STORMWATER CALCULATIONS

Prepared For:

JMI Investment Properties, LLC

4742 Liberty Road, Suite 182

Salem, OR 97302

Project:

Liberty Rd S & Hrubetz Rd SE Redevelopment

Salem, OR 97302

Permit Number:

Prepared By:

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June 2019

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PROJECT OVERVIEW & DESCRIPTION

1.1 SIZE & LOCATION OF PROJECT

The proposed project is located at the SE corner of Liberty Rd S and Hrubetz Rd SE in Salem, Oregon. The project site is approximately 1.5 acres. Refer to the Civil Drawings for a site map of the project area.

1.2 BRIEF DESCRIPTION OF PROJECT SCOPE AND PROPOSED IMPROVEMENTS

The phased project scope is to redevelop the project site for mixed commercial use with construction of three new buildings. The first phase includes constructing one building (Bldg A) and infrastructure for the entire site. The second phase will construct two additional buildings. Refer to the Civil Drawings for the proposed phasing. Both phases are analyzed in the stormwater calculations of this report. The project includes site preparation and construction of the facilities.

1.3 DESCRIPTION OF SIZE OF WATERSHED DRAINING TO THE SITE

The total site drainage area is 65,868 square feet which drain to the proposed stormwater facilities. This area includes street improvements along the property's Hrubetz frontage. No additional drainage area drains to the project site.

1.4 DESCRIPTION OF THE EXISTING SITE CONDITIONS, CONSTRAINTS, SENSITIVE AREAS & WATERWAYS

The existing site is entirely developed with mixed commercial and single-family residential. The site does not contain any other sensitive areas, waterways, etc.

1.5 SUMMARY OF EXISTING TREES & NATIVE VEGETATION

Three trees exists along the southern border of the subject property. Approximately half the site is covered in grasses associated with single-family residential lots.

1.6 SUMMARY OF GREEN STORMWATER INFRASTRUCTURE

Per Appendix 4E of the City of Salem (COS) Design Standards, a large project will be considered to have met the maximum extent feasible (MEF) requirement when the stormwater runoff from the total amount of new plus replaced impervious surfaces flows into an area set aside for GSI that is at least 10% of the total area of the new plus replaced impervious surfaces or at least 80% of all impervious area must be treated by GSI. This design implements GSI for the entire project site' impervious area and therefore meets MEF for GSI.

1.7 REGULATORY PERMITS REQUIRED

A 1200-C permit from DEQ will be required since more than one acre is disturbed by the project. City of Salem permits are required. No other permits are required for this project.

1.8 100 YEAR STORM ESCAPE ROUTES

Please refer to the Developed Basin Map in Appendix C for 100 year storm overflow routes.

METHODOLOGY

2.1 DEPTH TO GROUNDWATER

Nearby well logs indicate the groundwater level to be approximately 15 feet below ground surface. Per the proposed stormwater design, drain rock in the rain gardens conform to the COS Design Standards requirement of 3 feet of separation from groundwater. Refer to Appendix E for well logs.

2.2 MAXIMUM INFILTRATION AND VEGETATIVE TREATMENT

Per the attached Infiltration Memo in Appendix A, the average site infiltration rate is 0.04 inches per hour.

The proposed stormwater design will treat and detain the entire site's impervious area with rain gardens. Since stormwater for the entire site's impervious area will be treated and detained via GSI facilities, GSI has been implemented to the maximum extent feasible.

2.3 SOIL INFORMATION

The pre-developed project site contains hydrologic soil group C soils. Refer to the Soils Report in Appendix B for more details

2.4 HAZARDOUS MATERIAL

The owner is not aware of any hazardous material contamination onsite.

3.1 METHODS & SOFTWARE USED

HydroCAD modeling software was used to size the stormwater facilities. The Santa Barbara Unit Hydrograph Type 1A storm was used to model the required design storms. Per the City of Salem Design Standards the design storms used were the 1.38 inch, 24 hour (water quality storm), half the 2-year, 24-hour and the 10-year, 24-hour storm events.

Table 1 | City of Salem 24-hour Design Storms

	24-Hour Rainfall Depths for Salem, OR						
Recurrence Interval, Years	WQ	2	5	10	25	50	100
24-Hour Depths, Inches	1.38	2.2	2.7	3.2	3.6	4.1	4.4

Source: City of Salem Administrative Rules Chapter 109 – Division 004 Appendix D

3.2 CURVE NUMBER AND TIME OF CONCENTRATION CALCULATIONS

Per the COS Design Standards, the pre-developed site was covered in a combination of woods and good-grass, which corresponds to a pre-developed curve number of 72 for hydrologic soil group C-rated soils.

The developed impervious and pervious areas were assigned curve numbers of 98 and 74, respectively. The impervious areas were assigned a curve number of 98 which corresponds paved areas. The pervious areas were assigned a curve number of 74 which corresponds to open space landscaping with C-rated soils.

Time of concentration (Tc) for the pre-developed conditions was calculated to be 32.1 minutes using the sheet flow equation. See the Pre-Developed Basin Map in Appendix C for the flow path used and refer to the HydroCAD Summaries in Appendix D for calculations. A minimum time of concentration (Tc) of 5 minutes is applied to the developed basins due to the minimum time-step used by the HydroCAD modeling software.

3.3 TREATMENT & FLOW CONTROL SIZING CALCULATIONS

The site was analyzed as one (1) basin for predeveloped stormwater calculations and six (6) basins for developed calculations. General basin characteristics of both pre-developed and developed conditions are listed in Table 2. For more detail refer to the Basin Maps in Appendix C and the Civil Drawings.

Table 2 | General Basin Characteristics

Basin ID	Source (Roof/Road/ Other)	Impervious Area (sf)	Pervious Area (sf)	Design Storms		CN[1]	Tc (min)
				½ 2 Year (cfs)	10 Year (cfs)		
Predeveloped	Native	-	65,865	0.02	0.15	NA / 72	32.1
Developed Basins							
Basin 1	Paved/Roof/ Landscape	29,170	5,368	0.15	0.52	98 / 74	5.0
Basin 2	Paved/Roof/ Landscape	12,671	2,236	0.07	0.23	98 / 74	5.0
Basin 3	Paved/ Landscape	3,114	550	0.02	0.06	98 / 74	5.0
Basin 4	Paved/Roof/ Landscape	4,328	855	0.02	0.08	98 / 74	5.0
Basin 5	Paved	2,640	1,744	0.01	0.05	98 / 74	5.0
Basin 6	Paved	2,350	842	0.01	0.04	98 / 74	5.0
Total Developed		54,273	11,595	0.28	0.98	-	-

[1] Curve numbers listed for the impervious / pervious areas in the basin

Combination rain gardens are proposed to treat and detain the required storm events. The rain garden have been sized to drain the water quality storm below the growing media in a maximum of 50 hours from the start of the event, which is less than the required 54 hours per the COS Design Standards. See the HydroCAD Summaries in Appendix D for drain time during the water quality storm.

The combination rain gardens are proposed to infiltrate and detain the required storm events. The allowable release rates for the design storms are listed in Table 3.

Table 3 | Allowable Release Rates

Site Condition	Design Storm (cfs)	
	½ 2 Year	10 Year
Pre-Developed	0.02	0.15

Stormwater is released form the rain gardens by exfiltration into the subsoils and either one or two orifices within flow-control beehive catchbasins. Each rain garden is controlled by a separate flow-control beehive catchbasin. Perforated pipes run the length of the rain-garden to facilitate drainage. Flows exceeding the 10-year storm are released by the rim of the beehive catchbasin. See Tables 4 and 5 below for a summary of facility outlet sizing and release rates. Refer to the Basin Map in Appendix C and the Civil Drawings for more details.

Table 4 | Summary of Facility Outlet Sizing

Facility ID[1]	Orifice #1		Orifice #2		Beehive Catch Basin	
	Invert Elevation (ft)	Diameter (in)	Invert Elevation (ft)	Diameter (in)	Rim Invert Elevation (ft)	Diameter (in)
RG 1	467.00	0.6	469.60	1.6	471.0	24
RG 2	467.25	0.5	468.45	0.7	471.0	24
RG 3	468.75	0.4	NA	NA	472.5	24
RG 4	467.25	0.3	NA	NA	471.5	24
RG 5	467.25	0.3	NA	NA	471.5	24
RG 6	466.25	0.4	NA	NA	470.0	24

Table 5 | Summary of Facility Release Rates and Peak Water Surface Elevations (WSE)

Facility ID	Infiltration Rate (in/hr)	½ 2 Year Storm		WQ Storm		10 Year Storm	
		Release (cfs)	WSE (ft)	Release (cfs)	WSE (ft)	Release (cfs)	WSE (ft)
RG 1	0.04	0.01	467.88	0.02	469.68	0.09	470.86
RG 2	0.04	0.01	468.43	0.02	469.23	0.03	470.99
RG 3	0.04	0.00	468.96	0.00	469.18	0.01	472.29
RG 4	0.04	0.00	467.64	0.00	468.03	0.00	471.21
RG 5	0.04	0.00	467.51	0.00	467.81	0.00	471.09
RG 6	0.04	0.00	466.43	0.00	466.85	0.01	469.95
Total[1]	-	0.02	-	-	-	0.15	-
Allowable	-	0.02	-	-	-	0.15	-

[2]Totals do not sum to the addition of the individual flows. This is due to the fact that the release times vary for each facility. The totals are the combination of the facility hydrographs. Refer to Link 1L: junc in Appendix D.

Refer to Table 2 for pervious and impervious areas served by each rain garden. A summary of rain garden geometries and required drain rock is provided in Table 6 below. Please note the facilities requires drain rock with an areas specified below to detain and control the design storms in conformance with COS standards.

Table 6 | Facility Sizing Summary

Facility ID[1]	Facility Elevations[2] (ft)		Facility Surface Area[2] (SF)		Required Drain Rock Surface Area (SF)	Depth of Drain Rock (ft)
	Top	Bottom	Top	Bottom		
RG 1	472.0	469.5	1,350	672	1,350	3.5
RG 2	472.5	470	889	564	564	2.5
RG 3	473.5	471.0	200	50	200	2.5
RG 4	472.5	470.0	385	385	385	2.5
RG 5	472.5	470.0	250	250	250	2.5
RG 6	471.5	469.0	125	125	125	2.5

3.4 CONVEYANCE CAPACITY CALCULATIONS

Per the COS Design Standards for sites less than 50 acres, the stormwater facilities were designed to convey the developed 10-year, 24-hour storm which has an undetained peak flow of 0.98 cfs from the entire site. Stormwater runoff is conveyed from the rain gardens to a catch basin at the SE corner of Liberty Rd & Hrubetz Rd via a a 10-inch pipe. Below is a summary of the conveyance calculations.

- The 10-inch outlet pipe from the rain gardens is designed with a 0.3% slope. Using Manning's Equation per the Design Standards, a 10-inch pipe with a slope of 0.4% and Manning's n of 0.013 has a full flow capacity of 1.20 cfs which exceeds the undetained 10-year peak of 0.98 cfs from the entire site.

3.5 SUMMARY

The stormwater system has been designed to release half the 2-year, 24-hour and the 10-year, 24-hour storm events at rates less than their respective pre-developed storm. The proposed design also treats the water quality storm in less than the required 54 hours from the start of the storm event. Therefore, the project meets the flow control and treatment requirements as set forth in Administrative Rule 109 Division 004 - Stormwater System.

APPENDIX A

INFILTRATION MEMO

Memo

TO: **Jim Iverson – JMI Investment Properties**

FROM: **Kristopher T. Hauck, PE – Terracon**
Brice W. Plouse, PE – Terracon

CC: **Keith Brownell – N8 Excavation**

DATE: **1/4/2019**

RE: **Memorandum for SW 107th Avenue and Laurel Road Improvements**
Liberty Road Mixed Use Development
4704 Liberty Road S and 120 Hrubetz Road SE
Salem, Marion County, Oregon
Terracon Project No. 82185090

The purpose of this memo is to provide infiltration rates of the native soils near proposed stormwater facilities and pavement recommendations for the planned saw cut and replacement pavement section along Hrubetz Road SE. We conducted the infiltration testing on December 4, 2018 and pavement evaluations on December 13, 2018. This memo is not intended to replace a Geotechnical Engineering Report for the purpose of the subject Mixed-Use Development.

To expedite the permitting process with the City of Salem, JMI Investment Properties requested we provide recommendations for stormwater management and pavement reconstruction of Hrubetz Road. It is anticipated the City of Salem will require recommendations for either retaining the existing pavement road section or a constructing a new proposed road structural section.

FIELD EXPLORATION PROCEDURES

Infiltration Testing: Our field investigation included three hand auger investigations to a depth of 5 feet below the ground surface. We conducted one EPA Falling Head infiltration tests within each of the hand auger holes at depths ranging from 3 to 5 feet below the ground surface. The infiltration test locations are shown on our Exploration Plan. At the completion of our infiltration testing we collected samples from each infiltration depth.

Pavement Evaluation: Our field investigation included conducting two hand auger investigations to determine the existing asphaltic concrete pavement section. The purpose of the field explorations was to determine in-situ strength properties of the existing pavement base course

and subgrade soils. We utilized the Army Corp Dynamic Cone Penetrometer (DCP), per ASTM D6951, to correlate in-situ penetration resistance values to an average California Bearing Ratio (CBR) of the base course and subgrade layers.

At the completion of DCP testing, bulk samples of the upper 3 feet of subgrade were collected utilizing a hand auger to conduct laboratory modified proctor and CBR tests, per ASTM D1557 and D1883 (results of these tests are attached to this letter), respectively. These values produce the maximum dry density, optimum moisture content and anticipated maximum CBR value for the tested subgrade soils used in the pavement design. Exploration logs of the cores are attached to this letter.

PAVEMENTS

Pavement Design Recommendations

Based on traffic count data from the City of Salem's interactive Traffic Count map (https://www.cityofsalem.net/Pages/view-traffic-counts.aspx) we collected the following historic traffic information for Hrubetz Road SE:

Hrubetz Road SE: East of Liberty Road (Collector, ID: 28)	
Collection Date	**Total Daily Traffic Count**
1990	2,010
1993	2,080
1995	2,436
1997	1,755
1998	2,240
3/31/2006	1,980
Average	**2,084**

1. We have assumed the provided total traffic counts consider traffic in both travel directions and are for a single day.
2. We also assume these counts are for Hrubetz Road SE solely and do not consider additional traffic near the intersection of Liberty Road S due to business access.

The table below displays our average correlated California Bearing Ratio (CBR) values from our two core hole locations and laboratory CBR value. Based on our local knowledge of the fine-grained subgrade soils, we utilized a CBR value of 8 in our pavement design. This will account for saturated subgrade conditions (as encountered in the recent explorations) and the likelihood that the subgrades will not be able to be compacted to the minimum compaction levels.

Material	Field Correlated In Situ CBR C-1	Field Correlated In Situ CBR C-2	Laboratory CBR
Aggregate Base Course[1]	38	52	N/A
Elastic Silt Subgrade	14	9	12
Cemented Elastic Silt Subgrade	48	Not encountered	N/A

1. Based on field observations, the Aggregate Base Course consisted of ¾"-0 crushed aggregate.
2. Difference in CBR values caused by variations in density and grain-size.

Our recommendations are based on daily traffic counts developed from City of Salem traffic studies and the following assumptions:

1. We assume a traffic distribution of 97.5 percent car/trucks and 2.5 percent delivery and garbage vehicles for the traffic counts above;
2. Anticipated increase in traffic count by 1,000 cars, 5 delivery vehicles and 1 garbage vehicle per day due to the proposed development;
3. We assume this increased traffic count will be split evenly between the proposed site approach from Liberty Road and the Hrubetz Road/Liberty Road intersection; and
4. Anticipated annual increase in traffic of 1 percent.

The approximate Estimated Single Axle Loads (ESALs) are based on the average daily traffic count and assumptions above. For a 20-year design life, the ESALs would be approximately 232,719 (see Exhibits attached for ESAL calculation).

Below is a list of City of Salem and ODOT's specific requirements used in our AASHTO 1993 analysis:

City of Salem

§ All pavements shall be tested for compaction and the compaction requirement for any level of mix and any lift shall be 92% of Moving Average Maximum Density (MAMD) [City of Salem Compaction and Quality Control, 360.47 (b) (3)]. The average of a sublot should not exceed 95% of MAMD.

Oregon Department of Transportation

§ Layer coefficient for new asphalt concrete mix used in Oregon is 0.42. (Page 24 of ODOT Pavement Design Guide)

Based on these specifications, our field and laboratory testing and assumptions; we compute a required minimum pavement structural number of 2.35 for a 20-year design life. The following table shows the existing pavement sections at each location and the existing Structural Number. As shown below, the existing section does not meet the minimum 2.35 when we account for reduced structural support of the existing asphalt. However, if the intersection is replaced with the matching section, it would meet the required 2.35.

Existing Pavement Evaluation:

Pavement Type	Existing Pavement Section[1]	
	Intersection[4] (C-1)	Hrubetz Road (C-2)
Pavement Thickness (inches)	6	2½
Crushed Aggregate Base Thickness (inches)	10	6
Section Structural Number	2.27[6]	0.93[6]

1. Current Pavement Section values are based on DCP explorations.
2. Designed utilizing AASHTO 1993 methodologies.
3. Level 3, ½-inch HMAC recommended for Design Pavement Section
4. See Exploration Plan for approximate location.
5. Proofrolled and density tested.
6. Assumes degradation of current pavements to approximately 70 percent of new pavement structural number based on the current pavement condition.

Note that the above table takes into account degradation of the existing asphalt in place. However, the following table provides the same section as constructed with new asphalt. Therefore, replacing the existing section with like kind, would meet the required structural number in the intersection, but not on Hrubetz Road. We recommend the following pavement sections be constructed for each location:

New Pavement Evaluation:

Pavement Type	Existing Pavement Section[1]		Design Pavement Section[2,3]	
	Intersection[4] (C-1)	Hrubetz Road (C-2)	Intersection[4]	Hrubetz Road
Minimum Pavement Thickness (inches)	6	2½	4½	3½
Minimum Crushed Aggregate Base Thickness (inches) [5]	10	6	10	11
Undisturbed Subgrade[6]	--	--	--	--
Section Structural Number	3.32	1.53	2.7	2.37

Pavement Type	Existing Pavement Section[1]		Design Pavement Section[2,3]	
	Intersection[4] (C-1)	Hrubetz Road (C-2)	Intersection[4]	Hrubetz Road

1. Current Pavement Section values are based on DCP explorations.
2. Designed utilizing AASHTO 1993 methodologies.
3. Level 3, ½-inch HMAC recommended for Design Pavement Section
4. See Exploration Plan for approximate location.
5. Based on laboratory testing the in-place crushed aggregate base course is suitable for reuse in new pavement sections.
6. Proofrolled and density tested.

To provide a more economical design, we have recommended a different pavement section, with the same thickness, for the Liberty Road and Hrubetz Road intersection. However, this will need to be reviewed by the local jurisdiction for approval, as they may have pavement thickness requirements for maintenance purposes, which require the current pavement section to be reconstructed.

The pavement section above is provided assuming the following **Construction Considerations**, **Fill Material Types; Compaction Requirements** and **Maintenance Considerations** are followed during and after construction. We recommend a quality control/quality assurance (QC/QA) program be established to ensure proper construction and best management processes are being utilized.

Construction Considerations

On most project sites, the site grading is accomplished relatively early in the construction phase which results in an irregular occurrence of heavy truck traffic, poor runoff and messy roadways. To limit subgrade disturbance and help ensure proper drainage we suggest construction of pavements be conducted near the end of the project.

We recommend the current pavement subgrades be proofrolled and density tested immediately prior to placement of Crushed Aggregate Base (CAB) to provide a uniform subgrade for pavement construction. Areas that appear severely desiccated following removal of in-place materials may require further undercutting and replacement with CAB.

If a significant precipitation event occurs after the evaluation of subgrade soils or if the surface becomes disturbed, the subgrade should be reviewed by qualified personnel immediately prior to paving. The subgrade should be in its finished form at the time of the final review.

Long term pavement performance will be dependent upon several factors, including maintaining subgrade moisture levels and providing for preventive maintenance.

Fill Material Types

Structural fill, should consist of approved materials, free of organic material, debris and particles larger than about 4 inches. The maximum particle size criteria may be relaxed by the geotechnical engineer of record depending on construction techniques, material gradation, allowable lift thickness and observations during fill placement. Soils for use as structural fill material should conform to the following specifications:

Structural Fill Type [1]	Specification	Acceptable Location for Placement
Select Fill	OSSC 00330.14 Selected Granular Backfill with exception of no more than 5 percent passing the No. 200 sieve by weight and maximum aggregate size of 2 inches	All locations across the site, wet or dry weather conditions acceptable.
Crushed Aggregate Base (CAB)	OSSC 02630.10 Dense Graded Aggregate (1 ½"–0 to ¾"–0) with the additional requirement of less than 5 percent passing the No. 200 Sieve.	All locations across the site. Recommended for finished base course materials.

1. Controlled, compacted fill should consist of approved materials that are free (free = less than 3% by weight) of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the geotechnical engineer for evaluation.

Compaction Requirements

Structural fill should meet the following compaction requirements.

Item	Description
Fill Lift Thickness	4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack, plate compactor, etc.) is used 10-inches or less in loose thickness when heavy, self-propelled compaction equipment is used
Compaction Requirements [1,2]	Upper 2 feet: 95% of ASTM D1557 Below 2 feet: 90% of ASTM D1557 Datum = Finish grade
Moisture Content [3]	All Soils: -2 to +2% of ASTM D1557 optimum moisture Crushed Aggregates: -4 to +1% of ASTM D1557 optimum moisture

Item	Description
1.	We recommend that structural fill be tested for moisture content and compaction during placement. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.
2.	For pavement areas, compaction requirement depths are based on bottom of asphalt or concrete pavement as a datum.
3.	Specifically, moisture levels should be maintained low enough to allow for satisfactory compaction to be achieved without the cohesionless fill material pumping when proof-rolled.
4.	During the initial placement of material, full time observation of placement and compaction of material is recommended to define the appropriate number of coverages required by compaction equipment.

Pavement Maintenance

The pavement sections represent minimum recommended thicknesses and, as such, periodic maintenance should be anticipated. Therefore, preventive maintenance should be planned and provided for through an on-going pavement management program. Maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Maintenance consists of both localized maintenance (e.g. crack and joint sealing and patching) and global maintenance (e.g. surface sealing). Preventive maintenance is usually the priority when implementing a pavement maintenance program. Additional engineering observation is recommended to determine the type and extent of a cost-effective program. Even with periodic maintenance, some movements and related cracking may still occur and repairs may be required.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

- Final grade adjacent to paved areas should slope down from the edges at a minimum 2%.
- Subgrade and pavement surfaces should have a minimum 2% slope to promote proper surface drainage.
- Install below pavement drainage systems surrounding areas anticipated for frequent wetting.
- Install joint sealant and seal cracks immediately.
- Seal all landscaped areas in or adjacent to pavements to reduce moisture migration to subgrade soils.
- Place compacted, low permeability backfill against the exterior side of curb and gutter.
- Place curb, gutter and/or sidewalk directly on elastic silt subgrade soils rather than on unbound granular base course materials.

Wet-Weather Construction

The pavement subgrades soils are fine-grained soils and would be difficult to reuse as recompacted subgrade during wet weather. Consequently, we have recommended the use of Crushed Aggregate Base (CAB) to replace the recommended recompacted subgrade portion of the pavement section if the fine-grained subgrade soils are not able to be recompacted due to elevated moisture conditions or appear disturbed due to wetting. The use of high modulus geotextiles (i.e., engineering fabric such as Mirafi HP370 or equivalent) may be used to aid in stabilization of the subgrade. To reduce the potential for subgrade disturbance during wet-weather periods, excavations exposing subgrade soils should be covered the same day with CAB and minimal equipment should be allowed within the excavation to prevent disturbance.

STORMWATER MANAGEMENT

Based on conversations with Keith Brownell with N8 Excavation, we understand shallow infiltration galleries are planned at the site (see site Exploration Plan). To provide recommendations on the in-situ soil viability of infiltrating stormwater, we conducted three (3) infiltration tests in general accordance with the EPA Falling Head method at depths ranging between 3 and 5 feet below the ground surface until a relatively steady infiltration rate was observed; as provided in the table below.

Exploration Number	Test Depth Below Grade (ft)	Soil Type	Measured Infiltration Rate (in/hr)
IT-1	3.3	Cemented Elastic Silt	0.03
IT-2	3.0	Cemented Elastic Silt	0.01
IT-3	4.2	Cemented Elastic Silt	0.10

Based on the *City of Salem Administrative Rules document Division 004 – Stormwater System*, all infiltration facilities must have a minimum infiltration rate of 0.5 inches per hour. Based on the measured infiltration rates, we do not believe the site soils are suitable for infiltration.

GENERAL COMMENTS

The analysis and recommendations presented in this memo are based upon conversations with Jim Iverson with JMI Investment Properties and Keith Brownell with N8 Excavation, data obtained at the defined explorations locations, laboratory testing, and traffic count information from the City of Salem. This memo does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such

variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any geotechnical recommendations of the proposed development structures; or environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

ATTACHMENTS

Exhibit 1 - Site Plan
Exhibit 2 - Exploration Plan
Exhibit 3 to 7 - Exploration Logs (C-1, C-2 and IT-1 to IT-3)
Exhibit 8 - Modified Proctor Results
Exhibit 9 - California Bearing Ratio Results
Exhibit 10 - ESAL Calculation
Exhibit 11 - Photography Log

SITE LOCATION

Liberty Road Development ■ Salem, OR
January 4, 2019 ■ Terracon Project No. 82185090

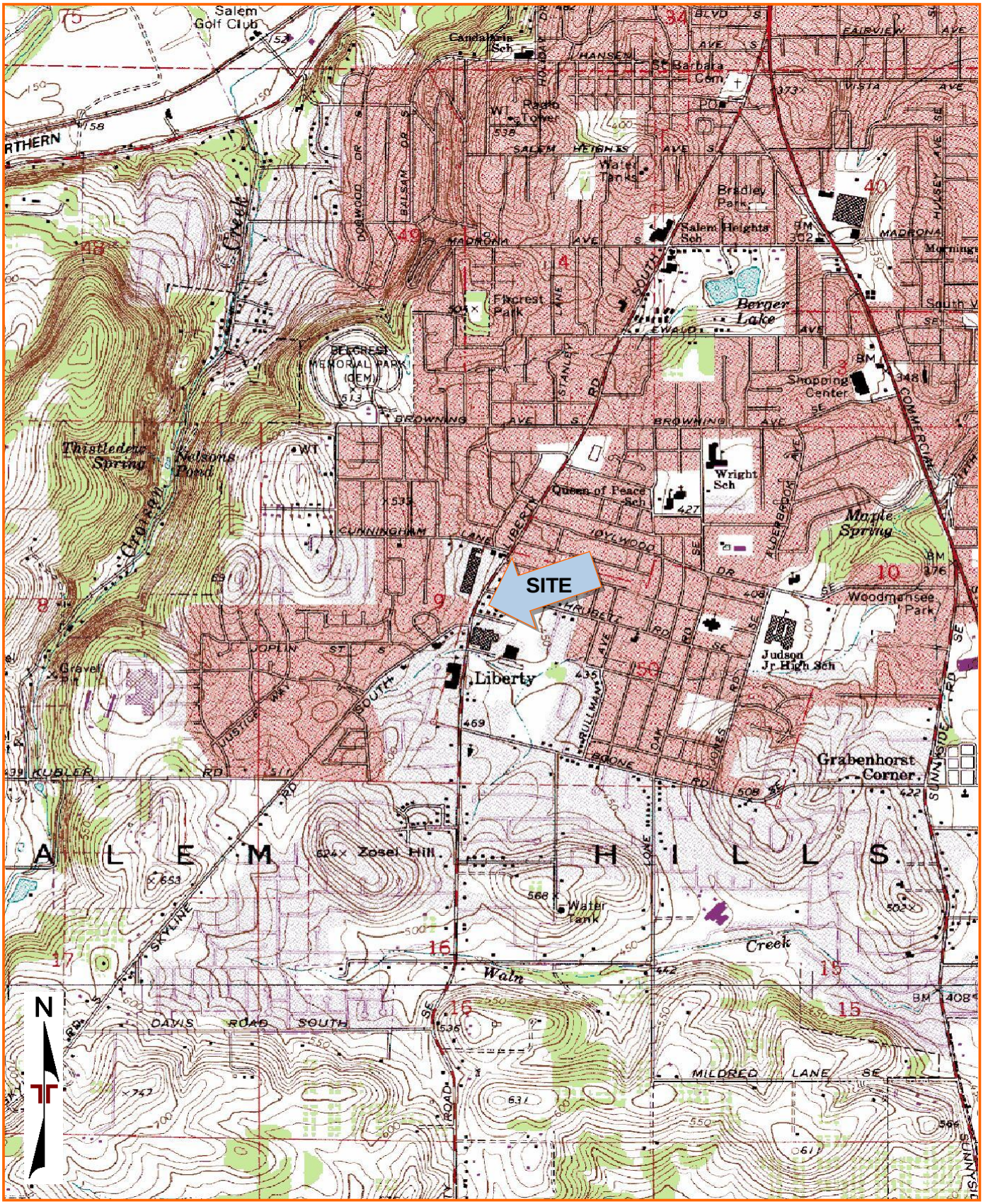


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

TOPOGRAPHIC MAP IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY
QUADRANGLES INCLUDE: SALEM WEST, OR (1/1/1986) and SIDNEY, OR (1/1/2002).

