condition, and should contain less than 2 percent fines.

A synthetic vapor retarder is recommended to control moisture migration through the slabs. This is of particular importance where the foundation elements are underlain by medium dense recessional soils, or where moisture migration through the slab is an issue, such as where adhesives are used to anchor carpet or tile to the slab.

A subgrade modulus of 350 kips per cubic foot (kcf) may be used for floor slab design. We estimate that settlement of the floor slabs designed and constructed as recommended, will be ½-inch or less over a span of 50 feet.

Subgrade/Basement Walls

Adequate drainage behind retaining structures is imperative. Positive drainage which controls the development of hydrostatic pressure can be accomplished by placing a zone of drainage behind the walls. Granular drainage material should contain less than 2 percent fines and at least 30 percent greater than the US No. 4 sieve. Assuming properly compacted structural fill is used to backfill the foundation walls, an allowable active fluid pressure of 35 pcf and an at-rest pressure of 55 pcf should be appropriate for design. A seismic surcharge of 10H should be applied in accordance with applicable building codes.

A minimum 4-inch diameter perforated or slotted PVC pipe should be placed in the drainage zone along the base and behind the wall to provide an outlet for accumulated water and direct accumulated water to an appropriate discharge location. We recommend that a nonwoven geotextile filter fabric be placed between the soil drainage material and the remaining wall backfill to reduce silt migration into the drainage zone. The infiltration of silt into the drainage zone can, with

time, reduce the permeability of the granular material. The filter fabric should be placed such that it fully separates the drainage material and the backfill, and should be extended over the top of the drainage zone.

A geocomposite drain mat may also be used instead of free draining soils, provided it is installed in accordance with the manufacturer's instructions. A soil drainage zone should extend horizontally at least 18 inches from the back of the wall. The drainage zone should also extend from the base of the wall to within 1 foot of the top of the wall. The soil drainage zone should be compacted to approximately 90 percent of the maximum dry density (MDD), as determined in accordance with ASTM D: 1557. Over-compaction should be avoided as this can lead to excessive lateral pressures.

Lateral loads may be resisted by friction on the base of footings and as passive pressure on the sides of footings and the buried portion of the wall, as described in the "**Foundation Support**" section of this report.

Temporary Excavations

All job site safety issues and precautions are the responsibility of the contractor providing services/work. The following cut/fill slope guidelines are provided for planning purposes only. Temporary cut slopes will likely be necessary during grading operations or utility installation. All excavations at the site associated with confined spaces, such as utility trenches and retaining walls, must be completed in accordance with local, state, or federal requirements. Based on current Washington State Safety and Health Administration (WSHA) regulations, the soils on the site would be classified as Type C soils.

According to WSHA, for temporary excavations of less than 20 feet in depth, the side slopes in Type C soils should be laid back at a slope inclination of 1½H:1V (Horizontal: Vertical) or flatter from the toe to the crest of the slope. All exposed slope faces should be covered with a durable reinforced plastic membrane during construction to prevent slope raveling and rutting during periods of precipitation. These guidelines assume 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 will be necessary where significant raveling or seepage occurs, or if construction materials will be stockpiled along the slope crest.

Where it is not feasible to slope the site soils back at these inclinations, a retaining structure should be considered. Where retaining structures are greater than 4-feet in height (bottom of footing to top of structure) or have slopes of greater than 15 percent above them, they should be engineered per Washington Administrative Code (WAC 51-16-080 item 5). This information is provided solely for the benefit of the owner and other design consultants, and should not be construed to imply that GeoResources assumes responsibility for job site safety. It is understood that job site safety is the sole responsibility of the project contractor.

Site Drainage

All ground surfaces, pavements and sidewalks at the site should be sloped away from the structures. Surface water runoff should be controlled by a system of curbs, berms, drainage swales, and or catch basins, and conveyed to an appropriate discharge point.

We recommend that footing drains are installed for the residence in accordance with the 2015 IBC, Section 1805.4.2, and basement walls (if utilized) have a wall drain as describe above. The roof drain should not be connected to the footing drain.

Stormwater Infiltration

Based on our subsurface explorations, onsite infiltration into the native golden brown gravel with silt and sand is feasible per the 2012 Stormwater Management Manual for Western Washington (SMMWW). We do not recommend infiltration occur within the upper silty soils.

Volume III, Section 3.3.6 of the 2012 SWMMWW allows for the infiltration rate to be determined using the soil gradation for soils unconsolidated by glacial advance, such as recessional outwash. Per Method 3 Soil Gradation Analysis Method, we recommend a long term design infiltration rate of 30 inches per hour be used in the native recessional outwash soils, which is the maximum rate allowed by the manual. Appropriate factors of safety have been applied to this value in accordance with the 2012 SWMMWW. We recommend that in-situ verification tests be performed at the time of construction to verify the provided infiltration rate.

Per the 2012 SWMMWW, Volume III, Section 3.3.7, SSC-5, a minimum vertical separation of 5 feet is required between the bottom of an infiltration facility and the top of bedrock, hardpan (glacial till), a water table, or an impermeable layer. Based on our 2018/2019 wet season groundwater monitoring, we anticipate the seasonal high groundwater level is approximately 12 feet below existing grades. Additionally, a minimum of 6 feet of vertical separation should be provided between the base flood elevation and the bottom of an infiltration facility in accordance with the YMC, 18.21.080.G.

EARTHWORK RECOMMENDATIONS

Site Preparation

All structural areas on the site to be graded should be stripped of vegetation, organic surface soils, and other deleterious materials including existing structures, foundations or abandoned utility lines. Organic topsoil is not suitable for use as structural fill, but may be used for limited depths in non-structural areas. Based on our subsurface exploration, we anticipate that stripping depth will likely range from about 1 to 3 feet. Areas of thicker topsoil or organic debris may be encountered in areas of heavy vegetation or depressions.

Where placement of fill material is required, the stripped/exposed subgrade areas should be compacted to a firm and unyielding surface prior to placement of new fill. Excavations for debris removal should be backfilled with structural fill compacted to the densities described in the "**Structural Fill**" section of this report.

We recommend that a member of our staff evaluate the exposed subgrade conditions after removal of vegetation and topsoil stripping is completed and prior to placement of structural fill. The exposed subgrade soil should be proof-rolled with heavy rubber-tired equipment during dry weather or probed with a ½-inch diameter steel T-probe during wet weather conditions.

Soft, loose or otherwise unsuitable areas delineated during proof-rolling or probing should be recompacted, if practical, or over-excavated and replaced with structural fill. The depth and extent of overexcavation should be evaluated by our field representative at the time of construction. The areas of old fill material should be evaluated during grading operations to determine if they need mitigation, recompaction, or removal.

Structural Fill

All material placed as fill associated with mass grading, as utility trench backfill, under building areas, or under roadways should be placed as structural fill. The structural fill should be

placed in horizontal lifts of appropriate thickness to allow adequate and uniform compaction of each lift. Structural fill should be compacted to at least 95 percent of the MDD.

The appropriate lift thickness will depend on the structural fill characteristics and compaction equipment used. We recommend that the appropriate lift thickness be evaluated by our field representative during construction. We recommend that our representative be present during site grading activities to observe the work and perform field density tests.

The suitability of material for use as structural fill will depend on the gradation and moisture content of the soil. As the amount of fines (material passing US No. 200 sieve) increases, soil becomes increasingly sensitive to small changes in moisture content and adequate compaction becomes more difficult to achieve. During wet weather, we recommend a material such as well-graded sand and gravel with less than 5 percent (by weight) passing the US No. 200 sieve based on that fraction passing the ¾-inch sieve, such as *Gravel Backfill for Walls* (WSDOT 9-03.12(2)). If prolonged dry weather prevails during the earthwork and foundation installation phase of construction, higher fines content (up to 10 to 12 percent) may be acceptable.

Material placed for structural fill should be free of debris, organic matter, trash, and cobbles greater than 6-inches in diameter. The moisture content of the fill material should be adjusted as necessary for proper compaction.

Suitability of On-Site Materials as Fill

During dry weather construction, any non-organic onsite soil may be considered for use as structural fill, provided it meets the criteria described above in the "**Structural Fill"** section and can be compacted as recommended. If the soil material is over optimum moisture at the time of excavation, it will be necessary to aerate or dry the soil prior to placement as structural fill. We generally did not observe the site soils to be excessively moist at the time of our subsurface explorations.

The recessional outwash encountered at depth in our explorations is generally comparable to *Select Borrow* (WSDOT Standard Specifications 9-03.14(3)). These soils should be suitable for use as structural fill provided the moisture content is maintained within 2 percent of the optimum moisture level. Because of the fines and organic content in the upper weathered silty gravel, we do not recommend that these soils are used for structural fill. These upper, silty soils may be used as fill in non-structural areas.

We recommend that completed graded-areas be restricted from traffic or protected prior to wet weather conditions. The graded areas may be protected by paving, placing asphalt-treated base, a layer of free-draining material such as pit run sand and gravel or clean crushed rock material containing less than 5 percent fines, or some combination of the above.

Erosion Control

Weathering and erosion are natural processes. As noted, no evidence of surficial raveling or sloughing was observed at the site. To manage and reduce the potential for these natural processes, we recommend erosion protection measures will need to be in place prior to grading activity on the site. Erosion hazards can be mitigated by applying Best Management Practices outlined in the 2012 SWMMWW.

Wet Weather and Wet Condition Considerations

In the Puget Sound area, the Washington State Department of Ecology generally defines the wet season as beginning October 1st and continuing through April 30th, although rainy periods could occur at any time of year. Therefore, it is strongly encouraged that earthwork be scheduled during the dry weather months. Most of the soil at the site does not contain sufficient fines to produce an unstable mixture when wet. Soils with high fines contents are highly susceptible to changes in water content and tends to become unstable and impossible to proof-roll and compact if the moisture content exceeds the optimum.

In addition, during wet weather months, the groundwater levels could increase, resulting in seepage into site excavations. Performing earthwork during dry weather would reduce these problems and costs associated with rainwater, construction traffic, and handling of wet soil. However, should wet weather/wet condition earthwork be unavoidable, the following recommendations are provided:

- The ground surface in and surrounding the construction area should be sloped as much as possible to promote runoff of precipitation away from work areas and to prevent ponding of water.
- Work areas or slopes should be covered with plastic when not being worked. The use of sloping, ditching, sumps, dewatering, and other measures should be employed as necessary to permit proper completion of the work.
- Earthwork should be accomplished in small sections to minimize exposure to wet conditions. That is, each section should be small enough so that the removal of unsuitable soils and placement and compaction of clean structural fill could be accomplished on the same day. The size of construction equipment may have to be limited to prevent soil disturbance. It may be necessary to excavate soils with a backhoe, or equivalent, and locate them so that equipment does not pass over the excavated area. Thus, subgrade disturbance caused by equipment traffic would be minimized.
- Fill material should consist of clean, well-graded, sand and gravel, of which not more than 5 percent fines by dry weight passes the No. 200 mesh sieve, based on wet-sieving (ASTM D: 1142) the fraction passing the ¾-inch mesh sieve. The gravel content should range from between 20 and 50 percent retained on a No. 4 mesh sieve. The fines should be non-plastic.
- No exposed soil should be left uncompacted and exposed to moisture. A smooth-drum vibratory roller, or equivalent, should roll the surface to seal out as much water as possible.
- In-place soil or fill soil that becomes wet and unstable and/or too wet to suitably compact should be removed and replaced with clean, granular soil (see gradation requirements above).
- Excavation and placement of structural fill material should be observed on a full-time basis by a geotechnical engineer (or representative) experienced in wet weather/wet condition earthwork to determine that all work is being accomplished in accordance with the project specifications and our recommendations.
- Grading and earthwork should not be accomplished during periods of heavy, continuous rainfall.

We recommend that the above requirements for wet weather/wet condition earthwork be incorporated into the contract specification.

LIMITATIONS

We have prepared this report for use by the Iris Group and other members of the design team, for use in the design of a portion of this project. The data used in preparing this report and this report should be provided to prospective contractors for their bidding or estimating purposes only. Our report, conclusions and interpretations are based on our subsurface explorations, data from others and limited site reconnaissance, and should not be construed as a warranty of the subsurface conditions.

Variations in subsurface conditions are possible between the explorations and may also occur with time. A contingency for unanticipated conditions should be included in the budget and schedule. Sufficient monitoring, testing and consultation should be provided by our firm 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 earthwork and foundation installation activities comply with contract plans and specifications.

The scope of our services does not include services related to environmental remediation and construction safety precautions. Our recommendations are not intended to direct the contractor's methods, techniques, sequences or procedures, except as specifically described in our report for consideration in design.

If there are any changes in the loads, grades, locations, configurations or type of facilities to be constructed, the conclusions and recommendations presented in this report may not be fully applicable. If such changes are made, we should be given the opportunity to review our recommendations and provide written modifications or verifications, as appropriate.

◆ ◆ ◆

We have appreciated the opportunity to be of service to you on this project. If you have any questions or comments, please do not hesitate to call at your earliest convenience.

Respectfully submitted,
GeoResources, LLC

Veronica Raub Mauren, EIT
Staff Engineer in Training

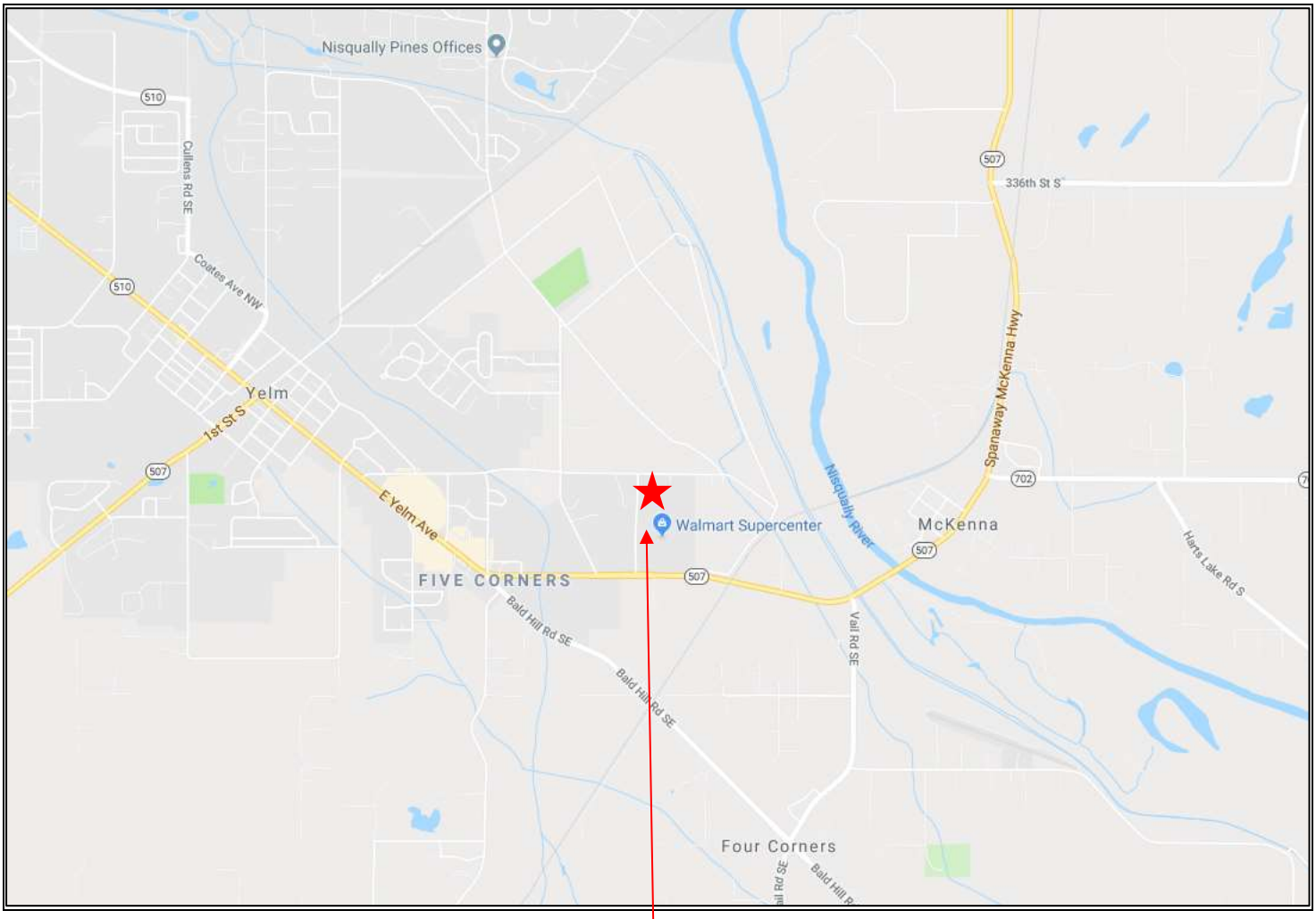
State of Washington
Engineering Geologist
925
Licensed Geologist
6/10/2019
KEITH SCOTT SCHEMBS

Keith S. Schembs, LEG
Principal

ERIC WILLIAM HELLER
STATE OF WASHINGTON
43471
REGISTERED
PROFESSIONAL ENGINEER
6/10/2019

Eric W. Heller, LG, PE
Senior Geotechnical Engineer

VRM:KSS:EWH/vrm
DocID: IrisGroup.103rdAveSE.RG
Attachments:
Figure 1: Site Location Map
Figure 2a: Proposed Site Plan
Figure 2b: Site and Exploration Map
Figure 3: NRCS Soils Map
Figure 4: Geologic Map
Figure 5: High Groundwater Hazard Area Mapping
Appendix A - Subsurface Explorations
Appendix B - Laboratory Test Results



Approximate Site Location

Map created from Google Maps (www.maps.google.com)

