3J CONSULTING

CIVIL ENGINEERING | WATER RESOURCES | LAND USE PLANNING

PRELIMINARY STORMWATER MANAGEMENT PLAN

CRESTVIEW CROSSING
NEWBERG, OR

June 6, 2018

Prepared For:

JT Smith Companies
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Lake Oswego, OR 97035

Prepared By:
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Project No: 17393
KEF

SLOPES V: Stormwater, Transportation and Utilities

(NMFS# NWR-2013-10411)

Stormwater Information Form

If you are submitting a project that includes a stormwater plan for review under SLOPES: Stormwater, Transportation and Utilities please fill out the following cover sheet to be included with stormwater management plan, and any other supporting materials.

Also include a drawing of the stormwater treatment area including drainage areas, direction of flow, BMP locations/types, contributing areas, other drainage features, receiving water/location, etc.

	Project Information	
	Corps of Engineers permit #	2008-192
	Name of Project:	Crestview Crossing
	Type of project (i.e., residential, commercial, industrial, or combination)	Residential and Commercial
	Nearest receiving water occupied by ESA-listed species or designated critical habitat	Spring Brook
	Have you contacted anyone at NMFS regarding this project?	No
1.	**Stormwater Designer and/or Engineer Contact Information**	
	Name:	Kathleen Freeman, PE
	Phone:	503-946-9365 Ext. 204
	Email:	Kathleen.freeman@3j-consulting.com
	Summary of Design Elements	
2.	**Total** contributing impervious area including all contiguous surface (e.g. roads, driveways, parking lots, sidewalks, roofs, and similar surfaces)	0 **Acres**
	Proposed new	17.076 Acres
	Existing	0 Acres
	Acres of total impervious area x design storm = 158,068 ft^3 to be treated	
3.	Peak discharge of design storm:	4.57 cfs
4.	Total stormwater to be treated:	158,068 ft^3 4.57 cfs
5.	24-hour design storm: 1.25 Inches	50%* or 67% of 2-yr, 24-hr storm fully treated: (Yes) No If no, project may not meet the SLOPES programmatic criteria *See PDC 36.e. for geographically based percentage
6.	Lat/Long (DDD.dddd) of Project Location: 45.311844/-122.934544	
7.	2 year, 24 hour storm from NOAA Precipitation Atlas: 2.14 Inches http://www.nws.noaa.gov/ohd/hdsc/noaaatlas2.htm **2.50 Inches was used to comply with City of Newberg**	
8.	Stormwater Design Manual Used and Year/Version: (example: City of Portland, Clean Water Services, King County, Western Washington) 2014 City of Newberg Design Standards Manual, Clean Water Services Design and Construction Standards (April 2017) and LIDA Handbook (June 2016), Oregon Department of Transportation Hydraulics Manual (April 2014) Describe which elements of your stormwater plan came from this manual: Water quality and detention requirements. Treatment and detention Low Impact Approach BMPs.	

9.	Have you treated all stormwater to the design storm within the contributing impervious area? (Yes) No If no, why not and how will you offset the effects from remaining stormwater?
	Water Quality
10.	Low Impact Development methods incorporated? (Yes) No (e.g. site layout, vegetation and soil protection, reforestation, integrated management practices such as amended soils, bioretention, permeable pavement, rainwater collection, tree retention) Please describe: Impervious areas from the entire development (except the multi-family residential) including, sidewalks and roads will be treated in vegetated facilities. Impervious area from the multi-family residential area will not be treated with vegetated facilities due to grading constraints. This area will be treated with an underground mechanical facility. How much of total stormwater is treated using LID: 94%
11.	Treatment train, including pretreatment and bioretention methods used to treat water quality: All runoff will be conveyed to trapped catch basins followed by sumped water quality manholes to remove coarse sediment. The manholes will convey the pretreated stormwater to vegetated swales which will provide filtration through the length of each swale. Why this treatment train was chosen for the project site: The treatment train was incorporated into the project site to work with the existing topography and drainage channel within the property. Page in stormwater plan where more details can be found: Beginning on Page 10 of 25
	Water Quantity
12.	Does the project discharge directly into a major water body (see PDC 36.c.iii)? Yes (No)
13.	Pre-development runoff rate (i.e., before human-induced changes to the unimproved property) 2-yr, 24-hour storm: 1.72 cfs 10-yr storm: 5.27 cfs Post-development runoff rate (i.e., after proposed developments) 2-yr, 24-hour storm: 0.86 cfs 10-yr storm: 5.27 cfs
	Post-development runoff rate must be less than or equal to pre-development runoff rate
14.	Methods used to treat water quantity: Detention ponds and underground detention facilities will be constructed to detain post-developed runoff. Baseflows from the upstream area will continue to flow through the drainage channel. Page in stormwater plan where more details can be found: Beginning on Page 12 of 25
	Maintenance and Inspection Plan
15.	Have you included a stormwater maintenance plan with a description of the onsite stormwater system, inspection schedule and process, maintenance activities, legal and financial responsibility, and inspection and maintenance logs? (Yes) No* *Projects cannot be submitted for review under SLOPES without a maintenance and inspection plan. Page in stormwater plan where plan can be found: Page 15 of 25 and the Preliminary O&M Plan

16.	Contact information for the party/parties that will be legally responsible for performing the inspections and maintenance or the stormwater facilities: Name: Jesse Nemec Phone number: 503-730-8620 Email: jnemec@jtsmithco.com Name: _____ Phone number: _____ Email: _____ Name: _____ Phone number: _____ Email: _____ Name: _____ Phone number: _____ Email: _____ Page in stormwater plan where more details can be found: Page 15 of 25 and the Preliminary O&M Plan

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I hereby certify that this Preliminary Stormwater Management Plan for Crestview Crossing has been prepared by me or under my supervision and meets minimum standards of the City of Newberg, Oregon Department of Transportation, SLOPES V and normal standards of engineering practice. I hereby acknowledge and agree that the jurisdiction does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities designed by me.

EXECUTIVE SUMMARY

The proposed project is located along OR 99W between Vittoria Way and NE Benjamin Rd in the City of Newberg, OR. The property consists of two tax lots (3216AC 13800 & 1100). The total area of the two tax lots is 33.11 acres containing a private residence and several outbuildings. The rest of the property is used for farming and is undeveloped. All existing structures and the driveway will be demolished for the proposed development. A commercial development consisting of 4.40 acres will be developed by others and is not included in this project.

The proposed project will consist of subdividing the property into 248 single-family residential lots, a two-building apartment complex with clubhouse and new roads and sidewalks. A commercial development will be constructed by others and will not contribute stormwater to any of the proposed stormwater facilities discussed in this report. The existing intermittent stream running through the site will remain in place providing conveyance for upstream flows, as well as onsite stormwater discharge points.

Due to the need of filling wetland on the site, stormwater facilities have been designed to comply with the Standard Local Operating Procedures for Endangered Species (SLOPES V) by the U.S. Army Corps of Engineers (ACOE 2014). The treatment and detention requirements are as follows:

- Treat the volume of water equal to 50% of the cumulative rainfall from the 2-year, 24-hour storm event using a continuous rainfall/runoff (flow duration) model, equating to 1.25 inches of precipitation over 24 hours. Flow duration matching requires a continuous simulation hydrologic model; this has not been adopted by the City of Newberg or Yamhill County. Therefore, the stormwater modeling will use an event based peak flow matching method (Santa Barbara Urban Hydrograph).
- Capture and detain the 2-year, 24-hour post developed runoff rate to ½ of the 2-year, 24-hour predeveloped discharge rate.
- Capture and detain the 10-year, 24-hour post developed runoff to the 10-year, 24-hour predeveloped discharge rate.

In addition to the SLOPES V requirements, the City of Newberg requires the 25-year post-developed runoff rate to match the 25-year predeveloped runoff rate. Also, since runoff enters a culvert crossing Highway 99W (Oregon Department of Transportation jurisdiction), the 50-year post-developed runoff rate is required to match the 50-year predeveloped runoff rate.

The project will discharge to the existing intermittent stream which is a tributary to Spring Brook and the Willamette River (Middle Willamette Basin). Spring Brook and the Willamette River are listed as a water quality limited streams for E. Coli. Typical pollutants from single-family residential projects include: nutrients, pesticides, metals, oil, grease, and other petroleum products, and sediment. Dissolved copper, dissolved zinc, and PAHs are typically the primary constituents of concern for stormwater in Oregon streams for their impact on ESA listed species.

Water quality treatment will occur through trapped catch basins, sedimentation water quality manholes, stormwater vegetated swales and rain gardens and an underground mechanical treatment facility.

Lots 8-248 will be treated in vegetated swales. The vegetated swales will be located in the bottom of each detention pond. Swales provide treatment through vegetation. Clean Water Services Design and Construction Standards will be utilized to design vegetated swales.

Water quality treatment and detention for lots 1-7 in the northern portion of the site will be provided on each lot. Treatment will be designed following Clean Water Services Low Impact Design Approach (LIDA) handbook and will consist of rain gardens or LIDA swales; treatment facilities will release to an underground detention system located on each lot designed to detain all storm events previously discussed.

Water quality treatment for the proposed multi-family apartment complex will be treated using an underground BaySaver BayFilter vault, which is an approved mechanical treatment approach approved by Clean Water Services.

The project site has been delineated into five sub-basins (sub-basin 5 consists off lots 1-7). The calculated peak water quality flow from the disturbed portion of the site, including ODOT Highway 99W of impervious area is 4.57 cfs with approximately 158,068 ft^3 runoff volume. Water quantity control will occur with detention ponds and underground detention.

Stormwater conveyance will be designed in the final design phase of the development.

The proposed development will meet the requirements of the City of Newberg and ODOT as well as conform to Standard Local Operating Procedures for Endangered Species (SLOPES V) as part of the wetland fill permit with the Army Corp of Engineers.

PROJECT DESCRIPTION

The proposed project will consist of subdividing the property into 248 single-family residential lots, a two-building apartment complex with clubhouse and new roads and sidewalks. A commercial development will be constructed by others and will not contribute stormwater to any of the proposed stormwater facilities discussed in this report. The existing intermittent stream running through the site will remain in place providing conveyance for upstream flows, as well as onsite stormwater discharge points.

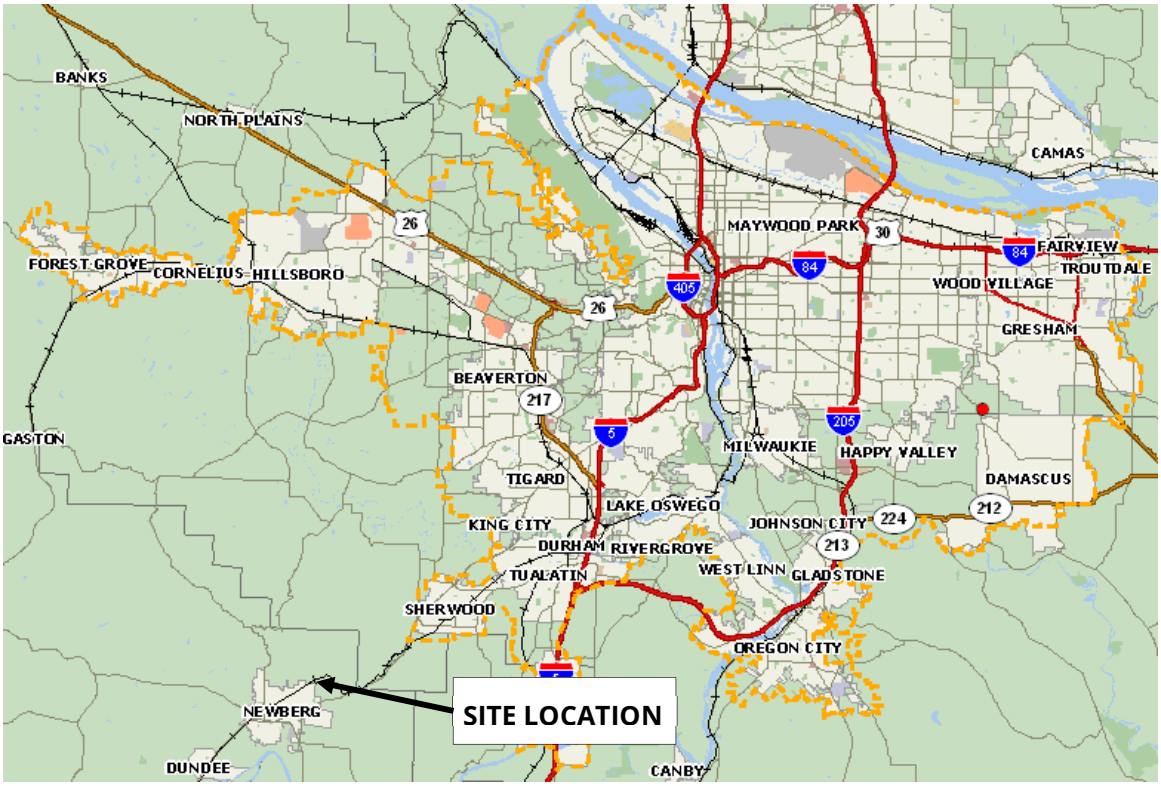


Figure 1 - Vicinity Map

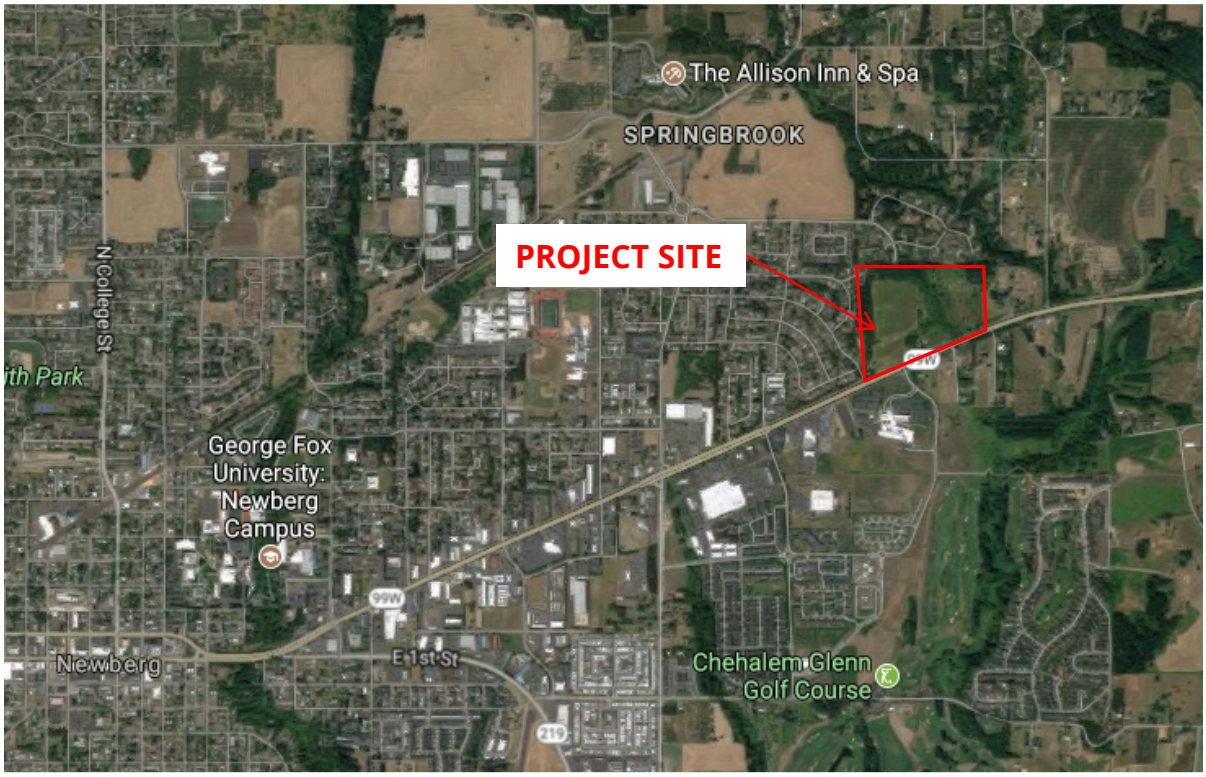


Figure 2 - Site Location

EXISTING CONDITIONS

Site

The existing site contains a private residence, driveway and outbuildings. All existing structures will be demolished for the proposed development.

Flood Map

The site is located within Zone X (un-shaded) per flood insurance rate map (FIRM) community-panel number 41071C 0241D (See Technical Appendix: Exhibits – FIRM: 41071C 0241D). FEMA's definition of Zone X (un-shaded) is an area of minimal flood risk outside the 0.2% annual chance floodplain.

Site Geology

The soil types as classified by the United States Department of Agriculture Soil Survey of Washington County are identified in Table 1 (See Technical Appendix: Exhibits – Hydrologic Soil Group-Yamhill County, Oregon). Soils hydrologically categorized as C/D have been classified as D soils for this analysis.

Soil Type	Hydrologic Group	Percent of Site
Amity Silt Loam	C/D	51.4%
Woodburn Silt Loam	C	48.6%

Table 1 - Soil Characteristics

Geotechnical Report

A geotechnical investigation by GeoEngineers has been included in the Technical Appendix. Infiltration testing was conducted in two locations at depths 2 and 3 feet below ground surface. The field infiltration rates were 0.1 and 0.0 in/hr, respectively. Therefore, GeoEngineers do not recommend stormwater infiltrating facilities.

Existing Site Storm

Runoff from the site generally sheet flows to the intermittent stream that flows from the northwest corner of the site to the south. A 24-inch culvert carries the runoff underneath OR 99W to a ditch that discharges to Spring Brook.

Existing Offsite Storm

Offsite basins discharge into the intermittent stream at three locations (See Technical Appendix: Exhibits – City of Newberg Public Utility Map).

Offsite Basin West drains towards the onsite property from the west (See Technical Appendix: Exhibits – Predeveloped Basin Delineation). The basin includes fourteen lots, roadway and sidewalks and Spring Meadow Park. Stormwater is discharged into an existing wetland onto the onsite property via an 8-inch clay pipe. The wetland eventually drains to the intermittent stream.

Offsite Basin North conveys stormwater via a 15-inch pipe and discharges directly into the intermittent stream (See Technical Appendix: Exhibits – Offsite Basin North).

Offsite Basin Northwest on the northwest side of the property conveys stormwater via a 36-inch pipe and discharges directly into the intermittent stream (See Technical Appendix: Exhibits – Offsite Basin Northwest).

Predeveloped Basin Areas

Table 2 shows the basin areas for the property (See Technical Appendix: Exhibits – Predeveloped Basin Delineation). Predeveloped conditions have been used for analysis to determine runoff rates, therefore, it is assumed the property and area captured from ODOT Highway 99W is 100 percent pervious.

Basin	C Soils (CN=70), Acres	D Soils (CN=77), Acres
Basin 1	6.081	2.077
Basin 2	3.867	7.028
Basin 3	[1]4.324	3.460
Basin 4	1.227	0.567
Basin 5	0.314	1.053
Total Predeveloped Area	15.813	14.184

[1]Includes 2.988 acres from ODOT Right-of-Way

Table 2 – Predeveloped Onsite Basin Areas

Approximately 1.701 acres will remain unchanged and consists of the intermittent stream, adjacent wetlands and construction buffer areas. Additionally, 4.40 acres will be developed by others and is not part of this development.

POST-DEVELOPED CONDITIONS

Site

The existing intermittent stream with adjacent wetlands running through the site will remain in place and undisturbed to convey upstream flows and provide discharge points for the proposed stormwater management systems.

Water quality treatment will occur through trapped catch basins, sedimentation water quality manholes, stormwater vegetated swales and rain gardens and an underground mechanical treatment facility.

The vegetated swales will be located in the bottom of each detention pond. Swales provide treatment through vegetation. Clean Water Services Design and Construction Standards will be utilized to design vegetated swales.

Water quality treatment and detention for lots 1-7 in the northern portion of the site will be provided on each lot. Treatment will be designed following Clean Water Services Low Impact Design Approach (LIDA) handbook and will consist of rain gardens or LIDA swales; treatment facilities will release to an underground detention system located on each lot designed to detain all storm events previously discussed.

The existing 8-inch clay pipe in Offsite Basin West will be connected to the proposed onsite storm system conveying it to the Basin 2 pond. The flow control structure will sized to release the to the required predeveloped flows plus the runoff from Offsite Basin West.

Final conveyance sizing of the pipes will be provided in the final stormwater management plan.

Post-Developed Basin Areas

Table 3 shows the proposed impervious and pervious areas for each sub-basin (See Technical Appendix: Exhibits – Post-Developed Area Delineation). Per City of Newberg Design Standards, when the average lot size is less than 3,000 ft^2, the actual impervious area can be used. The average lot size for lots 19-248 is 1,618 ft^2. Lots 1-18, the average lot size exceeds 3,000 ft^2; therefore, the actual impervious area for lots 19-248 was used and 2,877 ft^2 was used for lots 1-18.

Post-Developed Basin	C Soils (CN=74), Acres	D Soils (CN=80), Acres	Impervious Area (CN=98), Acres
1	3.090	0.919	4.149
2	1.789	3.330	5.777
3	1.062	1.231	5.489
4	0.387	0.209	1.199
5	0.189	0.715	0.462
Total Post-Developed Area	6.517	6.405	17.076

Table 3 – Post-Developed Onsite Basin Area

Of the disturbed portions of the property, including the ODOT Highway 99W, the proposed impervious area will be 56% of the total disturbed area. According to Figure 2-5 Future Conditions Land Use of the City's Stormwater Master Plan Update, dated June 2014, the property is zoned Commercial (85% impervious) and Medium Density (60%) impervious (See Technical Appendix: Exhibits – Figure 2-5 Future Conditions Land Use).

Offsite Basin West Area

Offsite Basin West has a total area of approximately 7.156 acres. Fourteen single family residences contribute runoff to the 8-inch clay pipe with an average lot size greater than 3,000 ft^2; therefore, it was assumed that each lot has an impervious area of 2,877 ft^2. The total impervious and pervious area for the basin is approximately 1.761 acres 5.395 acres, respectively. Runoff rates were calculated for this basin since stormwater will be conveyed through the onsite system and drain to pond 2.

Offsite Basins North and Northwest

Runoff from these two basins will be conveyed directly to the intermittent stream in one storm line. The storm line will enter the stream on the north end of site and will not enter any of the stormwater detention facilities.

HYDROLOGIC ANALYSIS DESIGN GUIDELINES

Design Guidelines

The site is located within the jurisdiction of the City of Newberg. The hydrology and hydraulics modeling will follow the requirements of the City of Newberg's Design Standards, SLOPES V and ODOT.

Hydrograph Method

The Santa Barbara Urban Hydrograph (SBUH) method was used to develop runoff rates since the City and County do not have a continuous simulation model. The computer software XPSTORM was used in modeling the hydrology during the predeveloped and post-developed storm events to determine the required water quality treatment flows and detention volumes.

Design Storm

The rainfall distribution to be used for this area is the design storm of 24-hour duration based on the standard Type 1A rainfall distribution. Table 4 shows total precipitation depths for the storm events used in the analysis, which were used as multipliers for the Type 1A 24-hour rainfall distribution.

Recurrence Interval (Years)	Total Precipitation Depth (inches)
WQ	1.25
2	2.50
10	3.50
25	4.00
50	4.20

Table 4 - Design Storms

RUNOFF PARAMETERS

Curve Number

The major factors for determining the CN values are hydrologic soil group, cover type, treatment, hydrologic condition, and antecedent runoff condition. The curve number represents runoff potential from the ground. Table 2-2a and 2-2c from the TR55 Urban Hydrology for Small Watersheds were used to determine the appropriate curve numbers (See Technical Appendix: Exhibits – Table 2-2a and 2-2c Runoff Curve Numbers).

The predeveloped site was given a curve number of 70 for C soils and 77 for D soils, which corresponds to woods in good condition. The post-developed site and Offsite Basin West was given a curve number of 74 for C soils and 80 for D soils, which corresponds to open space in good condition. All impervious surface was given a curve number of 98.

Time of Concentration

The time of concentration for each sub-basin was calculated using the TR-55 Method and the existing contours. See Table 5 for the time of concentration calculated for each sub-basin (See Technical Appendix: Calculations – Time of Concentration). A time of concentration for lots 1-18 (predeveloped and post), ODOT Highway 99W predeveloped and the post-developed conditions were assumed to be 5 minutes.

Post-Developed Onsite Basin Area	Time of Concentration (minutes)
1	22
2	24
3	24
4	25

Table 5 – Existing Time of Concentration

Basin Runoff

The predeveloped runoff rates for each basin are shown in Table 6 (See Technical Appendix: Hydrographs).

Basin	2-YR Runoff Rate (cfs)	10-YR Runoff Rate (cfs)	25-YR Runoff Rate (cfs)	50-YR Runoff Rate (cfs)
1	0.34	1.20	1.75	1.98
2	0.71	2.00	2.78	3.11
3	0.44	1.43	2.02	2.27
4	0.08	0.26	0.38	0.43
5	0.15	0.38	0.51	0.56
Total Predeveloped Runoff	**1.72**	**5.27**	**7.44**	**8.35**

Table 6 – Predeveloped Basin Runoff Rates

Table 7 below shows the post-developed peak runoff rates (without flow control mitigation).

Basin	2-YR Runoff Rate (cfs)	10-YR Runoff Rate (cfs)	25-YR Runoff Rate (cfs)	50-YR Runoff Rate (cfs)
1	2.78	4.46	5.35	5.71
2	4.03	6.37	7.59	8.09
3	3.45	5.19	6.09	6.45
4	0.76	1.15	1.35	1.44
5	0.40	0.68	0.84	0.90
Total Post-Developed Runoff	**11.42**	**17.85**	**21.22**	**22.59**

Table 7 – Post-Developed Basin Runoff Rates

Table 8 below shows the runoff rates for Offsite Basin West and will not be detained.

Recurrence Interval (Years)	Peak Runoff Rate
2	1.46
10	2.73
25	3.43
50	3.72

Table 8 – Offsite Basin West Runoff Rates

HYDRAULIC ANALYSIS AND DESIGN CHARACTERISTICS

System Characteristics

The stormwater conveyance system will be sized in the final design phase of the project to convey all storm events up to and including the 100-year storm event without any out of system flooding.

Conveyance pipe sizing for Offsite Basins North and Northwest will be determined based on the capacity of the existing pipes, as well as assuming undetained flow from Lots 1-7. Conveyance for this system will be determined in the final design phase of the project.

WATER QUALITY

Water Quality Guidelines

The site is required to follow City of Newberg, SLOPES V, and ODOT Water Quality Standards. See below for each Jurisdictions standard.

- City of Newberg
  - The stormwater quality only facilities shall be designed for a dry weather storm event totaling 1.0 inches of precipitation falling in 24 hours with an average storm return period of 96 hours.
- SLOPES V
  - All stormwater quality treatment practices and facilities will be designed to accept and fully treat the volume of water equal to 50% of the cumulative rainfall from the 2-year, 24-hour storm for that site.
- ODOT
  - Stormwater quality treatment facilities shall be designed to treat the water quality design flow rate or water quality design volume. The water quality storm is designated as a percentage of the 2-year, 24-hour design storm, depending on the location of the site. For the proposed site the water quality design storm is 50% of the 2-year, 24-hour design storm.

SLOPES V and ODOT have the same water quality design storm and the most stringent. The water quality facilities will be sized to treat 50% of the 2-year, 24-hour design storm.

The project will discharge to an existing intermittent stream which is a tributary to Spring Brook and the Willamette River (Middle Willamette Basin). Spring Brook and the Willamette River are listed as a water quality limited streams for E. Coli. Typical pollutants from single-family residential projects include: nutrients, pesticides, metals, oil, grease, and other petroleum products, and sediment. Dissolved copper, dissolved zinc, and PAHs are typically the primary constituents of concern for stormwater in Oregon streams for their impact on ESA listed species.

Water Quality Facilities

Lots 8-248 and All Roads and Sidewalks (Basins 1, 2 and 3)

Water quality treatment will occur through trapped catch basins, sedimentation water quality manholes and stormwater vegetated swales. The vegetated swales will be located in the bottom of each detention pond. Swales provide treatment through vegetation and will provide flow attenuation to reduce hydraulic impacts from urban developments on the downstream surface water systems. Clean Water Services Design and Construction Standards will be utilized to design vegetated swales.

Table 9 below shows the water quality flow rate as modeled in XPSTORM (See Technical Appendix: Hydrographs).

Basin	WQ Treatment Runoff Rate (cfs)
1	1.11
2	1.55
3	1.47

Table 9 – Basins 1-3 Water Quality Runoff Rates

Table 10 below shows the minimum dimensions for each swale (See Technical Appendix: Calculations – Swale Calculations). Each swale will have a minimum hydraulic residence time of 9 minutes and maximum depth of 0.50 feet during the water quality event.

Basin	Minimum Length (ft)	Minimum Bottom Width (ft)	Side Slopes (H:V)	Maximum Swale Slope (ft/ft)
1	126.6	7.2	4:1	0.005
2	184.2	7	4:1	0.010
3	133.4	10	4:1	0.005

Table 10 – Proposed Water Quality Swales

Basin 4

Water quality treatment flow rate for Basin 4 is 0.32 cfs. The proposed basin will utilize BayFilter by BaySaver Technologies, Inc to treat runoff (or equivalent). BayFilter is listed as an approved stormwater treatment technology for Clean Water Services. All runoff from the basin will be conveyed to a single BayFilter vault upstream of the underground detention facility where it will be treated using 4 (four) BayFilter Enhanced Media Cartridges. One cartridge is capable of treating up to 45 gpm of flow, which is equal to 0.10 cfs. Table 11 below shows the required number of cartridges needed to treat Water Quality flow of 0.32 cfs.

Facility	Water Quality Flow (cfs)	Quantity of Cartridges	Treatment Capacity of Facilities	Excess Treatment Capacity (cfs)
BayFilter Manhole	0.32	4	0.40 cfs	0.08

Table 11 – BayFilter Cartridge Calculation

Basin 5 (Lots 1-7)
Water Quality treatment on lots 1-7 will be achieved by implementing Low Impact Development Approaches (LIDA) following Clean Water Services LIDA Handbook. The LIDA Handbook utilizes a sizing ratio of 6% per 1 ft^2 of impervious area. Assuming 2,877 ft^2 of impervious area per lot, 173 ft^2 LIDA facility will be required. The water quality treatment flow rate using the SBUH method is 0.12 cfs.

Water Quality Treatment Volume
Table 12 shows the water quality volume for the post-developed site. Volume is based on the following calculation:

$$\text{WQ Volume} = \frac{1.25\text{ in}}{12\text{in}} \times 1\text{ft} \times \text{Imp Area } (ft^2)$$

Basin	WQ Treatment Volume (cf)
1	18,826
2	47,184
3	64,756
4	18,498
5	8,805
Total Volume	158,068

Table 12 – Water Quality Volume

WATER QUANTITY

Water Quantity Guidelines
The site is required to meet the City of Newberg, SLOPES V and ODOT flow control requirements. See below for each Jurisdictions standard.

- City of Newberg
  - Stormwater quantity on-site detention facilities shall be designed to capture runoff so the post-development runoff rates from the site do not exceed the pre-developed runoff rates from the site, based on 24-hour storm events ranging from ½ the 2-year return storm to the 25-year return storm. Specifically, the ½ of the 2, 2, 10, and 25-year post-development runoff rates will not exceed their respective ½ of the 2, 2, 10, and 25-year pre-development runoff rates.

- SLOPES V
    - The post-developed runoff rate for the 2-year design storm shall not exceed ½ of the 2-year pre-development runoff rate. Additionally, the post-developed runoff rate for the 10-year design storm shall not exceed the 10-year pre-developed runoff rate.
- ODOT
    - The post-developed runoff rate for the 2, 10, and 50-year design storm shall not exceed their respective pre-developed 2, 10, and 50-year runoff rates.

The calculated water quantity volume for the northern portion of the site is approximately 72,885 ft^3 and the southern portion is approximately 36,945 ft^3. Flow control areas and structures will be fully designed at the final design phase.

Water Quantity Facilities

Lots 8-248 and All Roads and Sidewalks (Basins 1, 2 and 3)
Three detention ponds will be constructed to detain all required storm events. Each will have a flow control manhole which will control the release rate so that the following is met:

- The post-developed runoff rate for the 2-year design storm shall not exceed ½ of the 2-year pre-development runoff rate.
- The post-developed runoff rate for the 10-year design storm shall not exceed the 10-year pre-developed runoff rate.
- The post-developed runoff rate for the 25-year design storm shall not exceed the 25-year pre-developed runoff rate.
- The post-developed runoff rate for the 50-year design storm shall not exceed the 50-year pre-developed runoff rate.

The design of flow control structures and outfall protection will be provided in the final design phase.

Basins 4
Underground detention in the form of StormTech Chambers (or equivalent) will be provided under the proposed parking lot of the multi-family residential basin. Detention will be provided downstream of the water quality treatment and will release detained stormwater to the intermittent stream. The design of flow control structures will be provided in the final design phase.

Basin 5
Lots 1-7 will contain underground detention in the form of StormTech Chambers (or equivalent) under each LIDA facility. The detention facilities will release stormwater to the bypass storm line provided to convey offsite flows to the intermittent stream. The design of flow control structures will be provided in the final design phase.

Table 13 shows the allowable release rates from the site after development. The allowable release rate for basin 2 (pond 2) will be the combined allowable release rate from the predeveloped flows plus the runoff rates shown in Table 8.

Basin	2-YR Allowable Release Rate (cfs)	10-YR Allowable Release Rate (cfs)	25-YR Allowable Release Rate (cfs)	50-YR Allowable Release Rate (cfs)
1	0.17	1.20	1.75	1.98
2	0.36+*1.46*	2.00+*2.73*	2.78+*3.43*	3.11+*3.72*
3	0.22	1.43	2.02	2.27
4	0.04	0.26	0.38	0.43
5	0.08	0.38	0.51	0.56
Allowable Release Rates from Site	**2.33**	**8.00**	**10.87**	**12.07**

Runoff from Offsite Basin West

Table 13 –Allowable Release Rates

DOWNSTREAM ANALYSIS

According to the City's Design Manual, a certificate of investigation stating that the engineer has taken downstream impacts into consideration is required for each development constructing, collecting or discharging more than 500 ft^2 of new impervious area.

The City's Stormwater Master Plan (SWMP), dated June 2014, was used to investigate the downstream system to determine if there are currently any known downstream deficiencies in the system. According to the SWMP, the Spring Brook Subcatchment was delineated and analyzed for existing and future capacity issues (See Technical Appendix: Downstream Analysis – Figure 2-6 Drainage System and Study Area). The analysis utilized two methods to identify flooding problems. The first method modeled the existing storm systems using PC SWMM 2012. In addition to the existing flow modeling, the study utilized future conditions based on the zoning showing in Figure 2-5. The second method evaluated the storm systems through discussions with City staff and reviewing existing reports that documented potential problems.

Per Figure 3-1 Predicted Flooding: Existing Land Use, 10-YR Design Storm, the existing storm system does not experience any flooding during the 10-year storm event (See Technical Appendix: Downstream Analysis – Figure 3-1 Predicted Flooding: Existing Land Use, 10-YR Design Storm). Figure 3-1 depicts areas that have both major and minor flooding. Minor flooding was defined in the SWMP "as flooding that occurs for less than 2-hours during the peak 24-hour design storm", while major flooding occurs longer than 2-hours during the peak design storm. Additionally, Figure 3-2 Predicted Flooding: Future Land Use, 10-YR Design Storm shows there are no predicted flooding in the downstream system for Spring Brook.

In discussions with the City, it was noted that flooding occurred at the Chehalem Glenn Golf Course during a January 2012 storm event.

The proposed stormwater management system for Crestview Crossing will detain all storm events to the required predeveloped release rates up to and including the 50-year storm events. Based on the City's SWMP, the proposed developed should not impact the downstream system.

OPERATIONS & MAINTENANCE

The performance of the water quality treatment and detention facilities is very important to ensure prolonged use and functionality. Stormwater facilities will be operated and maintained privately by the homeowners and the apartment complex. Until an HOA can be created, please contact Jesse Nemec at 503-730-8620 or jnemec@jtsmithco.com about inspection and maintenance of the proposed stormwater facilities.

It's vital that the owners of the stormwater management systems insure proper maintenance and operation to ensure water quality facilities function to remove petroleum hydrocarbons, sediments, metals, bacteria and nutrients from stormwater runoff. Additionally, owners must ensure that detention facilities are regulating the release and volume of stormwater prior to leaving the property. See the Technical Appendix for the Operation and Maintenance Plan.

SUMMARY

The proposed stormwater management system design for the Crestview Crossing development followed the City of Newberg's Design Standards dated 2014. Additionally, the project will comply with the National Marine Fisheries Service criteria as part of the March 2014 Programmatic Biological Opinion and Essential Fish Habitat Consultation for the Standard Local Operating Procedures for Endangered Species (SLOPES V) as part of the Wetland Fill Permit with the Army Corp of Engineers.

TECHNICAL APPENDIX

Exhibits

- Oregon's 2012 Integrated Report
- FIRM: 41071C0241D
- Hydrologic Soil Group-Yamhill County
- Tables 2-2a Runoff Curve Numbers
- City of Newberg Public Utility Map
- Offsite Basin North
- Offsite Basin Northwest
- Figure 2-5 Future Conditions Land Use
- Existing Basin Delineation
- Proposed Conditions

Drawings

- Sheet C210 – Overall Site Plan
- Sheet C215 – Multi-Family Site Plan
- Sheet C300 – Composite Utility Plan
- Sheet C303 – Multi-Family Composite Utility Plan

Calculations

- Time of Concentration
- Swale Calculation (Swale 1, 2, & 3)

Hydrographs

- Existing Hydrographs
    - Node – E-Basin 1, 2, 3, 4 & 5
- Post-Developed Hydrographs
    - Node – P-Basin 1, 2, 3, 4 & 5
- Offsite Basin West

Downstream Analysis

- Figure 2-6 Drainage System and Study Area
- Figure 3-1 Predicted Flooding: Existing Land Use, 10-YR Design Storm
- Figure 3-1 Predicted Flooding: Future Land Use, 10-YR Design Storm

Operations & Maintenance Plan

- Preliminary Operations & Maintenance Plan

Geotechnical Report

- Geotechnical Engineering Report, GeoEngineers, March 12, 2018

REFERENCES

1. City of Newberg Design Standards Manual, 2014
2. City of Newberg Stormwater Master Plan, June 2014
3. Clean Water Services Design and Construction Standards, April 2017

4. Clean Water Services LIDA Handbook, 2016
5. Oregon Department of Transportation Hydraulics Manual, 2014

EXHIBITS

2/7/2018 9:14:29 AM (Page 1 of 1)

Oregon's 2012 Integrated Report

To select new search criteria click here - **DO NOT USE THE BACK ARROW**

Refresh Report | Show All Records | Records per page: 100

Lookup LASARStation data | Link to LASAR Web

Basin Name Subbasin 4th Field HUC Record ID	Water Body LLID River Miles Segment Miles Beach Name Beach ID	Pollutant	Season	Criteria	Beneficial Uses	Status	2012 Assessment Action	[Data Source] Supporting Data
Willamette Middle Willamette 17090007 24852	Spring Brook 1229212452679 0 to 7.3 7.3	E. Coli	Summer	30-day log mean of 126 E. coli organisms per 100 ml; no single sample > 406 organisms per 100 ml	Water contact recreation	Cat 4A: Water quality limited, TMDL approved	New Cat 4A: Water quality limited, TMDL approved	TMDL Approved: 07/31/2001 Tillamook Bay Watershed TMDL Tillamook Bay Watershed TMDL Based on EPA analysis of available data for 303(d) additions proposed in March 2012: Six exceedences of the 406 maximum criteria out of 9 days of sampling at LASAR station 28468, Springbrook Creek upstream of Wilsonville Road, between 8/26/02 and 9/15/03.

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 10. The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from multiple sources. Base map files were provided in digital format by the State of Oregon. This information was compiled from the U.S. Geological Survey (2007), Oregon Department of Transportation (2007), OR/WA Bureau of Land Management (2005), Oregon Department of Forestry (2003), NGS (2007), and USDA-FSA (2006) at a scale of 1:24,000.

The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a **Listing of Communities** table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at **1-800-358-9616** for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at http://msc.fema.gov.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip/.

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% Annual Chance Floodplain Boundary

0.2% Annual Chance Floodplain Boundary

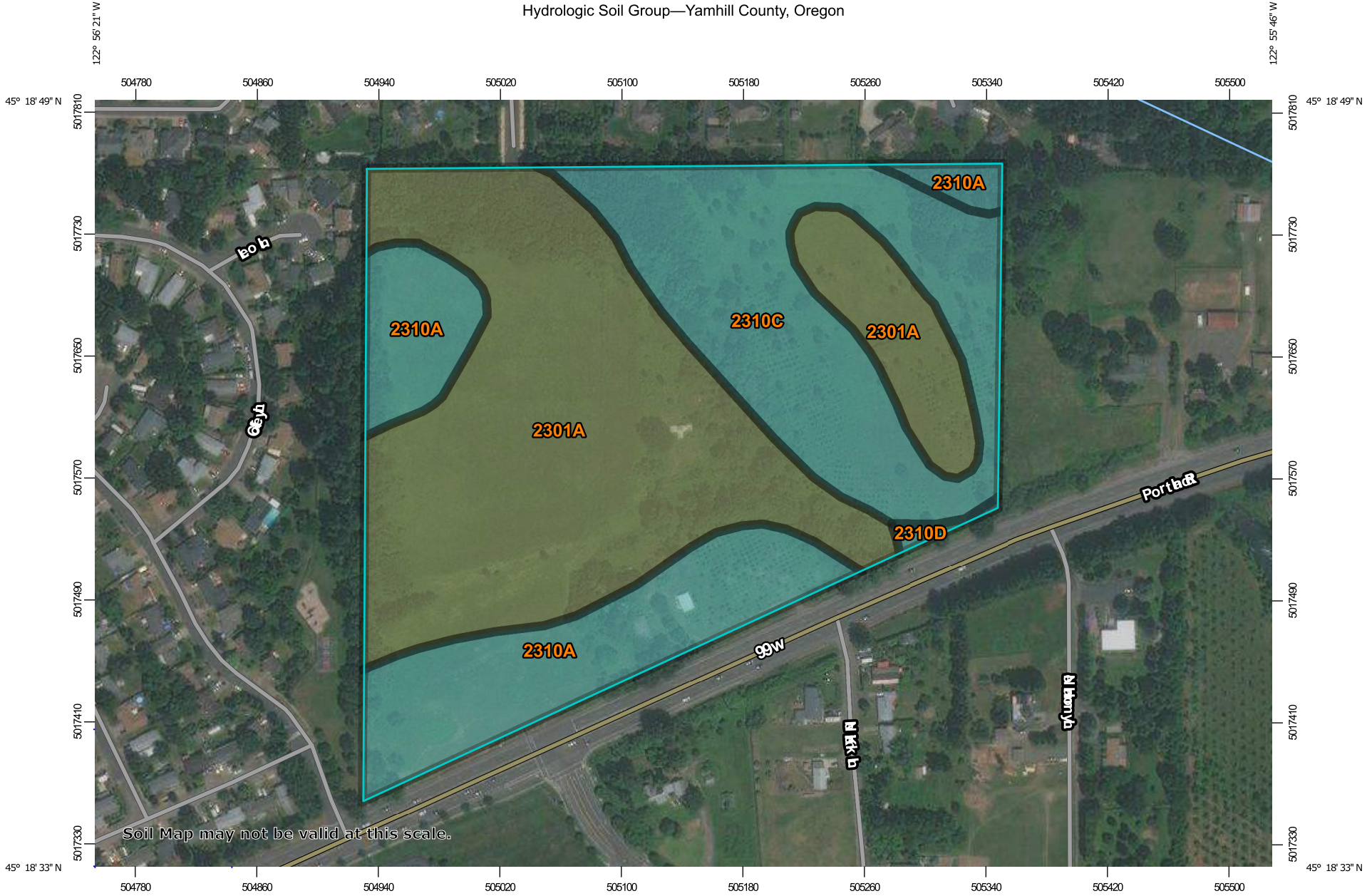
Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

~~~ 513 ~~~ Base Flood Elevation line and value; elevation in feet*

(EL 987) Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

(A)——(A) Cross section line

(23)- - - -(23) Transect line

45° 02' 08", 93° 02' 12" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere

3100000 FT — 5000-foot ticks: Oregon State Plane North Zone (FIPS Zone 3601), Lambert Conformal Conic projection

4989000 N — 1000-meter Universal Transverse Mercator grid values, zone 10N

DX5510 × — Bench mark (see explanation in Notes to Users section of this FIRM panel)

• M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
March 2, 2010
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0241D

FIRM
FLOOD INSURANCE RATE MAP
YAMHILL COUNTY, OREGON
AND INCORPORATED AREAS

PANEL 241 OF 675
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
NEWBERG, CITY OF	410256	0241	D
YAMHILL COUNTY	410249	0241	D

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
41071C0241D

EFFECTIVE DATE
MARCH 2, 2010

Federal Emergency Management Agency
~~~



Map Scale: 1:3,540 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 150 300 600 900

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 Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

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: Yamhill County, Oregon
Survey Area Data: Version 4, Sep 16, 2016

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

Date(s) aerial images were photographed: Aug 19, 2015—Sep 13, 2016

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

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Yamhill County, Oregon (OR071)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
2301A	Amity silt loam, 0 to 3 percent slopes	C/D	17.0	51.4%
2310A	Woodburn silt loam, 0 to 3 percent slopes	C	7.3	21.9%
2310C	Woodburn silt loam, 3 to 12 percent slopes	C	8.7	26.3%
2310D	Woodburn silt loam, 12 to 20 percent slopes	C	0.2	0.5%
Totals for Area of Interest			**33.2**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Table 2-2a Runoff curve numbers for urban areas [1/]

Cover description		Curve numbers for hydrologic soil group			
Cover type and hydrologic condition	Average percent impervious area [2/]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3/]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4/]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5/]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

[1] Average runoff condition, and $I_a = 0.2S$.

[2] The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

[3] CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

[4] Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

[5] Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Table 2-2c Runoff curve numbers for other agricultural lands [1/]

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing. [2/]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element. [3/]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30 [4/]	48	65	73
Woods—grass combination (orchard or tree farm). [5/]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods. [6/]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30 [4/]	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

1 Average runoff condition, and $I_a = 0.2S$.

2 *Poor:* <50%) ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: > 75% ground cover and lightly or only occasionally grazed.

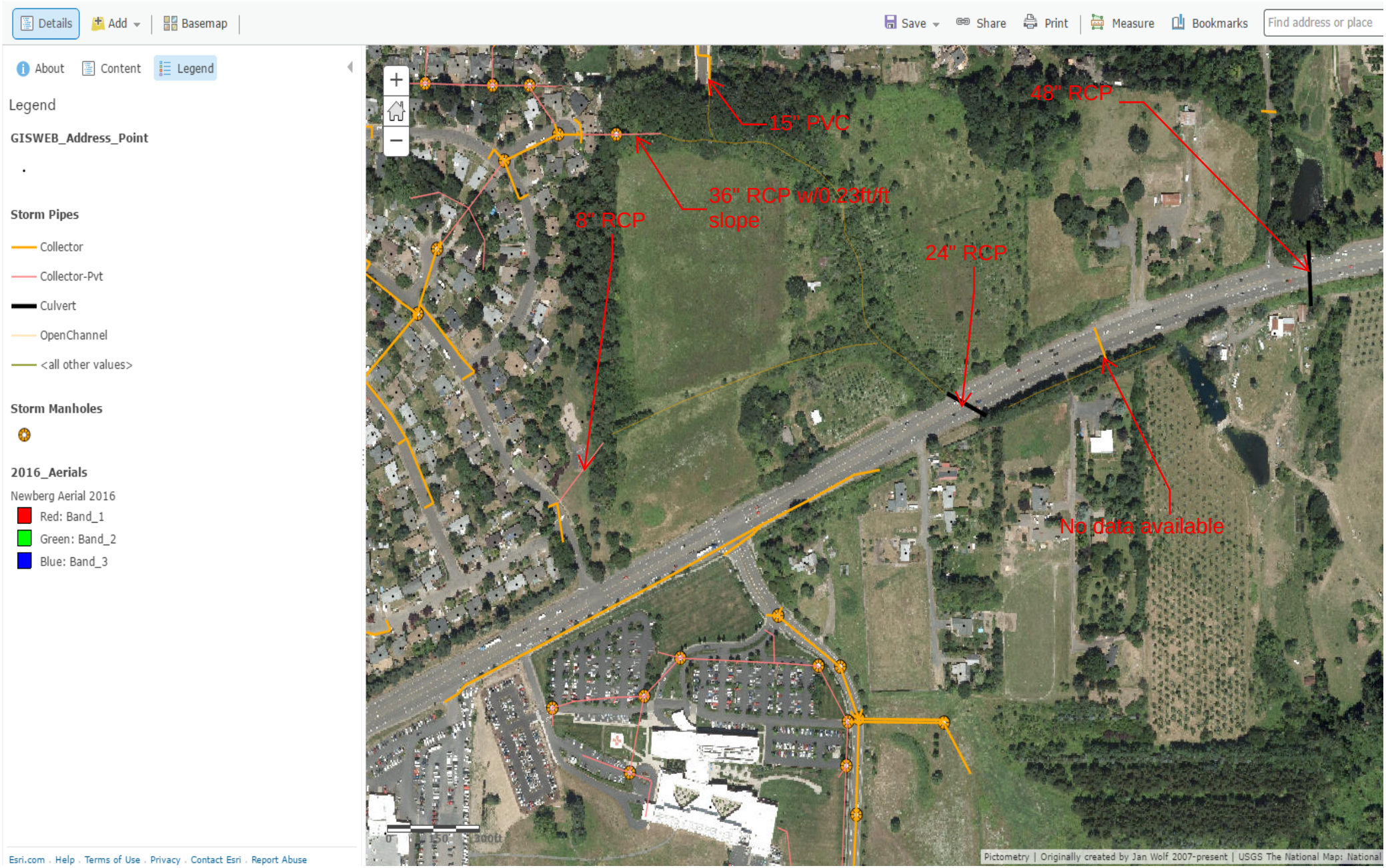
3 *Poor:* <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.

