Country Meadows Estates Phase 2

Staff Report Supplement

Published May 20th, 2024

Table of Exhibits:

Country Meadows Estates Phase 2
Staff Report Supplement
Exhibit A: Traffic Impact Analysis

COUNTRY MEADOW ESTATES II

Yelm, WA/Thurston County

TRAFFIC IMPACT ASSESSMENT (TIA)

Revised: March 29, 2024

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Transportation Planning & Engineering

COUNTRY MEADOW ESTATES II
TRAFFIC IMPACT ANALYSIS

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03/29/2024

Olympic Region

PLANS, SPECIFICATIONS AND ESTIMATE
Review Comment Disposition Form

Project Title:	SR 507 – Yelm Country Meadows Estates Phase II TIA	Job Charge #:	
Reviewer (name & office) Sarah Bogue – Traffic Design Daniel Grimm – Traffic Design Date of Review Comments: 3/27/2024		Responses By: Date of Disposition:	

Comment No.	Sht or Pg.	Review Comment	Status Code	Designer's Response
1.	GEN	Please provide Synchro model for SR 507/Bald Hill Rd. Was signal timing requested from WSDOT?	B	Signal timing was not requested from WSDOT. Video footage of the signal was reviewed and inputted in Synchro. The Synchro model will be sent over with the updated TIA.
2.	PDF p13	Please provide map for crash data. Please see Safety Analysis Guide p. 24 for guidance (https://wsdot.wa.gov/publications/fulltext/design/ASDE/Safety-Analysis-Guide.pdf).	A	A collision history map has been incorporated in the updated TIA, please see Figure A in the report.
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				

Status Code Legend: A = Incorporated B = Open/Under Review C = Evaluated/Not Incorporated D = Beyond Scope/Not Evaluated

All "B" and "C" responses require explanatory comments.

February 21, 2024

City of Yelm/WSDOT

Subject: Revisions to The Country Meadow Estates II Traffic Impact Analysis.

This letter is in response to the city of Yelm review comments regarding the TIA for The Country Meadow Estates II project.

TIA Changes

- Figure 1: The vicinity map has been changed to show both phases of development.
- Section 3.1 now includes the WSDOT Functional Class.
- All future level of service included a 1.0 peak hour factor (PHF) for State intersections.
- Section 3.7 Collision History has been added.
- The horizon year has been changed to 2027 instead of 2026 (Phase I horizon year).

City Comments

- Please collect additional count data to verify that the evening peak hour on Morris Road occurs in the 4:00-6:00 timeframe.

  Counts at Bald Hill Road SE & Morris Road SE were extended to 2-6 PM. Based on the extended count volumes, the peak hour was shown to remain at 4:30-5:30 PM.

- It is recommended that a meeting occur with City staff to discuss this intersection (Bald Hill Road & Morris Road) and possible solutions.

  A meeting has occurred, and narrative has been included in the mitigation section of the updated TIA.

Please call if you require anything further.

Sincerely,
Aaron Van Aken, P.E., PTOE

COUNTRY MEADOW ESTATES II
TRAFFIC IMPACT ANALYSIS

CONTENTS

TABLES

FIGURES

COUNTRY MEADOW ESTATES II
TRAFFIC IMPACT ANALYSIS

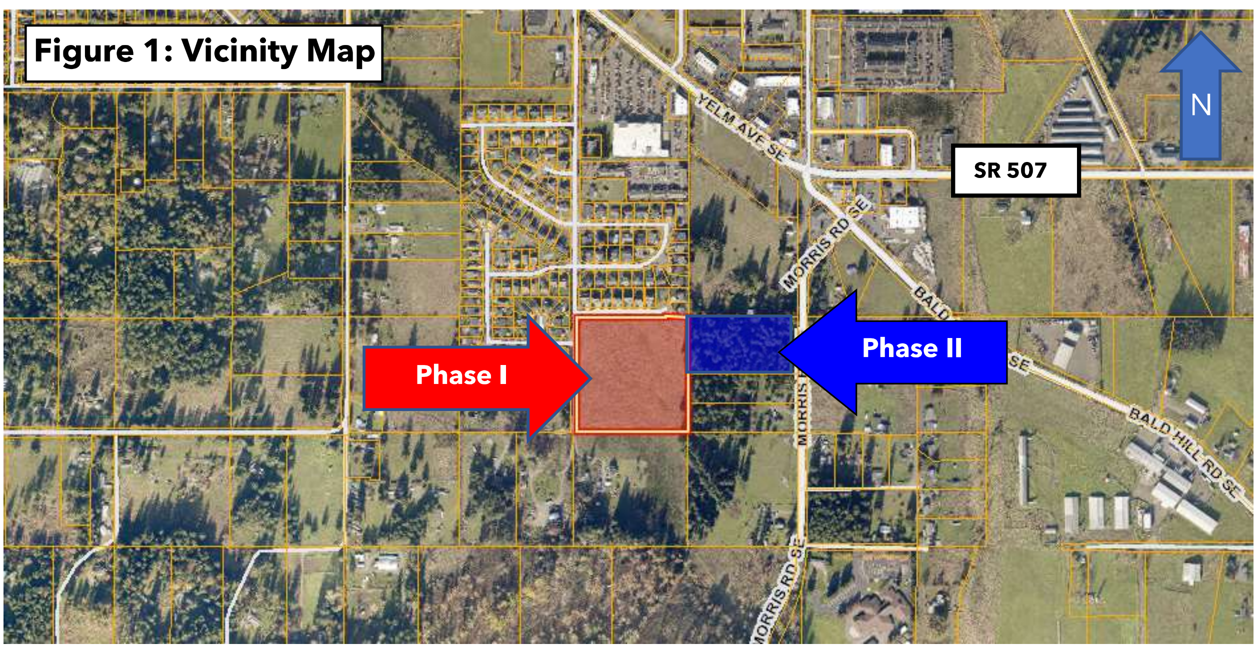
1. INTRODUCTION

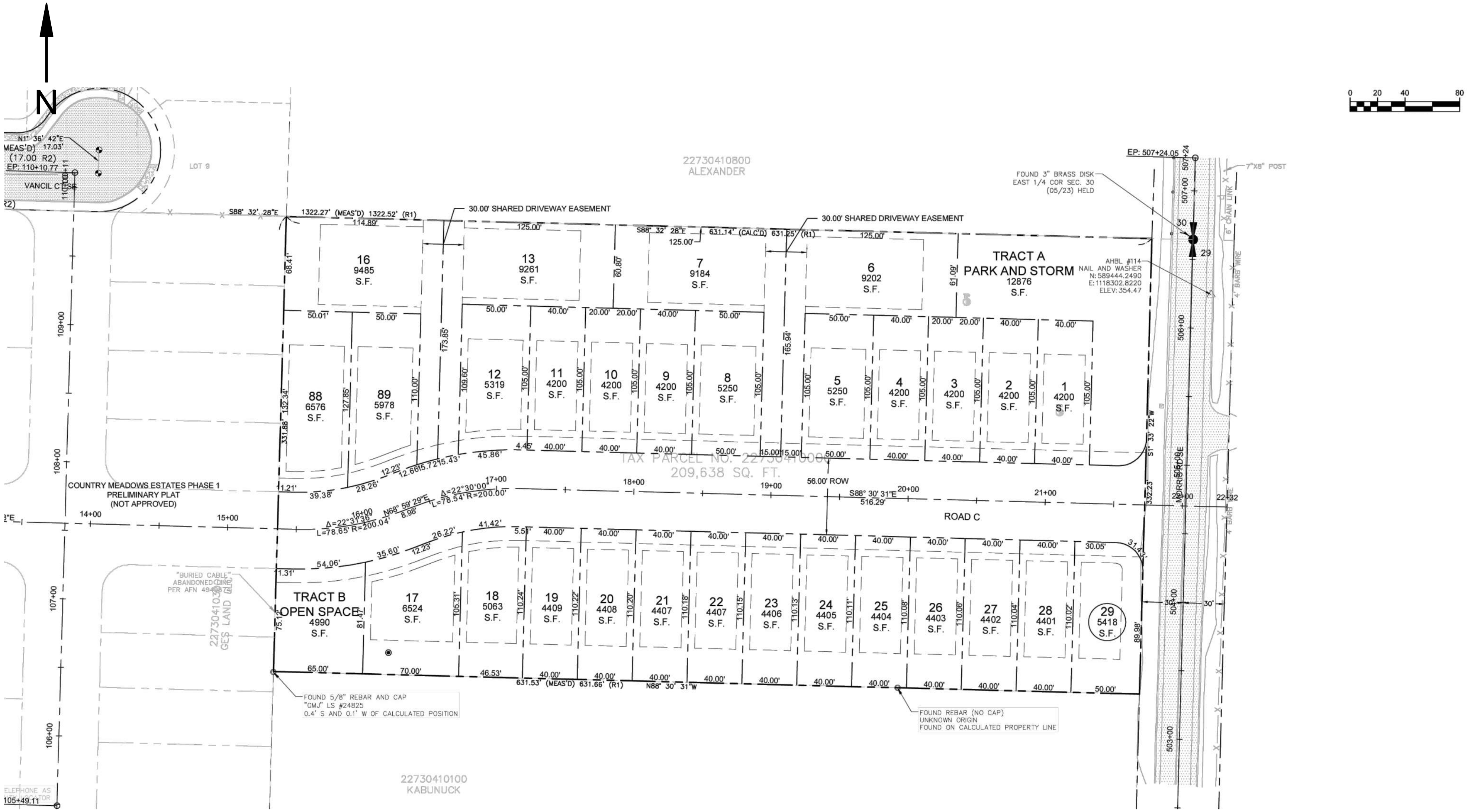
The main goals of this study focus on the assessment of existing roadway conditions and forecasts of newly generated project traffic. The first task includes the review of general roadway information on the adjacent street system and baseline vehicular volumes. Forecasts of future traffic and dispersion patterns on the street system are then determined using established trip generation and distribution techniques. As a final step, appropriate conclusions and mitigation measures are defined if needed.

2. PROJECT DESCRIPTION

Country Meadow Estates II is a proposed residential development comprised of 29 single family homes located within the Yelm Urban Growth Area (UGA) of Thurston County. The subject site is bordered to the east by Morris Road SE situated on tax parcel #: 22730410000 comprised of 5.0-acres. Access to and from the site is proposed via one new roadway extending west from Morris Road SE with westerly connection to Country Meadows I and northerly connection to Vancil Court SE. A vicinity map is provided below with Phase I shown in red and phase II shown in blue. Figure 2 on the following page displays the conceptual site plan.

Figure 1: Vicinity Map





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COUNTRY MEADOW ESTATES II

SITE PLAN
FIGURE 2

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3. EXISTING CONDITIONS

3.1 Existing Street System

Characteristics of the major roadways and arterials serving the subject site are provided in Table 1 below.

Table 1: Roadway Network

Functional Classification	Roadway	Speed Limit (MPH)	Lanes	Sidewalk/ Walking Path	Street Parking	Bike Lane
Major Arterial	SR 507[1]	25-45	2-3	In city area	Some	Some
Urban Arterial	Bald Hill Rd	40	2	Some	Some	No
Commercial	Creek St SE	25	2-3	Yes	No	No
Collector	Morris Rd SE	35	2	No	No	No

*No observed speed limit so city standard 25 mph applies.

3.2 Transit Service

A review of the Intercity Transit regional bus schedule indicates that transit is available within walking distance (under one mile) from the subject site. The closest stop in relation to the subject site is located at the intersection of SR 507 & Bald Hill Road SE (~1,200 feet north). The bus route served at the intersection is Route 94 – Boulevard Road/Yelm. Route 94 provides service from the Olympia Transit Center to the Yelm Walmart. Weekday service is provided from 6:04 AM – 9:58 PM with approximately 60-minute headways during peak travel times. Weekend service is provided from 6:39 AM – 9:58 PM with approximately 60-minute headways. Refer to the Intercity Transit website for more detailed information.

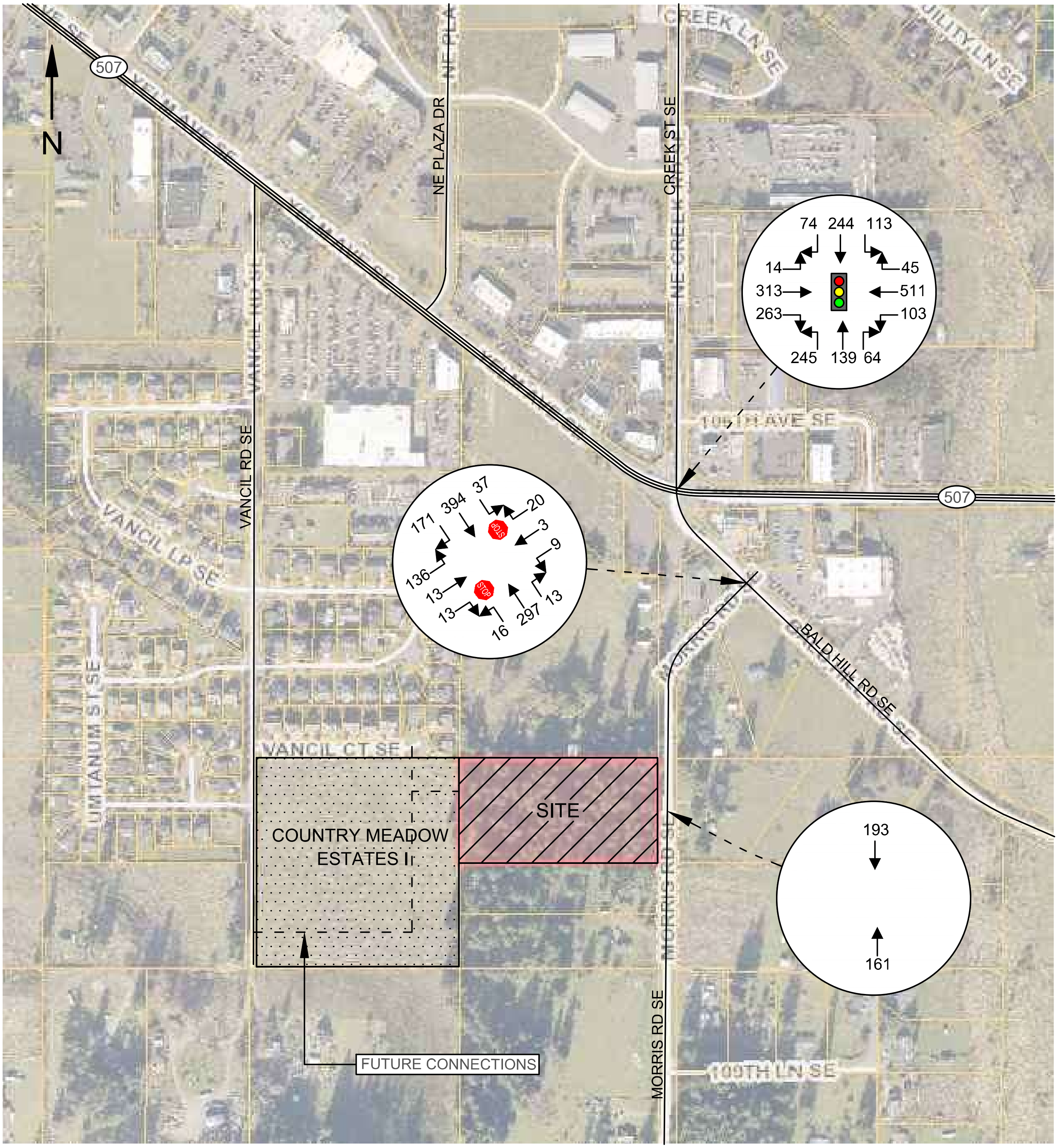
[1] WSDOT – Functional Class 4 (Minor Arterial)

3.3 Existing Peak Hour Volumes and Travel Patterns

Field data for this study was collected in June 2023 at two outlying study intersections and the access along Morris Road SE (school still in session). Each intersection is listed below.

1. SR 507 & Bald Hill Road SE/Creek Street SE (6/14/2023)
2. Bald Hill Road SE & Morris Road SE (6/14/2023)
3. Morris Road SE at proposed point of access (6/14/2023)

Data were obtained during the PM peak period from 4:00-6:00 PM. However, per City request, counts were extended at Morris Road SE & Bald Hill Road from 2:00-4:00 PM to capture school dismissal traffic and to determine whether this would change the peak hour. Based on the extended count, the peak hour was shown to remain in the 4:00-6:00 PM period (peak hour is 4:30-5:30 PM). Figure 3 highlights existing PM peak hour volumes. Count sheets, including the extended count, are included in the appendix for reference.



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COUNTRY MEADOW ESTATES II

EXISTING PM PEAK HOUR VOLUMES
FIGURE 3

3.4 Roadway Improvements

The city of Yelm's most recent (2022-2027) Transportation Improvement Plan, the Thurston County Transportation Plan (2023-2028), and the Washington State STIP (Statewide Transportation Improvement program) (2023-2026) were all reviewed. The city of Yelm's TIP and the WSDOT STIP both indicated planned improvements in the vicinity of the proposed project, each project is listed and described below.

Table 2: Transportation Improvement Projects

Name	Location	Improvement	Cost
		City of Yelm	
2nd Ave SE ID #: WA12343	Mosman Ave to 575' south	Construct 5-foot-wide multi-use concrete sidewalk along the west side of 2nd Street SE from Cochrane Park to the existing sidewalk at Mosman Ave.	$250,000
Mosman Ave SE ID #: WA-12344	2nd St SE to 3rd St SE	Construct sidewalks on both sides of Mosman Ave, install intersection treatment at 2nd St and Mosman Ave. Construct bike lanes from 2nd St to 3rd St.	$310,000
Yelm Ave Improvements ID #: WA-12346	1st St to 4th St	Construction and repair of sidewalks, installation of new parallel parking, intersection treatment, and access control along both sides of Yelm Ave.	$2,321,800
Mosman Ave II ID #: Yelm 13 01	Longmire to Railroad	Construct a new road connecting Longmire St with the new Mosman Ave intersection. Bike lanes, sidewalk, street lighting, and storm water improvements are included. Improvements include construction of new road from Longmire to Solberg, and reconstruction of Mosman between Solberg and Railroad.	$11,482,200
Bald Hill Rd ID #: Yelm 13 14	City Limits to 5 Corners	This project is a feasibility study to identify a project that resolves seasonal flooding issues.	$70,000
		Statewide Transportation Improvement Plan	
SR 510/Yelm Loop	SR 510	Traffic throughout the city is extremely congested at this time. This project will construct the second stage of a new alignment for SR 510 through the city of Yelm. When complete, this project will relieve congestion and improve motorist safety.	$58,697,552

Several planned improvements would further increase non-motorist mobility in the area. Moreover, the SR 510 loop would relieve congestion along SR 507 (E Yelm Avenue).

Lastly, while not listed on the City's TIP, improvements are planned for the SR 507 (E Yelm Avenue) & Bald Hill Road SE intersection to convert the signal to a roundabout. Additionally, Morris Road SE may relocate and tie into the roundabout resulting in a five-leg design. However, the design process is underway, and the extent of improvements are unknown at this time.

3.5 Existing Level of Service

Peak hour delays were determined through the use of the *Highway Capacity Manual* 7th Edition. Capacity analysis is used to determine level of service (LOS) which is an established measure of congestion for transportation facilities. The range[2] for intersection level of service is LOS A to LOS F with the former indicating the best operating conditions with low control delays and the latter indicating the worst conditions with heavy control delays. Detailed descriptions of intersection LOS are given in the Highway Capacity Manual. Level of service calculations were made through the use of the *Synchro 12* analysis program. For signalized intersections, LOS is determined by the overall average delay. For side-street stop-controlled intersections, LOS is determined by the approach with the highest delay. Table 3 below summarizes existing LOS and delays for the key intersections of study.

Table 3: Existing PM Peak Hour Level of Service

Delays given in seconds per vehicle

Intersection	Control	Movement	LOS	Delay
SR 507 & Bald Hill Rd SE/Creek St SE	Signal	Overall	C	25.8
Bald Hill Rd SE & Morris Rd SE	Two-Way Stop	NEB	F	56.6

*NEB-Northeast Bound

City Level of Service Standards[3]: Yelm has an adopted a Level of Service Standard D.

State Level of Service Standards[4]: SR 507 also has an adopted a Level of Service Standard D.

SR 507 & Bald Hill Road SE/Creek Street SE: Is shown to operate with acceptable LOS C conditions in the PM peak hour.

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2 *Signalized Intersections - Level of Service*

Level of Service	Control Delay per Vehicle (sec)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

Stop Controlled Intersections – Level of Service

Level of Service	Control Delay per Vehicle (sec)
A	≤10
B	>10 and ≤15
C	>15 and ≤25
D	>25 and ≤35
E	>35 and ≤50
F	>50

Highway Capacity Manual, 7th Edition

3 Yelm Comprehensive Plan.

4 WSDOT – Level of Service Standard - ArcGIS

Bald Hill Road SE & Morris Road SE: Is shown to operate with LOS F conditions for the northbound approach (i.e., drivers from Morris Road waiting to enter Bald Hill Road). This is due to the observed 136 vehicles attempting to make a left-turn (compared to 13 right-turning vehicles) in the peak hour.

According to the City's Transportation System Plan[5] Project Y9 intends to reconstruct Bald Hill Road to comprise three-lanes (presently two-lanes) from Yelm Avenue to the Western Chehalis Rail. A three-lane cross-section would accommodate a center two-way left-turn lane across Morris Road SE whereby motorists could perform two-staged entry to the roadway. Additional analysis on the improvement and its effect on operations will be examined in Section 4. Also, as mentioned previously, Morris Road SE may tie into a new roundabout at SR 507. Additional information is needed from the City to determine timing and extent of improvements to Morris Road.

3.6 Non-Motorist Activity and Infrastructure

Pedestrian and bicycle activity were monitored at each intersection studied for this project during routine PM peak hour field counts. The intersection of SR 507 & Bald Hill Road SE/Creek Street SE received two pedestrians, one crossing the north leg and one crossing the east leg. The intersection of Bald Hill Road SE & Morris Road SE received one bicyclist crossing the Morris Road SE intersection leg.

Non motorist infrastructure in the area consists of continuous sidewalk along Bald Hill Road SE which provides connection to SR 507 where many amenities and transit opportunities are present.

[5] City of Yelm Transportation System Plan - 2022

3.7 Collision History

Collision history at each study intersection was requested from WSDOT for five full years from the beginning of 2018 through 2022. For each intersection, the crash rate per million entering vehicles (MEV)[6] was calculated. ADT estimates are based on the PM peak hour volumes multiplied by ten. Refer to Table 4 below.

Table 4: Collision History

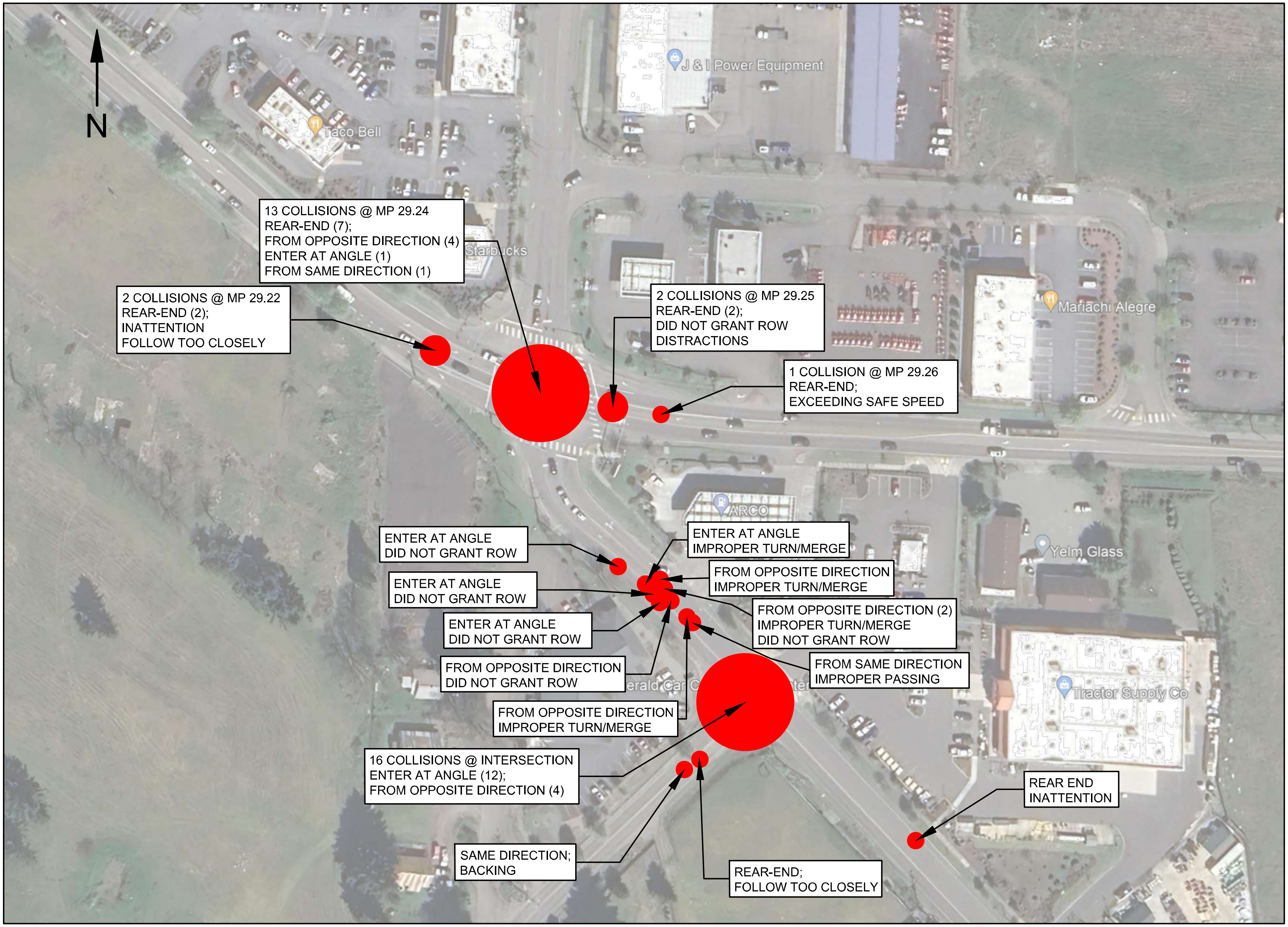
Intersection	2018	2019	2020	2021	2022	Avg/Yr	MEV
SR 507 & Bald Hill Rd SE	4	2	3	5	4	3.6	0.5
Bald Hill Rd SE & Morris Rd SE	5	3	6	7	8	5.8	**1.4**
Morris Rd SE & Access	0	0	0	0	0	0.0	0.0

The three study intersections had a total of 47 reported collisions, 16 of which resulted in possible injury and three in suspected minor injury. No serious injuries, non-motorist incidents, or fatalities were reported. The collision types were listed as "enter at angle" (17), followed by "rear-end" (14), "from opposite direction" (13), and "from same direction (3)". Refer to Figure A on the following page for the collision history map.

Bald Hill Rd SE & Morris Rd SE: has a rate of 1.4 collisions per million entering vehicles. Approximately 70% (20/29) collisions involved left-turn vehicles. This intersection, while also deficient in LOS, is planned for improvements that should address safety and capacity.

It is important to note that there were two collisions listed as "not at intersection and not related" along Morris Road SE. The collisions do not have a location indicator but do state that the vehicles were negotiating a curve.

[6] $R = \frac{A*1,000,000}{365*N*V}$, Where A = # of crashes and V = Intersection ADT



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COUNTRY MEADOW ESTATES II

COLLISION HISTORY LOCATION MAP
FIGURE A

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4. FORECAST TRAFFIC DEMAND & ANALYSIS

4.1 Project Trip Generation

Trip generation is defined as the number of vehicle movements that enter or exit the respective project site during a designated time period, such as a specific peak hour (AM or PM) or an entire day. The magnitude of the anticipated vehicle trip generation for the proposed project was derived from the Institute of Transportation Engineers (ITE) publication, *Trip Generation,* 11th Edition. Based on the proposed development, the designated land use is defined as LUC – 210 Single-Family Detached Housing. Dwelling units were used as the input variable and ITE's equations were used to determine trip ends. ITE trip generation sheets have been included in the appendix for reference. See Table 5 below.

Table 5: Project Trip Generation

Land Use	Units	AWDT	AM Peak-Hour Trips			PM Peak-Hour Trips		
			In	Out	Total	In	Out	Total
LUC 210 Single Family	29	323	6	18	**24**	20	11	**31**

Based on the data presented in Table 5, the project is estimated to generate 323 average weekday daily trips with 24 trips (6 inbound / 18 outbound) occurring in the AM peak hour and 31 trips (20 inbound / 11 outbound) occurring in the PM peak hour.

4.2 Distribution & Assignment

Trip distribution describes the process by which project generated trips are dispersed on the roadway network surrounding the site. Trip distribution for this project utilized the TAZ 726—consistent with Country Meadow Estates I. Trip distribution herein assumes completion of Country Meadow Estates I whereupon an east-west connection between Morris Road SE & Vancil Road SE will be provided. Therefore, project traffic heading to/from the west may utilize this connection through Country Meadow Estates I. The PM peak hour trip distribution & assignment is shown in Figure 6.

Figure 4: New East-West Connection

Country Meadow Estates I

All traffic was assigned to/from Vancil Road per the initial traffic study. Adjustments, therefore, occurred to travel assignments to/from the east such as Morris Road, Bald Hill, and half of traffic to SR 507 due to a more direct route through Estates II. This resulted in a redistribution of 8 entering and 5 exiting movements from Estates I.

Local Neighborhood Rerouting

Also taken into consideration, as part of Country Meadow Estates II development and the east/west connectivity, redistribution of local traffic is anticipated. In review of the existing area and in context to the site layout, Figure 5 below shows the anticipated capture area. The new roadway connection would mainly attract drivers going to/from Bald Hill Road SE and/or Morris Road SE.

Figure 5: Reroute Area

As shown, approximately 35 single-family residences could utilize the new east/west connection. Applying ITE data suggests a total of 37 PM peak hour trips (23 in / 14 out). Applying the same travel assignments to the anticipated routes (e.g., Bald Hill and Morris—no appreciable change to SR 507 is anticipated), results in 2 entering and 1 exiting rerouted motorists.

When Country Meadow Estates II is completed, a new east-west roadway connection would be available for nearby residents. The new roadway would provide a through connection from Vancil Road SE to Morris Road SE. The new roadway connection would mainly attract drivers going to/from Bald Hill Road SE and/or Morris Road SE.

Rerouted traffic from both the nearby existing residents and The Country Meadow Estates II project is shown in Figure 7, which are included in forecast analysis.

4.4 Future Peak Hour Volumes

A 3-year horizon of 2027 was used for future traffic delay analysis. Forecast 2027 background traffic volumes were derived by applying a one percent compound annual growth rate to the existing volumes shown in Figure 3. This growth rate was developed from WSDOT volumes along SR 507 just northwest of Bald Hill Road SE which are shown to be consistent from 2016 (ADT – 19,000) to 2019 (ADT – 19,000) (pre-COVID conditions) (2021 ADT – 18,000). Moreover, also taken into consideration are in-process developments within the city which includes: The Hutch[7], Durant Street Plat, Alpine Estates, Tahoma Boulevard Apartments, El Rey Burro, The Summit at Thompson Creek, Samantha Ridge, Habitat for Humanity, Liberty Grove, 407 E Yelm Coffee, and Country Meadow Estates I[8]. PM peak hour pipeline volumes are shown in Figure 8.

Forecast 2027 PM peak hour volumes without the project (background growth plus pipeline) are shown in Figure 9 while Figure 10 illustrates forecast 2027 volumes with the addition of project-generated traffic.

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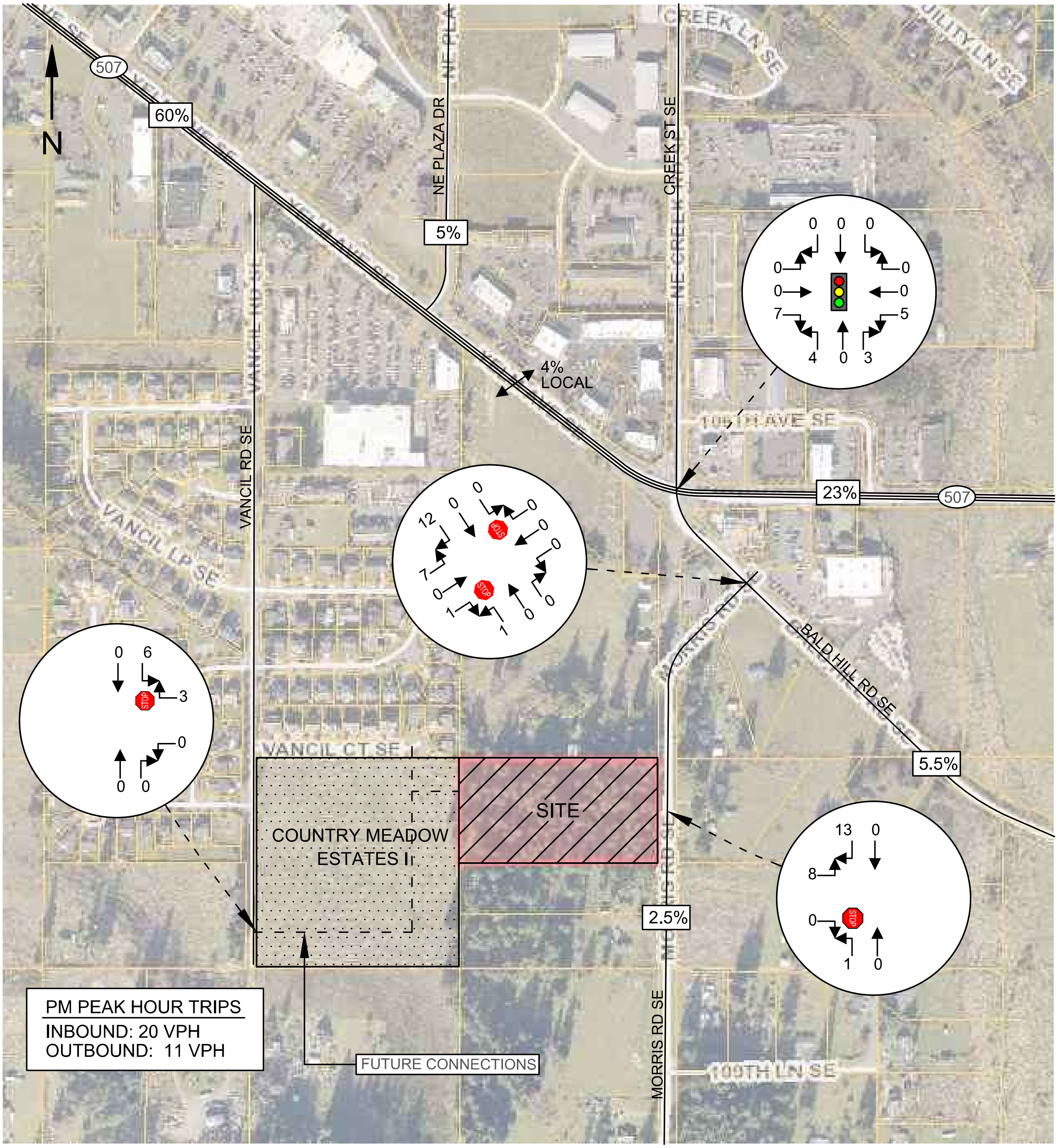
7 Based on site visit (6/14/23), approximately 40/118 homes were constructed and occupied. Therefore, 70% of the trips have been applied as pipeline trips.

8 Trips adjusted to account for east-west connectivity.



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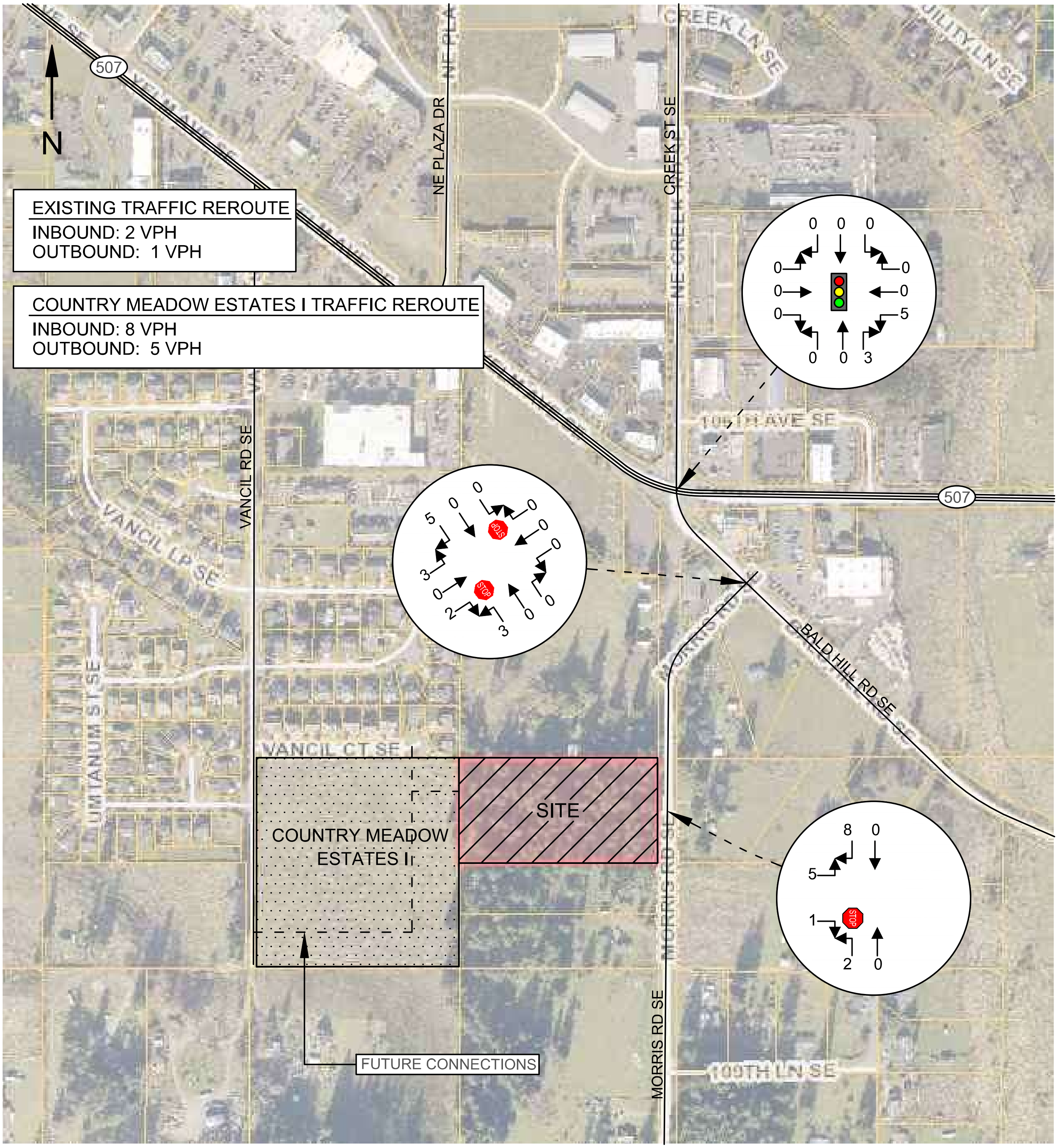
COUNTRY MEADOW ESTATES II

PM PEAK HOUR TRIP DISTRIBUTION & ASSIGNMENT
FIGURE 6



COUNTRY MEADOW ESTATES II

TRAFFIC REROUTE
FIGURE 7

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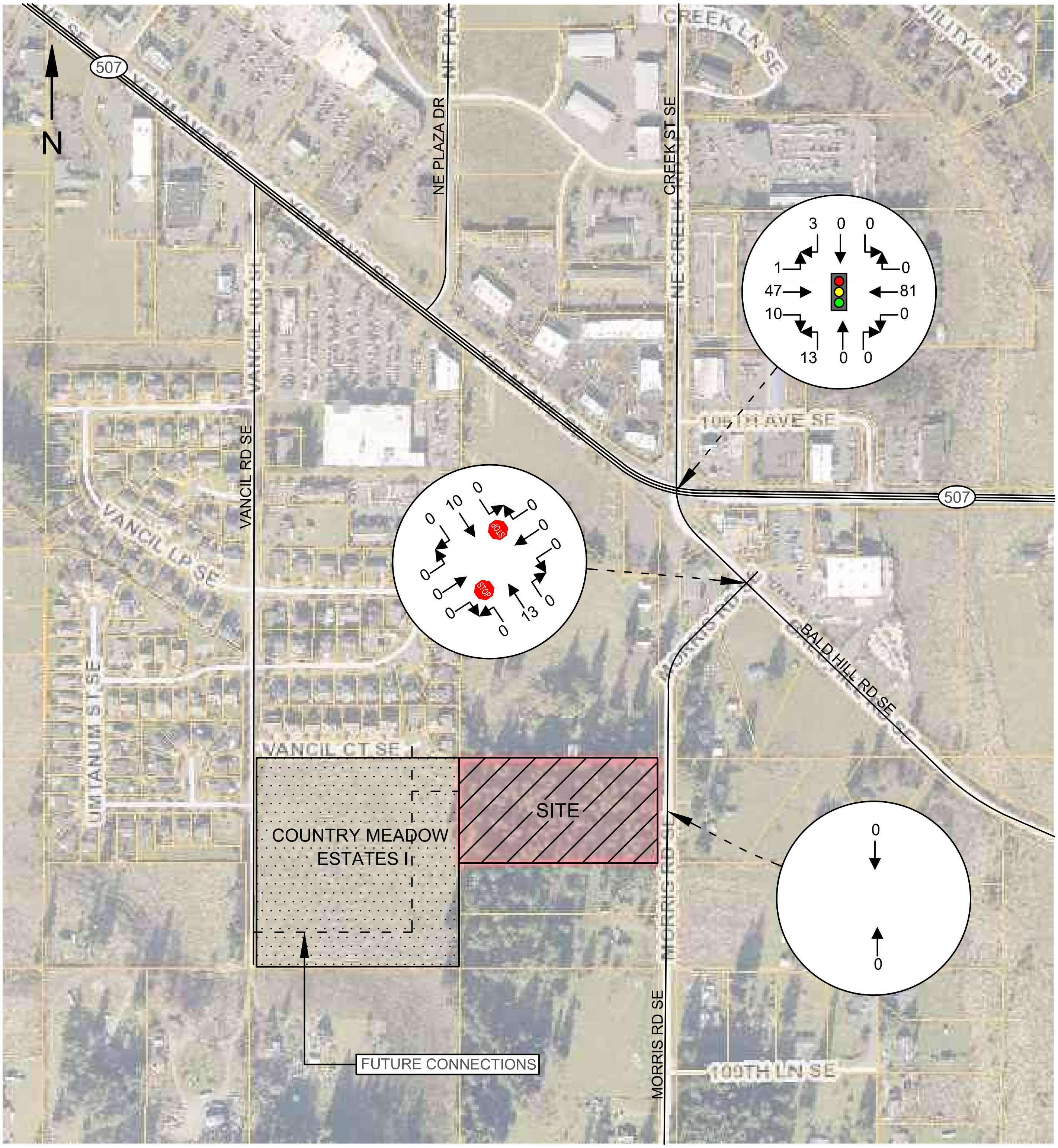

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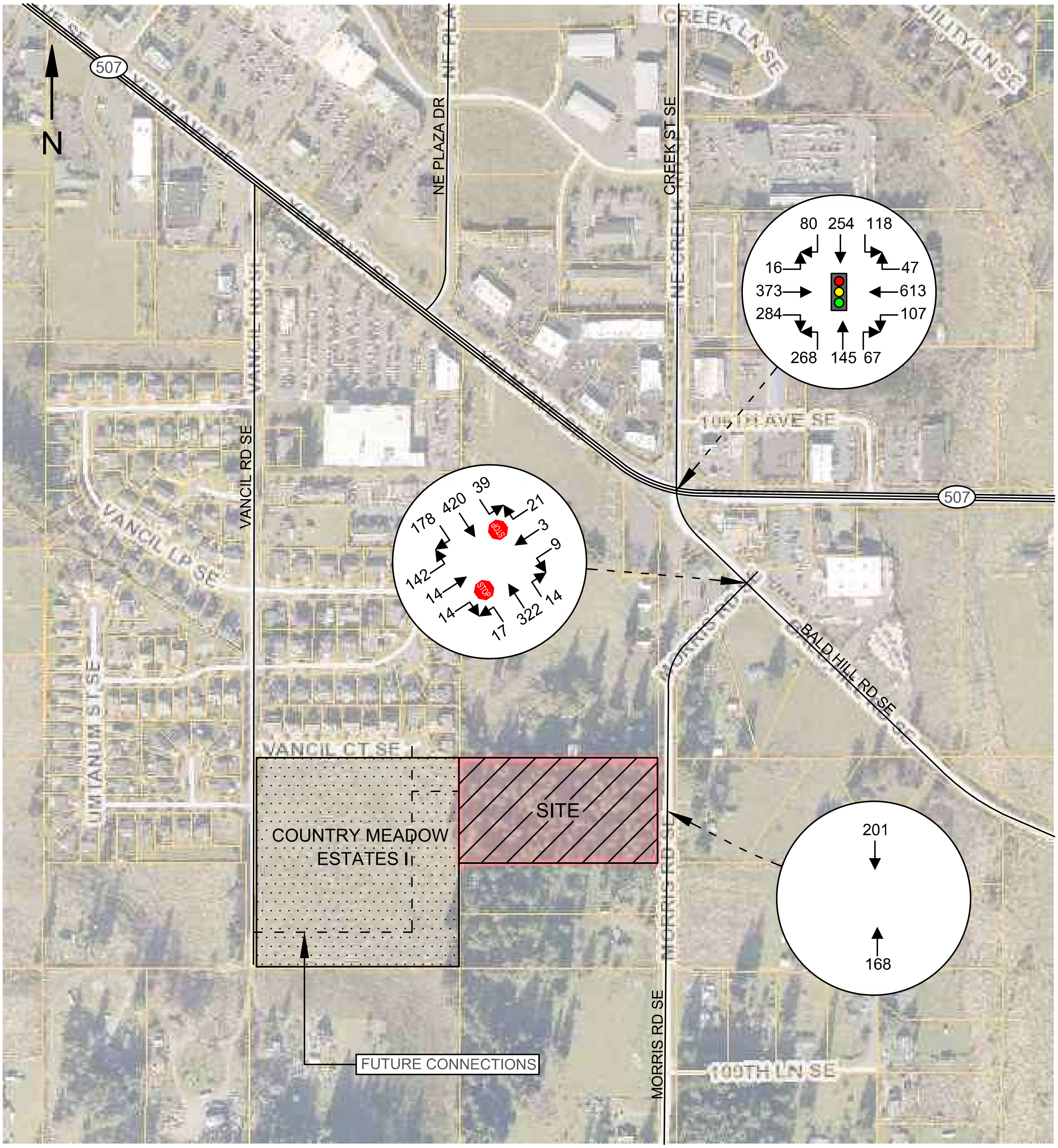
COUNTRY MEADOW ESTATES II

PM PEAK HOUR PIPELINE VOLUMES
FIGURE 8



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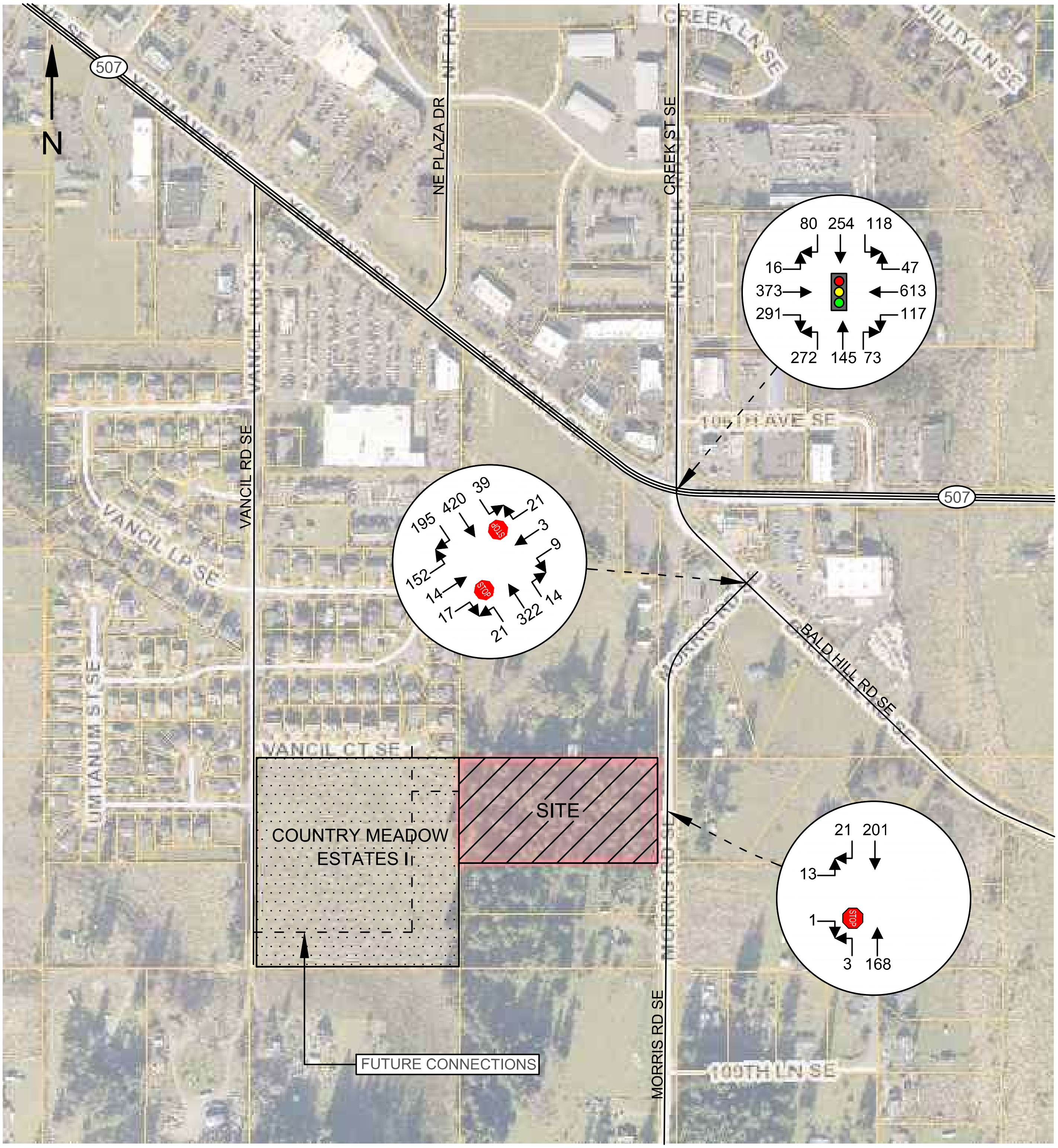
COUNTRY MEADOW ESTATES II

FORECAST 2027 PM PEAK HOUR VOLUMES WITHOUT PROJECT

FIGURE 9



COUNTRY MEADOW ESTATES II

FORECAST 2027 PM PEAK HOUR VOLUMES WITH PROJECT

FIGURE 10

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4.4 Future Level of Service

Level of service analyses were made of the future PM peak hour volumes without (background) and with project related trips added to the key roadways and intersections. This analysis once again involved the use of the *Synchro 12 analysis* program. Delays for the study/access intersections under future conditions are shown below in Table 6. Per WSDOT Synchro policy, the peak hour factor (PHF) for all state intersections are set to 1.0 under forecast conditions.