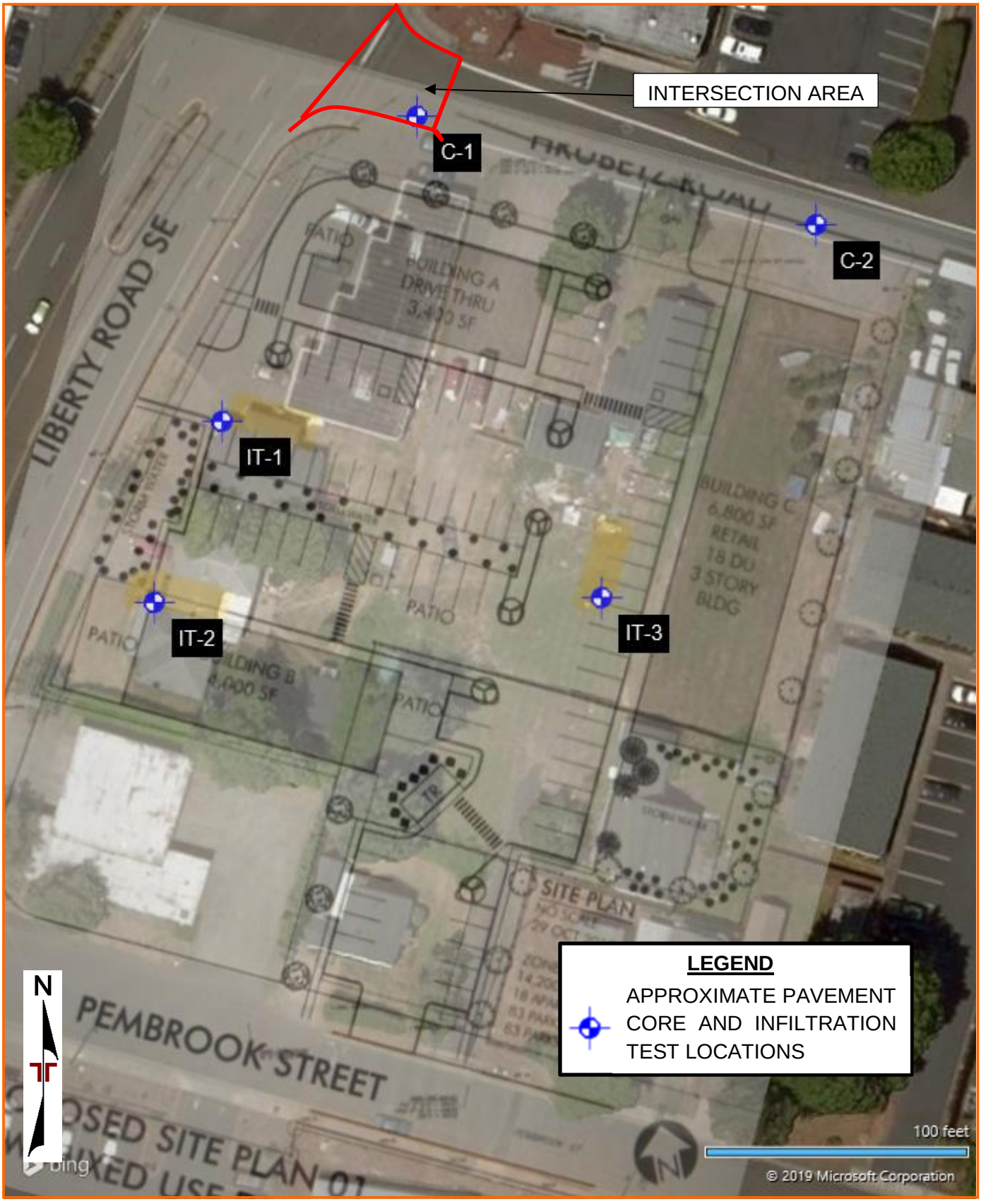


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

BORING LOG NO. C-1

PROJECT: Liberty Road Development

CLIENT: JMI Investment Properties
Salem, OR

SITE: 120 Hrubetz Road SE
Salem, OR

LOCATION See Exploration Plan

Latitude: 44.8908° Longitude: -123.0596°

GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	PERCENT FINES
	ASPHALT, 6 inches thick					
	0.5 **AGGREGATE BASE COURSE**, angular, 10 inches thick, 3/4"-0 crushed aggregate					
	1.3 **ELASTIC SILT (MH)**, medium to high plasticity, brownish red				5	8
	tan, gray and brown, weak cementation					
	3.0 ***Boring Terminated at 3 Feet***					

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Hand Auger

Abandonment Method:
Exploration backfilled with soil cuttings upon completion.
Sealed with bituminous cold patch at surface.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not encountered

Terracon
4103 SE International Way, Ste 300
Portland, OR

Boring Started: 12-13-2018 | Boring Completed: 12-13-2018

Drill Rig: Hand Auger | Driller: Terracon

Project No.: 82185090 | Exhibit 3

BORING LOG NO. C-2

PROJECT: Liberty Road Development

CLIENT: JMI Investment Properties
Salem, OR

SITE: 120 Hrubetz Road SE
Salem, OR

LOCATION See Exploration Plan

Latitude: 44.8907° Longitude: -123.059°

GRAPHIC LOG	DEPTH		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	PERCENT FINES
	0.2	**ASPHALT**, 2.5 inches thick					
	0.8	**AGGREGATE BASE COURSE**, subangular, 6 inches thick, 3/4"-0 crushed aggregate				6	8
	3.0	**ELASTIC SILT (MH)**, medium to high plasticity, brownish red					
		Boring Terminated at 3 Feet					

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Hand Auger

Abandonment Method:
Exploration backfilled with soil cuttings upon completion.
Sealed with bituminous cold patch at surface.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not encountered

Terracon
4103 SE International Way, Ste 300
Portland, OR

Boring Started: 12-13-2018 | Boring Completed: 12-13-2018

Drill Rig: Hand Auger | Driller: Terracon

Project No.: 82185090 | Exhibit 4

BORING LOG NO. IT-1

PROJECT: Liberty Road Development

CLIENT: JMI Investment Properties
Salem, OR

SITE: 120 Hrubetz Road SE
Salem, OR

LOCATION See Exploration Plan

Latitude: 44.8905° Longitude: -123.0599°

GRAPHIC LOG	DEPTH		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE
		FILL - CONSTRUCTION DEBRIS			
	0.5				
		ELASTIC SILT (MH), medium to high plasticity, brownish red			
		tan, gray and brown, weak cementation			
	5.0				
		Boring Terminated at 5 Feet	5		

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Hand Auger

Abandonment Method:
Exploration backfilled with auger cuttings.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not encountered

Terracon
4103 SE International Way, Ste 300
Portland, OR

Boring Started: 12-04-2018	Boring Completed: 12-04-2018
Drill Rig: Hand Auger	Driller: Terracon
Project No.: 82185090	Exhibit 5

BORING LOG NO. IT-2

PROJECT: Liberty Road Development

CLIENT: JMI Investment Properties
Salem, OR

SITE: 120 Hrubetz Road SE
Salem, OR

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 44.8903° Longitude: -123.06° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE
	FILL - CONSTRUCTION DEBRIS			
	0.5			
	ELASTIC SILT (MH), medium to high plasticity, brownish red			
	tan, gray and brown, weak cementation			
	5.0			
	Boring Terminated at 5 Feet	5		

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Hand Auger

Abandonment Method:
Exploration backfilled with auger cuttings.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not encountered

Terracon
4103 SE International Way, Ste 300
Portland, OR

Boring Started: 12-04-2018	Boring Completed: 12-04-2018
Drill Rig: Hand Auger	Driller:Terracon
Project No.: 82185090	Exhibit 6

BORING LOG NO. IT-3

PROJECT: Liberty Road Development

CLIENT: JMI Investment Properties
Salem, OR

SITE: 120 Hrubetz Road SE
Salem, OR

LOCATION See Exploration Plan

Latitude: 44.8903° Longitude: -123.0594°

GRAPHIC LOG	DEPTH		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE
	0.3	**TOPSOIL**, 3 inch grass and rootlet zone			
		ELASTIC SILT (MH), trace gravel, medium to high plasticity, brownish red			
		brownish red and tan, weak cementation			
	5.0	***Boring Terminated at 5 Feet***	5		

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Hand Auger

Abandonment Method:
Exploration backfilled with auger cuttings.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

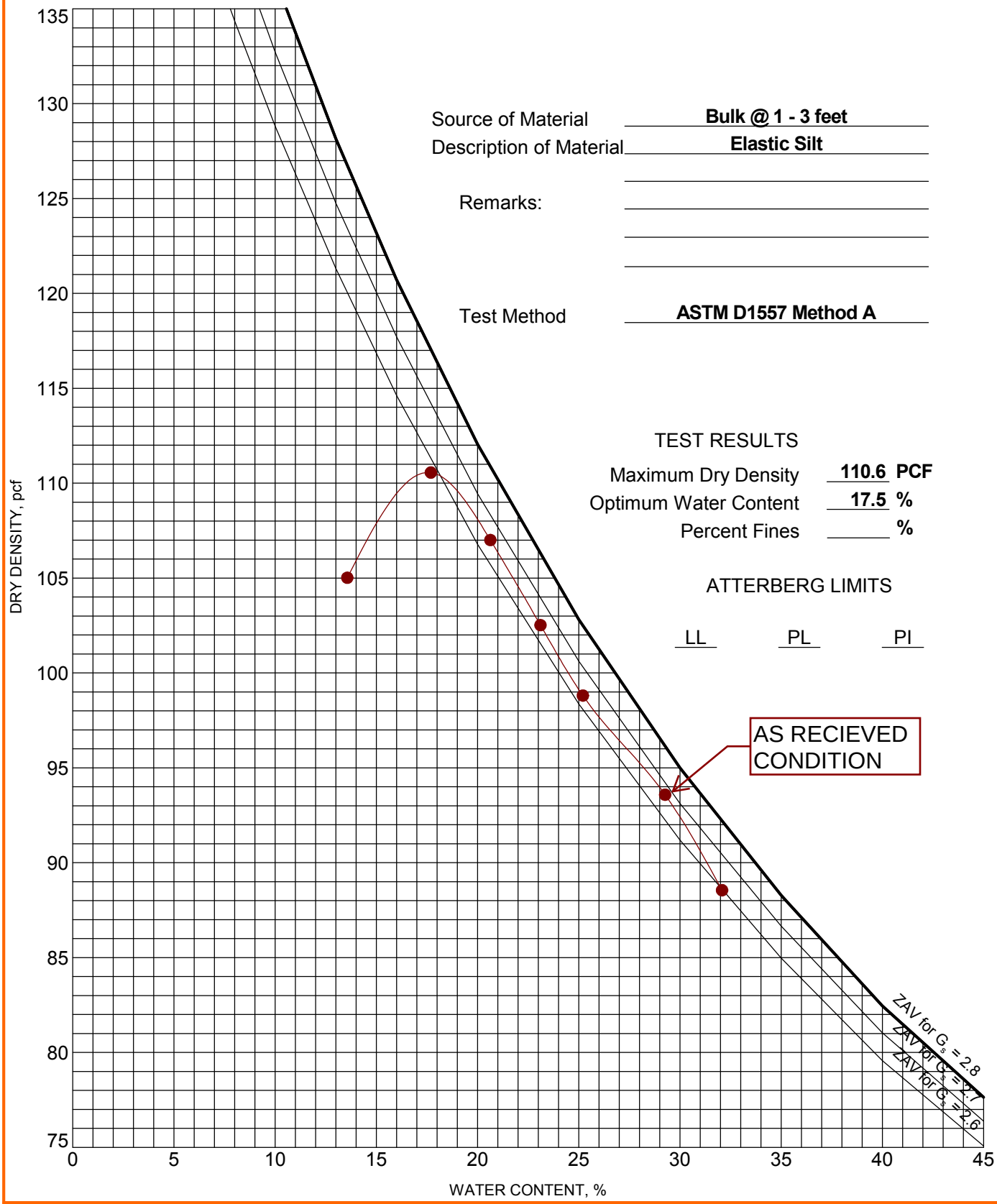
Not encountered

Terracon
4103 SE International Way, Ste 300
Portland, OR

Boring Started: 12-04-2018	Boring Completed: 12-04-2018
Drill Rig: Hand Auger	Driller: Terracon
Project No.: 82185090	Exhibit 7

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material: **Bulk @ 1 - 3 feet**

Description of Material: **Elastic Silt**

Remarks:

Test Method: **ASTM D1557 Method A**

TEST RESULTS

Maximum Dry Density	**110.6**	**PCF**
Optimum Water Content	**17.5**	**%**
Percent Fines		**%**

ATTERBERG LIMITS

LL	PL	PI

PROJECT: Liberty Road Development

PROJECT NUMBER: 82185090

SITE: 120 Hrubetz Road SE
Salem, OR

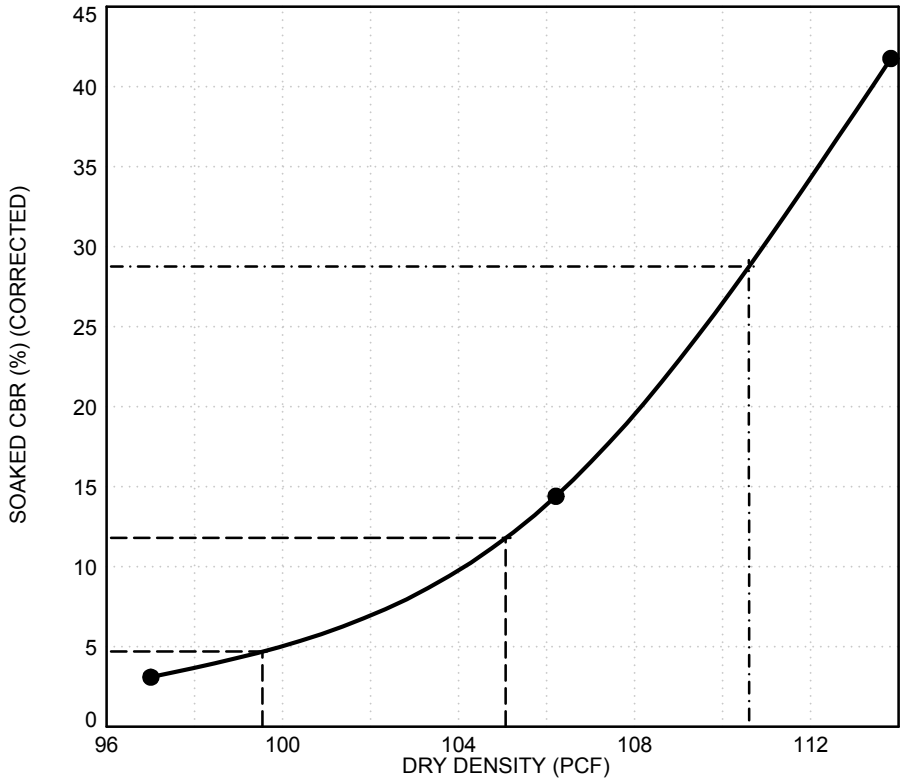
Terracon
4103 SE International Way, Ste 300
Portland, OR

CLIENT: JMI Investment Properties
Salem, OR

Exhibit 8

CALIFORNIA BEARING RATIO

ASTM D1883-07[2]



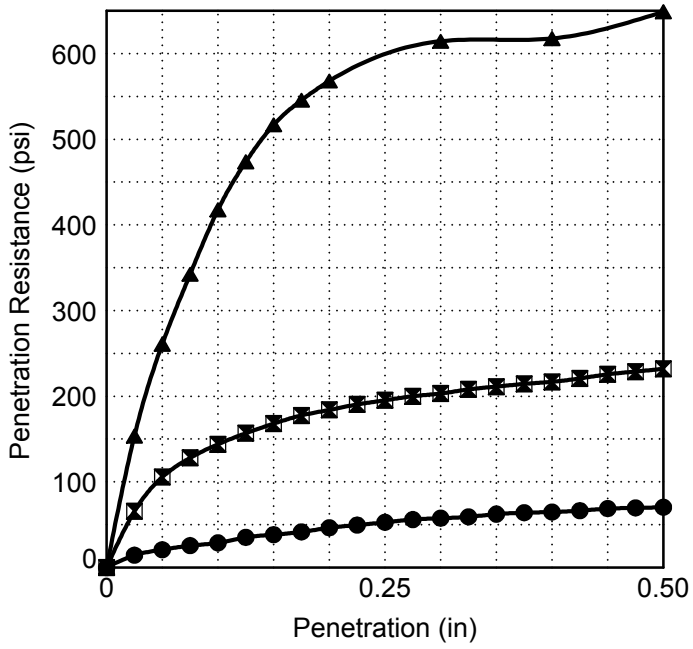
Source of Material **Bulk 1.0**

Description of Material **Elastic Silt**

Remarks:

Percent Fines **%**

Atterberg Limits LL PL PI



Sample No.	1	2	3
Sample Condition		Soaked	
Compaction Method		1557A	
Maximum Dry Density, (pcf)		110.6	
Optimum Moisture Content, (%)		17.5	
Dry Density before Soaking, (pcf)	97.00	106.21	113.82
Moisture Content, (%)			
After Compaction	17.3	18	16.5
Top 1" After Soaking	27.9	24.2	20.7
Surcharge,. (lbs)	25.00	25.00	25.00
Swell, (%)	0.49	0.44	0.29
Bearing Ratio, (%)	2.9	14.4	41.8

Dry Density @ 90% 99.5 pcf

Dry Density @ 95% 105.1 pcf

Dry Density @ 100% 110.6 pcf

CBR @ 90% Density 4.7

CBR @ 95% Density 11.8

CBR @ 100% Density 28.8

PROJECT: Liberty Road Development

PROJECT NUMBER: 82185090

SITE: 120 Hrubetz Road SE
Salem, OR

Terracon
4103 SE International Way, Ste 300
Portland, OR

CLIENT: JMI Investment Properties
Salem, OR

Exhibit 9

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. CBR 3PT REPORT 82185090 LIBERTY ROAD DEVE - COPY.GPJ TERRACON_DATATEMPLATE.GDT 1/3/19

AASHTO 1993 ESAL Calculator for Flexible Pavements

Vehicle Description	Traffic Volume			Analysis	Axle Load and Type						Gross	Equivalency Factors			ESAL's
	Quantity in the Design Lane	Days per Week	Weeks per Year	Period (years)	Axle 1 (kips)		Axle 2 (kips)		Axle 3 (kips)		Weight (pounds)	Axle 1	Axle 2	Axle 3	
Passenger car	**1,292**	**7**	**52**	**20**	2	S	2	S			4,000	0.0002	0.0002	0	4,140
Pick-up truck or van	**1,292**	**7**	**52**	**20**	2	S	4	S			6,000	0.0002	0.003	0	33,139
Recreational vehicle					4	S	4	S			8,000	0.003	0.003	0	0
School bus					6	S	14	S			20,000	0.012	0.338	0	0
TARC bus					8	S	14	S			22,000	0.035	0.338	0	0
Greyhound MC-12 bus					13.4	S	18.4	S	6	S	37,800	0.2897	1.118	0.012	0
Package delivery truck	**55**	**7**	**52**	**20**	4	S	14	S			18,000	0.003	0.338	0	150,324
Beverage delivery truck		**7**	**52**	**20**	6	S	12	S	12	S	30,000	0.012	0.177	0.177	0
Garbage/dumpster truck	**2**	**7**	**52**	**20**	20	S	35	T			55,000	1.59	1.225	0	45,117
Concrete truck (full)					20	S	48	R			68,000	1.59	0.992	0	0
Dump truck (full)					20	S	48	R			68,000	1.59	0.992	0	0
Semi-tractor (no trailer)					8	S	2	T			10,000	0.035	0	0	0
Semi-tractor trailer (empty)					8	S	8	T	6	T	22,000	0.035	0.003	0.001	0
Semi-tractor trailer					12	S	34	T	34	T	80,000	0.177	1.07	1.07	0
User Defined					6	S	29	s	20	T	55,000	0.012	8.655	0.117	0
User Defined					8	S	8	T		T	16,000	0.035	0.003	0	0
Vehicle type H10					4	S	16	S			20,000	0.003	0.598	0	0
Vehicle type H15					6	S	24	S			30,000	0.012	3.62	0	0
Vehicle type H20					8	S	32	S			40,000	0.035	13.5	0	0
Vehicle type 3					16	S	34	T			50,000	0.598	1.07	0	0
Vehicle type HS15					6	S	24	S	24	S	54,000	0.012	3.62	3.62	0
Vehicle type HS20					8	S	32	S	32	S	72,000	0.035	13.5	13.5	0
Vehicle type 3S2					10	S	31	T	31	T	72,000	0.085	0.723	0.723	0

Terminal Serviceability, r_t	**2.0**
Assumed Structural Number, SN	**2**
Traffic Growth Rate, %/yr	**1**

Summary:

Total AASHTO ESAL's	**232,719**
Superpave	**ESAL Class 1**
Traffic Category	**Liberty/Hrubetz**

Project: Liberty Road Mixed-Use Location: Salem, Oregon Exhibit 10

Job No.: 82185090 Date: 1/4/2019

Terracon

Photo 1 - IT-2 Set up

Photo 2 – IT-1 Set up

Photo 3 – Liberty/Hrubetz Intersection

Photo 4 - Liberty/Hrubetz Intersection

Photo 5 – Hrubetz Road facing east from Liberty/Hrubetz intersection

Photo 6 – Utility markings onsite

Photo 7 – Utility patch across Hrubetz

Photo 8 – Hrubetz Facing east

Photo 9 – Utility markings on Hrubetz

Photo 10 – Utility markings on Hrubetz

Photo 11 – Utility markings on Hrubetz

Photo 12 – IT-3 Set up

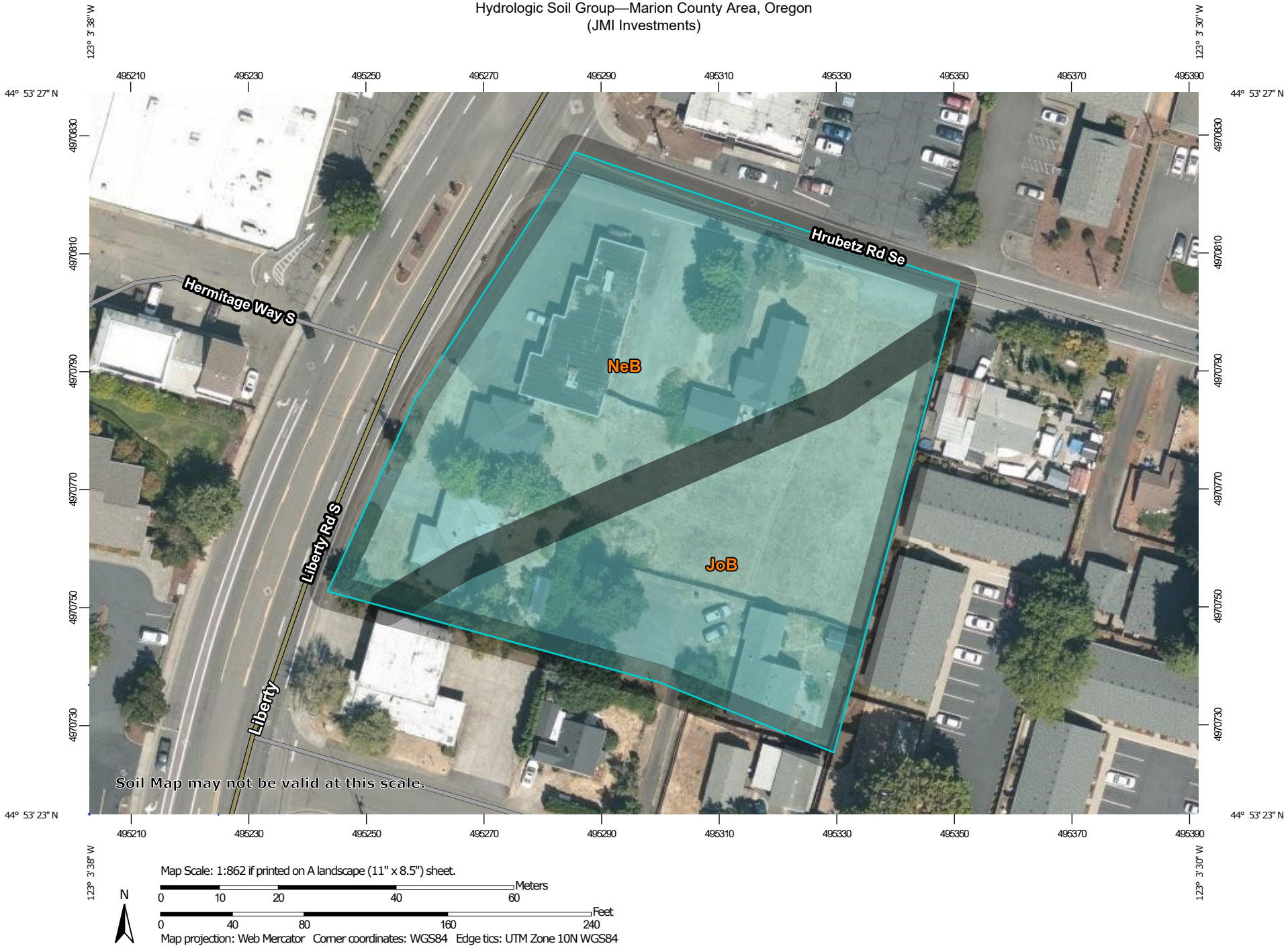
Photo 13 – Traffic delineation on Hrubetz for C-1 and C-2

Photo 14 – Traffic delineation on Hrubetz for C-1 and C-2

Photo 15 – Traffic delineation on Hrubetz for C-1 and C-2

APPENDIX B
NRCS SOIL REPORT

Hydrologic Soil Group—Marion County Area, Oregon
(JMI Investments)



Map Scale: 1:862 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 10 20 40 60

Feet: 0 40 80 160 240

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 1:20,000.

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: Marion County Area, Oregon
Survey Area Data: Version 15, Sep 18, 2018

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

Date(s) aerial images were photographed: Aug 1, 2018—Aug 31, 2018

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

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
JoB	Jory silty clay loam, 2 to 7 percent slopes	C	0.7	42.2%
NeB	Nekia silty clay loam, 2 to 7 percent slopes	C	1.0	57.8%
Totals for Area of Interest			**1.6**	**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.

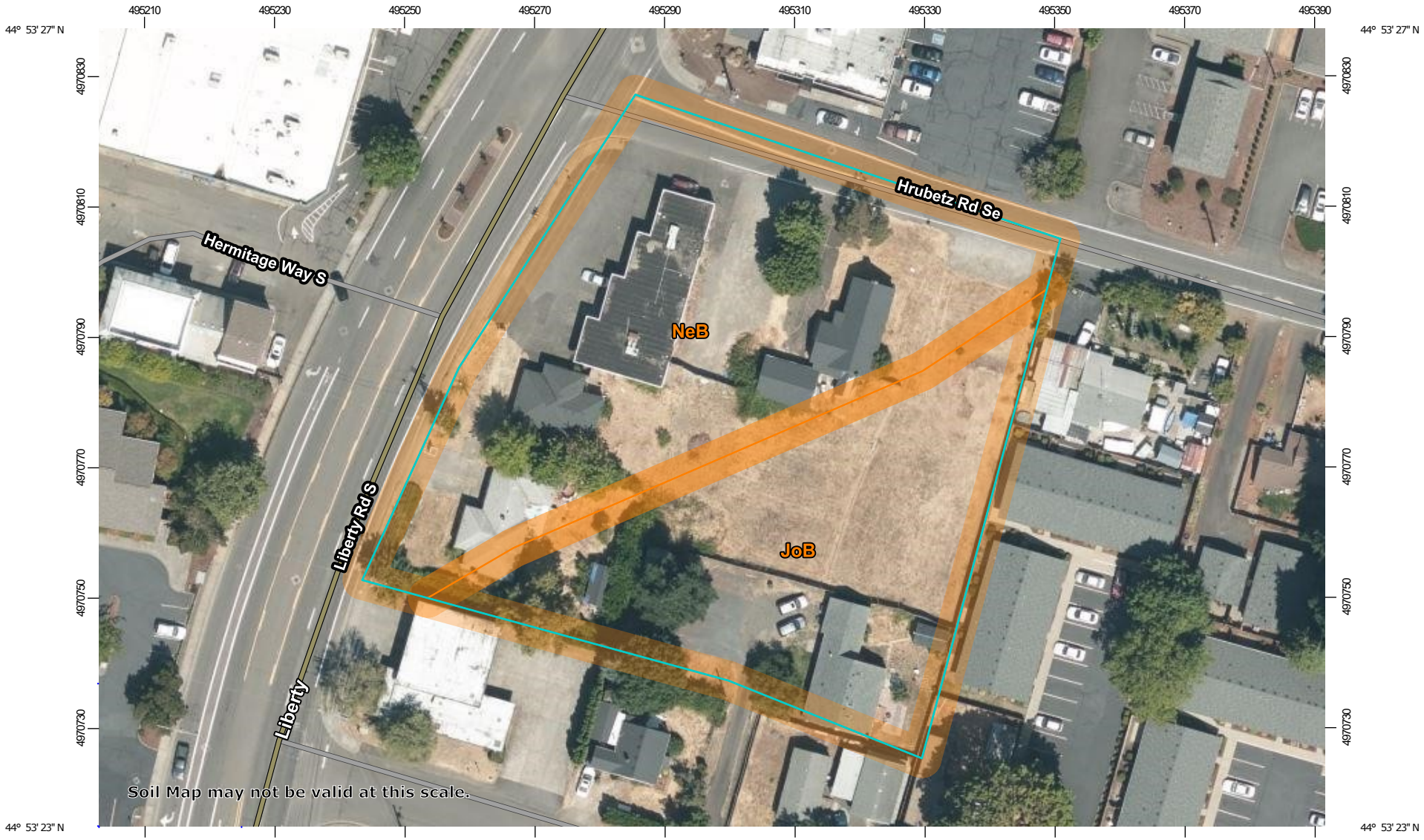
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Soil Map—Marion County Area, Oregon
(JMI Investments)



Map Scale: 1:862 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 10 20 40 60

Feet
0 40 80 160 240

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

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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: Marion County Area, Oregon
Survey Area Data: Version 15, Sep 18, 2018

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

Date(s) aerial images were photographed: Aug 1, 2018—Aug 31, 2018

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

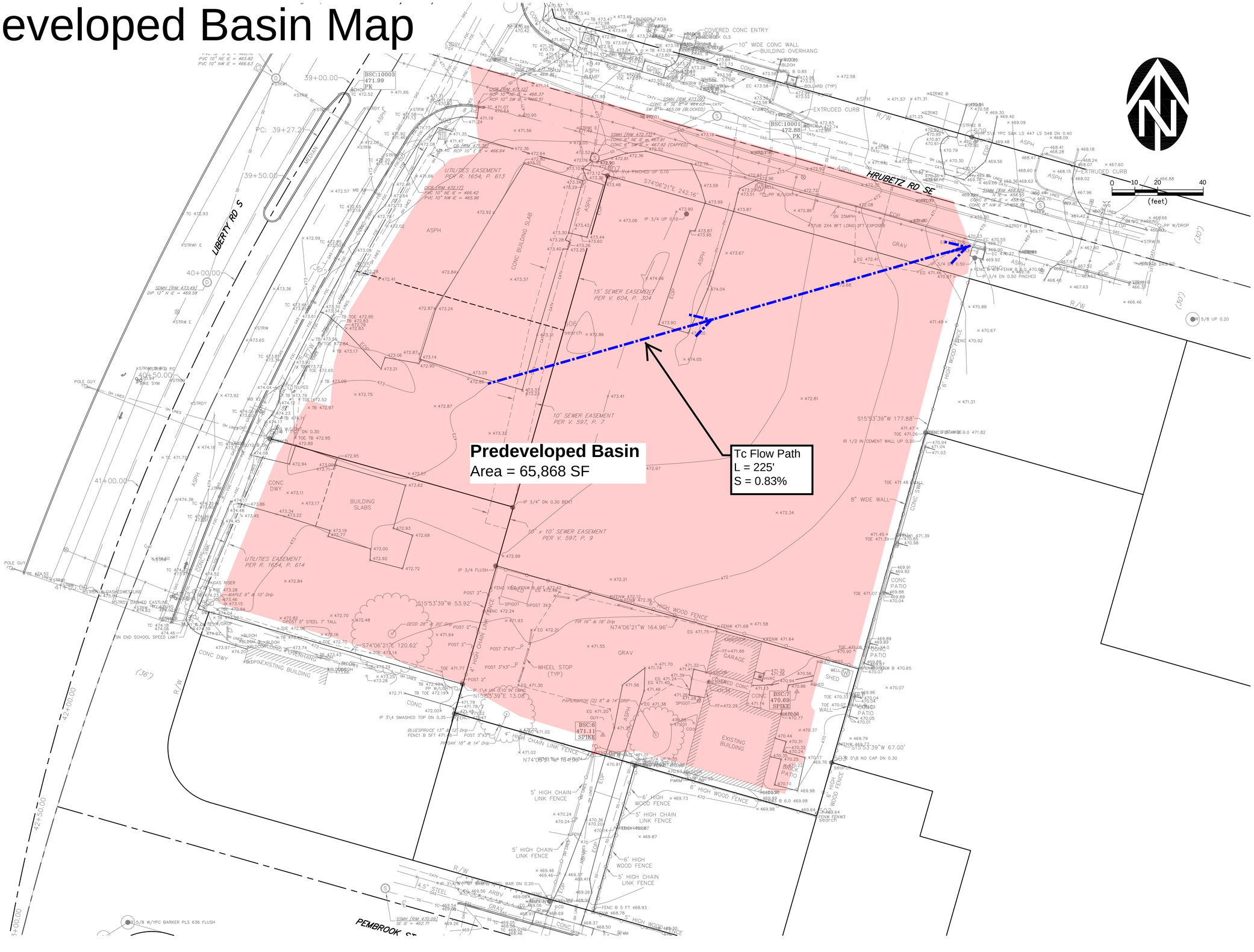
Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
JoB	Jory silty clay loam, 2 to 7 percent slopes	0.7	42.2%
NeB	Nekia silty clay loam, 2 to 7 percent slopes	1.0	57.8%
Totals for Area of Interest		**1.6**	**100.0%**