4 Actual curve number is less than 30; use CN = 30 for runoff computations.

5 CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

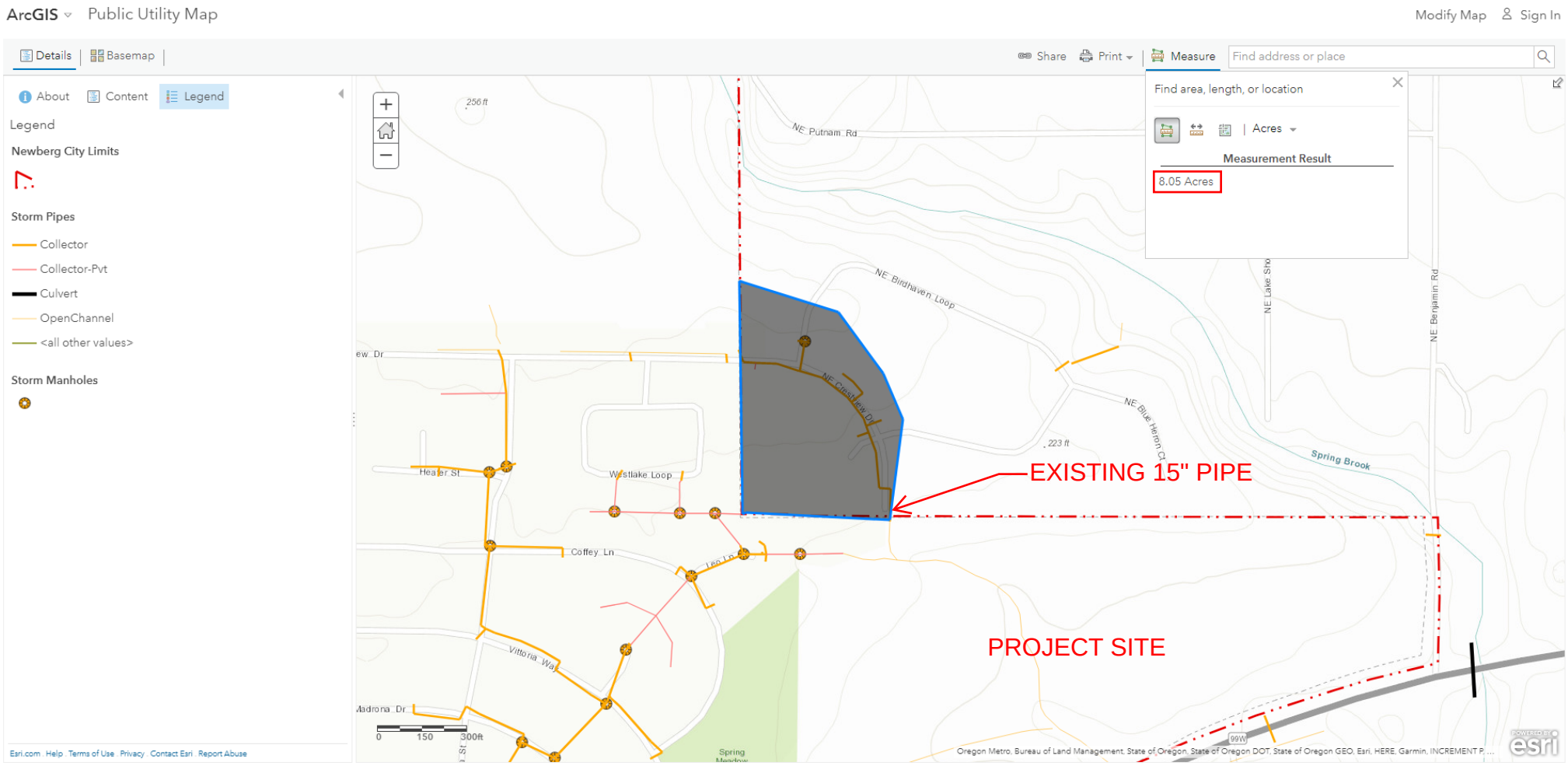
6 *Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

City of Newberg Public Utility Map

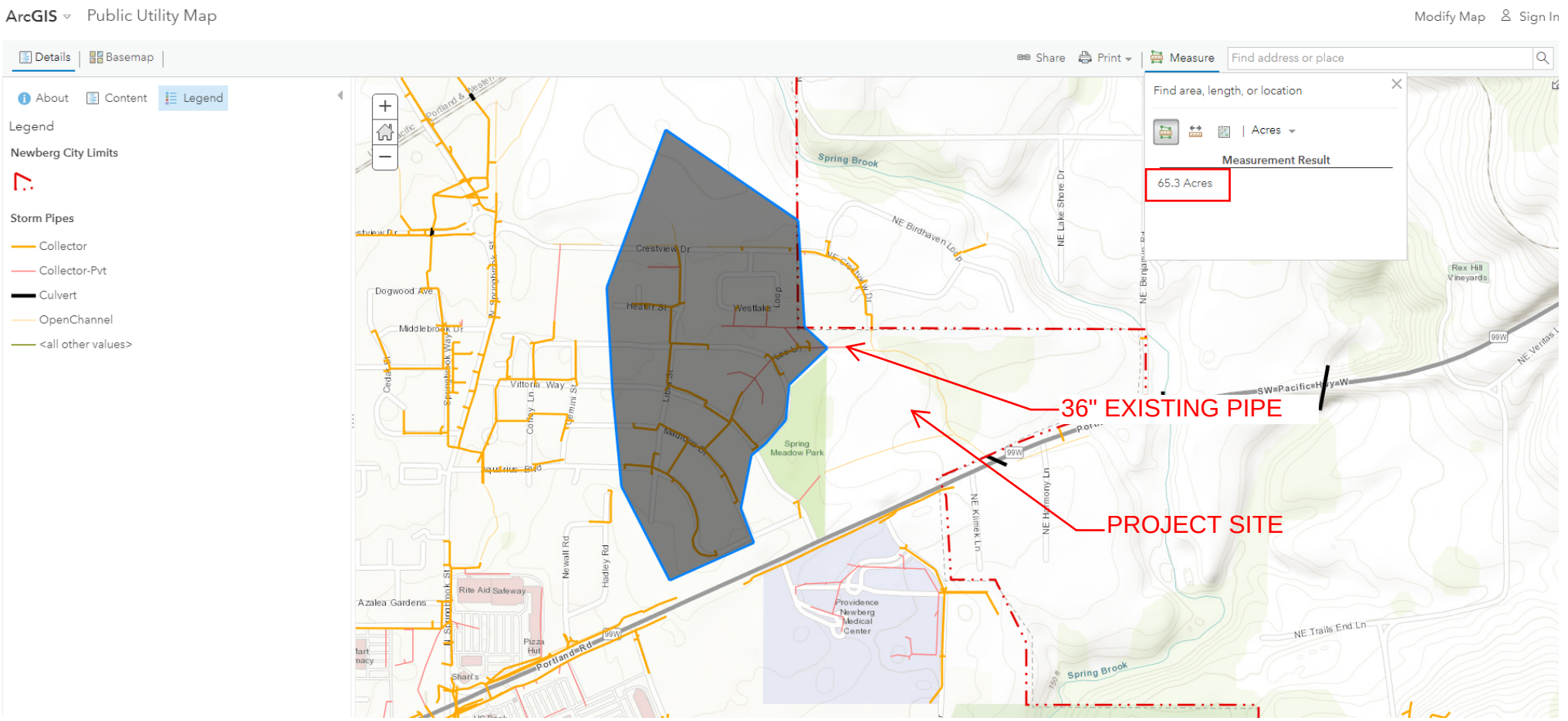


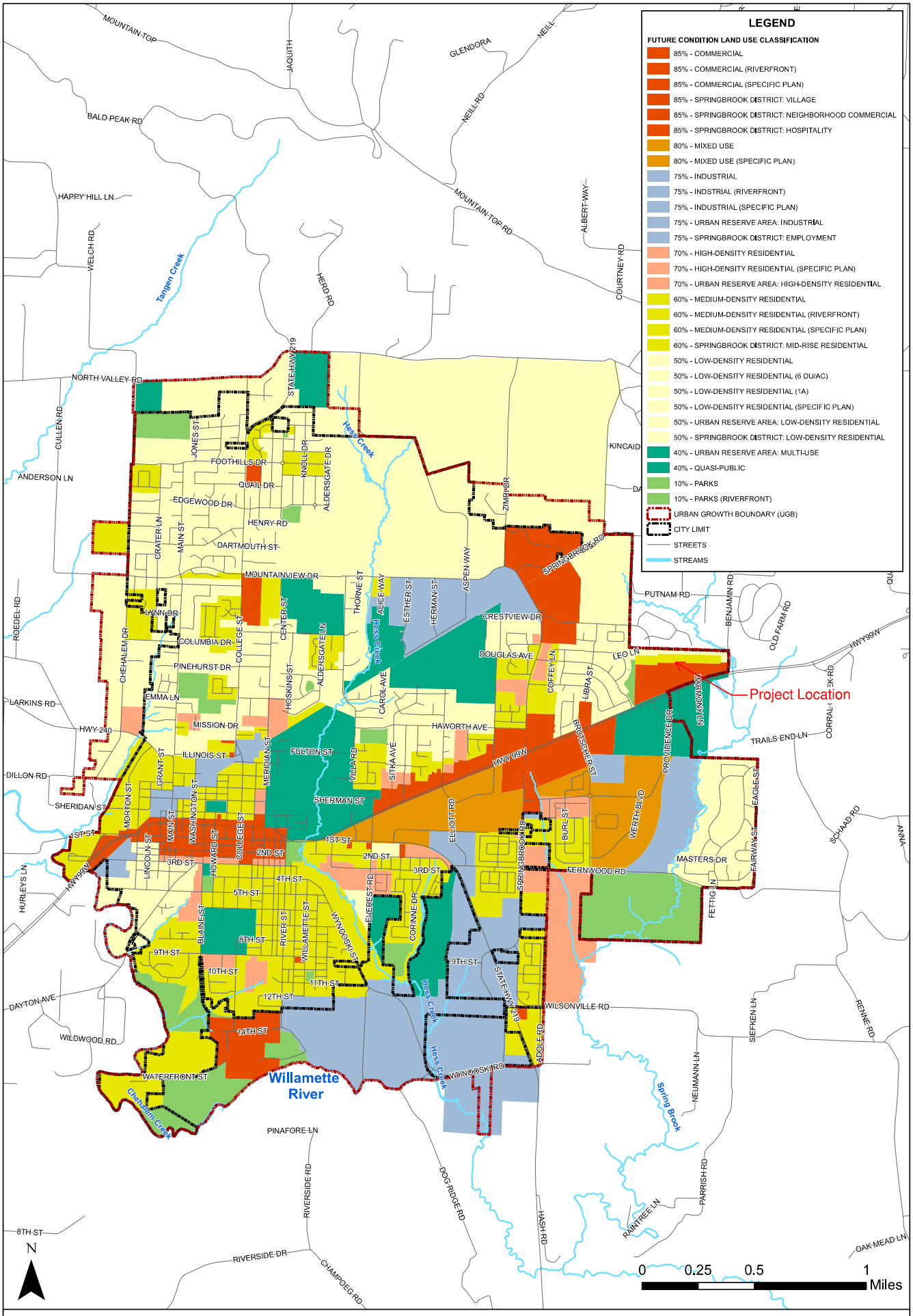
Pipes may or may not be RCP.

OFFSITE BASIN NORTH



OFFSITE BASIN NORTHWEST



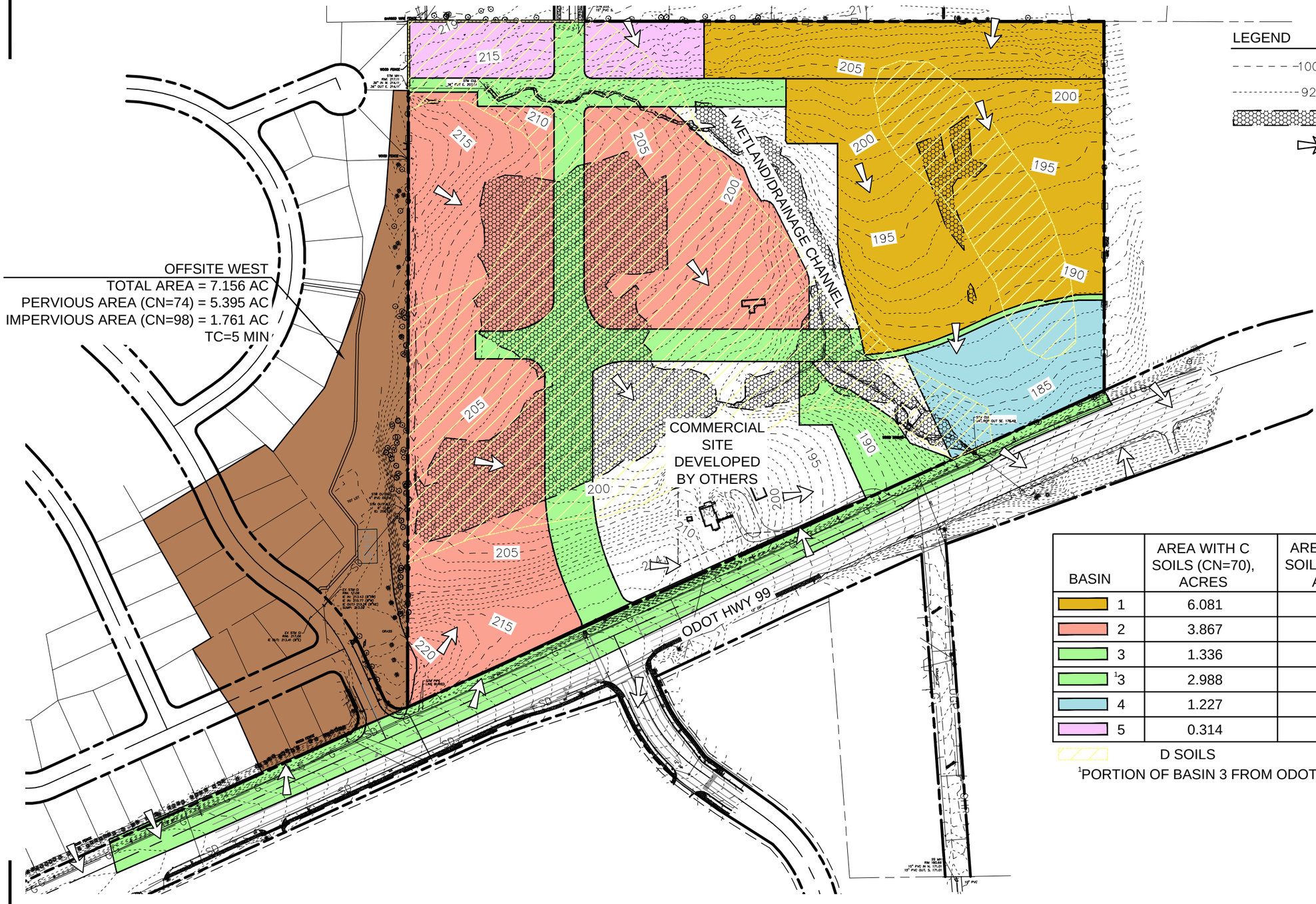


STORMWATER MASTER PLAN UPDATE

FIGURE 2-5. FUTURE CONDITIONS LAND USE

NEWBERG, OREGON

JUNE 2014



BASIN	AREA WITH C SOILS (CN=70), ACRES	AREA WITH D SOILS (CN=77), ACRES	TIME OF CONCENTRATION, MINUTES
1	6.081	2.077	22
2	3.867	7.028	24
3	1.336	3.460	24
[1]3	2.988	0.000	5
4	1.227	0.567	25
5	0.314	1.053	5

D SOILS

[1]PORTION OF BASIN 3 FROM ODOT HWY 99

N
W E
S

SCALE: 1" = 200'
0 200

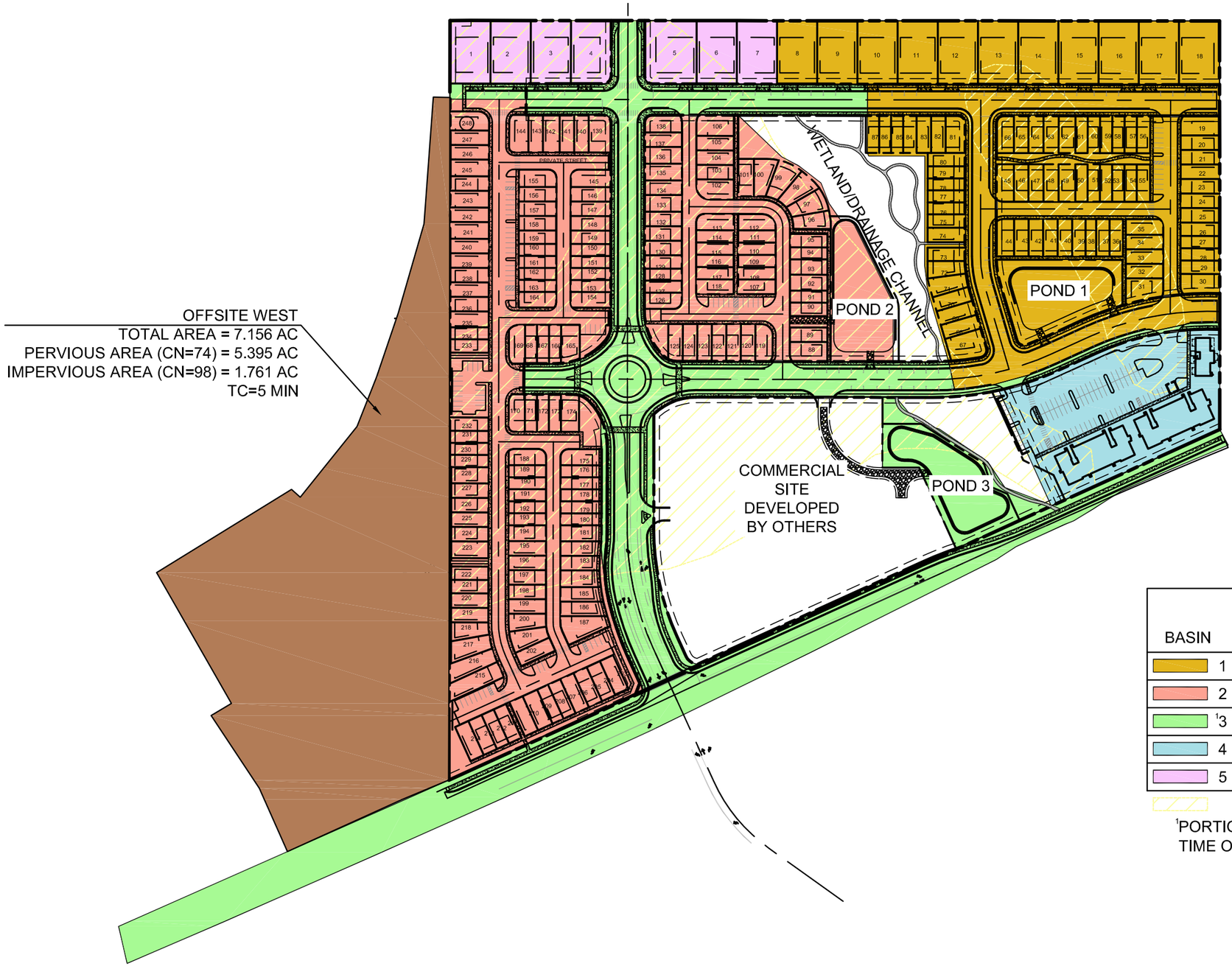
CRESTVIEW CROSSING

06/06/18

JT SMITH COMPANIES

EXHIBIT 1 - PREDEVELOPED CONDITIONS

3J CONSULTING
CIVIL ENGINEERING | WATER RESOURCES | LAND USE PLANNING



BASIN	AREA WITH C SOILS (CN=70), ACRES	AREA WITH D SOILS (CN=77), ACRES	IMPERVIOUS AREA (CN=98), ACRES
1	3.090	0.919	4.149
2	1.789	3.330	5.777
[1]3	1.062	1.231	5.489
4	0.387	0.209	1.199
5	0.189	0.715	0.462

D SOILS

[1]PORTION OF BASIN 3 FROM ODOT HWY 99
TIME OF CONCENTRATION = 5 MINUTES FOR ALL BASINS

N
W E
S

SCALE: 1" = 200'
0 200

CRESTVIEW CROSSING

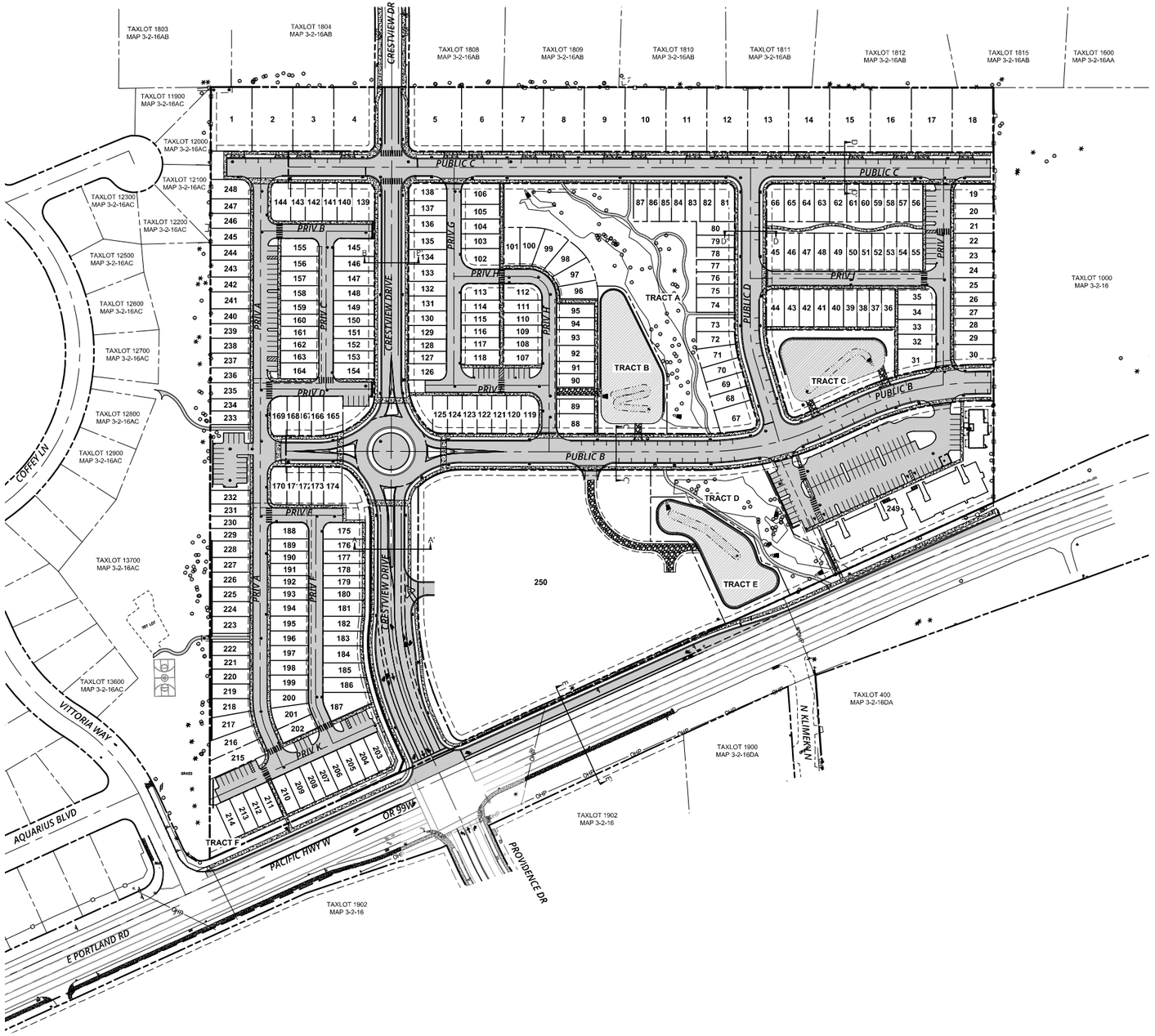
06/06/2018

JT SMITH COMPANIES

EXHIBIT 2 - PROPOSED CONDITIONS

3J CONSULTING
CIVIL ENGINEERING | WATER RESOURCES | LAND USE PLANNING

DRAWINGS



LEGEND

- PROJECT BOUNDARY
- EXISTING RIGHT-OF-WAY LINE
- EXISTING RIGHT-OF-WAY CENTERLINE
- EXISTING ADJACENT PROPERTY LINE
- PROPOSED RIGHT-OF-WAY LINE
- PROPOSED RIGHT-OF-WAY CENTERLINE
- PROPOSED LOT LINE
- PROPOSED SETBACK LINE
- PROPOSED EASEMENT
- PROPOSED CURB FACE
- PROPOSED CURB BACK
- PROPOSED LIP OF GUTTER
- PROPOSED WHITE STRIPING
- PROPOSED CONCRETE
- PROPOSED ASPHALT
- PROPOSED STORM FACILITY
- PROPOSED SWALE
- PROPOSED GRAVEL
- PROPOSED WOODCHIP PATH
- PROPOSED RETAINING WALL
- PROPOSED DRIVEWAY
- PROPOSED PEDESTRIAN CROSSWALK STRIPING
- PROPOSED TYPICAL STREET SECTION SEE SHEETS C200 & C201

Know what's below. Call before you dig.

N W E S

SCALE: 1" = 100'
0 100' 200'

PUBLISH DATE
06.06.2018
ISSUED FOR
LAND USE DOCUMENTS

OVERALL SITE PLAN
CRESTVIEW CROSSING
PLANNED UNIT DEVELOPMENT

JT SMITH COMPANIES
NEWBERG, OR

3J CONSULTING
CIVIL ENGINEERING
WATER RESOURCES
LAND USE PLANNING
5075 SW GRIFFITH DRIVE, SUITE 150, BEAVERTON, OR 97005

PROJECT INFORMATION
3J PROJECT # | 17393
TAX LOT(S) | 3S2W16 13800, 1100
LAND USE # | N/A
DESIGNED BY | ARS, JEJ, BMO
CHECKED BY | AJM, RGW

SHEET NUMBER
C210

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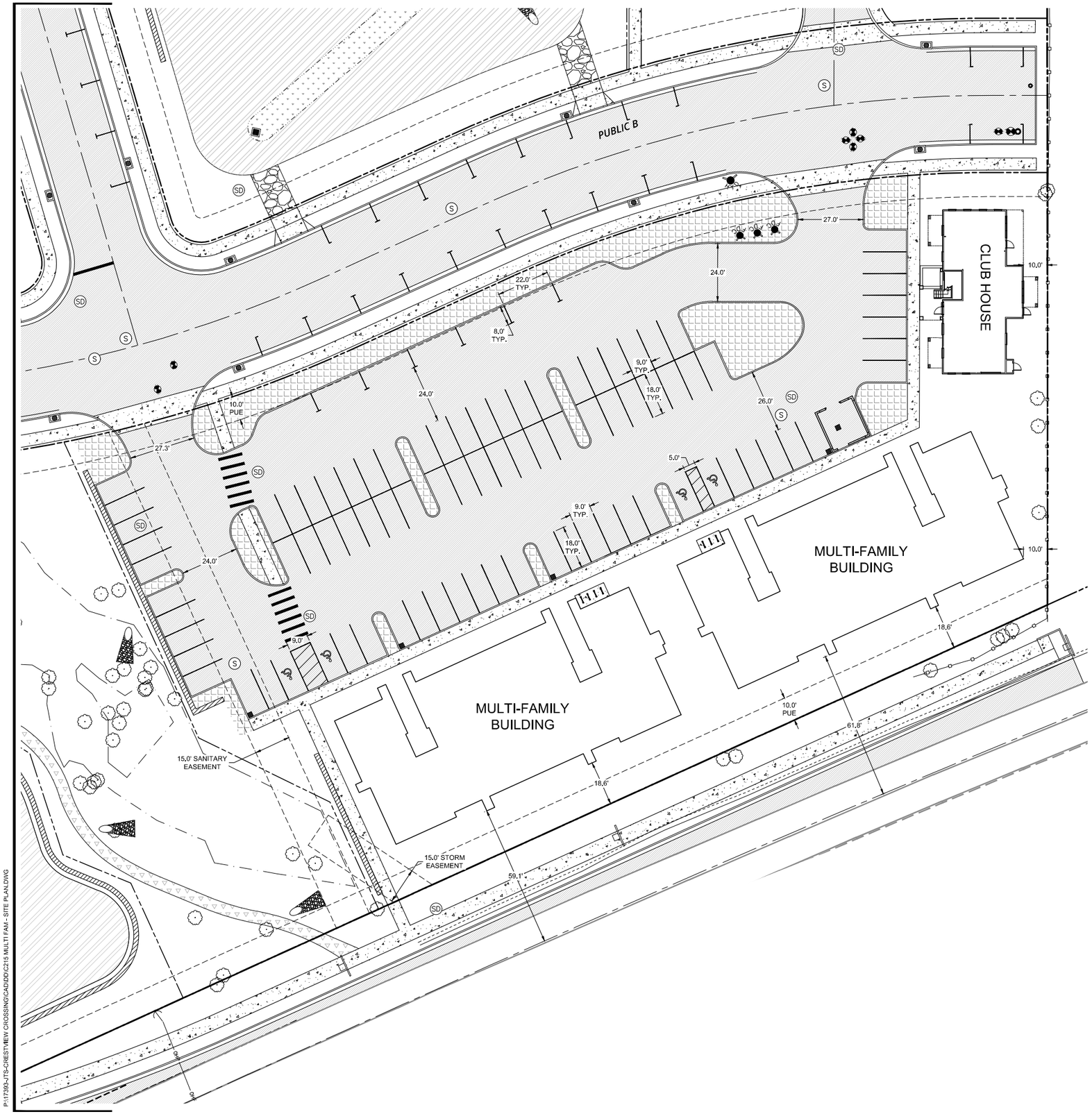


P:\17393-JT3-CRESTVIEW CROSSING\CAD\DD\C215 MULTI FAM - SITE PLAN.DWG

LEGEND

- PROJECT BOUNDARY
- EXISTING RIGHT-OF-WAY LINE
- EXISTING RIGHT-OF-WAY CENTERLINE
- EXISTING ADJACENT PROPERTY LINE
- PROPOSED RIGHT-OF-WAY LINE
- PROPOSED RIGHT-OF-WAY CENTERLINE
- PROPOSED LOT LINE
- PROPOSED SETBACK LINE
- PROPOSED EASEMENT
- PROPOSED CURB FACE
- PROPOSED CURB BACK
- PROPOSED LIP OF GUTTER
- PROPOSED WHITE STRIPING
- PROPOSED CONCRETE
- PROPOSED ASPHALT
- PROPOSED LANDSCAPING
- PROPOSED GRAVEL
- PROPOSED WOODCHIP PATH
- PROPOSED RETAINING WALL
- PROPOSED DRIVEWAY
- PROPOSED PEDESTRIAN CROSSWALK STRIPING
- PROPOSED BIKE PARKING
- PROPOSED ACCESSIBLE PARKING STALL
- PROPOSED HYDRANT
- PROPOSED VALVE
- PROPOSED BLOW-OFF / AIR RELEASE ASSY.
- PROPOSED FIRE DPT. CONNECTION
- PROPOSED SEWER MANHOLE
- PROPOSED STORM MANHOLE
- PROPOSED CATCH BASIN
- EXISTING DECIDUOUS TREE

PARKING STATISTICS - MULITFAMILY LOT

PROPOSED STALL COUNT & SUMMARY

TYPE = (WIDTH x DEPTH)	STANDARD 9' x 18'	PARALLEL 8' x 22'	ADA 9' x 18'	ADA - VAN 9' x 18'	TOTAL
MULTIPLE FAMILY APARTMENTS =	80	7	3	1	91
TOTAL =	80	7	3	1	91

VEHICLES

DEVELOPMENT CODE CHAPTER 15.440.30

MAXIMUM PARKING - MULTI-FAMILY	NONE
MINIMUM PARKING - MULTI-FAMILY	74
PROPOSED	91

BICYCLES

DEVELOPMENT CODE CHAPTER 15.440.90

	MINIMUM	PROPOSED
MINIMUM BICYCLE PARKING - MULTI-FAMILY	13	14

ACCESSIBLE

OSSC SECTION 1106.1

MULTI-FAMILY PARKING LOT (76 TO 100)	MINIMUM	PROPOSED
ACCESSIBLE SPACES	4	4
VAN ACCESSIBLE SPACES	1	1

LANDSCAPING

DEVELOPMENT CODE CHAPTER 15.420.010

	REQUIRED	PROPOSED
MULTI-FAMILY PARKING LOT (25 SF PER STALL)	2,275 SF	6,357 SF

SETBACKS

ZONE C3 - MULTI-FAMILY LOT

FRONT	10 FT
INTERIOR	0 FT/10 FT
STREET - EXPRESSWAY CENTERLINE	50 Ft

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

N W E S

SCALE: 1" = 20'
0 20 40

PUBLISH DATE
06.06.2018
ISSUED FOR
LAND USE DOCUMENTS

MULTI-FAMILY SITE PLAN
CRESTVIEW CROSSING
PLANNED UNIT DEVELOPMENT

JT SMITH COMPANIES
NEWBERG, OR

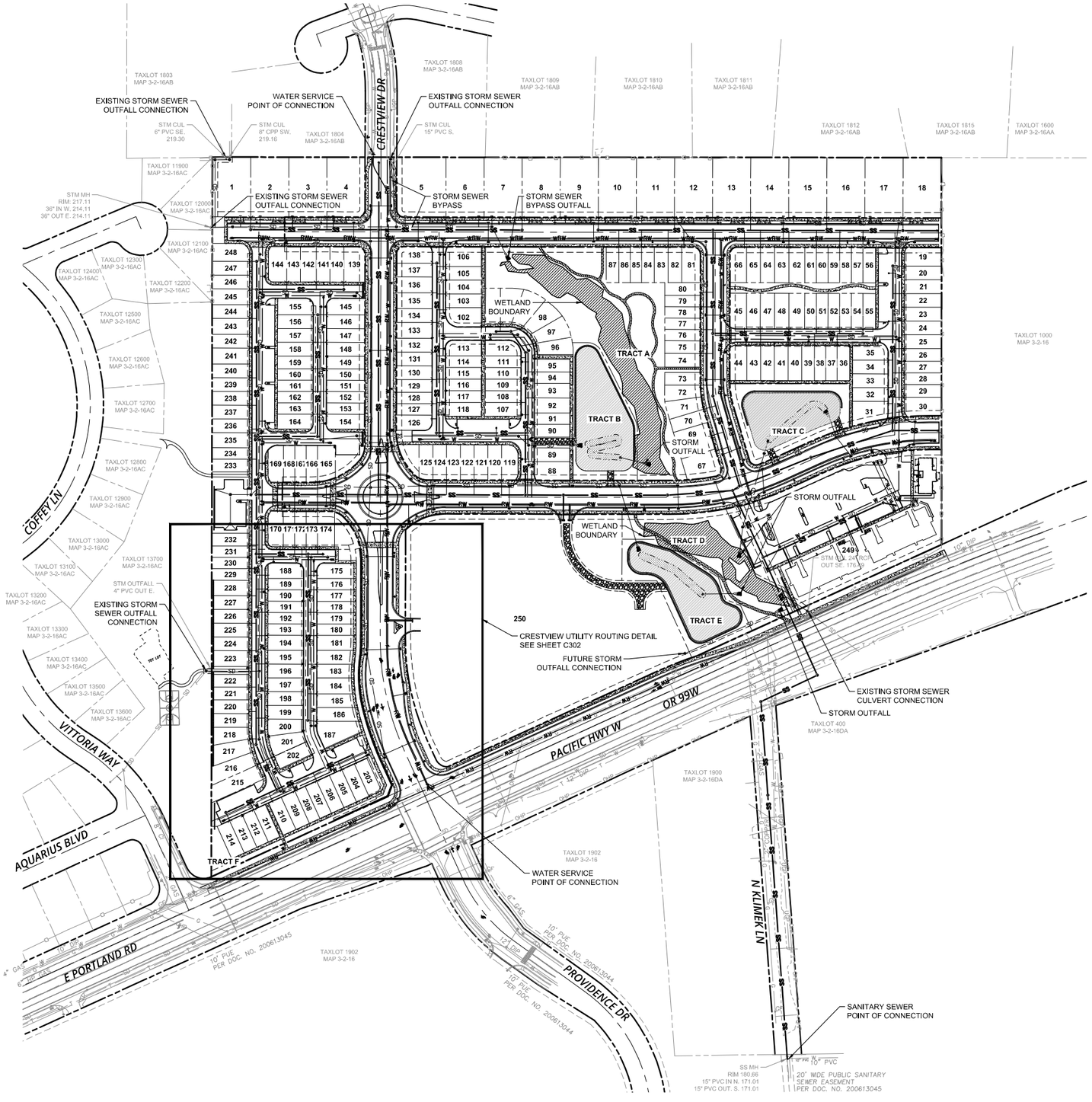
3J CONSULTING
CIVIL ENGINEERING
WATER RESOURCES
LAND USE PLANNING
5075 SW GRIFFITH DRIVE, SUITE 150, BEAVERTON, OR 97005

PROJECT INFORMATION
3J PROJECT # | 17393
TAX LOT(S) | 3S2W16 13800, 1100
LAND USE # | N/A
DESIGNED BY | ARS, JEJ, BMO
CHECKED BY | AJM, RGW

SHEET NUMBER
C215

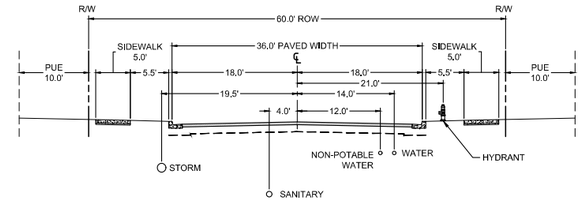
GENERAL NOTES

1. LOTS 1 THROUGH 7 SHALL HAVE STORMWATER QUALITY TREATMENT LOCATED WITHIN LOT BOUNDARIES. STORMWATER DISCHARGE FROM THESE LOTS SHALL CONNECT TO PROPOSED STORM SEWER BYPASS AND OUTFALL TO THE WETLAND.

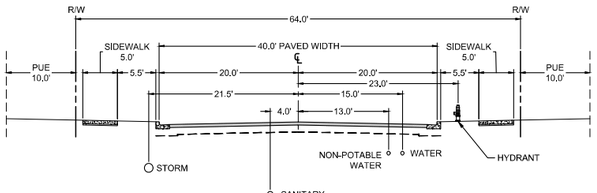


LEGEND

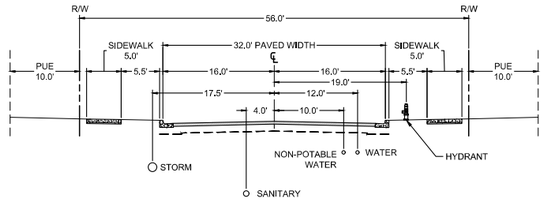
PROPOSED STORM PIPE	EXISTING TELECOM. LINE
PROPOSED SANITARY MAIN	EXISTING GAS LINE
PROPOSED WATER MAIN	EXISTING UNDERGROUND POWER
PROPOSED NON-POTABLE WATER MAIN	EXISTING OVERHEAD POWER
PROPOSED WATER FIRE SERVICE	EXISTING SANITARY SEWER
PROPOSED DETENTION POND	EXISTING STORM DRAIN
PROPOSED WATER QUALITY SWALE	EXISTING WATER MAIN
PIPE CAP / STUB	EXISTING HYDRANT
PROPOSED HYDRANT	EXISTING WATER VALVE
PROPOSED WATER VALVE	EXISTING SANITARY MANHOLE
PROPOSED WATER PIPE BLOWOFF/ PROPOSED AIR RELEASE ASSEMBLY	EXISTING STORM MANHOLE
PROPOSED FIRE DPT. CONNECTION	EXISTING STORM INLET
PROPOSED SANITARY MANHOLE	EXISTING POWER METER
PROPOSED SANITARY SERVICE LATERAL WITH CLEANOUT	EXISTING GAS METER
PROPOSED STORM MANHOLE	EXISTING TELEPHONE PEDESTAL
PROPOSED STORM OUTFALL PROTECTION	EXISTING GUY ANCHOR
PROPOSED STANDARD INLET MANHOLE	EXISTING LIGHT POLE
PROPOSED SUPERSIZED INLET MANHOLE	EXISTING UTILITY POLE
PROPOSED CATCH BASIN	EXISTING INTERSECTION SIGNAL
PROPOSED DITCH INLET	EXISTING ELECTRICAL BOX
PROPOSED STREET LIGHTING	



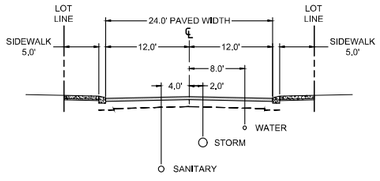
MAJOR COLLECTOR



MINOR COLLECTOR



LOCAL ROAD



PRIVATE ROAD

STREET UTILITIES TYPICAL SECTIONS

SCALE: NTS

Know what's below. Call before you dig.

SCALE: 1" = 100'

0 100' 200'

PUBLISH DATE
06.06.2018

ISSUED FOR
LAND USE DOCUMENTS

COMPOSITE UTILITY PLAN

CRESTVIEW CROSSING
PLANNED UNIT DEVELOPMENT

JT SMITH COMPANIES
NEWBERG, OR

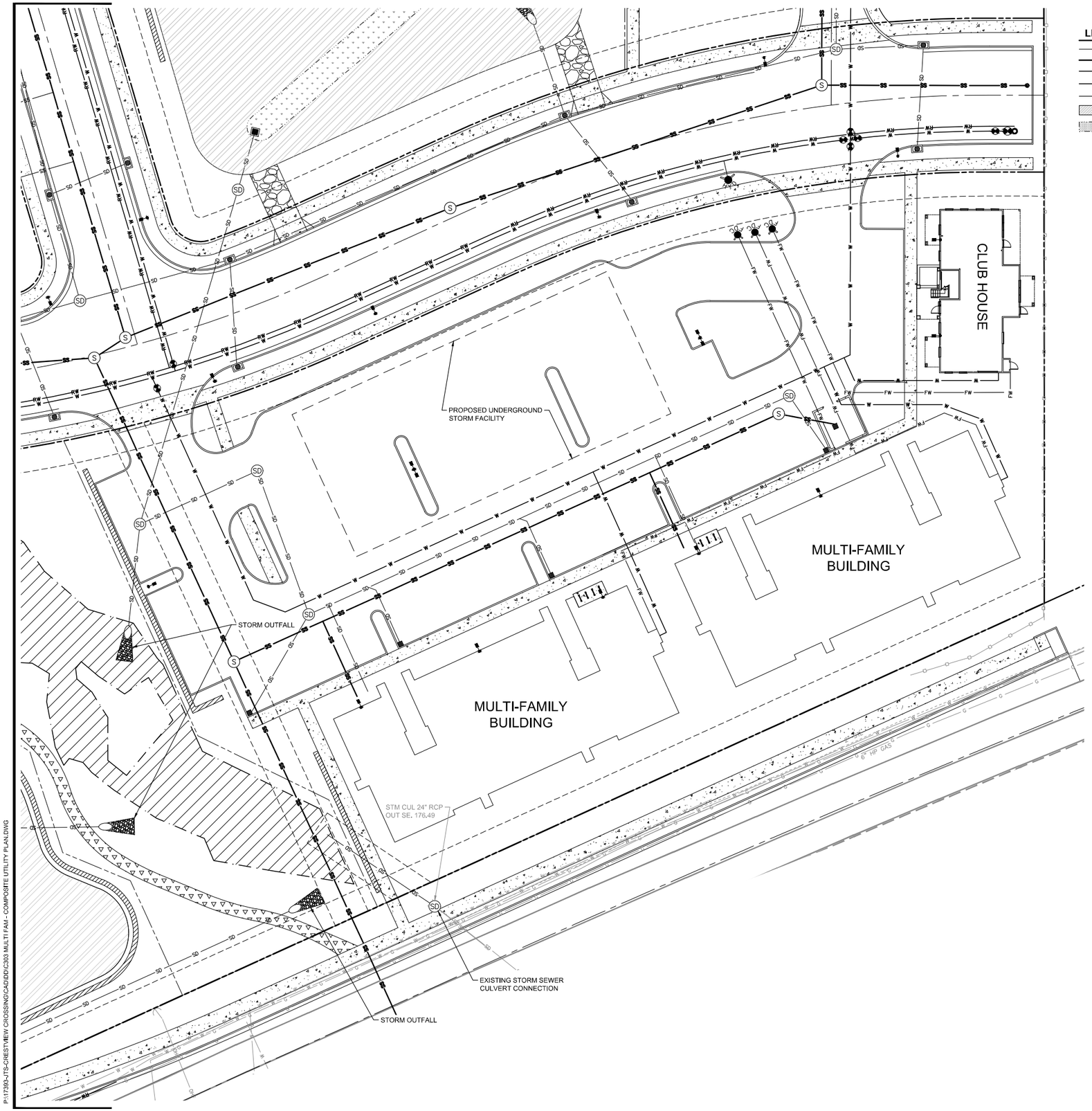
3J CONSULTING
CIVIL ENGINEERING
WATER RESOURCES
LAND USE PLANNING
5075 SW GRIFFITH DRIVE, SUITE 150; BEAVERTON, OR 97005

PROJECT INFORMATION

3J PROJECT #	17393
TAX LOT(S)	3S2W16 13800, 1100
LAND USE #	N/A
DESIGNED BY	ARS, JEJ, BMO
CHECKED BY	AJM, RGW

SHEET NUMBER
C300

P:\17393-JTS-CRESTVIEW CROSSING\CAD\DOC\300 COMPOSITE UTILITY PLAN.DWG



LEGEND

- PROPOSED STORM PIPE
- PROPOSED SANITARY MAIN
- PROPOSED WATER MAIN
- PROPOSED NON-POTABLE WATER MAIN
- PROPOSED WATER FIRE SERVICE
- PROPOSED DETENTION POND
- PROPOSED WATER QUALITY SWALE
- PIPE CAP / STUB
- PROPOSED HYDRANT
- PROPOSED FIRE DEPARTMENT CONNECTION
- PROPOSED WATER VALVE
- PROPOSED WATER PIPE BLOWOFF/ AIR RELEASE ASSEMBLY
- PROPOSED SANITARY MANHOLE
- PROPOSED SANITARY SERVICE LATERAL WITH CLEANOUT
- PROPOSED STORM MANHOLE
- PROPOSED STORM OUTFALL PROTECTION
- PROPOSED STANDARD INLET MANHOLE
- PROPOSED SUPERSIZED INLET MANHOLE
- PROPOSED CATCH BASIN
- PROPOSED DITCH INLET
- PROPOSED STREET LIGHTING
- EXISTING TELECOM. LINE
- EXISTING GAS LINE
- EXISTING UNDERGROUND POWER
- EXISTING OVERHEAD POWER
- EXISTING SANITARY SEWER
- EXISTING STORM DRAIN
- EXISTING WATER MAIN
- EXISTING HYDRANT
- EXISTING WATER VALVE
- EXISTING SANITARY MANHOLE
- EXISTING STORM MANHOLE
- EXISTING STORM INLET
- EXISTING POWER METER
- EXISTING GAS METER
- EXISTING TELEPHONE PEDESTAL
- EXISTING GUY ANCHOR
- EXISTING LIGHT POLE
- EXISTING UTILITY POLE
- EXISTING INTERSECTION SIGNAL
- EXISTING ELECTRICAL BOX

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

N W E S

SCALE: 1" = 100'
0 100' 200'

PUBLISH DATE
06.06.2018

ISSUED FOR
LAND USE DOCUMENTS

MULTI-FAMILY COMPOSITE UTILITY PLAN

CRESTVIEW CROSSING
PLANNED UNIT DEVELOPMENT

JT SMITH COMPANIES
NEWBERG, OR

3J CONSULTING
CIVIL ENGINEERING
WATER RESOURCES
LAND USE PLANNING
5075 SW GRIFFITH DRIVE, SUITE 150; BEAVERTON, OR 97005

PROJECT INFORMATION

3J PROJECT #	17393
TAX LOT(S)	3S2W16 13800, 1100
LAND USE #	N/A
DESIGNED BY	ARS, JEJ, BMO
CHECKED BY	AJM, RGW

SHEET NUMBER
C303

P:\17393-JTS-CRESTVIEW CROSSING\CAD\DD\C303 MULTI FAM - COMPOSITE UTILITY PLAN.DWG

CALCULATIONS

TIME OF CONCENTRATION

PROJECT NO. 17393	BY KEF	DATE 4/30/2018

SHEET FLOW			
INPUT	**BASIN 1**	**BASIN 2 & 3**	**BASIN 4**
Surface Description	**Type 7 Grass (Bermudagrass)**	**Type 7 Grass (Bermudagrass)**	**Type 7 Grass (Bermudagrass)**
Manning's "n"	**0.41**	**0.41**	**0.41**
Flow Length, L	**100** ft	**100** ft	**100** ft
2-Yr 24 Hour Rainfall, P_2	**2.5** in	**2.5** in	**2.5** in
Land Slope, s	**0.038** ft/ft	**0.032** ft/ft	**0.021** ft/ft
OUTPUT			
Travel Time	0.32 hr	0.34 hr	0.40 hr
SHALLOW CONCENTRATED FLOW			
INPUT	**VALUE**	**VALUE**	**VALUE**
Surface Description	**Unpaved**	**Unpaved**	**Unpaved**
Flow Length, L	**397** ft	**562** ft	**82** ft
Watercourse Slope*, s	**0.024371** ft/ft	**0.028** ft/ft	**0.065** ft/ft
OUTPUT			
Average Velocity, V	2.52 ft/s	2.71 ft/s	4.11 ft/s
Travel Time	0.044 hr	0.058 hr	0.006 hr
CHANNEL FLOW			
INPUT	**VALUE**	**VALUE**	**VALUE**
Cross Sectional Flow Area, a	**0** ft^2	**0** ft^2	**0** ft^2
Wetted Perimeter, P_w	**0** ft	**0** ft	**0** ft
Channel Slope, s	**0** ft/ft	**0** ft/ft	**0** ft/ft
Manning's "n"	**0.24**	**0.24**	**0.24**
Flow Length, L	**0** ft	**0** ft	**0** ft
OUTPUT			
Average Velocity	0.00 ft/s	0.00 ft/s	0.00 ft/s
Hydraulic Radius, r = a / P_w	1.00 ft	1.00 ft	1.00 ft
Travel Time	0.00 hr	0.00 hr	0.00 hr
Watershed or Subarea T_c =	**0.36 hr**	**0.40 hr**	**0.41 hr**
Watershed or Subarea T_c =	**22 minutes**	**24 minutes**	**25 minutes**