Not to Scale

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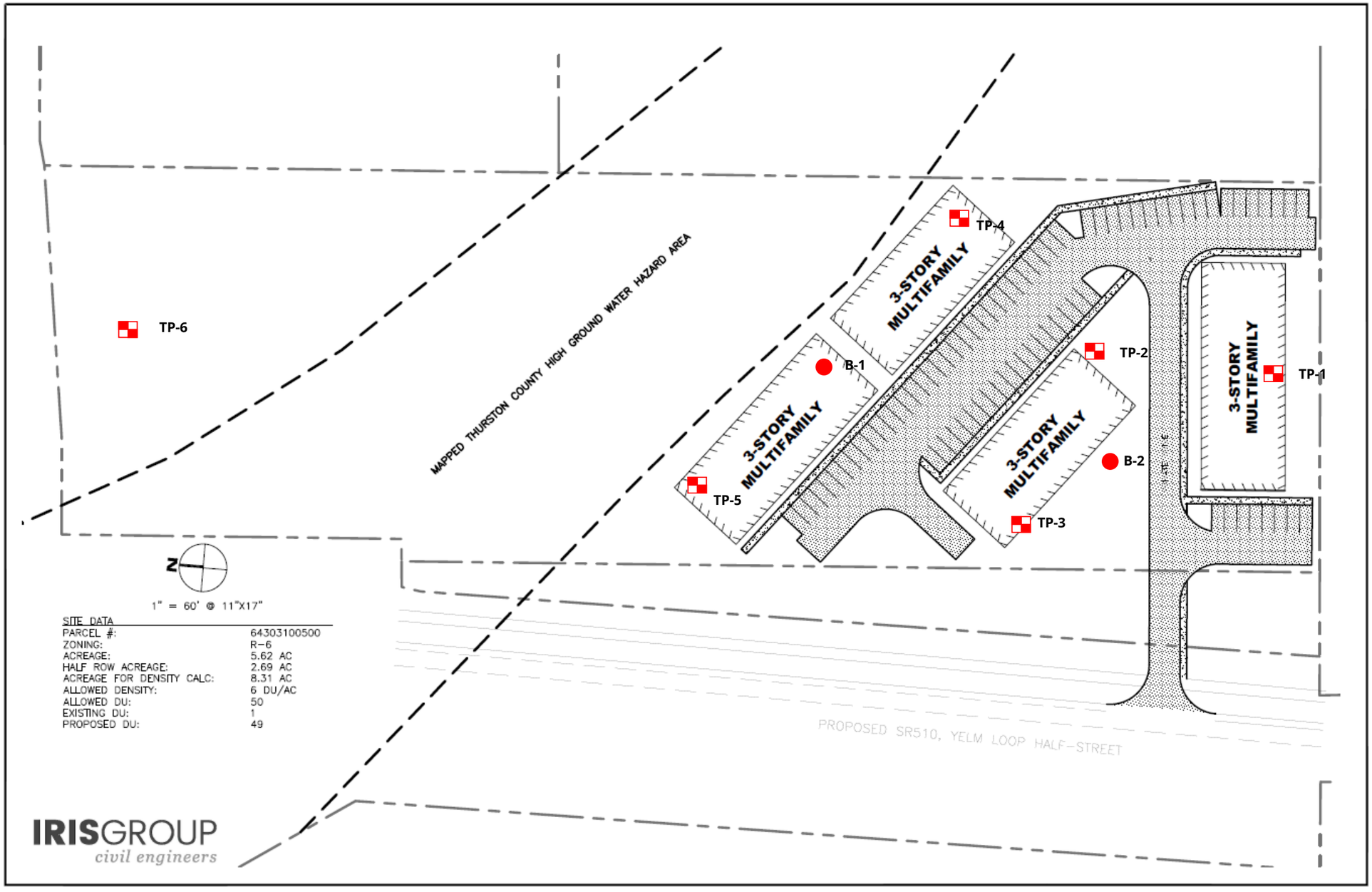
Site Location Map

Proposed Multi-Family Residential Development
17021 – 103rd Avenue SE
Yelm, Washington
PN: 64303100500

Doc ID: TheIrisGroup.103rdAveSE.F	November 2018	Figure 1



Site Plan Provide by Iris Group Civil Engineers
Not to scale

Approximate Test Pit Location -
Approximate Boring Location -

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Site and Exploration Plan
Proposed Multi-Family Residential Development
17021 – 103rd Avenue SE
Yelm, Washington
PN: 64303100500

Doc: IrisGroup.103rdAveSE.F2	November 2018	Figure 2a

Approximate Site Location

Map created from Thurston County GeoData
(http://map.co.thurston.wa.us/Html5Viewer/Index.html?viewer=uMap.Main)

TP-1 - Number and Approximate Location of Test Pit

B-1 - Number and Approximate Location of Boring

N W E S

Not to Scale

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Site and Exploration Map

Proposed Multi-Family Residential Development
17021 – 103rd Avenue SE
Yelm, Washington
PN: 64303100500

Doc ID: TheIrisGroup.103rdAveSE.F	November 2018	Figure 2b

Approximate Site Location

Map created from Web Soil Survey (http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx)

Soil Type	Soil Name	Parent Material	Slopes	Erosion Hazard	Hydrologic Soils Group
110	Spanaway gravelly sandy loam	Volcanic ash over gravelly outwash	0 to 3	Slight	A
113	Spanaway gravelly sandy loam	Volcanic ash over gravelly outwash	3 to 15	Slight	A

N W E S

Not to Scale

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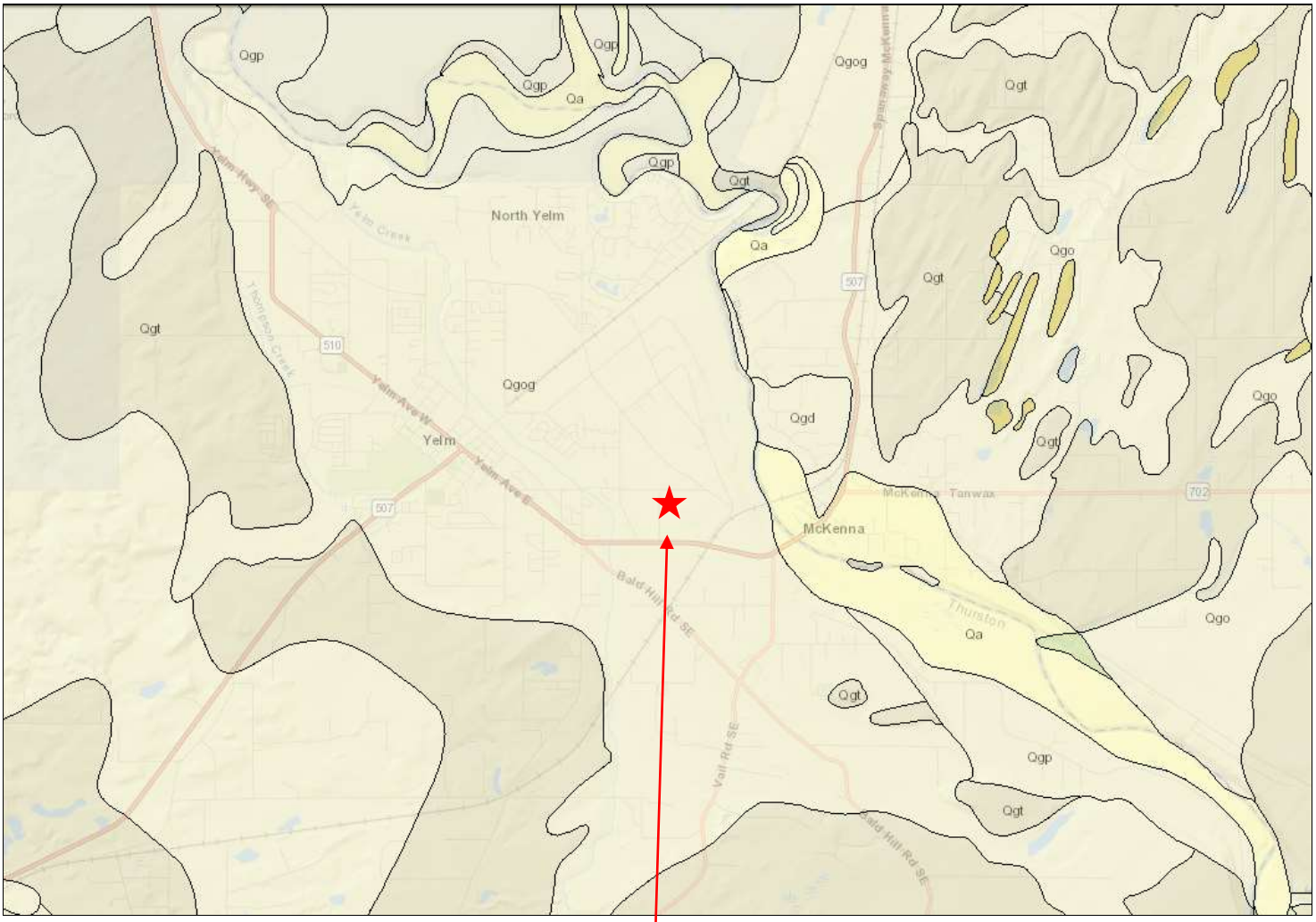
NRCS Soils Map

Proposed Multi-Family Residential Development
17021 – 103rd Avenue SE
Yelm, Washington
PN: 64303100500



Approximate Site Location

Map created from the Washington State Department of Natural Resources Information Portal (http://geologyportal.dnr.wa.gov/)

Qa	Alluvium
Qgog	Continental glacial outwash, gravel
Qgt	Continental glacial till

Not to Scale

Geologic Map

Proposed Multi-Family Residential Development
17021 – 103rd Avenue SE
Yelm, Washington
PN: 64303100500

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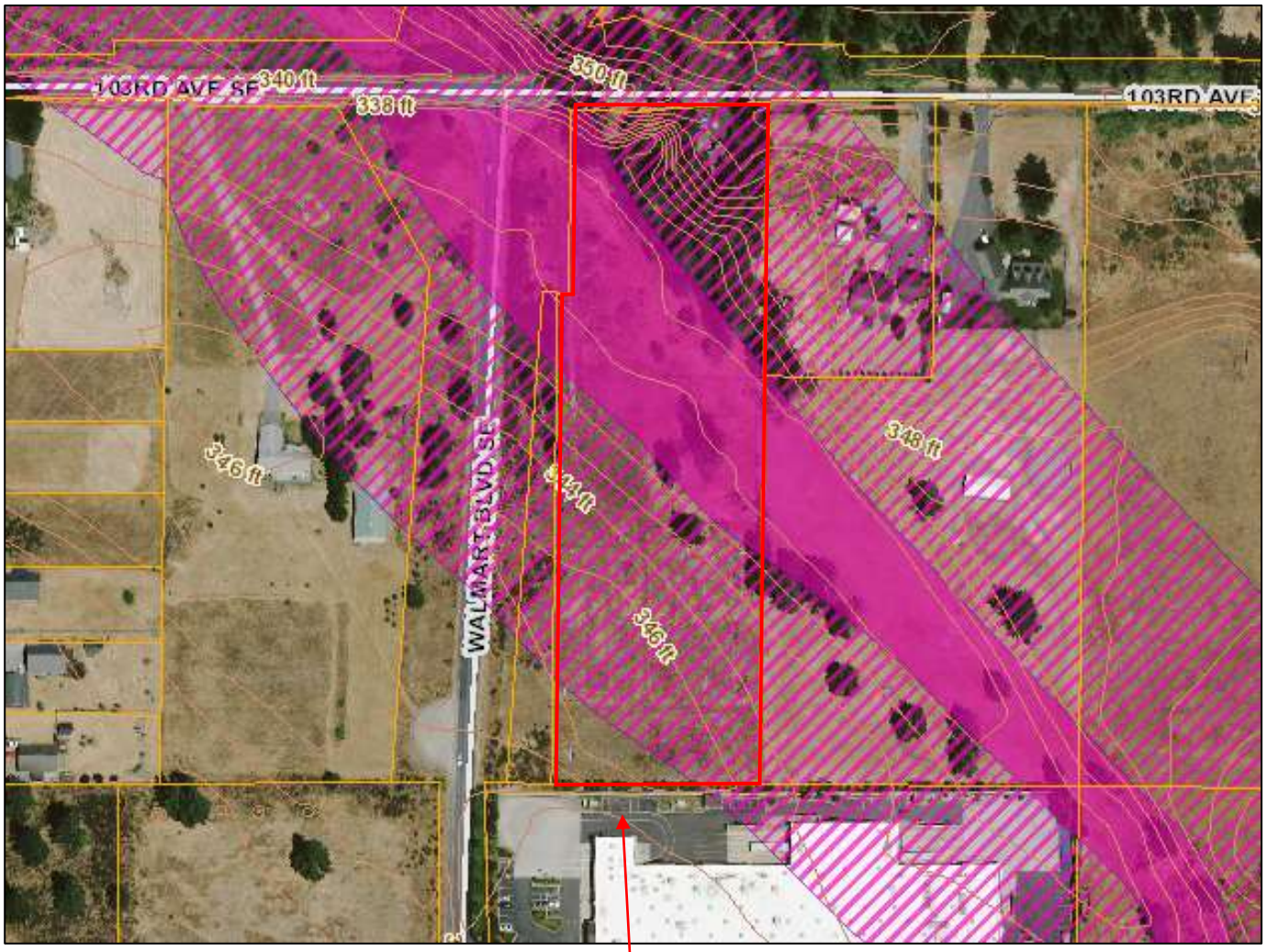
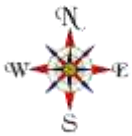
Doc ID: TheIrisGroup.103rdAveSE.F	November 2018	Figure 4



Approximate Site Location

Map created from Thurston County GeoData
(http://map.co.thurston.wa.us/Html5Viewer/Index.html?viewer=uMap.Main)

	HGW Hazard
	HGW Hazard-300' Buffer



Not to Scale

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High Groundwater Hazard Area Mapping

Proposed Multi-Family Residential Development
17021 – 103rd Avenue SE
Yelm, Washington
PN: 64303100500

Doc ID: TheIrisGroup.103rdAveSE.F	November 2018	Figure 4

Appendix A

Subsurface Explorations

SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE GRAINED SOILS More than 50% Retained on No. 200 Sieve	GRAVEL More than 50% Of Coarse Fraction Retained on No. 4 Sieve	CLEAN GRAVEL	GW	WELL-GRADED GRAVEL, FINE TO COARSE GRAVEL
			GP	POORLY-GRADED GRAVEL
		GRAVEL WITH FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SAND More than 50% Of Coarse Fraction Passes No. 4 Sieve	CLEAN SAND	SW	WELL-GRADED SAND, FINE TO COARSE SAND
			SP	POORLY-GRADED SAND
		SAND WITH FINES	SM	SILTY SAND
			SC	CLAYEY SAND
FINE GRAINED SOILS More than 50% Passes No. 200 Sieve	SILT AND CLAY Liquid Limit Less than 50	INORGANIC	ML	SILT
			CL	CLAY
		ORGANIC	OL	ORGANIC SILT, ORGANIC CLAY
	SILT AND CLAY 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

NOTES:

1. Field classification is based on visual examination of soil in general accordance with ASTM D2488-90.
2. Soil classification using laboratory tests is based on ASTM D2487-90.
3. Description of soil density or consistency are based on interpretation of blow count data, visual appearance of soils, and or test data.

SOIL MOISTURE MODIFIERS:

Dry- Absence of moisture, dry to the touch

Moist- Damp, but no visible water

Wet- Visible free water or saturated, usually soil is obtained from below water table

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Unified Soils Classification System

Proposed Multi-Family Residential Development
17021 – 103rd Avenue SE
Yelm, Washington
PN: 64303100500

Test Pit TP-1

Location: S-Central portion of site
Approximate Elevation: 346'

Depth (ft)			Soil Type	Soil Description
0	-	2.0	GP	Black to dark brown silty GRAVEL with sand (medium dense, moist)
2.0	-	8.0	GP	Golden brown GRAVEL with sand and boulders (medium dense, moist) (recessional outwash) Moisture decreased with depth after 3'

Terminated at 8.0 feet below ground surface.
Caving observed throughout excavation.
No groundwater seepage observed.
White mottling observed at approximately 6' below grade.

Test Pit TP-2

Location: Central portion of proposed development area
Approximate Elevation: 346'

Depth (ft)			Soil Type	Soil Description
0	-	3.0	GP	Black to dark brown silty GRAVEL with sand (medium dense, moist)
3.0	-	8.0	GP	Golden brown GRAVEL with sand and boulders (medium dense, moist) (recessional outwash)

Terminated at 8.0 feet below ground surface.
Caving observed throughout excavation.
No groundwater seepage observed.
White mottling observed at approximately 6' below grade.

Test Pit TP-3

Location: NW portion of proposed development
Approximate Elevation: 346'

Depth (ft)			Soil Type	Soil Description
0	-	1.5	GP	Black to dark brown silty GRAVEL with sand (medium dense, moist)
1.5	-	8.0	GP	Golden brown GRAVEL with sand and boulders (medium dense, moist) (recessional outwash) Moisture decreased with depth after 3.5'

Terminated at 8.0 feet below ground surface.
Caving observed throughout excavation.
No groundwater seepage observed.
White mottling observed at approximately 6' below grade.

Logged by: VRM **Excavated on: November 9, 2018**

Test Pit TP-4

Location: NE portion of proposed development
Approximate Elevation: 342'

Depth (ft)			Soil Type	Soil Description
0	-	2.5	GP	Black to dark brown silty GRAVEL with sand (medium dense, moist)
2.0	-	8.0	GP	Golden brown GRAVEL with sand and boulders (medium dense, moist) (recessional outwash) Moisture decreased with depth after 3'

Terminated at 8.0 feet below ground surface.
Caving observed throughout excavation.
No groundwater seepage observed.
White mottling observed at approximately 6' below grade.

Test Pit TP-5

Location: N-central portion of proposed development
Approximate Elevation: 343'

Depth (ft)			Soil Type	Soil Description
0	-	2.5	GP	Black to dark brown silty GRAVEL with sand (medium dense, moist)
2.5	-	9.0	GP	Golden brown GRAVEL with sand and boulders (medium dense, moist) (recessional outwash) Moisture decreased with depth after 3.5'

Terminated at 9.0 feet below ground surface.
Caving observed throughout excavation.
No groundwater seepage observed.
White mottling observed at approximately 6' below grade.

Test Pit TP-6

Location: NW corner of site
Approximate Elevation: 340'

Depth (ft)			Soil Type	Soil Description
0	-	2.0	GP	Black to dark brown silty GRAVEL with sand (medium dense, moist)
2.0	-	3.5	SM	Medium brown silty SAND with boulders (medium dense, moist) (recessional outwash)
3.5	-	7.5	GP	Golden brown silty GRAVEL with sand and boulders (medium dense, moist) (recessional outwash)

Terminated at 7.5 feet below ground surface.
Caving observed throughout excavation.
No groundwater seepage observed.
No mottling

Logged by: VRM **Excavated on: November 9, 2018**

TOTAL DEPTH:	20.75 ft	**DRILLING METHOD:**	HSA	**LOGGED BY:**	VRM/NT
TOP ELEVATION:	340'	**DRILLING COMPANY:**	Bore-tec	**HAMMER TYPE:**	Cat head
LATITUDE:		**DRILL RIG:**	EC95	**HAMMER WEIGHT:**	140 lbs
LONGITUDE:		**NOTES:**			

Depth	Elevation	SOIL DESCRIPTION	DRILLING NOTES	Sample	Sampler	Symbol	TEST RESULTS: Plastic Limit ⊢—⊣ Liquid Limit; % Water Content ●; % Fines (<0.075mm) ◇; Penetration - ▲ (blows per foot) 10 20 30 40 50	Blow Count	Ground Water	Well Schematic
0	340	Topsoil/duff								
		Brown sandy gravel with silt (medium dense, moist to wet)								
4	336			1			▲	50/4		
8	332									
				2			▲	16 50/2		
12	328									
			No recovery	3			▲	4 22 23		
16	324									
20	320		Refused on boulder					16 50/3		
		Bottom of Boring Completed11/16/18								
24	316									

NOTES

1. Refer to log key for definition of symbols, abbreviations and codes
2. USCS designation is based on visual manual classification and selected lab testing
3. Groundwater level, if indicated, is for the date shown and may vary
4. N.E. = Not Encountered

Proposed Apartments

LOG OF BORING B-1

JOB: IrisGroup.103rdAveSE *Sheet of 3*

GeoResources, LLC | **FIG.**

TOTAL DEPTH:	25.1	**DRILLING METHOD:**	HSA	**LOGGED BY:**	VRM/NT
TOP ELEVATION:	346'	**DRILLING COMPANY:**	Bore-tec	**HAMMER TYPE:**	Cat head
LATITUDE:		**DRILL RIG:**	EC95	**HAMMER WEIGHT:**	140 lbs
LONGITUDE:		**NOTES:**			

Depth	Elevation	SOIL DESCRIPTION	DRILLING NOTES	Sample	Sampler	Symbol	TEST RESULTS	Blow Count	Ground Water	Well Schematic
0		Topsoil/duff					Plastic Limit ⊢—⊣ Liquid Limit; % Water Content ●; % Fines (<0.075mm) ◇; Penetration - ▲ (blows per foot) 10 20 30 40 50			
		Brown sandy gravel with silt (medium dense, moist to wet)								
	344									
4								37		
	340							26		
								16		
8										
	336							19		
								19		
12								21		
	332									
			No recovery					16		
16								16		
	328							20		
20								50/4		
	324									
24										
		Bottom of Boring	No recovery					50/1		
	320									