APPENDIX C

BASIN MAPS

Predeveloped Basin Map



STUDIO 3 ARCHITECTURE INCORPORATED
222 COMMERCIAL ST. NE
SALEM, OR 97301-3410
P: 503.390.6500
F: 503.390.6501
www.studio3architecture.com

REGISTERED PROFESSIONAL ENGINEER
OREGON
NOV. 12, 2008
WILLIAM J. WELLS
RENEWS: 6/30/2020

REVIEW

PROJECT #
DATE: 4/5/2019
DRAWN BY:
CHECKED BY:
REVISIONS:

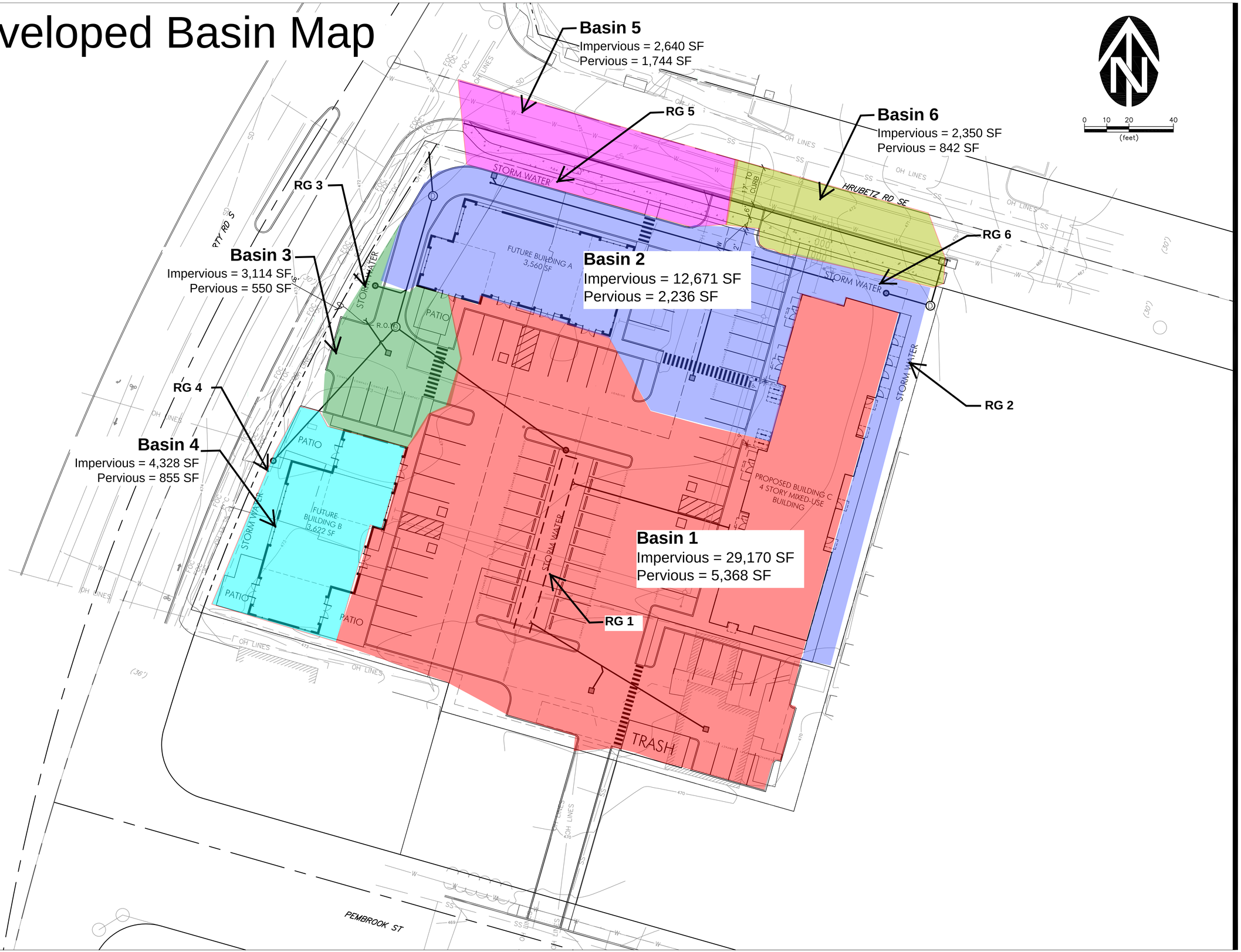
WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS
3841 Fairview Industrial Dr. S.E., Suite 100, Salem, OR 97302
Phone: (503) 585-2474 Fax: (503) 585-3986
E-mail: westech@westech-eng.com

NEW MIXED USE DEVELOPMENT:
SOUTH LIBERTY RD
SALEM, OR
LIBERTY RD SE AND HRUBETZ RD

SHEET:

6/8/2019 11:59:39 AM
R:\Dwg\MI Investments\Hrubetz and Liberty\Civil\Plots\z_StormwaterPre-AT.dwg, (C1.0 tab)

Developed Basin Map



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F: 503.390.6501
www.studio3architecture.com

REGISTERED PROFESSIONAL ENGINEER OREGON NOV. 12, 2008 WILLIAM J. WELLS

REVIEW

RENEWS: 6/30/2020

PROJECT # 3136.0000.0
DATE: 4/5/2019
DRAWN BY: AK
CHECKED BY: JW
REVISIONS:

WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS
3841 Fairview Industrial Dr. S.E., Suite 100, Salem, OR 97302
Phone: (503) 585-2474 Fax: (503) 585-3986
E-mail: westech@westech-eng.com

NEW MIXED USE DEVELOPMENT: SOUTH LIBERTY RD

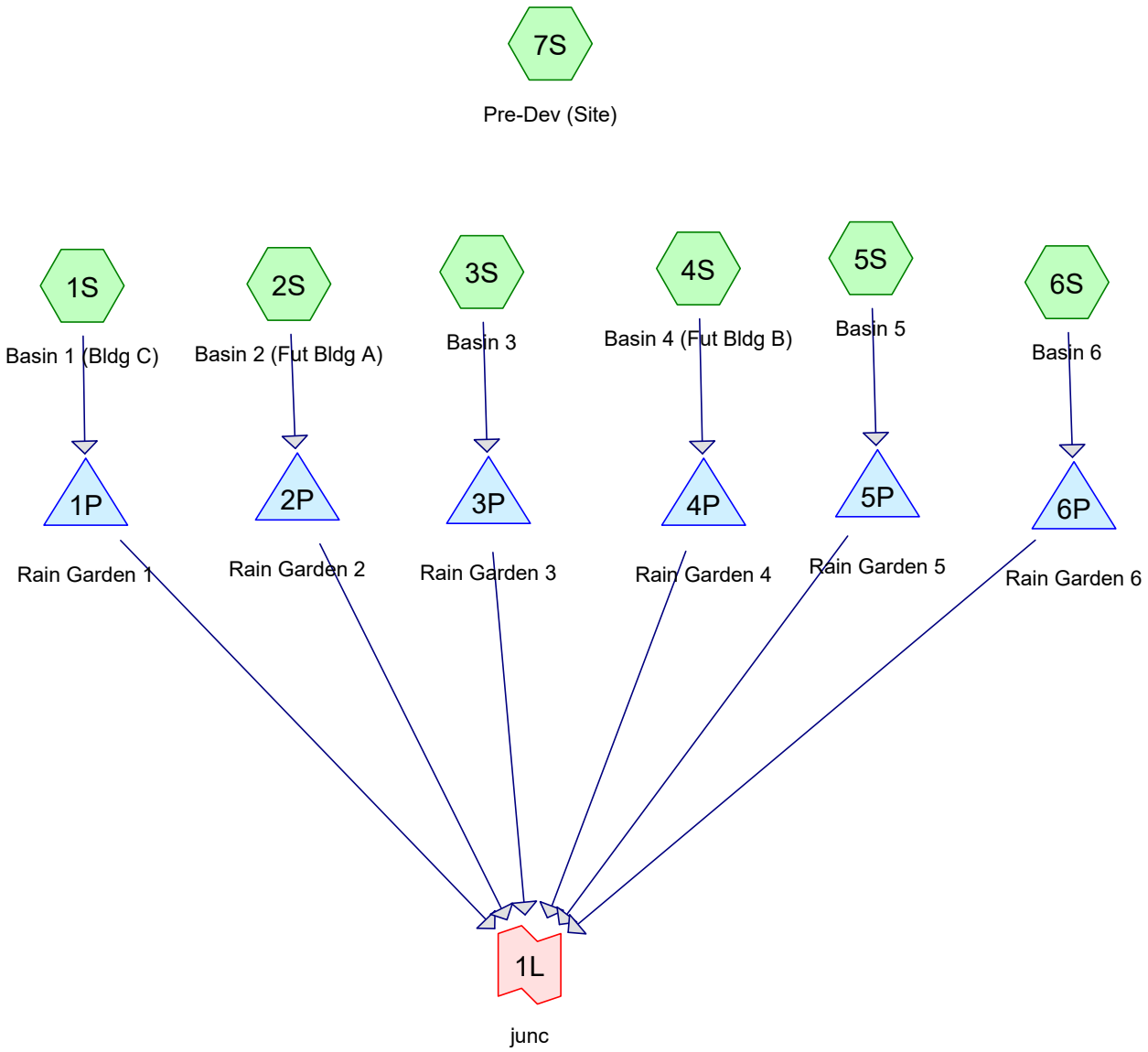
SALEM, OR
LIBERTY RD SE AND HRUBETZ RD

SHEET:

STORMWATER BASIN MAP

APPENDIX D

HYDROCAD SUMMARIES



Subcat Reach Pond Link

Routing Diagram for JMI_V1.0
Prepared by {enter your company name here}, Printed 6/8/2019

Summary for Subcatchment 7S: Pre-Dev (Site)

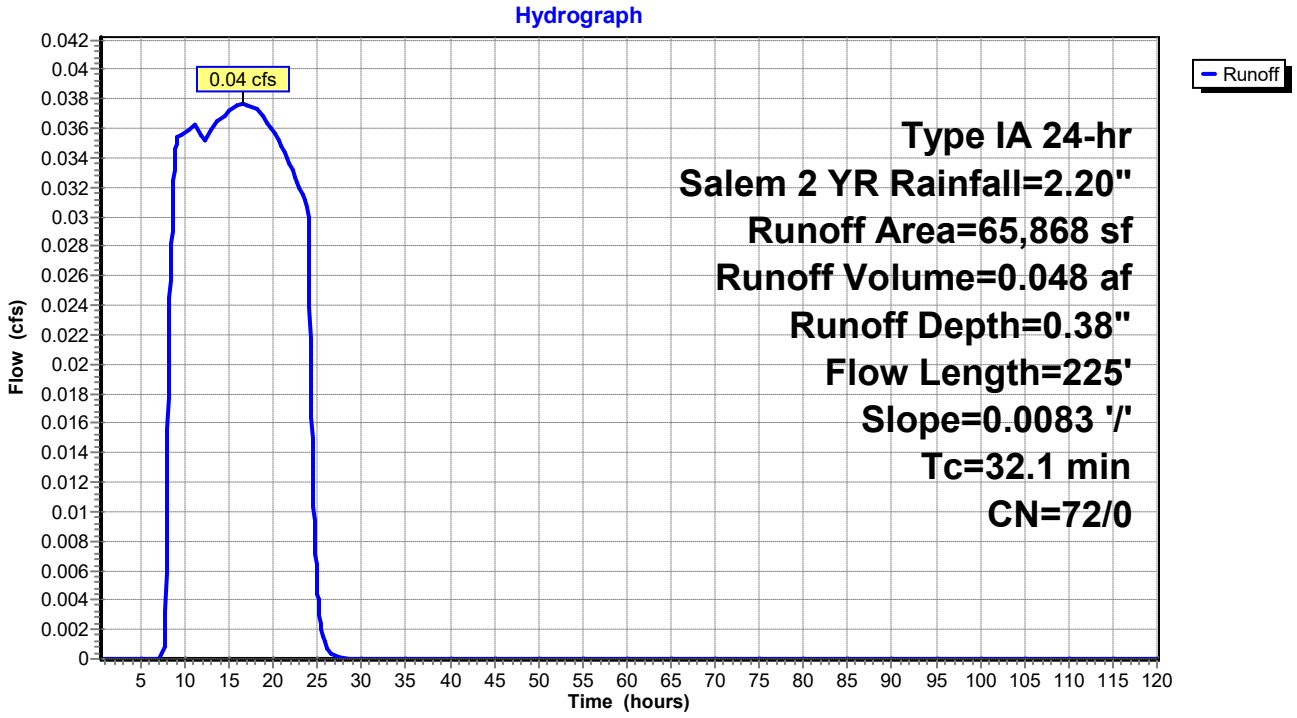
Runoff = 0.04 cfs @ 16.57 hrs, Volume= 0.048 af, Depth= 0.38"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr Salem 2 YR Rainfall=2.20"

Area (sf)	CN	Description
65,868	72	Woods/grass comb., Good, HSG C
65,868		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.1	225	0.0083	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.20"

Subcatchment 7S: Pre-Dev (Site)



Summary for Subcatchment 7S: Pre-Dev (Site)

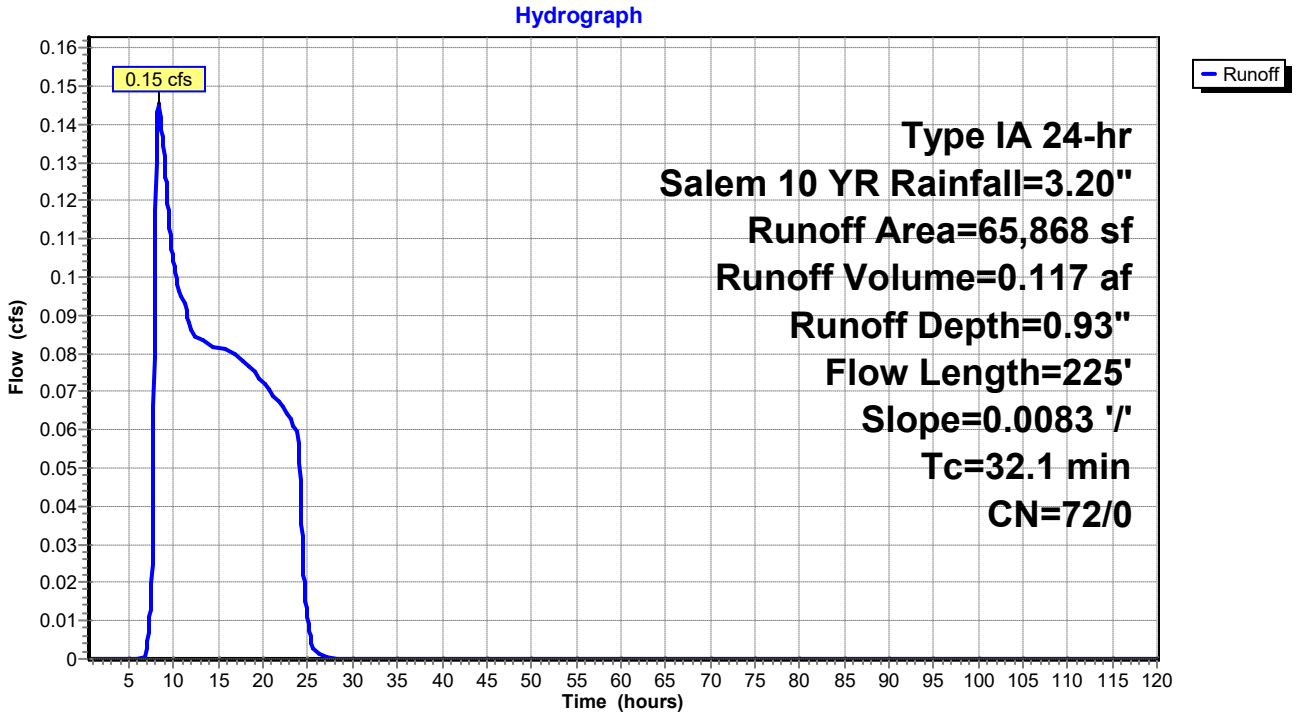
Runoff = 0.15 cfs @ 8.27 hrs, Volume= 0.117 af, Depth= 0.93"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr Salem 10 YR Rainfall=3.20"

Area (sf)	CN	Description
65,868	72	Woods/grass comb., Good, HSG C
65,868		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.1	225	0.0083	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.20"

Subcatchment 7S: Pre-Dev (Site)



Summary for Subcatchment 1S: Basin 1 (Bldg C)

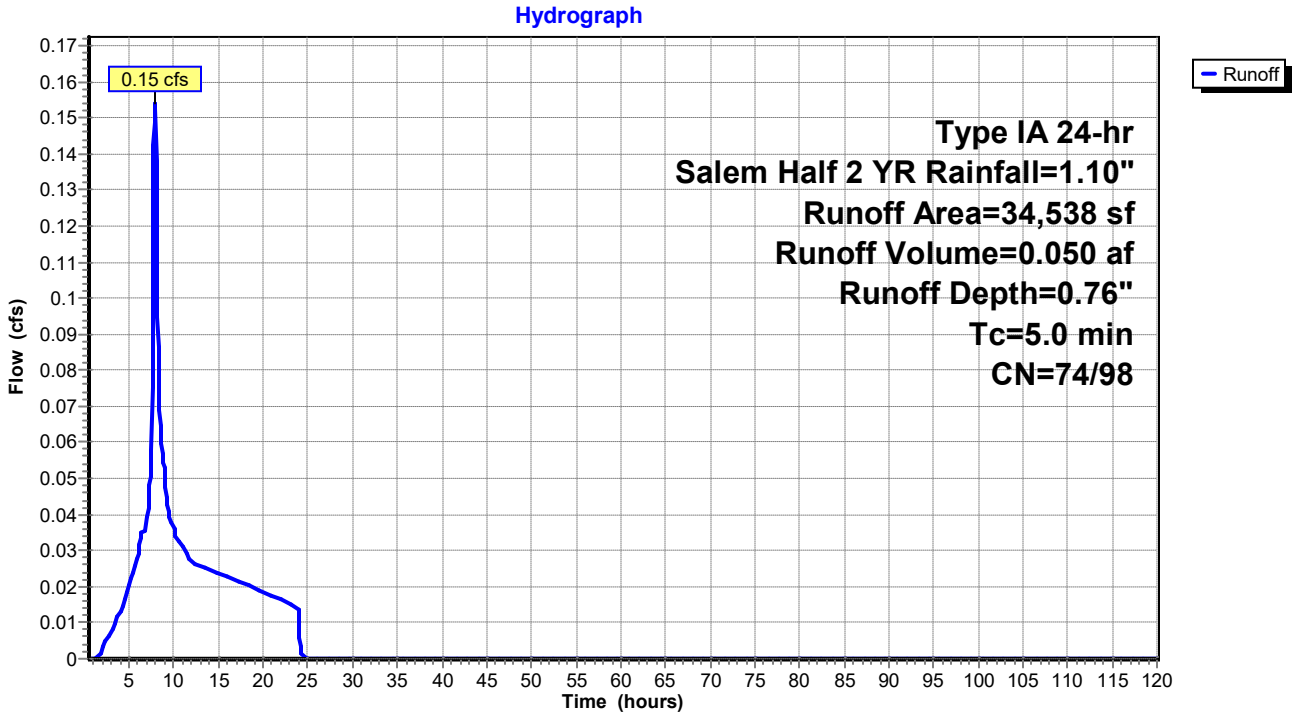
Runoff = 0.15 cfs @ 7.92 hrs, Volume= 0.050 af, Depth= 0.76"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr Salem Half 2 YR Rainfall=1.10"

	Area (sf)	CN	Description
*	29,170	98	impervious, HSG C
*	5,368	74	open space, HSG C
	34,538	94	Weighted Average
	5,368		15.54% Pervious Area
	29,170		84.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S: Basin 1 (Bldg C)



Summary for Subcatchment 2S: Basin 2 (Fut Bldg A)

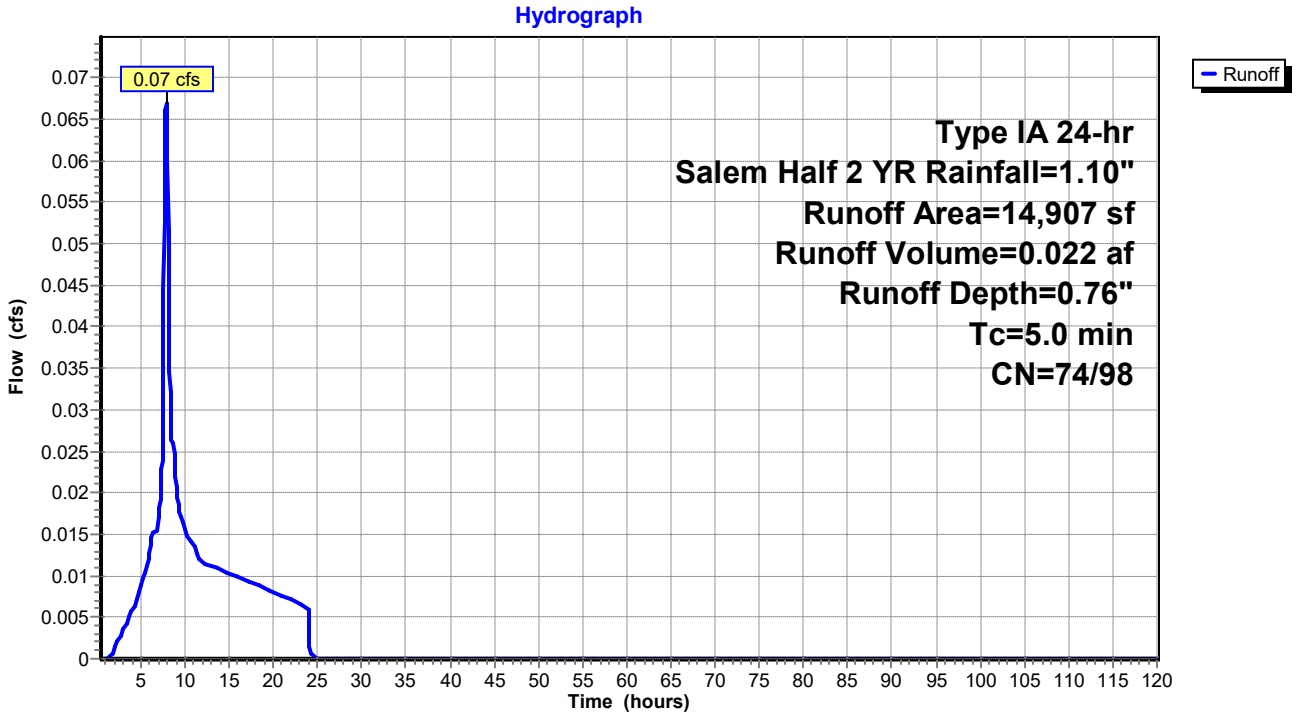
Runoff = 0.07 cfs @ 7.92 hrs, Volume= 0.022 af, Depth= 0.76"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr Salem Half 2 YR Rainfall=1.10"

	Area (sf)	CN	Description
*	12,671	98	impervious, HSG C
*	2,236	74	open space, HSG C
	14,907	94	Weighted Average
	2,236		15.00% Pervious Area
	12,671		85.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: Basin 2 (Fut Bldg A)



Summary for Subcatchment 3S: Basin 3

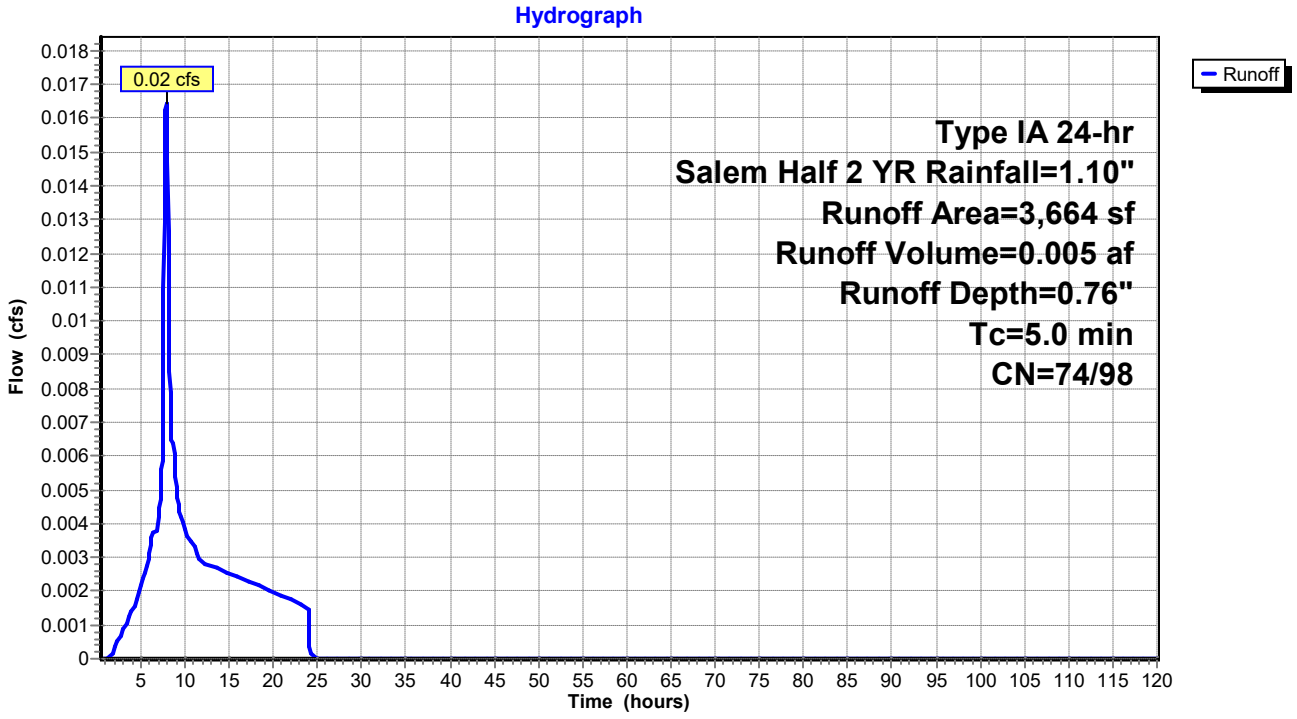
Runoff = 0.02 cfs @ 7.92 hrs, Volume= 0.005 af, Depth= 0.76"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr Salem Half 2 YR Rainfall=1.10"

	Area (sf)	CN	Description
*	3,114	98	impervious, HSG C
*	550	74	open space, HSG C
	3,664	94	Weighted Average
	550		15.01% Pervious Area
	3,114		84.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S: Basin 3



Summary for Subcatchment 4S: Basin 4 (Fut Bldg B)

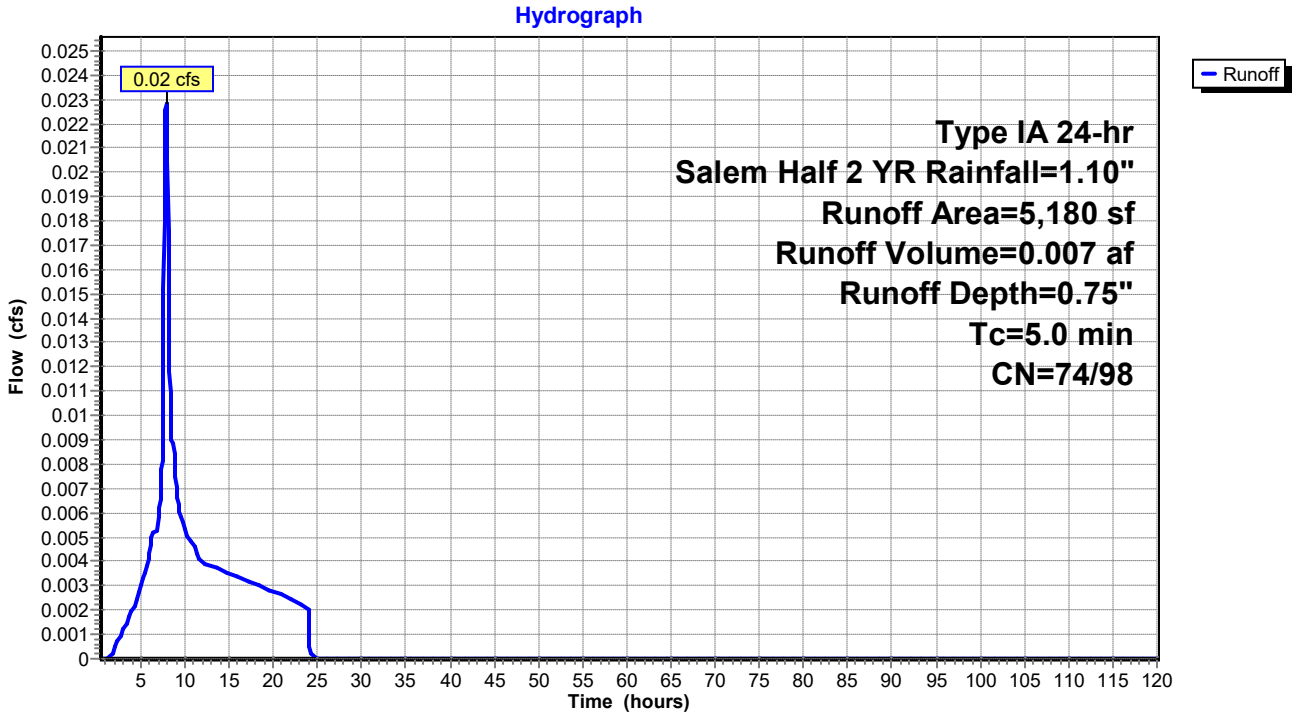
Runoff = 0.02 cfs @ 7.92 hrs, Volume= 0.007 af, Depth= 0.75"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr Salem Half 2 YR Rainfall=1.10"

	Area (sf)	CN	Description
*	4,325	98	impervious, HSG C
*	855	74	open space, HSG C
	5,180	94	Weighted Average
	855		16.51% Pervious Area
	4,325		83.49% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4S: Basin 4 (Fut Bldg B)