SWALE CALCULATION: SWALE 1

PROJECT NO.	17393	BY KEF	DATE 5/17/2018

Swale Characteristics		
Input		**Value**
Q	Peak design storm discharge	**1.11** cfs
n	Roughness factor	**0.24**
B	Swale width at base (Min Width = 2')	**7.207558** ft
Z	Side Slopes X:1 (4:1 for WQ Flow)	**4** H:1V
s	Slope of channel (ft/ft, 0.005 minimum)	**0.005** ft/ft
t	Minimum hydraulic residence time (Min HRT = 9 min)	**9** min
Flow Results (Q)		
Input		**Value**
Y	Normal depth (Max Depth @ WQ Event = 0.50')	**0.50** ft
P	Wetted perimeter	**11.33** ft
A	Cross section flow area	**4.61** ft^2
R	Hydraulic radius	**0.41** ft
W	Width of water surface in Swale	**11.21** ft
V	Velocity	**0.24** ft/s
L	Length (Min Length = 100')	**130.09** ft

SWALE CALCULATION: SWALE 2

PROJECT NO.	17393	BY KEF	DATE 5/17/2018

Swale Characteristics		
Input		**Value**
Q	Peak design storm discharge	**1.55** cfs
n	Roughness factor	**0.24**
B	Swale width at base (Min Width = 2')	**7** ft
Z	Side Slopes X:1 (4:1 for WQ Flow)	**4** H:1V
s	Slope of channel (ft/ft, 0.005 minimum)	**0.01** ft/ft
t	Minimum hydraulic residence time (Min HRT = 9 min)	**9** min
Flow Results (Q)		
Input		**Value**
Y	Normal depth (Max Depth @ WQ Event = 0.50')	**0.50** ft
P	Wetted perimeter	**11.16** ft
A	Cross section flow area	**4.54** ft^2
R	Hydraulic radius	**0.41** ft
W	Width of water surface in Swale	**11.03** ft
V	Velocity	**0.34** ft/s
L	Length (Min Length = 100')	**184.21** ft

SWALE CALCULATION: SWALE 3

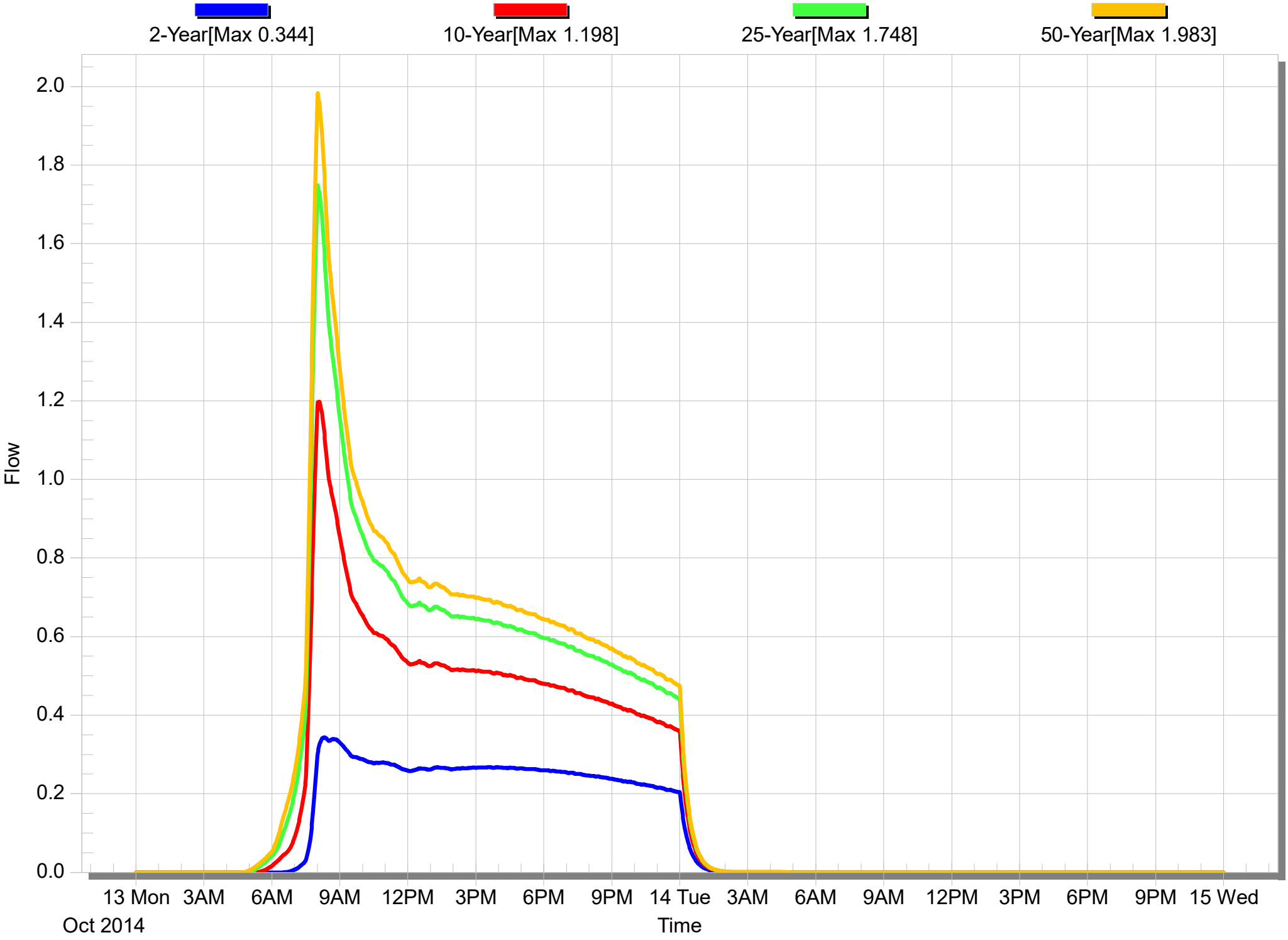
PROJECT NO.	17393	BY KEF	DATE 5/17/2018

Swale Characteristics		
Input		**Value**
Q	Peak design storm discharge	**1.47** cfs
n	Roughness factor	**0.24**
B	Swale width at base (Min Width = 2')	**10** ft
Z	Side Slopes X:1 (4:1 for WQ Flow)	**4** H:1V
s	Slope of channel (ft/ft, 0.005 minimum)	**0.005** ft/ft
t	Minimum hydraulic residence time (Min HRT = 9 min)	**9** min
Flow Results (Q)		
Input		**Value**
Y	Normal depth (Max Depth @ WQ Event = 0.50')	**0.50** ft
P	Wetted perimeter	**14.09** ft
A	Cross section flow area	**5.95** ft^2
R	Hydraulic radius	**0.42** ft
W	Width of water surface in Swale	**13.97** ft
V	Velocity	**0.25** ft/s
L	Length (Min Length = 100')	**133.41** ft

HYDROGRAPHS

EXISTING HYDROGRAPHS

Node - E-BASIN 1



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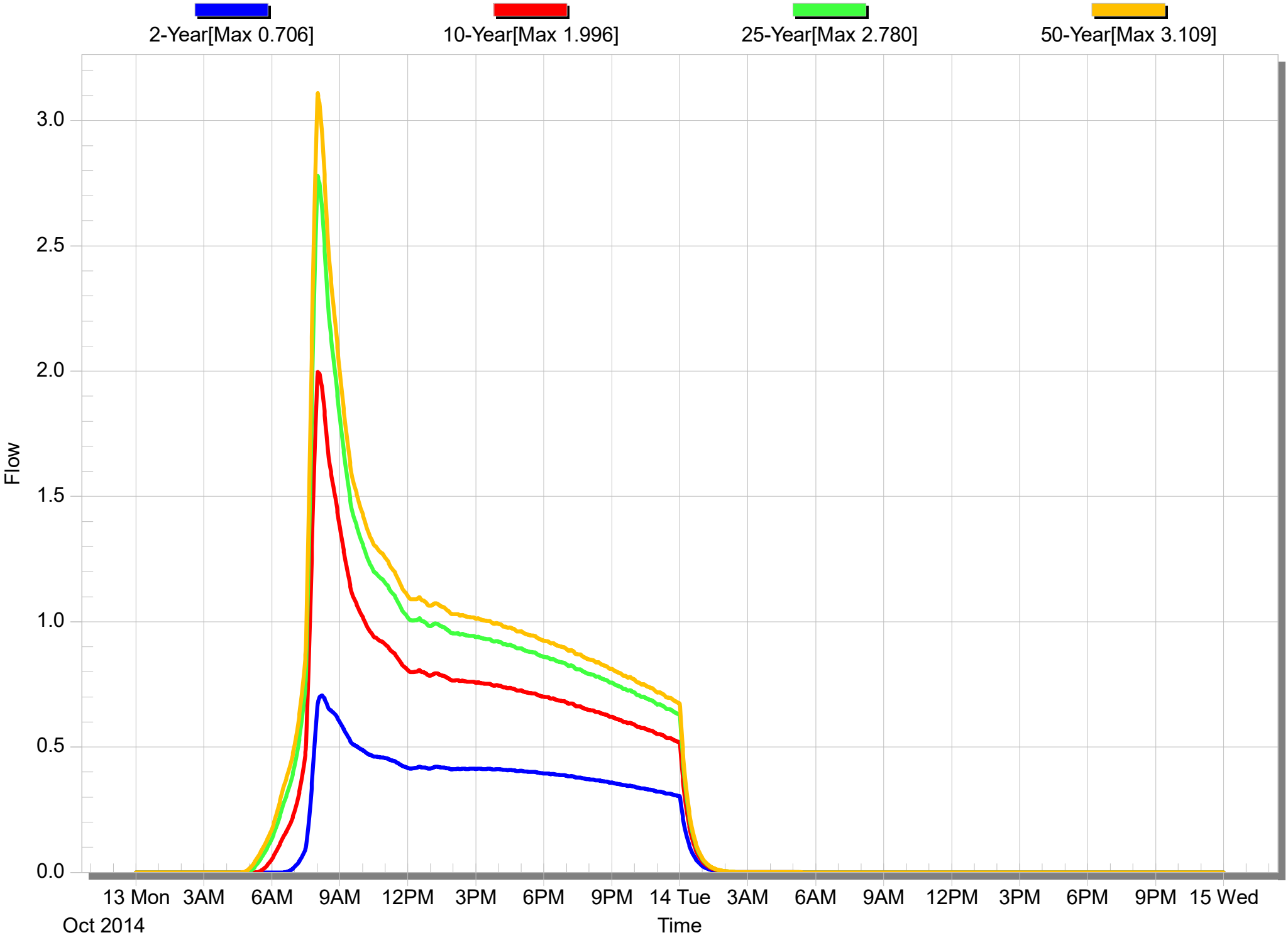

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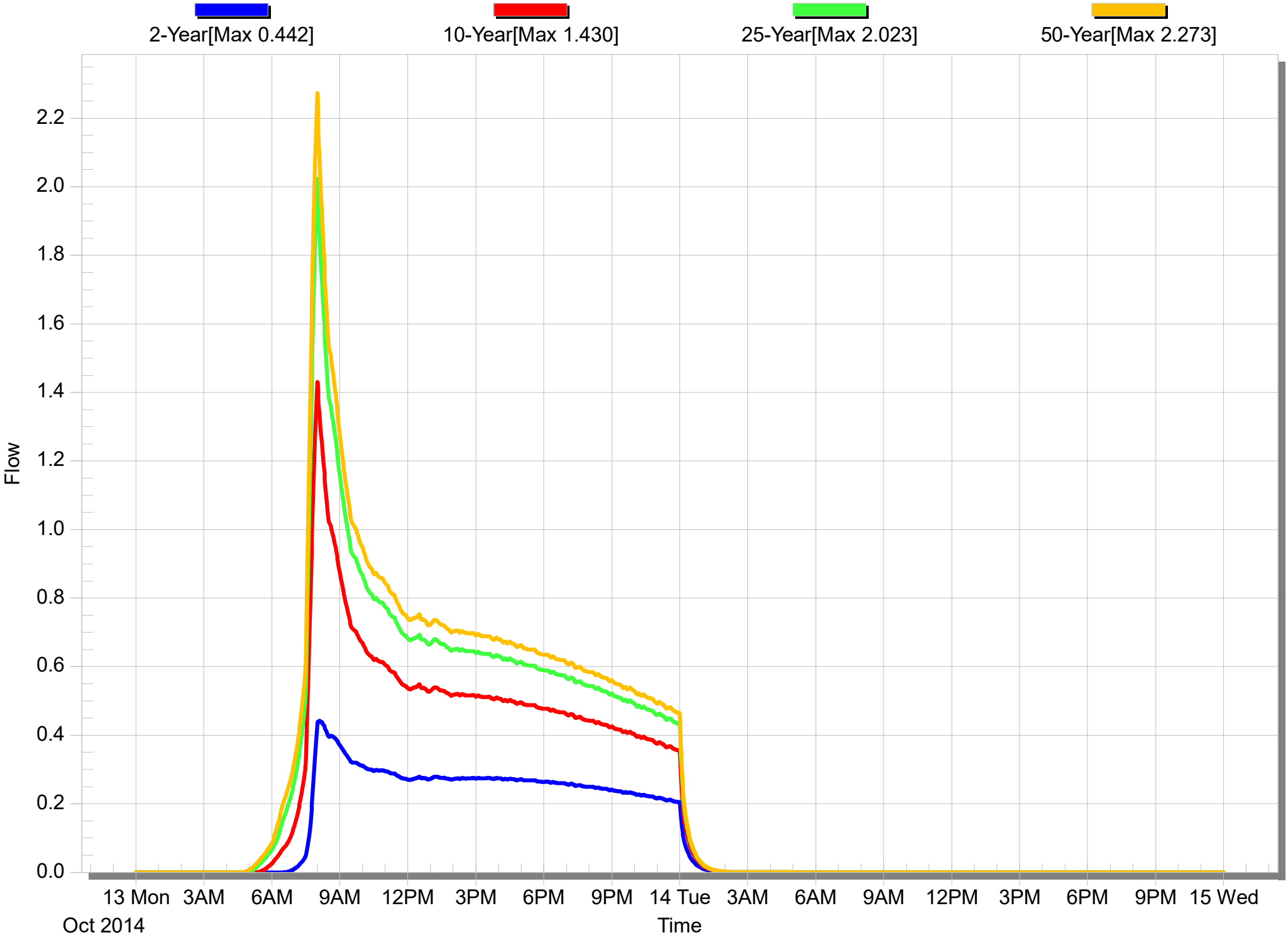
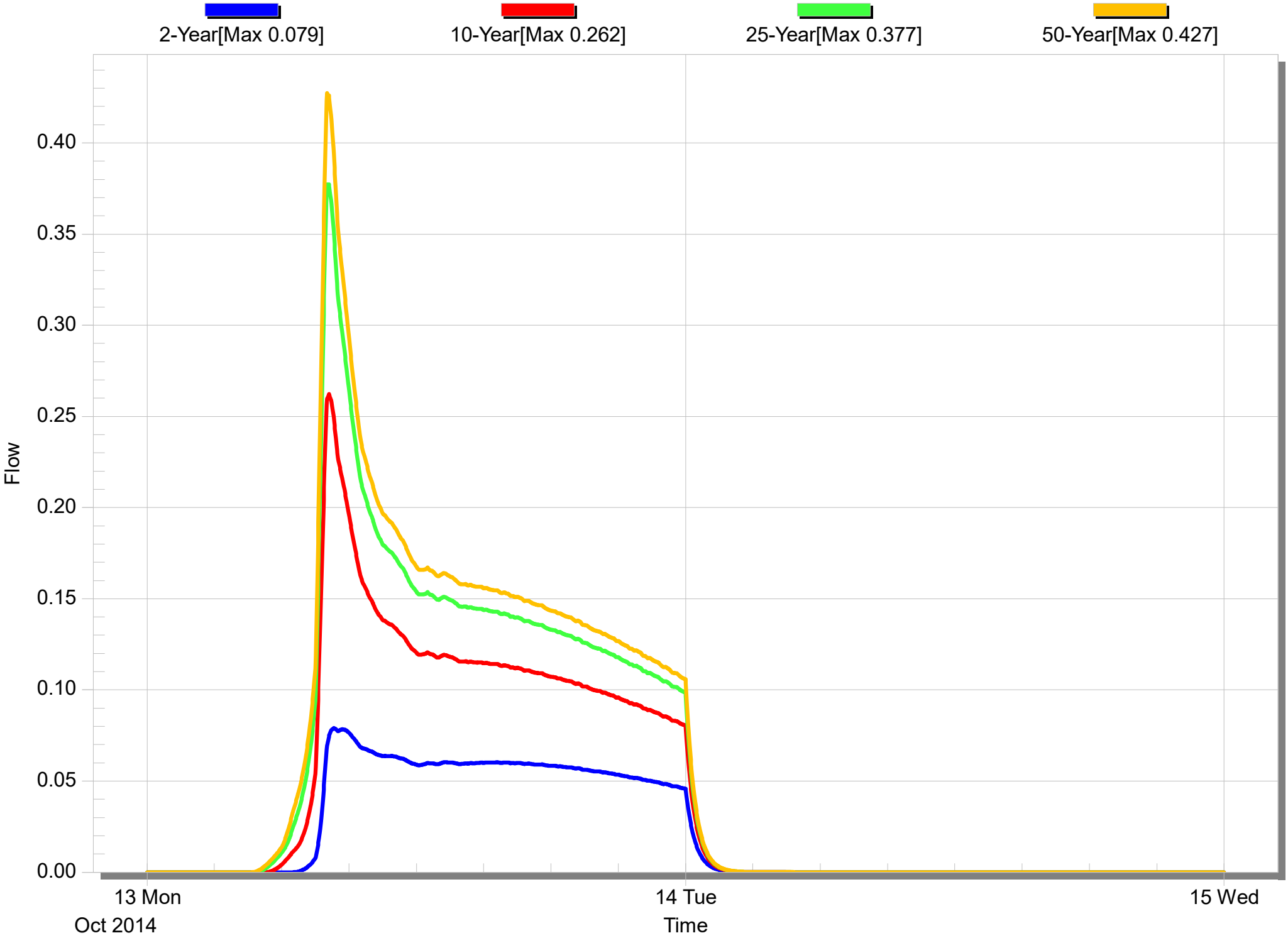
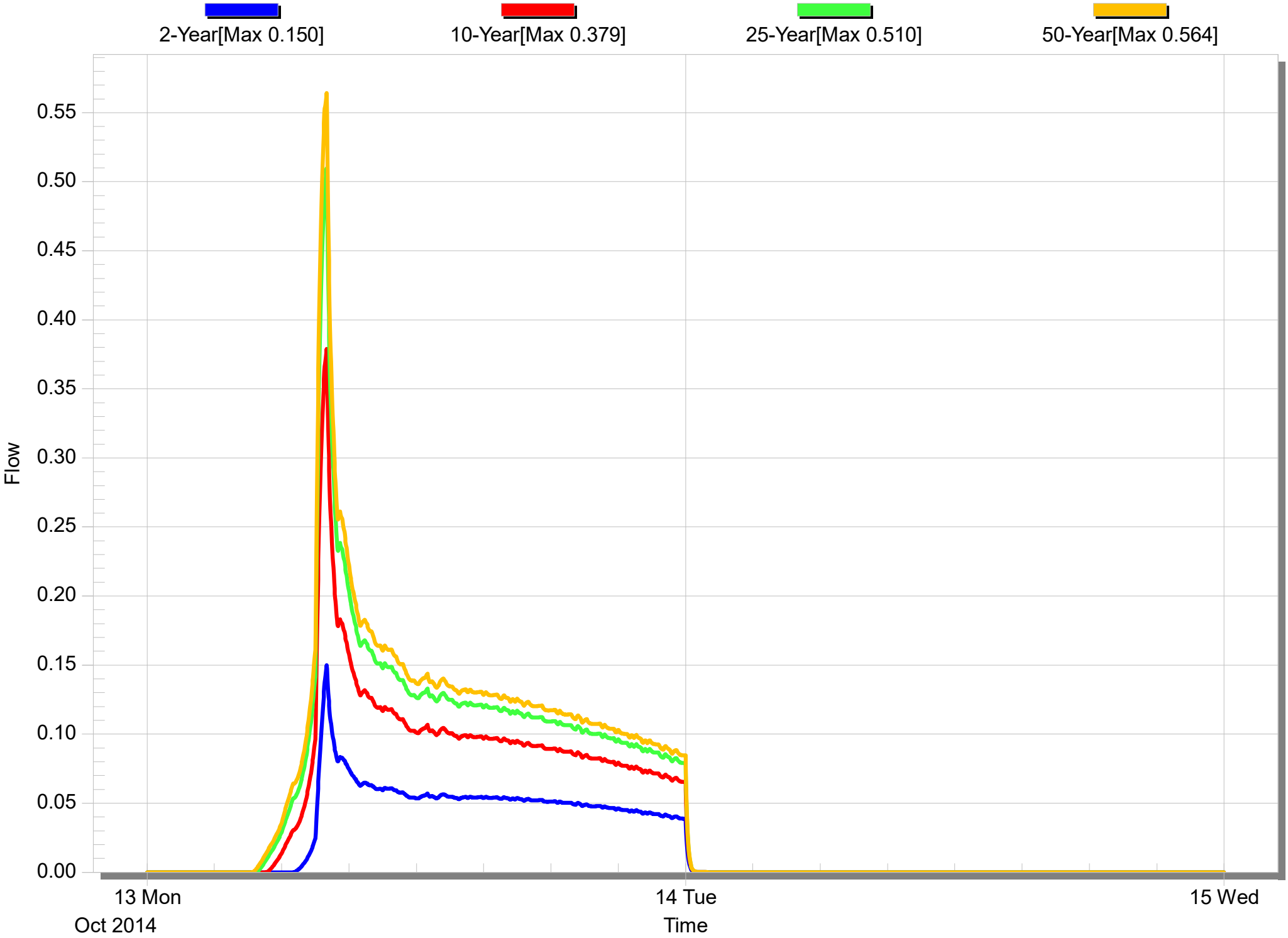


Node - E-BASIN 4

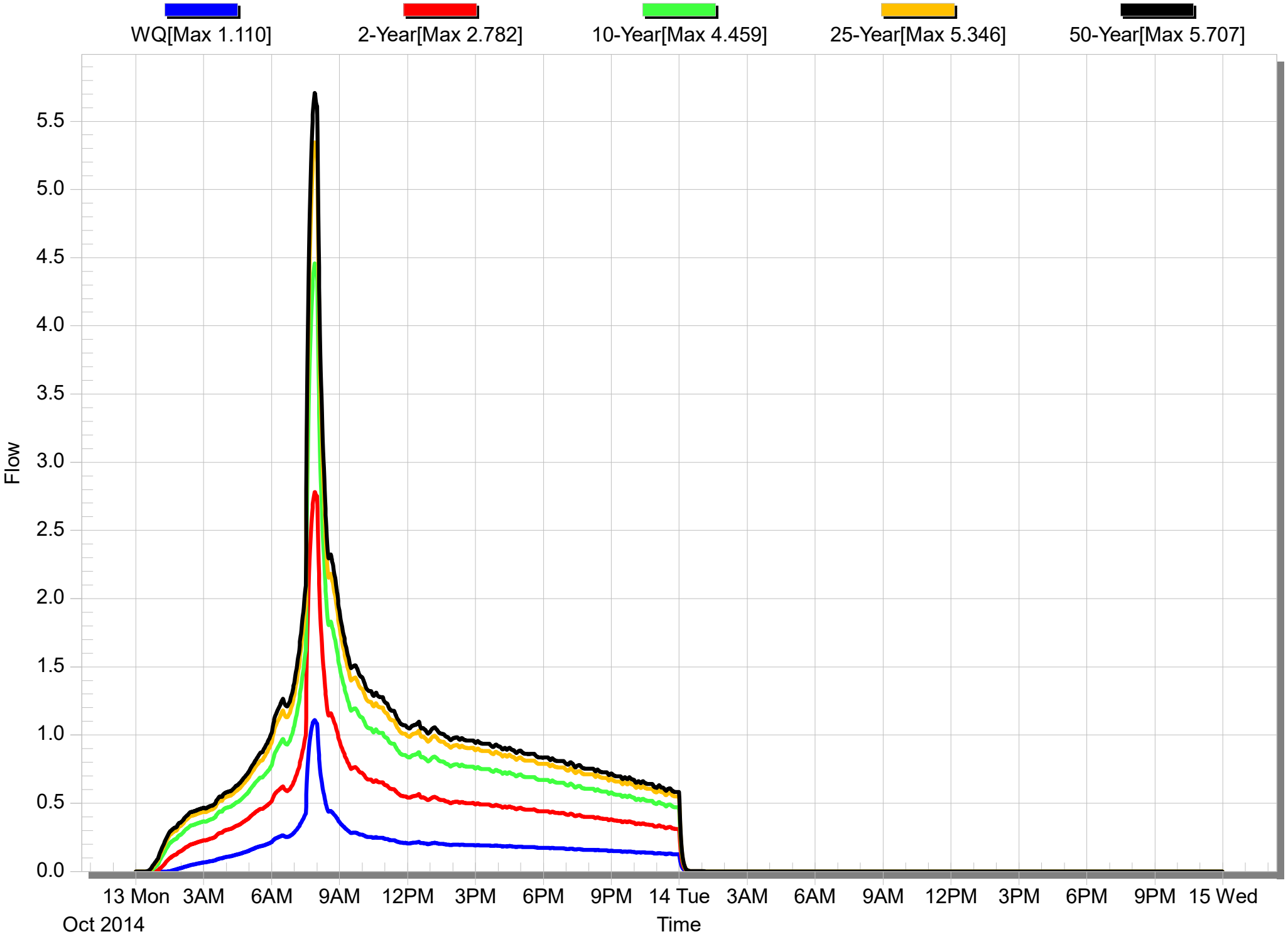


Node - E-BASIN 5



POST-DEVELOPED HYDROGRAPHS

Node - P-BASIN 1



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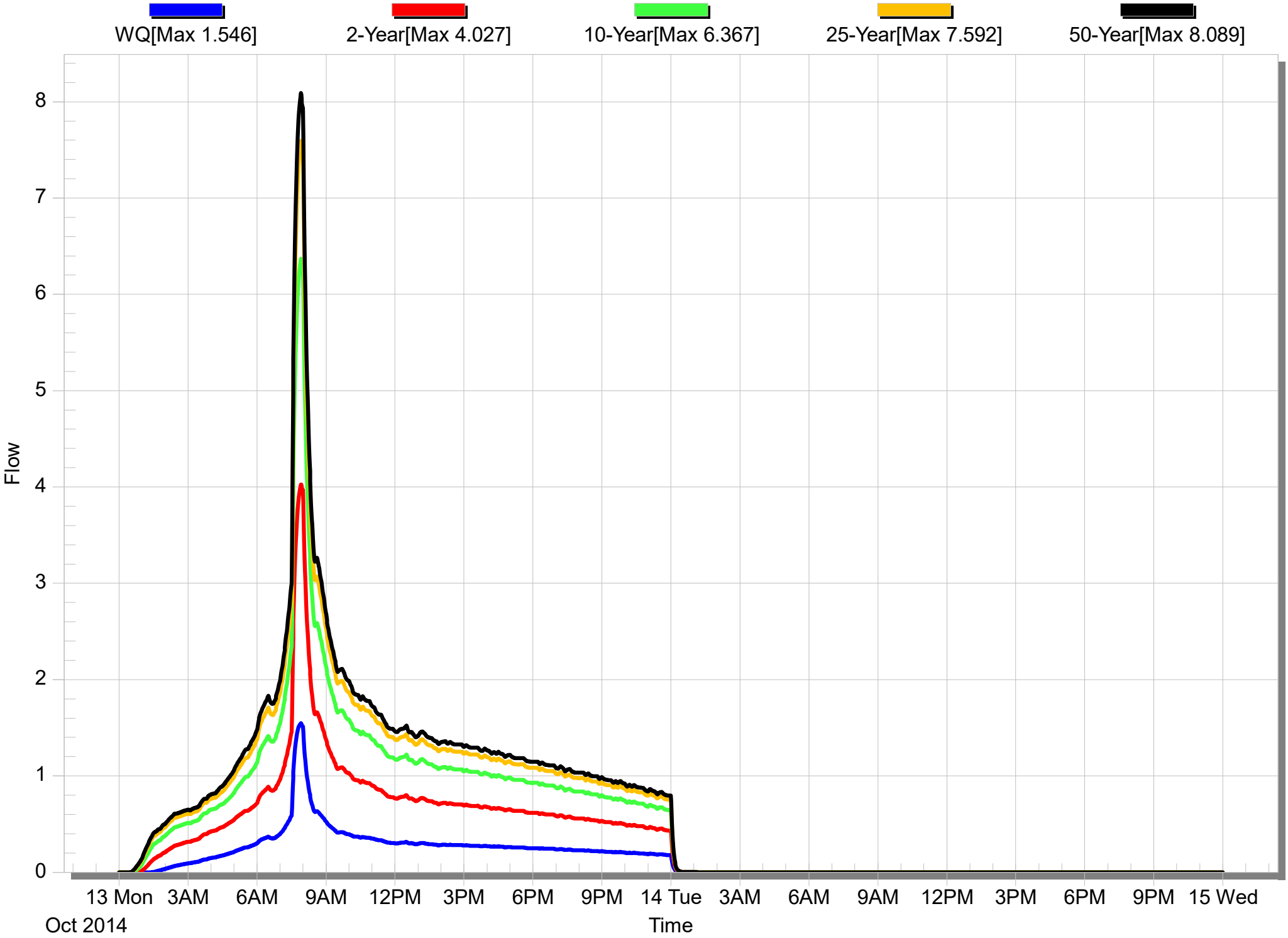

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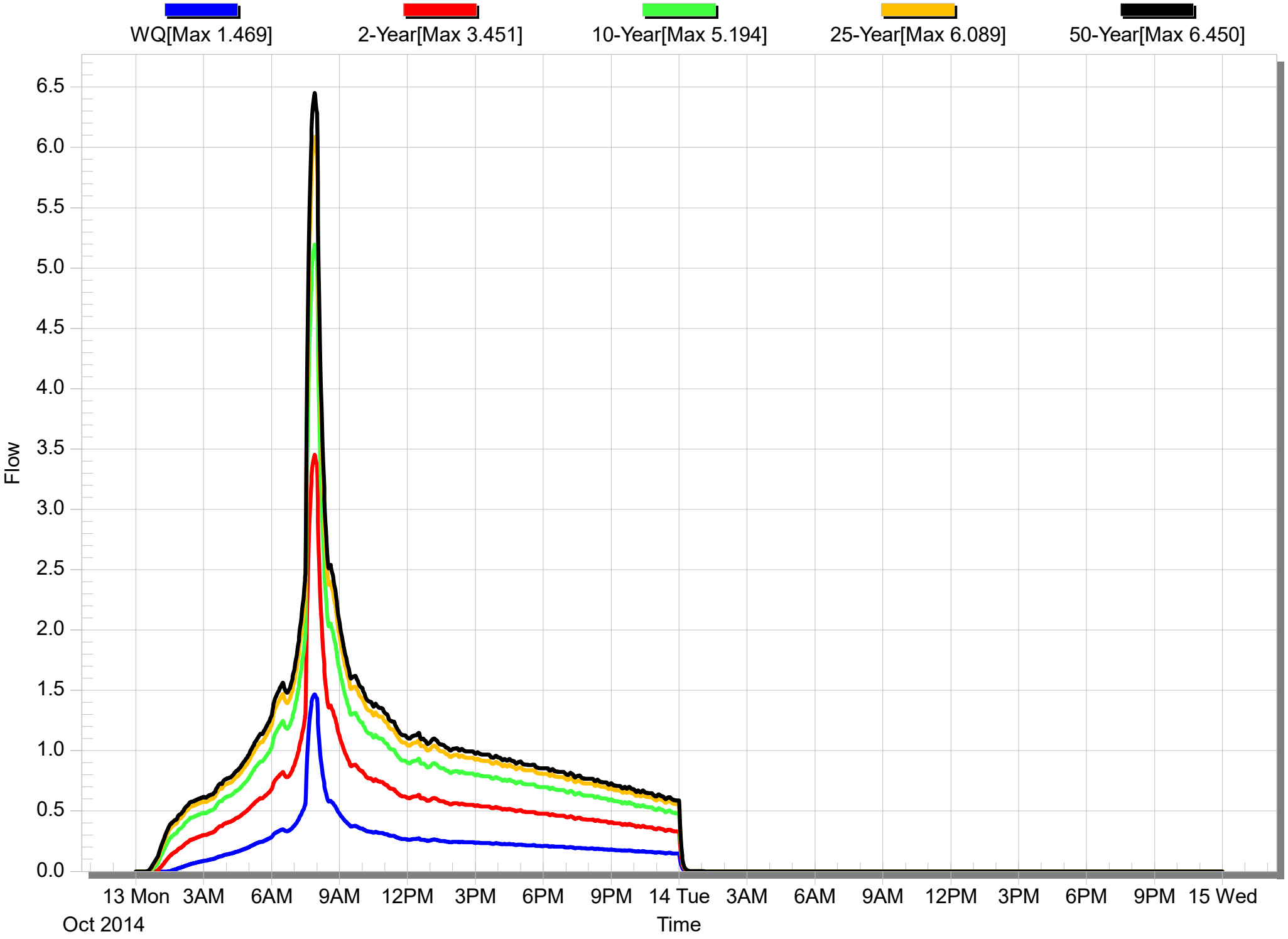

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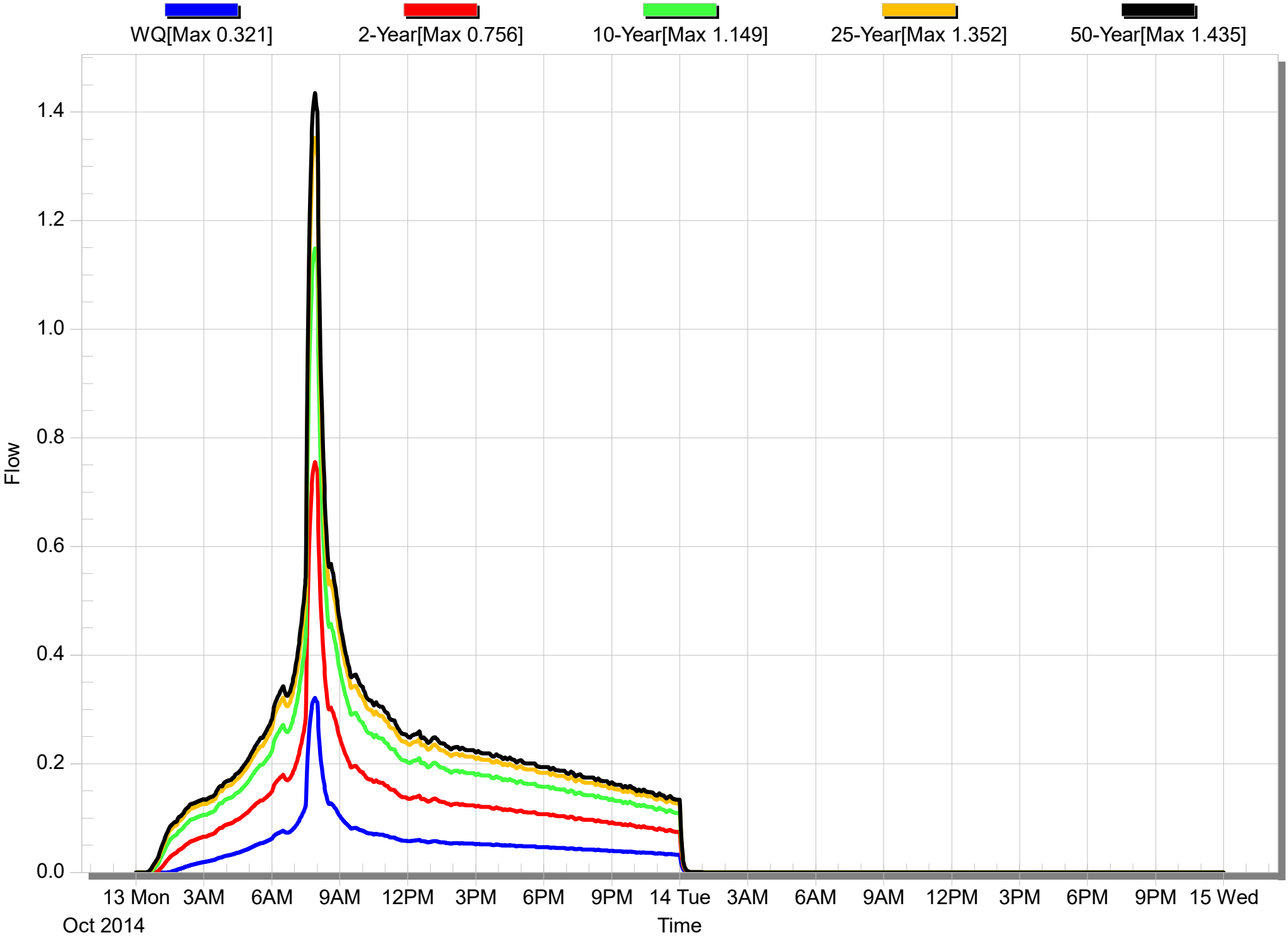

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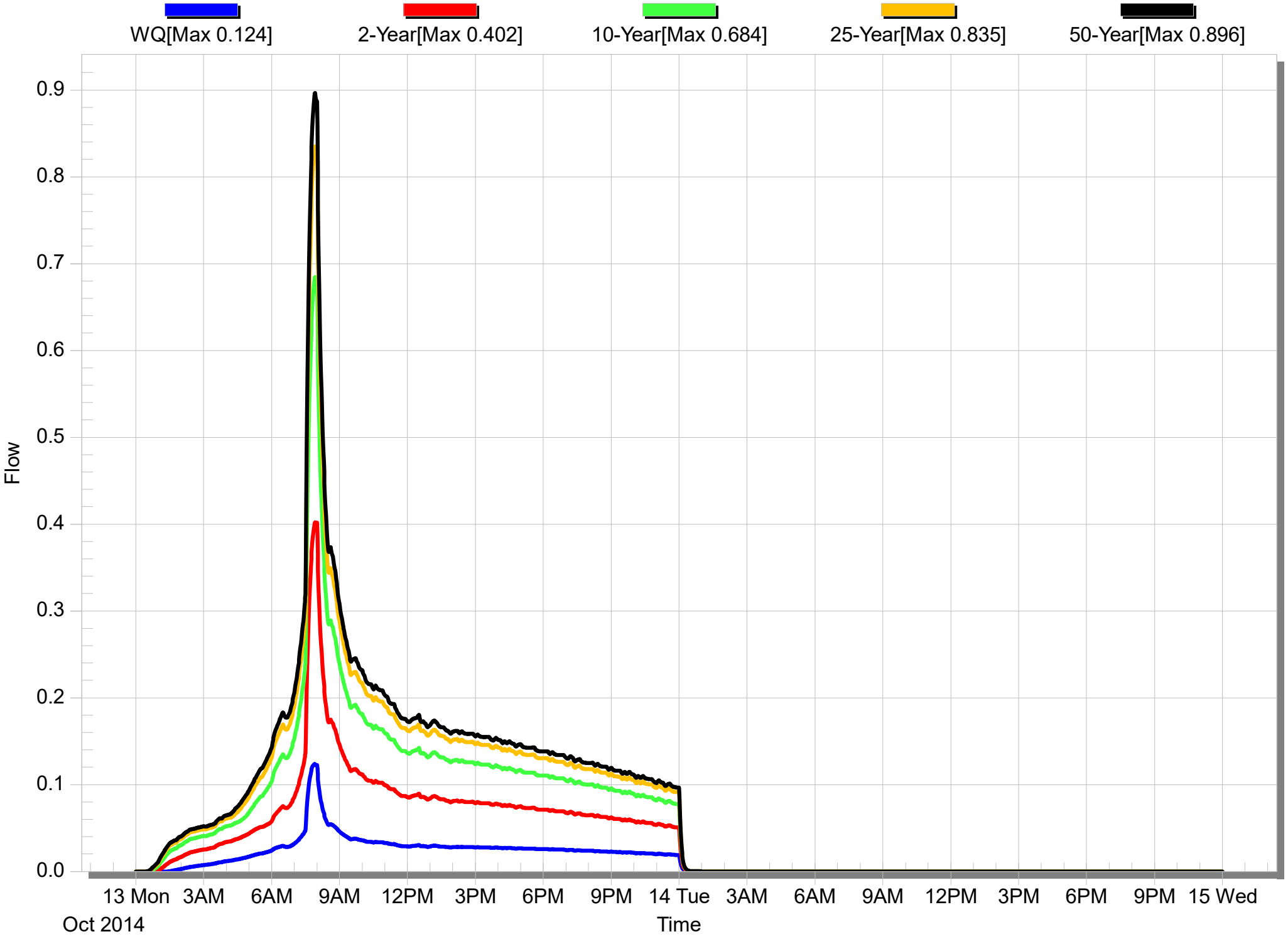

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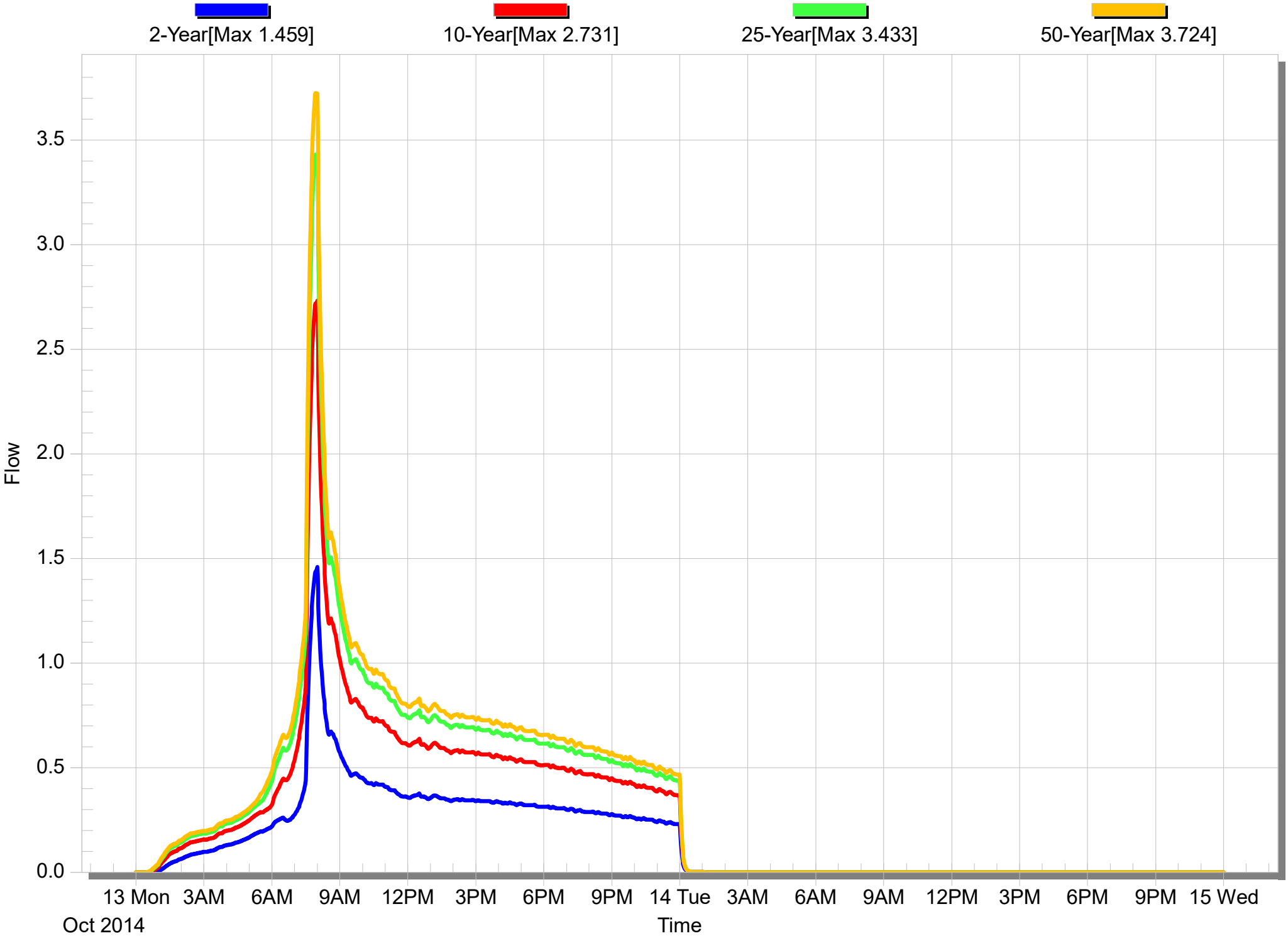
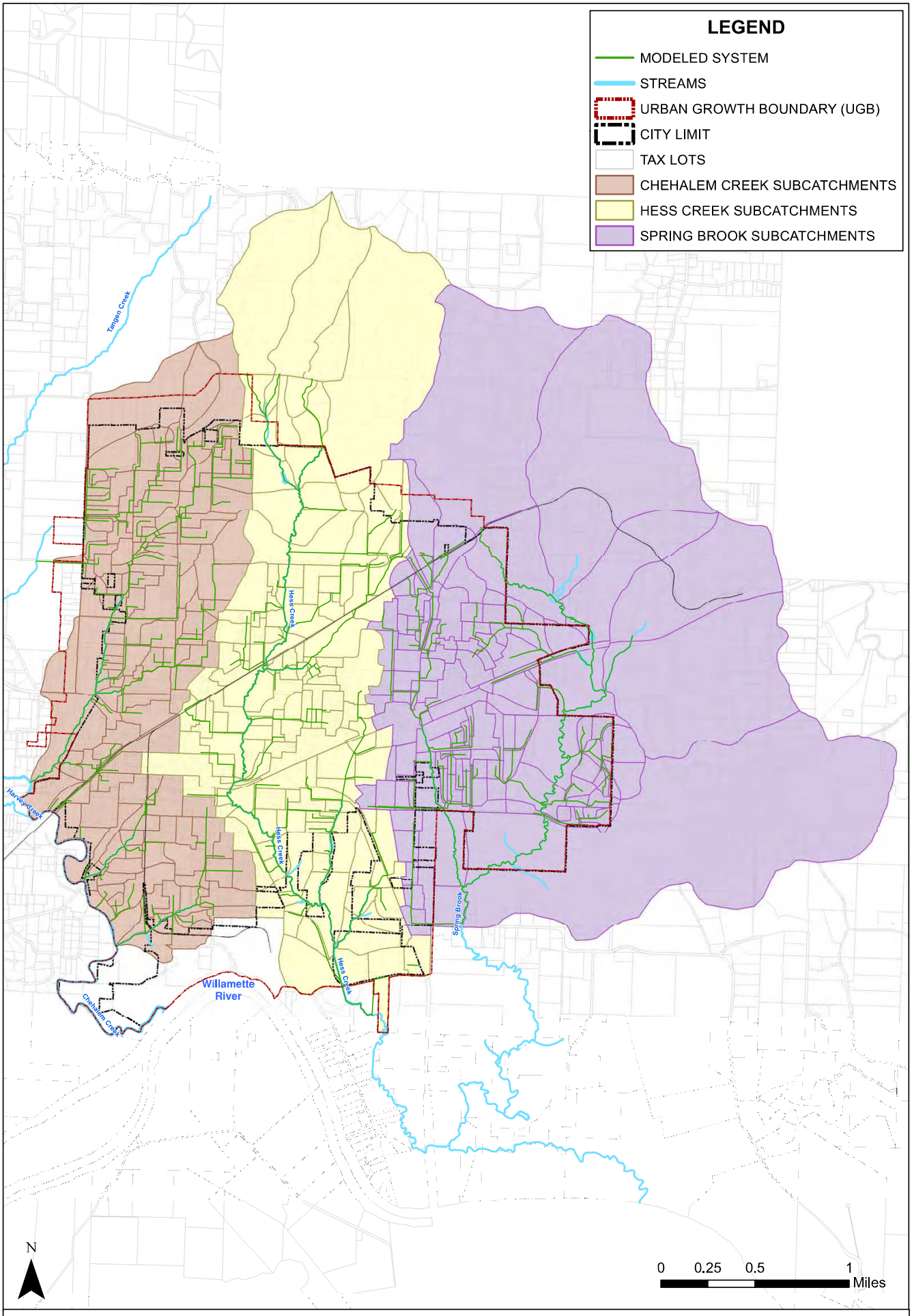