NOTES

1. Refer to log key for definition of symbols, abbreviations and codes
2. USCS designation is based on visual manual classification and selected lab testing
3. Groundwater level, if indicated, is for the date shown and may vary
4. N.E. = Not Encountered

Proposed Apartments

LOG OF BORING B-2

JOB: IrisGroup.103rdAveSE *Sheet of 3*

GeoResources, LLC | **FIG.**

TOTAL DEPTH:	25.1	**DRILLING METHOD:**	HSA	**LOGGED BY:**	VRM/NT
TOP ELEVATION:	346'	**DRILLING COMPANY:**	Bore-tec	**HAMMER TYPE:**	Cat head
LATITUDE:		**DRILL RIG:**	EC95	**HAMMER WEIGHT:**	140 lbs
LONGITUDE:		**NOTES:**			

Depth	Elevation	SOIL DESCRIPTION	DRILLING NOTES	Sample	Sampler	Symbol	TEST RESULTS	Blow Count	Ground Water	Well Schematic
		Completed11/16/18					Plastic Limit ⊢—⊣ Liquid Limit % Water Content ● % Fines (<0.075mm) ◇ Penetration - ▲ (blows per foot) 10 20 30 40 50			
	320									
28										
	316									
32										
	312									
36										
	308									
40										
	304									
44										
	300									
48										
	296									
52										

NOTES

1. Refer to log key for definition of symbols, abbreviations and codes
2. USCS designation is based on visual manual classification and selected lab testing
3. Groundwater level, if indicated, is for the date shown and may vary
4. N.E. = Not Encountered

Proposed Apartments

LOG OF BORING B-2

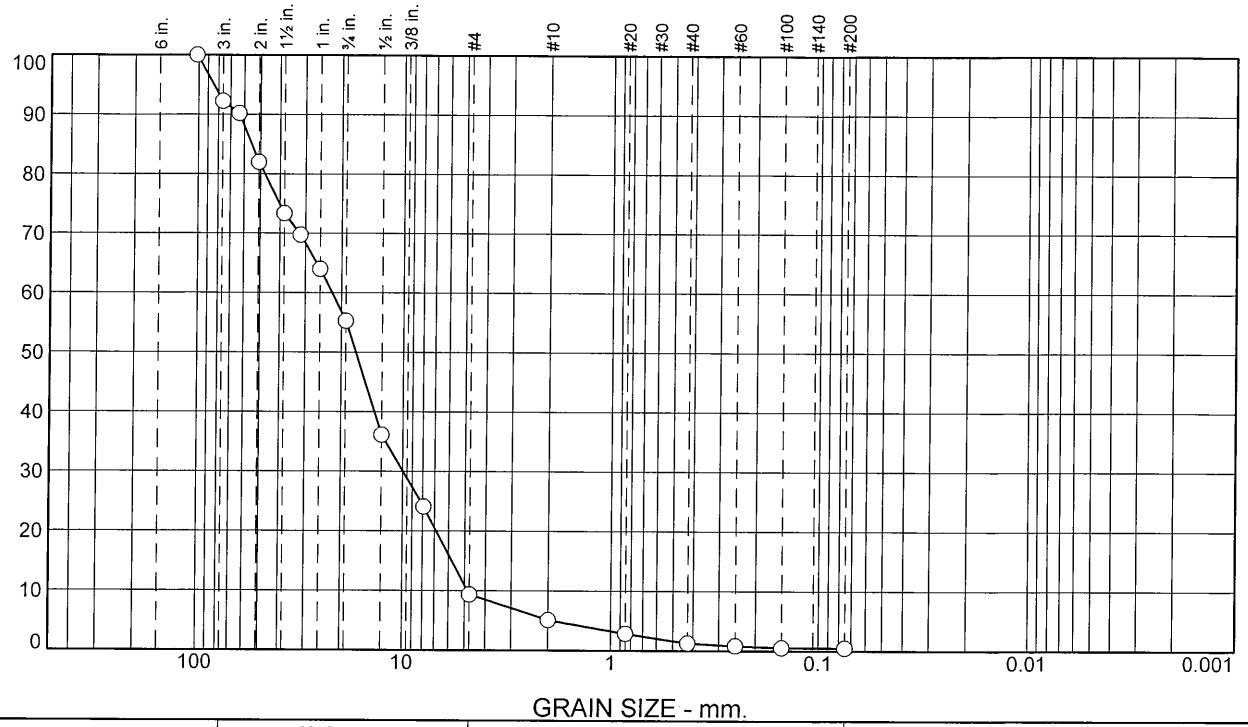
JOB: IrisGroup.103rdAveSE *Sheet of 3*

GeoResources, LLC | **FIG.**

Appendix B

Laboratory Analyses

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
7.8	36.9	45.9	4.3	3.8	0.8	0.5	

Test Results (ASTM D 422 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
4	100.0		
3.0	92.2		
2.5	90.2		
2.0	82.0		
1.5	73.4		
1.25	69.8		
1	64.0		
.75	55.3		
.5	36.1		
.3125	24.1		
#4	9.4		
#10	5.1		
#20	2.8		
#40	1.3		
#60	0.8		
#100	0.5		
#200	0.5		

* (no specification provided)

Material Description

poorly graded gravel

Atterberg Limits (ASTM D 4318)

PL= NP LL= PI=

Classification

USCS (D 2487)= GP AASHTO (M 145)=

Coefficients

D_{90}= 63.1284 D_{85}= 55.1284 D_{60}= 22.2511
D_{50}= 17.0295 D_{30}= 10.0012 D_{15}= 5.7836
D_{10}= 4.8578 C_u= 4.58 C_c= 0.93

Remarks

Date Received: 11/19/18 **Date Tested:** 11/13/18

Tested By: NT

Checked By:

Title:

Location: TP-2 **Date Sampled:** 11/09/18

Sample Number: 095922 **Depth:** 8'

GeoResources, LLC

Fife, WA

Client: Iris Group, Inc.

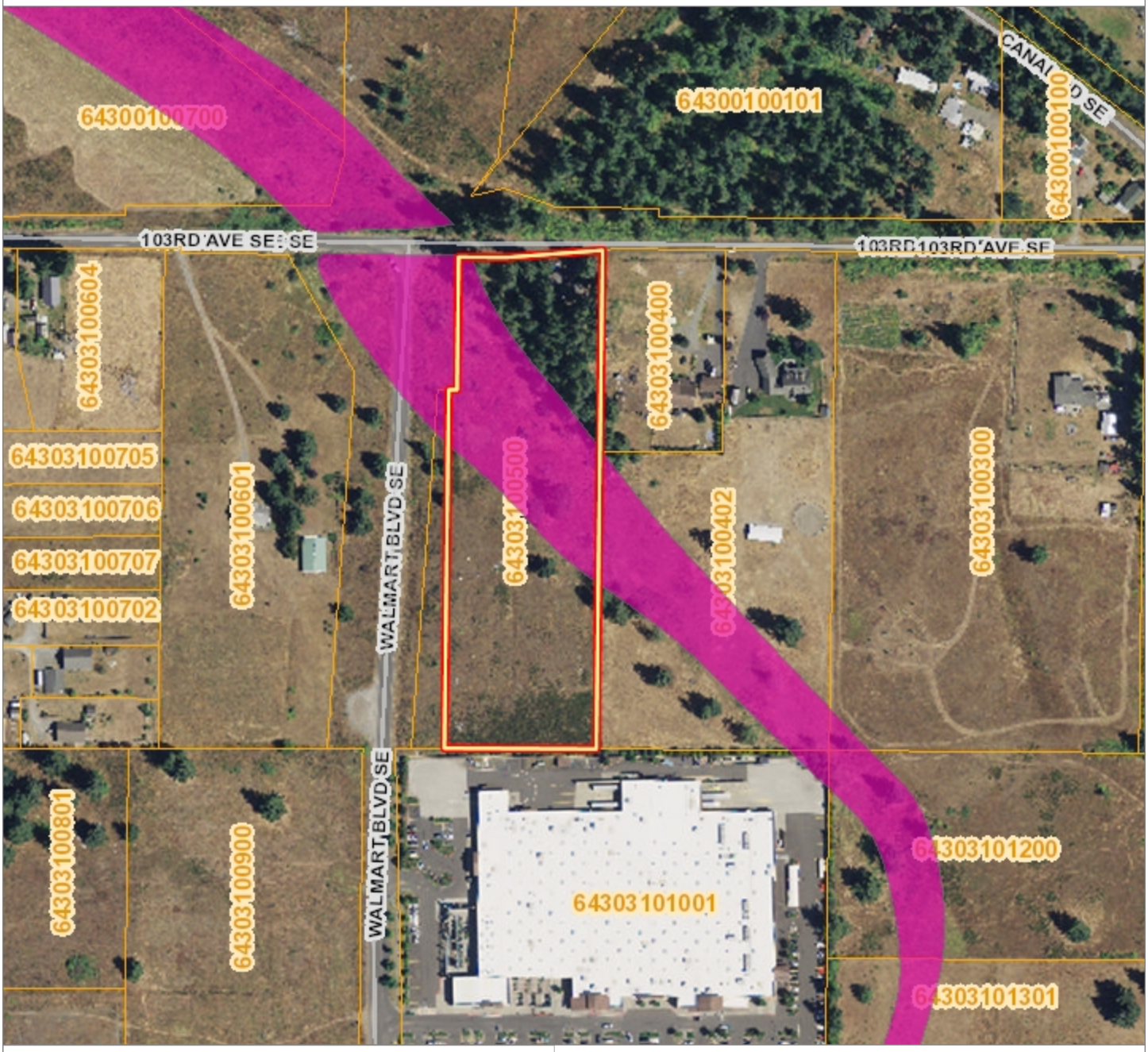
Project: Proposed Apartments

Project No: IrisGroup.103rdAveSE **Figure** B-1

Tested By: _____ **Checked By:** _____

Appendix F

High Groundwater Hazard Area Map



Legend

Flood Zones FEMA
- 100 Year (1%)
- 500 Year (0.2%)

Flood Zones 2012 to 2016 FEMA
- 100 Year (1%)
- 500 Year (0.2%)

Flood Zones pre 2012 FEMA
- 100 Year (1%)
- 500 Year (0.2%)
- Floodways

Salmon Creek High Groundwater Hazard

Scale 1: 4,922

0 200 400

Feet

Map Created Using GeoData Public Website

Published: 7/5/2019

Note:

THURSTON COUNTY
WASHINGTON
SINCE 1852

Thurston County GeoData Center

Appendix G

National Flood Hazard Layer FIRMette

FEMA

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 6/30/2019 at 5:06:31 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.

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June 10, 2019

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Geotechnical Engineering Report
Proposed Multi-Family Residential Development
17021 – 103rd Avenue Southeast
Yelm, Washington
PN: 64303100500
Doc ID: IrisGroup.103rdAveSE.RG

INTRODUCTION

This geotechnical engineering report summarizes our site observations, subsurface explorations, laboratory testing, and engineering analyses, and provides geotechnical recommendations and design criteria for the proposed multi-family residential development to be constructed at 17021 – 103rd Avenue Southeast in Yelm, Washington. The general location of the site is shown on the attached Site Location Map, Figure 1.

Our understanding of the project is based on our discussions with you, our November 9 and 16, 2018 site visits, our understanding of the City of Yelm Development Codes, and our experience in the site area. We understand that the site is currently undeveloped except for a single family residence and detached garage in the north portion of the site. We further understand that you propose to construct four 3-story multi-family residential buildings in the south portion of the site, including paved access roads and parking stalls, and associated utilities. We anticipate that the new buildings will be three-story, wood framed structures supported by conventional shallow foundations with slab on grade floors. A copy of the proposed site plan has been included as Figure 2a.

We understand the City of Yelm is requiring our *Geotechnical Engineering Report* dated December 26, 2006 be updated to meet the current City of Yelm Development Codes. Additionally, the City of Yelm has adopted the 2012 Stormwater Management Manual for Western Washington with 2014 Amendments (2012 SWMMWW), and is requiring a report be prepared to address the feasibility of onsite infiltration in accordance with Volume I, Section 3.1.1.

SCOPE

The purpose of our services was to evaluate the surface and subsurface conditions across the site as a basis for providing geotechnical recommendations and design criteria for the proposed development. Specifically, the scope of services for this project included the following:

1. Reviewing existing geological, hydrogeological, and geotechnical literature for the site area;
2. Exploring the subsurface conditions by monitoring the excavation of 6 test pits at select locations across the site and by monitoring the drilling of 2 borings completed as groundwater observation wells;
3. Collecting select soil samples from the explorations and conducting 2 grain size analyses, as appropriate;
4. Describing surface and subsurface conditions, including soil type, depth to groundwater, and estimate of high groundwater;
5. Addressing the appropriate criteria for Geologic Hazards per the current City of Yelm Geologically Hazardous Areas Title 18.21;
6. Providing geotechnical conclusions and recommendations regarding seismic site class and design coefficients, seismic hazard analysis, site grading activities including; site preparation, subgrade preparation, fill placement criteria, suitability of on-site soils for use as structural fill, temporary and permanent cut and fill slopes, drainage and erosion control measures;
7. Providing conclusions regarding foundations, including shallow conventional footings, along with floor slab support and design criteria, including bearing capacity and subgrade modulus if appropriate;
8. Providing our opinion about the feasibility of onsite infiltration in accordance with the 2012 SWMMWW, including a preliminary design infiltration rate based on grain size data, as appropriate, to meet the Soils Report requirement of the 2012 SWMMWW;
9. Providing recommendations for erosion and sediment control during wet weather grading and construction; and
10. Preparing this written *Geotechnical Engineering Report* with design recommendations summarizing our site observations and conclusions, and our geotechnical recommendations and design criteria, along with the supporting data.

The above scope of work was summarized in our *Proposal for Geotechnical Engineering* Services dated September 27, 2018. We received written authorization to proceed by you on November 4, 2018

SITE CONDITIONS

Surface Conditions

The site is located at 17021 – 103rd Avenue Southeast in Yelm, Washington within an area of agricultural, residential, and commercial development. The site is generally rectangular in shape, measures approximately 265 to 285 feet wide (east to west) by 900 to 915 feet deep (north to south), and encompasses about 5.62 acres. The site is bounded by Walmart Boulevard Southeast to the west, 103rd Avenue Southeast to the north, Walmart to the south, and pasture to the east.

The site generally slopes down from the southwest and northeast to a shallow drainage that runs from southeast to northwest through the central portion of the site. The bottom of the drainage

gently slopes down to the northwest at approximately 1 percent or less. The upper, northeastern portion of the site slopes down to the southwest at approximately 8 to 16 percent before flattening out to 1 percent or less through the central drainage. The southwestern portion of the site slopes up from the drainage at approximately 4 to 5 percent before flattening out to 1 percent or less in the southwestern corner of the site. The total topographic relief across the site is on the order of 18 feet. The existing site configuration and topography is shown on the Site and Exploration Map, Figure 2b.

Vegetation across the site generally consists of unmaintained grass and scotch broom. The northeastern portion of the site is vegetated with a moderate stand of fir trees with a sparse to moderate understory of small deciduous trees and native and invasive plants and shrubs. No areas of surficial erosion, standing water, seeps, springs, or deep seated slope movement was observed during our site reconnaissance.

Site Soils

The USDA Natural Resource Conservation Service (NRCS) Web Soil Survey maps the site as being underlain by Spanaway gravelly sandy loam (110 and 113) soils. The Spanaway soils are derived from volcanic ash over gravelly outwash, have a "slight" erosion hazard when exposed, and are included in hydrologic soils group A. The 110 soils form on slopes of 0 to 3 percent, while the 113 soils form on slopes of 3 to 15 percent. A copy of the soils map for the site vicinity is provided as Figure 3.

Site Geology

The Washington Geologic Information Portal maps the site as being underlain by continental glacial outwash, gravel (Qgog). These soils were generally deposited during the most recent Vashon Stade of the Fraser Glaciation, some 12,000 to 15,000 years ago. The recessional outwash soils consist of a poorly sorted, lightly stratified mixture of sand and gravel that may contain localized deposits of clay and silt that were deposited by meltwater streams emanating from the retreating continental ice mass. The recessional outwash deposits are considered normally consolidated and offer moderate strength and compressibility characteristics, where undisturbed. An excerpt of the above reference geologic map is attached as Figure 4.

Subsurface Explorations

On November 9, 2018 a representative from GeoResources, LLC (GeoResources) visited the site and monitored the excavation of 6 test pits to depths 7½ to 9 feet below the existing ground surface. We returned to the site on November 16, 2018 to monitor the drilling of two borings to 19½ and 26½ feet below the existing ground surface. The test pits were excavated by a licensed earthwork contractor operating a track-mounted excavator and the borings were drilled by a licensed drilling contractor operating a small track-mounted drill rig, both working under contract for GeoResources.

The specific number, locations, and depths of our explorations were selected based on the configuration of the proposed development and were adjusted in the field based on site access limitations. A representative from our office continuously monitored the explorations, maintained logs of the subsurface conditions encountered, obtained representative soil samples, and observed pertinent site features. Representative soil samples obtained from the explorations were placed in sealed plastic bags and taken to our laboratory for further examination and testing as deemed necessary. The test pits were backfilled with the excavated soils and bucket tamped, but not

otherwise compacted, while the borings were backfilled with bentonite chips and abandoned by the driller in accordance with Washington State Department of Ecology requirements.

During drilling, soil samples were obtained at 2½- and 5-foot depth intervals in accordance with Standard Penetration Test (SPT) as per the test method outlined by ASTM: D1586. The SPT method consists of driving a standard 2-inch-diameter split-spoon sampler 18-inches into the soil with a 140-pound hammer. The number of blows required to drive the sampler through each 6-inch interval is counted, and the total number of blows struck during the final 12 inches is recorded as the Standard Penetration Resistance, or "SPT blow count". The resulting Standard Penetration Resistance values indicate the relative density of granular soils and the relative consistency of cohesive soils.

The subsurface explorations completed as part of this evaluation indicate the subsurface conditions at specific locations only, as actual subsurface conditions can vary across the site. Furthermore, the nature and extent of such variation would not become evident until additional explorations are performed or until construction activities have begun.

The soils encountered were visually classified in accordance with the Unified Soil Classification System (USCS) and ASTM D: 2488. The approximate locations of our explorations are indicated on the attached Site and Exploration Plan, Figures 2a and 2b. The USCS is included in Appendix A as Figure A-1, while descriptive logs of the soils encountered are included as Figures A-2 through A-5.

Subsurface Conditions

Our explorations encountered relatively uniform subsurface conditions that generally agrees with the mapped stratigraphy within the site vicinity. In general, our explorations encountered 1.5 to 3 feet of black silty gravel with sand in a medium dense, moist condition underlain by golden brown sandy gravel with cobbles and variable amounts of silt in a medium dense, moist condition that was encountered to the full depth explored. These soils appear consistent with the mapped recessional outwash.

In test pit TP-6, the upper black silty gravel was underlain by brown silty sand with boulders in a medium dense, moist conditions that was underlain by golden-brown silty gravel with sand and boulders in a medium dense, moist condition that was encountered to the full depth explored. These soils appear to be consistent with weathered recessional outwash over recessional outwash.

Laboratory Testing

Geotechnical laboratory tests were performed on select samples retrieved from the test pits to determine soil index and engineering properties encountered. Laboratory testing included visual soil classification per ASTM D: 2488, and grain size analyses per ASTM D: 422 standard procedures. The results of the laboratory tests are included in Appendix B.