Summary for Subcatchment 5S: Basin 5

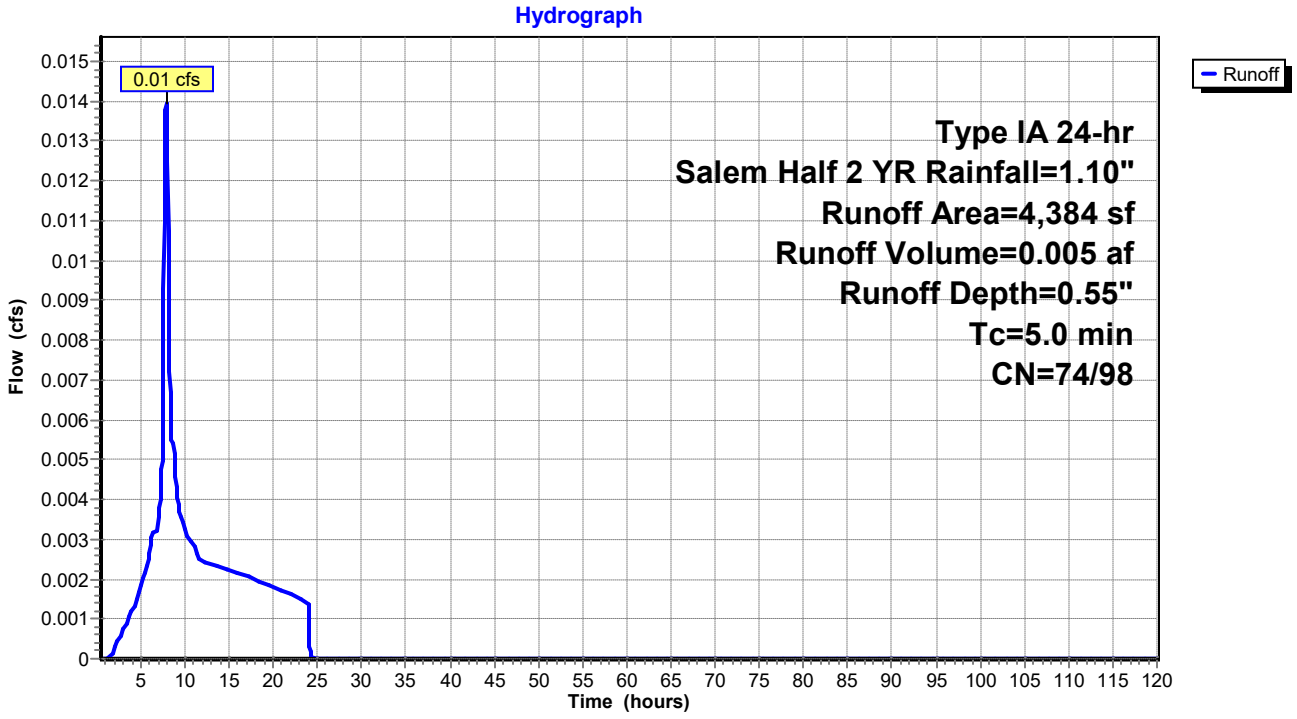
Runoff = 0.01 cfs @ 7.92 hrs, Volume= 0.005 af, Depth= 0.55"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr Salem Half 2 YR Rainfall=1.10"

	Area (sf)	CN	Description
*	2,640	98	impervious, HSG C
*	1,744	74	open space, HSG C
	4,384	88	Weighted Average
	1,744		39.78% Pervious Area
	2,640		60.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: Basin 5



Summary for Subcatchment 6S: Basin 6

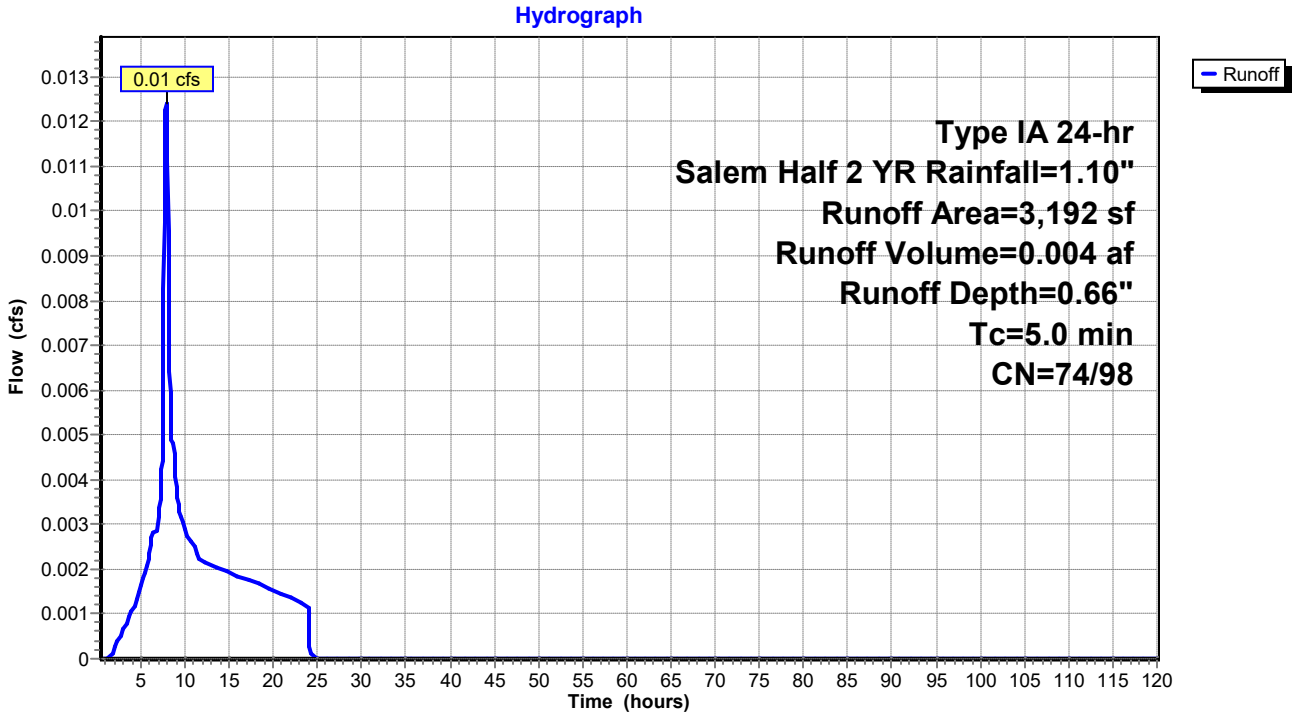
Runoff = 0.01 cfs @ 7.92 hrs, Volume= 0.004 af, Depth= 0.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr Salem Half 2 YR Rainfall=1.10"

	Area (sf)	CN	Description
*	2,350	98	impervious, HSG C
*	842	74	open space, HSG C
	3,192	92	Weighted Average
	842		26.38% Pervious Area
	2,350		73.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: Basin 6



Summary for Pond 1P: Rain Garden 1

Inflow Area = 0.793 ac, 84.46% Impervious, Inflow Depth = 0.76" for Salem Half 2 YR event
Inflow = 0.15 cfs @ 7.92 hrs, Volume= 0.050 af
Outflow = 0.01 cfs @ 24.06 hrs, Volume= 0.027 af, Atten= 94%, Lag= 968.4 min
Discarded = 0.00 cfs @ 3.70 hrs, Volume= 0.012 af
Primary = 0.01 cfs @ 24.06 hrs, Volume= 0.014 af

Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Peak Elev= 467.88' @ 24.06 hrs Surf.Area= 1,350 sf Storage= 1,824 cf

Plug-Flow detention time= 2,100.2 min calculated for 0.027 af (53% of inflow)
Center-of-Mass det. time= 1,845.2 min (2,557.4 - 712.2)

Volume	Invert	Avail.Storage	Storage Description
#1	464.50'	4,923 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

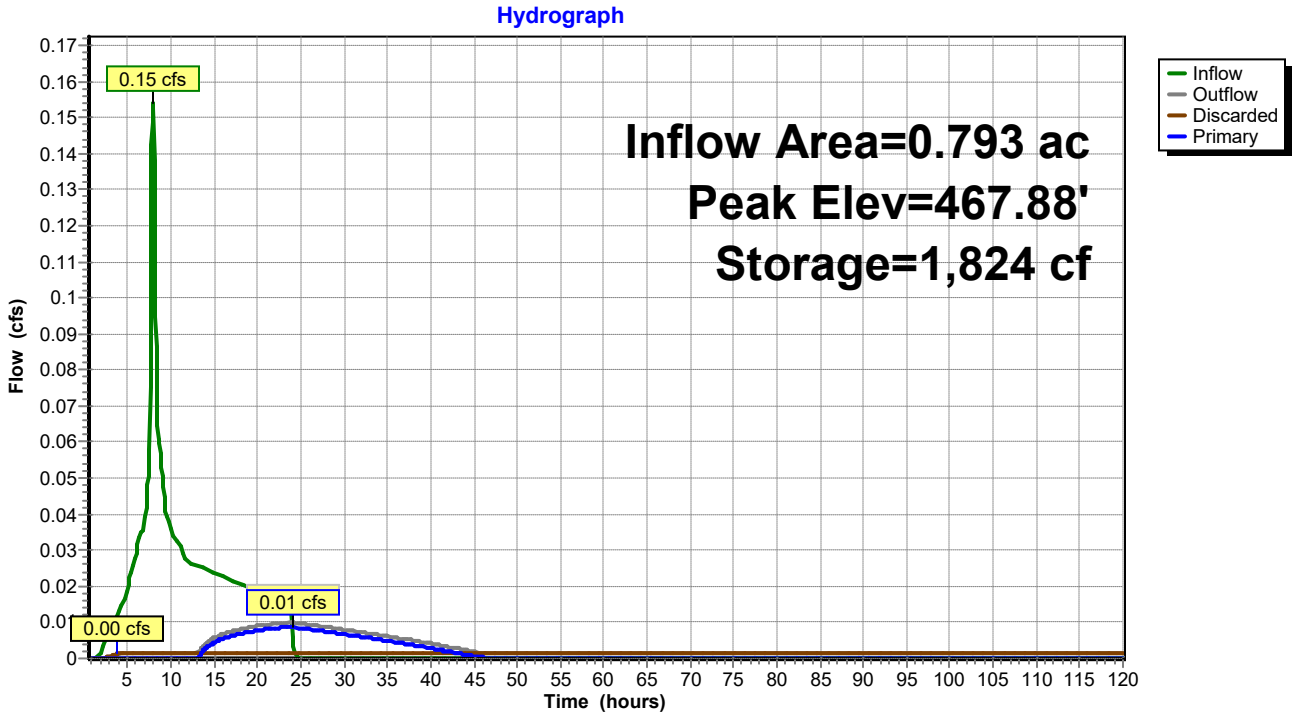
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
464.50	1,350	0.0	0	0
466.01	1,350	40.0	815	815
467.99	1,350	40.0	1,069	1,885
468.00	1,350	0.1	0	1,885
469.50	1,350	0.1	2	1,887
469.51	672	100.0	10	1,897
470.50	1,350	100.0	1,001	2,898
472.00	1,350	100.0	2,025	4,923

Device	Routing	Invert	Outlet Devices
#1	Discarded	464.50'	**0.040 in/hr Exfiltration over Surface area**
#2	Primary	467.00'	**0.6" Vert. Orifice/Grate** C= 0.600
#3	Primary	469.60'	**1.6" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.00 cfs @ 3.70 hrs HW=464.58' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.01 cfs @ 24.06 hrs HW=467.88' (Free Discharge)
├**2=Orifice/Grate** (Orifice Controls 0.01 cfs @ 4.45 fps)
└**3=Orifice/Grate** (Controls 0.00 cfs)

Pond 1P: Rain Garden 1



Summary for Pond 2P: Rain Garden 2

Inflow Area = 0.342 ac, 85.00% Impervious, Inflow Depth = 0.76" for Salem Half 2 YR event
Inflow = 0.07 cfs @ 7.92 hrs, Volume= 0.022 af
Outflow = 0.01 cfs @ 20.96 hrs, Volume= 0.019 af, Atten= 89%, Lag= 782.5 min
Discarded = 0.00 cfs @ 3.55 hrs, Volume= 0.005 af
Primary = 0.01 cfs @ 20.96 hrs, Volume= 0.014 af

Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Peak Elev= 468.43' @ 20.96 hrs Surf.Area= 564 sf Storage= 549 cf

Plug-Flow detention time= 1,339.0 min calculated for 0.019 af (86% of inflow)
Center-of-Mass det. time= 1,243.3 min (1,955.4 - 712.1)

Volume	Invert	Avail.Storage	Storage Description
#1	466.00'	2,783 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

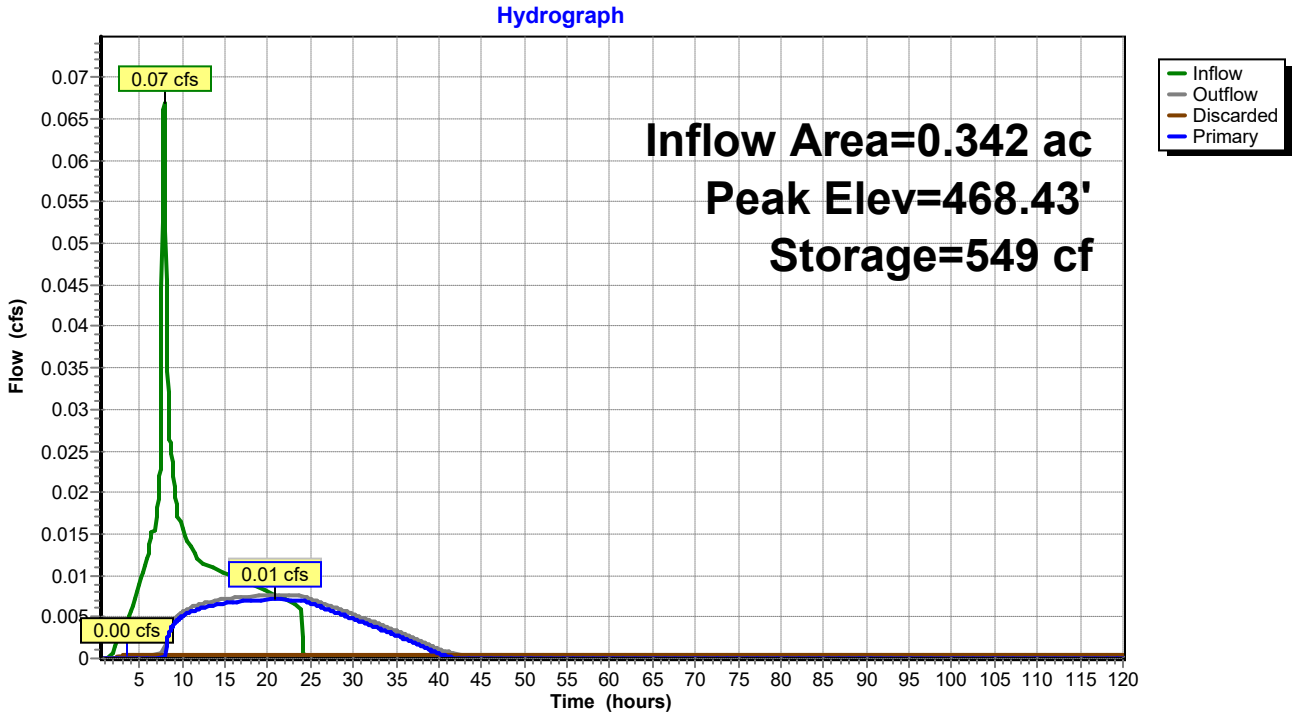
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
466.00	564	0.0	0	0
466.51	564	40.0	115	115
468.49	564	40.0	447	562
468.50	564	0.1	0	562
470.00	564	0.1	1	563
470.01	889	100.0	7	570
471.00	889	100.0	880	1,450
472.50	889	100.0	1,334	2,783

Device	Routing	Invert	Outlet Devices
#1	Discarded	466.00'	**0.040 in/hr Exfiltration over Surface area**
#2	Primary	467.25'	**0.5" Vert. Orifice/Grate** C= 0.600
#3	Primary	468.45'	**0.7" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.00 cfs @ 3.55 hrs HW=466.07' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.01 cfs @ 20.96 hrs HW=468.43' (Free Discharge)
├**2=Orifice/Grate** (Orifice Controls 0.01 cfs @ 5.19 fps)
└**3=Orifice/Grate** (Controls 0.00 cfs)

Pond 2P: Rain Garden 2



Summary for Pond 3P: Rain Garden 3

Inflow Area = 0.084 ac, 84.99% Impervious, Inflow Depth = 0.76" for Salem Half 2 YR event
Inflow = 0.02 cfs @ 7.92 hrs, Volume= 0.005 af
Outflow = 0.00 cfs @ 19.53 hrs, Volume= 0.004 af, Atten= 88%, Lag= 696.5 min
Discarded = 0.00 cfs @ 3.95 hrs, Volume= 0.002 af
Primary = 0.00 cfs @ 19.53 hrs, Volume= 0.002 af

Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Peak Elev= 468.96' @ 19.53 hrs Surf.Area= 200 sf Storage= 157 cf

Plug-Flow detention time= 1,956.4 min calculated for 0.004 af (66% of inflow)
Center-of-Mass det. time= 1,754.3 min (2,466.4 - 712.1)

Volume	Invert	Avail.Storage	Storage Description
#1	467.00'	625 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

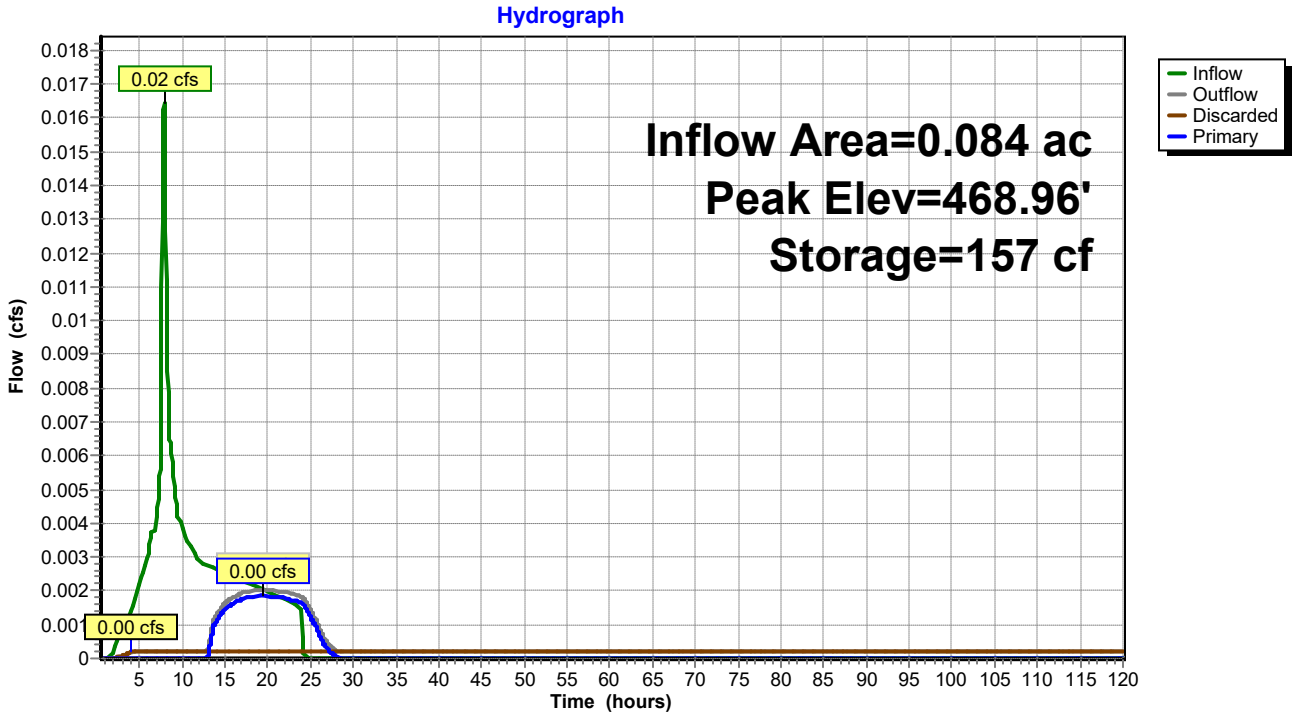
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
467.00	200	0.0	0	0
467.51	200	40.0	41	41
469.49	200	40.0	158	199
469.50	200	0.1	0	199
471.00	200	0.1	0	200
471.01	50	100.0	1	201
472.00	200	100.0	124	325
473.50	200	100.0	300	625

Device	Routing	Invert	Outlet Devices
#1	Discarded	467.00'	**0.040 in/hr Exfiltration over Surface area**
#2	Primary	468.75'	**0.4" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.00 cfs @ 3.95 hrs HW=467.07' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 19.53 hrs HW=468.96' (Free Discharge)
↑—**2=Orifice/Grate** (Orifice Controls 0.00 cfs @ 2.12 fps)

Pond 3P: Rain Garden 3



Summary for Pond 4P: Rain Garden 4

Inflow Area = 0.119 ac, 83.49% Impervious, Inflow Depth = 0.75" for Salem Half 2 YR event
Inflow = 0.02 cfs @ 7.92 hrs, Volume= 0.007 af
Outflow = 0.00 cfs @ 24.03 hrs, Volume= 0.005 af, Atten= 92%, Lag= 966.8 min
Discarded = 0.00 cfs @ 4.40 hrs, Volume= 0.003 af
Primary = 0.00 cfs @ 24.03 hrs, Volume= 0.002 af

Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Peak Elev= 467.64' @ 24.03 hrs Surf.Area= 385 sf Storage= 252 cf

Plug-Flow detention time= 2,342.2 min calculated for 0.005 af (73% of inflow)
Center-of-Mass det. time= 2,173.2 min (2,885.7 - 712.5)

Volume	Invert	Avail.Storage	Storage Description
#1	466.00'	1,347 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

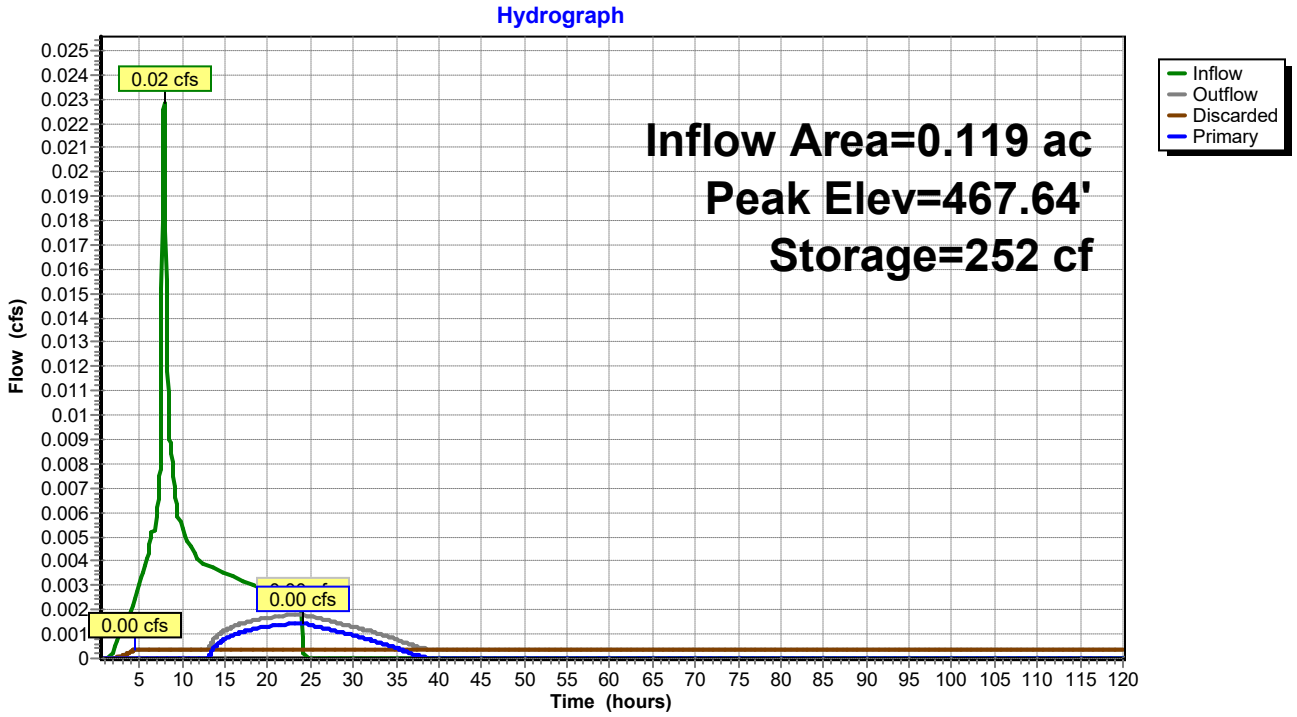
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
466.00	385	0.0	0	0
466.51	385	40.0	79	79
468.49	385	40.0	305	383
468.50	385	0.1	0	383
470.00	385	0.1	1	384
470.01	385	100.0	4	388
471.00	385	100.0	381	769
472.50	385	100.0	578	1,347

Device	Routing	Invert	Outlet Devices
#1	Discarded	466.00'	**0.040 in/hr Exfiltration over Surface area**
#2	Primary	467.25'	**0.3" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.00 cfs @ 4.40 hrs HW=466.07' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 24.03 hrs HW=467.64' (Free Discharge)
↑—**2=Orifice/Grate** (Orifice Controls 0.00 cfs @ 2.95 fps)

Pond 4P: Rain Garden 4



Summary for Pond 5P: Rain Garden 5

Inflow Area = 0.101 ac, 60.22% Impervious, Inflow Depth = 0.55" for Salem Half 2 YR event
Inflow = 0.01 cfs @ 7.92 hrs, Volume= 0.005 af
Outflow = 0.00 cfs @ 24.00 hrs, Volume= 0.003 af, Atten= 90%, Lag= 965.0 min
Discarded = 0.00 cfs @ 4.45 hrs, Volume= 0.002 af
Primary = 0.00 cfs @ 24.00 hrs, Volume= 0.001 af

Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Peak Elev= 467.51' @ 24.00 hrs Surf.Area= 250 sf Storage= 151 cf

Plug-Flow detention time= 2,325.5 min calculated for 0.003 af (74% of inflow)
Center-of-Mass det. time= 2,162.3 min (2,883.5 - 721.2)

Volume	Invert	Avail.Storage	Storage Description
#1	466.00'	874 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

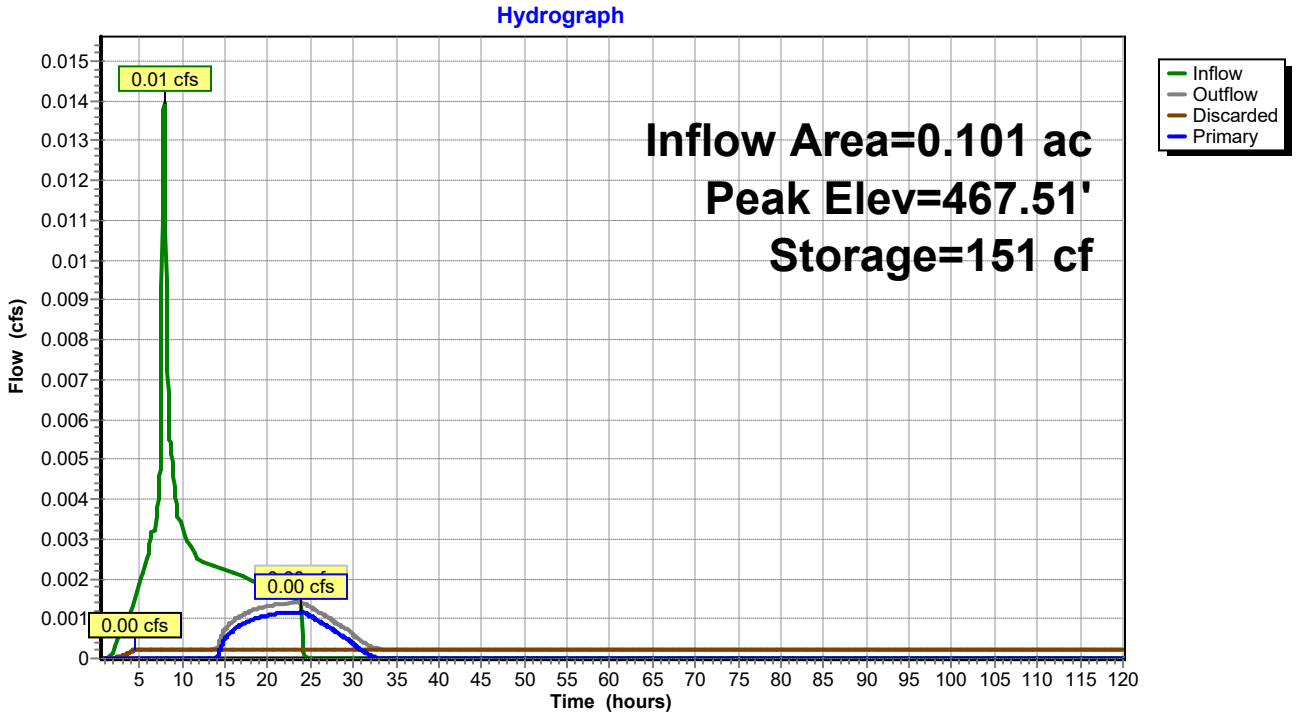
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
466.00	250	0.0	0	0
466.51	250	40.0	51	51
468.49	250	40.0	198	249
468.50	250	0.1	0	249
470.00	250	0.1	0	249
470.01	250	100.0	2	252
471.00	250	100.0	248	499
472.50	250	100.0	375	874

Device	Routing	Invert	Outlet Devices
#1	Discarded	466.00'	**0.040 in/hr Exfiltration over Surface area**
#2	Primary	467.25'	**0.3" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.00 cfs @ 4.45 hrs HW=466.07' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 24.00 hrs HW=467.51' (Free Discharge)
↑—**2=Orifice/Grate** (Orifice Controls 0.00 cfs @ 2.38 fps)

Pond 5P: Rain Garden 5



Summary for Pond 6P: Rain Garden 6

Inflow Area = 0.073 ac, 73.62% Impervious, Inflow Depth = 0.66" for Salem Half 2 YR event
Inflow = 0.01 cfs @ 7.92 hrs, Volume= 0.004 af
Outflow = 0.00 cfs @ 11.57 hrs, Volume= 0.004 af, Atten= 82%, Lag= 219.3 min
Discarded = 0.00 cfs @ 3.75 hrs, Volume= 0.001 af
Primary = 0.00 cfs @ 11.57 hrs, Volume= 0.002 af

Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Peak Elev= 466.53' @ 11.57 hrs Surf.Area= 125 sf Storage= 76 cf

Plug-Flow detention time= 1,213.7 min calculated for 0.004 af (87% of inflow)
Center-of-Mass det. time= 1,124.1 min (1,839.6 - 715.5)

Volume	Invert	Avail.Storage	Storage Description
#1	465.00'	437 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

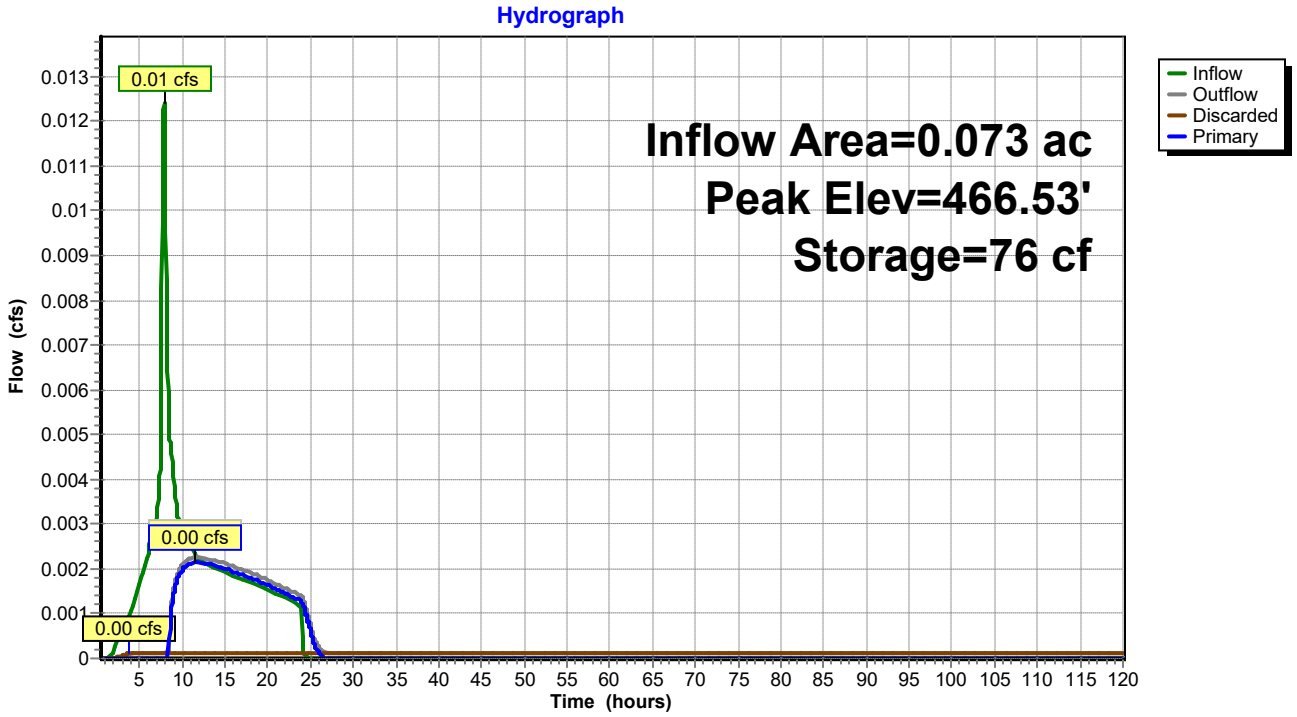
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
465.00	125	0.0	0	0
465.51	125	40.0	25	25
467.49	125	40.0	99	125
467.50	125	0.1	0	125
469.00	125	0.1	0	125
469.01	125	100.0	1	126
470.00	125	100.0	124	250
471.50	125	100.0	188	437