DOWNSTREAM ANALYSIS

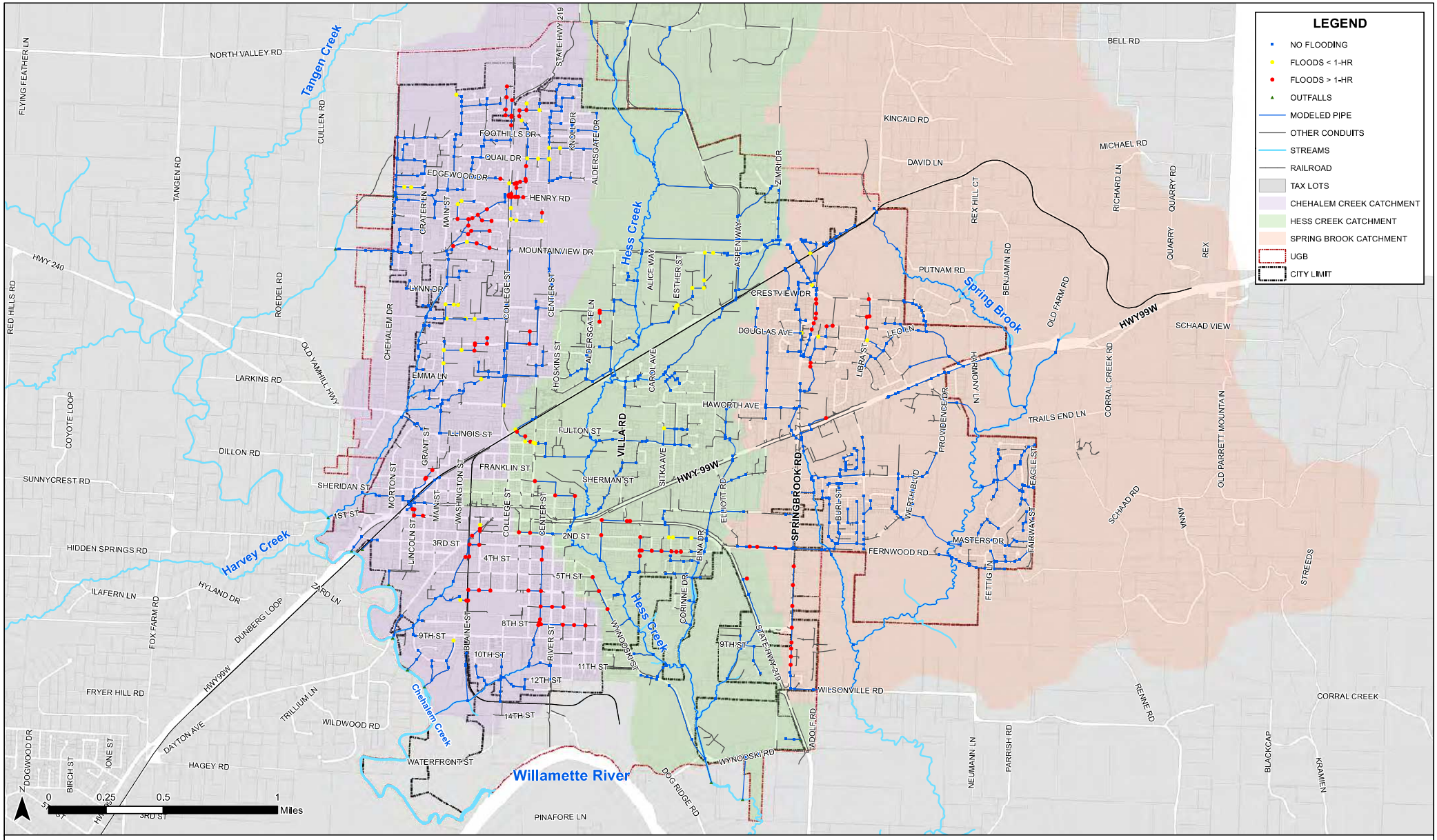


STORMWATER MASTER PLAN UPDATE

FIGURE 2-6. DRAINAGE SYSTEM AND STUDY AREA

NEWBERG, OREGON

JUNE 2014

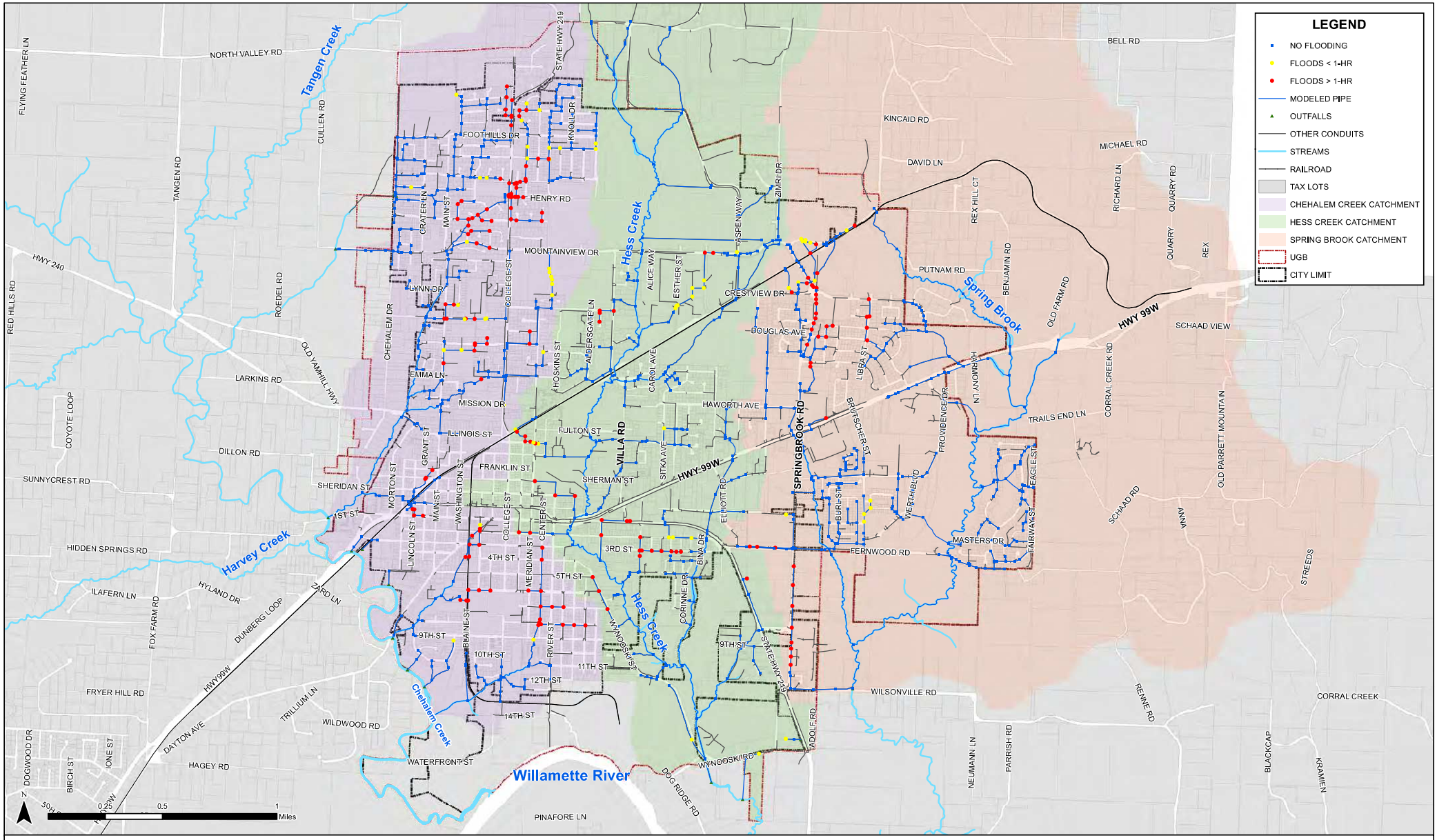


STORMWATER MASTER PLAN UPDATE

FIGURE 3-1. PREDICTED FLOODING: EXISTING LAND USE, 10-YR DESIGN STORM

NEWBERG, OREGON

JUNE 2014



STORMWATER MASTER PLAN UPDATE

FIGURE 3-2. PREDICTED FLOODING: FUTURE LAND USE, 10-YR DESIGN STORM

NEWBERG, OREGON

JUNE 2014

OPERATIONS & MAINTENANCE

3J CONSULTING

CIVIL ENGINEERING | WATER RESOURCES | LAND USE PLANNING

PRELIMINARY OPERATIONS & MAINTENANCE PLAN

CRESTVIEW CROSSING
Newberg, Oregon

June 6, 2018

Prepared For:

JT Smith Companies
5285 Meadows Road
Lake Oswego, OR 97035

Prepared By:
3J Consulting, Inc.
5075 Griffith Drive, Suite 150
Beaverton, Oregon 97005
Project No: 17393
KEF

PURPOSE

The purpose of this Operations and Maintenance (O&M) Plan is to bring attention to the on-going needs of the storm water management facilities that will be located at the proposed Crestview Crossing. In order for the facilities to operate as intended and increase the environmental benefits, a high quality maintenance program is required.

This document has been prepared to provide the Crestview Crossing development with a *Preliminary* single source document that will explain the maintenance requirements of the storm water facilities. This also serves the regulatory agencies in which legal requirements have been placed on this site. A formal maintenance agreement and O&M plan will be prepared and submitted as part of the CC&R's upon completion of construction.

STORMWATER FACILITIES

Water quality treatment will occur through trapped catch basins, sedimentation water quality manholes, stormwater vegetated swales and rain gardens and an underground mechanical treatment facility.

The vegetated swales will be located in the bottom of each detention pond. Water quality treatment and detention for lots 1-7 in the northern portion of the site will be provided on each lot. Treatment will consist of rain gardens or LIDA swales; treatment facilities will release to an underground detention system located on each lot designed to detain all storm events previously discussed.

Stormwater facility locations will be fully identified in the final O&M plan.

INSPECTION/MAINTENANCE SCHEDULE

Each part of the system shall be inspected and maintained quarterly and within 48 hours after each major storm event for the first three (3) years and at least twice thereafter. For this O&M plan, a major storm event is defined as at least 1.0 inch of rain in 24 hours or more. All components of the storm system as described above must be inspected and maintained frequently or they will cease to function effectively. All stormwater must drain out of the catch basins within 24-hours after rainfall ends. All structural components including inlets and outlets must freely convey stormwater. Desirable vegetation in the swales must cover at least 90% of the facility, excluding dead or stressed vegetation, dry grass or other plants and weeds.

The facility owner shall keep a log, recording all inspection dates, observations, and maintenance activities. Receipts shall be saved when maintenance is performed and there is a record of expense. The stormwater facilities will be operated and maintained by the Crestview Crossing HOA once construction has been completed. Prior to completion, Jesse Nemec from JT Smith Companies will be the responsible party.

Jesse Nemec Phone No: 503-730-8620
City of Newberg Public Works Maintenance Dept: 503-538-8321

Sedimentation Manhole and Catch Basins

- Remove sediment, oil, and debris from catch basins when 1/3 full and from gutters, inlets, outlets and pipes.
- Inspect and clean grate from catch basins. Remove debris and sediment.
- Manholes: remove oil, sediment and debris when sediment is 30% of the capacity or soil is 1 inch deep.

Maintenance Schedule:

- *Summer*: Make any structural repairs. Remove sediment, oil and debris from conveyance system and manholes.
- *Winter*: Monitor water levels and sediment level.

Vegetated Facilities (See excerpts from Clean Water Services Low Impact Development Approaches Handbook)

- Remove sediment when:
    - Sediment depth reaches 4 inches.
    - Sediment depth is damaging or killing vegetation
    - Sediment is preventing the facility from draining in the time specified.

Maintenance Schedule:

- *Summer*: Make any structural repairs. Improve filter medium as needed. Clear drain. Irrigate as needed.
- *Fall:* Replant exposed soil and replace dead plants. Remove sediment and plant debris.
- *Winter*: Monitor infiltration/flow-through rates. Clear inlets and outlets/overflows to maintain conveyance.
- *Spring:* Remove sediment and plant debris. Replant exposed soil and replace dead plants. Mulch.
- *All seasons:* Weed as necessary.

Baysaver Bayfilter™ Vault

The Vault shall be inspected and maintained quarterly for the first 2 years of operation and once per year thereafter. Additionally the vault shall be inspected within 48 hours after each major storm event.

- Maintenance should be performed per the attached BayFilter maintenance document).

StormTech Chambers - After the first 2 years of operation:

- The Chamber shall be inspected and maintained quarterly for the first 2 years of operation and once per year thereafter. Additionally the vault shall be inspected within 48 hours after each major storm event.
- Inspect per StormTech Chamber Inspection and Maintenance Guidance (Table 10).

Source Control

Measures should be taken to prevent pollutants from mixing with stormwater. Typically non-structural control measures include raking and removing leaves, sweeping, vacuum sweeping and limited controlled application of pesticides, herbicides and fertilizers.

Spill Prevention

Spill prevention measurements shall be exercised when handling substances that can contaminate stormwater. Activities that pose the chance of hazardous material spills shall not take place on or near any catch basins or inlets. Contact the proper authority and the property owner immediately if a spill is observed.

Flow Control

All facilities shall drain within 96 hours. Time/date, weather, and site conditions when ponding occurs shall be recorded.

Pollution Prevention

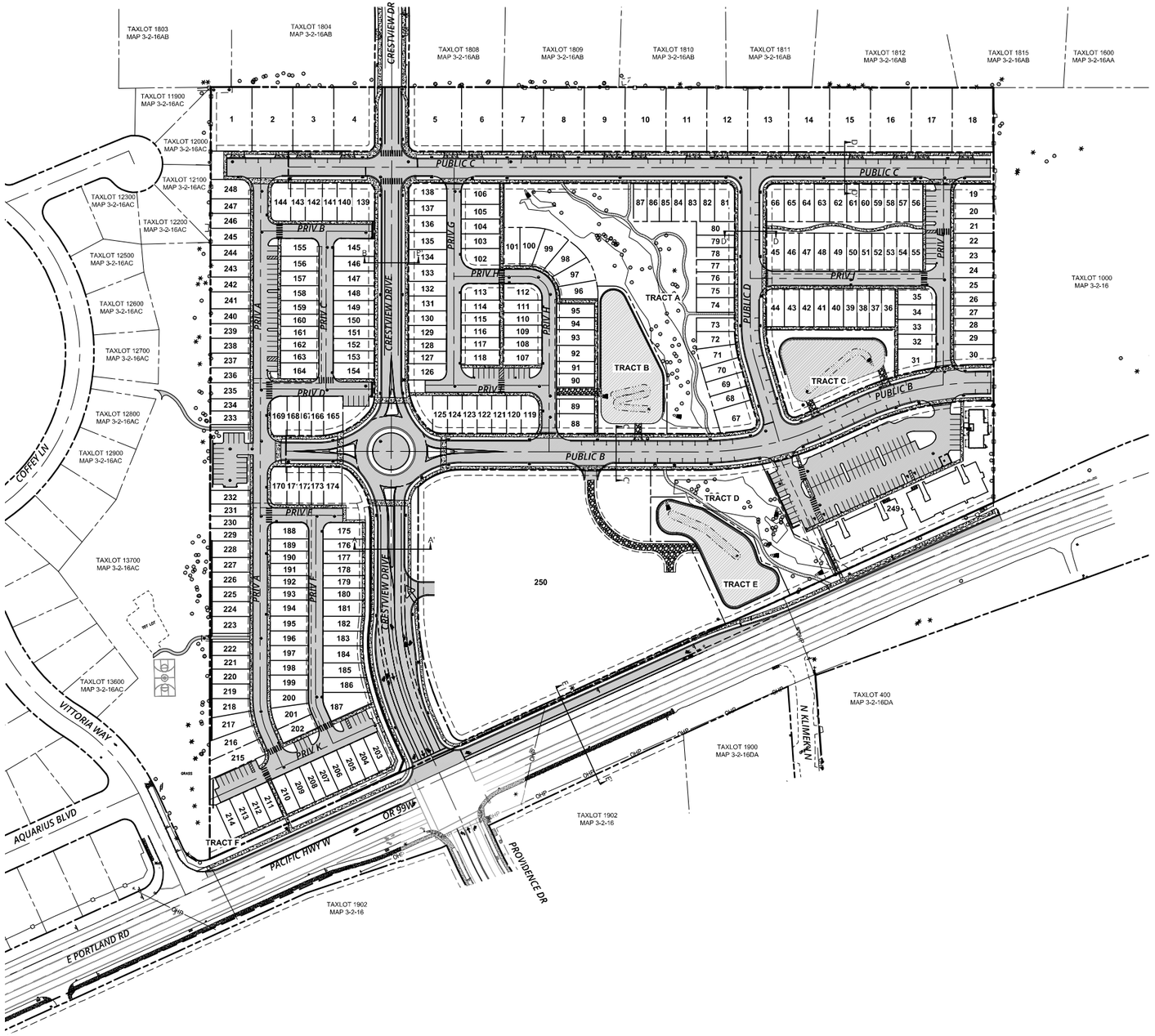
All sites shall implement best management practices to prevent hazardous wastes, litter, or excessive oil and sediment from contaminating stormwater. Contact City of Newberg Public Works Maintenance Department at 503-538-8321 for immediate assistance with responding to spills. Record time/date, weather, and site conditions if site activities are found to contaminate stormwater.

Vectors (mosquitoes and rodents)
Stormwater facilities shall not harbor mosquito larvae or rats that pose a threat to public health or that undermine the facility structure. Monitor standing water for small wiggling sticks perpendicular to the water's surface. Note holes/burrows in and around facilities. Call City of Newberg Public Works Maintenance Department at 503-538-8321 for immediate assistance with eradicating vectors. Record time/date, weather, and site conditions when vector activity is observed.

ELEMENTS

This document contains the following information.

1. Sheets C210, C215, C300 & C303
2. Vegetated Swale Operations and Maintenance Plan (CWS Low Impact Development Approaches Handbook)
3. Extended Dry Basin Operations and Maintenance Plan (CWS Low Impact Development Approaches Handbook)
4. Maintenance of the BayFilter™ System
5. 13.0 Inspection and Maintenance StormTech
6. Maintenance Logs



LEGEND

- PROJECT BOUNDARY
- EXISTING RIGHT-OF-WAY LINE
- EXISTING RIGHT-OF-WAY CENTERLINE
- EXISTING ADJACENT PROPERTY LINE
- PROPOSED RIGHT-OF-WAY LINE
- PROPOSED RIGHT-OF-WAY CENTERLINE
- PROPOSED LOT LINE
- PROPOSED SETBACK LINE
- PROPOSED EASEMENT
- PROPOSED CURB FACE
- PROPOSED CURB BACK
- PROPOSED LIP OF GUTTER
- PROPOSED WHITE STRIPING
- PROPOSED CONCRETE
- PROPOSED ASPHALT
- PROPOSED STORM FACILITY
- PROPOSED SWALE
- PROPOSED GRAVEL
- PROPOSED WOODCHIP PATH
- PROPOSED RETAINING WALL
- PROPOSED DRIVEWAY
- PROPOSED PEDESTRIAN CROSSWALK STRIPING
- PROPOSED TYPICAL STREET SECTION SEE SHEETS C200 & C201

Know what's below. Call before you dig.

N W E S

SCALE: 1" = 100'
0 100' 200'

PUBLISH DATE
06.06.2018
ISSUED FOR
LAND USE DOCUMENTS

OVERALL SITE PLAN
CRESTVIEW CROSSING
PLANNED UNIT DEVELOPMENT

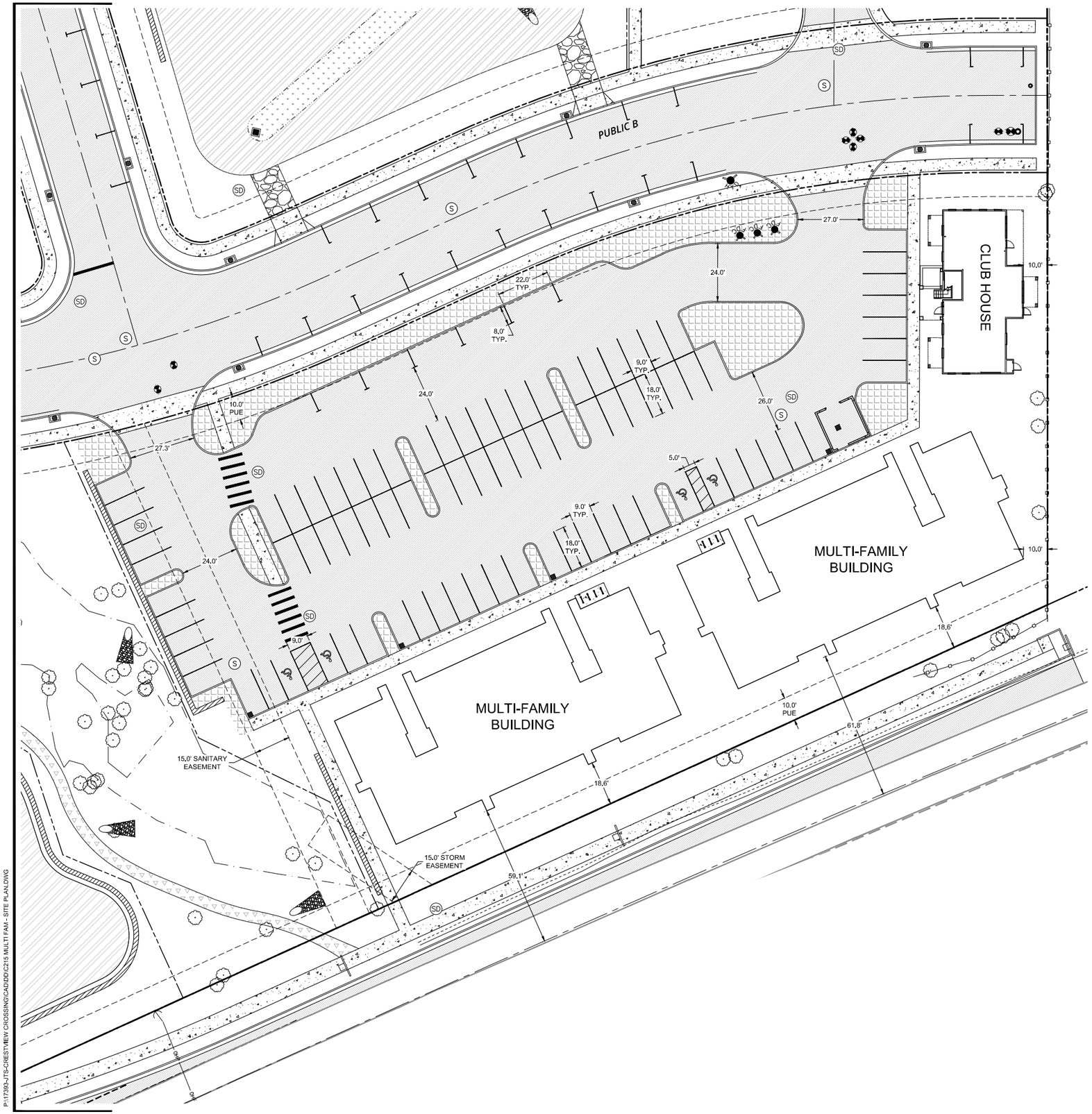
JT SMITH COMPANIES
NEWBERG, OR

3J CONSULTING
CIVIL ENGINEERING
WATER RESOURCES
LAND USE PLANNING
5075 SW GRIFFITH DRIVE, SUITE 150, BEAVERTON, OR 97005

PROJECT INFORMATION
3J PROJECT # | 17393
TAX LOT(S) | 3S2W16 13800, 1100
LAND USE # | N/A
DESIGNED BY | ARS, JEJ, BMO
CHECKED BY | AJM, RGW

SHEET NUMBER
C210

P:\17393-JTS-CRESTVIEW CROSSING\CAD\DD\C210 SITE PLAN.DWG



P:\17393-JT3-CRESTVIEW CROSSING\CAD\DD\C215 MULTI FAM - SITE PLAN.DWG

LEGEND

- PROJECT BOUNDARY
- EXISTING RIGHT-OF-WAY LINE
- EXISTING RIGHT-OF-WAY CENTERLINE
- EXISTING ADJACENT PROPERTY LINE
- PROPOSED RIGHT-OF-WAY LINE
- PROPOSED RIGHT-OF-WAY CENTERLINE
- PROPOSED LOT LINE
- PROPOSED SETBACK LINE
- PROPOSED EASEMENT
- PROPOSED CURB FACE
- PROPOSED CURB BACK
- PROPOSED LIP OF GUTTER
- PROPOSED WHITE STRIPING
- PROPOSED CONCRETE
- PROPOSED ASPHALT
- PROPOSED LANDSCAPING
- PROPOSED GRAVEL
- PROPOSED WOODCHIP PATH
- PROPOSED RETAINING WALL
- PROPOSED DRIVEWAY
- PROPOSED PEDESTRIAN CROSSWALK STRIPING
- PROPOSED BIKE PARKING
- PROPOSED ACCESSIBLE PARKING STALL
- PROPOSED HYDRANT
- PROPOSED VALVE
- PROPOSED BLOW-OFF / AIR RELEASE ASSY.
- PROPOSED FIRE DPT. CONNECTION
- PROPOSED SEWER MANHOLE
- PROPOSED STORM MANHOLE
- PROPOSED CATCH BASIN
- EXISTING DECIDUOUS TREE

PARKING STATISTICS - MULITFAMILY LOT

PROPOSED STALL COUNT & SUMMARY

TYPE = (WIDTH x DEPTH)	STANDARD 9' x 18'	PARALLEL 8' x 22'	ADA 9' x 18'	ADA - VAN 9' x 18'	TOTAL
MULTIPLE FAMILY APARTMENTS =	80	7	3	1	91
TOTAL =	80	7	3	1	91

VEHICLES

DEVELOPMENT CODE CHAPTER 15.440.30

MAXIMUM PARKING - MULTI-FAMILY	NONE
MINIMUM PARKING - MULTI-FAMILY	74
PROPOSED	91

BICYCLES

DEVELOPMENT CODE CHAPTER 15.440.90

	MINIMUM	PROPOSED
MINIMUM BICYCLE PARKING - MULTI-FAMILY	13	14

ACCESSIBLE

OSSC SECTION 1106.1

MULTI-FAMILY PARKING LOT (76 TO 100)	MINIMUM	PROPOSED
ACCESSIBLE SPACES	4	4
VAN ACCESSIBLE SPACES	1	1

LANDSCAPING

DEVELOPMENT CODE CHAPTER 15.420.010

	REQUIRED	PROPOSED
MULTI-FAMILY PARKING LOT (25 SF PER STALL)	2,275 SF	6,357 SF

SETBACKS

ZONE C3 - MULTI-FAMILY LOT

FRONT	10 FT
INTERIOR	0 FT/10 FT
STREET - EXPRESSWAY CENTERLINE	50 Ft

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N W E S

SCALE: 1" = 20'
0 20 40

PUBLISH DATE
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LAND USE DOCUMENTS

MULTI-FAMILY SITE PLAN
CRESTVIEW CROSSING
PLANNED UNIT DEVELOPMENT

JT SMITH COMPANIES
NEWBERG, OR

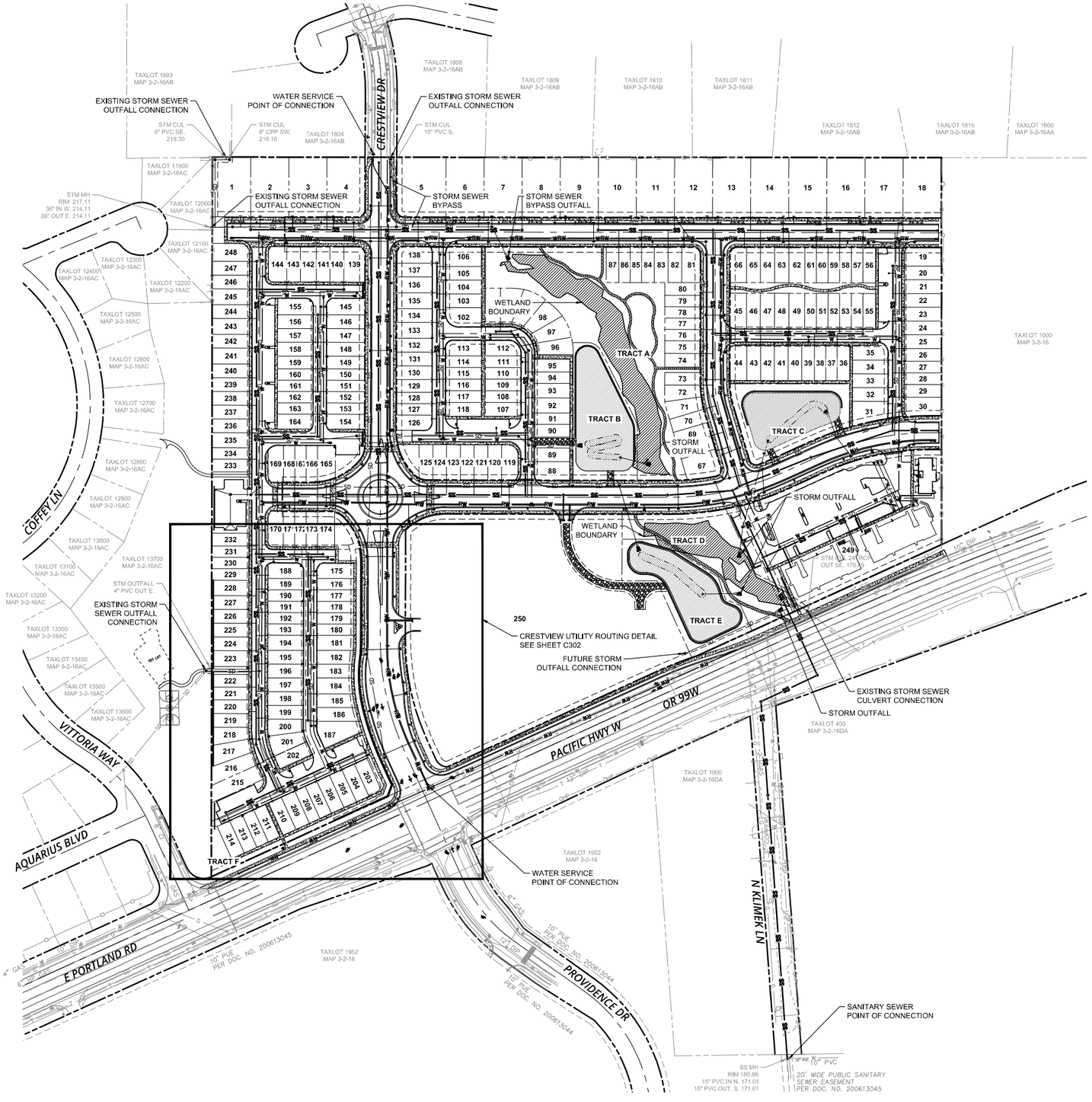
3J CONSULTING
CIVIL ENGINEERING
WATER RESOURCES
LAND USE PLANNING
5075 SW GRIFFITH DRIVE, SUITE 150, BEAVERTON, OR 97005

PROJECT INFORMATION
3J PROJECT # | 17393
TAX LOT(S) | 3S2W16 13800, 1100
LAND USE # | N/A
DESIGNED BY | ARS, JEJ, BMO
CHECKED BY | AJM, RGW

SHEET NUMBER
C215

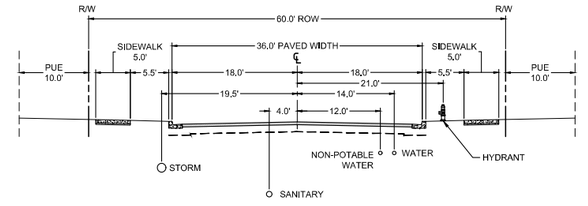
GENERAL NOTES

1. LOTS 1 THROUGH 7 SHALL HAVE STORMWATER QUALITY TREATMENT LOCATED WITHIN LOT BOUNDARIES. STORMWATER DISCHARGE FROM THESE LOTS SHALL CONNECT TO PROPOSED STORM SEWER BYPASS AND OUTFALL TO THE WETLAND.

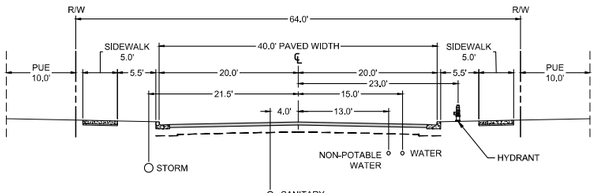


LEGEND

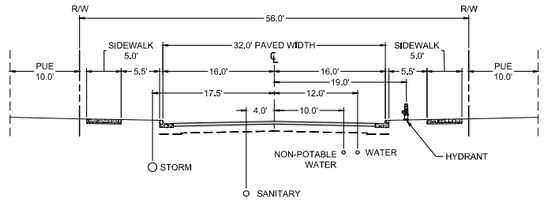
PROPOSED STORM PIPE	EXISTING TELECOM. LINE
PROPOSED SANITARY MAIN	EXISTING GAS LINE
PROPOSED WATER MAIN	EXISTING UNDERGROUND POWER
PROPOSED NON-POTABLE WATER MAIN	EXISTING OVERHEAD POWER
PROPOSED WATER FIRE SERVICE	EXISTING SANITARY SEWER
PROPOSED DETENTION POND	EXISTING STORM DRAIN
PROPOSED WATER QUALITY SWALE	EXISTING WATER MAIN
PIPE CAP / STUB	EXISTING HYDRANT
PROPOSED HYDRANT	EXISTING WATER VALVE
PROPOSED WATER VALVE	EXISTING SANITARY MANHOLE
PROPOSED WATER PIPE BLOWOFF/ PROPOSED AIR RELEASE ASSEMBLY	EXISTING STORM MANHOLE
PROPOSED FIRE DPT. CONNECTION	EXISTING STORM INLET
PROPOSED SANITARY MANHOLE	EXISTING POWER METER
PROPOSED SANITARY SERVICE LATERAL WITH CLEANOUT	EXISTING GAS METER
PROPOSED STORM MANHOLE	EXISTING TELEPHONE PEDESTAL
PROPOSED STORM OUTFALL PROTECTION	EXISTING GUY ANCHOR
PROPOSED STANDARD INLET MANHOLE	EXISTING LIGHT POLE
PROPOSED SUPERSIZED INLET MANHOLE	EXISTING UTILITY POLE
PROPOSED CATCH BASIN	EXISTING INTERSECTION SIGNAL
PROPOSED DITCH INLET	EXISTING ELECTRICAL BOX
PROPOSED STREET LIGHTING	



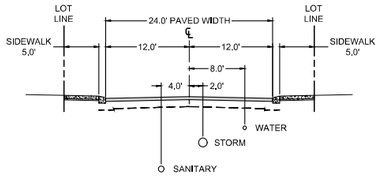
MAJOR COLLECTOR



MINOR COLLECTOR



LOCAL ROAD



PRIVATE ROAD

STREET UTILITIES TYPICAL SECTIONS

SCALE: NTS

Know what's below. Call before you dig.

SCALE: 1" = 100'

0 100' 200'

PUBLISH DATE
06.06.2018

ISSUED FOR
LAND USE DOCUMENTS

COMPOSITE UTILITY PLAN

CRESTVIEW CROSSING
PLANNED UNIT DEVELOPMENT

JT SMITH COMPANIES
NEWBERG, OR

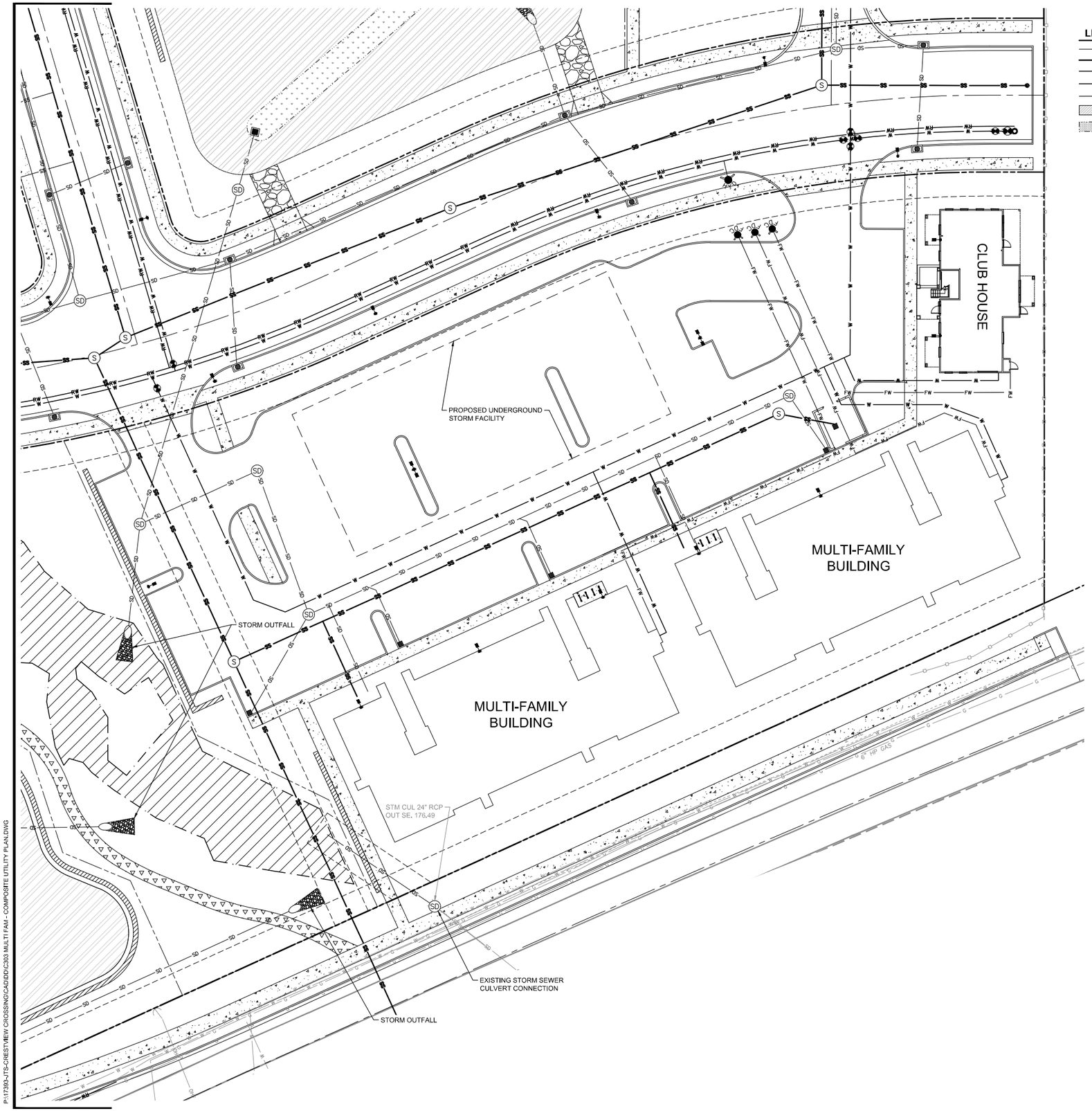
3J CONSULTING
CIVIL ENGINEERING
WATER RESOURCES
LAND USE PLANNING
5075 SW GRIFFITH DRIVE, SUITE 150; BEAVERTON, OR 97005

PROJECT INFORMATION

3J PROJECT #	17393
TAX LOT(S)	3S2W16 13800, 1100
LAND USE #	N/A
DESIGNED BY	ARS, JEJ, BMO
CHECKED BY	AJM, RGW

SHEET NUMBER
C300

P:\17393-JTS-CRESTVIEW CROSSING\CAD\DOC\300 COMPOSITE UTILITY PLAN.DWG



LEGEND

- PROPOSED STORM PIPE
- PROPOSED SANITARY MAIN
- PROPOSED WATER MAIN
- PROPOSED NON-POTABLE WATER MAIN
- PROPOSED WATER FIRE SERVICE
- PROPOSED DETENTION POND
- PROPOSED WATER QUALITY SWALE
- PIPE CAP / STUB
- PROPOSED HYDRANT
- PROPOSED FIRE DEPARTMENT CONNECTION
- PROPOSED WATER VALVE
- PROPOSED WATER PIPE BLOWOFF/ AIR RELEASE ASSEMBLY
- PROPOSED SANITARY MANHOLE
- PROPOSED SANITARY SERVICE LATERAL WITH CLEANOUT
- PROPOSED STORM MANHOLE
- PROPOSED STORM OUTFALL PROTECTION
- PROPOSED STANDARD INLET MANHOLE
- PROPOSED SUPERSIZED INLET MANHOLE
- PROPOSED CATCH BASIN
- PROPOSED DITCH INLET
- PROPOSED STREET LIGHTING
- EXISTING TELECOM. LINE
- EXISTING GAS LINE
- EXISTING UNDERGROUND POWER
- EXISTING OVERHEAD POWER
- EXISTING SANITARY SEWER
- EXISTING STORM DRAIN
- EXISTING WATER MAIN
- EXISTING HYDRANT
- EXISTING WATER VALVE
- EXISTING SANITARY MANHOLE
- EXISTING STORM MANHOLE
- EXISTING STORM INLET
- EXISTING POWER METER
- EXISTING GAS METER
- EXISTING TELEPHONE PEDESTAL
- EXISTING GUY ANCHOR
- EXISTING LIGHT POLE
- EXISTING UTILITY POLE
- EXISTING INTERSECTION SIGNAL
- EXISTING ELECTRICAL BOX

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

N W E S

SCALE: 1" = 100'
0 100' 200'

PUBLISH DATE
06.06.2018

ISSUED FOR
LAND USE DOCUMENTS

MULTI-FAMILY COMPOSITE UTILITY PLAN

CRESTVIEW CROSSING
PLANNED UNIT DEVELOPMENT

JT SMITH COMPANIES
NEWBERG, OR

3J CONSULTING
CIVIL ENGINEERING
WATER RESOURCES
LAND USE PLANNING
5075 SW GRIFFITH DRIVE, SUITE 150; BEAVERTON, OR 97005

PROJECT INFORMATION

3J PROJECT #	17393
TAX LOT(S)	3S2W16 13800, 1100
LAND USE #	N/A
DESIGNED BY	ARS, JEJ, BMO
CHECKED BY	AJM, RGW

SHEET NUMBER
C303

P:\17393-JTS-CRESTVIEW CROSSING\CAD\DD\C303 MULTI FAM - COMPOSITE UTILITY PLAN.DWG

Vegetated Swale Operation and Maintenance Plan

Annual inspections are required. It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

Identified Problem	Condition to Check for	Maintenance Activity	Maintenance Timing	✔ Task Complete Comments
Obstructed Inlet/Outlet	Material such as vegetation, sediment is blocking more than 10% of Inlet/ outlet pipe or basin opening	Remove blockages from facility		
Flow not distributed evenly	Flows unevenly distributed through swale due to uneven or clogged flow spreader	Level and clean the spreader so that flows spread evenly over entire swale width		
Sediment Accumulation in Treatment Area	Sediment depth in treatment area exceeds 3 inches	Remove sediment from treatment area. Ensure facility is level from side to side and drains freely toward outlet; no standing water once inflow has ceased	 Ideally in the dry season	
Tree/Shrub Growth	Tree/shrub growth shades out wetland/emergent grass in treatment area. Interferes with access for maintenance/inspection	Prune trees and shrubs that block sun from reaching treatment area. Remove trees that block access points. Do not remove trees that are not interfering with access or maintenance without first contacting Clean Water Services or local City	 Ideal timing for pruning is winter	
Hazard Trees	Observed dead, dying or diseased trees	Remove hazard trees. A certified arborist may be needed to determine health of tree or removal requirements	As Needed	

Vegetated Swale Operation and Maintenance Plan (continued)

Annual inspections are required. It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

Identified Problem	Condition to Check for	Maintenance Activity	Maintenance Timing	✔ Task Complete Comments
Erosion	Erosion or channelization that impacts or effects the function of the facility or creates a safety concern	Repair eroded areas and stabilized using proper erosion control measures. Establish appropriate vegetation as needed.		
Poor Vegetation Coverage	80% survival of approved vegetation and no bare areas large enough to affect function of facility	Determine cause of poor growth and correct the condition. Replant per the approved planting plan and applicable standards at time of construction. Remove excessive weeds and all invasive plants.	 Ideal time to plant is spring and fall seasons	
Invasive Vegetation as outlined in Appendix A	Invasive vegetation is found in facility. Examples include: Himalayan Blackberry; Reed Canary Grass; Teasel; English Ivy; Nightshade; Clematis; Cattail; Thistle; Scotch Broom	Remove excessive weeds and all invasive plants. Attempt to control even if complete eradication is not feasible. Refer to Clean Water Services Integrated Pest Management Plan for appropriate control methods, including proper use of chemical treatment		
Excessive Vegetation	Vegetation grows so tall it competes with or shades approved emergent wetland grass/shrubs; interferes with access or becomes fire danger	Cut tall grass to 4" to 6" and remove clippings. Prune emergent wetland grass/shrubs that have become overgrown.	 Ideal time to prune emergent wetland grass is spring. Cut grass in dry months	
Trash and Debris	Visual evidence of trash, debris or dumping	Trash and debris removed from facility. Dispose of properly		

Vegetated Swale Operation and Maintenance Plan (continued)

Annual inspections are required. It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

Identified Problem	Condition to Check for	Maintenance Activity	Maintenance Timing	✔ Task Complete Comments
Standing Water	Standing water in the swale between storms that does not drain freely	Remove sediment or trash blockages; improve grade from end to end of swale; no standing water 24 hours after any major storm (1-inch in 24 hours)	 Inspect after any major storm (1-inch in 24 hours)	
Vector Control	Evidence of rodents or water piping through facility via rodent holes. Harmful insects such as wasps and hornets interfere with maintenance/ inspection activities	Repair facility if damaged. Remove harmful insects, use professional if needed. Refer to Clean Water Services Integrated Pest Management Plan for management options	As Needed	
Contamination and Pollution	Evidence of oil, gasoline, contaminants, or other pollutants. Look for sheens, odor or signs of contamination	If contaminants or pollutants present, coordinate removal/ cleanup with local jurisdiction		
Grate Damaged, missing or not in place	Grate is missing or only partially in place, may have missing or broken grate members	Grate must be in place and meet design standards. Replace or repair any open structure, replace grate if missing.	As Needed	
Damage to Outlet Structure	Frame not sitting flush on top slab (more than ¾ inch between frame and top slab); frame not securely attached	Ensure frame is firmly attached and sits flush on riser rings or on top of slab. Structure replaced or repaired to design standards	As Needed	

Vegetated Swale Operation and Maintenance Plan (continued)

Annual inspections are required. It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

Identified Problem	Condition to Check for	Maintenance Activity	Maintenance Timing	✔ Task Complete Comments
Damage to Outlet Structure	Fractures or Cracks in Walls or Bottom. Maintenance person determines the structure is unsound. Soil entering structure through cracks	Structure replaced or repaired to design standards	As Needed	
Damage to Outlet Structure	Settlement or Misalignment. Failure of basin has created a safety, function, or design problem	Structure replaced or repaired to design standards	As Needed	

Extended Dry Basin Operation and Maintenance Plan

Annual inspections are required. It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

Identified Problem	Condition to Check for	Maintenance Activity	Maintenance Timing	✔ Task Complete Comments
Trash and Debris	Visual evidence of trash, debris or dumping	Remove trash and debris from facility. Dispose of properly		
Contamination and Pollution	Evidence of oil, gasoline, contaminants, or other pollutants. Look for sheens, odor or signs of contamination	Locate source of contamination and correct. Remove oil using oil-absorbent pads or vactor truck. If low levels of oil persist plant wetland plants that can uptake small concentrations of oil such as Juncus effuses. (soft rush) If high levels of contaminants or pollutants are present, coordinate removal/ cleanup with local jurisdiction		
Invasive vegetation as outlined in Appendix A.	Invasive vegetation found in facility. Examples include: Himalayan Blackberry, Reed Canary Grass, Teasel, English Ivy, Nightshade, Clematis, Cattail, Thistle, Scotch Broom	Remove excessive weeds and all invasive plants. Attempt to control even if complete eradication is not feasible; refer to Clean Water Services Integrated Pest Management Plan for appropriate control methods, including proper use of chemical treatment		
Obstructed Inlet/Outlet	Material such as vegetation, trash, sediment is blocking more than 10% of inlet/outlet pipe or basin opening	Remove blockages from facility	 Inspect after major storm (1-inch in 24 hours)	
Poor Vegetation Cover	80% survival of approved vegetation and no bare areas large enough to affect function of facility.	Determine cause of poor growth and correct the condition. Replant with plugs or containerized plants per the approved planting plan and applicable standards at time of construction. Remove excessive weeds and all invasive plants.	 Ideal time to plant is spring and fall seasons	

Extended Dry Basin Operation and Maintenance Plan (continued)

Annual inspections are required. It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

Identified Problem	Condition to Check for	Maintenance Activity	Maintenance Timing	✔ Task Complete Comments
Vector Control	Evidence of rodents or water piping through facility via rodent holes. Harmful insects present such as wasps and hornets that interfere with maintenance/ inspection activities	Repair facility if damaged. Remove harmful insects, use professional if needed. Refer to Clean Water Services Integrated Pest Management Plan for management options	As Needed	
Tree/Shrub Growth	Tree/shrub growth shades out wetland/ emergent grass in treatment area. Interferes with access for maintenance/ inspection	Prune trees and shrubs that block sun from reaching treatment area. Remove trees that block access points. Do not remove trees that are not interfering with access or maintenance without first contacting Clean Water Services or local City	 WINTER Ideal time for pruning is winter	
Hazard Trees	Observed dead, dying or diseased trees	Remove hazard trees. A certified Arborist may need to determine health of tree or removal requirements	As Needed	
Excessive Vegetation	Vegetation grows so tall that it competes with approved emergent wetland grass/shrubs, interferes with access or becomes a fire danger	Cut tall grass 4" to 6" and remove clippings. Prune emergent wetland grass/shrubs that have become overgrown.	 SPRING Ideal time to prune emergent wetland grass is spring. Cut grass in dry months	
Erosion	Erosion or channelization that impacts or effects the function of the facility or creates a safety concern	Repair eroded areas and stabilize using proper erosion control measures. Establish appropriate vegetation as needed	 FALL WINTER SPRING	

Extended Dry Basin Operation and Maintenance Plan (continued)

Annual inspections are required. It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

Identified Problem	Condition to Check for	Maintenance Activity	Maintenance Timing	✔ Task Complete Comments
Settlement of Pond Dike/ Berm	Look for any part of dike/berm that has settled 4 inches or more lower than the design elevation	Repair dike/berm to approved design specifications. A licensed civil engineer should be consulted to determine the source of the settlement	As Needed	
Blockage of Emergency Overflow/ Spillway	Blockage of overflow/ spillway by trees, vegetation or other material. Blockages may cause the berm to fail due to uncontrolled overtopping	Remove blockage. Small root system (base less than 4 inches) may be left in place; otherwise, roots are removed. A licensed civil engineer should be consulted for proper berm/spillway restoration.	 Inspect after major storm (1-inch in 24 hours)	
Erosion of Emergency Overflow/Spillway	Native soil is exposed at the spillway, or there is only one layer of rock in an area of 5 square feet or larger	Restore rock and pad depth to appropriate depth. Refer to design specifications	 Inspect after major storm (1-inch in 24 hours)	
Blockage of Overflow Structure/ Orifice Plate	Excessive standing water or water is not detained for required time.	Inspect and if needed clear orifice plate for proper drainage or re-install to ensure required detention.	 Inspect after major storm (1-inch in 24 hours)	
Sediment Accumulation in Pond Bottom	Sediment accumulation in pond bottom exceeds 6 inches or affects facility inlet/ outlet or plant growth in treatment area	Remove sediment from pond bottom. Re-establish designed pond shape and depth. Establish appropriate vegetation in treatment area	 Ideally in the dry season	

Extended Dry Basin Operation and Maintenance Plan (continued)

Annual inspections are required. It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

Identified Problem	Condition to Check for	Maintenance Activity	Maintenance Timing	✔ Task Complete Comments
Grate Damaged, missing or not in place	Grate is missing or only partially in place, may have missing or broken grate members.	Grate must be in place and meet design standards. Replace or repair any open structure, replace grate if missing	As Needed	
Damage to Outlet Structure	Damage to Frame or Top Slab. Frame not sitting flush on top slab (more than ¾ inch between frame and top slab); frame not securely attached	Ensure frame is firmly attached and sits flush on the riser rings or top slab	As Needed	
Damage to Outlet Structure	Fractures or Cracks in Walls or Bottom. Maintenance person determines the structure is unsound. Soil entering structure through cracks.	Structure replaced or repaired to design standards.	As Needed	
Damage to Outlet Structure	Settlement or Misalignment of Basin. Failure of basin has created a safety, function, or design problem	Structure replaced or repaired to design standards	As Needed	

Chapter 4

Maintenance of the BayFilter™ System

The BayFilter™ system requires periodic maintenance to continue operating at the design efficiency. The maintenance process comprises the removal and replacement of each BayFilter™ cartridge and drain down module and the cleaning of the vault or manhole with a vacuum truck. BayFilter™ maintenance should be performed by a BaySaver Technologies, Inc. certified maintenance contractor.