Table 6: Forecast 2027 Weekday Peak Hour Level of Service

Delays Given in Seconds per Vehicle

				Without Project		*With Project*	
Intersection	**Control**	**LOS Std.**	**Critical Mvmt.**	**LOS**	**Delay**	**LOS**	**Delay**
SR 507 & Bald Hill Rd SE/Creek St SE	Signal	D	Overall	C	29.6	C	30.0
Bald Hill Rd SE & Morris Rd SE	Stop	D	NEB	F	82.7	F	105.6
Morris Rd SE & Project Access	Stop	D		--	--	B	11.1

SR 507 & Bald Hill Road SE/Creek Street SE: Is shown to continue operating with LOS C conditions in the PM peak hour.

Bald Hill Road SE & Morris Road SE: Is shown to continue operating with LOS F conditions with or without the Country Meadow Estates II. A scenario with converting Bald Hill Road from two- to three-lanes is described in the following section.

Morris Road SE & Access: Is projected to operate with acceptable LOS B conditions.

4.5 Intersection Evaluation

Bald Hill Road & Morris Road presently operates at LOS F and is anticipated to continue operating at LOS F in the future assuming no improvements. Per the City's Transportation System Plan, improvements along Bald Hill Road are planned by way of converting the two-lane roadway to three-lanes. An evaluation was therefore conducted to examine operational improvements with a center two-way left-turn lane along Bald Hill Road and across Morris Road. However, it should be noted that the actual improvements to Morris Road SE and the Bald Hill Road are subject to change and depend on the roundabout design that is ultimately selected for the SR 507 intersection. An alternative access scenario is described in Section 4.6.

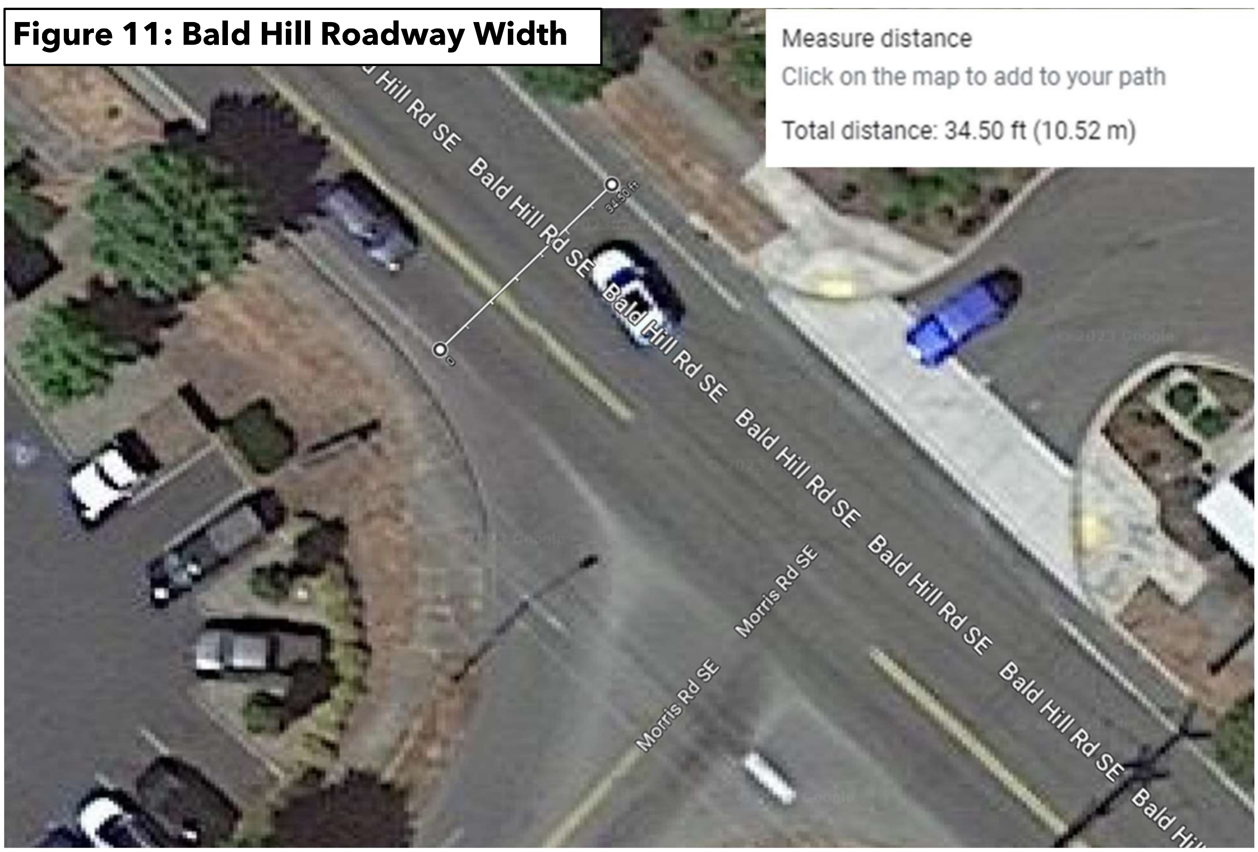
Table 7: Forecast 2027 Weekday Peak Hour Level of Service With Project

Delays Given in Seconds per Vehicle

Intersection	Control	Scenario	Movement	LOS	Delay
Bald Hill Rd SE & Morris Rd SE	Two-Way Stop	Existing Lane Configuration	NEB	F	105.6
		TWLTL Restriping	NEB	D	31.3

As shown above, a three-lane section at the intersection would bring LOS within City standards. The existing cross-section at Bald Hill Road & Morris Road, based on initial review, appears to be around 34-feet from fog line to fog line. Restriping could be achieved without roadway widening. A conceptual restriping plan is shown on Figure 12. Lane widths are shown at 11-feet but could be modified as needed.

Figure 11: Bald Hill Roadway Width



However, it is understood that Morris Road may ultimately tie into the planned roundabout at SR 507 & Bald Hill Road. Given the deficient LOS and crash history, an alternative scenario in which no access for Country Meadows to Morris Road is further examined.

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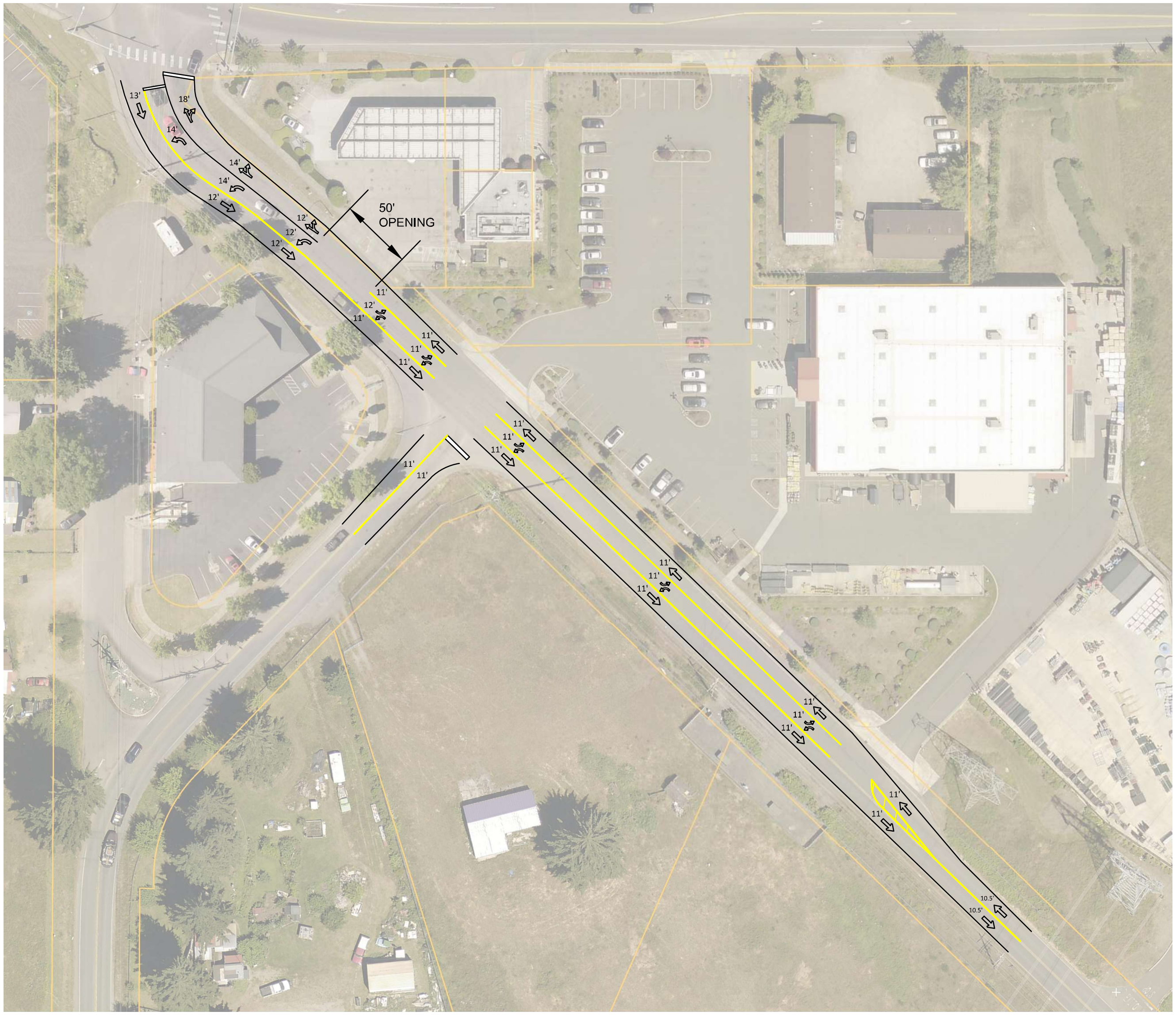

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COUNTRY MEADOW ESTATES II

CONCEPTUAL CROSS SECTION DESIGN
FIGURE 12

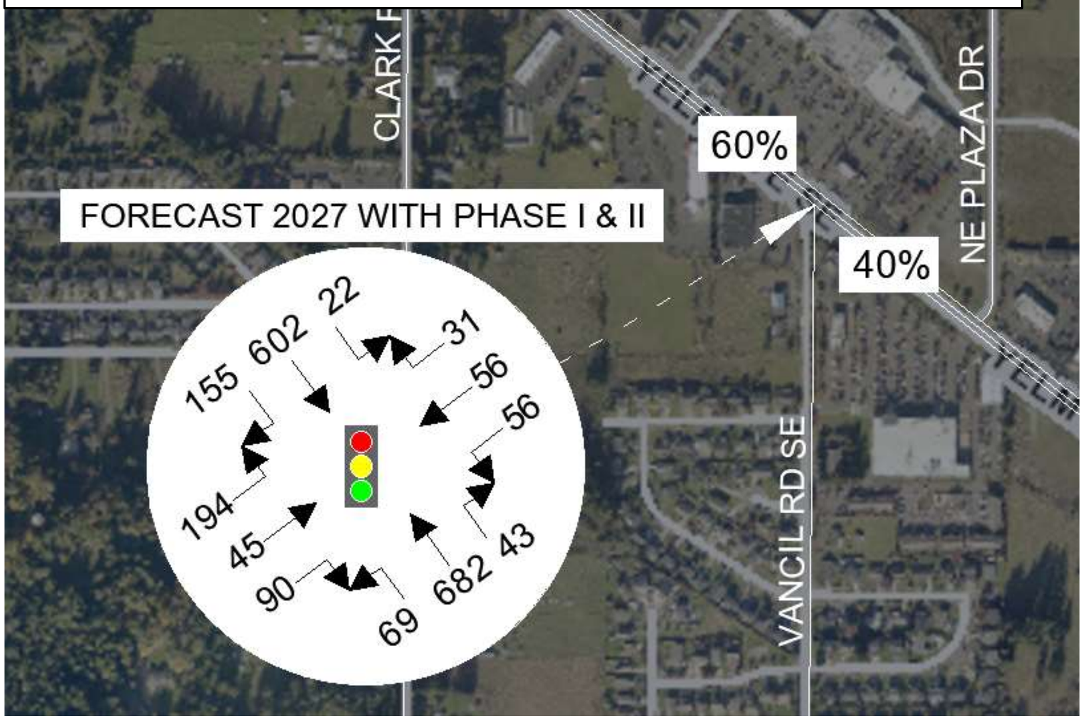
4.6 Consolidated Access

With deficient LOS, crash history, and unknown improvement plans for Morris Road SE at Bald Hill Road, an alternative access plan is as follows:

- Provide all Country Meadows Access (Phase 1 & 2) to Vancil Road SE.
  - Access to Morris Road SE would be gated for emergency vehicles only until such time that improvements are made to Morris Road/Bald Hill Road that addresses capacity and safety.

Shown below in Figure 13 is the forecast 2027 PM peak hour volumes with all project traffic (Phase I & II) assigned along Vancil Road SE and subsequently to SR 507.

Figure 13: Forecast 2027 PM Peak Hour Volumes (Phase 1 & 2) – Access to Vancil Road SE Only



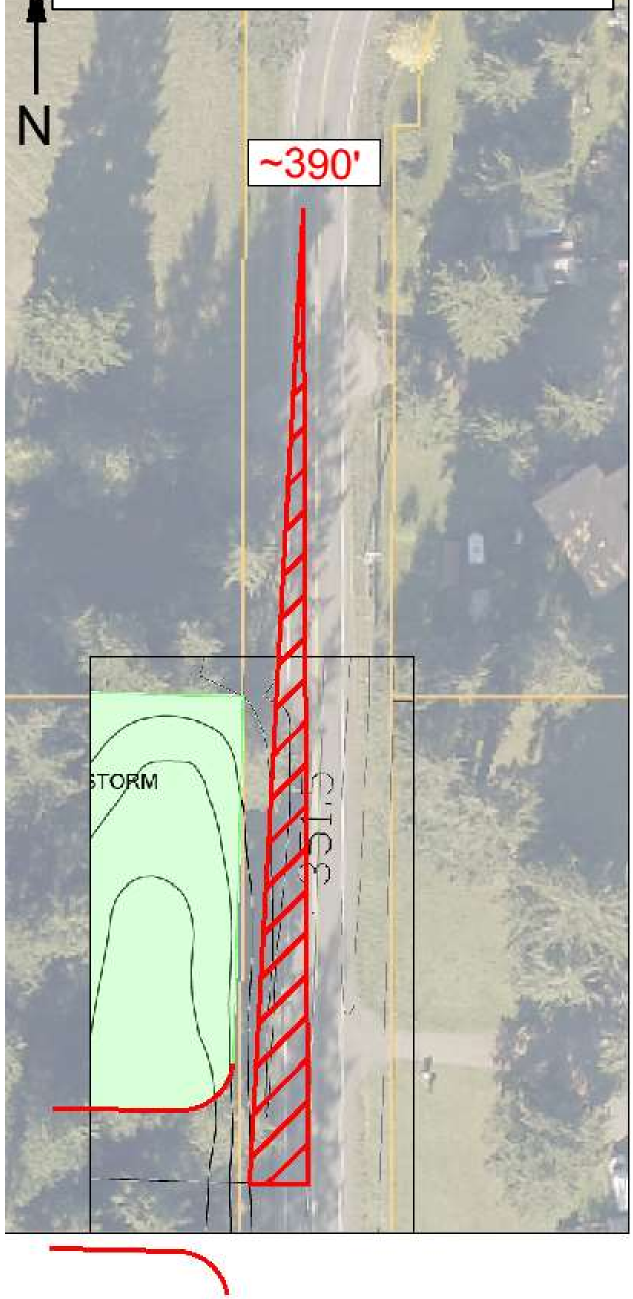
Capacity Analysis

Level of service analysis was conducted for the scenario described and shown above. The intersection, under forecast 2027 conditions (full buildout of Phase 1 & 2) is estimated to operate at **LOS C** conditions with **21.6 seconds** of delay, meeting City/WSDOT standards. Refer to the appendix for the Synchro output sheet. Overall, no significant issues are identified should Country Meadows be temporarily conditioned to omit ingress/egress to Morris Road SE.

4.7 Left Turn Lane Warrant

Left turn lanes are a means of providing necessary storage space for left turning vehicles at intersections. Procedures prescribed by WSDOT Design Manual Exhibit 1310-9 were used to ascertain storage requirements at the proposed access intersection via Morris Road SE. Based on forecast 2027 PM peak hour volumes with project and rerouted traffic – a left turn lane *would not be warranted*. Refer to the appendix for the left turn warrant nomograph.

Figure 14: Northern Sight Distance

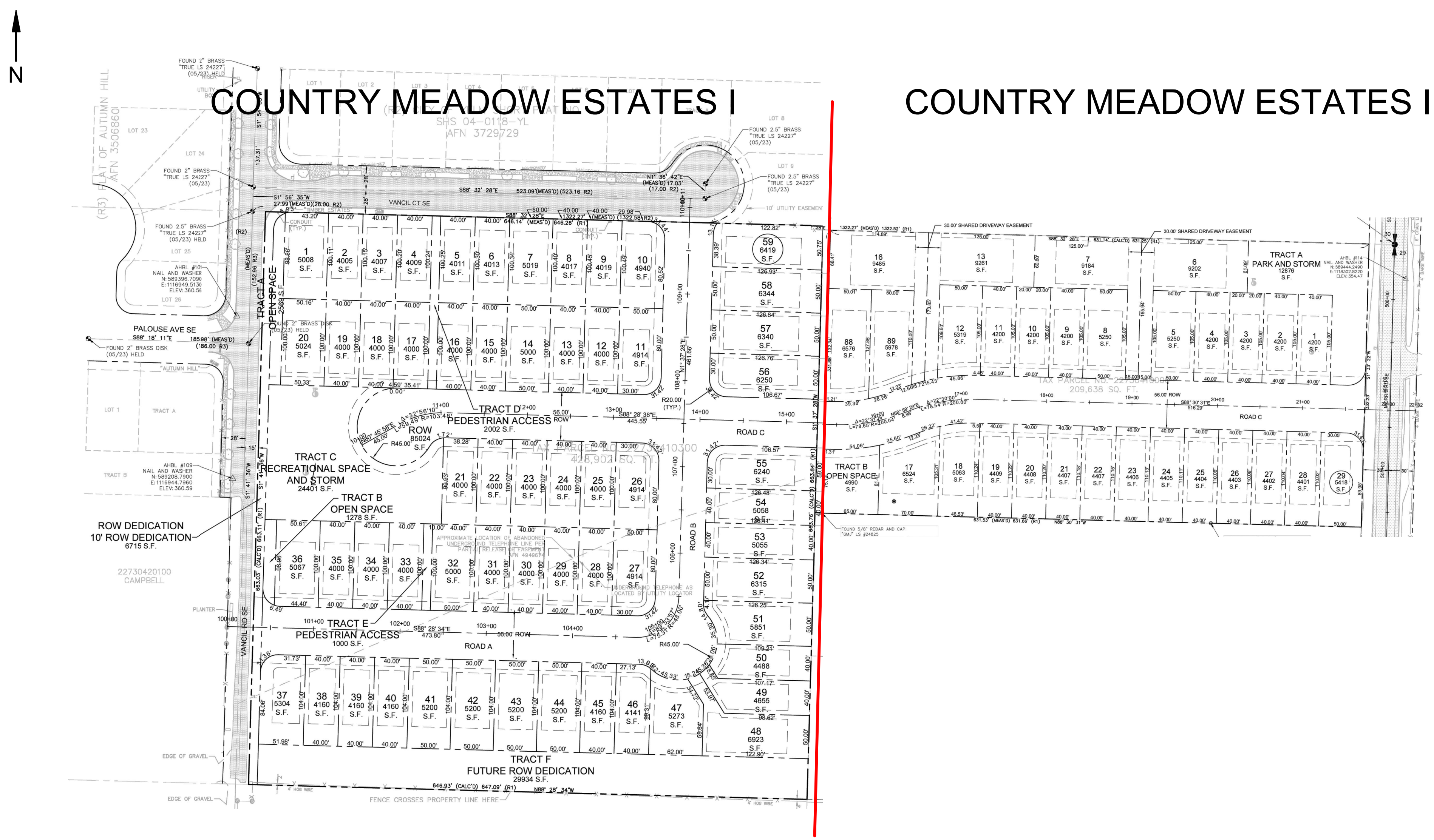


4.8 Access & Sight Distance

Access to and from the site is proposed via a roadway extending west from Morris Road SE. Moreover, a westerly connection to Country Meadows Estates I, will be provided. See Figure 15 on the following page which displays the combined Country Meadow Estates I and II combined site plan.

In accordance with established AASHTO Standards[9] and the 35-mph posted speed limit along Morris Road SE, sight lines would need to meet or exceed 390 feet. Based on preliminary measurements, sight lines to the north are shown to be clear in excess of 390-feet. Sight lines to the south are shown to exceed 500-feet. Refer to the figure to the right which shows the sight distance triangle to the north along Morris Road SE. No deficiencies are identified with the proposed access location.

[9] AASHTO Green Book



COUNTRY MEADOW ESTATES II

COMBINED SITE PLAN
FIGURE 15

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5. CONCLUSIONS & MITIGATION

Country Meadow Estates II proposes for the construction of a residential development comprised of 29 single-family homes located within the Yelm Urban Growth Area (UGA) of Thurston County. The subject site is bordered to the east by Morris Road SE within a single tax parcel comprised of 5.0-acres. Access is proposed via one new roadway extending west from Morris Road SE and would provide connectivity to Country Meadows Phase 1 and Vancil Road SE.

Existing LOS meets City and WSDOT LOS standards with the exception of Bald Hill Road SE & Morris Road SE, currently operating with LOS F conditions. According to the City of Yelm's Transportation System Plan 2022, Bald Hill Road SE is planned for improvements via upgrading the two-lane section to three-lanes between the Chehalis Railroad to SR 507 (Yelm Avenue). Additionally, a roundabout is planned at the intersection of SR 507 & Bald Hill Road SE where Morris Road SE is being considered as a potential fifth leg. Actual improvements and extent of the design are in-process, however.

Based on ITE data, the 29-unit plat is estimated to generate 323 average weekday daily trips with 24 AM peak hour trips and 31 PM peak hour trips. A three-year horizon of 2027 was used to assess future conditions with and without project generated traffic. Forecast 2027 PM peak hour LOS is projected to continue meeting City/WSDOT standards with the exception of Bald Hill Road SE & Morris Road SE operating at LOS F.

Based on the analysis above, recommended mitigation is as follows:

1. Given the deficient Level of Service (LOS) and collision rate, if City planned improvements along Bald Hill Road SE, Morris Road SE, and SR 507 (roundabout) are not completed by the time of Country Meadows Phase 2 buildout, it is recommended to restrict the proposed Morris Road SE site access to emergency vehicles only via bollards, a gate, or other similar means. Consequently, all traffic from Country Meadows Phase 1 & 2, assuming improvements are not completed at buildout, must use Vancil Road SE which was determined to have sufficient capacity to support both Phases.

   Recommendation: Contribute fees from Country Meadows Phase 1 & 2 towards future improvements on Morris Road SE & Bald Hill Road SE. Fee should be based on the number of project vehicles entering the intersection or a comparable assessment to establish proportionality. The exact fees will be based on the final design and budget of the planned improvements and as agreed upon with the City of Yelm.

2. In addition to off-site improvement fee contributions summarized above, the project would be subject to Transportation Facilities Charge per city of Yelm requirements. The City assesses fees at a rate of $1,497.00 per PM peak hour trip. Fees are estimated as follows:

   31 PM Peak Hour Trips x $1,497.00 = $46,407.00.

   Depending on mitigation outcome, credit may be received for any improvements along Bald Hill Road as the roadway is outlined within the City's Transportation System Plan.

Please feel free to contact me should you have any questions.

Aaron Van Aken, P.E., PTOE

COUNTRY MEADOW ESTATES II
TRAFFIC IMPACT ANALYSIS

APPENDIX

Heath & Associates

PO Box 397 Puyallup, WA 98371

File Name : 5165a
Site Code : 00005165
Start Date : 6/14/2023
Page No : 1

Groups Printed- Passenger + - Heavy

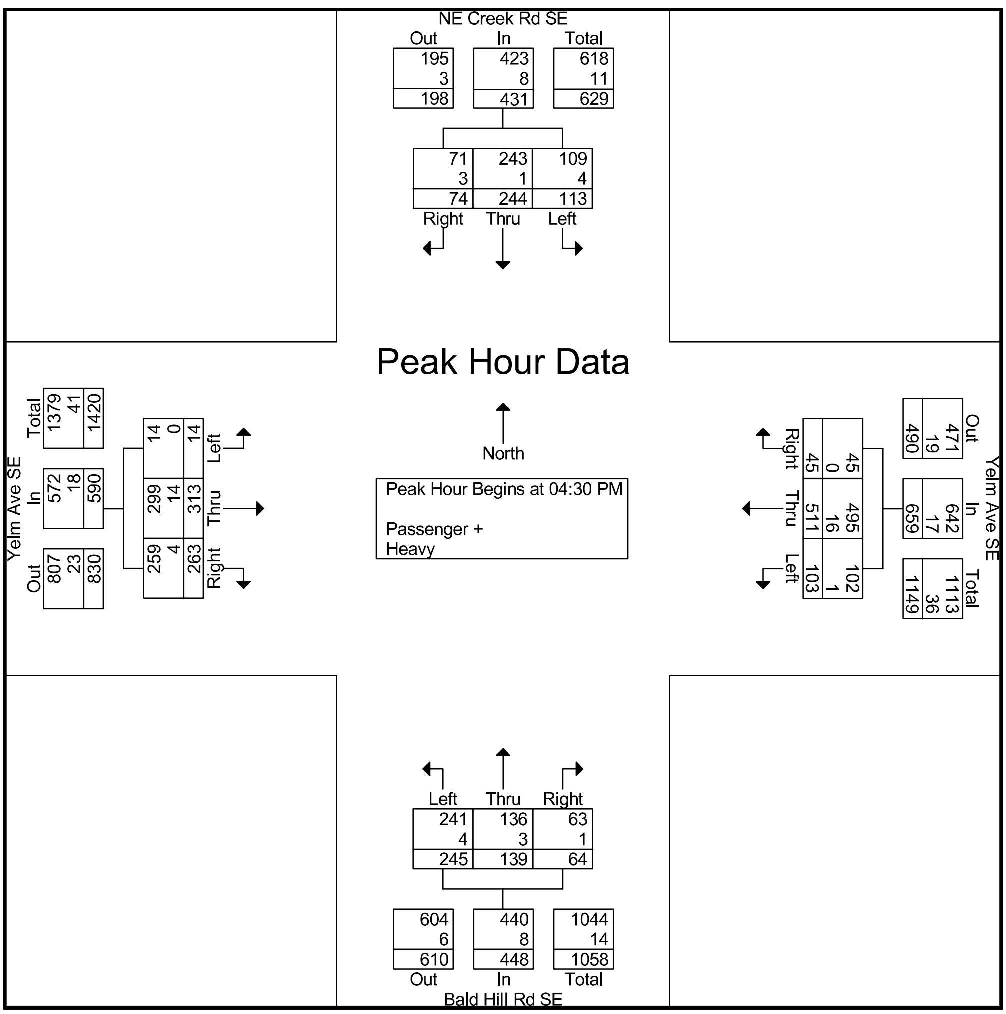
	NE Creek Rd SE Southbound				Yelm Ave SE Westbound				Bald Hill Rd SE Northbound				Yelm Ave SE Eastbound				
Start Time	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
04:00 PM	24	55	31	110	6	118	17	141	11	33	69	113	49	73	1	123	487
04:15 PM	21	38	18	77	14	131	23	168	21	25	62	108	55	94	4	153	506
04:30 PM	13	67	24	104	13	126	31	170	14	20	56	90	62	70	2	134	498
04:45 PM	18	55	26	99	11	123	25	159	21	54	68	143	65	78	6	149	550
Total	76	215	99	390	44	498	96	638	67	132	255	454	231	315	13	559	2041
05:00 PM	19	64	43	126	9	139	34	182	15	34	60	109	63	69	0	132	549
05:15 PM	24	58	20	102	12	123	13	148	14	31	61	106	73	96	6	175	531
05:30 PM	17	53	20	90	5	118	16	139	15	18	44	77	70	95	12	177	483
05:45 PM	18	47	27	92	8	127	21	156	6	20	63	89	63	102	6	171	508
Total	78	222	110	410	34	507	84	625	50	103	228	381	269	362	24	655	2071
Grand Total	154	437	209	800	78	1005	180	1263	117	235	483	835	500	677	37	1214	4112
Apprch %	19.2	54.6	26.1		6.2	79.6	14.3		14	28.1	57.8		41.2	55.8	3		
Total %	3.7	10.6	5.1	19.5	1.9	24.4	4.4	30.7	2.8	5.7	11.7	20.3	12.2	16.5	0.9	29.5	
Passenger +	147	436	205	788	78	973	179	1230	115	229	468	812	493	644	36	1173	4003
% Passenger +	95.5	99.8	98.1	98.5	100	96.8	99.4	97.4	98.3	97.4	96.9	97.2	98.6	95.1	97.3	96.6	97.3
Heavy	7	1	4	12	0	32	1	33	2	6	15	23	7	33	1	41	109
% Heavy	4.5	0.2	1.9	1.5	0	3.2	0.6	2.6	1.7	2.6	3.1	2.8	1.4	4.9	2.7	3.4	2.7

Heath & Associates

PO Box 397 Puyallup, WA 98371

File Name : 5165a
Site Code : 00005165
Start Date : 6/14/2023
Page No : 2

	NE Creek Rd SE Southbound				Yelm Ave SE Westbound				Bald Hill Rd SE Northbound				Yelm Ave SE Eastbound				
Start Time	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:30 PM																	
04:30 PM	13	**67**	24	104	**13**	126	31	170	14	20	56	90	62	70	2	134	498
04:45 PM	18	55	26	99	11	123	25	159	**21**	**54**	**68**	**143**	65	78	**6**	149	**550**
05:00 PM	19	64	**43**	**126**	9	**139**	**34**	**182**	15	34	60	109	63	69	0	132	549
05:15 PM	**24**	58	20	102	12	123	13	148	14	31	61	106	**73**	**96**	6	**175**	531
Total Volume	74	244	113	431	45	511	103	659	64	139	245	448	263	313	14	590	2128
% App. Total	17.2	56.6	26.2		6.8	77.5	15.6		14.3	31	54.7		44.6	53.1	2.4		
PHF	.771	.910	.657	.855	.865	.919	.757	.905	.762	.644	.901	.783	.901	.815	.583	.843	.967
Passenger +	71	243	109	423	45	495	102	642	63	136	241	440	259	299	14	572	2077
% Passenger +	95.9	99.6	96.5	98.1	100	96.9	99.0	97.4	98.4	97.8	98.4	98.2	98.5	95.5	100	96.9	97.6
Heavy	3	1	4	8	0	16	1	17	1	3	4	8	4	14	0	18	51
% Heavy	4.1	0.4	3.5	1.9	0	3.1	1.0	2.6	1.6	2.2	1.6	1.8	1.5	4.5	0	3.1	2.4



Heath & Associates

PO Box 397 Puyallup, WA 98371

File Name : 5165ba
Site Code : 00005165
Start Date : 6/14/2023
Page No : 1

Groups Printed- Passenger + - Heavy

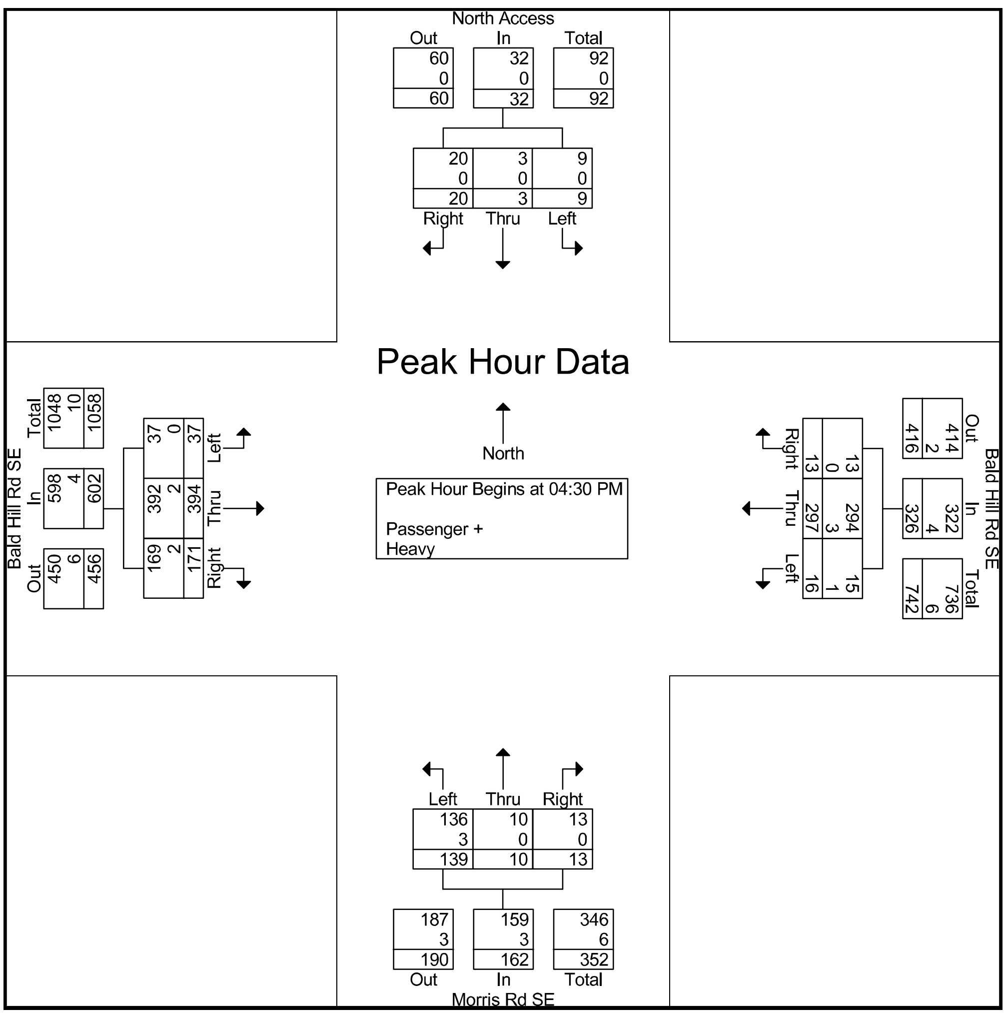
	North Access Southbound				Bald Hill Rd SE Westbound				Morris Rd SE Northbound				Bald Hill Rd SE Eastbound				
Start Time	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
02:00 PM	8	0	1	9	4	53	2	59	5	1	27	33	26	88	8	122	223
02:15 PM	4	2	3	9	1	69	4	74	4	0	23	27	37	91	11	139	249
02:30 PM	6	1	1	8	3	62	8	73	2	3	28	33	40	70	11	121	235
02:45 PM	9	0	0	9	1	65	10	76	1	2	18	21	43	84	4	131	237
Total	27	3	5	35	9	249	24	282	12	6	96	114	146	333	34	513	944
03:00 PM	7	1	0	8	2	71	2	75	10	5	63	78	46	89	2	137	298
03:15 PM	3	1	0	4	3	74	6	83	7	4	47	58	25	100	0	125	270
03:30 PM	2	0	2	4	2	72	2	76	1	1	31	33	31	85	11	127	240
03:45 PM	6	0	1	7	3	83	2	88	3	1	24	28	36	104	7	147	270
Total	18	2	3	23	10	300	12	322	21	11	165	197	138	378	20	536	1078
04:00 PM	7	0	1	8	4	82	2	88	6	2	23	31	37	91	11	139	266
04:15 PM	3	1	2	6	3	77	3	83	3	4	31	38	37	77	4	118	245
04:30 PM	2	0	4	6	4	63	4	71	5	4	32	41	32	110	14	156	274
04:45 PM	2	1	0	3	1	93	2	96	3	1	46	50	44	86	10	140	289
Total	14	2	7	23	12	315	11	338	17	11	132	160	150	364	39	553	1074
05:00 PM	11	2	3	16	3	70	6	79	1	3	35	39	56	99	8	163	297
05:15 PM	5	0	2	7	5	71	4	80	4	2	26	32	39	99	5	143	262
05:30 PM	4	0	1	5	2	63	4	69	4	1	24	29	31	105	6	142	245
05:45 PM	4	1	2	7	4	58	5	67	1	1	20	22	29	93	5	127	223
Total	24	3	8	35	14	262	19	295	10	7	105	122	155	396	24	575	1027
Grand Total	83	10	23	116	45	1126	66	1237	60	35	498	593	589	1471	117	2177	4123
Apprch %	71.6	8.6	19.8		3.6	91	5.3		10.1	5.9	84		27.1	67.6	5.4		
Total %	2	0.2	0.6	2.8	1.1	27.3	1.6	30	1.5	0.8	12.1	14.4	14.3	35.7	2.8	52.8	
Passenger +	83	10	23	116	45	1094	61	1200	55	35	479	569	573	1439	117	2129	4014
% Passenger +	100	100	100	100	100	97.2	92.4	97	91.7	100	96.2	96	97.3	97.8	100	97.8	97.4
Heavy	0	0	0	0	0	32	5	37	5	0	19	24	16	32	0	48	109
% Heavy	0	0	0	0	0	2.8	7.6	3	8.3	0	3.8	4	2.7	2.2	0	2.2	2.6

Heath & Associates

PO Box 397 Puyallup, WA 98371

File Name : 5165ba
Site Code : 00005165
Start Date : 6/14/2023
Page No : 2

	North Access				Bald Hill Rd SE				Morris Rd SE				Bald Hill Rd SE				
	Southbound				Westbound				Northbound				Eastbound				
Start Time	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
Peak Hour Analysis From 02:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:30 PM																	
04:30 PM	2	0	**4**	6	4	63	4	71	**5**	**4**	32	41	32	**110**	**14**	156	274
04:45 PM	2	1	0	3	1	**93**	2	**96**	3	1	**46**	**50**	44	86	10	140	289
05:00 PM	**11**	**2**	3	**16**	3	70	**6**	79	1	3	35	39	**56**	99	8	**163**	**297**
05:15 PM	5	0	2	7	**5**	71	4	80	4	2	26	32	39	99	5	143	262
Total Volume	20	3	9	32	13	297	16	326	13	10	139	162	171	394	37	602	1122
% App. Total	62.5	9.4	28.1		4	91.1	4.9		8	6.2	85.8		28.4	65.4	6.1		
PHF	.455	.375	.563	.500	.650	.798	.667	.849	.650	.625	.755	.810	.763	.895	.661	.923	.944
Passenger +	20	3	9	32	13	294	15	322	13	10	136	159	169	392	37	598	1111
% Passenger +	100	100	100	100	100	99.0	93.8	98.8	100	100	97.8	98.1	98.8	99.5	100	99.3	99.0
Heavy	0	0	0	0	0	3	1	4	0	0	3	3	2	2	0	4	11
% Heavy	0	0	0	0	0	1.0	6.3	1.2	0	0	2.2	1.9	1.2	0.5	0	0.7	1.0



Heath & Associates

PO Box 397 Puyallup, WA 98371

File Name : 5165c
Site Code : 00005165
Start Date : 6/14/2023
Page No : 1

Groups Printed- Passenger + - Heavy

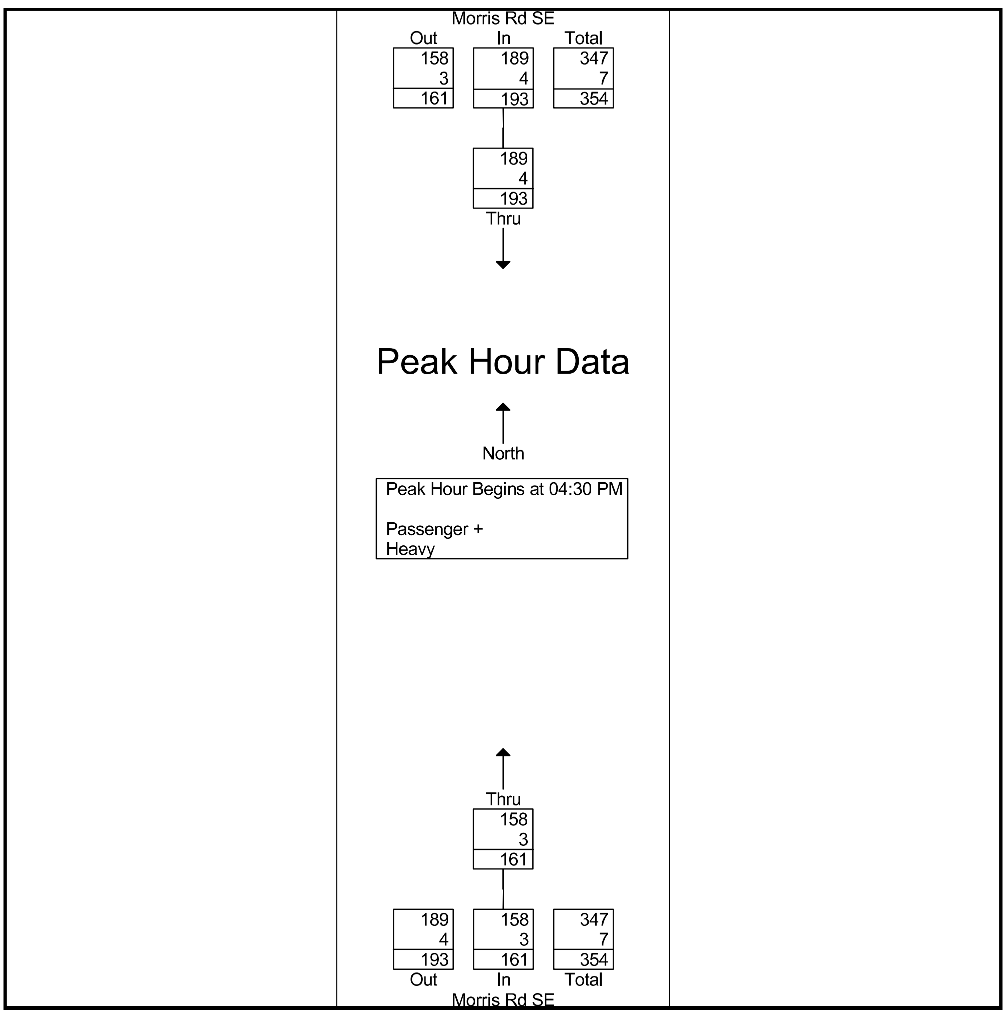
	Morris Rd SE Southbound		Morris Rd SE Northbound		
Start Time	Thru	App. Total	Thru	App. Total	Int. Total
04:00 PM	41	41	31	31	72
04:15 PM	44	44	36	36	80
04:30 PM	38	38	41	41	79
04:45 PM	46	46	44	44	90
Total	169	169	152	152	321
05:00 PM	62	62	41	41	103
05:15 PM	47	47	35	35	82
05:30 PM	39	39	23	23	62
05:45 PM	35	35	20	20	55
Total	183	183	119	119	302
Grand Total	352	352	271	271	623
Apprch %	100		100		
Total %	56.5	56.5	43.5	43.5	
Passenger +	348	348	265	265	613
% Passenger +	98.9	98.9	97.8	97.8	98.4
Heavy	4	4	6	6	10
% Heavy	1.1	1.1	2.2	2.2	1.6