Device	Routing	Invert	Outlet Devices
#1	Discarded	465.00'	**0.040 in/hr Exfiltration over Surface area**
#2	Primary	466.25'	**0.4" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.00 cfs @ 3.75 hrs HW=465.07' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 11.57 hrs HW=466.53' (Free Discharge)
↑—**2=Orifice/Grate** (Orifice Controls 0.00 cfs @ 2.47 fps)

Pond 6P: Rain Garden 6

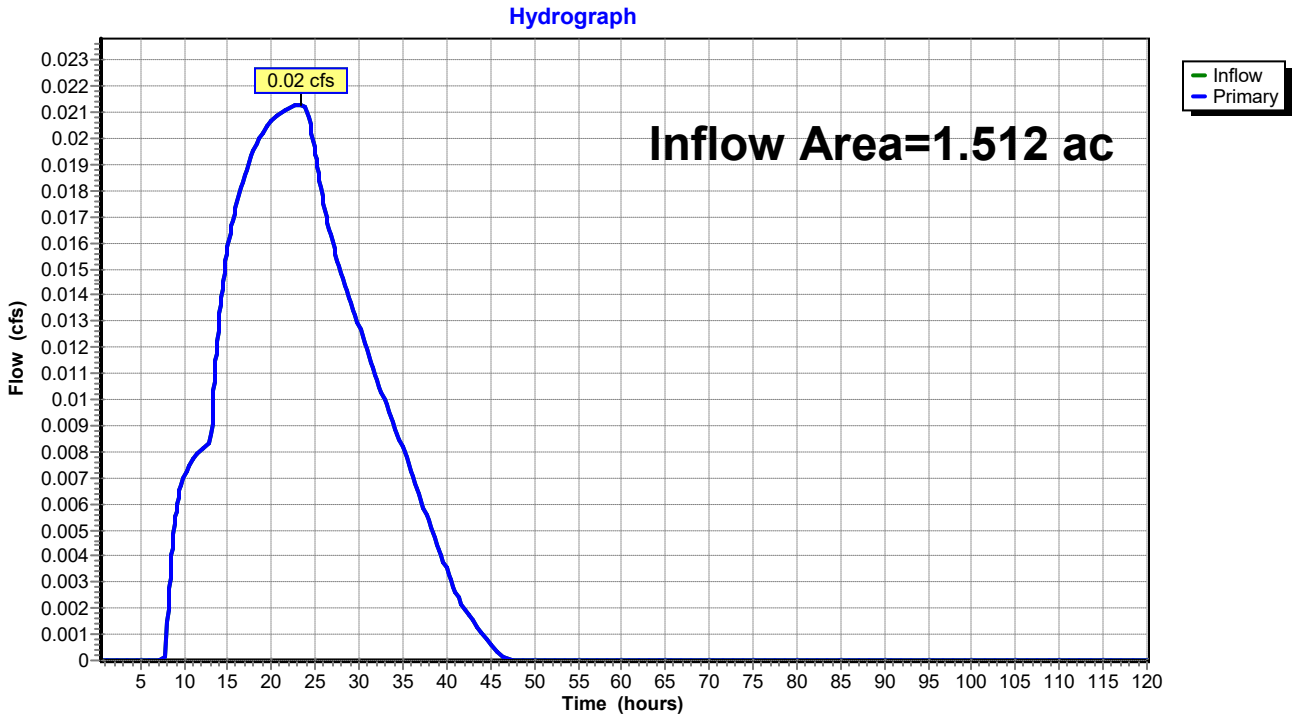


Summary for Link 1L: junc

Inflow Area = 1.512 ac, 82.40% Impervious, Inflow Depth = 0.28" for Salem Half 2 YR event
Inflow = 0.02 cfs @ 23.25 hrs, Volume= 0.035 af
Primary = 0.02 cfs @ 23.25 hrs, Volume= 0.035 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs

Link 1L: junc



Summary for Subcatchment 1S: Basin 1 (Bldg C)

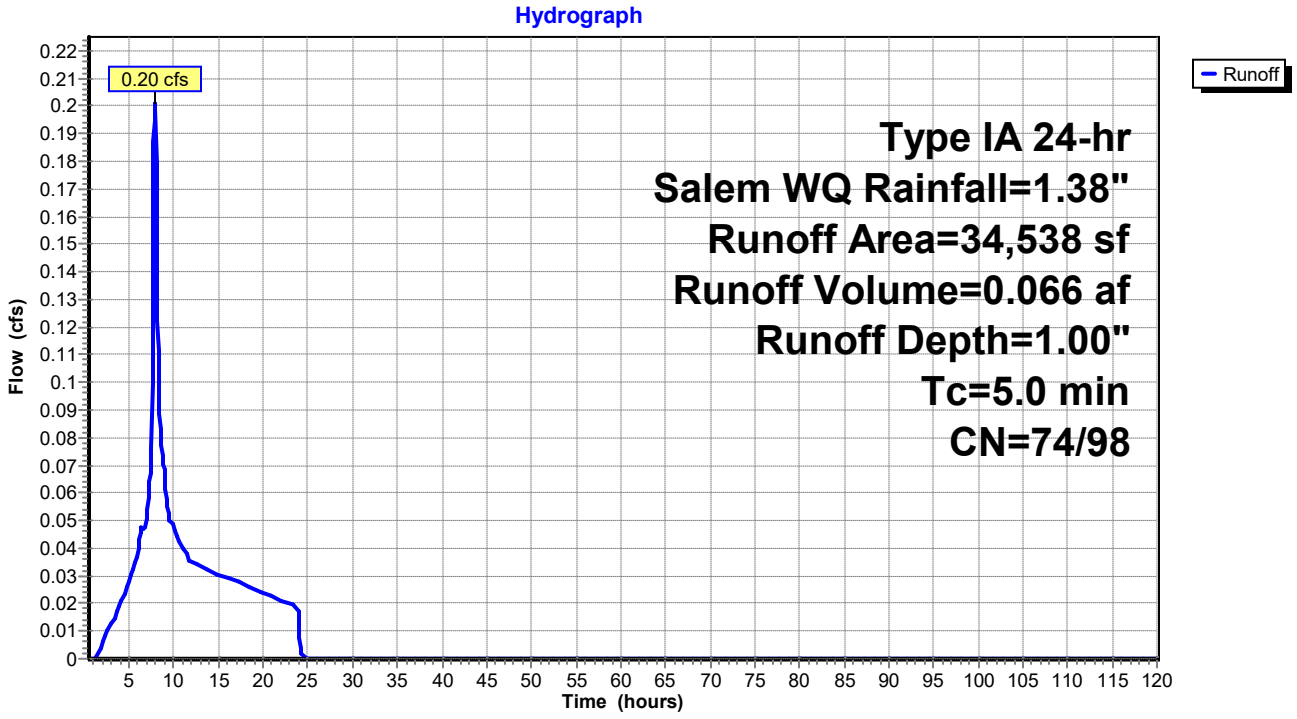
Runoff = 0.20 cfs @ 7.91 hrs, Volume= 0.066 af, Depth= 1.00"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr Salem WQ Rainfall=1.38"

	Area (sf)	CN	Description
*	29,170	98	impervious, HSG C
*	5,368	74	open space, HSG C
	34,538	94	Weighted Average
	5,368		15.54% Pervious Area
	29,170		84.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S: Basin 1 (Bldg C)



Summary for Subcatchment 2S: Basin 2 (Fut Bldg A)

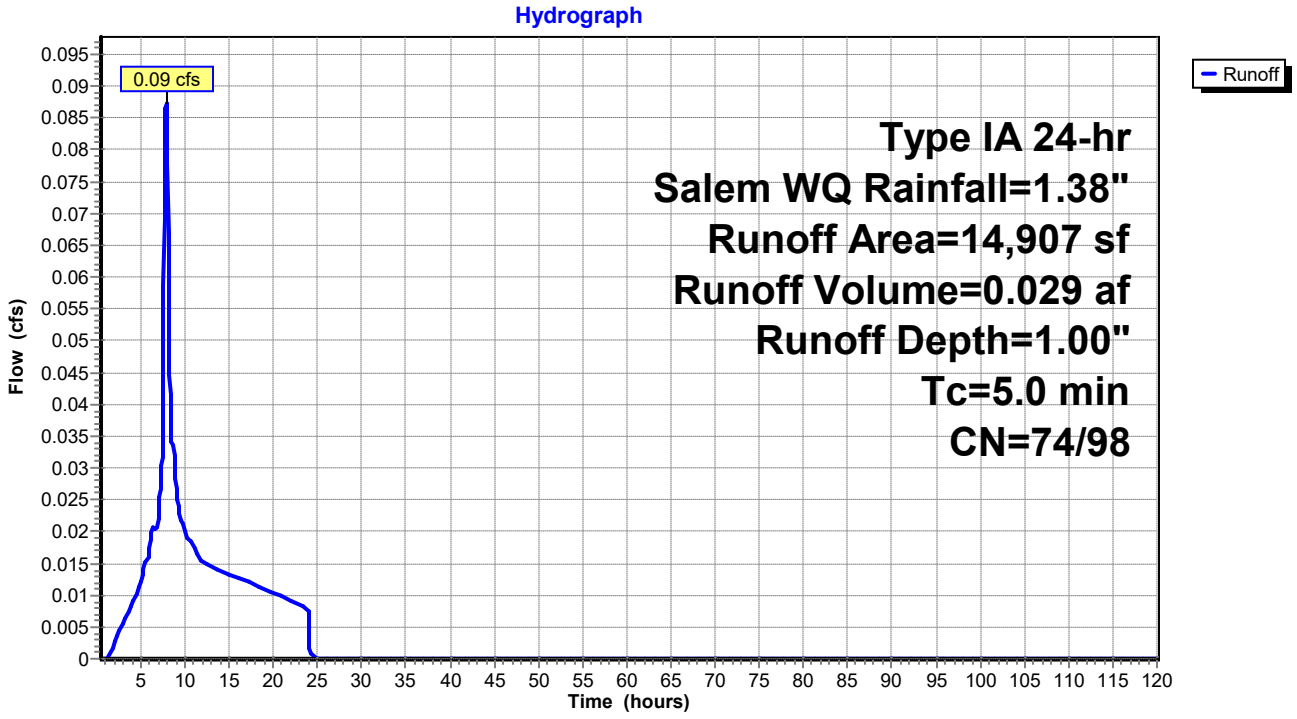
Runoff = 0.09 cfs @ 7.91 hrs, Volume= 0.029 af, Depth= 1.00"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr Salem WQ Rainfall=1.38"

	Area (sf)	CN	Description
*	12,671	98	impervious, HSG C
*	2,236	74	open space, HSG C
	14,907	94	Weighted Average
	2,236		15.00% Pervious Area
	12,671		85.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: Basin 2 (Fut Bldg A)



Summary for Subcatchment 3S: Basin 3

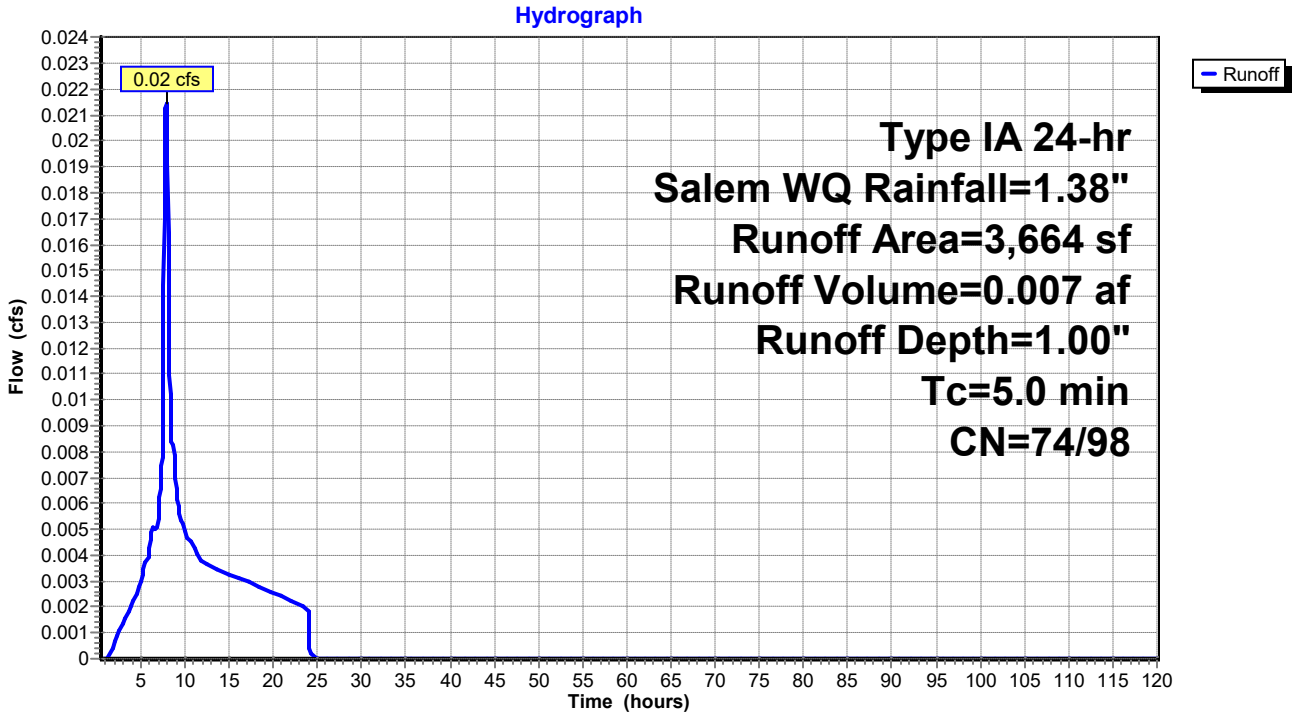
Runoff = 0.02 cfs @ 7.91 hrs, Volume= 0.007 af, Depth= 1.00"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr Salem WQ Rainfall=1.38"

	Area (sf)	CN	Description
*	3,114	98	impervious, HSG C
*	550	74	open space, HSG C
	3,664	94	Weighted Average
	550		15.01% Pervious Area
	3,114		84.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S: Basin 3



Summary for Subcatchment 4S: Basin 4 (Fut Bldg B)

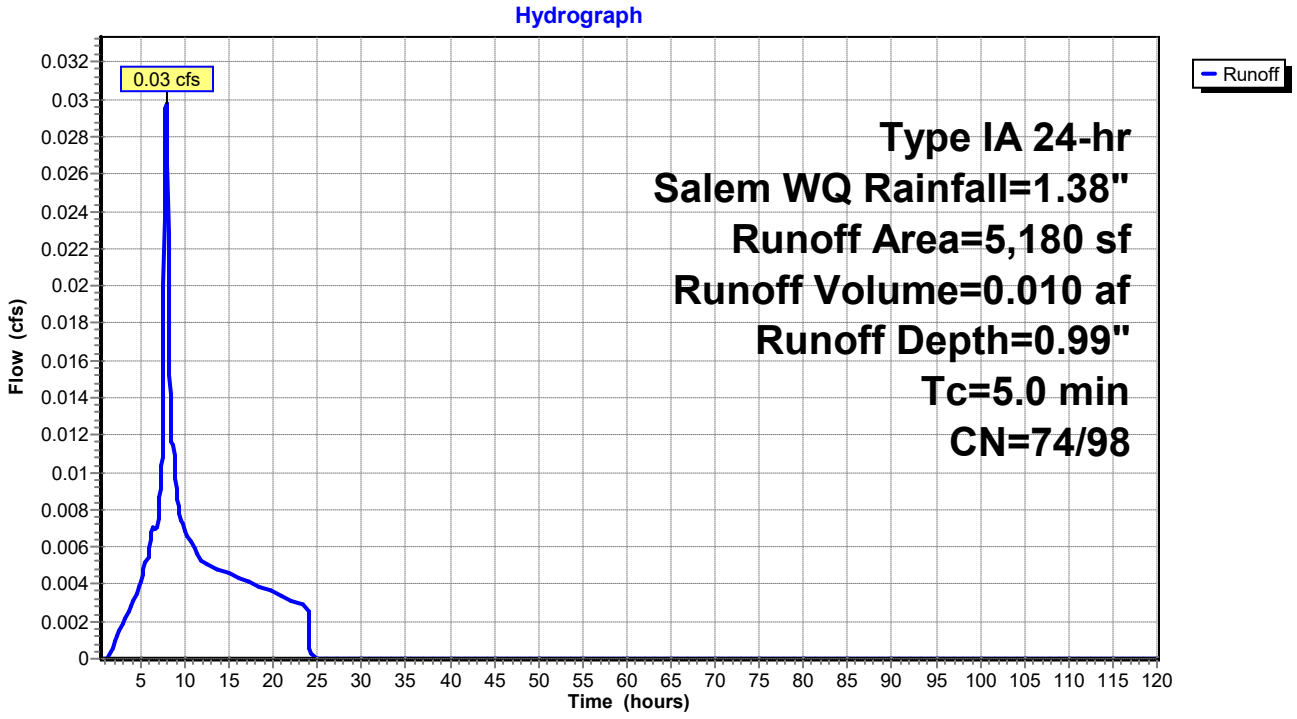
Runoff = 0.03 cfs @ 7.91 hrs, Volume= 0.010 af, Depth= 0.99"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr Salem WQ Rainfall=1.38"

	Area (sf)	CN	Description
*	4,325	98	impervious, HSG C
*	855	74	open space, HSG C
	5,180	94	Weighted Average
	855		16.51% Pervious Area
	4,325		83.49% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4S: Basin 4 (Fut Bldg B)



Summary for Subcatchment 5S: Basin 5

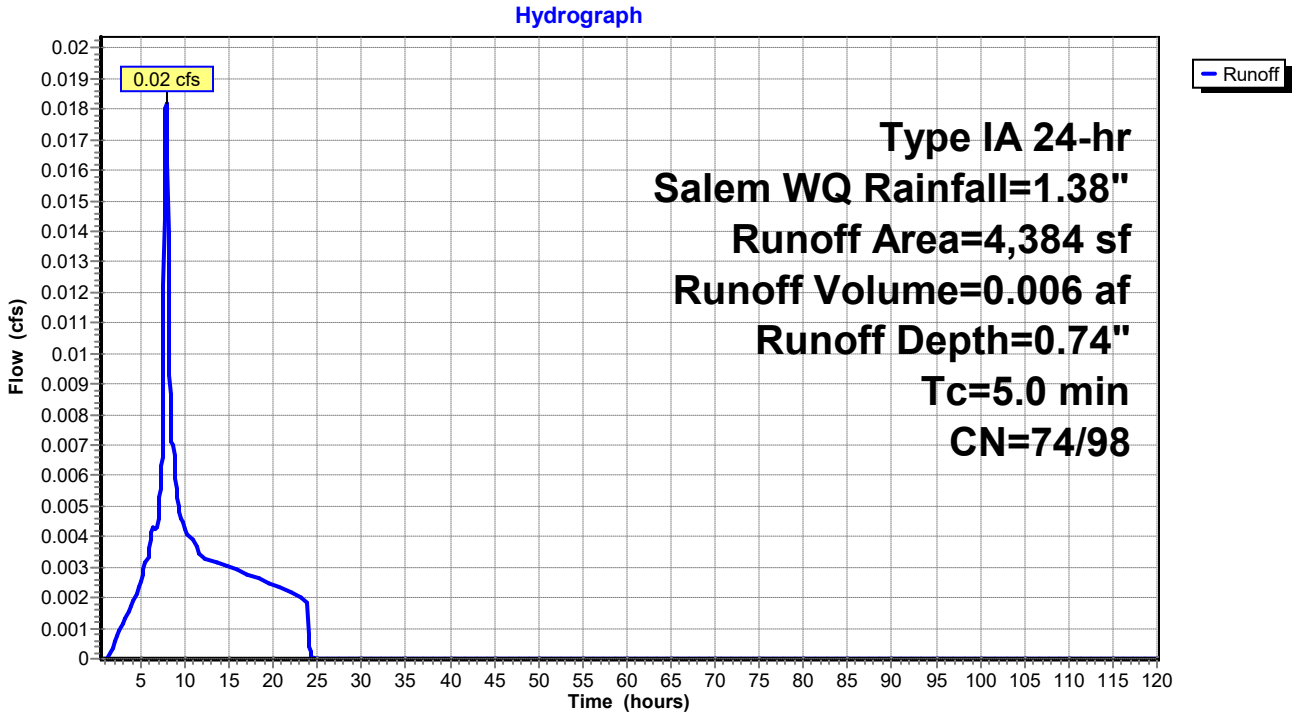
Runoff = 0.02 cfs @ 7.91 hrs, Volume= 0.006 af, Depth= 0.74"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr Salem WQ Rainfall=1.38"

	Area (sf)	CN	Description
*	2,640	98	impervious, HSG C
*	1,744	74	open space, HSG C
	4,384	88	Weighted Average
	1,744		39.78% Pervious Area
	2,640		60.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: Basin 5



Summary for Subcatchment 6S: Basin 6

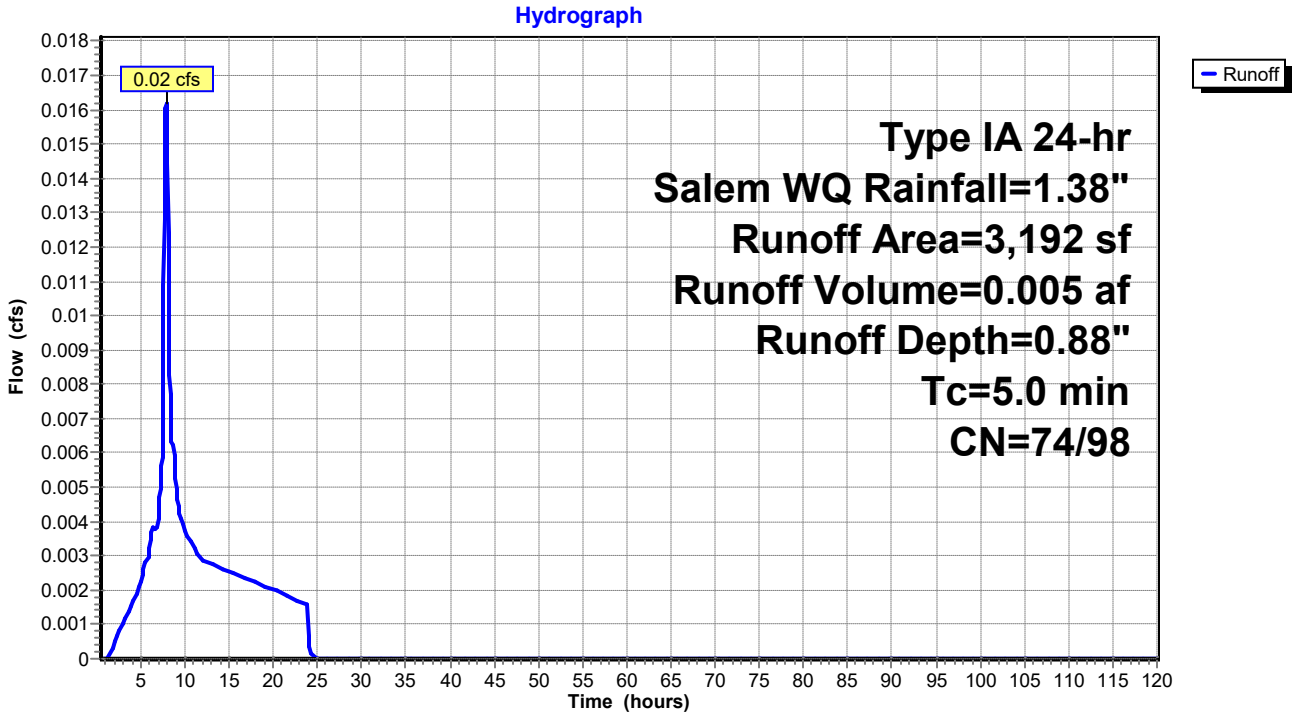
Runoff = 0.02 cfs @ 7.91 hrs, Volume= 0.005 af, Depth= 0.88"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr Salem WQ Rainfall=1.38"

	Area (sf)	CN	Description
*	2,350	98	impervious, HSG C
*	842	74	open space, HSG C
	3,192	92	Weighted Average
	842		26.38% Pervious Area
	2,350		73.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: Basin 6



Summary for Pond 1P: Rain Garden 1

Inflow Area = 0.793 ac, 84.46% Impervious, Inflow Depth = 1.00" for Salem WQ event
Inflow = 0.20 cfs @ 7.91 hrs, Volume= 0.066 af
Outflow = 0.02 cfs @ 19.89 hrs, Volume= 0.042 af, Atten= 88%, Lag= 718.7 min
Discarded = 0.00 cfs @ 3.05 hrs, Volume= 0.012 af
Primary = 0.02 cfs @ 19.89 hrs, Volume= 0.030 af

Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Peak Elev= 469.68' @ 19.89 hrs Surf.Area= 787 sf Storage= 2,019 cf

Plug-Flow detention time= 1,600.4 min calculated for 0.042 af (64% of inflow)
Center-of-Mass det. time= 1,389.8 min (2,093.0 - 703.2)

Volume	Invert	Avail.Storage	Storage Description
#1	464.50'	4,923 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

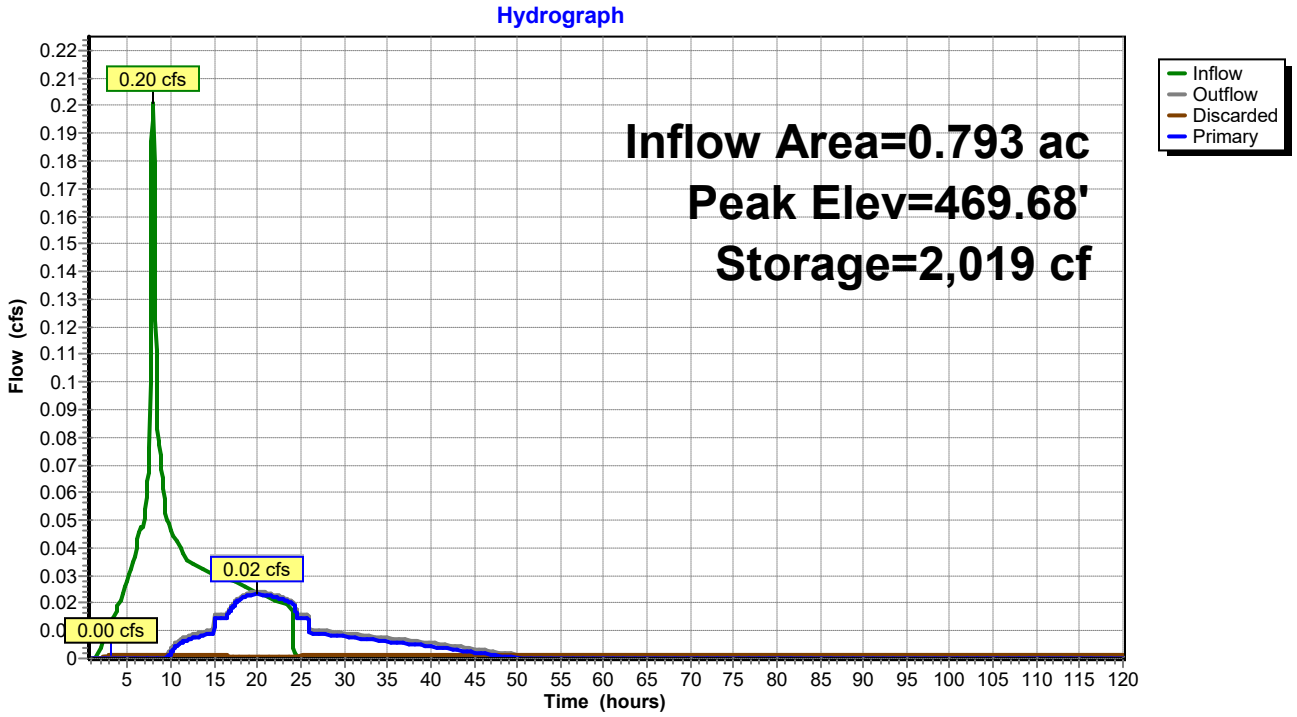
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
464.50	1,350	0.0	0	0
466.01	1,350	40.0	815	815
467.99	1,350	40.0	1,069	1,885
468.00	1,350	0.1	0	1,885
469.50	1,350	0.1	2	1,887
469.51	672	100.0	10	1,897
470.50	1,350	100.0	1,001	2,898
472.00	1,350	100.0	2,025	4,923

Device	Routing	Invert	Outlet Devices
#1	Discarded	464.50'	**0.040 in/hr Exfiltration over Surface area**
#2	Primary	467.00'	**0.6" Vert. Orifice/Grate** C= 0.600
#3	Primary	469.60'	**1.6" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.00 cfs @ 3.05 hrs HW=464.58' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.02 cfs @ 19.89 hrs HW=469.68' (Free Discharge)
├**2=Orifice/Grate** (Orifice Controls 0.02 cfs @ 7.84 fps)
└**3=Orifice/Grate** (Orifice Controls 0.01 cfs @ 0.95 fps)

Pond 1P: Rain Garden 1



Summary for Pond 2P: Rain Garden 2

Inflow Area = 0.342 ac, 85.00% Impervious, Inflow Depth = 1.00" for Salem WQ event
Inflow = 0.09 cfs @ 7.91 hrs, Volume= 0.029 af
Outflow = 0.02 cfs @ 10.16 hrs, Volume= 0.026 af, Atten= 76%, Lag= 135.1 min
Discarded = 0.00 cfs @ 2.90 hrs, Volume= 0.005 af
Primary = 0.02 cfs @ 10.16 hrs, Volume= 0.020 af

Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Peak Elev= 469.23' @ 10.16 hrs Surf.Area= 564 sf Storage= 562 cf

Plug-Flow detention time= 1,045.3 min calculated for 0.026 af (89% of inflow)
Center-of-Mass det. time= 969.8 min (1,672.8 - 703.0)

Volume	Invert	Avail.Storage	Storage Description
#1	466.00'	2,783 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