The maintenance cycle of the BayFilter™ system will be driven mostly by the actual solids load on the filter. The system should be periodically monitored to be certain it is operating correctly. Since stormwater solids loads can be variable, it is possible that the maintenance cycle could be more or less than the projected duration.

The BayFilter systems in New Development applications are designed to treat the WQv in 24 hours initially. Later in the cycle these cartridges will flow at a slower rate, and when the WQv does not drain down within +/- 40 hours after the storm event, the system must be maintained.

When a BayFilter™ system is first installed, it is recommended that it be inspected every six (6) months. When the filter system exhibits flows below design levels the system should be maintained. Filter cartridge replacement should also be considered when sediment levels are at or above the level of the 4 inch manifold system. Please contact the BaySaver Technologies Inc. Engineering Department for maintenance cycle estimations or assistance at 1.800.229.7283.

Maintenance Procedures

1. Remove the manhole covers and open all access hatches.

2. Before entering the system make sure the air is safe per OSHA Standards or use a breathing apparatus. Use low O_2, high CO, or other applicable warning devices per regulatory requirements.

3. Using a vacuum truck remove any liquid and sediments that can be removed prior to entry.

4. Using a small lift or the boom of the vacuum truck, remove the used cartridges by lifting them out.

5. Any cartridges that cannot be readily lifted directly out of the vault should be removed from their location and carried to the lifting point using the Trolley system installed in the Vault (if applicable).

6. When all cartridges and drain down modules are removed, remove the balance of the solids and water; then loosen the stainless clamps on the Fernco couplings in the pipe manifold; remove the drain pipes as well. Carefully cap the manifold and the Fernco's and rinse the floor removing the balance of the collected solids.

7. Clean the manifold pipes, inspect, and reinstall.

8. Install the exchange cartridges and close all covers.

9. The used cartridges must be sent back to BaySaver Technologies, Inc. for exchange/recycling and credit on undamaged units.

13.0 Inspection and Maintenance

13.1 TREATMENT TRAIN INSPECTION AND MAINTENANCE

The StormTech recommended treatment train inlet system has three tiers of treatment upstream of the StormTech chambers. It is recommended that inspection and maintenance (I&M) be initiated at the furthest upstream treatment tier and continue downstream as necessary. The following I&M procedures follow this approach providing I&M information in the following order: Tier 1 – Pretreatment (BMP); Tier 2 – StormTech Isolator Row, and ; Tier 3 – Eccentric Pipe Header System.

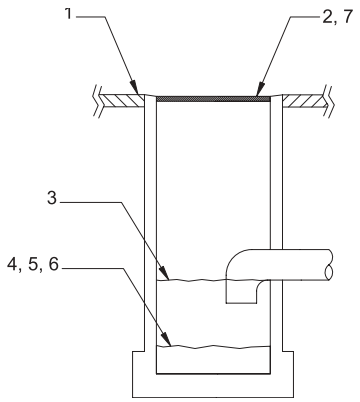
13.2 CATCHBASIN/MANHOLE I&M

Typically a stormwater system will have catchbasins and manholes upstream of the detention/retention system. In some cases these may be the only pre-treatment devices. Regular I&M of catchbasins and manholes should be scheduled and performed as part of a site's routine maintenance plan.

Catchbasin/Manhole – Step-by-Step Maintenance Procedures

1) Inspect catch basins and manholes upstream of StormTech chambers for sediment
2) Remove grate or cover
3) Skim off oils and floatables
4) Using a stadia rod, measure the depth of sediment
5) If sediment is at a depth greater than 6" proceed to step 6. If not proceed to step 7.
6) Vacuum or manually remove sediment
7) Replace grate
8) Record depth & date and schedule next inspection

Figure 17 – Catchbasin/Manhole I&M Steps



13.3 PRE-TREATMENT DEVICE I&M

Manufacturer's I&M procedures should be followed for proprietary pretreatment devices such as baffle boxes, swirl concentrators, oil-water separators, and filtration units. **Table 10** provides some general guidelines but is not a substitute for a manufacturer's specific instructions.

TABLE 10 – Pretreatment Inspection and Maintenance Guidelines

SEDIMENT CONTROL INSPECTION	INSPECTION*	MAINTENANCE**
StormTech Isolator™ Row	Bi-Annually	JetVac - Culvert Cleaning Nozzle Preferred
Sediment Basin	Quarterly or after large storm event	Excavate sediment
Catch Basin Sump	Quarterly	Excavate,pump, or vacuum
Sedimentation Structure	Quarterly	Excavate,pump, or vacuum
Catch Basin Filter Bags	After all storm events	Clean and/or replace filter bags
Porous Pavement	Quarterly	Sweep Pavement
Pipe Header Design	Quarterly	Excavate,pump, or vacuum
Water Quality Inlet	Quarterly	Excavate,pump, or vacuum
Sand Filters	Quarterly or after storm event	Remove & replace sand filter

13.0 Inspection & Maintenance

13.4 ISOLATOR™ ROW INSPECTION

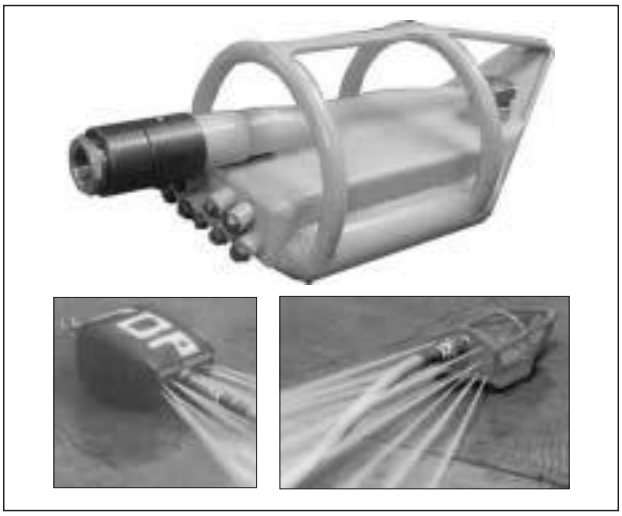
Regular inspection and maintenance are essential to assure a properly functioning stormwater system. Inspection is easily accomplished through the manhole or optional inspection ports of an Isolator Row. Please follow local and OSHA rules for a confined space entry.

Inspection ports can allow inspection to be accomplished completely from the surface without the need for a confined space entry. Inspection ports provide visual access to the system with the use of a flashlight. A stadia rod may be inserted to determine the depth of sediment. If upon visual inspection it is found that sediment has accumulated to an average depth exceeding 3 inches, cleanout is required.

A StormTech Isolator Row should initially be inspected immediately after completion of the site's construction. While every effort should be made to prevent sediment from entering the system during construction, it is during this time that excess amounts of sediments are most likely to enter any stormwater system. Inspection and maintenance, if necessary, should be performed prior to passing responsibility over to the site's owner. Once in normal service, a StormTech Isolator Row should be inspected bi-annually until an understanding of the sites characteristics is developed. The site's maintenance manager can then revise the inspection schedule based on experience or local requirements.

13.5 ISOLATOR ROW MAINTENANCE

JetVac maintenance is required if sediment has been collected to an average depth of 3 inches or more inside the Isolator Row. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, a wave of suspended sediments is flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45" are best. Most JetVac reels have a minimum of 400 feet of hose allowing maintenance of an Isolator Row up to 50 chambers long. The JetVac process shall only be performed on StormTech Rows that have AASHTO class 1 woven geotextile over their angular base stone.



STORMTECH ISOLATOR™ ROW - STEP-BY-STEP MAINTENANCE PROCEDURES

Step 1) Inspect Isolator Row for sediment

A) Inspection ports (if present)

i. Remove lid from floor box frame

ii. Remove cap from inspection riser

iii. Using a flashlight and stadia rod, measure depth of sediment

iv. If sediment is at, or above, 3 inch depth proceed to Step 2. If not proceed to step 3.

B) All Isolator Rows

i. Remove cover from manhole at upstream end of Isolator Row

ii. Using a flashlight, inspect down Isolator Row through outlet pipe

1. Mirrors on poles or cameras may be used to avoid a confined space entry

2. Follow OSHA regulations for confined space entry if entering manhole

iii. If sediment is at or above the lower row of sidewall holes (approximately 3 inches) proceed to Step 2. If not proceed to Step 3.

Step 2) Clean out Isolator Row using the JetVac process

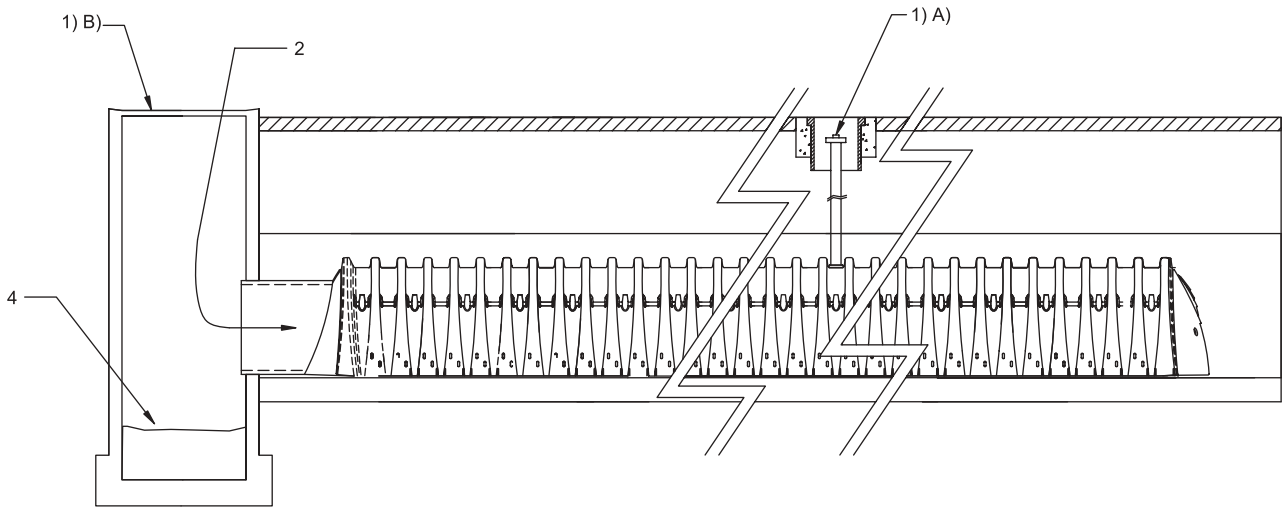
A) A fixed culvert cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable
B) Apply multiple passes of JetVac until backflush water is clean
C) Vacuum manhole sump as required

Step 3) Replace all caps, lids and covers

Step 4) Inspect & clean catch basins and manholes upstream of the StormTech system following the procedures for Classic Manifold Inlet System

Figure 18

StormTech Isolator Row (not to scale)



13.0 Inspection & Maintenance

13.6 ECCENTRIC PIPE HEADER INSPECTION

Theses guidelines do not supercede a pipe manufacturer's recommended I&M procedures. Consult with the manufacturer of the pipe header system for specific I&M procedures. Inspection of the header system should be carried out quarterly. On sites which generate higher levels of sediment more frequent inspections may be necessary. Headers may be accessed through risers, access ports or manholes. Measurement of sediment may be taken with a stadia rod or similar device. Clean-out of sediment should occur when the sediment volume has reduced the storage area by 25% or the depth of sediment has reached approximately 25% of the diameter of the structure.

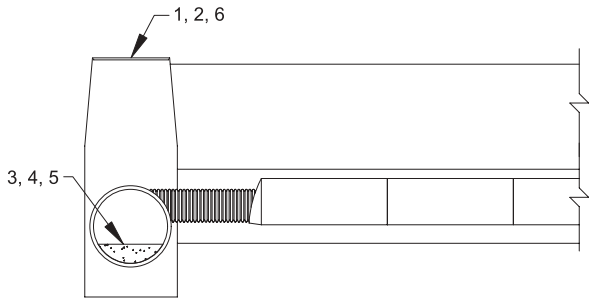
13.7 ECCENTRIC PIPE HEADER MAINTENANCE

Cleanout of accumulated material should be accomplished by vacuum pumping the material from the header. Cleanout should be accomplished during dry weather. Care should be taken to avoid flushing sediments out through the outlet pipes and into the chamber rows.

Eccentric Header Step-by-Step Maintenance Procedures

1. Locate manholes, access ports or risers connected to the header system
2. Remove grates or covers
3. Using a stadia rod, measure the depth of sediment
4. If sediment is at a depth of about 25% pipe volume or 25% pipe diameter proceed to step 5. If not proceed to step 6.
5. Vacuum pump the sediment. Do not flush sediment out inlet pipes.
6. Replace grates and covers
7. Record depth & date and schedule next inspection

Figure 19 – Manifold Maintenance



SAMPLE:

Month: Year: Initial & Date	Flow Control Manhole	Bayfilter Facilities	Catch Basins	Perfilter Facilities	Storm Tech System	Spill Kit	Drainblocker/cover	Document if materials are removed from catch basins
January								
February								
March								
April								
May								
June								
July								
August								
September								
October								
November								
December								

GEOTECHNICAL REPORT

Geotechnical Engineering Report

Crestview Crossing Development
Newberg, Oregon

for
J.T. Smith Companies

March 12, 2018

GeoEngineers
Earth Science + Technology

Geotechnical Engineering Report

Crestview Crossing Development
Newberg, Oregon

for
J.T. Smith Companies

March 12, 2018

GeoEngineers

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Geotechnical Engineering Report

Crestview Crossing Development
Newberg, Oregon

File No. 6748-002-00

March 12, 2018

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GeoEngineers

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INTRODUCTION

This geotechnical report summarizes our geotechnical engineering services provided for the proposed Crestview Crossing development in Newberg, Oregon. The proposed project is located north of Pacific Highway West (Hwy 99W) between Vittoria Way and North Harmony Lane. The site is currently undeveloped and is approximately 33 acres.

A preliminary site development drawing for Crestview Crossing was provided to us by 3J Consulting Engineers (3J). The plan is titled "Crestview Planned Development – Preliminary Zoning Map," dated June 2017. The preliminary zoning plan indicates the project will consist of multi-story apartment buildings, residential lots, commercial buildings, new City streets and shared access roadways, utilities associated with site development and off-site road improvements. The off-site road improvements include widening and intersection improvements along Hwy 99W adjacent to the site to the south.

Our recommendations for earthwork and retaining structures assume that maximum cuts and fills will be less than 10 feet each and that on-site retaining walls will be less than 10 feet in height.

Our structural design recommendations are based on the following:

- For commercial buildings, we assumed that maximum column and wall loads will be on the order of 40 kips per column and 2 kips per lineal foot (klf) respectively and that floor loads for slabs on grade will be 100 pounds per square foot (psf) or less.
- For apartments, we assumed typical light wood-frame structural loads.

The purpose of our services was to provide geotechnical design and construction recommendations for general site development (infrastructure development, overall site grading and design recommendations) and for proposed commercial and apartment buildings. Our report should not be used for individual residential lot development. Depending on building type, lot configuration and location, and final grading and site development as it varies across the site, lot-specific evaluation and additional geotechnical investigations may be required for future development for individual residential lots and near retaining walls, or for critical facilities if they are developed on site.

SCOPE OF SERVICES

The purpose of our services was to evaluate soil and groundwater conditions as a basis for developing geotechnical engineering design recommendations for general site development. Our proposed scope of services included the following:

1. Reviewed selected information regarding subsurface soil and groundwater at the site.
2. Coordinated and managed the field explorations, including public utility notification and scheduling of subcontractors and GeoEngineers' field staff.
3. Explored subsurface soil and groundwater conditions at the site by conducting:
    a. Twenty-one test pit explorations in proposed building and parking areas to depths of 8 to 12 feet below the ground surface (bgs).

b. Nine pavement explorations (on the shoulder lane) along the proposed lane widening of Hwy 99W to depths between 4 and 6½ feet bgs.

c. Four direct cone penetration tests (DCP) tests in four of the pavement explorations.

d. Four hand augers and DCP in on-site new roadway areas to depths between 3 and 4½ feet bgs.

e. Two infiltration tests near the proposed enhanced wetland areas.

4. Obtained samples at representative intervals from the explorations, observed groundwater conditions and maintained detailed logs in general accordance with ASTM International (ASTM) Standard Practices Test Method D 2488. Qualified staff from our office observed and documented field activities.

5. Performed laboratory tests on selected soil samples obtained from the explorations to evaluate pertinent engineering characteristics.

6. Performed a general geologic assessment of slopes at the site relative to existing stability and impact on proposed site development.

7. Provided a geotechnical evaluation of the site and design recommendations in this geotechnical report to address the following geotechnical engineering components:

    a. A general description of site topography, geology and subsurface conditions.

    b. An opinion, from a geotechnical engineering standpoint, as to the adequacy of the encountered soils to support the proposed development based on our recommendations.

    c. Recommendations for site preparation measures, including disposition of undocumented fill and unsuitable native soils, recommendations for temporary cut slopes and constraints for wet weather construction.

    d. Recommendations for temporary excavation and temporary excavation protection, such as excavation sheeting and bracing.

    e. Recommendations for earthwork construction, including use of on-site and imported structural fill and fill placement and compaction requirements.

    f. Geotechnical engineering recommendations for use in designing conventional retaining walls, including backfill and drainage requirements.

    g. Recommendations for foundations to support proposed structures, including minimum width and embedment, design soil bearing pressures, settlement estimates (total and differential), coefficient of friction and passive earth pressures for sliding resistance. We assumed that shallow foundations could be used to adequately support the structures.

    h. Recommendations for supporting on-grade slabs, including aggregate base, capillary break and modulus of subgrade reaction.

    i. Seismic design parameters, including soil site class evaluation in accordance with the current version of the International Building Code (IBC).

    j. Infiltration test results at infiltration facility locations provided by the project civil engineer.

    k. Pavement recommendations for widening Hwy 99W meeting Oregon Department of Transportation (ODOT) Pavement Design recommendations.

l. Pavement recommendations for constructing asphaltic concrete (AC) pavements for proposed on-site roadways, including subgrade, drainage, base rock and pavement section.

SITE CONDITIONS

Site Geology

The project site is located within the western edge of the Willamette Basin physiographic province near the border with the Chehalem Mountains that separate the Willamette and Tualatin Basins. The project site is located within the Chehalem Creek Valley, a broad alluvial drainage that forms an embayment of the Willamette Valley extending north and northwest into the Chehalem Mountains.

The *Engineering Geology of the Tualatin Valley Region, Oregon* (Schlicker and Deacon 1967) shows the Newberg area mantled by "Willamette Silt," the term used by this publication for what is now more typically referred to as "fine-grained flood deposits" (Madin 1990). This alluvial sediment is described as "unconsolidated beds and lenses of fine sand, silt and clay." The mapping shows the project site within an area mapped as mantled by more clayey materials that are reported to accumulate in low-lying areas (Schlicker and Deacon 1967). The topography of the site and our field investigation suggests that the area of clay mantling is incorrectly mapped at this location but that the near-surface site geology is otherwise generally consistent with published geologic mapping.

Surface Conditions

A representative of GeoEngineers performed a general visual reconnaissance of the site. The site was accessed from a driveway located just off Hwy 99W that leads up to the single-family residence identified as 4505 East Portland Road. The residence appeared abandoned at the time of our field reconnaissance.

The site is approximately 33 acres of undeveloped land aside from the single-family residence, a barn and several small structures (animal coops/pens or storage sheds). The site appears to have been farmland that was used for pasture/hay, with a smaller portion (approximately 3 acres) in the southwest corner used as an orchard. Portions of the site appear to have been used as a tree farm in the past; however, in recent years much of the subject property appears to have been left fallow.

Site vegetation is variable and consists of tall grasses, brush, shrubs and trees. The trees are small to large (semi-mature to mature) individual trees, dense stands of trees and an old orchard area.

Surrounding properties are generally residential and farmland (orchards and other crops) with a commercial development (Providence Medical Center) to the south of the site across Hwy 99W. The area immediately north of the site is generally single-family residential properties. The area to the east of the site is generally single-family residential with farmland. The area west of the site is generally single-family residential properties.

Slope Conditions

In addition to our general site reconnaissance, we performed a visual geologic reconnaissance on September 29, 2017, to observe existing slope conditions. Site topography is undulatory to gently sloping, with maximum gradients typically less than 4H:1V (horizontal to vertical) to as low as 10H:1V or flatter. The

exception to this is the cut slope along the Hwy 99W right-of-way that has been constructed to gradients as steep as 1H:1V locally.

The interior site slopes appear planar to convex and regular. We did not observe indications of large, deeply-seated, recent or active slope instability such as concave, steeply-inclined bare-soil scarps, bulging or hummocky topography, anomalous drainage features or vegetation. Minor sloughing or slumping along a portion of the Hwy 99W cut slope appears related to localized oversteepening of the slope cut. The exposed soils in this cut are fine-grained soils that correspond to the same silt soil unit we encountered in the site test pits.

Light Detection and Ranging (LiDAR) landslide hazard mapping has not been completed for the Newberg area. The Oregon State Landslide Information Layer (SLIDO) (Oregon Department of Geology and Mineral Industries 2017) shows a large area of "landslide topography" extending to within ¼ mile of the site. The SLIDO layer states that this is based on the hazard mapping of Schlicker and Deacon (1967), but a close examination of the hazard map from the earlier publication shows that the investigators did not extend the "landslide area" as far south as shown on the SLIDO database. Our observations likewise do not support the proximity of this old or ancient landslide to the project site.

Subsurface Conditions

We completed field explorations at the site on September 20, 21 and 26, 2017. Our explorations included:

- Twenty-one test pit (TP) explorations, TP-1 to TP-21, to depths of 8 to 12 feet bgs.
- Nine pavement borings, B-1 to B-9, to depths between 4 and 6½ feet bgs, with four DCP tests completed in four of the borings (B-2, B-4, B-6 and B-8).
- Four hand augers with DCP to depths between 3 and 4½ feet bgs.
- Two infiltration tests near the proposed onsite enhanced wetlands.

The approximate locations of the explorations are shown in the Site Plan, Figure 2. A member of our professional staff maintained detailed logs of the soils encountered and gathered representative soil samples. Appendix A summarizes our exploration methods and presents our exploration logs and DCP results. Laboratory test results are provided in the exploration logs and described in Appendix A.

Hwy 99W Pavement Explorations

In general, our Hwy 99W pavement explorations encountered typical pavement sections (AC underlain by aggregate base) over native subgrade material. Specifically, the ground surface at the pavement explorations consisted of 3 to 9½ inches of AC. The AC was underlain by gravel fill (aggregate base) having a variable thickness between approximately 11½ and 26 inches. In six of the pavement explorations, the gravel fill was underlain by native medium stiff brown silt. However, we encountered additional layers of fill materials underlying the pavement section in three of the borings, B-6, B-8 and B-9. The reader is referred to the boring logs and DCP results in Appendix A for more detailed information about the soils encountered in the pavement explorations.

Site Test Pits and Hand Augers

In general, our test pit and hand-auger explorations conducted on the proposed development site encountered a topsoil layer, underlain by a tilled soil zone, which was in turn underlain by native soil materials. The topsoil is approximately 6 inches thick and consists of brown to dark brown silt with roots and organic material.

The material underlying the topsoil is a tilled zone typical of previously farmed land and extends approximately 12 inches below the topsoil. The tilled zone is brown and gray silt classified as soft in consistency based on its disturbed state.

The tilled zone is underlain by native soils consisting primarily of medium stiff to stiff brown and gray silt. The consistency of the silt material has some variability with depth based on encountering some areas of stiff silt in addition to the medium stiff silt in several explorations. The silt also had zones of yellow, orange and red mottling. Although the primary native material observed in our test pits was silt, we encountered clay in two of our test pits, TP-3 and TP-8. The reader is referred to the exploration logs and DCP results for more detailed information about the soils encountered in the pavement explorations.

Groundwater

Our explorations revealed the following information about groundwater:

- Areal groundwater was not observed in most of our explorations.
- We did observe groundwater in boring B-7, which was drilled in Hwy 99W. Based on adjacent site grades (uphill to the north on to the site from Hwy 99W), and the nature of the native fine-grained silt and clay to perch groundwater, downslope areas may encounter perched groundwater above the level of permanent groundwater.
- The site soils, particularly the near-surface soils, contain high amounts of moisture.

Based on our site explorations, we expect that groundwater will be present at shallow depths in a perched condition during wet times of the year or during extended periods of wet weather. Some artesian-type groundwater conditions (upward flowing from perched conditions upslope) may be encountered in downslope areas. Groundwater conditions at the site are expected to vary seasonally due to rainfall events and other factors not observed in our explorations. For example, our past experience with agricultural sites indicates that remnant drainage features, such as buried clay tiles and cisterns, can produce local groundwater and temporary strong flow into excavations where drain tiles are pierced.

CONCLUSIONS

General

Based on our explorations, testing and analyses, it is our opinion that the site is suitable for the proposed project from a geotechnical standpoint, provided the recommendations in this report are incorporated into the project design and implemented during construction. We offer the following conclusions regarding geotechnical engineering design and construction at the site.

- Existing site structures and structural features designated for removal should be demolished and completely removed from the site.
- Existing utilities below proposed structural areas, including proposed buildings and roads, should be relocated or abandoned and grouted full if left in place.
- Surface conditions at the site consist primarily of vegetated areas covered with grasses, shrubs and trees; therefore, clearing, stripping and grubbing will be required. We anticipate a stripping depth of approximately 6 inches bgs to remove the topsoil layer. Grubbing and deeper excavations up to several feet will be required to remove the root zones of shrubs and trees. Portions of the site are heavily vegetated and previously buried roots are also expected, even in the current grassy areas of the site. Cleared, stripped and grubbed materials should be hauled off-site and properly disposed unless otherwise allowed by the project specifications for other uses such as landscaping, stockpiling or on-site burning.
- A "tilled zone" mantels the site from previous agriculture land use. The tilled zone consists of moist loose silt with trace roots and extends to a depth of approximately 18 inches bgs. The tilled zone is too loose to support structures, including buildings, foundations, floor slabs, pavements and other settlement-sensitive structures. Therefore, in areas designated to receive fill, and in areas where site cuts do not extend below the tilled zone, it should be either: (1) scarified, moisture-conditioned and compacted in place during the dry season; or (2) removed and replaced with Imported Select Structural Fill if construction occurs during the wet season or at other times when the material cannot be compacted in place.
- The soils at the site below the topsoil zone are suitable to use as structural fill if they are properly moisture conditioned and compacted. Because the site soils have a moisture content that is currently wet of optimum, they will become significantly disturbed from construction traffic, particularly during wet weather. Wet weather construction practices will be required over exposed native soils and to protect exposed subgrades, except during the dry summer months.
- Previously farmed areas can have buried features that are not encountered in geotechnical borings and test pits, for example: old foundations, structures, agricultural drain pipes and cisterns. We recommend a budget contingency for removing old buried features.
- Groundwater was not encountered during our explorations, but based on our experience and our observations, perched groundwater may be present during periods of persistent rainfall.
- Proposed commercial and apartment structures can be satisfactorily supported on continuous and isolated shallow foundations supported on the firm native soils encountered below the tilled zone, or on structural fill that extends to the firm native soils.
- Slabs on grade for proposed commercial and apartment structures can be satisfactorily supported on Aggregate Base that is founded on the firm native soils encountered below the tilled zone, or on structural fill that extends to the firm native soils. We recommend that slabs-on-grade be provided with proper moisture control by constructing the aggregate base as a capillary break and providing a vapor barrier for moisture-sensitive applications.
- Based on the assumed design loads described in the "Introduction" section of this report, we estimate total settlements will be less than 1 inch for foundations constructed as recommended. If larger structural loads are anticipated, we should review and reassess the estimated settlement.

- As stated earlier, our report should not be used for individual residential lot development. Lot-specific studies and additional geotechnical assessment/investigations may be required for future development for individual residential lots.
- Standard pavement sections as summarized in this report, consisting of AC over Aggregate Base and/or Aggregate Subbase, over properly prepared subgrade, can be used to support the estimated traffic loads provided the pavement sections are designed and constructed as recommended in this report.

EARTHWORK RECOMMENDATIONS

In general, site preparation and earthwork operations will include the following:

- Demolishing and disposing of debris from existing structures and hardscapes.
- Removing or relocating existing site utilities if present.
- Clearing to remove vegetation and grubbing to remove roots.
- Site stripping.
- Recompacting (dry weather) or replacing (wet weather) the tilled zone.
- Cutting and filling for mass grading.
- Excavating and filling for grade separators, such as retaining walls and slopes.
- Excavating and filling for roads and pavements.
- Excavating and filling for foundations and site utilities.
- Fine-grading to establish final surface grades.

Site Preparation

In general, site preparation will include demolishing existing structures, removing or relocating existing site utilities, grubbing and stripping.

Demolition

All structures and belowground structures to be demolished should be completely removed from proposed structural areas and for a margin of at least 3 feet around proposed structural areas. Proposed structural areas are areas where new structures will be built, including building pads and roadways. Existing utilities that will be abandoned on site should be identified prior to construction. Abandoned utility lines should be completely removed or filled with grout if abandoned and left in place to reduce potential settlement or caving in the future. Materials generated during demolition should be transported off site and properly disposed.

Clearing and Grubbing

Site clearing will be required to remove site vegetation, including grass, shrubs and trees that are designated for removal. Following clearing, grubbing and excavations up to several feet will be required to remove the root zones of shrubs and trees. Deeper excavations, up to 6 or 8 feet may be required to remove the root zones of large trees. Roots larger than ½ inch in diameter should be removed. Excavations to

remove root zones should be done with a smooth-bucket to minimize subgrade disturbance. Portions of the site are heavily vegetated and previously buried roots are also expected, even in the current grassy areas of the site. Grubbed materials should be hauled off site and properly disposed unless otherwise allowed by the project specifications for other uses such as landscaping, stockpiling or on-site burning.

Existing voids and new depressions created during demolition, clearing, grubbing or other site preparation activities, should be excavated to firm soil and backfilled with Imported Select Structural Fill. Greater depths of disturbance should be expected if site preparation and earthwork are conducted during periods of wet weather.

Stripping

Based on our observations at the site, we estimate that the depth of stripping should be on the order of about 6 inches. Greater stripping depths may be required to remove localized zones of loose or organic soil, and in areas where moderate to heavy vegetation are present, or where surface disturbance from prior use has occurred. The actual stripping depth should be based on field observations at the time of construction. Stripped material should be transported off site for disposal unless otherwise allowed by the project specifications for other uses such as landscaping.

Subgrade Improvement for the Tilled Zone

A "tilled zone" mantels the site from previous agriculture land use. The tilled zone consists of disturbed soil comprised of moist, loose silt with trace roots and extends to a depth of approximately 18 inches bgs. The tilled zone is too loose to support structures, including buildings, foundations, floor slabs, pavements and other settlement-sensitive structures. Therefore, if the tilled zone remains in place to receive site fills during mass grading, it should be either: (1) scarified, moisture-conditioned and compacted in-place during the dry season; or (2) removed and replaced with Imported Select Structural Fill if construction occurs during the wet season, or at other times when the material cannot be compacted in place. If the tilled zone is cut away (cuts extend below the tilled zone) as a part of mass grading, recompaction or removal of in-place undisturbed soils is not required.

The tilled zone soil will be generally loose, especially when wet and will provide marginal to poor support for construction equipment. Wet weather construction practices will be required when improving the tilled zone, except during the dry summer months.

Subgrade improvement for the tilled zone can be accomplished by removing and replacing or scarifying and re-compacting the tilled zone. Scarification is typically performed by ripping with agricultural discs and aerating the soils to dry them during dry weather periods. Considerable soil processing, including moisture conditioning (primarily drying - to reduce the existing moisture content), should be expected to adequately compact the tilled zone. If the soil cannot be properly moisture conditioned (dried), the subgrade should be removed and replaced with Imported Select Structural Fill. If the project specifications allow, the tilled zone can be cement amended as described in "Soil Amendment with Cement" section of this report. Cement amendment is typically performed to depths of 12 to 18 inches. When performed in silty soils, such as those at the site, multiple tilling and application passes may be required to adequately blend and amend the soils.

Subgrade Evaluation

As described above, disturbed material may be present after demolition and site stripping are complete. Subgrade areas to be developed should be prepared to be in a uniformly firm and unyielding condition prior to placing structural fill or structural elements. We recommend that prepared subgrades be observed by a member of our firm, who will evaluate the suitability of the subgrade and identify areas of yielding, which are indicative of soft or loose soil.

Subgrades, including subgrades to receive fill, should be proof-rolled with heavy rubber-tired equipment and/or probed with a ½-inch-diameter steel rod, as appropriate depending on prevailing conditions. If soft, yielding or otherwise unsuitable areas revealed during probing or proof-rolling cannot be compacted to a stable and uniformly firm condition, we recommend that: (1) the subgrade soils be scarified, aerated and recompacted; or (2) the unsuitable soils be removed and replaced with Structural Fill.

Subgrade Protection and Wet Weather Considerations

The soils at the site are highly susceptible to moisture. Wet weather construction practices will be necessary if work is performed during periods of wet weather. If site grading will occur during wet weather conditions, it will be necessary to use track-mounted equipment, load removed material into trucks supported on gravel haul roads, use gravel working pads and employ other methods to reduce ground disturbance. The contractor should be responsible to protect the subgrade during construction.

Earthwork planning should include considerations for minimizing subgrade disturbance. We provide the following recommendations if wet weather construction is considered:

- The ground surface in and around the work area should be sloped so that surface water is directed to a sump or discharge location. The ground surface should be graded such that areas of ponded water do not develop. Measures should be taken by the contractor to prevent surface water from collecting in excavations and trenches. Measures should be implemented to remove surface water from the work areas.
- Earthwork activities should not take place during periods of heavy precipitation.
- Slopes with exposed soils should be covered with plastic sheeting or similar means.
- The site soils should not be left in a disturbed or uncompacted state and exposed to moisture. Sealing the surficial soils by rolling with a smooth-drum roller prior to periods of precipitation may reduce the extent to which these soils become wet or unstable.
- Construction activities should be scheduled so that the length of time that soils are left exposed to moisture is reduced to the extent practicable.
- Construction traffic should be restricted to specific areas of the site, preferably areas that are not susceptible to wet weather disturbance such as haul roads and areas that are adequately surfaced with working pad materials.
- When on-site soils are wet of optimum, they are easily disturbed and will not provide adequate support for construction traffic nor for the proposed development. The use of granular haul roads and staging areas will be necessary to support heavy construction traffic. Generally, a 12- to 16-inch-thick mat of Imported Select Structural Fill should be sufficient for light staging areas for the building pad and light staging activities but is not expected to be adequate to support repeated heavy equipment or truck

traffic. The thickness of the Imported Select Structural Fill for haul roads and areas with repeated heavy construction traffic should be increased to between 18 and 24 inches. The actual thickness of haul roads and staging areas should be determined at the time of construction and based on the contractor's approach to site development and the amount and type of construction traffic.

- The base rock (Aggregate Base and Aggregate Subbase) thicknesses described in the "Pavement Recommendations" sections of this report are intended to support post-construction design traffic loads. The design base rock thicknesses will likely not support repeated heavy construction traffic during site construction or during pavement construction. A thicker base rock section as described above for haul roads will likely be required to support construction traffic.
- During periods of wet weather, concrete should be placed as soon as practical after preparing foundation excavations. Foundation bearing surfaces should not be exposed to standing water. Should water infiltrate and pool in the excavation, the water should be removed, and the foundation subgrade should be re-evaluated before placing reinforcing steel or concrete. Foundation subgrade protection, such as a 3- to 4-inch thickness of Aggregate Base/Aggregate Subbase or lean concrete, may be necessary if footing excavations are exposed to extended wet weather conditions.

During wet weather, or when the exposed subgrade is wet or unsuitable for proof-rolling, the prepared subgrade should be evaluated by observing excavation activity and probing with a steel foundation probe. Observations and probing should be performed by a member of our staff. Wet soil that has been disturbed due to site preparation activities, or soft or loose zones identified during probing, should be removed and replaced with Imported Select Structural Fill.

Soil Amendment with Cement

As an alternative to the using Imported Select Structural Fill material for wet weather structural fill, an experienced contractor may be able to amend the on-site soil with portland cement concrete (PCC) to obtain suitable support properties. It is often less costly to amend on-site soils than to remove and replace soft soils with imported granular materials. We also considered lime amendment for the site soils. However, based on our experience on nearby sites, in-place soil moisture contents, observed soil types and processing speed, cement amendment would be more suitable at this site than lime amendment. Single pass tilling depths for cement amendment equipment is typically 18 inches or less. However, multiple tilling passes may be required to adequately blend in the cement with the soils and to sufficiently process the soils. It may also be necessary to place the recommended cement quantities in multiple passes between tilling passes, which requires intermediate compaction.

The contractor should be responsible for selecting the means and methods to construct the amended soil without disturbing exposed subgrades. We recommend low ground-pressure (such as balloon-tired) cement spreading equipment be required. We have observed other methods used for spreading that have resulted in significant site disturbance and high remedial costs. For example, we have observed amendment efforts using a spreader truck equipped with road tires pulled by track-mounted equipment that resulted in significant disturbance to the work area and required re-working large areas of cement-amended product at additional expense.

Some areas of the site, notably in the vicinity of test pits TP-3 and TP-8 appear to have higher clay contents, which typically results in higher cement volumes than in areas of predominantly silt and will likely require

multiple tilling and cement spreading passes, as well as higher cement volumes in order to achieve target soil strengths and required levels of compaction.

Areas of standing water, or areas where traffic patterns are concentrated and disturbing the subgrade, will also create a need for higher amounts of cement to be applied and additional tilling for better mixing and cement hydration prior to final compaction.

Successful use of soil amendment depends on the use of correct mixing techniques, the soil moisture content at the time of amendment and amendment quantities. Specific recommendations, based on exposed site conditions for soil amending, can be provided if necessary. However, for preliminary planning purposes, it may be assumed that a minimum of 5 percent cement (by dry weight, assuming a unit weight of 100 pounds per cubic foot [pcf]) will be sufficient for improving on-site soils. Treatment depths of 12 to 16 inches are typical (assuming a seven-day unconfined compressive strength of at least 80 pounds per square inch [psi]), although they may be adjusted in the field depending on site conditions. Soil amending should be conducted in accordance with the specifications provided in Oregon Structural Specialty Code (OSSC) 00344 (Treated Subgrade).

We recommend a target strength for cement-amended soils of 80 psi. The amount of cement used to achieve this target generally varies with moisture content and soil type. It is difficult to predict field performance of soil-to-cement amendment due to variability in soil response and we recommend laboratory testing to confirm expectations. However, for preliminary design purposes, 4 to 5 percent cement by weight of dry soil can generally be used when the soil moisture content does not exceed approximately 20 percent. If the soil moisture content is in the range of 20 to 35 percent, 5 to 7 percent by weight of dry soil is recommended. The amount of cement added to the soil should be adjusted based on field observations and performance.

PCC-amended soil is hard and has low permeability; therefore, this soil does not drain well nor is it suitable for planting. Future landscape areas should not be cement amended, if practical, or accommodations should be planned for drainage and planting. Cement amendment should not be used if runoff during construction cannot be directed away from adjacent low-lying wet areas and active waterways and drainage paths.

When used for constructing pavement, staging, or haul road subgrades, the amended surface should be protected from abrasion by placing a minimum 4-inch thickness of base rock material (Aggregate Base/Aggregate Subbase). To prevent strength loss during curing, cement-amended soil should be allowed to cure for a minimum of four days prior to placing the base rock. The base rock typically becomes contaminated with soil during construction. Contaminated base rock should be removed and replaced with clean base rock in pavement areas to meet the required thickness(es) in the “Pavement Recommendations” section to this report.

It is not possible to amend soil during heavy or continuous rainfall. Work should be completed during suitable weather conditions.

Separation Geotextile Fabric

A separation geotextile fabric should be placed as a barrier between the subgrade and granular fill materials in staging areas, haul road areas and in areas of repeated construction traffic. The geotextile should have

a minimum Mullen burst strength of 250 psi for puncture resistance and an apparent opening size (AOS) between U.S. Standard No. 70 and No. 100 sieves.

Erosion Control

Erosion control measures should be implemented in accordance with the City of Newberg's "Erosion and Sediment Control Manual."

Excavation

Based on the materials encountered in our subsurface exploration, it is our opinion that conventional earthmoving equipment in proper working condition should be capable of making necessary general excavations.

The earthwork contractor should be responsible for reviewing this report, including the boring logs, providing their own assessments and providing equipment and methods needed to excavate the site soils while protecting subgrades.

Dewatering

As discussed in the "Groundwater" section of this report, groundwater was not encountered in our explorations, and we do not expect groundwater to be a major factor during shallow excavations and earthwork. Excavations that extend into saturated/wet soils, or excavations that extend into perched groundwater, should be dewatered. Sump pumps are expected to adequately address groundwater encountered in shallow excavations. In addition to groundwater seepage, surface water inflow to the excavations during the wet season can be problematic. Provisions for surface water control during earthwork and excavations should be included in the project plans and should be installed prior to commencing earthwork.

Permanent Slopes

Permanent cut and fill slopes, where incorporated into the grading plan, should not exceed 2H:1V. The slopes should be planted with appropriate vegetation to provide protection against erosion as soon as possible after grading. Buildings, access roads and pavements should be located at least 10 feet from the top of new fill slopes or existing slopes. Placement of fill near the top of the existing slope should be limited to 2 feet or less in thickness. If the grading plan requires additional fill, we should be contacted to evaluate the impact of the additional loading on the slope. Surface water runoff should be collected and directed away from slopes to prevent water from running down the face of the slope.

Trench Cuts and Trench Shoring

All trench excavations should be made in accordance with applicable Occupational Safety and Health Administration (OSHA) and state regulations. In our opinion, native soils are generally OSHA Type B. Temporary excavations deeper than 4 feet should be shored or laid back at an inclination of 1H:1V or flatter if workers are required to enter. Excavations made to construct footings or other structural elements should be laid back or shored at the surface as necessary to prevent soil from falling into excavations.

It should be expected that unsupported cut slopes will experience some sloughing and raveling if exposed to water. Plastic sheeting, placed over the exposed slope and directing water away from the slope, will reduce the potential for sloughing and erosion of cut slopes during wet weather.

The contractor is responsible for shoring methods and shoring system design. Shoring systems should be designed by a professional engineer before installation.

In our opinion, the contractor will be in the best position to observe subsurface conditions continuously throughout the construction process and to respond to the soil and groundwater conditions. Construction site safety is generally the sole responsibility of the contractor, who also is solely responsible for the means, methods, and sequencing of the construction operations and choices regarding excavations and shoring.

Under no circumstances should the information provided by GeoEngineers be interpreted to mean that GeoEngineers is assuming responsibility for construction site safety or the contractor's activities; such responsibility is not being implied and should not be inferred.

Fill Materials

General

Structural areas include areas beneath foundations, floor slabs, pavements, and any other areas intended to support structures or within the influence zone of structures. Fill intended for use in structural areas should meet the criteria for structural fill presented below. All structural fill soils should be free of debris, clay balls, roots, organic matter, frozen soil, man-made contaminants, particles with greatest dimension exceeding 4 inches (3-inch-maximum particle size in building footprints) and other deleterious materials.

The suitability of soil for use as structural fill will depend on the gradation and moisture content of the soil. As the amount of fines in the soil matrix increases, the soil becomes increasingly more sensitive to small changes in moisture content and achieving the required degree of compaction becomes more difficult or impossible. Recommendations for suitable fill material are provided in the following sections.

On-Site Soils

The on-site soil is generally suitable for use as structural fill if it meets the requirements set forth in OSSC 00330.12 (Borrow Material). However, it will be very difficult to achieve adequate compaction during periods of wet weather or when the moisture content is above optimum. Accordingly, extended dry weather will be required to adequately condition and place the soils as structural fill.

The site soil is very sensitive to small changes in moisture content and highly susceptible to disturbance when wet. Use of the on-site soils as structural fill will be very difficult or may not be possible during wet weather (see the "Subgrade Protection and Wet Weather Considerations" section of this report).

The properly prepared and compacted on-site soils in the tilled zone qualify as structural fill provided they meet the recommendations in the "Subgrade Improvement for the Tilled Zone" section of this report.

Imported Select Structural Fill

Imported Select Structural Fill may be used as structural fill and should consist of pit or quarry run rock, crushed rock, or crushed gravel and sand that is fairly well-graded between coarse and fine sizes (approximately 25 to 65 percent passing the U.S. No. 4 sieve). It should have less than 5 percent passing the U.S. No. 200 sieve and have a minimum of 75 percent fractured particles according to American Association of State Highway and Transportation Officials (AASHTO) TP-61.

Aggregate Base

Aggregate Base material located under floor slabs and pavements, crushed rock used in footing overexcavations and retaining wall backfill should consist of imported clean, durable, crushed angular rock. Such rock should be well-graded, have a maximum particle size of 1 inch, have less than 5 percent passing the U.S. No. 200 sieve (3 percent for retaining walls) and meet the gradation requirements in Table 1. The gradations shown in Table 1 meet the requirements of ODOT Standard Section 02630. In addition, Aggregate Base shall have a minimum of 75 percent fractured particles according to AASHTO TP-61 and a sand equivalent of not less than 30 percent based on AASHTO T-176.

TABLE 1. RECOMMENDED GRADATION FOR AGGREGATE BASE

Sieve size	Percent Passing (by weight)
1 inch	100
½ inch	50 to 65
No. 4	40 to 60
No. 40	5 to 15
No. 200	0 to 5

Aggregate Subbase

Aggregate Subbase material should consist of imported, clean, durable, crushed angular rock. Such rock should be well-graded, have a maximum particle size of 1½ inch, have less than 5 percent passing the U.S. No. 200 sieve and meet the gradation requirements in ODOT Standard Section 00331. In addition, Aggregate Base shall have a minimum of 75 percent fractured particles according to AASHTO TP-61 and a sand equivalent of not less than 30 percent based on AASHTO T-176.

Trench Backfill

Backfill for pipe bedding and in the pipe zone should consist of well-graded granular material with a maximum particle size of ¾ inch and less than 5 percent passing the U.S. No. 200 sieve. The material should be free of organic matter and other deleterious materials. Further, the backfill should meet the pipe manufacturer's recommendations. Above the pipe zone backfill, Imported Select Structural Fill may be used as described above.

Fill Placement and Compaction

Structural fill should be compacted at moisture contents that are within 3 percent of the optimum moisture content as determined by ASTM Test Method D 1557 (Modified Proctor). The optimum moisture content varies with gradation and should be evaluated during construction. Fill material that is not near the optimum moisture content should be moisture conditioned prior to compaction.

Fill and backfill material should be placed in uniform, horizontal lifts and compacted with appropriate equipment. The appropriate lift thickness will vary depending on the material and compaction equipment used. Fill material should be compacted in accordance with Table 2. It is the contractor's responsibility to

select appropriate compaction equipment and place the material in lifts that are thin enough to meet these criteria. However, in no case should the loose lift thickness exceed 18 inches.

TABLE 2. COMPACTION CRITERIA

Fill Type	Compaction Requirements		
	Percent Maximum Dry Density Determined by ASTM Test Method D 1557 at ± 3% of Optimum Moisture		
	0 to 2 Feet Below Subgrade	> 2 Feet Below Subgrade	Pipe Zone
Fine-grained soils (non-expansive)	92	92	-----
Imported Granular, maximum particle size < 1¼ inch	95	95	-----
Imported Granular, maximum particle size 1¼ inch to 6 inches (3-inch-maximum under building footprints)	n/a (proof-roll)	n/a (proof-roll)	-----
Retaining Wall Backfill*	92	92	-----
Nonstructural Zones	90	90	90
Trench Backfill	95	90	90

Note:

* Measures should be taken to prevent overcompaction of the backfill behind retaining walls. We recommend placing the zone of backfill located within 5 feet of the wall in lifts not exceeding about 6 inches in loose thickness and compacting this zone with hand-operated equipment such as a vibrating plate compactor or a jumping jack.