Heath & Associates

PO Box 397 Puyallup, WA 98371

File Name : 5165c
Site Code : 00005165
Start Date : 6/14/2023
Page No : 2

	Morris Rd SE Southbound		Morris Rd SE Northbound		
Start Time	Thru	App. Total	Thru	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1					
Peak Hour for Entire Intersection Begins at 04:30 PM					
04:30 PM	38	38	41	41	79
04:45 PM	46	46	**44**	**44**	90
05:00 PM	**62**	**62**	41	41	**103**
05:15 PM	47	47	35	35	82
Total Volume	193	193	161	161	354
% App. Total	100		100		
PHF	.778	.778	.915	.915	.859
Passenger +	189	189	158	158	347
% Passenger +	97.9	97.9	98.1	98.1	98.0
Heavy	4	4	3	3	7
% Heavy	2.1	2.1	1.9	1.9	2.0



Single-Family Detached Housing
(210)

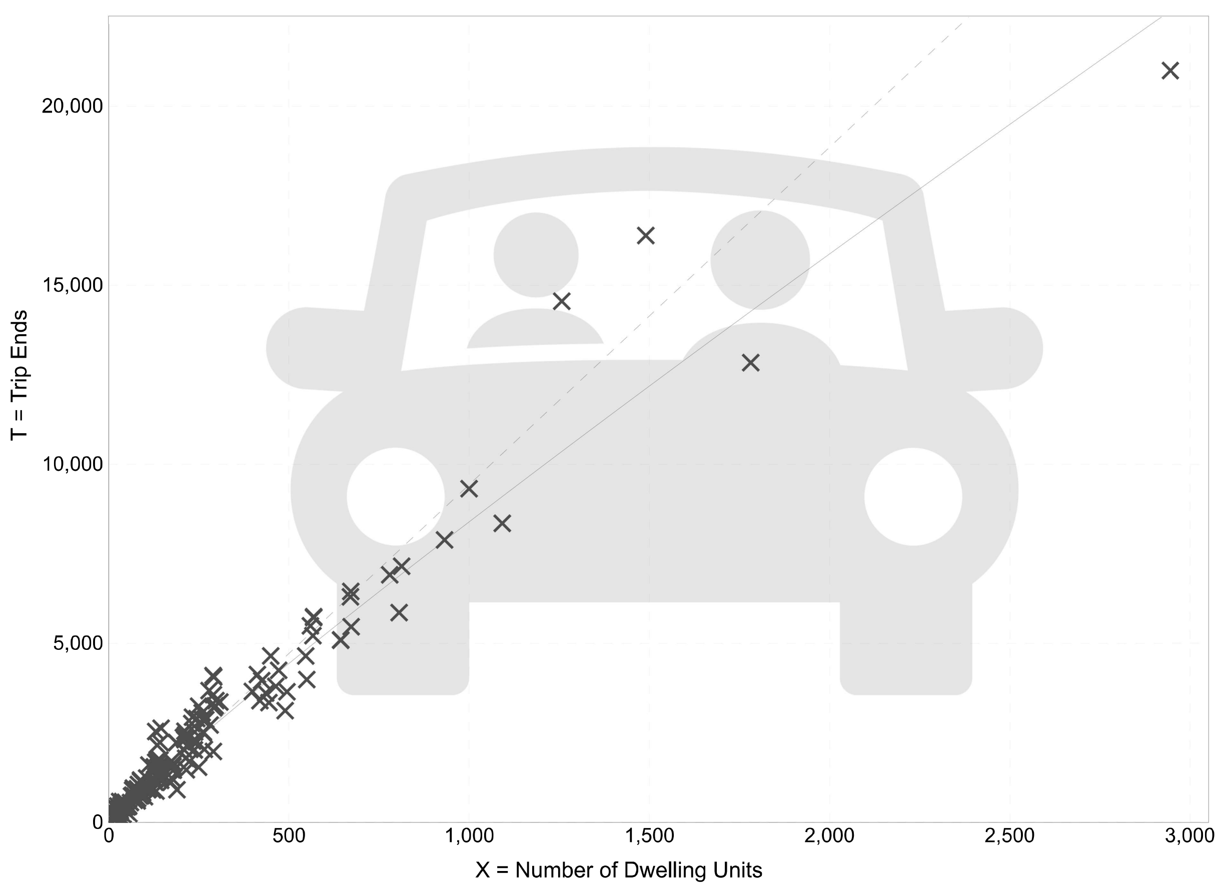
Vehicle Trip Ends vs: Dwelling Units
On a: Weekday

Setting/Location: General Urban/Suburban
Number of Studies: 174
Avg. Num. of Dwelling Units: 246
Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
9.43	4.45 - 22.61	2.13

Data Plot and Equation



Fitted Curve Equation: Ln(T) = 0.92 Ln(X) + 2.68 **R^2= 0.95**

Trip Gen Manual, 11th Edition • Institute of Transportation Engineers

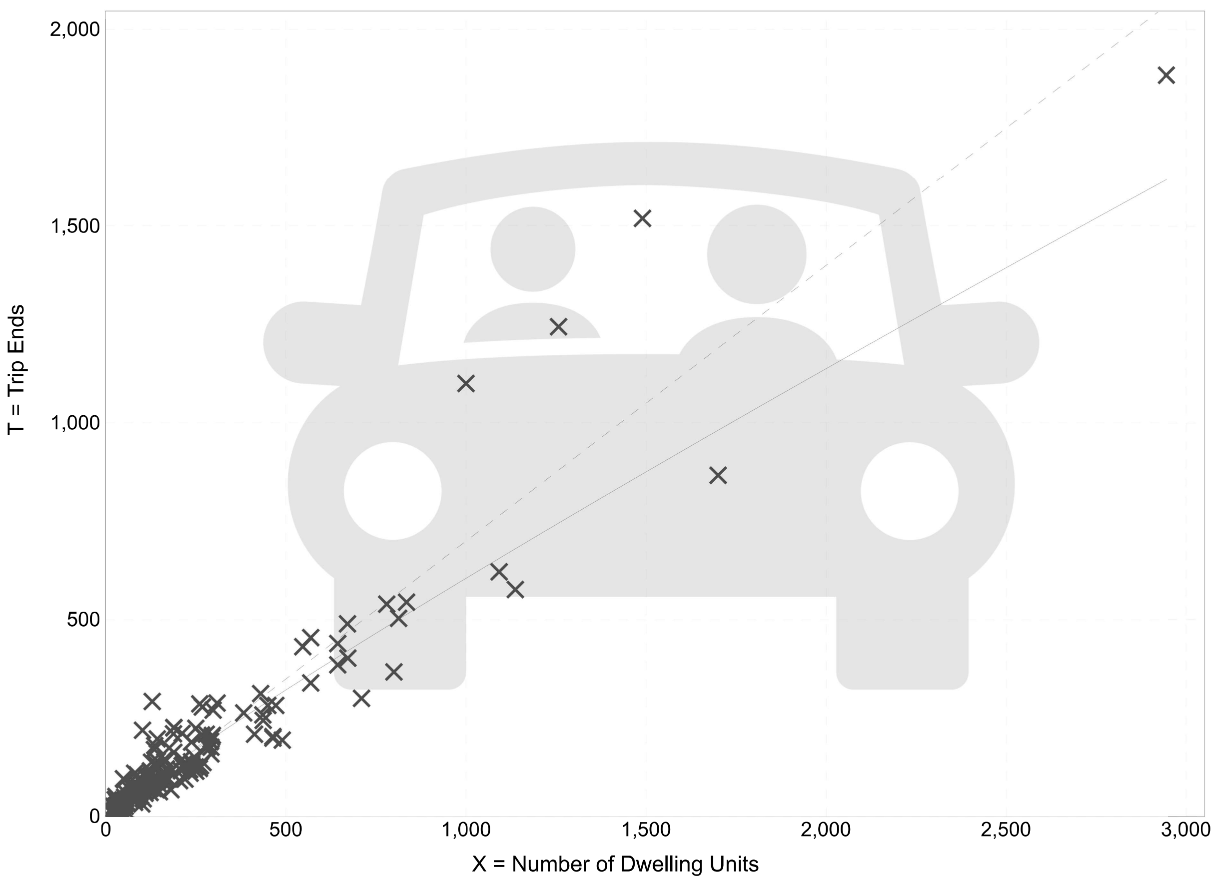
Single-Family Detached Housing
(210)

Vehicle Trip Ends vs:	**Dwelling Units**
On a:	**Weekday,**
	Peak Hour of Adjacent Street Traffic,
	One Hour Between 7 and 9 a.m.
Setting/Location:	**General Urban/Suburban**
Number of Studies:	192
Avg. Num. of Dwelling Units:	226
Directional Distribution:	26% entering, 74% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.70	0.27 - 2.27	0.24

Data Plot and Equation



Fitted Curve Equation: $Ln(T) = 0.91 Ln(X) + 0.12$ **$R^2 = 0.90$**

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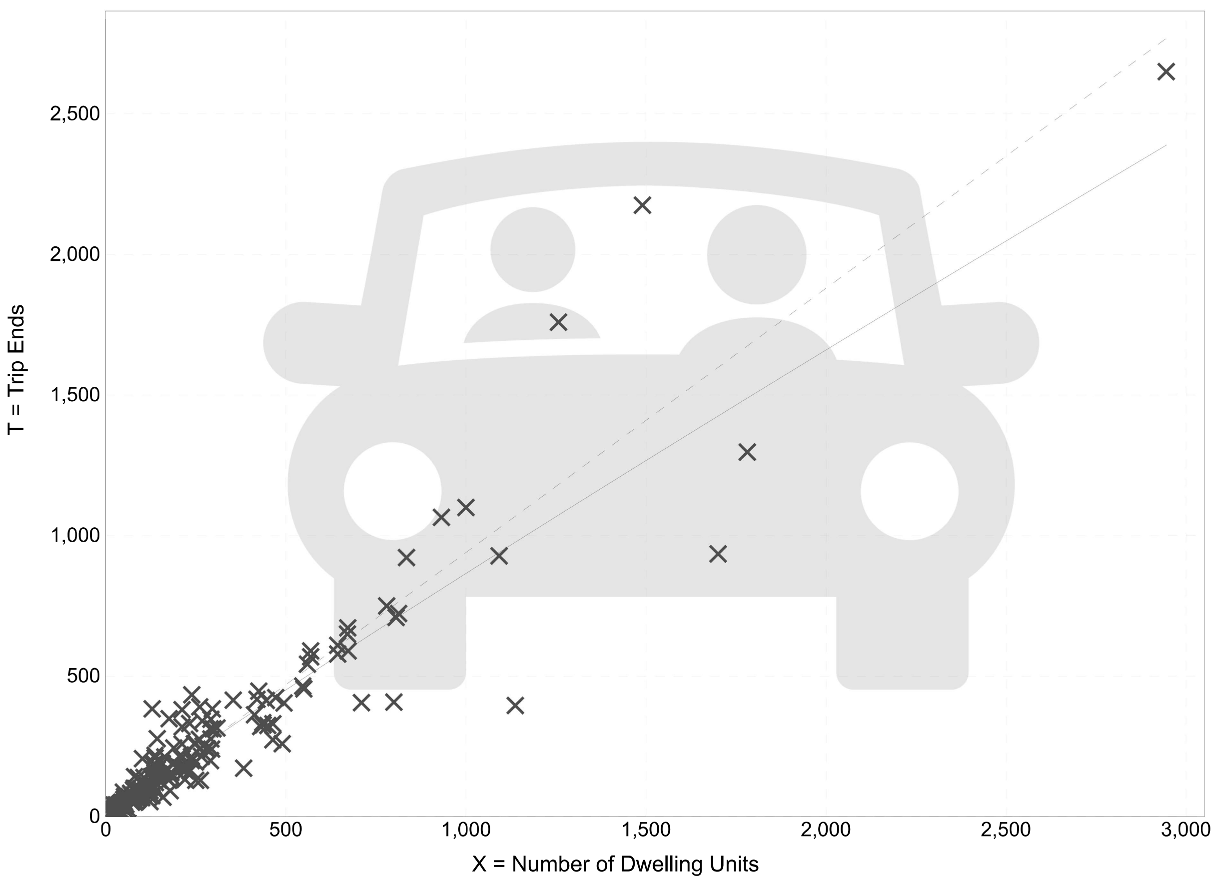
Single-Family Detached Housing
(210)

Vehicle Trip Ends vs:	**Dwelling Units**
On a:	**Weekday, Peak Hour of Adjacent Street Traffic, One Hour Between 4 and 6 p.m.**
Setting/Location:	**General Urban/Suburban**
Number of Studies:	208
Avg. Num. of Dwelling Units:	248
Directional Distribution:	63% entering, 37% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.94	0.35 - 2.98	0.31

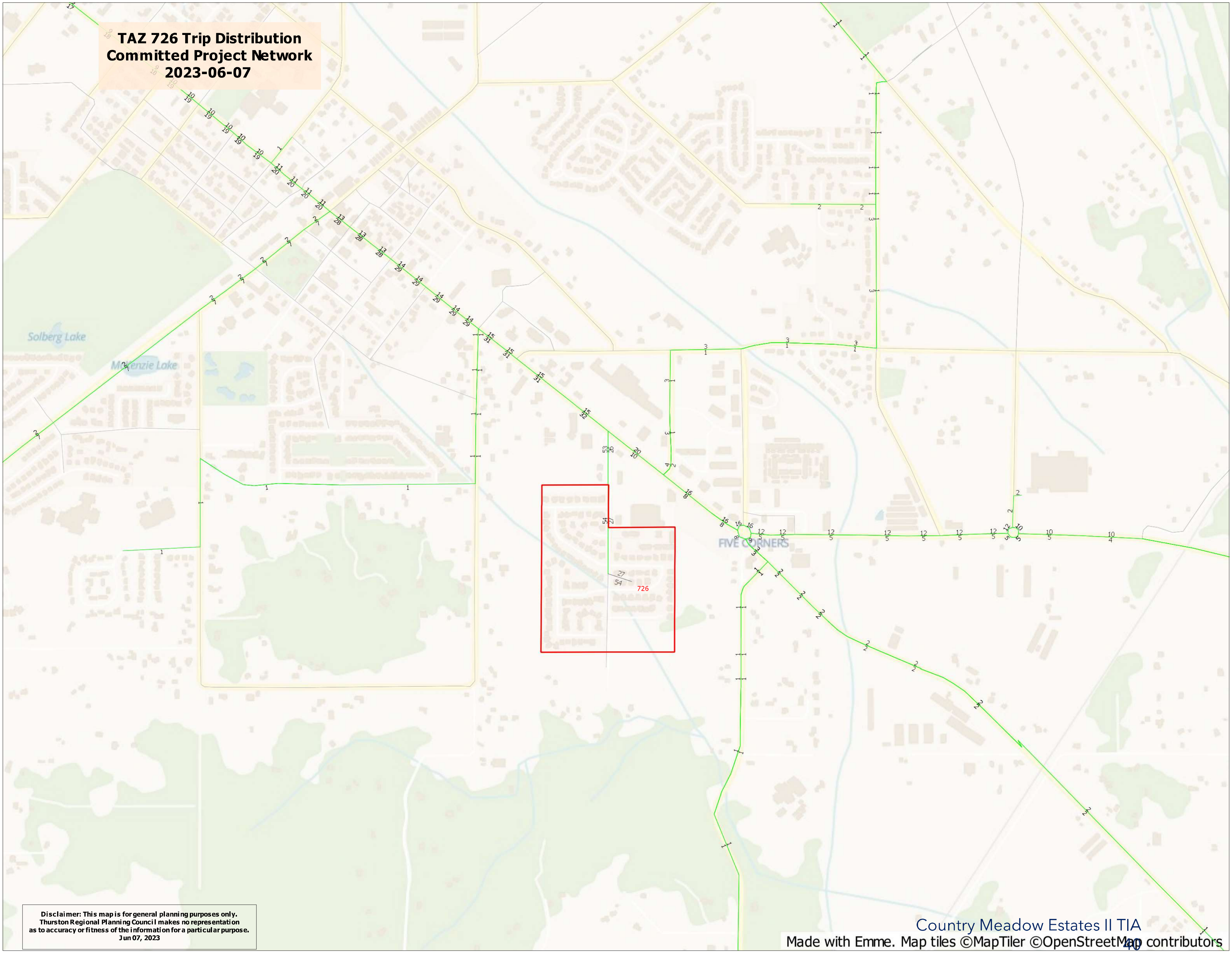
Data Plot and Equation



Fitted Curve Equation: Ln(T) = 0.94 Ln(X) + 0.27 **R^2= 0.92**

Trip Gen Manual, 11th Edition • Institute of Transportation Engineers

TAZ 726 Trip Distribution
Committed Project Network
2023-06-07



Disclaimer: This map is for general planning purposes only. Thurston Regional Planning Council makes no representation as to accuracy or fitness of the information for a particular purpose. Jun 07, 2023

Country Meadow Estates II TIA

Made with Emme. Map tiles ©MapTiler ©OpenStreetMap contributors

40

SR 507 & Bald Hill Rd SE

PM Peak Hour
Pipeline Volume Summations

	↲	↓	↳	⬑	←	⬐	↱	↑	↰	↴	→	⬏
1. The Hutch	3				10				5	3	4	1
2. Durant St Plat					6				1	1	3	
3. Alpine Estates					9				2	2	5	
4. Tahoma Blvd Apartments					9				1	1	6	
5. El Rey Burro					4				1	1	4	
6. The Summit At Thompson Creek					30				3	2	17	
7. Samantha Ridge					5						2	
8. Habitat for Humanity					4						3	
9. Liberty Grove												
10. 407 E Yelm Coffee											1	
11. Country Meadow Estates I					4						2	
	↲	↓	↳	⬑	←	⬐	↱	↑	↰	↴	→	⬏
Totals	3	0	0	0	81	0	0	0	13	10	47	1

Bald Hill Rd SE & Morris Rd SE

PM Peak Hour
Pipeline Volume Summations

	↲	↓	↳	⬑	←	⬐	↱	↑	↰	↴	→	⬏
1. The Hutch					5						3	
2. Durant St Plat					1						1	
3. Alpine Estates					2						2	
4. Tahoma Blvd Apartments					1						1	
5. El Rey Burro					1						1	
6. The Summit At Thompson Creek					3						2	
7. Samantha Ridge												
8. Habitat for Humanity												
9. Liberty Grove												
10. 407 E Yelm Coffee												

PM Peak Hour Forecast Intersection Volumes

Annual Growth Rate: 1 %

2027

# of Years to Horizon: 4

1. SR 507 & Bald Hill Rd SE / Creek St SE

	SBR	SBT	SBL	WBR	WBT	WBL	NBR	NBT	NBL	EBR	EBT	EBL
Existing	74	244	113	45	511	103	64	139	245	263	313	14
Project Trips	0	0	0	0	0	5	3	0	4	7	0	0
Pipeline	3	0	0	0	81	0	0	0	13	10	47	1
Traffic Reroute	0	0	0	0	0	5	3	0	0	0	0	0
Without	80	254	118	47	613	107	67	145	268	284	373	16
With	80	254	118	47	613	117	73	145	272	291	373	16

2. Bald Hill Rd SE & Marris Rd SE

	SBR	SBT	SBL	WBR	WBT	WBL	NBR	NBT	NBL	EBR	EBT	EBL
Existing	20	3	9	13	297	16	13	13	136	171	394	37
Project Trips	0	0	0	0	0	1	1	0	7	12	0	0
Pipeline	0	0	0	0	13	0	0	0	0	0	10	0
Traffic Reroute	0	0	0	0	0	3	2	0	3	5	0	0
Without	21	3	9	14	322	17	14	14	142	178	420	39
With	21	3	9	14	322	21	17	14	152	195	420	39

3. Morris Rd SE & Access

	SBR	SBT	SBL	WBR	WBT	WBL	NBR	NBT	NBL	EBR	EBT	EBL
Existing	0	193	0	0	0	0	0	161	0	0	0	0
Project Trips	13	0	0	0	0	0	0	0	1	0	0	8
Pipeline	0	0	0	0	0	0	0	0	0	0	0	0
Traffic Reroute	8	0	0	0	0	0	0	0	2	1	0	5
Without	0	201	0	0	0	0	0	168	0	0	0	0
With	21	201	0	0	0	0	0	168	3	1	0	13

A. SR 507 & Vancil Rd SE (Phase I & II Traffic)

	SBR	SBT	SBL	WBR	WBT	WBL	NBR	NBT	NBL	EBR
Existing	29	54	54	41	583	44	73	43	163	113
Project Trips	0	0	0	0	0	23	14	0	20	35
Pipeline	1	0	0	0	75	0	0	0	4	2
Without	31	56	56	43	682	46	76	45	174	120
With	31	56	56	43	682	69	90	45	194	155

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	14	313	263	103	511	45	245	139	64	113	244	74
Future Volume (veh/h)	14	313	263	103	511	45	245	139	64	113	244	74
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1885	1826	1870	1885	1856	1885	1870	1870	1870	1841	1885	1841
Adj Flow Rate, veh/h	14	323	271	106	527	46	253	143	66	116	252	76
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Percent Heavy Veh, %	1	5	2	1	3	1	2	2	2	4	1	4
Cap, veh/h	31	512	444	140	633	544	343	232	107	327	352	290
Arrive On Green	0.02	0.28	0.28	0.08	0.34	0.34	0.19	0.19	0.19	0.19	0.19	0.19
Sat Flow, veh/h	1795	1826	1582	1795	1856	1593	1781	1205	556	1753	1885	1552
Grp Volume(v), veh/h	14	323	271	106	527	46	253	0	209	116	252	76
Grp Sat Flow(s),veh/h/ln	1795	1826	1582	1795	1856	1593	1781	0	1761	1753	1885	1552
Q Serve(g_s), s	0.5	10.6	10.2	4.0	17.9	1.3	9.2	0.0	7.5	4.0	8.6	2.9
Cycle Q Clear(g_c), s	0.5	10.6	10.2	4.0	17.9	1.3	9.2	0.0	7.5	4.0	8.6	2.9
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.32	1.00		1.00
Lane Grp Cap(c), veh/h	31	512	444	140	633	544	343	0	339	327	352	290
V/C Ratio(X)	0.46	0.63	0.61	0.76	0.83	0.08	0.74	0.00	0.62	0.35	0.72	0.26
Avail Cap(c_a), veh/h	497	1064	922	497	1081	928	1064	0	1052	817	879	723
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	33.4	21.6	21.4	31.0	20.8	15.3	26.1	0.0	25.4	24.3	26.2	23.9
Incr Delay (d2), s/veh	10.2	1.3	1.4	8.2	2.9	0.1	3.1	0.0	1.8	0.7	2.7	0.5
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.3	4.3	3.6	1.9	7.5	0.5	3.9	0.0	3.0	1.7	4.0	1.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	43.7	22.9	22.8	39.2	23.7	15.4	29.2	0.0	27.2	25.0	28.9	24.3
LnGrp LOS	D	C	C	D	C	B	C		C	C	C	C
Approach Vol, veh/h		608			679			462			444	
Approach Delay, s/veh		23.3			25.6			28.3			27.1	
Approach LOS		C			C			C			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	9.8	23.8		17.3	5.7	27.9		17.7				
Change Period (Y+Rc), s	4.5	4.5		4.5	4.5	4.5		4.5				
Max Green Setting (Gmax), s	19.0	40.0		32.0	19.0	40.0		41.0				
Max Q Clear Time (g_c+I1), s	6.0	12.6		10.6	2.5	19.9		11.2				
Green Ext Time (p_c), s	0.2	2.9		2.1	0.0	3.4		1.9				

Intersection Summary			
HCM 7th Control Delay, s/veh			25.8
HCM 7th LOS			C

Intersection	
Int Delay, s/veh	9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	136	13	13	9	3	20	16	297	13	37	394	171
Future Vol, veh/h	136	13	13	9	3	20	16	297	13	37	394	171
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	94	94	94	94	94	94	94	94	94	94	94	94
Heavy Vehicles, %	1	23	1	1	1	1	6	1	1	1	1	1
Mvmt Flow	145	14	14	10	3	21	17	316	14	39	419	182

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	940	953	510	862	1037	323	601	0	0	330	0	0
Stage 1	589	589	-	357	357	-	-	-	-	-	-	-
Stage 2	352	364	-	505	680	-	-	-	-	-	-	-
Critical Hdwy	7.11	6.73	6.21	7.11	6.51	6.21	4.16	-	-	4.11	-	-
Critical Hdwy Stg 1	6.11	5.73	-	6.11	5.51	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.11	5.73	-	6.11	5.51	-	-	-	-	-	-	-
Follow-up Hdwy	3.509	4.207	3.309	3.509	4.009	3.309	2.254	-	-	2.209	-	-
Pot Cap-1 Maneuver	245	239	565	277	232	720	957	-	-	1235	-	-
Stage 1	496	464	-	663	630	-	-	-	-	-	-	-
Stage 2	667	589	-	551	452	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	218	222	565	236	216	720	957	-	-	1235	-	-
Mov Cap-2 Maneuver	218	222	-	236	216	-	-	-	-	-	-	-
Stage 1	486	441	-	648	616	-	-	-	-	-	-	-
Stage 2	630	576	-	495	430	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s/v	56.59	14.8	0.43	0.49
HCM LOS	F	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	957	-	-	229	401	1235	-	-
HCM Lane V/C Ratio	0.018	-	-	0.751	0.085	0.032	-	-
HCM Control Delay (s/veh)	8.8	0	-	56.6	14.8	8	0	-
HCM Lane LOS	A	A	-	F	B	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	5.2	0.3	0.1	-	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	16	373	284	107	613	47	268	145	67	118	254	80
Future Volume (veh/h)	16	373	284	107	613	47	268	145	67	118	254	80
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1885	1826	1870	1885	1856	1885	1870	1870	1870	1841	1885	1841
Adj Flow Rate, veh/h	16	373	284	107	613	47	268	145	67	118	254	80
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Percent Heavy Veh, %	1	5	2	1	3	1	2	2	2	4	1	4
Cap, veh/h	34	581	504	140	700	601	347	235	108	317	341	280
Arrive On Green	0.02	0.32	0.32	0.08	0.38	0.38	0.19	0.19	0.19	0.18	0.18	0.18
Sat Flow, veh/h	1795	1826	1583	1795	1856	1593	1781	1204	557	1753	1885	1551
Grp Volume(v), veh/h	16	373	284	107	613	47	268	0	212	118	254	80
Grp Sat Flow(s),veh/h/ln	1795	1826	1583	1795	1856	1593	1781	0	1761	1753	1885	1551
Q Serve(g_s), s	0.7	13.8	11.7	4.6	24.2	1.5	11.2	0.0	8.7	4.7	10.0	3.5
Cycle Q Clear(g_c), s	0.7	13.8	11.7	4.6	24.2	1.5	11.2	0.0	8.7	4.7	10.0	3.5
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.32	1.00		1.00
Lane Grp Cap(c), veh/h	34	581	504	140	700	601	347	0	343	317	341	280
V/C Ratio(X)	0.48	0.64	0.56	0.77	0.88	0.08	0.77	0.00	0.62	0.37	0.75	0.29
Avail Cap(c_a), veh/h	433	927	804	433	942	809	927	0	917	712	766	630
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	38.3	23.0	22.3	35.6	22.8	15.7	30.1	0.0	29.0	28.3	30.5	27.9
Incr Delay (d2), s/veh	10.0	1.2	1.0	8.4	7.3	0.1	3.7	0.0	1.8	0.7	3.3	0.6
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	5.7	4.2	2.3	11.0	0.5	4.9	0.0	3.6	2.0	4.8	1.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	48.3	24.2	23.3	44.0	30.1	15.8	33.7	0.0	30.8	29.1	33.8	28.4
LnGrp LOS	D	C	C	D	C	B	C		C	C	C	C
Approach Vol, veh/h		673			767			480			452	
Approach Delay, s/veh		24.4			31.1			32.5			31.6	
Approach LOS		C			C			C			C	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	10.6	29.6		18.7	6.0	34.2		19.8
Change Period (Y+Rc), s	4.5	4.5		4.5	4.5	4.5		4.5
Max Green Setting (Gmax), s	19.0	40.0		32.0	19.0	40.0		41.0
Max Q Clear Time (g_c+I1), s	6.6	15.8		12.0	2.7	26.2		13.2
Green Ext Time (p_c), s	0.2	3.3		2.1	0.0	3.5		2.0

Intersection Summary	
HCM 7th Control Delay, s/veh	29.6
HCM 7th LOS	C

Intersection	
Int Delay, s/veh	12.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	142	14	14	9	3	21	17	322	14	39	420	178
Future Vol, veh/h	142	14	14	9	3	21	17	322	14	39	420	178
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	94	94	94	94	94	94	94	94	94	94	94	94
Heavy Vehicles, %	1	23	1	1	1	1	6	1	1	1	1	1
Mvmt Flow	151	15	15	10	3	22	18	343	15	41	447	189

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1005	1018	541	923	1105	350	636	0	0	357	0	0
Stage 1	624	624	-	386	386	-	-	-	-	-	-	-
Stage 2	380	394	-	537	719	-	-	-	-	-	-	-
Critical Hdwy	7.11	6.73	6.21	7.11	6.51	6.21	4.16	-	-	4.11	-	-
Critical Hdwy Stg 1	6.11	5.73	-	6.11	5.51	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.11	5.73	-	6.11	5.51	-	-	-	-	-	-	-
Follow-up Hdwy	3.509	4.207	3.309	3.509	4.009	3.309	2.254	-	-	2.209	-	-
Pot Cap-1 Maneuver	221	218	543	251	212	696	928	-	-	1207	-	-
Stage 1	475	446	-	639	612	-	-	-	-	-	-	-
Stage 2	644	571	-	530	434	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	194	201	543	210	195	696	928	-	-	1207	-	-
Mov Cap-2 Maneuver	194	201	-	210	195	-	-	-	-	-	-	-
Stage 1	463	422	-	624	597	-	-	-	-	-	-	-
Stage 2	605	557	-	469	410	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s/v	82.7	15.65	0.43	0.5
HCM LOS	F	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	928	-	-	206	373	1207	-	-
HCM Lane V/C Ratio	0.019	-	-	0.879	0.094	0.034	-	-
HCM Control Delay (s/veh)	9	0	-	82.7	15.7	8.1	0	-
HCM Lane LOS	A	A	-	F	C	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	6.8	0.3	0.1	-	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	16	373	291	117	613	47	272	145	73	118	254	80
Future Volume (veh/h)	16	373	291	117	613	47	272	145	73	118	254	80
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1885	1826	1870	1885	1856	1885	1870	1870	1870	1841	1885	1841
Adj Flow Rate, veh/h	16	373	291	117	613	47	272	145	73	118	254	80
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Percent Heavy Veh, %	1	5	2	1	3	1	2	2	2	4	1	4
Cap, veh/h	34	568	492	152	699	600	351	230	116	316	340	280
Arrive On Green	0.02	0.31	0.31	0.08	0.38	0.38	0.20	0.20	0.20	0.18	0.18	0.18
Sat Flow, veh/h	1795	1826	1583	1795	1856	1593	1781	1168	588	1753	1885	1551
Grp Volume(v), veh/h	16	373	291	117	613	47	272	0	218	118	254	80
Grp Sat Flow(s),veh/h/ln	1795	1826	1583	1795	1856	1593	1781	0	1755	1753	1885	1551
Q Serve(g_s), s	0.7	14.0	12.3	5.1	24.4	1.5	11.5	0.0	9.0	4.7	10.1	3.5
Cycle Q Clear(g_c), s	0.7	14.0	12.3	5.1	24.4	1.5	11.5	0.0	9.0	4.7	10.1	3.5
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.33	1.00		1.00
Lane Grp Cap(c), veh/h	34	568	492	152	699	600	351	0	346	316	340	280
V/C Ratio(X)	0.48	0.66	0.59	0.77	0.88	0.08	0.77	0.00	0.63	0.37	0.75	0.29
Avail Cap(c_a), veh/h	430	921	798	430	936	804	921	0	908	708	761	626
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	38.5	23.7	23.1	35.5	23.0	15.9	30.2	0.0	29.2	28.6	30.8	28.1
Incr Delay (d2), s/veh	10.1	1.3	1.1	8.0	7.4	0.1	3.7	0.0	1.9	0.7	3.3	0.6
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	5.9	4.5	2.5	11.2	0.5	5.0	0.0	3.8	2.0	4.8	1.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	48.6	25.0	24.2	43.5	30.4	15.9	33.8	0.0	31.1	29.3	34.1	28.6
LnGrp LOS	D	C	C	D	C	B	C		C	C	C	C
Approach Vol, veh/h		680			777			490			452	
Approach Delay, s/veh		25.2			31.5			32.6			31.8	
Approach LOS		C			C			C			C	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	11.2	29.1		18.8	6.0	34.4		20.1
Change Period (Y+Rc), s	4.5	4.5		4.5	4.5	4.5		4.5
Max Green Setting (Gmax), s	19.0	40.0		32.0	19.0	40.0		41.0
Max Q Clear Time (g_c+I1), s	7.1	16.0		12.1	2.7	26.4		13.5
Green Ext Time (p_c), s	0.2	3.3		2.1	0.0	3.5		2.0

Intersection Summary	
HCM 7th Control Delay, s/veh	30.0
HCM 7th LOS	C

Intersection	
Int Delay, s/veh	16.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	152	14	17	9	3	21	21	322	14	39	420	195
Future Vol, veh/h	152	14	17	9	3	21	21	322	14	39	420	195
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	94	94	94	94	94	94	94	94	94	94	94	94
Heavy Vehicles, %	1	23	1	1	1	1	6	1	1	1	1	1
Mvmt Flow	162	15	18	10	3	22	22	343	15	41	447	207

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1022	1036	551	932	1132	350	654	0	0	357	0	0
Stage 1	634	634	-	395	395	-	-	-	-	-	-	-
Stage 2	389	402	-	537	737	-	-	-	-	-	-	-
Critical Hdwy	7.11	6.73	6.21	7.11	6.51	6.21	4.16	-	-	4.11	-	-
Critical Hdwy Stg 1	6.11	5.73	-	6.11	5.51	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.11	5.73	-	6.11	5.51	-	-	-	-	-	-	-
Follow-up Hdwy	3.509	4.207	3.309	3.509	4.009	3.309	2.254	-	-	2.209	-	-
Pot Cap-1 Maneuver	215	213	536	248	204	696	914	-	-	1207	-	-
Stage 1	469	442	-	633	607	-	-	-	-	-	-	-
Stage 2	637	565	-	530	426	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	188	195	536	204	187	696	914	-	-	1207	-	-
Mov Cap-2 Maneuver	188	195	-	204	187	-	-	-	-	-	-	-
Stage 1	455	417	-	613	588	-	-	-	-	-	-	-
Stage 2	595	548	-	466	402	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s/v	105.61	15.91	0.53	0.48
HCM LOS	F	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	914	-	-	200	365	1207	-	-
HCM Lane V/C Ratio	0.024	-	-	0.972	0.096	0.034	-	-
HCM Control Delay (s/veh)	9	0	-	105.6	15.9	8.1	0	-
HCM Lane LOS	A	A	-	F	C	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	8.2	0.3	0.1	-	-

Intersection	
Int Delay, s/veh	5.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	152	14	17	9	3	21	21	322	14	39	420	195
Future Vol, veh/h	152	14	17	9	3	21	21	322	14	39	420	195
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	1	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	94	94	94	94	94	94	94	94	94	94	94	94
Heavy Vehicles, %	1	23	1	1	1	1	6	1	1	1	1	1
Mvmt Flow	162	15	18	10	3	22	22	343	15	41	447	207

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1022	1036	551	932	1132	350	654	0	0	357	0	0
Stage 1	634	634	-	395	395	-	-	-	-	-	-	-
Stage 2	389	402	-	537	737	-	-	-	-	-	-	-
Critical Hdwy	7.11	6.73	6.21	7.11	6.51	6.21	4.16	-	-	4.11	-	-
Critical Hdwy Stg 1	6.11	5.73	-	6.11	5.51	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.11	5.73	-	6.11	5.51	-	-	-	-	-	-	-
Follow-up Hdwy	3.509	4.207	3.309	3.509	4.009	3.309	2.254	-	-	2.209	-	-
Pot Cap-1 Maneuver	215	213	536	248	204	696	914	-	-	1207	-	-
Stage 1	469	442	-	633	607	-	-	-	-	-	-	-
Stage 2	637	565	-	530	426	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	189	196	536	210	188	696	914	-	-	1207	-	-
Mov Cap-2 Maneuver	314	297	-	210	188	-	-	-	-	-	-	-
Stage 1	458	417	-	617	592	-	-	-	-	-	-	-
Stage 2	598	552	-	466	402	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s/v	31.28	15.71	0.53	0.48
HCM LOS	D	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	914	-	-	325	371	1207	-	-
HCM Lane V/C Ratio	0.024	-	-	0.599	0.095	0.034	-	-
HCM Control Delay (s/veh)	9	-	-	31.3	15.7	8.1	0	-
HCM Lane LOS	A	-	-	D	C	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	3.7	0.3	0.1	-	-

Intersection	
Int Delay, s/veh	0.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	13	1	3	168	201	21
Future Vol, veh/h	13	1	3	168	201	21
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	14	1	3	183	218	23

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	419	230	241	0	-	0
Stage 1	230	-	-	-	-	-
Stage 2	189	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	591	809	1325	-	-	-
Stage 1	808	-	-	-	-	-
Stage 2	843	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	589	809	1325	-	-	-
Mov Cap-2 Maneuver	589	-	-	-	-	-
Stage 1	806	-	-	-	-	-
Stage 2	843	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	11.15	0.14	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1325	-	601	-	-
HCM Lane V/C Ratio	0.002	-	0.025	-	-
HCM Control Delay (s/veh)	7.7	0	11.1	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	0.1	-	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	22	602	155	69	682	43	194	45	90	56	56	31
Future Volume (veh/h)	22	602	155	69	682	43	194	45	90	56	56	31
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		0.97	1.00		1.00	1.00		1.00	1.00		0.95
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1885	1841	1885	1885	1826	1885	1885	1885	1841	1885	1885	1885
Adj Flow Rate, veh/h	22	602	155	69	682	43	194	45	0	56	56	31
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Percent Heavy Veh, %	1	4	1	1	5	1	1	1	4	1	1	1
Cap, veh/h	45	765	643	97	812	708	247	400		87	137	76
Arrive On Green	0.03	0.42	0.42	0.05	0.44	0.44	0.14	0.21	0.00	0.05	0.12	0.12
Sat Flow, veh/h	1795	1841	1546	1795	1826	1592	1795	1885	0	1795	1117	618
Grp Volume(v), veh/h	22	602	155	69	682	43	194	45	0	56	0	87
Grp Sat Flow(s),veh/h/ln	1795	1841	1546	1795	1826	1592	1795	1885	0	1795	0	1736
Q Serve(g_s), s	0.8	18.9	4.3	2.5	22.1	1.0	7.0	1.3	0.0	2.0	0.0	3.1
Cycle Q Clear(g_c), s	0.8	18.9	4.3	2.5	22.1	1.0	7.0	1.3	0.0	2.0	0.0	3.1
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.00	1.00		0.36
Lane Grp Cap(c), veh/h	45	765	643	97	812	708	247	400		87	0	214
V/C Ratio(X)	0.49	0.79	0.24	0.71	0.84	0.06	0.79	0.11		0.64	0.00	0.41
Avail Cap(c_a), veh/h	175	1918	1610	283	2012	1754	686	1173		283	0	689
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	32.1	16.9	12.7	31.0	16.4	10.6	27.8	21.2	0.0	31.2	0.0	27.0
Incr Delay (d2), s/veh	8.0	1.8	0.2	9.2	2.4	0.0	5.5	0.1	0.0	7.7	0.0	1.2
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	7.3	1.4	1.3	8.4	0.3	3.2	0.5	0.0	1.1	0.0	1.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	40.1	18.8	12.9	40.2	18.9	10.6	33.3	21.3	0.0	38.9	0.0	28.3
LnGrp LOS	D	B	B	D	B	B	C	C		D		C
Approach Vol, veh/h		779			794			239			143	
Approach Delay, s/veh		18.2			20.3			31.0			32.4	
Approach LOS		B			C			C			C	

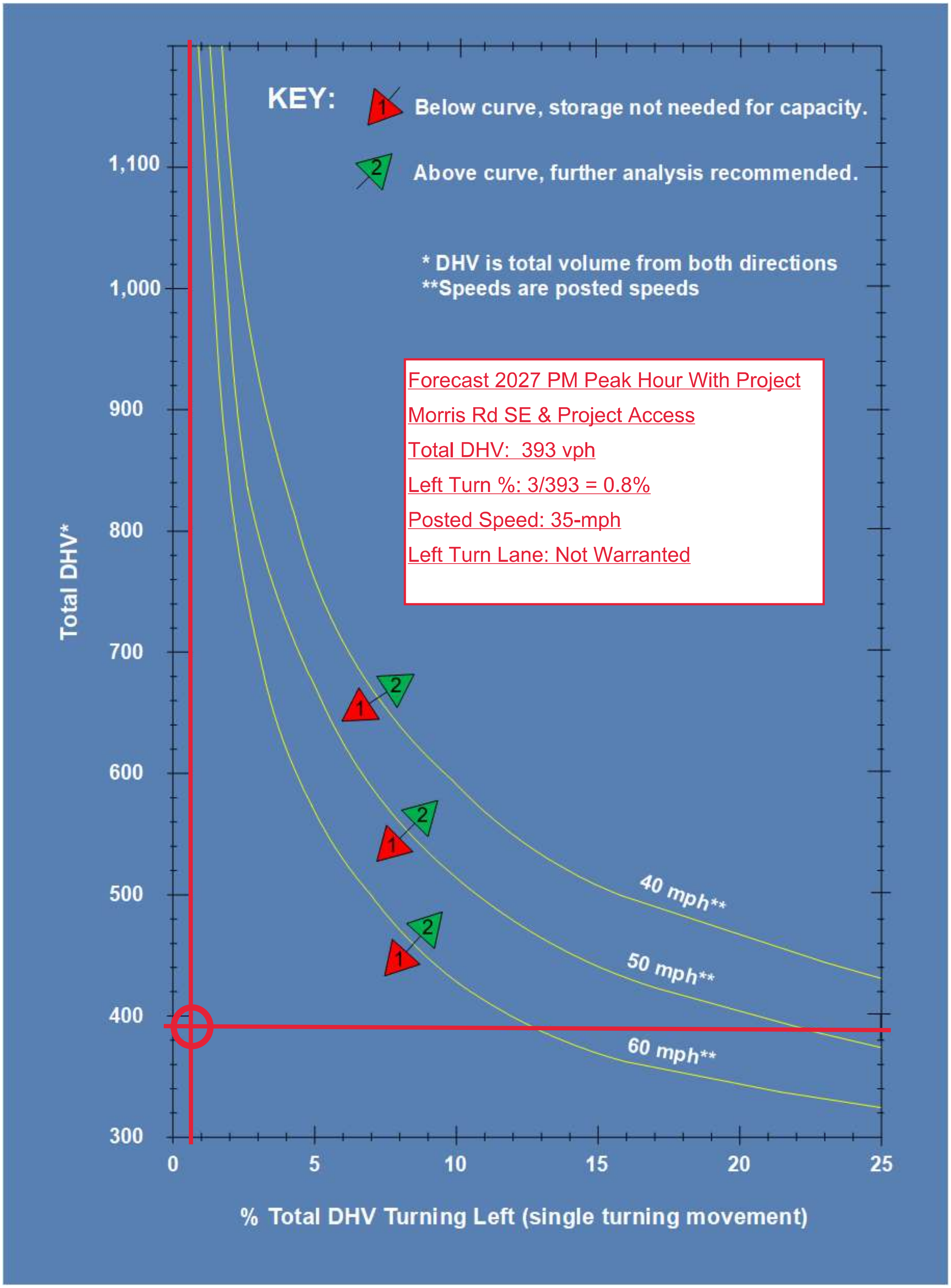
Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	8.1	32.2	13.7	12.7	6.2	34.2	7.7	18.6
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Max Green Setting (Gmax), s	10.5	69.5	25.5	26.5	6.5	73.5	10.5	41.5
Max Q Clear Time (g_c+I1), s	4.5	20.9	9.0	5.1	2.8	24.1	4.0	3.3
Green Ext Time (p_c), s	0.1	5.1	0.5	0.4	0.0	5.6	0.0	0.2

Intersection Summary	
HCM 7th Control Delay, s/veh	21.6
HCM 7th LOS	C

Notes

Unsignalized Delay for [NBR] is excluded from calculations of the approach delay and intersection delay.

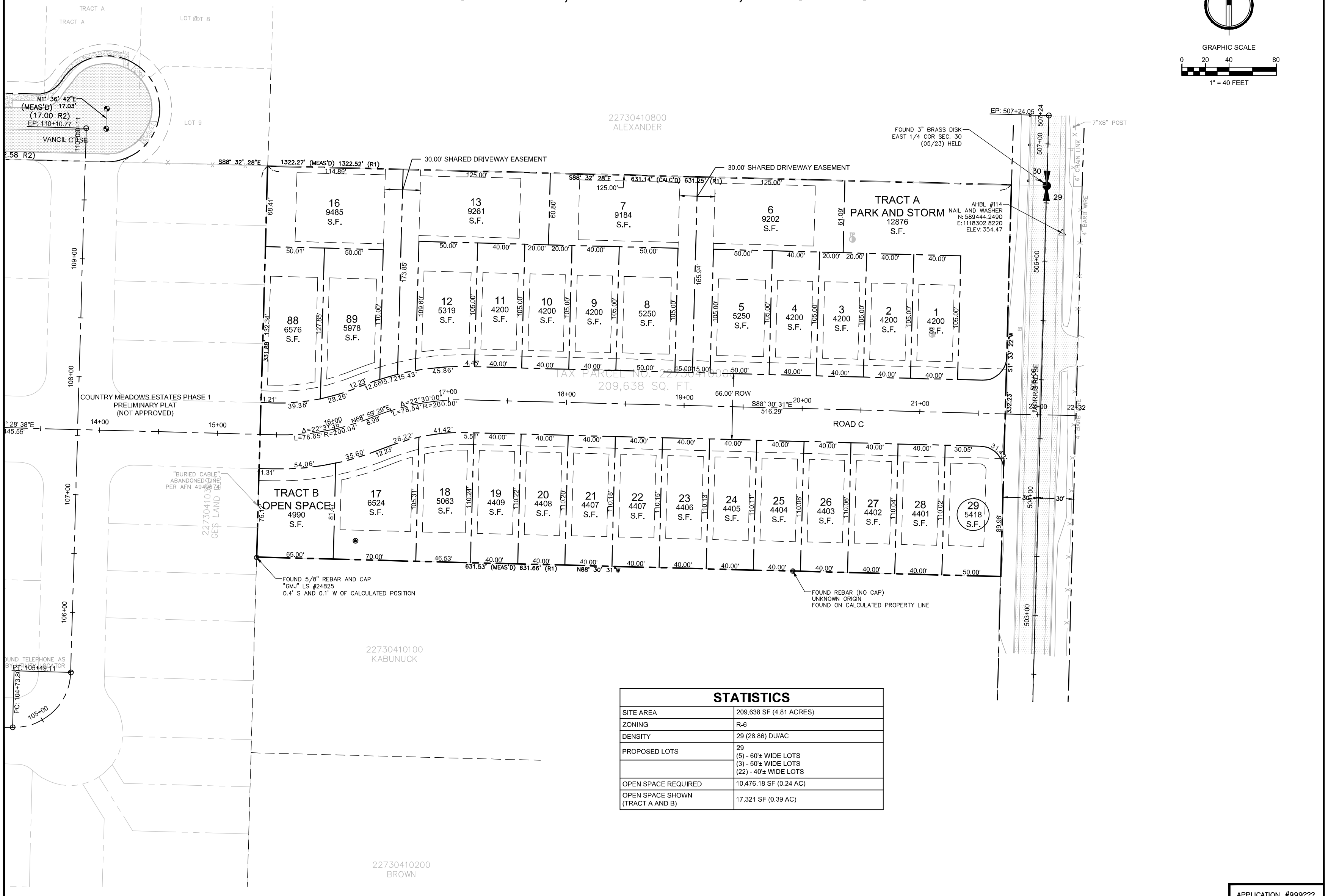
Exhibit 1310-9 Left-Turn Storage Guidelines: Two-Lane, Unsignalized



COUNTRY MEADOWS ESTATES PHASE 2 PRELIMINARY PLAT

A PORTION OF THE NE 1/4 OF THE SE 1/4 OF SEC. 30, TWN. 17 N., RGE. 02 E., W.M., CITY OF YELM, THURSTON COUNTY, WASHINGTON.

