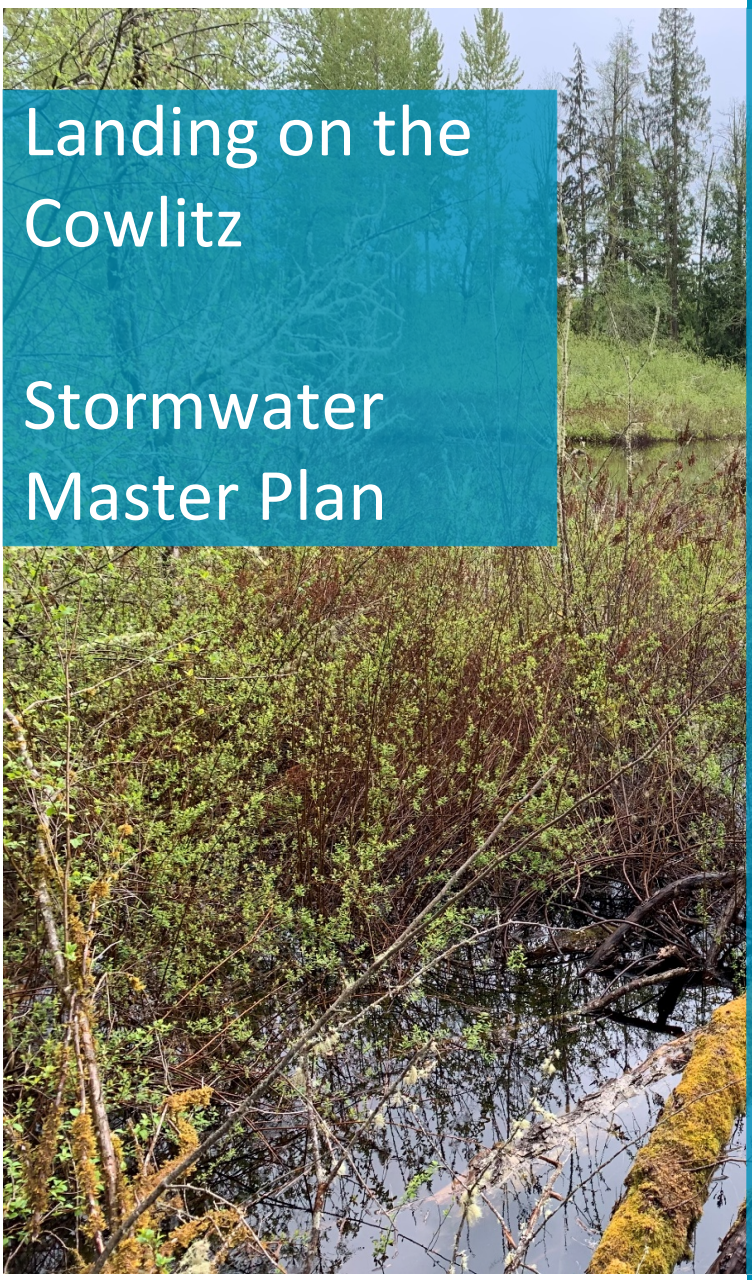
Landing on the Cowlitz

Stormwater Master Plan



Technical Information Report

Landing on the Cowlitz – Stormwater Master Plan

March 10, 2025

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03/10/2025

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March 10, 2025

Technical Information Report (TIR)
LOTC – Stormwater Master Plan

Engineer's Certification
March 10, 2025
City of Castle Rock
Development Engineer

"I hereby state this Technical Information Report (TIR) has been prepared under my supervision and meets the standards of care and expertise which is usual and customary in this community for professional engineers. The TIR includes the required information per City of Castle Rock's Storm Drainage Standards and complies with the 1992 Stormwater Management Manual for the Puget Sound Basin. The proposed stormwater design is feasible."



03/10/2025

Taylor Wilson, PE
Project Manager

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1. Project Overview

The Landing on the Cowlitz is an approved mixed-use master plan development with a site area of approximately 118 acres.

The approved uses on the site include light industrial, flex/office space, commercial, single-family residential, and recreational. Approximately 53.5 acres have been identified for light industrial use, 12.5 acres for flex/office space, 9.9 acres for commercial uses, 10.3 acres for residential, and 13.9 acres for recreational use (which will include an RV park, recreational trails and other recreational amenities). The remaining acreage consists of public/private roadways and undevelopable shoreline along the Cowlitz River.

This report is being prepared to analyze the future stormwater demands of the site, as well as sizing the storm drain main lines for the site's stormwater outfall and Phase 1 access road (connecting the site to Huntington Ave).

Site Location and Topography

The project is located in the City of Castle Rock, Cowlitz County, WA. The site consists of seven parcels (currently being adjusted per CR-BLA-24-01): Parcel 1 (308640100), Parcel 2 (30813), Parcel 3 (6143802), Parcel 4 (308100200), Parcel 5 (30812), Parcel 6 (308640200), and Parcel 7 (30864). Also, there is an adjacent DNR-owned property to the south that is expected to contribute to the site's runoff in the future and has been included in the contributing area (bounded by the Cowlitz River and Salmon Creek). The project site is accessed from I-5 at exit #48 and is located south of Huntington Avenue S. The property is situated between the BNSF line and Salmon Creek to the east and south, and the Cowlitz River to the west. North of the property is the Timberlake Church and some residential uses along Larsen Lane.

The site is mostly flat, with several closed depressions. Along the western and southern ends of the site, there is a berm that separates the site from Salmon Creek and the Cowlitz River. Towards the southern end of the site there is an approximately 33% slope at the dredge pile that is partially located on the Landing site, with the other part of the pile being located on the DNR parcel.

Existing and Proposed Storm Systems for Early Grading

Prior to any onsite grading, the existing site contained two private ditches to convey stormwater. The main ditch generally runs north-south through the center of the site and utilizes 3 culverts (ranging in size from 15"-24" diam.) to cross existing access roads. The existing secondary ditch is located at the toe of the dredge pile slope located near the southern portion of the site. Both ditches convey stormwater drainage to an existing 24" diameter outfall culvert which discharges to Salmon Creek.

With the initial grading to fill the site above the 100-year flood elevation, the existing primary ditch was widened in its existing alignment. New ditches were installed along the west perimeter of the site to capture and convey onsite runoff and allow neighboring properties to drain in the event of a large storm or flood event. The perimeter ditches are conveyed to a large, flat ditch which acts as a detention pond for the Phase 1 mass grading prior to discharging to Salmon Creek. Temporary sediment and detention ponds were installed near the downstream end of the new ditches while keeping clear of the wetland buffers.

Drainage to and From Adjacent Properties

The overall project site is surrounded by residential lots and a church to the north, the Cowlitz River to the west, the BNSF railroad to the east, Huntington Avenue to the northeast, and Salmon Creek to the south.

Currently there are approximately 5.3 acres of offsite stormwater that flows onto the site from the BNSF railroad to the east and 2.1 acres that flow onto the site from Huntington Ave. In large storm events, it is anticipated that runoff can occur from the adjacent lots to the northwest that are primarily single-family homes on larger lots (along Larsen Lane) and also a Church directly adjacent to the site with paved parking (roughly 32 acres of mostly pervious area). However, this offsite area has many intermediate low points that would need to fill and overflow before making its way onsite.

Environmental Impacts

The FEMA flood map for the project site shows flooding for the 100-year storm event at an elevation of 48' (See appendix A for details). There is an existing wetland that has been mapped near the southeast portion of the property. There is a 200 ft Shoreline Buffer and a 250 ft Critical Habit Buffer that extends onto the site from the ordinary high water mark (OHWM) of both the Cowlitz River and Salmon Creek.

2. Minimum Requirements Overview

The stormwater management design for this project is required to comply with Section 5 of the City of Castle Rock Development Polices and Public Works Standards, and the 1992 Stormwater Management Manual for the Puget Sound Basin. Per section I-2.4.1 of the 1992 Stormwater Management Manual for the Puget Sound Basin and figure I-2.1 "Flowchart for determining Minimum Requirements" (see Appendix A), minimum requirements 1-11 will apply to the site development. The site results in over an acre of land disturbing area. See the Stormwater Master Plan Basin and Conveyance Exhibit, attached in Appendix A, for a more detailed summary of basin areas and conveyance assumptions. For a summary of the basin areas used in all stormwater models, reference the tables below.

Table 1 – Proposed Onsite Basin Summary

Basin	Pervious Area (AC)	Impervious Area (AC)	Total Area (AC)
Road 1	1.160	1.684	2.844
Basin 1	1.210	10.889	12.099
Road 2	0.091	0.250	0.341
Basin 2	4.645	4.276	8.921
Road 3	0.239	0.710	0.949
Basin 3	0.306	2.757	3.063
Basin 4	9.462	66.396	75.858
Total	**17.113**	**86.962**	**104.075**

Table 2 – Proposed Offsite Basin Summary

Basin	Pervious Area (AC)	Impervious Area (AC)	Total Area (AC)
Offsite	25.386	6.346	31.732
Road 4	0.107	0.156	0.263
Total	**25.493**	**6.502**	**31.995**

Below is the summary of the requirements and a brief description of how each applies.

I-2.5 Minimum Requirement #1: Erosion and Sediment Control

For each phase of the project, an Erosion Control Plan and Stormwater Pollution Prevention Plan (SWPPP) will be prepared in accordance with the city requirements.

I-2.6 Minimum Requirement #2: Preservation of Natural Drainage Systems

Natural drainage patterns will be maintained as feasible.

I-2.7 Minimum Requirement #3: Source Control of Pollution

Each phase of the development will implement applicable Source Control BMP's based on the proposed land use.

I-2.8 Minimum Requirement #4: Runoff Treatment BMPs

As each phase is developed, Treatment BMP's will be designed to meet quality control requirements for each land use.

I-2.9 Minimum Requirement #5: Streambank Erosion Control

See Section 3 below for further details.

I-2.10 Minimum Requirement #6: Wetlands

No hydrologic modifications to the existing conditions are proposed for the wetland areas on the site.

I-2.11 Minimum Requirement #7: Water Quality Sensitive Areas

There are no sensitive areas that will be impacted by the current development.

I-2.12 Minimum Requirement #8: Off-site Analysis and Mitigation

See Section 5 below for further discussion.

I-2.13 Minimum Requirement #9: Basin Planning

No watershed-based basin plans are intended to be used to modify any of the minimum requirements at this time.

I-2.14 Minimum Requirement #10: Operation and Maintenance

All onsite stormwater treatment systems will be privately maintained by an HOA. The City of Castle Rock will own, operate, and maintain the proposed offsite stormwater facilities and the two proposed stormwater outfalls to the Cowlitz River. Pages from the 1992 SWMMPSB are attached in Appendix E detailing maintenance requirements for applicable components onsite. The site will be inspected for defects and maintained as needed at least once every season, as well as after all major storm events (including and in excess of the 100-year storm event).

I-2.15 Minimum Requirement #11: Financial Liability

A performance bond or other appropriate financial instruments (as approved by the City) shall be provided to ensure compliance with these standards.

3. Streambank Erosion Control

Per Section 5 of the City of Castle Rock Development Polices and Public Works Standards and the 1992 Stormwater Management Manual for the Puget Sound Basin, the project is required to limit the peak rate of runoff from the developed site to:

- 50% of the existing 2-year, 24-hour design storm
- the 10 year, 24-hour design storm.
- the 25 year, 24-hour design storm.
- the 100 year, 24-hour design storm.

Since the different onsite soils are all classified as Hydrologic Soil Group A, management of runoff is generally through infiltration due to the limited runoff experienced from Group A soils.

Review of the onsite soils for infiltration potential was completed by Columbia West Engineering (CWE) in March 2023 with follow up exploration in March 2024. See Appendix C for the CWE Geotechnical Report and Exploration Map showing locations and tested infiltration rates. Tested infiltration rates ranged from a high of 200 in/hr. to negligible. The test pits identified hardpan layers and strata with very high silt content resulting in very variable rates across the site. Groundwater was also encountered between 9ft and 35ft with the likelihood of perched groundwater at even shallower depths being encountered. Due to the issues related to infiltration rates identified in CWE's original investigation, further investigation was completed in March 2024. The follow up investigations confirmed CWE's recommendations that infiltration should only be used to address Low Impact Development (LID) Best Management Practices (BMP's) rather than as the mechanism to remove all runoff from the site.

Discussions were had with CWE to reclassify the onsite soil from a Group A to a tighter soil type with higher historical runoff. However, due to the high rates tested, a reclassification was not possible. Due to the issues related to both detention and infiltration, direct discharge from the site was explored.

Per the 2024 Stormwater Management Manual for Western Washington Section 1-3.4.7: Flow Control, under TDA Exemption, it states: Flow Control is not required for TDAs that discharge directly to, or

indirectly through an MS4 to a water listed in Appendix 1-A: Flow Control Exempt Receiving Waters. Based on Appendix 1-A, the Cowlitz River is Flow Control Exempt Downstream of confluence of the Ohanapecosh River and the Clear Fork Cowlitz River. Since the confluence of the Ohanapecosh is approximately 85 miles upstream of the site, the project is well within the Flow Control Exempt reaches of the Cowlitz River.

Applying the latest Stormwater Manual for Western Washington (SWMMWW) and thus the Flow Control Exemption rather than the 1992 Puget Sound Manual was discussed with the city. Based on the above site issues, City staff supported using the SWMMWW due to the afore mentioned issues. By applying the flow control exemption, the project also takes on the responsibility to apply the Minimum Requirements (MR) from the manual. The only MR that really differs between the two manuals is the requirement in the SWMMWW to address LID standards. Therefore, future development on the site will meet the LID standards per the requirements.

4. Direct Discharge to the Cowlitz River

Since the site is predominantly located within a 100-year flood zone of the Cowlitz River, any design has to address the ability of a system to remove stormwater from the site in all situations without impacting any buildings or creating any safety issues to the public. There are two distinct areas associated with the project drainage:

- Onsite Areas that will be raised to or above the 100-year flood elevation
- Offsite Areas that will stay at the existing elevation between 42ft and 55ft

The development of the project site will be creating a significant amount of impervious surface that will create a large increase in both runoff flow and volume. To convey this flow from the different parts of the site creates a hydraulic grade line that exceeds the offsite elevation. To address this difference in flow elevation and flow rate/volume, two systems are being proposed for the project; an offsite system and an onsite system, both with their own direct discharge to the Cowlitz River. These systems will be kept hydraulically disconnected so the onsite flow elevation will not impact the elevation of the offsite storm.

Since the offsite area is well below the 100-year flood elevation of 48 ft, this project is proposing several measures to prevent the offsite area from being adversely impacted by not only this development, but also from flooding of the Cowlitz River. The paths that stormwater runoff take to get to the site will remain largely unchanged. The existing culverts from neighboring properties and the series of smaller ditches along the norther boundary that lead to the large drainage ditch onsite will remain in place, with minor modifications to their grades/depths. To keep the offsite and onsite stormwater runoff hydraulically disconnected, an earthen berm will be constructed that separates the existing drainage ditch into two separate detention ponds. The northern most portion of the ditch will be tied to the offsite system while the remaining portion will be used for the onsite system. A 30” storm pipe will be used to convey water from the offsite system to a new outfall along the Cowlitz River. To prevent backflow into the offsite system during flood events in the Cowlitz River, an internal check valve will be installed in the 30” pipe. As a secondary measure, a manhole with a manual slide gate valve will also be installed so that the City can manually isolate the offsite detention pond if the primary valve fails.

If either (or both) of the valves are closed, the offsite system will require a pumping system to ensure that offsite runoff doesn’t flood the basin. Since the need for pumping is anticipated to be infrequent

the development is not proposing a permanent pump station at this time. Instead, a dry sump manhole will be constructed in close proximity to the proposed slide gate manhole in which a portable pump can be utilized. Tapani/CT6 is currently in possession of a 2,290 GPM portable pump to maintain the existing drainage system and has agreed to donate that pump to the City upon completion of construction for use on this offsite system. Please see Section 5 for more information on pumping frequency and anticipated performance of the offsite system.

For the onsite area, the conveyance system is being sized to minimize localized flooding even when the Cowlitz River reaches flood stage. Roads and parking will be designed through site development to provide flow routes and ponding locations to ensure that no buildings are impacted if there was ever a 100-yeaar storm event. Onsite conveyance will consist of both underground piping and above ground drainage channels that lead to a second (and separate) outfall at the Cowlitz River. A manhole will be constructed within the earthen berm described above to combine the underground flows with the above ground flows in remaining portion of the onsite ditch. From that point, a 48" storm pipe will convey runoff to the discharge point at the Cowlitz River. This 48" line will also have an internal check valve to prevent backflow onto the site during flood conditions in the Cowlitz River. However, due to the higher hydraulic grade of the onsite system, we do not anticipate that the internal check valve on the onsite system will close as frequently as the valve on the offsite system. In the rare occasions that the internal check valve does close, the remaining portion of the onsite ditch will act as onsite detention until river levels subside. As a measure of extreme precaution, the Phase 1 roadway has been designed so that the surface elevations gradually cascade down towards the river. Runoff can surface flow down the roadway towards the existing ditch until it spills over the edge towards the river. Please see Section 5 for more information on the capabilities and expected operation of the onsite storm system.

5. Conveyance System Analysis and Design

Determination of Ordinary Highwater Mark

In the early stages of the stormwater master planning process, we walked the project frontage along the Cowlitz River with the client and their environmental consultant (Ecological Land Services) to better understand the flow patterns of the river before setting a location and elevation for a potential outfall. Based on observations in the field and the ordinary highwater mark (OHWM) shown on preliminary design documents, it became evident that the OHWM may not have been accurately represented on the preliminary plans. To more clearly define it, we studied the available data for the Cowlitz River at a nearby gauging station and compared it to survey information gathered at various locations along the project frontage on the river.

The nearest gauging station for the Cowlitz River is located at the bridge crossing the river just north of the project site in Castle Rock. On April 25, 2024, surveyors collected the water elevation under the bridge and then captured the water elevation at the location of the proposed outfall location. The water elevation at the bridge gauging station was 33.501 feet at 11:22 am. The water elevation at the north property line of the project was 27.205 feet at 11:51 am. This shows a drop of 6.3 feet from the bridge to the site.

Next, we compared this to the readings at the gauging station from the USGS Gauging Station Web Site. On April 25, 2024, the reading for the water elevation at the bridge was listed as 34.17 feet (at 11:15 am, 11:30 am, and 11:45 am). This shows a difference in datum of 0.7 feet.

Water elevations of the Cowlitz at the gauging station for the previous 4 winters were then downloaded (See Appendix B). Based on the graphs of these flows, a river elevation was estimated that would cover the extended higher flow river surfaces for all the four years. A line at this elevation has been added the graphs. The estimated elevation was 37.2 feet. Based on the difference in datum between the gauging station and the surveyed readings of 0.7 feet, the resulting ordinary high water elevation at the site is 36.5 feet.

Determination of Flood Stage Elevation

The USGS River Gaging Station website lists four classes of flood stages for the Cowlitz River at the Castle Rock Gaging Station: Action Stage (46 ft), Minor Flood Stage (48 ft), Moderate Flood Stage (54 ft), and Major Flood Stage (57 ft). Based on these classifications, a flood event at this site would be any event resulting in a water elevation of 48 feet or higher. Using the same methodology that we used to assume the OHWM at our site in relation to the reading at the gaging station, we were able to determine that any river water level above 41 feet in elevation at the project site should be considered a flood event. More specifically, the flood stages in relation to our site are as follows: Minor Flood Stage (41 ft), Moderate Flood Stage (47 ft), and Major Flood Stage (50 ft).

The USGS Gaging Station website has data for this location dating back to 2007. Since 2007, there have been a total of three events that have reached flood stages (2 minor and 1 moderate). See Appendix B for more information on these events.

Hydraulic Analysis

The stormwater master plan breaks the development into four (4) distinct drainage basins to be drained by either a piped system or ditch in addition to the one (1) offsite drainage basin (See Master Storm Conveyance Plan in Appendix A). In order to simplify the calculations, additional basins were created for the portions of the proposed Phase 1 roadway adjacent to those basins. In accordance with the SWMMWW, the onsite flows to be used in the analysis of the storm system were calculated using WSDOE's WWHM model.

Overall, the stormwater master plan conveyance model for the site is comprised of five (5) nodes. Four of those nodes are tied to the onsite system, while the last node represents the offsite system. A summary of the nodes is shown below:

- Node A – Captures Drainage from Basin 1 (commercial and flex properties) and the adjacent public roadway. Runoff leaves this node in a 24" pipe.
- Node B – Runoff from Basin 2 (residential) and the adjacent public roadway enters the storm main and continues downstream in a 24" pipe.
- Node C – Runoff from Basin 3 (flex) and the adjacent public roadway enters the storm main and the storm pipe is upsized to 30".
- Node D – Runoff from the rest of the onsite area is conveyed to the large onsite drainage ditch/detention pond through a combination of roadside swales, ditches, and culverts. This ditch is tied into a manhole (by 30" pipe) where it converges with the rest of the runoff from Nodes A-C. Runoff leaves this node in a 48" pipe where it continued towards the ultimate discharge point at the proposed Cowlitz River outfall.
- Node E – Any onsite runoff that makes its way to the northern limits of the project area will be collected via ditches along the property lines or culverts to the remaining portion of the existing

ditch that has been preserved for the offsite system. A short stretch of the roadway improvements on Larsen Lane will also be conveyed to this offsite system due to the transitioning grade from our raised site to the lower existing elevations.

To determine the flow from each of the basin areas, a separate WWHM model was developed for the basins leading to each node. Due to the requirements of this project including stormwater treatment and infiltration (to meet the LID Standard), preliminary bioretention planters and infiltration trenches were designed for each basin. These facilities do assist in reducing the amount of runoff being generated by the parcels and help reduce the pipe sizes in our conveyance system. While these designs are not final, preliminary sizing as completed for this report should be a close approximation. These models provide the necessary design flows for each storm event in each basin (See Appendix C for WWHM models). Based on the models, the flows associated with the 2-year, 10-year, 25-year and 100-year storm events for each basin are as follows:

Table 3 - WWHM Flow Rates for the 2-, 10-, 25- and 100-year storm events

	Flow (CFS)				
Storm	Node A	Node B	Node C	Node D	Node E (Offsite)
2 Yr	3.504	2.939	1.112	16.233	10.287
10 Yr	8.044	6.235	2.689	25.643	21.126
25 Yr	10.575	7.928	3.607	29.385	26.397
100 Yr	14.402	10.369	5.016	34.011	33.741

Since conveyance is generally sized to convey the 25-year storm, the table below shows the cumulative flow that can be expected at each node for both the 25-year and 100-year storm events.

Table 4 – Cumulative WWHM Flow Rates at each node for the 25 and 100-year storm events

Node	25-Year	100-Year
A	10.575 CFS	14.402 CFS
B	18.503 CFS	24.771 CFS
C	22.110 CFS	29.787 CFS
D	51.495 CFS	63.798 CFS
E (Offsite)*	26.397 CFS	33.741 CFS

*Offsite system is completely disconnected from the onsite system.

Due to the size of the site, limited vertical elevation available, and the impact from the Cowlitz River, head losses within the conveyance system become the key factor in sizing pipes within the storm system. To offset the project size and losses within the last pipe from the site to the Cowlitz River, a ponded area is being proposed. This ponded area will act as overflow of the open channel ditch that

provides conveyance for Basin 4. The detention provided in this area reduces the peak flow within the pipe thus reducing head losses.

Assumptions and Basis for Conveyance Modeling

HydroCAD was used to model the conveyance since it has the capacity to model detention, change tailwater elevations to determine hydraulic grades though the system, and add pump flows. For the standard 2-, 10-, 25-, and 100-year storm events, the lowest downstream nodes were set to open flow conditions. To hydraulically connect the nodes within HydroCAD, we utilized catch basin ponds instead of reaches. The furthest downstream nodes (D & E) were set with storage areas to match the volumes of the ditches/detention ponds that they're attached to. The offsite system pond storage was designed to match the volume of the remaining ditch, plus a 2' deep area adjacent on the offsite area where any overflow would collect (should that be necessary). This elevation would still be at least 2-3 feet below the finished floor elevations of the nearest structures on the property. The onsite pond was modeled to reflect a future relocation/realignment of the existing onsite drainage ditch. For these models, it was assumed that the end of the pond will end near the end of the future Phase 2 Road cul-de-sac. In the interim condition, the existing onsite ditch actually has more storage than we've accounted for in these calculations. We also included a large overflow extending from the top of the ditch, as described earlier in this report. Outlet pipes matching the outfall design and free discharge conditions were also modeled. The peak water elevation at a node was then applied to the next node upstream of it as tailwater, to represent the hydraulic grade line in the pipe at that node.

For the onsite system, the pipe diameter was reduced by one pipe size to represent the potential head loss within the outfall pipe to compensate for the backflow device. This approach was not applied to the offsite drainage system due to the smaller size and flatter hydraulic grade. While an effort was made to represent the head loss due to these valves, it should be noted that the Tideflex CheckMate UltraFlex Inline Check Valve is known for causing extremely low headloss. For more information, please reference the product brochure in Appendix D.

For the offsite system, it should be noted that no storm system exists on the neighboring properties. Therefore, the majority of runoff is sheet flow over vegetated areas with little to no concentration of the flow with the exception of the Church parking lot. It should also be noted that the ditches constructed along the west property line of the site do not currently see flow even in large storm events. The above flows associated with the offsite area assume the runoff reaches the outfall area. Based on visual observations, it is likely the offsite flows will be significantly less than what was calculated using the hydrologic modelling.

HydroCAD Reports for all the scenarios that were run for this site are provided in Appendix D.

To properly evaluate the performance of the proposed drainage systems, we modeled a variety of scenarios combining different storm events with various potential flood events of the Cowlitz River. Those scenarios include an analysis of the 25- and 100-year storm events (both on- and offsite) when the Cowlitz River is as at/or Below the OHWM, at the Minor Flood Stage, at the Moderate Flood Stage, at the FEMA 100-year flood plain elevation, and at Major Flood Stage.

Cowlitz River Elevation at/or below OHWM

The first scenario modeled reflects the ideal scenario for the site in which the Cowlitz elevation is at or below the OHWM. In this condition, we see the typical free discharge system with no initial tailwater applied to Node D or E (the furthest downstream nodes). The following results for the proposed system when the river levels were at the OHWM or below were calculated:

Table 5 - Water Elevation and Free-board at each node for the 25-Year Storm

Node	A	B	C	D	E (Offsite)
Water Elevation	50.24	48.56	44.32	42.27	40.30
Rim Elevation	50.41	49.52	48.83	45.29	42.00*
Free-Board	0.17	0.96	4.51	3.02	1.70

*Approximate elevation at which water could overflow ditch into offsite area.

Table 6 - Water Elevation and Free-board at each node for the 100-Year Storm

Node	A	B	C	D	E (Offsite)
Water Elevation	50.56	49.68	46.40	43.12	40.85
Rim Elevation	50.41	49.52	48.83	45.29	42.00*
Free-Board	-0.15	-0.16	2.43	2.17	1.15

*Approximate elevation at which water could overflow ditch into offsite area.

Only two nodes on the model are shown exceeding the rim elevation (by less than 3”) during the 100-year storm event. Both the onsite and offsite systems show adequate capacity to convey these storm events in this condition. The development should have no adverse impacts on the neighboring offsite areas when the Cowlitz River is at or below the OHWM. Additionally, no pumping assistance will be needed in these conditions.

Cowlitz River Elevation at Minor Flood Stage

With the onsite and offsite storm systems performing more than adequately while the Cowlitz River is at or below the OHWM, we then updated the models to test the condition in which the flood stages are reached. As previously explained in this report, minor flood events in the Cowlitz would be equal to an elevation of 41 feet at our site. The inline backflow valve will automatically close when the flood stage exceeds the outfall IE by a few inches and the upstream water elevation is at or lower than this elevation. By closing, any onsite stormwater storage is preserved for use by an onsite storm event. For the following onsite analysis, the most conservative approach has been taken by assuming the onsite storage is already full to the elevation of the flood stage in the Cowlitz River being studied. As the onsite ponded elevation exceeds that of the Cowlitz River, the check valve will open to allow flow into the river. For the onsite model, we’ve assigned a tailwater elevation of 41 feet as the basis for Node D. The results for the onsite system during a flood event on the Cowlitz are shown below.

Table 7 - Water Elevation and Free-board at each node for the 25-Year Storm

Node	A	B	C	D
Water Elevation	50.45	48.77	44.53	42.48
Rim Elevation	50.41	49.52	48.83	45.29
Free-Board	-0.04	0.75	4.30	2.81

Table 8 - Water Elevation and Free-board at each node for the 100-Year Storm

Node	A	B	C	D
Water Elevation	50.56	49.68	46.47	43.19
Rim Elevation	50.41	49.52	48.83	45.29
Free-Board	-0.15	-0.16	2.36	2.10

With the data shown above, our onsite system shows it can handle the 25-year storm while maintaining a hydraulic grade line just above the surface elevation at the high point of the storm main when the river is experiencing a minor flood stage. During the 100-year storm, only the two upper nodes on the are shown exceeding the rim elevation and by less than 3”.

For the offsite system, a flood stage of 41 will almost certainly close the internal check valve due to the lack of head behind the offsite flows. If for some reason the internal check valve doesn’t close, we would recommend that the City close the manual slide gate valve to ensure that the offsite area is protected from flooding. With the valves closed, the offsite system is essentially an isolated detention pond with no gravity outlet. In this condition, the temporary pump should be used to drain the pond and force water out towards the river. As mentioned above, the City would need to use the Tapani-provided pump (capable of pumping 5.0 CFS) to lower the water level in the detention pond. Whenever the pump is to be operated, the City should manually close the slide valve to ensure that none of the pump water makes its way back into the pond. This pump has been modeled in HydroCAD as a Skimmer outlet at elevation 40.

Table 9 - Water Elevation and Free-board at each node for the 25-Year Storm

Node	E
Water Elevation	42.45**
Rim Elevation	42.00*
Overflow Depth	0.45

*Approximate elevation at which water could overflow ditch into offsite area.
**Assumes use of pump, operating at 5.0 CFS outflow

Table 10 - Water Elevation and Free-board at each node for the 100-Year Storm

Node	A
Water Elevation	43.65**
Rim Elevation	42.00*
Overflow Depth	1.65

*Approximate elevation at which water could overflow ditch into offsite area.
**Assumes use of pump, operating at 5.0 CFS outflow

As shown above, minor overflowing of the stormwater detention pond is possible when flood elevations force the valves to close and a 25-year or greater storm event occurs. However, the proposed pump should minimize that to less than 2' of ponding within the existing localized depression adjacent to the detention pond. Topographic surveys of the area show that none of the existing structures adjacent to the property line are below a finished floor elevation of 46 feet, more than 2' above the peak elevation of the 100-year design storm. It's also important to note that the models that have been prepared show a simplified offsite system with a single point of confluence and do not factor in the numerous local depressions, conveyance systems, or infiltration facilities that exist on the adjacent properties. Actual surface conditions will likely result in much less surface runoff than the models show.

Cowlitz River Elevation at Moderate Flood Stage

When the Cowlitz River reaches major flood stages, the equivalent elevation at our site would be 47 feet. As described above in the Minor Flood section, the inline check valve for the onsite system will likely remain closed until the ponded elevation of water on the site exceeds the level of water in the river. In this model, we have made the same conservative assumption that the water elevation onsite will be matching the river elevation prior to the valve closing and therefore reducing the available storage in the detention pond. To test the capacity of the system at this elevation, we've assigned a tailwater elevation of 47 feet as the basis for Node D. In addition to the 48" outlet pipe, this scenario also includes a weir at elevation 48. With the tailwater elevation being so high, the weir was provided as an emergency overflow. The proposed weir would be approximately 30'-wide and the location is yet to be determined, but it would need to lead directly to the Cowlitz River or Salmon Creek. In the interim condition, additional flooding within Basin 4 should have no impact on the site as the existing ditch has an existing spillway to Salmon Creek. In the final condition, a relocated/realigned ditch would likely also provide an emergency overflow to Salmon Creek. The results for the onsite system during a flood event on the Cowlitz are shown below.

Table 11 - Water Elevation and Free-board at each node for the 25-Year Storm

Node	A	B	C	D
Water Elevation	50.51	49.73	48.92	47.56
Rim Elevation	50.41	49.52	48.83	48.00*
Free-Board	-0.10	-0.21	-0.09	0.44

*Elevation of the proposed weir.

Table 12 - Water Elevation and Free-board at each node for the 100-Year Storm

Node	A	B	C	D
Water Elevation	50.57	49.80	49.06	48.12
Rim Elevation	50.41	49.52	48.83	48.00*
Free-Board	-0.16	-0.28	-0.23	-0.12

*Elevation of the proposed weir.

With the Cowlitz River in moderate flood stages, we start seeing the impact of the flooding on the onsite system. The 25-year design storm event maintain an HGL just above the proposed roadway elevation without reaching an elevation where the emergency overflow weir is utilized. However, we start to see some water making its way over the spillway during the 100-year storm. In this condition, we also see runoff at a surface level at depths up to 3.5". Due to the design of the road profile for Phase 1, surface runoff that backs up into the roadway will eventually spill down to the existing pond and over the weir (if necessary). Please note that this scenario was modeled with the assumption that the elevation of ponder water in the onsite detention pond was already equivalent to the river flood elevation prior to the event beginning. In actuality, the available storage in the detention pond will likely be much greater and the resulting water elevations at each node would likely come down below the surface elevation of the roadway.

For the offsite system, a flood stage of 47 will certainly close the internal check valve and it is likely that the City would choose to manually close the slide gate valve if the river reached moderate flood stares. In this scenario, the offsite system will operate in exactly the same fashion as it does during the minor flood stage. The offsite storm system has shown adequate capacity up to the 100-year storm event when the system is totally isolated from the river outfall. As long as the river elevation stays below the highest point of the bank, the offsite storm pond can still handle the full 100-year storm event with the pump is running at full capacity.

Cowlitz River Elevation at FEMA 100-year Flood Plain Elevation of 48

As previously mentioned, the inline check valve will close once the river elevation exceeds the IE of the outflow pipe by a few inches and the upstream water elevation is at or less than the river elevation. As the river floods to an elevation of 48ft, it is highly likely that considerable onsite detention volume will still be available for an onsite storm event. However, to analyze the most conservative option, it is assumed that all onsite storage volume is already at an elevation of 48ft and flow through the outfall pipe is negligible. In this scenario, the volume available to store any onsite runoff is restricted to the area adjacent to the onsite ditch/detention pond. The plan is to have a low area of parking along the ditch to provide this volume. For this study, the volume in the model for node D is assumed as approximately 200ft wide parking at 2% slope to ditch for the length of the ditch. Total depth of this volume is 2ft. With the 30ft overflow to Salmon creek at the south end of the property. The maximum depth for this pond was found to be 0.61ft or 48.61ft. At this time, we anticipate the minimum building elevations onsite to be 50ft. Therefore, all buildings will be over 1ft above the highest 100yr onsite flood elevation under the most conservative assumptions. To simplify the calculations for this scenario, we started directly with the 100-year storm event. The results for the onsite system during a flood event on the Cowlitz are shown below.

Table 13 - Water Elevation and Free-board at each node for the 100-Year Storm

Node	A	B	C	D
Water Elevation	50.49	49.71	49.02	48.61
Rim Elevation	50.41	49.52	48.83	48.00*
Free-Board	-0.08	-0.19	-0.19	N/A

*Elevation of the proposed weir.

As shown above, the system is capable of passing the 100-year storm event even if the river elevation reaches the 100-year flood plain elevation of 48. In this scenario, water will fill the entire onsite conveyance system and then surface flow down the proposed Phase 1 road towards the ditch (less than 3" deep). At the weir, water could reach a peak elevation of 48.61 feet and spill into Salmon Creek or the Cowlitz directly, depending on the location chosen. It is important to note that even in this condition, we do not anticipate any surface runoff on the roadway to run towards the existing Larsen Lane. The elevations of Node C consistently stay below the high point on our proposed extension of Larsen Lane. This scenario was also tested for the actual isopluvial rainfall and the results were very similar to the data above. In that report, a peak elevation of 48.85 feet is shown at the weir which is still more than 1' lower than the minimum finish floor of 50ft.

Once again, the offsite system would be fully isolated in this condition and no additional analysis was required.

Cowlitz River at Major Flood Stage

If the Cowlitz River ever reaches Major Flood Stages (elevation 50 or higher per USGS), the river elevation would likely breach the banks along the project frontage and cause flooding in both the onsite and offsite systems. This level of flooding exceeds even the FEMA 100-year flood elevation and is beyond what is required for our analysis. But as river elevations subside below the bank elevation for the proposed systems, flooding should dissipate much faster than it would in current conditions.

Frequency of Large Storm Events, Flooding, and Need for Pumping

The impact to the site when the Cowlitz River is in flood stages depends on the local weather during the period in which the river levels are high. The Cowlitz River has two major dams upriver from the site. The impact of the dams is that the peaks in flow are modulated and peak flows are generally short in nature. Reviewing the gauging data from 2007 to present, there have only been three events that are considered within flood stage. Between the three events, the river was considered above flood stage for a total of 3 days. Since elevated water elevation in the Cowlitz River is based on extreme weather in its upper reaches rather than local weather, a severe local event occurring at the same time is very unlikely.

In addition to the river flood elevation available on the USGS website, we were also provided with actual rainfall data by the City of Castle Rock Public Works Department. After reviewing their records (which go back to January of 2007), we identified 11 storm events in that time period that would be considered a significant storm event. Nine of those events qualified as 2-year storm events, one as a 10-year storm,

and one as a 100-year storm. Of those nine events in the past 17 years, only two of them occurred on a day in which the river elevation was also at a flood stage elevation.

In the past 17 years, it appears that there were only two (2) occasions in which the offsite system would have required pumping (1/8/2009 and 12/9/2015). In both cases, the inline check valve would have closed, the City would have closed the manual slide gate valve, and pumping would have been needed for no more than 24 hours. While the data suggests that pumping was needed approximately once every ten years, it should be assumed that the pump should be prepared for use any time that the river gage shows flood conditions and a significant storm event is forecasted. Based on historic data, this may occur only every few years. Over time, City staff should become educated on the likely events and conditions that may require the use of the pump. The City could also opt to operate the pump more frequently to ease the concerns of the neighbors if they deem it necessary.

6. References

Castle Rock Public Works Department. 2020. *Development Policies and Public Works Standards.* Castle Rock, WA: City of Castle Rock.

Cowlitz County Public Works Department. 2017. *Cowlitz County Stormwater Drainage Manual.* Cowlitz County.

Hinman, Curtis. 2012. *Low Impact Development Technical Guidance Manual for Puget Sound.* PSP 2012-3. Puyallup, WA: Washington State University Extension.

Ridgefield Public Works Department. 2017. *Engineering Standards for Public Works Construction.* Ridgefield, WA: City of Ridgefield.

USDA Natural Resources Conservation Service. 2023. *National Soil Survey Handbook, Title 430.* United States Department of Agriculture.

USDA Soil Conservation Service. 1972. *Soil Survey of Clark County.* United States Department of Agriculture.

USDA Soil Science Division Staff. 2018. *Soil Survey Manual.* United States Department of Agriculture.

WADOE. 2006. *Guidance for UIC Wells that Manage Stormwater.* 05-10-067. Olympia, WA: Washington State Department of Ecology.

—. 1992. *Stormwater Management Manual for the Puget Sound Basin.*

—. 2019. *Stormwater Manual for Western Washington.* 19-10-021. Olympia, WA: Washington State Department of Ecology.

Appendix A: Maps & Figures

USDA Soil Map

Isopluvial Maps- Figures III-A.1 through A.3

1992 Stormwater Manual "Figure I-2.1 Flowchart for Determining Minimum Requirements"

FEMA Flood Map

Stormwater Master Plan Basin and Conveyance Exhibit

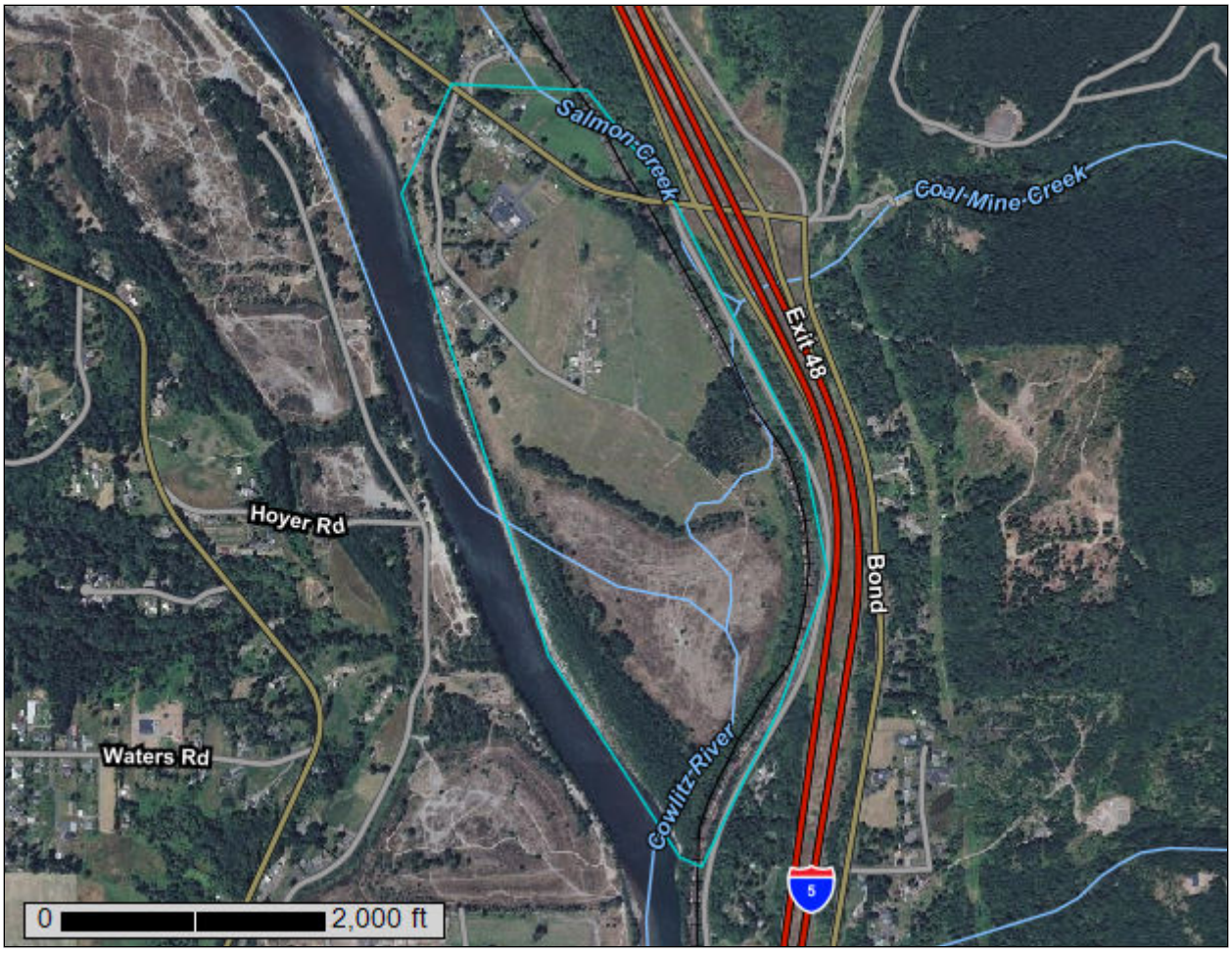
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for Cowlitz County, Washington



April 28, 2022

Preface

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

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

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

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

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

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

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How Soil Surveys Are Made

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

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

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

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

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

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

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

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

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

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

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

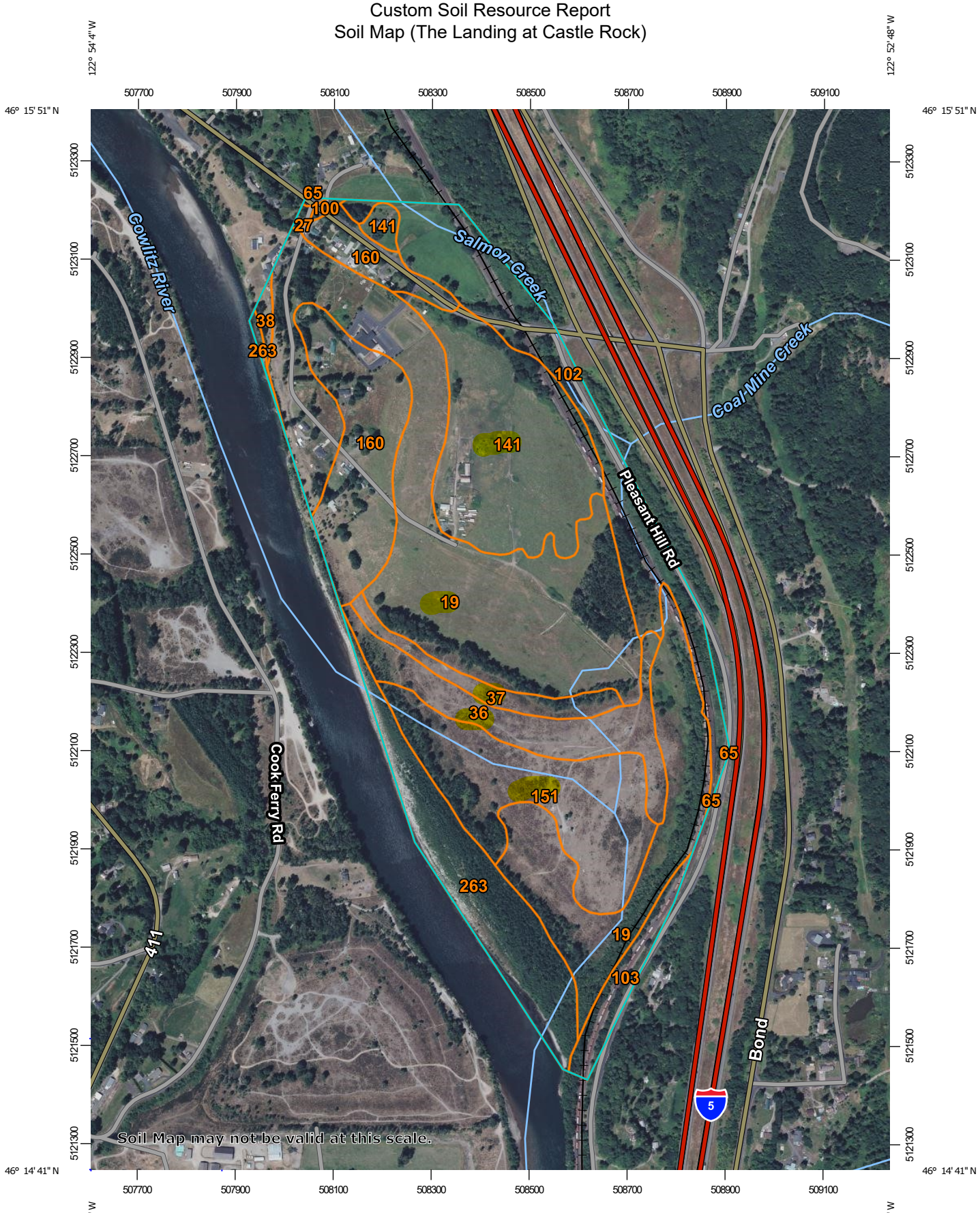
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

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

Custom Soil Resource Report
Soil Map (The Landing at Castle Rock)



Map Scale: 1:10,500 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 150 300 600 900

Feet: 0 500 1000 2000 3000

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

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Cowlitz County, Washington
Survey Area Data: Version 22, Aug 23, 2021

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

Date(s) aerial images were photographed: Nov 21, 2021—Nov 22, 2021

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 (The Landing at Castle Rock)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
19	Carrolls loamy sand, 0 to 2 percent slopes	87.9	35.9%
27	Cinebar silt loam, 20 to 30 percent slopes	0.3	0.1%
36	Cowlitz extremely gravelly sand, disturbed, 0 to 5 percent slopes	14.4	5.9%
37	Cowlitz extremely gravelly sand, disturbed, 5 to 15 percent slopes	5.2	2.1%
38	Cowlitz extremely gravelly sand, disturbed, 15 to 30 percent slopes	0.9	0.4%
65	Godfrey silt loam, 0 to 3 percent slopes	0.2	0.1%
100	Kelso silt loam, 0 to 8 percent slopes	0.4	0.2%
102	Kelso silt loam, 15 to 30 percent slopes	26.4	10.8%
103	Kelso silt loam, 30 to 50 percent slopes	5.2	2.1%
141	Newberg fine sandy loam, 0 to 3 percent slopes	32.5	13.3%
151	Panamaker gravelly sand, 0 to 3 percent slopes	25.9	10.6%
160	Pilchuck loamy fine sand, 0 to 8 percent slopes	25.0	10.2%
263	Water	20.2	8.3%
Totals for Area of Interest		**244.4**	**100.0%**

Map Unit Descriptions (The Landing at Castle Rock)

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

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the

landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

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

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

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

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

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

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

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

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present

or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

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

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

Cowlitz County, Washington

19—Carrolls loamy sand, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2f5r
Elevation: 10 to 100 feet
Mean annual precipitation: 45 to 60 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 150 to 200 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Carrolls and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Carrolls

Setting

Landform: Flood plains
Parent material: Sandy alluvium over mudflow deposits

Typical profile

H1 - 0 to 7 inches: loamy sand
H2 - 7 to 10 inches: very fine sandy loam
H3 - 10 to 60 inches: loamy sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water supply, 0 to 60 inches: Low (about 5.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: A/D
Ecological site: F002XB007WA - Portland Basin Wet Forest
Forage suitability group: Wet Soils (G002XV102WA)
Other vegetative classification: Wet Soils (G002XV102WA)
Hydric soil rating: Yes

Minor Components

Mountsolo

Percent of map unit: 10 percent
Landform: Terraces
Hydric soil rating: Yes

Unnamed, poorly drained
Percent of map unit: 5 percent
Hydric soil rating: No

27—Cinebar silt loam, 20 to 30 percent slopes

Map Unit Setting
National map unit symbol: 2fbd
Elevation: 50 to 2,000 feet
Mean annual precipitation: 50 to 75 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 160 to 250 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Cinebar and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cinebar

Setting
Landform: Hillslopes
Parent material: Volcanic ash over glaciofluvial deposits

Typical profile
H1 - 0 to 10 inches: silt loam
H2 - 10 to 23 inches: silt loam
H3 - 23 to 60 inches: silt loam

Properties and qualities
Slope: 20 to 30 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very high (about 16.6 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: F002XB004WA - Portland Basin Forest
Forage suitability group: Sloping to Steep Soils (G002XV702WA)
Other vegetative classification: Sloping to Steep Soils (G002XV702WA)
Hydric soil rating: No

Minor Components

Zynbar
Percent of map unit: 10 percent
Hydric soil rating: No

Newaukum
Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed, moderately well drained
Percent of map unit: 5 percent
Hydric soil rating: No

36—Cowlitz extremely gravelly sand, disturbed, 0 to 5 percent slopes

Map Unit Setting
National map unit symbol: 2fd1
Elevation: 10 to 200 feet
Mean annual precipitation: 45 to 60 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 150 to 200 days
Farmland classification: Not prime farmland

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

Description of Cowlitz

Setting
Landform: Terraces, flood plains
Parent material: Alluvium over mudflow deposits

Typical profile
H1 - 0 to 11 inches: extremely gravelly sand
H2 - 11 to 60 inches: very gravelly sand

Properties and qualities
Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: F002XA004WA - Puget Lowlands Forest
Forage suitability group: Droughty Soils (G002XV402WA)
Other vegetative classification: Droughty Soils (G002XV402WA)
Hydric soil rating: No

Minor Components

Panamaker

Percent of map unit: 5 percent
Hydric soil rating: No

37—Cowlitz extremely gravelly sand, disturbed, 5 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2fd5
Elevation: 10 to 200 feet
Mean annual precipitation: 45 to 60 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 150 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Cowlitz and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cowlitz

Setting

Landform: Terraces, flood plains
Parent material: Alluvium over mudflow deposits

Typical profile

H1 - 0 to 11 inches: extremely gravelly sand
H2 - 11 to 60 inches: very gravelly sand

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: F002XA004WA - Puget Lowlands Forest
Forage suitability group: Droughty Soils (G002XV402WA)
Other vegetative classification: Droughty Soils (G002XV402WA)
Hydric soil rating: No

Minor Components

Panamaker

Percent of map unit: 15 percent
Hydric soil rating: No

38—Cowlitz extremely gravelly sand, disturbed, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2fdb
Elevation: 10 to 200 feet
Mean annual precipitation: 45 to 60 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 150 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Cowlitz and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cowlitz

Setting

Landform: Terraces, flood plains
Parent material: Alluvium over mudflow deposits

Typical profile

H1 - 0 to 11 inches: extremely gravelly sand
H2 - 11 to 60 inches: very gravelly sand

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: F002XA004WA - Puget Lowlands Forest
Forage suitability group: Droughty Soils (G003XF403WA)
Other vegetative classification: Droughty Soils (G003XF403WA)
Hydric soil rating: No

Minor Components

Panamaker

Percent of map unit: 15 percent
Hydric soil rating: No

65—Godfrey silt loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2flz
Elevation: 20 to 300 feet
Mean annual precipitation: 40 to 65 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 150 to 200 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Godfrey and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Godfrey

Setting

Landform: Flood plains
Parent material: Alluvium

Typical profile

H1 - 0 to 5 inches: silt loam
H2 - 5 to 27 inches: silty clay loam
H3 - 27 to 60 inches: sandy clay

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 20 to 59 inches to abrupt textural change
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 0 to 24 inches
Frequency of flooding: NoneOccasional
Frequency of ponding: None

Available water supply, 0 to 60 inches: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: D
Ecological site: F002XA008WA - Puget Lowlands Riparian Forest
Forage suitability group: Seasonally Wet Soils (G002XV202WA)
Other vegetative classification: Seasonally Wet Soils (G002XV202WA)
Hydric soil rating: Yes

Minor Components

Godfrey, drained

Percent of map unit: 10 percent
Hydric soil rating: Yes

Caples

Percent of map unit: 5 percent
Landform: Flood plains
Hydric soil rating: Yes

100—Kelso silt loam, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2f11
Elevation: 50 to 200 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 52 degrees F
Frost-free period: 165 to 180 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Kelso and similar soils: 80 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kelso

Setting

Landform: Terraces
Parent material: Alluvium

Typical profile

H1 - 0 to 11 inches: silt loam
H2 - 11 to 34 inches: silt loam
H3 - 34 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 24 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 11.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C
Ecological site: F002XA004WA - Puget Lowlands Forest
Forage suitability group: Seasonally Wet Soils (G002XV202WA)
Other vegetative classification: Seasonally Wet Soils (G002XV202WA)
Hydric soil rating: No

Minor Components

Hazeldell

Percent of map unit: 5 percent
Hydric soil rating: No

Olympic

Percent of map unit: 5 percent
Hydric soil rating: No

102—Kelso silt loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2f18
Elevation: 50 to 200 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 52 degrees F
Frost-free period: 165 to 180 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Kelso and similar soils: 80 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kelso

Setting

Landform: Escarpments, terraces
Parent material: Alluvium

Typical profile

H1 - 0 to 11 inches: silt loam
H2 - 11 to 34 inches: silt loam
H3 - 34 to 60 inches: silt loam

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 24 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 11.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: F002XA004WA - Puget Lowlands Forest
Forage suitability group: Sloping to Steep Soils (G002XV702WA)
Other vegetative classification: Sloping to Steep Soils (G002XV702WA)
Hydric soil rating: No

Minor Components

Hazeldell

Percent of map unit: 5 percent
Hydric soil rating: No

Olympic

Percent of map unit: 5 percent
Hydric soil rating: No

103—Kelso silt loam, 30 to 50 percent slopes

Map Unit Setting

National map unit symbol: 2f19
Elevation: 50 to 200 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 52 degrees F
Frost-free period: 165 to 180 days
Farmland classification: Not prime farmland

Map Unit Composition

Kelso and similar soils: 80 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kelso

Setting

Landform: Escarpments, terraces
Parent material: Alluvium

Typical profile

H1 - 0 to 11 inches: silt loam
H2 - 11 to 34 inches: silt loam
H3 - 34 to 60 inches: silt loam

Properties and qualities

Slope: 30 to 50 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 24 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 11.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C
Ecological site: F002XA004WA - Puget Lowlands Forest
Hydric soil rating: No

Minor Components

Olympic

Percent of map unit: 5 percent
Hydric soil rating: No

Hazeldell

Percent of map unit: 5 percent
Hydric soil rating: No

141—Newberg fine sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2f3d
Elevation: 10 to 1,500 feet
Mean annual precipitation: 18 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Prime farmland if protected from flooding or not frequently flooded during the growing season

Map Unit Composition

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

Description of Newberg

Setting

Landform: Flood plains
Parent material: Alluvium

Typical profile

H1 - 0 to 10 inches: fine sandy loam
H2 - 10 to 28 inches: very fine sandy loam
H3 - 28 to 60 inches: fine sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: NoneOccasional
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A
Ecological site: F002XA008WA - Puget Lowlands Riparian Forest
Forage suitability group: Soils with Few Limitations (G002XV502WA)
Other vegetative classification: Soils with Few Limitations (G002XV502WA)
Hydric soil rating: No

Minor Components

Chehalis

Percent of map unit: 5 percent
Hydric soil rating: No

151—Panamaker gravelly sand, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2f3s
Elevation: 200 to 600 feet
Mean annual precipitation: 45 to 60 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 150 to 200 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Panamaker and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Panamaker

Setting

Landform: Flood plains, terraces
Parent material: Sandy drege material from mudflow deposits

Typical profile

H1 - 0 to 3 inches: gravelly sand
H2 - 3 to 60 inches: sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: NoneRare
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Ecological site: F002XA005WA - Puget Lowlands Moist Forest
Forage suitability group: Droughty Soils (G002XV402WA)
Other vegetative classification: Droughty Soils (G002XV402WA)
Hydric soil rating: No

160—Pilchuck loamy fine sand, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2f45
Elevation: 10 to 50 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 195 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Pilchuck and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pilchuck

Setting

Landform: Flood plains
Parent material: Alluvium

Typical profile

H1 - 0 to 12 inches: loamy fine sand

H2 - 12 to 36 inches: fine sand
H3 - 36 to 60 inches: gravelly sand

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: NoneRare
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Ecological site: F002XA005WA - Puget Lowlands Moist Forest
Forage suitability group: Droughty Soils (G002XV402WA)
Other vegetative classification: Droughty Soils (G002XV402WA)
Hydric soil rating: No

263—Water

Map Unit Composition

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

Description of Water

Setting

Landform: Alluvial cones

References

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

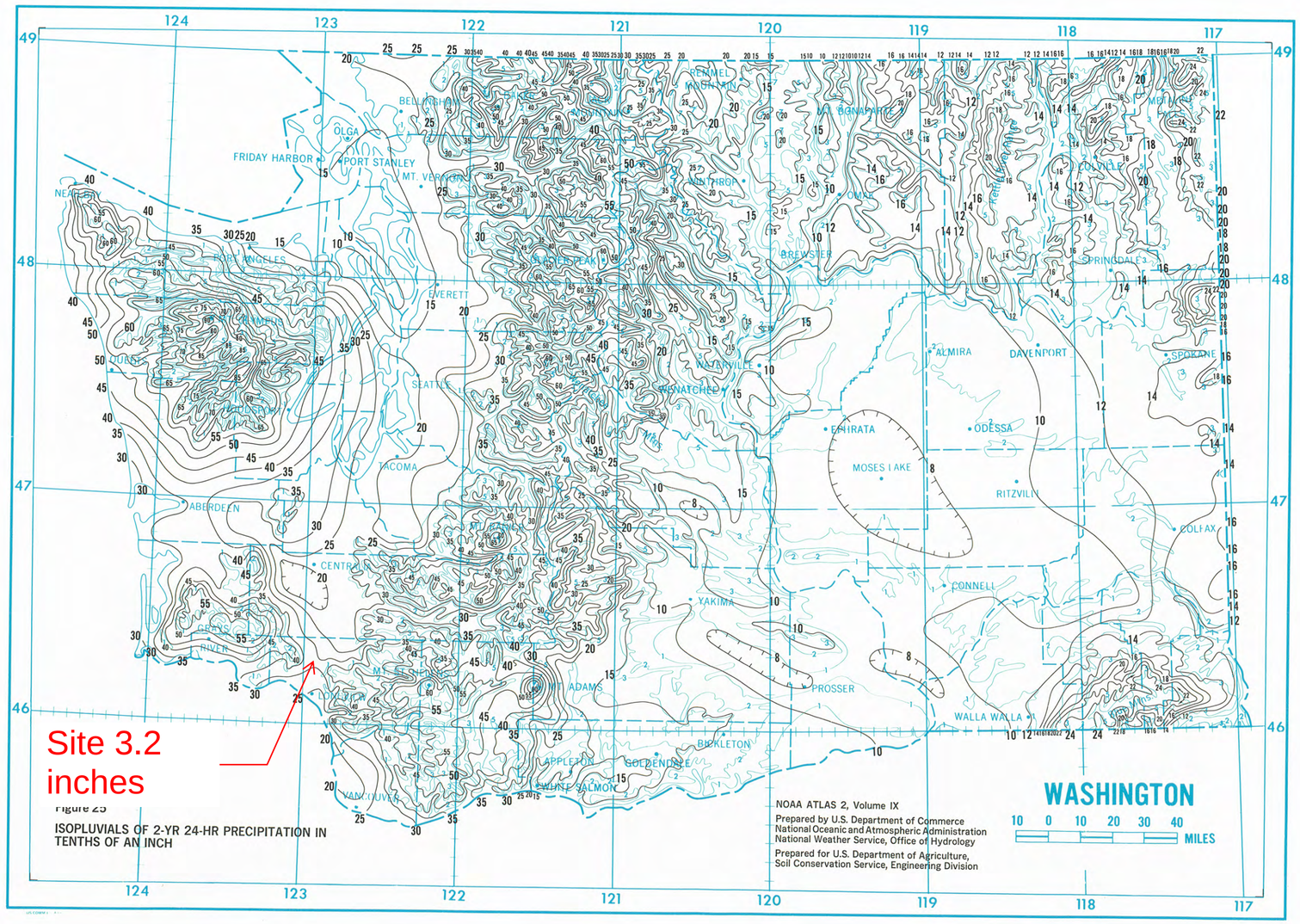


Figure 25

ISOPLUVIALS OF 2-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

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National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

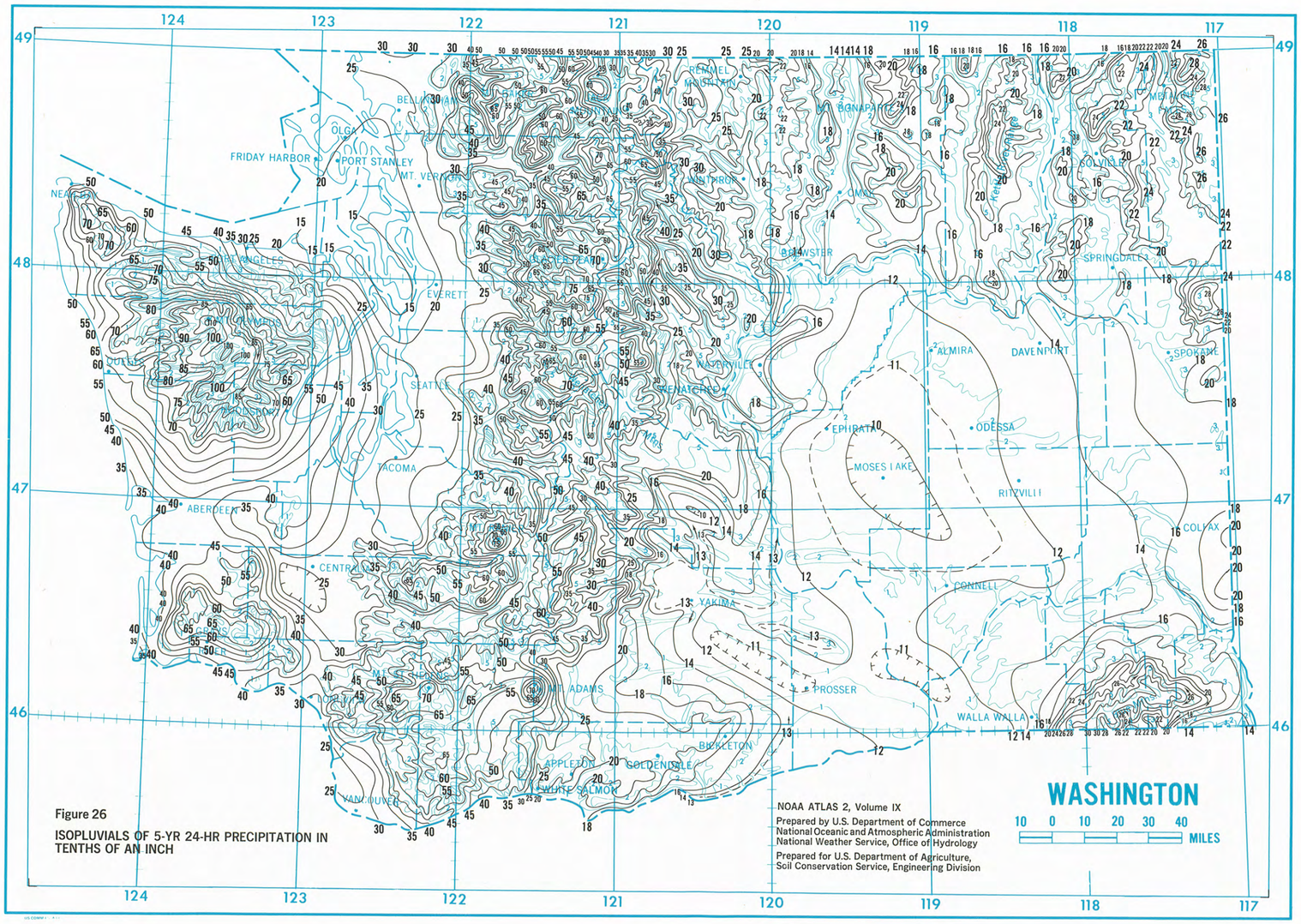


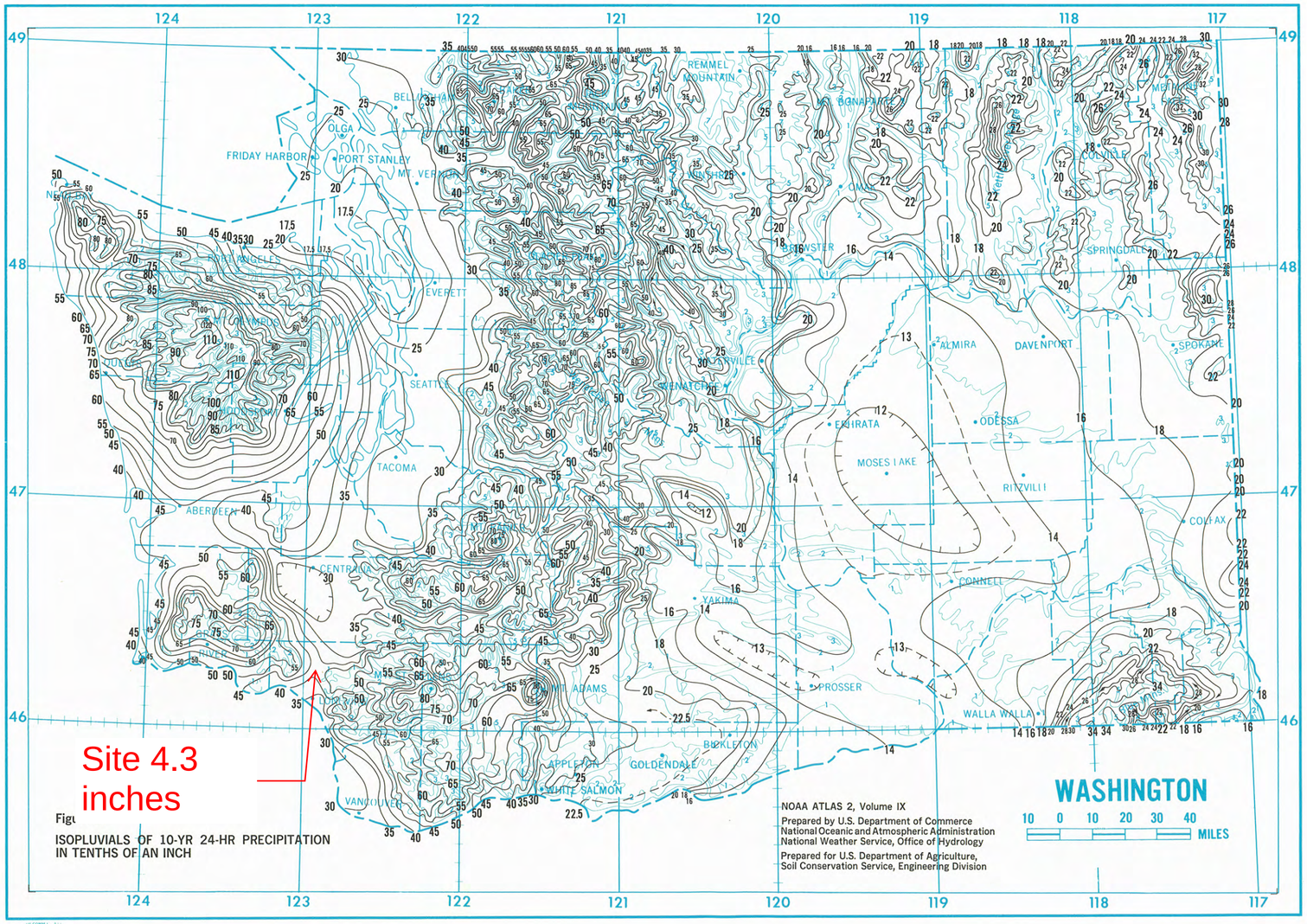
Figure 26

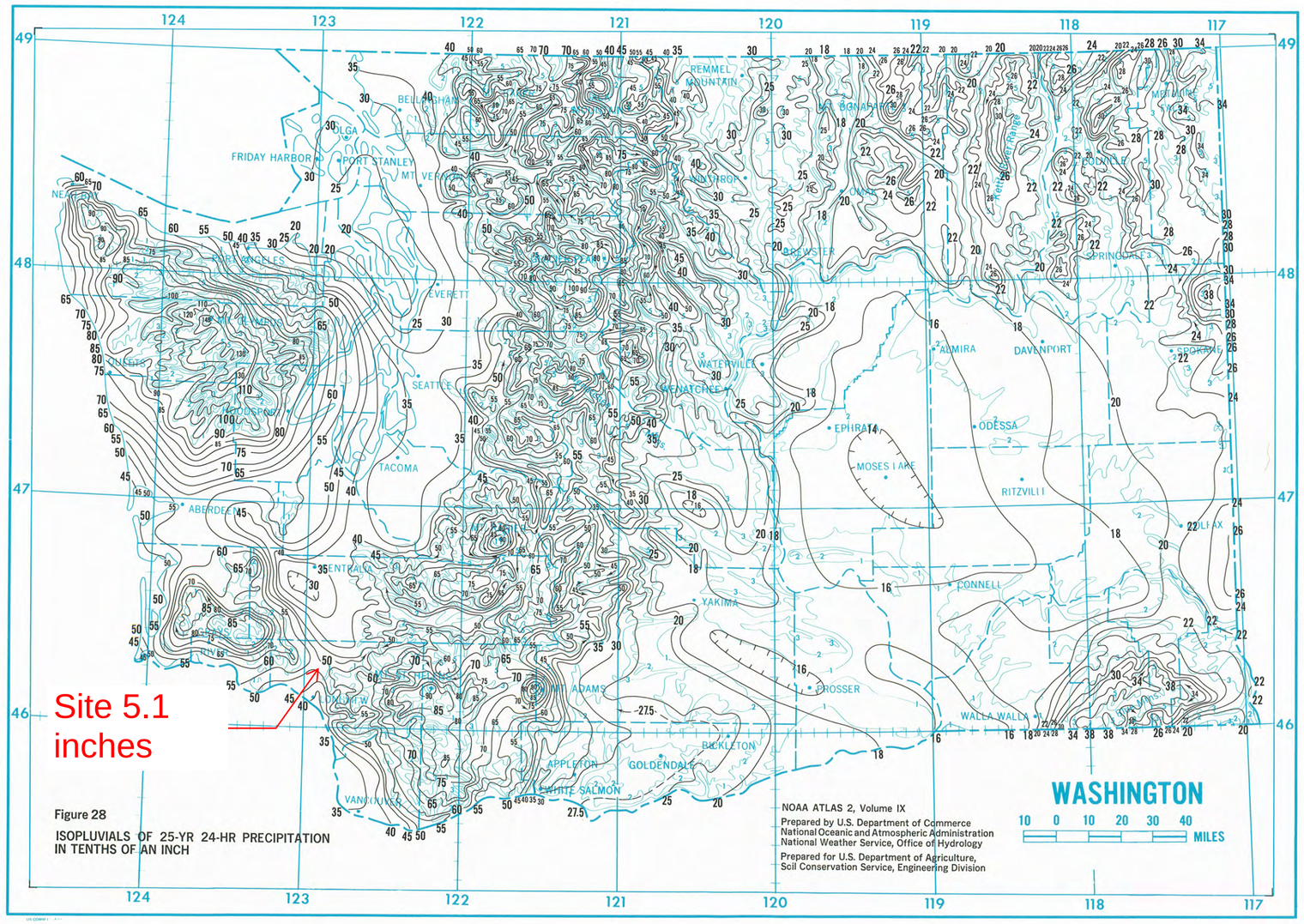
ISOPLUVIALS OF 5-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

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National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division


124
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FRIDAY HARBOR
PORT STANLEY
OLGA
BELLINGHAM
MT. VERNON
EVERETT
SEATTLE
TACOMA
ABERDEEN
CENTRALIA
CHEHALIS
MT. ADAMS
VANCOUVER
APPLETON
GOLDENDALE
BICKLETON
WHITE SALMON
YAKIMA
PROSSER
WALLA WALLA
REMMEL MOUNTAIN
BONAPARTE
OMAK
OKANOGAN
BREWSTER
SPRINGDALE
COLVILLE
ALMIRA
DAVENPORT
SPOKANE
EPHRATA
ODESSA
MOSES LAKE
RITZVILLE
COLFAX
CONNELL
Site 4.3
inches
Figu
ISOPLUVIALS OF 10-YR 24-HR PRECIPITATION
IN TENTHS OF AN INCH
NOAA ATLAS 2, Volume IX
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National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division
WASHINGTON
10 0 10 20 30 40
MILES


Site 5.1 inches
WASHINGTON
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National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division
10 0 10 20 30 40 MILES
FRIDAY HARBOR
PORT STANLEY
OLGA
BELLINGHAM
EVERETT
SEATTLE
TACOMA
ABERDEEN
OLYMPIA
CENTRALIA
CHEHALIS
YAKIMA
ELLENSBURG
WENATCHEE
WATERVILLE
OMAK
OKANOGAN
BREWSTER
CHELAN
REMMEL MOUNTAIN
MT. VERNON
NEWHALEM
PORT ANGELES
QUILLAYUTE
HOQUIAM
MOUNT ADAMS
GOLDENDALE
APPLETON
WHITE SALMON
VANCOUVER
BICKLETON
PROSSER
WALLA WALLA
EPHRATA
MOSES LAKE
RITZVILLE
ODESSA
DAVENPORT
ALMIRA
SPRINGDALE
COLVILLE
METALINE
SPOKANE
COLFAX
CONNELL
Figure 28
ISOPLUVIALS OF 25-YR 24-HR PRECIPITATION
IN TENTHS OF AN INCH

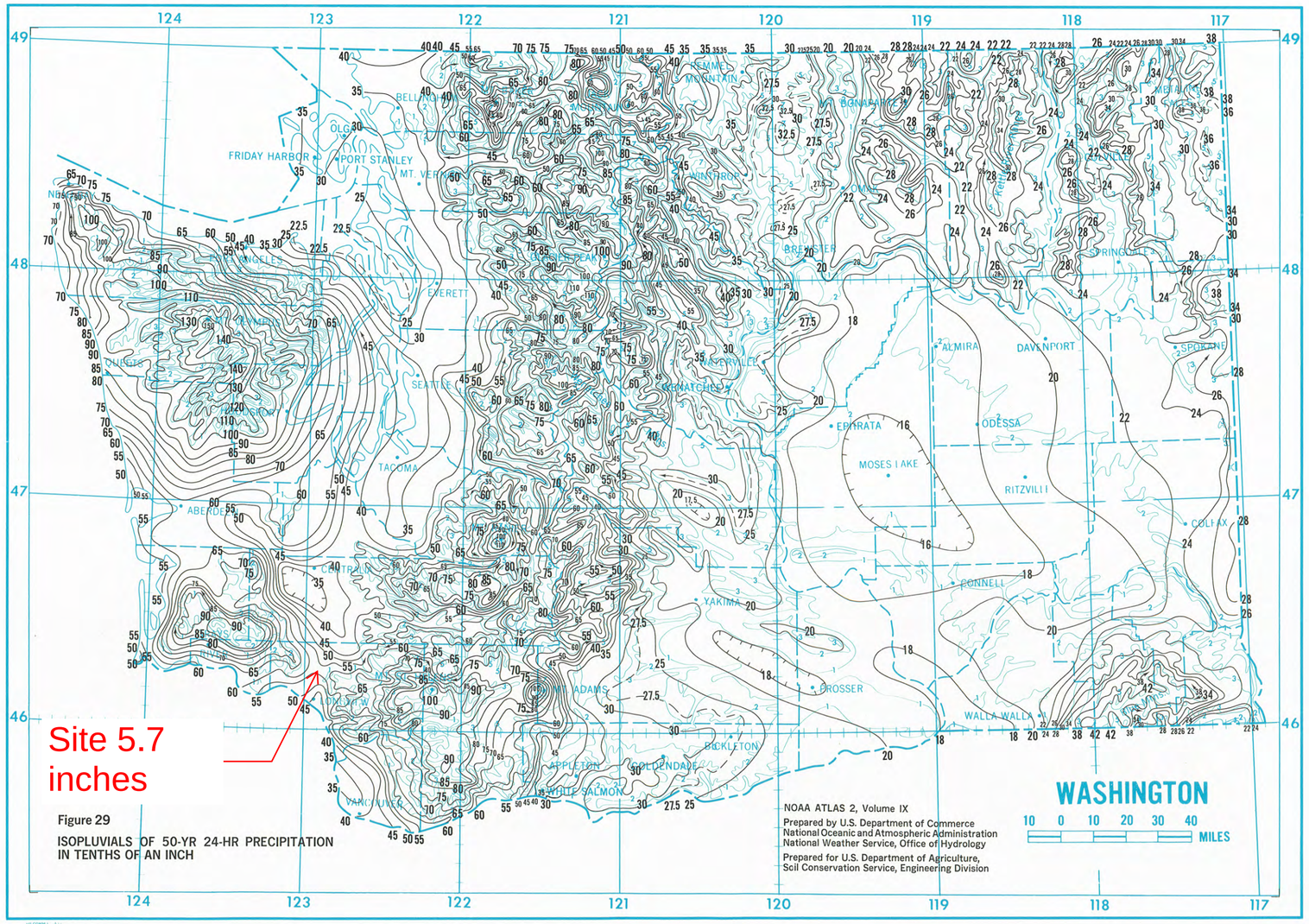
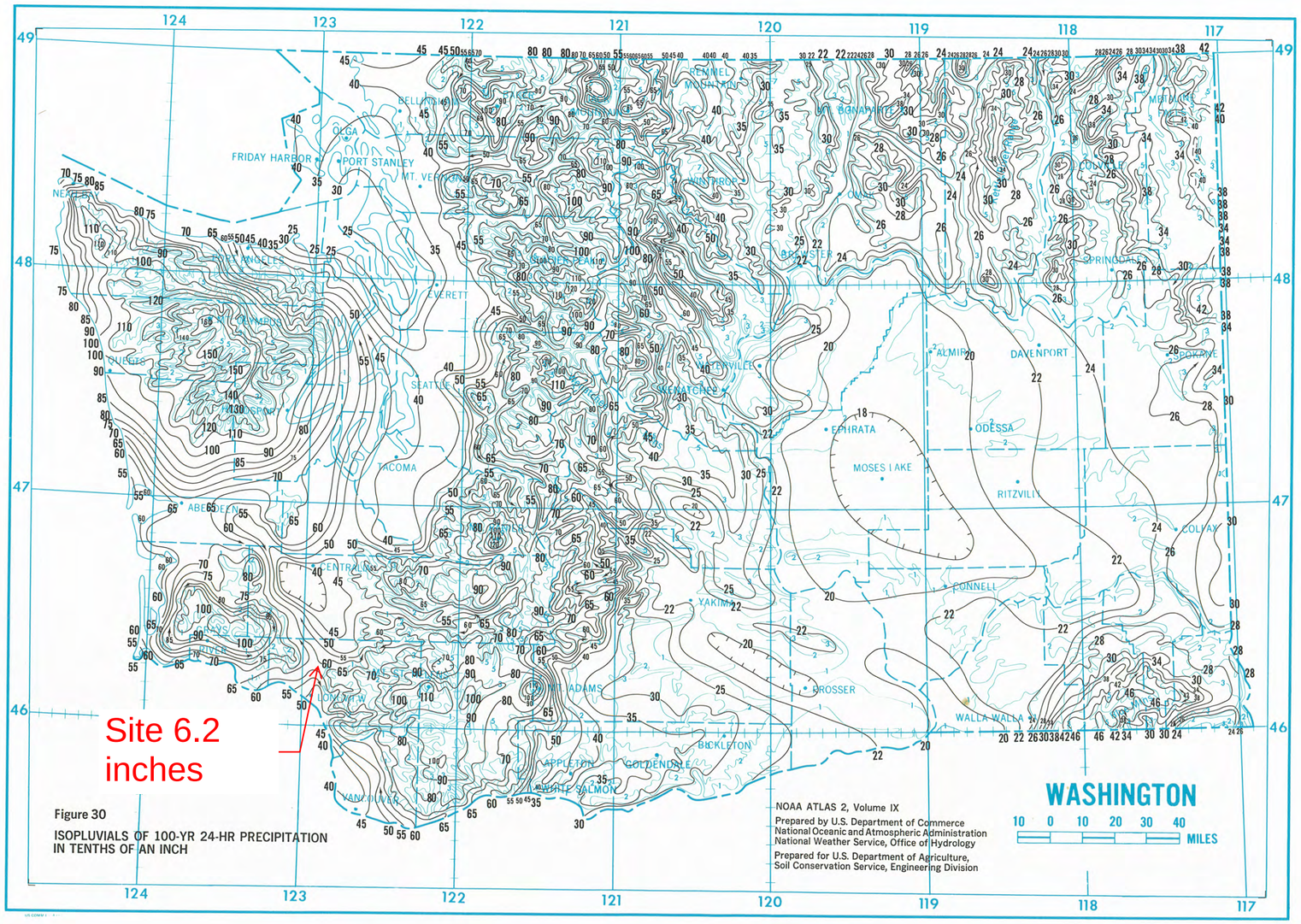