A representative from GeoEngineers should evaluate compaction of each lift of fill. Compaction should be evaluated by compaction testing unless other methods are proposed for oversized materials and are approved by GeoEngineers during construction. These other methods typically involve procedural placement and compaction specifications together with verification requirements such as proof-rolling.

INFILTRATION TESTING

As requested, we conducted infiltration testing to assist in evaluating the site for design for stormwater infiltration. We conducted infiltration testing in general accordance with the City of Portland Stormwater Design Manual (2014 version) at depths between 2 and 3 feet bgs, marked as IT-1 and IT-2 in Figure 2. Testing was conducted using the encased falling head and open pit infiltration testing procedures.

Testing Methods and Results

For the encased falling head testing a 6-inch-layer of pea gravel was placed in the pipe prior to adding water to diminish disturbance from water flowing at the base of the pipe interior. The test area was pre-soaked over a 4-hour period by adding water into the pipe when necessary. A good seal was present between the base of the pipe and the underlying soil, in our opinion.

For the open pit infiltration testing, test pits were 2 feet wide and 2 to 3 feet long with a testing depth of 1 foot. Approximately 2 inches of clean rock was placed in the bottom of the test locations to help minimize disturbance of the fine-grained materials in the excavation while adding water. Between 12 and 14 inches of water was added to the test pits for a period of 4 hours to saturate the underlying soils.

After the saturation period, the test locations were filled with clean water to at least 1 foot above the bottom of the pipe or excavation. The drop-in water level was measured over a period of 1 hour after the soak period. In the case where the water level falls during the time-measured testing, infiltration rates diminish as a result of less head from the water column in the test. In this test, we observed zero to negligible drops in the water level during the testing period. The field test results are summarized in Table 3.

TABLE 3. INFILTRATION RESULTS

Infiltration Test No.	Test Method	Depth (feet)	USCS Material Type	Field Measured Infiltration Rate[1] (inches/hour)
IT-1	Open Pit	2	ML	0.1
IT-2	Encased Falling Head	3	ML	0.0

Notes:

[1] Appropriate factors should be applied to the field-measured infiltration rate, based on the design methodology and specific system used.

USCS = Unified Soil Classification System

Based on the test results, we do not recommend on-site stormwater disposal unless additional testing is performed and yields higher infiltration rates in other areas of the site, or at different elevations.

The infiltration rates shown in Table 3 are field-measured infiltration rates. These represent a relatively short-term measured rate taken after the required saturation period, and factors of safety have not been applied for the type of infiltration system being considered, or for variability that may be present in the on-site soil. In our opinion, and consistent with the state of the practice, correction factors should be applied to this measured rate to reflect the small area of testing and the number of tests conducted.

During infiltration testing, we observed negligible infiltration rates (effectively zero). If other textural-based infiltration rates (even if they are very low infiltration rates) are used for design, appropriate correction factors should also be applied by the project civil engineer to account for long-term infiltration parameters. From a geotechnical perspective, we recommend a factor of safety (correction factor) of at least 3 be applied to the infiltration values derived from field observations to account for potential soil variability with depth and location within the area tested. In addition, the stormwater system design engineer should determine and apply appropriate remaining correction factor values, or factors of safety, to account for repeated wetting and drying that occur in this area, degree of in-system filtration, frequency and type of system maintenance, vegetation, potential for siltation and bio-fouling, etc., as well as system design correction factors for overflow or redundancy and base and facility size.

The actual depths, lateral extent and estimated infiltration rates can vary from the values presented above. Field testing/confirmation during construction is often required in large or long systems or other situations where soil conditions may vary within the area where the system is constructed. The results of this field testing might necessitate that the infiltration locations be modified to achieve the design infiltration rate.

Also, infiltration flow rate of a focused stormwater system typically diminishes over time as suspended solids and precipitates in the stormwater further clog the void spaces between the soil particles or cake on the infiltration surface. The serviceable life of an infiltration media in a stormwater system can be extended by pre-filtering or with on-going accessible maintenance. Eventually, most systems will fail and will need to be replaced or have media regenerated or replaced. We recommend that infiltration systems include an overflow that is connected to a suitable discharge point. Also, infiltration systems can cause localized high groundwater levels and should not be located near basement walls, retaining walls, or other embedded structures unless these are specifically designed to account for the resulting hydrostatic pressure. Infiltration locations should not be located on sloping ground, unless it is approved by a geotechnical engineer, and should not be infiltrated at a location that allows for flow to travel laterally toward a slope face, such as a mounded water condition or too close to a slope face.

Suitability of Infiltration System

Successful design and implementation of stormwater infiltration systems and whether a system is suitable for a development depend on several site-specific factors. Stormwater infiltration systems are generally best suited for sites having sandy or gravelly soil with saturated hydraulic conductivities greater than 2 inches per hour. Sites with silty or clayey soil such as encountered at this site, are generally not well-suited for stormwater infiltration. Soils that have fine-grained matrices are susceptible to volumetric change and softening during wetting and drying cycles. Fine-grained soils also have large variations in the magnitude of infiltration rates because of bedding and stratification that occurs during alluvial deposition, and often have thin layers of less permeable or impermeable soil within a larger layer.

Based on the fine-grained soil conditions and very low to negligible measured infiltration rates, we recommend infiltration of stormwater not be used as the sole method of stormwater management at this site unless those design factors can be otherwise accounted for.

PAVEMENT RECOMMENDATIONS

Our pavement recommendations are based on the results of our field testing and analysis. The Hwy 99W pavement analysis and recommendations were developed in general accordance with the ODOT Pavement Design Guide.

The recommended pavement sections assume that final improvements surrounding the pavement will be designed and constructed such that stormwater or excess irrigation water from landscape areas does not infiltrate below the pavement section into the base rock materials.

Dynamic Cone Penetrometer (DCP) Field Testing and Resilient Modulus (M_R)

We conducted four DCP tests onsite near the proposed locations of the new roadway and four DCP tests in the north shoulder of Hwy 99W for widening the road. The tests were conducted in general accordance with ASTM D 6951 to estimate the subgrade support value, M_R. At each test location, we recorded penetration depths of the cone versus hammer blow counts. The DCP tests were terminated at depths between 3 and 5 feet bgs. The resilient modulus was estimated in general accordance with the ODOT Pavement Design Guide using a conversion coefficient, C_f, of 0.35.

Table 4 lists the estimated subgrade resilient modulus at each test location based on data obtained in the upper 18 inches below the proposed pavement section. Field DCP data are summarized in Figures A-37 through A-44.

TABLE 4. ESTIMATED SUBGRADE RESILIENT MODULI BASED ON DCP TESTING

Boring Number	Estimated Resilient Modulus (psi)
HA-1	4,800
HA-2	3,900
HA-3	5,000
HA-5	4,500
B-2	4,600
B-4	4,800
B-6	5,200
B-8	5,000

On-Site Local Roads

Pavement subgrades should be prepared in accordance with the "Earthwork Recommendations" section of this report. Our pavement recommendations at the site are based on estimated average daily traffic provided by the project traffic engineer. We have based our design analysis for truck traffic percentages from a nearby traffic count on Hwy 99W provided by ODOT.

Our pavement recommendations are based on the following assumptions and design parameters included in the ODOT Pavement Design Guide:

- The pavement subgrades, fill subgrades and site earthwork used to establish road grades below the Aggregate Subbase and Aggregate Base materials have been prepared as described in the "Earthwork Recommendations" section of this report.
- A resilient modulus of 20,000 psi has been estimated for compacted Aggregate Subbase and Aggregate Base materials.
- A resilient modulus of 4,200 psi was estimated for firm native soils below the tilled zone or structural fill placed on firm native soils below the tilled zone.
- Initial and terminal serviceability indices of 4.2 and 2.0, respectively.
- Reliability and standard deviations of 75 percent and 0.49, respectively.
- Structural coefficients of 0.42 and 0.10 for the asphalt and base rock, respectively.
- A 20-year design life.
- Estimated traffic levels based on annul average daily traffic (AADT) provided by the project traffic engineer. The design Equivalent Single Axle Loads (ESAL) calculated from the AADT are 1,190,805 from

Hwy 99W to the roundabout and 1,069,585 for the remaining on-site roads, for a 20-year design life, 2 percent growth and single-lane, one-way traffic.

- Estimated combined truck percentage of 5.4 percent is based on nearby ODOT traffic counts on Hwy 99W.

If any of the noted assumptions vary from project design use, our office should be contacted with the appropriate information so that the pavement designs can be revised or confirmed adequate.

The recommended minimum pavement sections are provided in Table 5. Pavement recommendations for "On-Site Local Roads" are for roadways within the development.

The alternate pavement section using Aggregate Subbase material is provided because it may be more applicable during wet-weather construction where a gravel haul road or working surface is needed to support construction traffic. Wet weather construction recommendations are provided in the "Earthworks Recommendations" section of this report. The sub-base material can be incorporated into the gravel working blankets and haul roads provided the material meets the minimum thickness in Table 5 and meets the specifications for Aggregate Subbase. Working blanket and haul road materials that pump excessively, or have excessive fines from construction traffic, should be removed and replaced with specified materials prior to constructing roadways over those areas.

If cement amendment is used during site development, as described in the "Earthwork Recommendations" section of this report, it may be possible to reduce the amount of aggregate base for the pavement sections. This will depend on several factors, including the prevailing weather conditions, depth of amendment and condition of the subgrade after amendment. GeoEngineers can provide additional information for on-site pavement sections if cement amendment will be used during construction.

TABLE 5. MINIMUM PAVEMENT SECTIONS FOR ON-SITE ROADS

Road Section	Minimum Asphalt Thickness (inches)	Minimum Aggregate Base Thickness (inches)	Minimum Aggregate Sub-Base Thickness (inches)
On-site Local Road between Hwy 99W and Roundabout	6.0	17.5	0.0
	6.0	8.0	12.0
Other On-site Local Roads	6.0	15.5	0.0
	6.0	6.0	12.0

The aggregate base course should conform to the "Aggregate Base" section of this report and be compacted to at least 95 percent of the maximum dry density (MDD) determined in accordance with AASHTO T-180/ASTM Test Method D 1557.

The AC pavement should conform to Section 00745 of the most current edition of the ODOT Standard Specifications for Highway Construction. The Job Mix Formula should meet the requirements for a ½-inch Dense Graded Level 2 Mix. The AC should be PG 64-22 grade meeting the ODOT Standard Specifications for Asphalt Materials. AC pavement should be compacted to 92.0 percent at Maximum Theoretical Unit Weight (Rice Gravity) of AASHTO T-209.

Hwy 99W Widening Pavement

Project development includes widening Hwy 99W to include a turn lane into the development. Widening the roadway will involve raising the current grade to match the existing roadway elevation. Fill placement to raise subgrade elevations and pavement subgrades should be prepared in accordance with the "Earthwork Recommendations" section of this report.

Our pavement recommendations for the right turn lane are based on estimated ADT provided by the traffic engineers. We have based our design analysis for truck traffic percentages from a nearby traffic count on Hwy 99W provided by ODOT.

Our pavement recommendations are based on the following assumptions and design parameters included in the ODOT Pavement Design Guide:

- The pavement subgrades, fill subgrades and site earthwork used to establish road grades below the Aggregate Subbase and Aggregate Base materials have been prepared as described in the "Earthwork Recommendations" section of this report.
- A resilient modulus of 20,000 psi has been estimated for compacted Aggregate Base.
- A resilient modulus of 4,800 psi was estimated for subgrade prepared and compacted as recommended.
- Initial and terminal serviceability indices of 4.2 and 2.5, respectively.
- Reliability and standard deviations of 85 percent and 0.49, respectively.
- Structural coefficients of 0.42 and 0.10 for the asphalt and base rock, respectively.
- A 20-year design life.
- Estimated traffic levels based on estimated AADT from the traffic engineer. Estimated combined truck percentage of 5.4 percent is based on nearby ODOT traffic counts on Hwy 99W. The design ESALs calculated from the AADT are 2,907,533 for a 20-year design life, 3.4 percent growth and single-lane, one-way traffic.
- Truck traffic consists of a range of 2- to 6-axle trucks with the distribution equaling the truck counts at the ODOT traffic counts on Hwy 99W.

Road widening AC pavement recommendations are for the turn lane widening entering the development. The recommended pavement sections are provided in Table 6. If any of the noted assumptions vary from project design use, our office should be contacted with the appropriate information so that the pavement designs can be revised or confirmed adequate.

TABLE 6. MINIMUM PAVEMENT SECTIONS FOR HWY 99W TURN LANE

Minimum Asphalt Thickness (inches)	Minimum Aggregate Base Thickness (inches)	Minimum Aggregate Sub-Base Thickness (inches)
7.0	18.0	0.0
7.0	8.5	12.0

The AC pavement should conform to Section 00745 of the most current edition of the ODOT Standard Specifications for Highway Construction. The Job Mix Formula should meet the requirements for a ½-inch Dense Graded Level 2 Mix. The AC should be PG 70-22 grade meeting the ODOT Standard Specifications for Asphalt Materials. AC pavement should be compacted to 91.0 percent at Maximum Theoretical Unit Weight (Rice Gravity) of AASHTO T-209.

STRUCTURAL DESIGN RECOMMENDATIONS

Foundation Support Recommendations

Proposed commercial and apartment structures can be satisfactorily founded on continuous wall or isolated column footings supported on firm native soils encountered below the tilled zone, or on structural fill placed over firm native soils. Exterior footings should be established at least 18 inches below the lowest adjacent grade. The recommended minimum footing depth is greater than the anticipated frost depth. Interior footings can be founded a minimum of 12 inches below the top of the first-floor slab. Isolated column and continuous wall footings should have minimum widths of 24 and 18 inches, respectively. We have assumed that the column loads will be 40 kips or less, wall loads will be 2 klf or less, and floor loads for slabs on grade will be 100 psf or less for the proposed buildings. If design loads exceed these values, our recommendations may need to be revised.

Foundation Subgrade Preparation

The subgrades beneath proposed structural elements should be prepared as described below and in the "Earthworks Recommendations" section of this report. We recommend loose or disturbed soils resulting from foundation excavation be removed before placing reinforcing steel and concrete. Foundation bearing surfaces should not be exposed to standing water. If water infiltrates and pools in the excavation, the water, along with any disturbed soil, should be removed before placing reinforcing steel and concrete. A thin gravel layer consisting of Aggregate Base or Aggregate Subbase material can be placed at the base of foundation excavations to help protect the subgrade from weather and light foot traffic. The layer thickness for the gravel layer should be determined at the time of construction but is typically 3 to 4 inches. The gravel layer should be compacted as described in the "Fill Placement and Compaction" section.

We recommend GeoEngineers observe all foundation subgrades before placing concrete forms and reinforcing steel to determine that bearing surfaces have been adequately prepared and the soil conditions are consistent with those observed during our explorations.

Bearing Capacity – Spread Footings

We recommend conventional footings be proportioned using a maximum allowable bearing pressure of 2,500 psf if supported on firm native soils below the tilled zone, or on structural fill placed over firm native soils. This bearing pressure applies to the total of dead and long-term live loads and may be increased by one-third when considering earthquake or wind loads. This is a net bearing pressure. The weight of the footing and overlying backfill can be ignored in calculating footing sizes.

Foundation Settlement

Foundations designed and constructed as recommended are expected to experience settlements of less than 1 inch. Differential settlements of up to one half of the total settlement magnitude can be expected between adjacent footings supporting comparable loads.

Lateral Resistance

The ability of the soil to resist lateral loads is a function of frictional resistance, which can develop on the base of footings and slabs, and the passive resistance, which can develop on the face of below-grade elements of the structure as these elements tend to move into the soil. For footings and floor slabs founded in accordance with the recommendations presented above, the allowable frictional resistance may be computed using a coefficient of friction of 0.30 applied to vertical dead-load forces. Our analysis indicates that the available passive earth pressure for footings confined by on-site soil and structural fill is 350 pcf, modeled as an equivalent fluid pressure. Typically, the movement required to develop the available passive resistance may be relatively large; therefore, we recommend using a reduced passive pressure of 250 pcf equivalent fluid pressure. In addition, in order to rely on passive resistance, a minimum of 10 feet of horizontal clearance must exist between the face of the footings and adjacent downslopes.

The passive earth pressure and friction components may be combined provided that the passive component does not exceed two-thirds of the total. The passive earth pressure value is based on the assumptions that the adjacent grade is level and that groundwater remains below the base of the footing throughout the year. The top foot of soil should be neglected when calculating passive lateral earth pressures unless the foundation area is covered with pavement or slab-on-grade. The lateral resistance values include a safety factor of approximately 1.5.

Drainage Considerations

We recommend the ground surface be sloped away from the buildings at least 2 percent. All downspouts should be tightlined away from the building foundation areas and should be discharged into a stormwater system. Downspouts should not be connected to footing drains.

Although not required based on groundwater depths observed in our explorations, if perimeter footing drains are used for below-grade structural elements or walls or to capture perched groundwater resulting from downslope cuts, they should be installed at the base of the exterior footings. The perimeter footing drains should be provided with cleanouts and should consist of at least 4-inch-diameter perforated pipe placed on a 3-inch bed of, and surrounded by, 6 inches of granular drainage material. Aggregate Base can be used for the granular pipe bedding and drainage materials provided the material has less than 3 percent passing the U.S. No. 200 sieve. The drainage material should be enclosed in a non-woven geotextile such as Mirafi 140N (or approved alternate) to prevent fine soil from migrating into the drain material. We recommend against using flexible tubing for footing drainpipes. The perimeter drains should be sloped to drain by gravity to a suitable discharge, preferably a storm drain. We recommend that the cleanouts be covered and placed in flush-mounted utility boxes. Water collected in roof downspout lines must not be routed to the footing drain lines.

Floor Slabs

Satisfactory subgrade support for floor slabs on grade supporting the planned 100 psf floor loads can be obtained provided the floor slab subgrade is described in the “Earthworks Recommendations” section of

this report. Slabs should be reinforced according to their proposed use and per the structural engineer's recommendations. Subgrade support for concrete slabs can be obtained from the firm native soils underlying the tilled zone or on structural fill placed over firm native soils.

We recommend that on-grade slabs be underlain by a minimum 6-inch-thickness of Aggregate Base acting as a capillary break material to reduce the potential for moisture migration into the slab. The capillary break material should be placed as recommended in the "Fill Placement and Compaction" section of this report.

If dry on-grade slabs are required, for example at interior spaces where adhesives are used to anchor carpet or tile to the slab, a waterproof liner may be placed as a vapor barrier below the slab. The vapor barrier should be selected by the structural engineer and should be accounted for in the design floor section and mix design selection for the concrete, to accommodate the effect of the vapor barrier on concrete slab curing. Load-bearing concrete slabs should be designed assuming a modulus of subgrade reaction (k) of 150 psi per inch. We estimate that concrete slabs constructed as recommended will settle less than ½ inch. Floor slab subgrades should be evaluated according to the "Subgrade Evaluation" section of this report.

Conventional Retaining Walls

Drainage

Positive drainage is imperative behind retaining structures. This can be accomplished by providing a drainage zone behind the wall consisting of free-draining material and perforated pipes to collect and dispose the water. The drainage material should consist of Aggregate Base having less than 3 percent passing the U.S. No. 200 sieve. The wall drainage zone should extend horizontally at least 18 inches from the back of the wall.

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

Design Parameters

The pressures presented assume that backfill placed within 2 feet of the wall is compacted by hand-operated equipment to a density of 90 percent of the MDD and that wall drainage measures are included as previously recommended. For walls constructed as described above, we recommend using an active lateral earth pressure corresponding to an equivalent fluid density of 35 pcf for the level backfill condition. For walls with backfill sloping upward behind the wall at 2H:1V, an equivalent fluid density of 55 pcf should be used. This assumes that the tops of the walls are not structurally restrained and are free to rotate. For the at-rest condition (walls restrained from movement at the top) an equivalent fluid density of 55 pcf should be used for design. For seismic conditions, we recommend a uniform lateral pressure of 4H (where H is the height of the wall) psf be added to these lateral pressures. If the retaining system is designed as a braced system but is expected to yield a small amount during a seismic event, an active earth pressure condition may be assumed and combined with the uniform seismic surcharge pressure.

The recommended pressures do not include the effects of surcharges from surface loads. If vehicles will be operated within one-half the height of the wall, a traffic surcharge should be added to the wall pressure. The traffic surcharge can be approximated by the equivalent weight of an additional 2 feet of backfill behind the wall. Additional surcharge loading conditions should also be considered on a case-by-case basis.

Retaining walls founded on native soil, or structural fill extending to these materials, may be designed using the allowable soil bearing values and lateral resistance values presented above in the "Shallow Foundations" section of this report. We estimate settlement of retaining structures will be similar to the values previously presented for building foundations.

Seismic Design

We recommend seismic design be performed using the procedure outlined in the 2012/2015 IBC and the 2014 OSSC. The parameters provided in Table 7 are based on the conditions encountered during our subsurface exploration program and should be used in preparation of response spectra for the proposed structures.

TABLE 7. SEISMIC DESIGN PARAMETERS

Parameter	Value
Site Class	D
Spectral Response Acceleration, S_s	0.95 g
Spectral Response Acceleration, S_1	0.43 g
Site Coefficient, F_a	1.12
Site Coefficient, F_v	1.57
Spectral Response Acceleration (Short Period), S_{DS}	0.71 g
Spectral Response Acceleration (1-Second Period) S_{D1}	0.45 g

Liquefaction Potential

Liquefaction is a phenomenon caused by a rapid increase in pore water pressure that reduces the effective stress between soil particles to near zero. The excessive buildup of pore water pressure results in the sudden loss of shear strength in a soil. Granular soil, which relies on interparticle friction for strength, is susceptible to liquefaction until the excess pore pressures can dissipate. Sand boils and flows observed at the ground surface after an earthquake are the result of excess pore pressures dissipating upwards, carrying soil particles with the draining water. In general, loose, saturated sand soil with low silt and clay contents is the most susceptible to liquefaction. Low plasticity, silty sand may be moderately susceptible to liquefaction under relatively higher levels of ground shaking.

Based on our analysis, the site soils are not prone to liquefaction during the design level earthquake. Accordingly, lateral spreading or liquefaction induced deformations are not expected.

DESIGN REVIEW AND CONSTRUCTION SERVICES

Recommendations provided in this report are based on the assumptions and preliminary design information stated herein. We welcome the opportunity to review and discuss construction plans and specifications for this project as they are being developed. In addition, GeoEngineers should be retained to review the geotechnical-related portions of the plans and specifications to evaluate whether they are in conformance with the recommendations provided in this report.

Satisfactory foundation and earthwork performance depends to a large degree on quality of construction. Sufficient monitoring of the contractor's activities is a key part of determining that the work is completed in accordance with the construction drawings and specifications. Subsurface conditions observed during construction should be compared with those encountered during the subsurface explorations. Recognition of changed conditions often requires experience; therefore, qualified personnel should visit the site with sufficient frequency to detect whether subsurface conditions change significantly from those anticipated.

We recommend that GeoEngineers be retained to observe construction at the site to confirm that subsurface conditions are consistent with the site explorations, and to confirm that the intent of project plans and specifications relating to earthwork, pavement and foundation construction are being met.

LIMITATIONS

We have prepared this report for the exclusive use of 3J Consulting, Inc., J.T. Smith Companies and their authorized agents and/or regulatory agencies for the proposed Crestview Crossing Development at located north of Hwy 99W between Vittoria Way and North Harmony Way in Newberg, Oregon.

This report is not intended for use by others and the information contained herein is not applicable to other sites. No other party may rely on the product of our services unless we agree in advance and in writing to such reliance.

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

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

REFERENCES

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Madin, I. P. 1990. Earthquake Hazard Geology Maps of the Portland Metropolitan Area, Oregon: Test and Map Explanation, DOGAMI Open File Report 0-90-2.

Occupational Safety and Health Administration (OSHA) Technical Manual Section V: Chapter 2, Excavations: Hazard Recognition in Trenching and Shoring: http://www.osha.gov/dts/osta/otm/otm_v/otm_v_2.html.

Oregon Department of Geology and Mineral Industries. SLIDO: Statewide Landslide Information Layer for Oregon: accessed online at https://gis.dogami.oregon.gov/slido/, October 18, 2017 at 11:05 a.m.

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FIGURES

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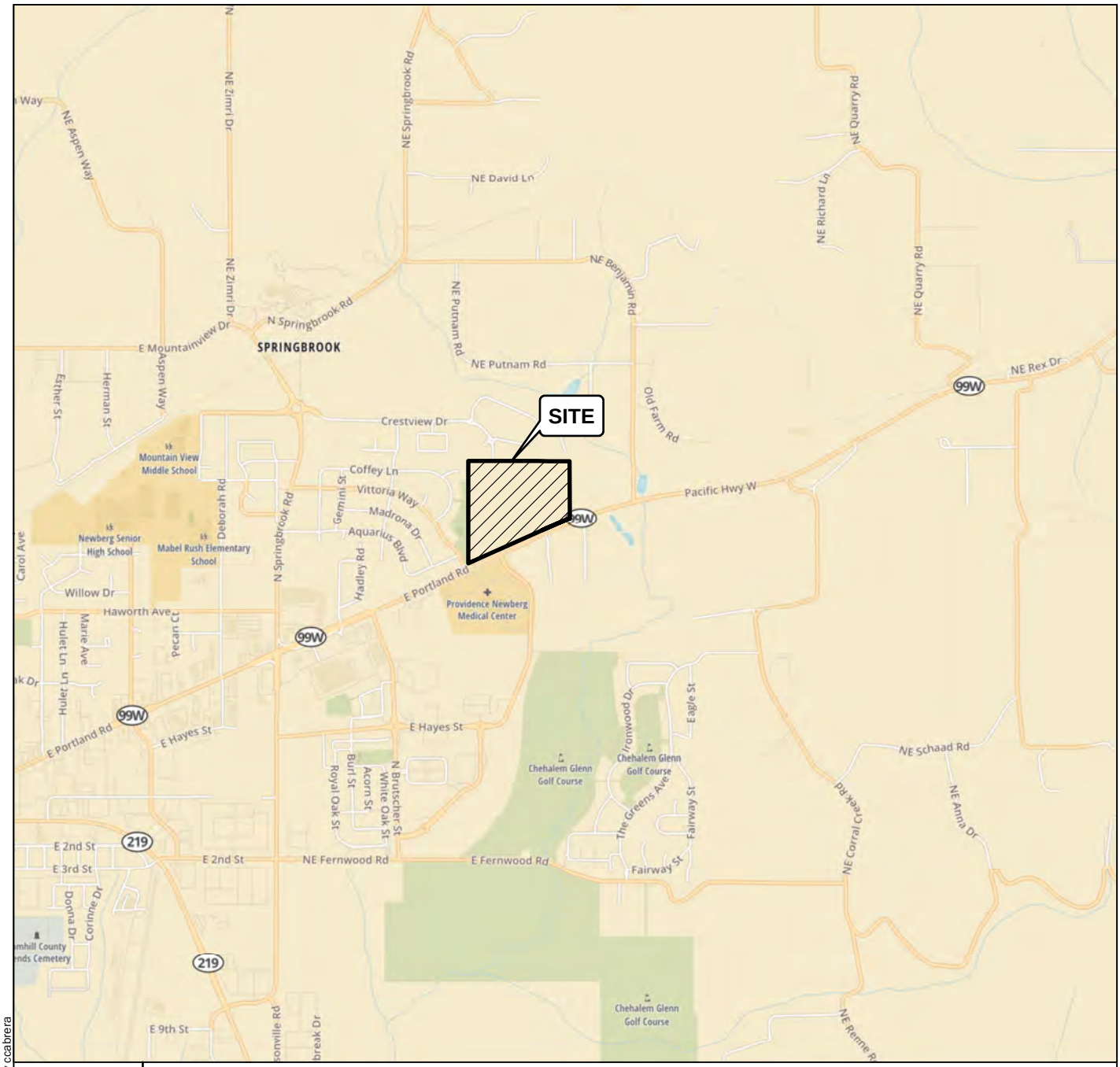
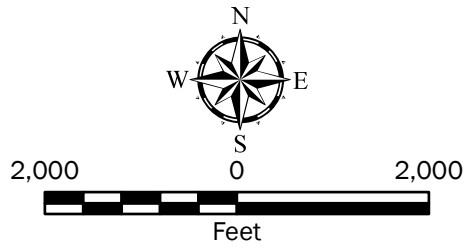




Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Mapbox Open Street Map, 2017

Projection: NAD 1983 UTM Zone 10N

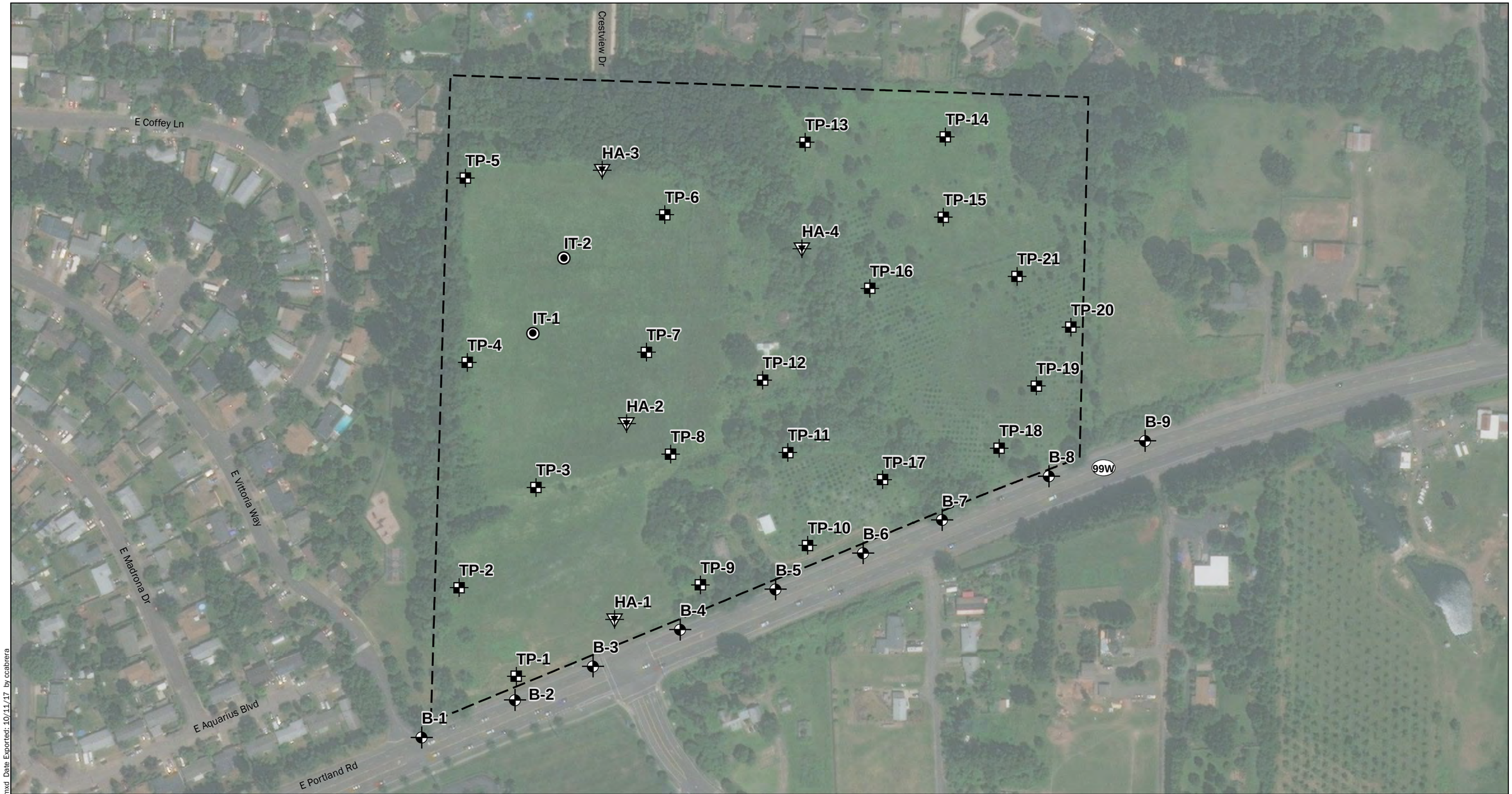
Vicinity Map

Crestview Crossing
Newberg, Oregon

GeoEngineers

Figure 1

P:\6\6748002\GIS\MXD\6748002200_F01_VM.mxd Date Exported: 09/29/17 by ccabrera



Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Aerial from ESRI ArcGIS Online.
Base image from 3J Consulting, August 8, 2017.

Projection: NAD 1983 HARN StatePlane Oregon North FIPS 3601 IntlFeet

Legend

- B-1 — Boring Number and Approximate Location
- HA-1 — Hand Auger Number and Approximate Location
- IT-1 — Infiltration Test Number and Approximate Location
- TP-1 — Test Pit Number and Approximate Location
- Project Approximate Extents

N W E S

200 0 200

Feet

Site Plan

Crestview Crossing
Newberg, Oregon

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Figure 2

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APPENDICES

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APPENDIX A
Field Explorations and Laboratory Testing

APPENDIX A
FIELD EXPLORATIONS AND LABORATORY TESTING

Field Explorations

Soil and groundwater conditions at the proposed Crestview Crossing Development locations were explored on August 20, 21 and 26, 2017, by completing nine borings (B-1 through B-9), twenty-one test pits (TP-1 through TP-21), four hand augers (HA-1 through HA-4), two infiltration tests (IT-1 and IT-2) and eight DCP soundings. Boring depths extended between 4 and 6½ feet bgs, test pits were extended to depths between 8 and 12 feet bgs, hand augers were extended to depth between 3 and 4½ feet bgs, and DCP soundings were extended to depths between 3 and 4 feet bgs at the approximate locations shown in Figure 2.

The borings were advanced using solid stem drilling techniques using a trailer-mounted drill rig owned and operated by Dan Fischer Excavating of Banks, Oregon. Test pits were excavated using a mini-excavator owned and operated by K&E Excavating out of Salem, Oregon.

The drilling was continuously monitored by a staff engineer from our office who maintained a detailed log of subsurface explorations, visually classified the soil encountered and obtained representative soil samples from the borings. Representative soil samples were obtained from each boring at approximate 2½- to 5-foot-depth intervals using a standard split spoon sampler. The samplers were driven into the soil using an automatic 140-pound hammer, free-falling 30 inches on each blow. The number of blows required to drive the sampler each of three, 6-inch increments of penetration were recorded in the field. The sum of the blow counts for the last two, 6-inch increments of penetration is reported on the boring logs as the ASTM D 1556 Standard Penetration Test (SPT) N-value.

The test pit excavations were continuously monitored by an engineer from our office who maintained a detailed log of subsurface explorations, visually classified the soil encountered and obtained representative soil samples from the test pits, from the sidewalls above a depth of 4 feet bgs and from excavation spoil below that depth.

DCP soundings were performed by a staff geotechnical engineer from our office who recorded blow count versus cumulative penetration depth. This penetration resistance data was compared to the nearby borings where a detailed log of subsurface explorations was maintained, the soils encountered were visually classified and representative soil samples from the borings were obtained. The results of the DCP soundings are presented in Figures A-3 through A-10.

Recovered soil samples from exploratory borings were visually classified in the field in general accordance with ASTM D 2488 and the classification chart listed in Key to Exploration Logs, Figure A-1. Logs of the borings are presented in Figures A-2 through A-10. Logs of the test pits are presented in Figures A-11 through A-31. Logs of the hand augers are presented in Figures A-32 through A-35. The logs are based on interpretation of the field and laboratory data and indicate the depth at which subsurface materials or their characteristics change, although these changes might actually be gradual.

Laboratory Testing

Soil samples obtained from the explorations were visually classified in the field and in our laboratory using the USCS and ASTM classification methods. ASTM Test Method D 2488 was used to visually classify the soil samples, while ASTM D 2487 was used to classify the soils based on laboratory tests results. Moisture

content tests were performed in general accordance with ASTM D 2216-05. Atterberg limits test (ASTM 4813) were completed on representative soil samples. Results of the moisture contents testing are presented in the appropriate exploration logs at the respective sample depths and the Atterberg limits results in Figure A-36 in this appendix.

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% RETAINED ON NO. 200 SIEVE	SAND AND SANDY SOILS	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS
				SP	POORLY-GRADED SANDS, GRAVELLY SAND
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS, ROCK FLOUR, CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% PASSING NO. 200 SIEVE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS AND SILTS OF MEDIUM TO HIGH PLASTICITY
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: Multiple symbols are used to indicate borderline or dual soil classifications

ADDITIONAL MATERIAL SYMBOLS

SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
	AC	Asphalt Concrete
	CC	Cement Concrete
	CR	Crushed Rock/ Quarry Spalls
	SOD	Sod/Forest Duff
	TS	Topsoil

Groundwater Contact

Measured groundwater level in exploration, well, or piezometer

Measured free product in well or piezometer

Graphic Log Contact

Distinct contact between soil strata

Approximate contact between soil strata

Material Description Contact

Contact between geologic units

Contact between soil of the same geologic unit

Sampler Symbol Descriptions

2.4-inch I.D. split barrel

Standard Penetration Test (SPT)

Shelby tube

Piston

Direct-Push

Bulk or grab

Continuous Coring

Blowcount is recorded for driven samplers as the number of blows required to advance sampler 12 inches (or distance noted). See exploration log for hammer weight and drop.

"P" indicates sampler pushed using the weight of the drill rig.

"WOH" indicates sampler pushed using the weight of the hammer.

Laboratory / Field Tests

%F	Percent fines
%G	Percent gravel
AL	Atterberg limits
CA	Chemical analysis
CP	Laboratory compaction test
CS	Consolidation test
DD	Dry density
DS	Direct shear
HA	Hydrometer analysis
MC	Moisture content
MD	Moisture content and dry density
Mohs	Mohs hardness scale
OC	Organic content
PM	Permeability or hydraulic conductivity
PI	Plasticity index
PP	Pocket penetrometer
SA	Sieve analysis
TX	Triaxial compression
UC	Unconfined compression
VS	Vane shear

Sheen Classification

NS	No Visible Sheen
SS	Slight Sheen
MS	Moderate Sheen
HS	Heavy Sheen

NOTE: The reader must refer to the discussion in the report text and the logs of explorations for a proper understanding of subsurface conditions. Descriptions on the logs apply only at the specific exploration locations and at the time the explorations were made; they are not warranted to be representative of subsurface conditions at other locations or times.

Key to Exploration Logs

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Figure A-1

Drilled Start 9/21/2017 End 9/21/2017	Total Depth (ft) 6.5	Logged By TAP Checked By TAP	Driller Dan Fischer Excavating, Inc.	Drilling Method Solid-stem Auger	
Surface Elevation (ft) 220 Vertical Datum NAVD88		Hammer Data Rope & Cathead 140 (lbs) / 30 (in) Drop		Drilling Equipment Portable Beaver Drill Trailer Mounted	
Easting (X) 7575194 Northing (Y) 608424		System Datum OR State Plane North NAD83 (feet)		Groundwater not observed at time of exploration	
Notes:					

Elevation (feet)	Depth (feet)	FIELD DATA: Interval Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0						AC	7 inches asphalt			
							GM	11 inches brown silty gravel with sand (fill)			
		18	11		1 MC		ML	Gray silt with sand (stiff, moist)	19		
215	5	18	9		2						

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery, Vertical approximated based on DEM

Log of Boring B-1/C-1

GeoEngineers

Project: Crestview Crossing
Project Location: Newberg, Oregon
Project Number: 6748-002-00

Figure A-2
Sheet 1 of 1

Drilled Start 9/21/2017 End 9/21/2017	Total Depth (ft) 6.5	Logged By TAP Checked By TAP	Driller Dan Fischer Excavating, Inc.	Drilling Method Solid-stem Auger	
Surface Elevation (ft) 218 Vertical Datum NAVD88		Hammer Data Rope & Cathead 140 (lbs) / 30 (in) Drop		Drilling Equipment Portable Beaver Drill Trailer Mounted	
Easting (X) 7575389 Northing (Y) 608503		System Datum OR State Plane North NAD83 (feet)		Groundwater not observed at time of exploration	
Notes:					

Elevation (feet)	Depth (feet)	FIELD DATA: Interval Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0						AC	5½ inches asphalt			
		18	13		1		GM	13 inches silty gravel with sand (fill)			PP = 4 tsf
215							ML	Brown silt with trace sand (stiff, moist)			
	5	18	6		2			Becomes medium stiff			PP = 1.5 tsf

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery, Vertical approximated based on DEM

Log of Boring B-2/C-2

GeoEngineers

Project: Crestview Crossing
Project Location: Newberg, Oregon
Project Number: 6748-002-00

Drilled Start 9/21/2017 End 9/21/2017	Total Depth (ft) 6.5	Logged By TAP Checked By TAP	Driller Dan Fischer Excavating, Inc.	Drilling Method Solid-stem Auger	
Surface Elevation (ft) 211 Vertical Datum NAVD88		Hammer Data Rope & Cathead 140 (lbs) / 30 (in) Drop		Drilling Equipment Portable Beaver Drill Trailer Mounted	
Easting (X) 7575553 Northing (Y) 608574		System Datum OR State Plane North NAD83 (feet)		Groundwater not observed at time of exploration	
Notes:					

Elevation (feet)	Depth (feet)	FIELD DATA: Interval Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0						AC	4½ inches asphalt			
							GM	8½ inches silty fine to coarse gravel with sand (fill)			
210							ML	Brown silt with trace sand (medium stiff, moist)			
		18	7		1 AL				32		AL (LL = 39; PI = 14)
	5	18	5		2						
205											

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery, Vertical approximated based on DEM

Log of Boring B-3/C-3

GeoEngineers

Project: Crestview Crossing
Project Location: Newberg, Oregon
Project Number: 6748-002-00

Figure A-4
Sheet 1 of 1

Drilled Start 9/21/2017 End 9/21/2017	Total Depth (ft) 6.5	Logged By TAP Checked By TAP	Driller Dan Fischer Excavating, Inc.	Drilling Method Solid-stem Auger	
Surface Elevation (ft) 213 Vertical Datum NAVD88		Hammer Data Rope & Cathead 140 (lbs) / 30 (in) Drop		Drilling Equipment Portable Beaver Drill Trailer Mounted	
Easting (X) 7575736 Northing (Y) 608651		System Datum OR State Plane North NAD83 (feet)		Groundwater not observed at time of exploration	
Notes:					

Elevation (feet)	Depth (feet)	FIELD DATA: Interval Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0						AC	3 inches asphalt			
							GM	26 inches silty fine to coarse gravel with sand (fill)			
210		4	7		1		ML	Brown silt (medium stiff, moist)			
	5	18	7		2			Becomes red brown			

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery, Vertical approximated based on DEM

Log of Boring B-4/C-4

GeoEngineers

Project: Crestview Crossing
Project Location: Newberg, Oregon
Project Number: 6748-002-00

Figure A-5
Sheet 1 of 1

Drilled Start 9/21/2017 End 9/21/2017	Total Depth (ft) 6.5	Logged By TAP Checked By TAP	Driller Dan Fischer Excavating, Inc.	Drilling Method Solid-stem Auger	
Surface Elevation (ft) 202 Vertical Datum NAVD88		Hammer Data Rope & Cathead 140 (lbs) / 30 (in) Drop		Drilling Equipment Portable Beaver Drill Trailer Mounted	
Easting (X) 7575936 Northing (Y) 608735		System Datum OR State Plane North NAD83 (feet)		Groundwater not observed at time of exploration	
Notes:					

Elevation (feet)	Depth (feet)	FIELD DATA: Interval Recovered (in)	FIELD DATA: Blows/foot	FIELD DATA: Collected Sample	FIELD DATA: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
200	0						AC	5½ inches asphalt			
							GM	16½ inches silty fine to coarse gravel with sand (fill)			
		18	7		1		ML	Brown silt with trace sand (medium stiff, moist)			PP = 2 tsf
	5		4		MC				33		PP = 1 tsf

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery, Vertical approximated based on DEM

Log of Boring B-5/C-5

GeoEngineers

Project: Crestview Crossing
Project Location: Newberg, Oregon
Project Number: 6748-002-00

Figure A-6
Sheet 1 of 1

Drilled Start 9/21/2017 End 9/21/2017	Total Depth (ft) 6.5	Logged By TAP Checked By TAP	Driller Dan Fischer Excavating, Inc.	Drilling Method Solid-stem Auger	
Surface Elevation (ft) 200 Vertical Datum NAVD88		Hammer Data Rope & Cathead 140 (lbs) / 30 (in) Drop		Drilling Equipment Portable Beaver Drill Trailer Mounted	
Easting (X) 7576120 Northing (Y) 608811		System Datum OR State Plane North NAD83 (feet)		Groundwater not observed at time of exploration	
Notes:					

Elevation (feet)	Depth (feet)	FIELD DATA: Interval Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0						AC	9½ inches asphalt			
							GP	11½ inches brown fine gravel with sand, trace silt (fill)			
		18	8		1		ML	Brown silt with trace sand (medium stiff, moist)			PP = 2.5 tsf
195	5		6		2			Becomes clayey silt			PP 1.25 tsf

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery, Vertical approximated based on DEM

Log of Boring B-6/C-6

GeoEngineers

Project: Crestview Crossing
Project Location: Newberg, Oregon
Project Number: 6748-002-00

Drilled Start 9/21/2017 End 9/21/2017	Total Depth (ft) 4.5	Logged By TAP Checked By TAP	Driller Dan Fischer Excavating, Inc.	Drilling Method Solid-stem Auger	
Surface Elevation (ft) 190 Vertical Datum NAVD88		Hammer Data Rope & Cathead 140 (lbs) / 30 (in) Drop		Drilling Equipment Portable Beaver Drill Trailer Mounted	
Easting (X) 7576285 Northing (Y) 608880		System Datum OR State Plane North NAD83 (feet)		Groundwater not observed at time of exploration	
Notes:					

Elevation (feet)	Depth (feet)	FIELD DATA: Interval Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0						AC	5½ inches asphalt			
							GM	19½ inches silty gravel (fill)			
			20		1 MC		ML	Orange-brown sandy silt, trace organic matter (very stiff, dry)	32		Organic matter are roots and some burnt
								Boring terminated due to refusal			Smooth, hard drilling at 4 feet below ground surface Unable to drill past 4½ feet below ground surface. Attempt to sample 50/2" sample. Water is filling up the hole. Public works notified and observed water and stated that it was not from a utility.