Know what's below. Call before you dig.



STATISTICS

SITE AREA	209,638 SF (4.81 ACRES)
ZONING	R-6
DENSITY	29 (28.86) DU/AC
PROPOSED LOTS	29 (5) - 60'± WIDE LOTS (3) - 50'± WIDE LOTS (22) - 40'± WIDE LOTS
OPEN SPACE REQUIRED	10,476.18 SF (0.24 AC)
OPEN SPACE SHOWN (TRACT A AND B)	17,321 SF (0.39 AC)

APPLICATION #999???

DATE: July 21, 2023 FILENAME: Q:\2023\2230299\10_CIV\CAD_Preliminary Plat\2230299-SH-PLAT MAP.dwg

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Project Title: COUNTRY MEADOWS ESTATES PHASE 2 PRELIMINARY PLAT

Client: COPPER RIDGE LLC

P.O.BOX 73790
PUYALLUP, WA 98373
KURT WILSON / EVAN MANN

Project No. 2230299.10

Issue Set & Date: PRELIMINARY PLAT
JULY 2023

J. MATTHEW WEBER
STATE OF WASHINGTON
34856
REGISTERED
PROFESSIONAL ENGINEER

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Revisions:

Sheet Title: PLAT MAP

Designed by: | Drawn by: | Checked by: MW/SK

Sheet No. C1.1

3 of ? Sheets

Country Meadows Estates Phase 2
Staff Report Supplement
Exhibit B: Gopher Report

MORRIS ROAD MAZAMA POCKET GOPHER (*Thomomys Mazama)* and REGULATED PRAIRIE ABSENCE REPORT

Prepared for AHBL

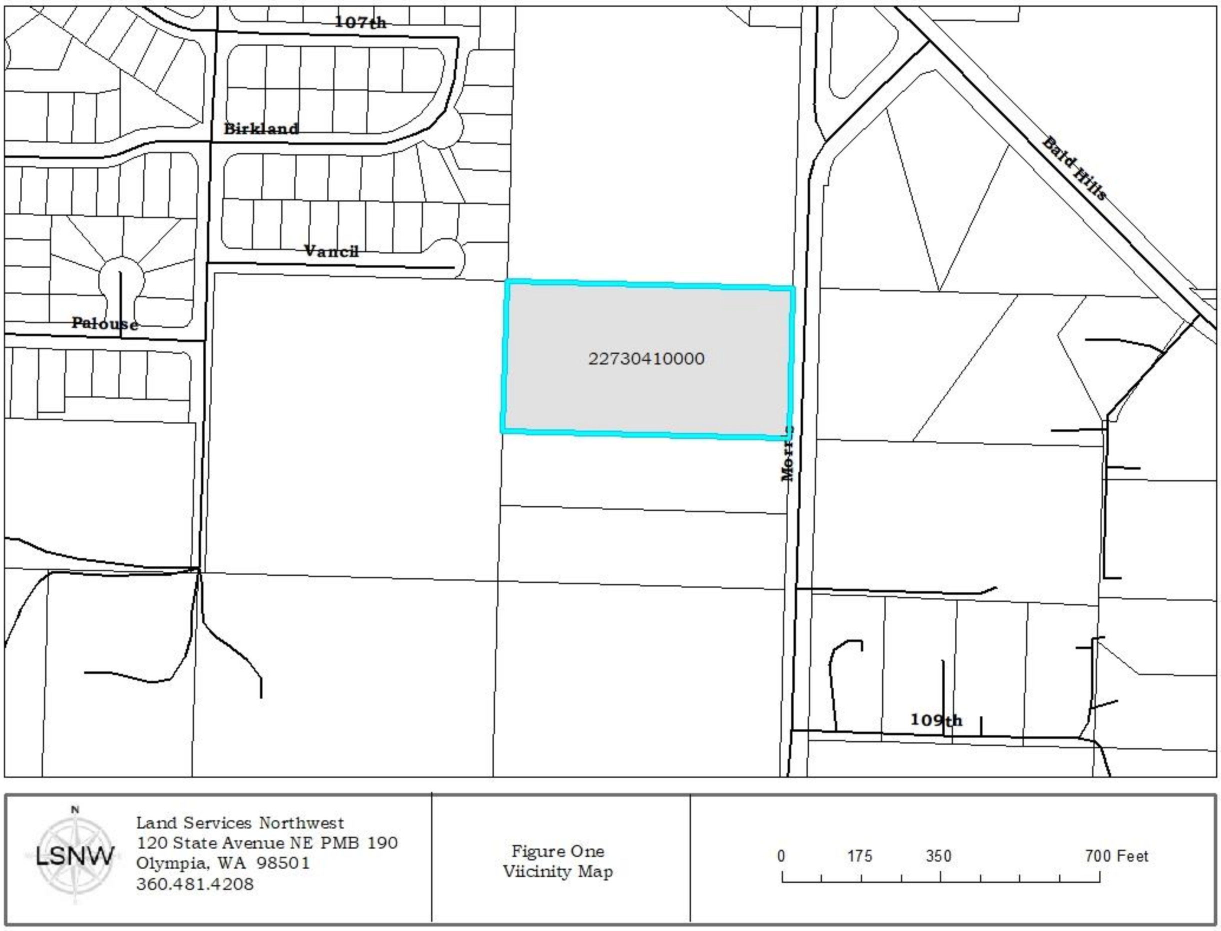
LAND SERVICES NORTHWEST

Prepared by
Alexander Callender, M.S., PWS
Land Services Northwest
Olympia, WA

October 20, 2022

1.0 INTRODUCTION

This report is the result of a Mazama Pocket Gopher and Regulated Prairie survey of the 5-acre parcel #22730410000 at xxx Morris Road Yelm, WA with the legal description of 30-17-2E N2 NE NE SE 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) and Regulated Prairie under City of Yelm Code Chapter 1821**.**

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.

Mazama Pocket Gopher

Four subspecies of Mazama pocket gophers found in Thurston City 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 harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect any threatened or endangered species.

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 City 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 Spanaway stony loam 0 to 3 percent slopes and Spanaway gravelly sandy loam o to 3 percent slopes on and within 300 feet of the subject property, which are more and less preferred by the MPG (**Figure 2) and (Attachment A).**

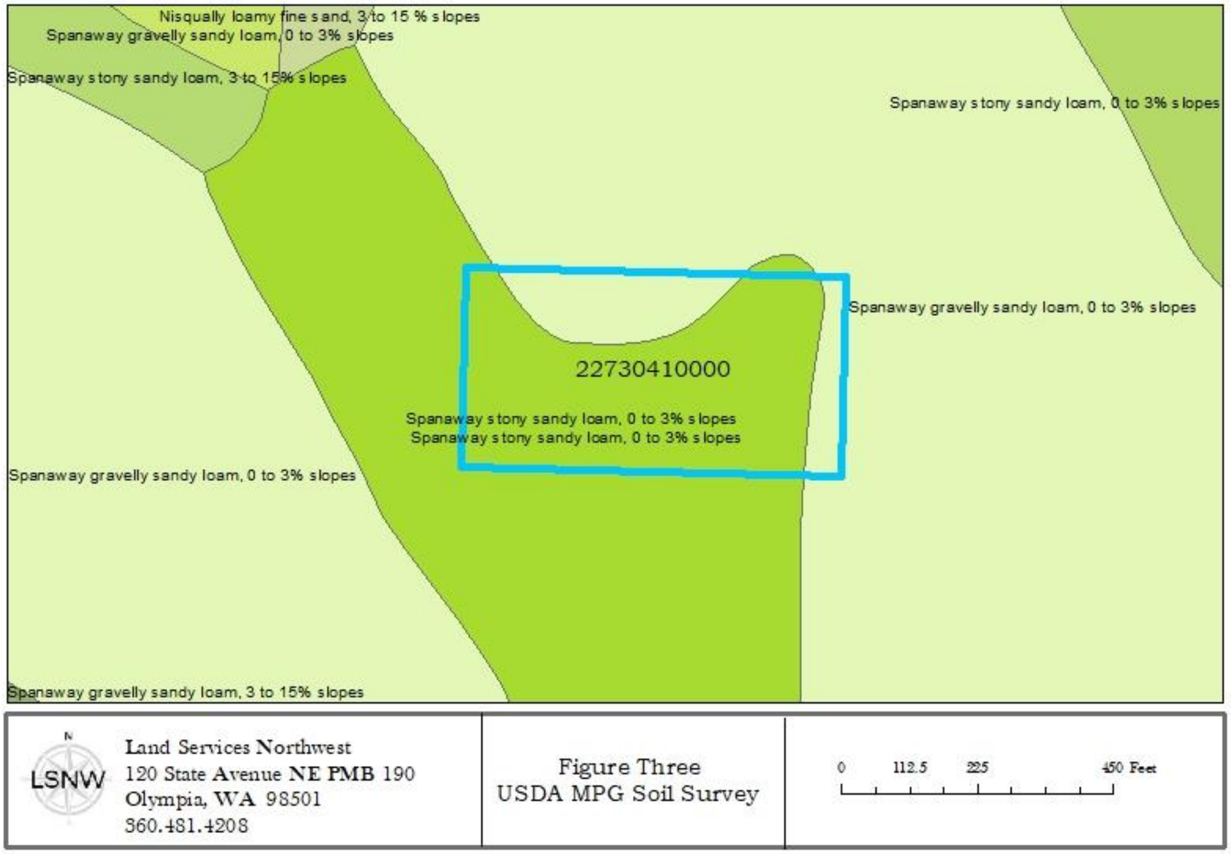


Figure Three
USDA MPG Soil Survey

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

The WDFW Priority Habitats and Species Map does not show the MPG within 600 feet of the subject property (**Appendix B**).

2.3 2022 Mazama Pocket Gopher Protocol

A. General Information – 2022 Approach

1. The MPG review season will run June 1-October 31, 2022.

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.

The property was not known to be occupied by the MPG since April 2014.

3. Negative determinations will be valid for the length of the underlying City permit or approval, per City code.

No signs of the Mazama pocket gopher were found during the site visits.

4. Qualified consultants may perform field reviews and submit results for City evaluation, per the CAO. Consultants must have received training from USFWS at one of the two trainings offered in May/June 2018 and is certified to conduct these surveys.

Alex Callender is qualified as a consultant as he received training and certification during the May 2018 class conducted by the United States Fish and Wildlife Service.

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

b. On or within 300 feet of a soil type known to be associated with MPG occupancy.

The parcels are on and within 300 feet of soil types known to be associated with MPG occupancy (Figure 2) (Appendix A).

8. Yelm 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 City as directed in the City's Critical Areas Ordinance (Title 24TCC); or 2) contacting USFWS directly to discuss the review, assessment, and mitigation process most appropriate for their site(s) and proposed activities,

.

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 City 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:

- Locations west of the Black River, or on the Steamboat Island or Cooper Point peninsulas.
  N/A
- Sites submerged for 30 consecutive days or more since October 31, 2017.
- Sites covered with impervious surfaces (as defined in CAO Chapter 17.15 and Title 24).
- Fully forested (>30%) sites with shrub and fern understory.
  The parcel is predominantly forested with a shrub and fern understory. The excluded area is shown on the transect maps in Appendix C.

- Sites that consist of slopes greater than 40 percent, or that contain landslide hazard areas (per existing City regulations).
  N/A
- Sites on less preferred MPG soils north of Interstate 5.
  N/A
- Building to take place in the footprint of an existing structure (also mobile home replacements in the same footprint).
  N/A
- Mobile home replacements in existing lots in an existing mobile home park.
  N/A
- Heating oil tank removal
  N/A
- Foundation repair
  N/A
- Projects which lie >300 feet from mapped gopher soils.
  The parcel is on and within 300 feet of mapped gopher soils.

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.

In order to ensure the review process runs efficiently, the following measures will be implemented as part of the 2019 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.

   We could see the ground. Site mowing was not necessary for the survey area and not feasible or necessary in the excluded area.

3. No further screening will be conducted in 2022 following the detection of MPG mounds on a property. The city will notify landowners that MPG evidence has been detected within two weeks.

   No MPG mounds were found.

4. At the end of the 2022 season, City 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 City 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

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, 2022. Site visits outside that survey window will not be considered valid.

The visits were conducted according to the protocol.

2. A site or parcel is considered to be the entire property, not just the footprint of the proposed project.

The parcel is predominantly forested, and the excluded area is shown on the transect maps in Appendix C.

3. Sites with less preferred soils (see Attachment A) will be visited two (2) times, at least 30 days apart.

The surveys were conducted according to the protocol.

4. Sites with more preferred soils (see Attachment A) will be visited two (2) times, at least 30 days apart.

The surveys were conducted according to the protocol.

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 city website at http://www.co.thurston.wa.us/permitting/gopher-reviews/index.html

The data sheets are provided in Appendix C.

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 city.

The parcel is predominantly forested, and the excluded area is shown on the transect maps in Appendix C.

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 ground was visible. Site mowing was not necessary for the survey area and not feasible or necessary in the excluded area

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.

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 an MPG or mole mound. If it is an MPG mound, identify it as a singular mound or a group (3 mounds or more) on a data sheet to be submitted to the city. (City has developed data sheets for your use on http://www.co.thurston.wa.us/permitting/gopher-reviews/index.html)

No MPG or 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 City GPS data instruction for each MPG mound. Submit GPS data in a form acceptable to the city. City 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 during the survey.

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 City:
   - At least one up-close photo to depict mound characteristics
     No MPG mounds were found.
   - At least one photo depicting groups of mounds as a whole (when groups are encountered).
     N/A

- 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
- Photos can be taken with the GPS unit or a separate, camera, preferably a camera with locational features (latitude, longitude)
  N/A
- Photo point description or noteworthy landscape or other features to aid in relocation. Additional photos to be considered.
  N/A
- The approximate building footprint location from at least two cardinal directions.
  N/A
- Landscape photos to depict habitat type and in some cases to indicate why not all portions of a property require gopher screening.
  Appendix A Photos

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.

The parcel is predominantly forested, and the excluded area is shown on the transect maps in 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 city to accurately review Critical Area Reports submitted in lieu of City field inspections the information collected in the field (GPS, data sheets, field notes, transect representations on aerial, etc.) shall be filed with the City. GPS

No mounds were found, the information was submitted in an acceptable format.

2.4Regulated Prairie Survey Protocol

1. Prairie Review Method

The parcel contains soil types associated with prairies as defined in the Thurston County Critical Areas Ordinance. Transects were walked throughout the parcel, except for the excluded areas, looking for signs of regulated prairie plants.

2. A list of plant species encountered during the survey was recorded and CAO target prairie plants were noted.

Plants encountered are listed on the CAO plant list (Appendix D).

3. Confirmation that CAO prairie plants were surveyed for and either found or not found, prairie criteria met or not met, etc. An example statement of your findings could be:

No CAO prairie plants were found.

4. If prairie habitat is identified onsite it is regulated pursuant to Chapter 24.25 of the CAO. Provide either a GPS map or hand-drawn aerial map indicating location of prairie plants on the parcel in relation to the proposed building area.

N/A

5. A full species list of plants (prairie and non-prairie) found at the time of survey. Attached is a blank checklist and data sheet if you choose to use. Even if no CAO prairie plants were detected, a complete species list of vegetation observed helps characterize site conditions.

The full plant list is in Appendix D.

6. Color photos of plant species encountered.

See Appendix A.

7. Transect map. If done concurrently with gopher review, you can use the same transect map.

Transect maps are shown in Appendix C.

8. Oregon white oak trees, if observed onsite, must also be documented, mapped, and included in the prairie plant survey. As with prairie plants, provide either a GPS map or hand-drawn aerial map indicating location of oaks on the parcel in relation to the proposed building area.

N/S

9. Mima mounds, if observed onsite, must also be documented, mapped, and included in the prairie plant survey. Provide either a GPS map or hand-drawn aerial map indicating location of Mima mounds on the parcel in relation to the proposed building area.

N/A

3.0 CURRENT CONDITIONS AND METHODS

Land Services Northwest conducted surveys on July 19, September 19 and October 19, 2022, walking the area and looking for signs of the MPG and regulated prairie in accordance with the protocol.

The undeveloped, forested parcel is situated between single family homes on large lots to the north and south with a vacant field to the west. Morris Road is to the east.

4.0 RESULTS

No Mazama pocket gophers were found on site.

No CAO prairie plants, Garry oaks or Mima mounds were found.

.

Appendix A

Photos


Morris Road
09.19.2022 11:33 AM
16344 Vancil Ct SE, Yelm, WA 98597, USA


Morris Road
09.19.2022 11:33 AM
16344 Vancil Ct SE, Yelm, WA 98597, USA


Morris Road
09.19.2022 11:35 AM
16344 Vancil Ct SE, Yelm, WA 98597, USA

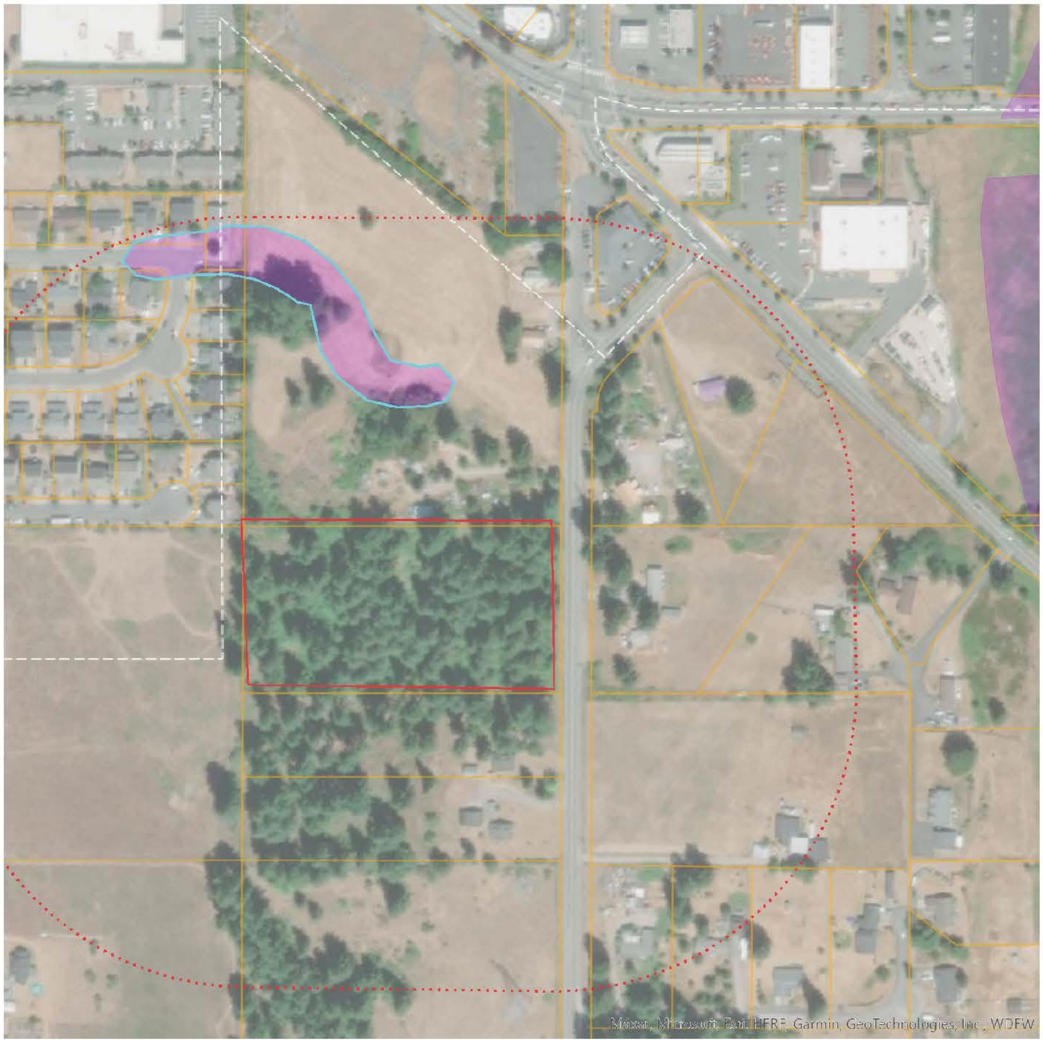

Morris Road
09.19.2022 11:46 AM
10815 Morris Rd SE, Yelm, WA 98597, USA


Morris Road
09.19.2022 11:46 AM
10815 Morris Rd SE, Yelm, WA 98597 USA

Appendix B

WDFW Priority Habitats and Species Map

Priority Habitats and Species on the Web



Buffer radius: 600 Feet

Report Date: 07/11/2022

PHS Species/Habitats Overview:

Occurence Name	Federal Status	State Status	Sensitive Location
Freshwater Emergent Wetland	N/A	N/A	No
Townsend's Big-eared Bat	N/A	Candidate	Yes
Yuma myotis	N/A	N/A	Yes

PHS Species/Habitats Details:

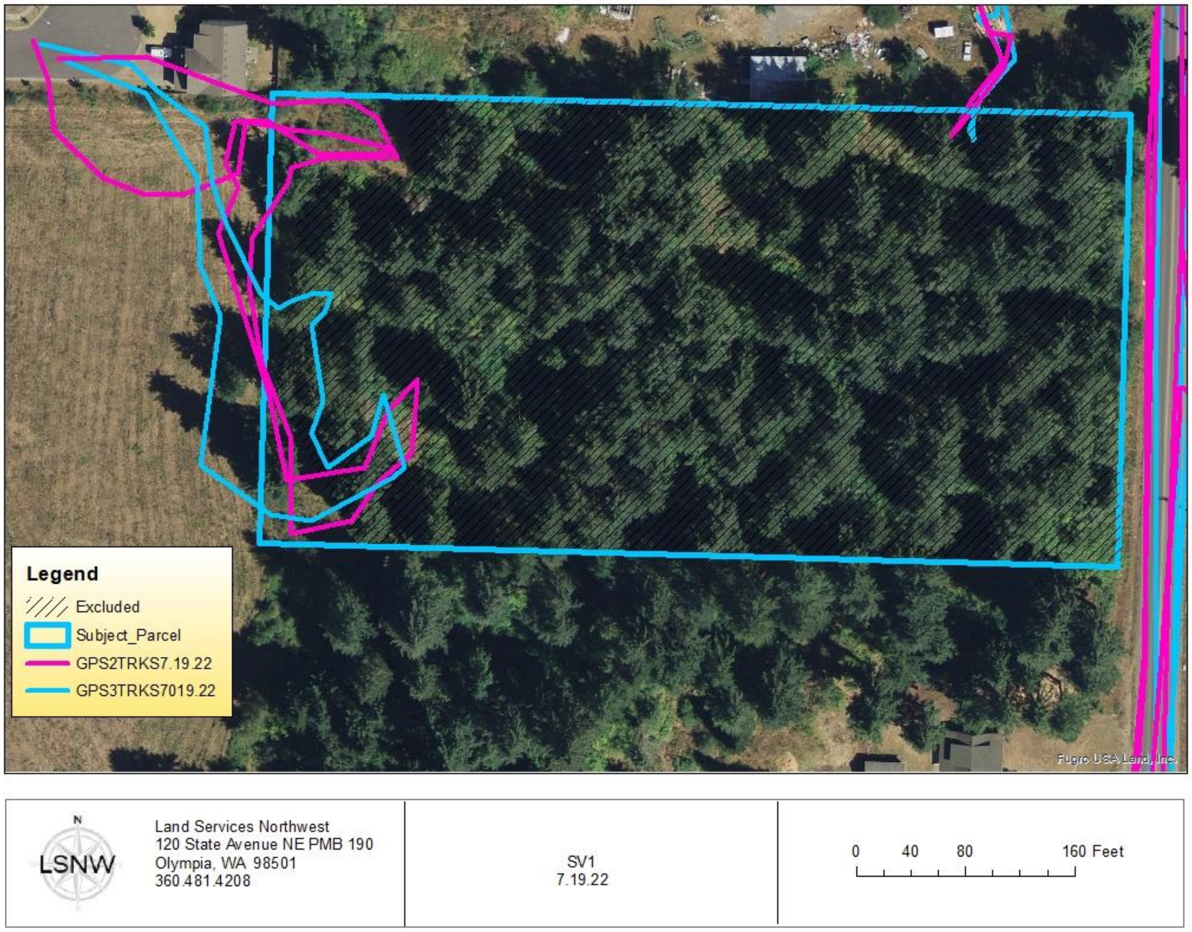
Freshwater Emergent Wetland	
Priority Area	Aquatic Habitat
Site Name	N/A
Accuracy	NA
Notes	Wetland System: Freshwater Emergent Wetland - NWI Code: PEM1C
Source Dataset	NWIWetlands
Source Name	Not Given
Source Entity	US Fish and Wildlife Service
Federal Status	N/A
State Status	N/A
PHS Listing Status	PHS Listed Occurrence
Sensitive	N
SGCN	N
Display Resolution	AS MAPPED
ManagementRecommendations	http://www.ecy.wa.gov/programs/sea/wetlands/bas/index.html
Geometry Type	Polygons

Townsend's Big-eared Bat	
Scientific Name	*Corynorhinus townsendii*
Notes	This polygon mask represents one or more records of the above species or habitat occurrence. Contact PHS Data Release (360-902-2543) for obtaining information about masked sensitive species and habitats.
Federal Status	N/A
State Status	Candidate
PHS Listing Status	PHS Listed Occurrence
Sensitive	Y
SGCN	Y
Display Resolution	TOWNSHIP
ManagementRecommendations	http://wdfw.wa.gov/publications/pub.php?id=00027

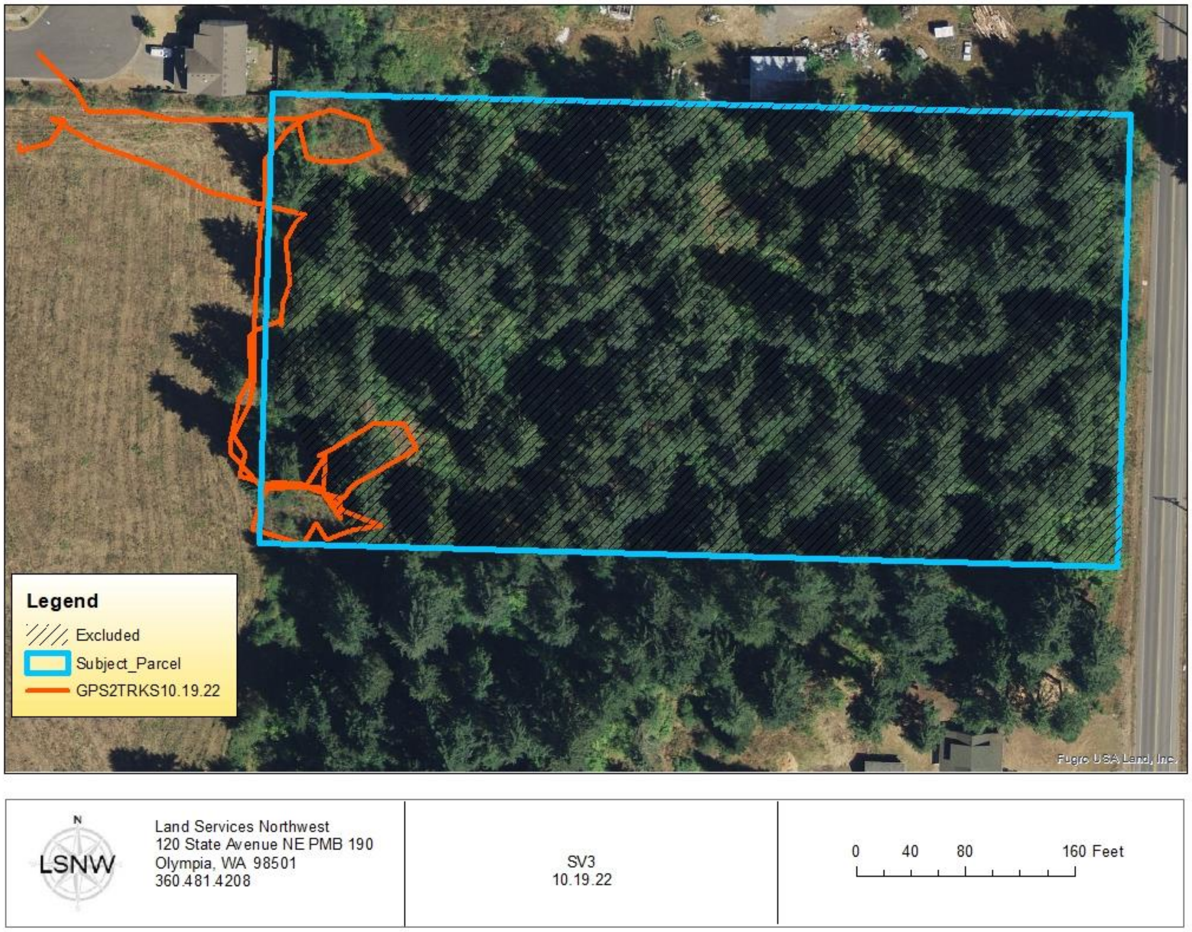
Yuma myotis	
Scientific Name	*Myotis yumanensis*
Notes	This polygon mask represents one or more records of the above species or habitat occurrence. Contact PHS Data Release (360-902-2543) for obtaining information about masked sensitive species and habitats.
Federal Status	N/A
State Status	N/A
PHS Listing Status	PHS Listed Occurrence
Sensitive	Y
SGCN	N
Display Resolution	TOWNSHIP
ManagementRecommendations	http://wdfw.wa.gov/publications/pub.php?id=00605

Appendix C

MPG Survey Form and Transect Map


Legend
Excluded
Subject_Parcel
GPS2TRKS7.19.22
GPS3TRKS7019.22
Fugro USA Land, Inc.
N
LSNW
Land Services Northwest
120 State Avenue NE PMB 190
Olympia, WA 98501
360.481.4208
SV1
7.19.22
0 40 80 160 Feet

LSNW Land Services Northwest 120 State Avenue NE PMB 190 Olympia, WA 98501 360.481.4208	SV2 9.19.22	0 40 80 160 Feet


Legend
Excluded
Subject_Parcel
GPS2TRKS10.19.22
Fugro USA Land, Inc.
LSNW
Land Services Northwest
120 State Avenue NE PMB 190
Olympia, WA 98501
360.481.4208
SV3
10.19.22
0 40 80 160 Feet

2021 Thurston County Mazama Pocket Gopher Screening Field Form **Site Visit Date:** 07.19.22

Site Name and Parcel #	**Parcel #:** 22730410000 **Project #:** **Site/Landowner:** Morris Road
How were the data collected? **(circle the method for each)**	**Transcript:** **Trimble** **Garmin** **Aerial** **Mounds** **Trimble** **Garmin** **Aerial** **Notes:**
Field Team Personnel: **(Indicate all staff present, CIRCLE who filled out form)**	**Name**Alex Callender **Name:** Susan Callender **Name:**
Others onsite (name/affiliation)	
Site visit # **(CIRCLE all that apply)**	**1st** **2nd** **Unable to screen** **Notes:**
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:** The parcel is predominantly forested. The ground was visible in survey areas.
Request mowing? **(CIRCLE and DESCRIBE WHERE MOWING IS NEEDED and SHOW ON AERIAL PHOTO**	**Yes** **No** **N/A** **Notes:**

Page 1 of 2

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
	0	0	0	0	0
	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 parcel is predominantly forested and the excluded area is shown on the transect maps in Appendix C.
Notes -	Describe, and show on parcel map/aerial if applicable:
Team reviewed and agreed to data recorded on form? (CIRCLE, and EXPLAIN if "No")	Yes No Reviewed by initials: AC SC Notes:

Information provided by Thurston County Government Page 2 of 2

2021 Thurston County Mazama Pocket Gopher Screening Field Form **Site Visit Date:** 09.19.22

Site Name and Parcel #	**Parcel #:** 22730410000 **Project #:** **Site/Landowner:** Morris Road
How were the data collected? (circle the method for each)	**Transcect:** Trimble Garmin Aerial **Mounds** Trimble Garmin Aerial **Notes:**
Field Team Personnel: **(Indicate all staff present, CIRCLE who filled out form)**	**Name** Alex Callender **Name:** Susan Callender **Name:**
Others onsite (name/affiliation)	
Site visit # **(CIRCLE all that apply)**	1st 2nd Unable to screen **Notes:**
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:** The parcel is predominantly forested. The ground was visible in survey areas.
Request mowing? **(CIRCLE and DESCRIBE WHERE MOWING IS NEEDED and SHOW ON AERIAL PHOTO**	**Yes No N/A Notes:**

Page 1 of 2

Mounds observed over the whole site are characteristic of:	**MPG Mounds**	**Likely MPG Mounds**	**Indeterminate**	**Likely Mole Mounds**	**Mole Mounds**
Quantify or describe amount of each type and approx. # of mounds ***Group = 3 mounds or more***	0	0	0	0	0
	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 parcel is predominantly forested and the excluded area is shown on the transect maps in Appendix C.				
Notes -	**Describe, and show on parcel map/aerial if applicable:**				
Team reviewed and agreed to data recorded on form? **(CIRCLE, and EXPLAIN if "No")**	**Yes No Reviewed by initials:** AC SC **Notes:**				

Information provided by Thurston County Government Page 2 of 2

2021 Thurston County Mazama Pocket Gopher Screening Field Form **Site Visit Date:** 10.19.22

Site Name and Parcel #	**Parcel #:** 22730410000 **Project #:** **Site/Landowner:** Morris Road
How were the data collected? **(circle the method for each)**	**Transect:** Trimble Garmin Aerial **Mounds** Trimble Garmin Aerial **Notes:**
Field Team Personnel: **(Indicate all staff present, CIRCLE who filled out form)**	**Name:** Alex Callender **Name:** **Name:**
Others onsite (name/affiliation)	
Site visit # **(CIRCLE all that apply)**	**1st** **2nd** **Unable to screen** **Notes:** 3rd
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:** The parcel is predominantly forested. Ground was visible in survey areas.
Request mowing? **(CIRCLE and DESCRIBE WHERE MOWING IS NEEDED and SHOW ON AERIAL PHOTO**	**Yes** **No** **N/A** **Notes:**

Page 1 of 2

Mounds observed over the whole site are characteristic of:	**MPG Mounds**	**Likely MPG Mounds**	**Indeterminate**	**Likely Mole Mounds**	**Mole Mounds**
Quantify or describe amount of each type and approx. # of mounds ***Group = 3 mounds or more***	0	0	0	0	0
	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 parcel is predominantly forested and the excluded area is shown on the transect maps in Appendix C.				
Notes -	**Describe, and show on parcel map/aerial if applicable:**				
Team reviewed and agreed to data recorded on form? **(CIRCLE, and EXPLAIN if "No")**	**Yes No Reviewed by initials:** AC ___ ___ ___ **Notes:**				

Information provided by Thurston County Government

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Appendix D

Prairie Plants

2019 Thurston County Critical Areas Ordinance (CAO) Prairie Screening Data Sheet

Parcel Number:	22730410000	**CAO prairie criteria met?**	Yes or No
Property Owner:	Cynthia Hutley and Howard Alexander	**Mima mounds present?**	Yes or No
Surveyor(s):	Alex and Susan Callender	**Oaks (*Quercus garryana*) present?**	Yes or No
Date: 7.19.22, 9.19.22 and 10.19.22		Mature:	
Composition of Vegetation:		Sapling:	
		Seedling:	

X	Target species	Class* (circle)
	Apocynum androsaemifolium	1 2 3 4 5 N/A
	Balsamorhiza deltoidea	Present / Absent
	Bistorta bistortoides	Present / Absent
	Brodiaea coronaria	1 2 3 4 5 N/A
	Camassia leichtlinii	1 2 3 4 5 N/A
	Camassia quamash	Present / Absent
	Carex densa	Present / Absent
	Carex feta	1 2 3 4 5 N/A
	Carex inops ssp. *inops*	1 2 3 4 5 N/A
	Carex tumulicola	1 2 3 4 5 N/A
	Carex unilateralis	1 2 3 4 5 N/A
	Castilleja hispida	1 2 3 4 5 N/A
	Castilleja levisecta	Present / Absent
	Danthonia californica	1 2 3 4 5 N/A
	Delphinium menziesii	1 2 3 4 5 N/A
	Delphinium nuttallii	1 2 3 4 5 N/A
	Deschampsia cespitosa	1 2 3 4 5 N/A
	Deschampsia danthonioides	1 2 3 4 5 N/A
	Dodecatheon hendersonii	1 2 3 4 5 N/A
	Downingia yina	1 2 3 4 5 N/A
	Erigeron speciosus	1 2 3 4 5 N/A
	Eriophyllum lanatum	Cover: ___ m^2 N/A
	Eryngium petiolatum	Present / Absent
	Festuca roemeri (F. idahoensis)	1 2 3 4 5 N/A
	Fragaria virginiana	Cover: 3 m^2 N/A
	Fritillaria affinis	1 2 3 4 5 N/A
	Hieracium scouleri	1 2 3 4 5 N/A
	Hosackia pinnata *(Lotus pinnatus)*	Present / Absent
	Koeleria macrantha (K. cristata)	1 2 3 4 5 N/A
	Leptosiphon bicolor (Linanthus b.)	1 2 3 4 5 N/A
	Lomatium bradshawii	Present / Absent
	Lomatium nudicaule	1 2 3 4 5 N/A
	Lomatium triternatum	1 2 3 4 5 N/A
	Lomatium utriculatum	Present / Absent
	Lupinus albicaulis	1 2 3 4 5 N/A
	Lupinus lepidus var. *lepidus*	1 2 3 4 5 N/A
	Lupinus polyphyllus	1 2 3 4 5 N/A
	Micranthes integrifolia (Saxifraga i.)	Present / Absent
	Micranthes oregana (Saxifraga o.)	1 2 3 4 5 N/A
	Microseris laciniata	Present / Absent
	Perideridia gairdneri	1 2 3 4 5 N/A
	Plagiobothrys figuratus	1 2 3 4 5 N/A
	Plectritis congesta	Present / Absent
	Polemonium carneum	Present / Absent
	Potentilla gracillis	Present / Absent
	Ranunculus alismifolius	1 2 3 4 5 N/A
	Ranunculus occidentalis	Present / Absent
	Ranunculus orthorhynchus	1 2 3 4 5 N/A
	Sericocarpus rigidus	Present / Absent
	Sidalcea malviflora* var. *virgata	Present / Absent
	Silene scouleri	Present / Absent
	Sisyrinchium idahoense	1 2 3 4 5 N/A
	Solidago missouriensis	1 2 3 4 5 N/A
	Solidago simplex (S. spathulata)	1 2 3 4 5 N/A
	Toxicoscordion venenosum var. venenosum (Zigadenus venenosus)	1 2 3 4 5 N/A
	Trifolium willdenowii (T. tridentatum)	1 2 3 4 5 N/A
	Triteleia grandiflora	1 2 3 4 5 N/A
	Triteleia hyacinthina	1 2 3 4 5 N/A
	Veratrum californicum	1 2 3 4 5 N/A
	Veratrum viride	1 2 3 4 5 N/A
	Viola adunca	1 2 3 4 5 N/A
	Viola praemorsa var. *nuttallii*	1 2 3 4 5 N/A

*Species Count Class:
1 = < 25
2 = 25 - 49
3 = 50 - 74
4 = 75 - 100
5 = >100

Prairie Plant Manual:
https://www.thurstoncountywa.gov/planning/planningdocuments/cao-prairie-plant-manual-4.23.2018.pdf

Page 1 of 2

Non-CAO vegetation

Species or codons (i.e. "HYPRAD" for *Hypochaeris radicata*)	Notes
1 Himalayan blackberry (*Rubus armeniacus*)	16.)
2 Hairy brackenfern *(Pteridium aquilinum)*	17.
3 Wild carrot *(Daucus carota)*	
4 Trailing blackberry (Rubus ursinus)	
5 Scotch broom *(Cytisus scoparius)*	
6 Tall oregon grape (Mahonia aquifolium)	
7 Western swordfern (Polystichum munitum)	
8 Colonial bentgrass (Agrostis capillaris)	
9 Hawkweed (Hieracium spp.)	
10 Snowberry (*Symphoricarpos albus)*	
11 Orchard grass (*Dactylis glomerata*)	
12	
13	
14	
15	

Prairie Habitat Criteria: If at any point at least three target species, totaling in general at least 25 plants each are encountered within about 5 meters of each other (WDFW 2015), the area in question meets the criteria to be established as occurrence of prairie. For certain plants such as WNHP rare plants (indicated here in bold), or species which serves as nectar or host plants for both TCB and either SCC or SGCN butterflies (indicated here with underline), presence is enough to meet prairie habitat criteria for such species, even if their count is less than 25 individual plants. CAO wet and dry prairie plant lists can be found in Tables 24.25-7 and 24.25-8, respectively. More info available at: https://www.thurstoncountywa.gov/planning/Pages/hcp-prairie-review.aspx
Mima mounds and oak habitat definitions can be found in TCC 24.03.010

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Appendix E

Site Plan

Country Meadows Estates Phase 2
Staff Report Supplement
Exhibit C: Geotech Report

Earth Solutions NW LLC

Geotechnical Engineering
Construction Observation/Testing
Environmental Services

GEOTECHNICAL ENGINEERING STUDY
PROPOSED VANCIL ROAD SUBDIVISION
10800 VANCIL ROAD SOUTHEAST
THURSTON COUNTY (YELM), WASHINGTON

ES-9150

15365 N.E. 90th Street, Suite 100 | Redmond, WA 98052
(425) 449-4704 Fax (425) 449-4711
www.earthsolutionsnw.com

PREPARED FOR

COPPER RIDGE, LLC

June 14, 2023

06/14/2023

Scott S. Riegel

Scott S. Riegel, L.G., L.E.G.
Associate Principal Geologist

06/14/2023

Kyle R. Campbell, P.E.
Senior Principal Engineer

GEOTECHNICAL ENGINEERING STUDY
PROPOSED VANCIL ROAD SUBDIVISION
10800 VANCIL ROAD SOUTHEAST
THURSTON COUNTY (YELM), WASHINGTON

ES-9150

Earth Solutions NW, LLC
15365 Northeast 90th Street, Suite 100
Redmond, Washington 98052
Phone: 425-449-4704 | Fax: 425-449-4711
www.earthsolutionsnw.com

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:
- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:
- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept* *responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are <u>not</u> final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are <u>Not</u> Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will <u>not</u> of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are <u>not</u> building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

Earth Solutions NW LLC
Geotechnical Engineering, Construction Observation/Testing and Environmental Services

June 14, 2023
ES-9150

Copper Ridge, LLC
P.O. Box 73790
Puyallup, Washington 98373

Attention: Evan Mann

Dear Evan:

Earth Solutions NW, LLC (ESNW), is pleased to present this report to support the proposed project. Based on the results of our investigation, construction of the proposed residential development is feasible from a geotechnical standpoint.

Based on conditions observed during our fieldwork, the site is underlain primarily by native soils consisting of glacial outwash sand/gravel deposits. The proposed residential structures can be supported on conventional spread and continuous foundations bearing on undisturbed competent native soil, recompacted native soil, or new structural fill placed directly on a competent subgrade surface. We anticipate competent native soil suitable for support of foundations will generally be encountered beginning at depths of about two to four feet below existing grades across the site.

Based on our investigation, infiltration is considered feasible from a geotechnical standpoint due to the pervasive presence of relatively clean outwash sand/gravel soils.

This report provides geotechnical analyses and recommendations for the proposed residential development. We appreciate the opportunity to be of service to you on this project. If you have any questions regarding the content of this study, please call.

Sincerely,

EARTH SOLUTIONS NW, LLC

Scott S. Riegel, L.G., L.E.G.
Associate Principal Geologist

15365 N.E. 90th Street, Suite 100 • Redmond, WA 98052 • (425) 449-4704 • FAX (425) 449-4711

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GEOTECHNICAL ENGINEERING STUDY
VANCIL ROAD SUBDIVISION
10800 VANCIL ROAD SOUTHEAST
THURSTON COUNTY (YELM), WASHINGTON

ES-9150

INTRODUCTION

General

This geotechnical engineering study (study) was prepared for the proposed residential development to be constructed in Yelm, Washington. To complete our scope of services, we performed the following:

- Subsurface exploration to characterize the soil and groundwater conditions.
- Laboratory testing of representative soil samples collected on site.
- Engineering analyses.
- Preparation of this report.

The following documents and resources were reviewed as part of our report preparation:

- Vancil Road Layout, provided by the client, dated February 27, 2023.
- Morris Road Plat, prepared by AHBL, dated June 15, 2022.
- Surficial hydrogeologic units of the Puget Sound aquifer system, Washington and British Columbia, for the Centralia quadrangle (Plate 17 of 18) M.A. Jones 1998.
- Web Soil Survey (WSS) online resource, maintained by the Natural Resources Conservation Service (NRCS) under the United States Department of Agriculture (USDA).
- Pierce County Stormwater Management and Site Development Manual, effective July 1, 2021.
- Yelm Municipal Code Chapter 18.21.

Project Description

The overall project area is located off the east side of Vancil Road Southeast in Yelm, Washington.

Site grading plans were not available at the time of this proposal; however, we understand the Vancil Road project will consist of construction of 60 single-family homesites and the Morris Road site will be developed with 30 lots and associated infrastructure improvements. Each site will include a stormwater management facility, and will require seasonal groundwater monitoring. We presume infiltration will be pursued to the extent feasible.

At the time of report submission, specific building loads were not available for review; however, we anticipate the proposed residential structures will consist of relatively lightly loaded wood framing supported on conventional foundations. Based on our experience with similar developments, we estimate wall loads of about 1 to 3 kips per linear foot and slab-on-grade loading of 150 pounds per square foot (psf) will be incorporated into the final design. Based on the low topographic relief on this site, we anticipate grading will be limited to cuts and fills of about five feet or less for lots. Deeper cuts will occur for utilities and the stormwater tracts.

If the above design assumptions are incorrect or change, ESNW should be contacted to review the recommendations provided in this report. ESNW should review final designs to confirm that appropriate geotechnical recommendations have been incorporated into the plans.

SITE CONDITIONS

Surface

The two properties that comprise the Vancil Road and Morris Road sites consist of Thurston County Parcel Nos. 22730410300 & 22730410000. The sites are vacant and the majority of the Vancil Road site area is surfaced with field grass used as fenced pasture while the Morris Road site is largely forested. Topography is gently undulating. The Vancil Road property is bordered to the north and west by residential development, to the east by the Morris Road property and to the south by open space. The Morris Road property is bordered to the north and south by residential property, to the east by Morris Road Southeast and to the west by the Vancil Road property.

Subsurface

A representative of ESNW observed, logged, and sampled 18 test pits at accessible locations within the property boundaries on April 24/25, 2023 using a machine and operator provided by the client. The explorations were completed to assess and classify the site soils and to characterize the groundwater conditions within areas proposed for new development. The maximum exploration depth was approximately 16 feet below the existing ground surface (bgs).

The approximate locations of the test pits are depicted on Plate 2 (Test Pit Location Plan). Please refer to the test pit logs provided in Appendix A for a more detailed description of subsurface conditions. Representative soil samples collected at our exploration locations were analyzed in general accordance with Unified Soil Classification System (USCS) and USDA methods and procedures.