Figure 29

ISOPLUVIALS OF 50-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH



Site 6.2 inches

Figure 30

ISOPLUVIALS OF 100-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

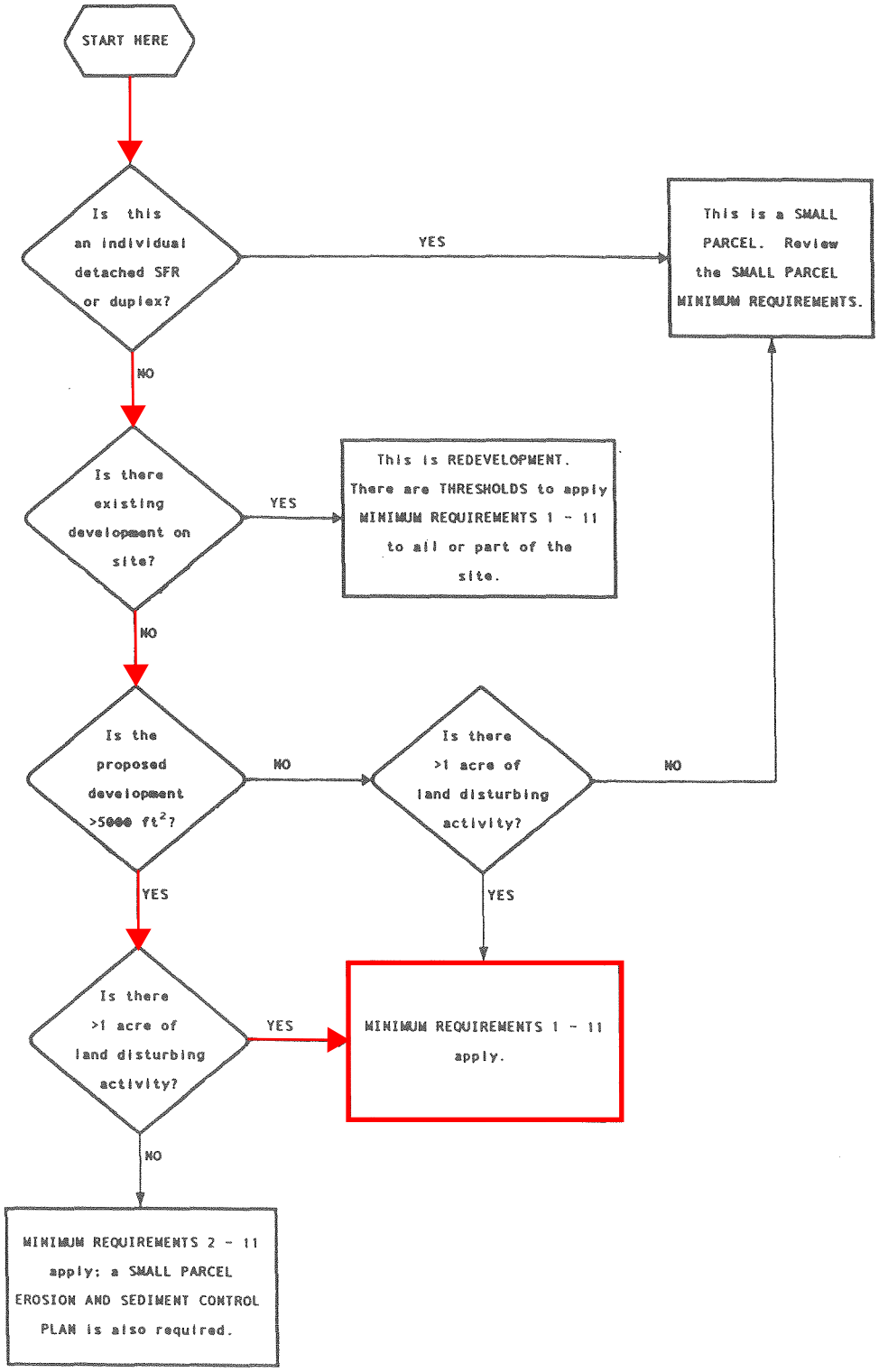
NOAA ATLAS 2, Volume IX

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

☆ U.S. GOVERNMENT PRINTING OFFICE : 1974 O—507-860

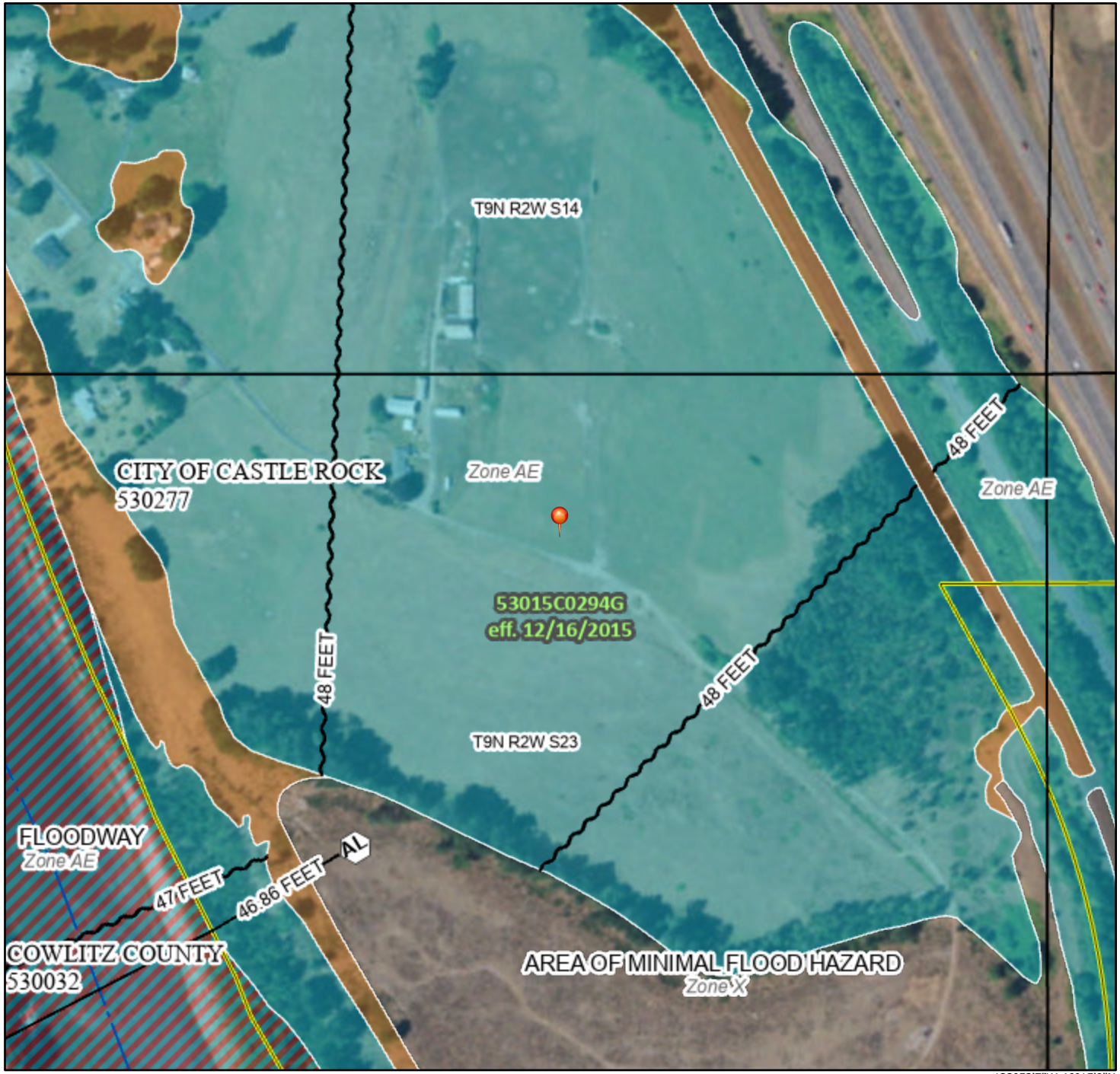
Figure I-2.1 Flowchart Demonstrating Minimum Requirements



National Flood Hazard Layer FIRMette

FEMA

122°53'44"W 46°15'34"N



0 250 500 1,000 1,500 2,000 Feet 1:6,000

122°53'7"W 46°15'9"N

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

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

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

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

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

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

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

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

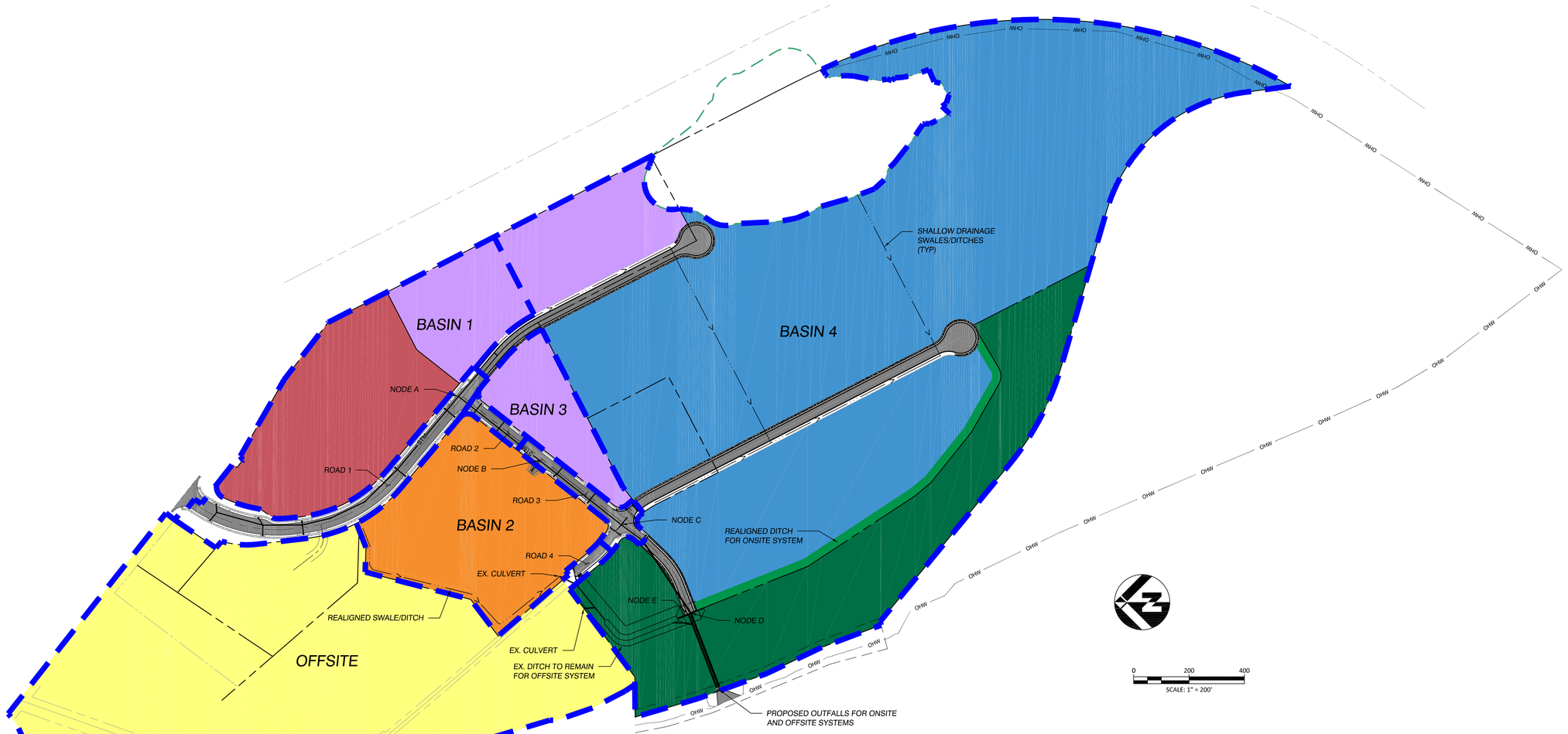
N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 2/16/2021 at 1:53 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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



PROPOSED ONSITE BASIN SUMMARY

BASIN	ROOF AREA (AC)	IMPERVIOUS AREA (AC)	PERVIOUS AREA (AC)	TOTAL AREA	NODE CONNECTED TO
ROAD 1	---	1.684	1.160	2.844	A
BASIN 1	3.373	7.516	1.210	12.099	A
ROAD 2	---	0.250	0.091	0.341	B
BASIN 2	2.100	2.176	4.645	8.921	B
ROAD 3	---	0.710	0.239	0.949	C
BASIN 3	1.072	1.685	0.306	3.063	C
BASIN 4	20.159	46.237	9.462	75.858	D
TOTAL	26.704	60.258	17.113	104.075	

PROPOSED OFFSITE BASIN SUMMARY

BASIN	ROOF AREA (AC)	IMPERVIOUS AREA (AC)	PERVIOUS AREA (AC)	TOTAL AREA	NODE CONNECTED TO
OFFSITE	---	6.346	25.386	31.732	E
ROAD 4	---	0.156	0.107	0.263	E
TOTAL	---	6.502	25.493	31.995	

NOTES:

1. SURFACE COVERAGE PERCENTAGES HAVE BEEN ASSUMED FOR THE LIGHT INDUSTRIAL, FLEX, AND COMMERCIAL ZONES BASED ON TYPICAL LOT COVERAGE FOR THOSE USES. THE PERCENTAGES APPLIED TO THOSE PARCELS ARE AS FOLLOWS:

   BLUE ZONE: LIGHT INDUSTRIAL
   ROOF AREA - 35%
   IMPERVIOUS - 55%
   LAWN & LANDSCAPE - 10%

   PURPLE ZONE: FLEX
   ROOF AREA - 35%
   IMPERVIOUS - 55%
   LAWN & LANDSCAPE - 10%

   MAROON ZONE: COMMERCIAL
   ROOF AREA - 25%
   IMPERVIOUS - 65%
   LAWN & LANDSCAPE - 10%

2. PROPOSED LOT COVERAGE AREAS HAVE BEEN CALCULATED FOR THE RESIDENTIAL, RV PARK, AND ONSITE ROADS BASED ON THE LATEST AVAILABLE SITE PLANS.
3. THE CALCULATED OFFSITE AREAS ARE BASED ON THE EXISTING BASIN MAPS INCLUDED IN THE MASS GRADING DESIGN. PROPERTY LINES HAVE SINCE BEEN ADJUSTED, THEREFORE THE AREAS HAVE BEEN ADJUSTED ACCORDINGLY. IT WAS ASSUMED THAT THE SAME PERVIOUS/IMPERVIOUS RATIO APPLIES TO THE NEW AREA.
4. CONVEYANCE FOR BASIN 4 IS ANTICIPATED TO BE ACHIEVED WITH ABOVE GROUND CONVEYANCE TOWARDS THE ONSITE DRAINAGE DITCH USING ROADSIDE SWALES, DITCHES, AND CULVERTS. EARLY CONCEPTS OF THESE ARE SHOWN ON THE PLAN ABOVE FOR REFERENCE.

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

PRELIMINARY

1/29/2025

MASTER STORM CONVEYANCE PLAN

LANDING ON THE COWLITZ
CITY OF CASTLE ROCK, WA

REVISIONS:

JOB NO.:	18591
DATE:	1/29/2025
SCALE: H: 1"= 200'	V: N/A
DESIGNED BY:	TAW
DRAWN BY:	TAW
CHECKED BY:	PAT

LANDING ON THE COWLITZ

C1.0

FILE: W:\18591 LOTC Phase 1\500 Design\501 Documents\Technical Files\Working Docs\Stormwater\Stormwater Master Plan_Working Docs\18591_Conceptual Master Drainage.dwg PLOTSTYLE: Storm.stb

Appendix B: River and Rainfall Data

Cowlitz River - Castle Rock River Gauge Information

City of Castle Rock Rainfall Data Summary

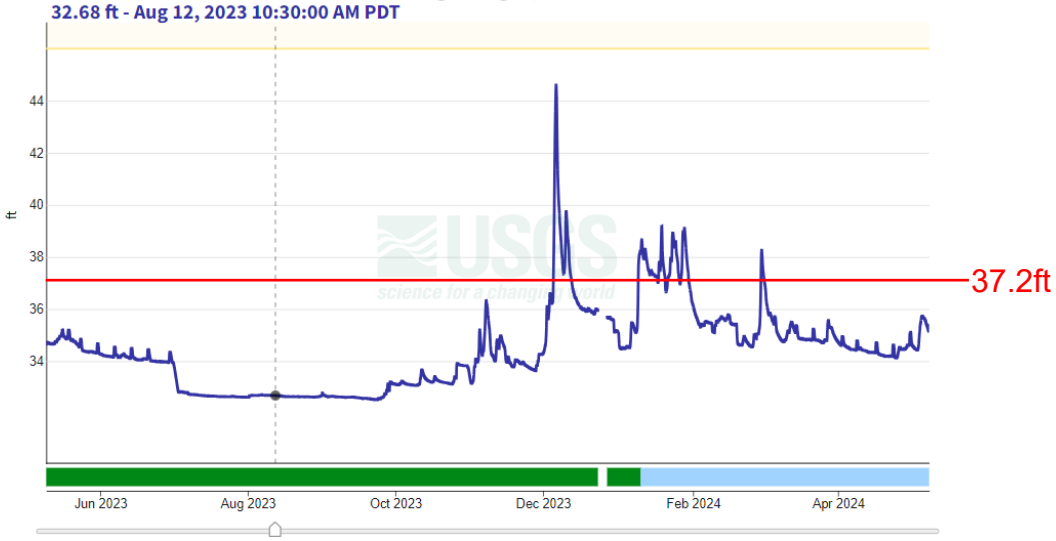
7 days 30 days 1 year

Cowlitz River at Castle Rock, WA - 14243000

May 9, 2023 - May 8, 2024

Gage height, feet

32.68 ft - Aug 12, 2023 10:30:00 AM PDT



IMPORTANT Data may be provisional

Show legend

	Value	Status	Time
Latest value	35.18 ft	Provisional	May 08, 2024 09:30:00 AM PDT
Selected	32.68 ft	Approved	Aug 12, 2023 10:30:00 AM PDT

High 44.60ft, Dec 6, 2023

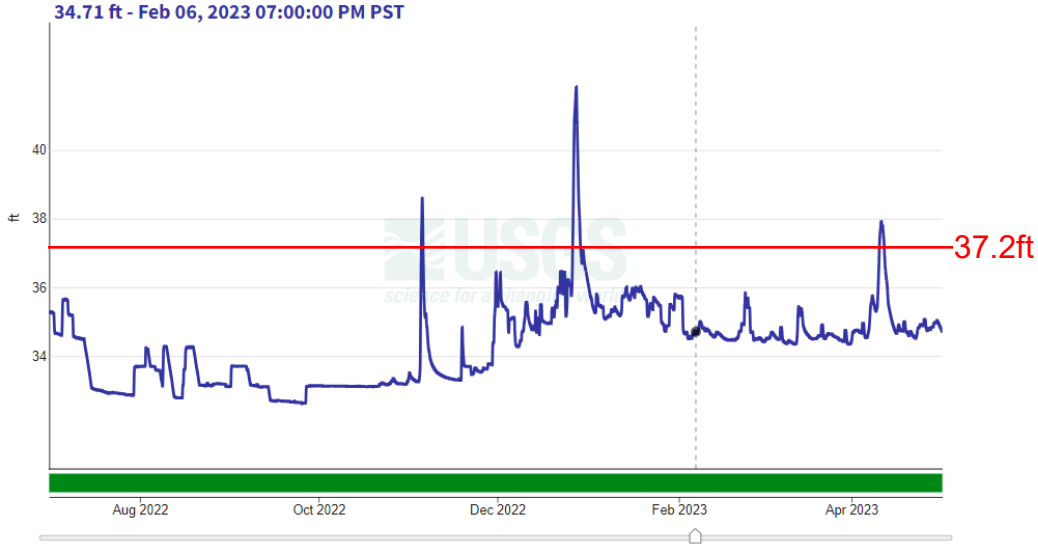
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

July 1, 2022 - May 1, 2023

Gage height, feet

34.71 ft - Feb 06, 2023 07:00:00 PM PST



IMPORTANT Data may be provisional

Show legend

	Value	Status	Time
Latest value	35.18 ft	Provisional	May 08, 2024 09:30:00 AM PDT
Selected	34.71 ft	Approved	Feb 06, 2023 07:00:00 PM PST

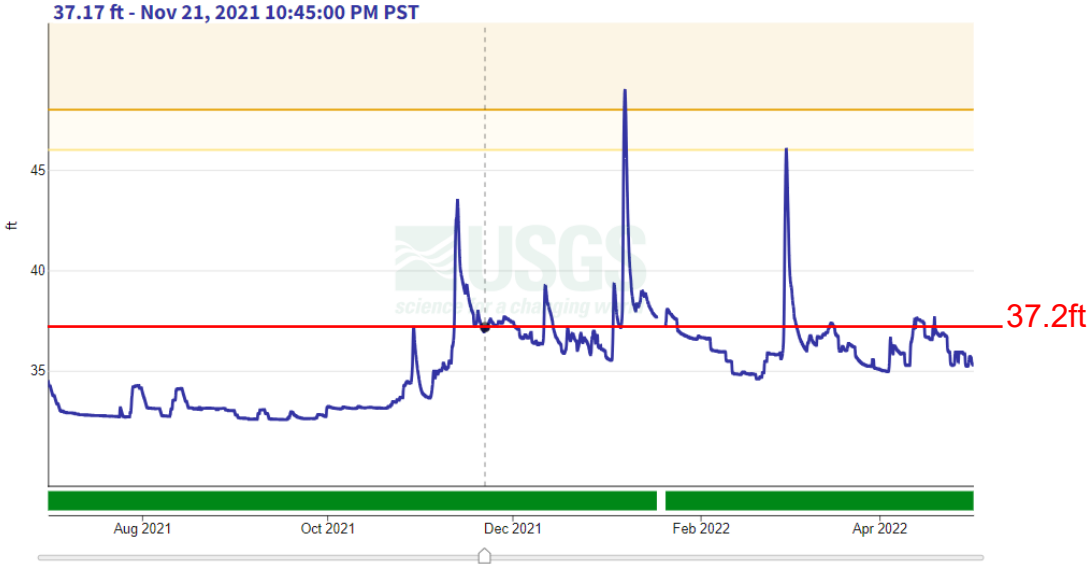
High 41.84, Dec 27, 2022

Cowlitz River at Castle Rock, WA - 14243000

July 1, 2021 - May 1, 2022

Gage height, feet

37.17 ft - Nov 21, 2021 10:45:00 PM PST



IMPORTANT Data may be provisional

Show legend

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Selected	37.17 ft	Approved	Nov 21, 2021

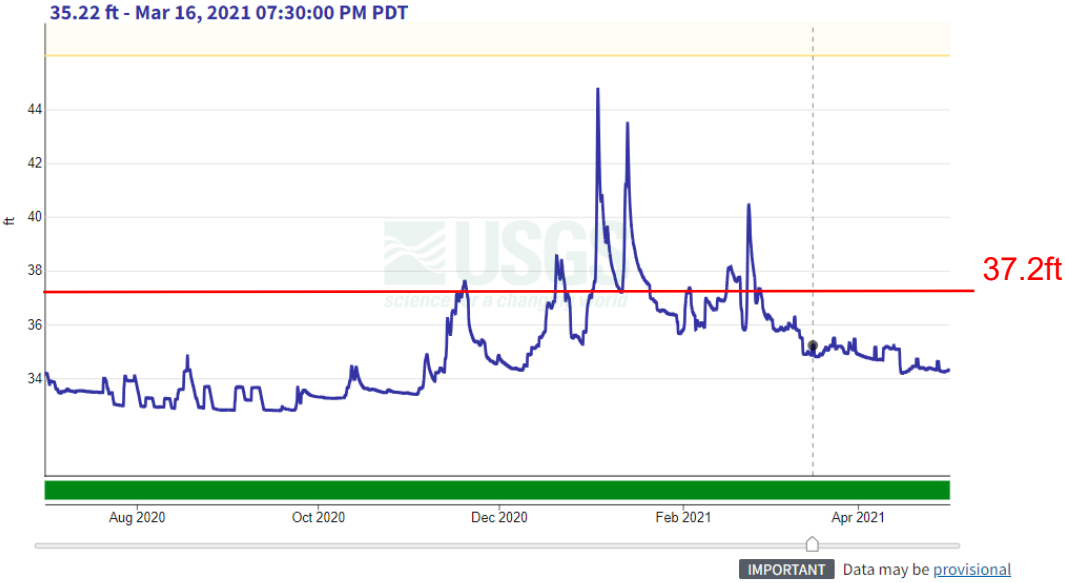
High 48.86 Jan 07, 2022

Cowlitz River at Castle Rock, WA - 14243000

July 1, 2020 - May 1, 2021

Gage height, feet

35.22 ft - Mar 16, 2021 07:30:00 PM PDT



IMPORTANT Data may be provisional

Show legend

	Value	Status	Time
Latest value	35.18 ft	Provisional	May 08, 2024 09:30:00 AM PDT
Selected	35.22 ft	Approved	Mar 16, 2021

High 44.70ft Jan 3, 2021

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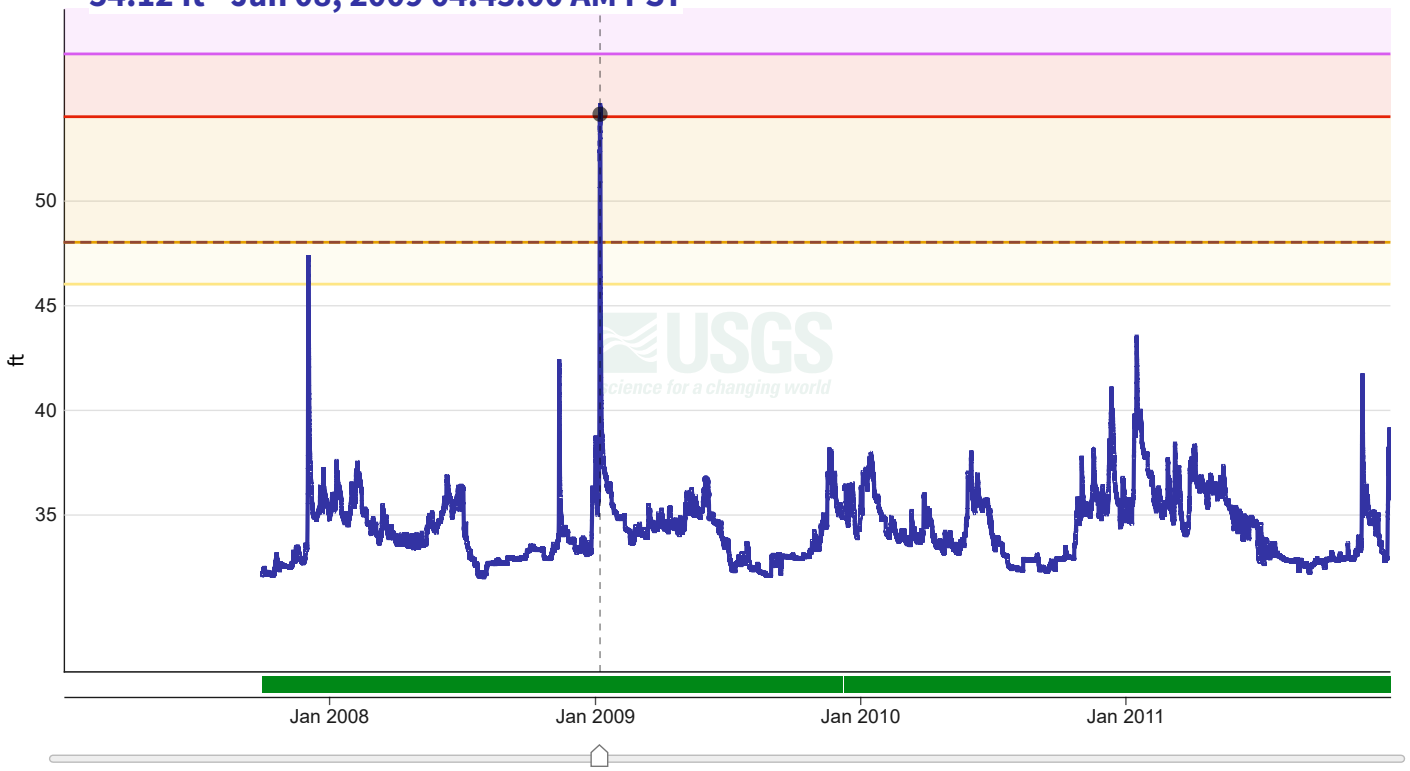
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

January 1, 2007 - December 31, 2011

Gage height, feet [NAVD 1988, feet]

54.12 ft - Jan 08, 2009 04:45:00 AM PST



IMPORTANT Data may be provisional

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Hide graph details

	Value	Status
Latest Jan 29, 2025 08:30:00 AM PST	34.98	Provisional
Selected Jan 08, 2009 04:45:00 AM PST	54.12	Approved
Compare		

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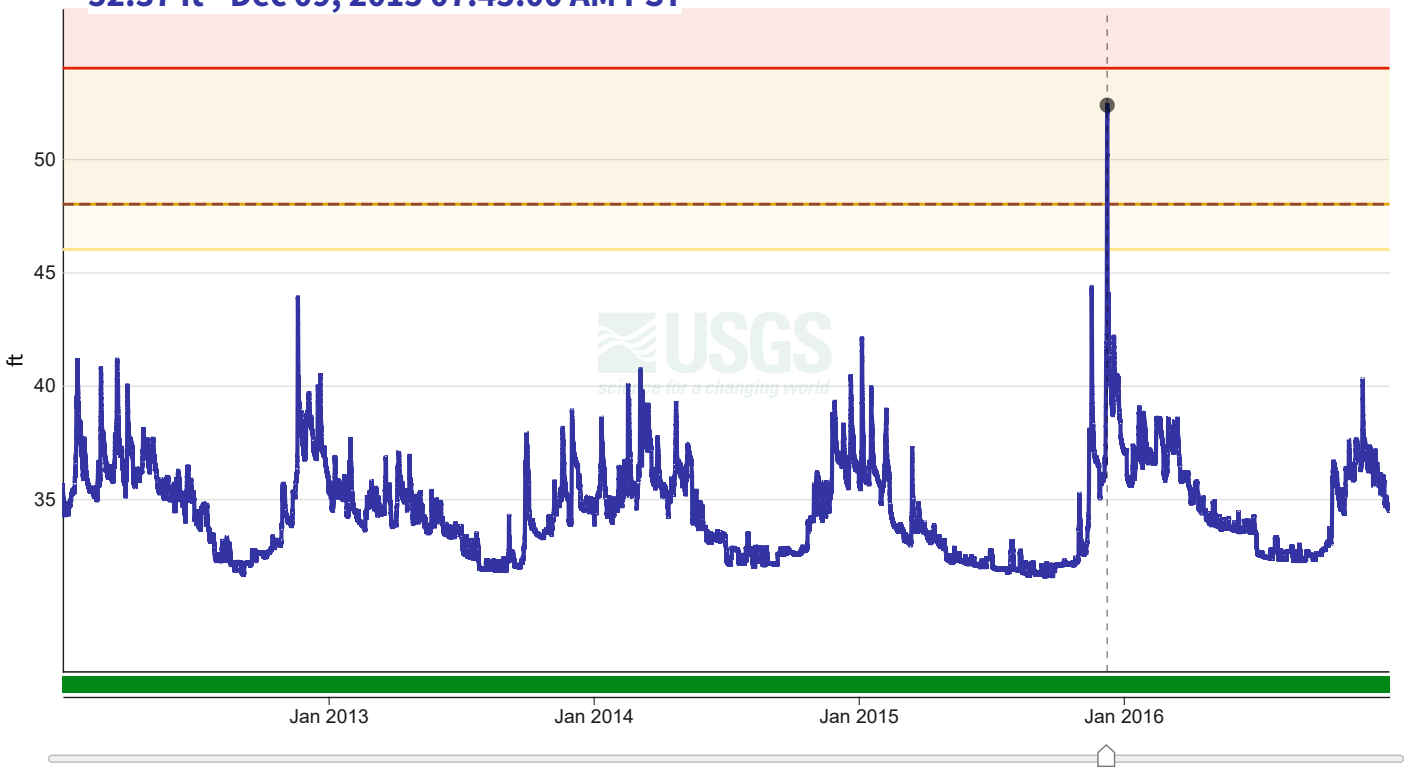
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

January 1, 2012 - December 31, 2016

Gage height, feet [NAVD 1988, feet]

52.37 ft - Dec 09, 2015 07:45:00 AM PST



IMPORTANT Data may be provisional

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	Value	Status
Latest Jan 29, 2025 08:30:00 AM PST	34.98	Provisional
Selected Dec 09, 2015 07:45:00 AM PST	52.37	Approved
Compare		

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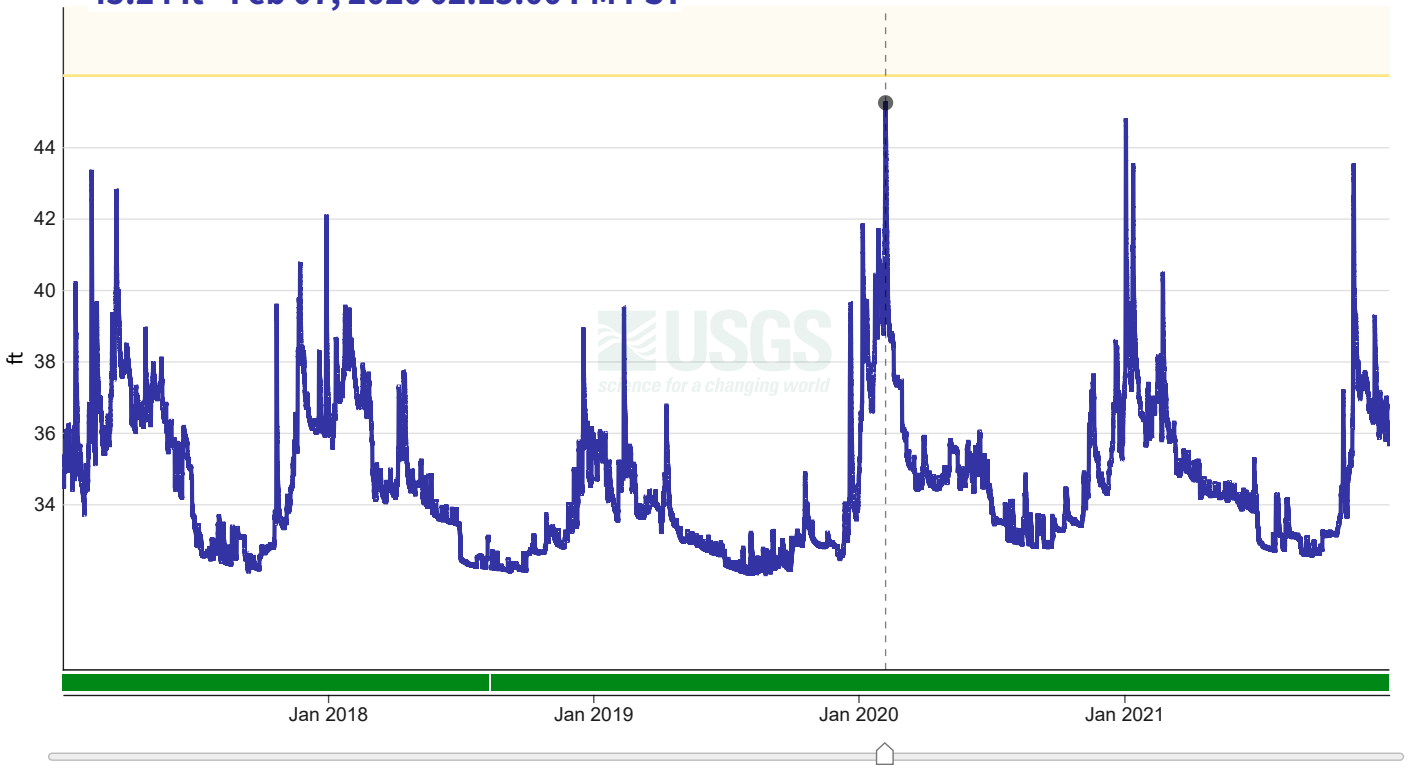
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

January 1, 2017 - December 31, 2021

Gage height, feet [NAVD 1988, feet]

45.24 ft - Feb 07, 2020 02:15:00 PM PST



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Hide graph details

	Value	Status
Latest Jan 29, 2025 08:30:00 AM PST	34.98	Provisional
Selected Feb 07, 2020 02:15:00 PM PST	45.24	Approved
Compare		

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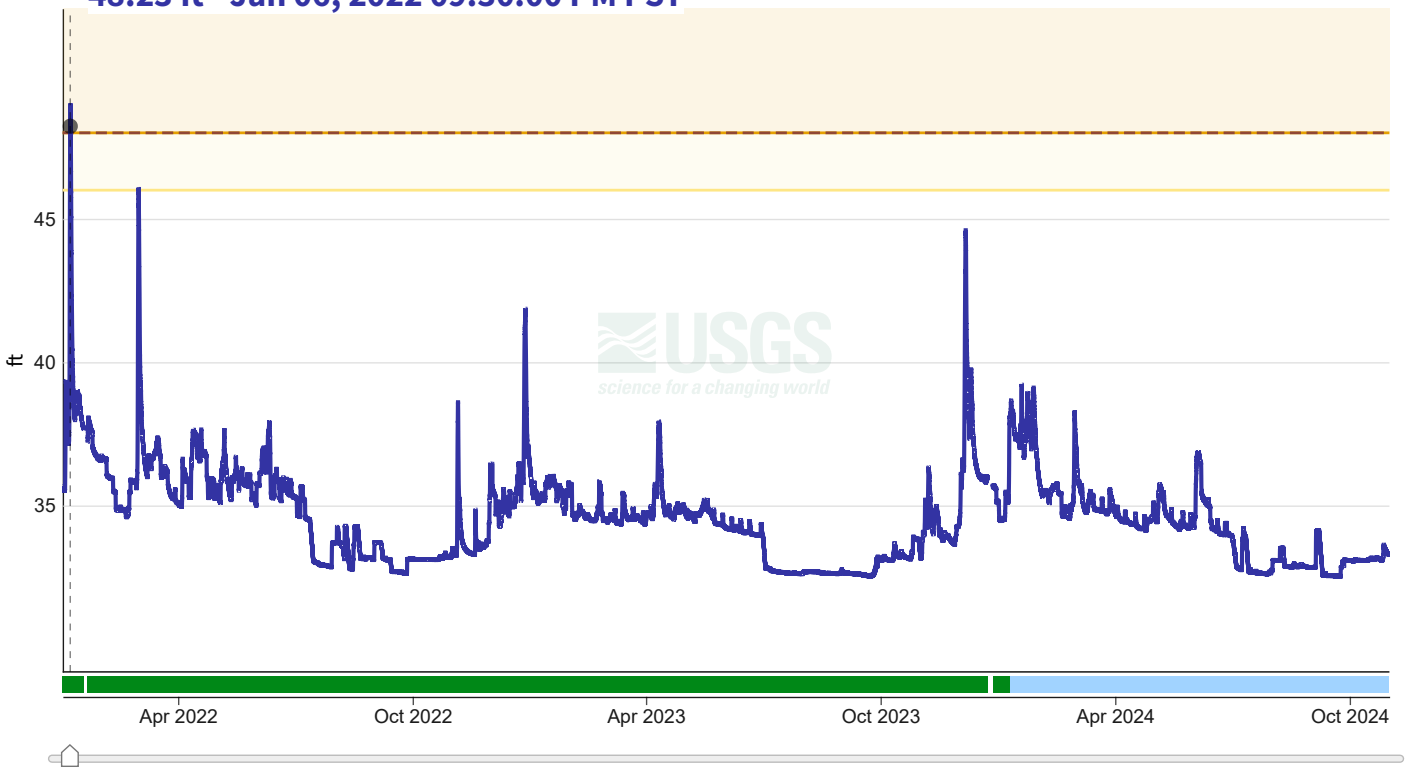
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

January 1, 2022 - October 31, 2024

Gage height, feet [NAVD 1988, feet]

48.23 ft - Jan 06, 2022 09:30:00 PM PST



IMPORTANT Data may be provisional

Show legend

Hide graph details

	Value	Status
Latest Jan 29, 2025 08:30:00 AM PST	34.98	Provisional
Selected Jan 06, 2022 09:30:00 PM PST	48.23	Approved
Compare		

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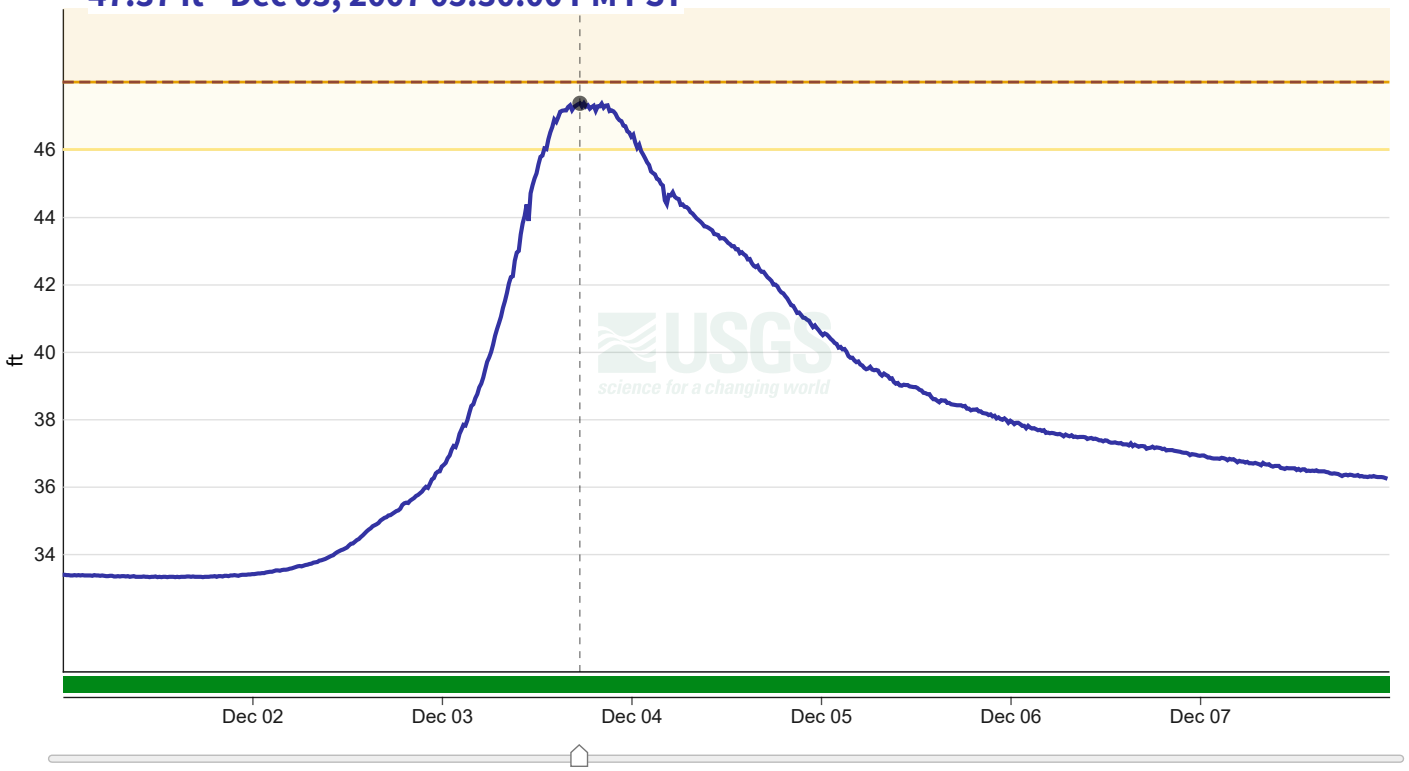
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

December 1, 2007 - December 7, 2007

Gage height, feet [NAVD 1988, feet]

47.37 ft - Dec 03, 2007 05:30:00 PM PST



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Hide graph details

	Value	Status
Latest Jan 29, 2025 08:30:00 AM PST	34.98	Provisional
Selected Dec 03, 2007 05:30:00 PM PST	47.37	Approved
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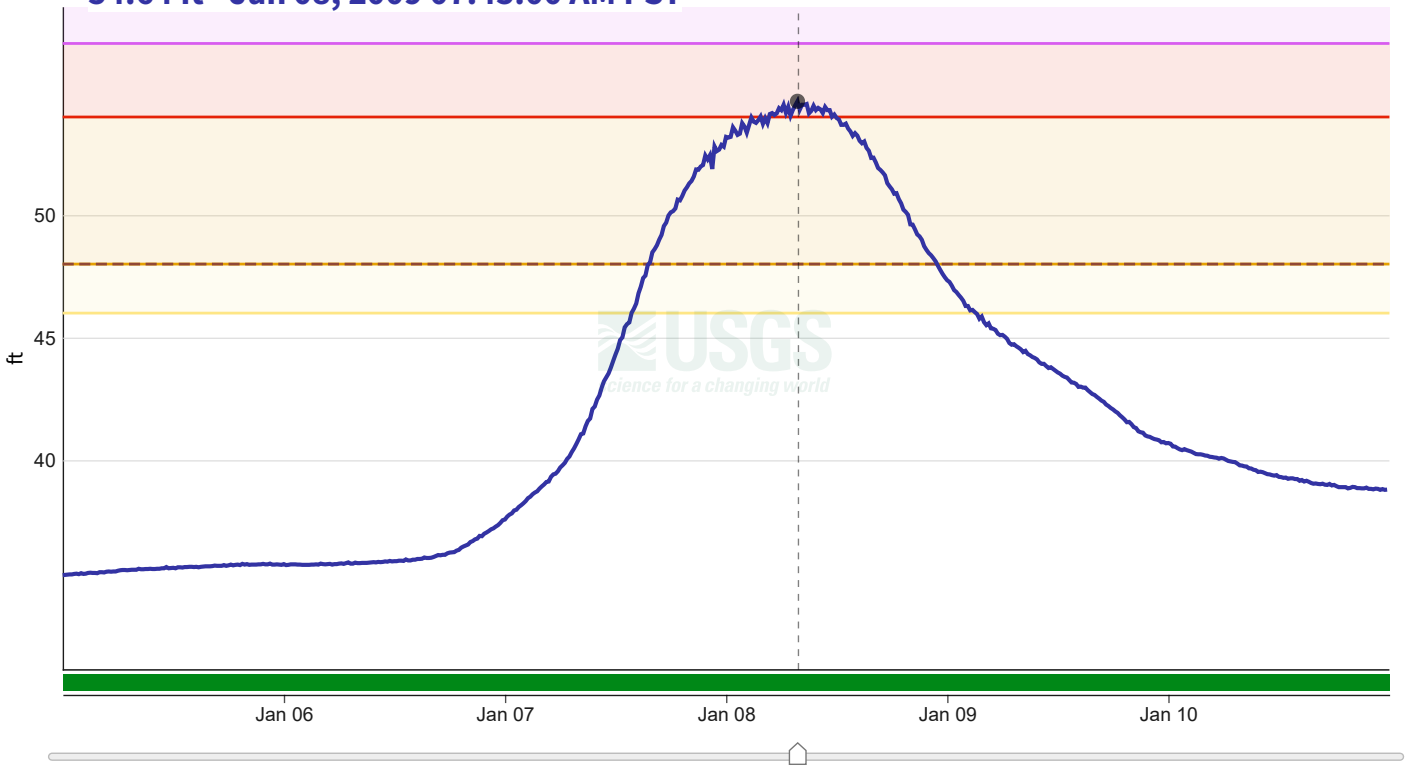
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

January 5, 2009 - January 10, 2009

Gage height, feet [NAVD 1988, feet]

54.64 ft - Jan 08, 2009 07:45:00 AM PST



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Hide graph details

	Value	Status
Latest Jan 29, 2025 08:30:00 AM PST	34.98	Provisional
Selected Jan 08, 2009 07:45:00 AM PST	54.64	Approved
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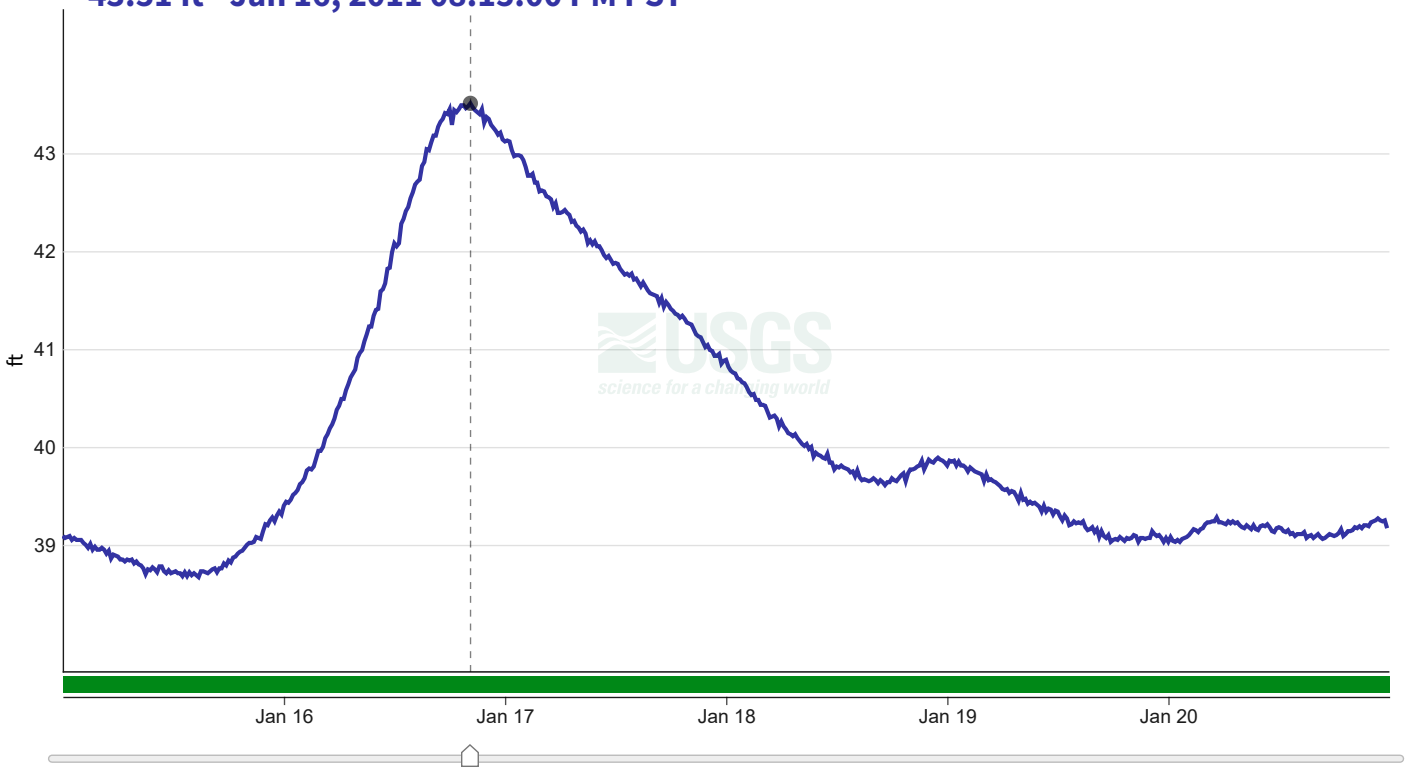
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

January 15, 2011 - January 20, 2011

Gage height, feet [NAVD 1988, feet]

43.51 ft - Jan 16, 2011 08:15:00 PM PST



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	Value	Status
Latest Jan 29, 2025 08:30:00 AM PST	34.98	Provisional
Selected Jan 16, 2011 08:15:00 PM PST	43.51	Approved
Compare		

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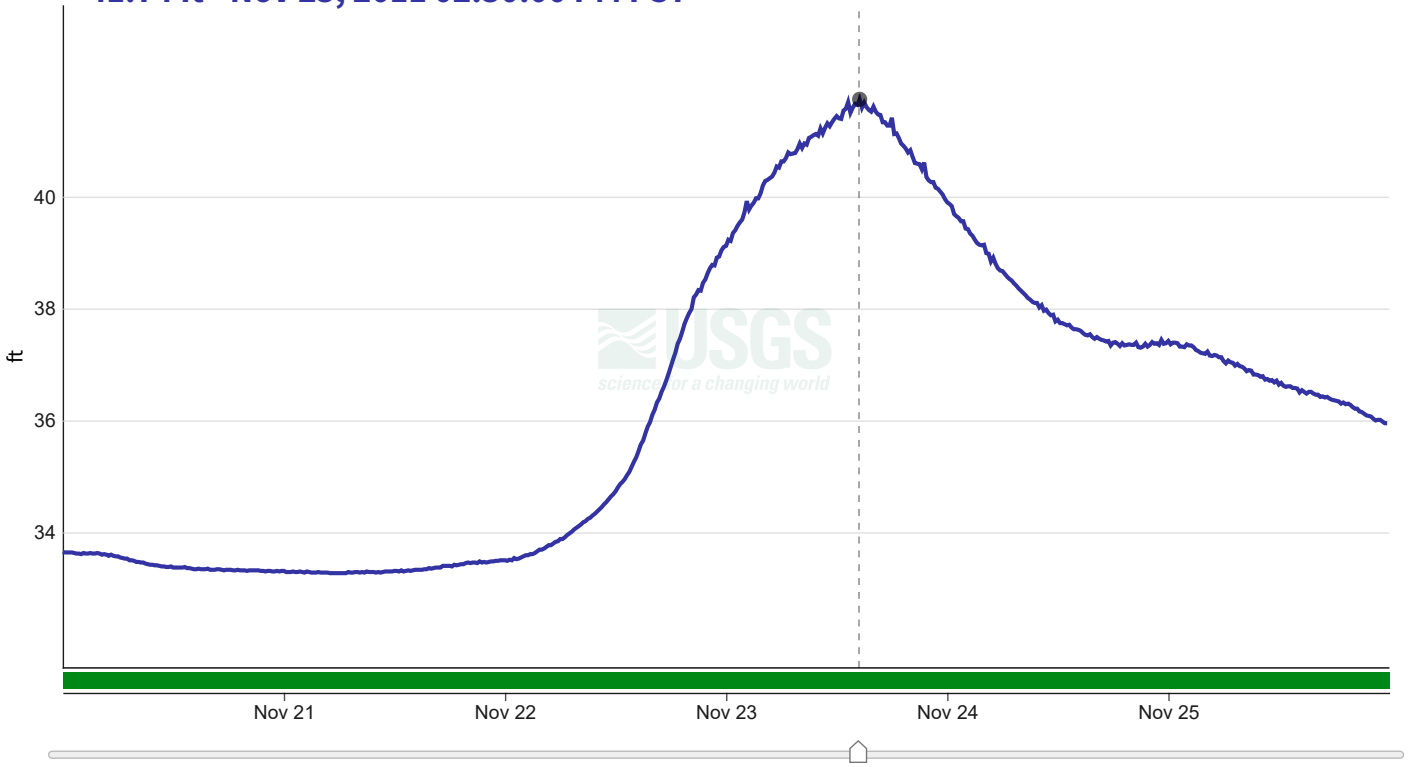
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

November 20, 2011 - November 25, 2011

Gage height, feet [NAVD 1988, feet]

41.74 ft - Nov 23, 2011 02:30:00 PM PST



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	Value	Status
Latest Jan 29, 2025 08:30:00 AM PST	34.98	Provisional
Selected Nov 23, 2011 02:30:00 PM PST	41.74	Approved
Compare		

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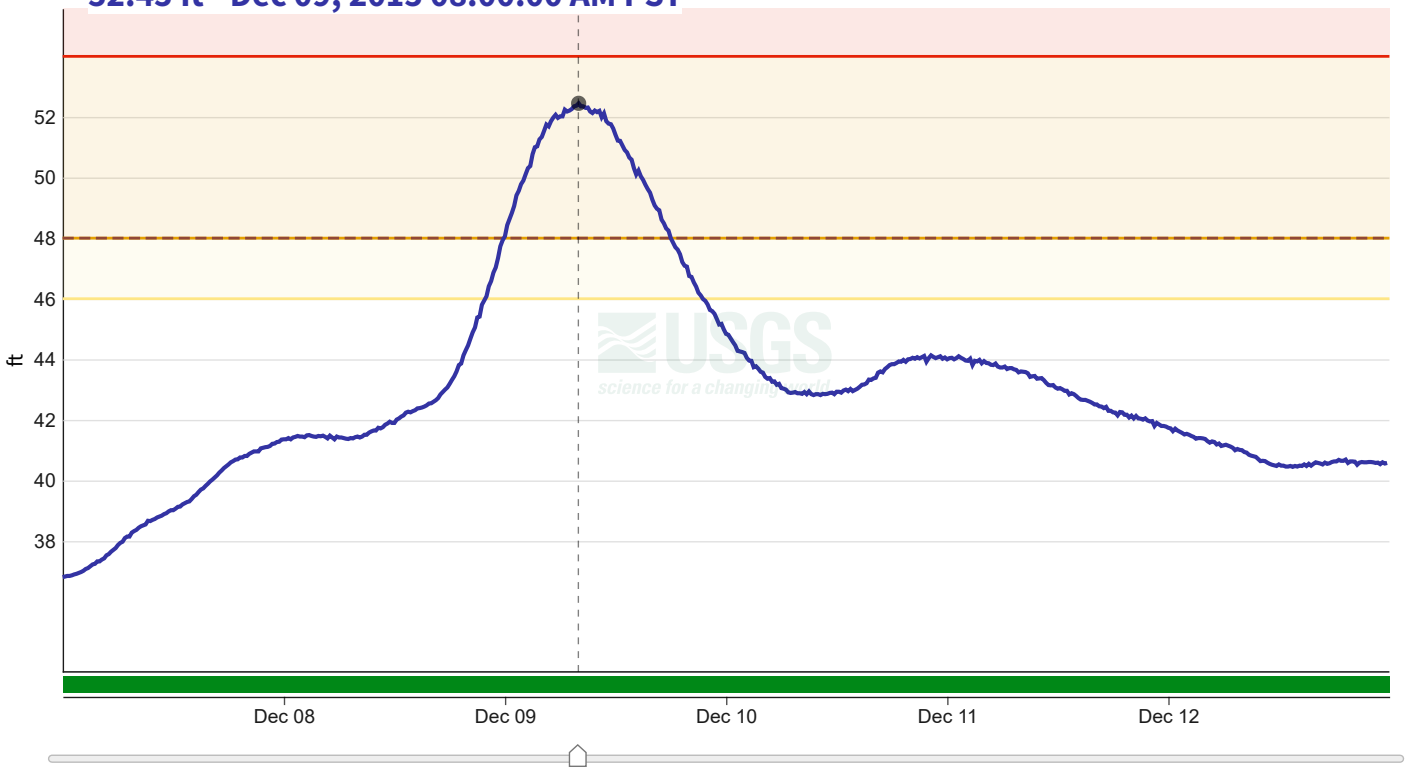
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

December 7, 2015 - December 12, 2015

Gage height, feet [NAVD 1988, feet]

52.45 ft - Dec 09, 2015 08:00:00 AM PST



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	Value	Status
Latest Jan 29, 2025 08:30:00 AM PST	34.98	Provisional
Selected Dec 09, 2015 08:00:00 AM PST	52.45	Approved
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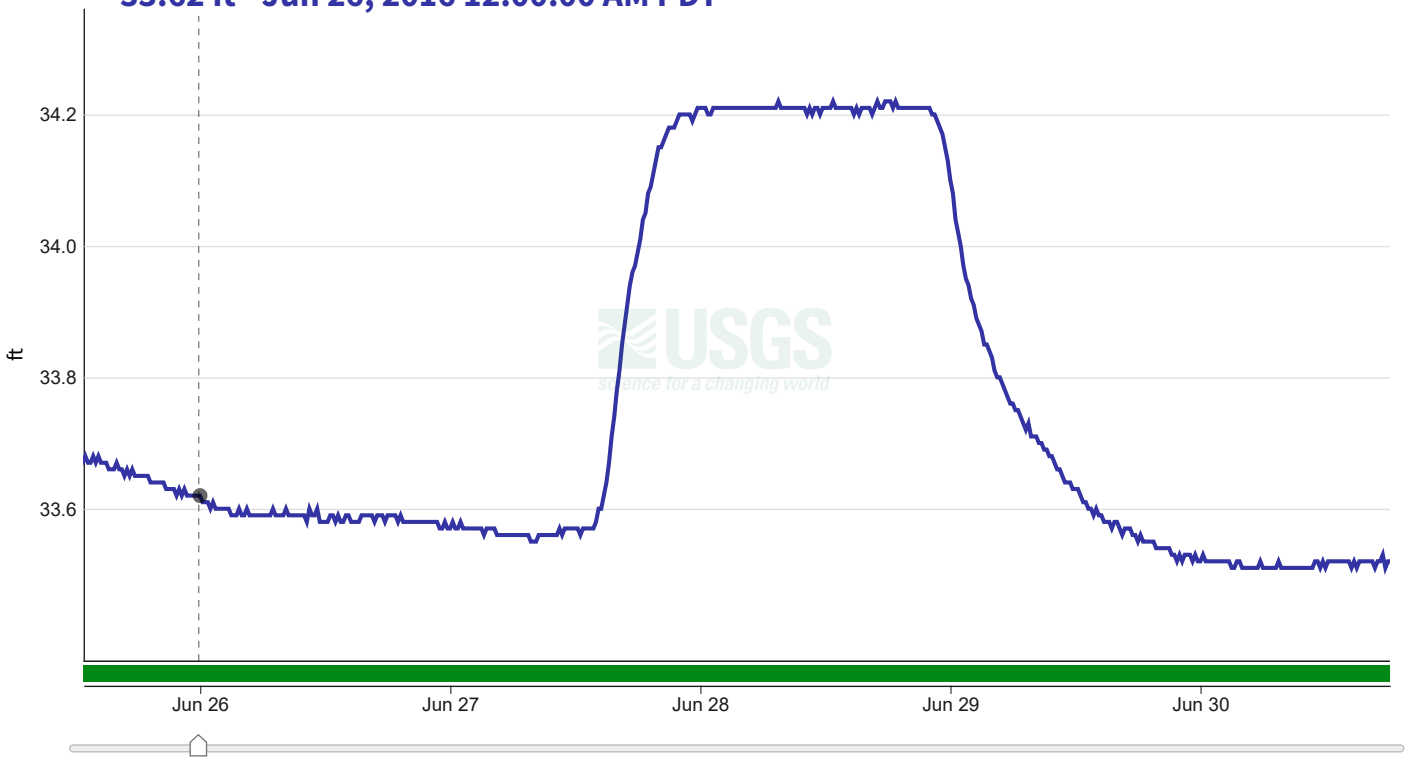
- using custom time span -
- using graph zoom -

Cowlitz River at Castle Rock, WA - 14243000

June 25, 2016 - June 30, 2016

Gage height, feet [NAVD 1988, feet]

33.62 ft - Jun 26, 2016 12:00:00 AM PDT



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Hide graph details

	Value	Status
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Selected Jun 26, 2016 12:00:00 AM PDT	33.62	Approved
Compare		

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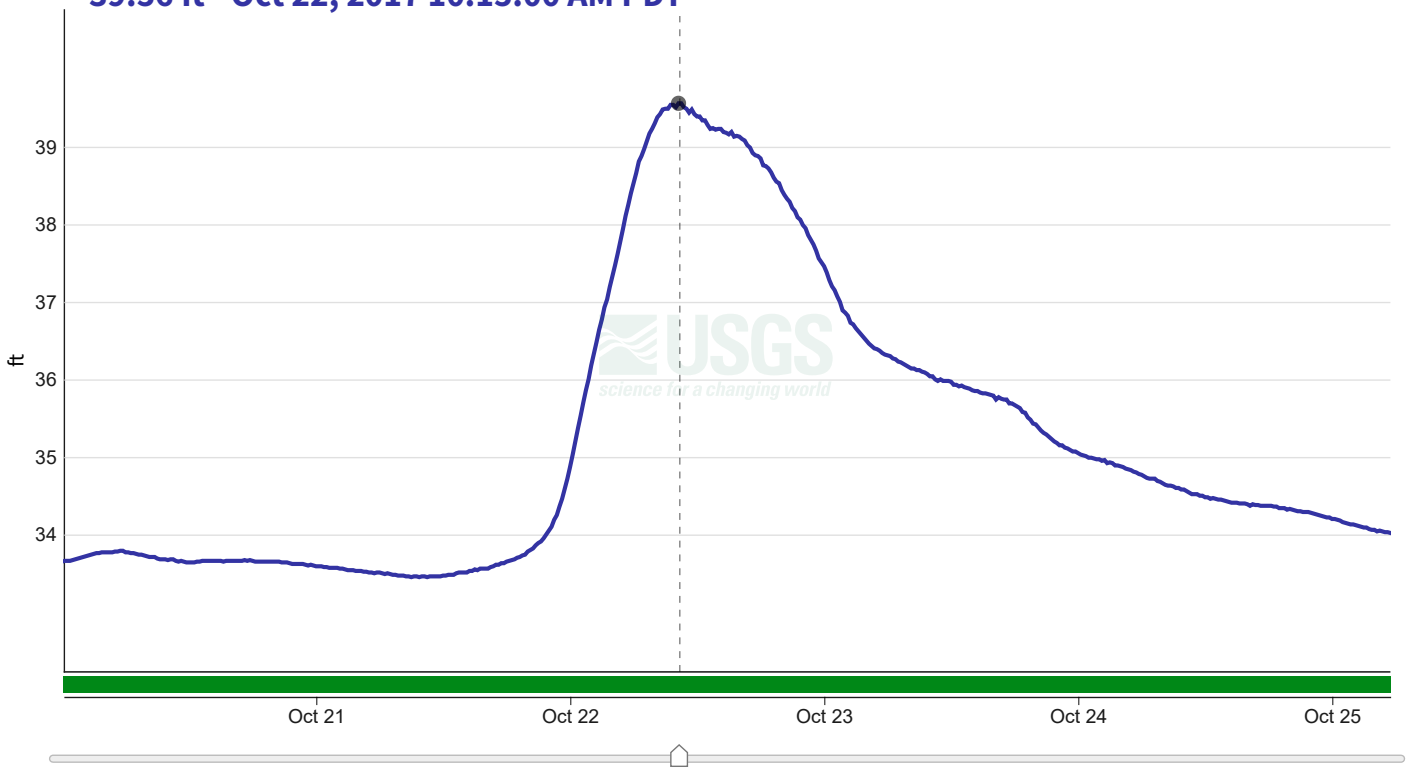
- using custom time span -
- using graph zoom -

Cowlitz River at Castle Rock, WA - 14243000

October 20, 2017 - October 25, 2017

Gage height, feet [NAVD 1988, feet]

39.56 ft - Oct 22, 2017 10:15:00 AM PDT



IMPORTANT Data may be provisional

Show legend

Hide graph details

	Value	Status
Latest Jan 29, 2025 08:30:00 AM PST	34.98	Provisional
Selected Oct 22, 2017 10:15:00 AM PDT	39.56	Approved
Compare Not available with custom time spans		

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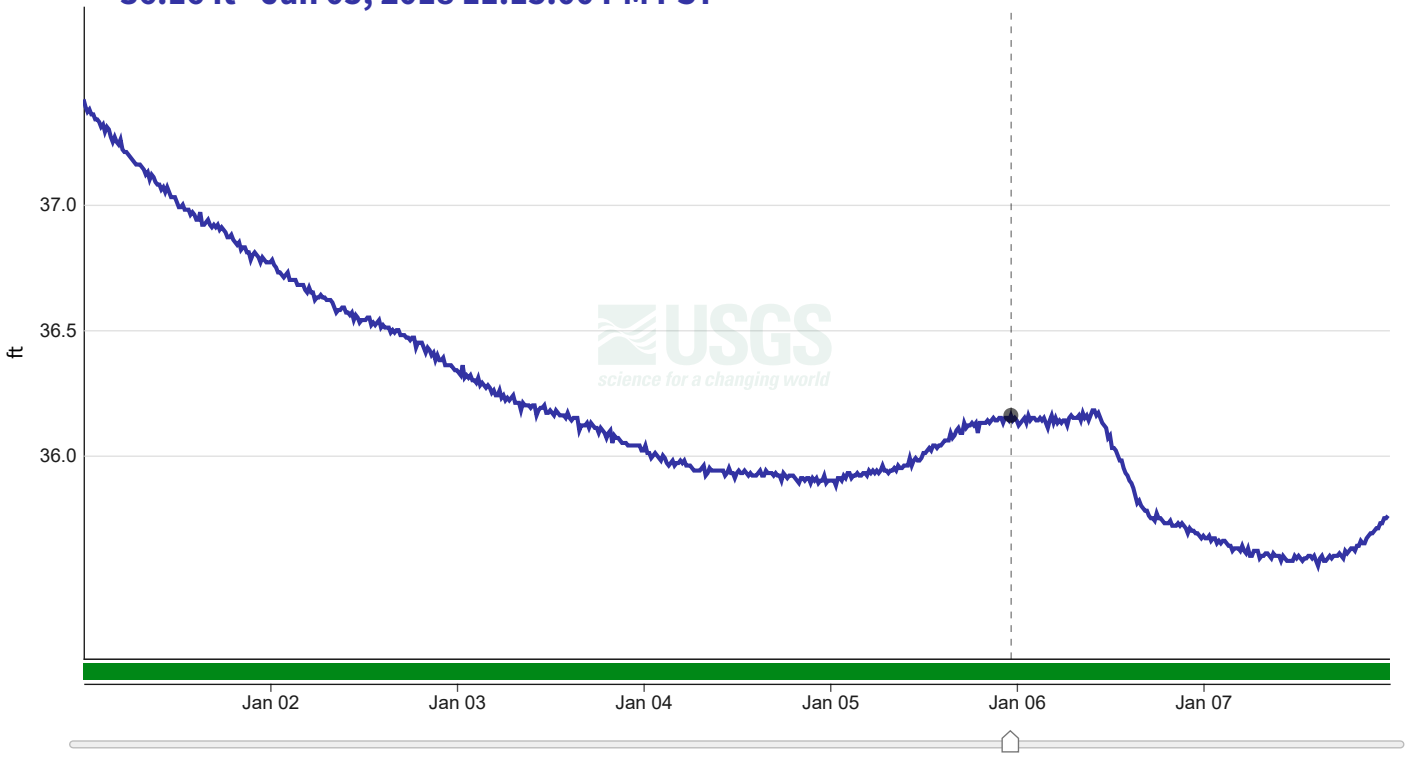
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

January 1, 2018 - January 7, 2018

Gage height, feet [NAVD 1988, feet]

36.16 ft - Jan 05, 2018 11:15:00 PM PST



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	Value	Status
Latest Jan 29, 2025 08:30:00 AM PST	34.98	Provisional
Selected Jan 05, 2018 11:15:00 PM PST	36.16	Approved
Compare Not available with custom time spans		
Median Add median data to graph		

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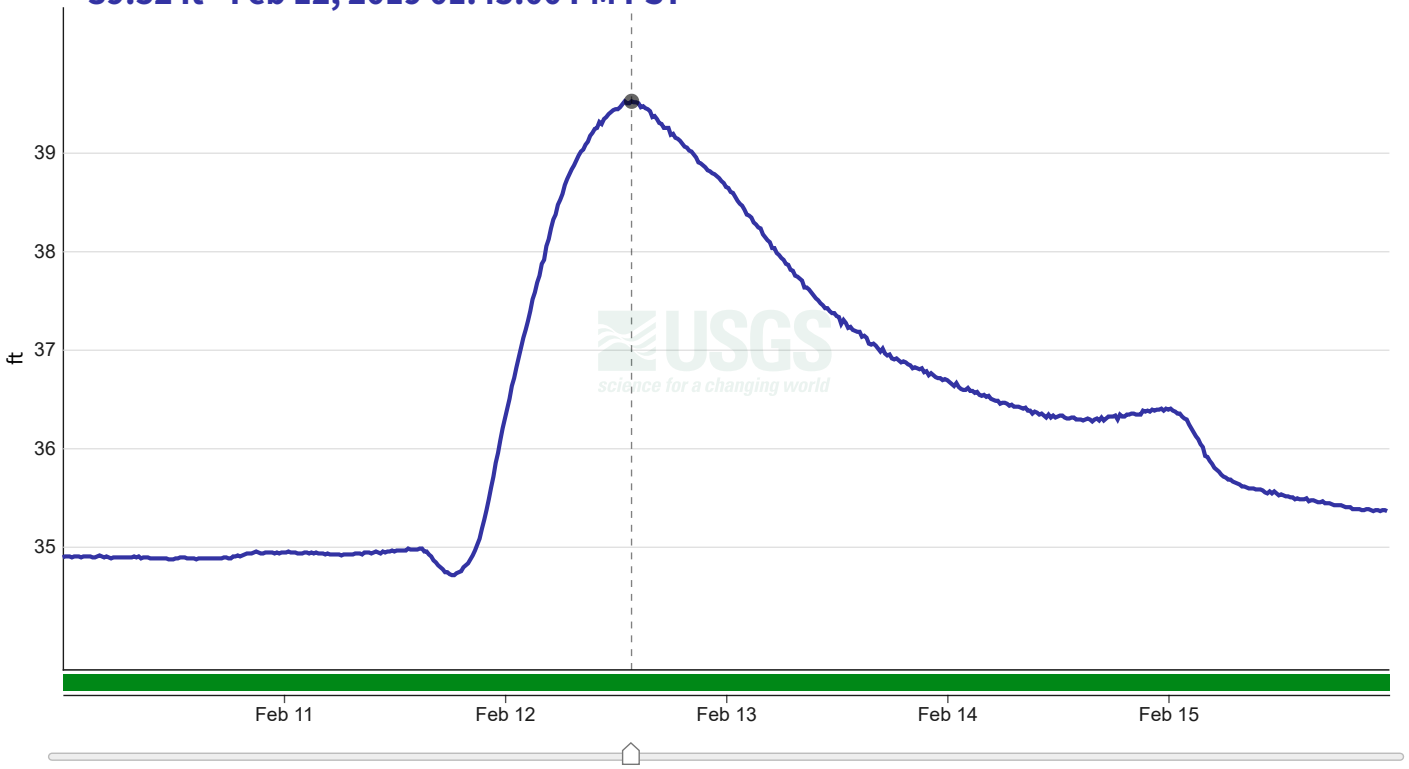
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

February 10, 2019 - February 15, 2019

Gage height, feet [NAVD 1988, feet]

39.52 ft - Feb 12, 2019 01:45:00 PM PST



IMPORTANT Data may be provisional

Show legend

Hide graph details

	Value	Status
Latest Jan 29, 2025 08:30:00 AM PST	34.98	Provisional
Selected Feb 12, 2019 01:45:00 PM PST	39.52	Approved
Compare		

Not available with custom time spans

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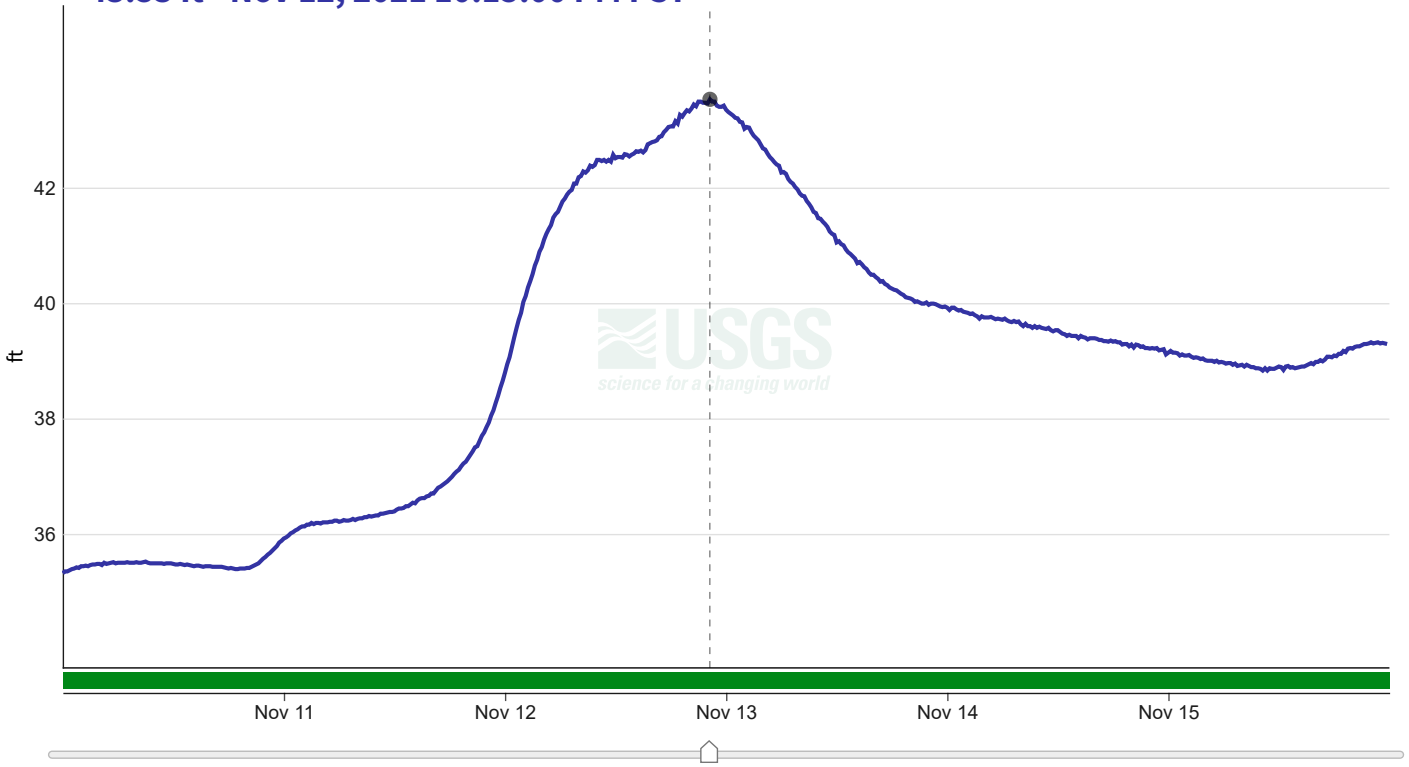
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

November 10, 2021 - November 15, 2021

Gage height, feet [NAVD 1988, feet]

43.53 ft - Nov 12, 2021 10:15:00 PM PST



IMPORTANT Data may be provisional

Show legend

Hide graph details

	Value	Status
Latest Jan 29, 2025 08:30:00 AM PST	34.98	Provisional
Selected Nov 12, 2021 10:15:00 PM PST	43.53	Approved
Compare Not available with custom time spans		

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7 days 30 days 1 year

Scale Linear Log

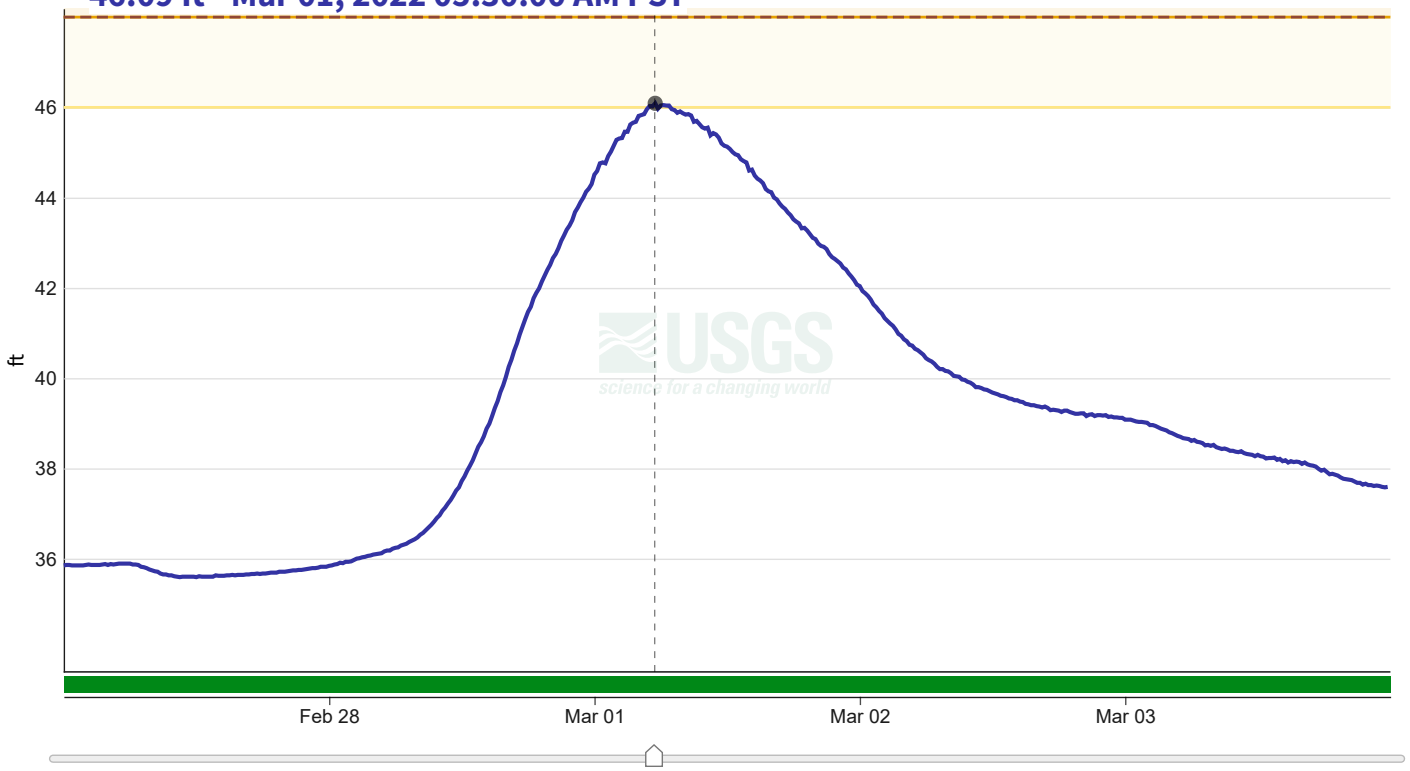
- using custom time span -

Cowlitz River at Castle Rock, WA - 14243000

February 27, 2022 - March 3, 2022

Gage height, feet [NAVD 1988, feet]

46.09 ft - Mar 01, 2022 05:30:00 AM PST



IMPORTANT Data may be provisional

Show legend

Hide graph details

	Value	Status
Latest Jan 29, 2025 08:30:00 AM PST	34.98	Provisional
Selected Mar 01, 2022 05:30:00 AM PST	46.09	Approved
Compare		

Not available with custom time spans

City of Castler Rock Actual Rainfall Data from 1/1/07 to 10/31/24

Date	Daily Rainfall (inches)	Event Size
12/3/2007	3.79	2-year
1/8/2009	3.31	2-year
1/17/2011	4.00	2-year
11/23/2011	3.35	2-year
12/9/2015	3.37	2-year
6/26/2016	6.50	100-year
10/22/2017	4.12	2-year
1/5/2018	4.00	2-year
2/12/2019	3.42	2-year
11/12/2021	3.41	2-year
3/1/2022	4.50	10-year

USGS Cowlitz River Gage Data at Castle Rock During Heavy Rain Events

Date	River Elevation @ Gage*	Equivalent Elevation @ Site**
12/3/2007	47.37	40.37
1/8/2009	54.64	47.64
1/17/2011	43.51	36.51
11/23/2011	41.74	34.74
12/9/2015	52.45	45.45
6/26/2016	33.62	26.62
10/22/2017	39.56	32.56
1/5/2018	36.16	29.16
2/12/2019	39.52	32.52
11/12/2021	43.53	36.53
3/1/2022	46.09	39.09

* This is the actual reading at the gage

** This equivalent includes a 6.3' drop from the gage to our site, plus a 0.7' drop for datum change

Appendix C: Stormwater Volume Calculations

WWHM Reports for:

Node A

Node B

Node C

Node D

Node E

WWHM2012

PROJECT REPORT

General Model Information

WWHM2012 Project Name: 18591_Node A

Site Name:	LOTC
Site Address:	
City:	Castle Rock, WA
Report Date:	1/21/2025
Gage:	Longview
Data Start:	1955/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	1.429
Version Date:	2024/06/28
Version:	4.3.1

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year
Low Flow Threshold for POC2:	50 Percent of the 2 Year
High Flow Threshold for POC2:	50 Year

Landuse Basin Data

Predeveloped Land Use

Node A - Existing Public

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Forest, Mod	2.844
Pervious Total	2.844
Impervious Land Use	acre
Impervious Total	0
Basin Total	2.844

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 1	POC 1	

Node A - Existng C/F

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Forest, Mod	12.099
Pervious Total	12.099
Impervious Land Use	acre
Impervious Total	0
Basin Total	12.099

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

POC 2	POC 2

Mitigated Land Use

Node A - Public PGIS

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	1.684
Impervious Total	1.684
Basin Total	1.684

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
Surface Bioretention	Surface Bioretention	

Node A - C/F PGIS

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	7.516
Impervious Total	7.516
Basin Total	7.516

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

Surface	Interflow	Groundwater
Bioretention	Bioretention	

Node A - Public Non-PGIS

Bypass:	Yes
GroundWater:	No
Pervious Land Use	acre
A B, Lawn, Mod	1.16
Pervious Total	1.16
Impervious Land Use	acre
Impervious Total	0
Basin Total	1.16