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery, Vertical approximated based on DEM

Log of Boring B-7/C-7

GeoEngineers

Project: Crestview Crossing
Project Location: Newberg, Oregon
Project Number: 6748-002-00

Drilled Start 9/21/2017 End 9/21/2017	Total Depth (ft) 6.5	Logged By TAP Checked By TAP	Driller Dan Fischer Excavating, Inc.	Drilling Method Solid-stem Auger	
Surface Elevation (ft) 184 Vertical Datum NAVD88		Hammer Data Rope & Cathead 140 (lbs) / 30 (in) Drop		Drilling Equipment Portable Beaver Drill Trailer Mounted	
Easting (X) 7576509 Northing (Y) 608972		System Datum OR State Plane North NAD83 (feet)		Groundwater not observed at time of exploration	
Notes:					

Elevation (feet)	Depth (feet)	FIELD DATA: Interval Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0						AC	5½ inches asphalt			
							GM	17 inches silty fine to coarse gravel with sand (fill)			
		18	19		1		ML	Gray brown silt with sand (stiff, moist)			
180							GM	Gray silty fine to coarse gravel with trace sand (medium dense, moist)			
							ML	Gray silt with orange mottling (medium stiff, moist)			
	5		10		2 MC				24		

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery, Vertical approximated based on DEM

Log of Boring B-8/C-8

GeoEngineers

Project: Crestview Crossing
Project Location: Newberg, Oregon
Project Number: 6748-002-00

Figure A-9
Sheet 1 of 1

Drilled Start 9/21/2017 End 9/21/2017	Total Depth (ft) 4	Logged By TAP Checked By TAP	Driller Dan Fischer Excavating, Inc.	Drilling Method Solid-stem Auger	
Surface Elevation (ft) 182 Vertical Datum NAVD88		Hammer Data Rope & Cathead 140 (lbs) / 30 (in) Drop		Drilling Equipment Portable Beaver Drill Trailer Mounted	
Easting (X) 7576711 Northing (Y) 609047		System Datum OR State Plane North NAD83 (feet)		Groundwater not observed at time of exploration	
Notes:					

Elevation (feet)	Depth (feet)	FIELD DATA: Interval Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0						AC	5½ inches asphalt			
							GM	16½ inches brown silty fine to coarse gravel with sand (fill)			
180		18	23		1		ML	Gray brown silt with trace sand (stiff, moist) (fill)			
							GM	Gray silty gravel with sand (medium dense, moist) (fill)			
							AC	Asphalt			
								Boring terminated due to presence of unlocatable utility and encountering asphalt			

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery, Vertical approximated based on DEM

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Log of Boring B-9/C-9

GeoEngineers

Project: Crestview Crossing
Project Location: Newberg, Oregon
Project Number: 6748-002-00

Figure A-10
Sheet 1 of 1

Date Excavated 9/20/2017	Total Depth (ft) 11.5	Logged By DMH Checked By TAP	Excavator Dan Fischer Excavating, Inc. Equipment CAT 305 E Mini-excavator	Groundwater not observed Caving not observed	
Surface Elevation (ft) 218 Vertical Datum NAVD88		Easting (X) 7575392 Northing (Y) 608552		Coordinate System OR State Plane North Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
					OL	Dark brown topsoil with organic matter (topsoil)			
217	1				ML	Light brown silt with trace organic matter (medium stiff, moist) (tilled zone)			
216	2		1 MC		ML	Light brown silt with trace organic matter (stiff, moist) (native)	21		
215	3								
214	4								
213	5					Becomes medium stiff			
212	6								
211	7								
210	8								
209	9								
208	10								
207	11		2						

Test pit completed at 11½ feet below ground surface

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery, Vertical approximated based on DEM

Log of Test Pit TP-1

GeoEngineers

Project: Crestview Crossing
Project Location: Newberg, Oregon
Project Number: 6748-002-00

Figure A-11
Sheet 1 of 1

Date Excavated 9/20/2017	Total Depth (ft) 12	Logged By DMH Checked By TAP	Excavator Dan Fischer Excavating, Inc. Equipment CAT 305 E Mini-excavator	Groundwater not observed Caving not observed
Surface Elevation (ft) 209 Vertical Datum NAVD88		Easting (X) 7575272 Northing (Y) 608739	Coordinate System OR State Plane North Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
					OL	Dark brown topsoil with organic matter (soft, moist) (topsoil)			
208	1				ML	Light brown silt with organic matter (medium stiff, dry to moist) (tilled zone)			
207	2				ML	Light brown silt with organic matter (medium stiff, dry to moist) (native)			
206	3		1						
205	4								
204	5								
203	6								
202	7								
201	8								
200	9								
199	10					Becomes light brown with dark brown mottling			
198	11		2						
197	12		3						

Test pit completed at 12 feet below ground surface

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery, Vertical approximated based on DEM

Log of Test Pit TP-2

GeoEngineers

Project: Crestview Crossing
Project Location: Newberg, Oregon
Project Number: 6748-002-00

Figure A-12
Sheet 1 of 1

Date Excavated 9/21/2017	Total Depth (ft) 9.5	Logged By DMH Checked By TAP	Excavator Dan Fischer Excavating, Inc. Equipment CAT 305 E Mini-excavator	Groundwater not observed Caving not observed	
Surface Elevation (ft) 207 Vertical Datum NAVD88		Easting (X) 7575434 Northing (Y) 608948		Coordinate System OR State Plane North Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
206	1				OL	Dark brown topsoil with organic matter (soft, moist) (topsoil)			
					ML	Gray silt with trace organic matter (stiff, dry) (tilled zone)			
205	2				CL	Dark gray clay with trace organic matter (very stiff, dry to moist) (native)			
204	3		1 MC				24		
203	4								
202	5								
201	6								
200	7								
199	8				ML	Gray brown silt with trace fine sand (stiff, moist)			
198	9		2						

Test pit completed at 9½ feet below ground surface

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery, Vertical approximated based on DEM

Log of Test Pit TP-3

GeoEngineers

Project: Crestview Crossing
Project Location: Newberg, Oregon
Project Number: 6748-002-00

Figure A-13
Sheet 1 of 1

Date Excavated 9/21/2017	Total Depth (ft) 10.5	Logged By DMH Checked By TAP	Excavator Dan Fischer Excavating, Inc. Equipment CAT 305 E Mini-excavator	Groundwater not observed Caving not observed
Surface Elevation (ft) 211 Vertical Datum NAVD88		Easting (X) 7575289 Northing (Y) 609211		Coordinate System OR State Plane North Horizontal Datum NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
210	1				OL	Dark brown topsoil with organic matter (soft, moist) (topsoil)			
					ML	Gray silt with trace organic matter (stiff, dry to moist) (tilled zone)			
209	2				ML	Gray silt with trace organic matter (stiff, dry to moist) (native)			
208	3		1			Becomes brown, moist			
207	4								
206	5								
205	6								
204	7								
203	8								
202	9					Becomes brown with orange mottling, with trace fine sand			
201	10		2						

Test pit completed at 10½ feet below ground surface

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery, Vertical approximated based on DEM

Log of Test Pit TP-4

GeoEngineers

Project: Crestview Crossing
Project Location: Newberg, Oregon
Project Number: 6748-002-00

Figure A-14
Sheet 1 of 1

Date Excavated 9/21/2017	Total Depth (ft) 11	Logged By DMH Checked By TAP	Excavator Dan Fischer Excavating, Inc. Equipment CAT 305 E Mini-excavator	Groundwater not observed Caving not observed	
Surface Elevation (ft) 213 Vertical Datum NAVD88		Easting (X) 7575285 Northing (Y) 609598		Coordinate System OR State Plane North Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
212	1				OL	Dark brown topsoil with organic matter (soft, moist) (topsoil)			
					ML	Brown silt with trace organic matter (stiff, dry to moist) (tilled zone)			
211	2				ML	Brown silt with trace organic matter (stiff, dry to moist) (native)			
210	3		1 AL				16		AL (LL = 44; PI = 16)
209	4								
208	5								
207	6					Becomes moist			
206	7					Becomes very stiff			
205	8								
204	9								
203	10					Grades to with trace fine sand			
202	11		2			Test pit completed at 11 feet below ground surface			

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery, Vertical approximated based on DEM

Log of Test Pit TP-5

GeoEngineers

Project: Crestview Crossing
Project Location: Newberg, Oregon
Project Number: 6748-002-00

Figure A-15
Sheet 1 of 1

Date Excavated 9/21/2017	Total Depth (ft) 10	Logged By DMH Checked By TAP	Excavator Dan Fischer Excavating, Inc. Equipment CAT 305 E Mini-excavator	Groundwater not observed Caving not observed
Surface Elevation (ft) 207 Vertical Datum NAVD88		Easting (X) 7575703 Northing (Y) 609521	Coordinate System OR State Plane North Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
					OL	Dark brown topsoil with organic matter (stiff, moist) (topsoil)			
206	1				ML	Gray-brown silt with trace organic matter (stiff, dry) (tilled zone)			
205	2		1 MC		ML	Gray-brown silt with trace organic matter (stiff, dry) (native) Becomes brown, moist	21		
204	3								
203	4								
202	5								
201	6								
200	7								
199	8								
198	9								
197	10		2						

Test completed at 10 feet below ground surface

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery, Vertical approximated based on DEM

Log of Test Pit TP-6

GeoEngineers

Project: Crestview Crossing
Project Location: Newberg, Oregon
Project Number: 6748-002-00

Figure A-16
Sheet 1 of 1

Date Excavated 9/21/2017	Total Depth (ft) 10.5	Logged By DMH Checked By TAP	Excavator Dan Fischer Excavating, Inc. Equipment CAT 305 E Mini-excavator	Groundwater not observed Caving not observed
Surface Elevation (ft) 204 Vertical Datum NAVD88		Easting (X) 7575665 Northing (Y) 609233	Coordinate System OR State Plane North Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
					OL	Dark brown topsoil with organic matter (soft, moist) (topsoil)			
203	1				ML	Gray-brown silt with trace organic matter (stiff, dry) (tilled zone)			
202	2				ML	Gray-brown silt with trace organic matter (stiff, moist) (native)			
201	3								
200	4		1						
199	5								
198	6								
197	7								
196	8								
195	9					Becomes gray-brown and black mottling, trace fine sand			
194	10		2						

Test pit completed at 10½ feet below ground surface

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery, Vertical approximated based on DEM

Log of Test Pit TP-7

GeoEngineers

Project: Crestview Crossing
Project Location: Newberg, Oregon
Project Number: 6748-002-00

Figure A-17
Sheet 1 of 1

Date Excavated 9/21/2017	Total Depth (ft) 9.5	Logged By DMH Checked By TAP	Excavator Dan Fischer Excavating, Inc. Equipment CAT 305 E Mini-excavator	Groundwater not observed Caving not observed
Surface Elevation (ft) 202 Vertical Datum NAVD88		Easting (X) 7575716 Northing (Y) 609019	Coordinate System OR State Plane North Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
201	1				OL	Dark brown topsoil with organic matter (soft, moist) (topsoil)			
					ML	Gray silt with trace organic matter (stiff, dry) (tilled zone)			
200	2				CL	Dark gray clay with trace organic matter (very stiff, dry to moist)			
199	3		1 MC				21		
198	4								
197	5								
196	6								
195	7		2		ML	Gray-brown silt with orange mottling (stiff, moist)			
194	8								
193	9								

Test pit completed at 9½ feet below ground surface

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery, Vertical approximated based on DEM

Log of Test Pit TP-8

GeoEngineers

Project: Crestview Crossing
Project Location: Newberg, Oregon
Project Number: 6748-002-00

Figure A-18
Sheet 1 of 1

Date Excavated 9/21/2017	Total Depth (ft) 11.5	Logged By DMH Checked By TAP	Excavator Dan Fischer Excavating, Inc. Equipment CAT 305 E Mini-excavator	Groundwater not observed Caving not observed
Surface Elevation (ft) 210 Vertical Datum NAVD88		Easting (X) 7575778 Northing (Y) 608744	Coordinate System OR State Plane North Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
209	1				ML	Brown silt with organic matter (soft, moist) (topsoil)			
208	2				ML	Brown silt with organic matter (stiff, moist) (native) Grades to trace organic matter			
207	3		1						
206	4								
205	5								
204	6								
203	7								
202	8								
201	9								
200	10								
199	11		2						

Test pit completed at 11½ feet below ground surface

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery, Vertical approximated based on DEM

Log of Test Pit TP-9

GeoEngineers

Project: Crestview Crossing
Project Location: Newberg, Oregon
Project Number: 6748-002-00

Figure A-19
Sheet 1 of 1

Date Excavated 9/20/2017	Total Depth (ft) 12	Logged By DMH Checked By TAP	Excavator Dan Fischer Excavating, Inc. Equipment CAT 305 E Mini-excavator	Groundwater not observed Caving not observed
Surface Elevation (ft) 202 Vertical Datum NAVD88		Easting (X) 7576003 Northing (Y) 608827	Coordinate System OR State Plane North Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
201	1				OL	Dark brown topsoil with organic matter (soft, dry to moist) (topsoil)			
					ML	Light brown silt with organic matter (soft, dry to moist) (tilled zone)			
200	2				ML	Light brown silt (soft, dry to moist) (native)			
199	3		1 MC			Becomes to without organic matter	24		
198	4								
197	5								
196	6								
195	7					Becomes stiff			
194	8								
193	9								
192	10								
191	11								
190	12		2			Test pit completed at 12 feet below ground surface			

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery, Vertical approximated based on DEM

Log of Test Pit TP-10

GeoEngineers

Project: Crestview Crossing
Project Location: Newberg, Oregon
Project Number: 6748-002-00

Figure A-20
Sheet 1 of 1

Date Excavated 9/20/2017	Total Depth (ft) 11.5	Logged By DMH Checked By TAP	Excavator Dan Fischer Excavating, Inc. Equipment CAT 305 E Mini-excavator	Groundwater not observed Caving not observed	
Surface Elevation (ft) 194 Vertical Datum NAVD88		Easting (X) 7575961 Northing (Y) 609022		Coordinate System OR State Plane North Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
193	0				OL	Dark brown topsoil with organic matter (topsoil)			
	1				ML	Light brown silt with organic matter (medium stiff, dry to moist) (tilled zone)			
192	2				ML	Light brown silt (medium stiff, dry to moist) (native)			
191	3		1			Becomes light brown-gray with black mottling			
190	4								
189	5								
188	6								
187	7								
186	8								
185	9								
184	10								
183	11		2						

Test pit completed at 11½ feet below ground surface

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery, Vertical approximated based on DEM

Log of Test Pit TP-11

GeoEngineers

Project: Crestview Crossing
Project Location: Newberg, Oregon
Project Number: 6748-002-00

Figure A-21
Sheet 1 of 1

Date Excavated 9/20/2017	Total Depth (ft) 8	Logged By DMH Checked By TAP	Excavator Dan Fischer Excavating, Inc. Equipment CAT 305 E Mini-excavator	Groundwater not observed Caving not observed
Surface Elevation (ft) 198 Vertical Datum NAVD88		Easting (X) 7575909 Northing (Y) 609174		Coordinate System OR State Plane North Horizontal Datum NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
					OL	Dark brown topsoil with organic matter (topsoil)			
197	1				ML	Brown silt with organic matter (medium stiff, moist) (tilled zone)			
196	2				ML	Brown silt (medium stiff, moist) (native)			
195	3								
194	4								
193	5								
192	6								
191	7								
190	8		1 AL				31		AL (LL = 33; PI = 5)

Test pit completed at 8 feet below ground surface

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery, Vertical approximated based on DEM

Log of Test Pit TP-12

GeoEngineers

Project: Crestview Crossing
Project Location: Newberg, Oregon
Project Number: 6748-002-00

Figure A-22
Sheet 1 of 1

Date Excavated 9/20/2017	Total Depth (ft) 8.5	Logged By DMH Checked By TAP	Excavator Dan Fischer Excavating, Inc. Equipment CAT 305 E Mini-excavator	Groundwater not observed Caving not observed	
Surface Elevation (ft) 206 Vertical Datum NAVD88		Easting (X) 7575998 Northing (Y) 609673		Coordinate System OR State Plane North Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
					OL	Dark brown topsoil with organic matter (topsoil)			
205	1				ML	Gray-brown silt with organic matter (medium dense, dry to moist) (tilled zone)			
204	2				ML	Gray-brown silt (medium dense, dry to moist) (native)			
203	3								
202	4								
201	5								
200	6					Becomes moist			
199	7								
198	8		1						

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery, Vertical approximated based on DEM

Log of Test Pit TP-13

GeoEngineers

Project: Crestview Crossing
Project Location: Newberg, Oregon
Project Number: 6748-002-00

Figure A-23
Sheet 1 of 1

Date Excavated 9/20/2017	Total Depth (ft) 9	Logged By DMH Checked By TAP	Excavator Dan Fischer Excavating, Inc. Equipment CAT 305 E Mini-excavator	Groundwater not observed Caving not observed
Surface Elevation (ft) 205 Vertical Datum NAVD88		Easting (X) 7576292 Northing (Y) 609684	Coordinate System OR State Plane North Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
204	0				OL	Dark brown topsoil with organic matter (topsoil)			
	1				ML	Brown silt with organic matter (medium stiff, moist) (tilled zone)			
203	2				ML	Brown silt (medium stiff, moist) (native)			
202	3								
201	4								
200	5								
199	6								
198	7								
197	8								
196	9		1 AL				30		AL (LL = 41; PI = 17)

Test pit completed at 9 feet below ground surface

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery, Vertical approximated based on DEM

Log of Test Pit TP-14

GeoEngineers

Project: Crestview Crossing
Project Location: Newberg, Oregon
Project Number: 6748-002-00

Figure A-24
Sheet 1 of 1

Date Excavated 9/20/2017	Total Depth (ft) 9	Logged By DMH Checked By TAP	Excavator Dan Fischer Excavating, Inc. Equipment CAT 305 E Mini-excavator	Groundwater not observed Caving not observed
Surface Elevation (ft) 201 Vertical Datum NAVD88		Easting (X) 7576287 Northing (Y) 609516	Coordinate System OR State Plane North Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
200	0				OL	Dark brown topsoil with organic matter (topsoil)			
	1				ML	Gray silt with organic matter (medium stiff, dry) (tilled zone)			
199	2				ML	Gray silt (medium stiff, dry) (native)			
198	3								
197	4					Becomes gray-brown, moist			
196	5								
195	6								
194	7								
193	8								
192	9	1	MC				36		

Test pit completed at 9 feet below ground surface

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery, Vertical approximated based on DEM

Log of Test Pit TP-15

GeoEngineers

Project: Crestview Crossing
Project Location: Newberg, Oregon
Project Number: 6748-002-00

Figure A-25
Sheet 1 of 1

Date Excavated 9/20/2017	Total Depth (ft) 8.5	Logged By DMH Checked By TAP	Excavator Dan Fischer Excavating, Inc. Equipment CAT 305 E Mini-excavator	Groundwater not observed Caving not observed
Surface Elevation (ft) 196 Vertical Datum NAVD88		Easting (X) 7576133 Northing (Y) 609366	Coordinate System OR State Plane North Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
195	0				OL	Dark brown topsoil with organic matter (topsoil)			
	1				ML	Brown silt with organic matter (medium stiff, moist) (tilled zone)			
194	2				ML	Brown silt (medium stiff, moist) (native)			
193	3								
192	4								
191	5								
190	6								
189	7								
188	8	1	MC				34		

Test pit completed at 8½ feet below ground surface

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery, Vertical approximated based on DEM

Log of Test Pit TP-16

GeoEngineers

Project: Crestview Crossing
Project Location: Newberg, Oregon
Project Number: 6748-002-00

Figure A-26
Sheet 1 of 1

Date Excavated 9/20/2017	Total Depth (ft) 11.5	Logged By DMH Checked By TAP	Excavator Dan Fischer Excavating, Inc. Equipment CAT 305 E Mini-excavator	Groundwater not observed Caving not observed	
Surface Elevation (ft) 193 Vertical Datum NAVD88		Easting (X) 7576160 Northing (Y) 608965		Coordinate System OR State Plane North Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
192	0				OL	Dark brown topsoil with organic matter (topsoil)			
	1				ML	Brown silt with organic matter (soft, dry to moist) (tilled zone)			
191	2				ML	Brown silt (soft, dry to moist) (native)			
190	3		1 MC				23		
189	4								
188	5					Becomes soft, moist			
187	6								
186	7								
185	8					Becomes gray-brown with black mottling (soft, moist)			
184	9								
183	10		2						
182	11		3			Becomes light brown with orange mottling			

Test pit completed at 11½ feet below ground surface

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery, Vertical approximated based on DEM

Log of Test Pit TP-17

GeoEngineers

Project: Crestview Crossing
Project Location: Newberg, Oregon
Project Number: 6748-002-00

Figure A-27
Sheet 1 of 1

Date Excavated 9/20/2017	Total Depth (ft) 8	Logged By DMH Checked By TAP	Excavator Dan Fischer Excavating, Inc. Equipment CAT 305 E Mini-excavator	Groundwater not observed Caving not observed
Surface Elevation (ft) 187 Vertical Datum NAVD88		Easting (X) 7576405 Northing (Y) 609031	Coordinate System OR State Plane North Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
					OL	Dark brown topsoil with organic matter (topsoil)			
186	1				ML	Light brown-gray silt with organic matter (medium stiff, dry to moist) (tilled zone)			
185	2				ML	Light brown-gray silt (medium stiff, dry to moist) (native)			
184	3					Becomes moist			
183	4								
182	5								
181	6					Becomes gray with orange mottling			
180	7								
179	8		1			Test pit completed at 8 feet below ground surface			

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery, Vertical approximated based on DEM

Log of Test Pit TP-18

GeoEngineers

Project: Crestview Crossing
Project Location: Newberg, Oregon
Project Number: 6748-002-00

Figure A-28
Sheet 1 of 1

Date Excavated 9/20/2017	Total Depth (ft) 8	Logged By DMH Checked By TAP	Excavator Dan Fischer Excavating, Inc. Equipment CAT 305 E Mini-excavator	Groundwater not observed Caving not observed
Surface Elevation (ft) 191 Vertical Datum NAVD88		Easting (X) 7576483 Northing (Y) 609162	Coordinate System OR State Plane North Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
190	0				OL	Dark brown topsoil with organic matter (topsoil)			
	1				ML	Light brown-gray silt with organic matter (medium stiff, dry to moist) (tilled zone)			
189	2				ML	Light brown-gray silt (medium stiff, dry to moist) (native)			
188	3								
187	4					Becomes moist			
186	5								
185	6								
184	7								
183	8	1	MC				37		

Test pit completed at 8 feet below ground surface

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery, Vertical approximated based on DEM

Log of Test Pit TP-19

GeoEngineers

Project: Crestview Crossing
Project Location: Newberg, Oregon
Project Number: 6748-002-00

Figure A-29
Sheet 1 of 1

Date Excavated 9/20/2017	Total Depth (ft) 9.5	Logged By DMH Checked By TAP	Excavator Dan Fischer Excavating, Inc. Equipment CAT 305 E Mini-excavator	Groundwater not observed Caving not observed	
Surface Elevation (ft) 192 Vertical Datum NAVD88		Easting (X) 7576555 Northing (Y) 609285		Coordinate System OR State Plane North Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
191	1				OL	Dark brown topsoil with organic matter (topsoil)			
					ML	LIght brown silt with organic matter (medium stiff, dry to moist) (tilled zone)			
190	2				ML	LIght brown silt (medium stiff, dry to moist) (native)			
189	3					Becomes moist			
188	4								
187	5								
186	6								
185	7								
184	8								
183	9		1						

Test pit completed at 9½ feet below ground surface

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery, Vertical approximated based on DEM

Log of Test Pit TP-20

GeoEngineers

Project: Crestview Crossing
Project Location: Newberg, Oregon
Project Number: 6748-002-00

Figure A-30
Sheet 1 of 1

Date Excavated 9/20/2017	Total Depth (ft) 8.5	Logged By DMH Checked By TAP	Excavator Dan Fischer Excavating, Inc. Equipment CAT 305 E Mini-excavator	Groundwater not observed Caving not observed	
Surface Elevation (ft) 195 Vertical Datum NAVD88		Easting (X) 7576442 Northing (Y) 609391		Coordinate System OR State Plane North Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
194	0				OL	Dark brown topsoil with organic matter (topsoil)			
	1				ML	Gray silt with organic matter (medium stiff, dry to moist) (tilled zone)			
193	2				ML	Gray silt (medium stiff, dry to moist) (native)			
192	3								
191	4					Becomes gray-brown, moist			
190	5								
189	6								
188	7								
187	8		1 MC				36		

Test pit completed at 8½ feet below ground surface

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery, Vertical approximated based on DEM

Log of Test Pit TP-21

GeoEngineers

Project: Crestview Crossing
Project Location: Newberg, Oregon
Project Number: 6748-002-00

Figure A-31
Sheet 1 of 1

Date Excavated 9/26/2017	Total Depth (ft) 4.5	Logged By JLL Checked By TAP	Excavator GeoEngineers, Inc. Equipment Hand Tools	Groundwater not observed Caving not observed	
Surface Elevation (ft) 214 Vertical Datum NAVD88		Easting (X) 7575598 Northing (Y) 608672		Coordinate System OR State Plane North Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
213	1				OL	Dark brown topsoil with organic matter (topsoil)			
					ML	Brown silt with organic matter (stiff, dry to moist) (tilled zone)			
212	2		1		ML	Yellow-brown silt (medium stiff to stiff) (native)			
211	3								
210	4								

Notes: See Figure A-1 for explanation of symbols.
The depths on the hand-augered boring logs are based on an average of measurements across the hand-auger and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery, Vertical approximated based on DEM

Log of Hand Auger HA-1

GeoEngineers

Project: Crestview Crossing
Project Location: Newberg, Oregon
Project Number: 6748-002-00

Figure A-32
Sheet 1 of 1

Date Excavated 9/26/2017	Total Depth (ft) 4.5	Logged By JLL Checked By TAP	Excavator GeoEngineers, Inc. Equipment Hand Tools	Groundwater not observed Caving not observed
Surface Elevation (ft) 204 Vertical Datum NAVD88		Easting (X) 7575624 Northing (Y) 609083	Coordinate System OR State Plane North Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
203	1				OL	Dark brown topsoil with organic matter (topsoil)			
					ML	Dark brown silt with organic matter (medium stiff, moist) (tilled zone)			
202	2				ML	Yellow-brown silt (medium stiff, moist) (native)			
201	3		1			Grades to brown with red-brown mottling			
200	4								

Notes: See Figure A-1 for explanation of symbols.
The depths on the hand-augered boring logs are based on an average of measurements across the hand-auger and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery, Vertical approximated based on DEM

Log of Hand Auger HA-2

GeoEngineers

Project: Crestview Crossing
Project Location: Newberg, Oregon
Project Number: 6748-002-00

Figure A-33
Sheet 1 of 1

Date Excavated 9/26/2017	Total Depth (ft) 4	Logged By JLL Checked By TAP	Excavator GeoEngineers, Inc. Equipment Hand Tools	Groundwater not observed Caving not observed
Surface Elevation (ft) 210 Vertical Datum NAVD88		Easting (X) 7575572 Northing (Y) 609614	Coordinate System OR State Plane North Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
209	1				OL	Dark brown topsoil with organic matter (topsoil)			
					ML	Brown silt organic matter (stiff, moist) (topsoil)			
208	2				ML	Yellow-brown silt (native)			
207	3								
206	4								

Notes: See Figure A-1 for explanation of symbols.
The depths on the hand-augered boring logs are based on an average of measurements across the hand-auger and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery, Vertical approximated based on DEM

Log of Hand Auger HA-3

GeoEngineers

Project: Crestview Crossing
Project Location: Newberg, Oregon
Project Number: 6748-002-00

Figure A-34
Sheet 1 of 1

Date Excavated 9/26/2017	Total Depth (ft) 3	Logged By JLL Checked By TAP	Excavator GeoEngineers, Inc. Equipment Hand Tools	Groundwater not observed Caving not observed
Surface Elevation (ft) 200 Vertical Datum NAVD88		Easting (X) 7575991 Northing (Y) 609449		Coordinate System OR State Plane North Horizontal Datum NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
199	0				OL	Dark brown topsoil with organic matter (topsoil)			
					ML	Light brown silt, fine roots and organic matter (stiff, dry) (tilled zone)			
198	1				ML	Yellow-brown silt (stiff, dry to moist) (native)			
197	2								
	3								

Notes: See Figure A-1 for explanation of symbols.
The depths on the hand-augered boring logs are based on an average of measurements across the hand-auger and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery, Vertical approximated based on DEM

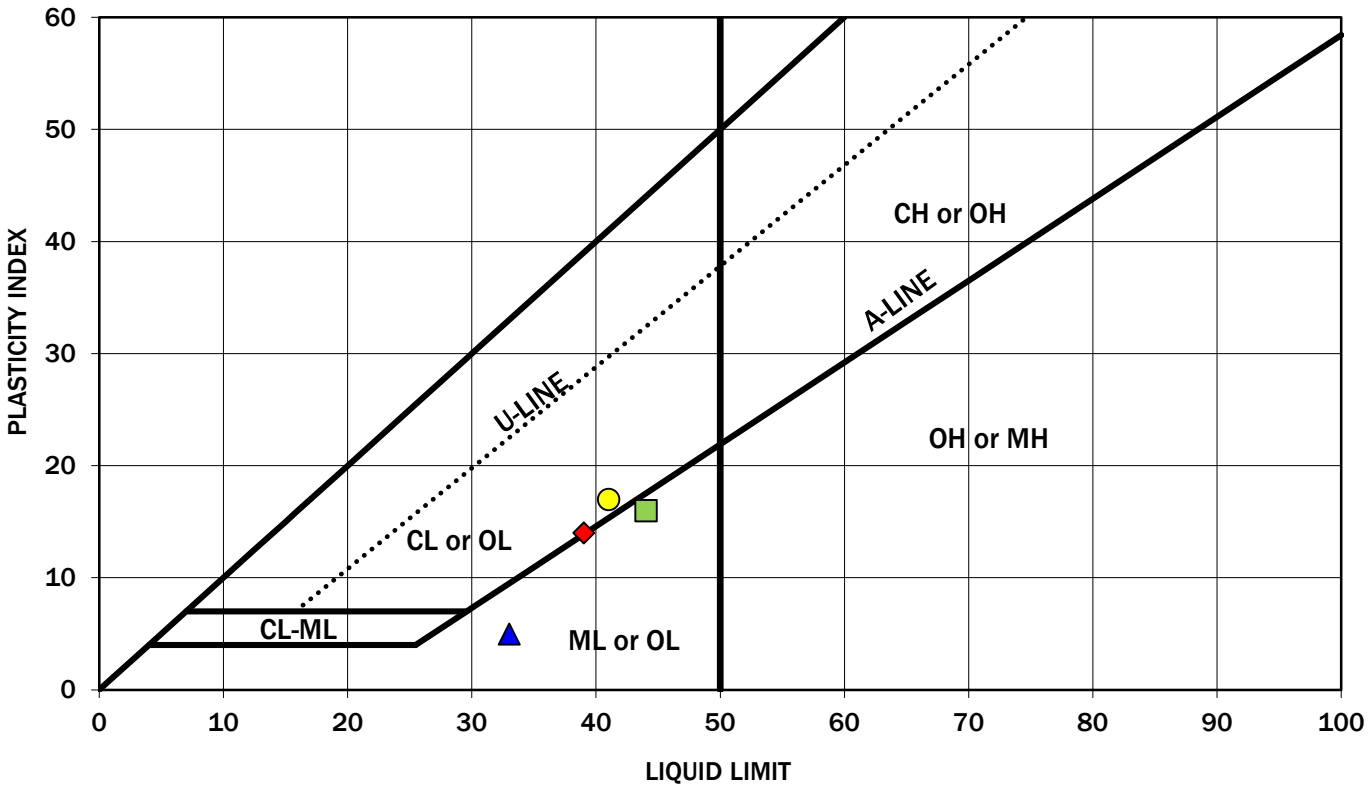
Log of Hand Auger HA-4

GeoEngineers

Project: Crestview Crossing
Project Location: Newberg, Oregon
Project Number: 6748-002-00

Figure A-35
Sheet 1 of 1

PLASTICITY CHART



Symbol	Boring Number	Depth (feet)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Soil Description
◆	B-3	2.5	32	39	14	Silt (ML)
■	TP-5	3	16	44	16	Silt (ML)
▲	TP-12	8	31	33	5	Silt (ML)
●	TP-14	9	30	41	17	Lean clay (CL)

The liquid limit and plasticity index were obtained in general accordance with ASTM D 4318.

Atterberg Limits Test Results

Crestview Crossing Development
Newberg, Oregon

GeoEngineers

Figure A-36

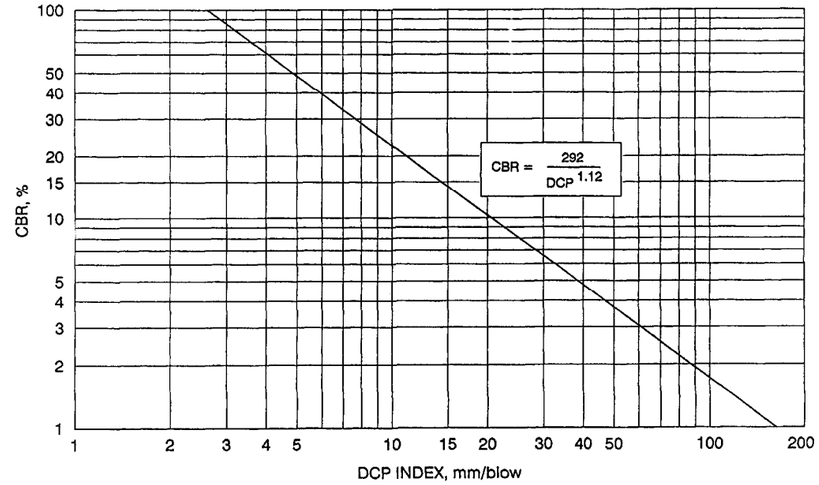
Location: Pacific Highway at NE Harmony
Depth to bottom: 2.86' (87.3cm)
Tester's Name: John Lawes
Tester's Company: GeoEngineers, Inc.

Date: 9/26/2017
Dimension: 4" N/A
Tester's Contact No:

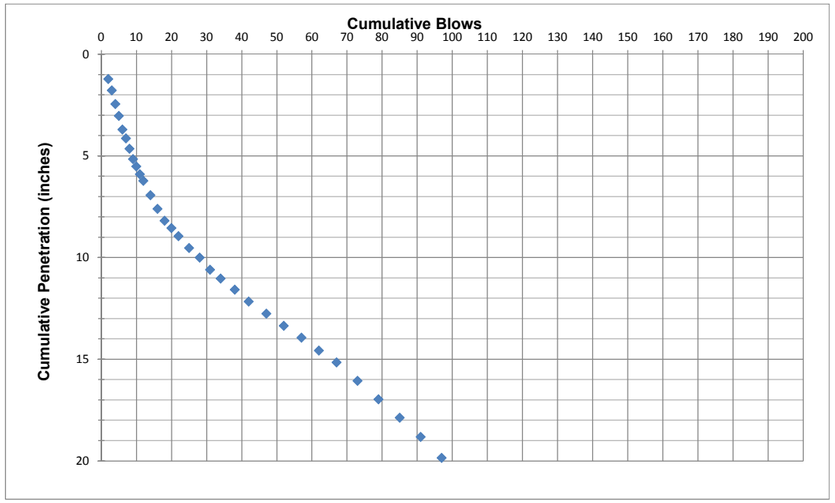
Test Hole Number: HA-1
Test Method: Dynamic Cone Penetration
GeoEngineers Job: 6748-002-00

Depth, feet	Soil Texture
0-4.5	Yellow-brown SILT, topsoil in the top 12-14"

Test increment	Number of blows	Cumulative blows	Depth below ground surface	Penetration per increment	Cumulative penetration	Cummulative Penetration	Penetration per blow set	Penetration per blow	Hammer blow factor	DCP Index	DCP Index	CBR	M_R
#	#	#	(in)	(mm)	(mm)	(in)	(in)	(in)	1 for 8-kg 2 for 4.6-kg hammer	in/blow	mm/blow	%	psi
1	1	2	1.2	31.0	31.0	1.2	1.2	1.22	2	2.44	62.00	3	3431
2	1	3	1.8	14.0	45.0	1.8	0.6	0.55	2	1.10	28.00	7	4678
3	1	4	2.4	17.0	62.0	2.4	0.7	0.67	2	1.34	34.00	6	4337
4	1	5	3.0	15.0	77.0	3.0	0.6	0.59	2	1.18	30.00	6	4554
5	1	6	3.7	17.0	94.0	3.7	0.7	0.67	2	1.34	34.00	6	4337
6	1	7	4.1	11.0	105.0	4.1	0.4	0.43	2	0.87	22.00	9	5140
7	1	8	4.6	13.0	118.0	4.6	0.5	0.51	2	1.02	26.00	8	4815
8	1	9	5.2	13.0	131.0	5.2	0.5	0.51	2	1.02	26.00	8	4815
9	1	10	5.5	9.0	140.0	5.5	0.4	0.35	2	0.71	18.00	11	5558
10	1	11	5.9	10.0	150.0	5.9	0.4	0.39	2	0.79	20.00	10	5334
11	1	12	6.2	8.0	158.0	6.2	0.3	0.31	2	0.63	16.00	13	5819
12	2	14	6.9	18.0	176.0	6.9	0.7	0.35	2	0.71	18.00	11	5558
13	2	16	7.6	17.0	193.0	7.6	0.7	0.33	2	0.67	17.00	12	5683
14	2	18	8.2	15.0	208.0	8.2	0.6	0.30	2	0.59	15.00	14	5967
15	2	20	8.5	9.0	217.0	8.5	0.4	0.18	2	0.35	9.00	25	7283
16	2	22	8.9	10.0	227.0	8.9	0.4	0.20	2	0.39	10.00	22	6990
17	3	25	9.5	15.0	242.0	9.5	0.6	0.20	2	0.39	10.00	22	6990
18	3	28	10.0	12.0	254.0	10.0	0.5	0.16	2	0.31	8.00	28	7625
19	3	31	10.6	15.0	269.0	10.6	0.6	0.20	2	0.39	10.00	22	6990
20	3	34	11.0	11.0	280.0	11.0	0.4	0.14	2	0.29	7.33	31	7889
21	4	38	11.6	14.0	294.0	11.6	0.6	0.14	2	0.28	7.00	33	8033
22	4	42	12.2	15.0	309.0	12.2	0.6	0.15	2	0.30	7.50	31	7820
23	5	47	12.8	15.0	324.0	12.8	0.6	0.12	2	0.24	6.00	39	8531
24	5	52	13.3	15.0	339.0	13.3	0.6	0.12	2	0.24	6.00	39	8531
25	5	57	13.9	15.0	354.0	13.9	0.6	0.12	2	0.24	6.00	39	8531
26	5	62	14.6	16.0	370.0	14.6	0.6	0.13	2	0.25	6.40	37	8319
27	5	67	15.2	15.0	385.0	15.2	0.6	0.12	2	0.24	6.00	39	8531
28	6	73	16.1	23.0	408.0	16.1	0.9	0.15	2	0.30	7.67	30	7753
29	6	79	17.0	23.0	431.0	17.0	0.9	0.15	2	0.30	7.67	30	7753
30	6	85	17.9	23.0	454.0	17.9	0.9	0.15	2	0.30	7.67	30	7753
31	6	91	18.8	24.0	478.0	18.8	0.9	0.16	2	0.31	8.00	28	7625
32	6	97	19.8	26.0	504.0	19.8	1.0	0.17	2	0.34	8.67	26	7391
33	6	103	20.9	26.0	530.0	20.9	1.0	0.17	2	0.34	8.67	26	7391
34	6	109	21.9	27.0	557.0	21.9	1.1	0.18	2	0.35	9.00	25	7283
35	6	115	23.0	28.0	585.0	23.0	1.1	0.18	2	0.37	9.33	24	7180
36	6	121	24.5	37.0	622.0	24.5	1.5	0.24	2	0.49	12.33	18	6441
37	6	127	26.0	38.0	660.0	26.0	1.5	0.25	2	0.50	12.67	17	6374
38	6	133	28.0	52.0	712.0	28.0	2.0	0.34	2	0.68	17.33	12	5640
39	2	135	28.8	20.0	732.0	28.8	0.8	0.39	2	0.79	20.00	10	5334
40	2	137	29.5	17.0	749.0	29.5	0.7	0.33	2	0.67	17.00	12	5683
41	2	139	32.0	63.0	812.0	32.0	2.5	1.24	2	2.48	63.00	3	3410
42	2	141	32.6	15.0	827.0	32.6	0.6	0.30	2	0.59	15.00	14	5967
43	2	143	33.1	15.0	842.0	33.1	0.6	0.30	2	0.59	15.00	14	5967
44	2	145	33.8	16.0	858.0	33.8	0.6	0.31	2	0.63	16.00	13	5819
45	2	147	34.4	15.0	873.0	34.4	0.6	0.30	2	0.59	15.00	14	5967



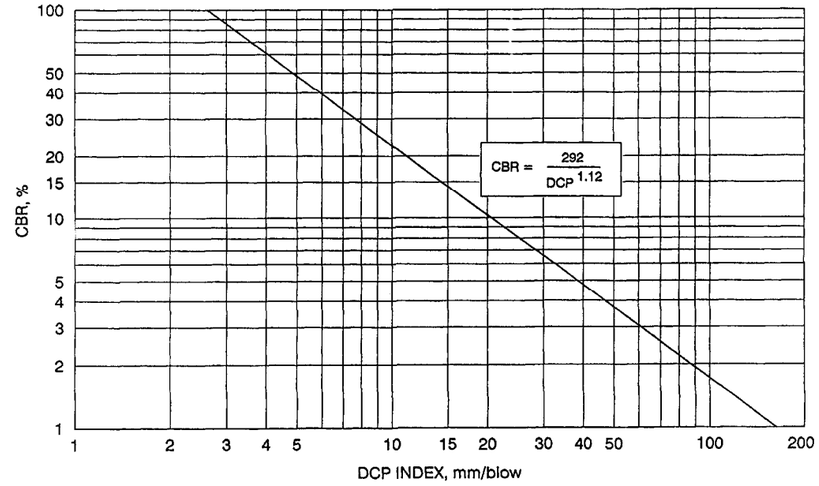
(after Webster et al., 1992)
Webster, S. L., Grau, R. H., and Williams, T. P. (1992). Description and application of dual mass dynamic cone penetrometer. Department of the Army Waterways Equipment Station, No. GL-92-3.



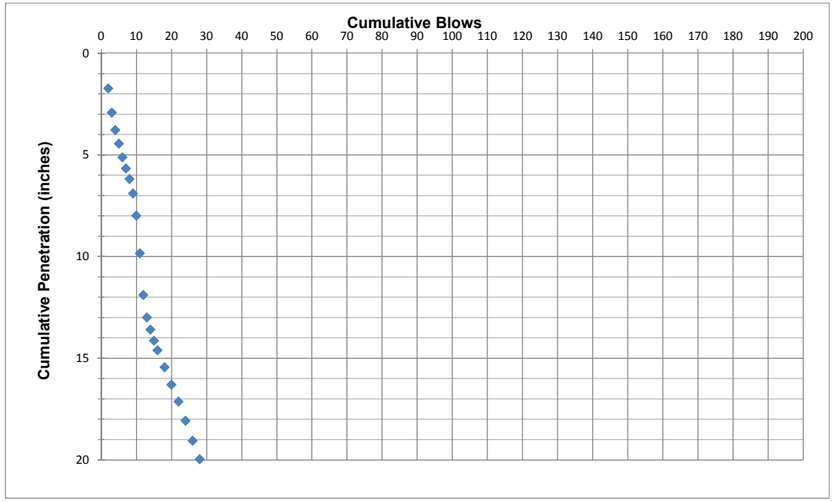
Location: Pacific Highway at NE Harmony | Date: 9/26/2017 | Test Hole Number: HA-2
Depth to bottom: 2.67' (81.4cm) | Dimension: 4" | N/A | Test Method: Dynamic Cone Penetration
Tester's Name: John Lawes | GeoEngineers Job: 6748-002-00
Tester's Company: GeoEngineers, Inc. | Tester's Contact No:

Depth, feet	Soil Texture
0-4.5	Yellow-brown SILT, topsoil in the top 12-14"

Test increment	Number of blows	Cumulative blows	Depth below ground surface	Penetration per increment	Cumulative penetration	Cummulative Penetration	Penetration per blow set	Penetration per blow	Hammer blow factor	DCP Index	DCP Index	CBR	M_R
#	#	#	(in)	(mm)	(mm)	(in)	(in)	(in)	1 for 8-kg 2 for 4.6-kg hammer	in/blow	mm/blow	%	psi
1	1	2	16.7	44.0	44.0	1.7	1.7	1.73	2	3.46	88.00	2	2993
2	1	3	17.9	30.0	74.0	2.9	1.2	1.18	2	2.36	60.00	3	3475
3	1	4	18.8	22.0	96.0	3.8	0.9	0.87	2	1.73	44.00	4	3922
4	1	5	19.4	17.0	113.0	4.4	0.7	0.67	2	1.34	34.00	6	4337
5	1	6	20.1	17.0	130.0	5.1	0.7	0.67	2	1.34	34.00	6	4337
6	1	7	20.7	14.0	144.0	5.7	0.6	0.55	2	1.10	28.00	7	4678
7	1	8	21.2	13.0	157.0	6.2	0.5	0.51	2	1.02	26.00	8	4815
8	1	9	21.9	18.0	175.0	6.9	0.7	0.71	2	1.42	36.00	5	4241
9	1	10	23.0	28.0	203.0	8.0	1.1	1.10	2	2.20	56.00	3	3570
10	1	11	24.8	47.0	250.0	9.8	1.9	1.85	2	3.70	94.00	2	2917
11	1	12	26.9	52.0	302.0	11.9	2.0	2.05	2	4.09	104.00	2	2804
12	1	13	28.0	28.0	330.0	13.0	1.1	1.10	2	2.20	56.00	3	3570
13	1	14	28.6	15.0	345.0	13.6	0.6	0.59	2	1.18	30.00	6	4554
14	1	15	29.1	14.0	359.0	14.1	0.6	0.55	2	1.10	28.00	7	4678
15	1	16	29.6	12.0	371.0	14.6	0.5	0.47	2	0.94	24.00	8	4968
16	2	18	30.4	21.0	392.0	15.4	0.8	0.41	2	0.83	21.00	10	5234
17	2	20	31.3	22.0	414.0	16.3	0.9	0.43	2	0.87	22.00	9	5140
18	2	22	32.1	21.0	435.0	17.1	0.8	0.41	2	0.83	21.00	10	5234
19	2	24	33.1	24.0	459.0	18.1	0.9	0.47	2	0.94	24.00	8	4968
20	2	26	34.1	25.0	484.0	19.1	1.0	0.49	2	0.98	25.00	8	4890
21	2	28	35.0	23.0	507.0	20.0	0.9	0.45	2	0.91	23.00	9	5051
22	2	30	35.9	25.0	532.0	20.9	1.0	0.49	2	0.98	25.00	8	4890
23	2	32	36.8	22.0	554.0	21.8	0.9	0.43	2	0.87	22.00	9	5140
24	2	34	37.6	20.0	574.0	22.6	0.8	0.39	2	0.79	20.00	10	5334
25	2	36	38.4	21.0	595.0	23.4	0.8	0.41	2	0.83	21.00	10	5234
26	2	38	39.2	19.0	614.0	24.2	0.7	0.37	2	0.75	19.00	11	5442
27	2	40	39.9	18.0	632.0	24.9	0.7	0.35	2	0.71	18.00	11	5558
28	2	42	40.7	22.0	654.0	25.7	0.9	0.43	2	0.87	22.00	9	5140
29	2	44	41.5	18.0	672.0	26.5	0.7	0.35	2	0.71	18.00	11	5558
30	2	46	42.2	20.0	692.0	27.2	0.8	0.39	2	0.79	20.00	10	5334
31	2	48	43.0	20.0	712.0	28.0	0.8	0.39	2	0.79	20.00	10	5334
32	2	50	43.8	20.0	732.0	28.8	0.8	0.39	2	0.79	20.00	10	5334
33	2	52	44.5	17.0	749.0	29.5	0.7	0.33	2	0.67	17.00	12	5683
34	2	54	45.1	15.0	764.0	30.1	0.6	0.30	2	0.59	15.00	14	5967
35	2	56	45.9	20.0	784.0	30.9	0.8	0.39	2	0.79	20.00	10	5334
36	2	58	46.5	15.0	799.0	31.5	0.6	0.30	2	0.59	15.00	14	5967
37	2	60	47.0	15.0	814.0	32.0	0.6	0.30	2	0.59	15.00	14	5967



(after Webster et al., 1992)
Webster, S. L., Grau, R. H., and Williams, T. P. (1992). Description and application of dual mass dynamic cone penetrometer. Department of the Army Waterways Equipment Station, No. GL-92-3.



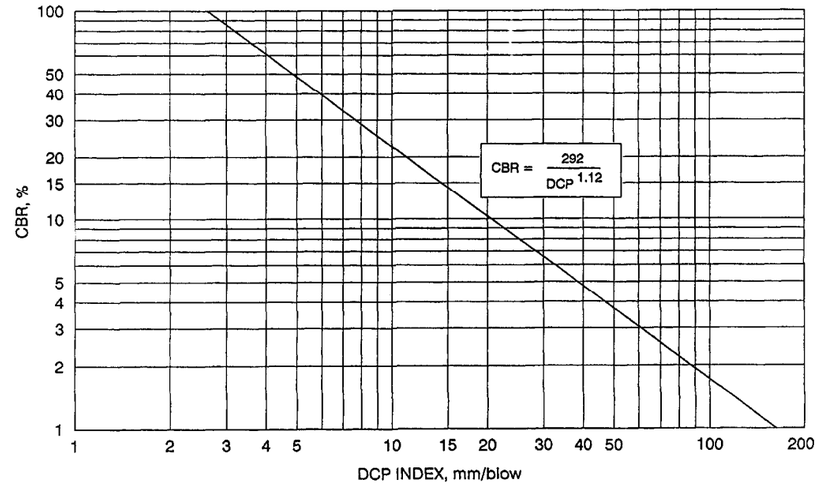
Location: Pacific Highway at NE Harmony
Depth to bottom: 2.58' (78.8cm)
Tester's Name: John Lawes
Tester's Company: GeoEngineers, Inc.