Topsoil and Fill

Topsoil was generally encountered within the upper 12 to 18 inches of existing grades at the test pit locations, except several explorations that encountered up to 24 inches. It is possible that deeper or shallower pockets of topsoil will be encountered locally across the site. The topsoil was characterized by its dark brown color, the presence of fine organic material, and small root intrusions.

Fill was not encountered during the subsurface exploration; however, fill is likely present to varying degrees around existing structures.

Native Soil

Underlying the topsoil, native soils consisting primarily of medium dense poorly and well graded gravel with sand (USCS: GP and GW) soils were encountered. At an isolated location TP-6 at 16 feet), a well graded sand with silt (USCS: SW-SM) layer was encountered. Fines contents within the native soil deposits were less than 5 percent, except the isolated layer of sand with silt which had a fines content of about 7.4 percent at TP-6. The native soils were primarily observed to be in a damp to moist condition and caving was common within the relatively clean sandy gravel deposits.

Geologic Setting

Geologic mapping of the area identifies recessional outwash gravel deposits (Qvrg) as the primary geologic unit underlying the site. The online WSS resource identifies Spanaway series soils (Map Units 110 and 112) roughly evenly distributed across the site. The referenced soil survey characterizes Spanaway gravelly sandy loam with slow surface water runoff and little to no hazard of water erosion and are assigned to hydrologic soil group A.

Based on the soil conditions encountered during our fieldwork, the native soils are consistent with the geologic and soils mapping resources outlined in this section of outwash sand/gravel soils.

Groundwater

Groundwater was not observed, during the April 2023 subsurface explorations. Groundwater flow rates and elevations may fluctuate depending on many factors, including precipitation duration and intensity, the time of year, and soil conditions. In general, groundwater flow rates are higher during the winter, spring, and early summer months. In any case, groundwater conditions should be expected within deeper site excavations, particularly during the wet season. Depending on the timing, depth, and extent of such excavations, temporary dewatering may be necessary.

GEOLOGIC CRITICAL AREAS EVALUATION

The subject property was evaluated for the presence of geologic critical areas in general accordance with Yelm Municipal Code Chapter 18.21. Based on our review no geologic critical areas are present on or immediately adjacent to the subject site.

Based on review of the Thurston County Wellhead Protection Areas map, the site is located within a 10-year Time-of-Travel area.

DISCUSSION AND RECOMMENDATIONS

General

Based on the results of our investigation, construction of the proposed residential development is feasible from a geotechnical standpoint. The primary geotechnical considerations associated with the proposed project include earthwork, temporary excavations, subgrade preparation, foundation support, and drainage.

Based on local geologic mapping and conditions observed during our fieldwork, the site is underlain primarily by native soils consisting of medium dense outwash sandy gravel deposits. The proposed residential structures can be supported on conventional spread and continuous foundations bearing on undisturbed competent native soil, recompacted native soil, or new structural fill placed directly on a competent subgrade. We anticipate competent native soil suitable for support of foundations will generally be encountered beginning at depths of about two to four feet below existing grades across the site.

Based on our investigation, infiltration is considered feasible from a geotechnical standpoint due to the presence of Spanaway gravel soils across the site.

This study has been prepared for the exclusive use of Copper Ridge, LLC and their representatives. No warranty, expressed or implied, is made. This study has been prepared in a manner consistent with the level of care and skill ordinarily exercised by other members of the profession currently practicing under similar conditions in this area.

Site Preparation and Earthwork

Site preparation activities should consist of installing temporary erosion control measures, establishing grading limits, and performing site stripping. Subsequent earthwork activities will likely include site grading, utility installations, and associated site improvements.

Temporary Erosion Control

The following temporary erosion and sediment control Best Management Practices (BMPs) are recommended:

- Temporary construction entrances and drive lanes, consisting of at least six inches of quarry spalls, should be considered to both minimize off-site soil tracking and provide stable surfaces at site entrances. Placing geotextile fabric underneath the quarry spalls will provide greater stability if needed.

- Silt fencing should be placed around the appropriate portions of the site perimeter to prevent offsite migration of sediment.

- When not in use, soil stockpiles should be covered or otherwise protected (as necessary) to reduce the potential for soil erosion, especially during periods of wet weather.

- As necessary, temporary measures for controlling surface water runoff, such as interceptor trenches, sumps, or interceptor swales, should be installed prior to beginning earthwork activities. For this site, infiltration may also be considered for control of surface water runoff.

- Dry soils disturbed during construction should be wetted to minimize dust and airborne soil erosion.

Additional Best Management Practices, as specified by the project civil engineer and indicated on the plans, should be incorporated into construction activities. Temporary erosion control measures may be modified during construction as site conditions require, as approved by the site erosion control lead.

Stripping

Topsoil was encountered generally within the upper 12 to 18 inches with isolated areas up to 24 inches of existing grades at the test pit locations. ESNW should be retained to observe site stripping activities at the time of construction so that the degree of required stripping may be assessed. The exposed subgrade may still possess root elements, other organic material, or be present in a loose condition. As such, ESNW should evaluate the exposed soil subgrade to determine if further stripping or in-situ compaction efforts prior to fill operations or finish grading is necessary. Over-stripping should be avoided, as it is unnecessary and may result in increased project development costs. Topsoil and organic-rich soil are neither suitable for foundation support nor for use as structural fill. Topsoil and organic-rich soil may be used in non-structural areas if desired.

In-situ and Imported Soil

The in-situ soils encountered at the subject site have a low to moderate sensitivity to moisture and were generally in a damp to moist condition at the time of exploration. Soils anticipated to be exposed on site may degrade if exposed to wet weather and construction traffic. Compaction of the soils to the levels necessary for use as structural fill may be difficult to impossible during wet weather conditions. Soils encountered during site excavations that are excessively over the optimum moisture content will likely require aeration or treatment prior to placement and compaction. Conversely, soils that are substantially below the optimum moisture content will require moisture conditioning through the addition of water prior to use as structural fill. An ESNW representative should determine the suitability of in-situ soils for use as structural fill at the time of construction.

Imported soil intended for use as structural fill should be evaluated by ESNW during construction. The imported soil must be workable to the optimum moisture content, as determined by the Modified Proctor Method (ASTM D1557), at the time of placement and compaction. During wet weather conditions, imported soil intended for use as structural fill should consist of a well-graded, granular soil with a fines content of 5 percent or less (where the fines content is defined as the percent passing the Number 200 sieve, based on the minus three-quarter-inch fraction).

Structural Fill

Structural fill is defined as compacted soil placed in foundation, slab-on-grade, roadway, permanent slope, retaining wall, and utility trench backfill areas. Structural fill placed and compacted during site grading activities should meet the following specifications and guidelines:

• Structural fill material	Granular soil*
• Moisture content	At or slightly above optimum†
• Relative compaction (minimum)	95 percent (Modified Proctor)‡
• Loose lift thickness (maximum)	12 inches

* *Existing gravel soils will likely require moisture conditioning (addition of water) prior to placement and compaction.*
† *Soil shall not be placed dry of optimum and should be evaluated by ESNW during construction.*
‡ *Minimum relative compaction of 90% may be feasible for mass grading activities and should be evaluated by ESNW during construction.*

With respect to underground utility installations and backfill, local jurisdictions may dictate the soil type(s) and compaction requirements. Unsuitable material or debris must be removed from structural areas if encountered.

Excavations and Slopes

The following Federal Occupation Safety and Health Administration and Washington Industrial Safety and Health Act soil classifications and maximum allowable temporary slope inclinations may be used:

- Areas exposing groundwater seepage 1.5H:1V (Type C)
- Loose soil and fill 1.5H:1V (Type C)
- Medium dense to dense soil 1H:1V (Type B)

Groundwater seepage should be anticipated during excavation activities, especially if excavations take place during the wet season. An ESNW representative should observe temporary excavations to evaluate the presence of groundwater seepage. If seepage is not observed, steeper temporary slope inclinations may be feasible pending evaluation by the geotechnical engineer.

Subgrade Preparation

Foundations should be constructed on competent native soil or structural fill placed directly on competent native soil. Loose or unsuitable soil conditions encountered below areas of footing and slab elements should be remedied as recommended in this report. In general, foundation subgrades on native cut surfaces should be compacted in-situ to a minimum depth of one foot below the design subgrade elevation. Uniform compaction of the foundation and slab subgrade areas will establish a relatively consistent subgrade condition below the foundation and slab elements. ESNW should observe the foundation and slab subgrade prior to placing formwork. Supplementary recommendations for subgrade improvement can be provided at the time of construction and would likely include further mechanical compaction effort and/or overexcavation and replacement with suitable structural fill.

Foundations

The proposed structures can be constructed on conventional continuous and spread footing foundations bearing on competent native soil, recompacted native soil, or new structural fill placed directly on competent native soil. Where loose or unsuitable soil conditions are encountered at foundation subgrade elevations, compaction of the soils to the specifications of structural fill, or overexcavation and replacement with suitable structural fill will likely be necessary. A representative of ESNW should confirm suitability of foundation subgrades at the time of construction. If deemed necessary, the undisturbed weathered native soils may be compacted in-situ provided the soil is at or slightly above the optimum moisture content.

Provided the structures will be supported as described above, the following parameters may be used for design of the new foundations:

- Allowable soil bearing capacity 2,500 psf
- Passive earth pressure 300 pcf
- Coefficient of friction 0.40

A one-third increase in the allowable soil bearing capacity can be assumed for short-term wind and seismic loading conditions. The passive earth pressure and coefficient of friction values include a safety factor of 1.5. With structural loading as expected, total settlement in the range of one inch is anticipated, with differential settlement of about one-half inch. The majority of the settlement should occur during construction as dead loads are applied.

Retaining Walls

Retaining walls must be designed to resist earth pressures and applicable surcharge loads. The following parameters may be used for retaining wall design:

- Active earth pressure (unrestrained condition) 35 pcf
- At-rest earth pressure (restrained condition) 55 pcf
- Traffic surcharge (passenger vehicles) 70 psf (rectangular distribution)
- Passive earth pressure 300 pcf
- Coefficient of friction 0.40
- Seismic surcharge 8H psf*

* *Where H equals the retained height (in feet).*

The passive earth pressure and coefficient of friction values include a safety factor of 1.5. Additional surcharge loading from adjacent foundations, sloped backfill, or other loads should be included in the retaining wall design.

Retaining walls should be backfilled with free-draining material that extends along the height of the wall and a distance of at least 18 inches behind the wall. Relatively clean (fines content less than 5 percent) native soils may be used as the drainage zone, but should be observed by ESNW prior to placement. The upper 12 inches of the wall backfill may consist of a less permeable soil, if desired.

Drainage should be provided behind retaining walls such that hydrostatic pressures do not develop. If drainage is not provided, hydrostatic pressures should be included in the wall design. A perforated drainpipe should be placed along the base of the wall and connected to an approved discharge location. A typical retaining wall drainage detail is provided on Plate 3.

Seismic Design

The 2018 International Building Code (2018 IBC) recognizes the most recent edition of the Minimum Design Loads for Buildings and Other Structures manual (ASCE 7-16) for seismic design, specifically with respect to earthquake loads. Based on the soil conditions encountered at the test pit locations, the parameters and values provided below are recommended for seismic design per the 2018 IBC.

Parameter	**Value**
Site Class	D*
Mapped short period spectral response acceleration, S_S (g)	1.280
Mapped 1-second period spectral response acceleration, S_1 (g)	0.463
Short period site coefficient, F_a	1.000
Long period site coefficient, F_v	1.837
Adjusted short period spectral response acceleration, S_{MS} (g)	1.280
Adjusted 1-second period spectral response acceleration, S_{M1} (g)	0.850
Design short period spectral response acceleration, S_{DS} (g)	0.853
Design 1-second period spectral response acceleration, S_{D1} (g)	0.567

* *Assumes medium dense soil conditions, encountered to a maximum depth of 16 feet bgs during the April 2023 field exploration, remain medium dense or better to at least 100 feet bgs.*

† *Values assume F_v may be determined using linear interpolation per Table 11.4-2 in ASCE 7-16.*

As indicated in the table footnote, several of the seismic design values provided above are dependent on the assumption that site-specific ground motion analysis (per Section 11.4.8 of ASCE 7-16) will not be required for the subject project. ESNW recommends the validity of this assumption be confirmed at the earliest available opportunity during the planning and early design stages of the project. Further discussion between the project structural engineer, the project owner (or their representative), and ESNW may be prudent to determine the possible impacts to the structural design due to increased earthquake load requirements under the 2018 IBC. ESNW can provide additional consulting services to aid with design efforts, including supplementary geotechnical and geophysical investigation, upon request.

Liquefaction is a phenomenon where saturated or loose soil suddenly loses internal strength and behaves as a fluid. This behavior is in response to increased pore water pressures resulting from an earthquake or another intense ground shaking. In our opinion, site susceptibility to liquefaction may be considered negligible. The absence of a shallow groundwater table and the coarse (gravel) gradation of the native soil were the primary bases for this opinion.

Slab-on-Grade Floors

Slab-on-grade floors should be supported on a firm and unyielding subgrade consisting of competent native soil or at least 12 inches of new structural fill. Unstable or yielding areas of the subgrade should be recompacted or overexcavated and replaced with suitable structural fill prior to slab construction.

A capillary break consisting of a minimum of four inches of free-draining crushed rock or gravel should be placed below the slab. The free-draining material should have a fines content of 5 percent or less defined as the percent passing the number 200 sieve, based on the minus three-quarters-inch fraction. In areas where slab moisture is undesirable, installation of a vapor barrier below the slab should be considered. The relatively clean (less than 5 percent fines) native gravel soils may be used or considered functionally equivalent as a capillary break; however, ESNW should observe native soils prior to placement to confirm suitability. If used, the vapor barrier should consist of a material specifically designed to function as a vapor barrier and should be installed in accordance with the manufacturer's specifications.

Drainage

Temporary measures to control surface water runoff and groundwater during construction would likely involve passive elements such as interceptor trenches, interceptor swales, and sumps. ESNW should be consulted during preliminary grading to identify areas of seepage and provide recommendations to reduce the potential for seepage-related instability.

Finish grades must be designed to direct surface drain water away from structures and slopes. Water must not be allowed to pond adjacent to structures or slopes. Based on the presence of relatively clean sand/gravel soils on this site, footing drains may be omitted at the owner's discretion. If footing drains are omitted, we recommend ESNW be contacted to observe the subgrade to ensure the entire alignment exposes relatively free-draining sand/gravel. If footing drains will be installed, a foundation drain should be installed along building perimeter footings. A typical foundation drain detail is provided on Plate 4.

Preliminary Infiltration Evaluation

As indicated on the referenced preliminary site plan, a stormwater tract will be created in each of the project areas. The Vancil Road plat will include a storm tract in the western portion of the site, while the Morris Road plat will include a storm tract in the eastern portion. ESNW excavated three test pits in each storm tract (TP-5 through TP-7 for Vancil Road and TP-11 through TP-13 for the Morris Road site). Native soils encountered across the site during our fieldwork were characterized primarily as recessional outwash gravel deposits with relatively low fines contents. Based on our laboratory analyses, the native soils classify primarily as USDA loamy sand with fines contents ranging from about 1.3 to 4.7 percent with one outlier (TP-6) with a fines content of 7.4 percent. The results of our laboratory analyses are included in Appendix B of this report.

Using Method 3 - Soil Grain Size Analysis Method, in conjunction with the presence of Type A soil on the subject site, we determined a preliminary long-term design infiltration rate to be used primarily as a feasibility screening tool. A preliminary long-term design rate is calculated following the equation below, located in the Pierce County Stormwater and Site Development Manual.

$$log_{10}\,(K_{sat}) = -1.57 + 1.90D_{10} + 0.015D_{60} - 0.013D_{90} - 2.08F_{fines}$$

The relatively clean Spanaway (Type A) gravels observed in across the site exhibit favorable infiltration characteristics and will likely be feasible for full infiltration. Based on the soil samples obtained at TP-5 through TP-7 and TP-11 through TP-13 within the vicinity of the proposed infiltration facilities at representative depths, preliminary calculated long-term design rates ranging between 7 inches/hour to 87 in/hr were calculated. We recommend using an allowable infiltration rate of 20 in/hr for the Vancil Road plat and 30 in/hr for preliminary sizing calculations/design for the proposed Morris Road stormwater facility. In-situ pilot infiltration testing should be completed for final design of the infiltration ponds.

Groundwater monitoring piezometers were installed at three test locations within each of the proposed stormwater tracts for future groundwater monitoring services, to be completed in the coming wet season. While no indications of seasonal groundwater were observed during the subsurface investigation, winter monitoring may result in alterations to future facility design based on potential groundwater conditions.

Based on our field observations and laboratory analyses, the native gravelly soils do not meet the requirements for water quality treatment per Volume V, Chapter 6.3 of the stormwater manual. Specifically, the measured soil infiltration rate significantly higher than the maximum allowable nine inches per hour. Additionally, the native Spanaway gravels likely possess a lower cation exchange capacity (CEC) and organic content than required by the manual. Therefore, a treatment layer or other provision will likely be required for facility designs.

Utility Support and Trench Backfill

In our opinion, the on-site soil will generally be suitable for support of utilities. Based on the conditions encountered at the exploration locations, groundwater seepage may be exposed within utility trench excavations and will likely require temporary shoring and construction dewatering. Use of the native soil as structural backfill in the utility trench excavations will depend on the in-situ moisture content at the time of placement and compaction. If native soil is placed below the optimum moisture content, settlement will likely occur once wet weather impacts the trenches. As such, backfill soils should be properly moisture conditioned, as necessary, to ensure acceptability of the soil moisture content at the time of placement and compaction. Large clasts greater than about six inches should be removed from utility trench backfill if encountered. Utility trench backfill should be placed and compacted to the specifications of structural fill provided in this report or to the applicable requirements of the presiding jurisdiction.

Preliminary Pavement Sections

The performance of site pavements is largely related to the condition of the underlying subgrade. To ensure adequate pavement performance, the subgrade should be in a firm and unyielding condition when subjected to proof rolling with a loaded dump truck. Structural fill in pavement areas should be compacted to the specifications previously detailed in this report. Soft, wet, or otherwise unsuitable or yielding subgrade conditions will require remedial measures, such as overexcavation and/or placement of thick crushed rock or structural fill sections, prior to pavement. Cement treated base may be considered for stabilizing the subgrade if local jurisdictions allow this method of treatment.

We anticipate new pavement sections will be subjected primarily to passenger vehicle traffic. For lightly loaded pavement areas subjected primarily to passenger vehicles, the following preliminary pavement sections may be considered:

- A minimum of two inches of hot-mix asphalt (HMA) placed over four inches of crushed rock base (CRB), or;

- A minimum of two inches of HMA placed over three inches of asphalt-treated base (ATB).

Heavier traffic areas generally require thicker pavement sections depending on site usage, pavement life expectancy, and site traffic. For preliminary design purposes, the following pavement sections for occasional truck traffic and access roadway areas may be considered:

- Three inches of HMA placed over six inches of CRB, or;

- Three inches of HMA placed over four and one-half inches of ATB.

A representative of ESNW should be requested to observe subgrade conditions prior to placement of CRB or ATB. As necessary, supplemental recommendations for achieving subgrade stability and drainage can be provided. If on-site roads will be constructed with an inverted crown, additional drainage measures may be recommended to assist in maintaining road subgrade and pavement stability.

Final pavement design recommendations, including recommendations for heavy traffic areas, access roads, and frontage improvement areas, can be provided once final traffic loading has been determined. Road standards utilized by the governing jurisdiction may supersede the recommendations provided in this report. The HMA, ATB, and CRB materials should conform to WSDOT specifications. All soil base material should be compacted to a relative compaction of 95 percent, based on the laboratory maximum dry density as determined by ASTM D1557.

LIMITATIONS

This study has been prepared for the exclusive use of Copper Ridge, LLC, and its representatives. The recommendations and conclusions provided in this study are professional opinions consistent with the level of care and skill that is typical of other members in the profession currently practicing under similar conditions in this area. A warranty is neither expressed nor implied. Variations in the soil and groundwater conditions observed at the exploration locations may exist and may not become evident until construction. ESNW should reevaluate the conclusions provided in this study if variations are encountered.

Additional Services

ESNW should have an opportunity to review final project plans with respect to the geotechnical recommendations provided in this report. ESNW should also be retained to provide testing and consultation services as needed during future design and construction phases of the project.

Reference:
Thurston County, Washington
OpenStreetMap.org

NORTH

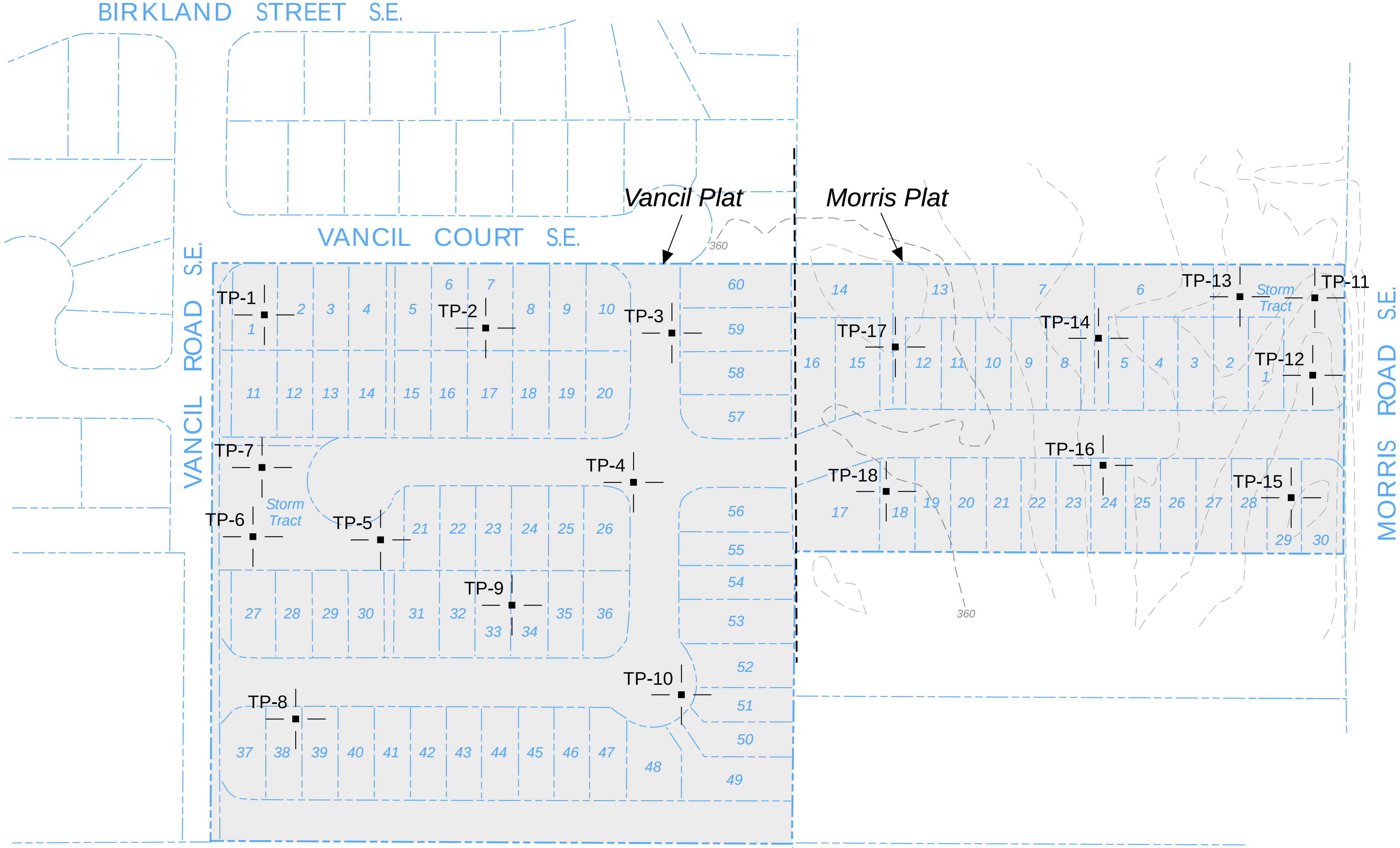
NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.

Earth Solutions NW LLC

Geotechnical Engineering, Construction Observation/Testing and Environmental Services

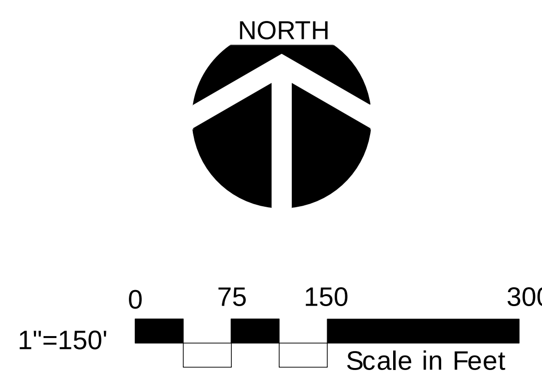
Vicinity Map
10800 Vancil Road S.E. Subdivision
Thurston County (Yelm), Washington

Drawn CAM	Date 06/06/2023	Proj. No. 9150
Checked SSR	Date June 2023	Plate 1



LEGEND

TP-1	Approximate Location of ESNW Test Pit, Proj. No. ES-9150, April 2023
	Subject Site
21	Proposed Lot Number



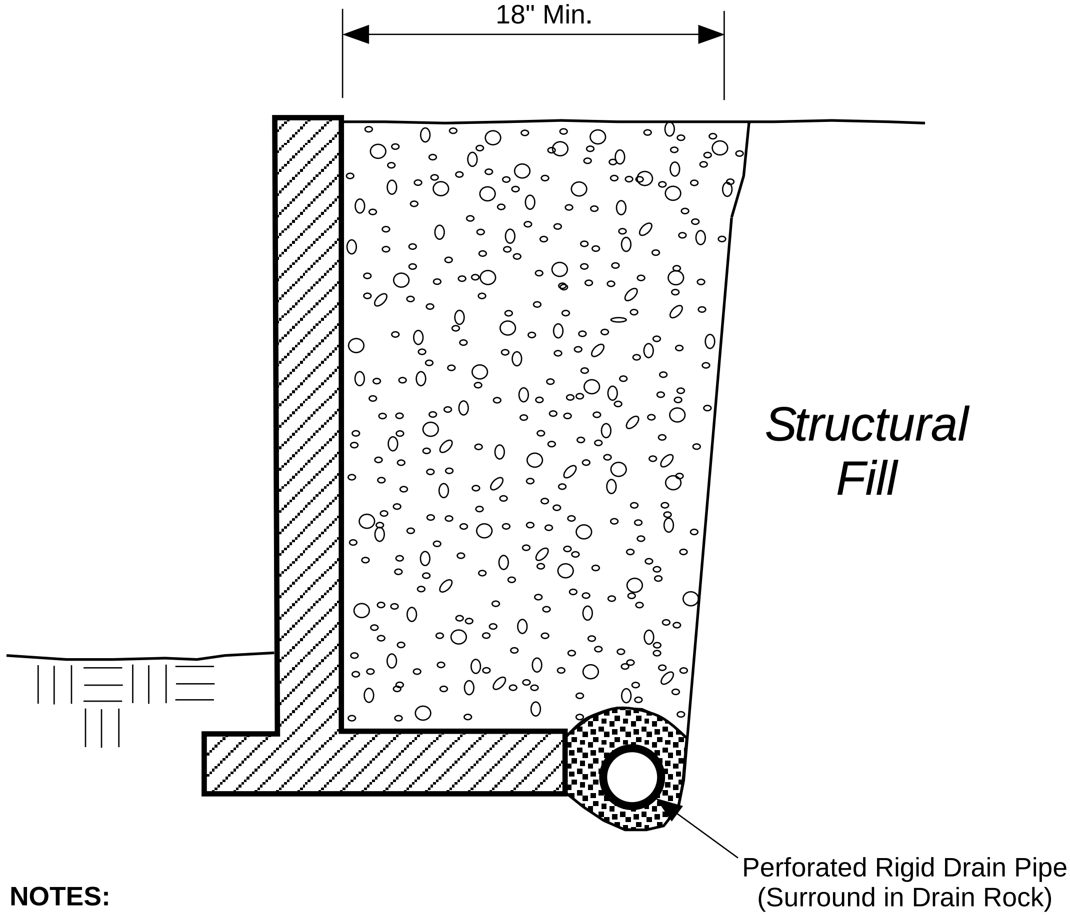
NOTE: The graphics shown on this plate are not intended for design purposes or precise scale measurements, but only to illustrate the approximate test locations relative to the approximate locations of existing and / or proposed site features. The information illustrated is largely based on data provided by the client at the time of our study. ESNW cannot be responsible for subsequent design changes or interpretation of the data by others.

NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.

Test Pit Location Plan
10800 Vancil Road S.E. Subdivision
Thurston County (Yelm), Washington

Earth Solutions NW LLC
Geotechnical Engineering, Construction Observation/Testing and Environmental Services

Drawn	CAM
Checked	SSR
Date	06/06/2023
Proj. No.	9150
Plate	2

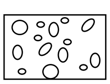


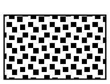
NOTES:

- Free-draining Backfill should consist of soil having less than 5 percent fines. Percent passing No. 4 sieve should be 25 to 75 percent.
- Sheet Drain may be feasible in lieu of Free-draining Backfill, per ESNW recommendations.
- Drain Pipe should consist of perforated, rigid PVC Pipe surrounded with 1-inch Drain Rock.

SCHEMATIC ONLY - NOT TO SCALE
NOT A CONSTRUCTION DRAWING

LEGEND:

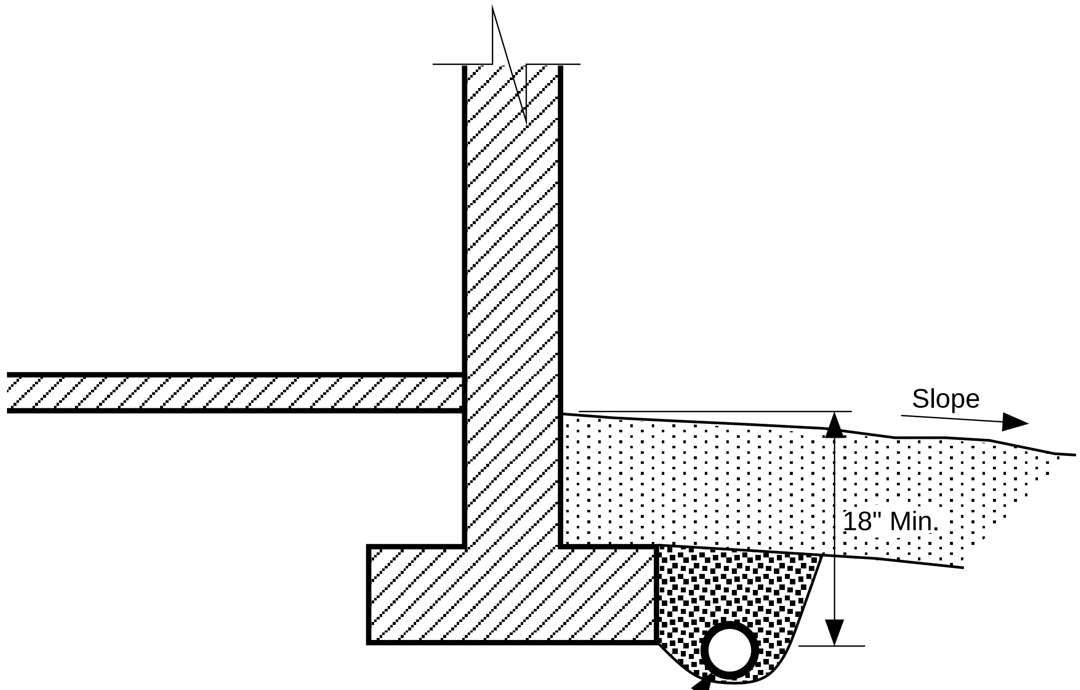
 Free-draining Structural Backfill

 1-inch Drain Rock

Earth Solutions NW LLC
Geotechnical Engineering, Construction Observation/Testing and Environmental Services

Retaining Wall Drainage Detail
10800 Vancil Road S.E. Subdivision
Thurston County (Yelm), Washington

Drawn CAM	Date 06/06/2023	Proj. No. 9150
Checked SSR	Date June 2023	Plate 3



Perforated Rigid Drain Pipe
(Surround in Drain Rock)

NOTES:

- Do NOT tie roof downspouts to Footing Drain.
- Surface Seal to consist of 12" of less permeable, suitable soil. Slope away from building.

LEGEND:

Surface Seal: native soil or other low-permeability material.

1-inch Drain Rock

SCHEMATIC ONLY - NOT TO SCALE
NOT A CONSTRUCTION DRAWING

Earth Solutions NWLLC
Geotechnical Engineering, Construction Observation/Testing and Environmental Services

Footing Drain Detail
10800 Vancil Road S.E. Subdivision
Thurston County (Yelm), Washington

Drawn CAM	Date 06/06/2023	Proj. No. 9150
Checked SSR	Date June 2023	Plate 4

Appendix A

Subsurface Exploration
Test Pit Logs

ES-9150

Subsurface conditions on site were explored by excavating 18 test pits on April 24/25, 2023, respectively, using equipment and operators provided by the client. The approximate locations of the test pits and borings are illustrated on Plate 2 of this study. The subsurface exploration logs are provided in this Appendix. The maximum exploration depth was 16 feet bgs.

The final logs represent the interpretations of the field logs and the results of laboratory analyses. The stratification lines on the logs represent the approximate boundaries between soil types. In actuality, the transitions may be more gradual.

Major Divisions			Group Symbol	Group Name
Coarse-Grained Soils - More Than 50% Retained on No. 200 Sieve	Gravels - More Than 50% of Coarse Fraction Retained on No. 4 Sieve	< 5% Fines	GW	Well-graded gravel with or without sand, little to no fines
			GP	Poorly graded gravel with or without sand, little to no fines
		> 12% Fines	GM	Silty gravel with or without sand
			GC	Clayey gravel with or without sand
	Sands - 50% or More of Coarse Fraction Passes No. 4 Sieve	< 5% Fines	SW	Well-graded sand with or without gravel, little to no fines
			SP	Poorly graded sand with or without gravel, little to no fines
		> 12% Fines	SM	Silty sand with or without gravel
			SC	Clayey sand with or without gravel
Fine-Grained Soils - 50% or More Passes No. 200 Sieve	Silts and Clays Liquid Limit Less Than 50		ML	Silt with or without sand or gravel; sandy or gravelly silt
			CL	Clay of low to medium plasticity; lean clay with or without sand or gravel; sandy or gravelly lean clay
			OL	Organic clay or silt of low plasticity
	Silts and Clays Liquid Limit 50 or More		MH	Elastic silt with or without sand or gravel; sandy or gravelly elastic silt
			CH	Clay of high plasticity; fat clay with or without sand or gravel; sandy or gravelly fat clay
			OH	Organic clay or silt of medium to high plasticity
Highly Organic Soils			PT	Peat, muck, and other highly organic soils
Fill			FILL	Made Ground

Moisture Content

Dry - Absence of moisture, dusty, dry to the touch

Damp - Perceptible moisture, likely below optimum MC

Moist - Damp but no visible water, likely at/near optimum MC

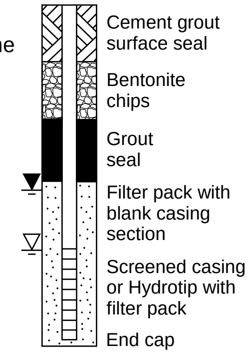
Wet - Water visible but not free draining, likely above optimum MC

Saturated/Water Bearing - Visible free water, typically below groundwater table

Symbols

ATD = At time of drilling

Static water level (date)



Terms Describing Relative Density and Consistency

Coarse-Grained Soils:

Density	SPT blows/foot
Very Loose	< 4
Loose	4 to 9
Medium Dense	10 to 29
Dense	30 to 49
Very Dense	≥ 50

Fine-Grained Soils:

Consistency	SPT blows/foot
Very Soft	< 2
Soft	2 to 3
Medium Stiff	4 to 7
Stiff	8 to 14
Very Stiff	15 to 29
Hard	≥ 30

Test Symbols & Units

Fines = Fines Content (%)

MC = Moisture Content (%)

DD = Dry Density (pcf)

Str = Shear Strength (tsf)

PID = Photoionization Detector (ppm)

OC = Organic Content (%)

CEC = Cation Exchange Capacity (meq/100 g)

LL = Liquid Limit (%)

PL = Plastic Limit (%)

PI = Plasticity Index (%)

Component Definitions

Descriptive Term	Size Range and Sieve Number
Boulders	Larger than 12"
Cobbles	3" to 12"
Gravel	3" to No. 4 (4.75 mm)
Coarse Gravel	3" to 3/4"
Fine Gravel	3/4" to No. 4 (4.75 mm)
Sand	No. 4 (4.75 mm) to No. 200 (0.075 mm)
Coarse Sand	No. 4 (4.75 mm) to No. 10 (2.00 mm)
Medium Sand	No. 10 (2.00 mm) to No. 40 (0.425 mm)
Fine Sand	No. 40 (0.425 mm) to No. 200 (0.075 mm)
Silt and Clay	Smaller than No. 200 (0.075 mm)

Modifier Definitions

Percentage by Weight (Approx.)	Modifier
< 5	Trace (sand, silt, clay, gravel)
5 to 14	Slightly (sandy, silty, clayey, gravelly)
15 to 29	Sandy, silty, clayey, gravelly
≥ 30	Very (sandy, silty, clayey, gravelly)

Classifications of soils in this geotechnical report and as shown on the exploration logs are based on visual field and/or laboratory observations, which include density/consistency, moisture condition, grain size, and plasticity estimates, and should not be construed to imply field or laboratory testing unless presented herein. Visual-manual and/or laboratory classification methods of ASTM D2487 and D2488 were used as an identification guide for the Unified Soil Classification System.

Earth Solutions NW LLC

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EXPLORATION LOG KEY

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-1

PROJECT NUMBER ES-9150
PROJECT NAME 10800 Vancil Road S.E. Subdivision
DATE STARTED 4/24/23 **COMPLETED** 4/24/23
GROUND ELEVATION 358 ft
EXCAVATION CONTRACTOR Client Provided
LATITUDE 46.93068 **LONGITUDE** -122.59518
LOGGED BY SKH **CHECKED BY** SSR
GROUND WATER LEVEL:
NOTES
AT TIME OF EXCAVATION
SURFACE CONDITIONS Field Grass
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			TPSL		Dark brown TOPSOIL, roots to 12"
1.5					(356.5)
			GP		Brown poorly graded GRAVEL with sand, medium dense, damp
	GB	MC = 7.5			-probed 4"
					-slight caving to BOH
5					
	GB	MC = 8.3			
10					
15	GB	MC = 7.6			
15.0					(343.0)

Test pit terminated at 15.0 feet below existing grade due to caving. No groundwater encountered during excavation. Caving observed from 3.0 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-2

PROJECT NUMBER ES-9150
PROJECT NAME 10800 Vancil Road S.E. Subdivision
DATE STARTED 4/24/23 **COMPLETED** 4/24/23
GROUND ELEVATION 358 ft
EXCAVATION CONTRACTOR Client Provided
LATITUDE 46.9305 **LONGITUDE** -122.59428
LOGGED BY SKH **CHECKED BY** SSR
GROUND WATER LEVEL:
NOTES
▽ **AT TIME OF EXCAVATION**
SURFACE CONDITIONS Field Grass
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			TPSL	1.0	Dark brown TOPSOIL, roots to 12"	357.0
			GW		Brown well-graded GRAVEL with sand, medium dense, damp	
	GB	MC = 5.8			-slight caving to BOH, probed 3"	
5						
	GB	MC = 8.8 Fines = 3.8			[USDA Classification: extremely gravelly coarse SAND]	
10						
					-becomes gray	
	GB	MC = 7.1		14.0		344.0

Test pit terminated at 14.0 feet below existing grade due to caving. No groundwater encountered during excavation. Caving observed from 2.0 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

GENERAL BH / TP / WELL - 9150.GPJ - GINT US.GDT - 6/6/23

Earth Solutions NW, LLC
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Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-3

PROJECT NUMBER ES-9150
PROJECT NAME 10800 Vancil Road S.E. Subdivision
DATE STARTED 4/24/23 **COMPLETED** 4/24/23
GROUND ELEVATION 360 ft
EXCAVATION CONTRACTOR Client Provided
LATITUDE 46.93058 **LONGITUDE** -122.59333
LOGGED BY SKH **CHECKED BY** SSR
GROUND WATER LEVEL:
NOTES
∇ **AT TIME OF EXCAVATION**
SURFACE CONDITIONS Field Grass
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elevation
0			TPSL		Dark brown TOPSOIL, roots to 12"	
1.0						359.0
			GP		Brown poorly graded GRAVEL with sand, medium dense, damp	
	GB	MC = 5.2			-probed 3"	
					-moderate caving to BOH	
5						
10					-becomes gray	
11.5	GB	MC = 7.8				348.5

Test pit terminated at 11.5 feet below existing grade due to caving. No groundwater encountered during excavation. Caving observed from 2.0 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

GENERAL BH / TP / WELL - 9150.GPJ - GINT US.GDT - 6/6/23

Earth Solutions NW, LLC
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Fax: 425-449-4711

TEST PIT NUMBER TP-4

PROJECT NUMBER ES-9150
PROJECT NAME 10800 Vancil Road S.E. Subdivision
DATE STARTED 4/24/23 **COMPLETED** 4/24/23
GROUND ELEVATION 361 ft
EXCAVATION CONTRACTOR Client Provided
LATITUDE 46.93021 **LONGITUDE** -122.59339
LOGGED BY SKH **CHECKED BY** SSR
GROUND WATER LEVEL:
NOTES
AT TIME OF EXCAVATION
SURFACE CONDITIONS Field Grass
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			TPSL		Dark brown TOPSOIL, roots to 12"	
1.0						360.0
			GP		Brown poorly graded GRAVEL with sand, medium dense, damp	
2	GB	MC = 6.8			-moderate caving to BOH -probed 4"	
5						
10						
12.0	GB	MC = 9.3				349.0

Test pit terminated at 12.0 feet below existing grade due to caving. No groundwater encountered during excavation. Caving observed from 2.0 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

Earth Solutions NW, LLC
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Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-5

PROJECT NUMBER ES-9150
PROJECT NAME 10800 Vancil Road S.E. Subdivision
DATE STARTED 4/24/23 **COMPLETED** 4/24/23
GROUND ELEVATION 357 ft
EXCAVATION CONTRACTOR Client Provided
LATITUDE 46.93001 **LONGITUDE** -122.59472
LOGGED BY SKH **CHECKED BY** SSR
GROUND WATER LEVEL:
NOTES
AT TIME OF EXCAVATION
SURFACE CONDITIONS Field Grass
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elevation
0			TPSL		Dark brown TOPSOIL, roots to 12"	
1.5						355.5
	GB	MC = 6.8	GP		Brown poorly graded GRAVEL with sand, medium dense, damp -moderate caving to BOH, probed 3"	
5.0						352.0
			GW		Brown well-graded GRAVEL with sand, medium dense, damp to moist	
13.0	GB	MC = 8.1 Fines = 4.7			[USDA Classification: extremely gravelly loamy coarse SAND]	344.0

Test pit terminated at 13.0 feet below existing grade due to caving. Piezo installed. No groundwater encountered during excavation. Caving observed from 2.5 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
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Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-6

PROJECT NUMBER ES-9150
PROJECT NAME 10800 Vancil Road S.E. Subdivision
DATE STARTED 4/24/23 **COMPLETED** 4/24/23
GROUND ELEVATION 357 ft
EXCAVATION CONTRACTOR Client Provided
LATITUDE 46.93002 **LONGITUDE** -122.59521
LOGGED BY SKH **CHECKED BY** SSR
GROUND WATER LEVEL:
NOTES
∇ **AT TIME OF EXCAVATION**
SURFACE CONDITIONS Field Grass
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elevation
0			TPSL		Dark brown TOPSOIL, roots to 12"	
1.5						355.5
	GB	MC = 7.7	GP		Brown poorly graded GRAVEL with sand, medium dense, damp -probed 3" -slight caving to BOH, probed 3"	
9.0						348.0
			GW		Brown well-graded GRAVEL with sand, medium dense, damp to moist	
15.0						342.0
	GB	MC = 10.9 Fines = 7.4	SW-SM		Brown well-graded SAND with silt, medium dense to dense, moist [USDA Classification: very gravelly loamy coarse SAND]	
16.0						341.0

Test pit terminated at 16.0 feet below existing grade. Piezo installed. No groundwater encountered during excavation. Caving observed from 3.0 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

Earth Solutions NW, LLC
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Telephone: 425-449-4704
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TEST PIT NUMBER TP-7

PROJECT NUMBER ES-9150
PROJECT NAME 10800 Vancil Road S.E. Subdivision
DATE STARTED 4/24/23 **COMPLETED** 4/24/23
GROUND ELEVATION 357 ft
EXCAVATION CONTRACTOR Client Provided
LATITUDE 46.9303 **LONGITUDE** -122.59519
LOGGED BY SKH **CHECKED BY** SSR
GROUND WATER LEVEL:
NOTES
AT TIME OF EXCAVATION
SURFACE CONDITIONS Field Grass
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			TPSL		Dark brown TOPSOIL, roots to 12"	
1.5						355.5
			GP		Brown poorly graded GRAVEL with sand, medium dense, damp	
	GB	MC = 7.8			-probed 3" -moderate caving to BOH	
5						
10						
14.0	GB	MC = 7.2 Fines = 4.9			[USDA Classification: extremely gravelly loamy coarse SAND]	343.0

Test pit terminated at 14.0 feet below existing grade due to caving. Piezo installed. No groundwater encountered during excavation. Caving observed from 3.0 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

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Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
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TEST PIT NUMBER TP-8

PROJECT NUMBER ES-9150
PROJECT NAME 10800 Vancil Road S.E. Subdivision
DATE STARTED 4/24/23 **COMPLETED** 4/24/23
GROUND ELEVATION 357 ft
EXCAVATION CONTRACTOR Client Provided
LATITUDE 46.92922 **LONGITUDE** -122.59478
LOGGED BY SKH **CHECKED BY** SSR
GROUND WATER LEVEL:
NOTES
∇ **AT TIME OF EXCAVATION**
SURFACE CONDITIONS Field Grass
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			TPSL		Dark brown TOPSOIL, roots to 12"	
1.5						355.5
			GP		Brown poorly graded GRAVEL with sand, medium dense, damp	
	GB	MC = 7.4			-probed 3"	
					-slight caving to BOH	
5						
10						
15.0	GB	MC = 8.5				342.0

Test pit terminated at 15.0 feet below existing grade due to caving. No groundwater encountered during excavation. Caving observed from 3.0 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

GENERAL BH / TP / WELL - 9150.GPJ - GINT US.GDT - 6/6/23

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-9

PROJECT NUMBER ES-9150		**PROJECT NAME** 10800 Vancil Road S.E. Subdivision	
DATE STARTED 4/24/23	**COMPLETED** 4/24/23	**GROUND ELEVATION** 358 ft	
EXCAVATION CONTRACTOR Client Provided		**LATITUDE** 46.92958	**LONGITUDE** -122.59398
LOGGED BY SKH	**CHECKED BY** SSR	**GROUND WATER LEVEL:**	
NOTES		▽ **AT TIME OF EXCAVATION**	
SURFACE CONDITIONS Field Grass		**AFTER EXCAVATION**	

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			TPSL	1.5	Dark brown TOPSOIL, roots to 18"	356.5
	GB	MC = 8.0 Fines = 5.3	GP-GM		Brown poorly graded GRAVEL with silt and sand, medium dense, damp -probed 4" [USDA Classification: extremely gravelly loamy coarse SAND] -slight caving to BOH	
5						
10						
	GB	MC = 8.1		13.0	-becomes gray	345.0