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

POC 1	POC 1

Node A - C/F Non-PGIS

Bypass:	Yes
GroundWater:	No

Pervious Land Use	acre
A B, Lawn, Mod	1.21
Pervious Total	1.21

Impervious Land Use	acre
ROOF TOPS FLAT	3.373
Impervious Total	3.373
Basin Total	4.583

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 2	POC 2	

Routing Elements
Predeveloped Routing

Mitigated Routing

Road Bioretention

Bottom Length:	250.00 ft.
Bottom Width:	5.00 ft.
Material thickness of first layer:	1.5
Material type for first layer:	SMMWW 12 in/hr
Material thickness of second layer:	1.5
Material type for second layer:	GRAVEL
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (feet):	1
Orifice Diameter (in.):	12
Offset (in.):	0
Flow Through Underdrain (ac-ft.):	381.644
Total Outflow (ac-ft.):	404.722
Percent Through Underdrain:	94.3
Discharge Structure	
Riser Height:	0.5 ft.
Riser Diameter:	12 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	
Gravel Trench Bed 2	

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0287	0.0000	0.0000	0.0000
0.0440	0.0287	0.0006	0.0000	0.0000
0.0879	0.0287	0.0012	0.0000	0.0000
0.1319	0.0287	0.0017	0.0000	0.0000
0.1758	0.0287	0.0023	0.0000	0.0000
0.2198	0.0287	0.0029	0.0008	0.0000
0.2637	0.0287	0.0035	0.0013	0.0000
0.3077	0.0287	0.0040	0.0021	0.0000
0.3516	0.0287	0.0046	0.0030	0.0000
0.3956	0.0287	0.0052	0.0042	0.0000
0.4396	0.0287	0.0058	0.0056	0.0000
0.4835	0.0287	0.0063	0.0073	0.0000
0.5275	0.0287	0.0069	0.0090	0.0000
0.5714	0.0287	0.0075	0.0092	0.0000
0.6154	0.0287	0.0081	0.0115	0.0000
0.6593	0.0287	0.0087	0.0141	0.0000
0.7033	0.0287	0.0092	0.0170	0.0000
0.7473	0.0287	0.0098	0.0202	0.0000
0.7912	0.0287	0.0104	0.0218	0.0000
0.8352	0.0287	0.0110	0.0238	0.0000
0.8791	0.0287	0.0115	0.0278	0.0000
0.9231	0.0287	0.0121	0.0321	0.0000
0.9670	0.0287	0.0127	0.0369	0.0000
1.0110	0.0287	0.0133	0.0417	0.0000
1.0549	0.0287	0.0138	0.0420	0.0000
1.0989	0.0287	0.0144	0.0475	0.0000
1.1429	0.0287	0.0150	0.0535	0.0000
1.1868	0.0287	0.0156	0.0599	0.0000

1.2308	0.0287	0.0162	0.0667	0.0000
1.2747	0.0287	0.0167	0.0697	0.0000
1.3187	0.0287	0.0173	0.0740	0.0000
1.3626	0.0287	0.0179	0.0818	0.0000
1.4066	0.0287	0.0185	0.0900	0.0000
1.4505	0.0287	0.0190	0.0987	0.0000
1.4945	0.0287	0.0196	0.1069	0.0000
1.5385	0.0287	0.0201	0.1078	0.0000
1.5824	0.0287	0.0207	0.1175	0.0000
1.6264	0.0287	0.0212	0.1276	0.0000
1.6703	0.0287	0.0217	0.1383	0.0000
1.7143	0.0287	0.0222	0.1494	0.0000
1.7582	0.0287	0.0228	0.1538	0.0000
1.8022	0.0287	0.0233	0.1609	0.0000
1.8462	0.0287	0.0238	0.1726	0.0000
1.8901	0.0287	0.0243	0.2315	0.0000
1.9341	0.0287	0.0248	0.2315	0.0000
1.9780	0.0287	0.0254	0.2315	0.0000
2.0220	0.0287	0.0259	0.2315	0.0000
2.0659	0.0287	0.0264	0.2315	0.0000
2.1099	0.0287	0.0269	0.2315	0.0000
2.1538	0.0287	0.0275	0.2315	0.0000
2.1978	0.0287	0.0280	0.2315	0.0000
2.2418	0.0287	0.0285	0.2315	0.0000
2.2857	0.0287	0.0290	0.2315	0.0000
2.3297	0.0287	0.0296	0.2315	0.0000
2.3736	0.0287	0.0301	0.2315	0.0000
2.4176	0.0287	0.0306	0.2315	0.0000
2.4615	0.0287	0.0311	0.2315	0.0000
2.5055	0.0287	0.0317	0.2315	0.0000
2.5495	0.0287	0.0322	0.2315	0.0000
2.5934	0.0287	0.0327	0.2315	0.0000
2.6374	0.0287	0.0332	0.2315	0.0000
2.6813	0.0287	0.0337	0.2315	0.0000
2.7253	0.0287	0.0343	0.2315	0.0000
2.7692	0.0287	0.0348	0.2315	0.0000
2.8132	0.0287	0.0353	0.2315	0.0000
2.8571	0.0287	0.0358	0.2315	0.0000
2.9011	0.0287	0.0364	0.2315	0.0000
2.9451	0.0287	0.0369	0.2315	0.0000
2.9890	0.0287	0.0374	0.2315	0.0000
3.0000	0.0287	0.0375	0.2315	0.0000

Bioretention Surface Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
3.0000	0.0287	0.0375	0.0000	0.1736	0.0000
3.0440	0.0287	0.0388	0.0000	0.1736	0.0000
3.0879	0.0287	0.0401	0.0000	0.1838	0.0000
3.1319	0.0287	0.0413	0.0000	0.1889	0.0000
3.1758	0.0287	0.0426	0.0000	0.1940	0.0000
3.2198	0.0287	0.0438	0.0000	0.1990	0.0000
3.2637	0.0287	0.0451	0.0000	0.2041	0.0000
3.3077	0.0287	0.0464	0.0000	0.2092	0.0000
3.3516	0.0287	0.0476	0.0000	0.2143	0.0000
3.3956	0.0287	0.0489	0.0000	0.2194	0.0000
3.4396	0.0287	0.0502	0.0000	0.2245	0.0000
3.4835	0.0287	0.0514	0.0000	0.2296	0.0000
3.5275	0.0287	0.0527	0.0483	0.2315	0.0000

3.5714	0.0287	0.0539	0.2020	0.2315	0.0000
3.6154	0.0287	0.0552	0.4122	0.2315	0.0000
3.6593	0.0287	0.0565	0.6597	0.2315	0.0000
3.7033	0.0287	0.0577	0.9282	0.2315	0.0000
3.7473	0.0287	0.0590	1.2008	0.2315	0.0000
3.7912	0.0287	0.0602	1.4606	0.2315	0.0000
3.8352	0.0287	0.0615	1.6924	0.2315	0.0000
3.8791	0.0287	0.0628	1.8845	0.2315	0.0000
3.9231	0.0287	0.0640	2.0318	0.2315	0.0000
3.9670	0.0287	0.0653	2.1391	0.2315	0.0000
4.0000	0.0287	0.0662	2.2515	0.2315	0.0000

Commerical/Flex Bioretention

Bottom Length:	120.00 ft.
Bottom Width:	50.00 ft.
Material thickness of first layer:	1.5
Material type for first layer:	SMMWW 12 in/hr
Material thickness of second layer:	1.5
Material type for second layer:	GRAVEL
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (feet):	1
Orifice Diameter (in.):	12
Offset (in.):	0
Flow Through Underdrain (ac-ft.):	1771.377
Total Outflow (ac-ft.):	1808.386
Percent Through Underdrain:	97.95
Discharge Structure	
Riser Height:	1 ft.
Riser Diameter:	24 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	
Road Infiltration Trench	

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.1377	0.0000	0.0000	0.0000
0.0549	0.1377	0.0035	0.0000	0.0000
0.1099	0.1377	0.0069	0.0000	0.0000
0.1648	0.1377	0.0104	0.0000	0.0000
0.2198	0.1377	0.0138	0.0057	0.0000
0.2747	0.1377	0.0173	0.0099	0.0000
0.3297	0.1377	0.0208	0.0156	0.0000
0.3846	0.1377	0.0242	0.0165	0.0000
0.4396	0.1377	0.0277	0.0232	0.0000
0.4945	0.1377	0.0311	0.0327	0.0000
0.5495	0.1377	0.0346	0.0442	0.0000
0.6044	0.1377	0.0381	0.0581	0.0000
0.6593	0.1377	0.0415	0.0699	0.0000
0.7143	0.1377	0.0450	0.0743	0.0000
0.7692	0.1377	0.0485	0.0930	0.0000
0.8242	0.1377	0.0519	0.1143	0.0000
0.8791	0.1377	0.0554	0.1384	0.0000
0.9341	0.1377	0.0588	0.1653	0.0000
0.9890	0.1377	0.0623	0.1727	0.0000
1.0440	0.1377	0.0658	0.1952	0.0000
1.0989	0.1377	0.0692	0.2282	0.0000
1.1538	0.1377	0.0727	0.2643	0.0000
1.2088	0.1377	0.0761	0.3036	0.0000
1.2637	0.1377	0.0796	0.3347	0.0000
1.3187	0.1377	0.0831	0.3464	0.0000
1.3736	0.1377	0.0865	0.3925	0.0000
1.4286	0.1377	0.0900	0.4421	0.0000
1.4835	0.1377	0.0934	0.4953	0.0000
1.5385	0.1377	0.0966	0.5521	0.0000
1.5934	0.1377	0.0997	0.5647	0.0000

1.6484	0.1377	0.1029	0.6126	0.0000
1.7033	0.1377	0.1060	0.6767	0.0000
1.7582	0.1377	0.1091	0.7444	0.0000
1.8132	0.1377	0.1123	0.8147	0.0000
1.8681	0.1377	0.1154	1.3889	0.0000
1.9231	0.1377	0.1186	1.3889	0.0000
1.9780	0.1377	0.1217	1.3889	0.0000
2.0330	0.1377	0.1249	1.3889	0.0000
2.0879	0.1377	0.1280	1.3889	0.0000
2.1429	0.1377	0.1311	1.3889	0.0000
2.1978	0.1377	0.1343	1.3889	0.0000
2.2527	0.1377	0.1374	1.3889	0.0000
2.3077	0.1377	0.1406	1.3889	0.0000
2.3626	0.1377	0.1437	1.3889	0.0000
2.4176	0.1377	0.1468	1.3889	0.0000
2.4725	0.1377	0.1500	1.3889	0.0000
2.5275	0.1377	0.1531	1.3889	0.0000
2.5824	0.1377	0.1563	1.3889	0.0000
2.6374	0.1377	0.1594	1.3889	0.0000
2.6923	0.1377	0.1625	1.3889	0.0000
2.7473	0.1377	0.1657	1.3889	0.0000
2.8022	0.1377	0.1688	1.3889	0.0000
2.8571	0.1377	0.1720	1.3889	0.0000
2.9121	0.1377	0.1751	1.3889	0.0000
2.9670	0.1377	0.1782	1.3889	0.0000
3.0000	0.1377	0.1801	1.3889	0.0000

Bioretention Surface Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
3.0000	0.1377	0.1801	0.0000	0.8333	0.0000
3.0549	0.1377	0.1877	0.0000	0.8333	0.0000
3.1099	0.1377	0.1953	0.0000	0.8944	0.0000
3.1648	0.1377	0.2028	0.0000	0.9249	0.0000
3.2198	0.1377	0.2104	0.0000	0.9554	0.0000
3.2747	0.1377	0.2180	0.0000	0.9860	0.0000
3.3297	0.1377	0.2255	0.0000	1.0165	0.0000
3.3846	0.1377	0.2331	0.0000	1.0470	0.0000
3.4396	0.1377	0.2407	0.0000	1.0775	0.0000
3.4945	0.1377	0.2482	0.0000	1.1081	0.0000
3.5495	0.1377	0.2558	0.0000	1.1386	0.0000
3.6044	0.1377	0.2634	0.0000	1.1691	0.0000
3.6593	0.1377	0.2709	0.0000	1.1996	0.0000
3.7143	0.1377	0.2785	0.0000	1.2302	0.0000
3.7692	0.1377	0.2861	0.0000	1.2607	0.0000
3.8242	0.1377	0.2937	0.0000	1.2912	0.0000
3.8791	0.1377	0.3012	0.0000	1.3217	0.0000
3.9341	0.1377	0.3088	0.0000	1.3523	0.0000
3.9890	0.1377	0.3164	0.0000	1.3828	0.0000
4.0440	0.1377	0.3239	0.1956	1.3889	0.0000
4.0989	0.1377	0.3315	0.6592	1.3889	0.0000
4.1538	0.1377	0.3391	1.2766	1.3889	0.0000
4.2088	0.1377	0.3466	2.0109	1.3889	0.0000
4.2637	0.1377	0.3542	2.8369	1.3889	0.0000
4.3187	0.1377	0.3618	3.7318	1.3889	0.0000
4.3736	0.1377	0.3693	4.6731	1.3889	0.0000
4.4286	0.1377	0.3769	5.6376	1.3889	0.0000
4.4835	0.1377	0.3845	6.6018	1.3889	0.0000
4.5385	0.1377	0.3920	7.5423	1.3889	0.0000

4.5934	0.1377	0.3996	8.4368	1.3889	0.0000
4.6484	0.1377	0.4072	9.2649	1.3889	0.0000
4.7033	0.1377	0.4147	10.010	1.3889	0.0000
4.7582	0.1377	0.4223	10.660	1.3889	0.0000
4.8132	0.1377	0.4299	11.211	1.3889	0.0000
4.8681	0.1377	0.4374	11.664	1.3889	0.0000
4.9231	0.1377	0.4450	12.034	1.3889	0.0000
4.9780	0.1377	0.4526	12.347	1.3889	0.0000
5.0000	0.1377	0.4556	12.805	1.3889	0.0000

Road Infiltration Trench

Bottom Length:	120.00 ft.
Bottom Width:	50.00 ft.
Trench bottom slope 1:	0 To 1
Trench Left side slope 0:	0 To 1
Trench right side slope 2:	0 To 1
Material thickness of first layer:	5
Pour Space of material for first layer:	0.35
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	2
Infiltration safety factor:	1
Total Volume Infiltrated (ac-ft.):	28.422
Total Volume Through Riser (ac-ft.):	8.597
Total Volume Through Facility (ac-ft.):	37.019
Percent Infiltrated:	76.78
Total Precip Applied to Facility:	0
Total Evap From Facility:	0
Discharge Structure	
Riser Height:	4.5 ft.
Riser Diameter:	24 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	

Gravel Trench Bed Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.137	0.000	0.000	0.000
0.0556	0.137	0.002	0.000	0.277
0.1111	0.137	0.005	0.000	0.277
0.1667	0.137	0.008	0.000	0.277
0.2222	0.137	0.010	0.000	0.277
0.2778	0.137	0.013	0.000	0.277
0.3333	0.137	0.016	0.000	0.277
0.3889	0.137	0.018	0.000	0.277
0.4444	0.137	0.021	0.000	0.277
0.5000	0.137	0.024	0.000	0.277
0.5556	0.137	0.026	0.000	0.277
0.6111	0.137	0.029	0.000	0.277
0.6667	0.137	0.032	0.000	0.277
0.7222	0.137	0.034	0.000	0.277
0.7778	0.137	0.037	0.000	0.277
0.8333	0.137	0.040	0.000	0.277
0.8889	0.137	0.042	0.000	0.277
0.9444	0.137	0.045	0.000	0.277
1.0000	0.137	0.048	0.000	0.277
1.0556	0.137	0.050	0.000	0.277
1.1111	0.137	0.053	0.000	0.277
1.1667	0.137	0.056	0.000	0.277
1.2222	0.137	0.058	0.000	0.277
1.2778	0.137	0.061	0.000	0.277
1.3333	0.137	0.064	0.000	0.277

1.3889	0.137	0.067	0.000	0.277
1.4444	0.137	0.069	0.000	0.277
1.5000	0.137	0.072	0.000	0.277
1.5556	0.137	0.075	0.000	0.277
1.6111	0.137	0.077	0.000	0.277
1.6667	0.137	0.080	0.000	0.277
1.7222	0.137	0.083	0.000	0.277
1.7778	0.137	0.085	0.000	0.277
1.8333	0.137	0.088	0.000	0.277
1.8889	0.137	0.091	0.000	0.277
1.9444	0.137	0.093	0.000	0.277
2.0000	0.137	0.096	0.000	0.277
2.0556	0.137	0.099	0.000	0.277
2.1111	0.137	0.101	0.000	0.277
2.1667	0.137	0.104	0.000	0.277
2.2222	0.137	0.107	0.000	0.277
2.2778	0.137	0.109	0.000	0.277
2.3333	0.137	0.112	0.000	0.277
2.3889	0.137	0.115	0.000	0.277
2.4444	0.137	0.117	0.000	0.277
2.5000	0.137	0.120	0.000	0.277
2.5556	0.137	0.123	0.000	0.277
2.6111	0.137	0.125	0.000	0.277
2.6667	0.137	0.128	0.000	0.277
2.7222	0.137	0.131	0.000	0.277
2.7778	0.137	0.133	0.000	0.277
2.8333	0.137	0.136	0.000	0.277
2.8889	0.137	0.139	0.000	0.277
2.9444	0.137	0.141	0.000	0.277
3.0000	0.137	0.144	0.000	0.277
3.0556	0.137	0.147	0.000	0.277
3.1111	0.137	0.150	0.000	0.277
3.1667	0.137	0.152	0.000	0.277
3.2222	0.137	0.155	0.000	0.277
3.2778	0.137	0.158	0.000	0.277
3.3333	0.137	0.160	0.000	0.277
3.3889	0.137	0.163	0.000	0.277
3.4444	0.137	0.166	0.000	0.277
3.5000	0.137	0.168	0.000	0.277
3.5556	0.137	0.171	0.000	0.277
3.6111	0.137	0.174	0.000	0.277
3.6667	0.137	0.176	0.000	0.277
3.7222	0.137	0.179	0.000	0.277
3.7778	0.137	0.182	0.000	0.277
3.8333	0.137	0.184	0.000	0.277
3.8889	0.137	0.187	0.000	0.277
3.9444	0.137	0.190	0.000	0.277
4.0000	0.137	0.192	0.000	0.277
4.0556	0.137	0.195	0.000	0.277
4.1111	0.137	0.198	0.000	0.277
4.1667	0.137	0.200	0.000	0.277
4.2222	0.137	0.203	0.000	0.277
4.2778	0.137	0.206	0.000	0.277
4.3333	0.137	0.208	0.000	0.277
4.3889	0.137	0.211	0.000	0.277
4.4444	0.137	0.214	0.000	0.277
4.5000	0.137	0.216	0.000	0.277
4.5556	0.137	0.219	0.277	0.277

4.6111	0.137	0.222	0.784	0.277
4.6667	0.137	0.225	1.438	0.277
4.7222	0.137	0.227	2.205	0.277
4.7778	0.137	0.230	3.059	0.277
4.8333	0.137	0.233	3.979	0.277
4.8889	0.137	0.235	4.939	0.277
4.9444	0.137	0.238	5.917	0.277
5.0000	0.137	0.241	6.887	0.277

Gravel Trench Bed 2

Bottom Length:	250.00 ft.
Bottom Width:	5.00 ft.
Trench bottom slope 1:	0 To 1
Trench Left side slope 0:	0 To 1
Trench right side slope 2:	0 To 1
Material thickness of first layer:	5
Pour Space of material for first layer:	0.35
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	2
Infiltration safety factor:	1
Total Volume Infiltrated (ac-ft.):	16.401
Total Volume Through Riser (ac-ft.):	6.676
Total Volume Through Facility (ac-ft.):	23.076
Percent Infiltrated:	71.07
Total Precip Applied to Facility:	0
Total Evap From Facility:	0
Discharge Structure	
Riser Height:	3 ft.
Riser Diameter:	12 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	

Gravel Trench Bed Hydraulic Table

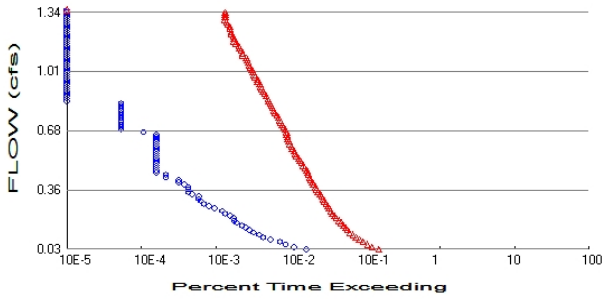
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.028	0.000	0.000	0.000
0.0556	0.028	0.000	0.000	0.057
0.1111	0.028	0.001	0.000	0.057
0.1667	0.028	0.001	0.000	0.057
0.2222	0.028	0.002	0.000	0.057
0.2778	0.028	0.002	0.000	0.057
0.3333	0.028	0.003	0.000	0.057
0.3889	0.028	0.003	0.000	0.057
0.4444	0.028	0.004	0.000	0.057
0.5000	0.028	0.005	0.000	0.057
0.5556	0.028	0.005	0.000	0.057
0.6111	0.028	0.006	0.000	0.057
0.6667	0.028	0.006	0.000	0.057
0.7222	0.028	0.007	0.000	0.057
0.7778	0.028	0.007	0.000	0.057
0.8333	0.028	0.008	0.000	0.057
0.8889	0.028	0.008	0.000	0.057
0.9444	0.028	0.009	0.000	0.057
1.0000	0.028	0.010	0.000	0.057
1.0556	0.028	0.010	0.000	0.057
1.1111	0.028	0.011	0.000	0.057
1.1667	0.028	0.011	0.000	0.057
1.2222	0.028	0.012	0.000	0.057
1.2778	0.028	0.012	0.000	0.057
1.3333	0.028	0.013	0.000	0.057

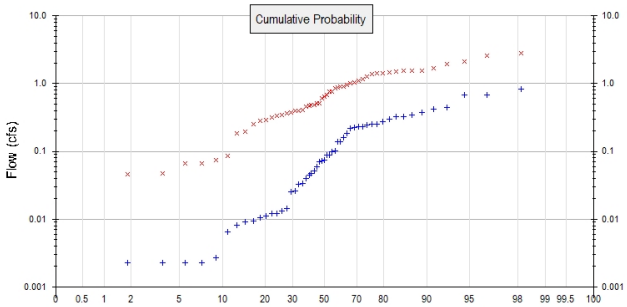
1.3889	0.028	0.013	0.000	0.057
1.4444	0.028	0.014	0.000	0.057
1.5000	0.028	0.015	0.000	0.057
1.5556	0.028	0.015	0.000	0.057
1.6111	0.028	0.016	0.000	0.057
1.6667	0.028	0.016	0.000	0.057
1.7222	0.028	0.017	0.000	0.057
1.7778	0.028	0.017	0.000	0.057
1.8333	0.028	0.018	0.000	0.057
1.8889	0.028	0.019	0.000	0.057
1.9444	0.028	0.019	0.000	0.057
2.0000	0.028	0.020	0.000	0.057
2.0556	0.028	0.020	0.000	0.057
2.1111	0.028	0.021	0.000	0.057
2.1667	0.028	0.021	0.000	0.057
2.2222	0.028	0.022	0.000	0.057
2.2778	0.028	0.022	0.000	0.057
2.3333	0.028	0.023	0.000	0.057
2.3889	0.028	0.024	0.000	0.057
2.4444	0.028	0.024	0.000	0.057
2.5000	0.028	0.025	0.000	0.057
2.5556	0.028	0.025	0.000	0.057
2.6111	0.028	0.026	0.000	0.057
2.6667	0.028	0.026	0.000	0.057
2.7222	0.028	0.027	0.000	0.057
2.7778	0.028	0.027	0.000	0.057
2.8333	0.028	0.028	0.000	0.057
2.8889	0.028	0.029	0.000	0.057
2.9444	0.028	0.029	0.000	0.057
3.0000	0.028	0.030	0.000	0.057
3.0556	0.028	0.030	0.138	0.057
3.1111	0.028	0.031	0.389	0.057
3.1667	0.028	0.031	0.703	0.057
3.2222	0.028	0.032	1.046	0.057
3.2778	0.028	0.032	1.383	0.057
3.3333	0.028	0.033	1.683	0.057
3.3889	0.028	0.034	1.921	0.057
3.4444	0.028	0.034	2.088	0.057
3.5000	0.028	0.035	2.203	0.057
3.5556	0.028	0.035	2.347	0.057
3.6111	0.028	0.036	2.462	0.057
3.6667	0.028	0.036	2.571	0.057
3.7222	0.028	0.037	2.676	0.057
3.7778	0.028	0.037	2.777	0.057
3.8333	0.028	0.038	2.875	0.057
3.8889	0.028	0.039	2.969	0.057
3.9444	0.028	0.039	3.060	0.057
4.0000	0.028	0.040	3.149	0.057
4.0556	0.028	0.040	3.235	0.057
4.1111	0.028	0.041	3.320	0.057
4.1667	0.028	0.041	3.402	0.057
4.2222	0.028	0.042	3.482	0.057
4.2778	0.028	0.043	3.560	0.057
4.3333	0.028	0.043	3.636	0.057
4.3889	0.028	0.044	3.711	0.057
4.4444	0.028	0.044	3.785	0.057
4.5000	0.028	0.045	3.857	0.057
4.5556	0.028	0.045	3.928	0.057

4.6111	0.028	0.046	3.997	0.057
4.6667	0.028	0.046	4.066	0.057
4.7222	0.028	0.047	4.133	0.057
4.7778	0.028	0.048	4.199	0.057
4.8333	0.028	0.048	4.264	0.057
4.8889	0.028	0.049	4.328	0.057
4.9444	0.028	0.049	4.391	0.057
5.0000	0.028	0.050	4.454	0.057

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 2.844
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 1.16
Total Impervious Area: 1.684

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.062613
5 year	0.245299
10 year	0.47044
25 year	0.899944
50 year	1.335307
100 year	1.873996

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.615424
5 year	1.548871
10 year	2.243406
25 year	3.088672
50 year	3.657997
100 year	4.163853

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1956	0.442	1.567
1957	0.045	1.366
1958	0.678	1.403
1959	0.161	0.757
1960	0.673	1.536
1961	0.328	0.863
1962	0.836	1.150
1963	0.246	2.107
1964	0.138	0.900
1965	0.073	0.195

1966	0.009	0.046
1967	0.033	0.516
1968	0.006	0.395
1969	0.033	0.286
1970	0.047	0.184
1971	0.299	0.505
1972	0.222	0.613
1973	0.011	0.480
1974	0.321	1.041
1975	0.346	1.501
1976	0.187	0.398
1977	0.002	0.075
1978	0.375	1.264
1979	0.012	0.471
1980	0.025	0.451
1981	0.040	0.413
1982	0.218	0.945
1983	0.089	0.643
1984	0.272	0.891
1985	0.008	0.379
1986	0.254	1.463
1987	0.013	1.016
1988	0.003	0.287
1989	0.009	0.067
1990	0.099	0.676
1991	0.235	0.361
1992	0.012	0.086
1993	0.059	0.254
1994	0.051	0.066
1995	0.014	1.566
1996	0.424	1.961
1997	0.103	0.870
1998	0.087	2.542
1999	0.011	0.315
2000	0.026	0.481
2001	0.002	0.001
2002	0.072	2.772
2003	0.002	1.678
2004	0.002	0.047
2005	0.002	0.342
2006	0.139	0.338
2007	0.230	1.433
2008	0.071	0.768
2009	0.254	1.096

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.8355	2.7716
2	0.6783	2.5416
3	0.6728	2.1065
4	0.4418	1.9614
5	0.4244	1.6777
6	0.3752	1.5671
7	0.3460	1.5662
8	0.3276	1.5360
9	0.3210	1.5011
10	0.2994	1.4632

11	0.2721	1.4325
12	0.2541	1.4032
13	0.2538	1.3658
14	0.2461	1.2635
15	0.2346	1.1495
16	0.2303	1.0961
17	0.2224	1.0414
18	0.2183	1.0159
19	0.1869	0.9448
20	0.1614	0.8997
21	0.1394	0.8913
22	0.1382	0.8696
23	0.1028	0.8631
24	0.0993	0.7678
25	0.0892	0.7573
26	0.0870	0.6762
27	0.0733	0.6433
28	0.0715	0.6132
29	0.0711	0.5163
30	0.0592	0.5047
31	0.0512	0.4814
32	0.0467	0.4801
33	0.0448	0.4709
34	0.0398	0.4512
35	0.0335	0.4130
36	0.0329	0.3982
37	0.0256	0.3954
38	0.0250	0.3786
39	0.0142	0.3608
40	0.0130	0.3417
41	0.0122	0.3385
42	0.0120	0.3152
43	0.0111	0.2866
44	0.0106	0.2860
45	0.0094	0.2536
46	0.0092	0.1946
47	0.0081	0.1839
48	0.0064	0.0864
49	0.0027	0.0749
50	0.0023	0.0667
51	0.0023	0.0658
52	0.0023	0.0469
53	0.0023	0.0456
54	0.0020	0.0009

Duration Flows

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0313	303	2874	948	Fail
0.0445	207	2342	1131	Fail
0.0576	161	2028	1259	Fail
0.0708	135	1759	1302	Fail
0.0840	101	1579	1563	Fail
0.0972	81	1416	1748	Fail
0.1103	71	1294	1822	Fail
0.1235	60	1167	1945	Fail
0.1367	52	1086	2088	Fail
0.1499	47	1033	2197	Fail
0.1630	42	965	2297	Fail
0.1762	36	895	2486	Fail
0.1894	33	832	2521	Fail
0.2025	32	775	2421	Fail
0.2157	29	732	2524	Fail
0.2289	25	683	2732	Fail
0.2421	23	649	2821	Fail
0.2552	18	619	3438	Fail
0.2684	15	591	3940	Fail
0.2816	13	565	4346	Fail
0.2947	12	534	4450	Fail
0.3079	11	507	4609	Fail
0.3211	11	490	4454	Fail
0.3343	9	468	5200	Fail
0.3474	8	441	5512	Fail
0.3606	8	423	5287	Fail
0.3738	8	405	5062	Fail
0.3869	7	384	5485	Fail
0.4001	6	368	6133	Fail
0.4133	6	350	5833	Fail
0.4265	4	340	8500	Fail
0.4396	4	325	8125	Fail
0.4528	3	318	10600	Fail
0.4660	3	310	10333	Fail
0.4791	3	292	9733	Fail
0.4923	3	279	9300	Fail
0.5055	3	264	8800	Fail
0.5187	3	252	8400	Fail
0.5318	3	240	8000	Fail
0.5450	3	226	7533	Fail
0.5582	3	214	7133	Fail
0.5713	3	209	6966	Fail
0.5845	3	199	6633	Fail
0.5977	3	193	6433	Fail
0.6109	3	185	6166	Fail
0.6240	3	179	5966	Fail
0.6372	3	173	5766	Fail
0.6504	3	170	5666	Fail
0.6635	3	166	5533	Fail
0.6767	2	166	8300	Fail
0.6899	1	159	15900	Fail
0.7031	1	152	15200	Fail
0.7162	1	146	14600	Fail
0.7294	1	140	14000	Fail

0.7426	1	135	13500	Fail
0.7558	1	130	13000	Fail
0.7689	1	123	12300	Fail
0.7821	1	116	11600	Fail
0.7953	1	111	11100	Fail
0.8084	1	108	10800	Fail
0.8216	1	104	10400	Fail
0.8348	1	100	10000	Fail
0.8480	0	96	n/a	Fail
0.8611	0	94	n/a	Fail
0.8743	0	89	n/a	Fail
0.8875	0	85	n/a	Fail
0.9006	0	80	n/a	Fail
0.9138	0	78	n/a	Fail
0.9270	0	75	n/a	Fail
0.9402	0	73	n/a	Fail
0.9533	0	68	n/a	Fail
0.9665	0	68	n/a	Fail
0.9797	0	63	n/a	Fail
0.9928	0	61	n/a	Fail
1.0060	0	59	n/a	Fail
1.0192	0	57	n/a	Fail
1.0324	0	54	n/a	Fail
1.0455	0	53	n/a	Fail
1.0587	0	51	n/a	Fail
1.0719	0	49	n/a	Fail
1.0850	0	48	n/a	Fail
1.0982	0	43	n/a	Fail
1.1114	0	43	n/a	Fail
1.1246	0	41	n/a	Fail
1.1377	0	39	n/a	Fail
1.1509	0	38	n/a	Fail
1.1641	0	35	n/a	Fail
1.1772	0	33	n/a	Fail
1.1904	0	33	n/a	Fail
1.2036	0	32	n/a	Fail
1.2168	0	30	n/a	Fail
1.2299	0	30	n/a	Fail
1.2431	0	29	n/a	Fail
1.2563	0	29	n/a	Fail
1.2694	0	27	n/a	Fail
1.2826	0	26	n/a	Fail
1.2958	0	25	n/a	Fail
1.3090	0	25	n/a	Fail
1.3221	0	25	n/a	Fail
1.3353	0	25	n/a	Fail

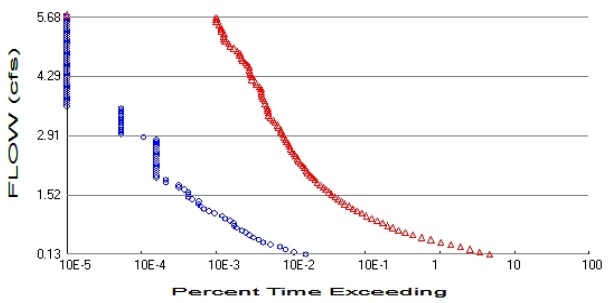
The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

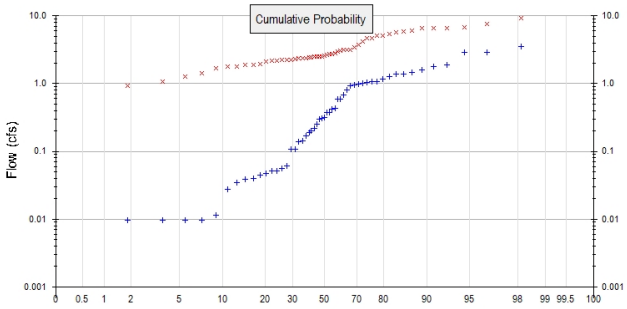
Water Quality

Water Quality BMP Flow and Volume for POC #1

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

POC 2





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #2
Total Pervious Area: 12.099
Total Impervious Area: 0

Mitigated Landuse Totals for POC #2
Total Pervious Area: 1.21
Total Impervious Area: 10.889

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #2

Return Period	**Flow(cfs)**
2 year	0.26637
5 year	1.043554
10 year	2.001356
25 year	3.82856
50 year	5.68069
100 year	7.972395

Flow Frequency Return Periods for Mitigated. POC #2

Return Period	**Flow(cfs)**
2 year	2.889243
5 year	4.566276
10 year	5.800523
25 year	7.486366
50 year	8.827735
100 year	10.23843

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #2

Year	**Predeveloped**	**Mitigated**
1956	1.879	5.091
1957	0.191	5.953
1958	2.885	5.077
1959	0.687	2.521
1960	2.862	6.767
1961	1.394	3.176
1962	3.555	4.703
1963	1.047	9.185
1964	0.588	2.726
1965	0.312	2.577
1966	0.039	2.396

1967	0.142	1.911
1968	0.027	1.674
1969	0.140	2.397
1970	0.199	1.801
1971	1.274	2.833
1972	0.946	2.361
1973	0.045	1.799
1974	1.366	3.180
1975	1.472	5.331
1976	0.795	3.163
1977	0.010	2.183
1978	1.596	5.737
1979	0.051	1.891
1980	0.106	2.320
1981	0.169	2.674
1982	0.929	2.226
1983	0.380	3.092
1984	1.158	2.262
1985	0.035	2.422
1986	1.080	6.547
1987	0.055	2.983
1988	0.011	2.199
1989	0.040	1.067
1990	0.423	2.518
1991	0.998	2.714
1992	0.052	2.117
1993	0.252	1.965
1994	0.218	1.437
1995	0.060	3.467
1996	1.805	6.540
1997	0.437	2.516
1998	0.370	6.571
1999	0.047	1.273
2000	0.109	2.431
2001	0.009	0.700
2002	0.304	7.511
2003	0.010	5.888
2004	0.010	0.931
2005	0.010	2.526
2006	0.593	2.238
2007	0.980	4.638
2008	0.302	3.725
2009	1.081	4.165

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #2

Rank	Predeveloped	Mitigated
1	3.5546	9.1846
2	2.8854	7.5112
3	2.8624	6.7666
4	1.8793	6.5715
5	1.8054	6.5471
6	1.5962	6.5399
7	1.4721	5.9535
8	1.3935	5.8880
9	1.3658	5.7369
10	1.2736	5.3314
11	1.1576	5.0914

12	1.0812	5.0766
13	1.0798	4.7033
14	1.0469	4.6378
15	0.9979	4.1648
16	0.9797	3.7254
17	0.9460	3.4669
18	0.9287	3.1801
19	0.7950	3.1759
20	0.6868	3.1629
21	0.5928	3.0922
22	0.5877	2.9830
23	0.4373	2.8334
24	0.4226	2.7256
25	0.3796	2.7137
26	0.3700	2.6741
27	0.3118	2.5769
28	0.3044	2.5263
29	0.3023	2.5212
30	0.2516	2.5180
31	0.2180	2.5160
32	0.1988	2.4307
33	0.1907	2.4217
34	0.1694	2.3967
35	0.1424	2.3960
36	0.1401	2.3606
37	0.1091	2.3201
38	0.1064	2.2620
39	0.0602	2.2380
40	0.0553	2.2258
41	0.0521	2.1991
42	0.0510	2.1831
43	0.0474	2.1171
44	0.0450	1.9647
45	0.0398	1.9106
46	0.0391	1.8910
47	0.0346	1.8006
48	0.0272	1.7992
49	0.0113	1.6743
50	0.0097	1.4372
51	0.0097	1.2734
52	0.0096	1.0675
53	0.0096	0.9313
54	0.0087	0.7003

Duration Flows

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.1332	300	87442	29147	Fail
0.1892	207	64303	31064	Fail
0.2453	161	48000	29813	Fail
0.3013	135	35541	26326	Fail
0.3573	100	26301	26301	Fail
0.4134	81	19333	23867	Fail
0.4694	70	14353	20504	Fail
0.5254	60	10730	17883	Fail
0.5815	52	8188	15746	Fail
0.6375	47	6497	13823	Fail
0.6935	42	5283	12578	Fail
0.7496	36	4454	12372	Fail
0.8056	33	3757	11384	Fail
0.8616	32	3198	9993	Fail
0.9177	29	2740	9448	Fail
0.9737	25	2314	9256	Fail
1.0298	23	1971	8569	Fail
1.0858	18	1715	9527	Fail
1.1418	15	1468	9786	Fail
1.1979	13	1298	9984	Fail
1.2539	12	1150	9583	Fail
1.3099	11	1011	9190	Fail
1.3660	11	909	8263	Fail
1.4220	9	821	9122	Fail
1.4780	8	742	9275	Fail
1.5341	8	675	8437	Fail
1.5901	8	622	7775	Fail
1.6461	7	556	7942	Fail
1.7022	6	516	8600	Fail
1.7582	6	472	7866	Fail
1.8142	4	430	10750	Fail
1.8703	4	401	10025	Fail
1.9263	3	371	12366	Fail
1.9824	3	345	11500	Fail
2.0384	3	320	10666	Fail
2.0944	3	303	10100	Fail
2.1505	3	289	9633	Fail
2.2065	3	273	9100	Fail
2.2625	3	256	8533	Fail
2.3186	3	244	8133	Fail
2.3746	3	234	7800	Fail
2.4306	3	221	7366	Fail
2.4867	3	210	7000	Fail
2.5427	3	197	6566	Fail
2.5987	3	187	6233	Fail
2.6548	3	182	6066	Fail
2.7108	3	177	5900	Fail
2.7668	3	165	5500	Fail
2.8229	3	159	5300	Fail
2.8789	2	156	7800	Fail
2.9350	1	149	14900	Fail
2.9910	1	140	14000	Fail
3.0470	1	138	13800	Fail
3.1031	1	130	13000	Fail

3.1591	1	126	12600	Fail
3.2151	1	116	11600	Fail
3.2712	1	110	11000	Fail
3.3272	1	101	10100	Fail
3.3832	1	96	9600	Fail
3.4393	1	95	9500	Fail
3.4953	1	93	9300	Fail
3.5513	1	93	9300	Fail
3.6074	0	91	n/a	Fail
3.6634	0	87	n/a	Fail
3.7195	0	85	n/a	Fail
3.7755	0	81	n/a	Fail
3.8315	0	78	n/a	Fail
3.8876	0	76	n/a	Fail
3.9436	0	76	n/a	Fail
3.9996	0	75	n/a	Fail
4.0557	0	72	n/a	Fail
4.1117	0	66	n/a	Fail
4.1677	0	64	n/a	Fail
4.2238	0	57	n/a	Fail
4.2798	0	57	n/a	Fail
4.3358	0	55	n/a	Fail
4.3919	0	54	n/a	Fail
4.4479	0	53	n/a	Fail
4.5039	0	53	n/a	Fail
4.5600	0	50	n/a	Fail
4.6160	0	47	n/a	Fail
4.6721	0	43	n/a	Fail
4.7281	0	41	n/a	Fail
4.7841	0	39	n/a	Fail
4.8402	0	39	n/a	Fail
4.8962	0	36	n/a	Fail
4.9522	0	33	n/a	Fail
5.0083	0	29	n/a	Fail
5.0643	0	28	n/a	Fail
5.1203	0	25	n/a	Fail
5.1764	0	24	n/a	Fail
5.2324	0	24	n/a	Fail
5.2884	0	24	n/a	Fail
5.3445	0	22	n/a	Fail
5.4005	0	22	n/a	Fail
5.4565	0	22	n/a	Fail
5.5126	0	21	n/a	Fail
5.5686	0	19	n/a	Fail
5.6247	0	19	n/a	Fail
5.6807	0	19	n/a	Fail

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

Water Quality

Water Quality BMP Flow and Volume for POC #2

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

Model Default Modifications

Total of 0 changes have been made.

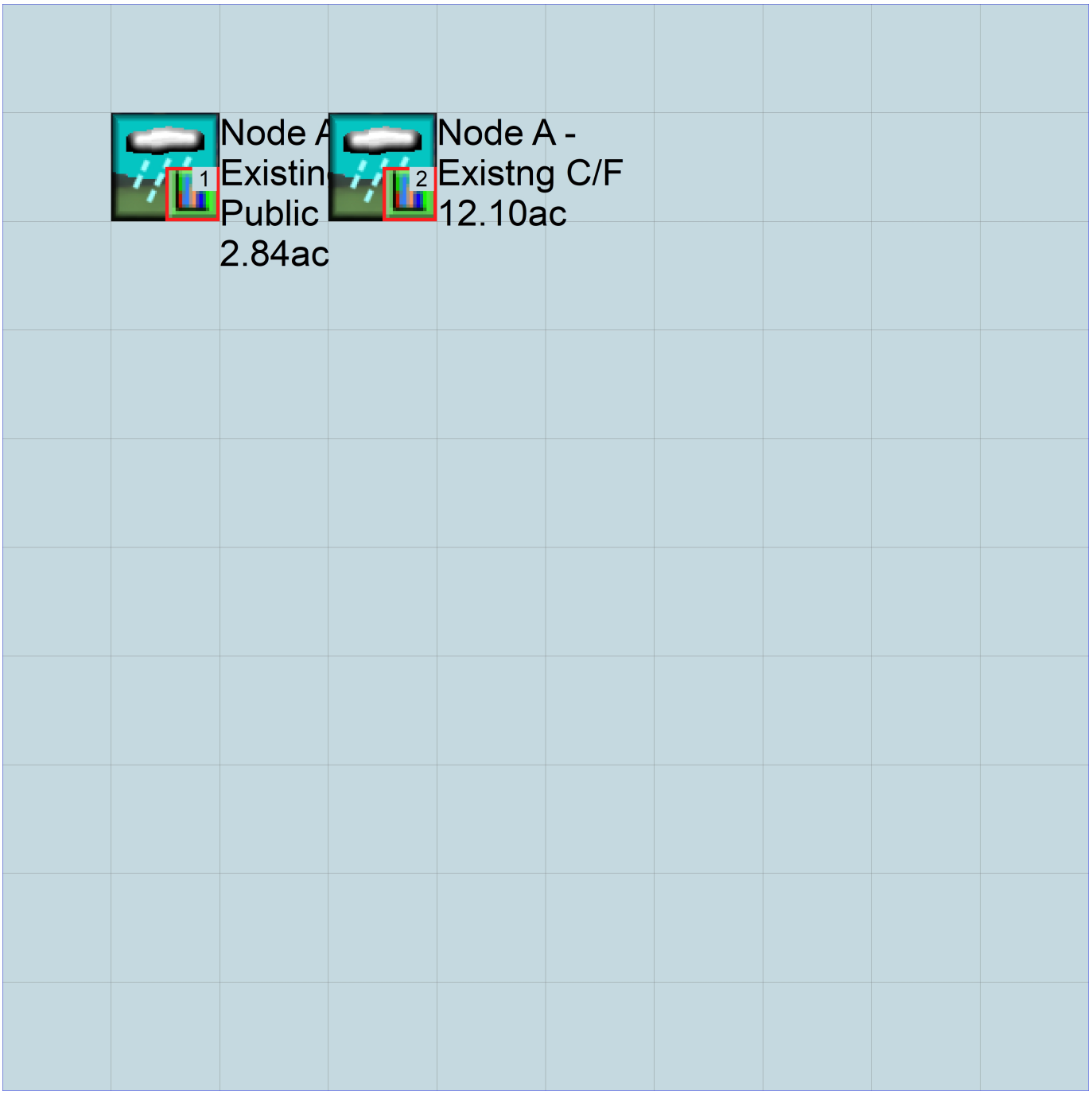
PERLND Changes

No PERLND changes have been made.

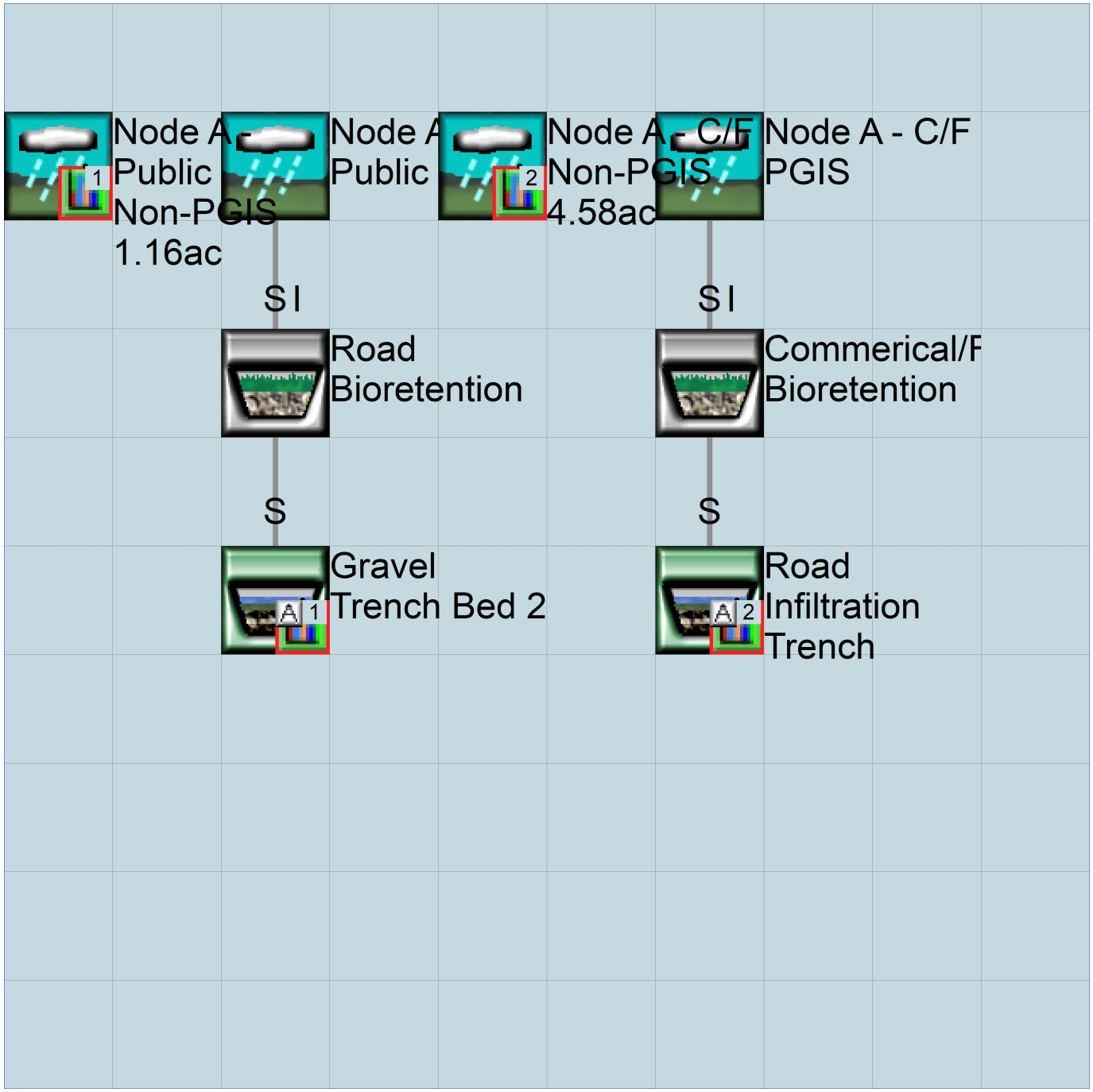
IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   18591_Node A.wdm
MESSU       25   Pre18591_Node A.MES
            27   Pre18591_Node A.L61
            28   Pre18591_Node A.L62
            30   POC18591_Node A1.dat
            31   POC18591_Node A2.dat
END FILES

OPN SEQUENCE
    INGRP               INDELT 00:15
      PERLND        2
      COPY        501
      COPY        502
      DISPLY        1
      DISPLY        2
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title---------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Node A - Existing Public    MAX                   1    2   30    9
    2        Node A - Existng C/F        MAX                   1    2   31    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  502         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
    2     A/B, Forest, Mod        1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    2         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
```

```
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
    2         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    2         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    2              0         5         2       400       0.1       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    2              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    2          0.2       0.5      0.35         0       0.7       0.7
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
             ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
    2              0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

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

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

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

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

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

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

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

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Node A - Existing Public***
PERLND   2                       2.844     COPY   501     12
PERLND   2                       2.844     COPY   501     13
Node A - Existng C/F***
PERLND   2                      12.099     COPY   502     12
PERLND   2                      12.099     COPY   502     13

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

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1
COPY   502 OUTPUT MEAN   1 1   48.4        DISPLY   2     INPUT  TIMSER 1



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

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

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

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

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

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

SPEC-ACTIONS
```

```
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.429          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.429          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
COPY   502 OUTPUT MEAN   1 1     48.4      WDM    502 FLOW     ENGL      REPL
END EXT TARGETS

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

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


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   18591_Node A.wdm
MESSU       25   Mit18591_Node A.MES
            27   Mit18591_Node A.L61
            28   Mit18591_Node A.L62
            31   POC18591_Node A2.dat
            30   POC18591_Node A1.dat
END FILES

OPN SEQUENCE
    INGRP               INDELT 00:15
      IMPLND       1
      PERLND       8
      IMPLND       4
      RCHRES       1
      RCHRES       2
      RCHRES       3
      RCHRES       4
      RCHRES       5
      RCHRES       6
      COPY         2
      COPY       502
      COPY       602
      COPY         1
      COPY       501
      COPY       601
      DISPLY       2
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    2        Road Infiltration Trench    MAX                    1    2   31    9
    1        Gravel Trench Bed 2         MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
    2         1    1
  502         1    1
  602         1    1
  501         1    1
  601         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
```

```
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                         User  t-series Engl Metr ***
                                        in  out           ***
    8     A/B, Lawn, Mod          1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    8         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
    8         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    8         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    8             0         5       0.8       400       0.1       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    8             0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    8          0.1       0.5      0.25         0       0.7      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
             ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
    8             0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                      in  out           ***
    1      ROADS/FLAT             1    1    1   27    0
    4      ROOF TOPS/FLAT         1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
    4         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
```

```
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    4    1    9
    4         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
    4         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
    4            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
    4              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
    4              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Node A - Public PGIS***
IMPLND   1                       1.684     RCHRES   1      5
Node A - C/F PGIS***
IMPLND   1                       7.516     RCHRES   3      5
Node A - Public Non-PGIS***
PERLND   8                        1.16     COPY   501     12
PERLND   8                        1.16     COPY   601     12
PERLND   8                        1.16     COPY   501     13
PERLND   8                        1.16     COPY   601     13
Node A - C/F Non-PGIS***
PERLND   8                        1.21     COPY   502     12
PERLND   8                        1.21     COPY   602     12
PERLND   8                        1.21     COPY   502     13
PERLND   8                        1.21     COPY   602     13
IMPLND   4                       3.373     COPY   502     15
IMPLND   4                       3.373     COPY   602     15

******Routing******
RCHRES   1                           1     RCHRES   6      7
RCHRES   1                                 COPY     1     17
RCHRES   1                           1     RCHRES   2      8
RCHRES   3                           1     RCHRES   5      7
RCHRES   3                                 COPY     2     17
RCHRES   3                           1     RCHRES   4      8
RCHRES   5                           1     COPY   502     17
RCHRES   6                           1     COPY   501     17
END SCHEMATIC