Groundwater Conditions

Groundwater was not observed in any of our explorations at the time of excavation; however, groundwater was encountered in the groundwater observation wells during our wet season monitoring. Based on the High Groundwater Hazard mapping by Thurston County GeoData, we anticipate the mottling is indicative of the seasonal high levels of the regional groundwater table. We anticipate fluctuations in the local groundwater levels may occur in response to precipitation patters, off-site construction activities, and site utilization. Table 1 summarizes the approximate depths and

elevations of groundwater observed at the time of our explorations and our subsequent readings in or borings, and the High Groundwater Hazard Map is included as Figure 5.

TABLE 1
APPROXIMATE DEPTHS, AND ELEVATION OF GROUNDWATER ENCOUNTERED IN EXPLORATIONS

Exploration Number	Depth to Groundwater (feet)	Estimated Elevation of Groundwater (feet)	Date Encountered
B-1	N/E	N/E	ATD (11/16/2018)
	N/E	N/E	12/14/18
	N/E	N/E	12/26/18
	17.40	322.6	1/9/2019
	16.03	323.97	1/22/2019
	15.05	324.95	2/15/2019
	12.84	327.16	2/27/2019
	13.24	326.76	3/15/2019
	14.39	325.61	3/29/2019
	14.95	325.05	4/10/2019
	14.67	325.33	4/26/2019
B-2	N/E	N/E	ATD (11/16/2018)
	N/E	N/E	12/14/18
	N/E	N/E	12/26/18
	19.21	326.79	1/9/2019
	18.95	327.05	1/22/2019
	16.75	329.25	2/15/2019
	14.56	331.44	2/27/2019
	15.50	330.5	3/15/2019
	16.08	329.92	3/29/2019
	16.70	329.3	4/10/2019
	16.4	329.6	4/26/2019

Notes: Elevations are based on topographic information obtained from Thurston County GeoData
ATD = At time of drilling/digging
N/E: Not encountered

ENGINEERING CONCLUSIONS AND RECOMMENDATIONS

Based on the results of our data review, site reconnaissance, subsurface explorations and our experience in the area, it is our opinion that the site is suitable for the proposed multi-family residential development. Pertinent conclusions and geotechnical recommendations regarding the design and construction of the proposed development are presented below.

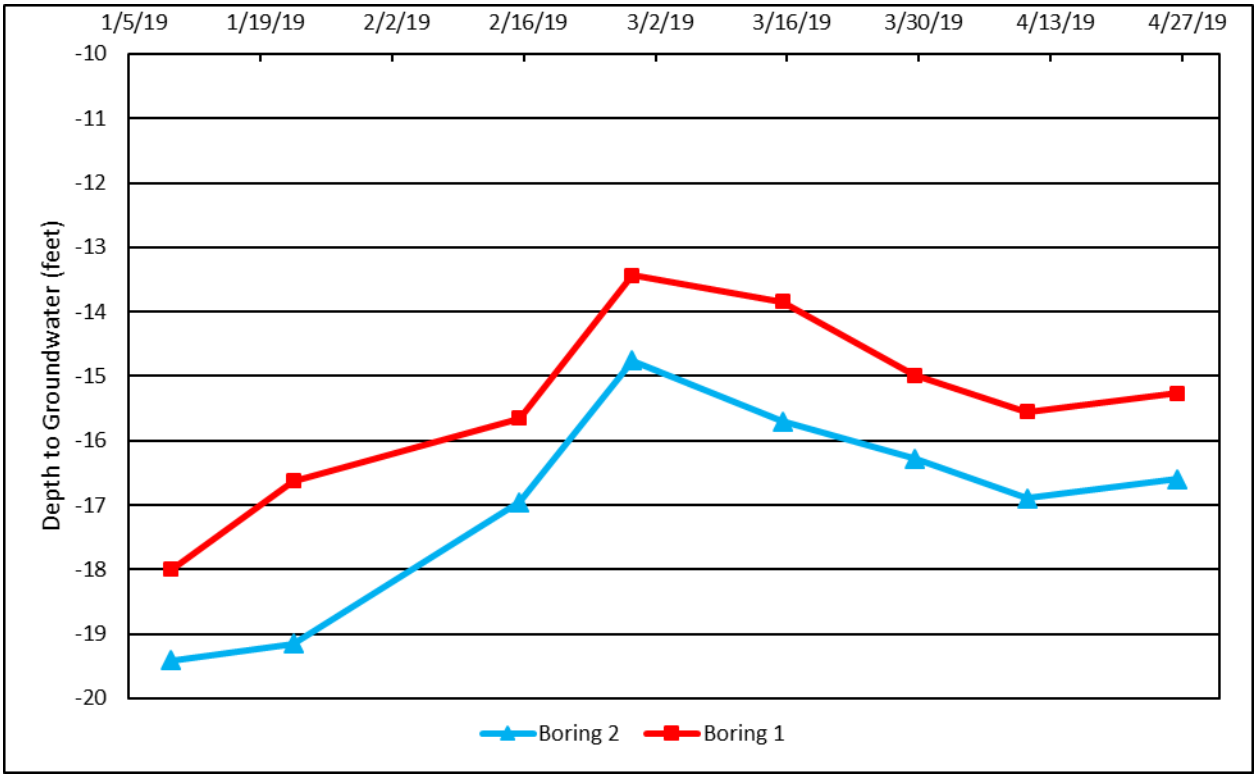
Frequently Flooded Areas YMC 18.21.080

Per the Yelm Municipal Code, Chapter 18.21.080 Frequently Flooded Areas, hall include areas identified by the Flood Insurance Rate Map(s) and areas mapped by Thurston County as high ground water flood hazard areas. The site is not mapped as a Floodway of a Flood Hazard Area by FEMA (FIRM, Panel 362 of 625). Thurston County maps the upper, central portion of the site as being a High Groundwater Hazard Area. A copy of the High Groundwater Hazard Area map for the site vicinity has been included as Figure 5.

Based on the above, the site does not trigger the performance standards for the FEMA 100-Year Floodplain; however, performance standards per the YMC 18.21.080.G should be met for High Groundwater Hazard Areas because of the mapped designation by Thurston County. Per the performance standards, development shall not be located within 50 horizontal feet or two vertical feet of the established base flood elevation, whichever is less. Additionally, the bottom of any infiltration facility for stormwater shall be located at least 6 feet above the base flood elevation.

Our two borings were installed as monitoring wells to observe the elevation of the seasonal groundwater table throughout the wet season. The results of our 2018-2019 wet season groundwater monitoring are summarized in Exhibit 1, below.

EXHIBIT 1
2018/2019 WET SEASON GROUNDWATER DEPTHS



Seismic Design

Based on our observations and the subsurface units mapped at the site, we interpret the structural site conditions to correspond to a seismic Site Class "D" in accordance with the 2015 IBC

documents and American Society of Civil Engineers (ASCE) standard 7-10 Chapter 20 Table 20.3-1. This is based on the anticipated range of SPT (Standard Penetration Test) blow counts for the soils types in the site area. These conditions were assumed to be representative for the subsurface conditions for the site in general based on our experience in the vicinity of the site.

The U.S. Geological Survey (USGS) completed probabilistic seismic hazard analyses (PSHA) for the entire country in November 1996, which were updated and republished in 2002 and 2008. The PSHA ground motion results can be obtained from the USGS 2015 IBC design. Table 2, below, summarizes the recommended design parameters.

TABLE 2
2015 IBC PARAMETERS FOR DESIGN OF SEISMIC STRUCTURES

Spectral Response Acceleration (SRA) and Site Coefficients	Short Period	1 Second Period
Mapped SRA	S_s = 1.244	S_1 = 0.494
Site Coefficients (Site Class D)	F_a = 1.003	F_v = 1.506
Maximum Considered Earthquake SRA	S_{MS} = 1.247	S_{M1} = 0.744
Design SRA	S_{DS} = 0.831	S_{D1} = 0.496

Earthquake-induced geologic hazards may include liquefaction, lateral spreading, slope instability, and ground surface fault rupture. In our opinion, the potential for liquefaction and lateral spreading is not significant because of the coarse nature of the soils encountered across the site. The ground surface at the project site is gently sloping; therefore, the potential for earthquake-induced slope instability is also low. According to the Department of Natural Resources Geologic Hazards Map, the site is not located near a known fault zone. No evidence of ground fault rupture was observed in the subsurface explorations or out site reconnaissance. Therefore, in our opinion, the potential for ground surface fault rupture is also low.

Foundation Support

Based on the subsurface soil conditions encountered across the site, we recommend that spread footings for the proposed structure be founded on the on the medium dense, golden brown recessional outwash or on appropriately prepared structural fill that extends to suitable native soils. Any areas of old debris should be removed prior to blending and recompaction. Because of the silty and organic nature of the dark brown soils, we do not recommend that footings be founded directly on the upper soils encountered across the site.

The soil at the base of the excavations should be disturbed as little as possible. All loose, soft or unsuitable material should be removed or recompacted, as appropriate. A representative from our firm should observe the foundation excavations to determine if suitable bearing surfaces have been prepared, particularly in the areas where the foundation will be situated on fill material.

We recommend a minimum width of 36 inches for isolated footings and at least 18 inches for continuous wall footings. All footing elements should be embedded at least 18 inches below grade for frost protection. Footings founded as described above on the recessional outwash or on structural fill that extends to suitable bearing soils may be designed with a maximum allowable

bearing pressure of 3,000 psf (pounds per square foot). This value is for combined dead and long-term live loads. The weight of the footing and any overlying backfill may be neglected. The allowable bearing value may be increased by one-third for transient loads such as those induced by seismic events or wind loads.

Lateral loads may be resisted by friction on the base of footings and floor slabs and as passive pressure on the sides of footings. We recommend that an allowable coefficient of friction of 0.35 be used to calculate friction between the concrete and the underlying native recessional outwash. Passive pressure may be determined using an allowable equivalent fluid density of 350 pcf (pounds per cubic foot). Factors of safety have been applied to these values.

We estimate that settlements of footings designed and constructed as recommended will be less than 1 inch, for the anticipated load conditions, with differential settlements between comparably loaded footings of ½-inch or less over a span of 50 feet. Most of the settlements should occur essentially as loads are being applied; however, disturbance of the foundation subgrade during construction could result in larger settlements than predicted.

Floor Slab Support

Slab-on-grade floors, where constructed, should be supported on the medium dense recessional outwash or on structural fill prepared as described in the "**Site Preparation**" section of this report. Any areas of old fill material should be evaluated during grading activity for suitability of structural support. Areas of significant organic debris should be removed.

We recommend that floor slabs be directly underlain by a minimum 4-inch thick capillary break that consists of clean, granular material, such as pea gravel or clean crushed rock. This layer should be placed in one lift, compacted to an unyielding condition, and should contain less than 2 percent fines.

A synthetic vapor retarder is recommended to control moisture migration through the slabs. This is of particular importance where the foundation elements are underlain by medium dense recessional soils, or where moisture migration through the slab is an issue, such as where adhesives are used to anchor carpet or tile to the slab.

A subgrade modulus of 350 kips per cubic foot (kcf) may be used for floor slab design. We estimate that settlement of the floor slabs designed and constructed as recommended, will be ½-inch or less over a span of 50 feet.

Subgrade/Basement Walls

Adequate drainage behind retaining structures is imperative. Positive drainage which controls the development of hydrostatic pressure can be accomplished by placing a zone of drainage behind the walls. Granular drainage material should contain less than 2 percent fines and at least 30 percent greater than the US No. 4 sieve. Assuming properly compacted structural fill is used to backfill the foundation walls, an allowable active fluid pressure of 35 pcf and an at-rest pressure of 55 pcf should be appropriate for design. A seismic surcharge of 10H should be applied in accordance with applicable building codes.

A minimum 4-inch diameter perforated or slotted PVC pipe should be placed in the drainage zone along the base and behind the wall to provide an outlet for accumulated water and direct accumulated water to an appropriate discharge location. We recommend that a nonwoven geotextile filter fabric be placed between the soil drainage material and the remaining wall backfill to reduce silt migration into the drainage zone. The infiltration of silt into the drainage zone can, with

time, reduce the permeability of the granular material. The filter fabric should be placed such that it fully separates the drainage material and the backfill, and should be extended over the top of the drainage zone.

A geocomposite drain mat may also be used instead of free draining soils, provided it is installed in accordance with the manufacturer's instructions. A soil drainage zone should extend horizontally at least 18 inches from the back of the wall. The drainage zone should also extend from the base of the wall to within 1 foot of the top of the wall. The soil drainage zone should be compacted to approximately 90 percent of the maximum dry density (MDD), as determined in accordance with ASTM D: 1557. Over-compaction should be avoided as this can lead to excessive lateral pressures.

Lateral loads may be resisted by friction on the base of footings and as passive pressure on the sides of footings and the buried portion of the wall, as described in the "**Foundation Support**" section of this report.

Temporary Excavations

All job site safety issues and precautions are the responsibility of the contractor providing services/work. The following cut/fill slope guidelines are provided for planning purposes only. Temporary cut slopes will likely be necessary during grading operations or utility installation. All excavations at the site associated with confined spaces, such as utility trenches and retaining walls, must be completed in accordance with local, state, or federal requirements. Based on current Washington State Safety and Health Administration (WSHA) regulations, the soils on the site would be classified as Type C soils.

According to WSHA, for temporary excavations of less than 20 feet in depth, the side slopes in Type C soils should be laid back at a slope inclination of 1½H:1V (Horizontal: Vertical) or flatter from the toe to the crest of the slope. All exposed slope faces should be covered with a durable reinforced plastic membrane during construction to prevent slope raveling and rutting during periods of precipitation. These guidelines assume 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 will be necessary where significant raveling or seepage occurs, or if construction materials will be stockpiled along the slope crest.

Where it is not feasible to slope the site soils back at these inclinations, a retaining structure should be considered. Where retaining structures are greater than 4-feet in height (bottom of footing to top of structure) or have slopes of greater than 15 percent above them, they should be engineered per Washington Administrative Code (WAC 51-16-080 item 5). This information is provided solely for the benefit of the owner and other design consultants, and should not be construed to imply that GeoResources assumes responsibility for job site safety. It is understood that job site safety is the sole responsibility of the project contractor.

Site Drainage

All ground surfaces, pavements and sidewalks at the site should be sloped away from the structures. Surface water runoff should be controlled by a system of curbs, berms, drainage swales, and or catch basins, and conveyed to an appropriate discharge point.

We recommend that footing drains are installed for the residence in accordance with the 2015 IBC, Section 1805.4.2, and basement walls (if utilized) have a wall drain as describe above. The roof drain should not be connected to the footing drain.

Stormwater Infiltration

Based on our subsurface explorations, onsite infiltration into the native golden brown gravel with silt and sand is feasible per the 2012 Stormwater Management Manual for Western Washington (SMMWW). We do not recommend infiltration occur within the upper silty soils.

Volume III, Section 3.3.6 of the 2012 SWMMWW allows for the infiltration rate to be determined using the soil gradation for soils unconsolidated by glacial advance, such as recessional outwash. Per Method 3 Soil Gradation Analysis Method, we recommend a long term design infiltration rate of 30 inches per hour be used in the native recessional outwash soils, which is the maximum rate allowed by the manual. Appropriate factors of safety have been applied to this value in accordance with the 2012 SWMMWW. We recommend that in-situ verification tests be performed at the time of construction to verify the provided infiltration rate.

Per the 2012 SWMMWW, Volume III, Section 3.3.7, SSC-5, a minimum vertical separation of 5 feet is required between the bottom of an infiltration facility and the top of bedrock, hardpan (glacial till), a water table, or an impermeable layer. Based on our 2018/2019 wet season groundwater monitoring, we anticipate the seasonal high groundwater level is approximately 12 feet below existing grades. Additionally, a minimum of 6 feet of vertical separation should be provided between the base flood elevation and the bottom of an infiltration facility in accordance with the YMC, 18.21.080.G.

EARTHWORK RECOMMENDATIONS

Site Preparation

All structural areas on the site to be graded should be stripped of vegetation, organic surface soils, and other deleterious materials including existing structures, foundations or abandoned utility lines. Organic topsoil is not suitable for use as structural fill, but may be used for limited depths in non-structural areas. Based on our subsurface exploration, we anticipate that stripping depth will likely range from about 1 to 3 feet. Areas of thicker topsoil or organic debris may be encountered in areas of heavy vegetation or depressions.

Where placement of fill material is required, the stripped/exposed subgrade areas should be compacted to a firm and unyielding surface prior to placement of new fill. Excavations for debris removal should be backfilled with structural fill compacted to the densities described in the "**Structural Fill**" section of this report.

We recommend that a member of our staff evaluate the exposed subgrade conditions after removal of vegetation and topsoil stripping is completed and prior to placement of structural fill. The exposed subgrade soil should be proof-rolled with heavy rubber-tired equipment during dry weather or probed with a ½-inch diameter steel T-probe during wet weather conditions.

Soft, loose or otherwise unsuitable areas delineated during proof-rolling or probing should be recompacted, if practical, or over-excavated and replaced with structural fill. The depth and extent of overexcavation should be evaluated by our field representative at the time of construction. The areas of old fill material should be evaluated during grading operations to determine if they need mitigation, recompaction, or removal.

Structural Fill

All material placed as fill associated with mass grading, as utility trench backfill, under building areas, or under roadways should be placed as structural fill. The structural fill should be

placed in horizontal lifts of appropriate thickness to allow adequate and uniform compaction of each lift. Structural fill should be compacted to at least 95 percent of the MDD.

The appropriate lift thickness will depend on the structural fill characteristics and compaction equipment used. We recommend that the appropriate lift thickness be evaluated by our field representative during construction. We recommend that our representative be present during site grading activities to observe the work and perform field density tests.

The suitability of material for use as structural fill will depend on the gradation and moisture content of the soil. As the amount of fines (material passing US No. 200 sieve) increases, soil becomes increasingly sensitive to small changes in moisture content and adequate compaction becomes more difficult to achieve. During wet weather, we recommend a material such as well-graded sand and gravel with less than 5 percent (by weight) passing the US No. 200 sieve based on that fraction passing the ¾-inch sieve, such as *Gravel Backfill for Walls* (WSDOT 9-03.12(2)). If prolonged dry weather prevails during the earthwork and foundation installation phase of construction, higher fines content (up to 10 to 12 percent) may be acceptable.

Material placed for structural fill should be free of debris, organic matter, trash, and cobbles greater than 6-inches in diameter. The moisture content of the fill material should be adjusted as necessary for proper compaction.

Suitability of On-Site Materials as Fill

During dry weather construction, any non-organic onsite soil may be considered for use as structural fill, provided it meets the criteria described above in the "**Structural Fill"** section and can be compacted as recommended. If the soil material is over optimum moisture at the time of excavation, it will be necessary to aerate or dry the soil prior to placement as structural fill. We generally did not observe the site soils to be excessively moist at the time of our subsurface explorations.

The recessional outwash encountered at depth in our explorations is generally comparable to *Select Borrow* (WSDOT Standard Specifications 9-03.14(3)). These soils should be suitable for use as structural fill provided the moisture content is maintained within 2 percent of the optimum moisture level. Because of the fines and organic content in the upper weathered silty gravel, we do not recommend that these soils are used for structural fill. These upper, silty soils may be used as fill in non-structural areas.

We recommend that completed graded-areas be restricted from traffic or protected prior to wet weather conditions. The graded areas may be protected by paving, placing asphalt-treated base, a layer of free-draining material such as pit run sand and gravel or clean crushed rock material containing less than 5 percent fines, or some combination of the above.