Test pit terminated at 13.0 feet below existing grade due to caving. No groundwater encountered during excavation. Caving observed from 3.0 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

Earth Solutions NW, LLC
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Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-10

PROJECT NUMBER ES-9150
PROJECT NAME 10800 Vancil Road S.E. Subdivision
DATE STARTED 4/24/23 **COMPLETED** 4/24/23
GROUND ELEVATION 359 ft
EXCAVATION CONTRACTOR Client Provided
LATITUDE 46.92938 **LONGITUDE** -122.59327
LOGGED BY SKH **CHECKED BY** SSR
GROUND WATER LEVEL:
NOTES
AT TIME OF EXCAVATION
SURFACE CONDITIONS Field Grass
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elevation
0			TPSL		Dark brown TOPSOIL, roots to 12"	
1.5						357.5
			GP		Brown poorly graded GRAVEL with sand, medium dense, damp	
3	GB	MC = 7.9			-slight caving to BOH, probed 3"	
5						
10						
					-becomes gray	
13.5	GB	MC = 7.9				345.5

Test pit terminated at 13.5 feet below existing grade due to caving. No groundwater encountered during excavation. Caving observed from 3.0 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

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Telephone: 425-449-4704
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TEST PIT NUMBER TP-11

PROJECT NUMBER ES-9150
PROJECT NAME 10800 Vancil Road S.E. Subdivision
DATE STARTED 4/24/23 **COMPLETED** 4/24/23
GROUND ELEVATION 355 ft
EXCAVATION CONTRACTOR Client Provided
LATITUDE 46.93071 **LONGITUDE** -122.59039
LOGGED BY SKH **CHECKED BY** SSR
GROUND WATER LEVEL:
NOTES
AT TIME OF EXCAVATION
SURFACE CONDITIONS Forest Duff
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elevation
0			TPSL		Dark brown TOPSOIL, roots to 18"	
1.5						353.5
			GP		Brown poorly graded GRAVEL with sand, medium dense, damp	
	GB	MC = 9.1			-probed 3" -moderate caving to BOH	
5						
10						
					-becomes gray	
15	GB	MC = 5.3 Fines = 2.2			[USDA Classification: extremely gravelly coarse SAND]	
15.0						340.0

Test pit terminated at 15.0 feet below existing grade due to caving. Piezo installed. No groundwater encountered during excavation. Caving observed from 3.0 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

GENERAL BH / TP / WELL - 9150.GPJ - GINT US.GDT - 6/6/23

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-12

PROJECT NUMBER ES-9150
PROJECT NAME 10800 Vancil Road S.E. Subdivision
DATE STARTED 4/24/23 **COMPLETED** 4/24/23
GROUND ELEVATION 356 ft
EXCAVATION CONTRACTOR Client Provided
LATITUDE 46.93049 **LONGITUDE** -122.59051
LOGGED BY SKH **CHECKED BY** SSR
GROUND WATER LEVEL:
NOTES
AT TIME OF EXCAVATION
SURFACE CONDITIONS Forest Duff
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elevation
0			TPSL		Dark brown TOPSOIL, roots to 18"	
1.5						354.5
	GB	MC = 7.0	GP		Brown poorly graded GRAVEL with sand, medium dense, damp -probed 3" -moderate caving to BOH	
5						
10						
14.0	GB	MC = 6.0 Fines = 3.5			[USDA Classification: extremely gravelly loamy coarse SAND]	342.0

Test pit terminated at 14.0 feet below existing grade due to caving. Piezo installed. No groundwater encountered during excavation. Caving observed from 3.0 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

GENERAL BH / TP / WELL - 9150.GPJ - GINT US.GDT - 6/6/23

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-13

PROJECT NUMBER ES-9150
PROJECT NAME 10800 Vancil Road S.E. Subdivision
DATE STARTED 4/24/23 **COMPLETED** 4/24/23
GROUND ELEVATION 351 ft
EXCAVATION CONTRACTOR Client Provided
LATITUDE 46.93071 **LONGITUDE** -122.59075
LOGGED BY SKH **CHECKED BY** SSR
GROUND WATER LEVEL:
NOTES
∇ **AT TIME OF EXCAVATION**
SURFACE CONDITIONS Forest Duff
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elevation
0			TPSL		Dark brown TOPSOIL, roots to 18"	
1.5						349.5
			GP		Brown poorly graded GRAVEL with sand, medium dense, damp	
	GB	MC = 7.3			-probed 3"	
					-slight caving to BOH	
10.0						341.0
			GW		Brown well-graded GRAVEL with sand, medium dense, damp to moist	
15.0	GB	MC = 4.8 Fines = 1.3			[USDA Classification: extremely gravelly SAND]	336.0

Test pit terminated at 15.0 feet below existing grade due to caving. Piezo installed. No groundwater encountered during excavation. Caving observed from 3.5 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-14

PROJECT NUMBER ES-9150
PROJECT NAME 10800 Vancil Road S.E. Subdivision
DATE STARTED 4/25/23 **COMPLETED** 4/25/23
GROUND ELEVATION 355 ft
EXCAVATION CONTRACTOR Client Provided
LATITUDE 46.93064 **LONGITUDE** -122.59146
LOGGED BY SKH **CHECKED BY** SSR
GROUND WATER LEVEL:
NOTES
AT TIME OF EXCAVATION
SURFACE CONDITIONS Forest Duff
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			TPSL		Dark brown TOPSOIL, roots to 24"	
1.5						353.5
			GW		Brown well-graded GRAVEL with sand, medium dense, damp to moist	
	GB	MC = 8.8			-probed 3" -moderate caving to BOH	
5						
	GB	MC = 5.2 Fines = 1.5			[USDA Classification: extremely gravelly coarse SAND]	
10						
12.5	GB	MC = 7.1				342.5

Test pit terminated at 12.5 feet below existing grade due to caving. No groundwater encountered during excavation. Caving observed from 3.0 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

GENERAL BH / TP / WELL - 9150.GPJ - GINT US.GDT - 6/6/23

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-15

PROJECT NUMBER ES-9150
PROJECT NAME 10800 Vancil Road S.E. Subdivision
DATE STARTED 4/25/23 **COMPLETED** 4/25/23
GROUND ELEVATION 356 ft
EXCAVATION CONTRACTOR Client Provided
LATITUDE 46.93019 **LONGITUDE** -122.59064
LOGGED BY SKH **CHECKED BY** SSR
GROUND WATER LEVEL:
NOTES
∇ **AT TIME OF EXCAVATION**
SURFACE CONDITIONS Forest Duff
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			TPSL		Dark brown TOPSOIL, roots to 18"	
1.5						354.5
	GB	MC = 10.6	GP		Brown poorly graded GRAVEL with sand, medium dense, damp -probed 3" -moderate caving to BOH	
5						
					-becomes gray	
	GB	MC = 8.5				
10						
15						
16.0	GB	MC = 9.8				340.0

Test pit terminated at 16.0 feet below existing grade due to caving. No groundwater encountered during excavation. Caving observed from 3.5 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

GENERAL BH / TP / WELL - 9150.GPJ - GINT US.GDT - 6/6/23

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-16

PROJECT NUMBER ES-9150
PROJECT NAME 10800 Vancil Road S.E. Subdivision
DATE STARTED 4/25/23 **COMPLETED** 4/25/23
GROUND ELEVATION
EXCAVATION CONTRACTOR Client Provided
LATITUDE 46.9302 **LONGITUDE** -122.59146
LOGGED BY SKH **CHECKED BY** SSR
GROUND WATER LEVEL:
NOTES
AT TIME OF EXCAVATION
SURFACE CONDITIONS Forest Duff
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			TPSL	2.0	Dark brown TOPSOIL, roots to 24"
	GB	MC = 9.2 Fines = 4.3	GW		Brown well-graded GRAVEL with sand, medium dense, damp -probed 3" [USDA Classification: extremely gravelly loamy coarse SAND] -slight caving to BOH
5					
10					
	GB	MC = 7.4		14.0	

Test pit terminated at 14.0 feet below existing grade due to caving. No groundwater encountered during excavation. Caving observed from 3.5 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

GENERAL BH / TP / WELL - 9150.GPJ - GINT US.GDT - 6/6/23

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-17

PROJECT NUMBER ES-9150
PROJECT NAME 10800 Vancil Road S.E. Subdivision
DATE STARTED 4/25/23 **COMPLETED** 4/25/23
GROUND ELEVATION
EXCAVATION CONTRACTOR Client Provided
LATITUDE 46.93064 **LONGITUDE** -122.59233
LOGGED BY SKH **CHECKED BY** SSR
GROUND WATER LEVEL:
NOTES
AT TIME OF EXCAVATION
SURFACE CONDITIONS Forest Duff
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			TPSL	2.0	Dark brown TOPSOIL, roots to 24"
	GB	MC = 7.9	GP		Brown poorly graded GRAVEL with sand, medium dense, damp -probed 3" -moderate caving to BOH
5					
10					
	GB	MC = 6.6		12.0	

Test pit terminated at 12.0 feet below existing grade. No groundwater encountered during excavation. Caving observed from 3.5 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-18

PROJECT NUMBER ES-9150
PROJECT NAME 10800 Vancil Road S.E. Subdivision
DATE STARTED 4/25/23 **COMPLETED** 4/25/23
GROUND ELEVATION 361 ft
EXCAVATION CONTRACTOR Client Provided
LATITUDE 46.93026 **LONGITUDE** -122.59252
LOGGED BY SKH **CHECKED BY** SSR
GROUND WATER LEVEL:
NOTES
∇ **AT TIME OF EXCAVATION**
SURFACE CONDITIONS Forest Duff
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			TPSL		Dark brown TOPSOIL, roots to 18"	
				1.5		359.5
			GP		Brown poorly graded GRAVEL with sand, medium dense, damp	
	GB	MC = 8.4			-probed 4"	
					-slight caving to BOH	
5						
10						
	GB	MC = 4.8		13.5		347.5

Test pit terminated at 13.5 feet below existing grade due to caving. No groundwater encountered during excavation. Caving observed from 3.5 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

Appendix B

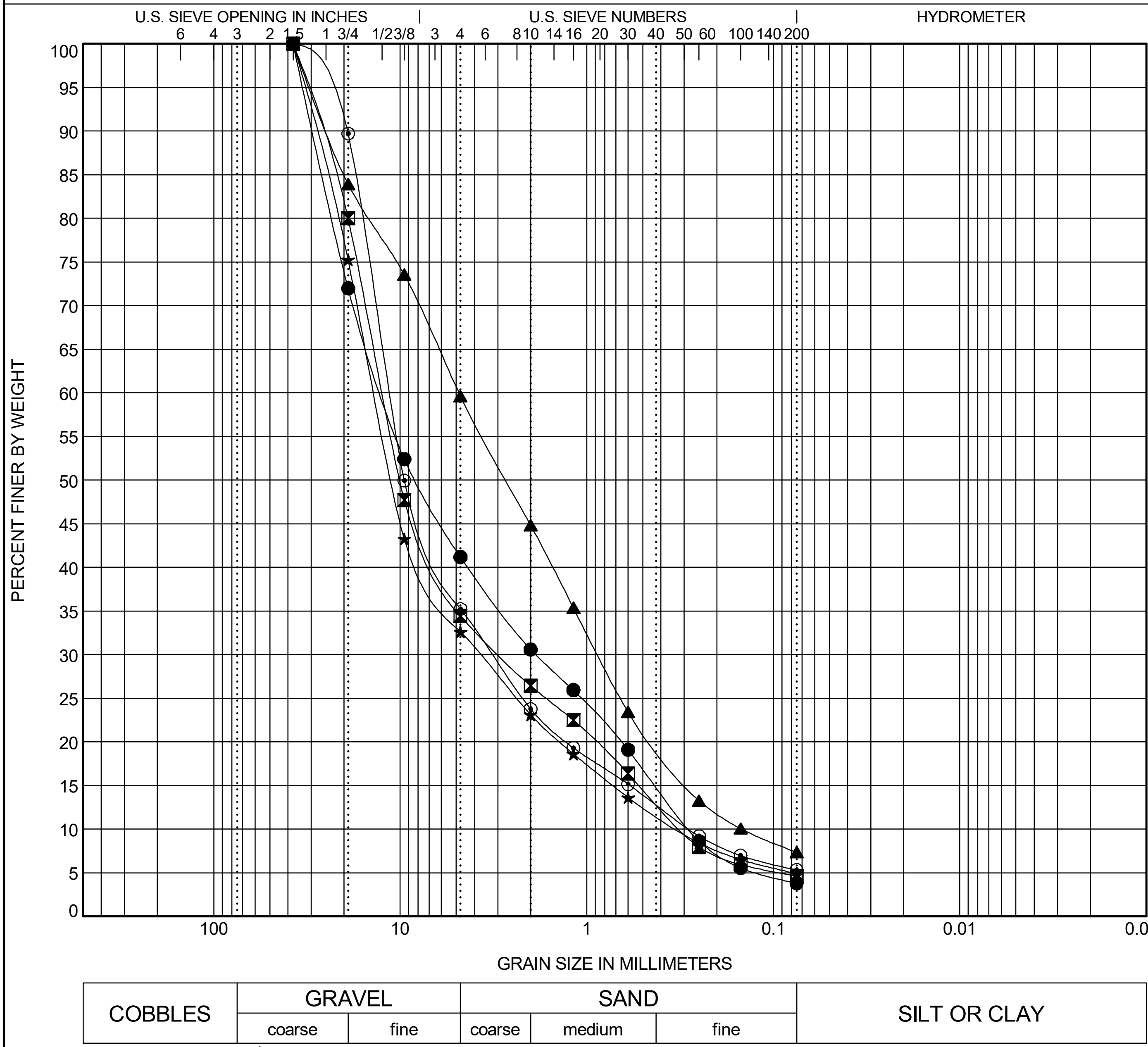
Laboratory Test Results

ES-9150

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

GRAIN SIZE DISTRIBUTION

PROJECT NUMBER ES-9150 **PROJECT NAME** 10800 Vancil Road S.E. Subdivision



	Specimen Identification		Classification	Cc	Cu
●	**TP-02**	**7.50ft.**	**USDA: Brown Extremely Gravelly Coarse Sand. USCS: GW with Sand.**	**1.00**	**44.36**
⧗	**TP-05**	**13.00ft.**	**USDA: Brown Extremely Gravelly Loamy Coarse Sand. USCS: GW with Sand.**	**2.26**	**40.04**
▲	**TP-06**	**16.00ft.**	**USDA: Brown Very Gravelly Loamy Coarse Sand. USCS: SW-SM with Gravel.**	**1.07**	**32.95**
★	**TP-07**	**14.00ft.**	**USDA: Brown Extremely Gravelly Loamy Coarse Sand. USCS: GP with Sand.**	**3.15**	**41.95**
⊙	**TP-09**	**2.00ft.**	**USDA: Brown Extremely Gravelly Loamy Coarse Sand. USCS: GP-GM with Sand.**	**3.22**	**40.31**

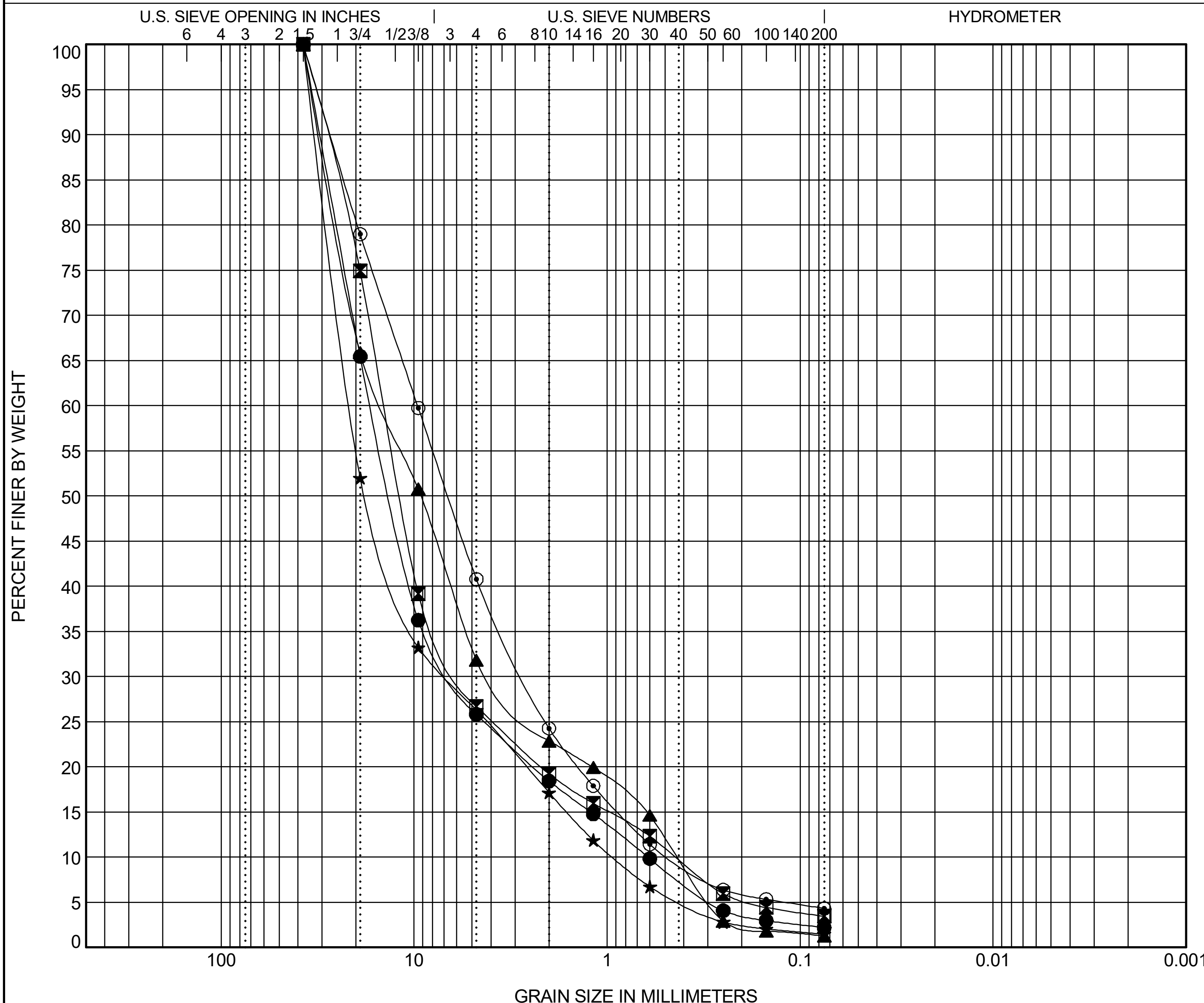
	Specimen Identification		D100	D60	D30	D10	LL	PL	PI	%Silt	%Clay
●	**TP-02**	**7.5ft.**	**37.5**	**12.425**	**1.868**	**0.28**				**3.8**	
⧗	**TP-05**	**13.0ft.**	**37.5**	**12.362**	**2.94**	**0.309**				**4.7**	
▲	**TP-06**	**16.0ft.**	**37.5**	**4.834**	**0.87**	**0.147**				**7.4**	
★	**TP-07**	**14.0ft.**	**37.5**	**13.65**	**3.741**	**0.325**				**4.9**	
⊙	**TP-09**	**2.0ft.**	**37.5**	**11.317**	**3.196**	**0.281**				**5.3**	

GRAIN SIZE USDA ES-9150 10800 VANCIL ROAD S.E. SUBDIVISION.GPJ GINT US LAB.GDT 5/3/23

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

GRAIN SIZE DISTRIBUTION

PROJECT NUMBER ES-9150 **PROJECT NAME** 10800 Vancil Road S.E. Subdivision



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	Cc	Cu
●	TP-11	15.00ft.	USDA: Gray Extremely Gravelly Coarse Sand. USCS: GP with Sand.	3.85	27.25
⧗	TP-12	14.00ft.	USDA: Brown Extremely Gravelly Loamy Coarse Sand. USCS: GP with Sand.	5.25	32.63
▲	TP-13	15.00ft.	USDA: Brown Extremely Gravelly Sand. USCS: GW with Sand.	2.58	34.17
★	TP-14	6.00ft.	USDA: Brown Extremely Gravelly Coarse Sand. USCS: GW with Sand.	2.41	23.12
⊙	TP-16	3.00ft.	USDA: Brown Extremely Gravelly Loamy Coarse Sand. USCS: GW with Sand.	1.62	20.48

	Specimen Identification		D100	D60	D30	D10	LL	PL	PI	%Silt	%Clay
●	TP-11	15.0ft.	37.5	16.693	6.273	0.613				2.2	
⧗	TP-12	14.0ft.	37.5	14.225	5.708	0.436				3.5	
▲	TP-13	15.0ft.	37.5	14.5	3.987	0.424				1.3	
★	TP-14	6.0ft.	37.5	21.278	6.876	0.92				1.5	
⊙	TP-16	3.0ft.	37.5	9.585	2.699	0.468				4.3	

GRAIN SIZE USDA ES-9150 10800 VANCIL ROAD S.E. SUBDIVISION.GPJ GINT US LAB.GDT 5/3/23

Report Distribution

ES-9150

EMAIL ONLY

Copper Ridge, LLC
P.O. Box 73790
Puyallup, Washington 98373

Attention: Evan Mann

Country Meadows Estates Phase 2
Staff Report Supplement
Exhibit D: Stormwater Report

Stormwater Report

PREPARED FOR:

Mr. Evan Mann
Copper Ridge LLC
PO Box 73790
Puyallup, WA 98373-0790

PROJECT:

County Meadows Estates
Phase 2 Preliminary Plat
Yelm, Washington
2230299.10

PREPARED BY:

Chris Flyckt, PE
Project Engineer

REVIEWED BY:

J. Matthew Weber, PE
Principal

DATE:

August 2023

Civil Engineers ● Structural Engineers ● Landscape Architects ● Community Planners ● Land Surveyors

Stormwater Report

PREPARED FOR:

Mr. Evan Mann
Copper Ridge LLC
PO Box 73790
Puyallup, WA 98373-0790

PROJECT:

County Meadows Estates
Phase 2 Preliminary Plat
Yelm, Washington
2230299.10

PREPARED BY:

Chris Flyckt, PE
Project Engineer

REVIEWED BY:

J. Matthew Weber, PE
Principal

DATE:

August 2023

08/11/2023

I hereby state that this Stormwater Report for County Meadows Estates Phase 2 Preliminary Plat has been prepared by me or under my supervision and meets the standard of care and expertise that is usual and customary in this community for professional engineers. I understand that City of Yelm does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities prepared by me.

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Appendices

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Stormwater Facility Sizing Calculations

Appendix C

Geotechnical Report
Earth Solutions NW, LLC
June 14, 2023

1.0 Project Overview

The following hydrology report summarizes the storm drainage analysis and design for a 29-lot development located on Morris Road in Yelm, Thurston County, Washington. Per the surveyed boundary the land is 4.81-acres. The project includes the addition of 29 residential lots for single-family homes, a new public road and sidewalks, sewer, water services, and stormwater facilities to treat and dispose of the project's stormwater. The proposed roadway features and utilities will be extended from Morris Road SE.

No offsite road improvements will be required, other than frontage improvements along Morris Road SE.

The 4.81-acre site is located in Section 30, Township 17 North, Range 02 East, W.M.
The Thurston County tax parcel number associated with the project is 22730410000.

The developed site and resulting stormwater runoff will be managed in accordance with the most recent Washington State Department of Ecology *Stormwater Management Manual for Western Washington (SWMMWW)*.

2.0 Summary of Minimum Requirements

This project is subject to the *SWMMWW* and is a new development that will add more than 10,000 square feet of impervious surfaces; therefore, all Minimum Requirements (MR) apply to this project.

2.1 MR 1 – Preparation of Stormwater Site Plans

This report and the project plans represent the Stormwater Site Plan (SWPPP) for this project and satisfy MR 1.

2.2 MR 2 - Construction Stormwater Pollution Prevention

A Construction Stormwater Pollution Prevention Plan will be prepared with final engineering.

2.3 MR 3 – Source Control of Pollution

Pollution source control will be provided for the site by separating roof runoff from pollution generating surfaces. The residential roads should be maintained and cleaned of debris, garbage, and sediment, as required.

The Construction SWPPP, addressing MR 3, will be prepared with final engineering.

2.4 MR 4 – Preservation of Natural Drainage Systems and Outfalls

The project proposes to infiltrate all stormwater runoff, so all runoff will be retained in the developed condition. There are no natural drainage systems or outfalls to preserve.

2.5 MR 5 – Onsite Stormwater Control

This project will meet the Low Impact Development (LID) Performance Standard. The onsite soils have a high infiltration capacity and all runoff will be retained onsite through treatment systems and infiltration facilities. The LID Performance Standard will be met by infiltrating all stormwater runoff from the site. Refer to Section 10.0 for facility sizing.

2.6 MR 6 – Runoff Treatment

Over 5,000 square feet of pollution generating impervious surface (PGIS) will be added as part of these improvements; therefore, runoff treatment is required for this site. Stormwater from the roadways will be conveyed to stormwater treatment filters before being infiltrated. One distinct basin will convey stormwater to a treatment system and infiltration trench. Final treatment system sizing will be completed with final engineering.

2.7 MR 7 – Flow Control

The project exceeds the thresholds for new development projects and must provide flow control. Proposed flow control is achieved with the use of infiltration trenches that will infiltrate 100 percent of runoff. Refer to Section 10.0 for facility sizing.

2.8 MR 8 – Wetlands Protection

To our knowledge, no wetlands are located on or adjacent to the site.

2.9 MR 9 – Basin/Watershed Planning

To our knowledge, no basin plans exist for the site. All of Yelm is within a critical aquifer recharge area. Treatment of stormwater prior to infiltration is proposed via media filter manholes. Final sizing of the treatment system will be done with final engineering.

2.10 MR 10 – Operation and Maintenance

The stormwater system for the roadway improvements will be publicly owned and maintained. City of Yelm shall be responsible for the operation and maintenance of the public stormwater facilities. An Operation and Maintenance Plan consisting of maintenance checklists for stormwater management will be prepared with final engineering. Operation and maintenance for drainage facilities constructed for each lot shall be the responsibility of the individual owners.

3.0 Existing Conditions

The site is presently covered with grass and over 200 deciduous trees spread through the area, with slopes ranging from 0 to 3 percent.

4.0 Soils Reports

Site soils are identified by the Natural Resources Conservation Service (NRCS) Web Soil Survey as Spanaway gravelly sandy loam, a Type A soil. This soil is characterized as very deep, somewhat excessively drained.

Earth Solutions NW, LLC conducted a site investigation to confirm subsurface soil conditions and establish a design infiltration rate. Soil test holes were dug in the vicinity of the proposed infiltration basins of the project and observations confirm that the soil types match the SCS soil description. A soil log map showing the location of the test holes is included in the geotechnical report. The report recommends a design infiltration rate of 30 inches per hour. Refer to Appendix C for the complete Earth Solutions NW report.

5.0 Wells

To our knowledge, no wells are located onsite.

6.0 Fuel Tanks

No fuel tanks were observed at the project site.

7.0 Sub-Basin Description

Per our review of field topography and county GIS it does not appear that offsite runoff enters the site. The undeveloped property to the north generally slopes to the northeast. The undeveloped property to the south generally slopes to the east. The soils in the vicinity have a high infiltration capacity and likely generate minimal surface runoff in the existing conditions.

There is one basin in the developed condition. A treatment and infiltration system is proposed to manage all runoff associated with the new public road, landscape areas, and on-lot driveways. The frontage road will continue to direct runoff to the existing shoulder north of the site mimicking the existing condition. The impervious areas used for determining flow control and water treatment do not include individual lots. On-lot runoff will be collected and infiltrated in individual drywells. Refer to Appendix A-3 for the Developed Conditions Map. Drywell sizing will be provided with final engineering.

8.0 Analysis of the 100-Year Flood

Federal Emergency Management Agency (FEMA) mapping does not indicate flooding in the immediate area. Refer to the exhibit in Appendix A-4.

9.0 Aesthetic Considerations for Facilities

The proposed stormwater infiltration facilities will be underground and have minimal impact to the aesthetics of the site.

10.0 Facility Sizing and Downstream Analysis

The stormwater system was sized and analyzed using the latest edition of the Western Washington Hydrology Model (WWHM) continuous modeling software. Conservative infiltration rates of 30 inches per hour were used for the design calculations.

10.1 Conveyance

Conveyance sizing will be completed with final engineering.

10.2 Treatment

Basic treatment will be provided via media filter cartridge manholes/catch basins. Final sizing will be completed with final engineering.

10.3 Flow Control

Flow control will be provided by an infiltration trench. The basin will have a single trench.

Basin A will have a 4.0-foot deep trench with a bottom area of 1,700 square feet that will be constructed in the open space in Tract A.

Infiltration Basin Summary

Basin	Pervious Area (ac)	Impervious Area (ac)	Impervious Area Offsite (ac)	Required Trench Area (sf)	Percent Infiltrated
A	1.65	1.50	0.23	1,700	100

The remaining 1.66 acres on the site are assumed to be covered by roofs; 2,500 square feet per lot was used as an impervious roof assumption. This runoff will be infiltrated by individual roof downspout infiltration trenches on each lot and as such is not included in the model.

The infiltration basin was sized in accordance with the *SWMMWW* and exceeds the required storage volumes.

10.4 Roof Runoff

Stormwater for the roof area of the homes will be infiltrated in individual infiltration trenches. The trenches will be sized in accordance with *SWMMWW* Volume 3, Chapter 3, Section 3.1.1 - BMP T5.10A Downspout Full Infiltration System. Refer to Appendix B-1 for the roof downspout system detail.

11.0 Covenants Dedications, Easements

The storm facilities for the right-of-way improvements shall be publicly owned and maintained. A maintenance agreement should be executed to ensure future maintenance of the facilities. The on-lot systems will be privately owned and maintained and therefore do not require covenants, dedications, or easements.

12.0 Property Owners Association Articles of Incorporation

Not applicable.

13.0 Conclusion

The proposed project involves site improvements associated with a 29-lot development. The project includes clearing, grading, erosion control, utility improvements, and stormwater management facilities. The site, as proposed, will meet the requirements of the most recent Department of Ecology *Stormwater Management Manual for Western Washington (SWMMWW)*. This report and associated plans have been prepared within the guidelines established by City of Yelm for stormwater management.

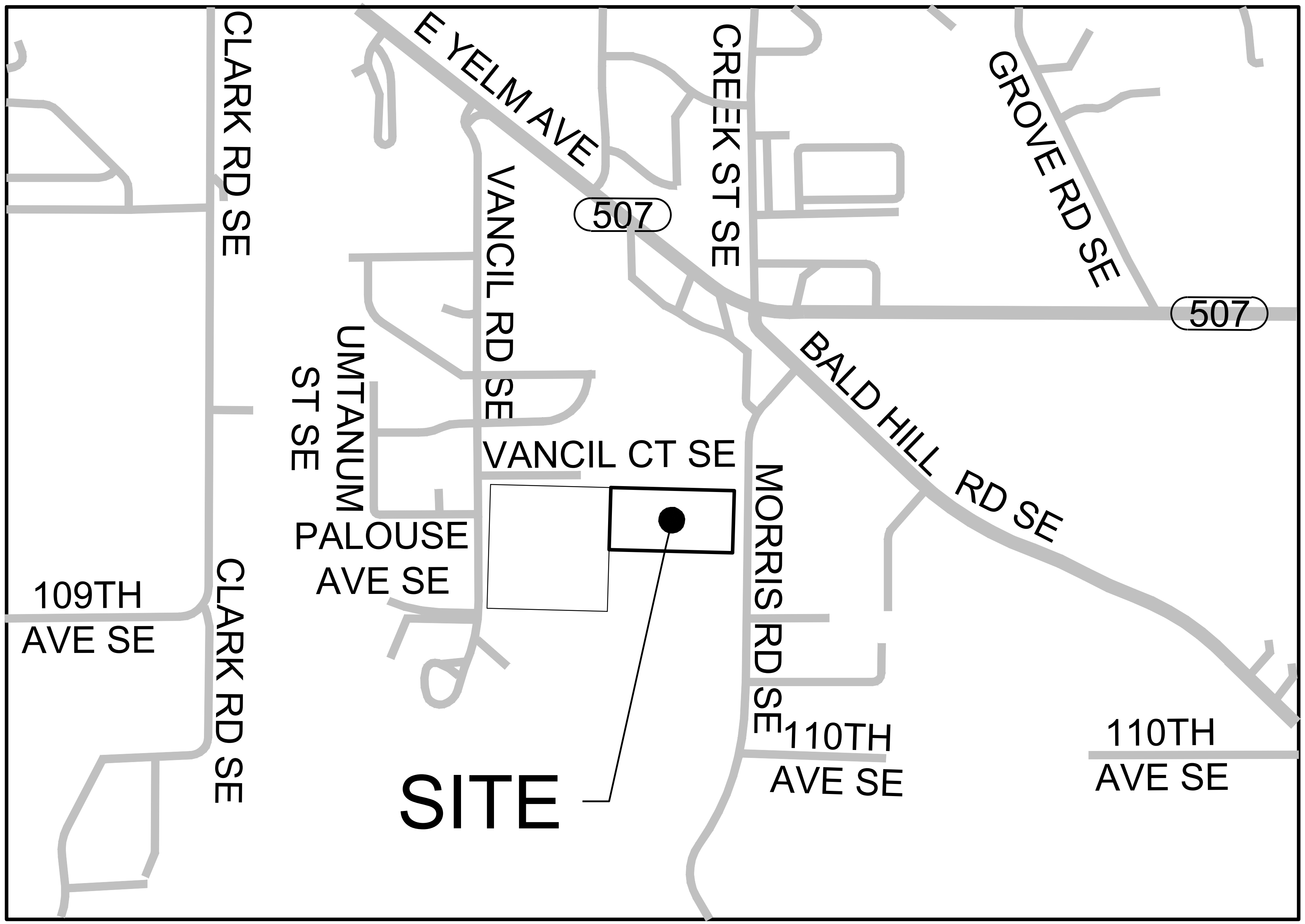
This analysis is based on data and records either supplied to or obtained by AHBL. These documents are referenced within the text of the analysis. The analysis has been prepared using procedures and practices within the standard accepted practices of the industry.

AHBL, Inc.

Chris Flyckt, PE
Project Engineer

Appendix A

Exhibits



VICINITY MAP

SCALE: 1" = 660' (1/8 MILE)

AHBL

2215 North 30th Street,
Suite 300,
Tacoma, WA 98403
253.383.2422 TEL
253.383.2572 FAX

Country Meadows Estate Preliminary Plat Phase 2	JOB NO.
VICINITY MAP	DATE:
	A-1

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Thurston County Area, Washington

July 17, 2023

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map

Map Scale: 1:1,250 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 15, 30, 60, 90

Feet: 0, 50, 100, 200, 300

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

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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

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

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

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

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

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

Soil Survey Area: Thurston County Area, Washington
Survey Area Data: Version 16, Sep 8, 2022

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

Date(s) aerial images were photographed: Jul 18, 2020—Jul 20, 2020

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
110	Spanaway gravelly sandy loam, 0 to 3 percent slopes	2.5	31.5%
112	Spanaway stony sandy loam, 0 to 3 percent slopes	5.4	68.5%
Totals for Area of Interest		**7.8**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Thurston County Area, Washington

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

Map Unit Setting

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

Map Unit Composition

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

Description of Spanaway

Setting

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

Typical profile

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

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Ecological site: R002XA006WA - Puget Lowlands Prairie
Forage suitability group: Droughty Soils (G002XS401WA)
Other vegetative classification: Droughty Soils (G002XS401WA)
Hydric soil rating: No

112—Spanaway stony sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2ndb8

Elevation: 660 to 1,310 feet
Mean annual precipitation: 35 to 65 inches
Mean annual air temperature: 50 degrees F
Frost-free period: 150 to 200 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Spanaway

Setting

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

Typical profile

H1 - 0 to 16 inches: stony sandy loam
H2 - 16 to 22 inches: very gravelly sandy loam
H3 - 22 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Ecological site: R002XA006WA - Puget Lowlands Prairie
Forage suitability group: Droughty Soils (G002XS401WA)
Other vegetative classification: Droughty Soils (G002XS401WA)
Hydric soil rating: No

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

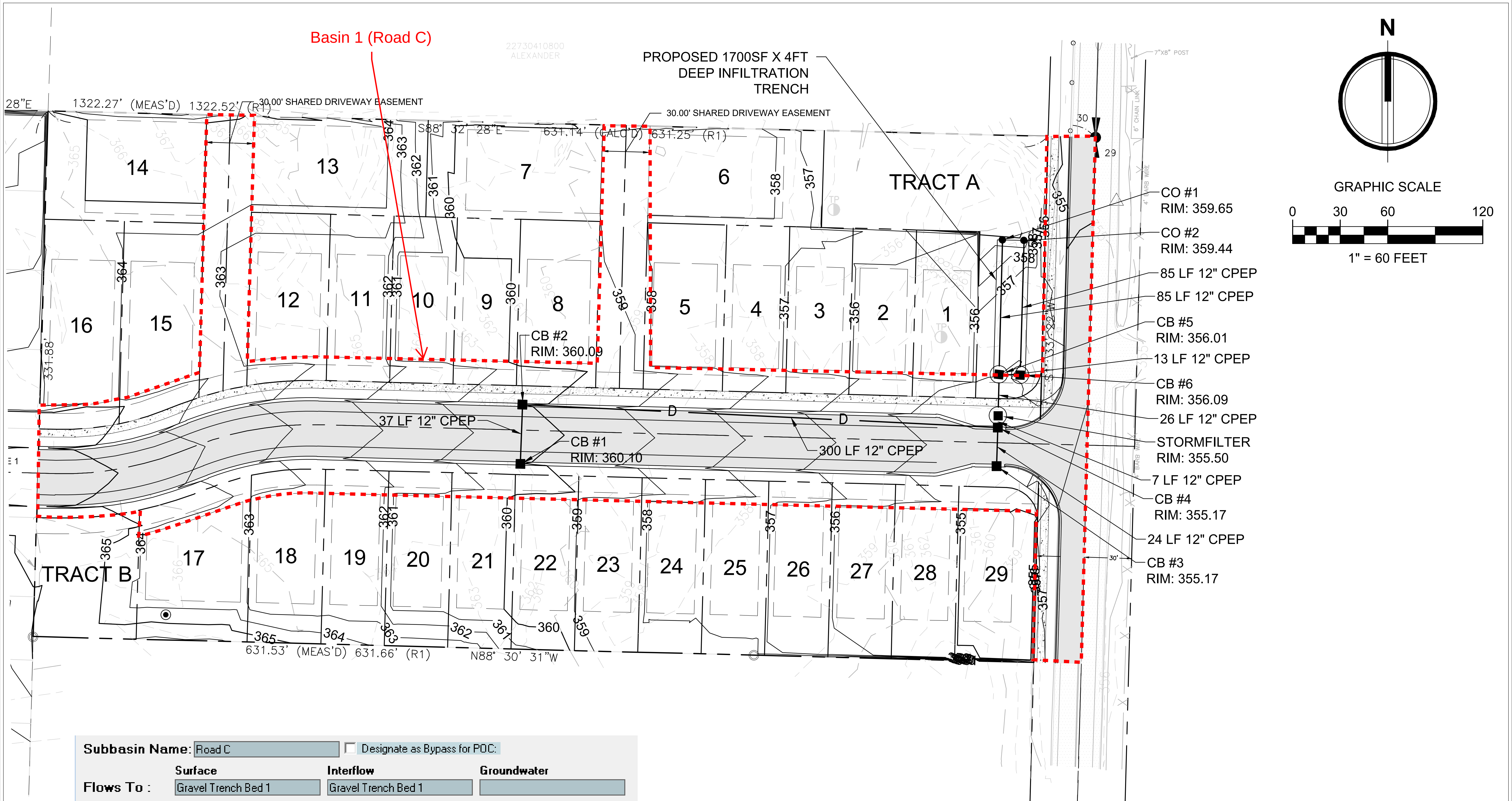
United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf



Subbasin Name: Road C ☐ Designate as Bypass for POC:

	Surface	Interflow	Groundwater
Flows To :	Gravel Trench Bed 1	Gravel Trench Bed 1	

Area in Basin ☑ Show Only Selected

Available Pervious	Acres	Available Impervious	Acres
☑ A/B, Forest, Flat	.2	☑ ROADS/FLAT	1.73
☑ A/B, Lawn, Flat	1.65		

AHBL

2215 North 30th Street,
Suite 300,
Tacoma, WA 98403
253.383.2422 TEL
253.383.2572 FAX

COUNTRY MEADOW ESTATES
PHASE 2

DEVELOPED CONDITIONS MAP

JOB NO.

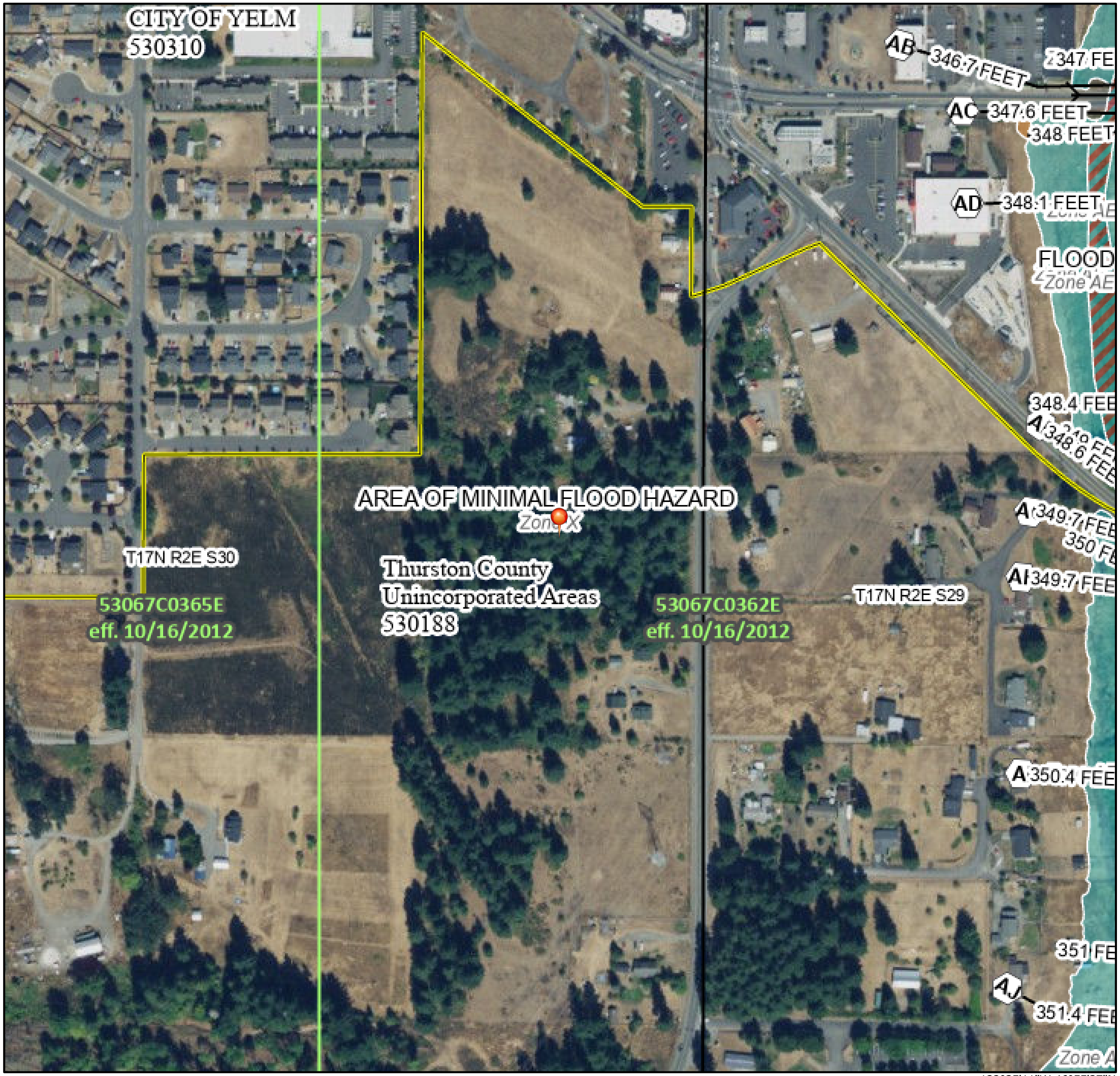
DATE:

A-3

National Flood Hazard Layer FIRMette

FEMA

122°35'48"W 46°56'1"N



Feet

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

1:6,000

122°35'11"W 46°55'37"N

Basemap Imagery Source: USGS National Map 2023

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	B 20.2 / 17.5	Cross Sections with 1% Annual Chance Water Surface Elevation
	8	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 7/18/2023 at 3:45 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.

Appendix B

Stormwater Facility Sizing Calculations

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	20230802 CountryMeadowsPhase2PrelimSizing
Site Name:	Country Meadows Estates Phase 2
Site Address:	
City:	Yelm
Report Date:	8/9/2023
Gage:	Lake Lawrence
Data Start:	1955/10/01
Data End:	2008/09/30
Timestep:	15 Minute
Precip Scale:	0.857
Version Date:	2021/08/18
Version:	4.2.18

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

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Forest, Flat	3.38
Pervious Total	3.38
Impervious Land Use	acre
Impervious Total	0
Basin Total	3.38

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Road C

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Forest, Flat	0.2
A B, Lawn, Flat	1.65
Pervious Total	1.85
Impervious Land Use	acre
ROADS FLAT	1.73
Impervious Total	1.73
Basin Total	3.58

Element Flows To:

Surface	Interflow	Groundwater
Gravel Trench Bed 1	Gravel Trench Bed 1	

Routing Elements
Predeveloped Routing

Mitigated Routing

Gravel Trench Bed 1

Bottom Length:	40.43 ft.
Bottom Width:	40.43 ft.
Trench bottom slope 1:	0 To 1
Trench Left side slope 0:	0 To 1
Trench right side slope 2:	0 To 1
Material thickness of first layer:	1
Pour Space of material for first layer:	0.33
Material thickness of second layer:	1
Pour Space of material for second layer:	0.33
Material thickness of third layer:	2
Pour Space of material for third layer:	0.33
Infiltration On	
Infiltration rate:	30
Infiltration safety factor:	1
Total Volume Infiltrated (ac-ft.):	304.241
Total Volume Through Riser (ac-ft.):	0
Total Volume Through Facility (ac-ft.):	304.241
Percent Infiltrated:	100
Total Precip Applied to Facility:	0
Total Evap From Facility:	0

Discharge Structure

Riser Height:	4 ft.
Riser Diameter:	10 in.