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

```
COPY   502 OUTPUT MEAN   1 1   48.4        DISPLY   2     INPUT  TIMSER 1
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1


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

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                        in  out                              ***
    1     Surface Bioreten-009    2    1    1    1   28    0    1
    2     Road Bioretentio-008    1    1    1    1   28    0    1
    3     Surface Bioreten-011    2    1    1    1   28    0    1
    4     Commerical/Flex -010    1    1    1    1   28    0    1
    5     Road Infiltratio-013    2    1    1    1   28    0    1
    6     Gravel Trench Be-020    2    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections ******************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
    2         1    0    0    0    0    0    0    0    0    0
    3         1    0    0    0    0    0    0    0    0    0
    4         1    0    0    0    0    0    0    0    0    0
    5         1    0    0    0    0    0    0    0    0    0
    6         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
    2         4    0    0    0    0    0    0    0    0    0    1    9
    3         4    0    0    0    0    0    0    0    0    0    1    9
    4         4    0    0    0    0    0    0    0    0    0    1    9
    5         4    0    0    0    0    0    0    0    0    0    1    9
    6         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                    ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
           FG FG FG FG  possible  exit  *** possible  exit      possible  exit
            *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
    1       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    2       0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
    3       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    4       0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
    5       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    6       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><--------->      ***
    1             1      0.01       0.0       0.0       0.0       0.0
    2             2      0.05       0.0       0.0       0.0       0.0
    3             3      0.01       0.0       0.0       0.0       0.0
    4             4      0.02       0.0       0.0       0.0       0.0
    5             5      0.02       0.0       0.0       0.5       0.0
    6             6      0.05       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                       ***
```

```
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
           *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    3            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    4            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    5            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    6            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      2
   70    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.028696  0.000000  0.000000
  0.043956  0.028696  0.000577  0.000000
  0.087912  0.028696  0.001154  0.000000
  0.131868  0.028696  0.001730  0.000000
  0.175824  0.028696  0.002307  0.000000
  0.219780  0.028696  0.002884  0.000792
  0.263736  0.028696  0.003461  0.001329
  0.307692  0.028696  0.004038  0.002053
  0.351648  0.028696  0.004615  0.002988
  0.395604  0.028696  0.005191  0.004154
  0.439560  0.028696  0.005768  0.005569
  0.483516  0.028696  0.006345  0.007252
  0.527473  0.028696  0.006922  0.009007
  0.571429  0.028696  0.007499  0.009218
  0.615385  0.028696  0.008076  0.011483
  0.659341  0.028696  0.008652  0.014061
  0.703297  0.028696  0.009229  0.016967
  0.747253  0.028696  0.009806  0.020214
  0.791209  0.028696  0.010383  0.021769
  0.835165  0.028696  0.010960  0.023814
  0.879121  0.028696  0.011536  0.027781
  0.923077  0.028696  0.012113  0.032125
  0.967033  0.028696  0.012690  0.036858
  1.010989  0.028696  0.013267  0.041677
  1.054945  0.028696  0.013844  0.041991
  1.098901  0.028696  0.014421  0.047536
  1.142857  0.028696  0.014997  0.053501
  1.186813  0.028696  0.015574  0.059897
  1.230769  0.028696  0.016151  0.066734
  1.274725  0.028696  0.016728  0.069738
  1.318681  0.028696  0.017305  0.074021
  1.362637  0.028696  0.017881  0.081766
  1.406593  0.028696  0.018458  0.089978
  1.450549  0.028696  0.019035  0.098664
  1.494505  0.028696  0.019612  0.106852
  1.538462  0.028696  0.020135  0.107830
  1.582418  0.028696  0.020659  0.117482
  1.626374  0.028696  0.021182  0.127623
  1.670330  0.028696  0.021706  0.138252
  1.714286  0.028696  0.022229  0.149359
  1.758242  0.028696  0.022753  0.153837
  1.802198  0.028696  0.023276  0.160904
  1.846154  0.028696  0.023800  0.172605
  1.890110  0.028696  0.024323  0.231481
  1.934066  0.028696  0.024847  0.231481
  1.978022  0.028696  0.025370  0.231481
  2.021978  0.028696  0.025894  0.231481
  2.065934  0.028696  0.026417  0.231481
  2.109890  0.028696  0.026940  0.231481
  2.153846  0.028696  0.027464  0.231481
  2.197802  0.028696  0.027987  0.231481
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2.241758  0.028696  0.028511  0.231481
2.285714  0.028696  0.029034  0.231481
2.329670  0.028696  0.029558  0.231481
2.373626  0.028696  0.030081  0.231481
2.417582  0.028696  0.030605  0.231481
2.461538  0.028696  0.031128  0.231481
2.505495  0.028696  0.031652  0.231481
2.549451  0.028696  0.032175  0.231481
2.593407  0.028696  0.032699  0.231481
2.637363  0.028696  0.033222  0.231481
2.681319  0.028696  0.033746  0.231481
2.725275  0.028696  0.034269  0.231481
2.769231  0.028696  0.034792  0.231481
2.813187  0.028696  0.035316  0.231481
2.857143  0.028696  0.035839  0.231481
2.901099  0.028696  0.036363  0.231481
2.945055  0.028696  0.036886  0.231481
2.989011  0.028696  0.037410  0.231481
3.000000  0.028696  0.042323  0.231481
END FTABLE  2
FTABLE      1
 24    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.028696  0.000000  0.000000  0.000000
0.043956  0.028696  0.001261  0.000000  0.173611
0.087912  0.028696  0.002523  0.000000  0.183786
0.131868  0.028696  0.003784  0.000000  0.188874
0.175824  0.028696  0.005045  0.000000  0.193961
0.219780  0.028696  0.006307  0.000000  0.199049
0.263736  0.028696  0.007568  0.000000  0.204136
0.307692  0.028696  0.008830  0.000000  0.209224
0.351648  0.028696  0.010091  0.000000  0.214311
0.395604  0.028696  0.011352  0.000000  0.219399
0.439560  0.028696  0.012614  0.000000  0.224486
0.483516  0.028696  0.013875  0.000000  0.229574
0.527473  0.028696  0.015136  0.048301  0.231481
0.571429  0.028696  0.016398  0.202028  0.231481
0.615385  0.028696  0.017659  0.412175  0.231481
0.659341  0.028696  0.018920  0.659695  0.231481
0.703297  0.028696  0.020182  0.928167  0.231481
0.747253  0.028696  0.021443  1.200769  0.231481
0.791209  0.028696  0.022705  1.460630  0.231481
0.835165  0.028696  0.023966  1.692395  0.231481
0.879121  0.028696  0.025227  1.884482  0.231481
0.923077  0.028696  0.026489  2.031838  0.231481
0.967033  0.028696  0.027750  2.139092  0.231481
1.000000  0.028696  0.028696  2.251466  0.231481
END FTABLE  1
FTABLE      4
 56    4
   Depth      Area    Volume  Outflow1 Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
0.000000  0.137741  0.000000  0.000000
0.054945  0.137741  0.003461  0.000000
0.109890  0.137741  0.006922  0.000000
0.164835  0.137741  0.010383  0.000000
0.219780  0.137741  0.013844  0.005654
0.274725  0.137741  0.017305  0.009856
0.329670  0.137741  0.020766  0.015634
0.384615  0.137741  0.024227  0.016455
0.439560  0.137741  0.027687  0.023180
0.494505  0.137741  0.031148  0.032664
0.549451  0.137741  0.034609  0.044245
0.604396  0.137741  0.038070  0.058067
0.659341  0.137741  0.041531  0.069906
0.714286  0.137741  0.044992  0.074267
0.769231  0.137741  0.048453  0.092974
0.824176  0.137741  0.051914  0.114309
0.879121  0.137741  0.055375  0.138388
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0.934066  0.137741  0.058836  0.165321
0.989011  0.137741  0.062297  0.172669
1.043956  0.137741  0.065758  0.195215
1.098901  0.137741  0.069219  0.228171
1.153846  0.137741  0.072680  0.264285
1.208791  0.137741  0.076141  0.303649
1.263736  0.137741  0.079601  0.334742
1.318681  0.137741  0.083062  0.346353
1.373626  0.137741  0.086523  0.392478
1.428571  0.137741  0.089984  0.442103
1.483516  0.137741  0.093445  0.495294
1.538462  0.137741  0.096586  0.552112
1.593407  0.137741  0.099727  0.564683
1.648352  0.137741  0.102868  0.612591
1.703297  0.137741  0.106008  0.676727
1.758242  0.137741  0.109149  0.744394
1.813187  0.137741  0.112290  0.814747
1.868132  0.137741  0.115431  1.388889
1.923077  0.137741  0.118572  1.388889
1.978022  0.137741  0.121712  1.388889
2.032967  0.137741  0.124853  1.388889
2.087912  0.137741  0.127994  1.388889
2.142857  0.137741  0.131135  1.388889
2.197802  0.137741  0.134276  1.388889
2.252747  0.137741  0.137416  1.388889
2.307692  0.137741  0.140557  1.388889
2.362637  0.137741  0.143698  1.388889
2.417582  0.137741  0.146839  1.388889
2.472527  0.137741  0.149980  1.388889
2.527473  0.137741  0.153120  1.388889
2.582418  0.137741  0.156261  1.388889
2.637363  0.137741  0.159402  1.388889
2.692308  0.137741  0.162543  1.388889
2.747253  0.137741  0.165684  1.388889
2.802198  0.137741  0.168824  1.388889
2.857143  0.137741  0.171965  1.388889
2.912088  0.137741  0.175106  1.388889
2.967033  0.137741  0.178247  1.388889
3.000000  0.137741  0.208827  1.388889
END FTABLE  4
FTABLE      3
 38    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)     (cfs)   (ft/sec)    (Minutes)***
0.000000  0.137741  0.000000  0.000000  0.000000
0.054945  0.137741  0.007568  0.000000  0.833334
0.109890  0.137741  0.015136  0.000000  0.894384
0.164835  0.137741  0.022705  0.000000  0.924909
0.219780  0.137741  0.030273  0.000000  0.955434
0.274725  0.137741  0.037841  0.000000  0.985959
0.329670  0.137741  0.045409  0.000000  1.016484
0.384615  0.137741  0.052977  0.000000  1.047009
0.439560  0.137741  0.060546  0.000000  1.077534
0.494505  0.137741  0.068114  0.000000  1.108059
0.549451  0.137741  0.075682  0.000000  1.138585
0.604396  0.137741  0.083250  0.000000  1.169110
0.659341  0.137741  0.090818  0.000000  1.199635
0.714286  0.137741  0.098386  0.000000  1.230160
0.769231  0.137741  0.105955  0.000000  1.260685
0.824176  0.137741  0.113523  0.000000  1.291210
0.879121  0.137741  0.121091  0.000000  1.321735
0.934066  0.137741  0.128659  0.000000  1.352260
0.989011  0.137741  0.136227  0.000000  1.382785
1.043956  0.137741  0.143796  0.195553  1.388889
1.098901  0.137741  0.151364  0.659242  1.388889
1.153846  0.137741  0.158932  1.276591  1.388889
1.208791  0.137741  0.166500  2.010935  1.388889
1.263736  0.137741  0.174068  2.836899  1.388889
1.318681  0.137741  0.181637  3.731796  1.388889
1.373626  0.137741  0.189205  4.673072  1.388889
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1.428571  0.137741  0.196773  5.637608  1.388889
1.483516  0.137741  0.204341  6.601841  1.388889
1.538462  0.137741  0.211909  7.542349  1.388889
1.593407  0.137741  0.219477  8.436754  1.388889
1.648352  0.137741  0.227046  9.264852  1.388889
1.703297  0.137741  0.234614  10.00993  1.388889
1.758242  0.137741  0.242182  10.66024  1.388889
1.813187  0.137741  0.249750  11.21062  1.388889
1.868132  0.137741  0.257318  11.66425  1.388889
1.923077  0.137741  0.264887  12.03449  1.388889
1.978022  0.137741  0.272455  12.34684  1.388889
2.000000  0.137741  0.275482  12.80450  1.388889
END FTABLE  3
FTABLE      5
 92    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.137741  0.000000  0.000000  0.000000
0.055556  0.137741  0.002678  0.000000  0.277778
0.111111  0.137741  0.005357  0.000000  0.277778
0.166667  0.137741  0.008035  0.000000  0.277778
0.222222  0.137741  0.010713  0.000000  0.277778
0.277778  0.137741  0.013391  0.000000  0.277778
0.333333  0.137741  0.016070  0.000000  0.277778
0.388889  0.137741  0.018748  0.000000  0.277778
0.444444  0.137741  0.021426  0.000000  0.277778
0.500000  0.137741  0.024105  0.000000  0.277778
0.555556  0.137741  0.026783  0.000000  0.277778
0.611111  0.137741  0.029461  0.000000  0.277778
0.666667  0.137741  0.032140  0.000000  0.277778
0.722222  0.137741  0.034818  0.000000  0.277778
0.777778  0.137741  0.037496  0.000000  0.277778
0.833333  0.137741  0.040174  0.000000  0.277778
0.888889  0.137741  0.042853  0.000000  0.277778
0.944444  0.137741  0.045531  0.000000  0.277778
1.000000  0.137741  0.048209  0.000000  0.277778
1.055556  0.137741  0.050888  0.000000  0.277778
1.111111  0.137741  0.053566  0.000000  0.277778
1.166667  0.137741  0.056244  0.000000  0.277778
1.222222  0.137741  0.058923  0.000000  0.277778
1.277778  0.137741  0.061601  0.000000  0.277778
1.333333  0.137741  0.064279  0.000000  0.277778
1.388889  0.137741  0.066957  0.000000  0.277778
1.444444  0.137741  0.069636  0.000000  0.277778
1.500000  0.137741  0.072314  0.000000  0.277778
1.555556  0.137741  0.074992  0.000000  0.277778
1.611111  0.137741  0.077671  0.000000  0.277778
1.666667  0.137741  0.080349  0.000000  0.277778
1.722222  0.137741  0.083027  0.000000  0.277778
1.777778  0.137741  0.085706  0.000000  0.277778
1.833333  0.137741  0.088384  0.000000  0.277778
1.888889  0.137741  0.091062  0.000000  0.277778
1.944444  0.137741  0.093740  0.000000  0.277778
2.000000  0.137741  0.096419  0.000000  0.277778
2.055556  0.137741  0.099097  0.000000  0.277778
2.111111  0.137741  0.101775  0.000000  0.277778
2.166667  0.137741  0.104454  0.000000  0.277778
2.222222  0.137741  0.107132  0.000000  0.277778
2.277778  0.137741  0.109810  0.000000  0.277778
2.333333  0.137741  0.112489  0.000000  0.277778
2.388889  0.137741  0.115167  0.000000  0.277778
2.444444  0.137741  0.117845  0.000000  0.277778
2.500000  0.137741  0.120523  0.000000  0.277778
2.555556  0.137741  0.123202  0.000000  0.277778
2.611111  0.137741  0.125880  0.000000  0.277778
2.666667  0.137741  0.128558  0.000000  0.277778
2.722222  0.137741  0.131237  0.000000  0.277778
2.777778  0.137741  0.133915  0.000000  0.277778
2.833333  0.137741  0.136593  0.000000  0.277778
2.888889  0.137741  0.139272  0.000000  0.277778
```

```
2.944444  0.137741  0.141950  0.000000  0.277778
3.000000  0.137741  0.144628  0.000000  0.277778
3.055556  0.137741  0.147306  0.000000  0.277778
3.111111  0.137741  0.149985  0.000000  0.277778
3.166667  0.137741  0.152663  0.000000  0.277778
3.222222  0.137741  0.155341  0.000000  0.277778
3.277778  0.137741  0.158020  0.000000  0.277778
3.333333  0.137741  0.160698  0.000000  0.277778
3.388889  0.137741  0.163376  0.000000  0.277778
3.444444  0.137741  0.166054  0.000000  0.277778
3.500000  0.137741  0.168733  0.000000  0.277778
3.555556  0.137741  0.171411  0.000000  0.277778
3.611111  0.137741  0.174089  0.000000  0.277778
3.666667  0.137741  0.176768  0.000000  0.277778
3.722222  0.137741  0.179446  0.000000  0.277778
3.777778  0.137741  0.182124  0.000000  0.277778
3.833333  0.137741  0.184803  0.000000  0.277778
3.888889  0.137741  0.187481  0.000000  0.277778
3.944444  0.137741  0.190159  0.000000  0.277778
4.000000  0.137741  0.192837  0.000000  0.277778
4.055556  0.137741  0.195516  0.000000  0.277778
4.111111  0.137741  0.198194  0.000000  0.277778
4.166667  0.137741  0.200872  0.000000  0.277778
4.222222  0.137741  0.203551  0.000000  0.277778
4.277778  0.137741  0.206229  0.000000  0.277778
4.333333  0.137741  0.208907  0.000000  0.277778
4.388889  0.137741  0.211586  0.000000  0.277778
4.444444  0.137741  0.214264  0.000000  0.277778
4.500000  0.137741  0.216942  0.000000  0.277778
4.555556  0.137741  0.219620  0.277796  0.277778
4.611111  0.137741  0.222299  0.784769  0.277778
4.666667  0.137741  0.224977  1.438492  0.277778
4.722222  0.137741  0.227655  2.205262  0.277778
4.777778  0.137741  0.230334  3.059929  0.277778
4.833333  0.137741  0.233012  3.979211  0.277778
4.888889  0.137741  0.235690  4.939668  0.277778
4.944444  0.137741  0.238369  5.917238  0.277778
5.000000  0.137741  0.241047  6.887532  0.277778
5.055556  0.137741  0.248699  7.826549  0.277778
END FTABLE  5
FTABLE      6
 92    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)     (cfs)   (ft/sec)    (Minutes)***
0.000000  0.028696  0.000000  0.000000  0.000000
0.055556  0.028696  0.000558  0.000000  0.057870
0.111111  0.028696  0.001116  0.000000  0.057870
0.166667  0.028696  0.001674  0.000000  0.057870
0.222222  0.028696  0.002232  0.000000  0.057870
0.277778  0.028696  0.002790  0.000000  0.057870
0.333333  0.028696  0.003348  0.000000  0.057870
0.388889  0.028696  0.003906  0.000000  0.057870
0.444444  0.028696  0.004464  0.000000  0.057870
0.500000  0.028696  0.005022  0.000000  0.057870
0.555556  0.028696  0.005580  0.000000  0.057870
0.611111  0.028696  0.006138  0.000000  0.057870
0.666667  0.028696  0.006696  0.000000  0.057870
0.722222  0.028696  0.007254  0.000000  0.057870
0.777778  0.028696  0.007812  0.000000  0.057870
0.833333  0.028696  0.008370  0.000000  0.057870
0.888889  0.028696  0.008928  0.000000  0.057870
0.944444  0.028696  0.009486  0.000000  0.057870
1.000000  0.028696  0.010044  0.000000  0.057870
1.055556  0.028696  0.010602  0.000000  0.057870
1.111111  0.028696  0.011160  0.000000  0.057870
1.166667  0.028696  0.011718  0.000000  0.057870
1.222222  0.028696  0.012276  0.000000  0.057870
1.277778  0.028696  0.012834  0.000000  0.057870
1.333333  0.028696  0.013391  0.000000  0.057870
1.388889  0.028696  0.013949  0.000000  0.057870
```

```
  1.444444  0.028696  0.014507  0.000000  0.057870
  1.500000  0.028696  0.015065  0.000000  0.057870
  1.555556  0.028696  0.015623  0.000000  0.057870
  1.611111  0.028696  0.016181  0.000000  0.057870
  1.666667  0.028696  0.016739  0.000000  0.057870
  1.722222  0.028696  0.017297  0.000000  0.057870
  1.777778  0.028696  0.017855  0.000000  0.057870
  1.833333  0.028696  0.018413  0.000000  0.057870
  1.888889  0.028696  0.018971  0.000000  0.057870
  1.944444  0.028696  0.019529  0.000000  0.057870
  2.000000  0.028696  0.020087  0.000000  0.057870
  2.055556  0.028696  0.020645  0.000000  0.057870
  2.111111  0.028696  0.021203  0.000000  0.057870
  2.166667  0.028696  0.021761  0.000000  0.057870
  2.222222  0.028696  0.022319  0.000000  0.057870
  2.277778  0.028696  0.022877  0.000000  0.057870
  2.333333  0.028696  0.023435  0.000000  0.057870
  2.388889  0.028696  0.023993  0.000000  0.057870
  2.444444  0.028696  0.024551  0.000000  0.057870
  2.500000  0.028696  0.025109  0.000000  0.057870
  2.555556  0.028696  0.025667  0.000000  0.057870
  2.611111  0.028696  0.026225  0.000000  0.057870
  2.666667  0.028696  0.026783  0.000000  0.057870
  2.722222  0.028696  0.027341  0.000000  0.057870
  2.777778  0.028696  0.027899  0.000000  0.057870
  2.833333  0.028696  0.028457  0.000000  0.057870
  2.888889  0.028696  0.029015  0.000000  0.057870
  2.944444  0.028696  0.029573  0.000000  0.057870
  3.000000  0.028696  0.030131  0.000000  0.057870
  3.055556  0.028696  0.030689  0.138729  0.057870
  3.111111  0.028696  0.031247  0.389839  0.057870
  3.166667  0.028696  0.031805  0.703432  0.057870
  3.222222  0.028696  0.032363  1.046030  0.057870
  3.277778  0.028696  0.032921  1.383552  0.057870
  3.333333  0.028696  0.033479  1.683468  0.057870
  3.388889  0.028696  0.034037  1.921105  0.057870
  3.444444  0.028696  0.034595  2.088233  0.057870
  3.500000  0.028696  0.035153  2.203335  0.057870
  3.555556  0.028696  0.035711  2.347596  0.057870
  3.611111  0.028696  0.036269  2.462179  0.057870
  3.666667  0.028696  0.036827  2.571662  0.057870
  3.722222  0.028696  0.037385  2.676671  0.057870
  3.777778  0.028696  0.037943  2.777713  0.057870
  3.833333  0.028696  0.038501  2.875206  0.057870
  3.888889  0.028696  0.039059  2.969500  0.057870
  3.944444  0.028696  0.039616  3.060890  0.057870
  4.000000  0.028696  0.040174  3.149630  0.057870
  4.055556  0.028696  0.040732  3.235937  0.057870
  4.111111  0.028696  0.041290  3.320002  0.057870
  4.166667  0.028696  0.041848  3.401989  0.057870
  4.222222  0.028696  0.042406  3.482047  0.057870
  4.277778  0.028696  0.042964  3.560305  0.057870
  4.333333  0.028696  0.043522  3.636879  0.057870
  4.388889  0.028696  0.044080  3.711875  0.057870
  4.444444  0.028696  0.044638  3.785384  0.057870
  4.500000  0.028696  0.045196  3.857493  0.057870
  4.555556  0.028696  0.045754  3.928279  0.057870
  4.611111  0.028696  0.046312  3.997811  0.057870
  4.666667  0.028696  0.046870  4.066155  0.057870
  4.722222  0.028696  0.047428  4.133369  0.057870
  4.777778  0.028696  0.047986  4.199507  0.057870
  4.833333  0.028696  0.048544  4.264619  0.057870
  4.888889  0.028696  0.049102  4.328752  0.057870
  4.944444  0.028696  0.049660  4.391949  0.057870
  5.000000  0.028696  0.050218  4.454250  0.057870
  5.055556  0.028696  0.051812  4.515690  0.057870
  END FTABLE  6
END FTABLES

EXT SOURCES
```

```
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.429          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.429          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP
WDM      2 PREC     ENGL    1.429          RCHRES   1     EXTNL  PREC
WDM      2 PREC     ENGL    1.429          RCHRES   3     EXTNL  PREC
WDM      1 EVAP     ENGL    0.5            RCHRES   1     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.76           RCHRES   2     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.5            RCHRES   3     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.76           RCHRES   4     EXTNL  POTEV

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   5 HYDR   RO     1 1        1      WDM   1004 FLOW     ENGL      REPL
RCHRES   5 HYDR   O      1 1        1      WDM   1005 FLOW     ENGL      REPL
RCHRES   5 HYDR   O      2 1        1      WDM   1006 FLOW     ENGL      REPL
RCHRES   5 HYDR   STAGE  1 1        1      WDM   1007 STAG     ENGL      REPL
COPY     2 OUTPUT MEAN   1 1     48.4      WDM    702 FLOW     ENGL      REPL
COPY   502 OUTPUT MEAN   1 1     48.4      WDM    802 FLOW     ENGL      REPL
COPY   602 OUTPUT MEAN   1 1     48.4      WDM    902 FLOW     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
COPY   601 OUTPUT MEAN   1 1     48.4      WDM    901 FLOW     ENGL      REPL
RCHRES   6 HYDR   RO     1 1        1      WDM   1014 FLOW     ENGL      REPL
RCHRES   6 HYDR   O      1 1        1      WDM   1015 FLOW     ENGL      REPL
RCHRES   6 HYDR   O      2 1        1      WDM   1016 FLOW     ENGL      REPL
RCHRES   6 HYDR   STAGE  1 1        1      WDM   1017 STAG     ENGL      REPL
END EXT TARGETS

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

  MASS-LINK        7
RCHRES     OFLOW  OVOL   1                 RCHRES         INFLOW IVOL
  END MASS-LINK    7

  MASS-LINK        8
RCHRES     OFLOW  OVOL   2                 RCHRES         INFLOW IVOL
  END MASS-LINK    8

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

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

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

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


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

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WWHM2012

PROJECT REPORT

General Model Information

WWHM2012 Project Name: 18591_Node B

Site Name:	LOTC
Site Address:	
City:	Castle Rock, WA
Report Date:	1/21/2025
Gage:	Longview
Data Start:	1955/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	1.429
Version Date:	2024/06/28
Version:	4.3.1

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year
Low Flow Threshold for POC2:	50 Percent of the 2 Year
High Flow Threshold for POC2:	50 Year

Landuse Basin Data

Predeveloped Land Use

Node A - Existing Public

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Forest, Mod	0.341
Pervious Total	0.341
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.341

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 1	POC 1	

Node A - Existng C/F

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Forest, Mod	8.921
Pervious Total	8.921
Impervious Land Use	acre
Impervious Total	0
Basin Total	8.921

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

POC 2	POC 2

Mitigated Land Use

Node B - Public PGIS

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	0.25
Impervious Total	0.25
Basin Total	0.25

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
Surface Bioretention	Surface Bioretention	

Node B - Subdivision PGIS

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	2.176
Impervious Total	2.176
Basin Total	2.176

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

Surface Bioretention	Surface Bioretention

Node B - Public Non-PGIS

Bypass:	Yes
GroundWater:	No
Pervious Land Use	acre
A B, Lawn, Mod	0.091
Pervious Total	0.091
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.091

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

POC 1	POC 1

Node B - Subdivision Non-PGIS

Bypass:	Yes
GroundWater:	No

Pervious Land Use	acre
A B, Lawn, Mod	4.645
Pervious Total	4.645

Impervious Land Use	acre
ROOF TOPS FLAT	2.1
Impervious Total	2.1
Basin Total	6.745

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 2	POC 2	

Mitigated Routing

Road Bioretention

Bottom Length:	40.00 ft.
Bottom Width:	5.00 ft.
Material thickness of first layer:	1.5
Material type for first layer:	SMMWW 12 in/hr
Material thickness of second layer:	1.5
Material type for second layer:	GRAVEL
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (feet):	1
Orifice Diameter (in.):	12
Offset (in.):	0
Flow Through Underdrain (ac-ft.):	57.121
Total Outflow (ac-ft.):	60.09
Percent Through Underdrain:	95.06
Discharge Structure	
Riser Height:	0.5 ft.
Riser Diameter:	12 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	
Gravel Trench Bed 1	

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0046	0.0000	0.0000	0.0000
0.0440	0.0046	0.0001	0.0000	0.0000
0.0879	0.0046	0.0002	0.0000	0.0000
0.1319	0.0046	0.0003	0.0000	0.0000
0.1758	0.0046	0.0004	0.0000	0.0000
0.2198	0.0046	0.0005	0.0001	0.0000
0.2637	0.0046	0.0006	0.0002	0.0000
0.3077	0.0046	0.0006	0.0003	0.0000
0.3516	0.0046	0.0007	0.0005	0.0000
0.3956	0.0046	0.0008	0.0007	0.0000
0.4396	0.0046	0.0009	0.0009	0.0000
0.4835	0.0046	0.0010	0.0012	0.0000
0.5275	0.0046	0.0011	0.0014	0.0000
0.5714	0.0046	0.0012	0.0015	0.0000
0.6154	0.0046	0.0013	0.0018	0.0000
0.6593	0.0046	0.0014	0.0022	0.0000
0.7033	0.0046	0.0015	0.0027	0.0000
0.7473	0.0046	0.0016	0.0032	0.0000
0.7912	0.0046	0.0017	0.0035	0.0000
0.8352	0.0046	0.0018	0.0038	0.0000
0.8791	0.0046	0.0018	0.0044	0.0000
0.9231	0.0046	0.0019	0.0051	0.0000
0.9670	0.0046	0.0020	0.0059	0.0000
1.0110	0.0046	0.0021	0.0067	0.0000
1.0549	0.0046	0.0022	0.0067	0.0000
1.0989	0.0046	0.0023	0.0076	0.0000
1.1429	0.0046	0.0024	0.0086	0.0000
1.1868	0.0046	0.0025	0.0096	0.0000

1.2308	0.0046	0.0026	0.0107	0.0000
1.2747	0.0046	0.0027	0.0112	0.0000
1.3187	0.0046	0.0028	0.0118	0.0000
1.3626	0.0046	0.0029	0.0131	0.0000
1.4066	0.0046	0.0030	0.0144	0.0000
1.4505	0.0046	0.0030	0.0158	0.0000
1.4945	0.0046	0.0031	0.0171	0.0000
1.5385	0.0046	0.0032	0.0173	0.0000
1.5824	0.0046	0.0033	0.0188	0.0000
1.6264	0.0046	0.0034	0.0204	0.0000
1.6703	0.0046	0.0035	0.0221	0.0000
1.7143	0.0046	0.0036	0.0239	0.0000
1.7582	0.0046	0.0036	0.0246	0.0000
1.8022	0.0046	0.0037	0.0257	0.0000
1.8462	0.0046	0.0038	0.0276	0.0000
1.8901	0.0046	0.0039	0.0370	0.0000
1.9341	0.0046	0.0040	0.0370	0.0000
1.9780	0.0046	0.0041	0.0370	0.0000
2.0220	0.0046	0.0041	0.0370	0.0000
2.0659	0.0046	0.0042	0.0370	0.0000
2.1099	0.0046	0.0043	0.0370	0.0000
2.1538	0.0046	0.0044	0.0370	0.0000
2.1978	0.0046	0.0045	0.0370	0.0000
2.2418	0.0046	0.0046	0.0370	0.0000
2.2857	0.0046	0.0046	0.0370	0.0000
2.3297	0.0046	0.0047	0.0370	0.0000
2.3736	0.0046	0.0048	0.0370	0.0000
2.4176	0.0046	0.0049	0.0370	0.0000
2.4615	0.0046	0.0050	0.0370	0.0000
2.5055	0.0046	0.0051	0.0370	0.0000
2.5495	0.0046	0.0051	0.0370	0.0000
2.5934	0.0046	0.0052	0.0370	0.0000
2.6374	0.0046	0.0053	0.0370	0.0000
2.6813	0.0046	0.0054	0.0370	0.0000
2.7253	0.0046	0.0055	0.0370	0.0000
2.7692	0.0046	0.0056	0.0370	0.0000
2.8132	0.0046	0.0057	0.0370	0.0000
2.8571	0.0046	0.0057	0.0370	0.0000
2.9011	0.0046	0.0058	0.0370	0.0000
2.9451	0.0046	0.0059	0.0370	0.0000
2.9890	0.0046	0.0060	0.0370	0.0000
3.0000	0.0046	0.0060	0.0370	0.0000

Bioretention Surface Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
3.0000	0.0046	0.0060	0.0000	0.0278	0.0000
3.0440	0.0046	0.0062	0.0000	0.0278	0.0000
3.0879	0.0046	0.0064	0.0000	0.0294	0.0000
3.1319	0.0046	0.0066	0.0000	0.0302	0.0000
3.1758	0.0046	0.0068	0.0000	0.0310	0.0000
3.2198	0.0046	0.0070	0.0000	0.0318	0.0000
3.2637	0.0046	0.0072	0.0000	0.0327	0.0000
3.3077	0.0046	0.0074	0.0000	0.0335	0.0000
3.3516	0.0046	0.0076	0.0000	0.0343	0.0000
3.3956	0.0046	0.0078	0.0000	0.0351	0.0000
3.4396	0.0046	0.0080	0.0000	0.0359	0.0000
3.4835	0.0046	0.0082	0.0000	0.0367	0.0000
3.5275	0.0046	0.0084	0.0483	0.0370	0.0000

3.5714	0.0046	0.0086	0.2020	0.0370	0.0000
3.6154	0.0046	0.0088	0.4122	0.0370	0.0000
3.6593	0.0046	0.0090	0.6597	0.0370	0.0000
3.7033	0.0046	0.0092	0.9282	0.0370	0.0000
3.7473	0.0046	0.0094	1.2008	0.0370	0.0000
3.7912	0.0046	0.0096	1.4606	0.0370	0.0000
3.8352	0.0046	0.0098	1.6924	0.0370	0.0000
3.8791	0.0046	0.0100	1.8845	0.0370	0.0000
3.9231	0.0046	0.0102	2.0318	0.0370	0.0000
3.9670	0.0046	0.0104	2.1391	0.0370	0.0000
4.0000	0.0046	0.0106	2.2515	0.0370	0.0000

Subdivision Bioretention

Bottom Length:	270.00 ft.
Bottom Width:	5.00 ft.
Material thickness of first layer:	1.5
Material type for first layer:	SMMWW 12 in/hr
Material thickness of second layer:	1.5
Material type for second layer:	GRAVEL
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (feet):	1
Orifice Diameter (in.):	12
Offset (in.):	0
Flow Through Underdrain (ac-ft.):	477.621
Total Outflow (ac-ft.):	521.954
Percent Through Underdrain:	91.51
Discharge Structure	
Riser Height:	0.5 ft.
Riser Diameter:	12 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	
Gravel Trench Bed 1	

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0310	0.0000	0.0000	0.0000
0.0440	0.0310	0.0006	0.0000	0.0000
0.0879	0.0310	0.0012	0.0000	0.0000
0.1319	0.0310	0.0019	0.0000	0.0000
0.1758	0.0310	0.0025	0.0000	0.0000
0.2198	0.0310	0.0031	0.0009	0.0000
0.2637	0.0310	0.0037	0.0014	0.0000
0.3077	0.0310	0.0044	0.0022	0.0000
0.3516	0.0310	0.0050	0.0032	0.0000
0.3956	0.0310	0.0056	0.0045	0.0000
0.4396	0.0310	0.0062	0.0060	0.0000
0.4835	0.0310	0.0069	0.0078	0.0000
0.5275	0.0310	0.0075	0.0097	0.0000
0.5714	0.0310	0.0081	0.0100	0.0000
0.6154	0.0310	0.0087	0.0124	0.0000
0.6593	0.0310	0.0093	0.0152	0.0000
0.7033	0.0310	0.0100	0.0183	0.0000
0.7473	0.0310	0.0106	0.0218	0.0000
0.7912	0.0310	0.0112	0.0235	0.0000
0.8352	0.0310	0.0118	0.0257	0.0000
0.8791	0.0310	0.0125	0.0300	0.0000
0.9231	0.0310	0.0131	0.0347	0.0000
0.9670	0.0310	0.0137	0.0398	0.0000
1.0110	0.0310	0.0143	0.0450	0.0000
1.0549	0.0310	0.0150	0.0454	0.0000
1.0989	0.0310	0.0156	0.0513	0.0000
1.1429	0.0310	0.0162	0.0578	0.0000
1.1868	0.0310	0.0168	0.0647	0.0000
1.2308	0.0310	0.0174	0.0721	0.0000
1.2747	0.0310	0.0181	0.0753	0.0000

1.3187	0.0310	0.0187	0.0799	0.0000
1.3626	0.0310	0.0193	0.0883	0.0000
1.4066	0.0310	0.0199	0.0972	0.0000
1.4505	0.0310	0.0206	0.1066	0.0000
1.4945	0.0310	0.0212	0.1154	0.0000
1.5385	0.0310	0.0217	0.1165	0.0000
1.5824	0.0310	0.0223	0.1269	0.0000
1.6264	0.0310	0.0229	0.1378	0.0000
1.6703	0.0310	0.0234	0.1493	0.0000
1.7143	0.0310	0.0240	0.1613	0.0000
1.7582	0.0310	0.0246	0.1661	0.0000
1.8022	0.0310	0.0251	0.1738	0.0000
1.8462	0.0310	0.0257	0.1864	0.0000
1.8901	0.0310	0.0263	0.2500	0.0000
1.9341	0.0310	0.0268	0.2500	0.0000
1.9780	0.0310	0.0274	0.2500	0.0000
2.0220	0.0310	0.0280	0.2500	0.0000
2.0659	0.0310	0.0285	0.2500	0.0000
2.1099	0.0310	0.0291	0.2500	0.0000
2.1538	0.0310	0.0297	0.2500	0.0000
2.1978	0.0310	0.0302	0.2500	0.0000
2.2418	0.0310	0.0308	0.2500	0.0000
2.2857	0.0310	0.0314	0.2500	0.0000
2.3297	0.0310	0.0319	0.2500	0.0000
2.3736	0.0310	0.0325	0.2500	0.0000
2.4176	0.0310	0.0331	0.2500	0.0000
2.4615	0.0310	0.0336	0.2500	0.0000
2.5055	0.0310	0.0342	0.2500	0.0000
2.5495	0.0310	0.0347	0.2500	0.0000
2.5934	0.0310	0.0353	0.2500	0.0000
2.6374	0.0310	0.0359	0.2500	0.0000
2.6813	0.0310	0.0364	0.2500	0.0000
2.7253	0.0310	0.0370	0.2500	0.0000
2.7692	0.0310	0.0376	0.2500	0.0000
2.8132	0.0310	0.0381	0.2500	0.0000
2.8571	0.0310	0.0387	0.2500	0.0000
2.9011	0.0310	0.0393	0.2500	0.0000
2.9451	0.0310	0.0398	0.2500	0.0000
2.9890	0.0310	0.0404	0.2500	0.0000
3.0000	0.0310	0.0405	0.2500	0.0000

Bioretention Surface Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
3.0000	0.0310	0.0405	0.0000	0.1875	0.0000
3.0440	0.0310	0.0419	0.0000	0.1875	0.0000
3.0879	0.0310	0.0433	0.0000	0.1985	0.0000
3.1319	0.0310	0.0446	0.0000	0.2040	0.0000
3.1758	0.0310	0.0460	0.0000	0.2095	0.0000
3.2198	0.0310	0.0474	0.0000	0.2150	0.0000
3.2637	0.0310	0.0487	0.0000	0.2205	0.0000
3.3077	0.0310	0.0501	0.0000	0.2260	0.0000
3.3516	0.0310	0.0514	0.0000	0.2315	0.0000
3.3956	0.0310	0.0528	0.0000	0.2370	0.0000
3.4396	0.0310	0.0542	0.0000	0.2424	0.0000
3.4835	0.0310	0.0555	0.0000	0.2479	0.0000
3.5275	0.0310	0.0569	0.0483	0.2500	0.0000
3.5714	0.0310	0.0583	0.2020	0.2500	0.0000
3.6154	0.0310	0.0596	0.4122	0.2500	0.0000

3.6593	0.0310	0.0610	0.6597	0.2500	0.0000
3.7033	0.0310	0.0623	0.9282	0.2500	0.0000
3.7473	0.0310	0.0637	1.2008	0.2500	0.0000
3.7912	0.0310	0.0651	1.4606	0.2500	0.0000
3.8352	0.0310	0.0664	1.6924	0.2500	0.0000
3.8791	0.0310	0.0678	1.8845	0.2500	0.0000
3.9231	0.0310	0.0692	2.0318	0.2500	0.0000
3.9670	0.0310	0.0705	2.1391	0.2500	0.0000
4.0000	0.0310	0.0715	2.2515	0.2500	0.0000

Gravel Trench Bed 1

Bottom Length:	40.00 ft.
Bottom Width:	5.00 ft.
Trench bottom slope 1:	0 To 1
Trench Left side slope 0:	0 To 1
Trench right side slope 2:	0 To 1
Material thickness of first layer:	5
Pour Space of material for first layer:	0.35
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	2
Infiltration safety factor:	1
Wetted surface area On	
Total Volume Infiltrated (ac-ft.):	2.156
Total Volume Through Riser (ac-ft.):	0.813
Total Volume Through Facility (ac-ft.):	2.969
Percent Infiltrated:	72.62
Total Precip Applied to Facility:	0
Total Evap From Facility:	0
Discharge Structure	
Riser Height:	3 ft.
Riser Diameter:	12 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	

Gravel Trench Bed Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.004	0.000	0.000	0.000
0.0556	0.004	0.000	0.000	0.009
0.1111	0.004	0.000	0.000	0.009
0.1667	0.004	0.000	0.000	0.009
0.2222	0.004	0.000	0.000	0.009
0.2778	0.004	0.000	0.000	0.009
0.3333	0.004	0.000	0.000	0.009
0.3889	0.004	0.000	0.000	0.009
0.4444	0.004	0.000	0.000	0.009
0.5000	0.004	0.000	0.000	0.009
0.5556	0.004	0.000	0.000	0.009
0.6111	0.004	0.001	0.000	0.009
0.6667	0.004	0.001	0.000	0.009
0.7222	0.004	0.001	0.000	0.009
0.7778	0.004	0.001	0.000	0.009
0.8333	0.004	0.001	0.000	0.009
0.8889	0.004	0.001	0.000	0.009
0.9444	0.004	0.001	0.000	0.009
1.0000	0.004	0.001	0.000	0.009
1.0556	0.004	0.001	0.000	0.009
1.1111	0.004	0.001	0.000	0.009
1.1667	0.004	0.001	0.000	0.009
1.2222	0.004	0.002	0.000	0.009
1.2778	0.004	0.002	0.000	0.009

1.3333	0.004	0.002	0.000	0.009
1.3889	0.004	0.002	0.000	0.009
1.4444	0.004	0.002	0.000	0.009
1.5000	0.004	0.002	0.000	0.009
1.5556	0.004	0.002	0.000	0.009
1.6111	0.004	0.002	0.000	0.009
1.6667	0.004	0.002	0.000	0.009
1.7222	0.004	0.002	0.000	0.009
1.7778	0.004	0.002	0.000	0.009
1.8333	0.004	0.002	0.000	0.009
1.8889	0.004	0.003	0.000	0.009
1.9444	0.004	0.003	0.000	0.009
2.0000	0.004	0.003	0.000	0.009
2.0556	0.004	0.003	0.000	0.009
2.1111	0.004	0.003	0.000	0.009
2.1667	0.004	0.003	0.000	0.009
2.2222	0.004	0.003	0.000	0.009
2.2778	0.004	0.003	0.000	0.009
2.3333	0.004	0.003	0.000	0.009
2.3889	0.004	0.003	0.000	0.009
2.4444	0.004	0.003	0.000	0.009
2.5000	0.004	0.004	0.000	0.009
2.5556	0.004	0.004	0.000	0.009
2.6111	0.004	0.004	0.000	0.009
2.6667	0.004	0.004	0.000	0.009
2.7222	0.004	0.004	0.000	0.009
2.7778	0.004	0.004	0.000	0.009
2.8333	0.004	0.004	0.000	0.009
2.8889	0.004	0.004	0.000	0.009
2.9444	0.004	0.004	0.000	0.009
3.0000	0.004	0.004	0.000	0.009
3.0556	0.004	0.004	0.138	0.009
3.1111	0.004	0.005	0.389	0.009
3.1667	0.004	0.005	0.703	0.009
3.2222	0.004	0.005	1.046	0.009
3.2778	0.004	0.005	1.383	0.009
3.3333	0.004	0.005	1.683	0.009
3.3889	0.004	0.005	1.921	0.009
3.4444	0.004	0.005	2.088	0.009
3.5000	0.004	0.005	2.203	0.009
3.5556	0.004	0.005	2.347	0.009
3.6111	0.004	0.005	2.462	0.009
3.6667	0.004	0.005	2.571	0.009
3.7222	0.004	0.006	2.676	0.009
3.7778	0.004	0.006	2.777	0.009
3.8333	0.004	0.006	2.875	0.009
3.8889	0.004	0.006	2.969	0.009
3.9444	0.004	0.006	3.060	0.009
4.0000	0.004	0.006	3.149	0.009
4.0556	0.004	0.006	3.235	0.009
4.1111	0.004	0.006	3.320	0.009
4.1667	0.004	0.006	3.402	0.009
4.2222	0.004	0.006	3.482	0.009
4.2778	0.004	0.006	3.560	0.009
4.3333	0.004	0.007	3.636	0.009
4.3889	0.004	0.007	3.711	0.009
4.4444	0.004	0.007	3.785	0.009
4.5000	0.004	0.007	3.857	0.009

4.5556	0.004	0.007	3.928	0.009
4.6111	0.004	0.007	3.997	0.009
4.6667	0.004	0.007	4.066	0.009
4.7222	0.004	0.007	4.133	0.009
4.7778	0.004	0.007	4.199	0.009
4.8333	0.004	0.007	4.264	0.009
4.8889	0.004	0.007	4.328	0.009
4.9444	0.004	0.007	4.391	0.009
5.0000	0.004	0.008	4.454	0.009

Gravel Trench Bed 1

Bottom Length:	270.00 ft.
Bottom Width:	5.00 ft.
Trench bottom slope 1:	0 To 1
Trench Left side slope 0:	0 To 1
Trench right side slope 2:	0 To 1
Material thickness of first layer:	6
Pour Space of material for first layer:	0.35
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	2
Infiltration safety factor:	1
Wetted surface area On	
Total Volume Infiltrated (ac-ft.):	31.896
Total Volume Through Riser (ac-ft.):	12.447
Total Volume Through Facility (ac-ft.):	44.343
Percent Infiltrated:	71.93
Total Precip Applied to Facility:	0
Total Evap From Facility:	0
Discharge Structure	
Riser Height:	4 ft.
Riser Diameter:	12 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	

Gravel Trench Bed Hydraulic Table

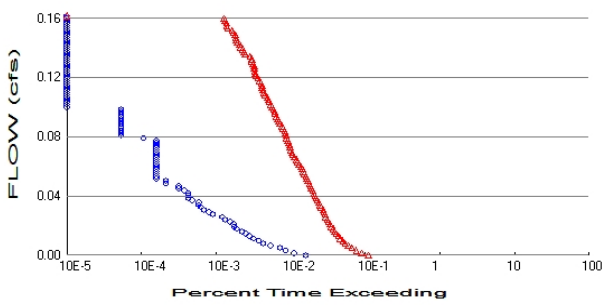
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.031	0.000	0.000	0.000
0.0667	0.031	0.000	0.000	0.062
0.1333	0.031	0.001	0.000	0.062
0.2000	0.031	0.002	0.000	0.062
0.2667	0.031	0.002	0.000	0.062
0.3333	0.031	0.003	0.000	0.062
0.4000	0.031	0.004	0.000	0.062
0.4667	0.031	0.005	0.000	0.062
0.5333	0.031	0.005	0.000	0.062
0.6000	0.031	0.006	0.000	0.062
0.6667	0.031	0.007	0.000	0.062
0.7333	0.031	0.008	0.000	0.062
0.8000	0.031	0.008	0.000	0.062
0.8667	0.031	0.009	0.000	0.062
0.9333	0.031	0.010	0.000	0.062
1.0000	0.031	0.010	0.000	0.062
1.0667	0.031	0.011	0.000	0.062
1.1333	0.031	0.012	0.000	0.062
1.2000	0.031	0.013	0.000	0.062
1.2667	0.031	0.013	0.000	0.062
1.3333	0.031	0.014	0.000	0.062
1.4000	0.031	0.015	0.000	0.062
1.4667	0.031	0.015	0.000	0.062
1.5333	0.031	0.016	0.000	0.062

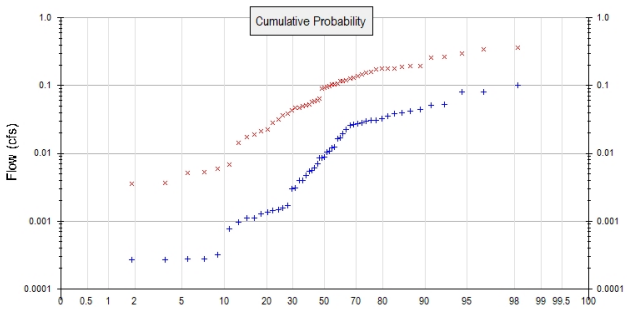
1.6000	0.031	0.017	0.000	0.062
1.6667	0.031	0.018	0.000	0.062
1.7333	0.031	0.018	0.000	0.062
1.8000	0.031	0.019	0.000	0.062
1.8667	0.031	0.020	0.000	0.062
1.9333	0.031	0.021	0.000	0.062
2.0000	0.031	0.021	0.000	0.062
2.0667	0.031	0.022	0.000	0.062
2.1333	0.031	0.023	0.000	0.062
2.2000	0.031	0.023	0.000	0.062
2.2667	0.031	0.024	0.000	0.062
2.3333	0.031	0.025	0.000	0.062
2.4000	0.031	0.026	0.000	0.062
2.4667	0.031	0.026	0.000	0.062
2.5333	0.031	0.027	0.000	0.062
2.6000	0.031	0.028	0.000	0.062
2.6667	0.031	0.028	0.000	0.062
2.7333	0.031	0.029	0.000	0.062
2.8000	0.031	0.030	0.000	0.062
2.8667	0.031	0.031	0.000	0.062
2.9333	0.031	0.031	0.000	0.062
3.0000	0.031	0.032	0.000	0.062
3.0667	0.031	0.033	0.000	0.062
3.1333	0.031	0.034	0.000	0.062
3.2000	0.031	0.034	0.000	0.062
3.2667	0.031	0.035	0.000	0.062
3.3333	0.031	0.036	0.000	0.062
3.4000	0.031	0.036	0.000	0.062
3.4667	0.031	0.037	0.000	0.062
3.5333	0.031	0.038	0.000	0.062
3.6000	0.031	0.039	0.000	0.062
3.6667	0.031	0.039	0.000	0.062
3.7333	0.031	0.040	0.000	0.062
3.8000	0.031	0.041	0.000	0.062
3.8667	0.031	0.041	0.000	0.062
3.9333	0.031	0.042	0.000	0.062
4.0000	0.031	0.043	0.000	0.062
4.0667	0.031	0.044	0.182	0.062
4.1333	0.031	0.044	0.509	0.062
4.2000	0.031	0.045	0.907	0.062
4.2667	0.031	0.046	1.318	0.062
4.3333	0.031	0.047	1.683	0.062
4.4000	0.031	0.047	1.960	0.062
4.4667	0.031	0.048	2.138	0.062
4.5333	0.031	0.049	2.300	0.062
4.6000	0.031	0.049	2.439	0.062
4.6667	0.031	0.050	2.571	0.062
4.7333	0.031	0.051	2.697	0.062
4.8000	0.031	0.052	2.817	0.062
4.8667	0.031	0.052	2.932	0.062
4.9333	0.031	0.053	3.042	0.062
5.0000	0.031	0.054	3.149	0.062
5.0667	0.031	0.055	3.252	0.062
5.1333	0.031	0.055	3.353	0.062
5.2000	0.031	0.056	3.450	0.062
5.2667	0.031	0.057	3.544	0.062
5.3333	0.031	0.057	3.636	0.062
5.4000	0.031	0.058	3.726	0.062

5.4667	0.031	0.059	3.814	0.062
5.5333	0.031	0.060	3.900	0.062
5.6000	0.031	0.060	3.984	0.062
5.6667	0.031	0.061	4.066	0.062
5.7333	0.031	0.062	4.146	0.062
5.8000	0.031	0.062	4.225	0.062
5.8667	0.031	0.063	4.303	0.062
5.9333	0.031	0.064	4.379	0.062
6.0000	0.031	0.065	4.454	0.062

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.341
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.091
Total Impervious Area: 0.25

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.007507
5 year	0.029412
10 year	0.056407
25 year	0.107905
50 year	0.160105
100 year	0.224695

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.070579
5 year	0.199326
10 year	0.302374
25 year	0.433258
50 year	0.524072
100 year	0.606271

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1956	0.053	0.196
1957	0.005	0.176
1958	0.081	0.196
1959	0.019	0.099
1960	0.081	0.191
1961	0.039	0.120
1962	0.100	0.145
1963	0.030	0.266
1964	0.017	0.117
1965	0.009	0.019

1966	0.001	0.004
1967	0.004	0.061
1968	0.001	0.047
1969	0.004	0.022
1970	0.006	0.014
1971	0.036	0.053
1972	0.027	0.089
1973	0.001	0.064
1974	0.038	0.126
1975	0.041	0.180
1976	0.022	0.031
1977	0.000	0.006
1978	0.045	0.158
1979	0.001	0.058
1980	0.003	0.047
1981	0.005	0.049
1982	0.026	0.104
1983	0.011	0.096
1984	0.033	0.117
1985	0.001	0.051
1986	0.030	0.177
1987	0.002	0.129
1988	0.000	0.036
1989	0.001	0.005
1990	0.012	0.092
1991	0.028	0.028
1992	0.001	0.007
1993	0.007	0.018
1994	0.006	0.005
1995	0.002	0.153
1996	0.051	0.257
1997	0.012	0.108
1998	0.010	0.338
1999	0.001	0.021
2000	0.003	0.059
2001	0.000	0.000
2002	0.009	0.362
2003	0.000	0.295
2004	0.000	0.004
2005	0.000	0.043
2006	0.017	0.039
2007	0.028	0.179
2008	0.009	0.104
2009	0.030	0.139

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.1002	0.3619
2	0.0813	0.3384
3	0.0807	0.2950
4	0.0530	0.2656
5	0.0509	0.2572
6	0.0450	0.1964
7	0.0415	0.1962
8	0.0393	0.1911
9	0.0385	0.1800
10	0.0359	0.1785

11	0.0326	0.1766
12	0.0305	0.1756
13	0.0304	0.1579
14	0.0295	0.1533
15	0.0281	0.1451
16	0.0276	0.1390
17	0.0267	0.1287
18	0.0262	0.1257
19	0.0224	0.1196
20	0.0194	0.1172
21	0.0167	0.1170
22	0.0166	0.1080
23	0.0123	0.1038
24	0.0119	0.1037
25	0.0107	0.0988
26	0.0104	0.0958
27	0.0088	0.0921
28	0.0086	0.0891
29	0.0085	0.0637
30	0.0071	0.0613
31	0.0061	0.0591
32	0.0056	0.0580
33	0.0054	0.0532
34	0.0048	0.0508
35	0.0040	0.0493
36	0.0039	0.0475
37	0.0031	0.0469
38	0.0030	0.0434
39	0.0017	0.0390
40	0.0016	0.0359
41	0.0015	0.0312
42	0.0014	0.0283
43	0.0013	0.0224
44	0.0013	0.0210
45	0.0011	0.0190
46	0.0011	0.0176
47	0.0010	0.0144
48	0.0008	0.0068
49	0.0003	0.0059
50	0.0003	0.0052
51	0.0003	0.0052
52	0.0003	0.0037
53	0.0003	0.0036
54	0.0002	0.0001

Duration Flows

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0038	300	2071	690	Fail
0.0053	207	1685	814	Fail
0.0069	161	1438	893	Fail
0.0085	135	1246	922	Fail
0.0101	100	1109	1109	Fail
0.0117	81	1022	1261	Fail
0.0132	70	949	1355	Fail
0.0148	60	875	1458	Fail
0.0164	52	823	1582	Fail
0.0180	47	772	1642	Fail
0.0195	42	730	1738	Fail
0.0211	36	702	1950	Fail
0.0227	33	667	2021	Fail
0.0243	32	633	1978	Fail
0.0259	29	607	2093	Fail
0.0274	25	587	2348	Fail
0.0290	23	562	2443	Fail
0.0306	17	543	3194	Fail
0.0322	15	526	3506	Fail
0.0338	13	513	3946	Fail
0.0353	12	485	4041	Fail
0.0369	11	471	4281	Fail
0.0385	11	449	4081	Fail
0.0401	9	427	4744	Fail
0.0417	8	412	5150	Fail
0.0432	8	400	5000	Fail
0.0448	8	387	4837	Fail
0.0464	7	375	5357	Fail
0.0480	6	357	5950	Fail
0.0496	6	350	5833	Fail
0.0511	4	335	8375	Fail
0.0527	4	322	8050	Fail
0.0543	3	311	10366	Fail
0.0559	3	303	10100	Fail
0.0574	3	287	9566	Fail
0.0590	3	280	9333	Fail
0.0606	3	270	9000	Fail
0.0622	3	258	8600	Fail
0.0638	3	244	8133	Fail
0.0653	3	233	7766	Fail
0.0669	3	226	7533	Fail
0.0685	3	210	7000	Fail
0.0701	3	200	6666	Fail
0.0717	3	196	6533	Fail
0.0732	3	190	6333	Fail
0.0748	3	185	6166	Fail
0.0764	3	182	6066	Fail
0.0780	3	177	5900	Fail
0.0796	3	173	5766	Fail
0.0811	2	167	8350	Fail
0.0827	1	164	16400	Fail
0.0843	1	160	16000	Fail
0.0859	1	157	15700	Fail
0.0875	1	150	15000	Fail

0.0890	1	145	14500	Fail
0.0906	1	136	13600	Fail
0.0922	1	131	13100	Fail
0.0938	1	127	12700	Fail
0.0954	1	121	12100	Fail
0.0969	1	116	11600	Fail
0.0985	1	116	11600	Fail
0.1001	1	112	11200	Fail
0.1017	0	107	n/a	Fail
0.1032	0	103	n/a	Fail
0.1048	0	97	n/a	Fail
0.1064	0	95	n/a	Fail
0.1080	0	92	n/a	Fail
0.1096	0	87	n/a	Fail
0.1111	0	82	n/a	Fail
0.1127	0	80	n/a	Fail
0.1143	0	78	n/a	Fail
0.1159	0	78	n/a	Fail
0.1175	0	76	n/a	Fail
0.1190	0	73	n/a	Fail
0.1206	0	69	n/a	Fail
0.1222	0	64	n/a	Fail
0.1238	0	63	n/a	Fail
0.1254	0	62	n/a	Fail
0.1269	0	61	n/a	Fail
0.1285	0	61	n/a	Fail
0.1301	0	59	n/a	Fail
0.1317	0	57	n/a	Fail
0.1333	0	57	n/a	Fail
0.1348	0	54	n/a	Fail
0.1364	0	46	n/a	Fail
0.1380	0	45	n/a	Fail
0.1396	0	43	n/a	Fail
0.1412	0	40	n/a	Fail
0.1427	0	39	n/a	Fail
0.1443	0	36	n/a	Fail
0.1459	0	35	n/a	Fail
0.1475	0	35	n/a	Fail
0.1490	0	34	n/a	Fail
0.1506	0	32	n/a	Fail
0.1522	0	31	n/a	Fail
0.1538	0	27	n/a	Fail
0.1554	0	26	n/a	Fail
0.1569	0	26	n/a	Fail
0.1585	0	25	n/a	Fail
0.1601	0	24	n/a	Fail

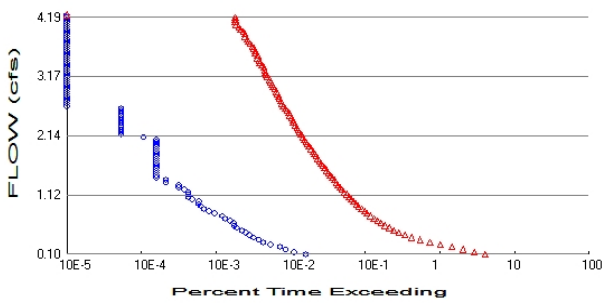
The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

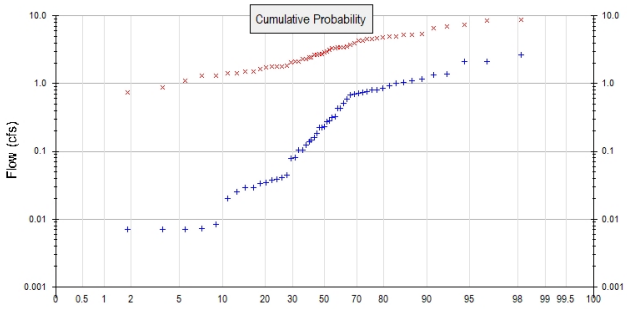
Water Quality

Water Quality BMP Flow and Volume for POC #1

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

POC 2





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #2
Total Pervious Area: 8.921
Total Impervious Area: 0

Mitigated Landuse Totals for POC #2
Total Pervious Area: 4.645
Total Impervious Area: 4.276

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #2

Return Period	**Flow(cfs)**
2 year	0.196403
5 year	0.769448
10 year	1.475668
25 year	2.822928
50 year	4.188567
100 year	5.878319

Flow Frequency Return Periods for Mitigated. POC #2

Return Period	**Flow(cfs)**
2 year	2.868293
5 year	4.69185
10 year	5.932872
25 year	7.49532
50 year	8.640685
100 year	9.763214

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #2

Year	**Predeveloped**	**Mitigated**
1956	1.386	5.348
1957	0.141	4.555
1958	2.128	4.802
1959	0.506	2.689
1960	2.111	5.210
1961	1.027	3.955
1962	2.621	4.530
1963	0.772	6.990
1964	0.433	3.370
1965	0.230	1.660
1966	0.029	1.497

1967	0.105	1.822
1968	0.020	1.439
1969	0.103	2.452
1970	0.147	1.738
1971	0.939	3.457
1972	0.698	2.448
1973	0.033	1.764
1974	1.007	4.317
1975	1.085	7.386
1976	0.586	3.305
1977	0.007	1.402
1978	1.177	4.325
1979	0.038	1.778
1980	0.078	2.286
1981	0.125	2.129
1982	0.685	3.376
1983	0.280	3.102
1984	0.854	3.385
1985	0.025	1.515
1986	0.796	4.936
1987	0.041	3.473
1988	0.008	2.117
1989	0.029	0.888
1990	0.312	2.615
1991	0.736	2.900
1992	0.038	1.318
1993	0.186	2.076
1994	0.161	1.110
1995	0.044	5.305
1996	1.331	6.563
1997	0.322	2.997
1998	0.273	8.364
1999	0.035	1.293
2000	0.080	2.319
2001	0.006	0.436
2002	0.224	8.813
2003	0.007	4.955
2004	0.007	0.737
2005	0.007	1.774
2006	0.437	2.765
2007	0.722	4.680
2008	0.223	2.746
2009	0.797	3.732

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #2

Rank	Predeveloped	Mitigated
1	2.6209	8.8125
2	2.1275	8.3638
3	2.1106	7.3857
4	1.3857	6.9896
5	1.3312	6.5631
6	1.1770	5.3481
7	1.0854	5.3052
8	1.0275	5.2096
9	1.0070	4.9547
10	0.9390	4.9359
11	0.8536	4.8018

12	0.7972	4.6799
13	0.7962	4.5549
14	0.7719	4.5303
15	0.7358	4.3252
16	0.7224	4.3172
17	0.6975	3.9553
18	0.6848	3.7317
19	0.5862	3.4734
20	0.5064	3.4571
21	0.4371	3.3854
22	0.4334	3.3764
23	0.3224	3.3704
24	0.3116	3.3051
25	0.2799	3.1021
26	0.2728	2.9973
27	0.2299	2.8999
28	0.2244	2.7653
29	0.2229	2.7457
30	0.1855	2.6888
31	0.1607	2.6153
32	0.1466	2.4515
33	0.1406	2.4484
34	0.1249	2.3191
35	0.1050	2.2856
36	0.1033	2.1292
37	0.0804	2.1169
38	0.0784	2.0765
39	0.0444	1.8221
40	0.0408	1.7776
41	0.0384	1.7736
42	0.0376	1.7640
43	0.0349	1.7380
44	0.0332	1.6603
45	0.0294	1.5147
46	0.0288	1.4970
47	0.0255	1.4394
48	0.0201	1.4024
49	0.0083	1.3182
50	0.0072	1.2933
51	0.0071	1.1102
52	0.0071	0.8885
53	0.0071	0.7370
54	0.0064	0.4364

Duration Flows

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0982	300	76687	25562	Fail
0.1395	207	54457	26307	Fail
0.1808	161	38646	24003	Fail
0.2222	135	27229	20169	Fail
0.2635	100	19257	19257	Fail
0.3048	81	13932	17200	Fail
0.3461	70	10282	14688	Fail
0.3874	60	7864	13106	Fail
0.4287	52	6415	12336	Fail
0.4701	47	5328	11336	Fail
0.5114	42	4565	10869	Fail
0.5527	36	3984	11066	Fail
0.5940	33	3475	10530	Fail
0.6353	32	3062	9568	Fail
0.6766	29	2772	9558	Fail
0.7180	25	2465	9860	Fail
0.7593	23	2212	9617	Fail
0.8006	18	1986	11033	Fail
0.8419	15	1842	12280	Fail
0.8832	13	1684	12953	Fail
0.9245	12	1544	12866	Fail
0.9659	11	1433	13027	Fail
1.0072	11	1313	11936	Fail
1.0485	9	1228	13644	Fail
1.0898	8	1147	14337	Fail
1.1311	8	1065	13312	Fail
1.1724	8	983	12287	Fail
1.2138	7	920	13142	Fail
1.2551	6	862	14366	Fail
1.2964	6	810	13500	Fail
1.3377	4	770	19250	Fail
1.3790	4	727	18175	Fail
1.4203	3	681	22700	Fail
1.4617	3	645	21500	Fail
1.5030	3	607	20233	Fail
1.5443	3	569	18966	Fail
1.5856	3	537	17900	Fail
1.6269	3	508	16933	Fail
1.6682	3	483	16100	Fail
1.7096	3	459	15300	Fail
1.7509	3	437	14566	Fail
1.7922	3	414	13800	Fail
1.8335	3	394	13133	Fail
1.8748	3	376	12533	Fail
1.9161	3	354	11800	Fail
1.9575	3	333	11100	Fail
1.9988	3	315	10500	Fail
2.0401	3	304	10133	Fail
2.0814	3	285	9500	Fail
2.1227	2	275	13750	Fail
2.1640	1	260	26000	Fail
2.2054	1	247	24700	Fail
2.2467	1	238	23800	Fail
2.2880	1	230	23000	Fail

2.3293	1	214	21400	Fail
2.3706	1	205	20500	Fail
2.4119	1	202	20200	Fail
2.4533	1	193	19300	Fail
2.4946	1	183	18300	Fail
2.5359	1	178	17800	Fail
2.5772	1	168	16800	Fail
2.6185	1	159	15900	Fail
2.6598	0	150	n/a	Fail
2.7012	0	143	n/a	Fail
2.7425	0	138	n/a	Fail
2.7838	0	132	n/a	Fail
2.8251	0	129	n/a	Fail
2.8664	0	126	n/a	Fail
2.9077	0	122	n/a	Fail
2.9491	0	116	n/a	Fail
2.9904	0	109	n/a	Fail
3.0317	0	106	n/a	Fail
3.0730	0	103	n/a	Fail
3.1143	0	98	n/a	Fail
3.1556	0	91	n/a	Fail
3.1970	0	88	n/a	Fail
3.2383	0	87	n/a	Fail
3.2796	0	85	n/a	Fail
3.3209	0	83	n/a	Fail
3.3622	0	78	n/a	Fail
3.4035	0	72	n/a	Fail
3.4449	0	72	n/a	Fail
3.4862	0	68	n/a	Fail
3.5275	0	68	n/a	Fail
3.5688	0	63	n/a	Fail
3.6101	0	63	n/a	Fail
3.6514	0	61	n/a	Fail
3.6928	0	58	n/a	Fail
3.7341	0	54	n/a	Fail
3.7754	0	51	n/a	Fail
3.8167	0	49	n/a	Fail
3.8580	0	46	n/a	Fail
3.8993	0	46	n/a	Fail
3.9407	0	44	n/a	Fail
3.9820	0	40	n/a	Fail
4.0233	0	38	n/a	Fail
4.0646	0	35	n/a	Fail
4.1059	0	34	n/a	Fail
4.1473	0	34	n/a	Fail
4.1886	0	34	n/a	Fail

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

Water Quality

Water Quality BMP Flow and Volume for POC #2

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

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

No PERLND changes have been made.

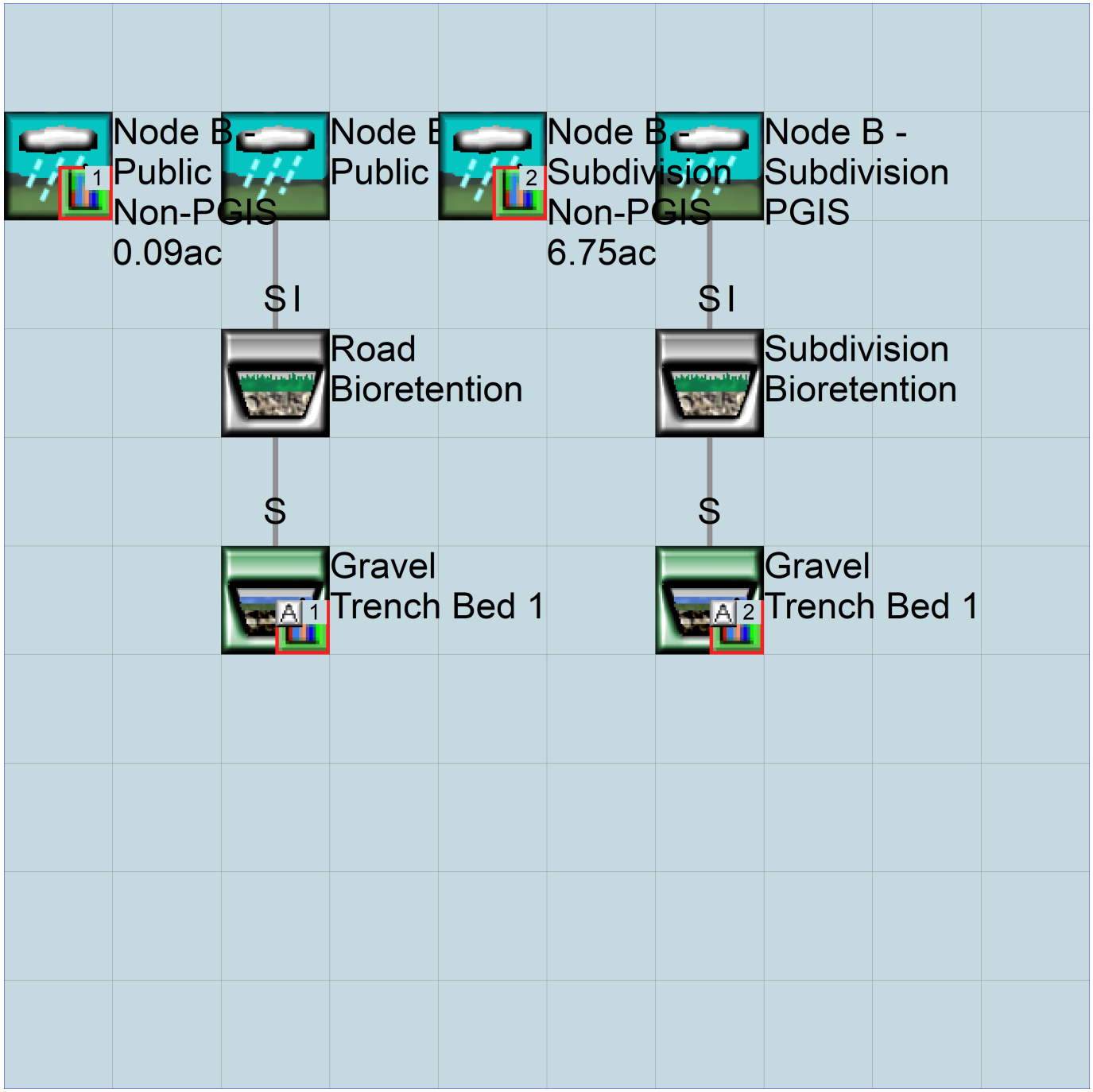
IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   18591_Node B.wdm
MESSU       25   Pre18591_Node B.MES
            27   Pre18591_Node B.L61
            28   Pre18591_Node B.L62
            30   POC18591_Node B1.dat
            31   POC18591_Node B2.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND       2
      COPY       501
      COPY       502
      DISPLY       1
      DISPLY       2
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title---------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Node A - Existing Public    MAX                   1    2   30    9
    2        Node A - Existng C/F        MAX                   1    2   31    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  502         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
    2     A/B, Forest, Mod        1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    2         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
```

```
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
    2         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    2         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    2              0         5         2       400       0.1       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    2              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    2          0.2       0.5      0.35         0       0.7       0.7
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
             ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
    2              0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

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

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

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

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

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

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

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

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Node A - Existing Public***
PERLND   2                       0.341     COPY   501     12
PERLND   2                       0.341     COPY   501     13
Node A - Existng C/F***
PERLND   2                       8.921     COPY   502     12
PERLND   2                       8.921     COPY   502     13

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

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1
COPY   502 OUTPUT MEAN   1 1   48.4        DISPLY   2     INPUT  TIMSER 1



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

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

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

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

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

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

SPEC-ACTIONS
```

```
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.429          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.429          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
COPY   502 OUTPUT MEAN   1 1     48.4      WDM    502 FLOW     ENGL      REPL
END EXT TARGETS

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

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


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   18591_Node B.wdm
MESSU       25   Mit18591_Node B.MES
            27   Mit18591_Node B.L61
            28   Mit18591_Node B.L62
            30   POC18591_Node B1.dat
            31   POC18591_Node B2.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      IMPLND       1
      PERLND       8
      IMPLND       4
      RCHRES       1
      RCHRES       2
      RCHRES       3
      RCHRES       4
      RCHRES       5
      RCHRES       6
      COPY         1
      COPY       501
      COPY       601
      COPY         2
      COPY       502
      COPY       602
      DISPLY       1
      DISPLY       2
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Gravel Trench Bed 1         MAX                    1    2   30    9
    2        Gravel Trench Bed 1         MAX                    1    2   31    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  601         1    1
    2         1    1
  502         1    1
  602         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
```

```
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                         User  t-series Engl Metr ***
                                        in  out           ***
    8     A/B, Lawn, Mod          1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    8         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
    8         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    8         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    8             0         5       0.8       400       0.1       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    8             0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    8          0.1       0.5      0.25         0       0.7      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
             ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
    8             0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                    in  out           ***
    1      ROADS/FLAT             1    1    1   27    0
    4      ROOF TOPS/FLAT         1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
    4         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
```

```
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    4    1    9
    4         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
    4         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
    4            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
    4              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
    4              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Node B - Public PGIS***
IMPLND   1                        0.25     RCHRES   1      5
Node B - Subdivision PGIS***
IMPLND   1                       2.176     RCHRES   3      5
Node B - Public Non-PGIS***
PERLND   8                       0.091     COPY   501     12
PERLND   8                       0.091     COPY   601     12
PERLND   8                       0.091     COPY   501     13
PERLND   8                       0.091     COPY   601     13
Node B - Subdivision Non-PGIS***
PERLND   8                       4.645     COPY   502     12
PERLND   8                       4.645     COPY   602     12
PERLND   8                       4.645     COPY   502     13
PERLND   8                       4.645     COPY   602     13
IMPLND   4                         2.1     COPY   502     15
IMPLND   4                         2.1     COPY   602     15

******Routing******
RCHRES   1                           1     RCHRES   5      7
RCHRES   1                                 COPY     1     17
RCHRES   1                           1     RCHRES   2      8
RCHRES   3                           1     RCHRES   6      7
RCHRES   3                                 COPY     2     17
RCHRES   3                           1     RCHRES   4      8
RCHRES   5                           1     COPY   501     17
RCHRES   6                           1     COPY   502     17
END SCHEMATIC

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

```
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1
COPY   502 OUTPUT MEAN   1 1   48.4        DISPLY   2     INPUT  TIMSER 1


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

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                        in  out                              ***
    1     Surface Bioreten-009    2    1    1    1   28    0    1
    2     Road Bioretentio-008    1    1    1    1   28    0    1
    3     Surface Bioreten-021    2    1    1    1   28    0    1
    4     Subdivision Bior-020    1    1    1    1   28    0    1
    5     Gravel Trench Be-022    2    1    1    1   28    0    1
    6     Gravel Trench Be-023    2    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
    2         1    0    0    0    0    0    0    0    0    0
    3         1    0    0    0    0    0    0    0    0    0
    4         1    0    0    0    0    0    0    0    0    0
    5         1    0    0    0    0    0    0    0    0    0
    6         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
    2         4    0    0    0    0    0    0    0    0    0    1    9
    3         4    0    0    0    0    0    0    0    0    0    1    9
    4         4    0    0    0    0    0    0    0    0    0    1    9
    5         4    0    0    0    0    0    0    0    0    0    1    9
    6         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                    ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
           FG FG FG FG  possible  exit  *** possible  exit      possible  exit
            *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
    1       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    2       0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
    3       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    4       0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
    5       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    6       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><--------->      ***
    1             1      0.01       0.0       0.0       0.0       0.0
    2             2      0.01       0.0       0.0       0.0       0.0
    3             3      0.01       0.0       0.0       0.0       0.0
    4             4      0.05       0.0       0.0       0.0       0.0
    5             5      0.01       0.0       0.0       0.5       0.0
    6             6      0.05       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                       ***
```

```
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
           *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    3            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    4            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    5            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    6            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      2
   70    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.004591  0.000000  0.000000
  0.043956  0.004591  0.000092  0.000000
  0.087912  0.004591  0.000185  0.000000
  0.131868  0.004591  0.000277  0.000000
  0.175824  0.004591  0.000369  0.000000
  0.219780  0.004591  0.000461  0.000127
  0.263736  0.004591  0.000554  0.000213
  0.307692  0.004591  0.000646  0.000329
  0.351648  0.004591  0.000738  0.000478
  0.395604  0.004591  0.000831  0.000665
  0.439560  0.004591  0.000923  0.000891
  0.483516  0.004591  0.001015  0.001160
  0.527473  0.004591  0.001107  0.001441
  0.571429  0.004591  0.001200  0.001475
  0.615385  0.004591  0.001292  0.001837
  0.659341  0.004591  0.001384  0.002250
  0.703297  0.004591  0.001477  0.002715
  0.747253  0.004591  0.001569  0.003234
  0.791209  0.004591  0.001661  0.003483
  0.835165  0.004591  0.001754  0.003810
  0.879121  0.004591  0.001846  0.004445
  0.923077  0.004591  0.001938  0.005140
  0.967033  0.004591  0.002030  0.005897
  1.010989  0.004591  0.002123  0.006668
  1.054945  0.004591  0.002215  0.006719
  1.098901  0.004591  0.002307  0.007606
  1.142857  0.004591  0.002400  0.008560
  1.186813  0.004591  0.002492  0.009584
  1.230769  0.004591  0.002584  0.010678
  1.274725  0.004591  0.002676  0.011158
  1.318681  0.004591  0.002769  0.011843
  1.362637  0.004591  0.002861  0.013083
  1.406593  0.004591  0.002953  0.014396
  1.450549  0.004591  0.003046  0.015786
  1.494505  0.004591  0.003138  0.017096
  1.538462  0.004591  0.003222  0.017253
  1.582418  0.004591  0.003305  0.018797
  1.626374  0.004591  0.003389  0.020420
  1.670330  0.004591  0.003473  0.022120
  1.714286  0.004591  0.003557  0.023897
  1.758242  0.004591  0.003640  0.024614
  1.802198  0.004591  0.003724  0.025745
  1.846154  0.004591  0.003808  0.027617
  1.890110  0.004591  0.003892  0.037037
  1.934066  0.004591  0.003975  0.037037
  1.978022  0.004591  0.004059  0.037037
  2.021978  0.004591  0.004143  0.037037
  2.065934  0.004591  0.004227  0.037037
  2.109890  0.004591  0.004310  0.037037
  2.153846  0.004591  0.004394  0.037037
  2.197802  0.004591  0.004478  0.037037
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2.241758  0.004591  0.004562  0.037037
2.285714  0.004591  0.004645  0.037037
2.329670  0.004591  0.004729  0.037037
2.373626  0.004591  0.004813  0.037037
2.417582  0.004591  0.004897  0.037037
2.461538  0.004591  0.004981  0.037037
2.505495  0.004591  0.005064  0.037037
2.549451  0.004591  0.005148  0.037037
2.593407  0.004591  0.005232  0.037037
2.637363  0.004591  0.005316  0.037037
2.681319  0.004591  0.005399  0.037037
2.725275  0.004591  0.005483  0.037037
2.769231  0.004591  0.005567  0.037037
2.813187  0.004591  0.005651  0.037037
2.857143  0.004591  0.005734  0.037037
2.901099  0.004591  0.005818  0.037037
2.945055  0.004591  0.005902  0.037037
2.989011  0.004591  0.005986  0.037037
3.000000  0.004591  0.006772  0.037037
END FTABLE  2
FTABLE      1
 24    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.004591  0.000000  0.000000  0.000000
0.043956  0.004591  0.000202  0.000000  0.027778
0.087912  0.004591  0.000404  0.000000  0.029406
0.131868  0.004591  0.000605  0.000000  0.030220
0.175824  0.004591  0.000807  0.000000  0.031034
0.219780  0.004591  0.001009  0.000000  0.031848
0.263736  0.004591  0.001211  0.000000  0.032662
0.307692  0.004591  0.001413  0.000000  0.033476
0.351648  0.004591  0.001615  0.000000  0.034290
0.395604  0.004591  0.001816  0.000000  0.035104
0.439560  0.004591  0.002018  0.000000  0.035918
0.483516  0.004591  0.002220  0.000000  0.036732
0.527473  0.004591  0.002422  0.048301  0.037037
0.571429  0.004591  0.002624  0.202028  0.037037
0.615385  0.004591  0.002825  0.412175  0.037037
0.659341  0.004591  0.003027  0.659695  0.037037
0.703297  0.004591  0.003229  0.928167  0.037037
0.747253  0.004591  0.003431  1.200769  0.037037
0.791209  0.004591  0.003633  1.460630  0.037037
0.835165  0.004591  0.003835  1.692395  0.037037
0.879121  0.004591  0.004036  1.884482  0.037037
0.923077  0.004591  0.004238  2.031838  0.037037
0.967033  0.004591  0.004440  2.139092  0.037037
1.000000  0.004591  0.004591  2.251466  0.037037
END FTABLE  1
FTABLE      4
 70    4
   Depth      Area    Volume  Outflow1 Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
0.000000  0.030992  0.000000  0.000000
0.043956  0.030992  0.000623  0.000000
0.087912  0.030992  0.001246  0.000000
0.131868  0.030992  0.001869  0.000000
0.175824  0.030992  0.002492  0.000000
0.219780  0.030992  0.003115  0.000855
0.263736  0.030992  0.003738  0.001435
0.307692  0.030992  0.004361  0.002218
0.351648  0.030992  0.004984  0.003227
0.395604  0.030992  0.005607  0.004486
0.439560  0.030992  0.006230  0.006015
0.483516  0.030992  0.006853  0.007832
0.527473  0.030992  0.007476  0.009728
0.571429  0.030992  0.008099  0.009955
0.615385  0.030992  0.008722  0.012401
0.659341  0.030992  0.009345  0.015186
0.703297  0.030992  0.009967  0.018325
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0.747253  0.030992  0.010590  0.021831
0.791209  0.030992  0.011213  0.023511
0.835165  0.030992  0.011836  0.025719
0.879121  0.030992  0.012459  0.030003
0.923077  0.030992  0.013082  0.034695
0.967033  0.030992  0.013705  0.039806
1.010989  0.030992  0.014328  0.045011
1.054945  0.030992  0.014951  0.045351
1.098901  0.030992  0.015574  0.051338
1.142857  0.030992  0.016197  0.057781
1.186813  0.030992  0.016820  0.064689
1.230769  0.030992  0.017443  0.072073
1.274725  0.030992  0.018066  0.075317
1.318681  0.030992  0.018689  0.079943
1.362637  0.030992  0.019312  0.088308
1.406593  0.030992  0.019935  0.097176
1.450549  0.030992  0.020558  0.106557
1.494505  0.030992  0.021181  0.115400
1.538462  0.030992  0.021746  0.116456
1.582418  0.030992  0.022312  0.126881
1.626374  0.030992  0.022877  0.137833
1.670330  0.030992  0.023442  0.149312
1.714286  0.030992  0.024008  0.161308
1.758242  0.030992  0.024573  0.166144
1.802198  0.030992  0.025138  0.173777
1.846154  0.030992  0.025704  0.186414
1.890110  0.030992  0.026269  0.250000
1.934066  0.030992  0.026834  0.250000
1.978022  0.030992  0.027400  0.250000
2.021978  0.030992  0.027965  0.250000
2.065934  0.030992  0.028530  0.250000
2.109890  0.030992  0.029096  0.250000
2.153846  0.030992  0.029661  0.250000
2.197802  0.030992  0.030226  0.250000
2.241758  0.030992  0.030792  0.250000
2.285714  0.030992  0.031357  0.250000
2.329670  0.030992  0.031922  0.250000
2.373626  0.030992  0.032488  0.250000
2.417582  0.030992  0.033053  0.250000
2.461538  0.030992  0.033618  0.250000
2.505495  0.030992  0.034184  0.250000
2.549451  0.030992  0.034749  0.250000
2.593407  0.030992  0.035315  0.250000
2.637363  0.030992  0.035880  0.250000
2.681319  0.030992  0.036445  0.250000
2.725275  0.030992  0.037011  0.250000
2.769231  0.030992  0.037576  0.250000
2.813187  0.030992  0.038141  0.250000
2.857143  0.030992  0.038707  0.250000
2.901099  0.030992  0.039272  0.250000
2.945055  0.030992  0.039837  0.250000
2.989011  0.030992  0.040403  0.250000
3.000000  0.030992  0.045709  0.250000
END FTABLE  4
FTABLE      3
 24    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.030992  0.000000  0.000000  0.000000
0.043956  0.030992  0.001362  0.000000  0.187500
0.087912  0.030992  0.002725  0.000000  0.198489
0.131868  0.030992  0.004087  0.000000  0.203984
0.175824  0.030992  0.005449  0.000000  0.209478
0.219780  0.030992  0.006811  0.000000  0.214973
0.263736  0.030992  0.008174  0.000000  0.220467
0.307692  0.030992  0.009536  0.000000  0.225962
0.351648  0.030992  0.010898  0.000000  0.231456
0.395604  0.030992  0.012260  0.000000  0.236951
0.439560  0.030992  0.013623  0.000000  0.242445
0.483516  0.030992  0.014985  0.000000  0.247940
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0.527473  0.030992  0.016347  0.048301  0.250000
0.571429  0.030992  0.017710  0.202028  0.250000
0.615385  0.030992  0.019072  0.412175  0.250000
0.659341  0.030992  0.020434  0.659695  0.250000
0.703297  0.030992  0.021796  0.928167  0.250000
0.747253  0.030992  0.023159  1.200769  0.250000
0.791209  0.030992  0.024521  1.460630  0.250000
0.835165  0.030992  0.025883  1.692395  0.250000
0.879121  0.030992  0.027245  1.884482  0.250000
0.923077  0.030992  0.028608  2.031838  0.250000
0.967033  0.030992  0.029970  2.139092  0.250000
1.000000  0.030992  0.030992  2.251466  0.250000
END FTABLE  3
FTABLE      5
 92    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.004591  0.000000  0.000000  0.000000
0.055556  0.004591  0.000089  0.000000  0.009259
0.111111  0.004591  0.000179  0.000000  0.009259
0.166667  0.004591  0.000268  0.000000  0.009259
0.222222  0.004591  0.000357  0.000000  0.009259
0.277778  0.004591  0.000446  0.000000  0.009259
0.333333  0.004591  0.000536  0.000000  0.009259
0.388889  0.004591  0.000625  0.000000  0.009259
0.444444  0.004591  0.000714  0.000000  0.009259
0.500000  0.004591  0.000803  0.000000  0.009259
0.555556  0.004591  0.000893  0.000000  0.009259
0.611111  0.004591  0.000982  0.000000  0.009259
0.666667  0.004591  0.001071  0.000000  0.009259
0.722222  0.004591  0.001161  0.000000  0.009259
0.777778  0.004591  0.001250  0.000000  0.009259
0.833333  0.004591  0.001339  0.000000  0.009259
0.888889  0.004591  0.001428  0.000000  0.009259
0.944444  0.004591  0.001518  0.000000  0.009259
1.000000  0.004591  0.001607  0.000000  0.009259
1.055556  0.004591  0.001696  0.000000  0.009259
1.111111  0.004591  0.001786  0.000000  0.009259
1.166667  0.004591  0.001875  0.000000  0.009259
1.222222  0.004591  0.001964  0.000000  0.009259
1.277778  0.004591  0.002053  0.000000  0.009259
1.333333  0.004591  0.002143  0.000000  0.009259
1.388889  0.004591  0.002232  0.000000  0.009259
1.444444  0.004591  0.002321  0.000000  0.009259
1.500000  0.004591  0.002410  0.000000  0.009259
1.555556  0.004591  0.002500  0.000000  0.009259
1.611111  0.004591  0.002589  0.000000  0.009259
1.666667  0.004591  0.002678  0.000000  0.009259
1.722222  0.004591  0.002768  0.000000  0.009259
1.777778  0.004591  0.002857  0.000000  0.009259
1.833333  0.004591  0.002946  0.000000  0.009259
1.888889  0.004591  0.003035  0.000000  0.009259
1.944444  0.004591  0.003125  0.000000  0.009259
2.000000  0.004591  0.003214  0.000000  0.009259
2.055556  0.004591  0.003303  0.000000  0.009259
2.111111  0.004591  0.003393  0.000000  0.009259
2.166667  0.004591  0.003482  0.000000  0.009259
2.222222  0.004591  0.003571  0.000000  0.009259
2.277778  0.004591  0.003660  0.000000  0.009259
2.333333  0.004591  0.003750  0.000000  0.009259
2.388889  0.004591  0.003839  0.000000  0.009259
2.444444  0.004591  0.003928  0.000000  0.009259
2.500000  0.004591  0.004017  0.000000  0.009259
2.555556  0.004591  0.004107  0.000000  0.009259
2.611111  0.004591  0.004196  0.000000  0.009259
2.666667  0.004591  0.004285  0.000000  0.009259
2.722222  0.004591  0.004375  0.000000  0.009259
2.777778  0.004591  0.004464  0.000000  0.009259
2.833333  0.004591  0.004553  0.000000  0.009259
2.888889  0.004591  0.004642  0.000000  0.009259
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2.944444  0.004591  0.004732  0.000000  0.009259
3.000000  0.004591  0.004821  0.000000  0.009259
3.055556  0.004591  0.004910  0.138729  0.009259
3.111111  0.004591  0.004999  0.389839  0.009259
3.166667  0.004591  0.005089  0.703432  0.009259
3.222222  0.004591  0.005178  1.046030  0.009259
3.277778  0.004591  0.005267  1.383552  0.009259
3.333333  0.004591  0.005357  1.683468  0.009259
3.388889  0.004591  0.005446  1.921105  0.009259
3.444444  0.004591  0.005535  2.088233  0.009259
3.500000  0.004591  0.005624  2.203335  0.009259
3.555556  0.004591  0.005714  2.347596  0.009259
3.611111  0.004591  0.005803  2.462179  0.009259
3.666667  0.004591  0.005892  2.571662  0.009259
3.722222  0.004591  0.005982  2.676671  0.009259
3.777778  0.004591  0.006071  2.777713  0.009259
3.833333  0.004591  0.006160  2.875206  0.009259
3.888889  0.004591  0.006249  2.969500  0.009259
3.944444  0.004591  0.006339  3.060890  0.009259
4.000000  0.004591  0.006428  3.149630  0.009259
4.055556  0.004591  0.006517  3.235937  0.009259
4.111111  0.004591  0.006606  3.320002  0.009259
4.166667  0.004591  0.006696  3.401989  0.009259
4.222222  0.004591  0.006785  3.482047  0.009259
4.277778  0.004591  0.006874  3.560305  0.009259
4.333333  0.004591  0.006964  3.636879  0.009259
4.388889  0.004591  0.007053  3.711875  0.009259
4.444444  0.004591  0.007142  3.785384  0.009259
4.500000  0.004591  0.007231  3.857493  0.009259
4.555556  0.004591  0.007321  3.928279  0.009259
4.611111  0.004591  0.007410  3.997811  0.009259
4.666667  0.004591  0.007499  4.066155  0.009259
4.722222  0.004591  0.007589  4.133369  0.009259
4.777778  0.004591  0.007678  4.199507  0.009259
4.833333  0.004591  0.007767  4.264619  0.009259
4.888889  0.004591  0.007856  4.328752  0.009259
4.944444  0.004591  0.007946  4.391949  0.009259
5.000000  0.004591  0.008035  4.454250  0.009259
5.055556  0.004591  0.008290  4.515690  0.009259
END FTABLE  5
FTABLE      6
 92    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.030992  0.000000  0.000000  0.000000
0.066667  0.030992  0.000723  0.000000  0.062500
0.133333  0.030992  0.001446  0.000000  0.062500
0.200000  0.030992  0.002169  0.000000  0.062500
0.266667  0.030992  0.002893  0.000000  0.062500
0.333333  0.030992  0.003616  0.000000  0.062500
0.400000  0.030992  0.004339  0.000000  0.062500
0.466667  0.030992  0.005062  0.000000  0.062500
0.533333  0.030992  0.005785  0.000000  0.062500
0.600000  0.030992  0.006508  0.000000  0.062500
0.666667  0.030992  0.007231  0.000000  0.062500
0.733333  0.030992  0.007955  0.000000  0.062500
0.800000  0.030992  0.008678  0.000000  0.062500
0.866667  0.030992  0.009401  0.000000  0.062500
0.933333  0.030992  0.010124  0.000000  0.062500
1.000000  0.030992  0.010847  0.000000  0.062500
1.066667  0.030992  0.011570  0.000000  0.062500
1.133333  0.030992  0.012293  0.000000  0.062500
1.200000  0.030992  0.013017  0.000000  0.062500
1.266667  0.030992  0.013740  0.000000  0.062500
1.333333  0.030992  0.014463  0.000000  0.062500
1.400000  0.030992  0.015186  0.000000  0.062500
1.466667  0.030992  0.015909  0.000000  0.062500
1.533333  0.030992  0.016632  0.000000  0.062500
1.600000  0.030992  0.017355  0.000000  0.062500
1.666667  0.030992  0.018079  0.000000  0.062500
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  1.733333  0.030992  0.018802  0.000000  0.062500
  1.800000  0.030992  0.019525  0.000000  0.062500
  1.866667  0.030992  0.020248  0.000000  0.062500
  1.933333  0.030992  0.020971  0.000000  0.062500
  2.000000  0.030992  0.021694  0.000000  0.062500
  2.066667  0.030992  0.022417  0.000000  0.062500
  2.133333  0.030992  0.023140  0.000000  0.062500
  2.200000  0.030992  0.023864  0.000000  0.062500
  2.266667  0.030992  0.024587  0.000000  0.062500
  2.333333  0.030992  0.025310  0.000000  0.062500
  2.400000  0.030992  0.026033  0.000000  0.062500
  2.466667  0.030992  0.026756  0.000000  0.062500
  2.533333  0.030992  0.027479  0.000000  0.062500
  2.600000  0.030992  0.028202  0.000000  0.062500
  2.666667  0.030992  0.028926  0.000000  0.062500
  2.733333  0.030992  0.029649  0.000000  0.062500
  2.800000  0.030992  0.030372  0.000000  0.062500
  2.866667  0.030992  0.031095  0.000000  0.062500
  2.933333  0.030992  0.031818  0.000000  0.062500
  3.000000  0.030992  0.032541  0.000000  0.062500
  3.066667  0.030992  0.033264  0.000000  0.062500
  3.133333  0.030992  0.033988  0.000000  0.062500
  3.200000  0.030992  0.034711  0.000000  0.062500
  3.266667  0.030992  0.035434  0.000000  0.062500
  3.333333  0.030992  0.036157  0.000000  0.062500
  3.400000  0.030992  0.036880  0.000000  0.062500
  3.466667  0.030992  0.037603  0.000000  0.062500
  3.533333  0.030992  0.038326  0.000000  0.062500
  3.600000  0.030992  0.039050  0.000000  0.062500
  3.666667  0.030992  0.039773  0.000000  0.062500
  3.733333  0.030992  0.040496  0.000000  0.062500
  3.800000  0.030992  0.041219  0.000000  0.062500
  3.866667  0.030992  0.041942  0.000000  0.062500
  3.933333  0.030992  0.042665  0.000000  0.062500
  4.000000  0.030992  0.043388  0.000000  0.062500
  4.066667  0.030992  0.044112  0.182234  0.062500
  4.133333  0.030992  0.044835  0.509662  0.062500
  4.200000  0.030992  0.045558  0.907676  0.062500
  4.266667  0.030992  0.046281  1.318080  0.062500
  4.333333  0.030992  0.047004  1.683468  0.062500
  4.400000  0.030992  0.047727  1.960035  0.062500
  4.466667  0.030992  0.048450  2.138326  0.062500
  4.533333  0.030992  0.049174  2.300165  0.062500
  4.600000  0.030992  0.049897  2.439693  0.062500
  4.666667  0.030992  0.050620  2.571662  0.062500
  4.733333  0.030992  0.051343  2.697182  0.062500
  4.800000  0.030992  0.052066  2.817115  0.062500
  4.866667  0.030992  0.052789  2.932146  0.062500
  4.933333  0.030992  0.053512  3.042832  0.062500
  5.000000  0.030992  0.054236  3.149630  0.062500
  5.066667  0.030992  0.054959  3.252924  0.062500
  5.133333  0.030992  0.055682  3.353037  0.062500
  5.200000  0.030992  0.056405  3.450247  0.062500
  5.266667  0.030992  0.057128  3.544792  0.062500
  5.333333  0.030992  0.057851  3.636879  0.062500
  5.400000  0.030992  0.058574  3.726693  0.062500
  5.466667  0.030992  0.059298  3.814391  0.062500
  5.533333  0.030992  0.060021  3.900119  0.062500
  5.600000  0.030992  0.060744  3.984002  0.062500
  5.666667  0.030992  0.061467  4.066155  0.062500
  5.733333  0.030992  0.062190  4.146681  0.062500
  5.800000  0.030992  0.062913  4.225672  0.062500
  5.866667  0.030992  0.063636  4.303214  0.062500
  5.933333  0.030992  0.064360  4.379383  0.062500
  6.000000  0.030992  0.065083  4.454250  0.062500
  6.066667  0.030992  0.067149  4.527878  0.062500
  END FTABLE  6
END FTABLES

EXT SOURCES
```

```
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.429          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.429          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP
WDM      2 PREC     ENGL    1.429          RCHRES   1     EXTNL  PREC
WDM      2 PREC     ENGL    1.429          RCHRES   3     EXTNL  PREC
WDM      1 EVAP     ENGL    0.5            RCHRES   1     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.76           RCHRES   2     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.5            RCHRES   3     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.76           RCHRES   4     EXTNL  POTEV

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
COPY   601 OUTPUT MEAN   1 1     48.4      WDM    901 FLOW     ENGL      REPL
COPY     2 OUTPUT MEAN   1 1     48.4      WDM    702 FLOW     ENGL      REPL
COPY   502 OUTPUT MEAN   1 1     48.4      WDM    802 FLOW     ENGL      REPL
COPY   602 OUTPUT MEAN   1 1     48.4      WDM    902 FLOW     ENGL      REPL
RCHRES   5 HYDR   RO     1 1        1      WDM   1020 FLOW     ENGL      REPL
RCHRES   5 HYDR   O      1 1        1      WDM   1021 FLOW     ENGL      REPL
RCHRES   5 HYDR   O      2 1        1      WDM   1022 FLOW     ENGL      REPL
RCHRES   5 HYDR   STAGE  1 1        1      WDM   1023 STAG     ENGL      REPL
RCHRES   6 HYDR   RO     1 1        1      WDM   1024 FLOW     ENGL      REPL
RCHRES   6 HYDR   O      1 1        1      WDM   1025 FLOW     ENGL      REPL
RCHRES   6 HYDR   O      2 1        1      WDM   1026 FLOW     ENGL      REPL
RCHRES   6 HYDR   STAGE  1 1        1      WDM   1027 STAG     ENGL      REPL
END EXT TARGETS

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

  MASS-LINK        7
RCHRES     OFLOW  OVOL   1                 RCHRES         INFLOW IVOL
  END MASS-LINK    7

  MASS-LINK        8
RCHRES     OFLOW  OVOL   2                 RCHRES         INFLOW IVOL
  END MASS-LINK    8

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

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

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

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


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

```
ERROR/WARNING ID:   341   6

DATE/TIME: 1997/10/30 11: 0

RCHRES:     3

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB().  To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows.  This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS         V1         V2        VOL
24 1305.5     1350.0     1360.1
```

```
ERROR/WARNING ID:   341   5

DATE/TIME: 1997/10/30 11: 0

RCHRES:     3

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated.  If extrapolation was small, no problem.
Remedy; extend ftable.  Relevant data are:

A          B          C      RDEP1      RDEP2  COUNT
0.0000E+00 2700.0     -3.311E+03    1.2262     1.2262       2
```

```
ERROR/WARNING ID:   341   6

DATE/TIME: 2002/ 1/ 6 17: 0

RCHRES:     3

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB().  To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows.  This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS         V1         V2        VOL
24 1305.5     1350.0     1447.7
```

```
ERROR/WARNING ID:   341   5

DATE/TIME: 2002/ 1/ 6 17: 0

RCHRES:     3

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated.  If extrapolation was small, no problem.
Remedy; extend ftable.  Relevant data are:

A          B          C      RDEP1      RDEP2  COUNT
0.0000E+00 2700.0     -8.625E+03    3.1945  3.1945E+00      2
```

```
ERROR/WARNING ID:   341   6

DATE/TIME: 2002/10/19 15: 0

RCHRES:     3
```

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB(). To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows. This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS	V1	V2	VOL
24	1.3055E+03	1350.0	1458.0

ERROR/WARNING ID: 341   5

DATE/TIME: 2002/10/19 15: 0

RCHRES: 3

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated. If extrapolation was small, no problem.
Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
0.0000E+00	2700.0	-9.248E+03	3.4253	3.4253E+00	2

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WWHM2012

PROJECT REPORT

General Model Information

WWHM2012 Project Name: 18591_Node C

Site Name:	LOTC
Site Address:	
City:	Castle Rock, WA
Report Date:	1/21/2025
Gage:	Longview
Data Start:	1955/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	1.429
Version Date:	2024/06/28
Version:	4.3.1

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year
Low Flow Threshold for POC2:	50 Percent of the 2 Year
High Flow Threshold for POC2:	50 Year

Landuse Basin Data
Predeveloped Land Use

Node C - Existing Public

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Forest, Mod	0.949
Pervious Total	0.949
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.949

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 1	POC 1	

Node C - Existng Flex

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Forest, Mod	3.063
Pervious Total	3.063
Impervious Land Use	acre
Impervious Total	0
Basin Total	3.063

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

POC 2	POC 2

Mitigated Land Use

Node C - Public PGIS

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	0.71
Impervious Total	0.71
Basin Total	0.71

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
Surface Bioretention	Surface Bioretention	

Node C - Flex PGIS

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	1.685
Impervious Total	1.685
Basin Total	1.685

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

Surface	Interflow	Groundwater
Surface Bioretention	Surface Bioretention	

Node C - Public Non-PGIS

Bypass:	Yes
GroundWater:	No
Pervious Land Use	acre
A B, Lawn, Mod	0.239
Pervious Total	0.239
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.239

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

POC 1	POC 1

Node C - Flex Non-PGIS

Bypass:	Yes
GroundWater:	No

Pervious Land Use	acre
A B, Lawn, Mod	0.306
Pervious Total	0.306

Impervious Land Use	acre
ROOF TOPS FLAT	1.072
Impervious Total	1.072
Basin Total	1.378

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 2	POC 2	

Mitigated Routing

Road Bioretention

Bottom Length:	120.00 ft.
Bottom Width:	5.00 ft.
Material thickness of first layer:	1.5
Material type for first layer:	SMMWW 12 in/hr
Material thickness of second layer:	1.5
Material type for second layer:	GRAVEL
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (feet):	1
Orifice Diameter (in.):	12
Offset (in.):	0
Flow Through Underdrain (ac-ft.):	163.644
Total Outflow (ac-ft.):	170.904
Percent Through Underdrain:	95.75
Discharge Structure	
Riser Height:	0.5 ft.
Riser Diameter:	12 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	
Gravel Trench Bed 2	

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0138	0.0000	0.0000	0.0000
0.0440	0.0138	0.0003	0.0000	0.0000
0.0879	0.0138	0.0006	0.0000	0.0000
0.1319	0.0138	0.0008	0.0000	0.0000
0.1758	0.0138	0.0011	0.0000	0.0000
0.2198	0.0138	0.0014	0.0004	0.0000
0.2637	0.0138	0.0017	0.0006	0.0000
0.3077	0.0138	0.0019	0.0010	0.0000
0.3516	0.0138	0.0022	0.0014	0.0000
0.3956	0.0138	0.0025	0.0020	0.0000
0.4396	0.0138	0.0028	0.0027	0.0000
0.4835	0.0138	0.0030	0.0035	0.0000
0.5275	0.0138	0.0033	0.0043	0.0000
0.5714	0.0138	0.0036	0.0044	0.0000
0.6154	0.0138	0.0039	0.0055	0.0000
0.6593	0.0138	0.0042	0.0067	0.0000
0.7033	0.0138	0.0044	0.0081	0.0000
0.7473	0.0138	0.0047	0.0097	0.0000
0.7912	0.0138	0.0050	0.0104	0.0000
0.8352	0.0138	0.0053	0.0114	0.0000
0.8791	0.0138	0.0055	0.0133	0.0000
0.9231	0.0138	0.0058	0.0154	0.0000
0.9670	0.0138	0.0061	0.0177	0.0000
1.0110	0.0138	0.0064	0.0200	0.0000
1.0549	0.0138	0.0066	0.0202	0.0000
1.0989	0.0138	0.0069	0.0228	0.0000
1.1429	0.0138	0.0072	0.0257	0.0000
1.1868	0.0138	0.0075	0.0288	0.0000

1.2308	0.0138	0.0078	0.0320	0.0000
1.2747	0.0138	0.0080	0.0335	0.0000
1.3187	0.0138	0.0083	0.0355	0.0000
1.3626	0.0138	0.0086	0.0392	0.0000
1.4066	0.0138	0.0089	0.0432	0.0000
1.4505	0.0138	0.0091	0.0474	0.0000
1.4945	0.0138	0.0094	0.0513	0.0000
1.5385	0.0138	0.0097	0.0518	0.0000
1.5824	0.0138	0.0099	0.0564	0.0000
1.6264	0.0138	0.0102	0.0613	0.0000
1.6703	0.0138	0.0104	0.0664	0.0000
1.7143	0.0138	0.0107	0.0717	0.0000
1.7582	0.0138	0.0109	0.0738	0.0000
1.8022	0.0138	0.0112	0.0772	0.0000
1.8462	0.0138	0.0114	0.0829	0.0000
1.8901	0.0138	0.0117	0.1111	0.0000
1.9341	0.0138	0.0119	0.1111	0.0000
1.9780	0.0138	0.0122	0.1111	0.0000
2.0220	0.0138	0.0124	0.1111	0.0000
2.0659	0.0138	0.0127	0.1111	0.0000
2.1099	0.0138	0.0129	0.1111	0.0000
2.1538	0.0138	0.0132	0.1111	0.0000
2.1978	0.0138	0.0134	0.1111	0.0000
2.2418	0.0138	0.0137	0.1111	0.0000
2.2857	0.0138	0.0139	0.1111	0.0000
2.3297	0.0138	0.0142	0.1111	0.0000
2.3736	0.0138	0.0144	0.1111	0.0000
2.4176	0.0138	0.0147	0.1111	0.0000
2.4615	0.0138	0.0149	0.1111	0.0000
2.5055	0.0138	0.0152	0.1111	0.0000
2.5495	0.0138	0.0154	0.1111	0.0000
2.5934	0.0138	0.0157	0.1111	0.0000
2.6374	0.0138	0.0159	0.1111	0.0000
2.6813	0.0138	0.0162	0.1111	0.0000
2.7253	0.0138	0.0164	0.1111	0.0000
2.7692	0.0138	0.0167	0.1111	0.0000
2.8132	0.0138	0.0170	0.1111	0.0000
2.8571	0.0138	0.0172	0.1111	0.0000
2.9011	0.0138	0.0175	0.1111	0.0000
2.9451	0.0138	0.0177	0.1111	0.0000
2.9890	0.0138	0.0180	0.1111	0.0000
3.0000	0.0138	0.0180	0.1111	0.0000

Bioretention Surface Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
3.0000	0.0138	0.0180	0.0000	0.0833	0.0000
3.0440	0.0138	0.0186	0.0000	0.0833	0.0000
3.0879	0.0138	0.0192	0.0000	0.0882	0.0000
3.1319	0.0138	0.0198	0.0000	0.0907	0.0000
3.1758	0.0138	0.0204	0.0000	0.0931	0.0000
3.2198	0.0138	0.0210	0.0000	0.0955	0.0000
3.2637	0.0138	0.0217	0.0000	0.0980	0.0000
3.3077	0.0138	0.0223	0.0000	0.1004	0.0000
3.3516	0.0138	0.0229	0.0000	0.1029	0.0000
3.3956	0.0138	0.0235	0.0000	0.1053	0.0000
3.4396	0.0138	0.0241	0.0000	0.1078	0.0000
3.4835	0.0138	0.0247	0.0000	0.1102	0.0000
3.5275	0.0138	0.0253	0.0483	0.1111	0.0000

3.5714	0.0138	0.0259	0.2020	0.1111	0.0000
3.6154	0.0138	0.0265	0.4122	0.1111	0.0000
3.6593	0.0138	0.0271	0.6597	0.1111	0.0000
3.7033	0.0138	0.0277	0.9282	0.1111	0.0000
3.7473	0.0138	0.0283	1.2008	0.1111	0.0000
3.7912	0.0138	0.0289	1.4606	0.1111	0.0000
3.8352	0.0138	0.0295	1.6924	0.1111	0.0000
3.8791	0.0138	0.0301	1.8845	0.1111	0.0000
3.9231	0.0138	0.0307	2.0318	0.1111	0.0000
3.9670	0.0138	0.0313	2.1391	0.1111	0.0000
4.0000	0.0138	0.0318	2.2515	0.1111	0.0000

Commerical/Flex Bioretention

Bottom Length:	60.00 ft.
Bottom Width:	20.00 ft.
Material thickness of first layer:	1.5
Material type for first layer:	SMMWW 12 in/hr
Material thickness of second layer:	1.5
Material type for second layer:	GRAVEL
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (feet):	1
Orifice Diameter (in.):	12
Offset (in.):	0
Flow Through Underdrain (ac-ft.):	392.553
Total Outflow (ac-ft.):	404.757
Percent Through Underdrain:	96.98
Discharge Structure	
Riser Height:	1 ft.
Riser Diameter:	24 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	
Road Infiltration Trench	

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0275	0.0000	0.0000	0.0000
0.0549	0.0275	0.0007	0.0000	0.0000
0.1099	0.0275	0.0014	0.0000	0.0000
0.1648	0.0275	0.0021	0.0000	0.0000
0.2198	0.0275	0.0028	0.0011	0.0000
0.2747	0.0275	0.0035	0.0020	0.0000
0.3297	0.0275	0.0042	0.0031	0.0000
0.3846	0.0275	0.0048	0.0033	0.0000
0.4396	0.0275	0.0055	0.0046	0.0000
0.4945	0.0275	0.0062	0.0065	0.0000
0.5495	0.0275	0.0069	0.0088	0.0000
0.6044	0.0275	0.0076	0.0116	0.0000
0.6593	0.0275	0.0083	0.0140	0.0000
0.7143	0.0275	0.0090	0.0149	0.0000
0.7692	0.0275	0.0097	0.0186	0.0000
0.8242	0.0275	0.0104	0.0229	0.0000
0.8791	0.0275	0.0111	0.0277	0.0000
0.9341	0.0275	0.0118	0.0331	0.0000
0.9890	0.0275	0.0125	0.0345	0.0000
1.0440	0.0275	0.0132	0.0390	0.0000
1.0989	0.0275	0.0138	0.0456	0.0000
1.1538	0.0275	0.0145	0.0529	0.0000
1.2088	0.0275	0.0152	0.0607	0.0000
1.2637	0.0275	0.0159	0.0669	0.0000
1.3187	0.0275	0.0166	0.0693	0.0000
1.3736	0.0275	0.0173	0.0785	0.0000
1.4286	0.0275	0.0180	0.0884	0.0000
1.4835	0.0275	0.0187	0.0991	0.0000
1.5385	0.0275	0.0193	0.1104	0.0000
1.5934	0.0275	0.0199	0.1129	0.0000

1.6484	0.0275	0.0206	0.1225	0.0000
1.7033	0.0275	0.0212	0.1353	0.0000
1.7582	0.0275	0.0218	0.1489	0.0000
1.8132	0.0275	0.0225	0.1629	0.0000
1.8681	0.0275	0.0231	0.2778	0.0000
1.9231	0.0275	0.0237	0.2778	0.0000
1.9780	0.0275	0.0243	0.2778	0.0000
2.0330	0.0275	0.0250	0.2778	0.0000
2.0879	0.0275	0.0256	0.2778	0.0000
2.1429	0.0275	0.0262	0.2778	0.0000
2.1978	0.0275	0.0269	0.2778	0.0000
2.2527	0.0275	0.0275	0.2778	0.0000
2.3077	0.0275	0.0281	0.2778	0.0000
2.3626	0.0275	0.0287	0.2778	0.0000
2.4176	0.0275	0.0294	0.2778	0.0000
2.4725	0.0275	0.0300	0.2778	0.0000
2.5275	0.0275	0.0306	0.2778	0.0000
2.5824	0.0275	0.0313	0.2778	0.0000
2.6374	0.0275	0.0319	0.2778	0.0000
2.6923	0.0275	0.0325	0.2778	0.0000
2.7473	0.0275	0.0331	0.2778	0.0000
2.8022	0.0275	0.0338	0.2778	0.0000
2.8571	0.0275	0.0344	0.2778	0.0000
2.9121	0.0275	0.0350	0.2778	0.0000
2.9670	0.0275	0.0356	0.2778	0.0000
3.0000	0.0275	0.0360	0.2778	0.0000