Erosion Control

Weathering and erosion are natural processes. As noted, no evidence of surficial raveling or sloughing was observed at the site. To manage and reduce the potential for these natural processes, we recommend erosion protection measures will need to be in place prior to grading activity on the site. Erosion hazards can be mitigated by applying Best Management Practices outlined in the 2012 SWMMWW.

Wet Weather and Wet Condition Considerations

In the Puget Sound area, the Washington State Department of Ecology generally defines the wet season as beginning October 1st and continuing through April 30th, although rainy periods could occur at any time of year. Therefore, it is strongly encouraged that earthwork be scheduled during the dry weather months. Most of the soil at the site does not contain sufficient fines to produce an unstable mixture when wet. Soils with high fines contents are highly susceptible to changes in water content and tends to become unstable and impossible to proof-roll and compact if the moisture content exceeds the optimum.

In addition, during wet weather months, the groundwater levels could increase, resulting in seepage into site excavations. Performing earthwork during dry weather would reduce these problems and costs associated with rainwater, construction traffic, and handling of wet soil. However, should wet weather/wet condition earthwork be unavoidable, the following recommendations are provided:

- The ground surface in and surrounding the construction area should be sloped as much as possible to promote runoff of precipitation away from work areas and to prevent ponding of water.
- Work areas or slopes should be covered with plastic when not being worked. The use of sloping, ditching, sumps, dewatering, and other measures should be employed as necessary to permit proper completion of the work.
- Earthwork should be accomplished in small sections to minimize exposure to wet conditions. That is, each section should be small enough so that the removal of unsuitable soils and placement and compaction of clean structural fill could be accomplished on the same day. The size of construction equipment may have to be limited to prevent soil disturbance. It may be necessary to excavate soils with a backhoe, or equivalent, and locate them so that equipment does not pass over the excavated area. Thus, subgrade disturbance caused by equipment traffic would be minimized.
- Fill material should consist of clean, well-graded, sand and gravel, of which not more than 5 percent fines by dry weight passes the No. 200 mesh sieve, based on wet-sieving (ASTM D: 1142) the fraction passing the ¾-inch mesh sieve. The gravel content should range from between 20 and 50 percent retained on a No. 4 mesh sieve. The fines should be non-plastic.
- No exposed soil should be left uncompacted and exposed to moisture. A smooth-drum vibratory roller, or equivalent, should roll the surface to seal out as much water as possible.
- In-place soil or fill soil that becomes wet and unstable and/or too wet to suitably compact should be removed and replaced with clean, granular soil (see gradation requirements above).
- Excavation and placement of structural fill material should be observed on a full-time basis by a geotechnical engineer (or representative) experienced in wet weather/wet condition earthwork to determine that all work is being accomplished in accordance with the project specifications and our recommendations.
- Grading and earthwork should not be accomplished during periods of heavy, continuous rainfall.

We recommend that the above requirements for wet weather/wet condition earthwork be incorporated into the contract specification.

LIMITATIONS

We have prepared this report for use by the Iris Group and other members of the design team, for use in the design of a portion of this project. The data used in preparing this report and this report should be provided to prospective contractors for their bidding or estimating purposes only. Our report, conclusions and interpretations are based on our subsurface explorations, data from others and limited site reconnaissance, and should not be construed as a warranty of the subsurface conditions.

Variations in subsurface conditions are possible between the explorations and may also occur with time. A contingency for unanticipated conditions should be included in the budget and schedule. Sufficient monitoring, testing and consultation should be provided by our firm 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 earthwork and foundation installation activities comply with contract plans and specifications.

The scope of our services does not include services related to environmental remediation and construction safety precautions. Our recommendations are not intended to direct the contractor's methods, techniques, sequences or procedures, except as specifically described in our report for consideration in design.

If there are any changes in the loads, grades, locations, configurations or type of facilities to be constructed, the conclusions and recommendations presented in this report may not be fully applicable. If such changes are made, we should be given the opportunity to review our recommendations and provide written modifications or verifications, as appropriate.

◆ ◆ ◆

We have appreciated the opportunity to be of service to you on this project. If you have any questions or comments, please do not hesitate to call at your earliest convenience.

Respectfully submitted,
GeoResources, LLC

Veronica Raub Mauren, EIT
Staff Engineer in Training

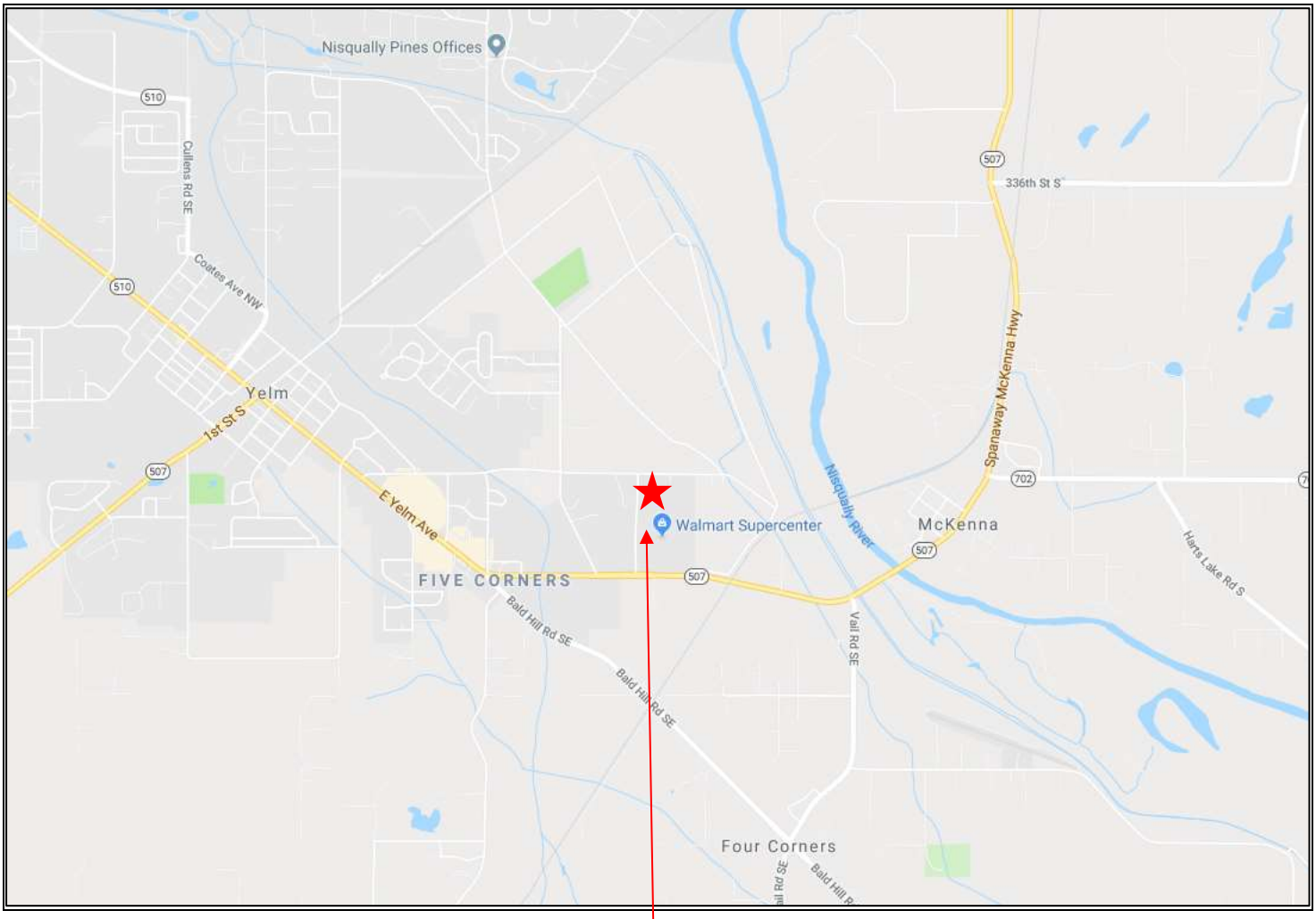
State of Washington
Engineering Geologist
925
Licensed Geologist
6/10/2019
KEITH SCOTT SCHEMBS

Keith S. Schembs, LEG
Principal

ERIC WILLIAM HELLER
STATE OF WASHINGTON
43471
REGISTERED
PROFESSIONAL ENGINEER
6/10/2019

Eric W. Heller, LG, PE
Senior Geotechnical Engineer

VRM:KSS:EWH/vrm
DocID: IrisGroup.103rdAveSE.RG
Attachments:
Figure 1: Site Location Map
Figure 2a: Proposed Site Plan
Figure 2b: Site and Exploration Map
Figure 3: NRCS Soils Map
Figure 4: Geologic Map
Figure 5: High Groundwater Hazard Area Mapping
Appendix A - Subsurface Explorations
Appendix B - Laboratory Test Results



Approximate Site Location

Map created from Google Maps (www.maps.google.com)

Not to Scale

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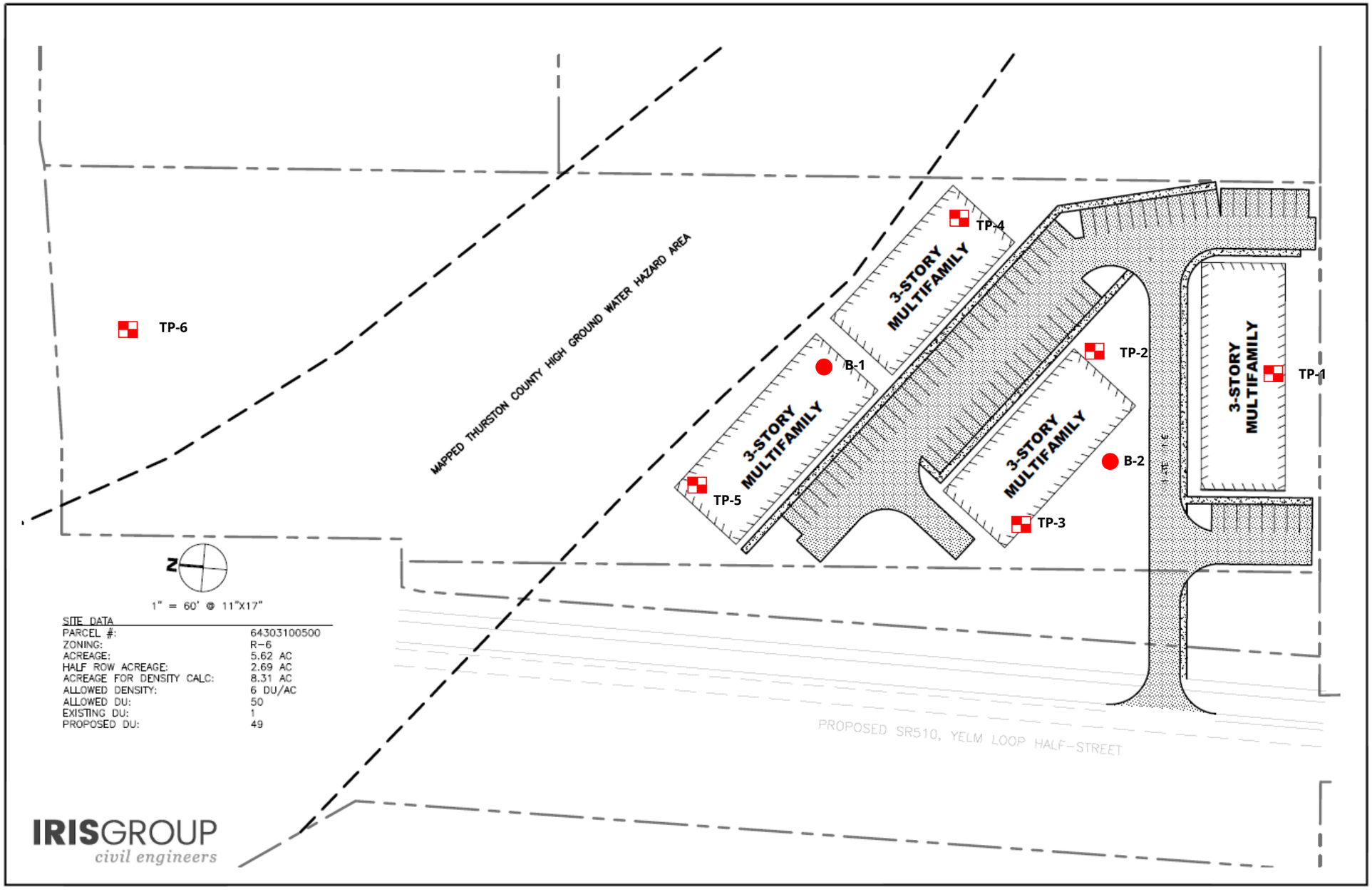
Site Location Map

Proposed Multi-Family Residential Development
17021 – 103rd Avenue SE
Yelm, Washington
PN: 64303100500

Doc ID: TheIrisGroup.103rdAveSE.F	November 2018	Figure 1



Site Plan Provide by Iris Group Civil Engineers
Not to scale

Approximate Test Pit Location -
Approximate Boring Location -

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Site and Exploration Plan
Proposed Multi-Family Residential Development
17021 – 103rd Avenue SE
Yelm, Washington
PN: 64303100500

Doc: IrisGroup.103rdAveSE.F2	November 2018	Figure 2a

Approximate Site Location

Map created from Thurston County GeoData
(http://map.co.thurston.wa.us/Html5Viewer/Index.html?viewer=uMap.Main)

TP-1 - Number and Approximate Location of Test Pit

B-1 - Number and Approximate Location of Boring

N W E S

Not to Scale

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Site and Exploration Map

Proposed Multi-Family Residential Development
17021 – 103rd Avenue SE
Yelm, Washington
PN: 64303100500

Doc ID: TheIrisGroup.103rdAveSE.F	November 2018	Figure 2b

Approximate Site Location

Map created from Web Soil Survey (http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx)

Soil Type	Soil Name	Parent Material	Slopes	Erosion Hazard	Hydrologic Soils Group
110	Spanaway gravelly sandy loam	Volcanic ash over gravelly outwash	0 to 3	Slight	A
113	Spanaway gravelly sandy loam	Volcanic ash over gravelly outwash	3 to 15	Slight	A

N W E S

Not to Scale

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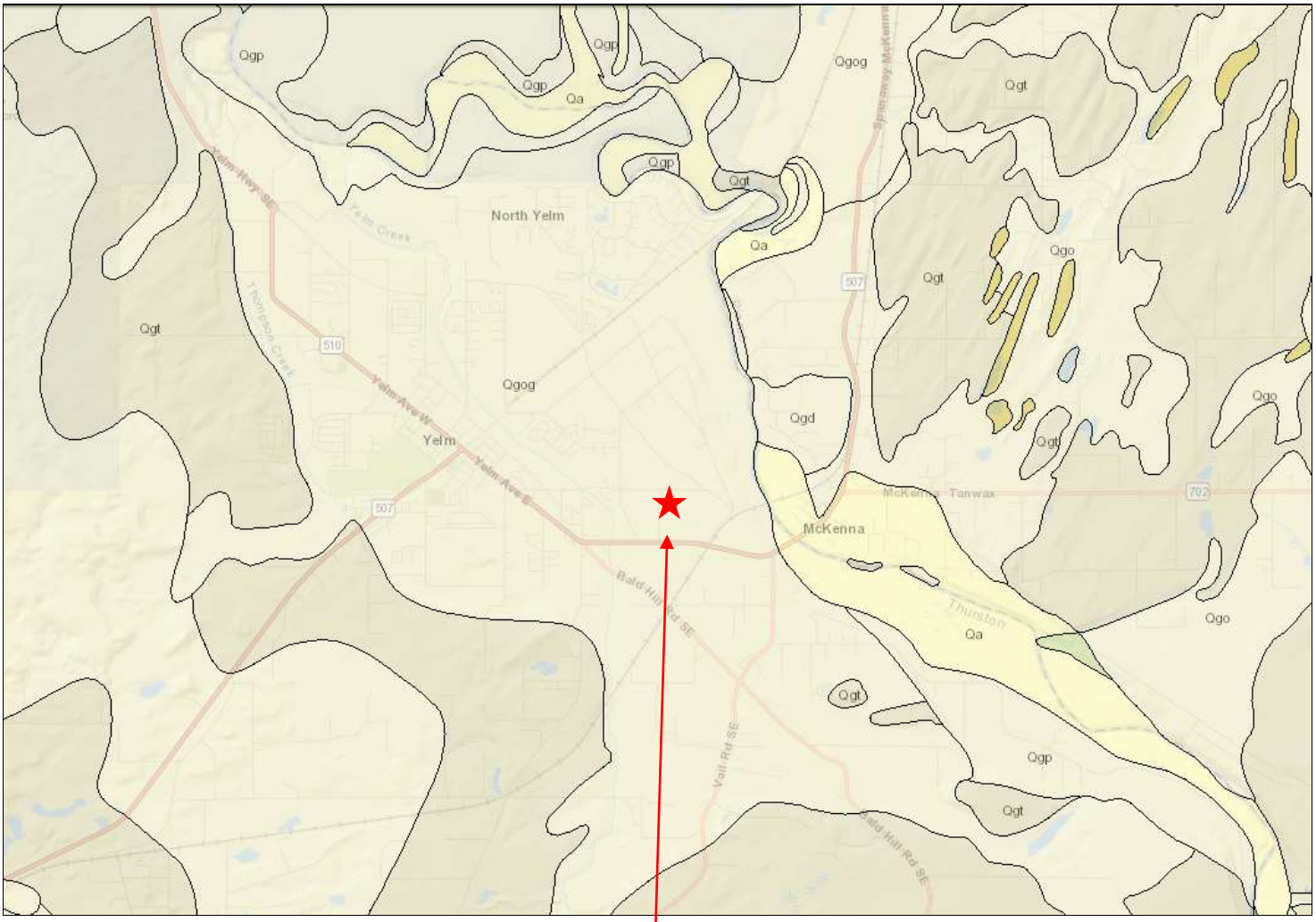
NRCS Soils Map

Proposed Multi-Family Residential Development
17021 – 103rd Avenue SE
Yelm, Washington
PN: 64303100500



Approximate Site Location

Map created from the Washington State Department of Natural Resources Information Portal (http://geologyportal.dnr.wa.gov/)

Qa	Alluvium
Qgog	Continental glacial outwash, gravel
Qgt	Continental glacial till

Not to Scale

Geologic Map

Proposed Multi-Family Residential Development
17021 – 103rd Avenue SE
Yelm, Washington
PN: 64303100500