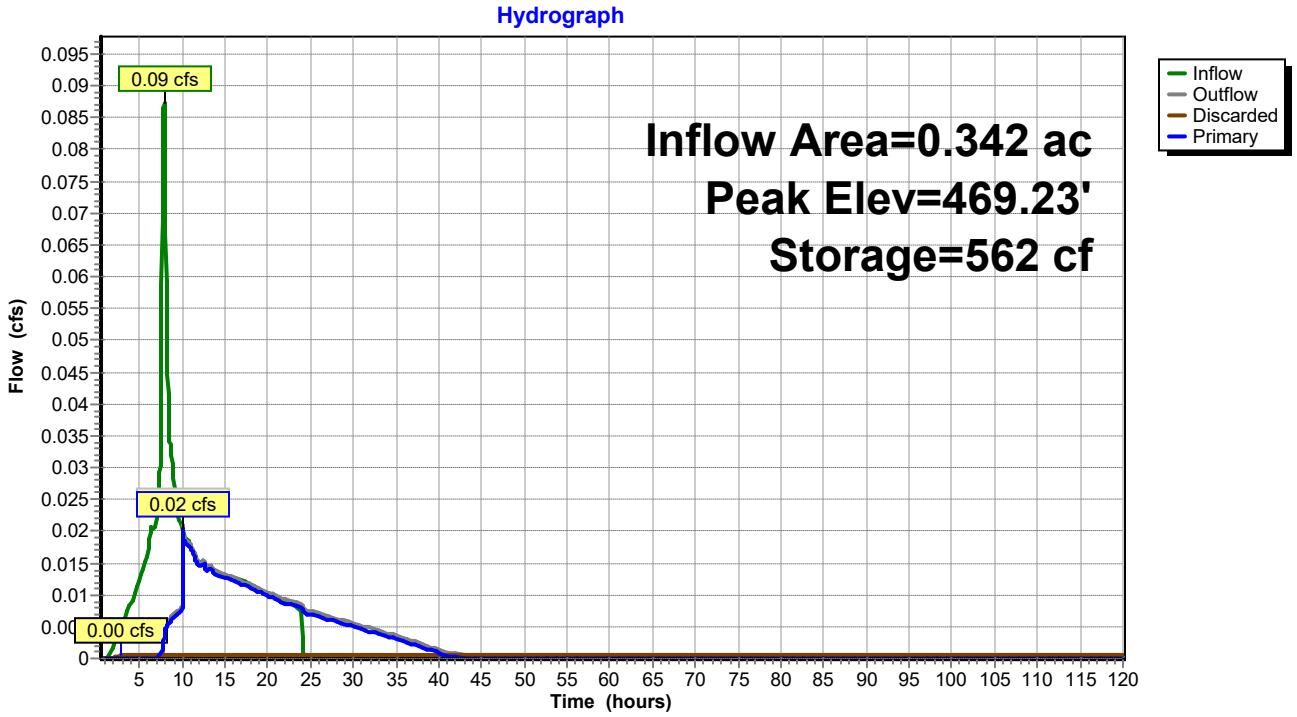
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
466.00	564	0.0	0	0
466.51	564	40.0	115	115
468.49	564	40.0	447	562
468.50	564	0.1	0	562
470.00	564	0.1	1	563
470.01	889	100.0	7	570
471.00	889	100.0	880	1,450
472.50	889	100.0	1,334	2,783

Device	Routing	Invert	Outlet Devices
#1	Discarded	466.00'	**0.040 in/hr Exfiltration over Surface area**
#2	Primary	467.25'	**0.5" Vert. Orifice/Grate** C= 0.600
#3	Primary	468.45'	**0.7" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.00 cfs @ 2.90 hrs HW=466.07' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.02 cfs @ 10.16 hrs HW=469.18' (Free Discharge)
├**2=Orifice/Grate** (Orifice Controls 0.01 cfs @ 6.65 fps)
└**3=Orifice/Grate** (Orifice Controls 0.01 cfs @ 4.03 fps)

Pond 2P: Rain Garden 2



Summary for Pond 3P: Rain Garden 3

Inflow Area = 0.084 ac, 84.99% Impervious, Inflow Depth = 1.00" for Salem WQ event
Inflow = 0.02 cfs @ 7.91 hrs, Volume= 0.007 af
Outflow = 0.00 cfs @ 17.67 hrs, Volume= 0.005 af, Atten= 87%, Lag= 585.3 min
Discarded = 0.00 cfs @ 3.25 hrs, Volume= 0.002 af
Primary = 0.00 cfs @ 17.67 hrs, Volume= 0.003 af

Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Peak Elev= 469.18' @ 17.67 hrs Surf.Area= 200 sf Storage= 174 cf

Plug-Flow detention time= 1,460.8 min calculated for 0.005 af (74% of inflow)
Center-of-Mass det. time= 1,298.7 min (2,001.7 - 703.0)

Volume	Invert	Avail.Storage	Storage Description
#1	467.00'	625 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

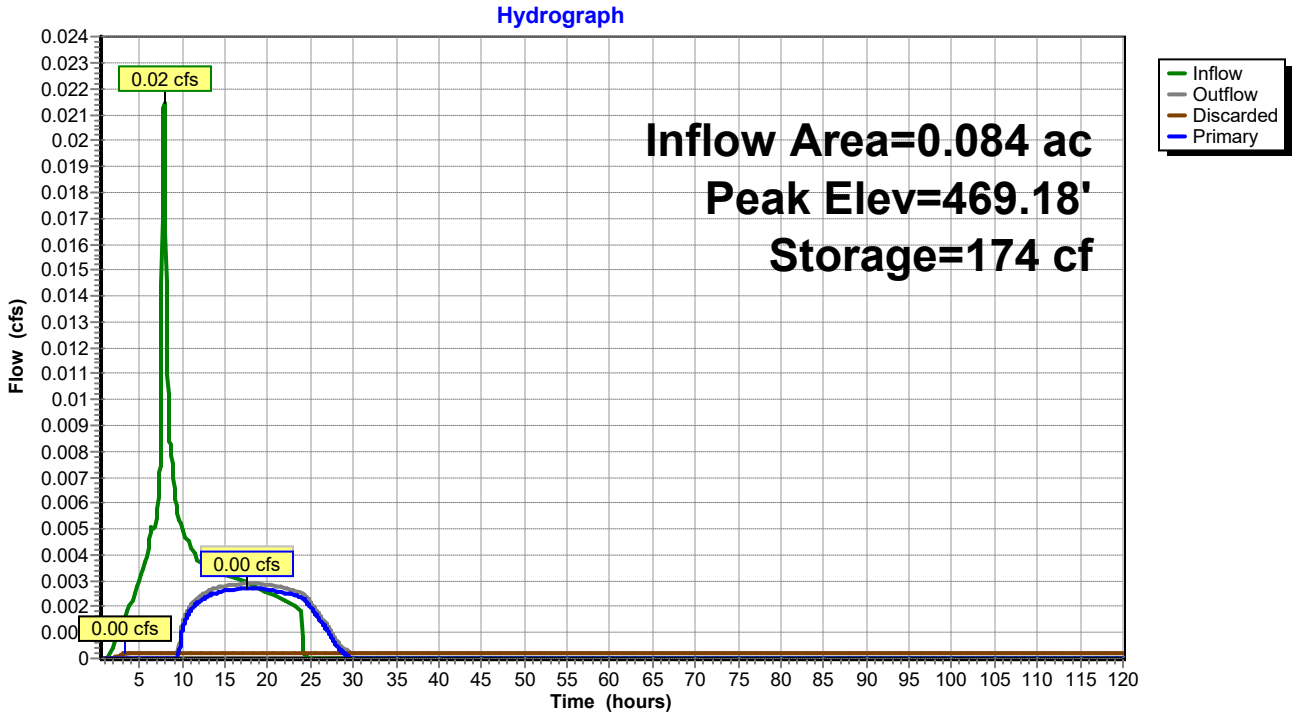
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
467.00	200	0.0	0	0
467.51	200	40.0	41	41
469.49	200	40.0	158	199
469.50	200	0.1	0	199
471.00	200	0.1	0	200
471.01	50	100.0	1	201
472.00	200	100.0	124	325
473.50	200	100.0	300	625

Device	Routing	Invert	Outlet Devices
#1	Discarded	467.00'	**0.040 in/hr Exfiltration over Surface area**
#2	Primary	468.75'	**0.4" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.00 cfs @ 3.25 hrs HW=467.07' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 17.67 hrs HW=469.18' (Free Discharge)
↑—**2=Orifice/Grate** (Orifice Controls 0.00 cfs @ 3.10 fps)

Pond 3P: Rain Garden 3



Summary for Pond 4P: Rain Garden 4

Inflow Area = 0.119 ac, 83.49% Impervious, Inflow Depth = 0.99" for Salem WQ event
Inflow = 0.03 cfs @ 7.91 hrs, Volume= 0.010 af
Outflow = 0.00 cfs @ 24.02 hrs, Volume= 0.008 af, Atten= 92%, Lag= 966.7 min
Discarded = 0.00 cfs @ 3.65 hrs, Volume= 0.003 af
Primary = 0.00 cfs @ 24.02 hrs, Volume= 0.004 af

Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Peak Elev= 468.03' @ 24.02 hrs Surf.Area= 385 sf Storage= 313 cf

Plug-Flow detention time= 1,950.7 min calculated for 0.008 af (77% of inflow)
Center-of-Mass det. time= 1,803.1 min (2,506.7 - 703.7)

Volume	Invert	Avail.Storage	Storage Description
#1	466.00'	1,347 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

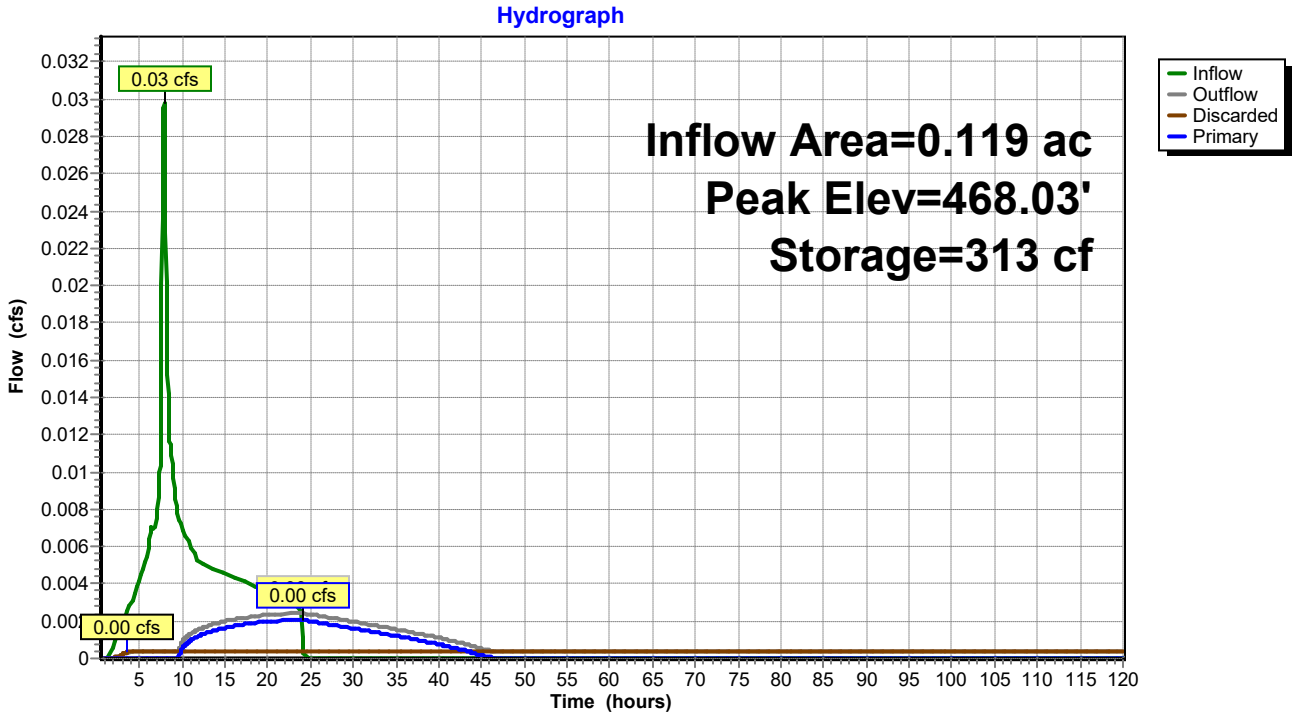
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
466.00	385	0.0	0	0
466.51	385	40.0	79	79
468.49	385	40.0	305	383
468.50	385	0.1	0	383
470.00	385	0.1	1	384
470.01	385	100.0	4	388
471.00	385	100.0	381	769
472.50	385	100.0	578	1,347

Device	Routing	Invert	Outlet Devices
#1	Discarded	466.00'	**0.040 in/hr Exfiltration over Surface area**
#2	Primary	467.25'	**0.3" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.00 cfs @ 3.65 hrs HW=466.07' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 24.02 hrs HW=468.03' (Free Discharge)
↑—**2=Orifice/Grate** (Orifice Controls 0.00 cfs @ 4.23 fps)

Pond 4P: Rain Garden 4



Summary for Pond 5P: Rain Garden 5

Inflow Area = 0.101 ac, 60.22% Impervious, Inflow Depth = 0.74" for Salem WQ event
Inflow = 0.02 cfs @ 7.91 hrs, Volume= 0.006 af
Outflow = 0.00 cfs @ 23.26 hrs, Volume= 0.005 af, Atten= 89%, Lag= 920.9 min
Discarded = 0.00 cfs @ 3.75 hrs, Volume= 0.002 af
Primary = 0.00 cfs @ 23.26 hrs, Volume= 0.003 af

Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Peak Elev= 467.81' @ 23.26 hrs Surf.Area= 250 sf Storage= 181 cf

Plug-Flow detention time= 1,815.5 min calculated for 0.005 af (79% of inflow)
Center-of-Mass det. time= 1,680.5 min (2,398.3 - 717.8)

Volume	Invert	Avail.Storage	Storage Description
#1	466.00'	874 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

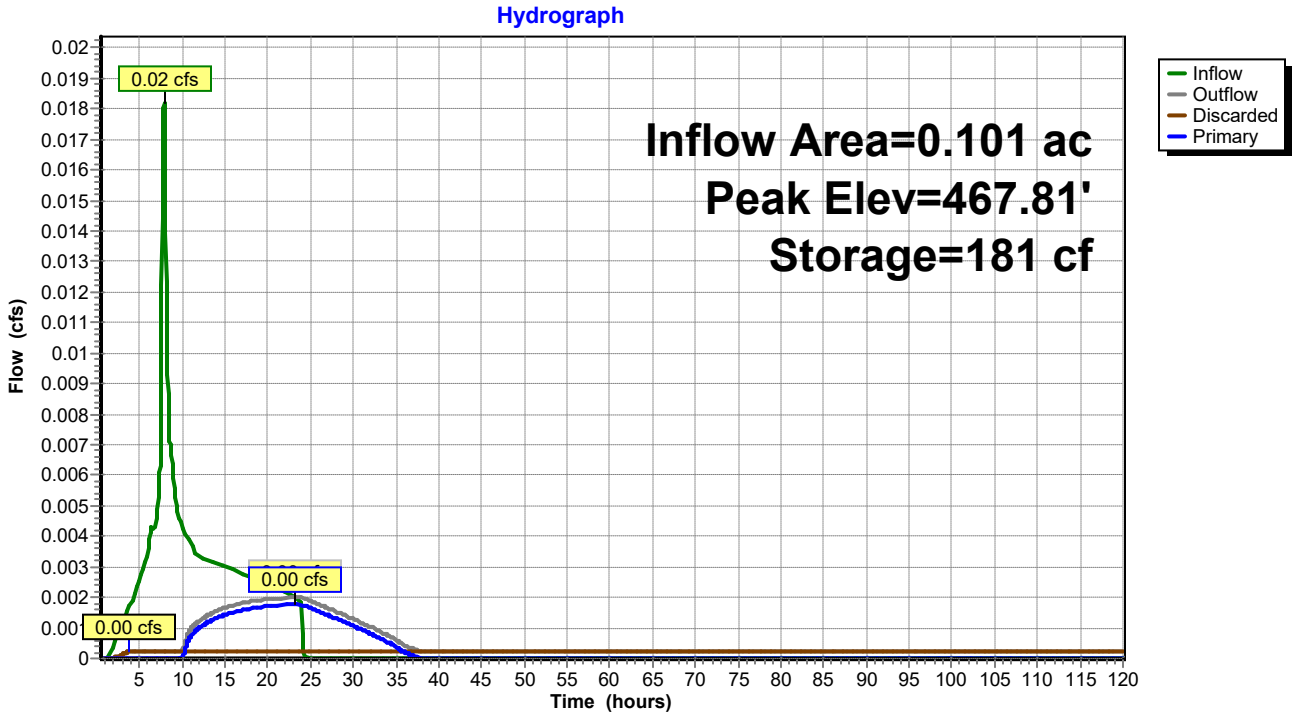
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
466.00	250	0.0	0	0
466.51	250	40.0	51	51
468.49	250	40.0	198	249
468.50	250	0.1	0	249
470.00	250	0.1	0	249
470.01	250	100.0	2	252
471.00	250	100.0	248	499
472.50	250	100.0	375	874

Device	Routing	Invert	Outlet Devices
#1	Discarded	466.00'	**0.040 in/hr Exfiltration over Surface area**
#2	Primary	467.25'	**0.3" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.00 cfs @ 3.75 hrs HW=466.07' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 23.26 hrs HW=467.81' (Free Discharge)
↑—**2=Orifice/Grate** (Orifice Controls 0.00 cfs @ 3.58 fps)

Pond 5P: Rain Garden 5



Summary for Pond 6P: Rain Garden 6

Inflow Area = 0.073 ac, 73.62% Impervious, Inflow Depth = 0.88" for Salem WQ event
Inflow = 0.02 cfs @ 7.91 hrs, Volume= 0.005 af
Outflow = 0.00 cfs @ 11.02 hrs, Volume= 0.005 af, Atten= 79%, Lag= 186.7 min
Discarded = 0.00 cfs @ 3.10 hrs, Volume= 0.001 af
Primary = 0.00 cfs @ 11.02 hrs, Volume= 0.004 af

Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Peak Elev= 466.85' @ 11.02 hrs Surf.Area= 125 sf Storage= 92 cf

Plug-Flow detention time= 945.7 min calculated for 0.005 af (90% of inflow)
Center-of-Mass det. time= 877.6 min (1,586.3 - 708.7)

Volume	Invert	Avail.Storage	Storage Description
#1	465.00'	437 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

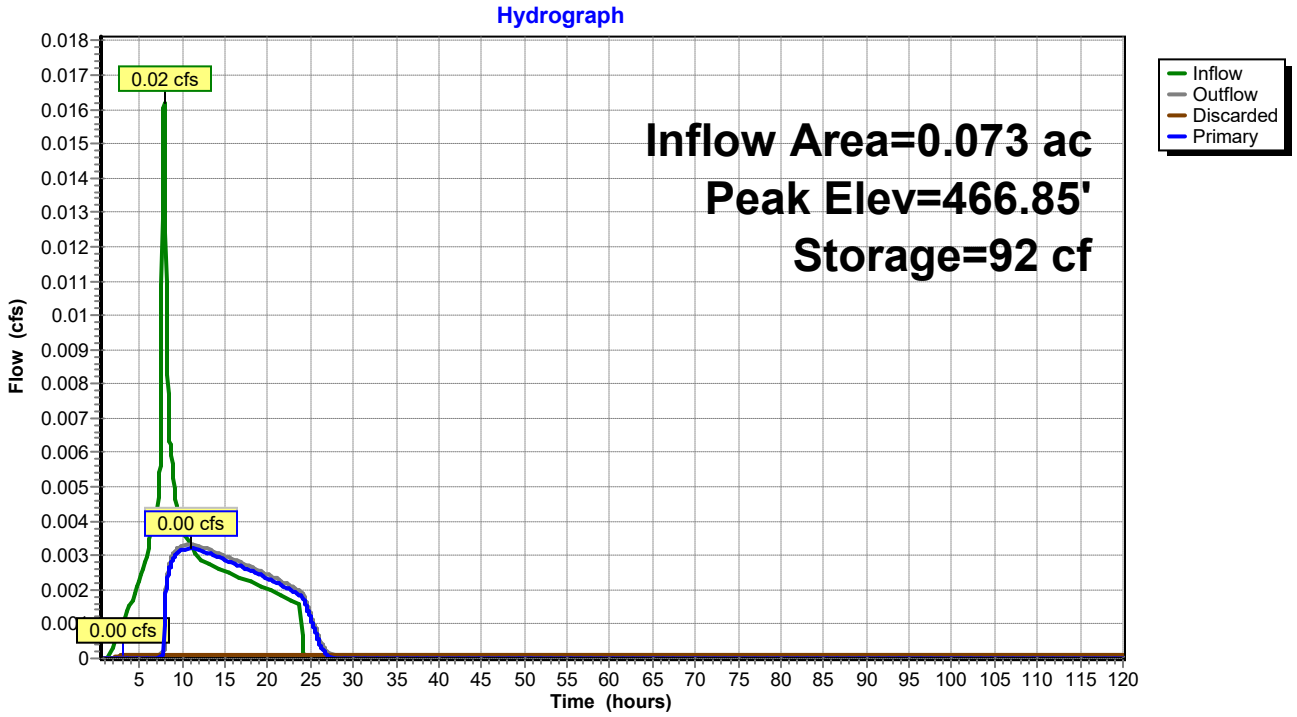
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
465.00	125	0.0	0	0
465.51	125	40.0	25	25
467.49	125	40.0	99	125
467.50	125	0.1	0	125
469.00	125	0.1	0	125
469.01	125	100.0	1	126
470.00	125	100.0	124	250
471.50	125	100.0	188	437

Device	Routing	Invert	Outlet Devices
#1	Discarded	465.00'	**0.040 in/hr Exfiltration over Surface area**
#2	Primary	466.25'	**0.4" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.00 cfs @ 3.10 hrs HW=465.07' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 11.02 hrs HW=466.85' (Free Discharge)
↑—**2=Orifice/Grate** (Orifice Controls 0.00 cfs @ 3.67 fps)

Pond 6P: Rain Garden 6

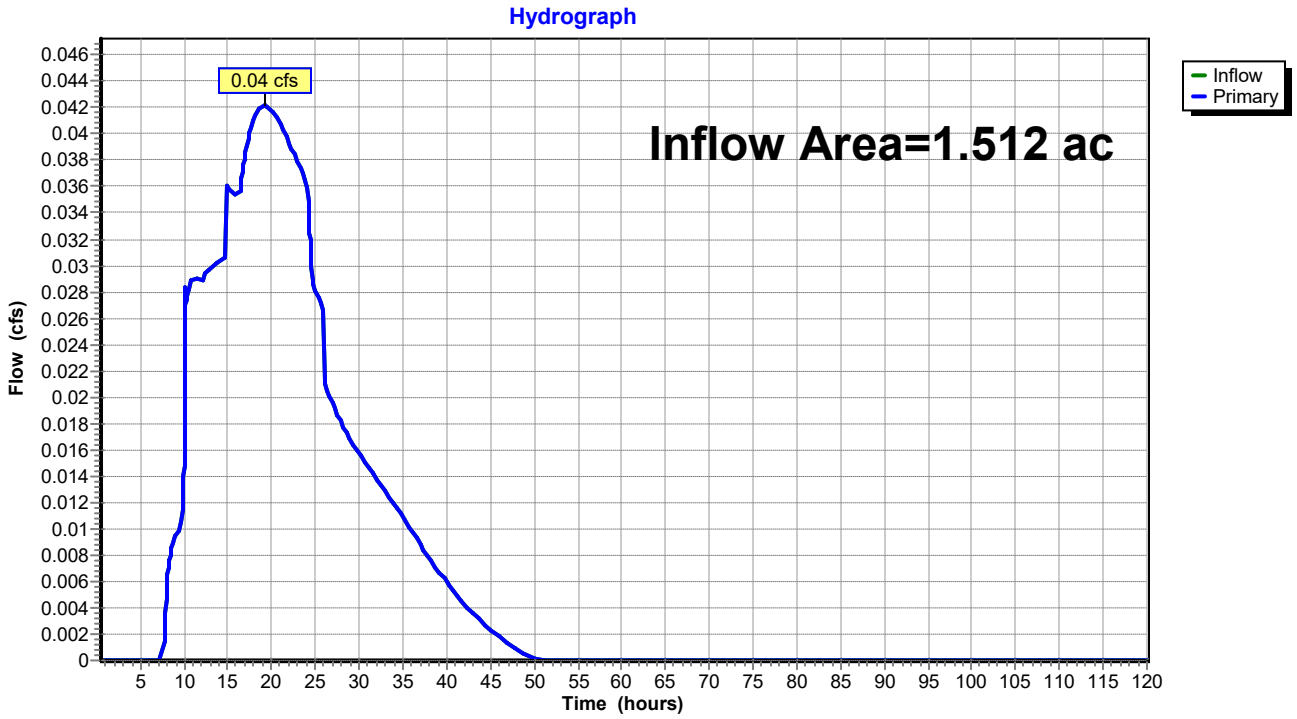


Summary for Link 1L: junc

Inflow Area = 1.512 ac, 82.40% Impervious, Inflow Depth = 0.51" for Salem WQ event
Inflow = 0.04 cfs @ 19.34 hrs, Volume= 0.065 af
Primary = 0.04 cfs @ 19.34 hrs, Volume= 0.065 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs

Link 1L: junc



Summary for Subcatchment 1S: Basin 1 (Bldg C)

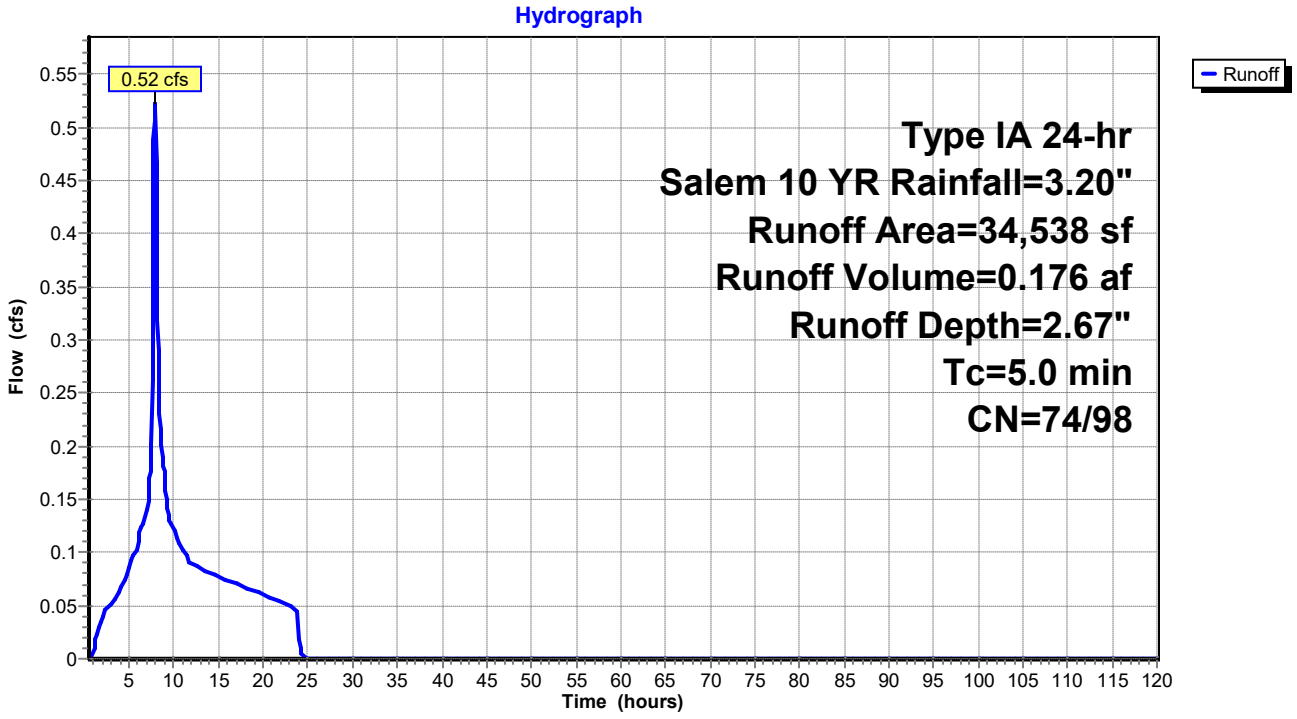
Runoff = 0.52 cfs @ 7.91 hrs, Volume= 0.176 af, Depth= 2.67"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr Salem 10 YR Rainfall=3.20"

	Area (sf)	CN	Description
*	29,170	98	impervious, HSG C
*	5,368	74	open space, HSG C
	34,538	94	Weighted Average
	5,368		15.54% Pervious Area
	29,170		84.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S: Basin 1 (Bldg C)



Summary for Subcatchment 2S: Basin 2 (Fut Bldg A)

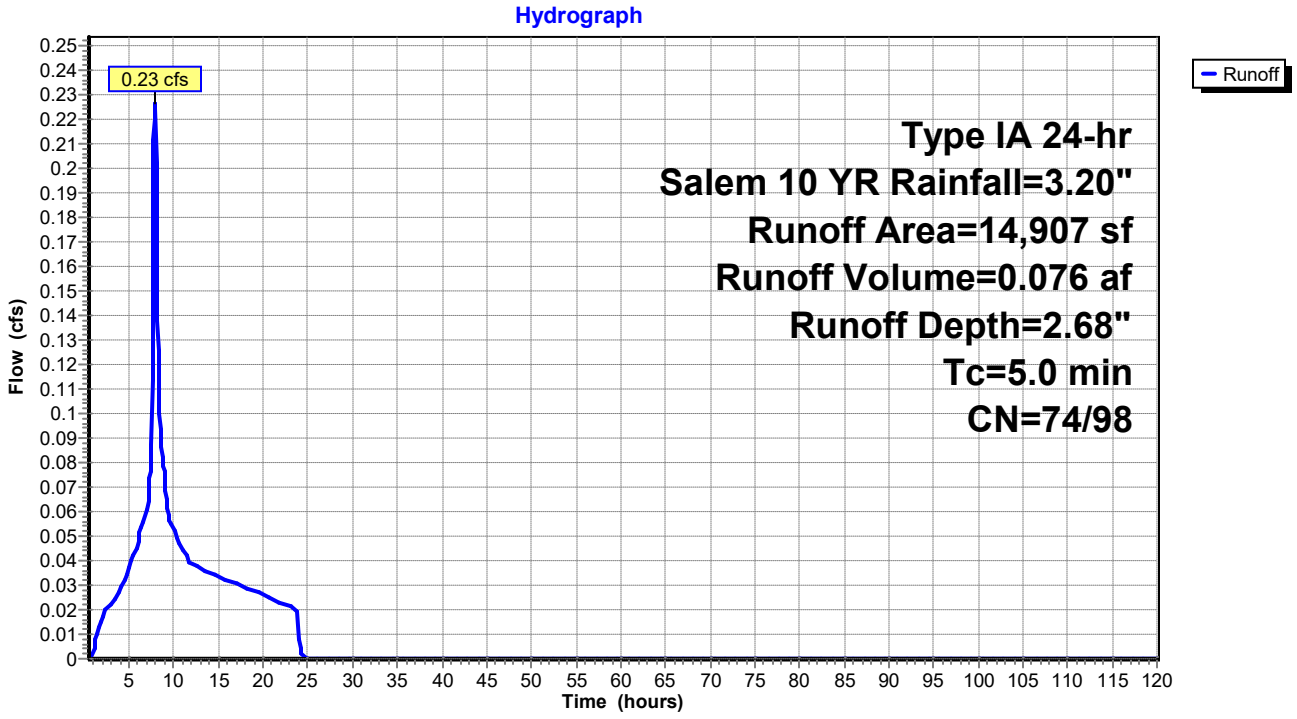
Runoff = 0.23 cfs @ 7.91 hrs, Volume= 0.076 af, Depth= 2.68"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr Salem 10 YR Rainfall=3.20"