Bioretention Surface Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
3.0000	0.0275	0.0360	0.0000	0.1667	0.0000
3.0549	0.0275	0.0375	0.0000	0.1667	0.0000
3.1099	0.0275	0.0391	0.0000	0.1789	0.0000
3.1648	0.0275	0.0406	0.0000	0.1850	0.0000
3.2198	0.0275	0.0421	0.0000	0.1911	0.0000
3.2747	0.0275	0.0436	0.0000	0.1972	0.0000
3.3297	0.0275	0.0451	0.0000	0.2033	0.0000
3.3846	0.0275	0.0466	0.0000	0.2094	0.0000
3.4396	0.0275	0.0481	0.0000	0.2155	0.0000
3.4945	0.0275	0.0496	0.0000	0.2216	0.0000
3.5495	0.0275	0.0512	0.0000	0.2277	0.0000
3.6044	0.0275	0.0527	0.0000	0.2338	0.0000
3.6593	0.0275	0.0542	0.0000	0.2399	0.0000
3.7143	0.0275	0.0557	0.0000	0.2460	0.0000
3.7692	0.0275	0.0572	0.0000	0.2521	0.0000
3.8242	0.0275	0.0587	0.0000	0.2582	0.0000
3.8791	0.0275	0.0602	0.0000	0.2643	0.0000
3.9341	0.0275	0.0618	0.0000	0.2705	0.0000
3.9890	0.0275	0.0633	0.0000	0.2766	0.0000
4.0440	0.0275	0.0648	0.1956	0.2778	0.0000
4.0989	0.0275	0.0663	0.6592	0.2778	0.0000
4.1538	0.0275	0.0678	1.2766	0.2778	0.0000
4.2088	0.0275	0.0693	2.0109	0.2778	0.0000
4.2637	0.0275	0.0708	2.8369	0.2778	0.0000
4.3187	0.0275	0.0724	3.7318	0.2778	0.0000
4.3736	0.0275	0.0739	4.6731	0.2778	0.0000
4.4286	0.0275	0.0754	5.6376	0.2778	0.0000
4.4835	0.0275	0.0769	6.6018	0.2778	0.0000
4.5385	0.0275	0.0784	7.5423	0.2778	0.0000

4.5934	0.0275	0.0799	8.4368	0.2778	0.0000
4.6484	0.0275	0.0814	9.2649	0.2778	0.0000
4.7033	0.0275	0.0829	10.010	0.2778	0.0000
4.7582	0.0275	0.0845	10.660	0.2778	0.0000
4.8132	0.0275	0.0860	11.211	0.2778	0.0000
4.8681	0.0275	0.0875	11.664	0.2778	0.0000
4.9231	0.0275	0.0890	12.034	0.2778	0.0000
4.9780	0.0275	0.0905	12.347	0.2778	0.0000
5.0000	0.0275	0.0911	12.805	0.2778	0.0000

Road Infiltration Trench

Bottom Length:	60.00 ft.
Bottom Width:	20.00 ft.
Trench bottom slope 1:	0 To 1
Trench Left side slope 0:	0 To 1
Trench right side slope 2:	0 To 1
Material thickness of first layer:	6
Pour Space of material for first layer:	0.35
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	2
Infiltration safety factor:	1
Wetted surface area On	
Total Volume Infiltrated (ac-ft.):	8.798
Total Volume Through Riser (ac-ft.):	3.405
Total Volume Through Facility (ac-ft.):	12.202
Percent Infiltrated:	72.1
Total Precip Applied to Facility:	0
Total Evap From Facility:	0
Discharge Structure	
Riser Height:	4 ft.
Riser Diameter:	12 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	

Gravel Trench Bed Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.027	0.000	0.000	0.000
0.0556	0.027	0.000	0.000	0.055
0.1111	0.027	0.001	0.000	0.055
0.1667	0.027	0.001	0.000	0.055
0.2222	0.027	0.002	0.000	0.055
0.2778	0.027	0.002	0.000	0.055
0.3333	0.027	0.003	0.000	0.055
0.3889	0.027	0.003	0.000	0.055
0.4444	0.027	0.004	0.000	0.055
0.5000	0.027	0.004	0.000	0.055
0.5556	0.027	0.005	0.000	0.055
0.6111	0.027	0.005	0.000	0.055
0.6667	0.027	0.006	0.000	0.055
0.7222	0.027	0.007	0.000	0.055
0.7778	0.027	0.007	0.000	0.055
0.8333	0.027	0.008	0.000	0.055
0.8889	0.027	0.008	0.000	0.055
0.9444	0.027	0.009	0.000	0.055
1.0000	0.027	0.009	0.000	0.055
1.0556	0.027	0.010	0.000	0.055
1.1111	0.027	0.010	0.000	0.055
1.1667	0.027	0.011	0.000	0.055
1.2222	0.027	0.011	0.000	0.055
1.2778	0.027	0.012	0.000	0.055

1.3333	0.027	0.012	0.000	0.055
1.3889	0.027	0.013	0.000	0.055
1.4444	0.027	0.013	0.000	0.055
1.5000	0.027	0.014	0.000	0.055
1.5556	0.027	0.015	0.000	0.055
1.6111	0.027	0.015	0.000	0.055
1.6667	0.027	0.016	0.000	0.055
1.7222	0.027	0.016	0.000	0.055
1.7778	0.027	0.017	0.000	0.055
1.8333	0.027	0.017	0.000	0.055
1.8889	0.027	0.018	0.000	0.055
1.9444	0.027	0.018	0.000	0.055
2.0000	0.027	0.019	0.000	0.055
2.0556	0.027	0.019	0.000	0.055
2.1111	0.027	0.020	0.000	0.055
2.1667	0.027	0.020	0.000	0.055
2.2222	0.027	0.021	0.000	0.055
2.2778	0.027	0.022	0.000	0.055
2.3333	0.027	0.022	0.000	0.055
2.3889	0.027	0.023	0.000	0.055
2.4444	0.027	0.023	0.000	0.055
2.5000	0.027	0.024	0.000	0.055
2.5556	0.027	0.024	0.000	0.055
2.6111	0.027	0.025	0.000	0.055
2.6667	0.027	0.025	0.000	0.055
2.7222	0.027	0.026	0.000	0.055
2.7778	0.027	0.026	0.000	0.055
2.8333	0.027	0.027	0.000	0.055
2.8889	0.027	0.027	0.000	0.055
2.9444	0.027	0.028	0.000	0.055
3.0000	0.027	0.028	0.000	0.055
3.0556	0.027	0.029	0.000	0.055
3.1111	0.027	0.030	0.000	0.055
3.1667	0.027	0.030	0.000	0.055
3.2222	0.027	0.031	0.000	0.055
3.2778	0.027	0.031	0.000	0.055
3.3333	0.027	0.032	0.000	0.055
3.3889	0.027	0.032	0.000	0.055
3.4444	0.027	0.033	0.000	0.055
3.5000	0.027	0.033	0.000	0.055
3.5556	0.027	0.034	0.000	0.055
3.6111	0.027	0.034	0.000	0.055
3.6667	0.027	0.035	0.000	0.055
3.7222	0.027	0.035	0.000	0.055
3.7778	0.027	0.036	0.000	0.055
3.8333	0.027	0.037	0.000	0.055
3.8889	0.027	0.037	0.000	0.055
3.9444	0.027	0.038	0.000	0.055
4.0000	0.027	0.038	0.000	0.055
4.0556	0.027	0.039	0.138	0.055
4.1111	0.027	0.039	0.389	0.055
4.1667	0.027	0.040	0.703	0.055
4.2222	0.027	0.040	1.046	0.055
4.2778	0.027	0.041	1.383	0.055
4.3333	0.027	0.041	1.683	0.055
4.3889	0.027	0.042	1.921	0.055
4.4444	0.027	0.042	2.088	0.055
4.5000	0.027	0.043	2.203	0.055

4.5556	0.027	0.043	2.347	0.055
4.6111	0.027	0.044	2.462	0.055
4.6667	0.027	0.045	2.571	0.055
4.7222	0.027	0.045	2.676	0.055
4.7778	0.027	0.046	2.777	0.055
4.8333	0.027	0.046	2.875	0.055
4.8889	0.027	0.047	2.969	0.055
4.9444	0.027	0.047	3.060	0.055
5.0000	0.027	0.048	3.149	0.055

Gravel Trench Bed 2

Bottom Length:	120.00 ft.
Bottom Width:	5.00 ft.
Trench bottom slope 1:	0 To 1
Trench Left side slope 0:	0 To 1
Trench right side slope 2:	0 To 1
Material thickness of first layer:	5
Pour Space of material for first layer:	0.35
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	2
Infiltration safety factor:	1
Wetted surface area On	
Total Volume Infiltrated (ac-ft.):	5.406
Total Volume Through Riser (ac-ft.):	1.854
Total Volume Through Facility (ac-ft.):	7.261
Percent Infiltrated:	74.45
Total Precip Applied to Facility:	0
Total Evap From Facility:	0
Discharge Structure	
Riser Height:	3 ft.
Riser Diameter:	12 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	

Gravel Trench Bed Hydraulic Table

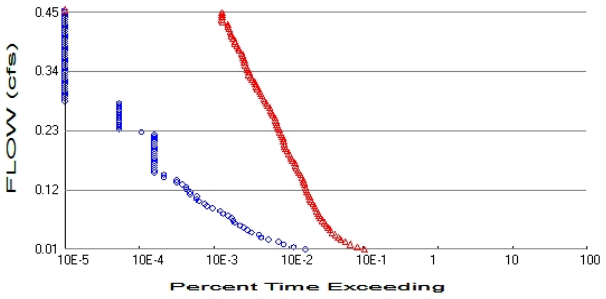
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.013	0.000	0.000	0.000
0.0556	0.013	0.000	0.000	0.027
0.1111	0.013	0.000	0.000	0.027
0.1667	0.013	0.000	0.000	0.027
0.2222	0.013	0.001	0.000	0.027
0.2778	0.013	0.001	0.000	0.027
0.3333	0.013	0.001	0.000	0.027
0.3889	0.013	0.001	0.000	0.027
0.4444	0.013	0.002	0.000	0.027
0.5000	0.013	0.002	0.000	0.027
0.5556	0.013	0.002	0.000	0.027
0.6111	0.013	0.002	0.000	0.027
0.6667	0.013	0.003	0.000	0.027
0.7222	0.013	0.003	0.000	0.027
0.7778	0.013	0.003	0.000	0.027
0.8333	0.013	0.004	0.000	0.027
0.8889	0.013	0.004	0.000	0.027
0.9444	0.013	0.004	0.000	0.027
1.0000	0.013	0.004	0.000	0.027
1.0556	0.013	0.005	0.000	0.027
1.1111	0.013	0.005	0.000	0.027
1.1667	0.013	0.005	0.000	0.027
1.2222	0.013	0.005	0.000	0.027
1.2778	0.013	0.006	0.000	0.027

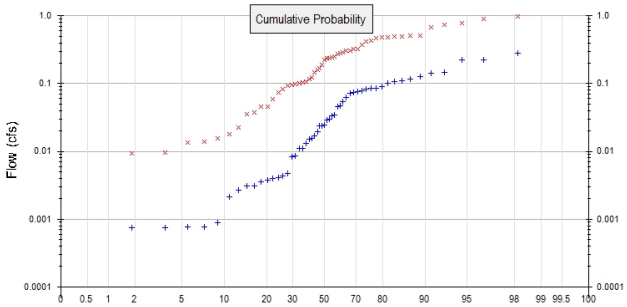
1.3333	0.013	0.006	0.000	0.027
1.3889	0.013	0.006	0.000	0.027
1.4444	0.013	0.007	0.000	0.027
1.5000	0.013	0.007	0.000	0.027
1.5556	0.013	0.007	0.000	0.027
1.6111	0.013	0.007	0.000	0.027
1.6667	0.013	0.008	0.000	0.027
1.7222	0.013	0.008	0.000	0.027
1.7778	0.013	0.008	0.000	0.027
1.8333	0.013	0.008	0.000	0.027
1.8889	0.013	0.009	0.000	0.027
1.9444	0.013	0.009	0.000	0.027
2.0000	0.013	0.009	0.000	0.027
2.0556	0.013	0.009	0.000	0.027
2.1111	0.013	0.010	0.000	0.027
2.1667	0.013	0.010	0.000	0.027
2.2222	0.013	0.010	0.000	0.027
2.2778	0.013	0.011	0.000	0.027
2.3333	0.013	0.011	0.000	0.027
2.3889	0.013	0.011	0.000	0.027
2.4444	0.013	0.011	0.000	0.027
2.5000	0.013	0.012	0.000	0.027
2.5556	0.013	0.012	0.000	0.027
2.6111	0.013	0.012	0.000	0.027
2.6667	0.013	0.012	0.000	0.027
2.7222	0.013	0.013	0.000	0.027
2.7778	0.013	0.013	0.000	0.027
2.8333	0.013	0.013	0.000	0.027
2.8889	0.013	0.013	0.000	0.027
2.9444	0.013	0.014	0.000	0.027
3.0000	0.013	0.014	0.000	0.027
3.0556	0.013	0.014	0.138	0.027
3.1111	0.013	0.015	0.389	0.027
3.1667	0.013	0.015	0.703	0.027
3.2222	0.013	0.015	1.046	0.027
3.2778	0.013	0.015	1.383	0.027
3.3333	0.013	0.016	1.683	0.027
3.3889	0.013	0.016	1.921	0.027
3.4444	0.013	0.016	2.088	0.027
3.5000	0.013	0.016	2.203	0.027
3.5556	0.013	0.017	2.347	0.027
3.6111	0.013	0.017	2.462	0.027
3.6667	0.013	0.017	2.571	0.027
3.7222	0.013	0.017	2.676	0.027
3.7778	0.013	0.018	2.777	0.027
3.8333	0.013	0.018	2.875	0.027
3.8889	0.013	0.018	2.969	0.027
3.9444	0.013	0.019	3.060	0.027
4.0000	0.013	0.019	3.149	0.027
4.0556	0.013	0.019	3.235	0.027
4.1111	0.013	0.019	3.320	0.027
4.1667	0.013	0.020	3.402	0.027
4.2222	0.013	0.020	3.482	0.027
4.2778	0.013	0.020	3.560	0.027
4.3333	0.013	0.020	3.636	0.027
4.3889	0.013	0.021	3.711	0.027
4.4444	0.013	0.021	3.785	0.027
4.5000	0.013	0.021	3.857	0.027

4.5556	0.013	0.022	3.928	0.027
4.6111	0.013	0.022	3.997	0.027
4.6667	0.013	0.022	4.066	0.027
4.7222	0.013	0.022	4.133	0.027
4.7778	0.013	0.023	4.199	0.027
4.8333	0.013	0.023	4.264	0.027
4.8889	0.013	0.023	4.328	0.027
4.9444	0.013	0.023	4.391	0.027
5.0000	0.013	0.024	4.454	0.027

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.949
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.239
Total Impervious Area: 0.71

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.020893
5 year	0.081852
10 year	0.156979
25 year	0.300298
50 year	0.445572
100 year	0.625325

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.171451
5 year	0.492709
10 year	0.752674
25 year	1.084996
50 year	1.316616
100 year	1.526848

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1956	0.147	0.490
1957	0.015	0.486
1958	0.226	0.516
1959	0.054	0.237
1960	0.225	0.516
1961	0.109	0.308
1962	0.279	0.415
1963	0.082	0.726
1964	0.046	0.306
1965	0.024	0.035

1966	0.003	0.009
1967	0.011	0.125
1968	0.002	0.117
1969	0.011	0.059
1970	0.016	0.038
1971	0.100	0.104
1972	0.074	0.222
1973	0.004	0.158
1974	0.107	0.323
1975	0.115	0.490
1976	0.062	0.082
1977	0.001	0.015
1978	0.125	0.425
1979	0.004	0.147
1980	0.008	0.093
1981	0.013	0.099
1982	0.073	0.238
1983	0.030	0.247
1984	0.091	0.244
1985	0.003	0.102
1986	0.085	0.483
1987	0.004	0.327
1988	0.001	0.046
1989	0.003	0.014
1990	0.033	0.190
1991	0.078	0.074
1992	0.004	0.018
1993	0.020	0.046
1994	0.017	0.014
1995	0.005	0.286
1996	0.142	0.673
1997	0.034	0.278
1998	0.029	0.899
1999	0.004	0.023
2000	0.009	0.168
2001	0.001	0.000
2002	0.024	0.982
2003	0.001	0.782
2004	0.001	0.010
2005	0.001	0.106
2006	0.047	0.094
2007	0.077	0.467
2008	0.024	0.271
2009	0.085	0.376

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.2788	0.9817
2	0.2263	0.8995
3	0.2245	0.7819
4	0.1474	0.7258
5	0.1416	0.6733
6	0.1252	0.5162
7	0.1155	0.5156
8	0.1093	0.4905
9	0.1071	0.4903
10	0.0999	0.4864

11	0.0908	0.4828
12	0.0848	0.4674
13	0.0847	0.4246
14	0.0821	0.4145
15	0.0783	0.3760
16	0.0768	0.3266
17	0.0742	0.3233
18	0.0728	0.3078
19	0.0624	0.3061
20	0.0539	0.2860
21	0.0465	0.2782
22	0.0461	0.2709
23	0.0343	0.2474
24	0.0331	0.2437
25	0.0298	0.2378
26	0.0290	0.2372
27	0.0245	0.2224
28	0.0239	0.1896
29	0.0237	0.1683
30	0.0197	0.1583
31	0.0171	0.1475
32	0.0156	0.1246
33	0.0150	0.1169
34	0.0133	0.1056
35	0.0112	0.1040
36	0.0110	0.1019
37	0.0086	0.0991
38	0.0083	0.0945
39	0.0047	0.0928
40	0.0043	0.0820
41	0.0041	0.0743
42	0.0040	0.0589
43	0.0037	0.0463
44	0.0035	0.0459
45	0.0031	0.0379
46	0.0031	0.0355
47	0.0027	0.0226
48	0.0021	0.0178
49	0.0009	0.0154
50	0.0008	0.0137
51	0.0008	0.0136
52	0.0008	0.0097
53	0.0008	0.0094
54	0.0007	0.0002

Duration Flows

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0104	315	1950	619	Fail
0.0148	220	1571	714	Fail
0.0192	161	1271	789	Fail
0.0236	137	1093	797	Fail
0.0280	100	948	947	Fail
0.0324	81	873	1077	Fail
0.0368	75	795	1060	Fail
0.0412	60	718	1196	Fail
0.0456	53	679	1281	Fail
0.0500	47	642	1365	Fail
0.0544	42	605	1440	Fail
0.0588	36	571	1586	Fail
0.0632	34	535	1573	Fail
0.0676	32	505	1578	Fail
0.0720	29	483	1665	Fail
0.0764	25	466	1864	Fail
0.0808	23	452	1965	Fail
0.0852	18	436	2422	Fail
0.0896	15	418	2786	Fail
0.0940	14	398	2842	Fail
0.0984	12	384	3200	Fail
0.1027	11	367	3336	Fail
0.1071	11	355	3227	Fail
0.1115	9	348	3866	Fail
0.1159	9	334	3711	Fail
0.1203	8	324	4050	Fail
0.1247	8	318	3975	Fail
0.1291	7	306	4371	Fail
0.1335	6	301	5016	Fail
0.1379	6	295	4916	Fail
0.1423	4	282	7050	Fail
0.1467	4	273	6825	Fail
0.1511	3	258	8600	Fail
0.1555	3	250	8333	Fail
0.1599	3	242	8066	Fail
0.1643	3	233	7766	Fail
0.1687	3	227	7566	Fail
0.1731	3	209	6966	Fail
0.1775	3	205	6833	Fail
0.1819	3	201	6700	Fail
0.1863	3	191	6366	Fail
0.1906	3	180	6000	Fail
0.1950	3	170	5666	Fail
0.1994	3	167	5566	Fail
0.2038	3	165	5500	Fail
0.2082	3	161	5366	Fail
0.2126	3	160	5333	Fail
0.2170	3	156	5200	Fail
0.2214	3	149	4966	Fail
0.2258	2	143	7150	Fail
0.2302	1	141	14100	Fail
0.2346	1	136	13600	Fail
0.2390	1	130	13000	Fail
0.2434	1	129	12900	Fail

0.2478	1	127	12700	Fail
0.2522	1	123	12300	Fail
0.2566	1	115	11500	Fail
0.2610	1	112	11200	Fail
0.2654	1	109	10900	Fail
0.2698	1	105	10500	Fail
0.2742	1	98	9800	Fail
0.2786	1	95	9500	Fail
0.2829	0	91	n/a	Fail
0.2873	0	88	n/a	Fail
0.2917	0	83	n/a	Fail
0.2961	0	80	n/a	Fail
0.3005	0	77	n/a	Fail
0.3049	0	73	n/a	Fail
0.3093	0	69	n/a	Fail
0.3137	0	68	n/a	Fail
0.3181	0	66	n/a	Fail
0.3225	0	61	n/a	Fail
0.3269	0	59	n/a	Fail
0.3313	0	55	n/a	Fail
0.3357	0	55	n/a	Fail
0.3401	0	53	n/a	Fail
0.3445	0	52	n/a	Fail
0.3489	0	50	n/a	Fail
0.3533	0	48	n/a	Fail
0.3577	0	48	n/a	Fail
0.3621	0	46	n/a	Fail
0.3665	0	46	n/a	Fail
0.3709	0	44	n/a	Fail
0.3752	0	41	n/a	Fail
0.3796	0	40	n/a	Fail
0.3840	0	38	n/a	Fail
0.3884	0	36	n/a	Fail
0.3928	0	36	n/a	Fail
0.3972	0	34	n/a	Fail
0.4016	0	32	n/a	Fail
0.4060	0	32	n/a	Fail
0.4104	0	31	n/a	Fail
0.4148	0	30	n/a	Fail
0.4192	0	29	n/a	Fail
0.4236	0	29	n/a	Fail
0.4280	0	25	n/a	Fail
0.4324	0	24	n/a	Fail
0.4368	0	24	n/a	Fail
0.4412	0	24	n/a	Fail
0.4456	0	24	n/a	Fail

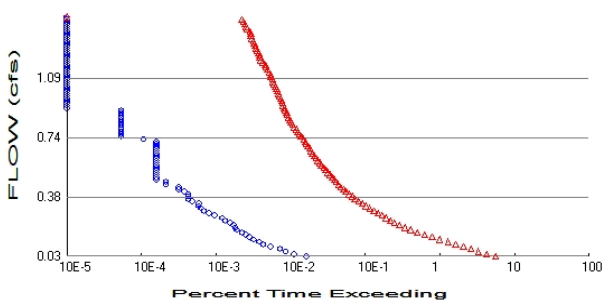
The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

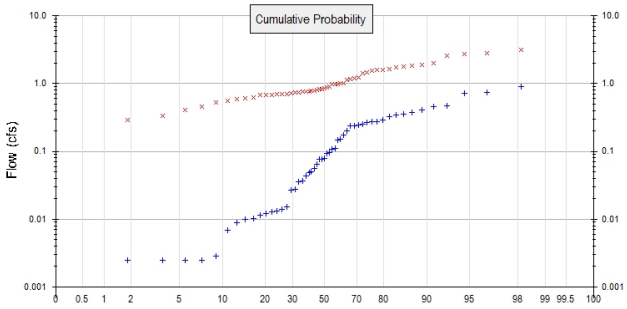
Water Quality

Water Quality BMP Flow and Volume for POC #1

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

POC 2





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #2
Total Pervious Area: 3.063
Total Impervious Area: 0

Mitigated Landuse Totals for POC #2
Total Pervious Area: 0.306
Total Impervious Area: 2.757

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #2

Return Period	**Flow(cfs)**
2 year	0.067435
5 year	0.264188
10 year	0.506666
25 year	0.969244
50 year	1.438131
100 year	2.018302

Flow Frequency Return Periods for Mitigated. POC #2

Return Period	**Flow(cfs)**
2 year	0.940639
5 year	1.511344
10 year	1.936477
25 year	2.522369
50 year	2.99203
100 year	3.488751

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #2

Year	**Predeveloped**	**Mitigated**
1956	0.476	1.430
1957	0.048	1.756
1958	0.730	1.819
1959	0.174	0.893
1960	0.725	1.901
1961	0.353	1.009
1962	0.900	1.477
1963	0.265	2.598
1964	0.149	1.015
1965	0.079	0.818
1966	0.010	0.761

1967	0.036	0.599
1968	0.007	0.532
1969	0.035	0.742
1970	0.050	0.560
1971	0.322	0.866
1972	0.239	0.750
1973	0.011	0.677
1974	0.346	0.973
1975	0.373	1.630
1976	0.201	0.978
1977	0.002	0.693
1978	0.404	1.612
1979	0.013	0.594
1980	0.027	0.720
1981	0.043	0.849
1982	0.235	0.786
1983	0.096	1.135
1984	0.293	0.697
1985	0.009	0.770
1986	0.273	1.774
1987	0.014	1.182
1988	0.003	0.684
1989	0.010	0.335
1990	0.107	0.767
1991	0.253	0.838
1992	0.013	0.673
1993	0.064	0.621
1994	0.055	0.457
1995	0.015	1.238
1996	0.457	2.013
1997	0.111	0.987
1998	0.094	2.809
1999	0.012	0.402
2000	0.028	0.772
2001	0.002	0.223
2002	0.077	3.175
2003	0.002	2.704
2004	0.002	0.293
2005	0.002	0.799
2006	0.150	0.689
2007	0.248	1.587
2008	0.077	1.153
2009	0.274	1.545

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #2

Rank	Predeveloped	Mitigated
1	0.8999	3.1751
2	0.7305	2.8089
3	0.7247	2.7045
4	0.4758	2.5985
5	0.4571	2.0129
6	0.4041	1.9010
7	0.3727	1.8190
8	0.3528	1.7738
9	0.3458	1.7558
10	0.3224	1.6296
11	0.2931	1.6117

12	0.2737	1.5869
13	0.2734	1.5448
14	0.2650	1.4773
15	0.2526	1.4305
16	0.2480	1.2383
17	0.2395	1.1822
18	0.2351	1.1531
19	0.2013	1.1346
20	0.1739	1.0154
21	0.1501	1.0090
22	0.1488	0.9873
23	0.1107	0.9783
24	0.1070	0.9734
25	0.0961	0.8926
26	0.0937	0.8663
27	0.0789	0.8487
28	0.0771	0.8380
29	0.0765	0.8179
30	0.0637	0.7989
31	0.0552	0.7862
32	0.0503	0.7724
33	0.0483	0.7695
34	0.0429	0.7670
35	0.0361	0.7614
36	0.0355	0.7502
37	0.0276	0.7424
38	0.0269	0.7204
39	0.0153	0.6965
40	0.0140	0.6935
41	0.0132	0.6893
42	0.0129	0.6838
43	0.0120	0.6771
44	0.0114	0.6728
45	0.0101	0.6214
46	0.0099	0.5992
47	0.0087	0.5935
48	0.0069	0.5598
49	0.0029	0.5321
50	0.0025	0.4567
51	0.0025	0.4024
52	0.0024	0.3347
53	0.0024	0.2928
54	0.0022	0.2226

Duration Flows

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0337	306	104673	34206	Fail
0.0479	209	80247	38395	Fail
0.0621	161	62183	38622	Fail
0.0763	135	49458	36635	Fail
0.0905	101	39120	38732	Fail
0.1046	81	30807	38033	Fail
0.1188	72	24350	33819	Fail
0.1330	60	18712	31186	Fail
0.1472	52	14803	28467	Fail
0.1614	47	11766	25034	Fail
0.1756	42	9422	22433	Fail
0.1898	36	7678	21327	Fail
0.2039	34	6436	18929	Fail
0.2181	32	5393	16853	Fail
0.2323	29	4673	16113	Fail
0.2465	25	4094	16375	Fail
0.2607	23	3624	15756	Fail
0.2749	18	3183	17683	Fail
0.2891	15	2804	18693	Fail
0.3033	13	2456	18892	Fail
0.3174	12	2168	18066	Fail
0.3316	11	1937	17609	Fail
0.3458	11	1730	15727	Fail
0.3600	9	1538	17088	Fail
0.3742	8	1379	17237	Fail
0.3884	8	1259	15737	Fail
0.4026	8	1155	14437	Fail
0.4167	7	1046	14942	Fail
0.4309	6	969	16150	Fail
0.4451	6	881	14683	Fail
0.4593	4	829	20725	Fail
0.4735	4	774	19350	Fail
0.4877	3	726	24200	Fail
0.5019	3	686	22866	Fail
0.5160	3	638	21266	Fail
0.5302	3	597	19900	Fail
0.5444	3	556	18533	Fail
0.5586	3	526	17533	Fail
0.5728	3	489	16300	Fail
0.5870	3	465	15500	Fail
0.6012	3	439	14633	Fail
0.6153	3	413	13766	Fail
0.6295	3	392	13066	Fail
0.6437	3	369	12300	Fail
0.6579	3	352	11733	Fail
0.6721	3	341	11366	Fail
0.6863	3	323	10766	Fail
0.7005	3	305	10166	Fail
0.7146	3	296	9866	Fail
0.7288	2	282	14100	Fail
0.7430	1	262	26200	Fail
0.7572	1	248	24800	Fail
0.7714	1	237	23700	Fail
0.7856	1	226	22600	Fail

0.7998	1	207	20700	Fail
0.8139	1	201	20100	Fail
0.8281	1	190	19000	Fail
0.8423	1	184	18400	Fail
0.8565	1	174	17400	Fail
0.8707	1	168	16800	Fail
0.8849	1	167	16700	Fail
0.8991	1	158	15800	Fail
0.9132	0	156	n/a	Fail
0.9274	0	151	n/a	Fail
0.9416	0	147	n/a	Fail
0.9558	0	143	n/a	Fail
0.9700	0	139	n/a	Fail
0.9842	0	134	n/a	Fail
0.9984	0	129	n/a	Fail
1.0126	0	125	n/a	Fail
1.0267	0	122	n/a	Fail
1.0409	0	118	n/a	Fail
1.0551	0	113	n/a	Fail
1.0693	0	109	n/a	Fail
1.0835	0	108	n/a	Fail
1.0977	0	103	n/a	Fail
1.1119	0	102	n/a	Fail
1.1260	0	97	n/a	Fail
1.1402	0	92	n/a	Fail
1.1544	0	88	n/a	Fail
1.1686	0	87	n/a	Fail
1.1828	0	81	n/a	Fail
1.1970	0	75	n/a	Fail
1.2112	0	73	n/a	Fail
1.2253	0	72	n/a	Fail
1.2395	0	70	n/a	Fail
1.2537	0	68	n/a	Fail
1.2679	0	64	n/a	Fail
1.2821	0	63	n/a	Fail
1.2963	0	61	n/a	Fail
1.3105	0	60	n/a	Fail
1.3246	0	57	n/a	Fail
1.3388	0	55	n/a	Fail
1.3530	0	55	n/a	Fail
1.3672	0	54	n/a	Fail
1.3814	0	50	n/a	Fail
1.3956	0	48	n/a	Fail
1.4098	0	46	n/a	Fail
1.4239	0	44	n/a	Fail
1.4381	0	42	n/a	Fail

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

Water Quality

Water Quality BMP Flow and Volume for POC #2

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

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

No PERLND changes have been made.

IMPLND Changes

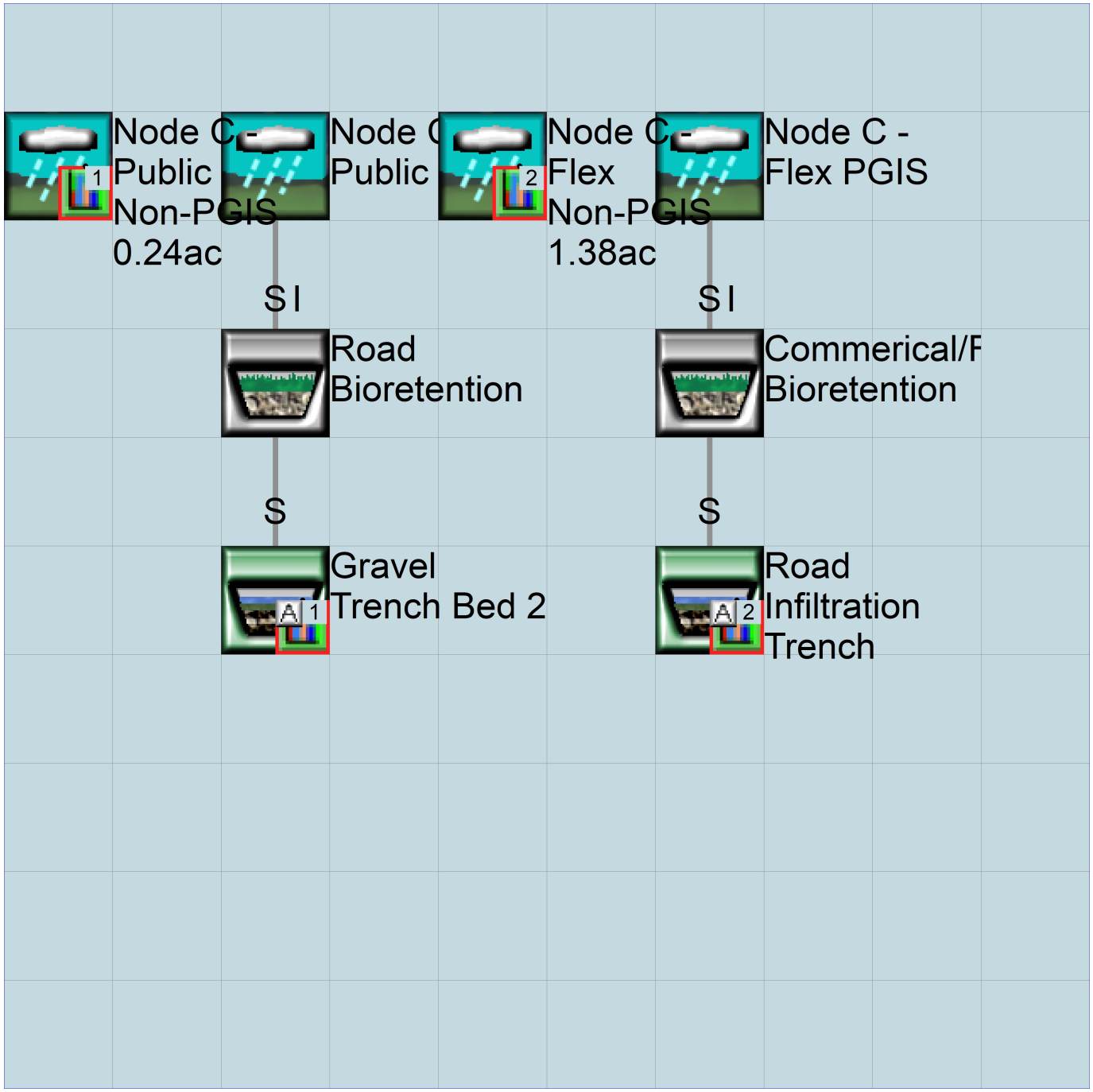
No IMPLND changes have been made.

Appendix

Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   18591_Node C.wdm
MESSU       25   Pre18591_Node C.MES
            27   Pre18591_Node C.L61
            28   Pre18591_Node C.L62
            30   POC18591_Node C1.dat
            31   POC18591_Node C2.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND       2
      COPY       501
      COPY       502
      DISPLY       1
      DISPLY       2
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title---------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Node C - Existing Public    MAX                   1    2   30    9
    2        Node C - Existng Flex       MAX                   1    2   31    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  502         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
    2     A/B, Forest, Mod        1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    2         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
```

```
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
    2         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    2         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    2              0         5         2       400       0.1       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    2              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    2          0.2       0.5      0.35         0       0.7       0.7
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
             ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
    2              0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

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

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

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

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

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

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

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

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Node C - Existing Public***
PERLND   2                       0.949     COPY   501     12
PERLND   2                       0.949     COPY   501     13
Node C - Existng Flex***
PERLND   2                       3.063     COPY   502     12
PERLND   2                       3.063     COPY   502     13

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

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1
COPY   502 OUTPUT MEAN   1 1   48.4        DISPLY   2     INPUT  TIMSER 1



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

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

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

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

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

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

SPEC-ACTIONS
```

```
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.429          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.429          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
COPY   502 OUTPUT MEAN   1 1     48.4      WDM    502 FLOW     ENGL      REPL
END EXT TARGETS

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

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


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   18591_Node C.wdm
MESSU       25   Mit18591_Node C.MES
            27   Mit18591_Node C.L61
            28   Mit18591_Node C.L62
            31   POC18591_Node C2.dat
            30   POC18591_Node C1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      IMPLND       1
      PERLND       8
      IMPLND       4
      RCHRES       1
      RCHRES       2
      RCHRES       3
      RCHRES       4
      RCHRES       5
      RCHRES       6
      COPY         2
      COPY       502
      COPY       602
      COPY         1
      COPY       501
      COPY       601
      DISPLY       2
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    2        Road Infiltration Trench    MAX                    1    2   31    9
    1        Gravel Trench Bed 2         MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
    2         1    1
  502         1    1
  602         1    1
  501         1    1
  601         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
```

```
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                         User  t-series Engl Metr ***
                                        in  out           ***
    8     A/B, Lawn, Mod          1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    8         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
    8         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    8         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    8             0         5       0.8       400       0.1       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    8             0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    8          0.1       0.5      0.25         0       0.7      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
             ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS       IFWS       LZS       AGWS      GWVS
    8             0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                      in  out           ***
    1      ROADS/FLAT             1    1    1   27    0
    4      ROOF TOPS/FLAT         1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
    4         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
```

```
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    4    1    9
    4         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
    4         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
    4            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
    4              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
    4              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                 <--Area-->     <-Target->   MBLK   ***
<Name>   #                 <-factor->     <Name>   #   Tbl#   ***
Node C - Public PGIS***
IMPLND   1                      0.71     RCHRES   1      5
Node C - Flex PGIS***
IMPLND   1                     1.685     RCHRES   3      5
Node C - Public Non-PGIS***
PERLND   8                     0.239     COPY   501     12
PERLND   8                     0.239     COPY   601     12
PERLND   8                     0.239     COPY   501     13
PERLND   8                     0.239     COPY   601     13
Node C - Flex Non-PGIS***
PERLND   8                     0.306     COPY   502     12
PERLND   8                     0.306     COPY   602     12
PERLND   8                     0.306     COPY   502     13
PERLND   8                     0.306     COPY   602     13
IMPLND   4                     1.072     COPY   502     15
IMPLND   4                     1.072     COPY   602     15

******Routing******
RCHRES   1                         1     RCHRES   6      7
RCHRES   1                               COPY     1     17
RCHRES   1                         1     RCHRES   2      8
RCHRES   3                         1     RCHRES   5      7
RCHRES   3                               COPY     2     17
RCHRES   3                         1     RCHRES   4      8
RCHRES   5                         1     COPY   502     17
RCHRES   6                         1     COPY   501     17
END SCHEMATIC

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

```
COPY   502 OUTPUT MEAN   1 1   48.4        DISPLY   2     INPUT  TIMSER 1
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1


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

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                        in  out                              ***
    1     Surface Bioreten-009    2    1    1    1   28    0    1
    2     Road Bioretentio-008    1    1    1    1   28    0    1
    3     Surface Bioreten-011    2    1    1    1   28    0    1
    4     Commerical/Flex -010    1    1    1    1   28    0    1
    5     Road Infiltratio-013    2    1    1    1   28    0    1
    6     Gravel Trench Be-021    2    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections ******************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
    2         1    0    0    0    0    0    0    0    0    0
    3         1    0    0    0    0    0    0    0    0    0
    4         1    0    0    0    0    0    0    0    0    0
    5         1    0    0    0    0    0    0    0    0    0
    6         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
    2         4    0    0    0    0    0    0    0    0    0    1    9
    3         4    0    0    0    0    0    0    0    0    0    1    9
    4         4    0    0    0    0    0    0    0    0    0    1    9
    5         4    0    0    0    0    0    0    0    0    0    1    9
    6         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                    ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
           FG FG FG FG  possible  exit  *** possible  exit      possible  exit
            *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
    1       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    2       0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
    3       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    4       0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
    5       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    6       0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><--------->      ***
    1             1      0.01       0.0       0.0       0.0       0.0
    2             2      0.02       0.0       0.0       0.0       0.0
    3             3      0.01       0.0       0.0       0.0       0.0
    4             4      0.01       0.0       0.0       0.0       0.0
    5             5      0.01       0.0       0.0       0.5       0.0
    6             6      0.02       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                       ***
```

```
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
           *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    3            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    4            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    5            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    6            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      2
   70    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.013774  0.000000  0.000000
  0.043956  0.013774  0.000277  0.000000
  0.087912  0.013774  0.000554  0.000000
  0.131868  0.013774  0.000831  0.000000
  0.175824  0.013774  0.001107  0.000000
  0.219780  0.013774  0.001384  0.000380
  0.263736  0.013774  0.001661  0.000638
  0.307692  0.013774  0.001938  0.000986
  0.351648  0.013774  0.002215  0.001434
  0.395604  0.013774  0.002492  0.001994
  0.439560  0.013774  0.002769  0.002673
  0.483516  0.013774  0.003046  0.003481
  0.527473  0.013774  0.003322  0.004323
  0.571429  0.013774  0.003599  0.004425
  0.615385  0.013774  0.003876  0.005512
  0.659341  0.013774  0.004153  0.006749
  0.703297  0.013774  0.004430  0.008144
  0.747253  0.013774  0.004707  0.009703
  0.791209  0.013774  0.004984  0.010449
  0.835165  0.013774  0.005261  0.011431
  0.879121  0.013774  0.005537  0.013335
  0.923077  0.013774  0.005814  0.015420
  0.967033  0.013774  0.006091  0.017692
  1.010989  0.013774  0.006368  0.020005
  1.054945  0.013774  0.006645  0.020156
  1.098901  0.013774  0.006922  0.022817
  1.142857  0.013774  0.007199  0.025680
  1.186813  0.013774  0.007476  0.028751
  1.230769  0.013774  0.007752  0.032033
  1.274725  0.013774  0.008029  0.033474
  1.318681  0.013774  0.008306  0.035530
  1.362637  0.013774  0.008583  0.039248
  1.406593  0.013774  0.008860  0.043189
  1.450549  0.013774  0.009137  0.047359
  1.494505  0.013774  0.009414  0.051289
  1.538462  0.013774  0.009665  0.051758
  1.582418  0.013774  0.009916  0.056391
  1.626374  0.013774  0.010168  0.061259
  1.670330  0.013774  0.010419  0.066361
  1.714286  0.013774  0.010670  0.071692
  1.758242  0.013774  0.010921  0.073842
  1.802198  0.013774  0.011173  0.077234
  1.846154  0.013774  0.011424  0.082851
  1.890110  0.013774  0.011675  0.111111
  1.934066  0.013774  0.011926  0.111111
  1.978022  0.013774  0.012178  0.111111
  2.021978  0.013774  0.012429  0.111111
  2.065934  0.013774  0.012680  0.111111
  2.109890  0.013774  0.012931  0.111111
  2.153846  0.013774  0.013183  0.111111
  2.197802  0.013774  0.013434  0.111111
```

```
2.241758  0.013774  0.013685  0.111111
2.285714  0.013774  0.013936  0.111111
2.329670  0.013774  0.014188  0.111111
2.373626  0.013774  0.014439  0.111111
2.417582  0.013774  0.014690  0.111111
2.461538  0.013774  0.014942  0.111111
2.505495  0.013774  0.015193  0.111111
2.549451  0.013774  0.015444  0.111111
2.593407  0.013774  0.015695  0.111111
2.637363  0.013774  0.015947  0.111111
2.681319  0.013774  0.016198  0.111111
2.725275  0.013774  0.016449  0.111111
2.769231  0.013774  0.016700  0.111111
2.813187  0.013774  0.016952  0.111111
2.857143  0.013774  0.017203  0.111111
2.901099  0.013774  0.017454  0.111111
2.945055  0.013774  0.017705  0.111111
2.989011  0.013774  0.017957  0.111111
3.000000  0.013774  0.020315  0.111111
END FTABLE  2
FTABLE      1
 24    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.013774  0.000000  0.000000  0.000000
0.043956  0.013774  0.000605  0.000000  0.083333
0.087912  0.013774  0.001211  0.000000  0.088217
0.131868  0.013774  0.001816  0.000000  0.090659
0.175824  0.013774  0.002422  0.000000  0.093101
0.219780  0.013774  0.003027  0.000000  0.095543
0.263736  0.013774  0.003633  0.000000  0.097985
0.307692  0.013774  0.004238  0.000000  0.100427
0.351648  0.013774  0.004844  0.000000  0.102869
0.395604  0.013774  0.005449  0.000000  0.105311
0.439560  0.013774  0.006055  0.000000  0.107753
0.483516  0.013774  0.006660  0.000000  0.110195
0.527473  0.013774  0.007265  0.048301  0.111111
0.571429  0.013774  0.007871  0.202028  0.111111
0.615385  0.013774  0.008476  0.412175  0.111111
0.659341  0.013774  0.009082  0.659695  0.111111
0.703297  0.013774  0.009687  0.928167  0.111111
0.747253  0.013774  0.010293  1.200769  0.111111
0.791209  0.013774  0.010898  1.460630  0.111111
0.835165  0.013774  0.011504  1.692395  0.111111
0.879121  0.013774  0.012109  1.884482  0.111111
0.923077  0.013774  0.012715  2.031838  0.111111
0.967033  0.013774  0.013320  2.139092  0.111111
1.000000  0.013774  0.013774  2.251466  0.111111
END FTABLE  1
FTABLE      4
 56    4
   Depth      Area    Volume  Outflow1 Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
0.000000  0.027548  0.000000  0.000000
0.054945  0.027548  0.000692  0.000000
0.109890  0.027548  0.001384  0.000000
0.164835  0.027548  0.002077  0.000000
0.219780  0.027548  0.002769  0.001131
0.274725  0.027548  0.003461  0.001971
0.329670  0.027548  0.004153  0.003127
0.384615  0.027548  0.004845  0.003291
0.439560  0.027548  0.005537  0.004636
0.494505  0.027548  0.006230  0.006533
0.549451  0.027548  0.006922  0.008849
0.604396  0.027548  0.007614  0.011613
0.659341  0.027548  0.008306  0.013981
0.714286  0.027548  0.008998  0.014853
0.769231  0.027548  0.009691  0.018595
0.824176  0.027548  0.010383  0.022862
0.879121  0.027548  0.011075  0.027678
```

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0.934066  0.027548  0.011767  0.033064
0.989011  0.027548  0.012459  0.034534
1.043956  0.027548  0.013152  0.039043
1.098901  0.027548  0.013844  0.045634
1.153846  0.027548  0.014536  0.052857
1.208791  0.027548  0.015228  0.060730
1.263736  0.027548  0.015920  0.066948
1.318681  0.027548  0.016612  0.069271
1.373626  0.027548  0.017305  0.078496
1.428571  0.027548  0.017997  0.088421
1.483516  0.027548  0.018689  0.099059
1.538462  0.027548  0.019317  0.110422
1.593407  0.027548  0.019945  0.112937
1.648352  0.027548  0.020574  0.122518
1.703297  0.027548  0.021202  0.135345
1.758242  0.027548  0.021830  0.148879
1.813187  0.027548  0.022458  0.162949
1.868132  0.027548  0.023086  0.277778
1.923077  0.027548  0.023714  0.277778
1.978022  0.027548  0.024342  0.277778
2.032967  0.027548  0.024971  0.277778
2.087912  0.027548  0.025599  0.277778
2.142857  0.027548  0.026227  0.277778
2.197802  0.027548  0.026855  0.277778
2.252747  0.027548  0.027483  0.277778
2.307692  0.027548  0.028111  0.277778
2.362637  0.027548  0.028740  0.277778
2.417582  0.027548  0.029368  0.277778
2.472527  0.027548  0.029996  0.277778
2.527473  0.027548  0.030624  0.277778
2.582418  0.027548  0.031252  0.277778
2.637363  0.027548  0.031880  0.277778
2.692308  0.027548  0.032509  0.277778
2.747253  0.027548  0.033137  0.277778
2.802198  0.027548  0.033765  0.277778
2.857143  0.027548  0.034393  0.277778
2.912088  0.027548  0.035021  0.277778
2.967033  0.027548  0.035649  0.277778
3.000000  0.027548  0.041765  0.277778
END FTABLE  4
FTABLE      3
 38    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)     (cfs)   (ft/sec)    (Minutes)***
0.000000  0.027548  0.000000  0.000000  0.000000
0.054945  0.027548  0.001514  0.000000  0.166667
0.109890  0.027548  0.003027  0.000000  0.178877
0.164835  0.027548  0.004541  0.000000  0.184982
0.219780  0.027548  0.006055  0.000000  0.191087
0.274725  0.027548  0.007568  0.000000  0.197192
0.329670  0.027548  0.009082  0.000000  0.203297
0.384615  0.027548  0.010595  0.000000  0.209402
0.439560  0.027548  0.012109  0.000000  0.215507
0.494505  0.027548  0.013623  0.000000  0.221612
0.549451  0.027548  0.015136  0.000000  0.227717
0.604396  0.027548  0.016650  0.000000  0.233822
0.659341  0.027548  0.018164  0.000000  0.239927
0.714286  0.027548  0.019677  0.000000  0.246032
0.769231  0.027548  0.021191  0.000000  0.252137
0.824176  0.027548  0.022705  0.000000  0.258242
0.879121  0.027548  0.024218  0.000000  0.264347
0.934066  0.027548  0.025732  0.000000  0.270452
0.989011  0.027548  0.027245  0.000000  0.276557
1.043956  0.027548  0.028759  0.195553  0.277778
1.098901  0.027548  0.030273  0.659242  0.277778
1.153846  0.027548  0.031786  1.276591  0.277778
1.208791  0.027548  0.033300  2.010935  0.277778
1.263736  0.027548  0.034814  2.836899  0.277778
1.318681  0.027548  0.036327  3.731796  0.277778
1.373626  0.027548  0.037841  4.673072  0.277778
```

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1.428571  0.027548  0.039355  5.637608  0.277778
1.483516  0.027548  0.040868  6.601841  0.277778
1.538462  0.027548  0.042382  7.542349  0.277778
1.593407  0.027548  0.043895  8.436754  0.277778
1.648352  0.027548  0.045409  9.264852  0.277778
1.703297  0.027548  0.046923  10.00993  0.277778
1.758242  0.027548  0.048436  10.66024  0.277778
1.813187  0.027548  0.049950  11.21062  0.277778
1.868132  0.027548  0.051464  11.66425  0.277778
1.923077  0.027548  0.052977  12.03449  0.277778
1.978022  0.027548  0.054491  12.34684  0.277778
2.000000  0.027548  0.055096  12.80450  0.277778
END FTABLE  3
FTABLE      5
 92    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.027548  0.000000  0.000000  0.000000
0.055556  0.027548  0.000536  0.000000  0.055556
0.111111  0.027548  0.001071  0.000000  0.055556
0.166667  0.027548  0.001607  0.000000  0.055556
0.222222  0.027548  0.002143  0.000000  0.055556
0.277778  0.027548  0.002678  0.000000  0.055556
0.333333  0.027548  0.003214  0.000000  0.055556
0.388889  0.027548  0.003750  0.000000  0.055556
0.444444  0.027548  0.004285  0.000000  0.055556
0.500000  0.027548  0.004821  0.000000  0.055556
0.555556  0.027548  0.005357  0.000000  0.055556
0.611111  0.027548  0.005892  0.000000  0.055556
0.666667  0.027548  0.006428  0.000000  0.055556
0.722222  0.027548  0.006964  0.000000  0.055556
0.777778  0.027548  0.007499  0.000000  0.055556
0.833333  0.027548  0.008035  0.000000  0.055556
0.888889  0.027548  0.008571  0.000000  0.055556
0.944444  0.027548  0.009106  0.000000  0.055556
1.000000  0.027548  0.009642  0.000000  0.055556
1.055556  0.027548  0.010178  0.000000  0.055556
1.111111  0.027548  0.010713  0.000000  0.055556
1.166667  0.027548  0.011249  0.000000  0.055556
1.222222  0.027548  0.011785  0.000000  0.055556
1.277778  0.027548  0.012320  0.000000  0.055556
1.333333  0.027548  0.012856  0.000000  0.055556
1.388889  0.027548  0.013391  0.000000  0.055556
1.444444  0.027548  0.013927  0.000000  0.055556
1.500000  0.027548  0.014463  0.000000  0.055556
1.555556  0.027548  0.014998  0.000000  0.055556
1.611111  0.027548  0.015534  0.000000  0.055556
1.666667  0.027548  0.016070  0.000000  0.055556
1.722222  0.027548  0.016605  0.000000  0.055556
1.777778  0.027548  0.017141  0.000000  0.055556
1.833333  0.027548  0.017677  0.000000  0.055556
1.888889  0.027548  0.018212  0.000000  0.055556
1.944444  0.027548  0.018748  0.000000  0.055556
2.000000  0.027548  0.019284  0.000000  0.055556
2.055556  0.027548  0.019819  0.000000  0.055556
2.111111  0.027548  0.020355  0.000000  0.055556
2.166667  0.027548  0.020891  0.000000  0.055556
2.222222  0.027548  0.021426  0.000000  0.055556
2.277778  0.027548  0.021962  0.000000  0.055556
2.333333  0.027548  0.022498  0.000000  0.055556
2.388889  0.027548  0.023033  0.000000  0.055556
2.444444  0.027548  0.023569  0.000000  0.055556
2.500000  0.027548  0.024105  0.000000  0.055556
2.555556  0.027548  0.024640  0.000000  0.055556
2.611111  0.027548  0.025176  0.000000  0.055556
2.666667  0.027548  0.025712  0.000000  0.055556
2.722222  0.027548  0.026247  0.000000  0.055556
2.777778  0.027548  0.026783  0.000000  0.055556
2.833333  0.027548  0.027319  0.000000  0.055556
2.888889  0.027548  0.027854  0.000000  0.055556
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2.944444  0.027548  0.028390  0.000000  0.055556
3.000000  0.027548  0.028926  0.000000  0.055556
3.055556  0.027548  0.029461  0.000000  0.055556
3.111111  0.027548  0.029997  0.000000  0.055556
3.166667  0.027548  0.030533  0.000000  0.055556
3.222222  0.027548  0.031068  0.000000  0.055556
3.277778  0.027548  0.031604  0.000000  0.055556
3.333333  0.027548  0.032140  0.000000  0.055556
3.388889  0.027548  0.032675  0.000000  0.055556
3.444444  0.027548  0.033211  0.000000  0.055556
3.500000  0.027548  0.033747  0.000000  0.055556
3.555556  0.027548  0.034282  0.000000  0.055556
3.611111  0.027548  0.034818  0.000000  0.055556
3.666667  0.027548  0.035354  0.000000  0.055556
3.722222  0.027548  0.035889  0.000000  0.055556
3.777778  0.027548  0.036425  0.000000  0.055556
3.833333  0.027548  0.036961  0.000000  0.055556
3.888889  0.027548  0.037496  0.000000  0.055556
3.944444  0.027548  0.038032  0.000000  0.055556
4.000000  0.027548  0.038567  0.000000  0.055556
4.055556  0.027548  0.039103  0.138729  0.055556
4.111111  0.027548  0.039639  0.389839  0.055556
4.166667  0.027548  0.040174  0.703432  0.055556
4.222222  0.027548  0.040710  1.046030  0.055556
4.277778  0.027548  0.041246  1.383552  0.055556
4.333333  0.027548  0.041781  1.683468  0.055556
4.388889  0.027548  0.042317  1.921105  0.055556
4.444444  0.027548  0.042853  2.088233  0.055556
4.500000  0.027548  0.043388  2.203335  0.055556
4.555556  0.027548  0.043924  2.347596  0.055556
4.611111  0.027548  0.044460  2.462179  0.055556
4.666667  0.027548  0.044995  2.571662  0.055556
4.722222  0.027548  0.045531  2.676671  0.055556
4.777778  0.027548  0.046067  2.777713  0.055556
4.833333  0.027548  0.046602  2.875206  0.055556
4.888889  0.027548  0.047138  2.969500  0.055556
4.944444  0.027548  0.047674  3.060890  0.055556
5.000000  0.027548  0.048209  3.149630  0.055556
5.055556  0.027548  0.048745  3.235937  0.055556
END FTABLE  5
FTABLE      6
 92    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.013774  0.000000  0.000000  0.000000
0.055556  0.013774  0.000268  0.000000  0.027778
0.111111  0.013774  0.000536  0.000000  0.027778
0.166667  0.013774  0.000803  0.000000  0.027778
0.222222  0.013774  0.001071  0.000000  0.027778
0.277778  0.013774  0.001339  0.000000  0.027778
0.333333  0.013774  0.001607  0.000000  0.027778
0.388889  0.013774  0.001875  0.000000  0.027778
0.444444  0.013774  0.002143  0.000000  0.027778
0.500000  0.013774  0.002410  0.000000  0.027778
0.555556  0.013774  0.002678  0.000000  0.027778
0.611111  0.013774  0.002946  0.000000  0.027778
0.666667  0.013774  0.003214  0.000000  0.027778
0.722222  0.013774  0.003482  0.000000  0.027778
0.777778  0.013774  0.003750  0.000000  0.027778
0.833333  0.013774  0.004017  0.000000  0.027778
0.888889  0.013774  0.004285  0.000000  0.027778
0.944444  0.013774  0.004553  0.000000  0.027778
1.000000  0.013774  0.004821  0.000000  0.027778
1.055556  0.013774  0.005089  0.000000  0.027778
1.111111  0.013774  0.005357  0.000000  0.027778
1.166667  0.013774  0.005624  0.000000  0.027778
1.222222  0.013774  0.005892  0.000000  0.027778
1.277778  0.013774  0.006160  0.000000  0.027778
1.333333  0.013774  0.006428  0.000000  0.027778
1.388889  0.013774  0.006696  0.000000  0.027778
```

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  1.444444  0.013774  0.006964  0.000000  0.027778
  1.500000  0.013774  0.007231  0.000000  0.027778
  1.555556  0.013774  0.007499  0.000000  0.027778
  1.611111  0.013774  0.007767  0.000000  0.027778
  1.666667  0.013774  0.008035  0.000000  0.027778
  1.722222  0.013774  0.008303  0.000000  0.027778
  1.777778  0.013774  0.008571  0.000000  0.027778
  1.833333  0.013774  0.008838  0.000000  0.027778
  1.888889  0.013774  0.009106  0.000000  0.027778
  1.944444  0.013774  0.009374  0.000000  0.027778
  2.000000  0.013774  0.009642  0.000000  0.027778
  2.055556  0.013774  0.009910  0.000000  0.027778
  2.111111  0.013774  0.010178  0.000000  0.027778
  2.166667  0.013774  0.010445  0.000000  0.027778
  2.222222  0.013774  0.010713  0.000000  0.027778
  2.277778  0.013774  0.010981  0.000000  0.027778
  2.333333  0.013774  0.011249  0.000000  0.027778
  2.388889  0.013774  0.011517  0.000000  0.027778
  2.444444  0.013774  0.011785  0.000000  0.027778
  2.500000  0.013774  0.012052  0.000000  0.027778
  2.555556  0.013774  0.012320  0.000000  0.027778
  2.611111  0.013774  0.012588  0.000000  0.027778
  2.666667  0.013774  0.012856  0.000000  0.027778
  2.722222  0.013774  0.013124  0.000000  0.027778
  2.777778  0.013774  0.013391  0.000000  0.027778
  2.833333  0.013774  0.013659  0.000000  0.027778
  2.888889  0.013774  0.013927  0.000000  0.027778
  2.944444  0.013774  0.014195  0.000000  0.027778
  3.000000  0.013774  0.014463  0.000000  0.027778
  3.055556  0.013774  0.014731  0.138729  0.027778
  3.111111  0.013774  0.014998  0.389839  0.027778
  3.166667  0.013774  0.015266  0.703432  0.027778
  3.222222  0.013774  0.015534  1.046030  0.027778
  3.277778  0.013774  0.015802  1.383552  0.027778
  3.333333  0.013774  0.016070  1.683468  0.027778
  3.388889  0.013774  0.016338  1.921105  0.027778
  3.444444  0.013774  0.016605  2.088233  0.027778
  3.500000  0.013774  0.016873  2.203335  0.027778
  3.555556  0.013774  0.017141  2.347596  0.027778
  3.611111  0.013774  0.017409  2.462179  0.027778
  3.666667  0.013774  0.017677  2.571662  0.027778
  3.722222  0.013774  0.017945  2.676671  0.027778
  3.777778  0.013774  0.018212  2.777713  0.027778
  3.833333  0.013774  0.018480  2.875206  0.027778
  3.888889  0.013774  0.018748  2.969500  0.027778
  3.944444  0.013774  0.019016  3.060890  0.027778
  4.000000  0.013774  0.019284  3.149630  0.027778
  4.055556  0.013774  0.019552  3.235937  0.027778
  4.111111  0.013774  0.019819  3.320002  0.027778
  4.166667  0.013774  0.020087  3.401989  0.027778
  4.222222  0.013774  0.020355  3.482047  0.027778
  4.277778  0.013774  0.020623  3.560305  0.027778
  4.333333  0.013774  0.020891  3.636879  0.027778
  4.388889  0.013774  0.021159  3.711875  0.027778
  4.444444  0.013774  0.021426  3.785384  0.027778
  4.500000  0.013774  0.021694  3.857493  0.027778
  4.555556  0.013774  0.021962  3.928279  0.027778
  4.611111  0.013774  0.022230  3.997811  0.027778
  4.666667  0.013774  0.022498  4.066155  0.027778
  4.722222  0.013774  0.022766  4.133369  0.027778
  4.777778  0.013774  0.023033  4.199507  0.027778
  4.833333  0.013774  0.023301  4.264619  0.027778
  4.888889  0.013774  0.023569  4.328752  0.027778
  4.944444  0.013774  0.023837  4.391949  0.027778
  5.000000  0.013774  0.024105  4.454250  0.027778
  5.055556  0.013774  0.024870  4.515690  0.027778
  END FTABLE  6
END FTABLES

EXT SOURCES
```

```
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.429          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.429          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP
WDM      2 PREC     ENGL    1.429          RCHRES   1     EXTNL  PREC
WDM      2 PREC     ENGL    1.429          RCHRES   3     EXTNL  PREC
WDM      1 EVAP     ENGL    0.5            RCHRES   1     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.76           RCHRES   2     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.5            RCHRES   3     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.76           RCHRES   4     EXTNL  POTEV

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   5 HYDR   RO     1 1        1      WDM   1004 FLOW     ENGL      REPL
RCHRES   5 HYDR   O      1 1        1      WDM   1005 FLOW     ENGL      REPL
RCHRES   5 HYDR   O      2 1        1      WDM   1006 FLOW     ENGL      REPL
RCHRES   5 HYDR   STAGE  1 1        1      WDM   1007 STAG     ENGL      REPL
COPY     2 OUTPUT MEAN   1 1     48.4      WDM    702 FLOW     ENGL      REPL
COPY   502 OUTPUT MEAN   1 1     48.4      WDM    802 FLOW     ENGL      REPL
COPY   602 OUTPUT MEAN   1 1     48.4      WDM    902 FLOW     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
COPY   601 OUTPUT MEAN   1 1     48.4      WDM    901 FLOW     ENGL      REPL
RCHRES   6 HYDR   RO     1 1        1      WDM   1014 FLOW     ENGL      REPL
RCHRES   6 HYDR   O      1 1        1      WDM   1015 FLOW     ENGL      REPL
RCHRES   6 HYDR   O      2 1        1      WDM   1016 FLOW     ENGL      REPL
RCHRES   6 HYDR   STAGE  1 1        1      WDM   1017 STAG     ENGL      REPL
END EXT TARGETS

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

  MASS-LINK        7
RCHRES     OFLOW  OVOL   1                 RCHRES         INFLOW IVOL
  END MASS-LINK    7

  MASS-LINK        8
RCHRES     OFLOW  OVOL   2                 RCHRES         INFLOW IVOL
  END MASS-LINK    8

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

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

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

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


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

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Local (360)943-0304

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WWHM2012

PROJECT REPORT

General Model Information

WWHM2012 Project Name: 18591_Node D

Site Name:	LOTC
Site Address:	
City:	Castle Rock, WA
Report Date:	3/7/2025
Gage:	Longview
Data Start:	1955/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	1.429
Version Date:	2024/06/28
Version:	4.3.1

POC Thresholds

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

Landuse Basin Data

Predeveloped Land Use

Node D - Remaining Onsite Areas

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A B, Forest, Mod	75.858
Pervious Total	75.858

Impervious Land Use	acre
Impervious Total	0
Basin Total	75.858

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

POC 1	POC 1	

Mitigated Land Use

Node D - Non-PGIS

Bypass:	Yes
GroundWater:	No

Pervious Land Use	acre
A B, Lawn, Mod	9.462
Pervious Total	9.462

Impervious Land Use	acre
ROOF TOPS FLAT	20.159
Impervious Total	20.159
Basin Total	29.621

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

POC 1	POC 1

Node D - PGIS

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	46.237
Impervious Total	46.237
Basin Total	46.237

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

Surface retention	1	Surface retention	1POC 1

Routing Elements
Predeveloped Routing

Mitigated Routing

Bioretention 1

Bottom Length:	270.00 ft.
Bottom Width:	270.00 ft.
Material thickness of first layer:	1.5
Material type for first layer:	SMMWW 12 in/hr
Material thickness of second layer:	3
Material type for second layer:	GRAVEL
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (feet):	2
Orifice Diameter (in.):	24
Offset (in.):	0
Flow Through Underdrain (ac-ft.):	11251.882
Total Outflow (ac-ft.):	11264.741
Percent Through Underdrain:	99.89
Discharge Structure	
Riser Height:	1 ft.
Riser Diameter:	60 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	
Gravel Trench Bed 1	

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	1.6736	0.0000	0.0000	0.0000
0.0714	1.6736	0.0547	0.0000	0.0000
0.1429	1.6736	0.1093	0.0000	0.0000
0.2143	1.6736	0.1640	0.0000	0.0000
0.2857	1.6736	0.2187	0.0000	0.0000
0.3571	1.6736	0.2733	0.0000	0.0000
0.4286	1.6736	0.3280	0.0000	0.0000
0.5000	1.6736	0.3827	0.0000	0.0000
0.5714	1.6736	0.4373	0.0000	0.0000
0.6429	1.6736	0.4920	0.0000	0.0000
0.7143	1.6736	0.5467	0.0000	0.0000
0.7857	1.6736	0.6013	0.0000	0.0000
0.8571	1.6736	0.6560	0.0000	0.0000
0.9286	1.6736	0.7107	0.0000	0.0000
1.0000	1.6736	0.7653	0.0000	0.0000
1.0714	1.6736	0.8200	0.0000	0.0000
1.1429	1.6736	0.8746	0.0000	0.0000
1.2143	1.6736	0.9293	0.0000	0.0000
1.2857	1.6736	0.9840	0.0000	0.0000
1.3571	1.6736	1.0386	0.0000	0.0000
1.4286	1.6736	1.0933	0.0000	0.0000
1.5000	1.6736	1.1480	0.0000	0.0000
1.5714	1.6736	1.1976	0.0000	0.0000
1.6429	1.6736	1.2472	0.0000	0.0000
1.7143	1.6736	1.2968	0.0000	0.0000
1.7857	1.6736	1.3464	0.0000	0.0000
1.8571	1.6736	1.3960	0.0000	0.0000
1.9286	1.6736	1.4456	0.0000	0.0000

2.0000	1.6736	1.4952	0.0000	0.0000
2.0714	1.6736	1.5448	0.0000	0.0000
2.1429	1.6736	1.5945	0.0000	0.0000
2.2143	1.6736	1.6441	0.0000	0.0000
2.2857	1.6736	1.6937	0.0000	0.0000
2.3571	1.6736	1.7433	0.0000	0.0000
2.4286	1.6736	1.7929	0.0000	0.0000
2.5000	1.6736	1.8425	0.0000	0.0000
2.5714	1.6736	1.8921	0.0000	0.0000
2.6429	1.6736	1.9417	0.0000	0.0000
2.7143	1.6736	1.9913	0.0000	0.0000
2.7857	1.6736	2.0409	0.0000	0.0000
2.8571	1.6736	2.0905	0.0000	0.0000
2.9286	1.6736	2.1402	0.0000	0.0000
3.0000	1.6736	2.1898	0.0000	0.0000
3.0714	1.6736	2.2394	0.0000	0.0000
3.1429	1.6736	2.2890	0.0000	0.0000
3.2143	1.6736	2.3386	0.0000	0.0000
3.2857	1.6736	2.3882	0.0000	0.0000
3.3571	1.6736	2.4378	0.0000	0.0000
3.4286	1.6736	2.4874	0.0000	0.0000
3.5000	1.6736	2.5370	0.0000	0.0000
3.5714	1.6736	2.5866	0.0000	0.0000
3.6429	1.6736	2.6362	0.0000	0.0000
3.7143	1.6736	2.6859	0.0000	0.0000
3.7857	1.6736	2.7355	0.0000	0.0000
3.8571	1.6736	2.7851	0.0000	0.0000
3.9286	1.6736	2.8347	0.0000	0.0000
4.0000	1.6736	2.8843	0.0000	0.0000
4.0714	1.6736	2.9339	0.0000	0.0000
4.1429	1.6736	2.9835	0.0000	0.0000
4.2143	1.6736	3.0331	0.0000	0.0000
4.2857	1.6736	3.0827	0.0000	0.0000
4.3571	1.6736	3.1323	0.0000	0.0000
4.4286	1.6736	3.1819	0.0000	0.0000
4.5000	1.6736	3.2315	0.0000	0.0000

Bioretention Surface Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
4.5000	1.6736	3.2315	0.0000	10.125	0.0000
4.5714	1.6736	3.3511	0.0000	10.125	0.0000
4.6429	1.6736	3.4706	0.0000	11.089	0.0000
4.7143	1.6736	3.5902	0.0531	11.571	0.0000
4.7857	1.6736	3.7097	0.0620	12.054	0.0000
4.8571	1.6736	3.8292	0.1138	12.536	0.0000
4.9286	1.6736	3.9488	0.2065	13.018	0.0000
5.0000	1.6736	4.0683	0.2736	13.500	0.0000
5.0714	1.6736	4.1879	0.3362	13.982	0.0000
5.1429	1.6736	4.3074	0.5073	14.464	0.0000
5.2143	1.6736	4.4269	0.6872	14.946	0.0000
5.2857	1.6736	4.5465	0.7239	15.429	0.0000
5.3571	1.6736	4.6660	0.9895	15.911	0.0000
5.4286	1.6736	4.7856	1.3076	16.393	0.0000
5.5000	1.6736	4.9051	1.3450	16.875	0.0000
5.5714	1.6736	5.0246	1.6814	16.875	0.0000
5.6429	1.6736	5.1442	2.1138	16.875	0.0000
5.7143	1.6736	5.2637	2.2825	16.875	0.0000
5.7857	1.6736	5.3833	2.6076	16.875	0.0000

5.8571	1.6736	5.5028	3.1654	16.875	0.0000
5.9286	1.6736	5.6223	3.5316	16.875	0.0000
6.0000	1.6736	5.7419	3.7898	16.875	0.0000
6.0714	1.6736	5.8614	4.4831	16.875	0.0000
6.1429	1.6736	5.9810	5.1210	16.875	0.0000
6.2143	1.6736	6.1005	5.2475	16.875	0.0000
6.2857	1.6736	6.2200	6.0849	16.875	0.0000
6.3571	1.6736	6.3396	6.9967	16.875	0.0000
6.4286	1.6736	6.4591	7.0772	16.875	0.0000
6.5000	1.6736	6.5787	7.9838	16.875	0.0000
6.5000	1.6736	6.5787	9.0444	16.875	0.0000

Gravel Trench Bed 1

Bottom Length:	270.00 ft.
Bottom Width:	270.00 ft.
Trench bottom slope 1:	0 To 1
Trench Left side slope 0:	0 To 1
Trench right side slope 2:	0 To 1
Material thickness of first layer:	5
Pour Space of material for first layer:	0.35
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	2
Infiltration safety factor:	1
Wetted surface area On	
Total Volume Infiltrated (ac-ft.):	12.558
Total Volume Through Riser (ac-ft.):	0.301
Total Volume Through Facility (ac-ft.):	12.859
Percent Infiltrated:	97.66
Total Precip Applied to Facility:	0
Total Evap From Facility:	0
Discharge Structure	
Riser Height:	3 ft.
Riser Diameter:	24 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	

Gravel Trench Bed Hydraulic Table

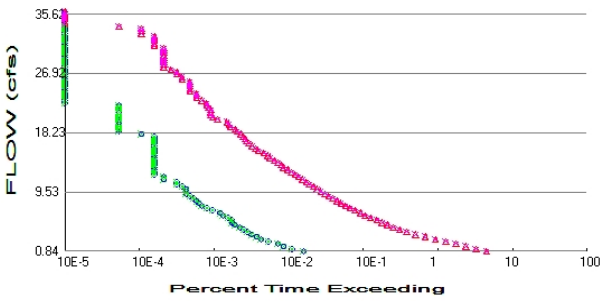
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	1.673	0.000	0.000	0.000
0.0556	1.673	0.032	0.000	3.375
0.1111	1.673	0.065	0.000	3.375
0.1667	1.673	0.097	0.000	3.375
0.2222	1.673	0.130	0.000	3.375
0.2778	1.673	0.162	0.000	3.375
0.3333	1.673	0.195	0.000	3.375
0.3889	1.673	0.227	0.000	3.375
0.4444	1.673	0.260	0.000	3.375
0.5000	1.673	0.292	0.000	3.375
0.5556	1.673	0.325	0.000	3.375
0.6111	1.673	0.358	0.000	3.375
0.6667	1.673	0.390	0.000	3.375
0.7222	1.673	0.423	0.000	3.375
0.7778	1.673	0.455	0.000	3.375
0.8333	1.673	0.488	0.000	3.375
0.8889	1.673	0.520	0.000	3.375
0.9444	1.673	0.553	0.000	3.375
1.0000	1.673	0.585	0.000	3.375
1.0556	1.673	0.618	0.000	3.375
1.1111	1.673	0.650	0.000	3.375
1.1667	1.673	0.683	0.000	3.375
1.2222	1.673	0.715	0.000	3.375
1.2778	1.673	0.748	0.000	3.375

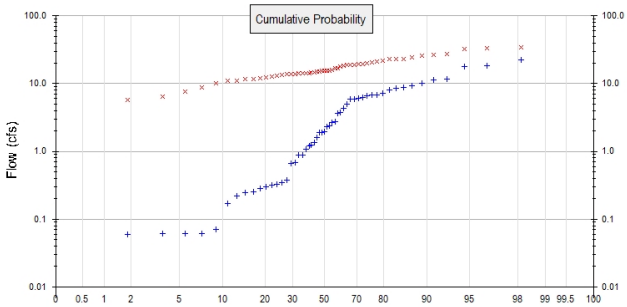
1.3333	1.673	0.781	0.000	3.375
1.3889	1.673	0.813	0.000	3.375
1.4444	1.673	0.846	0.000	3.375
1.5000	1.673	0.878	0.000	3.375
1.5556	1.673	0.911	0.000	3.375
1.6111	1.673	0.943	0.000	3.375
1.6667	1.673	0.976	0.000	3.375
1.7222	1.673	1.008	0.000	3.375
1.7778	1.673	1.041	0.000	3.375
1.8333	1.673	1.073	0.000	3.375
1.8889	1.673	1.106	0.000	3.375
1.9444	1.673	1.138	0.000	3.375
2.0000	1.673	1.171	0.000	3.375
2.0556	1.673	1.204	0.000	3.375
2.1111	1.673	1.236	0.000	3.375
2.1667	1.673	1.269	0.000	3.375
2.2222	1.673	1.301	0.000	3.375
2.2778	1.673	1.334	0.000	3.375
2.3333	1.673	1.366	0.000	3.375
2.3889	1.673	1.399	0.000	3.375
2.4444	1.673	1.431	0.000	3.375
2.5000	1.673	1.464	0.000	3.375
2.5556	1.673	1.496	0.000	3.375
2.6111	1.673	1.529	0.000	3.375
2.6667	1.673	1.562	0.000	3.375
2.7222	1.673	1.594	0.000	3.375
2.7778	1.673	1.627	0.000	3.375
2.8333	1.673	1.659	0.000	3.375
2.8889	1.673	1.692	0.000	3.375
2.9444	1.673	1.724	0.000	3.375
3.0000	1.673	1.757	0.000	3.375
3.0556	1.673	1.789	0.277	3.375
3.1111	1.673	1.822	0.784	3.375
3.1667	1.673	1.854	1.438	3.375
3.2222	1.673	1.887	2.205	3.375
3.2778	1.673	1.919	3.059	3.375
3.3333	1.673	1.952	3.979	3.375
3.3889	1.673	1.985	4.939	3.375
3.4444	1.673	2.017	5.917	3.375
3.5000	1.673	2.050	6.887	3.375
3.5556	1.673	2.082	7.826	3.375
3.6111	1.673	2.115	8.711	3.375
3.6667	1.673	2.147	9.523	3.375
3.7222	1.673	2.180	10.24	3.375
3.7778	1.673	2.212	10.86	3.375
3.8333	1.673	2.245	11.38	3.375
3.8889	1.673	2.277	11.81	3.375
3.9444	1.673	2.310	12.16	3.375
4.0000	1.673	2.343	12.46	3.375
4.0556	1.673	2.375	12.94	3.375
4.1111	1.673	2.408	13.28	3.375
4.1667	1.673	2.440	13.60	3.375
4.2222	1.673	2.473	13.92	3.375
4.2778	1.673	2.505	14.24	3.375
4.3333	1.673	2.538	14.54	3.375
4.3889	1.673	2.570	14.84	3.375
4.4444	1.673	2.603	15.14	3.375
4.5000	1.673	2.635	15.43	3.375

4.5556	1.673	2.668	15.71	3.375
4.6111	1.673	2.700	15.99	3.375
4.6667	1.673	2.733	16.26	3.375
4.7222	1.673	2.766	16.53	3.375
4.7778	1.673	2.798	16.79	3.375
4.8333	1.673	2.831	17.05	3.375
4.8889	1.673	2.863	17.31	3.375
4.9444	1.673	2.896	17.56	3.375
5.0000	1.673	2.928	17.81	3.375

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 75.858
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 9.462
Total Impervious Area: 66.396

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	1.670079
5 year	6.542852
10 year	12.548052
25 year	24.004219
50 year	35.616656
100 year	49.985137

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	16.233163
5 year	22.237087
10 year	25.642726
25 year	29.385321
50 year	31.824944
100 year	34.011067

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1956	11.783	20.849
1957	1.196	23.161
1958	18.091	23.233
1959	4.306	15.629
1960	17.947	24.220
1961	8.737	18.992
1962	22.286	22.757
1963	6.564	26.517
1964	3.685	16.922
1965	1.955	15.433

1966	0.245	14.323
1967	0.893	11.648
1968	0.171	10.007
1969	0.878	14.874
1970	1.246	11.115
1971	7.985	17.904
1972	5.931	14.145
1973	0.282	11.049
1974	8.563	20.064
1975	9.230	33.703
1976	4.984	19.669
1977	0.061	13.058
1978	10.008	20.342
1979	0.320	11.515
1980	0.667	14.348
1981	1.062	16.016
1982	5.823	13.914
1983	2.380	19.155
1984	7.258	14.153
1985	0.217	14.478
1986	6.770	18.775
1987	0.347	18.336
1988	0.071	13.572
1989	0.250	6.508
1990	2.649	13.690
1991	6.257	16.913
1992	0.326	12.653
1993	1.578	11.828
1994	1.367	8.665
1995	0.378	21.604
1996	11.319	25.823
1997	2.742	15.649
1998	2.320	32.629
1999	0.297	7.677
2000	0.684	14.529
2001	0.054	4.186
2002	1.908	34.153
2003	0.060	27.586
2004	0.060	5.656
2005	0.061	15.214
2006	3.717	13.999
2007	6.143	18.747
2008	1.895	12.420
2009	6.779	15.371

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	22.2864	34.1531
2	18.0910	33.7027
3	17.9468	32.6294
4	11.7830	27.5863
5	11.3193	26.5168
6	10.0080	25.8225
7	9.2298	24.2195
8	8.7370	23.2331
9	8.5630	23.1614
10	7.9849	22.7572

11	7.2581	21.6043
12	6.7787	20.8486
13	6.7703	20.3423
14	6.5635	20.0637
15	6.2565	19.6689
16	6.1427	19.1554
17	5.9314	18.9916
18	5.8228	18.7749
19	4.9844	18.7467
20	4.3062	18.3363
21	3.7170	17.9043
22	3.6851	16.9224
23	2.7417	16.9125
24	2.6495	16.0159
25	2.3802	15.6489
26	2.3197	15.6294
27	1.9547	15.4333
28	1.9082	15.3714
29	1.8954	15.2138
30	1.5777	14.8740
31	1.3666	14.5286
32	1.2462	14.4775
33	1.1956	14.3481
34	1.0620	14.3226
35	0.8929	14.1533
36	0.8782	14.1449
37	0.6839	13.9987
38	0.6671	13.9144
39	0.3777	13.6904
40	0.3468	13.5717
41	0.3264	13.0576
42	0.3199	12.6530
43	0.2971	12.4203
44	0.2819	11.8284
45	0.2497	11.6482
46	0.2449	11.5151
47	0.2167	11.1151
48	0.1708	11.0490
49	0.0708	10.0069
50	0.0611	8.6654
51	0.0608	7.6767
52	0.0604	6.5083
53	0.0603	5.6563
54	0.0543	4.1859

Duration Flows

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.8350	300	84223	28074	Fail
1.1864	207	61179	29555	Fail
1.5377	161	45046	27978	Fail
1.8890	135	32758	24265	Fail
2.2404	100	24010	24010	Fail
2.5917	81	17430	21518	Fail
2.9430	70	12757	18224	Fail
3.2943	60	9483	15805	Fail
3.6457	52	7239	13921	Fail
3.9970	47	5771	12278	Fail
4.3483	42	4743	11292	Fail
4.6997	36	3969	11025	Fail
5.0510	33	3348	10145	Fail
5.4023	32	2857	8928	Fail
5.7537	29	2361	8141	Fail
6.1050	25	1979	7916	Fail
6.4563	23	1720	7478	Fail
6.8076	18	1454	8077	Fail
7.1590	15	1254	8360	Fail
7.5103	13	1093	8407	Fail
7.8616	12	951	7925	Fail
8.2130	11	833	7572	Fail
8.5643	10	740	7400	Fail
8.9156	9	647	7188	Fail
9.2669	8	579	7237	Fail
9.6183	8	512	6400	Fail
9.9696	8	452	5650	Fail
10.3209	7	404	5771	Fail
10.6723	6	355	5916	Fail
11.0236	6	326	5433	Fail
11.3749	4	289	7225	Fail
11.7263	4	255	6375	Fail
12.0776	3	230	7666	Fail
12.4289	3	205	6833	Fail
12.7802	3	182	6066	Fail
13.1316	3	159	5300	Fail
13.4829	3	148	4933	Fail
13.8342	3	136	4533	Fail
14.1856	3	121	4033	Fail
14.5369	3	107	3566	Fail
14.8882	3	99	3300	Fail
15.2395	3	88	2933	Fail
15.5909	3	74	2466	Fail
15.9422	3	68	2266	Fail
16.2935	3	61	2033	Fail
16.6449	3	55	1833	Fail
16.9962	3	51	1700	Fail
17.3475	3	49	1633	Fail
17.6989	3	46	1533	Fail
18.0502	2	43	2150	Fail
18.4015	1	38	3800	Fail
18.7528	1	36	3600	Fail
19.1042	1	31	3100	Fail
19.4555	1	30	3000	Fail

19.8068	1	28	2800	Fail
20.1582	1	21	2100	Fail
20.5095	1	18	1800	Fail
20.8608	1	17	1700	Fail
21.2121	1	17	1700	Fail
21.5635	1	17	1700	Fail
21.9148	1	16	1600	Fail
22.2661	1	15	1500	Fail
22.6175	0	15	n/a	Fail
22.9688	0	13	n/a	Fail
23.3201	0	11	n/a	Fail
23.6715	0	11	n/a	Fail
24.0228	0	11	n/a	Fail
24.3741	0	9	n/a	Fail
24.7254	0	9	n/a	Fail
25.0768	0	9	n/a	Fail
25.4281	0	9	n/a	Fail
25.7794	0	9	n/a	Fail
26.1308	0	7	n/a	Fail
26.4821	0	7	n/a	Fail
26.8334	0	6	n/a	Fail
27.1847	0	6	n/a	Fail
27.5361	0	5	n/a	Fail
27.8874	0	4	n/a	Fail
28.2387	0	4	n/a	Fail
28.5901	0	4	n/a	Fail
28.9414	0	4	n/a	Fail
29.2927	0	4	n/a	Fail
29.6441	0	4	n/a	Fail
29.9954	0	4	n/a	Fail
30.3467	0	4	n/a	Fail
30.6980	0	4	n/a	Fail
31.0494	0	3	n/a	Fail
31.4007	0	3	n/a	Fail
31.7520	0	3	n/a	Fail
32.1034	0	3	n/a	Fail
32.4547	0	3	n/a	Fail
32.8060	0	2	n/a	Fail
33.1573	0	2	n/a	Fail
33.5087	0	2	n/a	Fail
33.8600	0	1	n/a	Fail
34.2113	0	0	n/a	Pass
34.5627	0	0	0	Pass
34.9140	0	0	0	Pass
35.2653	0	0	0	Pass
35.6167	0	0	0	Pass

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

Water Quality

Water Quality BMP Flow and Volume for POC #1

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

Model Default Modifications

Total of 0 changes have been made.