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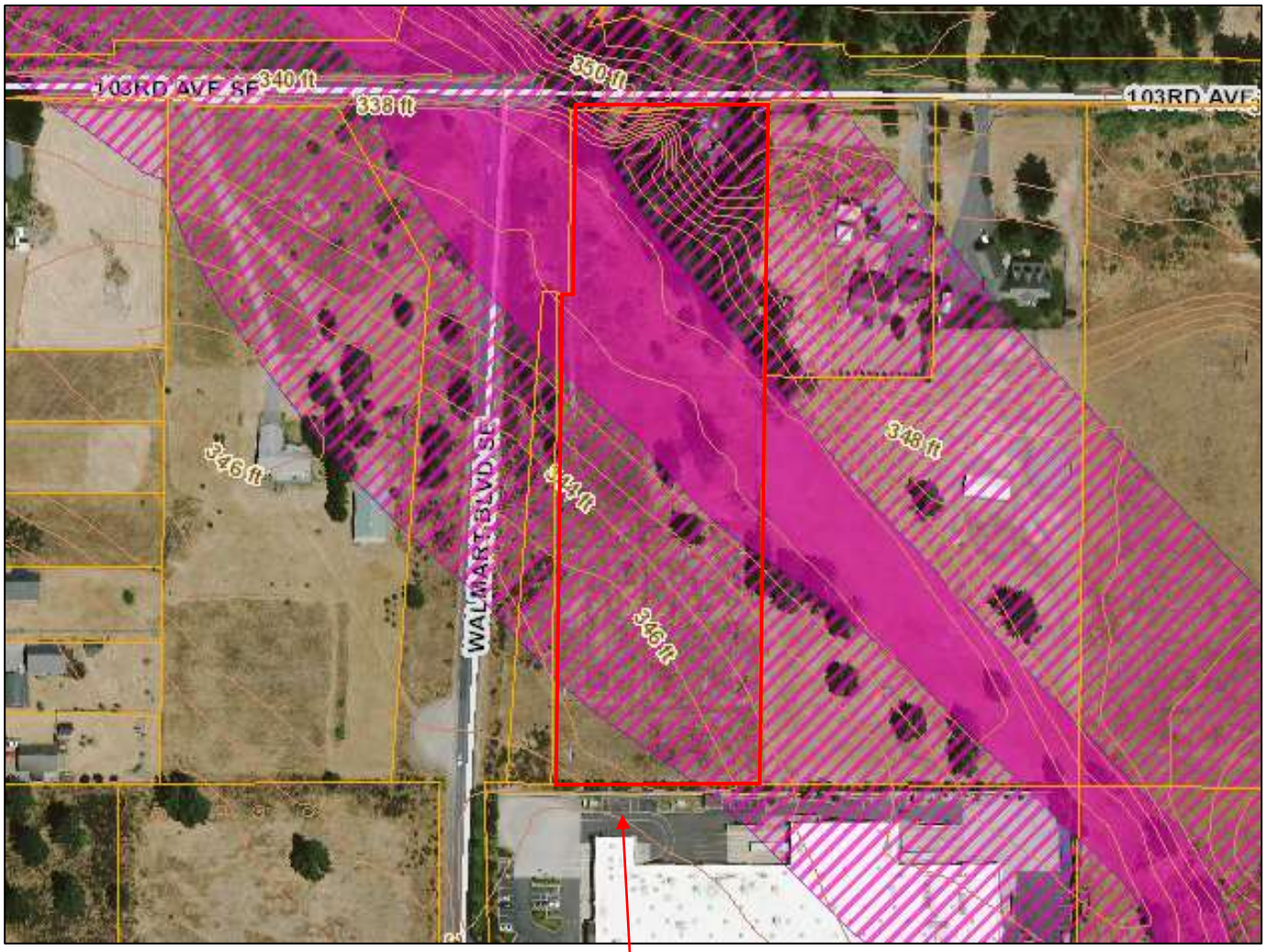
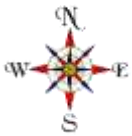
Doc ID: TheIrisGroup.103rdAveSE.F	November 2018	Figure 4



Approximate Site Location

Map created from Thurston County GeoData
(http://map.co.thurston.wa.us/Html5Viewer/Index.html?viewer=uMap.Main)

	HGW Hazard
	HGW Hazard-300' Buffer



Not to Scale

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High Groundwater Hazard Area Mapping

Proposed Multi-Family Residential Development
17021 – 103rd Avenue SE
Yelm, Washington
PN: 64303100500

Doc ID: TheIrisGroup.103rdAveSE.F	November 2018	Figure 4

Appendix A

Subsurface Explorations

SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE GRAINED SOILS More than 50% Retained on No. 200 Sieve	GRAVEL More than 50% Of Coarse Fraction Retained on No. 4 Sieve	CLEAN GRAVEL	GW	WELL-GRADED GRAVEL, FINE TO COARSE GRAVEL
			GP	POORLY-GRADED GRAVEL
		GRAVEL WITH FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SAND More than 50% Of Coarse Fraction Passes No. 4 Sieve	CLEAN SAND	SW	WELL-GRADED SAND, FINE TO COARSE SAND
			SP	POORLY-GRADED SAND
		SAND WITH FINES	SM	SILTY SAND
			SC	CLAYEY SAND
FINE GRAINED SOILS More than 50% Passes No. 200 Sieve	SILT AND CLAY Liquid Limit Less than 50	INORGANIC	ML	SILT
			CL	CLAY
		ORGANIC	OL	ORGANIC SILT, ORGANIC CLAY
	SILT AND CLAY 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

NOTES:

1. Field classification is based on visual examination of soil in general accordance with ASTM D2488-90.
2. Soil classification using laboratory tests is based on ASTM D2487-90.
3. Description of soil density or consistency are based on interpretation of blow count data, visual appearance of soils, and or test data.

SOIL MOISTURE MODIFIERS:

Dry- Absence of moisture, dry to the touch

Moist- Damp, but no visible water

Wet- Visible free water or saturated, usually soil is obtained from below water table

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Unified Soils Classification System

Proposed Multi-Family Residential Development
17021 – 103rd Avenue SE
Yelm, Washington
PN: 64303100500

Test Pit TP-1

Location: S-Central portion of site
Approximate Elevation: 346'

Depth (ft)			Soil Type	Soil Description
0	-	2.0	GP	Black to dark brown silty GRAVEL with sand (medium dense, moist)
2.0	-	8.0	GP	Golden brown GRAVEL with sand and boulders (medium dense, moist) (recessional outwash) Moisture decreased with depth after 3'

Terminated at 8.0 feet below ground surface.
Caving observed throughout excavation.
No groundwater seepage observed.
White mottling observed at approximately 6' below grade.

Test Pit TP-2

Location: Central portion of proposed development area
Approximate Elevation: 346'

Depth (ft)			Soil Type	Soil Description
0	-	3.0	GP	Black to dark brown silty GRAVEL with sand (medium dense, moist)
3.0	-	8.0	GP	Golden brown GRAVEL with sand and boulders (medium dense, moist) (recessional outwash)

Terminated at 8.0 feet below ground surface.
Caving observed throughout excavation.
No groundwater seepage observed.
White mottling observed at approximately 6' below grade.

Test Pit TP-3

Location: NW portion of proposed development
Approximate Elevation: 346'

Depth (ft)			Soil Type	Soil Description
0	-	1.5	GP	Black to dark brown silty GRAVEL with sand (medium dense, moist)
1.5	-	8.0	GP	Golden brown GRAVEL with sand and boulders (medium dense, moist) (recessional outwash) Moisture decreased with depth after 3.5'

Terminated at 8.0 feet below ground surface.
Caving observed throughout excavation.
No groundwater seepage observed.
White mottling observed at approximately 6' below grade.

Logged by: VRM **Excavated on: November 9, 2018**

Test Pit TP-4

Location: NE portion of proposed development
Approximate Elevation: 342'

Depth (ft)			Soil Type	Soil Description
0	-	2.5	GP	Black to dark brown silty GRAVEL with sand (medium dense, moist)
2.0	-	8.0	GP	Golden brown GRAVEL with sand and boulders (medium dense, moist) (recessional outwash) Moisture decreased with depth after 3'

Terminated at 8.0 feet below ground surface.
Caving observed throughout excavation.
No groundwater seepage observed.
White mottling observed at approximately 6' below grade.

Test Pit TP-5

Location: N-central portion of proposed development
Approximate Elevation: 343'

Depth (ft)			Soil Type	Soil Description
0	-	2.5	GP	Black to dark brown silty GRAVEL with sand (medium dense, moist)
2.5	-	9.0	GP	Golden brown GRAVEL with sand and boulders (medium dense, moist) (recessional outwash) Moisture decreased with depth after 3.5'

Terminated at 9.0 feet below ground surface.
Caving observed throughout excavation.
No groundwater seepage observed.
White mottling observed at approximately 6' below grade.

Test Pit TP-6

Location: NW corner of site
Approximate Elevation: 340'

Depth (ft)			Soil Type	Soil Description
0	-	2.0	GP	Black to dark brown silty GRAVEL with sand (medium dense, moist)
2.0	-	3.5	SM	Medium brown silty SAND with boulders (medium dense, moist) (recessional outwash)
3.5	-	7.5	GP	Golden brown silty GRAVEL with sand and boulders (medium dense, moist) (recessional outwash)

Terminated at 7.5 feet below ground surface.
Caving observed throughout excavation.
No groundwater seepage observed.
No mottling

Logged by: VRM **Excavated on: November 9, 2018**

TOTAL DEPTH:	20.75 ft	**DRILLING METHOD:**	HSA	**LOGGED BY:**	VRM/NT
TOP ELEVATION:	340'	**DRILLING COMPANY:**	Bore-tec	**HAMMER TYPE:**	Cat head
LATITUDE:		**DRILL RIG:**	EC95	**HAMMER WEIGHT:**	140 lbs
LONGITUDE:		**NOTES:**			

Depth	Elevation	SOIL DESCRIPTION	DRILLING NOTES	Sample	Sampler	Symbol	TEST RESULTS: Plastic Limit ⊢—⊣ Liquid Limit; % Water Content ●; % Fines (<0.075mm) ◇; Penetration - ▲ (blows per foot) 10 20 30 40 50	Blow Count	Ground Water	Well Schematic
0	340	Topsoil/duff								
		Brown sandy gravel with silt (medium dense, moist to wet)								
4	336			1			▲	50/4		
8	332									
				2			▲	16 50/2		
12	328									
			No recovery	3			▲	4 22 23		
16	324									
20	320		Refused on boulder					16 50/3		
		Bottom of Boring Completed11/16/18								
24	316									

NOTES

1. Refer to log key for definition of symbols, abbreviations and codes
2. USCS designation is based on visual manual classification and selected lab testing
3. Groundwater level, if indicated, is for the date shown and may vary
4. N.E. = Not Encountered

Proposed Apartments

LOG OF BORING B-1

JOB: IrisGroup.103rdAveSE *Sheet of 3*

GeoResources, LLC | **FIG.**

TOTAL DEPTH:	25.1	**DRILLING METHOD:**	HSA	**LOGGED BY:**	VRM/NT
TOP ELEVATION:	346'	**DRILLING COMPANY:**	Bore-tec	**HAMMER TYPE:**	Cat head
LATITUDE:		**DRILL RIG:**	EC95	**HAMMER WEIGHT:**	140 lbs
LONGITUDE:		**NOTES:**			

Depth	Elevation	SOIL DESCRIPTION	DRILLING NOTES	Sample	Sampler	Symbol	TEST RESULTS	Blow Count	Ground Water	Well Schematic
0		Topsoil/duff					Plastic Limit ⊢—⊣ Liquid Limit; % Water Content ●; % Fines (<0.075mm) ◇; Penetration - ▲ (blows per foot) 10 20 30 40 50			
		Brown sandy gravel with silt (medium dense, moist to wet)								
	344									
4								37		
	340							26		
								16		
8										
	336							19		
								19		
12								21		
	332									
			No recovery					16		
16								16		
	328							20		
20								50/4		
	324									
24										
		Bottom of Boring	No recovery					50/1		
	320									

NOTES

1. Refer to log key for definition of symbols, abbreviations and codes
2. USCS designation is based on visual manual classification and selected lab testing
3. Groundwater level, if indicated, is for the date shown and may vary
4. N.E. = Not Encountered

Proposed Apartments

LOG OF BORING B-2

JOB: IrisGroup.103rdAveSE *Sheet of 3*

GeoResources, LLC | **FIG.**

TOTAL DEPTH:	25.1	**DRILLING METHOD:**	HSA	**LOGGED BY:**	VRM/NT
TOP ELEVATION:	346'	**DRILLING COMPANY:**	Bore-tec	**HAMMER TYPE:**	Cat head
LATITUDE:		**DRILL RIG:**	EC95	**HAMMER WEIGHT:**	140 lbs
LONGITUDE:		**NOTES:**			

Depth	Elevation	SOIL DESCRIPTION	DRILLING NOTES	Sample	Sampler	Symbol	TEST RESULTS	Blow Count	Ground Water	Well Schematic
		Completed11/16/18					Plastic Limit ⊢—⊣ Liquid Limit % Water Content ● % Fines (<0.075mm) ◇ Penetration - ▲ (blows per foot) 10 20 30 40 50			
	320									
28										
	316									
32										
	312									
36										
	308									
40										
	304									
44										
	300									
48										
	296									
52										

NOTES

1. Refer to log key for definition of symbols, abbreviations and codes
2. USCS designation is based on visual manual classification and selected lab testing
3. Groundwater level, if indicated, is for the date shown and may vary
4. N.E. = Not Encountered

Proposed Apartments

LOG OF BORING B-2

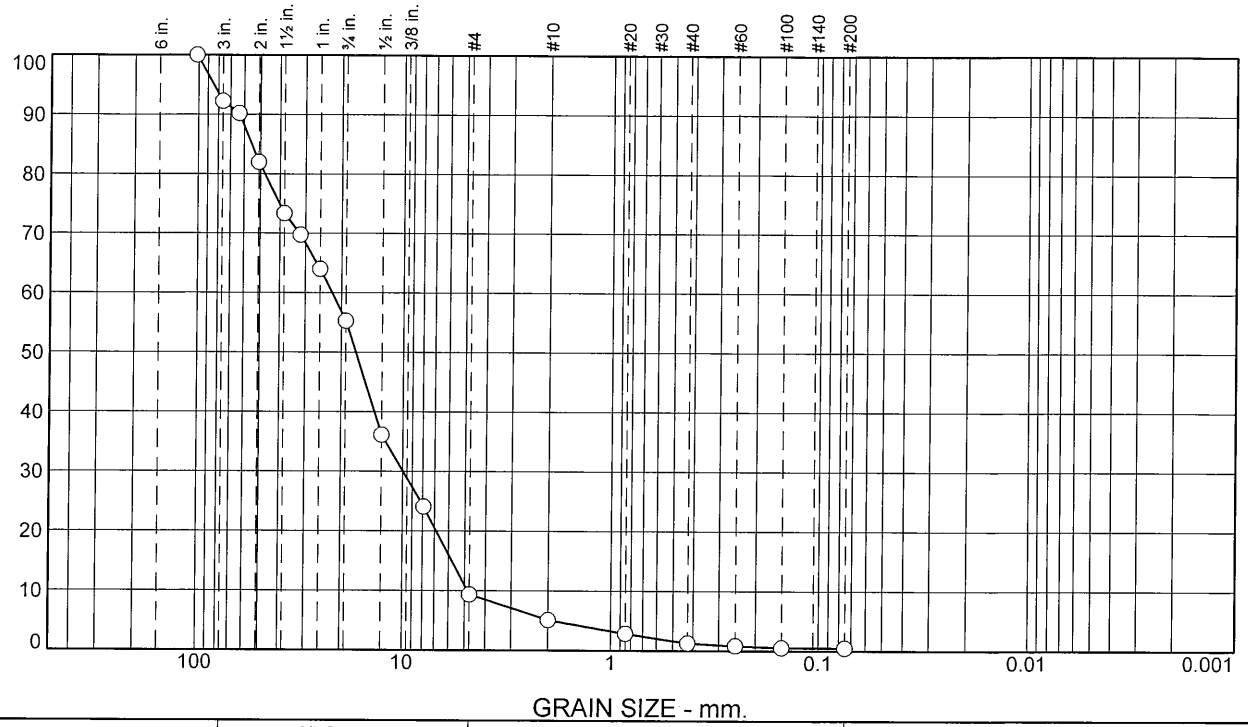
JOB: IrisGroup.103rdAveSE *Sheet of 3*

GeoResources, LLC | **FIG.**

Appendix B

Laboratory Analyses

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
7.8	36.9	45.9	4.3	3.8	0.8	0.5	

Test Results (ASTM D 422 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
4	100.0		
3.0	92.2		
2.5	90.2		
2.0	82.0		
1.5	73.4		
1.25	69.8		
1	64.0		
.75	55.3		
.5	36.1		
.3125	24.1		
#4	9.4		
#10	5.1		
#20	2.8		
#40	1.3		
#60	0.8		
#100	0.5		
#200	0.5		

* (no specification provided)

Material Description

poorly graded gravel

Atterberg Limits (ASTM D 4318)

PL= NP LL= PI=

Classification

USCS (D 2487)= GP AASHTO (M 145)=

Coefficients

D_{90}= 63.1284 D_{85}= 55.1284 D_{60}= 22.2511
D_{50}= 17.0295 D_{30}= 10.0012 D_{15}= 5.7836
D_{10}= 4.8578 C_u= 4.58 C_c= 0.93

Remarks

Date Received: 11/19/18 **Date Tested:** 11/13/18

Tested By: NT

Checked By:

Title:

Location: TP-2 **Date Sampled:** 11/09/18

Sample Number: 095922 **Depth:** 8'

GeoResources, LLC

Fife, WA

Client: Iris Group, Inc.

Project: Proposed Apartments

Project No: IrisGroup.103rdAveSE **Figure** B-1

Tested By: _____ **Checked By:** _____

DALY MAZAMA POCKET GOPHER (*Thomomys Mazama)* ABSENCE REPORT

Prepared For:
Dennis Daley
Xxxx Johnson Point NE
Olympia, WA 98506

Prepared By:

ALEXANDER CALLENDER, M.S. PWS
LAND SERVICES NORTHWEST LLC
OLYMPIA, WASHINGTON
September 27, 2018

Daly Mazama Pocket Gopher (*Thomomys Mazama)* Absence Report

Prepared for:

Dennis Daly
Xxxx Johnson Point NE
Olympia, WA 98506

Prepared by:

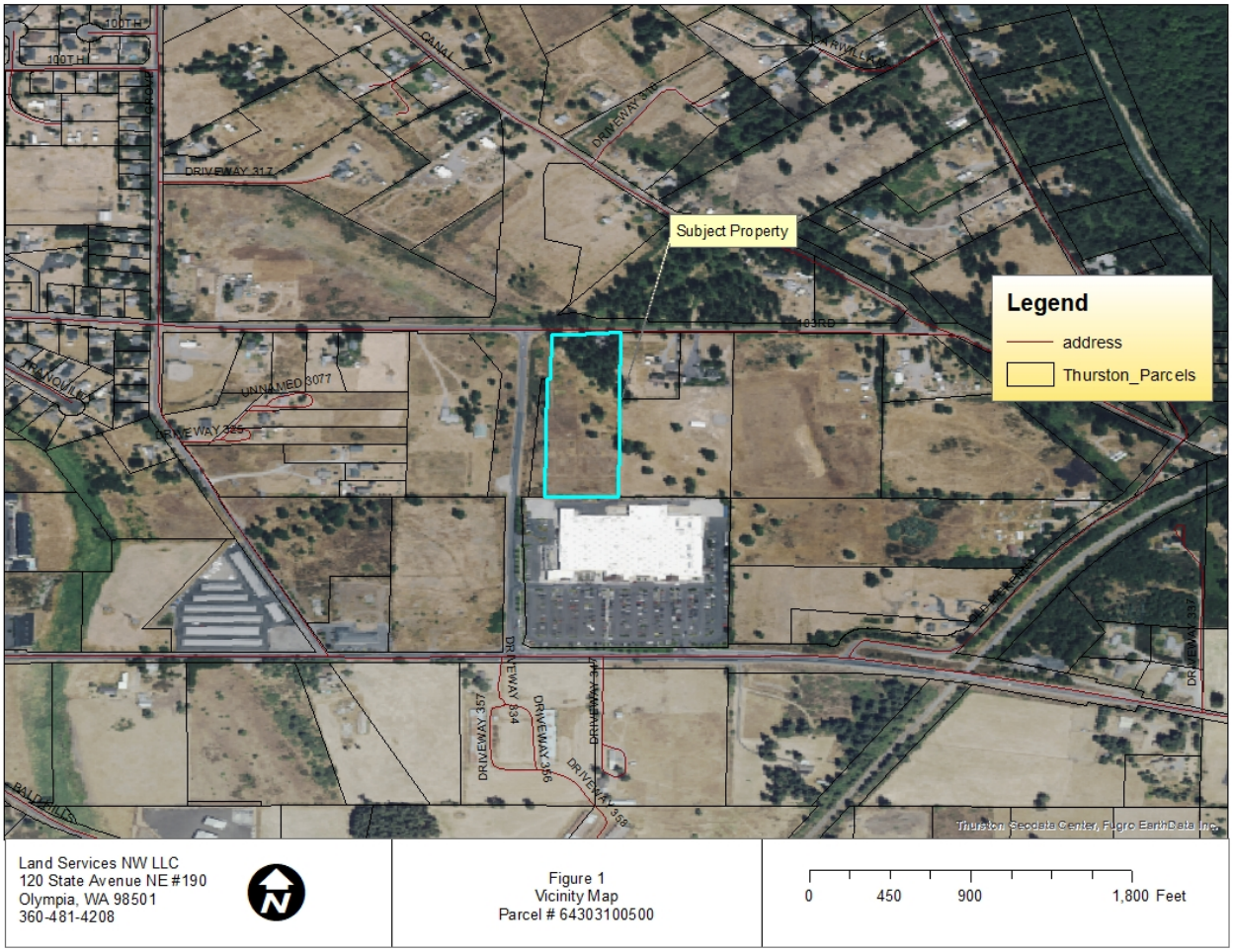
Alexander Callender, MS, PWS
Ecologist
LAND SERVICES NORTHWEST LLC

(360) 481-4208

September 27, 2018

1.0 INTRODUCTION

This report is the result of a survey of the 5.62 acre parcel at 17021 103rd Avenue SE Parcel # 64303100500 in Yelm, WA with the legal description of Section 29 Township 17 Range 2E Quarter NW NE Plat MCKENNA IRRIGATED TRACTS BLK 31 LT 4 & 5 Document 009/044 E 282F LYING WLY OF NLY EXT OF E LN OF LT 10 BLK 31 LESS CC 09-2-032159-4 in Thurston County (**Figure 1**).