	Area (sf)	CN	Description
*	12,671	98	impervious, HSG C
*	2,236	74	open space, HSG C
	14,907	94	Weighted Average
	2,236		15.00% Pervious Area
	12,671		85.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: Basin 2 (Fut Bldg A)



Summary for Subcatchment 3S: Basin 3

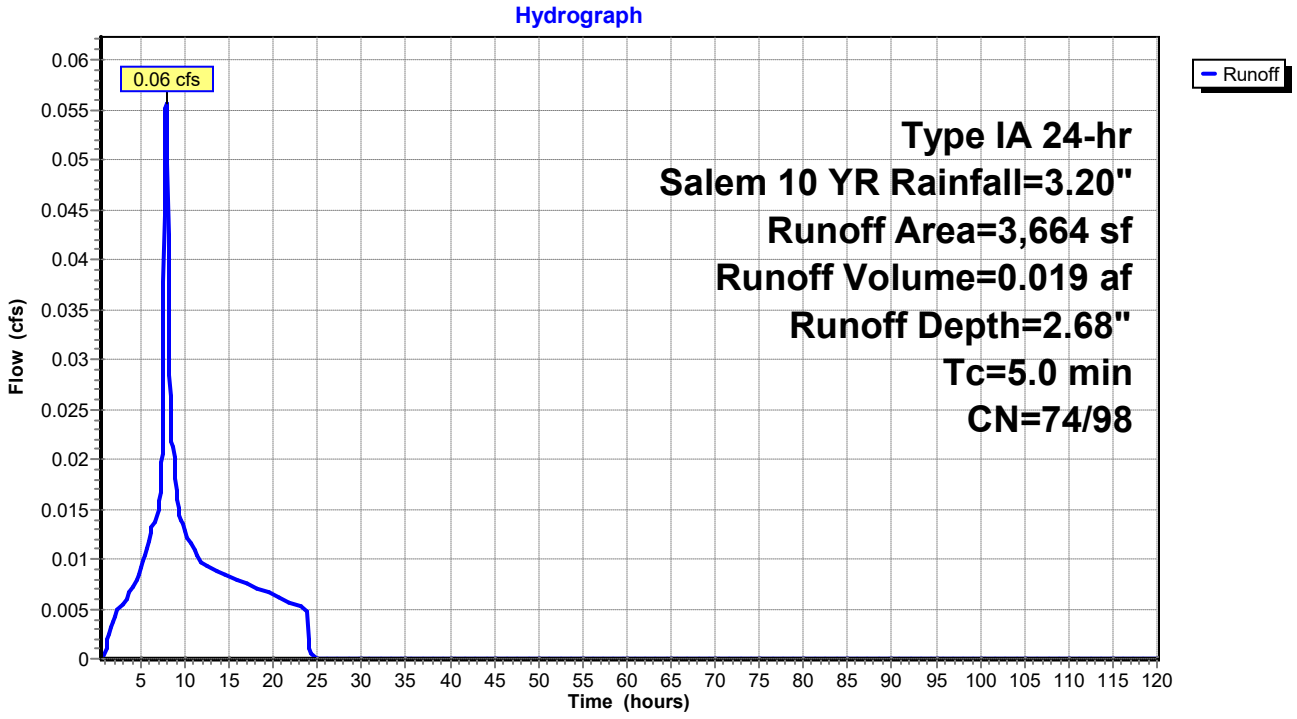
Runoff = 0.06 cfs @ 7.91 hrs, Volume= 0.019 af, Depth= 2.68"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr Salem 10 YR Rainfall=3.20"

	Area (sf)	CN	Description
*	3,114	98	impervious, HSG C
*	550	74	open space, HSG C
	3,664	94	Weighted Average
	550		15.01% Pervious Area
	3,114		84.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S: Basin 3



Summary for Subcatchment 4S: Basin 4 (Fut Bldg B)

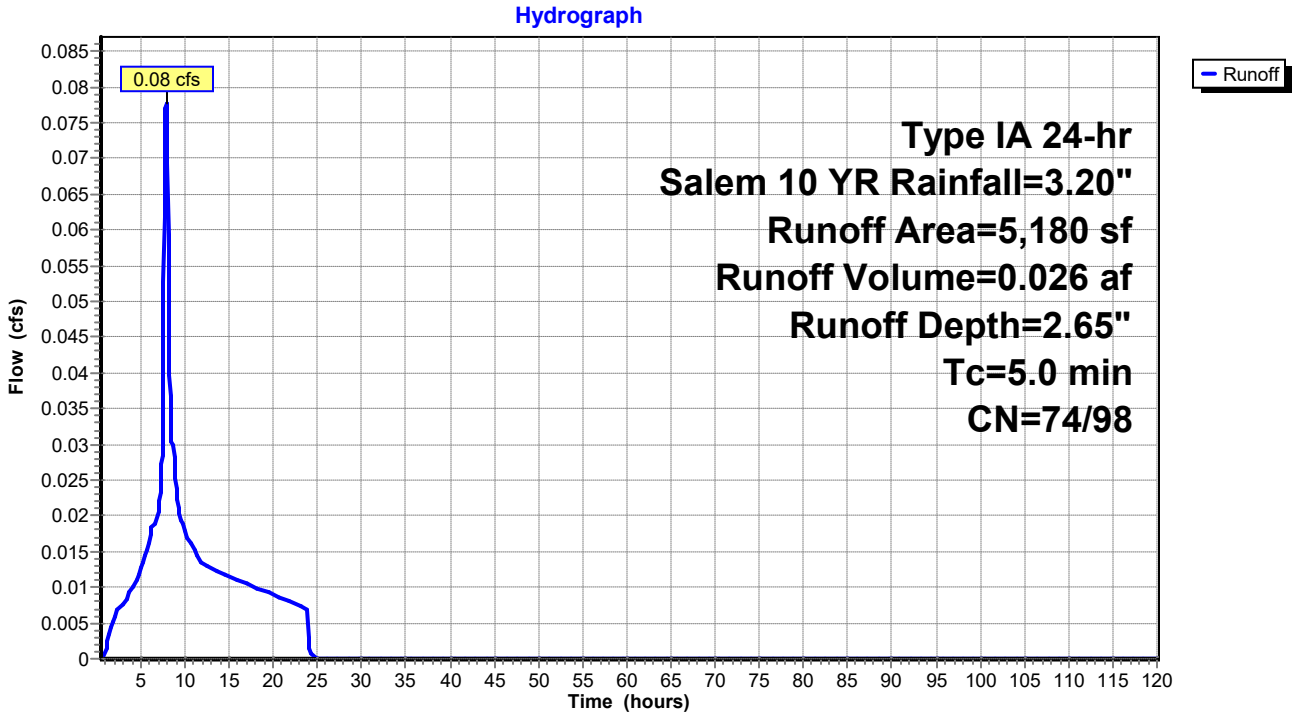
Runoff = 0.08 cfs @ 7.91 hrs, Volume= 0.026 af, Depth= 2.65"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr Salem 10 YR Rainfall=3.20"

	Area (sf)	CN	Description
*	4,325	98	impervious, HSG C
*	855	74	open space, HSG C
	5,180	94	Weighted Average
	855		16.51% Pervious Area
	4,325		83.49% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4S: Basin 4 (Fut Bldg B)



Summary for Subcatchment 5S: Basin 5

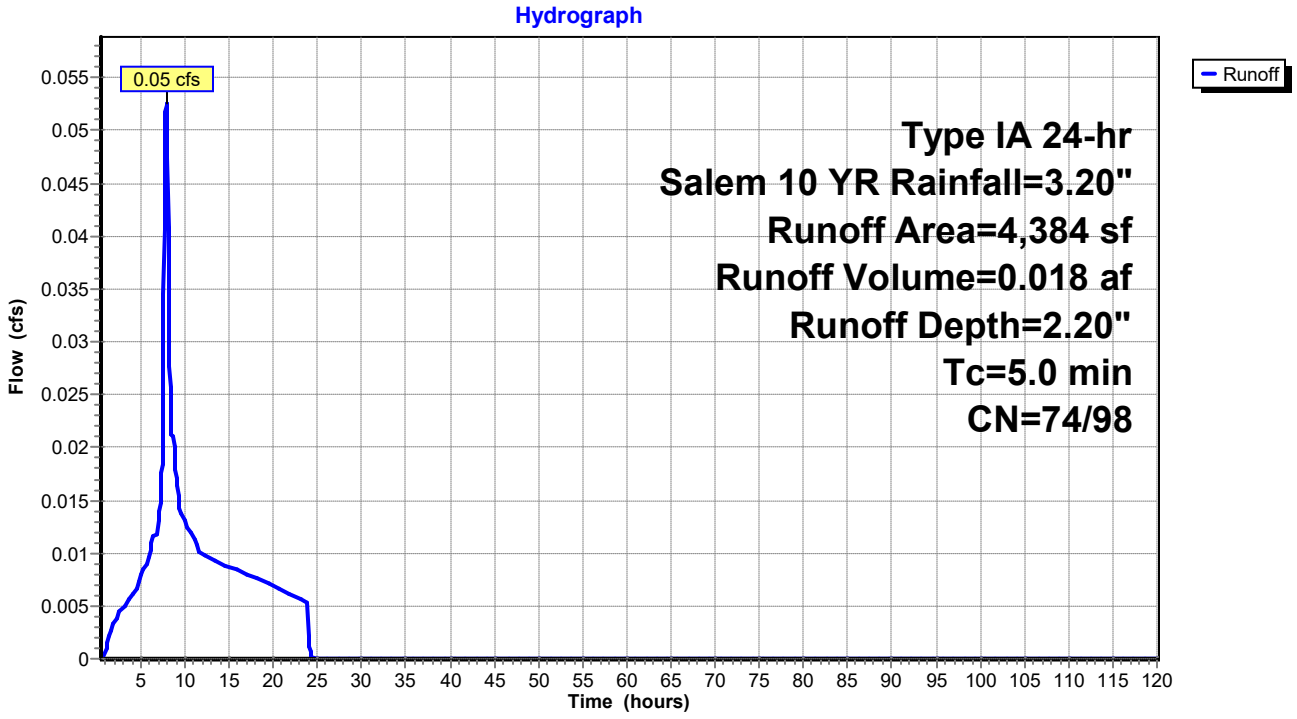
Runoff = 0.05 cfs @ 7.93 hrs, Volume= 0.018 af, Depth= 2.20"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr Salem 10 YR Rainfall=3.20"

	Area (sf)	CN	Description
*	2,640	98	impervious, HSG C
*	1,744	74	open space, HSG C
	4,384	88	Weighted Average
	1,744		39.78% Pervious Area
	2,640		60.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: Basin 5



Summary for Subcatchment 6S: Basin 6

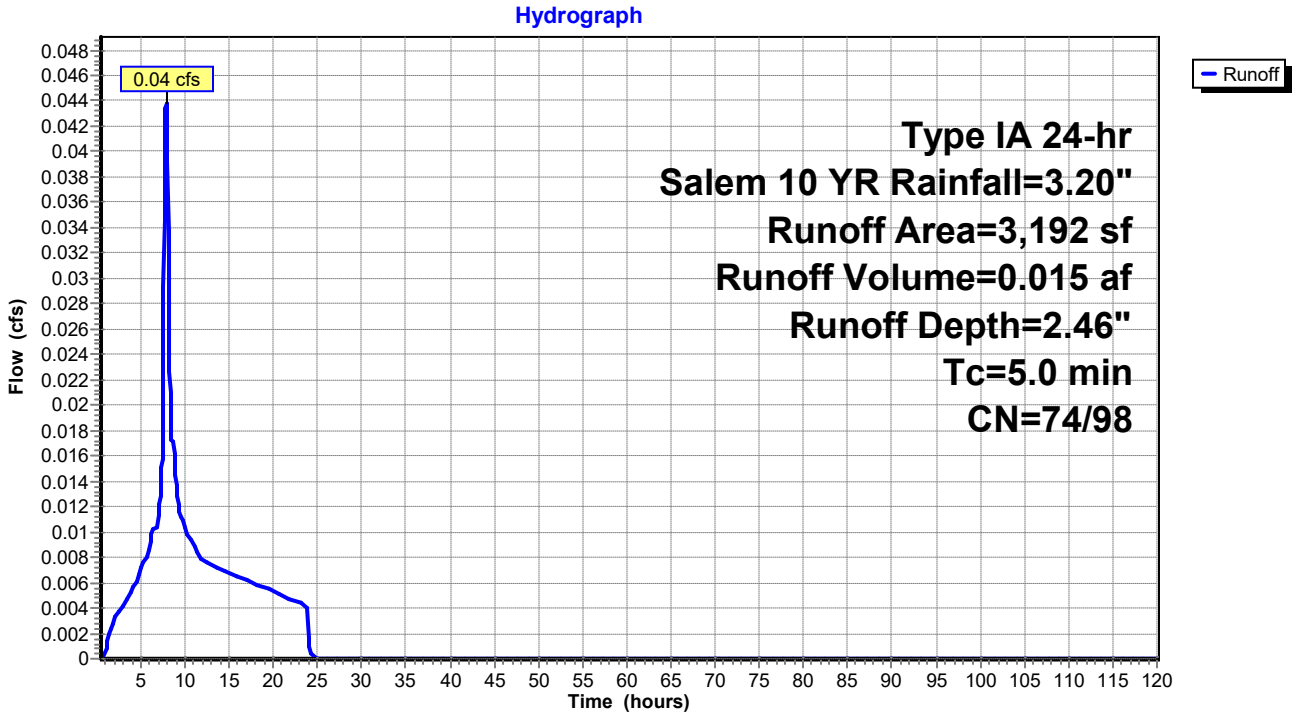
Runoff = 0.04 cfs @ 7.92 hrs, Volume= 0.015 af, Depth= 2.46"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr Salem 10 YR Rainfall=3.20"

	Area (sf)	CN	Description
*	2,350	98	impervious, HSG C
*	842	74	open space, HSG C
	3,192	92	Weighted Average
	842		26.38% Pervious Area
	2,350		73.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: Basin 6



Summary for Pond 1P: Rain Garden 1

Inflow Area = 0.793 ac, 84.46% Impervious, Inflow Depth = 2.67" for Salem 10 YR event
Inflow = 0.52 cfs @ 7.91 hrs, Volume= 0.176 af
Outflow = 0.09 cfs @ 11.58 hrs, Volume= 0.152 af, Atten= 82%, Lag= 220.4 min
Discarded = 0.00 cfs @ 1.60 hrs, Volume= 0.012 af
Primary = 0.09 cfs @ 11.58 hrs, Volume= 0.140 af

Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Peak Elev= 470.86' @ 11.58 hrs Surf.Area= 1,350 sf Storage= 3,382 cf

Plug-Flow detention time= 724.4 min calculated for 0.152 af (86% of inflow)
Center-of-Mass det. time= 629.2 min (1,307.6 - 678.4)

Volume	Invert	Avail.Storage	Storage Description
#1	464.50'	4,923 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

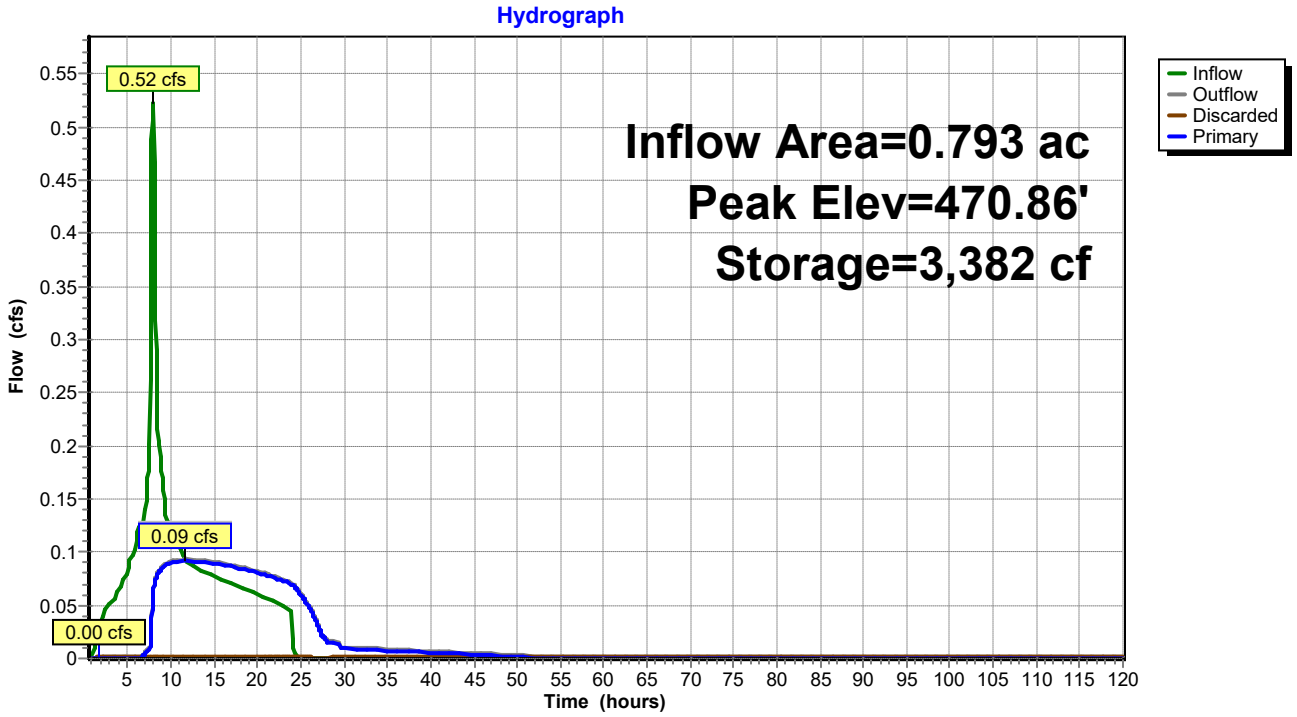
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
464.50	1,350	0.0	0	0
466.01	1,350	40.0	815	815
467.99	1,350	40.0	1,069	1,885
468.00	1,350	0.1	0	1,885
469.50	1,350	0.1	2	1,887
469.51	672	100.0	10	1,897
470.50	1,350	100.0	1,001	2,898
472.00	1,350	100.0	2,025	4,923

Device	Routing	Invert	Outlet Devices
#1	Discarded	464.50'	**0.040 in/hr Exfiltration over Surface area**
#2	Primary	467.00'	**0.6" Vert. Orifice/Grate** C= 0.600
#3	Primary	469.60'	**1.6" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.00 cfs @ 1.60 hrs HW=464.58' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.09 cfs @ 11.58 hrs HW=470.86' (Free Discharge)
├**2=Orifice/Grate** (Orifice Controls 0.02 cfs @ 9.43 fps)
└**3=Orifice/Grate** (Orifice Controls 0.07 cfs @ 5.26 fps)

Pond 1P: Rain Garden 1



Summary for Pond 2P: Rain Garden 2

Inflow Area = 0.342 ac, 85.00% Impervious, Inflow Depth = 2.68" for Salem 10 YR event
Inflow = 0.23 cfs @ 7.91 hrs, Volume= 0.076 af
Outflow = 0.03 cfs @ 14.72 hrs, Volume= 0.073 af, Atten= 85%, Lag= 408.9 min
Discarded = 0.00 cfs @ 6.80 hrs, Volume= 0.006 af
Primary = 0.03 cfs @ 14.72 hrs, Volume= 0.067 af

Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Peak Elev= 470.99' @ 14.72 hrs Surf.Area= 889 sf Storage= 1,437 cf

Plug-Flow detention time= 703.5 min calculated for 0.073 af (96% of inflow)
Center-of-Mass det. time= 672.6 min (1,350.5 - 677.9)

Volume	Invert	Avail.Storage	Storage Description
#1	466.00'	2,783 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

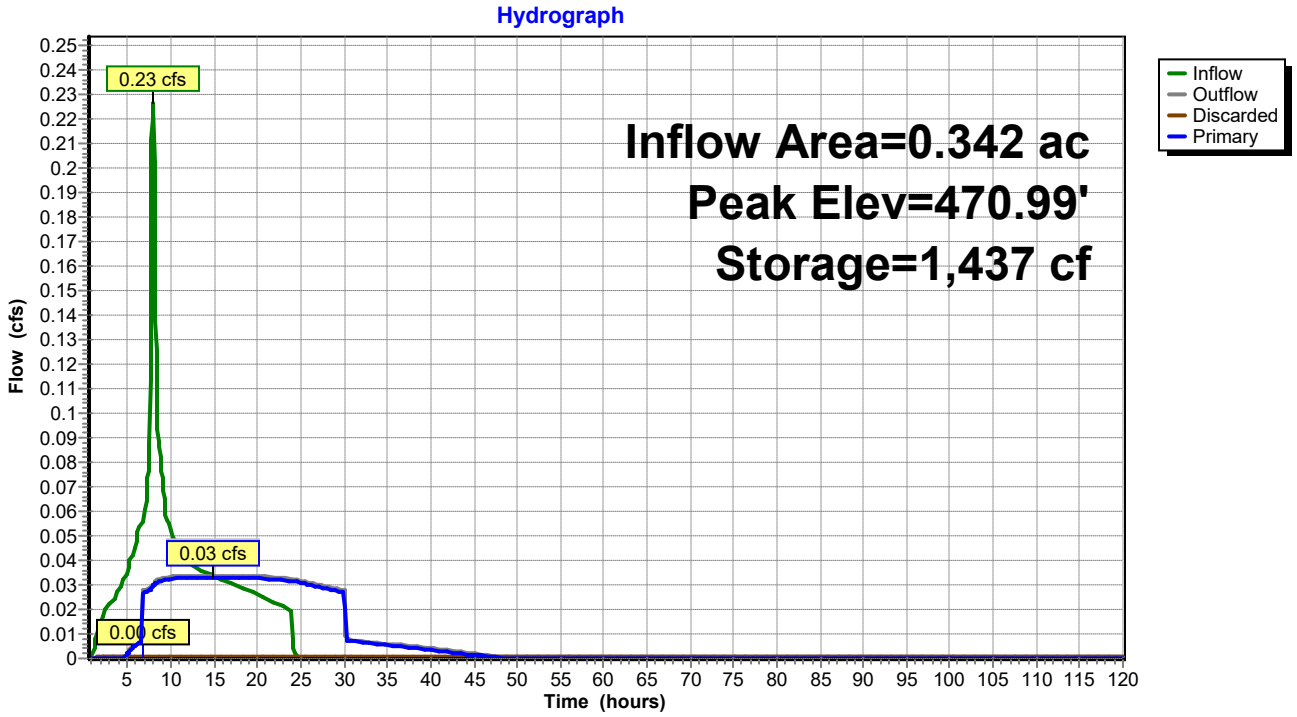
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
466.00	564	0.0	0	0
466.51	564	40.0	115	115
468.49	564	40.0	447	562
468.50	564	0.1	0	562
470.00	564	0.1	1	563
470.01	889	100.0	7	570
471.00	889	100.0	880	1,450
472.50	889	100.0	1,334	2,783

Device	Routing	Invert	Outlet Devices
#1	Discarded	466.00'	**0.040 in/hr Exfiltration over Surface area**
#2	Primary	467.25'	**0.5" Vert. Orifice/Grate** C= 0.600
#3	Primary	468.45'	**0.7" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.00 cfs @ 6.80 hrs HW=470.01' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.03 cfs @ 14.72 hrs HW=470.99' (Free Discharge)
├**2=Orifice/Grate** (Orifice Controls 0.01 cfs @ 9.28 fps)
└**3=Orifice/Grate** (Orifice Controls 0.02 cfs @ 7.62 fps)

Pond 2P: Rain Garden 2



Summary for Pond 3P: Rain Garden 3

Inflow Area = 0.084 ac, 84.99% Impervious, Inflow Depth = 2.68" for Salem 10 YR event
Inflow = 0.06 cfs @ 7.91 hrs, Volume= 0.019 af
Outflow = 0.01 cfs @ 15.42 hrs, Volume= 0.017 af, Atten= 86%, Lag= 451.0 min
Discarded = 0.00 cfs @ 1.70 hrs, Volume= 0.002 af
Primary = 0.01 cfs @ 15.42 hrs, Volume= 0.015 af

Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Peak Elev= 472.29' @ 15.42 hrs Surf.Area= 200 sf Storage= 382 cf

Plug-Flow detention time= 822.1 min calculated for 0.017 af (90% of inflow)
Center-of-Mass det. time= 747.7 min (1,425.6 - 677.9)

Volume	Invert	Avail.Storage	Storage Description
#1	467.00'	625 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

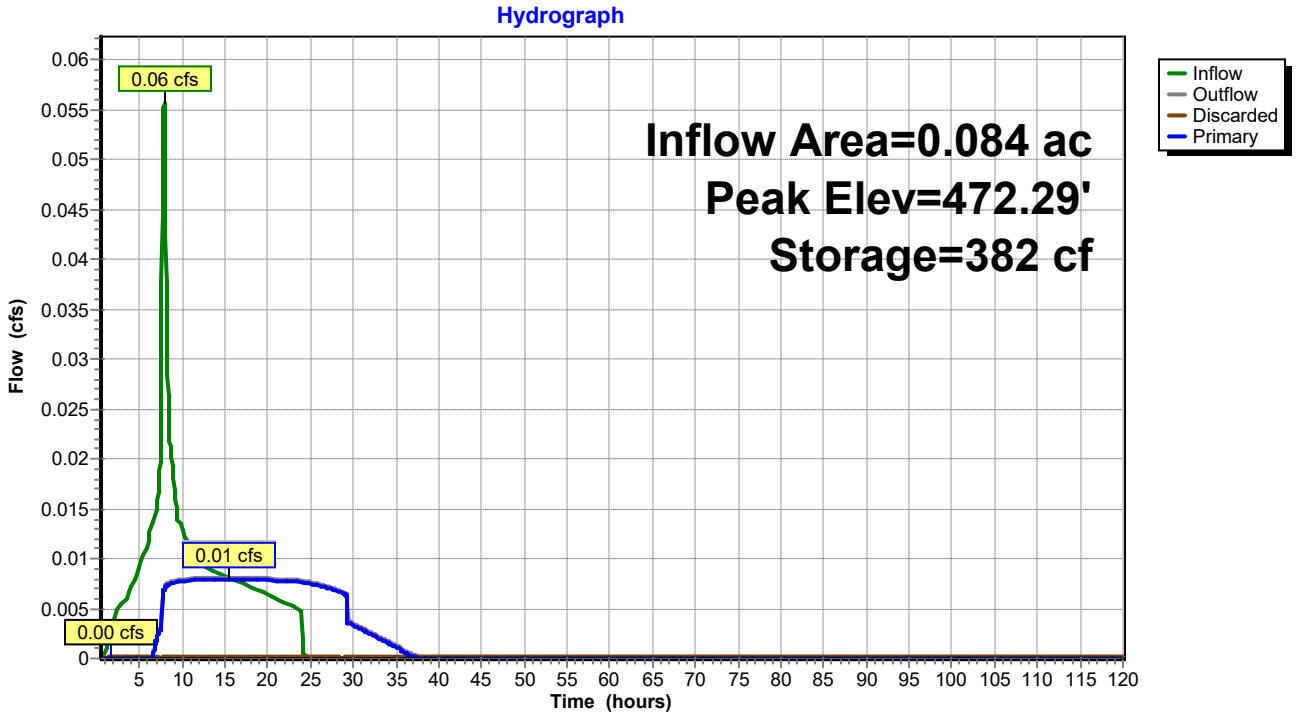
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
467.00	200	0.0	0	0
467.51	200	40.0	41	41
469.49	200	40.0	158	199
469.50	200	0.1	0	199
471.00	200	0.1	0	200
471.01	50	100.0	1	201
472.00	200	100.0	124	325
473.50	200	100.0	300	625

Device	Routing	Invert	Outlet Devices
#1	Discarded	467.00'	**0.040 in/hr Exfiltration over Surface area**
#2	Primary	468.75'	**0.4" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.00 cfs @ 1.70 hrs HW=467.07' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.01 cfs @ 15.42 hrs HW=472.29' (Free Discharge)
↑—**2=Orifice/Grate** (Orifice Controls 0.01 cfs @ 9.03 fps)

Pond 3P: Rain Garden 3



Summary for Pond 4P: Rain Garden 4

Inflow Area = 0.119 ac, 83.49% Impervious, Inflow Depth = 2.65" for Salem 10 YR event
Inflow = 0.08 cfs @ 7.91 hrs, Volume= 0.026 af
Outflow = 0.01 cfs @ 24.05 hrs, Volume= 0.023 af, Atten= 93%, Lag= 968.5 min
Discarded = 0.00 cfs @ 1.85 hrs, Volume= 0.003 af
Primary = 0.00 cfs @ 24.05 hrs, Volume= 0.019 af

Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Peak Elev= 471.21' @ 24.05 hrs Surf.Area= 385 sf Storage= 848 cf

Plug-Flow detention time= 1,756.9 min calculated for 0.023 af (87% of inflow)
Center-of-Mass det. time= 1,669.1 min (2,348.3 - 679.2)

Volume	Invert	Avail.Storage	Storage Description
#1	466.00'	1,347 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

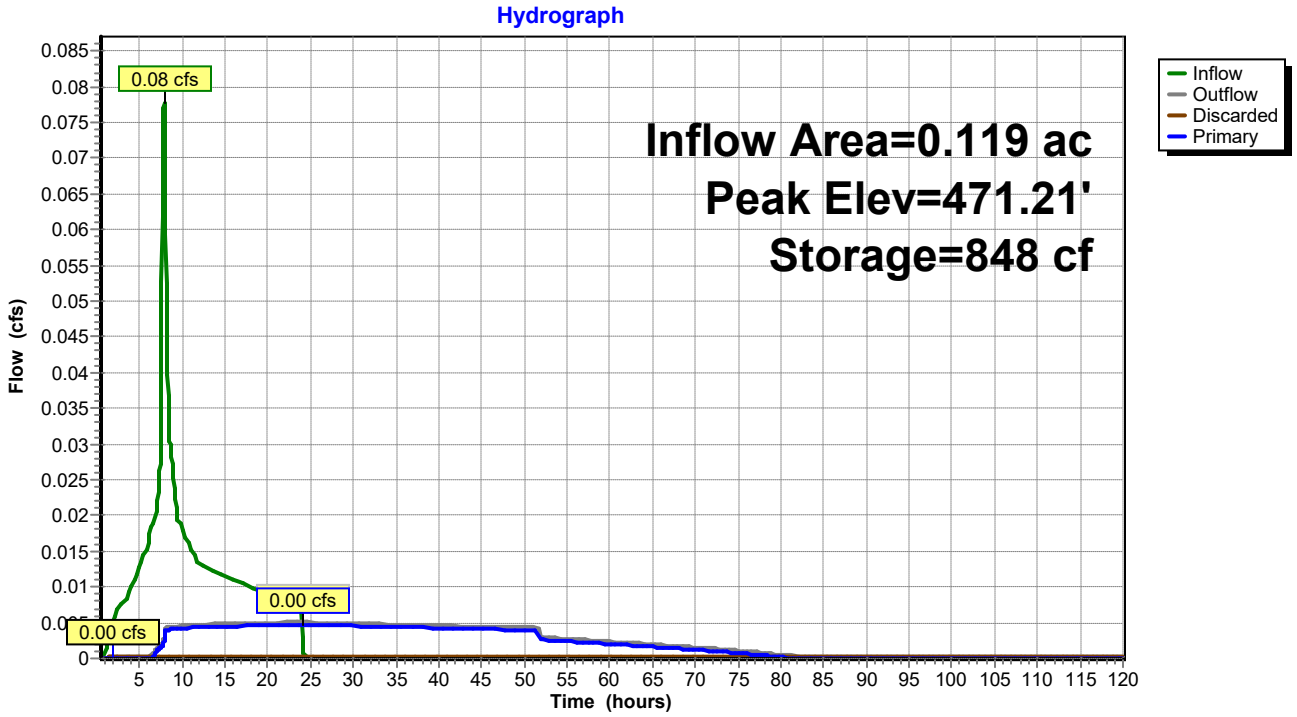
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
466.00	385	0.0	0	0
466.51	385	40.0	79	79
468.49	385	40.0	305	383
468.50	385	0.1	0	383
470.00	385	0.1	1	384
470.01	385	100.0	4	388
471.00	385	100.0	381	769
472.50	385	100.0	578	1,347