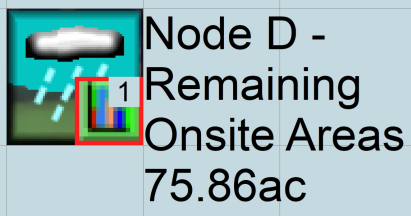
PERLND Changes

No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   18591_Node D.wdm
MESSU       25   Pre18591_Node D.MES
            27   Pre18591_Node D.L61
            28   Pre18591_Node D.L62
            30   POC18591_Node D1.dat
END FILES

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

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    2         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
    2         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    2         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    2               0         5         2       400       0.1       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    2              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    2          0.2       0.5      0.35         0       0.7       0.7
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
             ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
    2              0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

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

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

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

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

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

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

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

```
END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Node D - Remaining Onsite Areas***
PERLND   2                      75.858     COPY   501     12
PERLND   2                      75.858     COPY   501     13

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

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



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

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

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

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

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

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

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.429          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.429          IMPLND   1 999 EXTNL  PREC
```

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

END EXT SOURCES

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

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

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


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   18591_Node D.wdm
MESSU       25   Mit18591_Node D.MES
            27   Mit18591_Node D.L61
            28   Mit18591_Node D.L62
            30   POC18591_Node D1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND       8
      IMPLND       4
      IMPLND       1
      RCHRES       1
      RCHRES       2
      RCHRES       3
      COPY         1
      COPY       501
      COPY       601
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Gravel Trench Bed 1         MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  601         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
    8     A/B, Lawn, Mod          1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    8         0    0    1    0    0    0    0    0    0    0    0    0
```

```
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
    8         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    8         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    8              0         5       0.8       400       0.1       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    8              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    8          0.1       0.5      0.25         0       0.7      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
    8              0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                    in  out           ***
    4      ROOF TOPS/FLAT         1    1    1   27    0
    1      ROADS/FLAT             1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    4         0    0    1    0    0    0
    1         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    4         0    0    4    0    0    4    1    9
    1         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    4         0    0    0    0    0
    1         0    0    0    0    0
  END IWAT-PARM1
```

```
  IWAT-PARM2
    <PLS >       IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    4            400      0.01       0.1       0.1
    1            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >       IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    4              0         0
    1              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    4              0         0
    1              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Node D - PGIS***
IMPLND   1                      46.237     RCHRES   1      5
Node D - Non-PGIS***
PERLND   8                       9.462     COPY   501     12
PERLND   8                       9.462     COPY   601     12
PERLND   8                       9.462     COPY   501     13
PERLND   8                       9.462     COPY   601     13
IMPLND   4                      20.159     COPY   501     15
IMPLND   4                      20.159     COPY   601     15

******Routing******
RCHRES   1                           1     RCHRES   3      7
RCHRES   1                                 COPY     1     17
RCHRES   1                           1     RCHRES   2      8
RCHRES   3                           1     COPY   501     17
END SCHEMATIC

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



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

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<----------------><---> User T-series  Engl Metr LKFG             ***
                                        in  out                             ***
    1     Surface retentio-007    2    1    1    1   28    0    1
    2     Bioretention  1         1    1    1    1   28    0    1
    3     Gravel Trench Be-008    2    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
```

```
    2         1    0    0    0    0    0    0    0    0    0
    3         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

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

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

  HYDR-PARM2
    # -  #    FTABNO       LEN      DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><--------><--------> ***
    1              1      0.01       0.0       0.0       0.0       0.0
    2              2      0.05       0.0       0.0       0.0       0.0
    3              3      0.05       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                       ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    3            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      2
   64    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  1.673554  0.000000  0.000000
  0.071429  1.673554  0.054665  0.000000
  0.142857  1.673554  0.109331  0.000000
  0.214286  1.673554  0.163996  0.053063
  0.285714  1.673554  0.218662  0.062046
  0.357143  1.673554  0.273327  0.113823
  0.428571  1.673554  0.327993  0.206503
  0.500000  1.673554  0.382658  0.273592
  0.571429  1.673554  0.437323  0.336186
  0.642857  1.673554  0.491989  0.507312
  0.714286  1.673554  0.546654  0.687248
  0.785714  1.673554  0.601320  0.723873
  0.857143  1.673554  0.655985  0.989523
  0.928571  1.673554  0.710651  1.307648
  1.000000  1.673554  0.765316  1.344970
  1.071429  1.673554  0.819982  1.681409
  1.142857  1.673554  0.874647  2.113782
  1.214286  1.673554  0.929312  2.282526
  1.285714  1.673554  0.983978  2.607569
  1.357143  1.673554  1.038643  3.165420
  1.428571  1.673554  1.093309  3.531615
  1.500000  1.673554  1.147974  3.789831
  1.571429  1.673554  1.197583  4.483143
```

```
1.642857  1.673554  1.247192  5.121006
1.714286  1.673554  1.296801  5.247516
1.785714  1.673554  1.346410  6.084869
1.857143  1.673554  1.396019  6.996734
1.928571  1.673554  1.445628  7.077219
2.000000  1.673554  1.495237  7.983839
2.071429  1.673554  1.544845  9.044384
2.142857  1.673554  1.594454  9.424985
2.214286  1.673554  1.644063  10.12500
2.285714  1.673554  1.693672  12.82566
2.357143  1.673554  1.743281  14.15858
2.428571  1.673554  1.792890  15.05991
2.500000  1.673554  1.842499  15.63173
2.571429  1.673554  1.892108  16.18322
2.642857  1.673554  1.941717  16.71641
2.714286  1.673554  1.991326  16.87500
2.785714  1.673554  2.040935  16.87500
2.857143  1.673554  2.090544  16.87500
2.928571  1.673554  2.140152  16.87500
3.000000  1.673554  2.189761  16.87500
3.071429  1.673554  2.239370  16.87500
3.142857  1.673554  2.288979  16.87500
3.214286  1.673554  2.338588  16.87500
3.285714  1.673554  2.388197  16.87500
3.357143  1.673554  2.437806  16.87500
3.428571  1.673554  2.487415  16.87500
3.500000  1.673554  2.537024  16.87500
3.571429  1.673554  2.586633  16.87500
3.642857  1.673554  2.636242  16.87500
3.714286  1.673554  2.685851  16.87500
3.785714  1.673554  2.735459  16.87500
3.857143  1.673554  2.785068  16.87500
3.928571  1.673554  2.834677  16.87500
4.000000  1.673554  2.884286  16.87500
4.071429  1.673554  2.933895  16.87500
4.142857  1.673554  2.983504  16.87500
4.214286  1.673554  3.033113  16.87500
4.285714  1.673554  3.082722  16.87500
4.357143  1.673554  3.132331  16.87500
4.428571  1.673554  3.181940  16.87500
4.500000  1.673554  3.580206  16.87500
END FTABLE  2
FTABLE      1
 30    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)     (cfs)   (ft/sec)    (Minutes)***
0.000000  1.673554  0.000000  0.000000  0.000000
0.071429  1.673554  0.119540  0.000000  10.12501
0.142857  1.673554  0.239079  0.000000  11.08929
0.214286  1.673554  0.358619  0.000000  11.57144
0.285714  1.673554  0.478158  0.000000  12.05358
0.357143  1.673554  0.597698  0.000000  12.53572
0.428571  1.673554  0.717237  0.000000  13.01787
0.500000  1.673554  0.836777  0.000000  13.50001
0.571429  1.673554  0.956316  0.000000  13.98215
0.642857  1.673554  1.075856  0.000000  14.46430
0.714286  1.673554  1.195396  0.000000  14.94644
0.785714  1.673554  1.314935  0.000000  15.42858
0.857143  1.673554  1.434475  0.000000  15.91073
0.928571  1.673554  1.554014  0.000000  16.39287
1.000000  1.673554  1.673554  0.000000  16.87500
1.071429  1.673554  1.793093  1.013052  16.87500
1.142857  1.673554  1.912633  2.863613  16.87500
1.214286  1.673554  2.032172  5.257786  16.87500
1.285714  1.673554  2.151712  8.089179  16.87500
1.357143  1.673554  2.271251  11.29374  16.87500
1.428571  1.673554  2.390791  14.82485  16.87500
1.500000  1.673554  2.510331  18.64436  16.87500
1.571429  1.673554  2.629870  22.71831  16.87500
1.642857  1.673554  2.749410  27.01478  16.87500
```

```
1.714286  1.673554  2.868949  31.50260  16.87500
1.785714  1.673554  2.988489  36.15072  16.87500
1.857143  1.673554  3.108028  40.92774  16.87500
1.928571  1.673554  3.227568  45.80182  16.87500
2.000000  1.673554  3.347107  50.74064  16.87500
2.000000  1.673554  3.347107  55.71151  16.87500
END FTABLE  1
FTABLE      3
 92    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)     (cfs)   (ft/sec)    (Minutes)***
0.000000  1.673554  0.000000  0.000000  0.000000
0.055556  1.673554  0.032541  0.000000  3.375000
0.111111  1.673554  0.065083  0.000000  3.375000
0.166667  1.673554  0.097624  0.000000  3.375000
0.222222  1.673554  0.130165  0.000000  3.375000
0.277778  1.673554  0.162707  0.000000  3.375000
0.333333  1.673554  0.195248  0.000000  3.375000
0.388889  1.673554  0.227789  0.000000  3.375000
0.444444  1.673554  0.260331  0.000000  3.375000
0.500000  1.673554  0.292872  0.000000  3.375000
0.555556  1.673554  0.325413  0.000000  3.375000
0.611111  1.673554  0.357955  0.000000  3.375000
0.666667  1.673554  0.390496  0.000000  3.375000
0.722222  1.673554  0.423037  0.000000  3.375000
0.777778  1.673554  0.455579  0.000000  3.375000
0.833333  1.673554  0.488120  0.000000  3.375000
0.888889  1.673554  0.520661  0.000000  3.375000
0.944444  1.673554  0.553202  0.000000  3.375000
1.000000  1.673554  0.585744  0.000000  3.375000
1.055556  1.673554  0.618285  0.000000  3.375000
1.111111  1.673554  0.650826  0.000000  3.375000
1.166667  1.673554  0.683368  0.000000  3.375000
1.222222  1.673554  0.715909  0.000000  3.375000
1.277778  1.673554  0.748450  0.000000  3.375000
1.333333  1.673554  0.780992  0.000000  3.375000
1.388889  1.673554  0.813533  0.000000  3.375000
1.444444  1.673554  0.846074  0.000000  3.375000
1.500000  1.673554  0.878616  0.000000  3.375000
1.555556  1.673554  0.911157  0.000000  3.375000
1.611111  1.673554  0.943698  0.000000  3.375000
1.666667  1.673554  0.976240  0.000000  3.375000
1.722222  1.673554  1.008781  0.000000  3.375000
1.777778  1.673554  1.041322  0.000000  3.375000
1.833333  1.673554  1.073864  0.000000  3.375000
1.888889  1.673554  1.106405  0.000000  3.375000
1.944444  1.673554  1.138946  0.000000  3.375000
2.000000  1.673554  1.171488  0.000000  3.375000
2.055556  1.673554  1.204029  0.000000  3.375000
2.111111  1.673554  1.236570  0.000000  3.375000
2.166667  1.673554  1.269112  0.000000  3.375000
2.222222  1.673554  1.301653  0.000000  3.375000
2.277778  1.673554  1.334194  0.000000  3.375000
2.333333  1.673554  1.366736  0.000000  3.375000
2.388889  1.673554  1.399277  0.000000  3.375000
2.444444  1.673554  1.431818  0.000000  3.375000
2.500000  1.673554  1.464360  0.000000  3.375000
2.555556  1.673554  1.496901  0.000000  3.375000
2.611111  1.673554  1.529442  0.000000  3.375000
2.666667  1.673554  1.561983  0.000000  3.375000
2.722222  1.673554  1.594525  0.000000  3.375000
2.777778  1.673554  1.627066  0.000000  3.375000
2.833333  1.673554  1.659607  0.000000  3.375000
2.888889  1.673554  1.692149  0.000000  3.375000
2.944444  1.673554  1.724690  0.000000  3.375000
3.000000  1.673554  1.757231  0.000000  3.375000
3.055556  1.673554  1.789773  0.277796  3.375000
3.111111  1.673554  1.822314  0.784769  3.375000
3.166667  1.673554  1.854855  1.438492  3.375000
3.222222  1.673554  1.887397  2.205262  3.375000
```

```
  3.277778  1.673554  1.919938  3.059929  3.375000
  3.333333  1.673554  1.952479  3.979211  3.375000
  3.388889  1.673554  1.985021  4.939668  3.375000
  3.444444  1.673554  2.017562  5.917238  3.375000
  3.500000  1.673554  2.050103  6.887532  3.375000
  3.555556  1.673554  2.082645  7.826549  3.375000
  3.611111  1.673554  2.115186  8.711714  3.375000
  3.666667  1.673554  2.147727  9.523132  3.375000
  3.722222  1.673554  2.180269  10.24504  3.375000
  3.777778  1.673554  2.212810  10.86741  3.375000
  3.833333  1.673554  2.245351  11.38772  3.375000
  3.888889  1.673554  2.277893  11.81283  3.375000
  3.944444  1.673554  2.310434  12.16099  3.375000
  4.000000  1.673554  2.342975  12.46394  3.375000
  4.055556  1.673554  2.375517  12.94375  3.375000
  4.111111  1.673554  2.408058  13.28001  3.375000
  4.166667  1.673554  2.440599  13.60796  3.375000
  4.222222  1.673554  2.473140  13.92819  3.375000
  4.277778  1.673554  2.505682  14.24122  3.375000
  4.333333  1.673554  2.538223  14.54752  3.375000
  4.388889  1.673554  2.570764  14.84750  3.375000
  4.444444  1.673554  2.603306  15.14154  3.375000
  4.500000  1.673554  2.635847  15.42997  3.375000
  4.555556  1.673554  2.668388  15.71312  3.375000
  4.611111  1.673554  2.700930  15.99125  3.375000
  4.666667  1.673554  2.733471  16.26462  3.375000
  4.722222  1.673554  2.766012  16.53347  3.375000
  4.777778  1.673554  2.798554  16.79803  3.375000
  4.833333  1.673554  2.831095  17.05848  3.375000
  4.888889  1.673554  2.863636  17.31501  3.375000
  4.944444  1.673554  2.896178  17.56780  3.375000
  5.000000  1.673554  2.928719  17.81700  3.375000
  5.055556  1.673554  3.021694  18.06276  3.375000
  END FTABLE  3
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.429          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.429          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP
WDM      2 PREC     ENGL    1.429          RCHRES   1     EXTNL  PREC
WDM      1 EVAP     ENGL    0.5            RCHRES   1     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.76           RCHRES   2     EXTNL  POTEV

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
COPY   601 OUTPUT MEAN   1 1     48.4      WDM    901 FLOW     ENGL      REPL
RCHRES   3 HYDR   RO     1 1        1      WDM   1006 FLOW     ENGL      REPL
RCHRES   3 HYDR   O      1 1        1      WDM   1008 FLOW     ENGL      REPL
RCHRES   3 HYDR   O      2 1        1      WDM   1009 FLOW     ENGL      REPL
RCHRES   3 HYDR   STAGE  1 1        1      WDM   1007 STAG     ENGL      REPL
END EXT TARGETS

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

  MASS-LINK        7
RCHRES     OFLOW  OVOL   1                 RCHRES         INFLOW IVOL
```

```
  END MASS-LINK    7

  MASS-LINK        8
RCHRES     OFLOW  OVOL   2                RCHRES         INFLOW IVOL
  END MASS-LINK    8

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

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

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

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


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

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WWHM2012

PROJECT REPORT

General Model Information

WWHM2012 Project Name: 18591_Node E

Site Name:	LOTC
Site Address:	
City:	Castle Rock, WA
Report Date:	3/7/2025
Gage:	Longview
Data Start:	1955/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	1.429
Version Date:	2024/06/28
Version:	4.3.1

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year
Low Flow Threshold for POC2:	50 Percent of the 2 Year
High Flow Threshold for POC2:	50 Year

Landuse Basin Data
Predeveloped Land Use

Node E - Offsite

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A B, Forest, Mod	31.732
Pervious Total	31.732

Impervious Land Use	acre
Impervious Total	0
Basin Total	31.732

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

POC 1	POC 1	

Node E - Larson Runoff

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Forest, Mod	0.263
Pervious Total	0.263
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.263

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

POC 2	POC 2

Mitigated Land Use

Node E - Offsite

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A B, Lawn, Mod	25.386
Pervious Total	25.386

Impervious Land Use	acre
ROOF TOPS FLAT	6.346
Impervious Total	6.346
Basin Total	31.732

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 1	POC 1	

Node E - Larson Runoff

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A B, Lawn, Mod	0.107
Pervious Total	0.107

Impervious Land Use	acre
ROADS FLAT	0.156
Impervious Total	0.156
Basin Total	0.263

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

Surface retention 1	Surface retention 1	POC 1

Routing Elements
Predeveloped Routing

Mitigated Routing

Bioretention 1

Bottom Length:	20.00 ft.
Bottom Width:	5.00 ft.
Material thickness of first layer:	1.5
Material type for first layer:	SMMWW 12 in/hr
Material thickness of second layer:	1.5
Material type for second layer:	GRAVEL
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (feet):	1
Orifice Diameter (in.):	12
Offset (in.):	0
Flow Through Underdrain (ac-ft.):	34.447
Total Outflow (ac-ft.):	38.031
Percent Through Underdrain:	90.58
Discharge Structure	
Riser Height:	0.5 ft.
Riser Diameter:	12 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	
Gravel Trench Bed 1	

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0023	0.0000	0.0000	0.0000
0.0440	0.0023	0.0000	0.0000	0.0000
0.0879	0.0023	0.0001	0.0000	0.0000
0.1319	0.0023	0.0001	0.0000	0.0000
0.1758	0.0023	0.0002	0.0000	0.0000
0.2198	0.0023	0.0002	0.0000	0.0000
0.2637	0.0023	0.0003	0.0000	0.0000
0.3077	0.0023	0.0003	0.0000	0.0000
0.3516	0.0023	0.0004	0.0000	0.0000
0.3956	0.0023	0.0004	0.0000	0.0000
0.4396	0.0023	0.0005	0.0000	0.0000
0.4835	0.0023	0.0005	0.0000	0.0000
0.5275	0.0023	0.0006	0.0000	0.0000
0.5714	0.0023	0.0006	0.0000	0.0000
0.6154	0.0023	0.0006	0.0000	0.0000
0.6593	0.0023	0.0007	0.0000	0.0000
0.7033	0.0023	0.0007	0.0000	0.0000
0.7473	0.0023	0.0008	0.0000	0.0000
0.7912	0.0023	0.0008	0.0000	0.0000
0.8352	0.0023	0.0009	0.0000	0.0000
0.8791	0.0023	0.0009	0.0000	0.0000
0.9231	0.0023	0.0010	0.0000	0.0000
0.9670	0.0023	0.0010	0.0000	0.0000
1.0110	0.0023	0.0011	0.0000	0.0000
1.0549	0.0023	0.0011	0.0000	0.0000
1.0989	0.0023	0.0012	0.0000	0.0000
1.1429	0.0023	0.0012	0.0000	0.0000
1.1868	0.0023	0.0012	0.0000	0.0000

1.2308	0.0023	0.0013	0.0000	0.0000
1.2747	0.0023	0.0013	0.0000	0.0000
1.3187	0.0023	0.0014	0.0000	0.0000
1.3626	0.0023	0.0014	0.0000	0.0000
1.4066	0.0023	0.0015	0.0000	0.0000
1.4505	0.0023	0.0015	0.0000	0.0000
1.4945	0.0023	0.0016	0.0000	0.0000
1.5385	0.0023	0.0016	0.0000	0.0000
1.5824	0.0023	0.0017	0.0000	0.0000
1.6264	0.0023	0.0017	0.0000	0.0000
1.6703	0.0023	0.0017	0.0000	0.0000
1.7143	0.0023	0.0018	0.0000	0.0000
1.7582	0.0023	0.0018	0.0000	0.0000
1.8022	0.0023	0.0019	0.0000	0.0000
1.8462	0.0023	0.0019	0.0000	0.0000
1.8901	0.0023	0.0019	0.0000	0.0000
1.9341	0.0023	0.0020	0.0000	0.0000
1.9780	0.0023	0.0020	0.0000	0.0000
2.0220	0.0023	0.0021	0.0000	0.0000
2.0659	0.0023	0.0021	0.0000	0.0000
2.1099	0.0023	0.0022	0.0000	0.0000
2.1538	0.0023	0.0022	0.0000	0.0000
2.1978	0.0023	0.0022	0.0000	0.0000
2.2418	0.0023	0.0023	0.0000	0.0000
2.2857	0.0023	0.0023	0.0000	0.0000
2.3297	0.0023	0.0024	0.0000	0.0000
2.3736	0.0023	0.0024	0.0000	0.0000
2.4176	0.0023	0.0024	0.0000	0.0000
2.4615	0.0023	0.0025	0.0000	0.0000
2.5055	0.0023	0.0025	0.0000	0.0000
2.5495	0.0023	0.0026	0.0000	0.0000
2.5934	0.0023	0.0026	0.0000	0.0000
2.6374	0.0023	0.0027	0.0000	0.0000
2.6813	0.0023	0.0027	0.0000	0.0000
2.7253	0.0023	0.0027	0.0000	0.0000
2.7692	0.0023	0.0028	0.0000	0.0000
2.8132	0.0023	0.0028	0.0000	0.0000
2.8571	0.0023	0.0029	0.0000	0.0000
2.9011	0.0023	0.0029	0.0000	0.0000
2.9451	0.0023	0.0030	0.0000	0.0000
2.9890	0.0023	0.0030	0.0000	0.0000
3.0000	0.0023	0.0030	0.0000	0.0000

Bioretention Surface Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
3.0000	0.0023	0.0030	0.0000	0.0139	0.0000
3.0440	0.0023	0.0031	0.0000	0.0139	0.0000
3.0879	0.0023	0.0032	0.0000	0.0147	0.0000
3.1319	0.0023	0.0033	0.0000	0.0151	0.0000
3.1758	0.0023	0.0034	0.0000	0.0155	0.0000
3.2198	0.0023	0.0035	0.0001	0.0159	0.0000
3.2637	0.0023	0.0036	0.0001	0.0163	0.0000
3.3077	0.0023	0.0037	0.0002	0.0167	0.0000
3.3516	0.0023	0.0038	0.0002	0.0171	0.0000
3.3956	0.0023	0.0039	0.0003	0.0176	0.0000
3.4396	0.0023	0.0040	0.0004	0.0180	0.0000
3.4835	0.0023	0.0041	0.0006	0.0184	0.0000
3.5275	0.0023	0.0042	0.0007	0.0185	0.0000

3.5714	0.0023	0.0043	0.0007	0.0185	0.0000
3.6154	0.0023	0.0044	0.0009	0.0185	0.0000
3.6593	0.0023	0.0045	0.0011	0.0185	0.0000
3.7033	0.0023	0.0046	0.0014	0.0185	0.0000
3.7473	0.0023	0.0047	0.0016	0.0185	0.0000
3.7912	0.0023	0.0048	0.0017	0.0185	0.0000
3.8352	0.0023	0.0049	0.0019	0.0185	0.0000
3.8791	0.0023	0.0050	0.0022	0.0185	0.0000
3.9231	0.0023	0.0051	0.0026	0.0185	0.0000
3.9670	0.0023	0.0052	0.0029	0.0185	0.0000
4.0000	0.0023	0.0053	0.0033	0.0185	0.0000

Gravel Trench Bed 1

Bottom Length:	20.00 ft.
Bottom Width:	5.00 ft.
Trench bottom slope 1:	0 To 1
Trench Left side slope 0:	0 To 1
Trench right side slope 2:	0 To 1
Material thickness of first layer:	5
Pour Space of material for first layer:	0.35
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	2
Infiltration safety factor:	1
Wetted surface area On	
Total Volume Infiltrated (ac-ft.):	2.163
Total Volume Through Riser (ac-ft.):	1.42
Total Volume Through Facility (ac-ft.):	3.584
Percent Infiltrated:	60.35
Total Precip Applied to Facility:	0
Total Evap From Facility:	0
Discharge Structure	
Riser Height:	3 ft.
Riser Diameter:	12 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	

Gravel Trench Bed Hydraulic Table

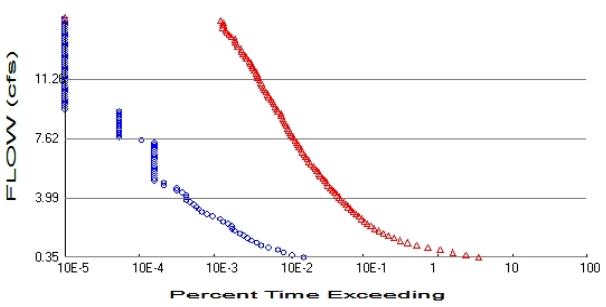
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.002	0.000	0.000	0.000
0.0556	0.002	0.000	0.000	0.004
0.1111	0.002	0.000	0.000	0.004
0.1667	0.002	0.000	0.000	0.004
0.2222	0.002	0.000	0.000	0.004
0.2778	0.002	0.000	0.000	0.004
0.3333	0.002	0.000	0.000	0.004
0.3889	0.002	0.000	0.000	0.004
0.4444	0.002	0.000	0.000	0.004
0.5000	0.002	0.000	0.000	0.004
0.5556	0.002	0.000	0.000	0.004
0.6111	0.002	0.000	0.000	0.004
0.6667	0.002	0.000	0.000	0.004
0.7222	0.002	0.000	0.000	0.004
0.7778	0.002	0.000	0.000	0.004
0.8333	0.002	0.000	0.000	0.004
0.8889	0.002	0.000	0.000	0.004
0.9444	0.002	0.000	0.000	0.004
1.0000	0.002	0.000	0.000	0.004
1.0556	0.002	0.000	0.000	0.004
1.1111	0.002	0.000	0.000	0.004
1.1667	0.002	0.000	0.000	0.004
1.2222	0.002	0.001	0.000	0.004
1.2778	0.002	0.001	0.000	0.004

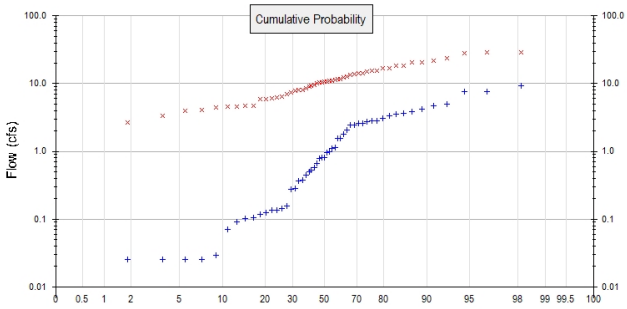
1.3333	0.002	0.001	0.000	0.004
1.3889	0.002	0.001	0.000	0.004
1.4444	0.002	0.001	0.000	0.004
1.5000	0.002	0.001	0.000	0.004
1.5556	0.002	0.001	0.000	0.004
1.6111	0.002	0.001	0.000	0.004
1.6667	0.002	0.001	0.000	0.004
1.7222	0.002	0.001	0.000	0.004
1.7778	0.002	0.001	0.000	0.004
1.8333	0.002	0.001	0.000	0.004
1.8889	0.002	0.001	0.000	0.004
1.9444	0.002	0.001	0.000	0.004
2.0000	0.002	0.001	0.000	0.004
2.0556	0.002	0.001	0.000	0.004
2.1111	0.002	0.001	0.000	0.004
2.1667	0.002	0.001	0.000	0.004
2.2222	0.002	0.001	0.000	0.004
2.2778	0.002	0.001	0.000	0.004
2.3333	0.002	0.001	0.000	0.004
2.3889	0.002	0.001	0.000	0.004
2.4444	0.002	0.002	0.000	0.004
2.5000	0.002	0.002	0.000	0.004
2.5556	0.002	0.002	0.000	0.004
2.6111	0.002	0.002	0.000	0.004
2.6667	0.002	0.002	0.000	0.004
2.7222	0.002	0.002	0.000	0.004
2.7778	0.002	0.002	0.000	0.004
2.8333	0.002	0.002	0.000	0.004
2.8889	0.002	0.002	0.000	0.004
2.9444	0.002	0.002	0.000	0.004
3.0000	0.002	0.002	0.000	0.004
3.0556	0.002	0.002	0.138	0.004
3.1111	0.002	0.002	0.389	0.004
3.1667	0.002	0.002	0.703	0.004
3.2222	0.002	0.002	1.046	0.004
3.2778	0.002	0.002	1.383	0.004
3.3333	0.002	0.002	1.683	0.004
3.3889	0.002	0.002	1.921	0.004
3.4444	0.002	0.002	2.088	0.004
3.5000	0.002	0.002	2.203	0.004
3.5556	0.002	0.002	2.347	0.004
3.6111	0.002	0.002	2.462	0.004
3.6667	0.002	0.002	2.571	0.004
3.7222	0.002	0.003	2.676	0.004
3.7778	0.002	0.003	2.777	0.004
3.8333	0.002	0.003	2.875	0.004
3.8889	0.002	0.003	2.969	0.004
3.9444	0.002	0.003	3.060	0.004
4.0000	0.002	0.003	3.149	0.004
4.0556	0.002	0.003	3.235	0.004
4.1111	0.002	0.003	3.320	0.004
4.1667	0.002	0.003	3.402	0.004
4.2222	0.002	0.003	3.482	0.004
4.2778	0.002	0.003	3.560	0.004
4.3333	0.002	0.003	3.636	0.004
4.3889	0.002	0.003	3.711	0.004
4.4444	0.002	0.003	3.785	0.004
4.5000	0.002	0.003	3.857	0.004

4.5556	0.002	0.003	3.928	0.004
4.6111	0.002	0.003	3.997	0.004
4.6667	0.002	0.003	4.066	0.004
4.7222	0.002	0.003	4.133	0.004
4.7778	0.002	0.003	4.199	0.004
4.8333	0.002	0.003	4.264	0.004
4.8889	0.002	0.003	4.328	0.004
4.9444	0.002	0.004	4.391	0.004
5.0000	0.002	0.004	4.454	0.004

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 31.732
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 25.386
Total Impervious Area: 6.346

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.698607
5 year	2.736926
10 year	5.248949
25 year	10.041153
50 year	14.898727
100 year	20.909175

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	10.181605
5 year	16.645989
10 year	20.920649
25 year	26.152545
50 year	29.881953
100 year	33.451577

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1956	4.929	18.492
1957	0.500	14.150
1958	7.568	18.468
1959	1.801	11.186
1960	7.507	20.649
1961	3.655	13.271
1962	9.323	20.388
1963	2.746	23.662
1964	1.541	11.684
1965	0.818	6.157

1966	0.102	4.539
1967	0.374	5.969
1968	0.071	4.412
1969	0.367	10.206
1970	0.521	7.051
1971	3.340	15.385
1972	2.481	10.422
1973	0.118	6.455
1974	3.582	16.943
1975	3.861	29.087
1976	2.085	13.884
1977	0.025	4.692
1978	4.186	14.240
1979	0.134	5.997
1980	0.279	9.360
1981	0.444	7.936
1982	2.436	10.529
1983	0.996	12.806
1984	3.036	10.830
1985	0.091	4.597
1986	2.832	16.637
1987	0.145	10.877
1988	0.030	8.578
1989	0.104	3.338
1990	1.108	9.592
1991	2.617	12.293
1992	0.137	4.696
1993	0.660	8.007
1994	0.572	3.999
1995	0.158	15.682
1996	4.735	21.445
1997	1.147	11.075
1998	0.970	28.091
1999	0.124	4.137
2000	0.286	7.504
2001	0.023	1.320
2002	0.798	28.796
2003	0.025	8.959
2004	0.025	2.686
2005	0.026	5.945
2006	1.555	10.670
2007	2.570	14.987
2008	0.793	8.057
2009	2.836	11.702

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	9.3226	29.0871
2	7.5676	28.7959
3	7.5073	28.0914
4	4.9289	23.6615
5	4.7350	21.4449
6	4.1865	20.6489
7	3.8609	20.3880
8	3.6548	18.4916
9	3.5820	18.4681
10	3.3401	16.9431

11	3.0361	16.6366
12	2.8356	15.6821
13	2.8321	15.3847
14	2.7456	14.9865
15	2.6171	14.2395
16	2.5696	14.1504
17	2.4811	13.8837
18	2.4357	13.2711
19	2.0850	12.8064
20	1.8013	12.2932
21	1.5549	11.7017
22	1.5415	11.6841
23	1.1469	11.1855
24	1.1083	11.0754
25	0.9957	10.8771
26	0.9703	10.8299
27	0.8177	10.6703
28	0.7982	10.5291
29	0.7928	10.4224
30	0.6600	10.2060
31	0.5717	9.5925
32	0.5213	9.3598
33	0.5001	8.9586
34	0.4442	8.5780
35	0.3735	8.0573
36	0.3674	8.0067
37	0.2861	7.9357
38	0.2790	7.5044
39	0.1580	7.0513
40	0.1451	6.4546
41	0.1365	6.1567
42	0.1338	5.9974
43	0.1243	5.9695
44	0.1179	5.9449
45	0.1045	4.6964
46	0.1024	4.6918
47	0.0906	4.5974
48	0.0715	4.5392
49	0.0296	4.4116
50	0.0255	4.1370
51	0.0254	3.9986
52	0.0253	3.3379
53	0.0252	2.6857
54	0.0227	1.3197

Duration Flows

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.3493	300	66557	22185	Fail
0.4963	207	44706	21597	Fail
0.6432	161	30031	18652	Fail
0.7902	135	20204	14965	Fail
0.9372	100	13879	13878	Fail
1.0841	81	9877	12193	Fail
1.2311	70	7426	10608	Fail
1.3781	60	5889	9815	Fail
1.5250	52	4874	9373	Fail
1.6720	47	4115	8755	Fail
1.8189	42	3511	8359	Fail
1.9659	36	3056	8488	Fail
2.1129	33	2687	8142	Fail
2.2598	32	2373	7415	Fail
2.4068	29	2123	7320	Fail
2.5538	25	1952	7808	Fail
2.7007	23	1787	7769	Fail
2.8477	18	1648	9155	Fail
2.9947	15	1504	10026	Fail
3.1416	13	1380	10615	Fail
3.2886	12	1290	10750	Fail
3.4355	11	1198	10890	Fail
3.5825	10	1115	11150	Fail
3.7295	9	1030	11444	Fail
3.8764	8	952	11900	Fail
4.0234	8	898	11225	Fail
4.1704	8	842	10525	Fail
4.3173	7	788	11257	Fail
4.4643	6	739	12316	Fail
4.6113	6	687	11450	Fail
4.7582	4	637	15925	Fail
4.9052	4	610	15250	Fail
5.0521	3	578	19266	Fail
5.1991	3	543	18100	Fail
5.3461	3	502	16733	Fail
5.4930	3	480	16000	Fail
5.6400	3	456	15200	Fail
5.7870	3	430	14333	Fail
5.9339	3	404	13466	Fail
6.0809	3	375	12500	Fail
6.2279	3	356	11866	Fail
6.3748	3	335	11166	Fail
6.5218	3	319	10633	Fail
6.6688	3	304	10133	Fail
6.8157	3	290	9666	Fail
6.9627	3	276	9200	Fail
7.1096	3	260	8666	Fail
7.2566	3	252	8400	Fail
7.4036	3	242	8066	Fail
7.5505	2	231	11550	Fail
7.6975	1	217	21700	Fail
7.8445	1	206	20600	Fail
7.9914	1	198	19800	Fail
8.1384	1	189	18900	Fail

8.2854	1	182	18200	Fail
8.4323	1	174	17400	Fail
8.5793	1	168	16800	Fail
8.7262	1	163	16300	Fail
8.8732	1	158	15800	Fail
9.0202	1	150	15000	Fail
9.1671	1	148	14800	Fail
9.3141	1	136	13600	Fail
9.4611	0	131	n/a	Fail
9.6080	0	123	n/a	Fail
9.7550	0	120	n/a	Fail
9.9020	0	115	n/a	Fail
10.0489	0	109	n/a	Fail
10.1959	0	103	n/a	Fail
10.3428	0	98	n/a	Fail
10.4898	0	94	n/a	Fail
10.6368	0	89	n/a	Fail
10.7837	0	86	n/a	Fail
10.9307	0	83	n/a	Fail
11.0777	0	81	n/a	Fail
11.2246	0	77	n/a	Fail
11.3716	0	73	n/a	Fail
11.5186	0	71	n/a	Fail
11.6655	0	70	n/a	Fail
11.8125	0	65	n/a	Fail
11.9594	0	62	n/a	Fail
12.1064	0	61	n/a	Fail
12.2534	0	59	n/a	Fail
12.4003	0	56	n/a	Fail
12.5473	0	51	n/a	Fail
12.6943	0	50	n/a	Fail
12.8412	0	46	n/a	Fail
12.9882	0	45	n/a	Fail
13.1352	0	44	n/a	Fail
13.2821	0	39	n/a	Fail
13.4291	0	38	n/a	Fail
13.5761	0	36	n/a	Fail
13.7230	0	36	n/a	Fail
13.8700	0	32	n/a	Fail
14.0169	0	30	n/a	Fail
14.1639	0	28	n/a	Fail
14.3109	0	27	n/a	Fail
14.4578	0	25	n/a	Fail
14.6048	0	25	n/a	Fail
14.7518	0	25	n/a	Fail
14.8987	0	23	n/a	Fail

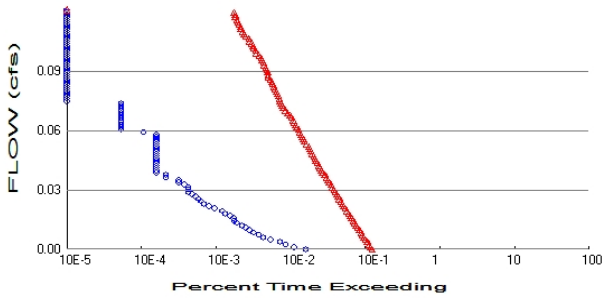
The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

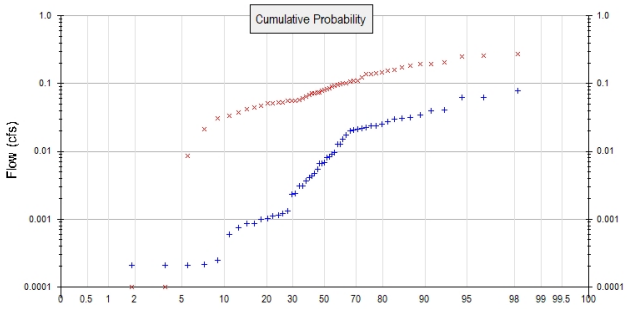
Water Quality

Water Quality BMP Flow and Volume for POC #1

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

POC 2





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #2
Total Pervious Area: 0.263
Total Impervious Area: 0

Mitigated Landuse Totals for POC #2
Total Pervious Area: 0.107
Total Impervious Area: 0.156

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #2

Return Period	**Flow(cfs)**
2 year	0.00579
5 year	0.022684
10 year	0.043504
25 year	0.083223
50 year	0.123483
100 year	0.173299

Flow Frequency Return Periods for Mitigated. POC #2

Return Period	**Flow(cfs)**
2 year	0.105461
5 year	0.168787
10 year	0.205135
25 year	0.243928
50 year	0.268061
100 year	0.288656

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #2

Year	**Predeveloped**	**Mitigated**
1956	0.041	0.155
1957	0.004	0.143
1958	0.063	0.172
1959	0.015	0.078
1960	0.062	0.181
1961	0.030	0.111
1962	0.077	0.111
1963	0.023	0.205
1964	0.013	0.102
1965	0.007	0.051
1966	0.001	0.031

1967	0.003	0.056
1968	0.001	0.052
1969	0.003	0.044
1970	0.004	0.056
1971	0.028	0.064
1972	0.021	0.093
1973	0.001	0.051
1974	0.030	0.148
1975	0.032	0.248
1976	0.017	0.058
1977	0.000	0.022
1978	0.035	0.123
1979	0.001	0.047
1980	0.002	0.089
1981	0.004	0.074
1982	0.020	0.096
1983	0.008	0.071
1984	0.025	0.097
1985	0.001	0.056
1986	0.023	0.140
1987	0.001	0.101
1988	0.000	0.038
1989	0.001	0.000
1990	0.009	0.072
1991	0.022	0.061
1992	0.001	0.042
1993	0.005	0.074
1994	0.005	0.009
1995	0.001	0.160
1996	0.039	0.196
1997	0.010	0.084
1998	0.008	0.259
1999	0.001	0.034
2000	0.002	0.085
2001	0.000	0.000
2002	0.007	0.273
2003	0.000	0.193
2004	0.000	0.000
2005	0.000	0.052
2006	0.013	0.069
2007	0.021	0.137
2008	0.007	0.080
2009	0.024	0.108

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #2

Rank	Predeveloped	Mitigated
1	0.0773	0.2727
2	0.0627	0.2588
3	0.0622	0.2484
4	0.0409	0.2052
5	0.0392	0.1964
6	0.0347	0.1934
7	0.0320	0.1809
8	0.0303	0.1720
9	0.0297	0.1599
10	0.0277	0.1547
11	0.0252	0.1478

12	0.0235	0.1425
13	0.0235	0.1400
14	0.0228	0.1374
15	0.0217	0.1226
16	0.0213	0.1112
17	0.0206	0.1110
18	0.0202	0.1081
19	0.0173	0.1020
20	0.0149	0.1010
21	0.0129	0.0975
22	0.0128	0.0963
23	0.0095	0.0934
24	0.0092	0.0893
25	0.0083	0.0849
26	0.0080	0.0835
27	0.0068	0.0797
28	0.0066	0.0783
29	0.0066	0.0737
30	0.0055	0.0735
31	0.0047	0.0717
32	0.0043	0.0710
33	0.0041	0.0688
34	0.0037	0.0643
35	0.0031	0.0612
36	0.0030	0.0576
37	0.0024	0.0564
38	0.0023	0.0561
39	0.0013	0.0559
40	0.0012	0.0520
41	0.0011	0.0520
42	0.0011	0.0512
43	0.0010	0.0507
44	0.0010	0.0475
45	0.0009	0.0443
46	0.0008	0.0425
47	0.0008	0.0377
48	0.0006	0.0338
49	0.0002	0.0311
50	0.0002	0.0215
51	0.0002	0.0085
52	0.0002	0.0000
53	0.0002	0.0000
54	0.0002	0.0000

Duration Flows

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0029	300	2335	778	Fail
0.0041	207	2210	1067	Fail
0.0053	161	2113	1312	Fail
0.0065	135	2001	1482	Fail
0.0078	100	1893	1893	Fail
0.0090	81	1797	2218	Fail
0.0102	70	1721	2458	Fail
0.0114	60	1656	2760	Fail
0.0126	52	1573	3025	Fail
0.0139	47	1493	3176	Fail
0.0151	42	1427	3397	Fail
0.0163	36	1361	3780	Fail
0.0175	33	1296	3927	Fail
0.0187	32	1234	3856	Fail
0.0199	29	1184	4082	Fail
0.0212	25	1134	4536	Fail
0.0224	23	1069	4647	Fail
0.0236	18	1016	5644	Fail
0.0248	15	963	6419	Fail
0.0260	13	927	7130	Fail
0.0273	12	893	7441	Fail
0.0285	11	850	7727	Fail
0.0297	10	813	8130	Fail
0.0309	9	782	8688	Fail
0.0321	8	747	9337	Fail
0.0333	8	721	9012	Fail
0.0346	8	683	8537	Fail
0.0358	7	653	9328	Fail
0.0370	6	622	10366	Fail
0.0382	6	594	9900	Fail
0.0394	4	569	14225	Fail
0.0407	4	541	13525	Fail
0.0419	3	506	16866	Fail
0.0431	3	485	16166	Fail
0.0443	3	470	15666	Fail
0.0455	3	451	15033	Fail
0.0467	3	427	14233	Fail
0.0480	3	411	13700	Fail
0.0492	3	400	13333	Fail
0.0504	3	385	12833	Fail
0.0516	3	369	12300	Fail
0.0528	3	353	11766	Fail
0.0541	3	340	11333	Fail
0.0553	3	328	10933	Fail
0.0565	3	303	10100	Fail
0.0577	3	287	9566	Fail
0.0589	3	281	9366	Fail
0.0601	3	269	8966	Fail
0.0614	3	258	8600	Fail
0.0626	2	251	12550	Fail
0.0638	1	241	24100	Fail
0.0650	1	226	22600	Fail
0.0662	1	218	21800	Fail
0.0675	1	209	20900	Fail

0.0687	1	205	20500	Fail
0.0699	1	194	19400	Fail
0.0711	1	185	18500	Fail
0.0723	1	170	17000	Fail
0.0735	1	161	16100	Fail
0.0748	1	149	14900	Fail
0.0760	1	146	14600	Fail
0.0772	1	138	13800	Fail
0.0784	0	136	n/a	Fail
0.0796	0	134	n/a	Fail
0.0809	0	129	n/a	Fail
0.0821	0	125	n/a	Fail
0.0833	0	121	n/a	Fail
0.0845	0	117	n/a	Fail
0.0857	0	112	n/a	Fail
0.0869	0	108	n/a	Fail
0.0882	0	105	n/a	Fail
0.0894	0	100	n/a	Fail
0.0906	0	94	n/a	Fail
0.0918	0	94	n/a	Fail
0.0930	0	93	n/a	Fail
0.0942	0	91	n/a	Fail
0.0955	0	88	n/a	Fail
0.0967	0	84	n/a	Fail
0.0979	0	82	n/a	Fail
0.0991	0	78	n/a	Fail
0.1003	0	76	n/a	Fail
0.1016	0	71	n/a	Fail
0.1028	0	65	n/a	Fail
0.1040	0	64	n/a	Fail
0.1052	0	60	n/a	Fail
0.1064	0	59	n/a	Fail
0.1076	0	57	n/a	Fail
0.1089	0	53	n/a	Fail
0.1101	0	52	n/a	Fail
0.1113	0	47	n/a	Fail
0.1125	0	45	n/a	Fail
0.1137	0	43	n/a	Fail
0.1150	0	40	n/a	Fail
0.1162	0	40	n/a	Fail
0.1174	0	38	n/a	Fail
0.1186	0	37	n/a	Fail
0.1198	0	36	n/a	Fail
0.1210	0	34	n/a	Fail
0.1223	0	34	n/a	Fail
0.1235	0	33	n/a	Fail

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

Water Quality

Water Quality BMP Flow and Volume for POC #2

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

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

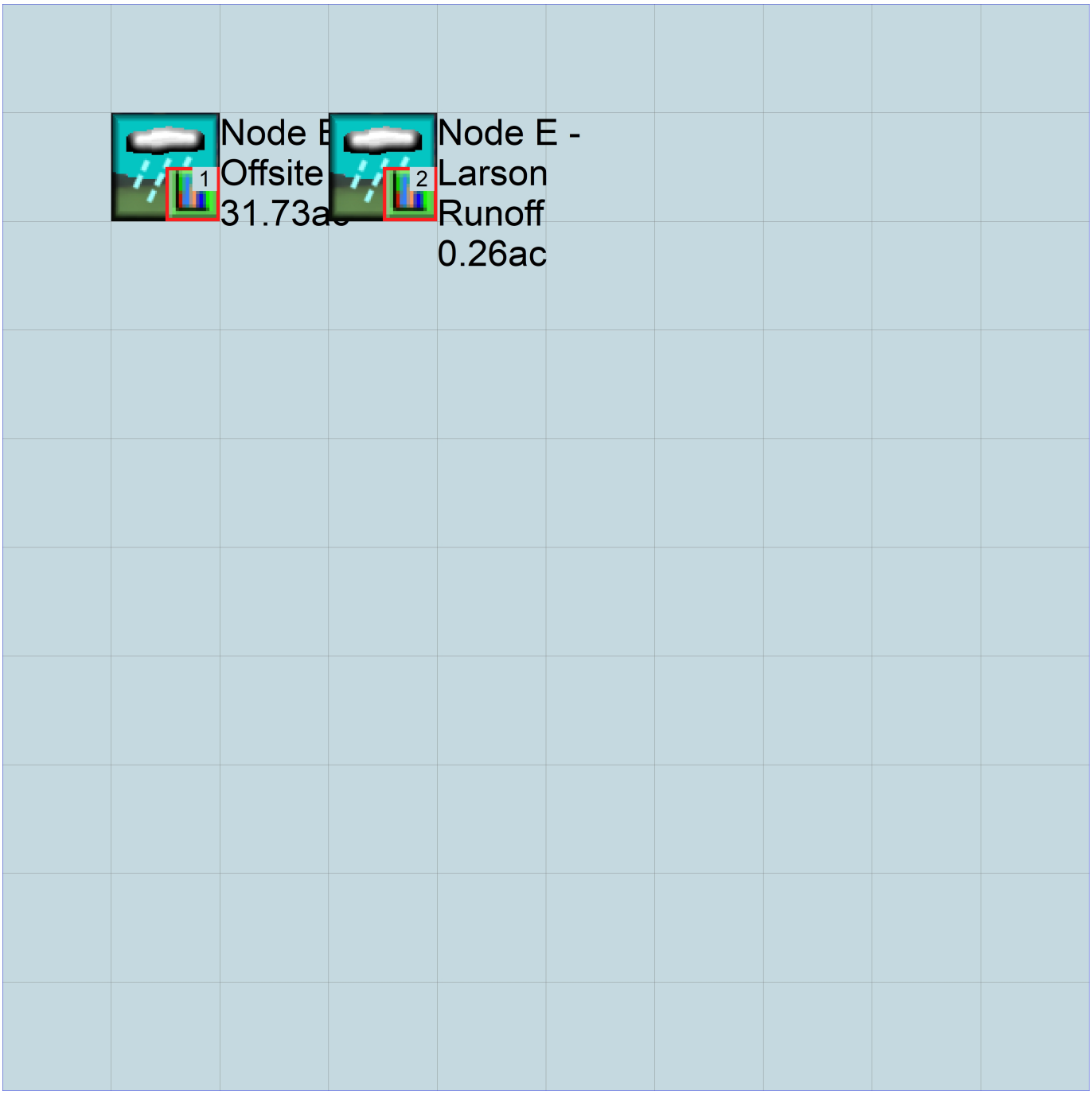
No PERLND changes have been made.

IMPLND Changes

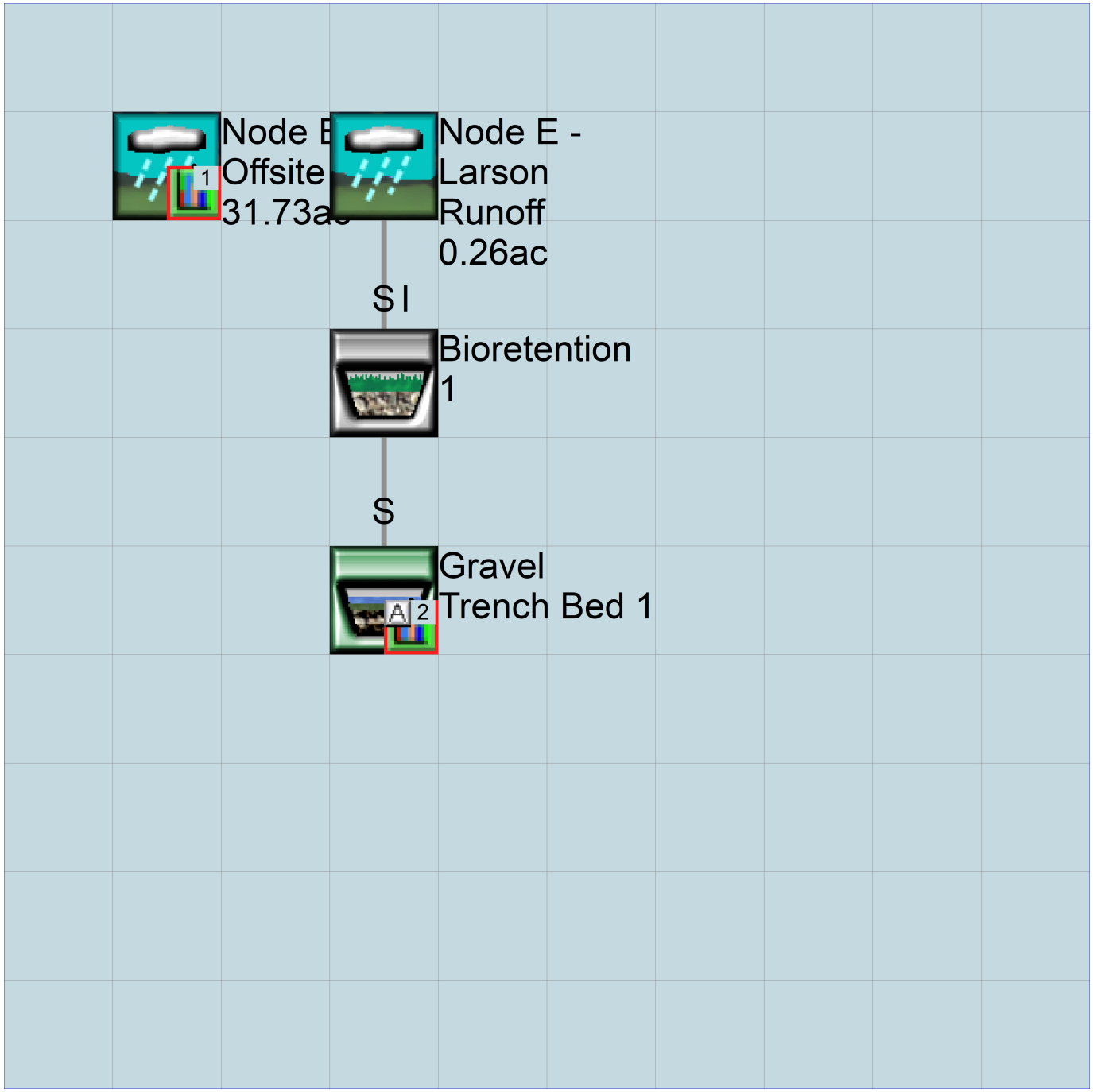
No IMPLND changes have been made.

Appendix

Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   18591_Node E.wdm
MESSU       25   Pre18591_Node E.MES
            27   Pre18591_Node E.L61
            28   Pre18591_Node E.L62
            30   POC18591_Node E1.dat
            31   POC18591_Node E2.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND       2
      COPY       501
      COPY       502
      DISPLY       1
      DISPLY       2
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title---------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Node E - Offsite           MAX                    1    2   30    9
    2        Node E - Larson Runoff     MAX                    1    2   31    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  502         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
    2     A/B, Forest, Mod        1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    2         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
```

```
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
    2         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    2         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    2              0         5         2       400       0.1       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    2              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                 ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    2          0.2       0.5      0.35         0       0.7       0.7
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
             ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
    2              0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

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

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

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

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

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

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

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

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Node E - Offsite***
PERLND   2                      31.732     COPY   501     12
PERLND   2                      31.732     COPY   501     13
Node E - Larson Runoff***
PERLND   2                       0.263     COPY   502     12
PERLND   2                       0.263     COPY   502     13

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

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1
COPY   502 OUTPUT MEAN   1 1   48.4        DISPLY   2     INPUT  TIMSER 1



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

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

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

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

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

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

SPEC-ACTIONS
```

```
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.429          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.429          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
COPY   502 OUTPUT MEAN   1 1     48.4      WDM    502 FLOW     ENGL      REPL
END EXT TARGETS

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

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


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   18591_Node E.wdm
MESSU       25   Mit18591_Node E.MES
            27   Mit18591_Node E.L61
            28   Mit18591_Node E.L62
            30   POC18591_Node E1.dat
            31   POC18591_Node E2.dat
END FILES

OPN SEQUENCE
    INGRP               INDELT 00:15
      PERLND       8
      IMPLND       4
      IMPLND       1
      RCHRES       1
      RCHRES       2
      RCHRES       3
      COPY       501
      COPY         2
      COPY       502
      DISPLY       1
      DISPLY       2
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Node E - Offsite           MAX                    1    2   30    9
    2        Gravel Trench Bed 1        MAX                    1    2   31    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
    2         1    1
  502         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
    8     A/B, Lawn, Mod          1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***
```

```
  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    8         0    0    1    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
    8         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    8         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    8              0         5       0.8       400       0.1       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    8              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    8          0.1       0.5      0.25         0       0.7      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
    8              0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out           ***
    4      ROOF TOPS/FLAT         1    1    1   27    0
    1      ROADS/FLAT             1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    4         0    0    1    0    0    0
    1         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    4         0    0    4    0    0    4    1    9
    1         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
```

```
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    4         0    0    0    0    0
    1         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    4            400      0.01       0.1       0.1
    1            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    4              0         0
    1              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    4              0         0
    1              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Node E - Larson Runoff***
PERLND   8                       0.107     RCHRES   1      2
PERLND   8                       0.107     RCHRES   1      3
IMPLND   1                       0.156     RCHRES   1      5
Node E - Offsite***
PERLND   8                      25.386     COPY   501     12
PERLND   8                      25.386     COPY   501     13
IMPLND   4                       6.346     COPY   501     15

******Routing******
RCHRES   1                           1     RCHRES   3      7
RCHRES   1                                 COPY     2     17
RCHRES   1                           1     RCHRES   2      8
RCHRES   3                           1     COPY   502     17
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1
COPY   502 OUTPUT MEAN   1 1   48.4        DISPLY   2     INPUT  TIMSER 1