The Purpose of this report is to provide a study of the presence or absence of indicators of the Mazama Pocket Gopher (*Thomomys Mazama*) (MPG)**.** Four subspecies of Mazama pocket gophers found in Thurston County are listed as threatened under the Endangered Species Act (ESA). Impacts to Mazama pocket gophers should be avoided or addressed through USFWS permitting processes**.** The presence of this species on a property may have regulatory implications that may limit the amount or type of development that can occur on a property in order to avoid "take" of the species. Take is defined under the ESA as as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect any threatened or endangered species. The Thurston County Protocol which has been adopted is accepted as the best available science in order to avoid the risk of take and requires two

visit 30 days apart among other things. The protocol has been copied and the information should meet the needs of the City of Yelm.

This study should allow the reader to assess whether the Mazama pocket gopher is likely to be found on site and what the implications of its presence or absence may have with regard to permitting a residence or other structures or development.

2.0 METHODS

2.1 Review of Existing Information

Background Review
Background information on the subject property was reviewed prior to field investigations and included the following:

- Thurston County Geodata Gopher Soils Shapefiles
- WDFW Priority Habitats and Species Information
- USFWS species list information
- WDFW species information

2.2 Summary of Existing Information

The existing information shows gopher soils within 600 feet of the subject property. They are a Spanaway gravelly sandy loam, 0 to 3 percent slopes and Spanaway gravelly sandy loam 3-15 percent slopes, which are more preferred according to Attachment A below (**Figure 2)** .

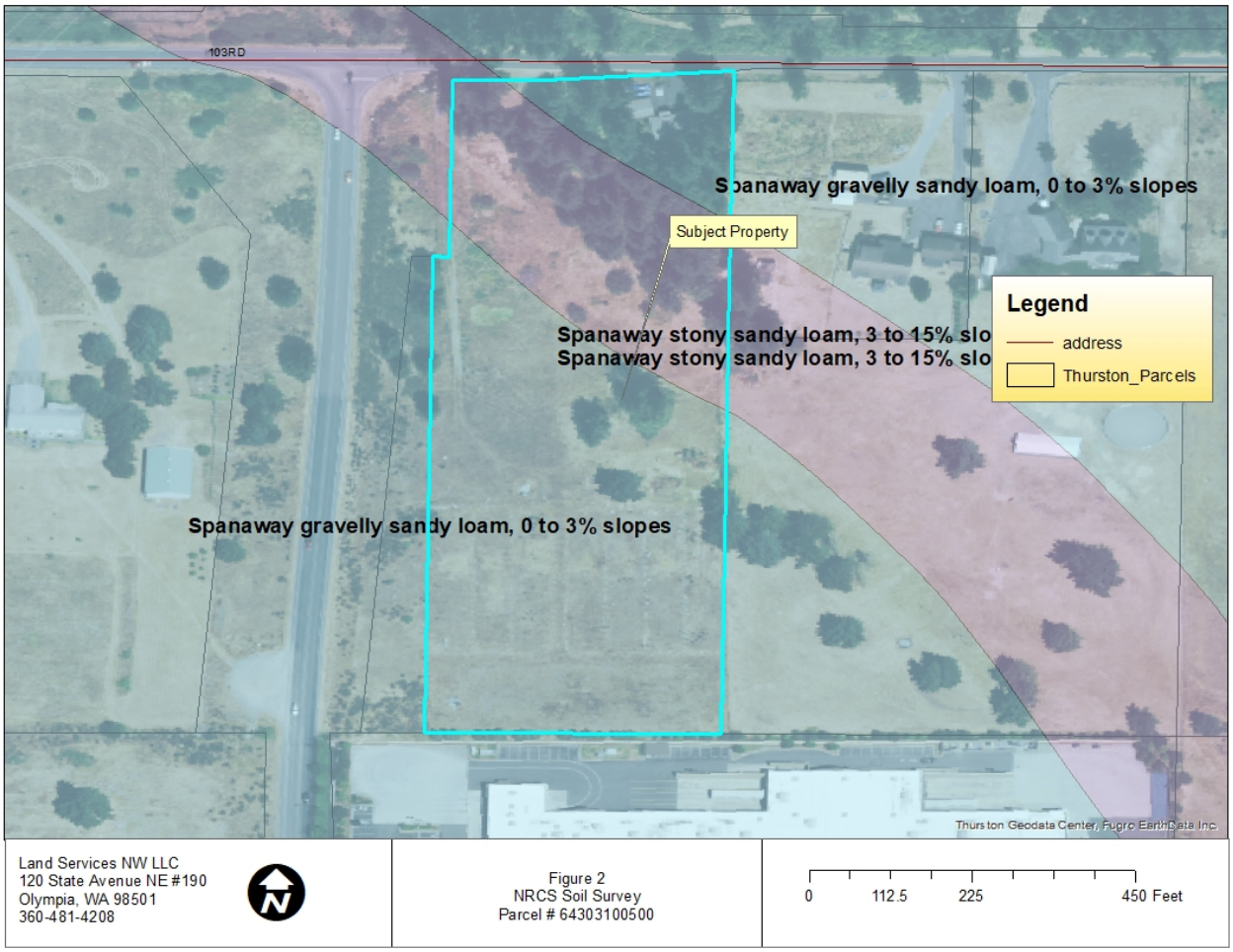
3.0 Existing Conditions

The subject property is a relatively flat 5.62 acre parcel. The parcel has fruit trees and large Douglas firs in the northeastern portion of the property and pastureland on the remaining acreage. Walmart is to the south (**Figure 3**). The site was cross fenced and there is a large amount of concrete debris found on site.

Attachment A

Table 1. Soils known to be associated with Mazama pocket gopher occupancy.

Mazama Pocket Gopher Preference	Soil Type
More Preferred (formerly High and Medium Preference Soils)	Nisqually loamy fine sand, 0 to 3 percent slopes Nisqually loamy fine sand, 3 to 15 percent slopes Spanaway-Nisqually complex, 2 to 10 percent slopes Cagey loamy sand Indianola loamy sand, 0 to 3 percent slopes Spanaway gravelly sandy loam, 0 to 3 percent slopes Spanaway gravelly sandy loam, 3 to 15% slopes
Less Preferred (formerly Low Preference Soils)	Alderwood gravelly sandy loam, 0 to 3 percent slopes Alderwood gravelly sandy loam, 3 to 15 percent slopes Everett very gravelly sandy loam, 0 to 3 percent slopes Everett very gravelly sandy loam, 3 to 15 percent slopes Indianola loamy sand, 3 to 15 percent slopes Kapowsin silt loam, 3 to 15 percent slopes McKenna gravelly silt loam, 0 to 5 percent slopes Norma fine sandy loam Norma silt loam Spana gravelly loam Spanaway stony sandy loam, 0 to 3 percent slopes Spanaway stony sandy loam, 3 to 15 percent slopes Yelm fine sandy loam, 0 to 3 percent slopes Yelm fine sandy loam, 3 to 15 percent slopes


103RD
Spanaway gravelly sandy loam, 0 to 3% slopes
Subject Property
Spanaway stony sandy loam, 3 to 15% slo
Spanaway stony sandy loam, 3 to 15% slo
Spanaway gravelly sandy loam, 0 to 3% slopes
Legend
address
Thurston_Parcels
Thurston Geodata Center, Fugro EarthData Inc.
Land Services NW LLC
120 State Avenue NE #190
Olympia, WA 98501
360-481-4208
Figure 2
NRCS Soil Survey
Parcel # 64303100500
0
112.5
225
450 Feet

The WDFW Priority Habitats and Species Map shows the MPG in the vicinity of the subject property within 600 feet (**Appendix B**).

2.3 2018 Mazama Pocket Gopher Protocol

A. General Information – 2018 Approach
1. The MPG review season will run June 1-October 31, 2018.
Survey Done August 24, 2018
2. The protocol described in this memorandum will only apply to properties not known to be occupied by MPG since April 2014, the date of the federal listing.
3. Negative determinations will be valid for the length of the underlying County permit or approval, per County code.
The determination is negative.
4. Qualified consultants may perform field reviews and submit results for County evaluation, per the CAO. Consultants must have received training from USFWS at one of the two trainings offered in May/June 2018.s
The author is on the USFWS list as having passed the training and is qualified to make a determination with this certification.
B. In-Office Procedures
1. Staff will review land use applications to determine if the MPG field screening protocols described in this memorandum must be initiated for the following:
a. Within 600 feet of a site known to have positive MPG occurrence; or
The PHS shows the Mazama pocket gophers in the vicinity of the site and within 600 feet.
b. On or within 300 feet of a soil type known to be associated with MPG occupancy.
The Map shows associated soils The soils are Spanaway gravelly sandy loam which are preferred by the MPG.
2. County staff will determine if other factors preclude the need for field screening. See Preliminary assessment below.
N/A
3. Staff will notify applicants if their application cannot be excluded from further review.
4. Applicants may hire a consultant to perform field review, or may request that field review be conducted by County staff according to the protocol described in this memorandum.
5. County staff will review critical area reports submitted by consultants.
6. For sites to be screened by the County, staff will coordinate site visits with landowners/applicants, ensure advance notification and property access, and develop site visit schedules.
7. For sites where no MPG activity is observed, the County will provide applicants with a project condition that requires them to stop construction activity and alert the County and USFWS if evidence of MPG occupancy is observed.
N/A - No activity observed
8. Thurston County landowners who know or learn that Mazama pocket gophers are present on their property can move forward with their proposed development by: 1) proposing mitigation to the County as directed in the County's Critical Areas Ordinance (Title 24 TCC); or 2) contacting USFWS directly to discuss the review, assessment, and mitigation process most appropriate for their site(s) and proposed activities; or 3) waiting to participate in the yet to be completed Thurston County HCP.

C. Preliminary Assessment

As land use applications are received, properties mapped with or within 300 feet of gopher and/or prairie soils undergo the following preliminary assessment in-office.
1. For properties or project areas that appear to meet County criteria below, an internal review is conducted by staff biologist to determine if the project may be released from the full gopher review process. The following criteria may release a project from further gopher review:
a. Locations west of the Black River, or on the Steamboat Island or Cooper Point peninsulas.
N/A
b. Sites submerged for 30 consecutive days or more since October 31, 2017.
N/A
c. Sites covered with impervious surfaces (as defined in CAO Chapter 17.15 and Title 24).
N/A
d. Fully forested (>30%) sites with shrub and fern understory.
N/A
e. Sites that consist of slopes greater than 40 percent, or that contain landslide hazard areas (per existing County regulations).
N/A
f. Sites on less preferred MPG soils north of Interstate 5.
N/A
g. Building to take place in the footprint of an existing structure (also mobile home replacements in the same footprint).
N/A
h. Mobile home replacements in existing lots in an existing mobile home park.
It is not a mobile home replacement.
i. Heating oil tank removal
N/A
j. Foundation repair
N/A
k. Projects which lie >300 feet from mapped gopher soils.

It is within 300 ft

There is a portion of the Northeast corner that would meet the fully forested conditions (Appendix C)

2. If a property and/or project area do not meet internal review criteria, the project is put on a list to be scheduled for full MPG review during the appropriate seasonal review period.
3. In addition to the in-office preliminary assessment, the County HCP biologist may, if time allows, visit properties prior to the first gopher review in order to screen for prairie habitat. This screening process focuses on the presence or absence of native prairie plants, Oregon white oak trees (Quercus garryana), or Mima mounds protected under the Critical Areas Ordinance (CAO).
Although there may be some prairie species present, the area has been pasture and has been graded and the prairie habitat was not found.
D. Implementation Measures
In order to ensure the review process runs efficiently, the following measures will be implemented as part of the 2018 screening approach. These are intended to reduce costs and staff

time, and ensure that MPG screening requests, especially those associated with building permit applications, are screened during the screening season.
1. No soil verification will be required in conjunction with MPG field screening.
2. Site mowing or brushing will be required to initiate first site visits, where necessary and feasible, and completed two to four weeks in advance of the site visit.
Site was mowed and the ground was visible in most areas.
3. No further screening will be conducted in 2018 following the detection of MPG mounds on a property. The County will notify landowners that MPG evidence has been detected within two weeks.
The Mazama pocket Gopher mounds were **not** found.
4. At the end of the 2018 season, County staff will provide data regarding MPG occupancy to USFWS.
5. No additional site visit will be required if indeterminate mounds are detected, if the full number of required visits has been completed.
N/A
6. The County will prioritize project specific applications over non-project applications. This will help ensure that applicants that have projects ready for construction will receive necessary permits and may initiate construction in a timely manner.

E. Site Visit Overview
County field personnel or hired consultants will conduct field observations to determine MPG presence on sites with potential habitat. These site visits will be conducted as follows:
1. All valid site visits must be conducted from June 1 through October 31, 2018. Site visits outside that survey window will not be considered valid.
Site visit conducted August 24, 2018 and September 25, 2018
2. A site or parcel is considered to be the entire property, not just the footprint of the proposed project.
The entire property was surveyed
3. Sites with less preferred soils (see Attachment A) will be visited two (2) times, at least 30 days apart.
N/A -No MPG activity found

4. Sites with more preferred soils (see Attachment A) will be visited two (2) times, at least 30 days apart.
No MPG activity found
5. Site conditions must be recorded on a data sheet or similar information documented in narrative form. A template data sheet can be found on the County website at http://www.co.thurston.wa.us/permitting/gopher-reviews/index.html

6. Document and describe which areas of the parcel cannot be screened due to limited accessibility and/or dense understory. This should be depicted on an aerial or site plan submitted to the County.
N/A
7. The ground must be easily visible to ensure mound observation and identification. Request mowing if necessary to ensure visibility. Wait two to three weeks after mowing before beginning screening.
The first survey was conducted without mowing, but visibility was ok. The area was mowed for the second survey and the survey was conducted 2 weeks after mowing.
http://www.co.thurston.wa.us/permitting/gopher-reviews/index.html F. Detailed Field Methodology

1. The survey crew orients themselves with the layout of the property using aerial maps, and strategizes their route for walking through the property.
2. Start GPS to record survey route.
3. Walk the survey transects methodically, slowly walking a straight line and scanning an area approximately 2-3 meters to the left and right as you walk, looking for mounds. Transects should be no more than five (5) meters apart when conducted by a single individual.
The survey was conducted according to the protocol with 5 meter transects performed by a single individual the first time and two people the second time.
4. If the survey is performed by a team, walk together in parallel lines approximately 5 meters apart while you are scanning left to right for mounds.
The survey was conducted according to the protocol.
5. At each mound found, stop and identify it as a MPG or mole mound. If it is a MPG mound, identify it as a singular mound or a group (3 mounds or more) on a data sheet to be submitted to the County. (County has developed data sheets for your use on http://www.co.thurston.wa.us/permitting/gopher-reviews/index.html)
Only mole mounds were found.
6. Record all positive MPG mounds, likely MPG mounds, and MPG mound groups in a GPS unit that provides a date, time, georeferenced point, and other required information in County GPS data instruction for each MPG mound. Submit GPS data in a form acceptable to the County. County GPS Data instruction can be found at http://www.co.thurston.wa.us/permitting/gopher-reviews/index.html
N /A
7. Photograph all MPG mounds or MPG mound groups. At a minimum, photograph MPG mounds or MPG mound groups representative of MPG detections on site.
No MPG mounds found.
8. Photos of mounds should include one that has identifiable landscape features for reference. In order to accurately depict the presence of gopher activity on a specific property, the following series of photos should be submitted to the County:
    a. At least one up-close photo to depict mound characteristics
    No MPG mounds were found.

b. At least one photo depicting groups of mounds as a whole (when groups are encountered).
N/A
c. At least one photo depicting gopher mounds with recognizable landscape features in the background, at each location where mounds are detected on a property
N/A
d. Photos can be taken with the GPS unit or a separate, camera, preferably a camera with locational features (latitude, longitude)
N/A
e. Photo point description or noteworthy landscape or other features to aid in relocation.Additional photos to be considered.
Photos are found in Appendix A
f. The approximate building footprint location from at least two cardinal directions.
N/A
g. Landscape photos to depict habitat type and in some cases to indicate why not all portions of a property require gopher screening.
Appendix C
9. Describe and/or quantify what portion and proportion of the property was screened, and

record your survey route and any MPG mounds found on either an aerial or parcel map.
90% of the property was screened. The impervious around the on site trailer and te forested area were not included, but were surveyed as available (Appendix C).
10. If MPG mounds are observed on a site, that day's survey effort should continue until the entire site is screened and all mounds present identified, but additional site visits are not required.
No mounds were found.
11. In order for the County to accurately review Critical Area Reports submitted in lieu of County field inspections the information collected in the field (GPS, data sheets, field notes, transect representations on aerial, etc.) shall be filed with the County. GPS
No mounds were found.

3.0 RECONNAISSANCE

Land Services NW LLC conducted a survey on August 24, 2018 and September 24, 2018 to identify mound features found on site. An additional survey was conducted on September 15, which showed no mounds as well

A walking survey was conducted and as mounds were encountered, a GPS point was taken with a Garmin 64 ST in WGS 84 projection and a photo was taken. The photos are in Appendix A. The transect tracks are located in Appendix C.