Element Flows To:

Outlet 1	Outlet 2

Gravel Trench Bed Hydraulic Table

Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**Infilt(cfs)**
0.0000	0.037	0.000	0.000	0.000
0.0444	0.037	0.000	0.000	1.135
0.0889	0.037	0.001	0.000	1.135
0.1333	0.037	0.001	0.000	1.135
0.1778	0.037	0.002	0.000	1.135
0.2222	0.037	0.002	0.000	1.135
0.2667	0.037	0.003	0.000	1.135
0.3111	0.037	0.003	0.000	1.135
0.3556	0.037	0.004	0.000	1.135
0.4000	0.037	0.005	0.000	1.135
0.4444	0.037	0.005	0.000	1.135
0.4889	0.037	0.006	0.000	1.135
0.5333	0.037	0.006	0.000	1.135
0.5778	0.037	0.007	0.000	1.135
0.6222	0.037	0.007	0.000	1.135
0.6667	0.037	0.008	0.000	1.135
0.7111	0.037	0.008	0.000	1.135
0.7556	0.037	0.009	0.000	1.135
0.8000	0.037	0.009	0.000	1.135
0.8444	0.037	0.010	0.000	1.135
0.8889	0.037	0.011	0.000	1.135
0.9333	0.037	0.011	0.000	1.135
0.9778	0.037	0.012	0.000	1.135
1.0222	0.037	0.012	0.000	1.135

1.0667	0.037	0.013	0.000	1.135
1.1111	0.037	0.013	0.000	1.135
1.1556	0.037	0.014	0.000	1.135
1.2000	0.037	0.014	0.000	1.135
1.2444	0.037	0.015	0.000	1.135
1.2889	0.037	0.016	0.000	1.135
1.3333	0.037	0.016	0.000	1.135
1.3778	0.037	0.017	0.000	1.135
1.4222	0.037	0.017	0.000	1.135
1.4667	0.037	0.018	0.000	1.135
1.5111	0.037	0.018	0.000	1.135
1.5556	0.037	0.019	0.000	1.135
1.6000	0.037	0.019	0.000	1.135
1.6444	0.037	0.020	0.000	1.135
1.6889	0.037	0.020	0.000	1.135
1.7333	0.037	0.021	0.000	1.135
1.7778	0.037	0.022	0.000	1.135
1.8222	0.037	0.022	0.000	1.135
1.8667	0.037	0.023	0.000	1.135
1.9111	0.037	0.023	0.000	1.135
1.9556	0.037	0.024	0.000	1.135
2.0000	0.037	0.024	0.000	1.135
2.0444	0.037	0.025	0.000	1.135
2.0889	0.037	0.025	0.000	1.135
2.1333	0.037	0.026	0.000	1.135
2.1778	0.037	0.027	0.000	1.135
2.2222	0.037	0.027	0.000	1.135
2.2667	0.037	0.028	0.000	1.135
2.3111	0.037	0.028	0.000	1.135
2.3556	0.037	0.029	0.000	1.135
2.4000	0.037	0.029	0.000	1.135
2.4444	0.037	0.030	0.000	1.135
2.4889	0.037	0.030	0.000	1.135
2.5333	0.037	0.031	0.000	1.135
2.5778	0.037	0.031	0.000	1.135
2.6222	0.037	0.032	0.000	1.135
2.6667	0.037	0.033	0.000	1.135
2.7111	0.037	0.033	0.000	1.135
2.7556	0.037	0.034	0.000	1.135
2.8000	0.037	0.034	0.000	1.135
2.8444	0.037	0.035	0.000	1.135
2.8889	0.037	0.035	0.000	1.135
2.9333	0.037	0.036	0.000	1.135
2.9778	0.037	0.036	0.000	1.135
3.0222	0.037	0.037	0.000	1.135
3.0667	0.037	0.038	0.000	1.135
3.1111	0.037	0.038	0.000	1.135
3.1556	0.037	0.039	0.000	1.135
3.2000	0.037	0.039	0.000	1.135
3.2444	0.037	0.040	0.000	1.135
3.2889	0.037	0.040	0.000	1.135
3.3333	0.037	0.041	0.000	1.135
3.3778	0.037	0.041	0.000	1.135
3.4222	0.037	0.042	0.000	1.135
3.4667	0.037	0.042	0.000	1.135
3.5111	0.037	0.043	0.000	1.135
3.5556	0.037	0.044	0.000	1.135
3.6000	0.037	0.044	0.000	1.135

3.6444	0.037	0.045	0.000	1.135
3.6889	0.037	0.045	0.000	1.135
3.7333	0.037	0.046	0.000	1.135
3.7778	0.037	0.046	0.000	1.135
3.8222	0.037	0.047	0.000	1.135
3.8667	0.037	0.047	0.000	1.135
3.9111	0.037	0.048	0.000	1.135
3.9556	0.037	0.049	0.000	1.135
4.0000	0.037	0.049	0.000	1.135

Analysis Results
POC 1
POC #1 was not reported because POC must exist in both scenarios and both scenarios must have been run.

Model Default Modifications

Total of 0 changes have been made.

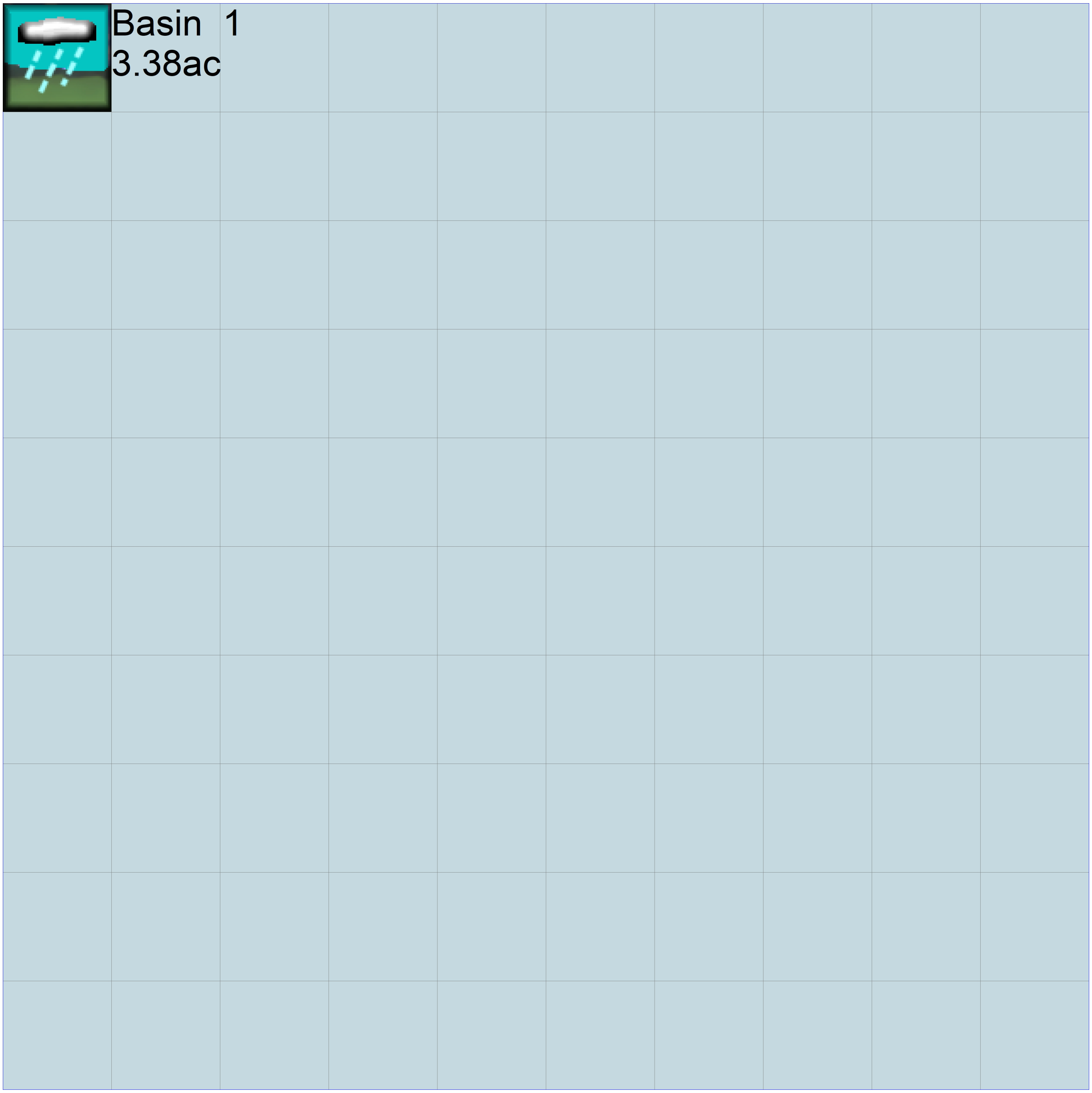
PERLND Changes

No PERLND changes have been made.

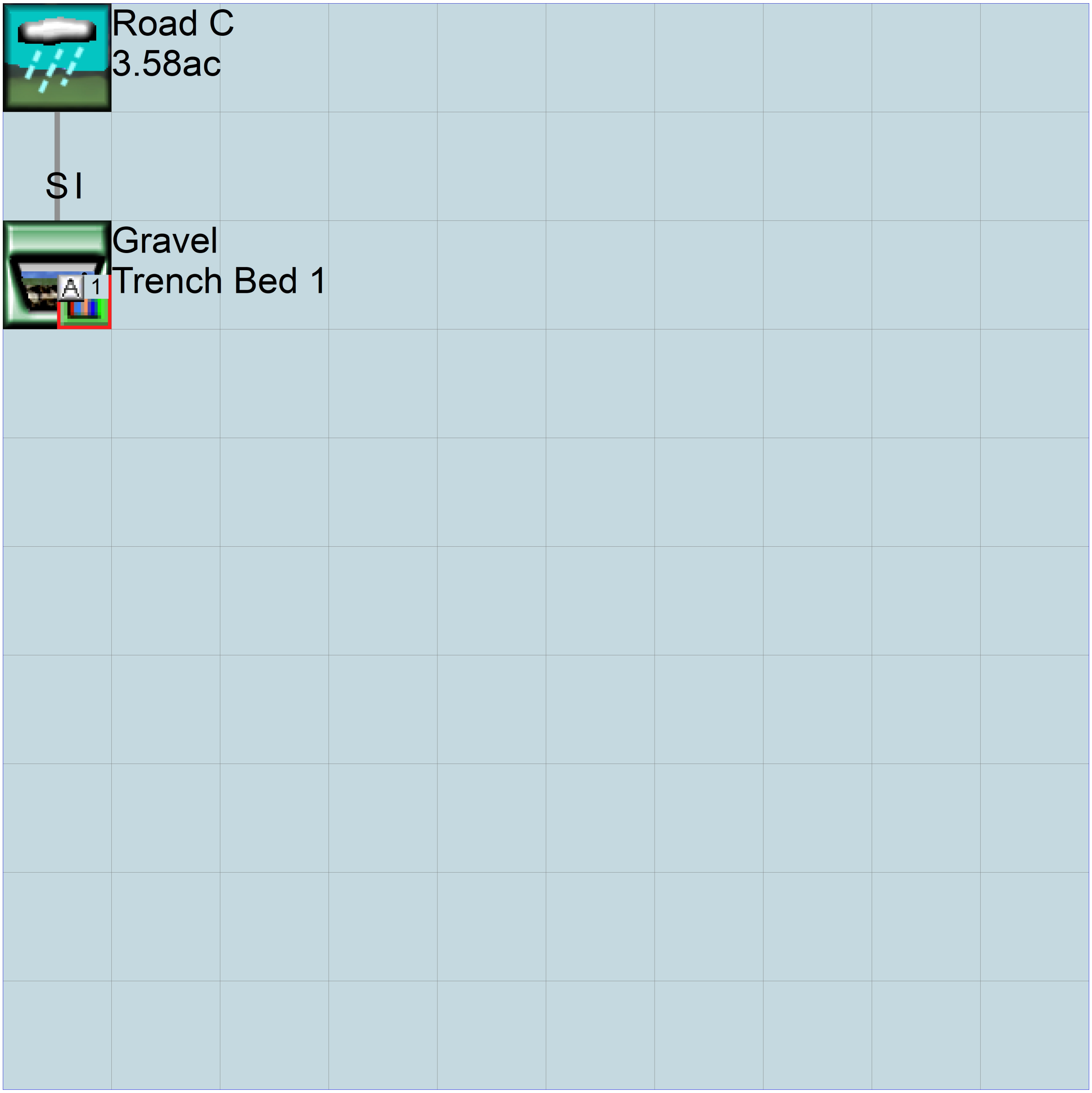
IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

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   20230802 CountryMeadowsPhase2PrelimSizing.wdm
MESSU      25   Mit20230802 CountryMeadowsPhase2PrelimSizing.MES
           27   Mit20230802 CountryMeadowsPhase2PrelimSizing.L61
           28   Mit20230802 CountryMeadowsPhase2PrelimSizing.L62
           30   POC20230802 CountryMeadowsPhase2PrelimSizing1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND       1
      PERLND       7
      IMPLND       1
      RCHRES       1
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Gravel Trench Bed 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           ***
    1     A/B, Forest, Flat       1    1    1    1   27    0
    7     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 ***
    1         0    0    1    0    0    0    0    0    0    0    0    0
    7         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  *********
    1         0    0    4    0    0    0    0    0    0    0    0    0    1    9
    7         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 ***
    1         0    0    0    0    0    0    0    0    0    0    0
    7         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
    1              0         5         2       400      0.05       0.3     0.996
    7              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
    1              0         0         2         2         0         0         0
    7              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    1            0.2       0.5      0.35         0       0.7       0.7
    7            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
    1              0         0         0         0         3         1         0
    7              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           ***
    1      ROADS/FLAT             1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         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     ***
    1         0    0    0    0    0
  END IWAT-PARM1
```

```
  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Road C***
PERLND   1                         0.2     RCHRES   1      2
PERLND   1                         0.2     RCHRES   1      3
PERLND   7                        1.65     RCHRES   1      2
PERLND   7                        1.65     RCHRES   1      3
IMPLND   1                        1.73     RCHRES   1      5

******Routing******
PERLND   1                         0.2     COPY     1     12
PERLND   7                        1.65     COPY     1     12
IMPLND   1                        1.73     COPY     1     15
PERLND   1                         0.2     COPY     1     13
PERLND   7                        1.65     COPY     1     13
RCHRES   1                           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     Gravel Trench Be-005    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
  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
```

```
  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
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1             1      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
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      1
   92    5
     Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.037523  0.000000  0.000000  0.000000
  0.044444  0.037523  0.000550  0.000000  1.135064
  0.088889  0.037523  0.001101  0.000000  1.135064
  0.133333  0.037523  0.001651  0.000000  1.135064
  0.177778  0.037523  0.002201  0.000000  1.135064
  0.222222  0.037523  0.002752  0.000000  1.135064
  0.266667  0.037523  0.003302  0.000000  1.135064
  0.311111  0.037523  0.003852  0.000000  1.135064
  0.355556  0.037523  0.004403  0.000000  1.135064
  0.400000  0.037523  0.004953  0.000000  1.135064
  0.444444  0.037523  0.005503  0.000000  1.135064
  0.488889  0.037523  0.006054  0.000000  1.135064
  0.533333  0.037523  0.006604  0.000000  1.135064
  0.577778  0.037523  0.007154  0.000000  1.135064
  0.622222  0.037523  0.007705  0.000000  1.135064
  0.666667  0.037523  0.008255  0.000000  1.135064
  0.711111  0.037523  0.008805  0.000000  1.135064
  0.755556  0.037523  0.009356  0.000000  1.135064
  0.800000  0.037523  0.009906  0.000000  1.135064
  0.844444  0.037523  0.010456  0.000000  1.135064
  0.888889  0.037523  0.011007  0.000000  1.135064
  0.933333  0.037523  0.011557  0.000000  1.135064
  0.977778  0.037523  0.012107  0.000000  1.135064
  1.022222  0.037523  0.012658  0.000000  1.135064
  1.066667  0.037523  0.013208  0.000000  1.135064
  1.111111  0.037523  0.013758  0.000000  1.135064
  1.155556  0.037523  0.014309  0.000000  1.135064
  1.200000  0.037523  0.014859  0.000000  1.135064
  1.244444  0.037523  0.015409  0.000000  1.135064
  1.288889  0.037523  0.015960  0.000000  1.135064
  1.333333  0.037523  0.016510  0.000000  1.135064
  1.377778  0.037523  0.017060  0.000000  1.135064
  1.422222  0.037523  0.017611  0.000000  1.135064
  1.466667  0.037523  0.018161  0.000000  1.135064
  1.511111  0.037523  0.018711  0.000000  1.135064
  1.555556  0.037523  0.019262  0.000000  1.135064
  1.600000  0.037523  0.019812  0.000000  1.135064
  1.644444  0.037523  0.020362  0.000000  1.135064
  1.688889  0.037523  0.020913  0.000000  1.135064
```

```
  1.733333  0.037523  0.021463  0.000000  1.135064
  1.777778  0.037523  0.022013  0.000000  1.135064
  1.822222  0.037523  0.022564  0.000000  1.135064
  1.866667  0.037523  0.023114  0.000000  1.135064
  1.911111  0.037523  0.023664  0.000000  1.135064
  1.955556  0.037523  0.024215  0.000000  1.135064
  2.000000  0.037523  0.024765  0.000000  1.135064
  2.044444  0.037523  0.025315  0.000000  1.135064
  2.088889  0.037523  0.025866  0.000000  1.135064
  2.133333  0.037523  0.026416  0.000000  1.135064
  2.177778  0.037523  0.026966  0.000000  1.135064
  2.222222  0.037523  0.027517  0.000000  1.135064
  2.266667  0.037523  0.028067  0.000000  1.135064
  2.311111  0.037523  0.028617  0.000000  1.135064
  2.355556  0.037523  0.029168  0.000000  1.135064
  2.400000  0.037523  0.029718  0.000000  1.135064
  2.444444  0.037523  0.030268  0.000000  1.135064
  2.488889  0.037523  0.030819  0.000000  1.135064
  2.533333  0.037523  0.031369  0.000000  1.135064
  2.577778  0.037523  0.031919  0.000000  1.135064
  2.622222  0.037523  0.032470  0.000000  1.135064
  2.666667  0.037523  0.033020  0.000000  1.135064
  2.711111  0.037523  0.033570  0.000000  1.135064
  2.755556  0.037523  0.034121  0.000000  1.135064
  2.800000  0.037523  0.034671  0.000000  1.135064
  2.844444  0.037523  0.035221  0.000000  1.135064
  2.888889  0.037523  0.035772  0.000000  1.135064
  2.933333  0.037523  0.036322  0.000000  1.135064
  2.977778  0.037523  0.036872  0.000000  1.135064
  3.022222  0.037523  0.037423  0.000000  1.135064
  3.066667  0.037523  0.037973  0.000000  1.135064
  3.111111  0.037523  0.038523  0.000000  1.135064
  3.155556  0.037523  0.039074  0.000000  1.135064
  3.200000  0.037523  0.039624  0.000000  1.135064
  3.244444  0.037523  0.040174  0.000000  1.135064
  3.288889  0.037523  0.040725  0.000000  1.135064
  3.333333  0.037523  0.041275  0.000000  1.135064
  3.377778  0.037523  0.041825  0.000000  1.135064
  3.422222  0.037523  0.042376  0.000000  1.135064
  3.466667  0.037523  0.042926  0.000000  1.135064
  3.511111  0.037523  0.043476  0.000000  1.135064
  3.555556  0.037523  0.044027  0.000000  1.135064
  3.600000  0.037523  0.044577  0.000000  1.135064
  3.644444  0.037523  0.045127  0.000000  1.135064
  3.688889  0.037523  0.045678  0.000000  1.135064
  3.733333  0.037523  0.046228  0.000000  1.135064
  3.777778  0.037523  0.046778  0.000000  1.135064
  3.822222  0.037523  0.047329  0.000000  1.135064
  3.866667  0.037523  0.047879  0.000000  1.135064
  3.911111  0.037523  0.048429  0.000000  1.135064
  3.955556  0.037523  0.048980  0.000000  1.135064
  4.000000  0.037523  0.049530  0.000000  1.135064
  4.044444  0.037523  0.051198  0.082732  1.135064
  END FTABLE  1
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***
RCHRES   1 HYDR   RO     1 1        1      WDM   1000 FLOW     ENGL      REPL
```

```
RCHRES   1 HYDR   O      1 1        1      WDM   1001 FLOW     ENGL      REPL
RCHRES   1 HYDR   O      2 1        1      WDM   1002 FLOW     ENGL      REPL
RCHRES   1 HYDR   STAGE  1 1        1      WDM   1003 STAG     ENGL      REPL
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  MASS-LINK        3
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  END MASS-LINK    3

  MASS-LINK        5
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  END MASS-LINK    5

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END MASS-LINK

END RUN
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Predeveloped HSPF Message File

Mitigated HSPF Message File

Disclaimer

Legal Notice

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6200 Capitol Blvd. Ste F
Olympia, WA. 98501
Toll Free 1(866)943-0304
Local (360)943-0304

www.clearcreeksolutions.com

Appendix C

Geotechnical Report
Earth Solutions NW, LLC
June 14, 2023

Earth Solutions NW LLC

Geotechnical Engineering
Construction Observation/Testing
Environmental Services

GEOTECHNICAL ENGINEERING STUDY
PROPOSED VANCIL ROAD SUBDIVISION
10800 VANCIL ROAD SOUTHEAST
THURSTON COUNTY (YELM), WASHINGTON

ES-9150

15365 N.E. 90th Street, Suite 100 | Redmond, WA 98052
(425) 449-4704 Fax (425) 449-4711
www.earthsolutionsnw.com

PREPARED FOR

COPPER RIDGE, LLC

June 14, 2023

State of Washington
Engineering Geologist
2561
Licensed Geologist
06/14/2023

Scott S. Riegel

Scott S. Riegel, L.G., L.E.G.
Associate Principal Geologist

KYLE R. CAMPBELL
STATE OF WASHINGTON
27674
REGISTERED
PROFESSIONAL ENGINEER
06/14/2023

Kyle R. Campbell, P.E.
Senior Principal Engineer

GEOTECHNICAL ENGINEERING STUDY
PROPOSED VANCIL ROAD SUBDIVISION
10800 VANCIL ROAD SOUTHEAST
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Earth Solutions NW, LLC
15365 Northeast 90th Street, Suite 100
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Phone: 425-449-4704 | Fax: 425-449-4711
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Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:
- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:
- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept* *responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are <u>not</u> final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are <u>Not</u> Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will <u>not</u> of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are <u>not</u> building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

Earth Solutions NW LLC

Geotechnical Engineering, Construction Observation/Testing and Environmental Services

June 14, 2023
ES-9150

Copper Ridge, LLC
P.O. Box 73790
Puyallup, Washington 98373

Attention: Evan Mann

Dear Evan:

Earth Solutions NW, LLC (ESNW), is pleased to present this report to support the proposed project. Based on the results of our investigation, construction of the proposed residential development is feasible from a geotechnical standpoint.

Based on conditions observed during our fieldwork, the site is underlain primarily by native soils consisting of glacial outwash sand/gravel deposits. The proposed residential structures can be supported on conventional spread and continuous foundations bearing on undisturbed competent native soil, recompacted native soil, or new structural fill placed directly on a competent subgrade surface. We anticipate competent native soil suitable for support of foundations will generally be encountered beginning at depths of about two to four feet below existing grades across the site.

Based on our investigation, infiltration is considered feasible from a geotechnical standpoint due to the pervasive presence of relatively clean outwash sand/gravel soils.

This report provides geotechnical analyses and recommendations for the proposed residential development. We appreciate the opportunity to be of service to you on this project. If you have any questions regarding the content of this study, please call.

Sincerely,

EARTH SOLUTIONS NW, LLC

Scott S. Riegel, L.G., L.E.G.
Associate Principal Geologist

15365 N.E. 90th Street, Suite 100 • Redmond, WA 98052 • (425) 449-4704 • FAX (425) 449-4711

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GEOTECHNICAL ENGINEERING STUDY
VANCIL ROAD SUBDIVISION
10800 VANCIL ROAD SOUTHEAST
THURSTON COUNTY (YELM), WASHINGTON

ES-9150

INTRODUCTION

General

This geotechnical engineering study (study) was prepared for the proposed residential development to be constructed in Yelm, Washington. To complete our scope of services, we performed the following:

- Subsurface exploration to characterize the soil and groundwater conditions.
- Laboratory testing of representative soil samples collected on site.
- Engineering analyses.
- Preparation of this report.

The following documents and resources were reviewed as part of our report preparation:

- Vancil Road Layout, provided by the client, dated February 27, 2023.
- Morris Road Plat, prepared by AHBL, dated June 15, 2022.
- Surficial hydrogeologic units of the Puget Sound aquifer system, Washington and British Columbia, for the Centralia quadrangle (Plate 17 of 18) M.A. Jones 1998.
- Web Soil Survey (WSS) online resource, maintained by the Natural Resources Conservation Service (NRCS) under the United States Department of Agriculture (USDA).
- Pierce County Stormwater Management and Site Development Manual, effective July 1, 2021.
- Yelm Municipal Code Chapter 18.21.

Project Description

The overall project area is located off the east side of Vancil Road Southeast in Yelm, Washington.

Site grading plans were not available at the time of this proposal; however, we understand the Vancil Road project will consist of construction of 60 single-family homesites and the Morris Road site will be developed with 30 lots and associated infrastructure improvements. Each site will include a stormwater management facility, and will require seasonal groundwater monitoring. We presume infiltration will be pursued to the extent feasible.

At the time of report submission, specific building loads were not available for review; however, we anticipate the proposed residential structures will consist of relatively lightly loaded wood framing supported on conventional foundations. Based on our experience with similar developments, we estimate wall loads of about 1 to 3 kips per linear foot and slab-on-grade loading of 150 pounds per square foot (psf) will be incorporated into the final design. Based on the low topographic relief on this site, we anticipate grading will be limited to cuts and fills of about five feet or less for lots. Deeper cuts will occur for utilities and the stormwater tracts.

If the above design assumptions are incorrect or change, ESNW should be contacted to review the recommendations provided in this report. ESNW should review final designs to confirm that appropriate geotechnical recommendations have been incorporated into the plans.

SITE CONDITIONS

Surface

The two properties that comprise the Vancil Road and Morris Road sites consist of Thurston County Parcel Nos. 22730410300 & 22730410000. The sites are vacant and the majority of the Vancil Road site area is surfaced with field grass used as fenced pasture while the Morris Road site is largely forested. Topography is gently undulating. The Vancil Road property is bordered to the north and west by residential development, to the east by the Morris Road property and to the south by open space. The Morris Road property is bordered to the north and south by residential property, to the east by Morris Road Southeast and to the west by the Vancil Road property.

Subsurface

A representative of ESNW observed, logged, and sampled 18 test pits at accessible locations within the property boundaries on April 24/25, 2023 using a machine and operator provided by the client. The explorations were completed to assess and classify the site soils and to characterize the groundwater conditions within areas proposed for new development. The maximum exploration depth was approximately 16 feet below the existing ground surface (bgs).

The approximate locations of the test pits are depicted on Plate 2 (Test Pit Location Plan). Please refer to the test pit logs provided in Appendix A for a more detailed description of subsurface conditions. Representative soil samples collected at our exploration locations were analyzed in general accordance with Unified Soil Classification System (USCS) and USDA methods and procedures.

Topsoil and Fill

Topsoil was generally encountered within the upper 12 to 18 inches of existing grades at the test pit locations, except several explorations that encountered up to 24 inches. It is possible that deeper or shallower pockets of topsoil will be encountered locally across the site. The topsoil was characterized by its dark brown color, the presence of fine organic material, and small root intrusions.

Fill was not encountered during the subsurface exploration; however, fill is likely present to varying degrees around existing structures.

Native Soil

Underlying the topsoil, native soils consisting primarily of medium dense poorly and well graded gravel with sand (USCS: GP and GW) soils were encountered. At an isolated location TP-6 at 16 feet), a well graded sand with silt (USCS: SW-SM) layer was encountered. Fines contents within the native soil deposits were less than 5 percent, except the isolated layer of sand with silt which had a fines content of about 7.4 percent at TP-6. The native soils were primarily observed to be in a damp to moist condition and caving was common within the relatively clean sandy gravel deposits.

Geologic Setting

Geologic mapping of the area identifies recessional outwash gravel deposits (Qvrg) as the primary geologic unit underlying the site. The online WSS resource identifies Spanaway series soils (Map Units 110 and 112) roughly evenly distributed across the site. The referenced soil survey characterizes Spanaway gravelly sandy loam with slow surface water runoff and little to no hazard of water erosion and are assigned to hydrologic soil group A.

Based on the soil conditions encountered during our fieldwork, the native soils are consistent with the geologic and soils mapping resources outlined in this section of outwash sand/gravel soils.

Groundwater

Groundwater was not observed, during the April 2023 subsurface explorations. Groundwater flow rates and elevations may fluctuate depending on many factors, including precipitation duration and intensity, the time of year, and soil conditions. In general, groundwater flow rates are higher during the winter, spring, and early summer months. In any case, groundwater conditions should be expected within deeper site excavations, particularly during the wet season. Depending on the timing, depth, and extent of such excavations, temporary dewatering may be necessary.

GEOLOGIC CRITICAL AREAS EVALUATION

The subject property was evaluated for the presence of geologic critical areas in general accordance with Yelm Municipal Code Chapter 18.21. Based on our review no geologic critical areas are present on or immediately adjacent to the subject site.

Based on review of the Thurston County Wellhead Protection Areas map, the site is located within a 10-year Time-of-Travel area.

DISCUSSION AND RECOMMENDATIONS

General

Based on the results of our investigation, construction of the proposed residential development is feasible from a geotechnical standpoint. The primary geotechnical considerations associated with the proposed project include earthwork, temporary excavations, subgrade preparation, foundation support, and drainage.

Based on local geologic mapping and conditions observed during our fieldwork, the site is underlain primarily by native soils consisting of medium dense outwash sandy gravel deposits. The proposed residential structures can be supported on conventional spread and continuous foundations bearing on undisturbed competent native soil, recompacted native soil, or new structural fill placed directly on a competent subgrade. We anticipate competent native soil suitable for support of foundations will generally be encountered beginning at depths of about two to four feet below existing grades across the site.

Based on our investigation, infiltration is considered feasible from a geotechnical standpoint due to the presence of Spanaway gravel soils across the site.

This study has been prepared for the exclusive use of Copper Ridge, LLC and their representatives. No warranty, expressed or implied, is made. This study has been prepared in a manner consistent with the level of care and skill ordinarily exercised by other members of the profession currently practicing under similar conditions in this area.

Site Preparation and Earthwork

Site preparation activities should consist of installing temporary erosion control measures, establishing grading limits, and performing site stripping. Subsequent earthwork activities will likely include site grading, utility installations, and associated site improvements.

Temporary Erosion Control

The following temporary erosion and sediment control Best Management Practices (BMPs) are recommended:

- Temporary construction entrances and drive lanes, consisting of at least six inches of quarry spalls, should be considered to both minimize off-site soil tracking and provide stable surfaces at site entrances. Placing geotextile fabric underneath the quarry spalls will provide greater stability if needed.

- Silt fencing should be placed around the appropriate portions of the site perimeter to prevent offsite migration of sediment.

- When not in use, soil stockpiles should be covered or otherwise protected (as necessary) to reduce the potential for soil erosion, especially during periods of wet weather.

- As necessary, temporary measures for controlling surface water runoff, such as interceptor trenches, sumps, or interceptor swales, should be installed prior to beginning earthwork activities. For this site, infiltration may also be considered for control of surface water runoff.

- Dry soils disturbed during construction should be wetted to minimize dust and airborne soil erosion.

Additional Best Management Practices, as specified by the project civil engineer and indicated on the plans, should be incorporated into construction activities. Temporary erosion control measures may be modified during construction as site conditions require, as approved by the site erosion control lead.

Stripping

Topsoil was encountered generally within the upper 12 to 18 inches with isolated areas up to 24 inches of existing grades at the test pit locations. ESNW should be retained to observe site stripping activities at the time of construction so that the degree of required stripping may be assessed. The exposed subgrade may still possess root elements, other organic material, or be present in a loose condition. As such, ESNW should evaluate the exposed soil subgrade to determine if further stripping or in-situ compaction efforts prior to fill operations or finish grading is necessary. Over-stripping should be avoided, as it is unnecessary and may result in increased project development costs. Topsoil and organic-rich soil are neither suitable for foundation support nor for use as structural fill. Topsoil and organic-rich soil may be used in non-structural areas if desired.

In-situ and Imported Soil

The in-situ soils encountered at the subject site have a low to moderate sensitivity to moisture and were generally in a damp to moist condition at the time of exploration. Soils anticipated to be exposed on site may degrade if exposed to wet weather and construction traffic. Compaction of the soils to the levels necessary for use as structural fill may be difficult to impossible during wet weather conditions. Soils encountered during site excavations that are excessively over the optimum moisture content will likely require aeration or treatment prior to placement and compaction. Conversely, soils that are substantially below the optimum moisture content will require moisture conditioning through the addition of water prior to use as structural fill. An ESNW representative should determine the suitability of in-situ soils for use as structural fill at the time of construction.

Imported soil intended for use as structural fill should be evaluated by ESNW during construction. The imported soil must be workable to the optimum moisture content, as determined by the Modified Proctor Method (ASTM D1557), at the time of placement and compaction. During wet weather conditions, imported soil intended for use as structural fill should consist of a well-graded, granular soil with a fines content of 5 percent or less (where the fines content is defined as the percent passing the Number 200 sieve, based on the minus three-quarter-inch fraction).

Structural Fill

Structural fill is defined as compacted soil placed in foundation, slab-on-grade, roadway, permanent slope, retaining wall, and utility trench backfill areas. Structural fill placed and compacted during site grading activities should meet the following specifications and guidelines:

- Structural fill material — Granular soil*
- Moisture content — At or slightly above optimum†
- Relative compaction (minimum) — 95 percent (Modified Proctor)‡
- Loose lift thickness (maximum) — 12 inches

* *Existing gravel soils will likely require moisture conditioning (addition of water) prior to placement and compaction.*
† *Soil shall not be placed dry of optimum and should be evaluated by ESNW during construction.*
‡ *Minimum relative compaction of 90% may be feasible for mass grading activities and should be evaluated by ESNW during construction.*

With respect to underground utility installations and backfill, local jurisdictions may dictate the soil type(s) and compaction requirements. Unsuitable material or debris must be removed from structural areas if encountered.

Excavations and Slopes

The following Federal Occupation Safety and Health Administration and Washington Industrial Safety and Health Act soil classifications and maximum allowable temporary slope inclinations may be used:

- Areas exposing groundwater seepage 1.5H:1V (Type C)
- Loose soil and fill 1.5H:1V (Type C)
- Medium dense to dense soil 1H:1V (Type B)

Groundwater seepage should be anticipated during excavation activities, especially if excavations take place during the wet season. An ESNW representative should observe temporary excavations to evaluate the presence of groundwater seepage. If seepage is not observed, steeper temporary slope inclinations may be feasible pending evaluation by the geotechnical engineer.

Subgrade Preparation

Foundations should be constructed on competent native soil or structural fill placed directly on competent native soil. Loose or unsuitable soil conditions encountered below areas of footing and slab elements should be remedied as recommended in this report. In general, foundation subgrades on native cut surfaces should be compacted in-situ to a minimum depth of one foot below the design subgrade elevation. Uniform compaction of the foundation and slab subgrade areas will establish a relatively consistent subgrade condition below the foundation and slab elements. ESNW should observe the foundation and slab subgrade prior to placing formwork. Supplementary recommendations for subgrade improvement can be provided at the time of construction and would likely include further mechanical compaction effort and/or overexcavation and replacement with suitable structural fill.

Foundations

The proposed structures can be constructed on conventional continuous and spread footing foundations bearing on competent native soil, recompacted native soil, or new structural fill placed directly on competent native soil. Where loose or unsuitable soil conditions are encountered at foundation subgrade elevations, compaction of the soils to the specifications of structural fill, or overexcavation and replacement with suitable structural fill will likely be necessary. A representative of ESNW should confirm suitability of foundation subgrades at the time of construction. If deemed necessary, the undisturbed weathered native soils may be compacted in-situ provided the soil is at or slightly above the optimum moisture content.

Provided the structures will be supported as described above, the following parameters may be used for design of the new foundations:

• Allowable soil bearing capacity	2,500 psf
• Passive earth pressure	300 pcf
• Coefficient of friction	0.40

A one-third increase in the allowable soil bearing capacity can be assumed for short-term wind and seismic loading conditions. The passive earth pressure and coefficient of friction values include a safety factor of 1.5. With structural loading as expected, total settlement in the range of one inch is anticipated, with differential settlement of about one-half inch. The majority of the settlement should occur during construction as dead loads are applied.

Retaining Walls

Retaining walls must be designed to resist earth pressures and applicable surcharge loads. The following parameters may be used for retaining wall design:

• Active earth pressure (unrestrained condition)	35 pcf
• At-rest earth pressure (restrained condition)	55 pcf
• Traffic surcharge (passenger vehicles)	70 psf (rectangular distribution)
• Passive earth pressure	300 pcf
• Coefficient of friction	0.40
• Seismic surcharge	8H psf*

* *Where H equals the retained height (in feet).*

The passive earth pressure and coefficient of friction values include a safety factor of 1.5. Additional surcharge loading from adjacent foundations, sloped backfill, or other loads should be included in the retaining wall design.

Retaining walls should be backfilled with free-draining material that extends along the height of the wall and a distance of at least 18 inches behind the wall. Relatively clean (fines content less than 5 percent) native soils may be used as the drainage zone, but should be observed by ESNW prior to placement. The upper 12 inches of the wall backfill may consist of a less permeable soil, if desired.

Drainage should be provided behind retaining walls such that hydrostatic pressures do not develop. If drainage is not provided, hydrostatic pressures should be included in the wall design. A perforated drainpipe should be placed along the base of the wall and connected to an approved discharge location. A typical retaining wall drainage detail is provided on Plate 3.

Seismic Design

The 2018 International Building Code (2018 IBC) recognizes the most recent edition of the Minimum Design Loads for Buildings and Other Structures manual (ASCE 7-16) for seismic design, specifically with respect to earthquake loads. Based on the soil conditions encountered at the test pit locations, the parameters and values provided below are recommended for seismic design per the 2018 IBC.

Parameter	**Value**
Site Class	D*
Mapped short period spectral response acceleration, S_S (g)	1.280
Mapped 1-second period spectral response acceleration, S_1 (g)	0.463
Short period site coefficient, F_a	1.000
Long period site coefficient, F_v	1.837
Adjusted short period spectral response acceleration, S_{MS} (g)	1.280
Adjusted 1-second period spectral response acceleration, S_{M1} (g)	0.850
Design short period spectral response acceleration, S_{DS} (g)	0.853
Design 1-second period spectral response acceleration, S_{D1} (g)	0.567

* *Assumes medium dense soil conditions, encountered to a maximum depth of 16 feet bgs during the April 2023 field exploration, remain medium dense or better to at least 100 feet bgs.*
† *Values assume F_v may be determined using linear interpolation per Table 11.4-2 in ASCE 7-16.*

As indicated in the table footnote, several of the seismic design values provided above are dependent on the assumption that site-specific ground motion analysis (per Section 11.4.8 of ASCE 7-16) will not be required for the subject project. ESNW recommends the validity of this assumption be confirmed at the earliest available opportunity during the planning and early design stages of the project. Further discussion between the project structural engineer, the project owner (or their representative), and ESNW may be prudent to determine the possible impacts to the structural design due to increased earthquake load requirements under the 2018 IBC. ESNW can provide additional consulting services to aid with design efforts, including supplementary geotechnical and geophysical investigation, upon request.

Liquefaction is a phenomenon where saturated or loose soil suddenly loses internal strength and behaves as a fluid. This behavior is in response to increased pore water pressures resulting from an earthquake or another intense ground shaking. In our opinion, site susceptibility to liquefaction may be considered negligible. The absence of a shallow groundwater table and the coarse (gravel) gradation of the native soil were the primary bases for this opinion.

Slab-on-Grade Floors

Slab-on-grade floors should be supported on a firm and unyielding subgrade consisting of competent native soil or at least 12 inches of new structural fill. Unstable or yielding areas of the subgrade should be recompacted or overexcavated and replaced with suitable structural fill prior to slab construction.

A capillary break consisting of a minimum of four inches of free-draining crushed rock or gravel should be placed below the slab. The free-draining material should have a fines content of 5 percent or less defined as the percent passing the number 200 sieve, based on the minus three-quarters-inch fraction. In areas where slab moisture is undesirable, installation of a vapor barrier below the slab should be considered. The relatively clean (less than 5 percent fines) native gravel soils may be used or considered functionally equivalent as a capillary break; however, ESNW should observe native soils prior to placement to confirm suitability. If used, the vapor barrier should consist of a material specifically designed to function as a vapor barrier and should be installed in accordance with the manufacturer's specifications.

Drainage

Temporary measures to control surface water runoff and groundwater during construction would likely involve passive elements such as interceptor trenches, interceptor swales, and sumps. ESNW should be consulted during preliminary grading to identify areas of seepage and provide recommendations to reduce the potential for seepage-related instability.

Finish grades must be designed to direct surface drain water away from structures and slopes. Water must not be allowed to pond adjacent to structures or slopes. Based on the presence of relatively clean sand/gravel soils on this site, footing drains may be omitted at the owner's discretion. If footing drains are omitted, we recommend ESNW be contacted to observe the subgrade to ensure the entire alignment exposes relatively free-draining sand/gravel. If footing drains will be installed, a foundation drain should be installed along building perimeter footings. A typical foundation drain detail is provided on Plate 4.

Preliminary Infiltration Evaluation

As indicated on the referenced preliminary site plan, a stormwater tract will be created in each of the project areas. The Vancil Road plat will include a storm tract in the western portion of the site, while the Morris Road plat will include a storm tract in the eastern portion. ESNW excavated three test pits in each storm tract (TP-5 through TP-7 for Vancil Road and TP-11 through TP-13 for the Morris Road site). Native soils encountered across the site during our fieldwork were characterized primarily as recessional outwash gravel deposits with relatively low fines contents. Based on our laboratory analyses, the native soils classify primarily as USDA loamy sand with fines contents ranging from about 1.3 to 4.7 percent with one outlier (TP-6) with a fines content of 7.4 percent. The results of our laboratory analyses are included in Appendix B of this report.

Using Method 3 - Soil Grain Size Analysis Method, in conjunction with the presence of Type A soil on the subject site, we determined a preliminary long-term design infiltration rate to be used primarily as a feasibility screening tool. A preliminary long-term design rate is calculated following the equation below, located in the Pierce County Stormwater and Site Development Manual.

$$log_{10}(K_{sat}) = -1.57 + 1.90D_{10} + 0.015D_{60} - 0.013D_{90} - 2.08F_{fines}$$

The relatively clean Spanaway (Type A) gravels observed in across the site exhibit favorable infiltration characteristics and will likely be feasible for full infiltration. Based on the soil samples obtained at TP-5 through TP-7 and TP-11 through TP-13 within the vicinity of the proposed infiltration facilities at representative depths, preliminary calculated long-term design rates ranging between 7 inches/hour to 87 in/hr were calculated. We recommend using an allowable infiltration rate of 20 in/hr for the Vancil Road plat and 30 in/hr for preliminary sizing calculations/design for the proposed Morris Road stormwater facility. In-situ pilot infiltration testing should be completed for final design of the infiltration ponds.

Groundwater monitoring piezometers were installed at three test locations within each of the proposed stormwater tracts for future groundwater monitoring services, to be completed in the coming wet season. While no indications of seasonal groundwater were observed during the subsurface investigation, winter monitoring may result in alterations to future facility design based on potential groundwater conditions.

Based on our field observations and laboratory analyses, the native gravelly soils do not meet the requirements for water quality treatment per Volume V, Chapter 6.3 of the stormwater manual. Specifically, the measured soil infiltration rate significantly higher than the maximum allowable nine inches per hour. Additionally, the native Spanaway gravels likely possess a lower cation exchange capacity (CEC) and organic content than required by the manual. Therefore, a treatment layer or other provision will likely be required for facility designs.

Utility Support and Trench Backfill

In our opinion, the on-site soil will generally be suitable for support of utilities. Based on the conditions encountered at the exploration locations, groundwater seepage may be exposed within utility trench excavations and will likely require temporary shoring and construction dewatering. Use of the native soil as structural backfill in the utility trench excavations will depend on the in-situ moisture content at the time of placement and compaction. If native soil is placed below the optimum moisture content, settlement will likely occur once wet weather impacts the trenches. As such, backfill soils should be properly moisture conditioned, as necessary, to ensure acceptability of the soil moisture content at the time of placement and compaction. Large clasts greater than about six inches should be removed from utility trench backfill if encountered. Utility trench backfill should be placed and compacted to the specifications of structural fill provided in this report or to the applicable requirements of the presiding jurisdiction.

Preliminary Pavement Sections

The performance of site pavements is largely related to the condition of the underlying subgrade. To ensure adequate pavement performance, the subgrade should be in a firm and unyielding condition when subjected to proof rolling with a loaded dump truck. Structural fill in pavement areas should be compacted to the specifications previously detailed in this report. Soft, wet, or otherwise unsuitable or yielding subgrade conditions will require remedial measures, such as overexcavation and/or placement of thick crushed rock or structural fill sections, prior to pavement. Cement treated base may be considered for stabilizing the subgrade if local jurisdictions allow this method of treatment.

We anticipate new pavement sections will be subjected primarily to passenger vehicle traffic. For lightly loaded pavement areas subjected primarily to passenger vehicles, the following preliminary pavement sections may be considered:

- A minimum of two inches of hot-mix asphalt (HMA) placed over four inches of crushed rock base (CRB), or;

- A minimum of two inches of HMA placed over three inches of asphalt-treated base (ATB).

Heavier traffic areas generally require thicker pavement sections depending on site usage, pavement life expectancy, and site traffic. For preliminary design purposes, the following pavement sections for occasional truck traffic and access roadway areas may be considered:

- Three inches of HMA placed over six inches of CRB, or;

- Three inches of HMA placed over four and one-half inches of ATB.

A representative of ESNW should be requested to observe subgrade conditions prior to placement of CRB or ATB. As necessary, supplemental recommendations for achieving subgrade stability and drainage can be provided. If on-site roads will be constructed with an inverted crown, additional drainage measures may be recommended to assist in maintaining road subgrade and pavement stability.

Final pavement design recommendations, including recommendations for heavy traffic areas, access roads, and frontage improvement areas, can be provided once final traffic loading has been determined. Road standards utilized by the governing jurisdiction may supersede the recommendations provided in this report. The HMA, ATB, and CRB materials should conform to WSDOT specifications. All soil base material should be compacted to a relative compaction of 95 percent, based on the laboratory maximum dry density as determined by ASTM D1557.

LIMITATIONS

This study has been prepared for the exclusive use of Copper Ridge, LLC, and its representatives. The recommendations and conclusions provided in this study are professional opinions consistent with the level of care and skill that is typical of other members in the profession currently practicing under similar conditions in this area. A warranty is neither expressed nor implied. Variations in the soil and groundwater conditions observed at the exploration locations may exist and may not become evident until construction. ESNW should reevaluate the conclusions provided in this study if variations are encountered.

Additional Services

ESNW should have an opportunity to review final project plans with respect to the geotechnical recommendations provided in this report. ESNW should also be retained to provide testing and consultation services as needed during future design and construction phases of the project.