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

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                        in  out                             ***
    1     Surface retentio-007    2    1    1    1   28    0    1
    2     Bioretention  1         1    1    1    1   28    0    1
    3     Gravel Trench Be-011    2    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***
```

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

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

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

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

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      2
   70    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.002296  0.000000  0.000000
  0.043956  0.002296  0.000046  0.000000
  0.087912  0.002296  0.000092  0.000000
  0.131868  0.002296  0.000138  0.000000
  0.175824  0.002296  0.000185  0.000000
  0.219780  0.002296  0.000231  0.000063
  0.263736  0.002296  0.000277  0.000106
  0.307692  0.002296  0.000323  0.000164
  0.351648  0.002296  0.000369  0.000239
  0.395604  0.002296  0.000415  0.000332
  0.439560  0.002296  0.000461  0.000446
  0.483516  0.002296  0.000508  0.000580
  0.527473  0.002296  0.000554  0.000721
  0.571429  0.002296  0.000600  0.000737
  0.615385  0.002296  0.000646  0.000919
  0.659341  0.002296  0.000692  0.001125
  0.703297  0.002296  0.000738  0.001357
  0.747253  0.002296  0.000784  0.001617
  0.791209  0.002296  0.000831  0.001742
```

```
0.835165  0.002296  0.000877  0.001905
0.879121  0.002296  0.000923  0.002222
0.923077  0.002296  0.000969  0.002570
0.967033  0.002296  0.001015  0.002949
1.010989  0.002296  0.001061  0.003334
1.054945  0.002296  0.001107  0.003359
1.098901  0.002296  0.001154  0.003803
1.142857  0.002296  0.001200  0.004280
1.186813  0.002296  0.001246  0.004792
1.230769  0.002296  0.001292  0.005339
1.274725  0.002296  0.001338  0.005579
1.318681  0.002296  0.001384  0.005922
1.362637  0.002296  0.001431  0.006541
1.406593  0.002296  0.001477  0.007198
1.450549  0.002296  0.001523  0.007893
1.494505  0.002296  0.001569  0.008548
1.538462  0.002296  0.001611  0.008626
1.582418  0.002296  0.001653  0.009399
1.626374  0.002296  0.001695  0.010210
1.670330  0.002296  0.001736  0.011060
1.714286  0.002296  0.001778  0.011949
1.758242  0.002296  0.001820  0.012307
1.802198  0.002296  0.001862  0.012872
1.846154  0.002296  0.001904  0.013808
1.890110  0.002296  0.001946  0.018519
1.934066  0.002296  0.001988  0.018519
1.978022  0.002296  0.002030  0.018519
2.021978  0.002296  0.002071  0.018519
2.065934  0.002296  0.002113  0.018519
2.109890  0.002296  0.002155  0.018519
2.153846  0.002296  0.002197  0.018519
2.197802  0.002296  0.002239  0.018519
2.241758  0.002296  0.002281  0.018519
2.285714  0.002296  0.002323  0.018519
2.329670  0.002296  0.002365  0.018519
2.373626  0.002296  0.002407  0.018519
2.417582  0.002296  0.002448  0.018519
2.461538  0.002296  0.002490  0.018519
2.505495  0.002296  0.002532  0.018519
2.549451  0.002296  0.002574  0.018519
2.593407  0.002296  0.002616  0.018519
2.637363  0.002296  0.002658  0.018519
2.681319  0.002296  0.002700  0.018519
2.725275  0.002296  0.002742  0.018519
2.769231  0.002296  0.002783  0.018519
2.813187  0.002296  0.002825  0.018519
2.857143  0.002296  0.002867  0.018519
2.901099  0.002296  0.002909  0.018519
2.945055  0.002296  0.002951  0.018519
2.989011  0.002296  0.002993  0.018519
3.000000  0.002296  0.003386  0.018519
END FTABLE  2
FTABLE      1
 24    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.002296  0.000000  0.000000  0.000000
0.043956  0.002296  0.000101  0.000000  0.013889
0.087912  0.002296  0.000202  0.000000  0.014703
0.131868  0.002296  0.000303  0.000000  0.015110
0.175824  0.002296  0.000404  0.000000  0.015517
0.219780  0.002296  0.000505  0.000000  0.015924
0.263736  0.002296  0.000605  0.000000  0.016331
0.307692  0.002296  0.000706  0.000000  0.016738
0.351648  0.002296  0.000807  0.000000  0.017145
0.395604  0.002296  0.000908  0.000000  0.017552
0.439560  0.002296  0.001009  0.000000  0.017959
0.483516  0.002296  0.001110  0.000000  0.018366
0.527473  0.002296  0.001211  0.048301  0.018519
0.571429  0.002296  0.001312  0.202028  0.018519
```

```
0.615385  0.002296  0.001413  0.412175  0.018519
0.659341  0.002296  0.001514  0.659695  0.018519
0.703297  0.002296  0.001615  0.928167  0.018519
0.747253  0.002296  0.001715  1.200769  0.018519
0.791209  0.002296  0.001816  1.460630  0.018519
0.835165  0.002296  0.001917  1.692395  0.018519
0.879121  0.002296  0.002018  1.884482  0.018519
0.923077  0.002296  0.002119  2.031838  0.018519
0.967033  0.002296  0.002220  2.139092  0.018519
1.000000  0.002296  0.002296  2.251466  0.018519
END FTABLE  1
FTABLE      3
 92    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.002296  0.000000  0.000000  0.000000
0.055556  0.002296  0.000045  0.000000  0.004630
0.111111  0.002296  0.000089  0.000000  0.004630
0.166667  0.002296  0.000134  0.000000  0.004630
0.222222  0.002296  0.000179  0.000000  0.004630
0.277778  0.002296  0.000223  0.000000  0.004630
0.333333  0.002296  0.000268  0.000000  0.004630
0.388889  0.002296  0.000312  0.000000  0.004630
0.444444  0.002296  0.000357  0.000000  0.004630
0.500000  0.002296  0.000402  0.000000  0.004630
0.555556  0.002296  0.000446  0.000000  0.004630
0.611111  0.002296  0.000491  0.000000  0.004630
0.666667  0.002296  0.000536  0.000000  0.004630
0.722222  0.002296  0.000580  0.000000  0.004630
0.777778  0.002296  0.000625  0.000000  0.004630
0.833333  0.002296  0.000670  0.000000  0.004630
0.888889  0.002296  0.000714  0.000000  0.004630
0.944444  0.002296  0.000759  0.000000  0.004630
1.000000  0.002296  0.000803  0.000000  0.004630
1.055556  0.002296  0.000848  0.000000  0.004630
1.111111  0.002296  0.000893  0.000000  0.004630
1.166667  0.002296  0.000937  0.000000  0.004630
1.222222  0.002296  0.000982  0.000000  0.004630
1.277778  0.002296  0.001027  0.000000  0.004630
1.333333  0.002296  0.001071  0.000000  0.004630
1.388889  0.002296  0.001116  0.000000  0.004630
1.444444  0.002296  0.001161  0.000000  0.004630
1.500000  0.002296  0.001205  0.000000  0.004630
1.555556  0.002296  0.001250  0.000000  0.004630
1.611111  0.002296  0.001295  0.000000  0.004630
1.666667  0.002296  0.001339  0.000000  0.004630
1.722222  0.002296  0.001384  0.000000  0.004630
1.777778  0.002296  0.001428  0.000000  0.004630
1.833333  0.002296  0.001473  0.000000  0.004630
1.888889  0.002296  0.001518  0.000000  0.004630
1.944444  0.002296  0.001562  0.000000  0.004630
2.000000  0.002296  0.001607  0.000000  0.004630
2.055556  0.002296  0.001652  0.000000  0.004630
2.111111  0.002296  0.001696  0.000000  0.004630
2.166667  0.002296  0.001741  0.000000  0.004630
2.222222  0.002296  0.001786  0.000000  0.004630
2.277778  0.002296  0.001830  0.000000  0.004630
2.333333  0.002296  0.001875  0.000000  0.004630
2.388889  0.002296  0.001919  0.000000  0.004630
2.444444  0.002296  0.001964  0.000000  0.004630
2.500000  0.002296  0.002009  0.000000  0.004630
2.555556  0.002296  0.002053  0.000000  0.004630
2.611111  0.002296  0.002098  0.000000  0.004630
2.666667  0.002296  0.002143  0.000000  0.004630
2.722222  0.002296  0.002187  0.000000  0.004630
2.777778  0.002296  0.002232  0.000000  0.004630
2.833333  0.002296  0.002277  0.000000  0.004630
2.888889  0.002296  0.002321  0.000000  0.004630
2.944444  0.002296  0.002366  0.000000  0.004630
3.000000  0.002296  0.002410  0.000000  0.004630
```

```
  3.055556  0.002296  0.002455  0.138729  0.004630
  3.111111  0.002296  0.002500  0.389839  0.004630
  3.166667  0.002296  0.002544  0.703432  0.004630
  3.222222  0.002296  0.002589  1.046030  0.004630
  3.277778  0.002296  0.002634  1.383552  0.004630
  3.333333  0.002296  0.002678  1.683468  0.004630
  3.388889  0.002296  0.002723  1.921105  0.004630
  3.444444  0.002296  0.002768  2.088233  0.004630
  3.500000  0.002296  0.002812  2.203335  0.004630
  3.555556  0.002296  0.002857  2.347596  0.004630
  3.611111  0.002296  0.002901  2.462179  0.004630
  3.666667  0.002296  0.002946  2.571662  0.004630
  3.722222  0.002296  0.002991  2.676671  0.004630
  3.777778  0.002296  0.003035  2.777713  0.004630
  3.833333  0.002296  0.003080  2.875206  0.004630
  3.888889  0.002296  0.003125  2.969500  0.004630
  3.944444  0.002296  0.003169  3.060890  0.004630
  4.000000  0.002296  0.003214  3.149630  0.004630
  4.055556  0.002296  0.003259  3.235937  0.004630
  4.111111  0.002296  0.003303  3.320002  0.004630
  4.166667  0.002296  0.003348  3.401989  0.004630
  4.222222  0.002296  0.003393  3.482047  0.004630
  4.277778  0.002296  0.003437  3.560305  0.004630
  4.333333  0.002296  0.003482  3.636879  0.004630
  4.388889  0.002296  0.003526  3.711875  0.004630
  4.444444  0.002296  0.003571  3.785384  0.004630
  4.500000  0.002296  0.003616  3.857493  0.004630
  4.555556  0.002296  0.003660  3.928279  0.004630
  4.611111  0.002296  0.003705  3.997811  0.004630
  4.666667  0.002296  0.003750  4.066155  0.004630
  4.722222  0.002296  0.003794  4.133369  0.004630
  4.777778  0.002296  0.003839  4.199507  0.004630
  4.833333  0.002296  0.003884  4.264619  0.004630
  4.888889  0.002296  0.003928  4.328752  0.004630
  4.944444  0.002296  0.003973  4.391949  0.004630
  5.000000  0.002296  0.004017  4.454250  0.004630
  5.055556  0.002296  0.004145  4.515690  0.004630
  END FTABLE  3
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.429          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.429          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP
WDM      2 PREC     ENGL    1.429          RCHRES   1     EXTNL  PREC
WDM      1 EVAP     ENGL    0.5            RCHRES   1     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.76           RCHRES   2     EXTNL  POTEV

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL       REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL       REPL
RCHRES   3 HYDR   RO     1 1        1      WDM   1010 FLOW     ENGL       REPL
RCHRES   3 HYDR   O      1 1        1      WDM   1011 FLOW     ENGL       REPL
RCHRES   3 HYDR   O      2 1        1      WDM   1012 FLOW     ENGL       REPL
RCHRES   3 HYDR   STAGE  1 1        1      WDM   1013 STAG     ENGL       REPL
COPY     2 OUTPUT MEAN   1 1     48.4      WDM    702 FLOW     ENGL       REPL
COPY   502 OUTPUT MEAN   1 1     48.4      WDM    802 FLOW     ENGL       REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>           <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        2
```

```
PERLND     PWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
PERLND     PWATER IFWO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    3

  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK        7
RCHRES     OFLOW  OVOL   1                 RCHRES         INFLOW IVOL
  END MASS-LINK    7

  MASS-LINK        8
RCHRES     OFLOW  OVOL   2                 RCHRES         INFLOW IVOL
  END MASS-LINK    8

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

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

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

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


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

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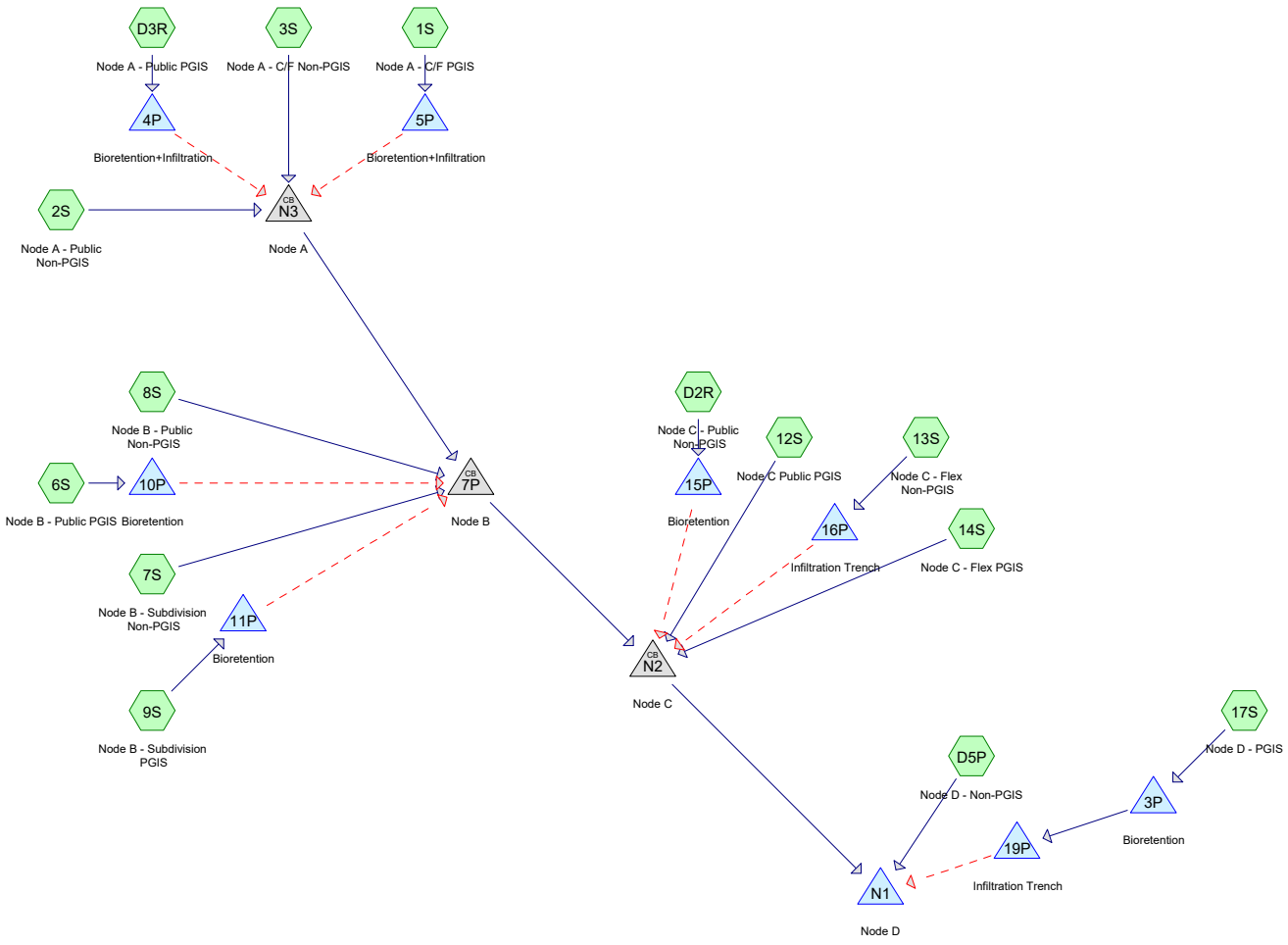
Appendix D: Stormwater Conveyance Calculations

HydroCAD Reports for:

- **Onsite 25-Year – OHWM or Below**
- **Onsite 100-Year – OHWM or Below**
- **Onsite 25-Year – Minor Flood Stage**
- **Onsite 100-Year – Minor Flood Stage**
- **Onsite 25-Year – Moderate Flood Stage**
- **Onsite 100-Year – Moderate Flood Stage**
- **Onsite 100-Year – Flooded and Closed**
- **Offsite 25-Year – OHWM or Below**
- **Offsite 100-Year – OHWM or Below**
- **Offsite 25-Year – Valves Closed**
- **Offsite 25-Year – Valves Closed**

Brochure for Tideflex CheckMate UltraFlex Check Valve

Pump Cut Sheet



Subcat Reach Pond Link

Routing Diagram for ALTERNATE _Onsite 25-Year Storm - Water @ OHWM or Below

Prepared by MacKay & Sposito, Inc, Printed 3/10/2025

HydroCAD® 10.20-5c s/n 01662 © 2023 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
9.462	49	50-75% Grass cover, Fair, HSG A (D5P)
2.370	59	50-75% Grass cover, Fair, HSG A/B (avg) (2S, 3S)
0.306	69	50-75% Grass cover, Fair, HSG B (13S)
0.239	68	<50% Grass cover, Poor, HSG A (D2R)
4.736	79	<50% Grass cover, Poor, HSG B (7S, 8S)
48.663	98	Paved parking, HSG A (6S, 9S, 17S)
11.595	98	Paved parking, HSG B (1S, 12S, 14S, D3R)
4.445	98	Roofs, HSG A (3S, 13S)
22.259	98	Roofs, HSG B (7S, D5P)
104.075	**92**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
65.179	HSG A	2S, 3S, 6S, 9S, 13S, 17S, D2R, D5P
38.896	HSG B	1S, 7S, 8S, 12S, 13S, 14S, D3R, D5P
0.000	HSG C	
0.000	HSG D	
0.000	Other	
104.075		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
11.832	0.306	0.000	0.000	0.000	12.138	50-75% Grass cover, Fair	2S, 3S, 13S, D5P
0.239	4.736	0.000	0.000	0.000	4.975	<50% Grass cover, Poor	7S, 8S, D2R
48.663	11.595	0.000	0.000	0.000	60.258	Paved parking	1S, 6S, 9S, 12S, 14S, 17S, D3R
4.445	22.259	0.000	0.000	0.000	26.704	Roofs	3S, 7S, 13S, D5P
65.179	**38.896**	**0.000**	**0.000**	**0.000**	**104.075**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	7P	40.33	39.19	379.7	0.0030	0.012	0.0	24.0	0.0	
2	N1	38.00	37.50	270.3	0.0018	0.012	0.0	42.0	0.0	
3	N2	39.19	38.00	410.7	0.0029	0.012	0.0	30.0	0.0	
4	N3	41.44	40.33	369.0	0.0030	0.012	0.0	24.0	0.0	

Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Node A - C/F PGIS Runoff Area=7.516 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=8.64 cfs 3.046 af

Subcatchment2S: Node A - Public Non-PGIS Runoff Area=1.160 ac 0.00% Impervious Runoff Depth=1.29"
Tc=20.0 min CN=59 Runoff=0.20 cfs 0.125 af

Subcatchment3S: Node A - C/F Non-PGIS Runoff Area=4.583 ac 73.60% Impervious Runoff Depth=3.76"
Tc=20.0 min CN=88 Runoff=4.22 cfs 1.438 af

Subcatchment6S: Node B - Public PGIS Runoff Area=0.250 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=0.29 cfs 0.101 af

Subcatchment7S: Node B - Subdivision Runoff Area=6.745 ac 31.13% Impervious Runoff Depth=3.46"
Tc=20.0 min CN=85 Runoff=5.62 cfs 1.945 af

Subcatchment8S: Node B - Public Non-PGIS Runoff Area=0.091 ac 0.00% Impervious Runoff Depth=2.89"
Tc=20.0 min CN=79 Runoff=0.06 cfs 0.022 af

Subcatchment9S: Node B - Subdivision Runoff Area=2.176 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=2.50 cfs 0.882 af

Subcatchment12S: Node C Public PGIS Runoff Area=0.710 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=0.82 cfs 0.288 af

Subcatchment13S: Node C - Flex Non-PGIS Runoff Area=1.378 ac 77.79% Impervious Runoff Depth=4.19"
Tc=20.0 min CN=92 Runoff=1.42 cfs 0.481 af

Subcatchment14S: Node C - Flex PGIS Runoff Area=1.685 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=1.94 cfs 0.683 af

Subcatchment17S: Node D - PGIS Runoff Area=46.237 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=53.15 cfs 18.738 af

SubcatchmentD2R: Node C - Public Runoff Area=0.239 ac 0.00% Impervious Runoff Depth=1.95"
Tc=20.0 min CN=68 Runoff=0.09 cfs 0.039 af

SubcatchmentD3R: Node A - Public PGIS Runoff Area=1.684 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=1.94 cfs 0.682 af

SubcatchmentD5P: Node D - Non-PGIS Runoff Area=29.621 ac 68.06% Impervious Runoff Depth=3.17"
Tc=20.0 min CN=82 Runoff=22.11 cfs 7.822 af

Pond 3P: Bioretention Peak Elev=54.62' Storage=2.845 af Inflow=53.15 cfs 18.738 af
Outflow=28.78 cfs 18.424 af

Pond 4P: Bioretention+Infiltration Peak Elev=3.73' Storage=0.037 af Inflow=1.94 cfs 0.682 af
Primary=0.15 cfs 0.277 af Secondary=1.78 cfs 0.406 af Outflow=1.93 cfs 0.682 af

Pond 5P: Bioretention+Infiltration Peak Elev=4.97' Storage=0.240 af Inflow=8.64 cfs 3.046 af
Primary=0.36 cfs 0.882 af Secondary=8.26 cfs 2.164 af Outflow=8.62 cfs 3.046 af

Pond 7P: Node B Peak Elev=48.56' Inflow=22.70 cfs 6.681 af
24.0" Round Culvert n=0.012 L=379.7' S=0.0030 '/' Outflow=22.70 cfs 6.681 af

Pond 10P: Bioretention Peak Elev=3.25' Storage=0.005 af Inflow=0.29 cfs 0.101 af
Primary=0.02 cfs 0.045 af Secondary=0.26 cfs 0.056 af Outflow=0.29 cfs 0.101 af

Pond 11P: Bioretention Peak Elev=4.87' Storage=0.053 af Inflow=2.50 cfs 0.882 af
Primary=0.19 cfs 0.356 af Secondary=2.30 cfs 0.526 af Outflow=2.48 cfs 0.882 af

Pond 15P: Bioretention Peak Elev=0.73' Storage=0.004 af Inflow=0.09 cfs 0.039 af
Primary=0.04 cfs 0.039 af Secondary=0.00 cfs 0.000 af Outflow=0.04 cfs 0.039 af

Pond 16P: Infiltration Trench Peak Elev=4.61' Storage=0.044 af Inflow=1.42 cfs 0.481 af
Primary=0.09 cfs 0.189 af Secondary=1.32 cfs 0.292 af Outflow=1.41 cfs 0.481 af

Pond 19P: Infiltration Trench Peak Elev=3.86' Storage=2.259 af Inflow=28.78 cfs 18.424 af
Primary=3.57 cfs 8.564 af Secondary=24.41 cfs 9.860 af Outflow=27.97 cfs 18.424 af

Pond N1: Node D Peak Elev=42.27' Storage=9,485 cf Inflow=65.60 cfs 25.625 af
42.0" Round Culvert n=0.012 L=270.3' S=0.0018 '/' Outflow=57.61 cfs 25.625 af

Pond N2: Node C Peak Elev=44.32' Inflow=26.76 cfs 7.943 af
30.0" Round Culvert n=0.012 L=410.7' S=0.0029 '/' Outflow=26.76 cfs 7.943 af

Pond N3: Node A Peak Elev=50.24' Inflow=14.45 cfs 4.132 af
24.0" Round Culvert n=0.012 L=369.0' S=0.0030 '/' Outflow=14.45 cfs 4.132 af

Total Runoff Area = 104.075 ac Runoff Volume = 36.290 af Average Runoff Depth = 4.18"
16.44% Pervious = 17.113 ac 83.56% Impervious = 86.962 ac

Summary for Subcatchment 1S: Node A - C/F PGIS

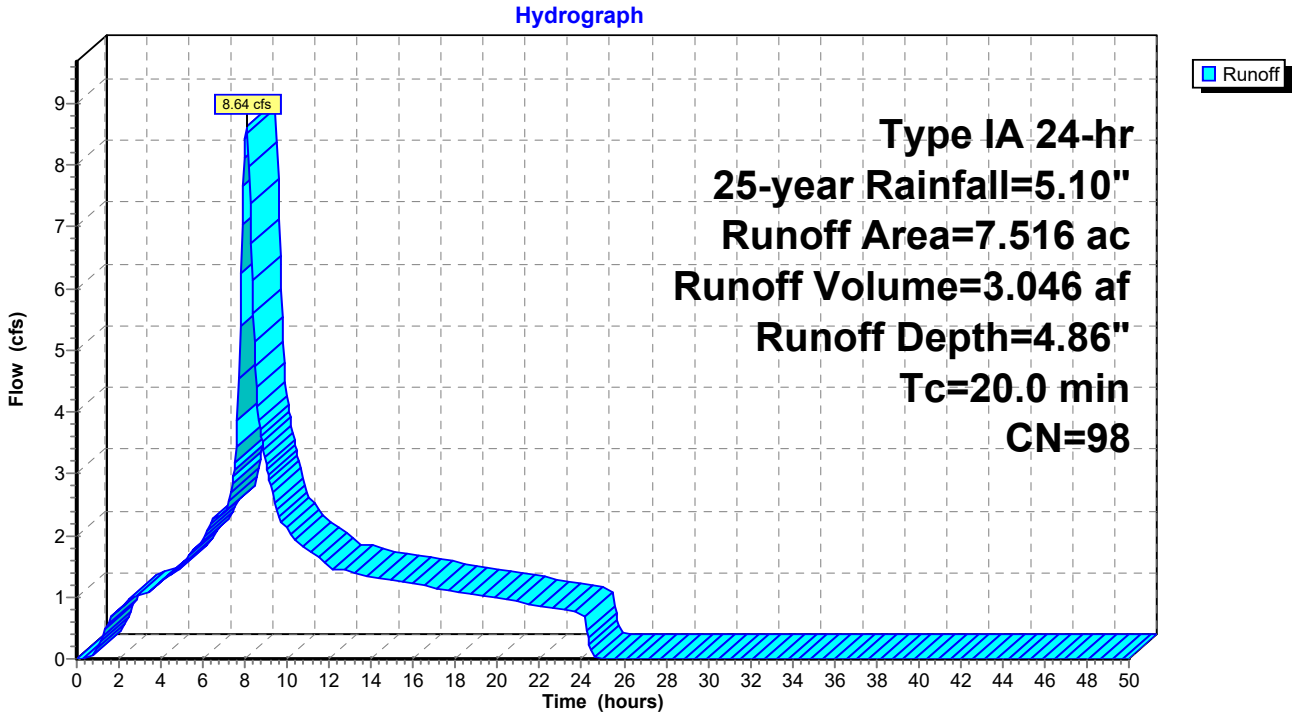
Runoff = 8.64 cfs @ 8.08 hrs, Volume= 3.046 af, Depth= 4.86"
Routed to Pond 5P : Bioretention+Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
7.516	98	Paved parking, HSG B
7.516		100.00% Impervious Area

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

Subcatchment 1S: Node A - C/F PGIS



Summary for Subcatchment 2S: Node A - Public Non-PGIS

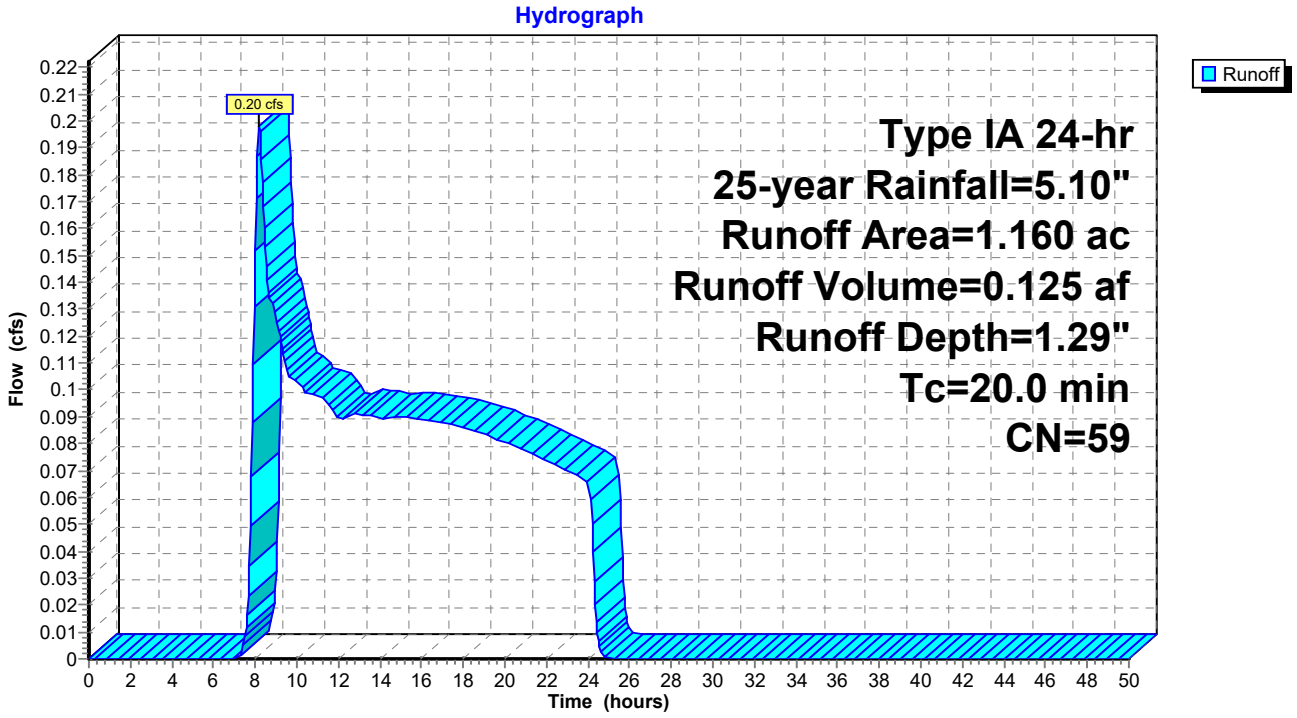
Runoff = 0.20 cfs @ 8.19 hrs, Volume= 0.125 af, Depth= 1.29"
Routed to Pond N3 : Node A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

	Area (ac)	CN	Description
*	1.160	59	50-75% Grass cover, Fair, HSG A/B (avg)
	1.160		100.00% Pervious Area

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

Subcatchment 2S: Node A - Public Non-PGIS



Summary for Subcatchment 3S: Node A - C/F Non-PGIS

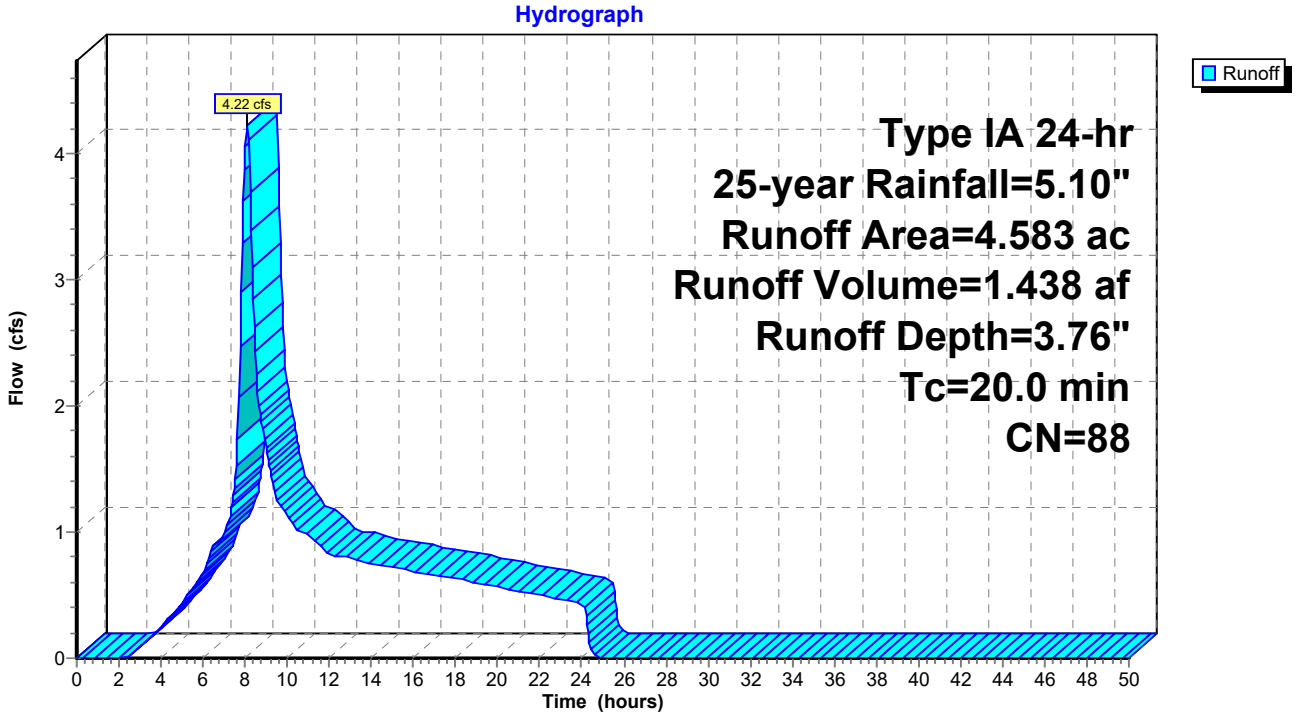
Runoff = 4.22 cfs @ 8.09 hrs, Volume= 1.438 af, Depth= 3.76"
Routed to Pond N3 : Node A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

	Area (ac)	CN	Description
*	1.210	59	50-75% Grass cover, Fair, HSG A/B (avg)
	3.373	98	Roofs, HSG A
	4.583	88	Weighted Average
	1.210		26.40% Pervious Area
	3.373		73.60% Impervious Area

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

Subcatchment 3S: Node A - C/F Non-PGIS



Summary for Subcatchment 6S: Node B - Public PGIS

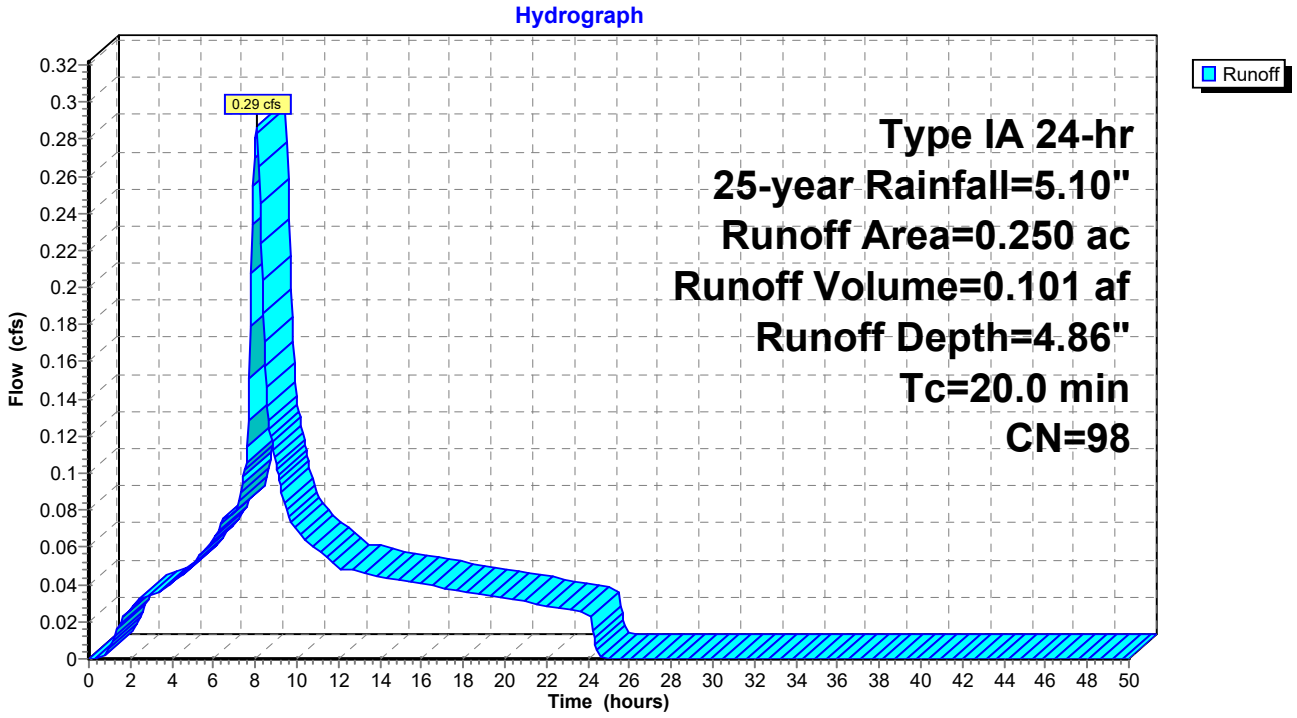
Runoff = 0.29 cfs @ 8.08 hrs, Volume= 0.101 af, Depth= 4.86"
Routed to Pond 10P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.250	98	Paved parking, HSG A
0.250		100.00% Impervious Area

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

Subcatchment 6S: Node B - Public PGIS



Summary for Subcatchment 7S: Node B - Subdivision Non-PGIS

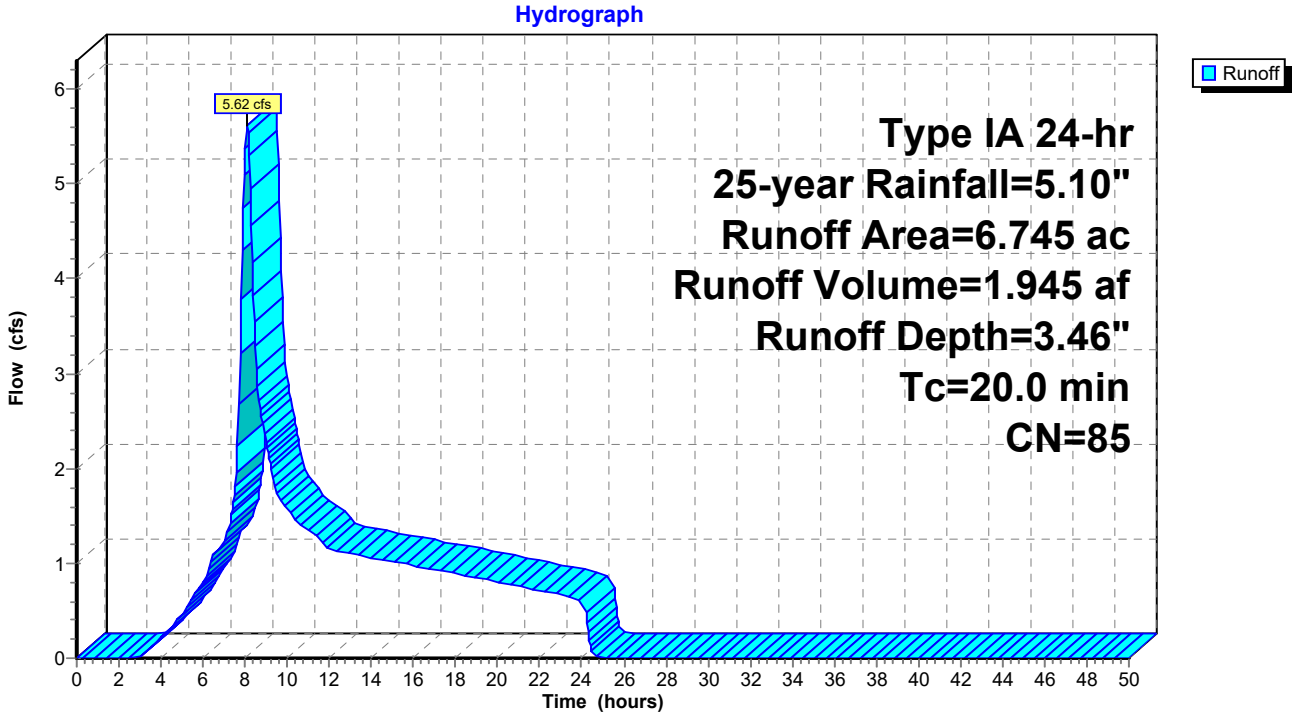
Runoff = 5.62 cfs @ 8.10 hrs, Volume= 1.945 af, Depth= 3.46"
Routed to Pond 7P : Node B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
2.100	98	Roofs, HSG B
4.645	79	<50% Grass cover, Poor, HSG B
6.745	85	Weighted Average
4.645		68.87% Pervious Area
2.100		31.13% Impervious Area

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

Subcatchment 7S: Node B - Subdivision Non-PGIS



Summary for Subcatchment 8S: Node B - Public Non-PGIS

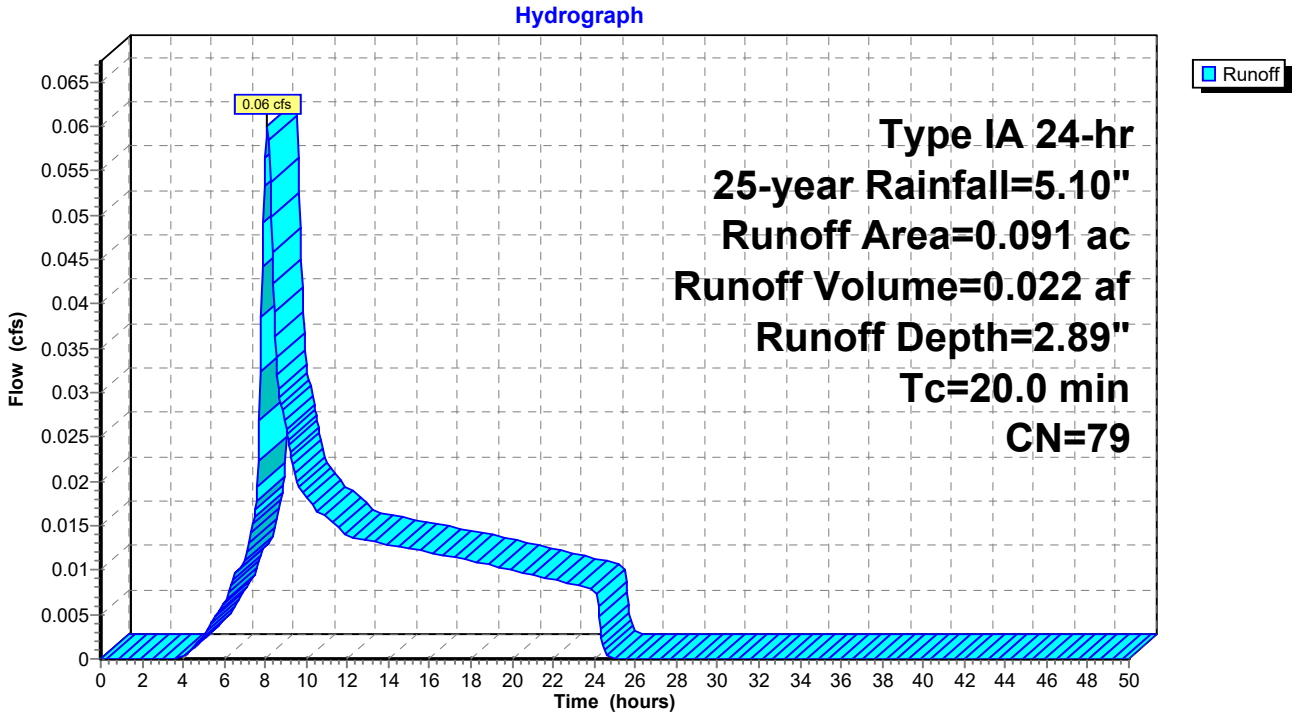
Runoff = 0.06 cfs @ 8.11 hrs, Volume= 0.022 af, Depth= 2.89"
Routed to Pond 7P : Node B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.091	79	<50% Grass cover, Poor, HSG B
0.091		100.00% Pervious Area

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

Subcatchment 8S: Node B - Public Non-PGIS



Summary for Subcatchment 9S: Node B - Subdivision PGIS

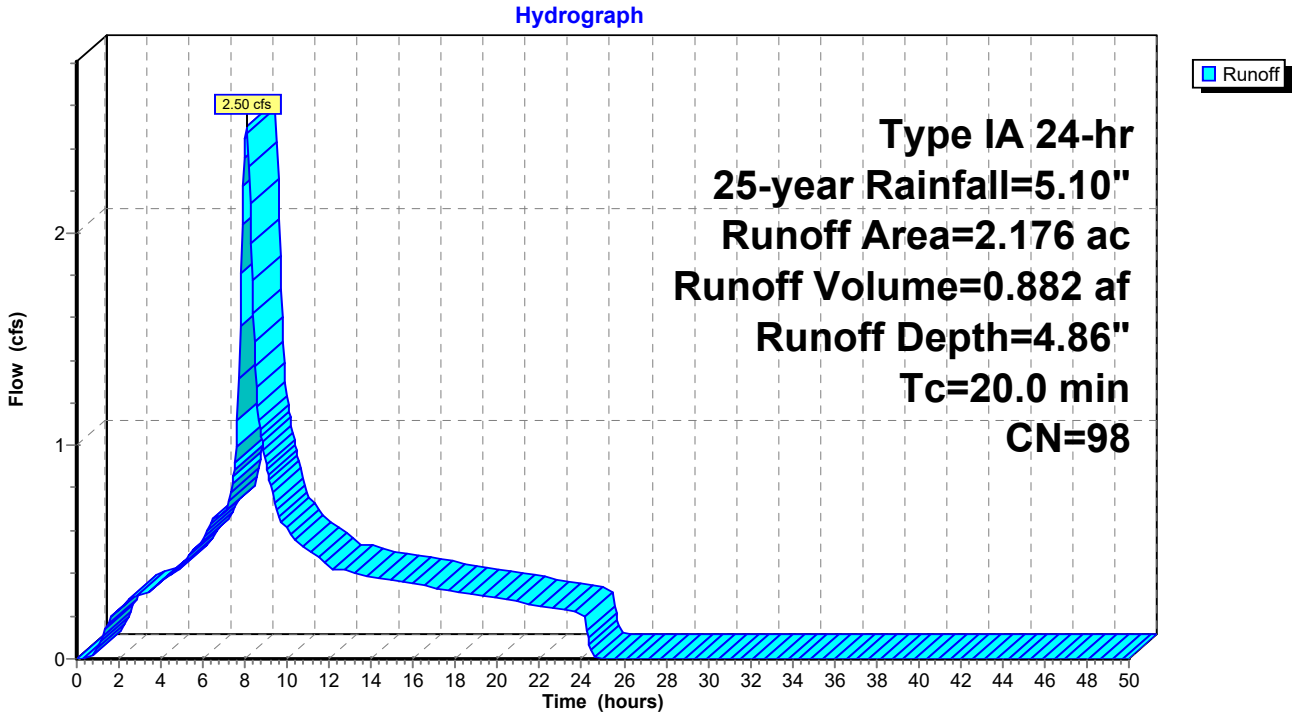
Runoff = 2.50 cfs @ 8.08 hrs, Volume= 0.882 af, Depth= 4.86"
Routed to Pond 11P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
2.176	98	Paved parking, HSG A
2.176		100.00% Impervious Area

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

Subcatchment 9S: Node B - Subdivision PGIS



Summary for Subcatchment 12S: Node C Public PGIS

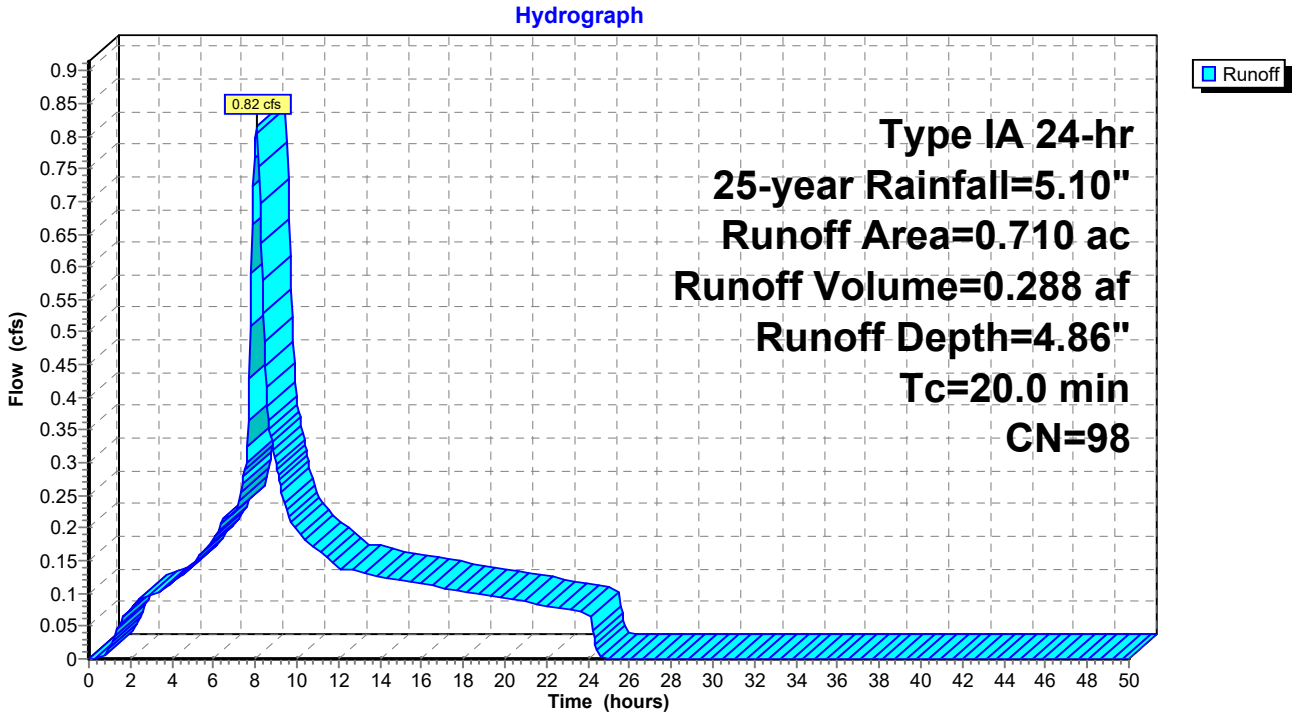
Runoff = 0.82 cfs @ 8.08 hrs, Volume= 0.288 af, Depth= 4.86"
Routed to Pond N2 : Node C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.710	98	Paved parking, HSG B
0.710		100.00% Impervious Area

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

Subcatchment 12S: Node C Public PGIS



Summary for Subcatchment 13S: Node C - Flex Non-PGIS

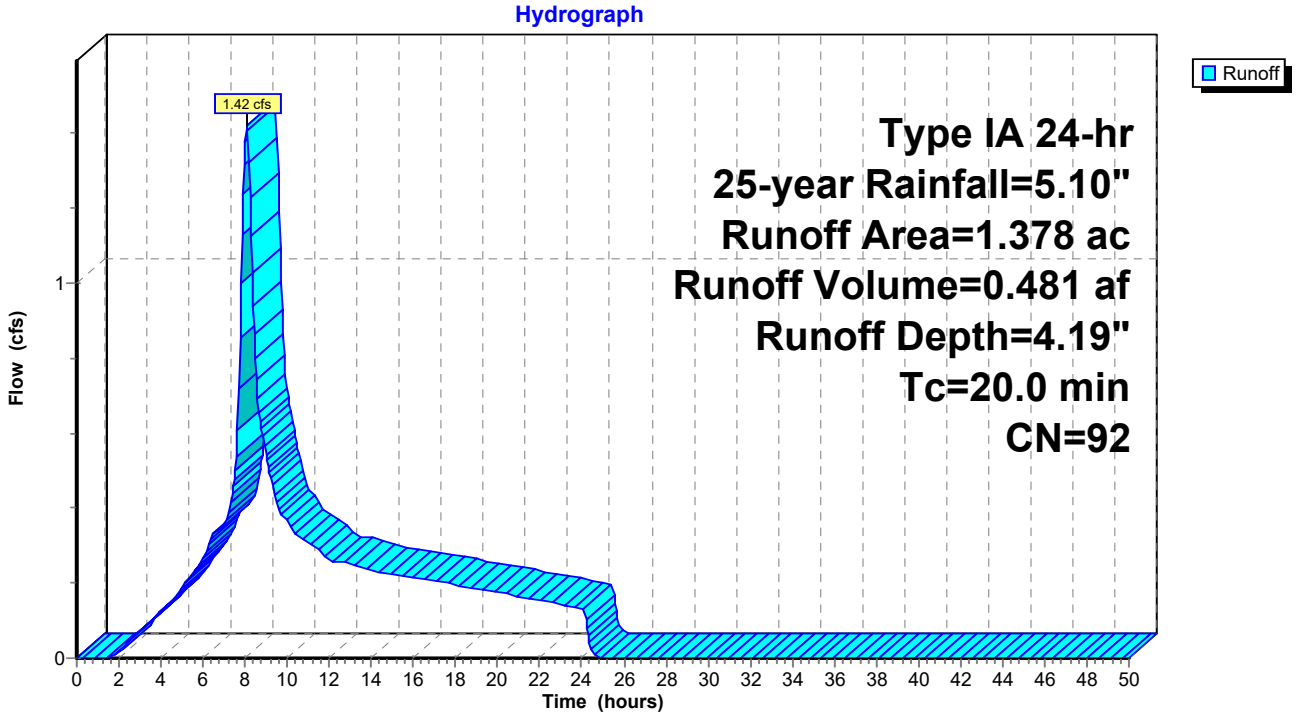
Runoff = 1.42 cfs @ 8.09 hrs, Volume= 0.481 af, Depth= 4.19"
Routed to Pond 16P : Infiltration Trench

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.306	69	50-75% Grass cover, Fair, HSG B
1.072	98	Roofs, HSG A
1.378	92	Weighted Average
0.306		22.21% Pervious Area
1.072		77.79% Impervious Area

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

Subcatchment 13S: Node C - Flex Non-PGIS



Summary for Subcatchment 14S: Node C - Flex PGIS

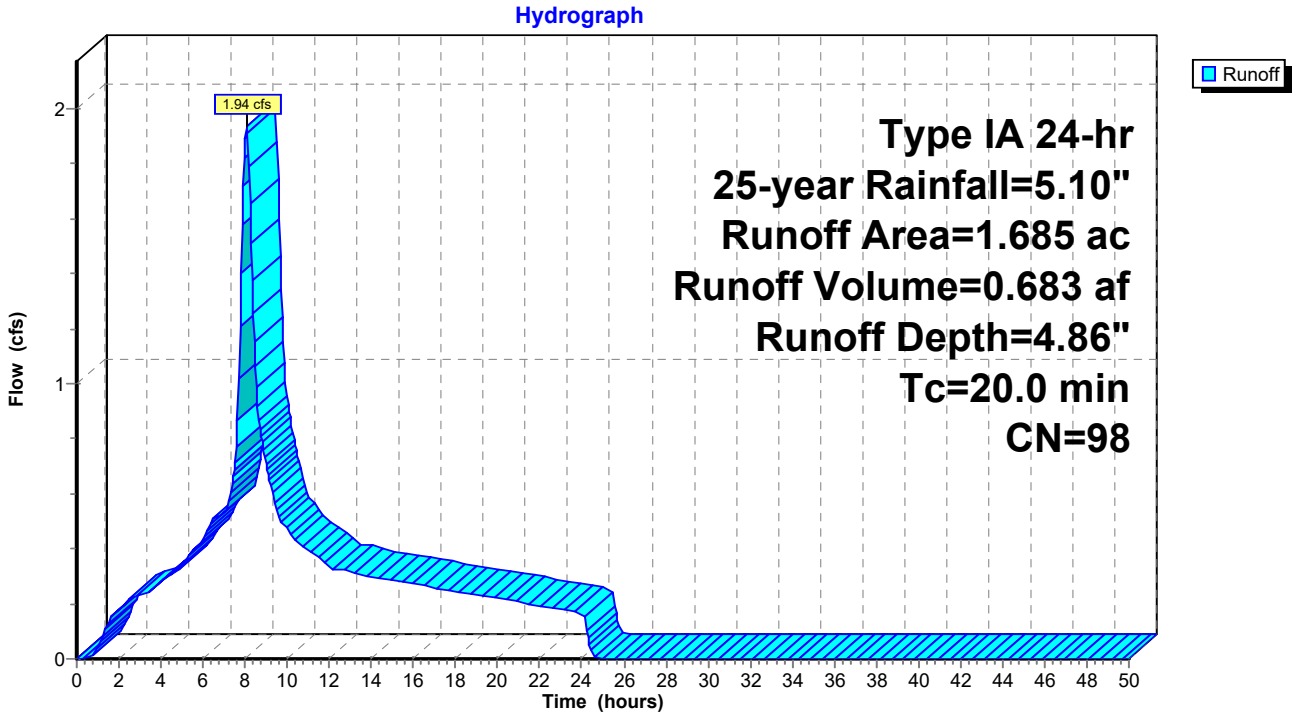
Runoff = 1.94 cfs @ 8.08 hrs, Volume= 0.683 af, Depth= 4.86"
Routed to Pond N2 : Node C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
1.685	98	Paved parking, HSG B
1.685		100.00% Impervious Area

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

Subcatchment 14S: Node C - Flex PGIS



Summary for Subcatchment 17S: Node D - PGIS

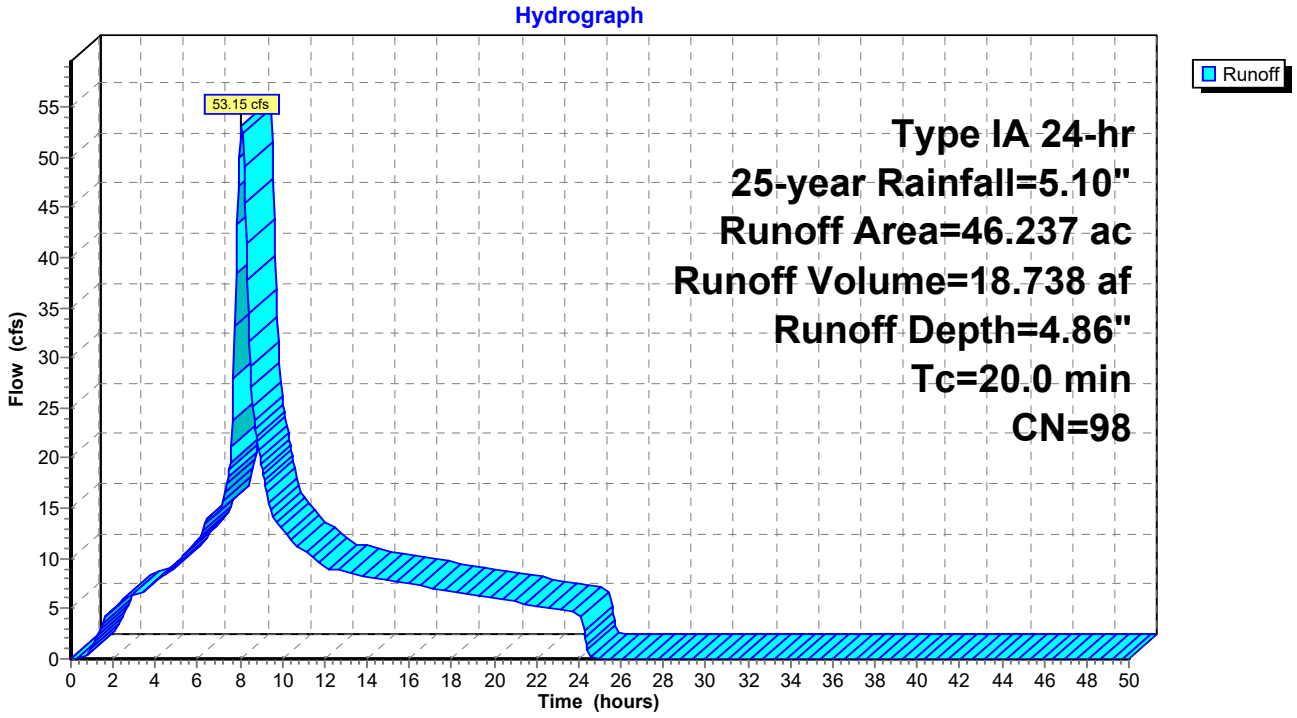
Runoff = 53.15 cfs @ 8.08 hrs, Volume= 18.738 af, Depth= 4.86"
Routed to Pond 3P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
46.237	98	Paved parking, HSG A
46.237		100.00% Impervious Area

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

Subcatchment 17S: Node D - PGIS



Summary for Subcatchment D2R: Node C - Public Non-PGIS

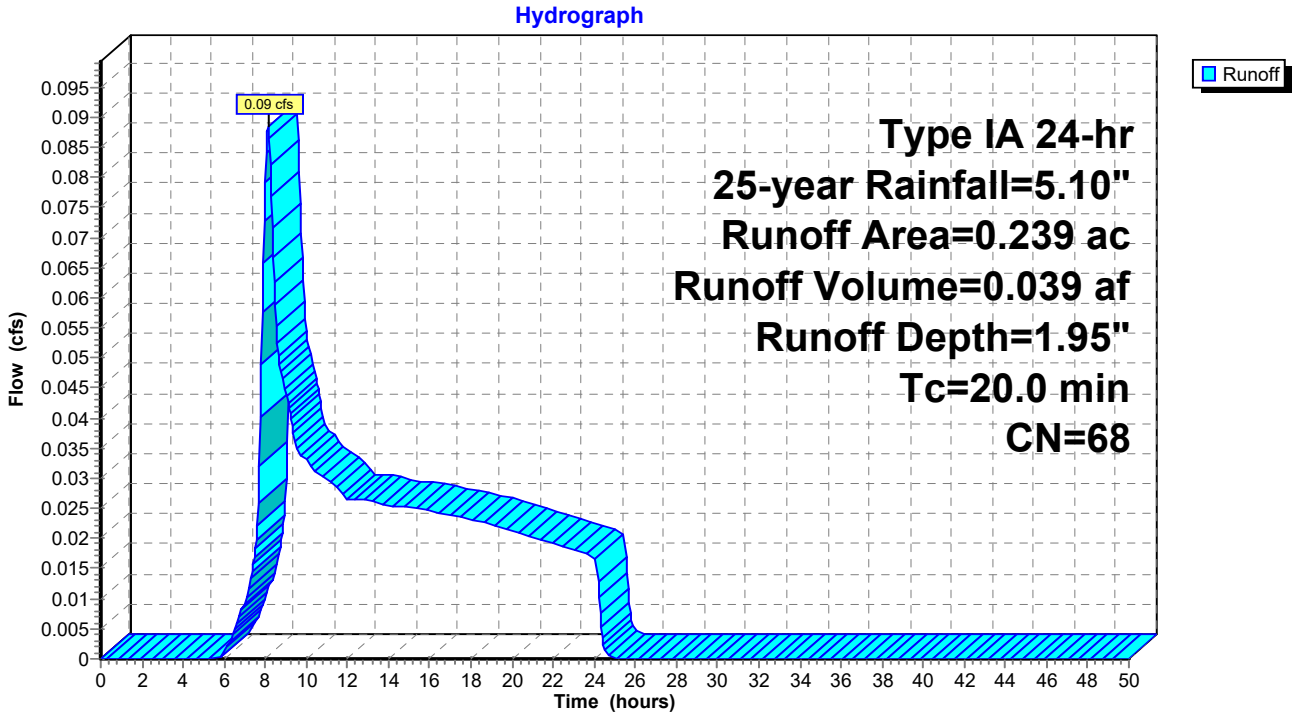
Runoff = 0.09 cfs @ 8.14 hrs, Volume= 0.039 af, Depth= 1.95"
Routed to Pond 15P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.239	68	<50% Grass cover, Poor, HSG A
0.239		100.00% Pervious Area

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

Subcatchment D2R: Node C - Public Non-PGIS



Summary for Subcatchment D3R: Node A - Public PGIS

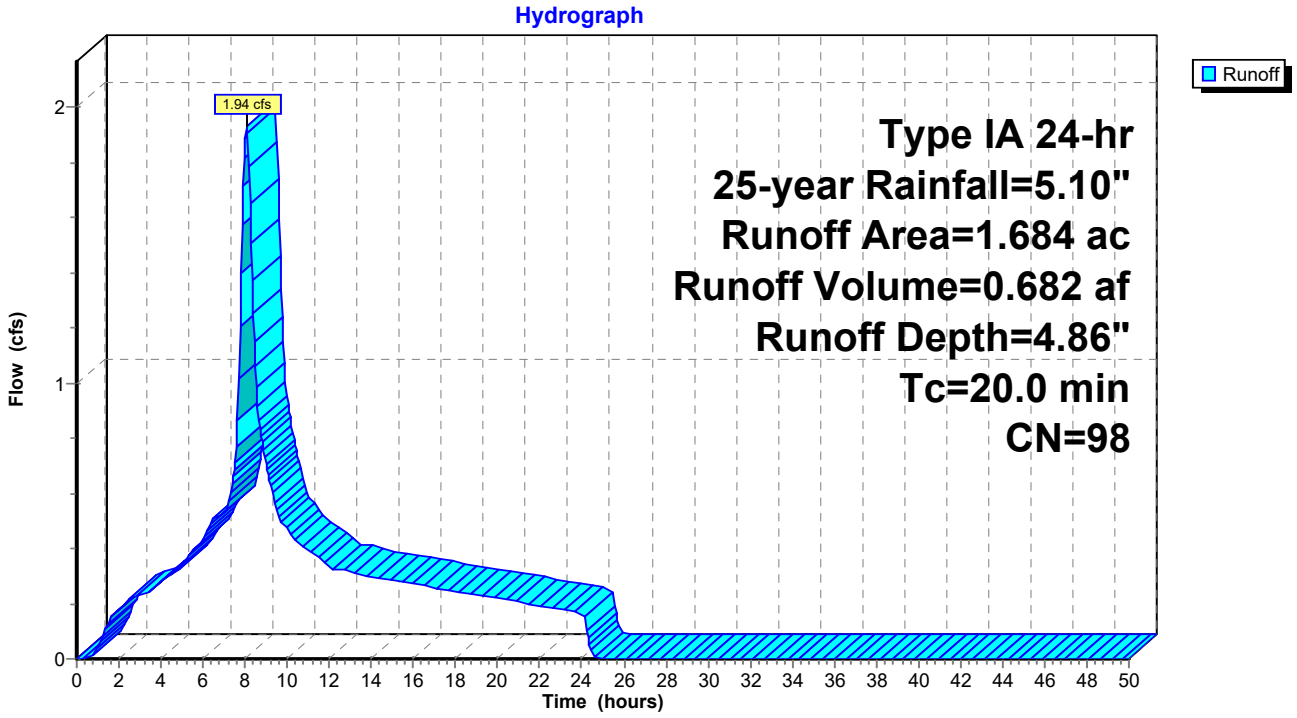
Runoff = 1.94 cfs @ 8.08 hrs, Volume= 0.682 af, Depth= 4.86"
Routed to Pond 4P : Bioretention+Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
1.684	98	Paved parking, HSG B
1.684		100.00% Impervious Area

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

Subcatchment D3R: Node A - Public PGIS



Summary for Subcatchment D5P: Node D - Non-PGIS

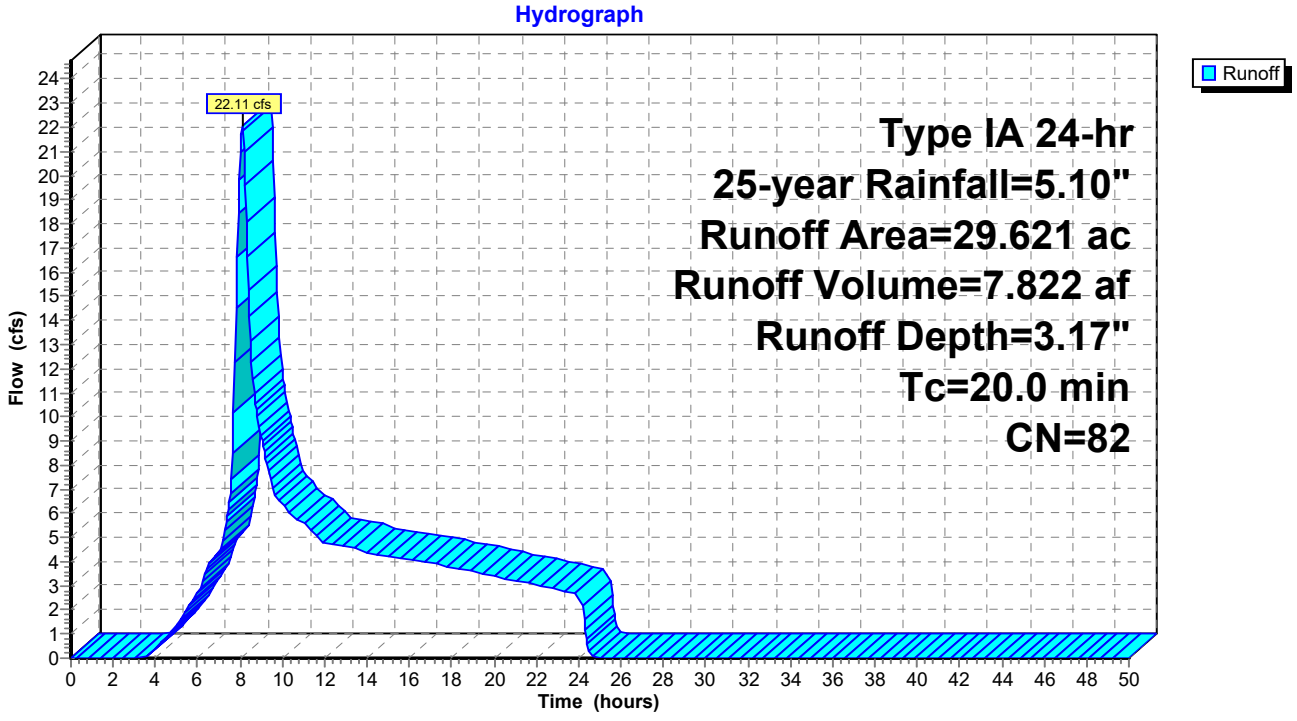
Runoff = 22.11 cfs @ 8.11 hrs, Volume= 7.822 af, Depth= 3.17"
Routed to Pond N1 : Node D

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
9.462	49	50-75% Grass cover, Fair, HSG A
20.159	98	Roofs, HSG B
29.621	82	Weighted Average
9.462		31.94% Pervious Area
20.159		68.06% Impervious Area

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

Subcatchment D5P: Node D - Non-PGIS



Summary for Pond 3P: Bioretention

Inflow Area = 46.237 ac,100.00% Impervious, Inflow Depth = 4.86" for 25-year event
Inflow = 53.15 cfs @ 8.08 hrs, Volume= 18.738 af
Outflow = 28.78 cfs @ 8.51 hrs, Volume= 18.424 af, Atten= 46%, Lag= 25.9 min
Primary = 28.78 cfs @ 8.51 hrs, Volume= 18.424 af
Routed to Pond 19P : Infiltration Trench

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 54.62' @ 8.51 hrs Surf.Area= 1.674 ac Storage= 2.845 af

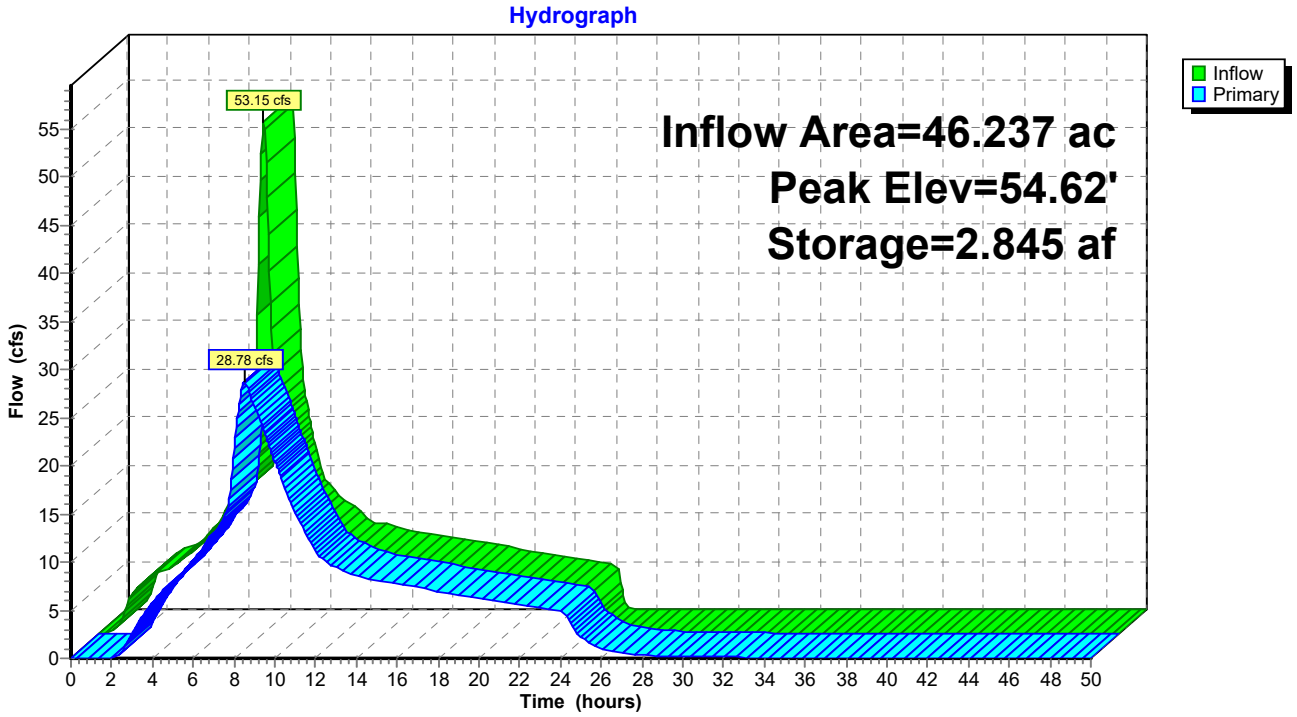
Plug-Flow detention time= 90.8 min calculated for 18.424 af (98% of inflow)
Center-of-Mass det. time= 77.7 min (745.3 - 667.6)

Volume	Invert	Avail.Storage	Storage Description
#1	50.00'	2.629 af	**270.00'W x 270.00'L x 6.50'H Prismatoid** 10.878 af Overall - 3.367 af Embedded = 7.512 af x 35.0% Voids
#2	54.50'	3.347 af	**270.00'W x 270.00'L x 2.00'H Prismatoid** Inside #1
#3	50.50'	0.019 af	**24.0" Round Pipe Storage** Inside #1 L= 269.0'
		5.996 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	54.50'	**60.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	50.50'	**24.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=28.76 cfs @ 8.51 hrs HW=54.62' (Free Discharge)
↑—**1=Orifice/Grate** (Weir Controls 2.05 cfs @ 1.12 fps)
└—**2=Orifice/Grate** (Orifice Controls 26.71 cfs @ 8.50 fps)

Pond 3P: Bioretention



Summary for Pond 4P: Bioretention+Infiltration

Inflow Area = 1.684 ac,100.00% Impervious, Inflow Depth = 4.86" for 25-year event
Inflow = 1.94 cfs @ 8.08 hrs, Volume= 0.682 af
Outflow = 1.93 cfs @ 8.11 hrs, Volume= 0.682 af, Atten= 0%, Lag= 1.7 min
Primary = 0.15 cfs @ 8.11 hrs, Volume= 0.277 af
Secondary = 1.78 cfs @ 8.11 hrs, Volume= 0.406 af
Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 3.73' @ 8.11 hrs Surf.Area= 0.029 ac Storage= 0.037 af

Plug-Flow detention time= 65.8 min calculated for 0.682 af (100% of inflow)
Center-of-Mass det. time= 65.7 min (733.3 - 667.6)

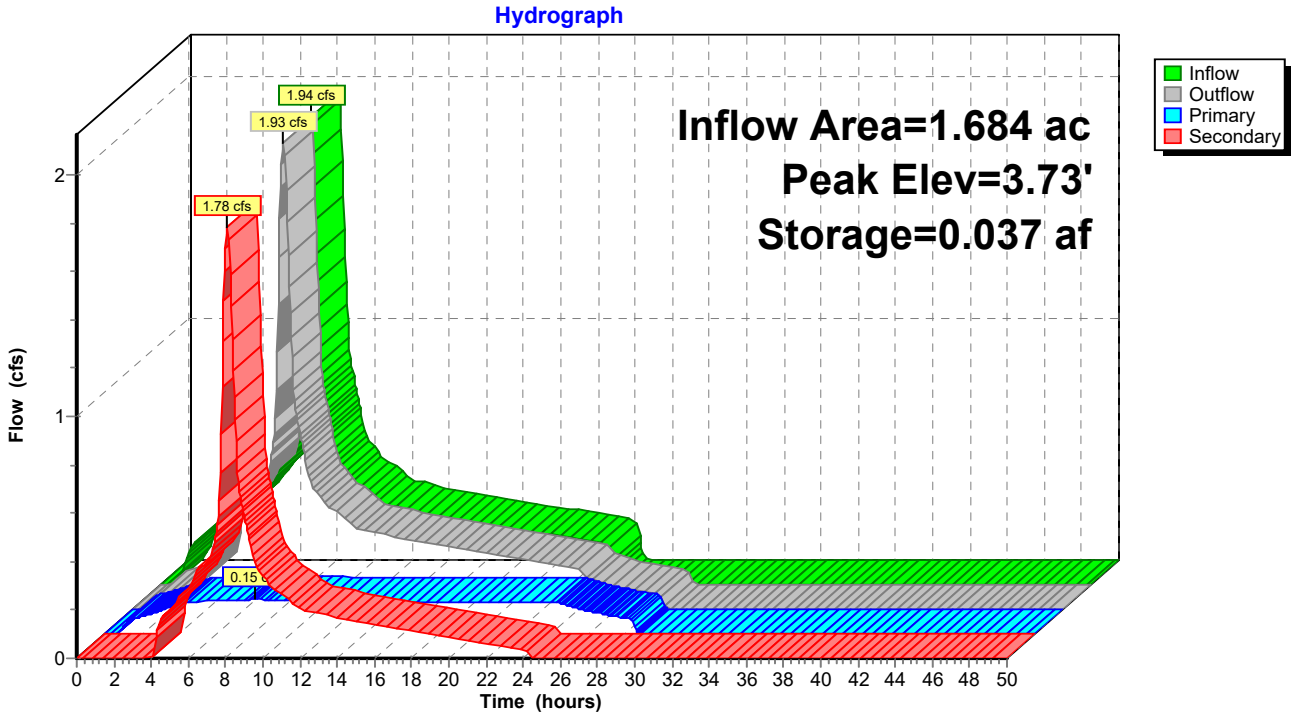
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.050 af	**5.00'W x 250.00'L x 5.00'H Bioretention** 0.143 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.15 cfs @ 8.11 hrs HW=3.73' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.15 cfs)

Secondary OutFlow Max=1.78 cfs @ 8.11 hrs HW=3.73' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 1.78 cfs @ 2.90 fps)

Pond 4P: Bioretention+Infiltration



Summary for Pond 5P: Bioretention+Infiltration

Inflow Area = 7.516 ac,100.00% Impervious, Inflow Depth = 4.86" for 25-year event
Inflow = 8.64 cfs @ 8.08 hrs, Volume= 3.046 af
Outflow = 8.62 cfs @ 8.10 hrs, Volume= 3.046 af, Atten= 0%, Lag= 1.2 min
Primary = 0.36 cfs @ 8.10 hrs, Volume= 0.882 af
Secondary = 8.26 cfs @ 8.10 hrs, Volume= 2.164 af
Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 4.97' @ 8.10 hrs Surf.Area= 0.138 ac Storage= 0.240 af