Device	Routing	Invert	Outlet Devices
#1	Discarded	466.00'	**0.040 in/hr Exfiltration over Surface area**
#2	Primary	467.25'	**0.3" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.00 cfs @ 1.85 hrs HW=466.07' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 24.05 hrs HW=471.21' (Free Discharge)
↑—**2=Orifice/Grate** (Orifice Controls 0.00 cfs @ 9.56 fps)

Pond 4P: Rain Garden 4



Summary for Pond 5P: Rain Garden 5

Inflow Area = 0.101 ac, 60.22% Impervious, Inflow Depth = 2.20" for Salem 10 YR event
Inflow = 0.05 cfs @ 7.93 hrs, Volume= 0.018 af
Outflow = 0.00 cfs @ 24.01 hrs, Volume= 0.017 af, Atten= 91%, Lag= 965.0 min
Discarded = 0.00 cfs @ 1.90 hrs, Volume= 0.002 af
Primary = 0.00 cfs @ 24.01 hrs, Volume= 0.014 af

Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Peak Elev= 471.09' @ 24.01 hrs Surf.Area= 250 sf Storage= 522 cf

Plug-Flow detention time= 1,320.7 min calculated for 0.017 af (90% of inflow)
Center-of-Mass det. time= 1,255.6 min (1,959.2 - 703.6)

Volume	Invert	Avail.Storage	Storage Description
#1	466.00'	874 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

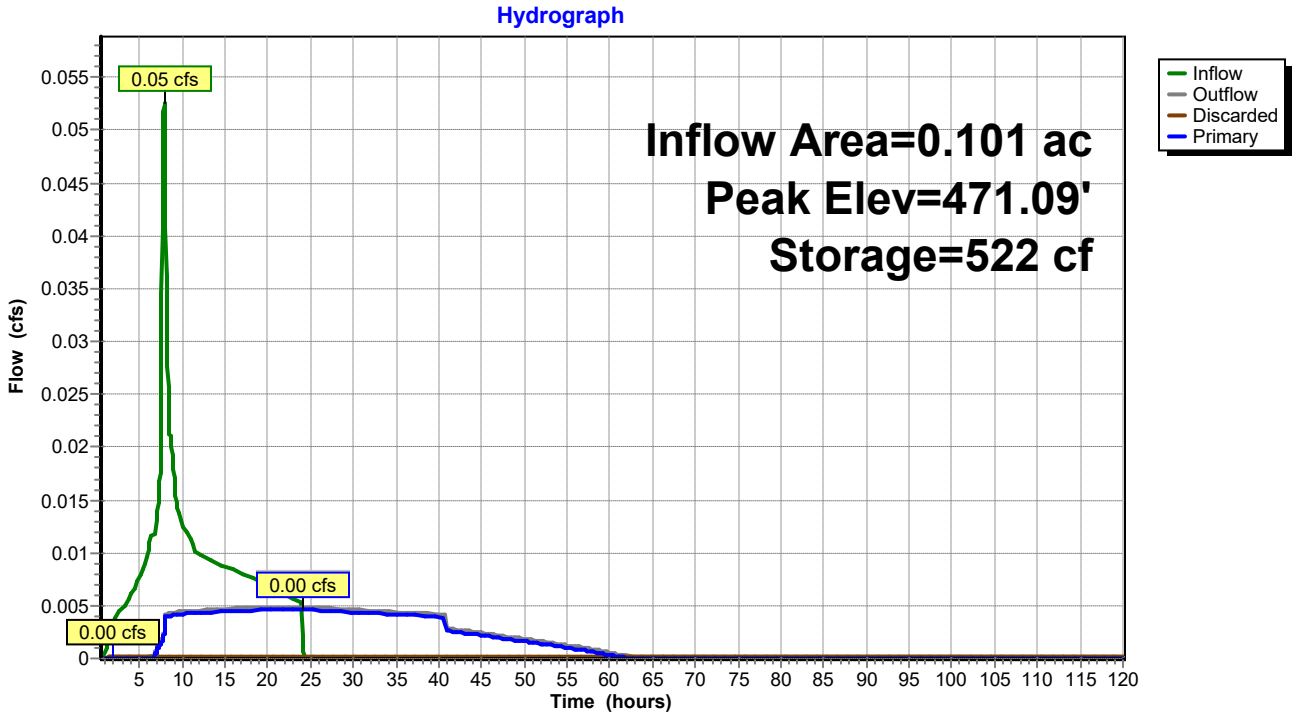
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
466.00	250	0.0	0	0
466.51	250	40.0	51	51
468.49	250	40.0	198	249
468.50	250	0.1	0	249
470.00	250	0.1	0	249
470.01	250	100.0	2	252
471.00	250	100.0	248	499
472.50	250	100.0	375	874

Device	Routing	Invert	Outlet Devices
#1	Discarded	466.00'	**0.040 in/hr Exfiltration over Surface area**
#2	Primary	467.25'	**0.3" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.00 cfs @ 1.90 hrs HW=466.07' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 24.01 hrs HW=471.09' (Free Discharge)
↑—**2=Orifice/Grate** (Orifice Controls 0.00 cfs @ 9.42 fps)

Pond 5P: Rain Garden 5



Summary for Pond 6P: Rain Garden 6

Inflow Area = 0.073 ac, 73.62% Impervious, Inflow Depth = 2.46" for Salem 10 YR event
Inflow = 0.04 cfs @ 7.92 hrs, Volume= 0.015 af
Outflow = 0.01 cfs @ 11.54 hrs, Volume= 0.014 af, Atten= 81%, Lag= 217.5 min
Discarded = 0.00 cfs @ 1.60 hrs, Volume= 0.001 af
Primary = 0.01 cfs @ 11.54 hrs, Volume= 0.013 af

Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Peak Elev= 469.95' @ 11.54 hrs Surf.Area= 125 sf Storage= 243 cf

Plug-Flow detention time= 567.6 min calculated for 0.014 af (96% of inflow)
Center-of-Mass det. time= 540.3 min (1,228.7 - 688.5)

Volume	Invert	Avail.Storage	Storage Description
#1	465.00'	437 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

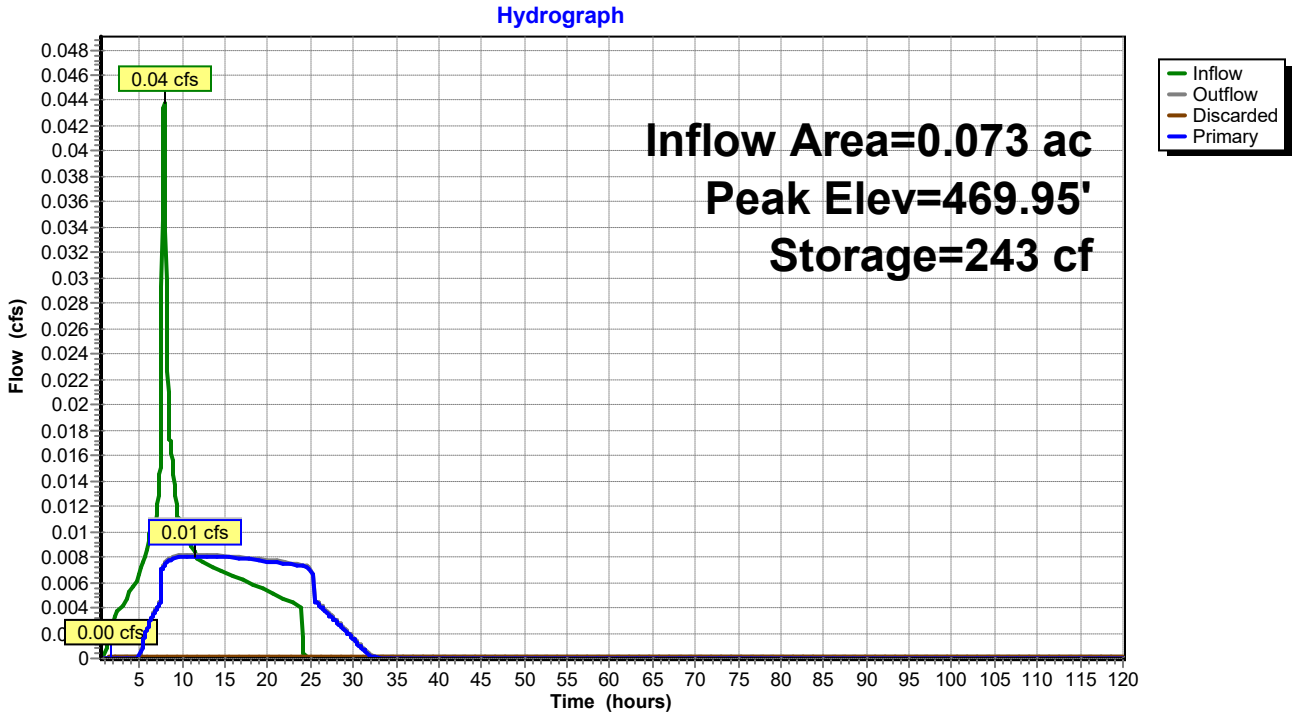
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
465.00	125	0.0	0	0
465.51	125	40.0	25	25
467.49	125	40.0	99	125
467.50	125	0.1	0	125
469.00	125	0.1	0	125
469.01	125	100.0	1	126
470.00	125	100.0	124	250
471.50	125	100.0	188	437

Device	Routing	Invert	Outlet Devices
#1	Discarded	465.00'	**0.040 in/hr Exfiltration over Surface area**
#2	Primary	466.25'	**0.4" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.00 cfs @ 1.60 hrs HW=465.07' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.01 cfs @ 11.54 hrs HW=469.95' (Free Discharge)
↑—**2=Orifice/Grate** (Orifice Controls 0.01 cfs @ 9.24 fps)

Pond 6P: Rain Garden 6

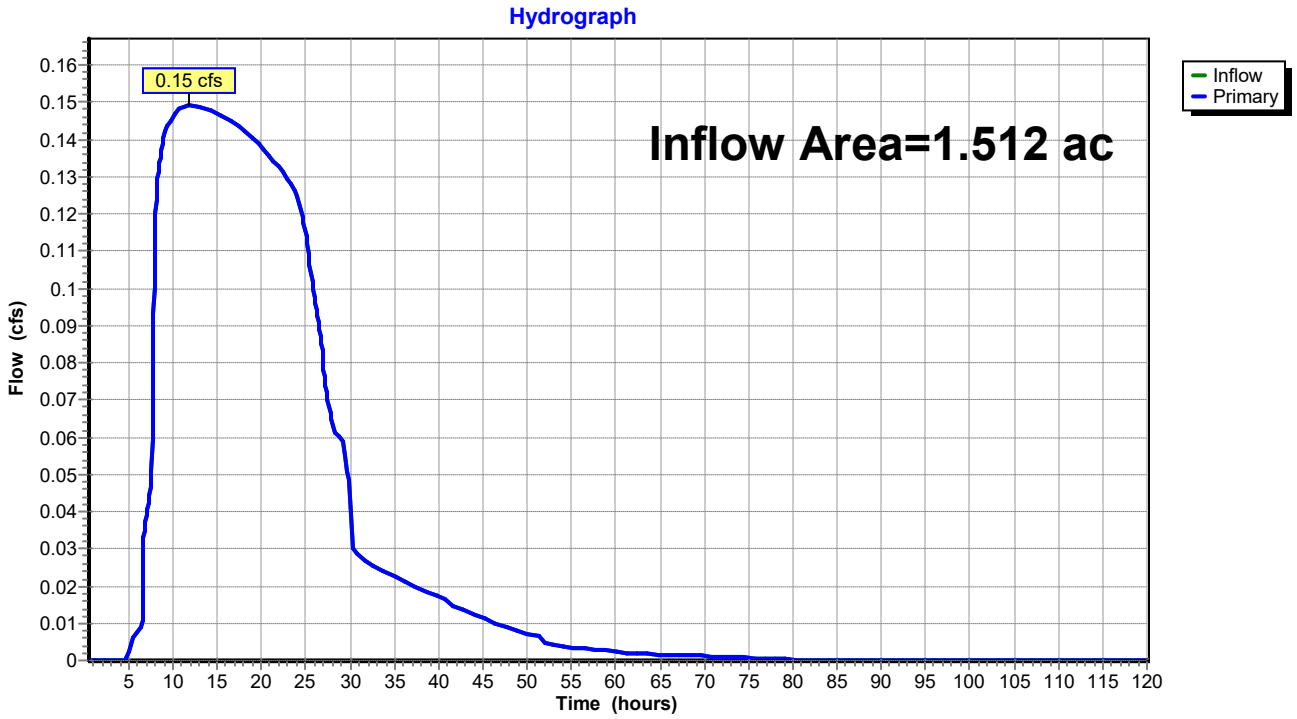


Summary for Link 1L: junc

Inflow Area = 1.512 ac, 82.40% Impervious, Inflow Depth = 2.14" for Salem 10 YR event
Inflow = 0.15 cfs @ 11.72 hrs, Volume= 0.269 af
Primary = 0.15 cfs @ 11.72 hrs, Volume= 0.269 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs

Link 1L: junc



APPENDIX E

WELL LOGS

MAR 54424

RECEIVED
OVER THE COUNTER

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765)
Instructions for completing this report are on the last page of this form.

WELL I.D. # L N/A
START CARD # 122359

(1) OWNER: Well Number
Name Esther Kuebler
Address 1125 N Manzanita St
City Canby State OR Zip 97013

(2) TYPE OF WORK
☐ New Well ☐ Deepening ☐ Alteration (repair/recondition) ☒ Abandonment

(3) DRILL METHOD:
☐ Rotary Air ☐ Rotary Mud ☐ Cable ☐ Auger
☒ Other

(4) PROPOSED USE:
☒ Domestic ☐ Community ☐ Industrial ☐ Irrigation
☐ Thermal ☐ Injection ☐ Livestock ☐ Other

RECEIVED
OCT 21 1999
WATER RESOURCES DEPT.
SALEM, OREGON

(5) BORE HOLE CONSTRUCTION:
Special Construction approval ☐ Yes ☒ No Depth of Completed Well ft.
Explosives used ☐ Yes ☒ No Type Amount

HOLE Diameter	From	To	SEAL Material	From	To	Sacks or pounds
		See #12				

How was seal placed: Method ☐A ☐B ☐C ☐D ☐E
☐ Other
Backfill placed from ft. to ft. Material
Gravel placed from ft. to ft. Size of gravel

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:		N/A			☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
Liner:					☐	☐	☐	☐
					☐	☐	☐	☐

Final location of shoe(s)

(7) PERFORATIONS/SCREENS:
☐ Perforations Method
☐ Screens Type Material

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
		N/A				☐	☐
						☐	☐
						☐	☐
						☐	☐
						☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour
☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
	N/A		1 hr.

Temperature of water N/A Depth Artesian Flow Found
Was a water analysis done? ☐ Yes By whom
Did any strata contain water not suitable for intended use? ☐ Too little
☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other
Depth of strata:

(9) LOCATION OF WELL by legal description:
County Marion Latitude Longitude
Township 8-S N or S Range 3-W E or W. WM.
Section 9 SW 1/4 SE 1/4
Tax Lot 2300 Lot Block Subdivision
Street Address of Well (or nearest address) 235 Hrubetz Rd SE Salem

(10) STATIC WATER LEVEL:
45 ft. below land surface. Date 8-27-99
lb. per square inch. Date

(11) WATER BEARING ZONES:
Depth at which water was first found N/A

From	To	Estimated Flow Rate	SWL
	N/A		

(12) WELL LOG:
Ground Elevation

Material	From	To	SWL
This Hand Dug Well was approx 48-inch in DIA. After pumping out the Water Concrete was pumped in to fill the well. 26 yards of Concrete was used to fill well up to -2 ft. This Abandonment was Approved By Mike McCord			

Date started 8/27/99 Completed 8/28/99

(unbonded) Water Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.
WWC Number
Signed Date

(bonded) Water Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.
WWC Number 1273
Signed Floyd Hope Date 9/4/99

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

MARI 61404

STATE OF OREGON
GEOTECHNICAL HOLE REPORT
(as required by OAR 690-240-0035)

Instructions for completing this report are on the last page of this form.

(1) OWNER/PROJECT Hole Number LGP-01
Name J.D.E. SALEM, LLC
Address 3340 QUAIL RIDGE COURT
City WEST LINN State OR Zip 97068

(2) TYPE OF WORK
☑ New ☐ Deepening ☐ Alteration (repair/recondition) ☑ Abandonment

(3) CONSTRUCTION
☐ Rotary Air ☐ Hand Auger ☐ Hollow Stem Auger
☐ Rotary Mud ☐ Cable Tool ☑ Push Probe ☐ Other _____

(4) TYPE OF HOLE
☑ Uncased Temporary ☐ Cased Permanent
☐ Uncased Permanent ☐ Slope Stability ☐ Other _____

(5) USE OF HOLE soil + water sample

(6) BORE HOLE CONSTRUCTION
Special Construction approval: ☐ Yes ☑ No Depth of Completed Well 20 ft.

HOLE Diameter	From	To	Material	SEAL From	To	Sacks or Pounds
2"	0	20'	Bentonite	0	20'	5 sacks

Backfill placed from 0 ft. to 20 ft. Material Bentonite
Filter Pack placed from _____ ft. to _____ ft. Size of pack _____

(7) CASING/SCREEN

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:			N/A		☐	☐	☐	☐
Screen:					☐	☐	☐	☐

Slot size _____

(8) WELL TEST
☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian
Permeability _____ Yield _____ GPM _____
Conductivity _____ PH _____
Temperature of water 56 ☐F ☐C Depth artesian flow found _____ ft.
Was a water analysis done? ☑ Yes ☐ No
By whom _____
Depth of strata analyzed. From _____ to _____
Remarks: _____

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WATER RESOURCES DEPT
SALEM, OREGON

(9) LOCATION OF HOLE (legal description)
County MARION
Tax Lot 3900 Lot _____
Township 8S N or S Range 3W E or W WM
Section 09 SW 1/4 NE 1/4
Lat ___°___'___" or _____ (degrees or decimal)
Long ___°___'___" or _____ (degrees or decimal)
Street Address of Well (or nearest address) 4760 LIBERTY ROAD SOUTH SALEM, OR

Map with location identified must be attached.

(10) STATIC WATER LEVEL
15 ft. below land surface. Date 1/25/08
Artesian pressure _____ lb. per square inch Date _____

(11) SUBSURFACE LOG
Ground Elevation _____

Material Description	From	To	SWL
red clay	0	20'	

Date Started 1/25/08 Completed 1/25/08

(12) ABANDONMENT LOG

Material Description	From	To	Sacks or Pounds
Bentonite	0	20'	5 sacks

Date Started 1/25/08 Completed 1/25/08

PROFESSIONAL CERTIFICATION
(to be signed by a licensed water supply or monitoring well constructor, or Oregon registered geologist or civil engineer.)

I accept responsibility for the construction, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon's geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

License or Registration Number 10357
Signed _____ Date 1/28/08
Affiliation CASCADE DRILLING, INC. P08030

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

ORIGINAL – WATER RESOURCES DEPARTMENT FIRST COPY – CONSTRUCTOR SECOND COPY – CUSTOMER 08/17/2005

MARI 61404

Cascade Project No. P08-030

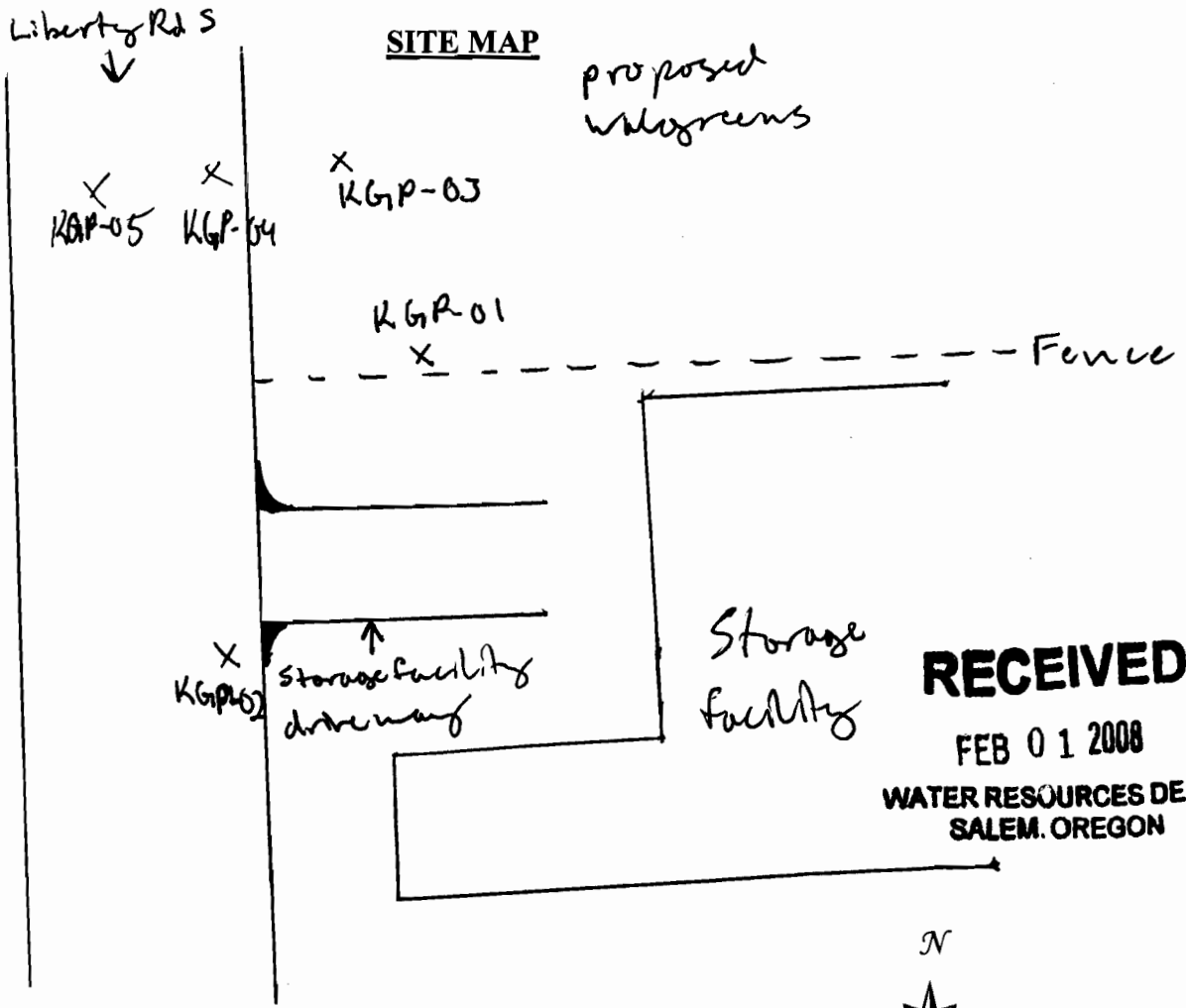
Oregon Water Resources Department (OWRD) requires completion of a Geotechnical Hole Report if any of the following apply:

- Geotechnical hole is greater than 18 feet deep;
- Within 50 feet of a water supply or monitoring well;
- Used to make a determination of water quality;
- Constructed in an area of known or reasonably suspected contamination.

In order to comply with OWRD requirements, please provide a Site Map:

Map shall include an approximate scale of north arrow. Upon completion of well activities, a site map with each well location identified must be filed with each Geotechnical Hole Report (OR 690-240-035).

Thank You for your information and assistance on compliance with Oregon Administrative Rules.



Site Address: 4760 Liberty Road South -Salem, OR

Client: Kleinfelder

Cascade Drilling Project No.: P08030

MARI 61408

STATE OF OREGON
GEOTECHNICAL HOLE REPORT
(as required by OAR 690-240-0035)

Instructions for completing this report are on the last page of this form.

(1) OWNER/PROJECT Hole Number HGP-05
Name J.D.E. SALEM, LLC
Address 3340 QUAIL RIDGE COURT
City WEST LINN State OR Zip 97068

(2) TYPE OF WORK
☑ New ☐ Deepening ☐ Alteration (repair/recondition) ☑ Abandonment

(3) CONSTRUCTION
☐ Rotary Air ☐ Hand Auger ☐ Hollow Stem Auger
☐ Rotary Mud ☐ Cable Tool ☑ Push Probe ☐ Other _____

(4) TYPE OF HOLE
☑ Uncased Temporary ☐ Cased Permanent
☐ Uncased Permanent ☐ Slope Stability ☐ Other _____

(5) USE OF HOLE soil + water sample

(6) BORE HOLE CONSTRUCTION
Special Construction approval: ☐ Yes ☑ No Depth of Completed Well 26 ft.

HOLE Diameter	From	To	SEAL Material	From	To	Sacks or Pounds
2"	0	25	bentonite	1'	25	15 sacks

Backfill placed from 1 ft. to 25 ft. Material Bentonite
Filter Pack placed from _____ ft. to _____ ft. Size of pack _____

(7) CASING/SCREEN

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
Screen:					☐	☐	☐	☐
					☐	☐	☐	☐

Slot size _____

(8) WELL TEST
☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian
Permeability _____ Yield _____ GPM _____
Conductivity _____ PH _____
Temperature of water 56 ☐ °F ☐ °C Depth artesian flow found _____ ft.
Was a water analysis done? ☑ Yes ☐ No
By whom _____
Depth of strata analyzed. From _____ ft. to _____ ft.
Remarks: _____

RECEIVED
FEB 01 2008
WATER RESOURCES DEPT
SALEM, OREGON

(9) LOCATION OF HOLE (legal description)
County MARION
Tax Lot 3900 Lot _____
Township 8S N or S Range 3W E or W WM
Section 09 SW 1/4 NE 1/4
Lat ___°___'___" or _____ (degrees or decimal)
Long ___°___'___" or _____ (degrees or decimal)
Street Address of Well (or nearest address) 4760 LIBERTY ROAD SOUTH SALEM, OR

Map with location identified must be attached.

(10) STATIC WATER LEVEL
17 ft. below land surface. Date 1/25/08
Artesian pressure _____ lb. per square inch Date _____

(11) SUBSURFACE LOG
Ground Elevation _____

Material Description	From	To	SWL
asphalt	0	1'	
rock chips	1'	25'	

Date Started 1/25/08 Completed 1/25/08

(12) ABANDONMENT LOG

Material Description	From	To	Sacks or Pounds
~~concrete~~	0	1'	10 lbs
~~rock chips~~			
Bentonite	1'	25'	.5 sacks

Date Started 1/25/08 Completed 1/25/08

PROFESSIONAL CERTIFICATION
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License or Registration Number 1635 7
Signed _____ Date 1/28/08
Affiliation CASCADE DRILLING, INC. P08030

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ORIGINAL – WATER RESOURCES DEPARTMENT FIRST COPY – CONSTRUCTOR SECOND COPY – CUSTOMER 08/17/2005

MARI 61408

Cascade Project No. P08-030

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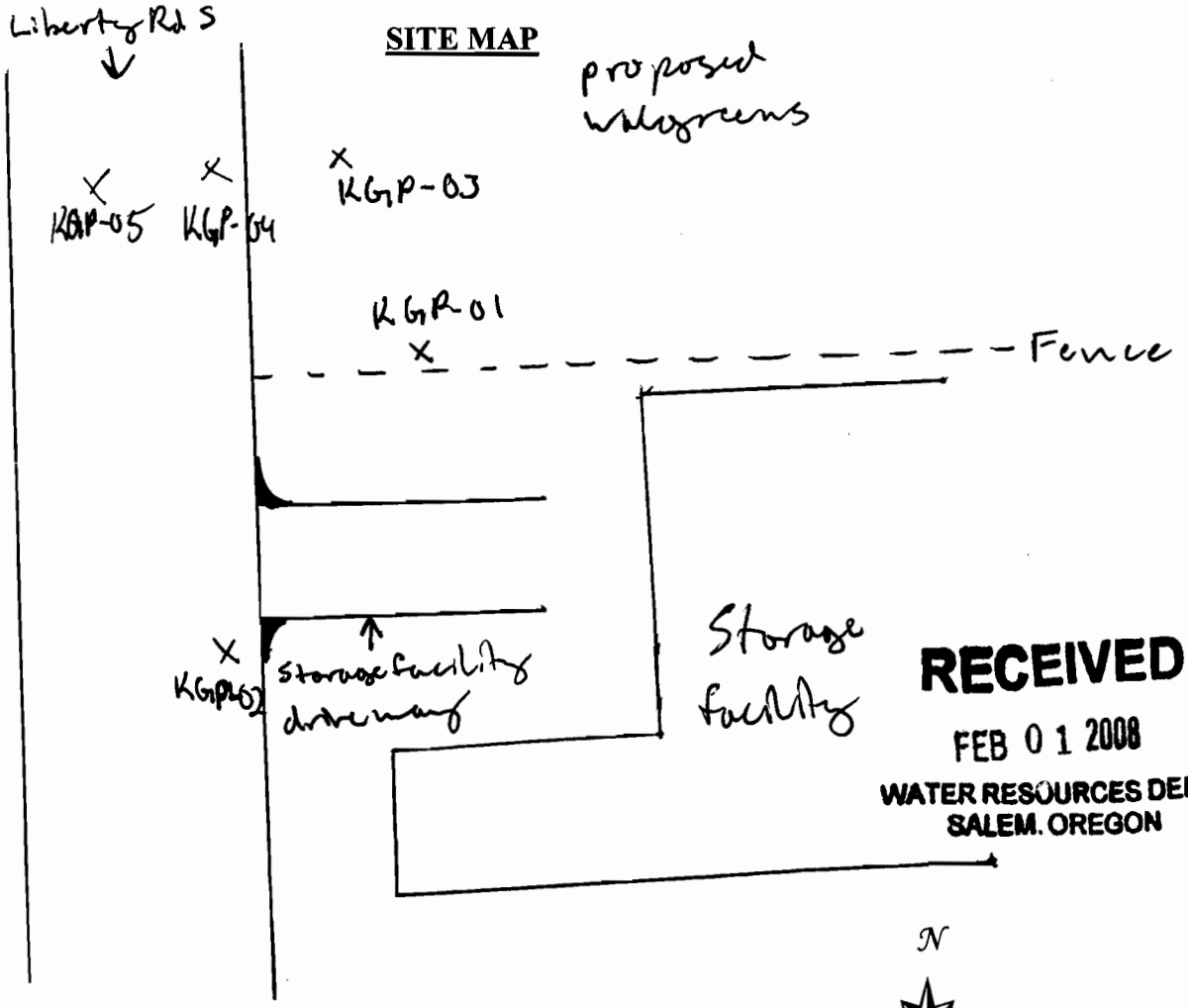
SITE MAP



Site Address: 4760 Liberty Road South -Salem, OR
Client: Kleinfelder
Cascade Drilling Project No.: P08030