Date: 9/26/2017
Dimension: 4" N/A
Tester's Contact No:

Test Hole Number: HA-3
Test Method: Dynamic Cone Penetration
GeoEngineers Job: 6748-002-00

Depth, feet	Soil Texture
0-4	Yellow-brown SILT, topsoil in the top 12-14"

Test increment	Number of blows	Cumulative blows	Depth below ground surface	Penetration per increment	Cumulative penetration	Cummulative Penetration	Penetration per blow set	Penetration per blow	Hammer blow factor	DCP Index	DCP Index	CBR	M_R
#	#	#	(in)	(mm)	(mm)	(in)	(in)	(in)	1 for 8-kg 2 for 4.6-kg hammer	in/blow	mm/blow	%	psi
1	1	2	15.4	10.0	10.0	0.4	0.4	0.39	2	0.79	20.00	10	5334
2	1	3	16.2	21.0	31.0	1.2	0.8	0.83	2	1.65	42.00	4	3994
3	1	4	16.8	15.0	46.0	1.8	0.6	0.59	2	1.18	30.00	6	4554
4	1	5	18.0	31.0	77.0	3.0	1.2	1.22	2	2.44	62.00	3	3431
5	1	6	18.5	12.0	89.0	3.5	0.5	0.47	2	0.94	24.00	8	4968
6	1	7	18.9	10.0	99.0	3.9	0.4	0.39	2	0.79	20.00	10	5334
7	1	8	19.5	15.0	114.0	4.5	0.6	0.59	2	1.18	30.00	6	4554
8	1	9	19.8	7.0	121.0	4.8	0.3	0.28	2	0.55	14.00	15	6130
9	2	11	20.7	23.0	144.0	5.7	0.9	0.45	2	0.91	23.00	9	5051
10	2	13	21.5	20.0	164.0	6.5	0.8	0.39	2	0.79	20.00	10	5334
11	2	15	22.2	20.0	184.0	7.2	0.8	0.39	2	0.79	20.00	10	5334
12	2	17	23.0	20.0	204.0	8.0	0.8	0.39	2	0.79	20.00	10	5334
13	3	20	23.9	21.0	225.0	8.9	0.8	0.28	2	0.55	14.00	15	6130
14	3	23	24.6	19.0	244.0	9.6	0.7	0.25	2	0.50	12.67	17	6374
15	3	26	25.4	20.0	264.0	10.4	0.8	0.26	2	0.52	13.33	16	6248
16	3	29	26.3	22.0	286.0	11.3	0.9	0.29	2	0.58	14.67	14	6020
17	4	33	27.4	28.0	314.0	12.4	1.1	0.28	2	0.55	14.00	15	6130
18	4	37	28.3	23.0	337.0	13.3	0.9	0.23	2	0.45	11.50	19	6619
19	2	39	28.8	13.0	350.0	13.8	0.5	0.26	2	0.51	13.00	17	6310
20	2	41	29.2	11.0	361.0	14.2	0.4	0.22	2	0.43	11.00	20	6735
21	4	45	30.1	23.0	384.0	15.1	0.9	0.23	2	0.45	11.50	19	6619
22	4	49	31.3	30.0	414.0	16.3	1.2	0.30	2	0.59	15.00	14	5967
23	4	53	32.0	18.0	432.0	17.0	0.7	0.18	2	0.35	9.00	25	7283
24	4	57	32.9	22.0	454.0	17.9	0.9	0.22	2	0.43	11.00	20	6735
25	4	61	33.8	23.0	477.0	18.8	0.9	0.23	2	0.45	11.50	19	6619
26	4	65	34.8	27.0	504.0	19.8	1.1	0.27	2	0.53	13.50	16	6218
27	4	69	35.8	24.0	528.0	20.8	0.9	0.24	2	0.47	12.00	18	6510
28	4	73	36.9	29.0	557.0	21.9	1.1	0.29	2	0.57	14.50	15	6047
29	6	79	38.5	39.0	596.0	23.5	1.5	0.26	2	0.51	13.00	17	6310
30	6	85	39.8	35.0	631.0	24.8	1.4	0.23	2	0.46	11.67	19	6582
31	6	91	41.3	38.0	669.0	26.3	1.5	0.25	2	0.50	12.67	17	6374
32	6	97	42.7	35.0	704.0	27.7	1.4	0.23	2	0.46	11.67	19	6582
33	6	103	44.2	38.0	742.0	29.2	1.5	0.25	2	0.50	12.67	17	6374
34	6	109	45.4	31.0	773.0	30.4	1.2	0.20	2	0.41	10.33	21	6901
35	6	115	46.0	15.0	788.0	31.0	0.6	0.10	2	0.20	5.00	48	9159



(after Webster et al., 1992)
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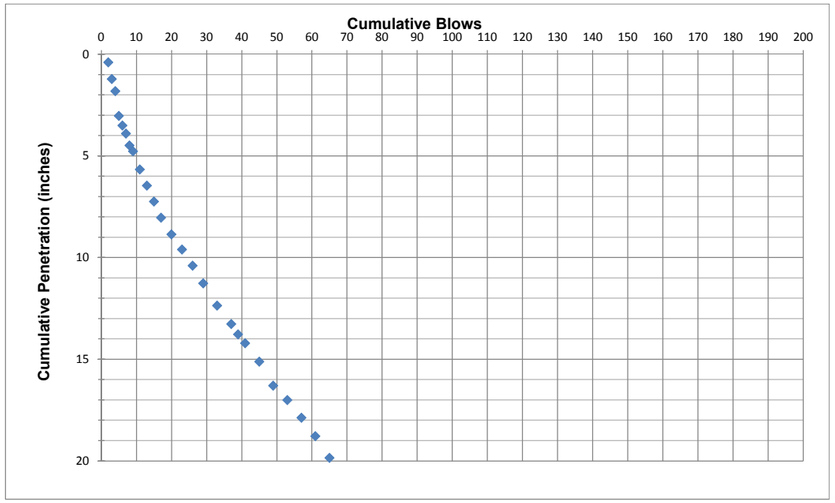


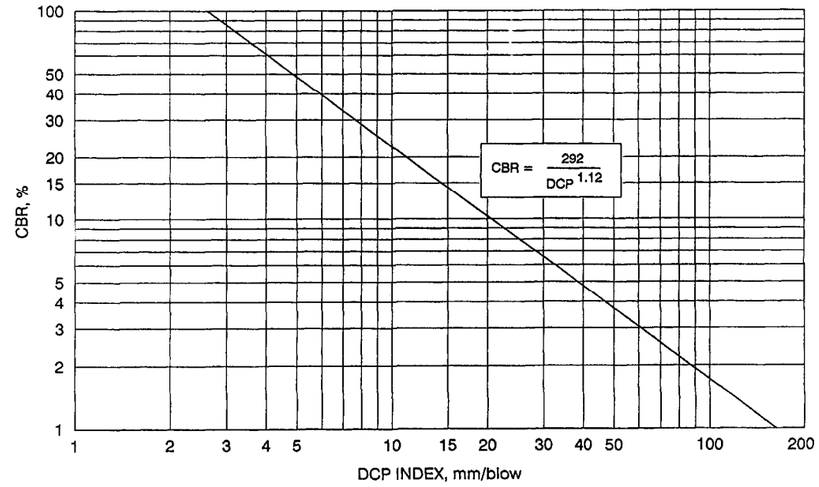
Location: Pacific Highway at NE Harmony
Depth to bottom: 2.12' (64.6cm)
Tester's Name: John Lawes
Tester's Company: GeoEngineers, Inc.

Date: 9/26/2017
Dimension: 4" N/A
Tester's Contact No:

Test Hole Number: HA-4
Test Method: Dynamic Cone Penetration
GeoEngineers Job: 6748-002-00

Depth, feet	Soil Texture
0-3	Yellow-brown SILT, topsoil in the top 10-12"

Test increment	Number of blows	Cumulative blows	Depth below ground surface	Penetration per increment	Cumulative penetration	Cummulative Penetration	Penetration per blow set	Penetration per blow	Hammer blow factor	DCP Index	DCP Index	CBR	M_R
#	#	#	(in)	(mm)	(mm)	(in)	(in)	(in)	1 for 8-kg 2 for 4.6-kg hammer	in/blow	mm/blow	%	psi
1	2	2	15.9	24.0	24.0	0.9	0.9	0.47	2	0.94	24.00	8	4968
2	2	4	17.4	36.0	60.0	2.4	1.4	0.71	2	1.42	36.00	5	4241
3	1	5	17.9	13.0	73.0	2.9	0.5	0.51	2	1.02	26.00	8	4815
4	1	6	18.6	19.0	92.0	3.6	0.7	0.75	2	1.50	38.00	5	4153
5	1	7	19.3	16.0	108.0	4.3	0.6	0.63	2	1.26	32.00	6	4441
6	1	8	19.9	16.0	124.0	4.9	0.6	0.63	2	1.26	32.00	6	4441
7	1	9	20.5	15.0	139.0	5.5	0.6	0.59	2	1.18	30.00	6	4554
8	1	10	21.1	15.0	154.0	6.1	0.6	0.59	2	1.18	30.00	6	4554
9	2	12	21.8	19.0	173.0	6.8	0.7	0.37	2	0.75	19.00	11	5442
10	2	14	22.9	27.0	200.0	7.9	1.1	0.53	2	1.06	27.00	7	4745
11	2	16	23.7	20.0	220.0	8.7	0.8	0.39	2	0.79	20.00	10	5334
12	2	18	24.3	15.0	235.0	9.3	0.6	0.30	2	0.59	15.00	14	5967
13	3	21	24.8	15.0	250.0	9.8	0.6	0.20	2	0.39	10.00	22	6990
14	3	24	25.4	15.0	265.0	10.4	0.6	0.20	2	0.39	10.00	22	6990
15	3	27	26.0	15.0	280.0	11.0	0.6	0.20	2	0.39	10.00	22	6990
16	3	30	26.6	15.0	295.0	11.6	0.6	0.20	2	0.39	10.00	22	6990
17	3	33	27.2	15.0	310.0	12.2	0.6	0.20	2	0.39	10.00	22	6990
18	3	36	27.9	18.0	328.0	12.9	0.7	0.24	2	0.47	12.00	18	6510
19	3	39	28.5	16.0	344.0	13.5	0.6	0.21	2	0.42	10.67	21	6816
20	3	42	29.2	16.0	360.0	14.2	0.6	0.21	2	0.42	10.67	21	6816
21	3	45	29.7	14.0	374.0	14.7	0.6	0.18	2	0.37	9.33	24	7180
22	3	48	30.4	16.0	390.0	15.4	0.6	0.21	2	0.42	10.67	21	6816
23	3	51	30.7	10.0	400.0	15.7	0.4	0.13	2	0.26	6.67	35	8187
24	4	55	31.5	20.0	420.0	16.5	0.8	0.20	2	0.39	10.00	22	6990
25	4	59	32.3	20.0	440.0	17.3	0.8	0.20	2	0.39	10.00	22	6990
26	4	63	33.1	20.0	460.0	18.1	0.8	0.20	2	0.39	10.00	22	6990
27	4	67	34.1	24.0	484.0	19.1	0.9	0.24	2	0.47	12.00	18	6510
28	4	71	35.0	24.0	508.0	20.0	0.9	0.24	2	0.47	12.00	18	6510
29	4	75	35.8	20.0	528.0	20.8	0.8	0.20	2	0.39	10.00	22	6990
30	4	79	36.7	22.0	550.0	21.7	0.9	0.22	2	0.43	11.00	20	6735
31	4	83	37.6	24.0	574.0	22.6	0.9	0.24	2	0.47	12.00	18	6510
32	4	87	38.6	25.0	599.0	23.6	1.0	0.25	2	0.49	12.50	17	6407
33	4	91	39.6	25.0	624.0	24.6	1.0	0.25	2	0.49	12.50	17	6407
34	4	95	40.4	22.0	646.0	25.4	0.9	0.22	2	0.43	11.00	20	6735
	4												



(after Webster et al., 1992)
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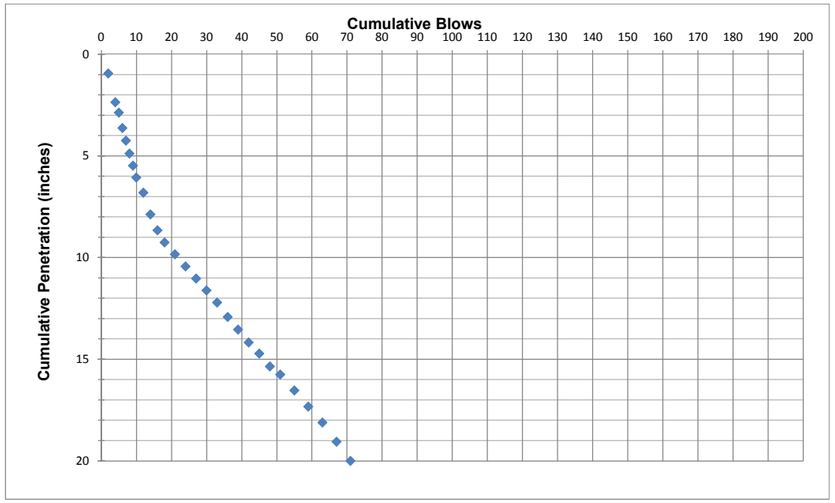


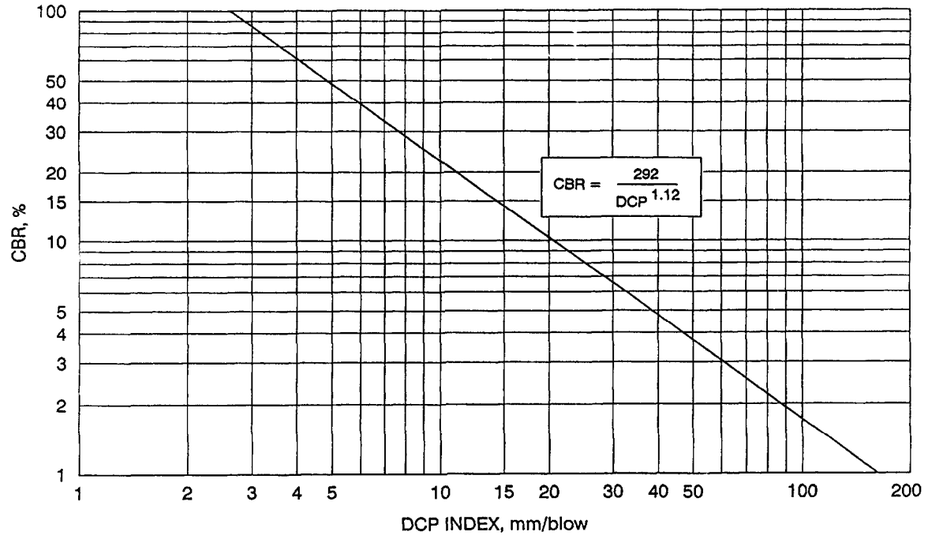
Location: Crestview, Newber, OR
Depth to bottom: 13"
Tester's Name: TAP
Tester's Company: GeoEngineers, Inc.

Date: 9/21/2017
Dimension: 4"
Tester's Contact No: 503-951-1810

Test Hole Number: B-2
Test Method: Dynamic Cone Penetration
GeoEngineers Job: 6748-002-00

Depth, feet	Soil Texture
0-13"	Silty Gravel Fill
13"-6.5'	Brown Silt trace sand

Test increment	Number of blows	Cumulative blows	Depth below ground surface	Cummulative Penetration	Penetration per blow set	Penetration per blow	Hammer blow factor	DCP Index	DCP Index	CBR	M_R
#	#	#	(in)	(in)	(in)	(in)	1 for 8-kg 2 for 4.6-kg hammer	in/blow	mm/blow	%	psi
1	1	1	14.2	1.2	1.2	1.2	1	1.2	30.48	6.357496	4525.87
2	1	2	15.2	2.2	1.0	1	1	1	25.4	7.797746	4859.401
3	1	3	16.1	3.1	0.9	0.9	1	0.9	22.86	8.774401	5063.236
4	1	4	17.2	4.2	1.1	1.1	1	1.1	27.94	7.008245	4682.089
5	1	5	18.2	5.2	1.0	1	1	1	25.4	7.797746	4859.401
6	1	6	19.3	6.3	1.1	1.1	1	1.1	27.94	7.008245	4682.089
7	1	7	20.5	7.5	1.2	1.2	1	1.2	30.48	6.357496	4525.87
8	1	8	21.6	8.6	1.1	1.1	1	1.1	27.94	7.008245	4682.089
9	1	9	22.6	9.6	1.0	1	1	1	25.4	7.797746	4859.401
10	1	10	23.6	10.6	1.0	1	1	1	25.4	7.797746	4859.401
11	1	11	24.7	11.7	1.1	1.1	1	1.1	27.94	7.008245	4682.089
12	1	12	25.5	12.5	0.8	0.8	1	0.8	20.32	10.01171	5301.243
13	1	13	26.2	13.2	0.7	0.7	1	0.7	17.78	11.62678	5584.632
14	1	14	26.8	13.8	0.6	0.6	1	0.6	15.24	13.81783	5930.67
15	1	15	28.1	15.1	1.3	1.3	1	1.3	33.02	5.81236	4386.77
16	1	16	29.3	16.3	1.2	1.2	1	1.2	30.48	6.357496	4525.87
17	1	17	30.6	17.6	1.3	1.3	1	1.3	33.02	5.81236	4386.77
18	1	18	31.8	18.8	1.2	1.2	1	1.2	30.48	6.357496	4525.87
19	1	19	33	20	1.2	1.2	1	1.2	30.48	6.357496	4525.87
20	1	20	34.1	21.1	1.1	1.1	1	1.1	27.94	7.008245	4682.089
21	1	21	35.1	22.1	1.0	1	1	1	25.4	7.797746	4859.401
22	1	22	36.1	23.1	1.0	1	1	1	25.4	7.797746	4859.401
23	1	23	37	24	0.9	0.9	1	0.9	22.86	8.774401	5063.236
24	1	24	37.9	24.9	0.9	0.9	1	0.9	22.86	8.774401	5063.236



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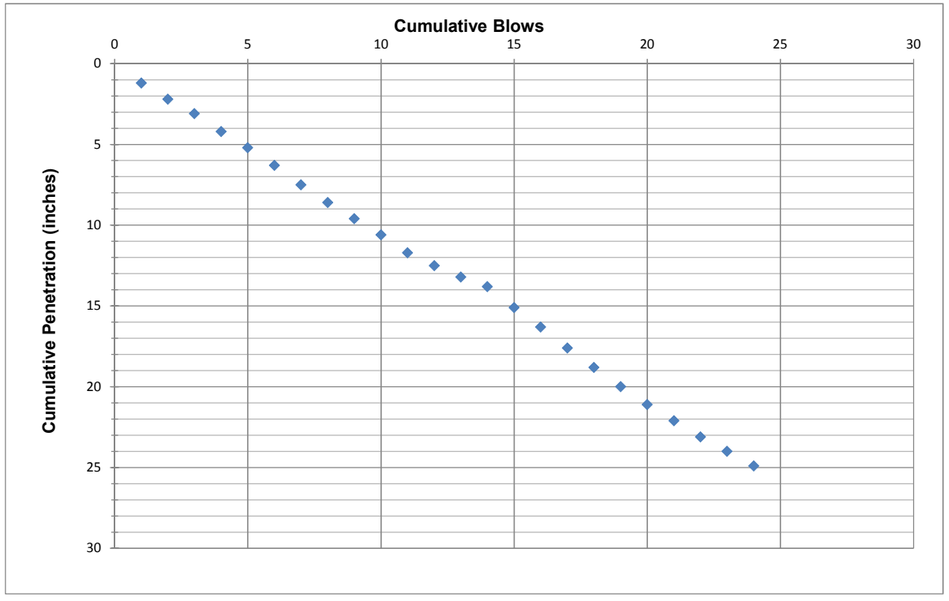


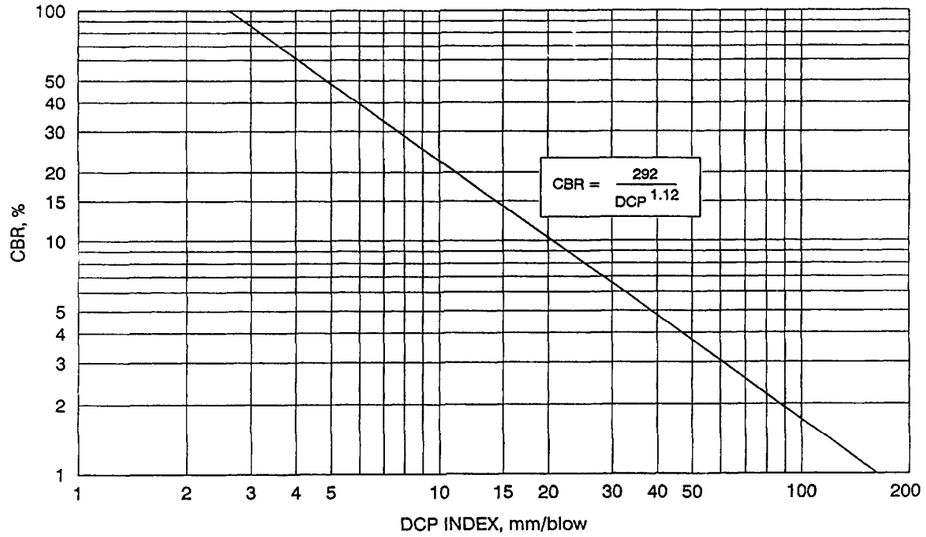
Location: Crestview, Newber, OR
Depth to bottom: 26"
Tester's Name: TAP
Tester's Company: GeoEngineers, Inc.

Date: 9/21/2017
Dimension: 4"
Tester's Contact No: 503-951-1810

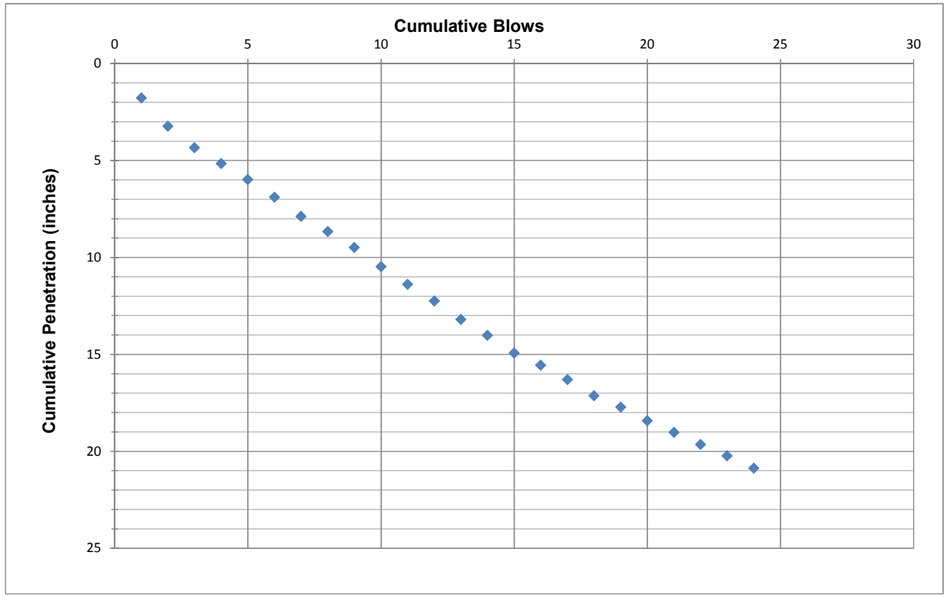
Test Hole Number: B-4
Test Method: Dynamic Cone Penetration
GeoEngineers Job: 6748-002-00

Depth, feet	Soil Texture
0-26"	Silty Gravel Fill
26"-6.5'	Brown Silt

Test increment	Number of blows	Cumulative blows	Depth below ground surface	Cummulative Penetration	Penetration per blow set	Penetration per blow	Hammer blow factor	DCP Index	DCP Index	CBR	M_R
#	#	#	(in)	(in)	(in)	(in)	1 for 8-kg 2 for 4.6-kg hammer	in/blow	mm/blow	%	psi
1	1	1	27.8	1.8	1.8	1.7716545	1	1.771655	45.00002	4.109458	3887.899
2	1	2	29.2	3.2	1.5	1.4566937	1	1.456694	37.00002	5.116779	4196.325
3	1	3	30.3	4.3	1.1	1.1023628	1	1.102363	28.00002	6.991423	4678.172
4	1	4	31.2	5.2	0.8	0.8267721	1	0.826772	21.00001	9.649326	5233.622
5	1	5	32.0	6.0	0.8	0.8267721	1	0.826772	21.00001	9.649326	5233.622
6	1	6	32.9	6.9	0.9	0.9055123	1	0.905512	23.00001	8.714599	5051.193
7	1	7	33.9	7.9	1.0	0.9842525	1	0.984253	25.00001	7.93761	4889.576
8	1	8	34.7	8.7	0.8	0.787402	1	0.787402	20.00001	10.19129	5334.161
9	1	9	35.5	9.5	0.8	0.8267721	1	0.826772	21.00001	9.649326	5233.622
10	1	10	36.5	10.5	1.0	0.9842525	1	0.984253	25.00001	7.93761	4889.576
11	1	11	37.4	11.4	0.9	0.9055123	1	0.905512	23.00001	8.714599	5051.193
12	1	12	38.2	12.2	0.9	0.8661422	1	0.866142	22.00001	9.159446	5139.525
13	1	13	39.2	13.2	0.9	0.9448824	1	0.944882	24.00001	8.308947	4968.044
14	1	14	40.0	14.0	0.8	0.8267721	1	0.826772	21.00001	9.649326	5233.622
15	1	15	40.9	14.9	0.9	0.9055123	1	0.905512	23.00001	8.714599	5051.193
16	1	16	41.6	15.6	0.6	0.6299216	1	0.629922	16.00001	13.08483	5819.17
17	1	17	42.3	16.3	0.7	0.7480319	1	0.748032	19.00001	10.7939	5441.942
18	1	18	43.1	17.1	0.8	0.8267721	1	0.826772	21.00001	9.649326	5233.622
19	1	19	43.7	17.7	0.6	0.5905515	1	0.590552	15.00001	14.06567	5967.498
20	1	20	44.4	18.4	0.7	0.7086618	1	0.708662	18.00001	11.46773	5557.911
21	1	21	45.0	19.0	0.6	0.5905515	1	0.590552	15.00001	14.06567	5967.498
22	1	22	45.6	19.6	0.6	0.6299216	1	0.629922	16.00001	13.08483	5819.17
23	1	23	46.2	20.2	0.6	0.5905515	1	0.590552	15.00001	14.06567	5967.498
24	1	24	46.9	20.9	0.6	0.6299216	1	0.629922	16.00001	13.08483	5819.17



(after Webster et al., 1992)
Webster, S. L., Grau, R. H., and Williams, T. P. (1992). Description and application of dual mass dynamic cone penetrometer. Department of the Army Waterways Equipment Station, No. GL-92-3.



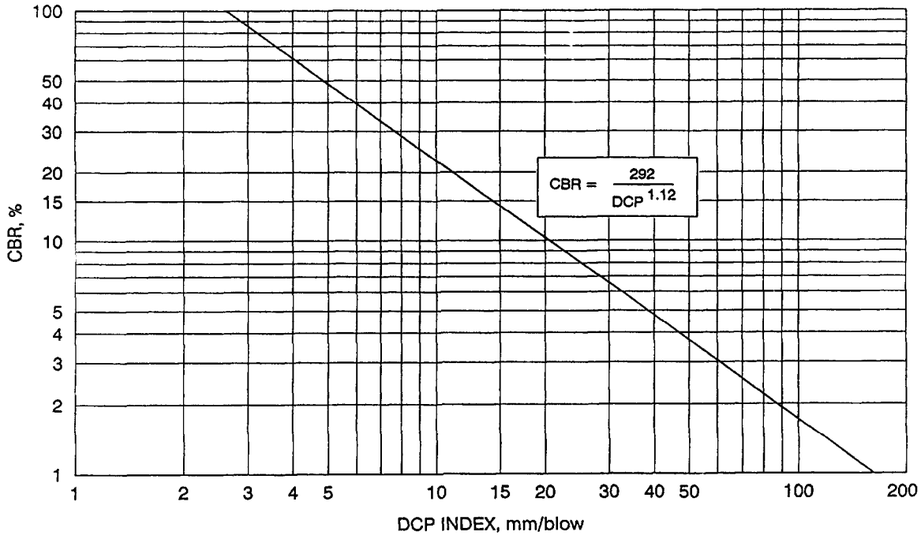
Location: Crestview, Newberg, OR
Depth to bottom: 22"
Tester's Name: TAP
Tester's Company: GeoEngineers, Inc.

Date: 9/21/2017
Dimension: 4"
Tester's Contact No: 503-951-1810

Test Hole Number: B-6
Test Method: Dynamic Cone Penetration
GeoEngineers Job: 6748-002-00

Depth, feet	Soil Texture
0-22"	Silty Gravel Fill
22"-6.5'	Brown Silt

Test increment	Number of blows	Cumulative blows	Depth below ground surface	Cummulative Penetration	Penetration per blow set	Penetration per blow	Hammer blow factor	DCP Index	DCP Index	CBR	M_R
#	#	#	(in)	(in)	(in)	(in)	1 for 8-kg 2 for 4.6-kg hammer	in/blow	mm/blow	%	psi
1	1	1	23.9	1.9	1.9	1.9	1	1.9	48.26	3.799838	3783.283
2	1	2	25.8	3.8	1.9	1.9	1	1.9	48.26	3.799838	3783.283
3	1	3	26.8	4.8	1.0	1	1	1	25.4	7.797746	4859.401
4	1	4	27.7	5.7	0.9	0.9	1	0.9	22.86	8.774401	5063.236
5	1	5	28.6	6.6	0.9	0.9	1	0.9	22.86	8.774401	5063.236
6	1	6	29.5	7.5	0.9	0.9	1	0.9	22.86	8.774401	5063.236
7	1	7	30.3	8.3	0.8	0.8	1	0.8	20.32	10.01171	5301.243
8	1	8	31.2	9.2	0.9	0.9	1	0.9	22.86	8.774401	5063.236
9	1	9	32	10	0.8	0.8	1	0.8	20.32	10.01171	5301.243
10	1	10	32.8	10.8	0.8	0.8	1	0.8	20.32	10.01171	5301.243
11	2	12	34.1	12.1	1.3	0.65	1	0.65	16.51	12.63299	5748.395
12	2	14	35.4	13.4	1.3	0.65	1	0.65	16.51	12.63299	5748.395
13	2	16	36.6	14.6	1.2	0.6	1	0.6	15.24	13.81783	5930.67
14	2	18	37.8	15.8	1.2	0.6	1	0.6	15.24	13.81783	5930.67
15	2	20	38.8	16.8	1.0	0.5	1	0.5	12.7	16.94817	6367.728
16	3	23	40.3	18.3	1.5	0.5	1	0.5	12.7	16.94817	6367.728
17	3	26	41.6	19.6	1.3	0.433333333	1	0.433333	11.00667	19.89429	6733.21
18	3	29	42.9	20.9	1.3	0.433333333	1	0.433333	11.00667	19.89429	6733.21
19	3	32	44.1	22.1	1.2	0.4	1	0.4	10.16	21.76015	6946.713
20	3	35	45.5	23.5	1.4	0.466666667	1	0.466667	11.85333	18.30971	6541.391
21	3	38	46.6	24.6	1.1	0.366666667	1	0.366667	9.313333	23.98751	7186.492
22	3	41	47.7	25.7	1.1	0.366666667	1	0.366667	9.313333	23.98751	7186.492
23	3	44	48.7	26.7	1.0	0.333333333	1	0.333333	8.466667	26.68977	7458.647



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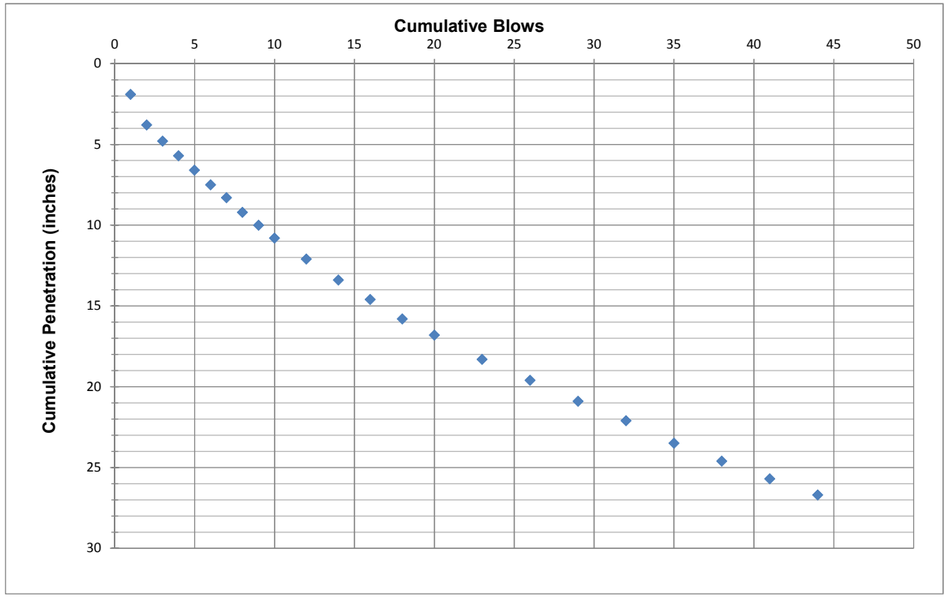


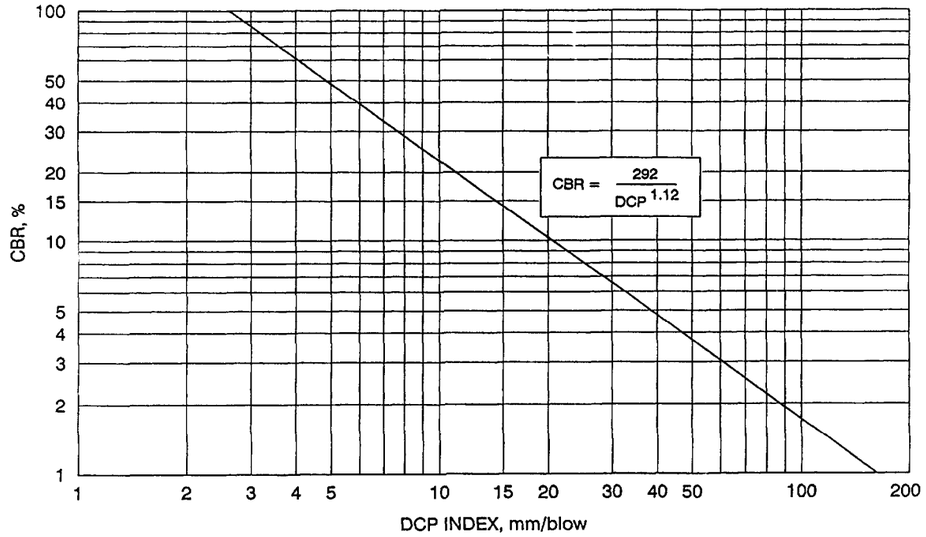
Location: Crestview, Newberg, OR
Depth to bottom: 22.5
Tester's Name: TAP
Tester's Company: GeoEngineers, Inc.

Date: 9/21/2017
Dimension: 4"
Tester's Contact No: 503-951-1810

Test Hole Number: B-8
Test Method: Dynamic Cone Penetration
GeoEngineers Job: 6748-002-00

Depth, feet	Soil Texture
0-22.5"	Silty Gravel Fill
22.5"-6.5'	Brown Silt

Test increment	Number of blows	Cumulative blows	Depth below ground surface	Cummulative Penetration	Penetration per blow set	Penetration per blow	Hammer blow factor	DCP Index	DCP Index	CBR	M_R
#	#	#	(in)	(in)	(in)	(in)	1 for 8-kg 2 for 4.6-kg hammer	in/blow	mm/blow	%	psi
1	1	1	24.4	1.9	1.9	1.9	1	1.9	48.26	3.799838	3783.283
2	1	2	25.2	2.7	0.8	0.8	1	0.8	20.32	10.01171	5301.243
3	1	3	26	3.5	0.8	0.8	1	0.8	20.32	10.01171	5301.243
4	1	4	27	4.5	1.0	1	1	1	25.4	7.797746	4859.401
5	1	5	27.9	5.4	0.9	0.9	1	0.9	22.86	8.774401	5063.236
6	1	6	28.7	6.2	0.8	0.8	1	0.8	20.32	10.01171	5301.243
7	2	8	29.5	7	0.8	0.4	1	0.4	10.16	21.76015	6946.713
8	2	10	30	7.5	0.5	0.25	1	0.25	6.35	36.83632	8344.228
9	2	12	30.6	8.1	0.6	0.3	1	0.3	7.62	30.03262	7771.511
10	3	15	31.3	8.8	0.7	0.233333333	1	0.233333	5.926667	39.7956	8571.796
11	3	18	32.1	9.6	0.8	0.266666667	1	0.266667	6.773333	34.26763	8136.825
12	3	21	33.1	10.6	1.0	0.333333333	1	0.333333	8.466667	26.68977	7458.647
13	3	24	33.8	11.3	0.7	0.233333333	1	0.233333	5.926667	39.7956	8571.796
14	3	27	35.2	12.7	1.4	0.466666667	1	0.466667	11.85333	18.30971	6541.391
15	3	30	36	13.5	0.8	0.266666667	1	0.266667	6.773333	34.26763	8136.825
16	3	33	36.5	14	0.5	0.166666667	1	0.166667	4.233333	58.00942	9773.762
17	4	37	37	14.5	0.5	0.125	1	0.125	3.175	80.06263	10934.22
18	4	41	37.5	15	0.5	0.125	1	0.125	3.175	80.06263	10934.22
19	5	46	38	15.5	0.5	0.1	1	0.1	2.54	102.7943	11928.42
20	5	51	38.7	16.2	0.7	0.14	1	0.14	3.556	70.51893	10461.47
21	5	56	39.9	17.4	1.2	0.24	1	0.24	6.096	38.5596	8478.136
22	5	61	40.8	18.3	0.9	0.18	1	0.18	4.572	53.21865	9484.763
23	5	66	41.5	19	0.7	0.14	1	0.14	3.556	70.51893	10461.47
24	5	71	42.5	20	1.0	0.2	1	0.2	5.08	47.29503	9102.927
25	6	77	43.1	20.6	0.6	0.1	1	0.1	2.54	102.7943	11928.42
26	6	83	43.4	20.9	0.3	0.05	1	0.05	1.27	223.4203	15630.92
27	6	89	43.8	21.3	0.4	0.066666667	1	0.066667	1.693333	161.8793	13971.99
28	6	95	44.3	21.8	0.5	0.083333333	1	0.083333	2.116667	126.0817	12807.47



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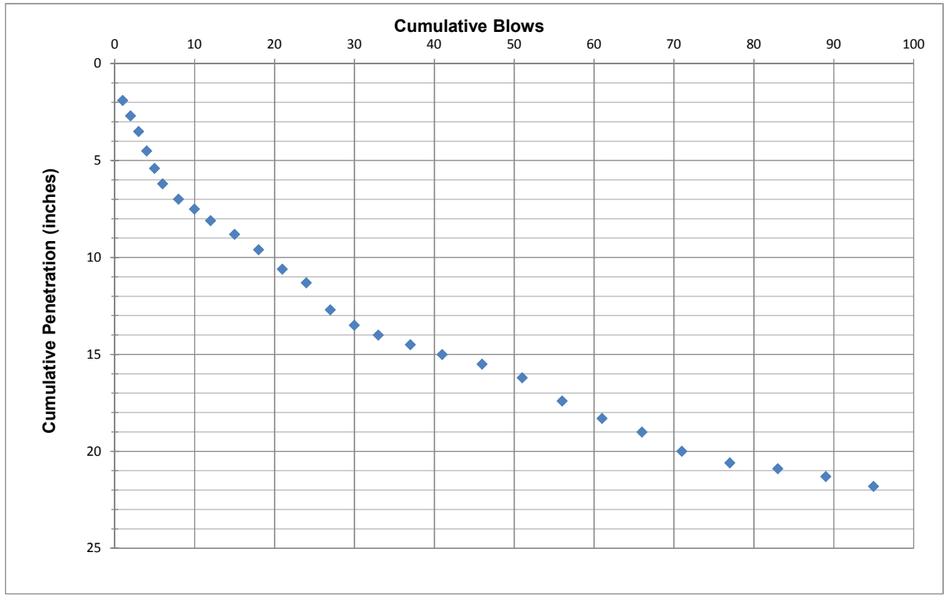


Location: Newberg, OR
Depth to bottom: 2'
Tester's Name: Danny Hess
Tester's Company: GeoEngineers, Inc.

Date: 9/21/2018
Dimension: 6"

Test Hole Number: IT-1
Test Method: Open Pit Fallin Head
GeoEngineers Job: 6748-002-00

Depth	Soil Texture
0-2'	Brown silt

Time of Day	Time Interval (min)	Total Time (min)	Depth to Water from Top of Pipe (inches)	Dist. Interval (inches)	Infiltration (inches/hour)	
10:43	0		1.17			Test #1
10:44	1	1	1.21	0.04	2.4	
10:45	1	2	1.23	0.02	1.2	
10:46	1	3	1.25	0.02	1.2	
10:47	1	4	1.27	0.02	1.2	
10:48	1	5	1.29	0.02	1.2	
10:49	1	6	1.31	0.02	1.2	
10:50	1	7	1.33	0.02	1.2	
10:51	1	8	1.36	0.03	1.8	
10:52	1	9	1.38	0.02	1.2	
10:53	1	10	1.38	0.00	0.0	
10:58	5	15	1.44	0.06	0.7	
11:03	5	20	1.50	0.06	0.7	
11:08	5	25	1.54	0.04	0.5	
11:13	5	30	1.58	0.04	0.5	
11:23	10	40	1.64	0.06	0.4	
11:33	10	50	1.70	0.06	0.4	
11:43	10	60	1.74	0.04	0.2	

Location: Newberg, OR
Depth to bottom: 3'
Tester's Name: Danny Hess
Tester's Company: GeoEngineers, Inc.

Date: 9/21/2018
Dimension: 6"

Test Hole Number: IT-2
Test Method: Encased Falling Head
GeoEngineers Job: 6748-002-00

	Depth	Soil Texture
	0-3'	Brown silt

Time of Day	Time Interval (min)	Total Time (min)	Depth to Water from Top of Pipe (inches)	Dist. Interval (inches)	Infiltration (inches/hour)	
15:00			3.98			
15:10	10	10	3.98	0.00	0.0	
15:20	10	20	3.98	0.00	0.0	
15:30	10	30	3.98	0.00	0.0	Test #1
15:40	10	40	3.98	0.00	0.0	
15:50	10	50	3.99	0.01	0.1	
16:00	10	60	3.99	0.00	0.0	

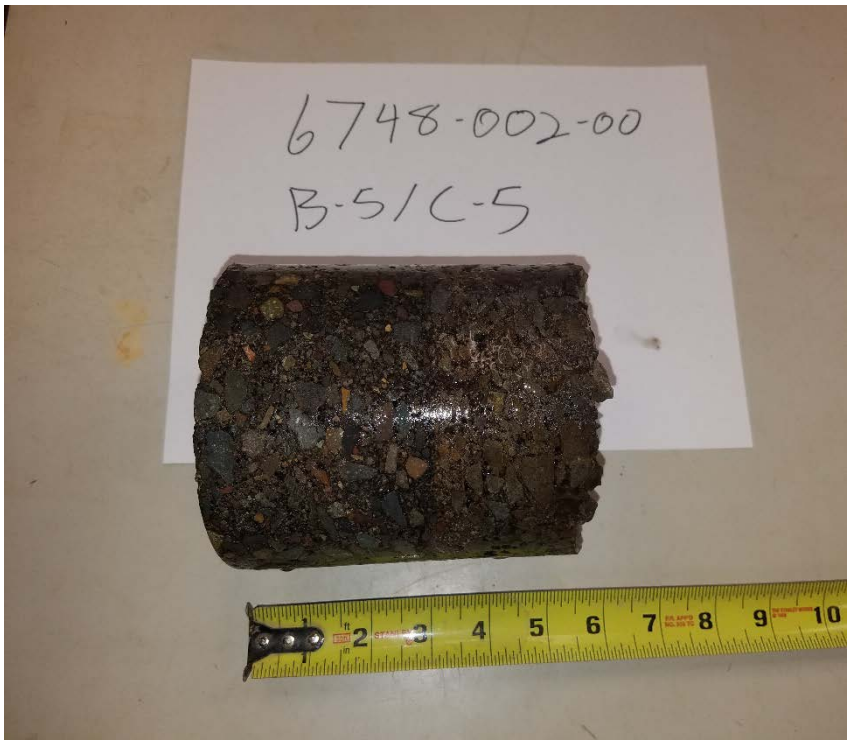
APPENDIX B
Asphalt Core Photographs

Top

Asphalt Core Photographs	
Crestview Crossing Development Newberg, Oregon	
GeoEngineers	Figure B-1

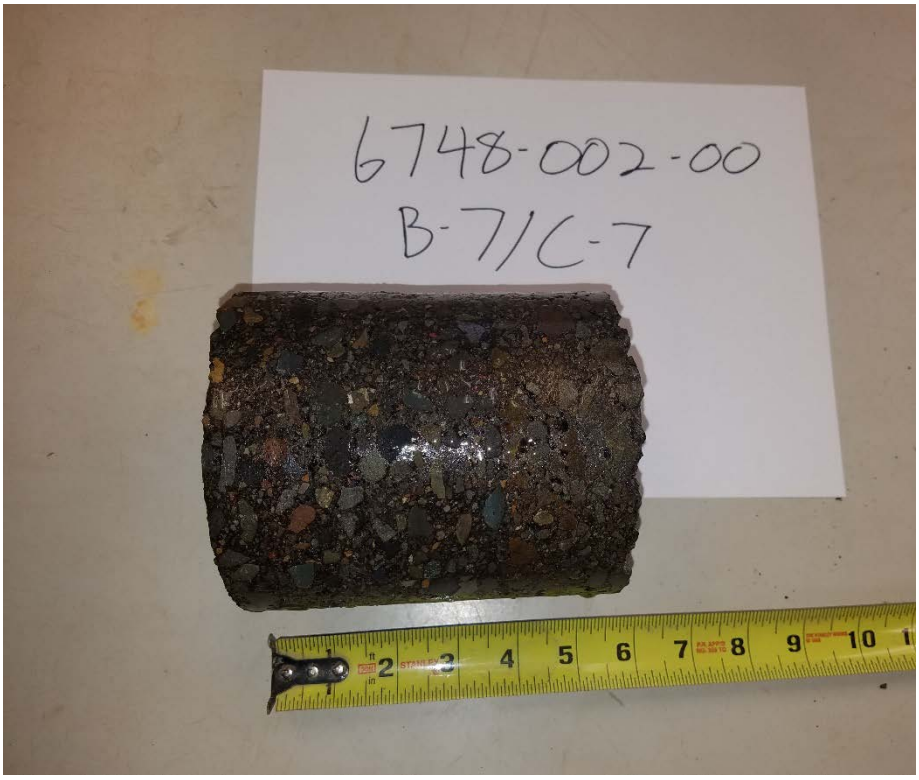
Top

Asphalt Core Photographs	
Crestview Crossing Development Newberg, Oregon	
GeoEngineers	Figure B-2



Top

Asphalt Core Photographs	
Crestview Crossing Development Newberg, Oregon	
GeoEngineers	Figure B-3



Top

Asphalt Core Photographs	
Crestview Crossing Development Newberg, Oregon	
GeoEngineers	Figure B-4

Top

Asphalt Core Photographs	
Crestview Crossing Development Newberg, Oregon	
GeoEngineers	Figure B-5

APPENDIX C
Report Limitations and Guidelines for Use

APPENDIX C
REPORT LIMITATIONS AND GUIDELINES FOR USE[1]

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

Read These Provisions Closely

It is important to recognize that the geoscience practices (geotechnical engineering, geology and environmental science) rely on professional judgment and opinion to a greater extent than other engineering and natural science disciplines, where more precise and/or readily observable data may exist. To help clients better understand how this difference pertains to our services, GeoEngineers includes the following explanatory "limitations" provisions in its reports. Please confer with GeoEngineers if you need to know more how these "Report Limitations and Guidelines for Use" apply to your project or site.

Geotechnical Services Are Performed for Specific Purposes, Persons and Projects

This report has been prepared for 3J Consulting, Inc., J.T. Smith Companies and their authorized agents and/or regulatory agencies for the project specifically identified in the report. The information contained herein is not applicable to other sites or projects.

GeoEngineers structures its services to meet the specific needs of its clients. No party other than the party to whom this report is addressed may rely on the product of our services unless we agree to such reliance in advance and in writing. Within the limitations of the agreed scope of services for the Project, and its schedule and budget, our services have been executed in accordance with our Agreement with J.T. Smith Companies dated June 29, 2017 and generally accepted geotechnical practices in this area at the time this report was prepared. We do not authorize, and will not be responsible for, the use of this report for any purposes or projects other than those identified in the report.

A Geotechnical Engineering or Geologic Report is Based on a Unique Set of Project-Specific Factors

This report has been prepared for the proposed Crestview Crossing Development north of Hwy 99W between Vittoria Way and North Harmony Lane in Newberg, Oregon. GeoEngineers considered a number of unique, project-specific factors when establishing the scope of services for this project and report. Unless GeoEngineers specifically indicates otherwise, it is important not to rely on this report if it was:

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

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

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

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

If changes occur after the date of this report, GeoEngineers cannot be responsible for any consequences of such changes in relation to this report unless we have been given the opportunity to review our interpretations and recommendations. Based on that review, we can provide written modifications or confirmation, as appropriate.

Environmental Concerns Are Not Covered

Unless environmental services were specifically included in our scope of services, this report does not provide any environmental findings, conclusions, or recommendations, including but not limited to, the likelihood of encountering underground storage tanks or regulated contaminants.

Subsurface Conditions Can Change

This geotechnical or geologic report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by man-made events such as construction on or adjacent to the site, new information or technology that becomes available subsequent to the report date, or by natural events such as floods, earthquakes, slope instability or groundwater fluctuations. If more than a few months have passed since issuance of our report or work product, or if any of the described events may have occurred, please contact GeoEngineers before applying this report for its intended purpose so that we may evaluate whether changed conditions affect the continued reliability or applicability of our conclusions and recommendations.

Geotechnical and Geologic Findings Are Professional Opinions

Our interpretations of subsurface conditions are based on field observations from widely spaced sampling locations at the site. Site exploration identifies the specific subsurface conditions only at those points where subsurface tests are conducted or samples are taken. GeoEngineers reviewed field and laboratory data and then applied its professional judgment to render an informed opinion about subsurface conditions at other locations. Actual subsurface conditions may differ, sometimes significantly, from the opinions presented in this report. Our report, conclusions and interpretations are not a warranty of the actual subsurface conditions.

Geotechnical Engineering Report Recommendations Are Not Final

We have developed the following recommendations based on data gathered from subsurface investigation(s). These investigations sample just a small percentage of a site to create a snapshot of the subsurface conditions elsewhere on the site. Such sampling on its own cannot provide a complete and accurate view of subsurface conditions for the entire site. Therefore, the recommendations included in this report are preliminary and should not be considered final. GeoEngineers' recommendations can be finalized only by observing actual subsurface conditions revealed during construction. GeoEngineers cannot assume responsibility or liability for the recommendations in this report if we do not perform construction observation.

We recommend that you allow sufficient monitoring, testing and consultation during construction by GeoEngineers to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes if the conditions revealed during the work differ from those anticipated, and to evaluate whether earthwork activities are completed in accordance with our recommendations. Retaining GeoEngineers for construction observation for this project is the most effective means of managing the risks associated with unanticipated conditions. If another party performs field observation and confirms our expectations, the other party must take full responsibility for both the observations and recommendations. Please note, however, that another party would lack our project-specific knowledge and resources.

A Geotechnical Engineering or Geologic Report Could Be Subject to Misinterpretation

Misinterpretation of this report by members of the design team or by contractors can result in costly problems. GeoEngineers can help reduce the risks of misinterpretation by conferring with appropriate members of the design team after submitting the report, reviewing pertinent elements of the design team's plans and specifications, participating in pre-bid and preconstruction conferences, and providing construction observation.

Do Not Redraw the Exploration Logs

Geotechnical engineers and geologists prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. The logs included in a geotechnical engineering or geologic report should never be redrawn for inclusion in architectural or other design drawings. Photographic or electronic reproduction is acceptable but separating logs from the report can create a risk of misinterpretation.

Give Contractors a Complete Report and Guidance

To help reduce the risk of problems associated with unanticipated subsurface conditions, GeoEngineers recommends giving contractors the complete geotechnical engineering or geologic report, including these "Report Limitations and Guidelines for Use." When providing the report, you should preface it with a clearly written letter of transmittal that:

- advises contractors that the report was not prepared for purposes of bid development and that its accuracy is limited; and
- encourages contractors to confer with GeoEngineers and/or to conduct additional study to obtain the specific types of information they need or prefer.

Contractors Are Responsible for Site Safety on Their Own Construction Projects

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

Biological Pollutants

GeoEngineers' Scope of Work specifically excludes the investigation, detection, prevention or assessment of the presence of Biological Pollutants. Accordingly, this report does not include any interpretations, recommendations, findings or conclusions regarding the detecting, assessing, preventing or abating of Biological Pollutants, and no conclusions or inferences should be drawn regarding Biological Pollutants as they may relate to this project. The term "Biological Pollutants" includes, but is not limited to, molds, fungi, spores, bacteria and viruses, and/or any of their byproducts.

A Client that desires these specialized services is advised to obtain them from a consultant who offers services in this specialized field.

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