4.0 RESULTS AND CONCLUSIONS

A previously mentioned, the area has highly preferred soils for the MPG, but the gopher was not found on site. The walking survey noted numerous mounds which were found in a linear association typical of moles. The mounds were circular and not crescent shaped and there were no visible plugs. All these indicators make it very likely that the area has moles, but no mounds typical of the Mazama pocket gopher were found on site.

Appendix A
Photos

Mole Mound

Vole Hole

Typical Mole Mound

The Exclusion Area was surveyed informally and no mounds were found.

Exclusion Area

Lumpy mound

Appendix B
WDFW Priority Habitats and Species Map

WASHINGTON DEPARTMENT OF FISH AND WILDLIFE
PRIORITY HABITATS AND SPECIES REPORT

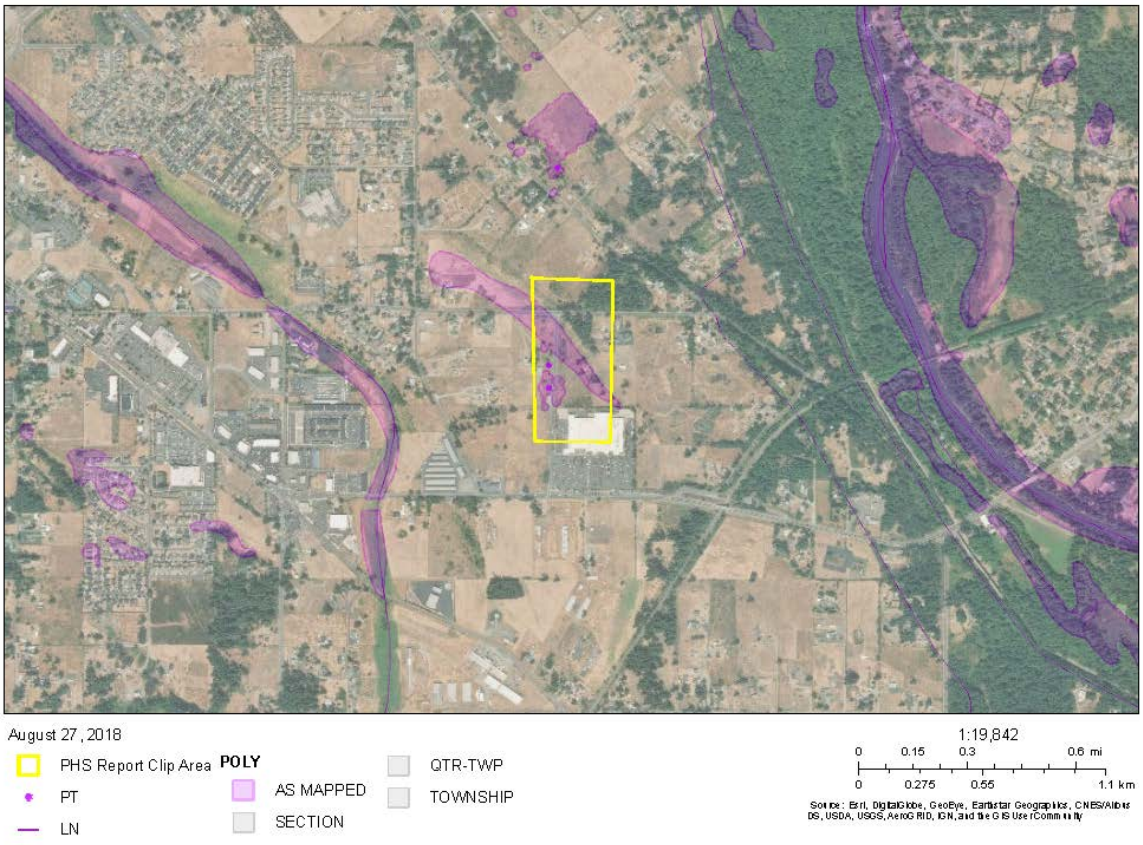
SOURCE DATASET: PHSPlusPublic Query ID: P180827133009
REPORT DATE: 08/27/2018 1.30

Common Name / Scientific Name / Notes	Site Name / Source Dataset / Source Record / Source Date	Priority Area / Occurrence Type / More Information (URL) / Mgmt Recommendations	Accuracy	Federal Status / State Status / PHS Listing Status	Sensitive Data / Resolution	Source Entity / Geometry Type
Freshwater Emergent	N/A NWIWetlands	Aquatic Habitat Aquatic habitat http://www.ecy.wa.	NA	N/A N/A PHS Listed	N AS MAPPED	US Fish and Wildlife Service Polygons
Freshwater Forested/Shrub	N/A NWIWetlands	Aquatic Habitat Aquatic habitat http://www.ecy.wa.	NA	N/A N/A PHS Listed	N AS MAPPED	US Fish and Wildlife Service Polygons
Mazama (Western) pocket Thomomys mazama	103RD ROW WS_OccurPoint 141180 November 07, 2013	Occurrence Biotic detection http://wdfw.wa.gov/publications/pub.php?	GPS	Threatened Threatened PHS LISTED	N AS MAPPED	WA Dept. of Fish and Wildlife Points
Mazama (Western) pocket Thomomys mazama	103RD ROW WS_OccurPoint 141181 November 07, 2013	Occurrence Biotic detection http://wdfw.wa.gov/publications/pub.php?	GPS	Threatened Threatened PHS LISTED	N AS MAPPED	WA Dept. of Fish and Wildlife Points
Mazama (Western) pocket Thomomys mazama	TENALQUOT PRAIRIE WS_OccurPolygon 4498 September 23, 2010	Occurrence Concentration http://wdfw.wa.gov/publications/pub.php?	GPS	Threatened Threatened PHS LISTED	N AS MAPPED	WA Dept. of Fish and Wildlife Polygons
Townsend's Big-eared Bat Corynorhinus townsendii	WS_OccurPoint 109970 June 22, 2009	Communal Roost Biotic detection http://wdfw.wa.gov/publications/pub.php?	GPS	N/A Candidate PHS LISTED	Y TOWNSHIP	WA Dept. of Fish and Wildlife Points
Townsend's Big-eared Bat Corynorhinus townsendii	WS_OccurPoint 109972 June 23, 2009	Communal Roost Biotic detection http://wdfw.wa.gov/publications/pub.php?	GPS	N/A Candidate PHS LISTED	Y TOWNSHIP	WA Dept. of Fish and Wildlife Points

08/27/2018 1.30 1

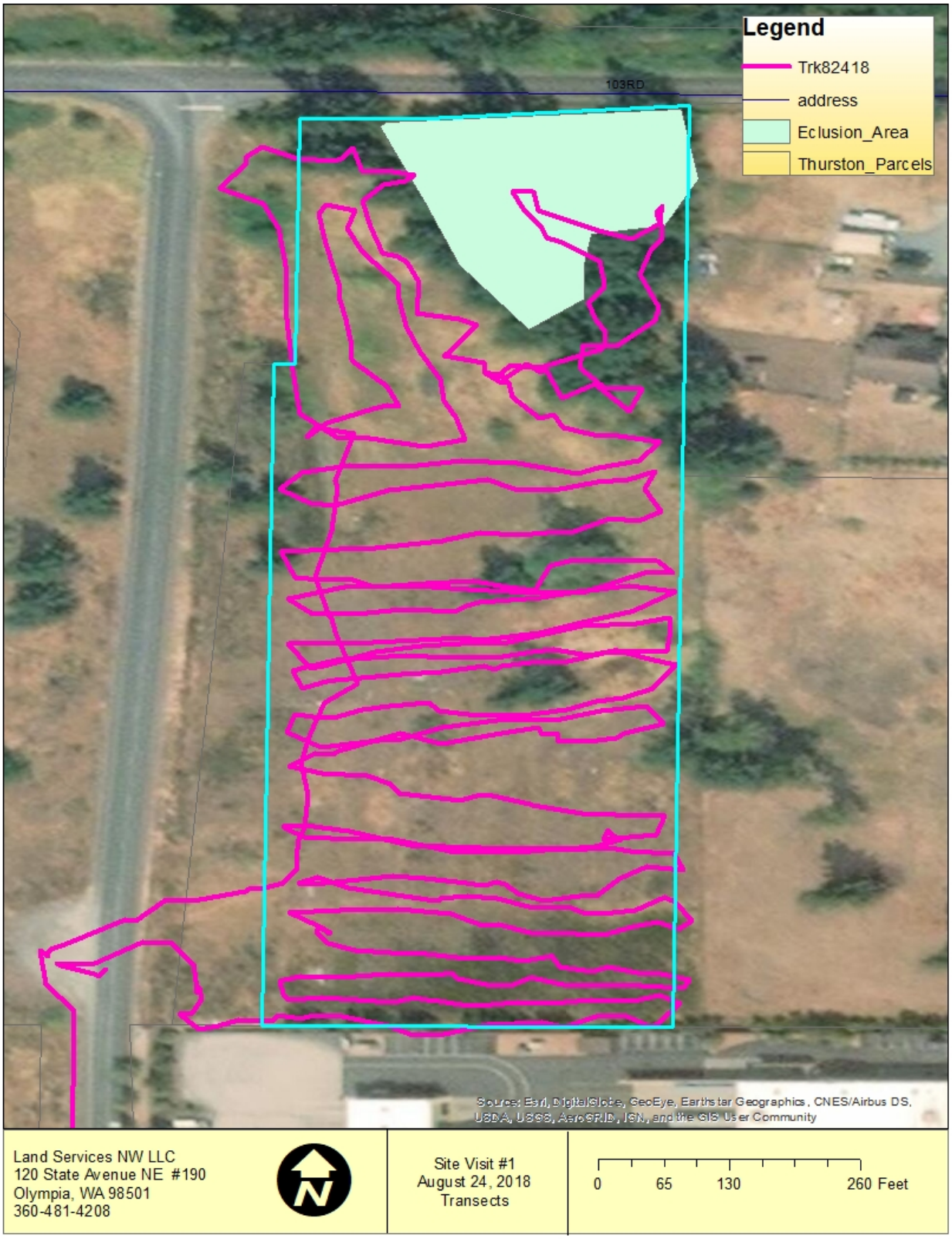
Common Name Scientific Name Notes	Site Name Source Dataset Source Record Source Date	Priority Area Occurrence Type More Information (URL) Mgmt Recommendations	Accuracy	Federal Status State Status PHS Listing Status	Sensitive Data Resolution	Source Entity Geometry Type
Yuma myotis		Communal Roost	GPS	N/A	Y	WA Dept. of Fish and Wildlife
Myotis yumanensis	WS_OccurPoint 141079 June 05, 2004	Biotic detection http://wdfw.wa.gov/publications/pub.php?		N/A PHS LISTED	TOWNSHIP	Points

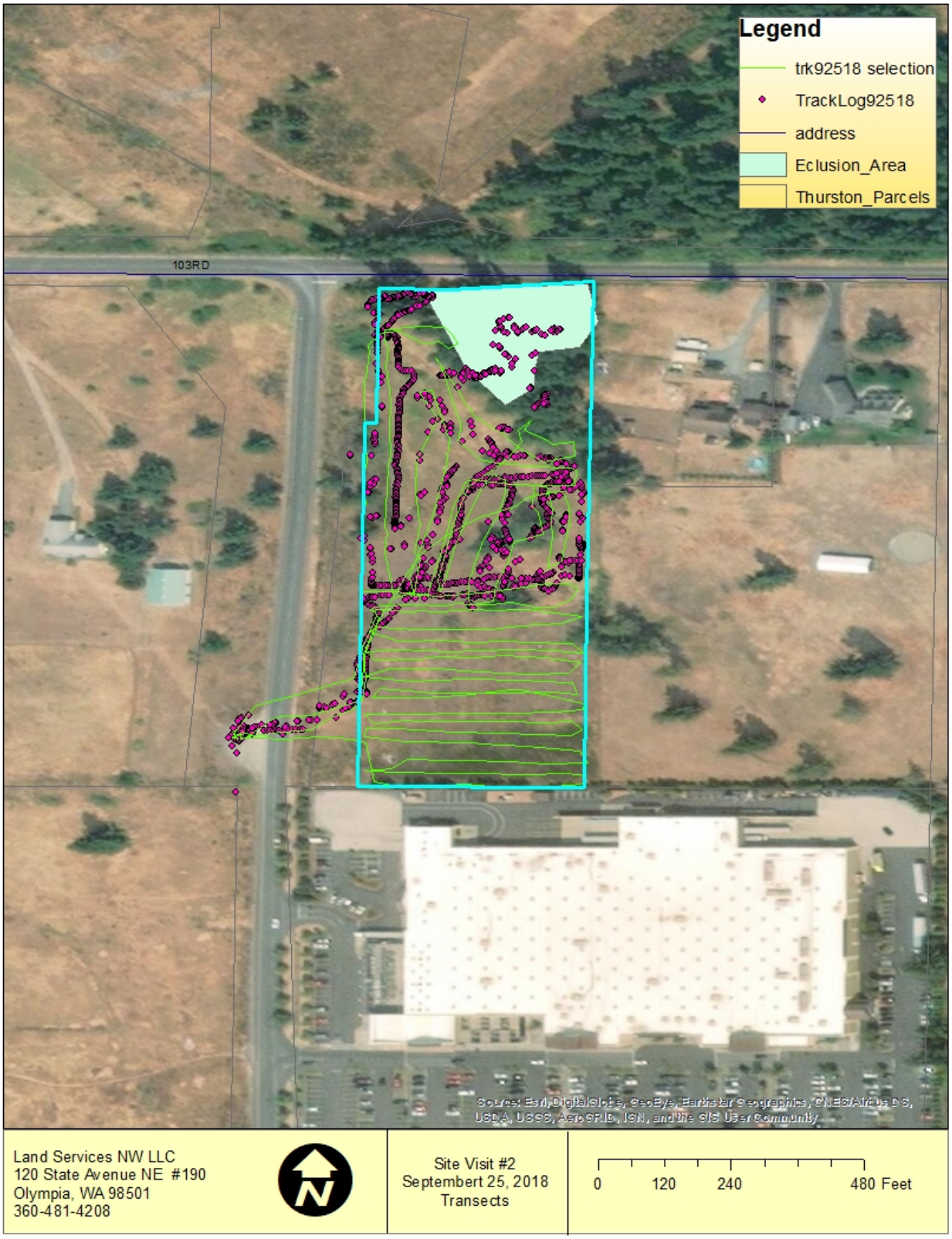
WDFW Test Map



Appendix C

MPG Survey Form and Transect Maps


Legend
Trk82418
address
Eclusion_Area
Thurston_Parcels
103RD
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Land Services NW LLC
120 State Avenue NE #190
Olympia, WA 98501
360-481-4208
Site Visit #1
August 24, 2018
Transects
0
65
130
260 Feet


Legend
trk92518 selection
TrackLog92518
address
Eclusion_Area
Thurston_Parcels
103RD
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Land Services NW LLC
120 State Avenue NE #190
Olympia, WA 98501
360-481-4208
Site Visit #2
Septembert 25, 2018
Transects
0
120
240
480 Feet

2018 Thurston County Mazama Pocket Gopher Screening Field Form **Site Visit Date:** 8/24/2018

Site Name and Parcel #	**Parcel #:** 64303100500 **Project #:** **Site/Landowner:** Dennis Daly
How were the data collected? **(circle the method for each)**	**Transect:** Trimble **Garmin** Aerial **Mounds** Trimble Garmin Aerial **Notes:** Thales Magellan Mobile Mapper CE
Field Team Personnel: **(Indicate all staff present, CIRCLE who filled out form)**	**Name:** Alex Callender MS, PWS **Name:** **Name:**
Others onsite (name/affiliation)	
Site visit # **(CIRCLE all that apply)**	**1st** **2nd** **Unable to screen** **Notes:** No Mazama Pocket Gophers Found
Do onsite conditions preclude the need for further visits?	**Yes** **No** **Dense woody cover that encompasses the entire site (trees/shrubs) that appears to preclude any potential MPG use.** **Impervious Compacted Graveled Flooded** **Other** **Notes:**
Describe visibility for mound detection:	**Poor Fair Good Notes:**
Request mowing? **(CIRCLE and DESCRIBE WHERE MOWING IS NEEDED and SHOW ON AERIAL PHOTO**	**Yes No N/A Notes:**

Mounds observed over the whole site are characteristic of: **Quantify or describe amount of each type and approx. # of mounds** ***Group = 3 mounds or more***	**MPG Mounds**	**Likely MPG Mounds**	**Indeterminate**	**Likely Mole Mounds**	**Mole Mounds**
					10+
	No MPG mounds (circle)				
MPG mounds in GPS? **(CIRCLE and DESCRIBE)** **If MPG mounds present, entered in GPS?**	**None** **All** **Most** **Some** **Notes:** **Yes** **No** **N/A**				
Does woody vegetation onsite match aerial photo?	**Yes** **No - describe differences and show on parcel map/aerial:**				
What portion(s) of the property was screened? **(CIRCLE and DESCRIBE)**	**All** **Part - describe and show on parcel map/aerial:** The area that was excluded was informally surveyed. Large rocks would prevent use.				
Notes -	**Describe, and show on parcel map/aerial if applicable:** See Appendix A				
Team reviewed and agreed to data recorded on form? **(CIRCLE, and EXPLAIN if "No")**	**Yes** **No** **Reviewed by initials:** AC _____ _____ _____ **Notes:**				

2018 Thurston County Mazama Pocket Gopher Screening Field Form **Site Visit Date:** 9/25/2018

Site Name and Parcel #	**Parcel #:** 64303100500 **Project #:** **Site/Landowner:** Dennis Daly
How were the data collected? **(circle the method for each)**	**Transect:** Trimble **Garmin** Aerial **Mounds** Trimble Garmin Aerial **Notes:** Thales Magellan Mobile Mapper CE
Field Team Personnel: **(Indicate all staff present, CIRCLE who filled out form)**	**Name:** Alex Callender MS, PWS **Name:** Susan Callender **Name:**
Others onsite (name/affiliation)	
Site visit # **(CIRCLE all that apply)**	1st **2nd** **Unable to screen** **Notes:** No Mazama Pocket Gophers Found
Do onsite conditions preclude the need for further visits?	**Yes** **No** **Dense woody cover that encompasses the entire site (trees/shrubs) that appears to preclude any potential MPG use.** **Impervious Compacted Graveled Flooded** **Other** **Notes:**
Describe visibility for mound detection:	**Poor Fair Good Notes:**
Request mowing? **(CIRCLE and DESCRIBE WHERE MOWING IS NEEDED and SHOW ON AERIAL PHOTO**	**Yes No N/A Notes:** Area was recently mowed and the ground was visible

Mounds observed over the whole site are characteristic of: **Quantify or describe amount of each type and approx. # of mounds** ***Group = 3 mounds or more***	**MPG Mounds**	**Likely MPG Mounds**	**Indeterminate**	**Likely Mole Mounds**	**Mole Mounds**
					10+
	No MPG mounds (circle)				
MPG mounds in GPS? **(CIRCLE and DESCRIBE)** **If MPG mounds present, entered in GPS?**	**None** **All** **Most** **Some** **Notes:** **Yes** **No** **N/A**				
Does woody vegetation onsite match aerial photo?	**Yes** **No - describe differences and show on parcel map/aerial:**				
What portion(s) of the property was screened? **(CIRCLE and DESCRIBE)**	**All** **Part - describe and show on parcel map/aerial:** The area that was excluded was informally surveyed. Large rocks would prevent use.				
Notes -	**Describe, and show on parcel map/aerial if applicable:** See Appendix A				
Team reviewed and agreed to data recorded on form? **(CIRCLE, and EXPLAIN if "No")**	**Yes** **No** **Reviewed by initials:** AC SC ____ ____ **Notes:**				