Reference:
Thurston County, Washington
OpenStreetMap.org

NORTH

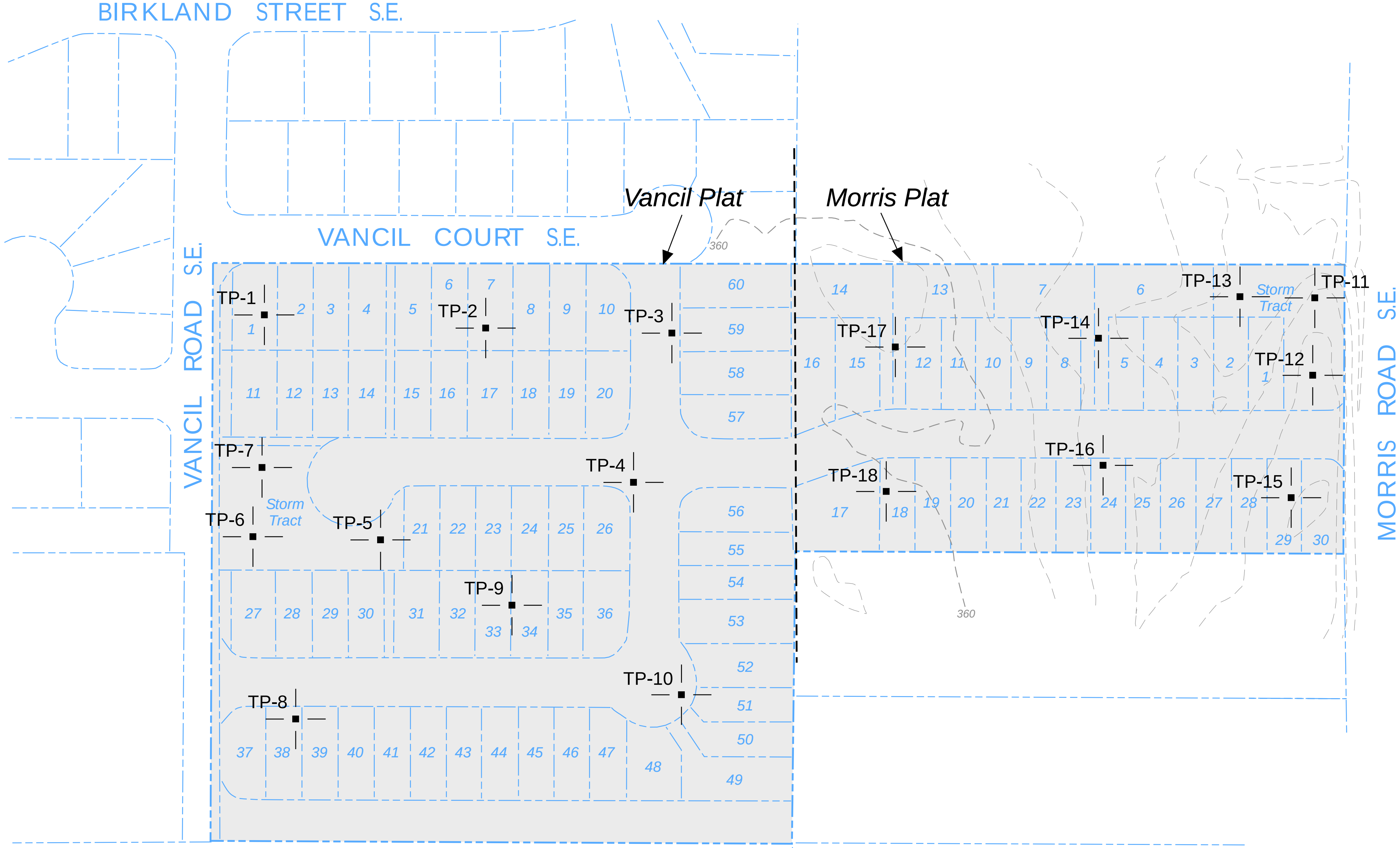
NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.

Earth Solutions NW LLC

Geotechnical Engineering, Construction Observation/Testing and Environmental Services

Vicinity Map
10800 Vancil Road S.E. Subdivision
Thurston County (Yelm), Washington

Drawn CAM	Date 06/06/2023	Proj. No. 9150
Checked SSR	Date June 2023	Plate 1

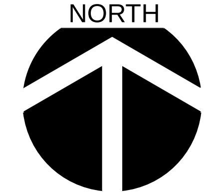


LEGEND

TP-1 — Approximate Location of ESNW Test Pit, Proj. No. ES-9150, April 2023

Subject Site

21 — Proposed Lot Number



1"=150'

0 75 150 300

Scale in Feet

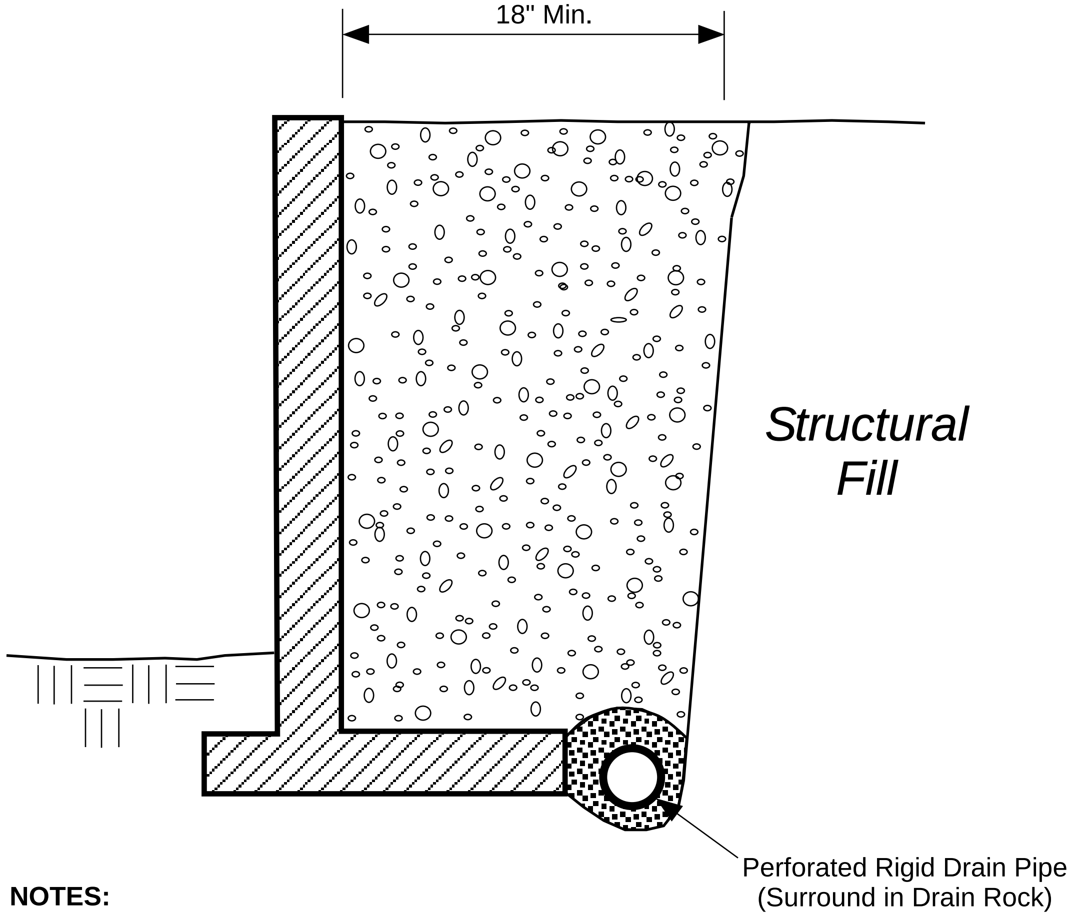
NOTE: The graphics shown on this plate are not intended for design purposes or precise scale measurements, but only to illustrate the approximate test locations relative to the approximate locations of existing and / or proposed site features. The information illustrated is largely based on data provided by the client at the time of our study. ESNW cannot be responsible for subsequent design changes or interpretation of the data by others.

NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.

Test Pit Location Plan
10800 Vancil Road S.E. Subdivision
Thurston County (Yelm), Washington

Earth Solutions NWLLC
Geotechnical Engineering, Construction Observation/Testing and Environmental Services

Drawn	CAM
Checked	SSR
Date	06/06/2023
Proj. No.	9150
Plate	2



NOTES:

- Free-draining Backfill should consist of soil having less than 5 percent fines. Percent passing No. 4 sieve should be 25 to 75 percent.
- Sheet Drain may be feasible in lieu of Free-draining Backfill, per ESNW recommendations.
- Drain Pipe should consist of perforated, rigid PVC Pipe surrounded with 1-inch Drain Rock.

SCHEMATIC ONLY - NOT TO SCALE
NOT A CONSTRUCTION DRAWING

LEGEND:

Free-draining Structural Backfill

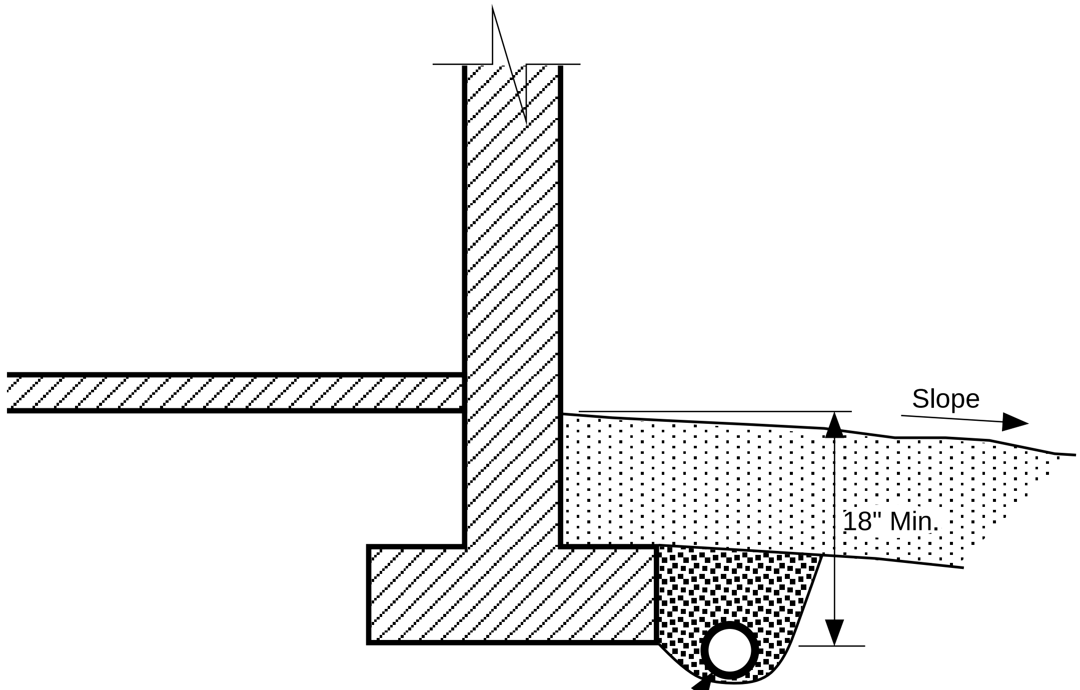
1-inch Drain Rock

Earth Solutions NW LLC

Earth Solutions NW LLC
Geotechnical Engineering, Construction Observation/Testing and Environmental Services

Retaining Wall Drainage Detail
10800 Vancil Road S.E. Subdivision
Thurston County (Yelm), Washington

Drawn CAM	Date 06/06/2023	Proj. No. 9150
Checked SSR	Date June 2023	Plate 3



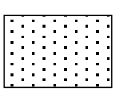
Perforated Rigid Drain Pipe
(Surround in Drain Rock)

NOTES:

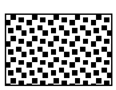
- Do NOT tie roof downspouts to Footing Drain.
- Surface Seal to consist of 12" of less permeable, suitable soil. Slope away from building.

SCHEMATIC ONLY - NOT TO SCALE
NOT A CONSTRUCTION DRAWING

LEGEND:



Surface Seal: native soil or other low-permeability material.



1-inch Drain Rock

Earth Solutions NW LLC
Earth Solutions NWLLC
Geotechnical Engineering, Construction Observation/Testing and Environmental Services

Footing Drain Detail
10800 Vancil Road S.E. Subdivision
Thurston County (Yelm), Washington

Drawn CAM	Date 06/06/2023	Proj. No. 9150
Checked SSR	Date June 2023	Plate 4

Appendix A

Subsurface Exploration
Test Pit Logs

ES-9150

Subsurface conditions on site were explored by excavating 18 test pits on April 24/25, 2023, respectively, using equipment and operators provided by the client. The approximate locations of the test pits and borings are illustrated on Plate 2 of this study. The subsurface exploration logs are provided in this Appendix. The maximum exploration depth was 16 feet bgs.

The final logs represent the interpretations of the field logs and the results of laboratory analyses. The stratification lines on the logs represent the approximate boundaries between soil types. In actuality, the transitions may be more gradual.

Major Divisions			Symbol	Description
Coarse-Grained Soils - More Than 50% Retained on No. 200 Sieve	Gravels - More Than 50% of Coarse Fraction Retained on No. 4 Sieve	< 5% Fines	GW	Well-graded gravel with or without sand, little to no fines
			GP	Poorly graded gravel with or without sand, little to no fines
		> 12% Fines	GM	Silty gravel with or without sand
			GC	Clayey gravel with or without sand
	Sands - 50% or More of Coarse Fraction Passes No. 4 Sieve	< 5% Fines	SW	Well-graded sand with or without gravel, little to no fines
			SP	Poorly graded sand with or without gravel, little to no fines
		> 12% Fines	SM	Silty sand with or without gravel
			SC	Clayey sand with or without gravel
Fine-Grained Soils - 50% or More Passes No. 200 Sieve	Silts and Clays Liquid Limit Less Than 50		ML	Silt with or without sand or gravel; sandy or gravelly silt
			CL	Clay of low to medium plasticity; lean clay with or without sand or gravel; sandy or gravelly lean clay
			OL	Organic clay or silt of low plasticity
	Silts and Clays Liquid Limit 50 or More		MH	Elastic silt with or without sand or gravel; sandy or gravelly elastic silt
			CH	Clay of high plasticity; fat clay with or without sand or gravel; sandy or gravelly fat clay
			OH	Organic clay or silt of medium to high plasticity
Highly Organic Soils			PT	Peat, muck, and other highly organic soils
Fill			FILL	Made Ground

Moisture Content

Dry - Absence of moisture, dusty, dry to the touch

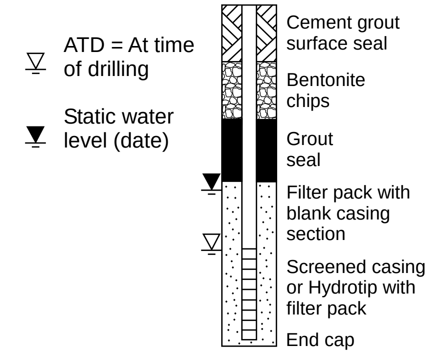
Damp - Perceptible moisture, likely below optimum MC

Moist - Damp but no visible water, likely at/near optimum MC

Wet - Water visible but not free draining, likely above optimum MC

Saturated/Water Bearing - Visible free water, typically below groundwater table

Symbols



Terms Describing Relative Density and Consistency

Coarse-Grained Soils:

Density	SPT blows/foot
Very Loose	< 4
Loose	4 to 9
Medium Dense	10 to 29
Dense	30 to 49
Very Dense	≥ 50

Fine-Grained Soils:

Consistency	SPT blows/foot
Very Soft	< 2
Soft	2 to 3
Medium Stiff	4 to 7
Stiff	8 to 14
Very Stiff	15 to 29
Hard	≥ 30

Test Symbols & Units

Fines = Fines Content (%)

MC = Moisture Content (%)

DD = Dry Density (pcf)

Str = Shear Strength (tsf)

PID = Photoionization Detector (ppm)

OC = Organic Content (%)

CEC = Cation Exchange Capacity (meq/100 g)

LL = Liquid Limit (%)

PL = Plastic Limit (%)

PI = Plasticity Index (%)

Component Definitions

Descriptive Term	Size Range and Sieve Number
Boulders	Larger than 12"
Cobbles	3" to 12"
Gravel	3" to No. 4 (4.75 mm)
Coarse Gravel	3" to 3/4"
Fine Gravel	3/4" to No. 4 (4.75 mm)
Sand	No. 4 (4.75 mm) to No. 200 (0.075 mm)
Coarse Sand	No. 4 (4.75 mm) to No. 10 (2.00 mm)
Medium Sand	No. 10 (2.00 mm) to No. 40 (0.425 mm)
Fine Sand	No. 40 (0.425 mm) to No. 200 (0.075 mm)
Silt and Clay	Smaller than No. 200 (0.075 mm)

Modifier Definitions

Percentage by Weight (Approx.)	Modifier
< 5	Trace (sand, silt, clay, gravel)
5 to 14	Slightly (sandy, silty, clayey, gravelly)
15 to 29	Sandy, silty, clayey, gravelly
≥ 30	Very (sandy, silty, clayey, gravelly)

Classifications of soils in this geotechnical report and as shown on the exploration logs are based on visual field and/or laboratory observations, which include density/consistency, moisture condition, grain size, and plasticity estimates, and should not be construed to imply field or laboratory testing unless presented herein. Visual-manual and/or laboratory classification methods of ASTM D2487 and D2488 were used as an identification guide for the Unified Soil Classification System.

Earth Solutions NW LLC

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Geotechnical Engineering, Construction Observation/Testing and Environmental Services

EXPLORATION LOG KEY

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-1

PROJECT NUMBER ES-9150
PROJECT NAME 10800 Vancil Road S.E. Subdivision
DATE STARTED 4/24/23 **COMPLETED** 4/24/23
GROUND ELEVATION 358 ft
EXCAVATION CONTRACTOR Client Provided
LATITUDE 46.93068 **LONGITUDE** -122.59518
LOGGED BY SKH **CHECKED BY** SSR
GROUND WATER LEVEL:
NOTES
∇ **AT TIME OF EXCAVATION**
SURFACE CONDITIONS Field Grass
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			TPSL		Dark brown TOPSOIL, roots to 12"	
1.5						356.5
	GB	MC = 7.5	GP		Brown poorly graded GRAVEL with sand, medium dense, damp -probed 4" -slight caving to BOH	
5						
	GB	MC = 8.3				
10						
15	GB	MC = 7.6				
15.0						343.0

Test pit terminated at 15.0 feet below existing grade due to caving. No groundwater encountered during excavation. Caving observed from 3.0 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

GENERAL BH / TP / WELL - 9150.GPJ - GINT US.GDT - 6/6/23

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-2

PROJECT NUMBER ES-9150
PROJECT NAME 10800 Vancil Road S.E. Subdivision
DATE STARTED 4/24/23 **COMPLETED** 4/24/23
GROUND ELEVATION 358 ft
EXCAVATION CONTRACTOR Client Provided
LATITUDE 46.9305 **LONGITUDE** -122.59428
LOGGED BY SKH **CHECKED BY** SSR
GROUND WATER LEVEL:
NOTES
AT TIME OF EXCAVATION
SURFACE CONDITIONS Field Grass
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			TPSL	1.0	Dark brown TOPSOIL, roots to 12"	357.0
			GW		Brown well-graded GRAVEL with sand, medium dense, damp	
	GB	MC = 5.8			-slight caving to BOH, probed 3"	
5						
	GB	MC = 8.8 Fines = 3.8			[USDA Classification: extremely gravelly coarse SAND]	
10						
					-becomes gray	
	GB	MC = 7.1		14.0		344.0

Test pit terminated at 14.0 feet below existing grade due to caving. No groundwater encountered during excavation. Caving observed from 2.0 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

GENERAL BH / TP / WELL - 9150.GPJ - GINT US.GDT - 6/6/23

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-3

PROJECT NUMBER ES-9150
PROJECT NAME 10800 Vancil Road S.E. Subdivision
DATE STARTED 4/24/23 **COMPLETED** 4/24/23
GROUND ELEVATION 360 ft
EXCAVATION CONTRACTOR Client Provided
LATITUDE 46.93058 **LONGITUDE** -122.59333
LOGGED BY SKH **CHECKED BY** SSR
GROUND WATER LEVEL:
NOTES
AT TIME OF EXCAVATION
SURFACE CONDITIONS Field Grass
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elevation
0			TPSL		Dark brown TOPSOIL, roots to 12"	
1.0						359.0
	GB	MC = 5.2	GP		Brown poorly graded GRAVEL with sand, medium dense, damp -probed 3" -moderate caving to BOH	
5						
10					-becomes gray	
11.5	GB	MC = 7.8				348.5

Test pit terminated at 11.5 feet below existing grade due to caving. No groundwater encountered during excavation. Caving observed from 2.0 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-4

PROJECT NUMBER ES-9150
PROJECT NAME 10800 Vancil Road S.E. Subdivision
DATE STARTED 4/24/23 **COMPLETED** 4/24/23
GROUND ELEVATION 361 ft
EXCAVATION CONTRACTOR Client Provided
LATITUDE 46.93021 **LONGITUDE** -122.59339
LOGGED BY SKH **CHECKED BY** SSR
GROUND WATER LEVEL:
NOTES
AT TIME OF EXCAVATION
SURFACE CONDITIONS Field Grass
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			TPSL	1.0	Dark brown TOPSOIL, roots to 12"	360.0
			GP		Brown poorly graded GRAVEL with sand, medium dense, damp	
	GB	MC = 6.8			-moderate caving to BOH	
					-probed 4"	
5						
10						
	GB	MC = 9.3		12.0		349.0

Test pit terminated at 12.0 feet below existing grade due to caving. No groundwater encountered during excavation. Caving observed from 2.0 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

GENERAL BH / TP / WELL - 9150.GPJ - GINT US.GDT - 6/6/23

Earth Solutions NWLLC

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-5

PROJECT NUMBER ES-9150
PROJECT NAME 10800 Vancil Road S.E. Subdivision
DATE STARTED 4/24/23 **COMPLETED** 4/24/23
GROUND ELEVATION 357 ft
EXCAVATION CONTRACTOR Client Provided
LATITUDE 46.93001 **LONGITUDE** -122.59472
LOGGED BY SKH **CHECKED BY** SSR
GROUND WATER LEVEL:
NOTES
AT TIME OF EXCAVATION
SURFACE CONDITIONS Field Grass
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
0			TPSL		Dark brown TOPSOIL, roots to 12"	
1.5						355.5
	GB	MC = 6.8	GP		Brown poorly graded GRAVEL with sand, medium dense, damp -moderate caving to BOH, probed 3"	
5.0						352.0
5			GW		Brown well-graded GRAVEL with sand, medium dense, damp to moist	
10						
13.0	GB	MC = 8.1 Fines = 4.7			[USDA Classification: extremely gravelly loamy coarse SAND]	344.0

Test pit terminated at 13.0 feet below existing grade due to caving. Piezo installed. No groundwater encountered during excavation. Caving observed from 2.5 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-6

PROJECT NUMBER ES-9150
PROJECT NAME 10800 Vancil Road S.E. Subdivision
DATE STARTED 4/24/23 **COMPLETED** 4/24/23
GROUND ELEVATION 357 ft
EXCAVATION CONTRACTOR Client Provided
LATITUDE 46.93002 **LONGITUDE** -122.59521
LOGGED BY SKH **CHECKED BY** SSR
GROUND WATER LEVEL:
NOTES
∇ **AT TIME OF EXCAVATION**
SURFACE CONDITIONS Field Grass
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elevation
0			TPSL		Dark brown TOPSOIL, roots to 12"	
1.5						355.5
			GP		Brown poorly graded GRAVEL with sand, medium dense, damp -probed 3"	
	GB	MC = 7.7			-slight caving to BOH, probed 3"	
5						
9.0						348.0
10			GW		Brown well-graded GRAVEL with sand, medium dense, damp to moist	
15.0						342.0
15			SW-SM		Brown well-graded SAND with silt, medium dense to dense, moist	
16.0	GB	MC = 10.9 Fines = 7.4			[USDA Classification: very gravelly loamy coarse SAND]	341.0

Test pit terminated at 16.0 feet below existing grade. Piezo installed. No groundwater encountered during excavation. Caving observed from 3.0 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-7

PROJECT NUMBER ES-9150
PROJECT NAME 10800 Vancil Road S.E. Subdivision
DATE STARTED 4/24/23 **COMPLETED** 4/24/23
GROUND ELEVATION 357 ft
EXCAVATION CONTRACTOR Client Provided
LATITUDE 46.9303 **LONGITUDE** -122.59519
LOGGED BY SKH **CHECKED BY** SSR
GROUND WATER LEVEL:
NOTES
∇ **AT TIME OF EXCAVATION**
SURFACE CONDITIONS Field Grass
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			TPSL		Dark brown TOPSOIL, roots to 12"
1.5					(355.5)
	GB	MC = 7.8	GP		Brown poorly graded GRAVEL with sand, medium dense, damp -probed 3" -moderate caving to BOH
5					
10					
14.0	GB	MC = 7.2 Fines = 4.9			[USDA Classification: extremely gravelly loamy coarse SAND] (343.0)

Test pit terminated at 14.0 feet below existing grade due to caving. Piezo installed. No groundwater encountered during excavation. Caving observed from 3.0 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

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TEST PIT NUMBER TP-8

PROJECT NUMBER ES-9150
PROJECT NAME 10800 Vancil Road S.E. Subdivision
DATE STARTED 4/24/23 **COMPLETED** 4/24/23
GROUND ELEVATION 357 ft
EXCAVATION CONTRACTOR Client Provided
LATITUDE 46.92922 **LONGITUDE** -122.59478
LOGGED BY SKH **CHECKED BY** SSR
GROUND WATER LEVEL:
NOTES
AT TIME OF EXCAVATION
SURFACE CONDITIONS Field Grass
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			TPSL	1.5	Dark brown TOPSOIL, roots to 12"	355.5
	GB	MC = 7.4	GP		Brown poorly graded GRAVEL with sand, medium dense, damp -probed 3" -slight caving to BOH	
5						
10						
15	GB	MC = 8.5		15.0		342.0

Test pit terminated at 15.0 feet below existing grade due to caving. No groundwater encountered during excavation. Caving observed from 3.0 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

GENERAL BH / TP / WELL - 9150.GPJ - GINT US.GDT - 6/6/23

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TEST PIT NUMBER TP-9

PROJECT NUMBER ES-9150
PROJECT NAME 10800 Vancil Road S.E. Subdivision
DATE STARTED 4/24/23 **COMPLETED** 4/24/23
GROUND ELEVATION 358 ft
EXCAVATION CONTRACTOR Client Provided
LATITUDE 46.92958 **LONGITUDE** -122.59398
LOGGED BY SKH **CHECKED BY** SSR
GROUND WATER LEVEL:
NOTES
▽ **AT TIME OF EXCAVATION**
SURFACE CONDITIONS Field Grass
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			TPSL	1.5	Dark brown TOPSOIL, roots to 18"	356.5
	GB	MC = 8.0 Fines = 5.3	GP-GM		Brown poorly graded GRAVEL with silt and sand, medium dense, damp -probed 4" [USDA Classification: extremely gravelly loamy coarse SAND] -slight caving to BOH	
5						
10						
	GB	MC = 8.1		13.0	-becomes gray	345.0

Test pit terminated at 13.0 feet below existing grade due to caving. No groundwater encountered during excavation. Caving observed from 3.0 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

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TEST PIT NUMBER TP-10

PROJECT NUMBER ES-9150
PROJECT NAME 10800 Vancil Road S.E. Subdivision
DATE STARTED 4/24/23 **COMPLETED** 4/24/23
GROUND ELEVATION 359 ft
EXCAVATION CONTRACTOR Client Provided
LATITUDE 46.92938 **LONGITUDE** -122.59327
LOGGED BY SKH **CHECKED BY** SSR
GROUND WATER LEVEL:
NOTES
▽ **AT TIME OF EXCAVATION**
SURFACE CONDITIONS Field Grass
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			TPSL		Dark brown TOPSOIL, roots to 12"	
1.5						357.5
			GP		Brown poorly graded GRAVEL with sand, medium dense, damp	
	GB	MC = 7.9			-slight caving to BOH, probed 3"	
5						
10						
					-becomes gray	
13.5	GB	MC = 7.9				345.5

Test pit terminated at 13.5 feet below existing grade due to caving. No groundwater encountered during excavation. Caving observed from 3.0 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

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TEST PIT NUMBER TP-11

PROJECT NUMBER ES-9150
PROJECT NAME 10800 Vancil Road S.E. Subdivision
DATE STARTED 4/24/23 **COMPLETED** 4/24/23
GROUND ELEVATION 355 ft
EXCAVATION CONTRACTOR Client Provided
LATITUDE 46.93071 **LONGITUDE** -122.59039
LOGGED BY SKH **CHECKED BY** SSR
GROUND WATER LEVEL:
NOTES
∇ **AT TIME OF EXCAVATION**
SURFACE CONDITIONS Forest Duff
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
0			TPSL		Dark brown TOPSOIL, roots to 18"	
1.5						353.5
			GP		Brown poorly graded GRAVEL with sand, medium dense, damp	
	GB	MC = 9.1			-probed 3"	
					-moderate caving to BOH	
5						
10						
					-becomes gray	
15	GB	MC = 5.3 Fines = 2.2			[USDA Classification: extremely gravelly coarse SAND]	
15.0						340.0

Test pit terminated at 15.0 feet below existing grade due to caving. Piezo installed. No groundwater encountered during excavation. Caving observed from 3.0 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

GENERAL BH / TP / WELL - 9150.GPJ - GINT US.GDT - 6/6/23

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TEST PIT NUMBER TP-12

PROJECT NUMBER ES-9150
PROJECT NAME 10800 Vancil Road S.E. Subdivision
DATE STARTED 4/24/23 **COMPLETED** 4/24/23
GROUND ELEVATION 356 ft
EXCAVATION CONTRACTOR Client Provided
LATITUDE 46.93049 **LONGITUDE** -122.59051
LOGGED BY SKH **CHECKED BY** SSR
GROUND WATER LEVEL:
NOTES
∇ **AT TIME OF EXCAVATION**
SURFACE CONDITIONS Forest Duff
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elevation
0–1.5			TPSL		Dark brown TOPSOIL, roots to 18"	354.5
1.5–14.0	GB	MC = 7.0	GP		Brown poorly graded GRAVEL with sand, medium dense, damp -probed 3" -moderate caving to BOH	
14.0	GB	MC = 6.0 Fines = 3.5			[USDA Classification: extremely gravelly loamy coarse SAND]	342.0

Test pit terminated at 14.0 feet below existing grade due to caving. Piezo installed. No groundwater encountered during excavation. Caving observed from 3.0 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

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TEST PIT NUMBER TP-13

PROJECT NUMBER ES-9150
PROJECT NAME 10800 Vancil Road S.E. Subdivision
DATE STARTED 4/24/23 **COMPLETED** 4/24/23
GROUND ELEVATION 351 ft
EXCAVATION CONTRACTOR Client Provided
LATITUDE 46.93071 **LONGITUDE** -122.59075
LOGGED BY SKH **CHECKED BY** SSR
GROUND WATER LEVEL:
NOTES
AT TIME OF EXCAVATION
SURFACE CONDITIONS Forest Duff
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elevation
0			TPSL		Dark brown TOPSOIL, roots to 18"	
1.5						349.5
			GP		Brown poorly graded GRAVEL with sand, medium dense, damp	
	GB	MC = 7.3			-probed 3"	
					-slight caving to BOH	
5						
10.0						341.0
			GW		Brown well-graded GRAVEL with sand, medium dense, damp to moist	
15.0	GB	MC = 4.8 Fines = 1.3			[USDA Classification: extremely gravelly SAND]	336.0

Test pit terminated at 15.0 feet below existing grade due to caving. Piezo installed. No groundwater encountered during excavation. Caving observed from 3.5 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

GENERAL BH / TP / WELL - 9150.GPJ - GINT US.GDT - 6/6/23

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TEST PIT NUMBER TP-14

PAGE 1 OF 1

PROJECT NUMBER ES-9150
PROJECT NAME 10800 Vancil Road S.E. Subdivision
DATE STARTED 4/25/23 **COMPLETED** 4/25/23
GROUND ELEVATION 355 ft
EXCAVATION CONTRACTOR Client Provided
LATITUDE 46.93064 **LONGITUDE** -122.59146
LOGGED BY SKH **CHECKED BY** SSR
GROUND WATER LEVEL:
NOTES
AT TIME OF EXCAVATION
SURFACE CONDITIONS Forest Duff
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			TPSL	1.5	Dark brown TOPSOIL, roots to 24"	353.5
	GB	MC = 8.8	GW		Brown well-graded GRAVEL with sand, medium dense, damp to moist -probed 3" -moderate caving to BOH	
5	GB	MC = 5.2 Fines = 1.5			[USDA Classification: extremely gravelly coarse SAND]	
10						
	GB	MC = 7.1		12.5		342.5

Test pit terminated at 12.5 feet below existing grade due to caving. No groundwater encountered during excavation. Caving observed from 3.0 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

GENERAL BH / TP / WELL - 9150.GPJ - GINT US.GDT - 6/6/23

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TEST PIT NUMBER TP-15

PROJECT NUMBER ES-9150
PROJECT NAME 10800 Vancil Road S.E. Subdivision
DATE STARTED 4/25/23 **COMPLETED** 4/25/23
GROUND ELEVATION 356 ft
EXCAVATION CONTRACTOR Client Provided
LATITUDE 46.93019 **LONGITUDE** -122.59064
LOGGED BY SKH **CHECKED BY** SSR
GROUND WATER LEVEL:
NOTES
AT TIME OF EXCAVATION
SURFACE CONDITIONS Forest Duff
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elevation
0–1.5			TPSL		Dark brown TOPSOIL, roots to 18"	354.5
1.5–16.0			GP		Brown poorly graded GRAVEL with sand, medium dense, damp	340.0
2	GB	MC = 10.6			-probed 3"	
3.5					-moderate caving to BOH	
6					-becomes gray	
7	GB	MC = 8.5				
16	GB	MC = 9.8				

Test pit terminated at 16.0 feet below existing grade due to caving. No groundwater encountered during excavation. Caving observed from 3.5 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

GENERAL BH / TP / WELL - 9150.GPJ - GINT US.GDT - 6/6/23

Earth Solutions NW LLC

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TEST PIT NUMBER TP-16

PAGE 1 OF 1

PROJECT NUMBER ES-9150
PROJECT NAME 10800 Vancil Road S.E. Subdivision
DATE STARTED 4/25/23 **COMPLETED** 4/25/23
GROUND ELEVATION
EXCAVATION CONTRACTOR Client Provided
LATITUDE 46.9302 **LONGITUDE** -122.59146
LOGGED BY SKH **CHECKED BY** SSR
GROUND WATER LEVEL:
NOTES
AT TIME OF EXCAVATION
SURFACE CONDITIONS Forest Duff
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			TPSL	2.0	Dark brown TOPSOIL, roots to 24"
	GB	MC = 9.2 Fines = 4.3	GW		Brown well-graded GRAVEL with sand, medium dense, damp -probed 3" [USDA Classification: extremely gravelly loamy coarse SAND] -slight caving to BOH
5					
10					
	GB	MC = 7.4		14.0	

Test pit terminated at 14.0 feet below existing grade due to caving. No groundwater encountered during excavation. Caving observed from 3.5 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

GENERAL BH / TP / WELL - 9150.GPJ - GINT US.GDT - 6/6/23

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TEST PIT NUMBER TP-17

PROJECT NUMBER ES-9150 **PROJECT NAME** 10800 Vancil Road S.E. Subdivision
DATE STARTED 4/25/23 **COMPLETED** 4/25/23 **GROUND ELEVATION**
EXCAVATION CONTRACTOR Client Provided **LATITUDE** 46.93064 **LONGITUDE** -122.59233
LOGGED BY SKH **CHECKED BY** SSR **GROUND WATER LEVEL:**
NOTES ∇ **AT TIME OF EXCAVATION**
SURFACE CONDITIONS Forest Duff **AFTER EXCAVATION**

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			TPSL		Dark brown TOPSOIL, roots to 24"
2.0			GP		Brown poorly graded GRAVEL with sand, medium dense, damp
	GB	MC = 7.9			-probed 3"
					-moderate caving to BOH
5					
10					
12.0	GB	MC = 6.6			

Test pit terminated at 12.0 feet below existing grade. No groundwater encountered during excavation. Caving observed from 3.5 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

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Earth Solutions NW, LLC
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TEST PIT NUMBER TP-18

PROJECT NUMBER ES-9150 **PROJECT NAME** 10800 Vancil Road S.E. Subdivision

DATE STARTED 4/25/23 **COMPLETED** 4/25/23 **GROUND ELEVATION** 361 ft

EXCAVATION CONTRACTOR Client Provided **LATITUDE** 46.93026 **LONGITUDE** -122.59252

LOGGED BY SKH **CHECKED BY** SSR **GROUND WATER LEVEL:**

NOTES **AT TIME OF EXCAVATION**

SURFACE CONDITIONS Forest Duff **AFTER EXCAVATION**

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			TPSL		Dark brown TOPSOIL, roots to 18"	
1.5						359.5
			GP		Brown poorly graded GRAVEL with sand, medium dense, damp	
	GB	MC = 8.4			-probed 4"	
					-slight caving to BOH	
5						
10						
13.5	GB	MC = 4.8				347.5

Test pit terminated at 13.5 feet below existing grade due to caving. No groundwater encountered during excavation. Caving observed from 3.5 feet to BOH.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

GENERAL BH / TP / WELL - 9150.GPJ - GINT US.GDT - 6/6/23

Appendix B

Laboratory Test Results

ES-9150

Earth Solutions NW, LLC
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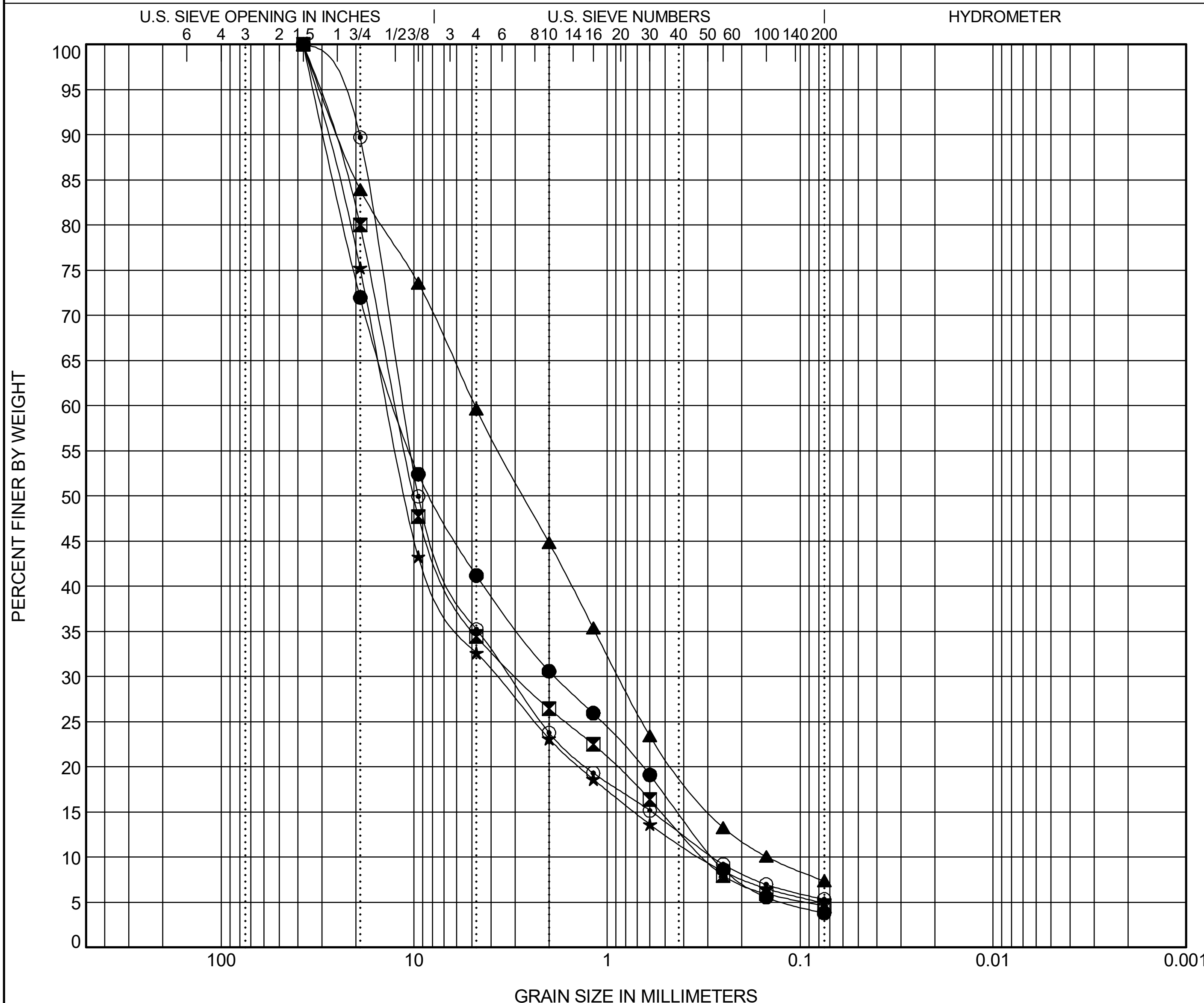
Telephone: 425-449-4704
Fax: 425-449-4711

GRAIN SIZE DISTRIBUTION

PROJECT NUMBER ES-9150 **PROJECT NAME** 10800 Vancil Road S.E. Subdivision



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	Cc	Cu
●	TP-02	7.50ft.	USDA: Brown Extremely Gravelly Coarse Sand. USCS: GW with Sand.	1.00	44.36
⧗	TP-05	13.00ft.	USDA: Brown Extremely Gravelly Loamy Coarse Sand. USCS: GW with Sand.	2.26	40.04
▲	TP-06	16.00ft.	USDA: Brown Very Gravelly Loamy Coarse Sand. USCS: SW-SM with Gravel.	1.07	32.95
★	TP-07	14.00ft.	USDA: Brown Extremely Gravelly Loamy Coarse Sand. USCS: GP with Sand.	3.15	41.95
⊙	TP-09	2.00ft.	USDA: Brown Extremely Gravelly Loamy Coarse Sand. USCS: GP-GM with Sand.	3.22	40.31

	Specimen Identification		D100	D60	D30	D10	LL	PL	PI	%Silt	%Clay
●	TP-02	7.5ft.	37.5	12.425	1.868	0.28				3.8	
⧗	TP-05	13.0ft.	37.5	12.362	2.94	0.309				4.7	
▲	TP-06	16.0ft.	37.5	4.834	0.87	0.147				7.4	
★	TP-07	14.0ft.	37.5	13.65	3.741	0.325				4.9	
⊙	TP-09	2.0ft.	37.5	11.317	3.196	0.281				5.3	

GRAIN SIZE USDA ES-9150 10800 VANCIL ROAD S.E. SUBDIVISION.GPJ GINT US LAB.GDT 5/3/23

Earth Solutions NW, LLC
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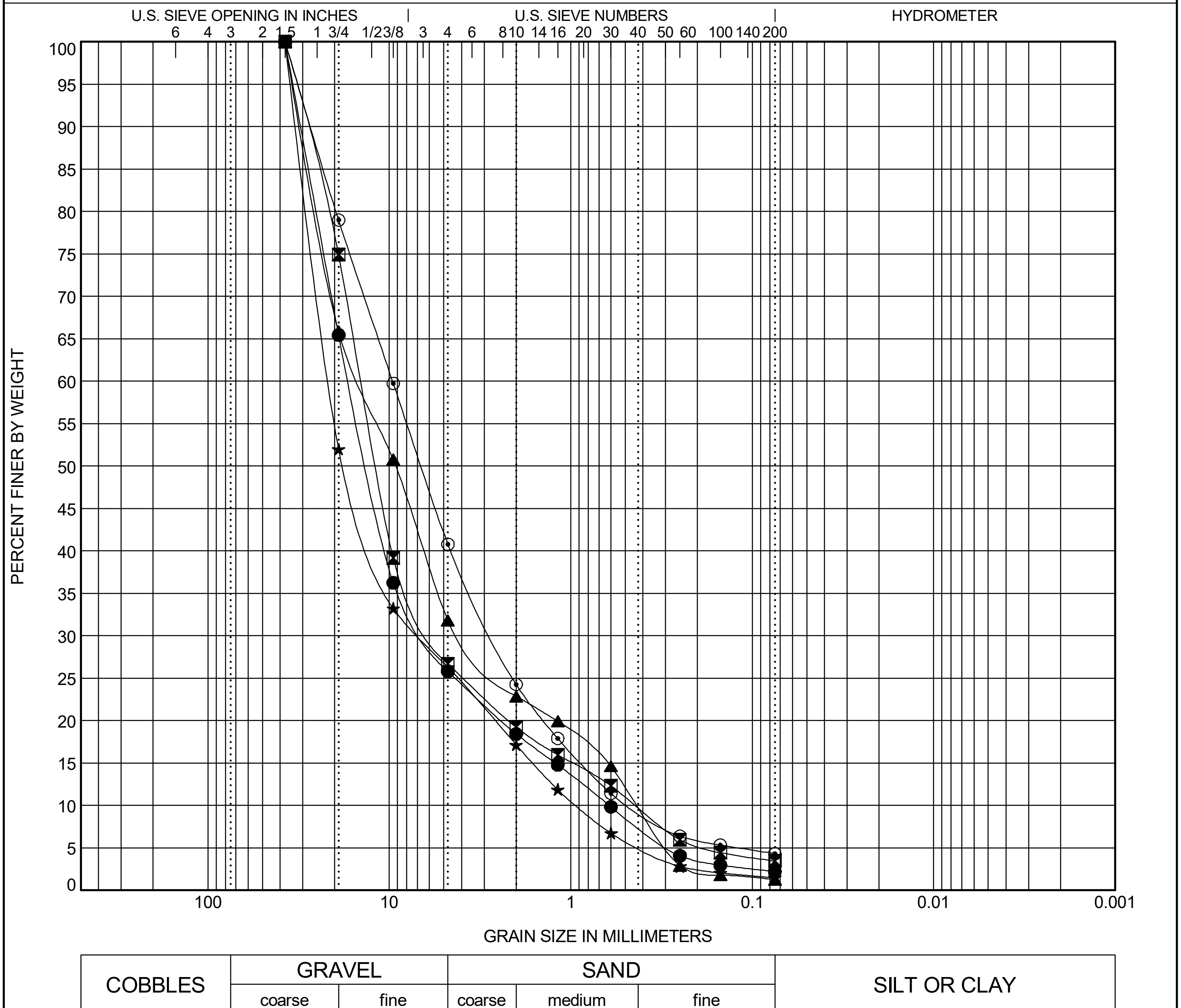
Telephone: 425-449-4704
Fax: 425-449-4711

GRAIN SIZE DISTRIBUTION

PROJECT NUMBER ES-9150 **PROJECT NAME** 10800 Vancil Road S.E. Subdivision



	Specimen Identification		Classification	Cc	Cu
●	**TP-11**	**15.00ft.**	**USDA: Gray Extremely Gravelly Coarse Sand. USCS: GP with Sand.**	**3.85**	**27.25**
⧗	**TP-12**	**14.00ft.**	**USDA: Brown Extremely Gravelly Loamy Coarse Sand. USCS: GP with Sand.**	**5.25**	**32.63**
▲	**TP-13**	**15.00ft.**	**USDA: Brown Extremely Gravelly Sand. USCS: GW with Sand.**	**2.58**	**34.17**
★	**TP-14**	**6.00ft.**	**USDA: Brown Extremely Gravelly Coarse Sand. USCS: GW with Sand.**	**2.41**	**23.12**
⊙	**TP-16**	**3.00ft.**	**USDA: Brown Extremely Gravelly Loamy Coarse Sand. USCS: GW with Sand.**	**1.62**	**20.48**

	Specimen Identification		D100	D60	D30	D10	LL	PL	PI	%Silt	%Clay
●	**TP-11**	**15.0ft.**	**37.5**	**16.693**	**6.273**	**0.613**				**2.2**	
⧗	**TP-12**	**14.0ft.**	**37.5**	**14.225**	**5.708**	**0.436**				**3.5**	
▲	**TP-13**	**15.0ft.**	**37.5**	**14.5**	**3.987**	**0.424**				**1.3**	
★	**TP-14**	**6.0ft.**	**37.5**	**21.278**	**6.876**	**0.92**				**1.5**	
⊙	**TP-16**	**3.0ft.**	**37.5**	**9.585**	**2.699**	**0.468**				**4.3**	

GRAIN SIZE USDA ES-9150 10800 VANCIL ROAD S.E. SUBDIVISION.GPJ GINT US LAB.GDT 5/3/23

Report Distribution

ES-9150

<u>**EMAIL ONLY**</u>

Copper Ridge, LLC
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Puyallup, Washington 98373

Attention: Evan Mann