Plug-Flow detention time= 109.9 min calculated for 3.046 af (100% of inflow)
Center-of-Mass det. time= 109.8 min (777.4 - 667.6)

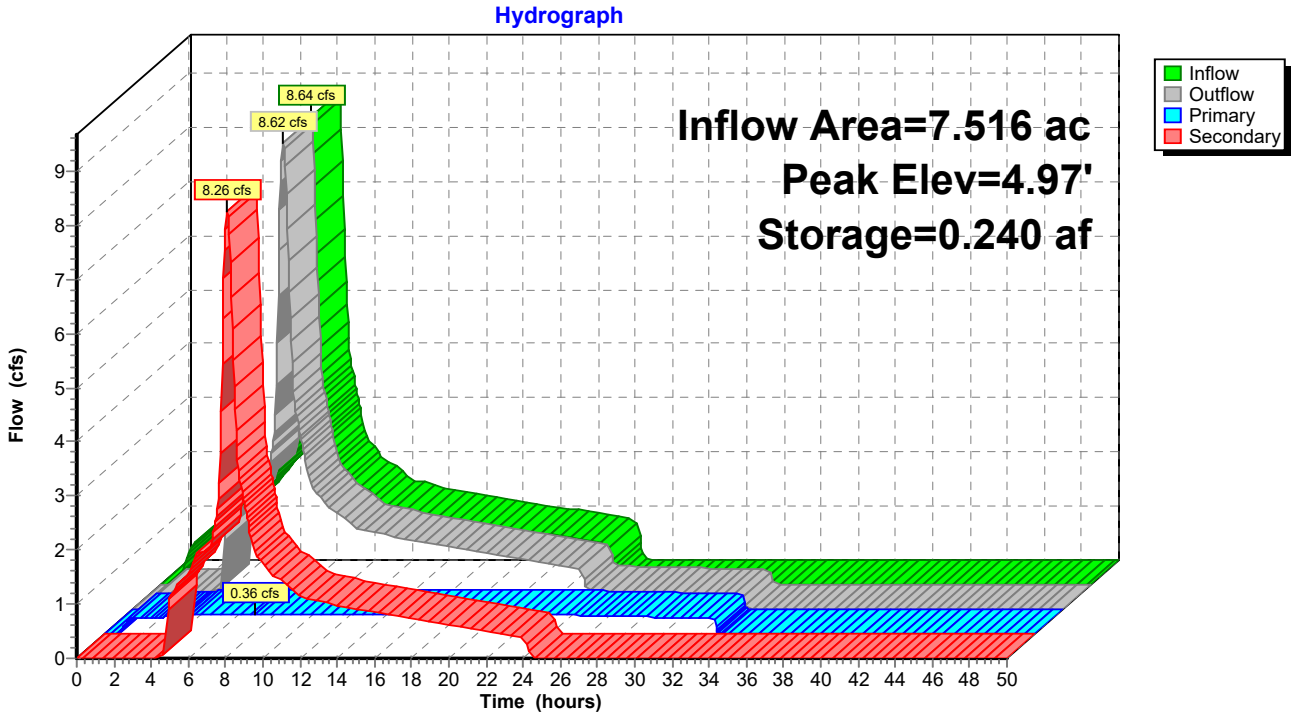
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.241 af	**50.00'W x 120.00'L x 5.00'H Infiltration Trench** 0.689 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.50'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.36 cfs @ 8.10 hrs HW=4.97' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.36 cfs)

Secondary OutFlow Max=8.25 cfs @ 8.10 hrs HW=4.97' (Free Discharge)
└**2=Orifice/Grate** (Weir Controls 8.25 cfs @ 2.24 fps)

Pond 5P: Bioretention+Infiltration



Summary for Pond 7P: Node B

[57] Hint: Peaked at 48.56' (Flood elevation advised)
[81] Warning: Exceeded Pond 10P by 45.31' @ 8.10 hrs
[81] Warning: Exceeded Pond 11P by 44.32' @ 33.00 hrs
[79] Warning: Submerged Pond N3 Primary device # 1 INLET by 7.12'

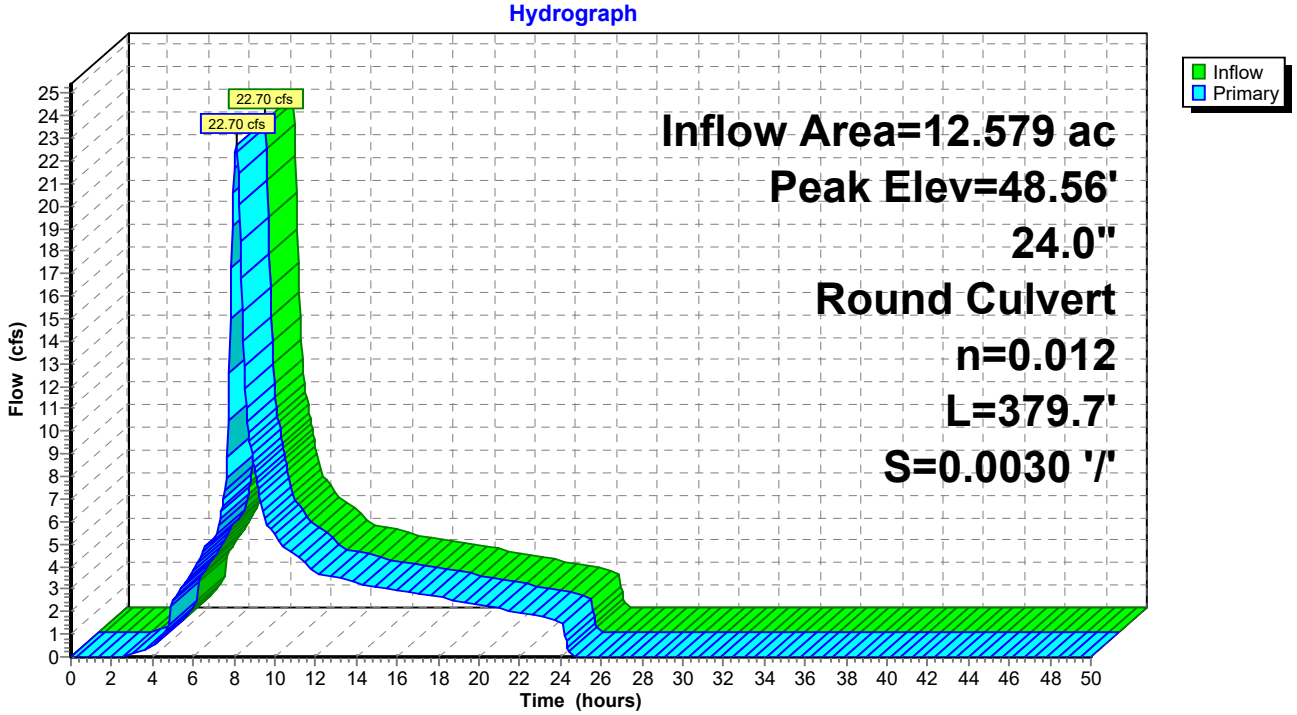
Inflow Area = 12.579 ac, 43.51% Impervious, Inflow Depth = 6.37" for 25-year event
Inflow = 22.70 cfs @ 8.10 hrs, Volume= 6.681 af
Outflow = 22.70 cfs @ 8.10 hrs, Volume= 6.681 af, Atten= 0%, Lag= 0.0 min
Primary = 22.70 cfs @ 8.10 hrs, Volume= 6.681 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 48.56' @ 8.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	40.33'	**24.0" Round Culvert** L= 379.7' Ke= 0.200 Inlet / Outlet Invert= 40.33' / 39.19' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=22.70 cfs @ 8.10 hrs HW=48.56' TW=44.32' (Fixed TW Elev= 44.32')
1=Culvert (Outlet Controls 22.70 cfs @ 7.22 fps)

Pond 7P: Node B



Summary for Pond 10P: Bioretention

Inflow Area = 0.250 ac,100.00% Impervious, Inflow Depth = 4.86" for 25-year event
Inflow = 0.29 cfs @ 8.08 hrs, Volume= 0.101 af
Outflow = 0.29 cfs @ 8.09 hrs, Volume= 0.101 af, Atten= 0%, Lag= 0.5 min
Primary = 0.02 cfs @ 8.09 hrs, Volume= 0.045 af
Secondary = 0.26 cfs @ 8.09 hrs, Volume= 0.056 af
Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 3.25' @ 8.09 hrs Surf.Area= 0.005 ac Storage= 0.005 af

Plug-Flow detention time= 67.0 min calculated for 0.101 af (100% of inflow)
Center-of-Mass det. time= 67.1 min (734.7 - 667.6)

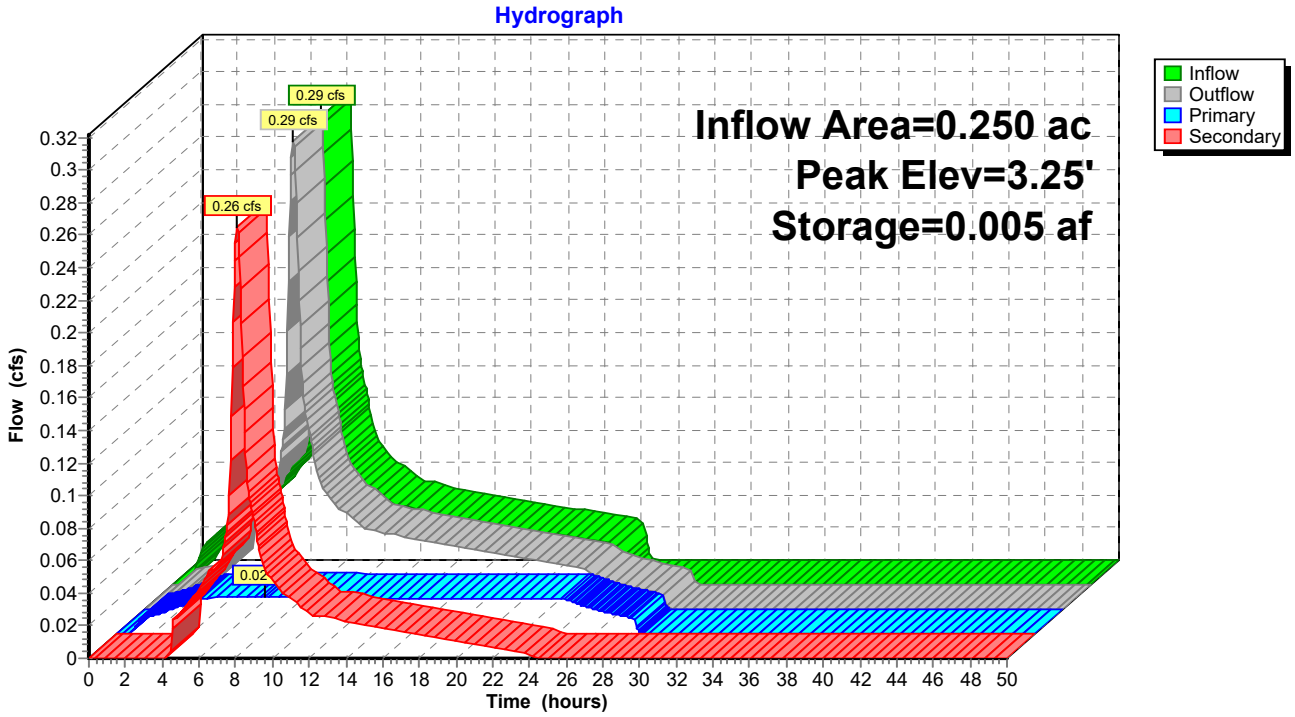
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.008 af	**5.00'W x 40.00'L x 5.00'H Bioretention** 0.023 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.02 cfs @ 8.09 hrs HW=3.25' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Secondary OutFlow Max=0.26 cfs @ 8.09 hrs HW=3.25' (Free Discharge)
↑**2=Orifice/Grate** (Orifice Controls 0.26 cfs @ 1.71 fps)

Pond 10P: Bioretention



Summary for Pond 11P: Bioretention

Inflow Area = 2.176 ac,100.00% Impervious, Inflow Depth = 4.86" for 25-year event
Inflow = 2.50 cfs @ 8.08 hrs, Volume= 0.882 af
Outflow = 2.48 cfs @ 8.11 hrs, Volume= 0.882 af, Atten= 1%, Lag= 2.0 min
Primary = 0.19 cfs @ 8.11 hrs, Volume= 0.356 af
Secondary = 2.30 cfs @ 8.11 hrs, Volume= 0.526 af
Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 4.87' @ 8.11 hrs Surf.Area= 0.031 ac Storage= 0.053 af

Plug-Flow detention time= 73.2 min calculated for 0.881 af (100% of inflow)
Center-of-Mass det. time= 73.4 min (741.0 - 667.6)

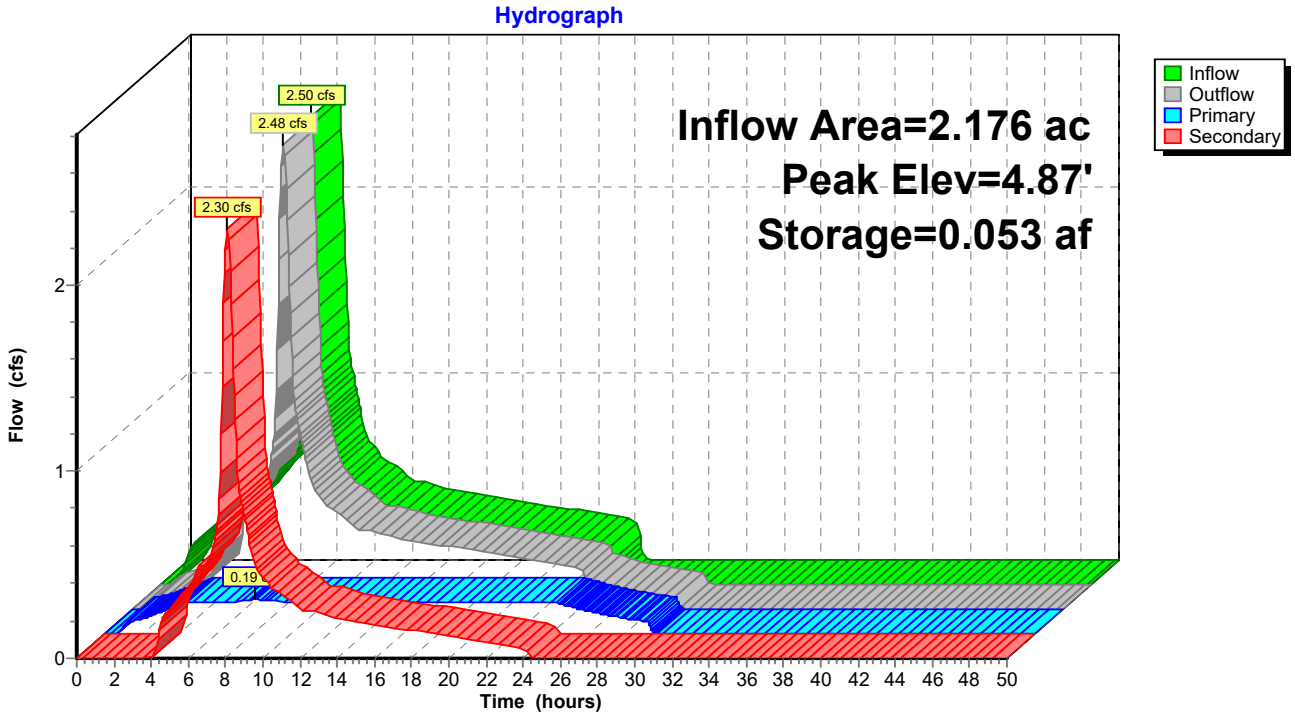
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.065 af	**5.00'W x 270.00'L x 6.00'H Bioretention** 0.186 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.19 cfs @ 8.11 hrs HW=4.87' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.19 cfs)

Secondary OutFlow Max=2.30 cfs @ 8.11 hrs HW=4.87' (Free Discharge)
↑**2=Orifice/Grate** (Orifice Controls 2.30 cfs @ 3.17 fps)

Pond 11P: Bioretention



Summary for Pond 15P: Bioretention

Inflow Area = 0.239 ac, 0.00% Impervious, Inflow Depth = 1.95" for 25-year event
Inflow = 0.09 cfs @ 8.14 hrs, Volume= 0.039 af
Outflow = 0.04 cfs @ 9.47 hrs, Volume= 0.039 af, Atten= 59%, Lag= 79.6 min
Primary = 0.04 cfs @ 9.47 hrs, Volume= 0.039 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 0.73' @ 9.47 hrs Surf.Area= 0.014 ac Storage= 0.004 af

Plug-Flow detention time= 31.1 min calculated for 0.039 af (100% of inflow)
Center-of-Mass det. time= 31.1 min (884.7 - 853.6)

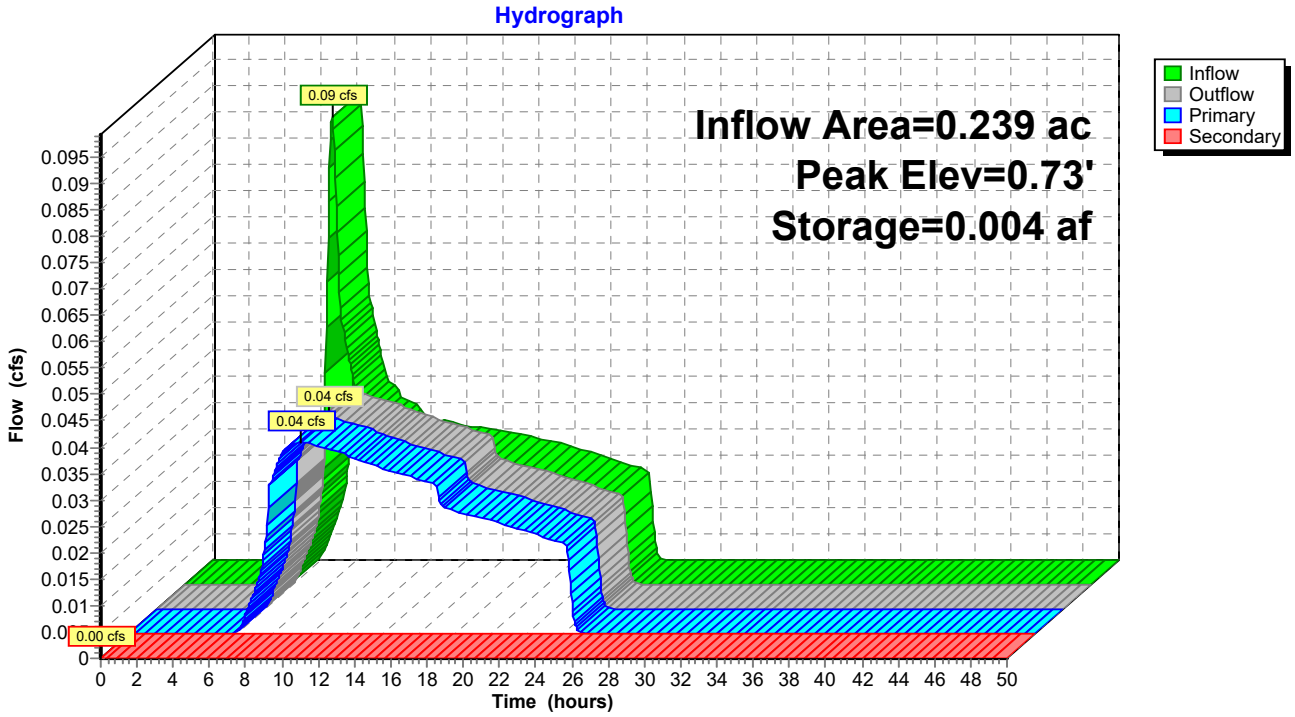
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.024 af	**5.00'W x 120.00'L x 5.00'H Bioretention** 0.069 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.04 cfs @ 9.47 hrs HW=0.73' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
└**2=Orifice/Grate** (Controls 0.00 cfs)

Pond 15P: Bioretention



Summary for Pond 16P: Infiltration Trench

Inflow Area = 1.378 ac, 77.79% Impervious, Inflow Depth = 4.19" for 25-year event
Inflow = 1.42 cfs @ 8.09 hrs, Volume= 0.481 af
Outflow = 1.41 cfs @ 8.12 hrs, Volume= 0.481 af, Atten= 1%, Lag= 1.8 min
Primary = 0.09 cfs @ 8.12 hrs, Volume= 0.189 af
Secondary = 1.32 cfs @ 8.12 hrs, Volume= 0.292 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 4.61' @ 8.12 hrs Surf.Area= 0.028 ac Storage= 0.044 af

Plug-Flow detention time= 110.7 min calculated for 0.480 af (100% of inflow)
Center-of-Mass det. time= 111.0 min (827.2 - 716.3)

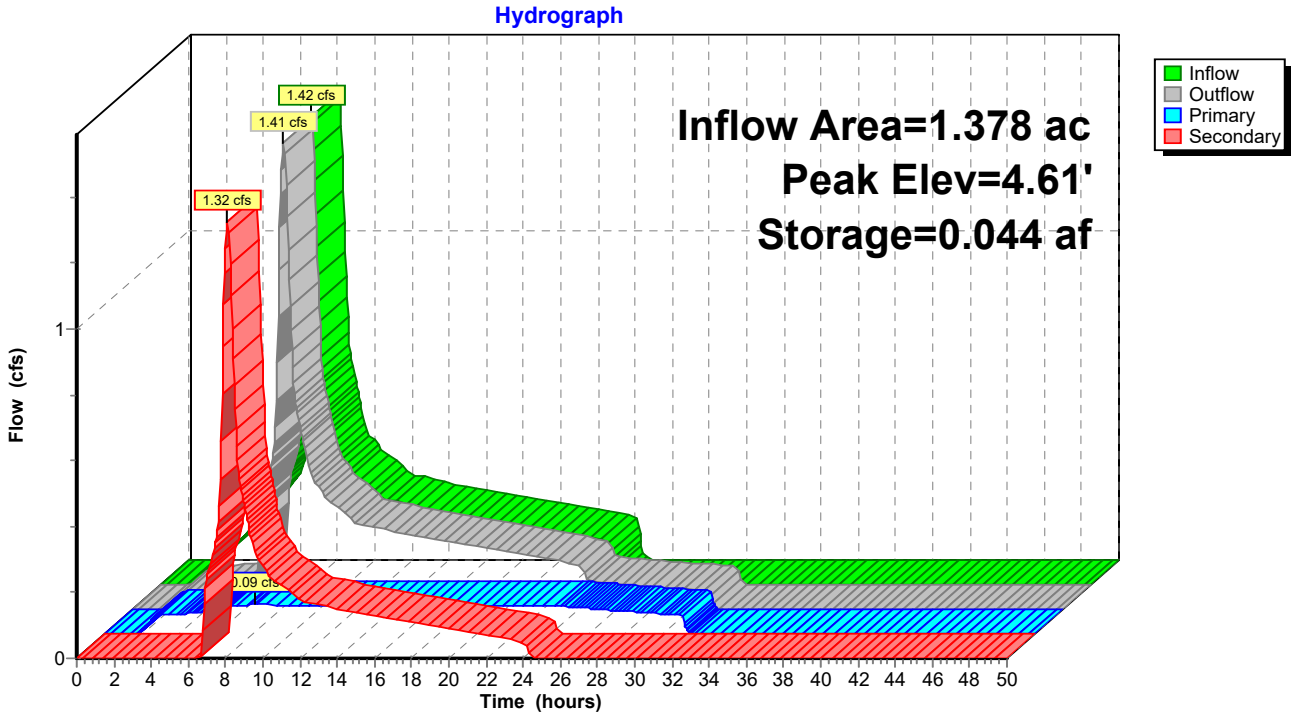
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.058 af	**20.00'W x 60.00'L x 6.00'H Infiltration Trench** 0.165 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.09 cfs @ 8.12 hrs HW=4.61' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Secondary OutFlow Max=1.32 cfs @ 8.12 hrs HW=4.61' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 1.32 cfs @ 2.65 fps)

Pond 16P: Infiltration Trench



Summary for Pond 19P: Infiltration Trench

Inflow Area = 46.237 ac,100.00% Impervious, Inflow Depth > 4.78" for 25-year event
Inflow = 28.78 cfs @ 8.51 hrs, Volume= 18.424 af
Outflow = 27.97 cfs @ 8.70 hrs, Volume= 18.424 af, Atten= 3%, Lag= 11.7 min
Primary = 3.57 cfs @ 8.70 hrs, Volume= 8.564 af
Secondary = 24.41 cfs @ 8.70 hrs, Volume= 9.860 af
Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 3.86' @ 8.70 hrs Surf.Area= 1.674 ac Storage= 2.259 af

Plug-Flow detention time= 143.4 min calculated for 18.424 af (100% of inflow)
Center-of-Mass det. time= 143.3 min (888.6 - 745.3)

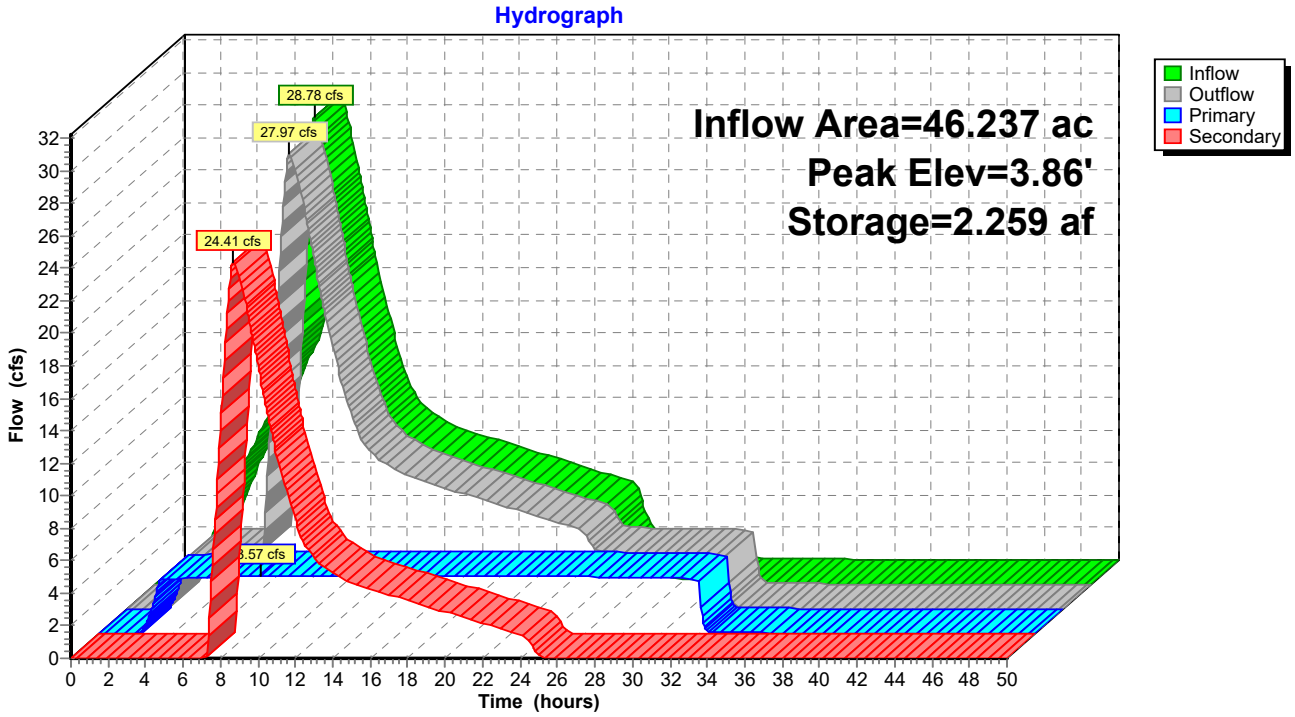
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	2.929 af	**270.00'W x 270.00'L x 5.00'H Infiltration Trench** 8.368 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.57 cfs @ 8.70 hrs HW=3.86' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 3.57 cfs)

Secondary OutFlow Max=24.40 cfs @ 8.70 hrs HW=3.86' (Free Discharge)
↑**2=Orifice/Grate** (Weir Controls 24.40 cfs @ 3.03 fps)

Pond 19P: Infiltration Trench



Summary for Pond N1: Node D

[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=13)
[81] Warning: Exceeded Pond 19P by 38.51' @ 8.25 hrs
[79] Warning: Submerged Pond N2 Primary device # 1 INLET by 3.08'

Inflow Area = 44.595 ac, 62.85% Impervious, Inflow Depth = 6.90" for 25-year event
Inflow = 65.60 cfs @ 8.14 hrs, Volume= 25.625 af
Outflow = 57.61 cfs @ 8.35 hrs, Volume= 25.625 af, Atten= 12%, Lag= 12.5 min
Primary = 57.61 cfs @ 8.35 hrs, Volume= 25.625 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 42.27' @ 8.35 hrs Surf.Area= 34,718 sf Storage= 9,485 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.3 min (742.9 - 742.5)

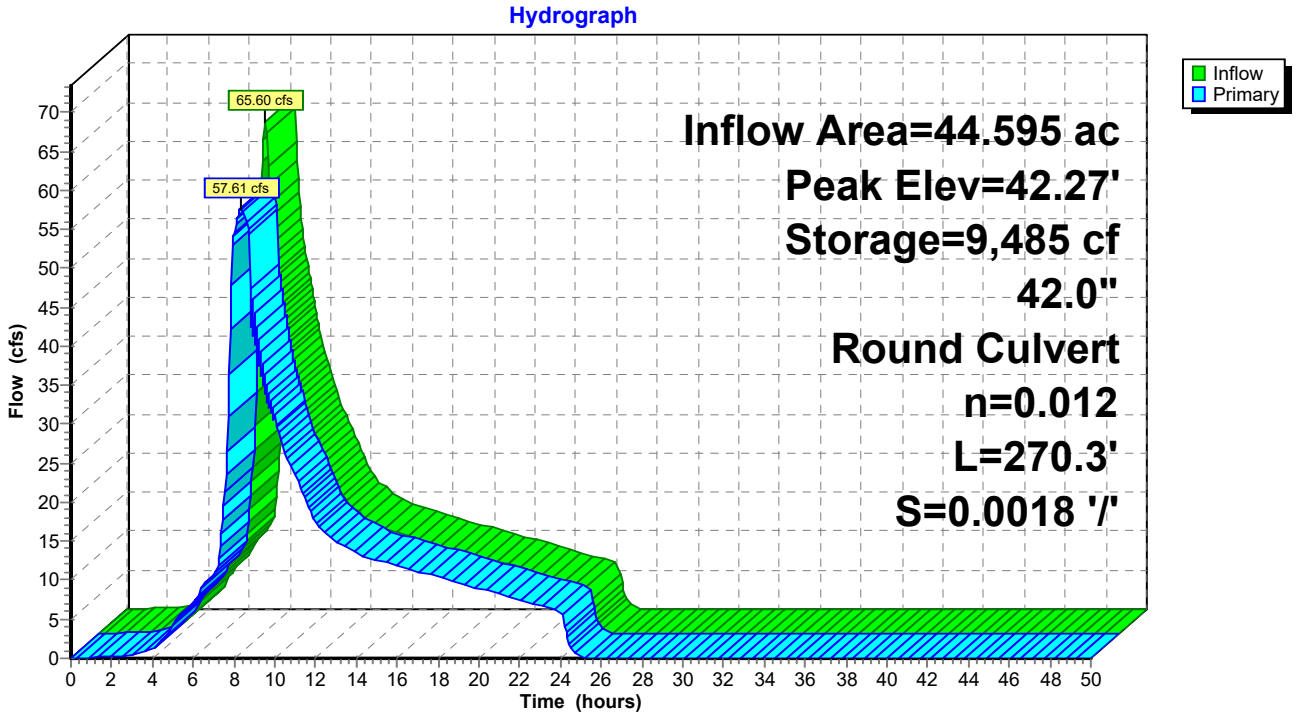
Volume	Invert	Avail.Storage	Storage Description
#1	38.00'	922,840 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	50	0	0
41.99	50	200	200
42.00	32,000	160	360
48.00	91,616	370,848	371,208
49.00	270,816	181,216	552,424
50.00	470,016	370,416	922,840

Device	Routing	Invert	Outlet Devices
#1	Primary	38.00'	**42.0" Round Culvert** L= 270.3' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 38.00' / 37.50' S= 0.0018 '/' Cc= 0.900 n= 0.012, Flow Area= 9.62 sf

Primary OutFlow Max=57.64 cfs @ 8.35 hrs HW=42.27' (Free Discharge)
1=Culvert (Barrel Controls 57.64 cfs @ 6.24 fps)

Pond N1: Node D



Summary for Pond N2: Node C

[57] Hint: Peaked at 44.32' (Flood elevation advised)
[81] Warning: Exceeded Pond 7P by 1.94' @ 2.10 hrs
[81] Warning: Exceeded Pond 15P by 44.04' @ 8.10 hrs
[81] Warning: Exceeded Pond 16P by 42.27' @ 1.60 hrs

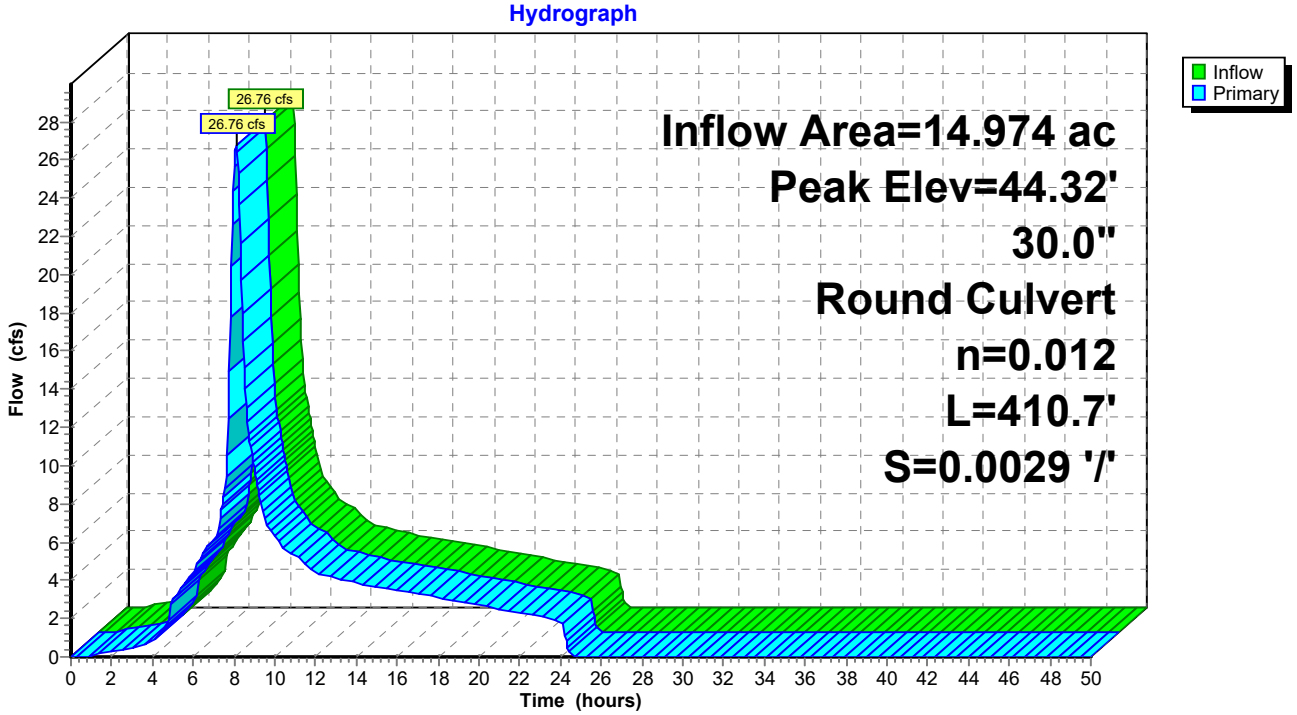
Inflow Area = 14.974 ac, 52.54% Impervious, Inflow Depth = 6.37" for 25-year event
Inflow = 26.76 cfs @ 8.10 hrs, Volume= 7.943 af
Outflow = 26.76 cfs @ 8.10 hrs, Volume= 7.943 af, Atten= 0%, Lag= 0.0 min
Primary = 26.76 cfs @ 8.10 hrs, Volume= 7.943 af
Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 44.32' @ 8.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	39.19'	**30.0" Round Culvert** L= 410.7' Ke= 0.200 Inlet / Outlet Invert= 39.19' / 38.00' S= 0.0029 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 4.91 sf

Primary OutFlow Max=26.76 cfs @ 8.10 hrs HW=44.32' TW=42.27' (Fixed TW Elev= 42.27')
1=Culvert (Outlet Controls 26.76 cfs @ 5.45 fps)

Pond N2: Node C



Summary for Pond N3: Node A

[57] Hint: Peaked at 50.24' (Flood elevation advised)
[81] Warning: Exceeded Pond 4P by 48.49' @ 31.50 hrs
[81] Warning: Exceeded Pond 5P by 48.49' @ 35.90 hrs

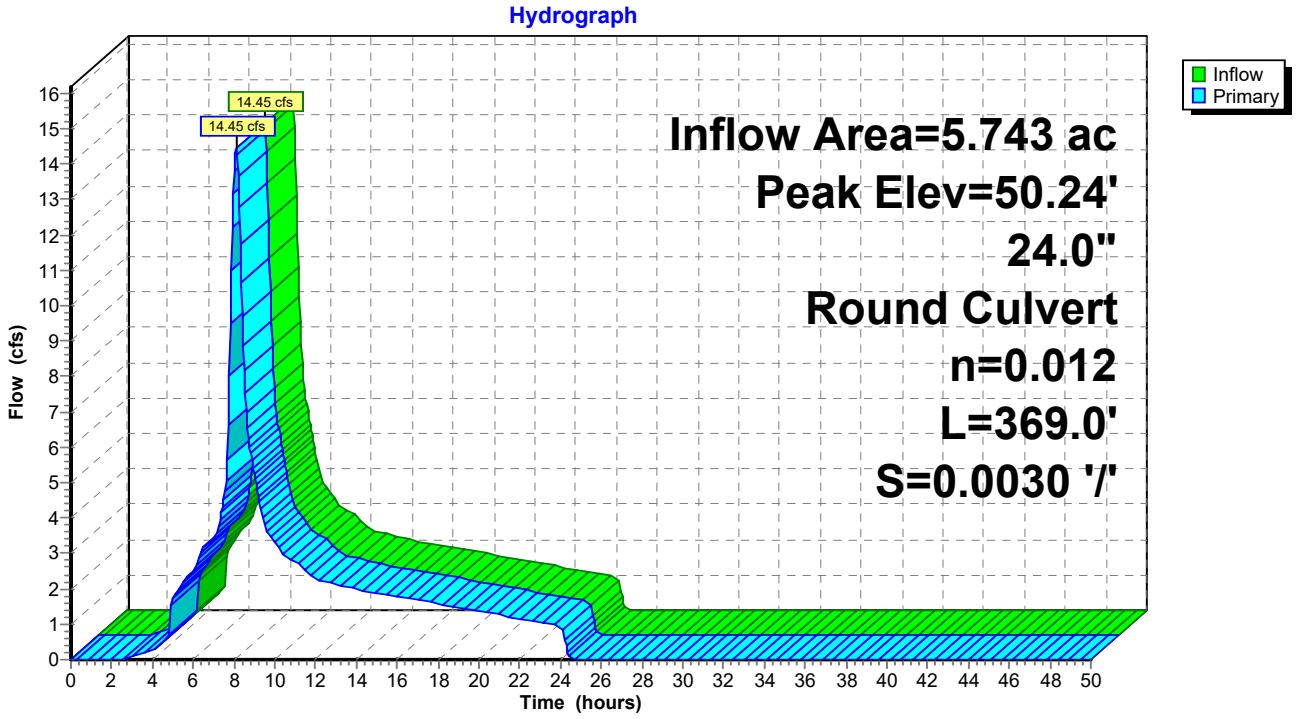
Inflow Area = 5.743 ac, 58.73% Impervious, Inflow Depth = 8.63" for 25-year event
Inflow = 14.45 cfs @ 8.10 hrs, Volume= 4.132 af
Outflow = 14.45 cfs @ 8.10 hrs, Volume= 4.132 af, Atten= 0%, Lag= 0.0 min
Primary = 14.45 cfs @ 8.10 hrs, Volume= 4.132 af
Routed to Pond 7P : Node B

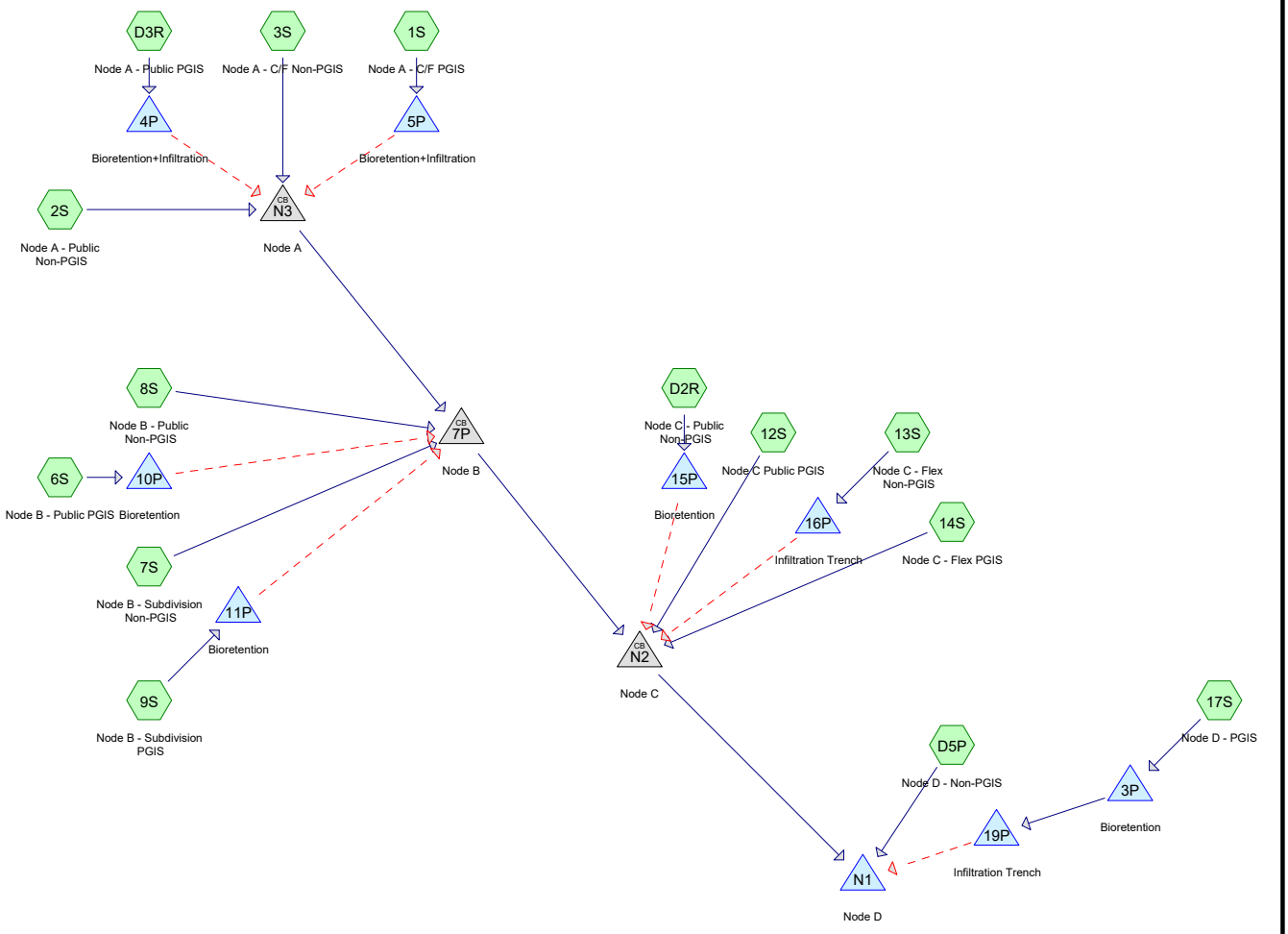
Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 50.24' @ 8.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	41.44'	**24.0" Round Culvert** L= 369.0' Ke= 0.200 Inlet / Outlet Invert= 41.44' / 40.33' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=14.45 cfs @ 8.10 hrs HW=50.24' TW=48.56' (Fixed TW Elev= 48.56')
1=Culvert (Outlet Controls 14.45 cfs @ 4.60 fps)

Pond N3: Node A





Subcat Reach Pond Link

Routing Diagram for ALTERNATE _Onsite 100-Year Storm - Water @ OHWM or Below

Prepared by MacKay & Sposito, Inc, Printed 3/10/2025

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
9.462	49	50-75% Grass cover, Fair, HSG A (D5P)
2.370	59	50-75% Grass cover, Fair, HSG A/B (avg) (2S, 3S)
0.306	69	50-75% Grass cover, Fair, HSG B (13S)
0.239	68	<50% Grass cover, Poor, HSG A (D2R)
4.736	79	<50% Grass cover, Poor, HSG B (7S, 8S)
48.663	98	Paved parking, HSG A (6S, 9S, 17S)
11.595	98	Paved parking, HSG B (1S, 12S, 14S, D3R)
4.445	98	Roofs, HSG A (3S, 13S)
22.259	98	Roofs, HSG B (7S, D5P)
104.075	**92**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
65.179	HSG A	2S, 3S, 6S, 9S, 13S, 17S, D2R, D5P
38.896	HSG B	1S, 7S, 8S, 12S, 13S, 14S, D3R, D5P
0.000	HSG C	
0.000	HSG D	
0.000	Other	
104.075		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
11.832	0.306	0.000	0.000	0.000	12.138	50-75% Grass cover, Fair	2S, 3S, 13S, D5P
0.239	4.736	0.000	0.000	0.000	4.975	<50% Grass cover, Poor	7S, 8S, D2R
48.663	11.595	0.000	0.000	0.000	60.258	Paved parking	1S, 6S, 9S, 12S, 14S, 17S, D3R
4.445	22.259	0.000	0.000	0.000	26.704	Roofs	3S, 7S, 13S, D5P
65.179	**38.896**	**0.000**	**0.000**	**0.000**	**104.075**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	7P	40.33	39.19	379.7	0.0030	0.012	0.0	24.0	0.0	
2	N1	38.00	37.50	270.3	0.0018	0.012	0.0	42.0	0.0	
3	N2	39.19	38.00	410.7	0.0029	0.012	0.0	30.0	0.0	
4	N3	41.44	40.33	369.0	0.0030	0.012	0.0	24.0	0.0	

Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Node A - C/F PGIS Runoff Area=7.516 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=10.54 cfs 3.734 af

Subcatchment2S: Node A - Public Non-PGIS Runoff Area=1.160 ac 0.00% Impervious Runoff Depth=1.97"
Tc=20.0 min CN=59 Runoff=0.38 cfs 0.190 af

Subcatchment3S: Node A - C/F Non-PGIS Runoff Area=4.583 ac 73.60% Impervious Runoff Depth=4.82"
Tc=20.0 min CN=88 Runoff=5.43 cfs 1.840 af

Subcatchment6S: Node B - Public PGIS Runoff Area=0.250 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=0.35 cfs 0.124 af

Subcatchment7S: Node B - Subdivision Runoff Area=6.745 ac 31.13% Impervious Runoff Depth=4.49"
Tc=20.0 min CN=85 Runoff=7.39 cfs 2.525 af

Subcatchment8S: Node B - Public Non-PGIS Runoff Area=0.091 ac 0.00% Impervious Runoff Depth=3.86"
Tc=20.0 min CN=79 Runoff=0.08 cfs 0.029 af

Subcatchment9S: Node B - Subdivision Runoff Area=2.176 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=3.05 cfs 1.081 af

Subcatchment12S: Node C Public PGIS Runoff Area=0.710 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=1.00 cfs 0.353 af

Subcatchment13S: Node C - Flex Non-PGIS Runoff Area=1.378 ac 77.79% Impervious Runoff Depth=5.27"
Tc=20.0 min CN=92 Runoff=1.78 cfs 0.605 af

Subcatchment14S: Node C - Flex PGIS Runoff Area=1.685 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=2.36 cfs 0.837 af

Subcatchment17S: Node D - PGIS Runoff Area=46.237 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=64.81 cfs 22.971 af

SubcatchmentD2R: Node C - Public Runoff Area=0.239 ac 0.00% Impervious Runoff Depth=2.78"
Tc=20.0 min CN=68 Runoff=0.14 cfs 0.055 af

SubcatchmentD3R: Node A - Public PGIS Runoff Area=1.684 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=2.36 cfs 0.837 af

SubcatchmentD5P: Node D - Non-PGIS Runoff Area=29.621 ac 68.06% Impervious Runoff Depth=4.17"
Tc=20.0 min CN=82 Runoff=29.72 cfs 10.297 af

Pond 3P: Bioretention Peak Elev=54.89' Storage=3.301 af Inflow=64.81 cfs 22.971 af
Outflow=40.37 cfs 22.657 af

Pond 4P: Bioretention+Infiltration Peak Elev=3.84' Storage=0.039 af Inflow=2.36 cfs 0.837 af
Primary=0.15 cfs 0.283 af Secondary=2.20 cfs 0.554 af Outflow=2.35 cfs 0.837 af

Pond 5P: Bioretention+Infiltration Peak Elev=5.04' Storage=0.241 af Inflow=10.54 cfs 3.734 af
Primary=0.36 cfs 0.890 af Secondary=10.21 cfs 2.844 af Outflow=10.57 cfs 3.734 af

Pond 7P: Node B Peak Elev=49.68' Inflow=28.83 cfs 8.778 af
Outflow=28.83 cfs 8.778 af

Pond 10P: Bioretention Peak Elev=3.28' Storage=0.005 af Inflow=0.35 cfs 0.124 af
Primary=0.02 cfs 0.046 af Secondary=0.33 cfs 0.078 af Outflow=0.35 cfs 0.124 af

Pond 11P: Bioretention Peak Elev=5.06' Storage=0.055 af Inflow=3.05 cfs 1.081 af
Primary=0.19 cfs 0.364 af Secondary=2.82 cfs 0.717 af Outflow=3.02 cfs 1.081 af

Pond 15P: Bioretention Peak Elev=1.52' Storage=0.007 af Inflow=0.14 cfs 0.055 af
Primary=0.05 cfs 0.055 af Secondary=0.00 cfs 0.000 af Outflow=0.05 cfs 0.055 af

Pond 16P: Infiltration Trench Peak Elev=4.70' Storage=0.045 af Inflow=1.78 cfs 0.605 af
Primary=0.09 cfs 0.193 af Secondary=1.68 cfs 0.411 af Outflow=1.77 cfs 0.605 af

Pond 19P: Infiltration Trench Peak Elev=4.09' Storage=2.393 af Inflow=40.37 cfs 22.657 af
Primary=3.58 cfs 8.734 af Secondary=34.89 cfs 13.923 af Outflow=38.47 cfs 22.657 af

Pond N1: Node D Peak Elev=43.12' Storage=42,363 cf Inflow=84.32 cfs 34.599 af
Primary=66.43 cfs 34.599 af Secondary=0.00 cfs 0.000 af Outflow=66.43 cfs 34.599 af

Pond N2: Node C Peak Elev=46.40' Inflow=33.86 cfs 10.379 af
Outflow=33.86 cfs 10.379 af

Pond N3: Node A Peak Elev=50.56' Inflow=18.21 cfs 5.428 af
Outflow=18.21 cfs 5.428 af

Total Runoff Area = 104.075 ac Runoff Volume = 45.478 af Average Runoff Depth = 5.24"
16.44% Pervious = 17.113 ac 83.56% Impervious = 86.962 ac

Summary for Subcatchment 1S: Node A - C/F PGIS

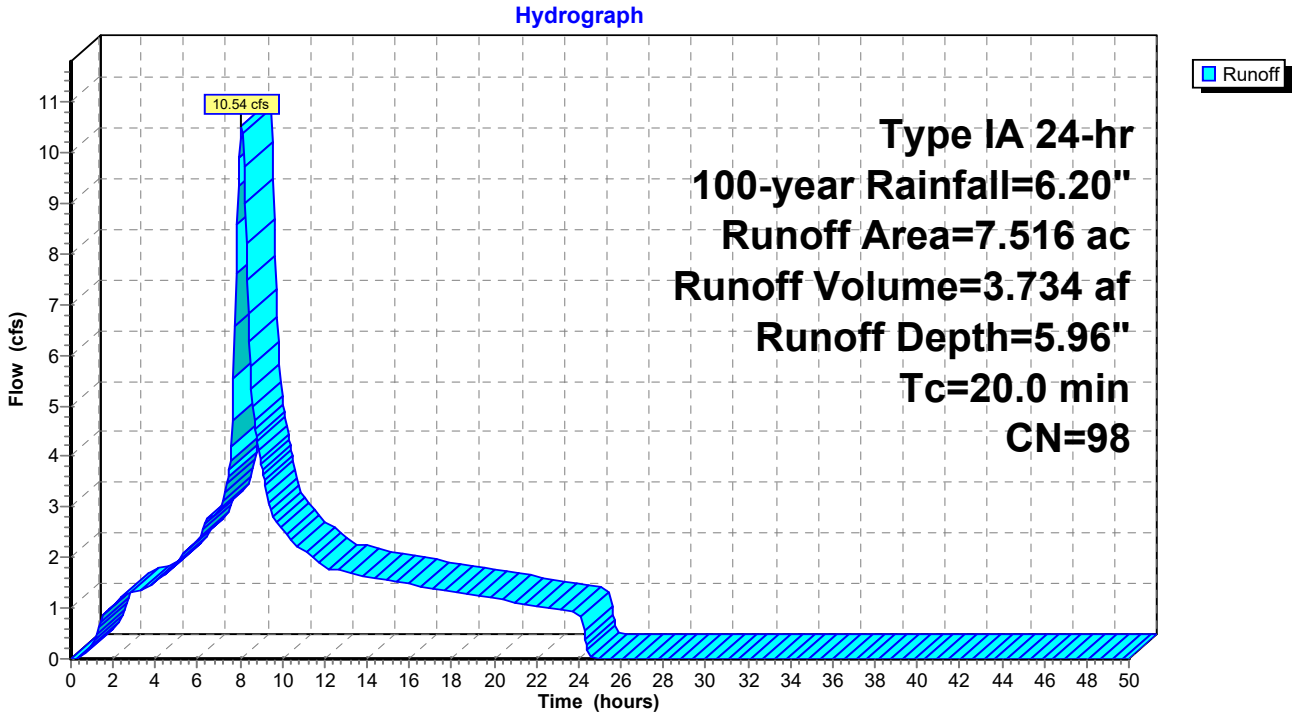
Runoff = 10.54 cfs @ 8.08 hrs, Volume= 3.734 af, Depth= 5.96"
Routed to Pond 5P : Bioretention+Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
7.516	98	Paved parking, HSG B
7.516		100.00% Impervious Area

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

Subcatchment 1S: Node A - C/F PGIS



Summary for Subcatchment 2S: Node A - Public Non-PGIS

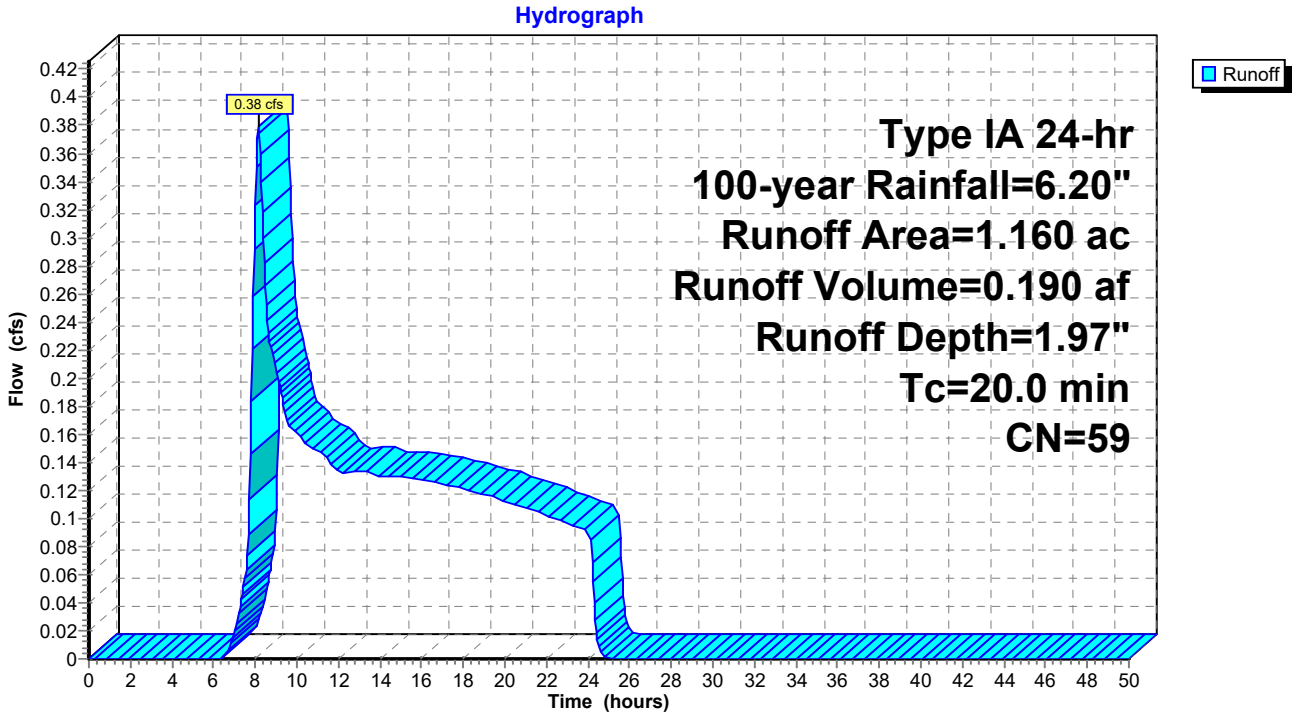
Runoff = 0.38 cfs @ 8.16 hrs, Volume= 0.190 af, Depth= 1.97"
Routed to Pond N3 : Node A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

	Area (ac)	CN	Description
*	1.160	59	50-75% Grass cover, Fair, HSG A/B (avg)
	1.160		100.00% Pervious Area

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

Subcatchment 2S: Node A - Public Non-PGIS



Summary for Subcatchment 3S: Node A - C/F Non-PGIS

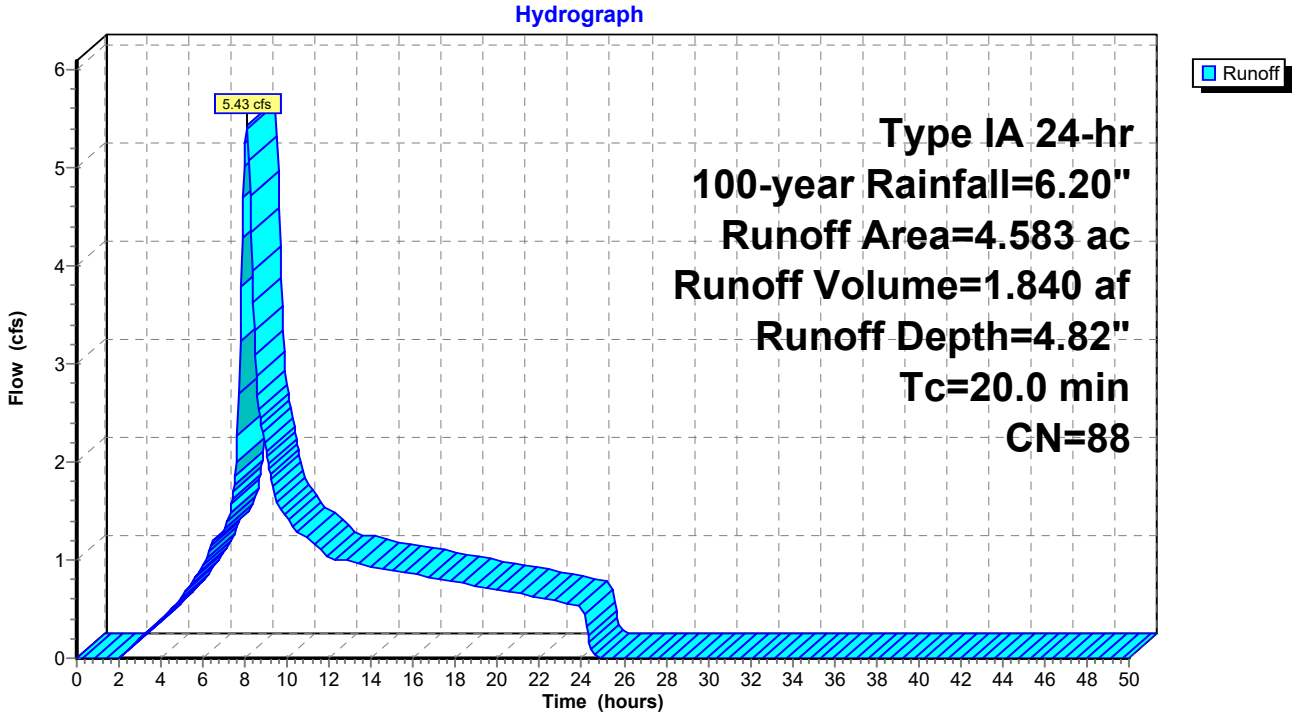
Runoff = 5.43 cfs @ 8.09 hrs, Volume= 1.840 af, Depth= 4.82"
Routed to Pond N3 : Node A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

	Area (ac)	CN	Description
*	1.210	59	50-75% Grass cover, Fair, HSG A/B (avg)
	3.373	98	Roofs, HSG A
	4.583	88	Weighted Average
	1.210		26.40% Pervious Area
	3.373		73.60% Impervious Area

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

Subcatchment 3S: Node A - C/F Non-PGIS



Summary for Subcatchment 6S: Node B - Public PGIS

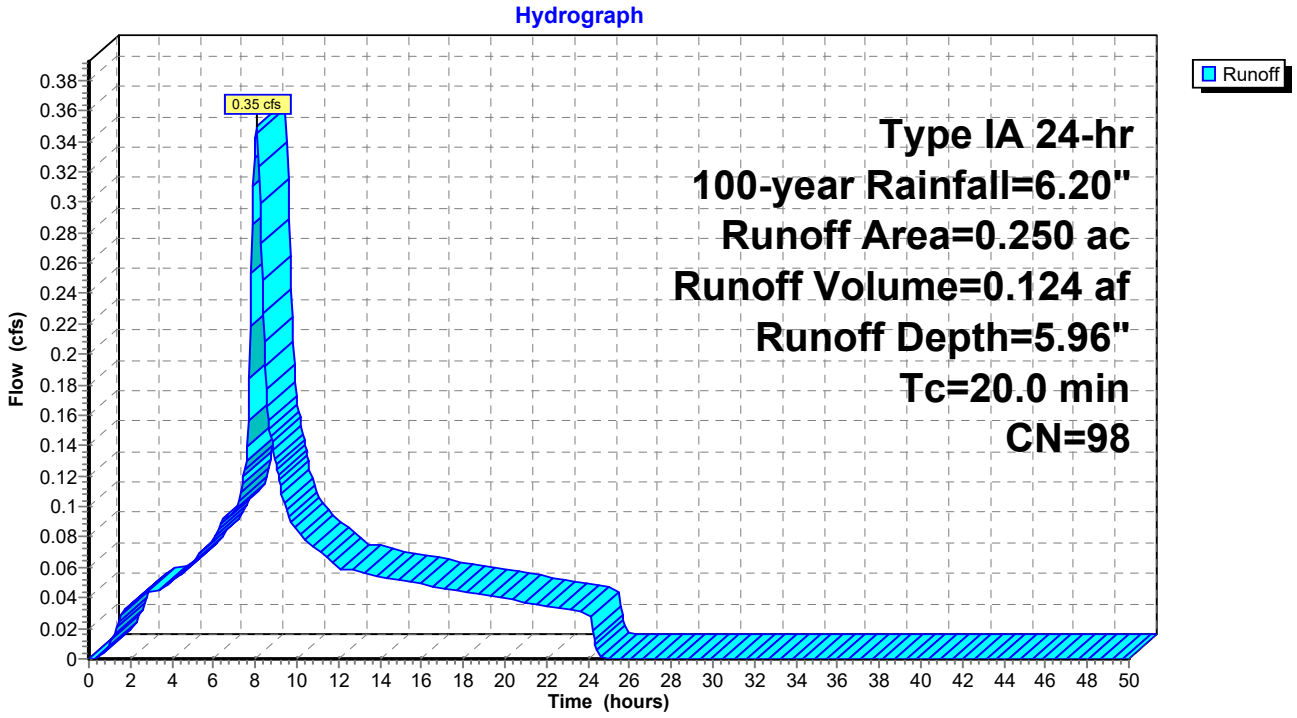
Runoff = 0.35 cfs @ 8.08 hrs, Volume= 0.124 af, Depth= 5.96"
Routed to Pond 10P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.250	98	Paved parking, HSG A
0.250		100.00% Impervious Area

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

Subcatchment 6S: Node B - Public PGIS



Summary for Subcatchment 7S: Node B - Subdivision Non-PGIS

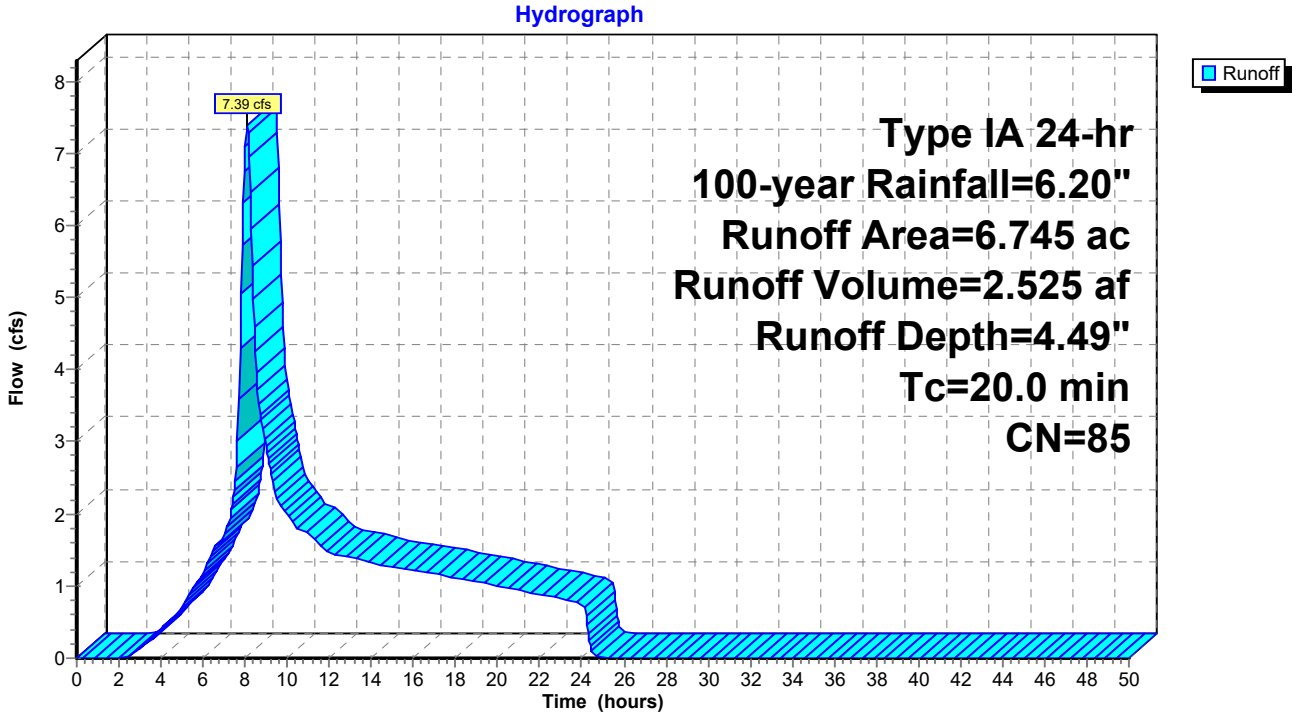
Runoff = 7.39 cfs @ 8.09 hrs, Volume= 2.525 af, Depth= 4.49"
Routed to Pond 7P : Node B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
2.100	98	Roofs, HSG B
4.645	79	<50% Grass cover, Poor, HSG B
6.745	85	Weighted Average
4.645		68.87% Pervious Area
2.100		31.13% Impervious Area

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

Subcatchment 7S: Node B - Subdivision Non-PGIS



Summary for Subcatchment 8S: Node B - Public Non-PGIS

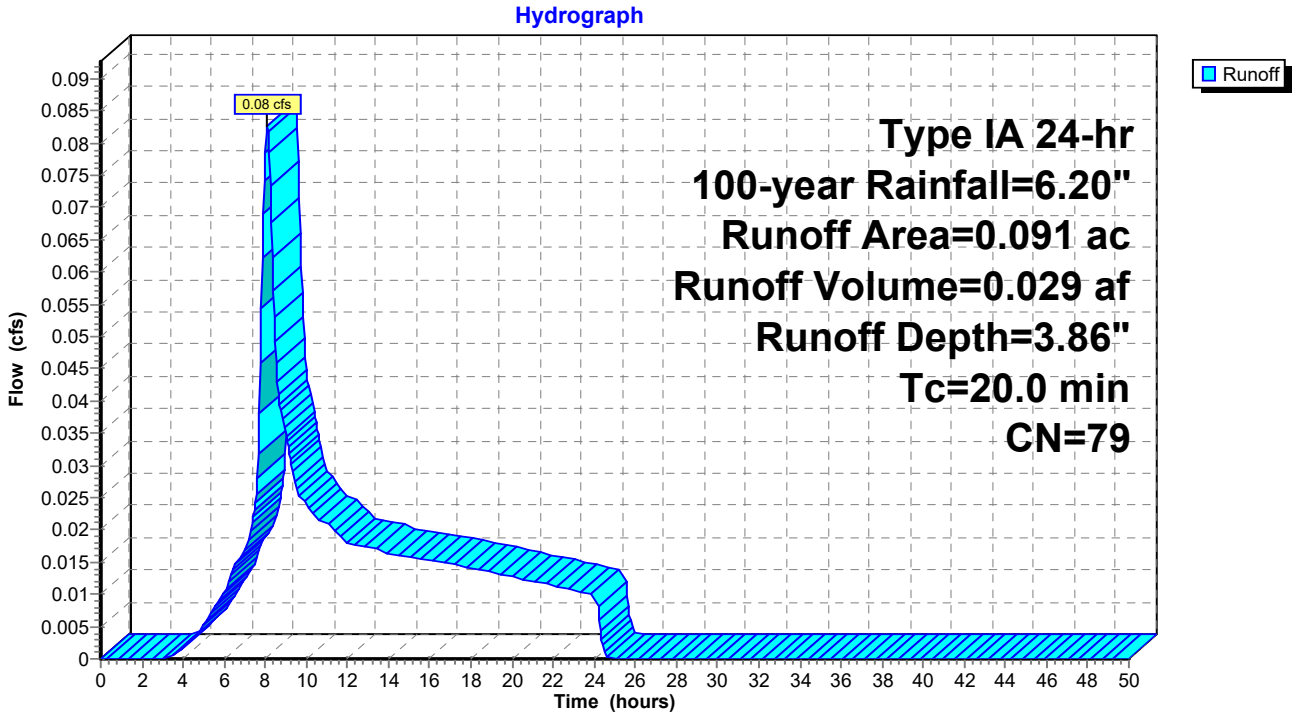
Runoff = 0.08 cfs @ 8.11 hrs, Volume= 0.029 af, Depth= 3.86"
Routed to Pond 7P : Node B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.091	79	<50% Grass cover, Poor, HSG B
0.091		100.00% Pervious Area

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

Subcatchment 8S: Node B - Public Non-PGIS



Summary for Subcatchment 9S: Node B - Subdivision PGIS

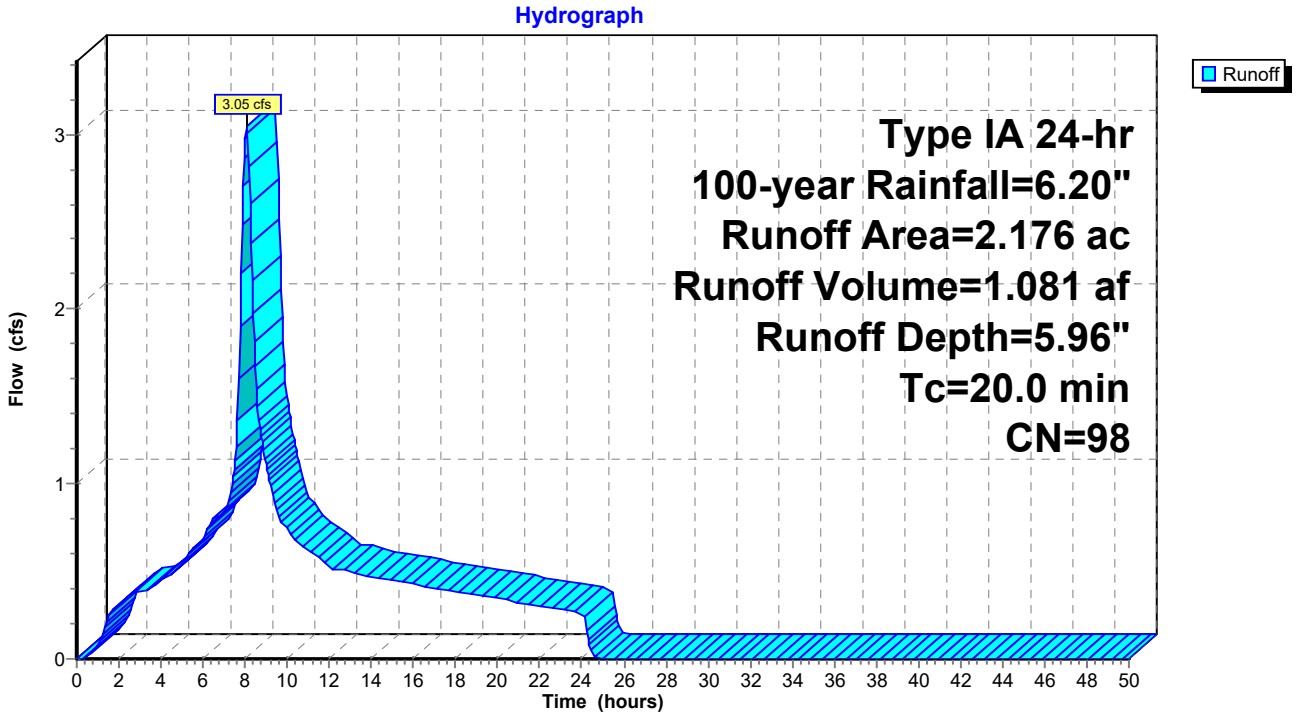
Runoff = 3.05 cfs @ 8.08 hrs, Volume= 1.081 af, Depth= 5.96"
Routed to Pond 11P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
2.176	98	Paved parking, HSG A
2.176		100.00% Impervious Area

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

Subcatchment 9S: Node B - Subdivision PGIS



Summary for Subcatchment 12S: Node C Public PGIS

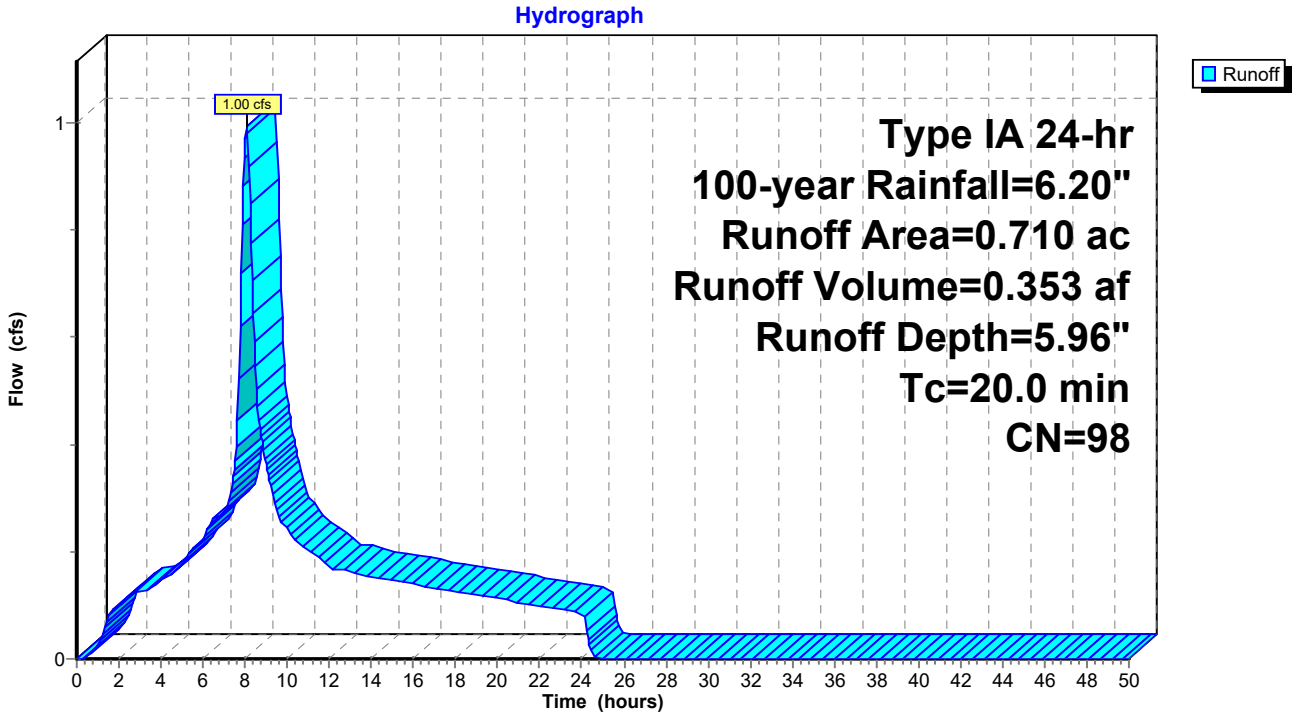
Runoff = 1.00 cfs @ 8.08 hrs, Volume= 0.353 af, Depth= 5.96"
Routed to Pond N2 : Node C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.710	98	Paved parking, HSG B
0.710		100.00% Impervious Area

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

Subcatchment 12S: Node C Public PGIS



Summary for Subcatchment 13S: Node C - Flex Non-PGIS

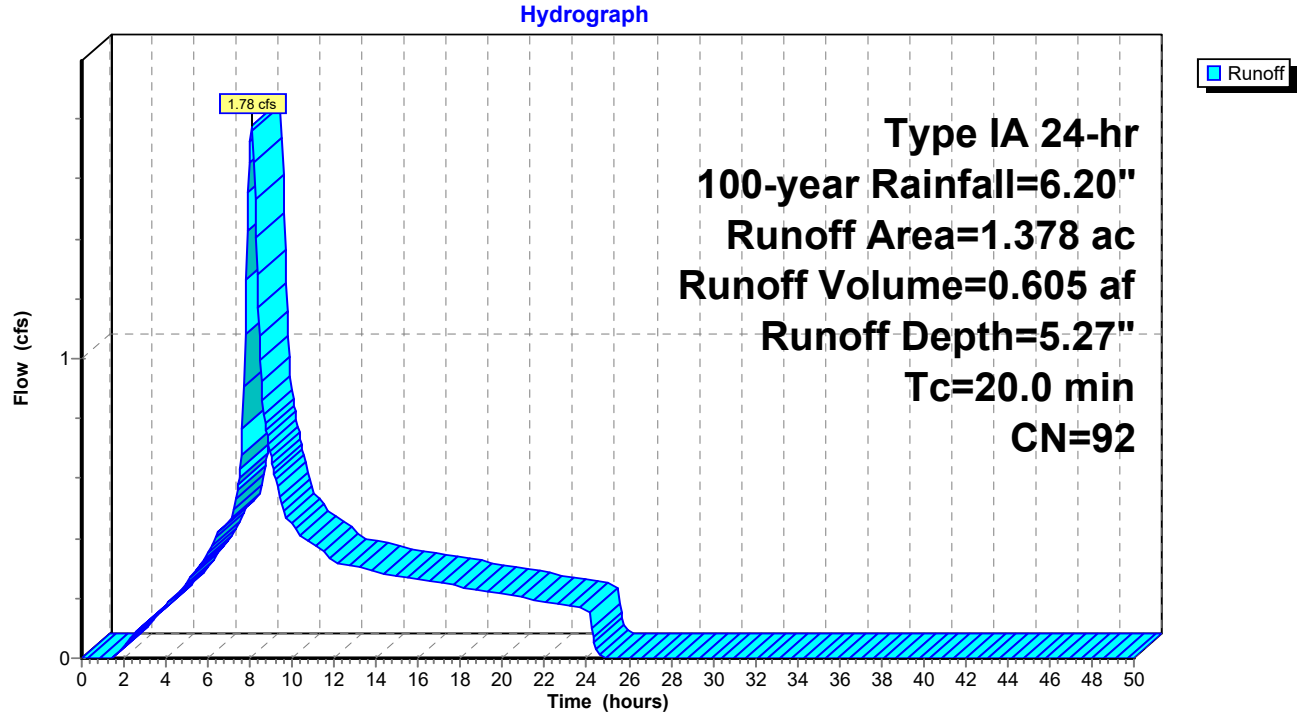
Runoff = 1.78 cfs @ 8.08 hrs, Volume= 0.605 af, Depth= 5.27"
Routed to Pond 16P : Infiltration Trench

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.306	69	50-75% Grass cover, Fair, HSG B
1.072	98	Roofs, HSG A
1.378	92	Weighted Average
0.306		22.21% Pervious Area
1.072		77.79% Impervious Area

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

Subcatchment 13S: Node C - Flex Non-PGIS



Summary for Subcatchment 14S: Node C - Flex PGIS

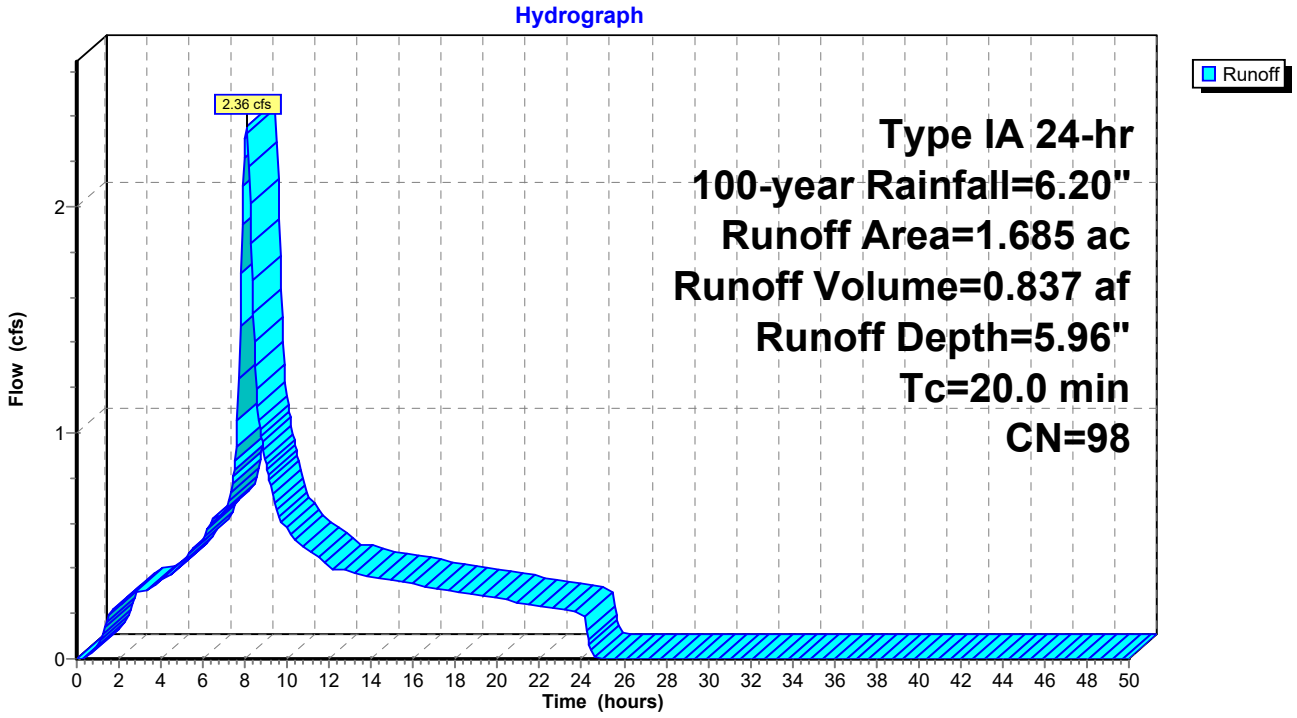
Runoff = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af, Depth= 5.96"
Routed to Pond N2 : Node C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
1.685	98	Paved parking, HSG B
1.685		100.00% Impervious Area

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

Subcatchment 14S: Node C - Flex PGIS



Summary for Subcatchment 17S: Node D - PGIS

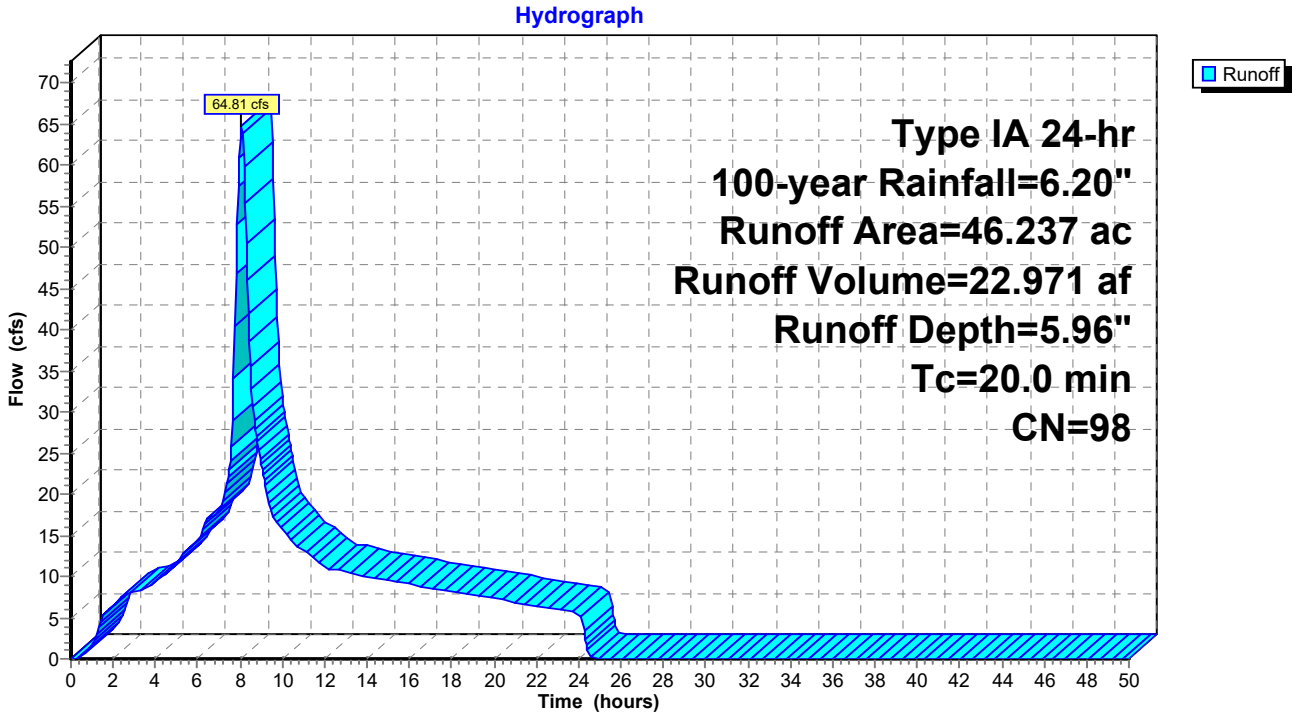
Runoff = 64.81 cfs @ 8.08 hrs, Volume= 22.971 af, Depth= 5.96"
Routed to Pond 3P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
46.237	98	Paved parking, HSG A
46.237		100.00% Impervious Area

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

Subcatchment 17S: Node D - PGIS



Summary for Subcatchment D2R: Node C - Public Non-PGIS

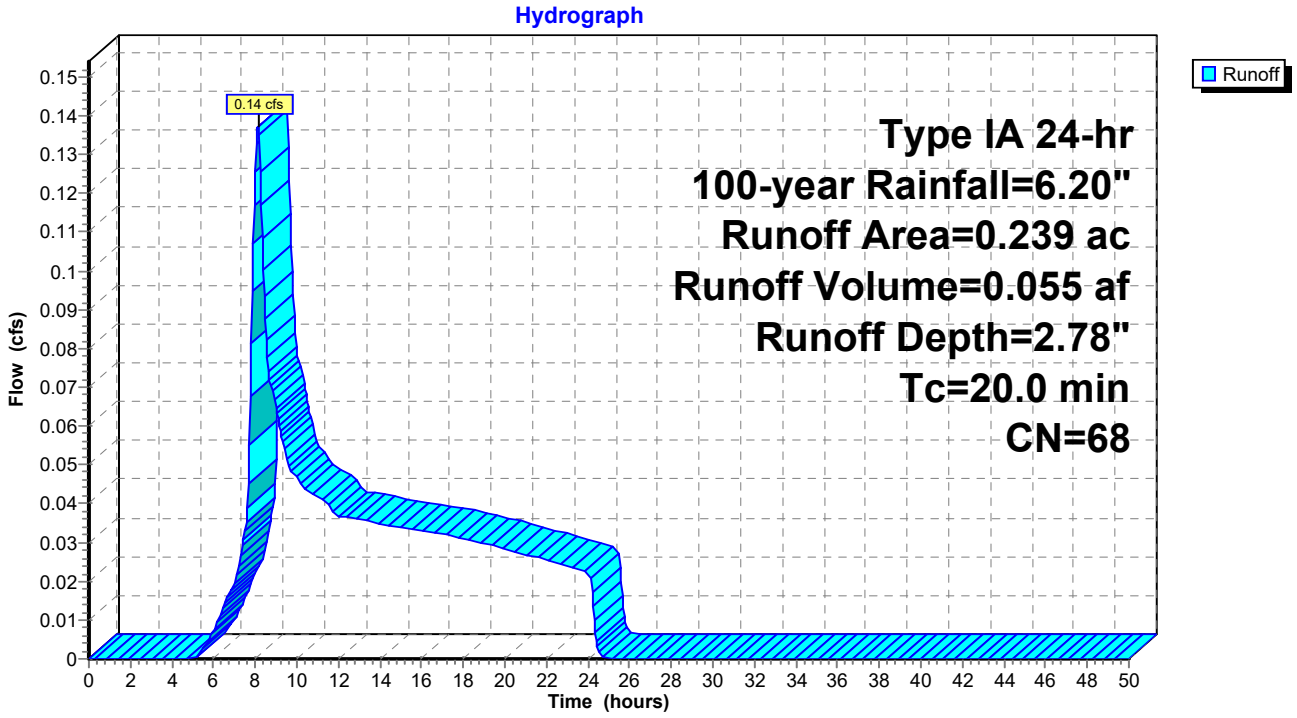
Runoff = 0.14 cfs @ 8.13 hrs, Volume= 0.055 af, Depth= 2.78"
Routed to Pond 15P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.239	68	<50% Grass cover, Poor, HSG A
0.239		100.00% Pervious Area

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

Subcatchment D2R: Node C - Public Non-PGIS



Summary for Subcatchment D3R: Node A - Public PGIS

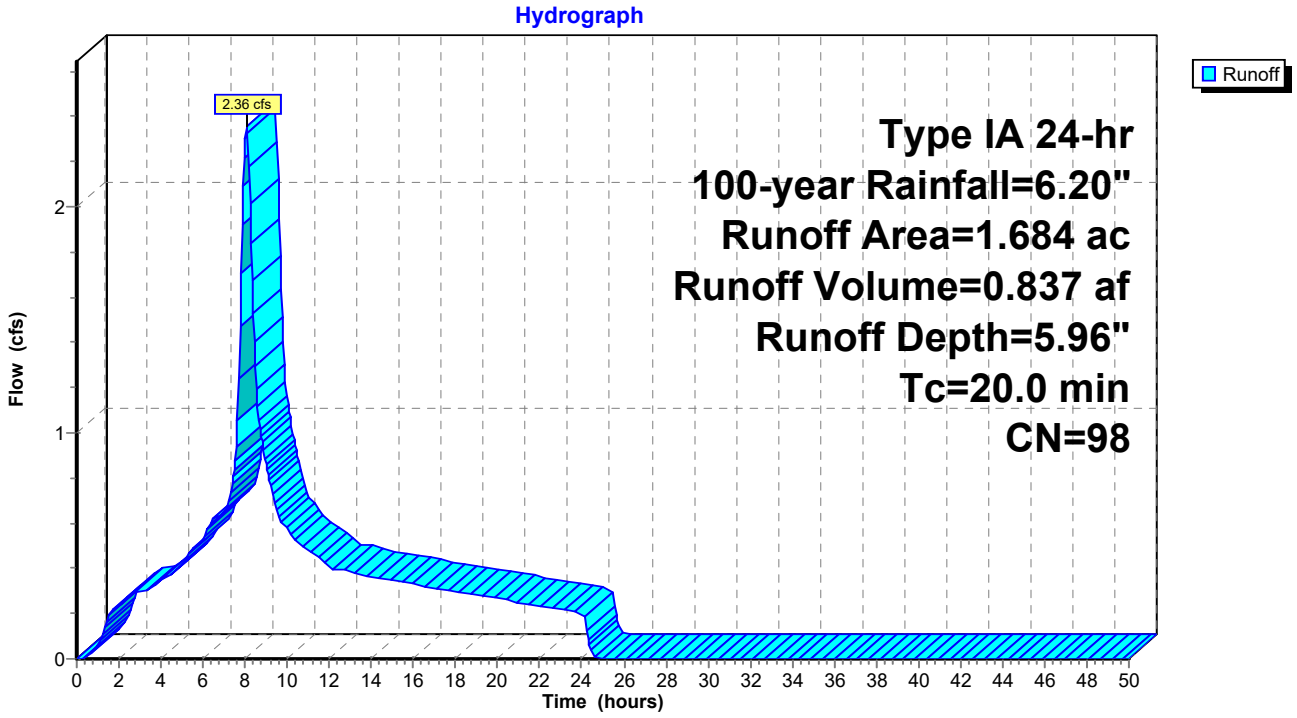
Runoff = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af, Depth= 5.96"
Routed to Pond 4P : Bioretention+Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
1.684	98	Paved parking, HSG B
1.684		100.00% Impervious Area

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

Subcatchment D3R: Node A - Public PGIS



Summary for Subcatchment D5P: Node D - Non-PGIS

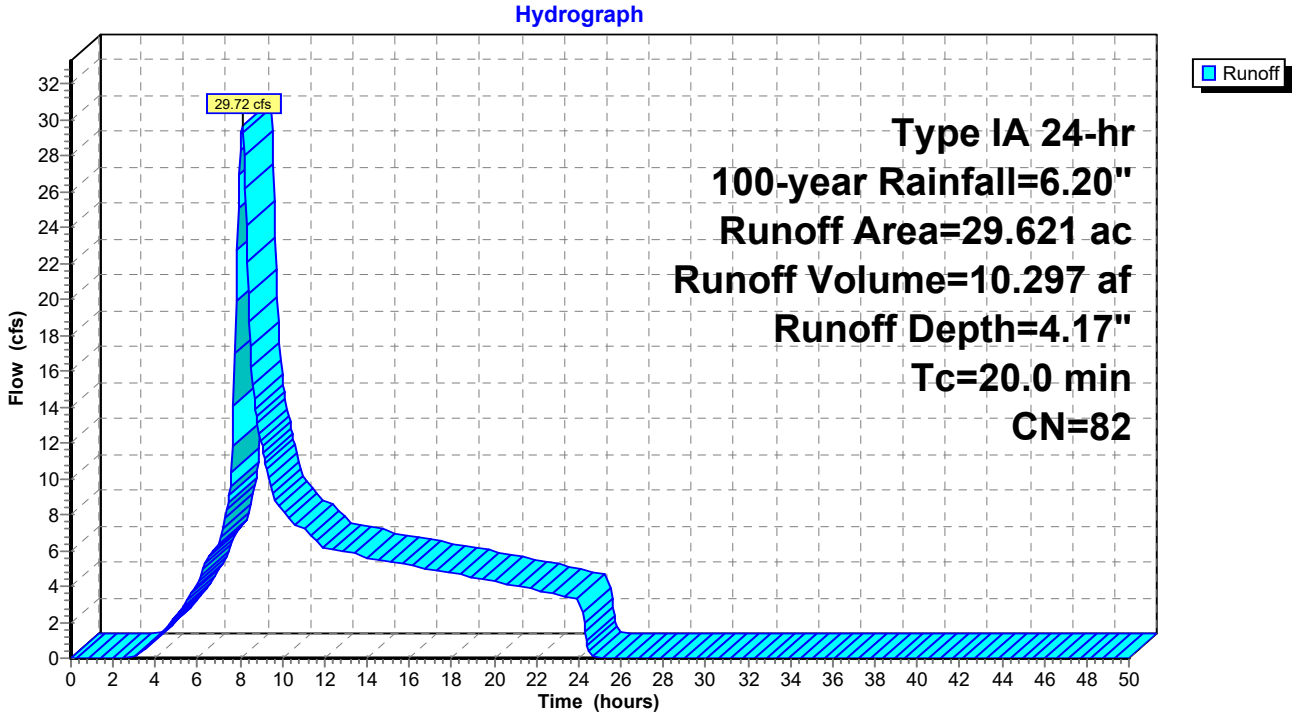
Runoff = 29.72 cfs @ 8.10 hrs, Volume= 10.297 af, Depth= 4.17"
Routed to Pond N1 : Node D

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
9.462	49	50-75% Grass cover, Fair, HSG A
20.159	98	Roofs, HSG B
29.621	82	Weighted Average
9.462		31.94% Pervious Area
20.159		68.06% Impervious Area

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

Subcatchment D5P: Node D - Non-PGIS



Summary for Pond 3P: Bioretention

Inflow Area = 46.237 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 64.81 cfs @ 8.08 hrs, Volume= 22.971 af
Outflow = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af, Atten= 38%, Lag= 20.8 min
Primary = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af
Routed to Pond 19P : Infiltration Trench

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 54.89' @ 8.42 hrs Surf.Area= 1.674 ac Storage= 3.301 af

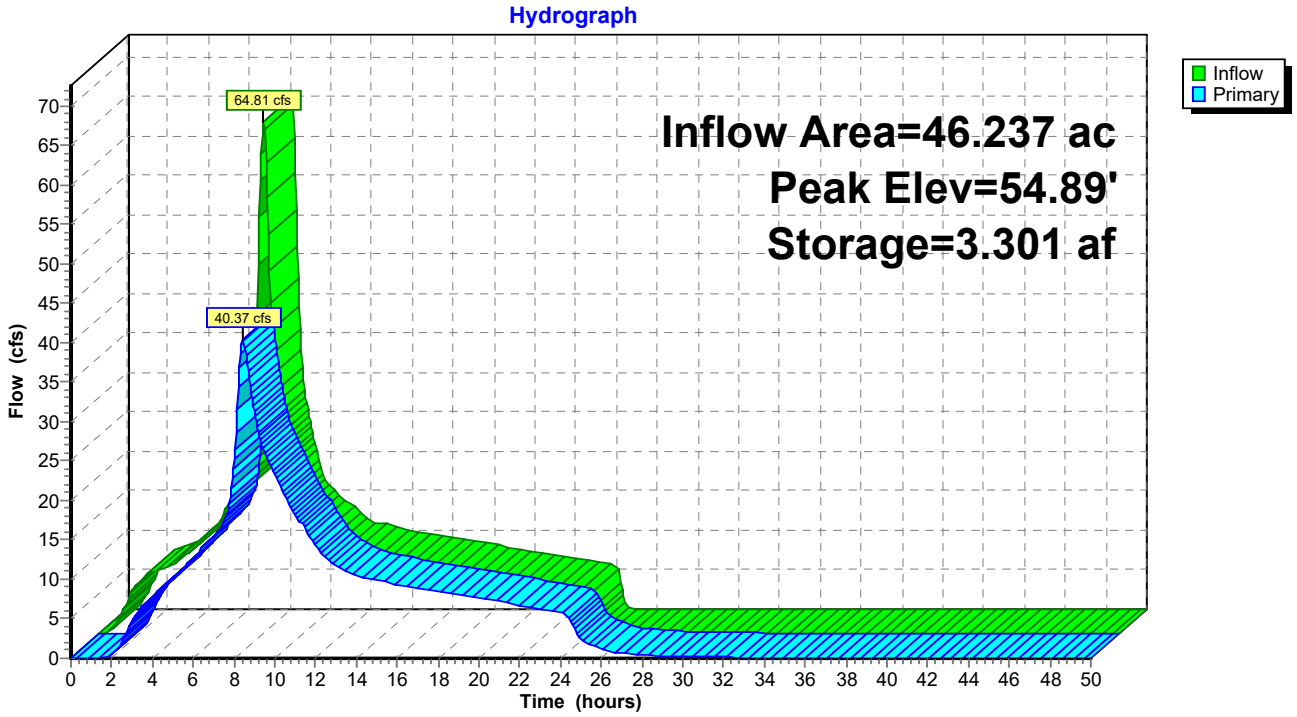
Plug-Flow detention time= 83.2 min calculated for 22.657 af (99% of inflow)
Center-of-Mass det. time= 72.4 min (736.4 - 664.0)

Volume	Invert	Avail.Storage	Storage Description
#1	50.00'	2.629 af	**270.00'W x 270.00'L x 6.50'H Prismatoid** 10.878 af Overall - 3.367 af Embedded = 7.512 af x 35.0% Voids
#2	54.50'	3.347 af	**270.00'W x 270.00'L x 2.00'H Prismatoid** Inside #1
#3	50.50'	0.019 af	**24.0" Round Pipe Storage** Inside #1 L= 269.0'
		5.996 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	54.50'	**60.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	50.50'	**24.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=40.28 cfs @ 8.42 hrs HW=54.89' (Free Discharge)
└─**1=Orifice/Grate** (Weir Controls 12.44 cfs @ 2.04 fps)
└─**2=Orifice/Grate** (Orifice Controls 27.85 cfs @ 8.86 fps)

Pond 3P: Bioretention



Summary for Pond 4P: Bioretention+Infiltration

Inflow Area = 1.684 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af
Outflow = 2.35 cfs @ 8.11 hrs, Volume= 0.837 af, Atten= 1%, Lag= 1.8 min
Primary = 0.15 cfs @ 8.11 hrs, Volume= 0.283 af
Secondary = 2.20 cfs @ 8.11 hrs, Volume= 0.554 af
Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 3.84' @ 8.11 hrs Surf.Area= 0.029 ac Storage= 0.039 af

Plug-Flow detention time= 55.2 min calculated for 0.836 af (100% of inflow)
Center-of-Mass det. time= 55.4 min (719.4 - 664.0)

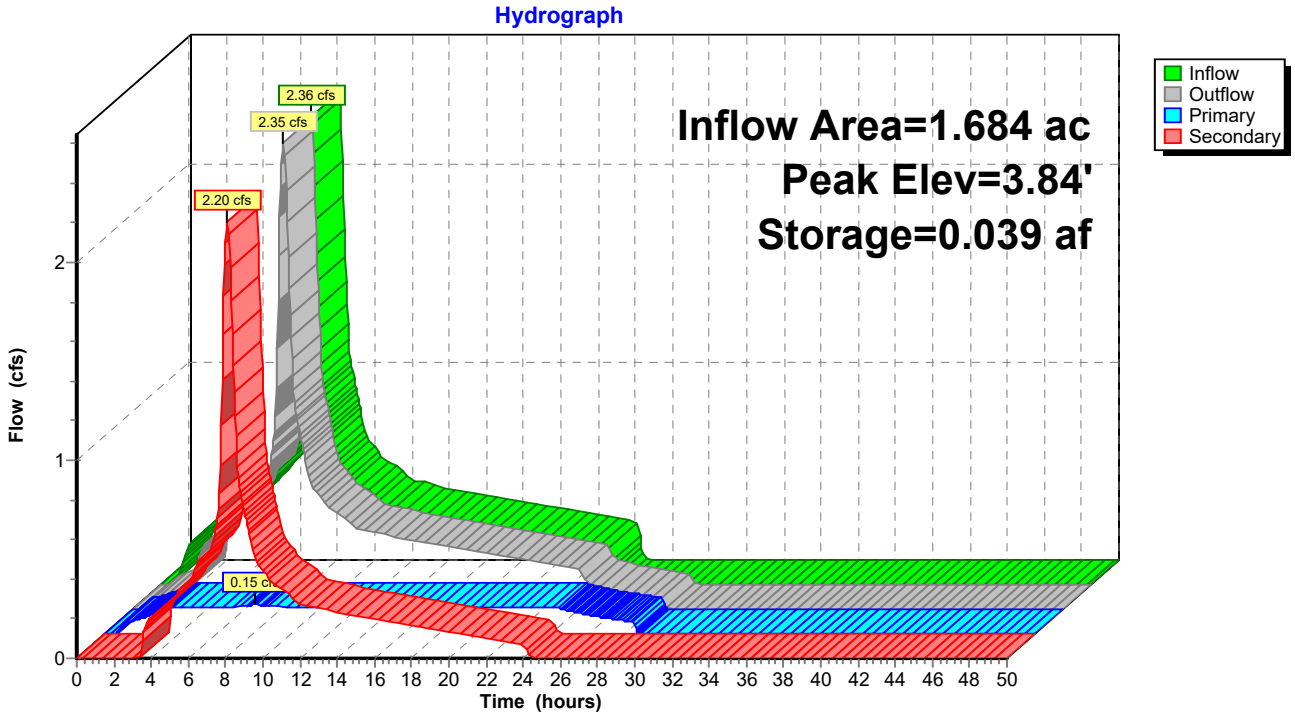
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.050 af	**5.00'W x 250.00'L x 5.00'H Bioretention** 0.143 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.15 cfs @ 8.11 hrs HW=3.84' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.15 cfs)

Secondary OutFlow Max=2.20 cfs @ 8.11 hrs HW=3.84' (Free Discharge)
↑**2=Orifice/Grate** (Orifice Controls 2.20 cfs @ 3.12 fps)

Pond 4P: Bioretention+Infiltration



Summary for Pond 5P: Bioretention+Infiltration

[93] Warning: Storage range exceeded by 0.04'
[88] Warning: Qout>Qin may require smaller dt or Finer Routing

Inflow Area = 7.516 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 10.54 cfs @ 8.08 hrs, Volume= 3.734 af
Outflow = 10.57 cfs @ 8.09 hrs, Volume= 3.734 af, Atten= 0%, Lag= 0.5 min
Primary = 0.36 cfs @ 7.95 hrs, Volume= 0.890 af
Secondary = 10.21 cfs @ 8.09 hrs, Volume= 2.844 af
Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 5.04' @ 8.09 hrs Surf.Area= 0.138 ac Storage= 0.241 af

Plug-Flow detention time= 91.6 min calculated for 3.730 af (100% of inflow)
Center-of-Mass det. time= 92.0 min (756.0 - 664.0)

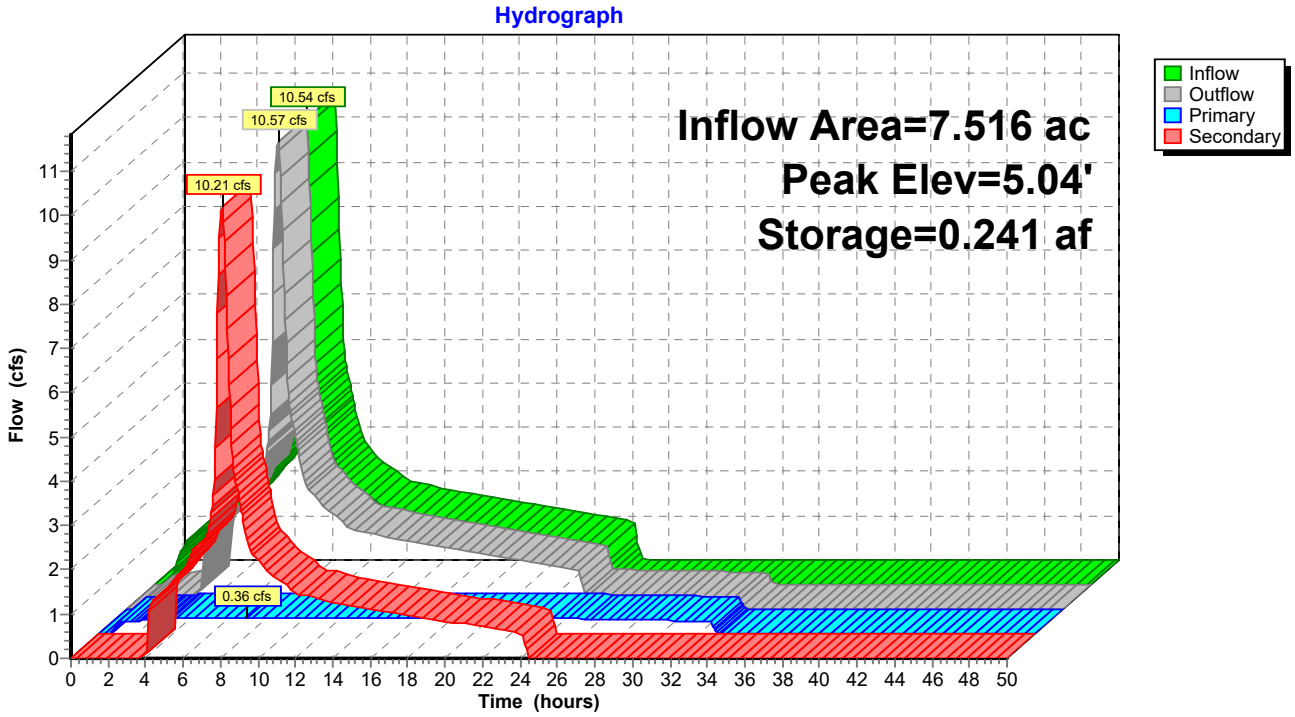
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.241 af	**50.00'W x 120.00'L x 5.00'H Infiltration Trench** 0.689 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.50'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.36 cfs @ 7.95 hrs HW=5.01' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.36 cfs)

Secondary OutFlow Max=10.16 cfs @ 8.09 hrs HW=5.04' (Free Discharge)
└**2=Orifice/Grate** (Weir Controls 10.16 cfs @ 2.40 fps)

Pond 5P: Bioretention+Infiltration



Summary for Pond 7P: Node B

[57] Hint: Peaked at 49.68' (Flood elevation advised)
[81] Warning: Exceeded Pond 10P by 46.40' @ 31.35 hrs
[81] Warning: Exceeded Pond 11P by 46.40' @ 33.05 hrs

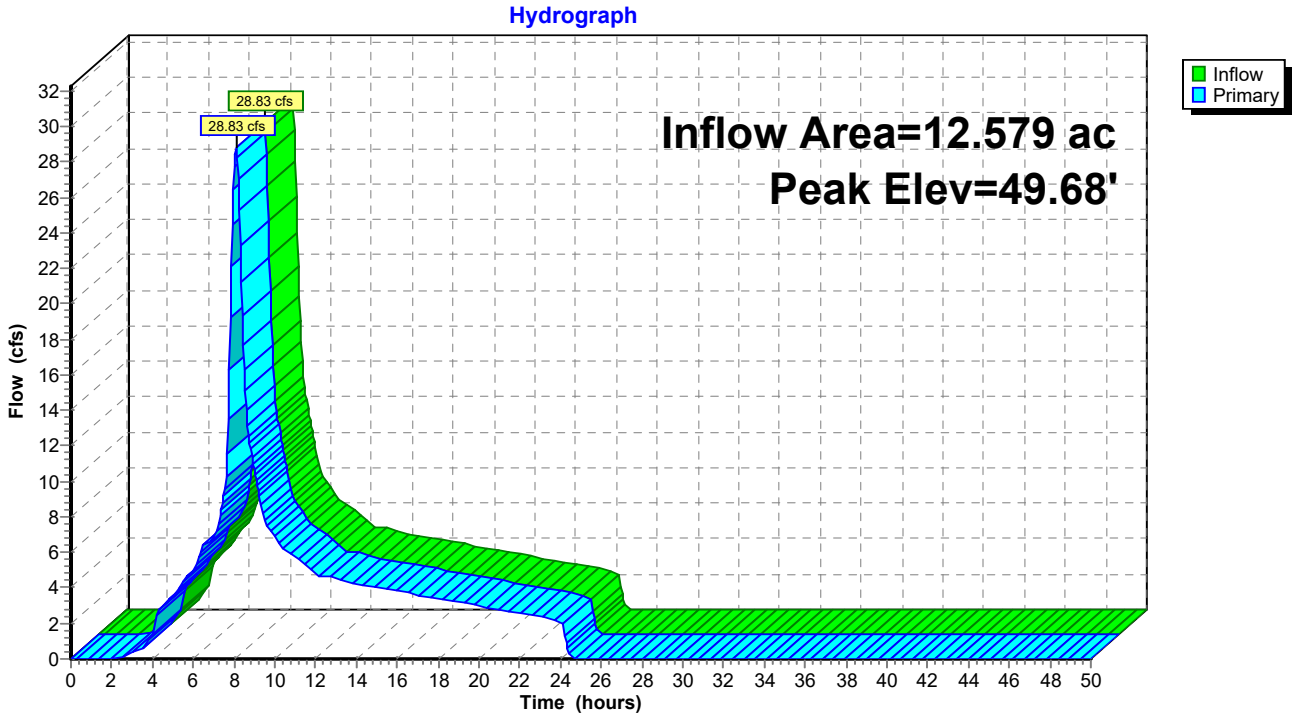
Inflow Area = 12.579 ac, 43.51% Impervious, Inflow Depth = 8.37" for 100-year event
Inflow = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af
Outflow = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af, Atten= 0%, Lag= 0.0 min
Primary = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 49.68' @ 8.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	40.33'	**24.0" Round Culvert** L= 379.7' Ke= 0.200 Inlet / Outlet Invert= 40.33' / 39.19' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Primary	49.50'	**36.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=28.67 cfs @ 8.09 hrs HW=49.68' TW=46.40' (Fixed TW Elev= 46.40')
1=Culvert (Outlet Controls 19.95 cfs @ 6.35 fps)
2=Sharp-Crested Rectangular Weir (Weir Controls 8.72 cfs @ 1.37 fps)

Pond 7P: Node B



Summary for Pond 10P: Bioretention

Inflow Area = 0.250 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 0.35 cfs @ 8.08 hrs, Volume= 0.124 af
Outflow = 0.35 cfs @ 8.09 hrs, Volume= 0.124 af, Atten= 0%, Lag= 0.5 min
Primary = 0.02 cfs @ 8.09 hrs, Volume= 0.046 af
Secondary = 0.33 cfs @ 8.09 hrs, Volume= 0.078 af
Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 3.28' @ 8.09 hrs Surf.Area= 0.005 ac Storage= 0.005 af

Plug-Flow detention time= 56.2 min calculated for 0.124 af (100% of inflow)
Center-of-Mass det. time= 56.3 min (720.4 - 664.0)

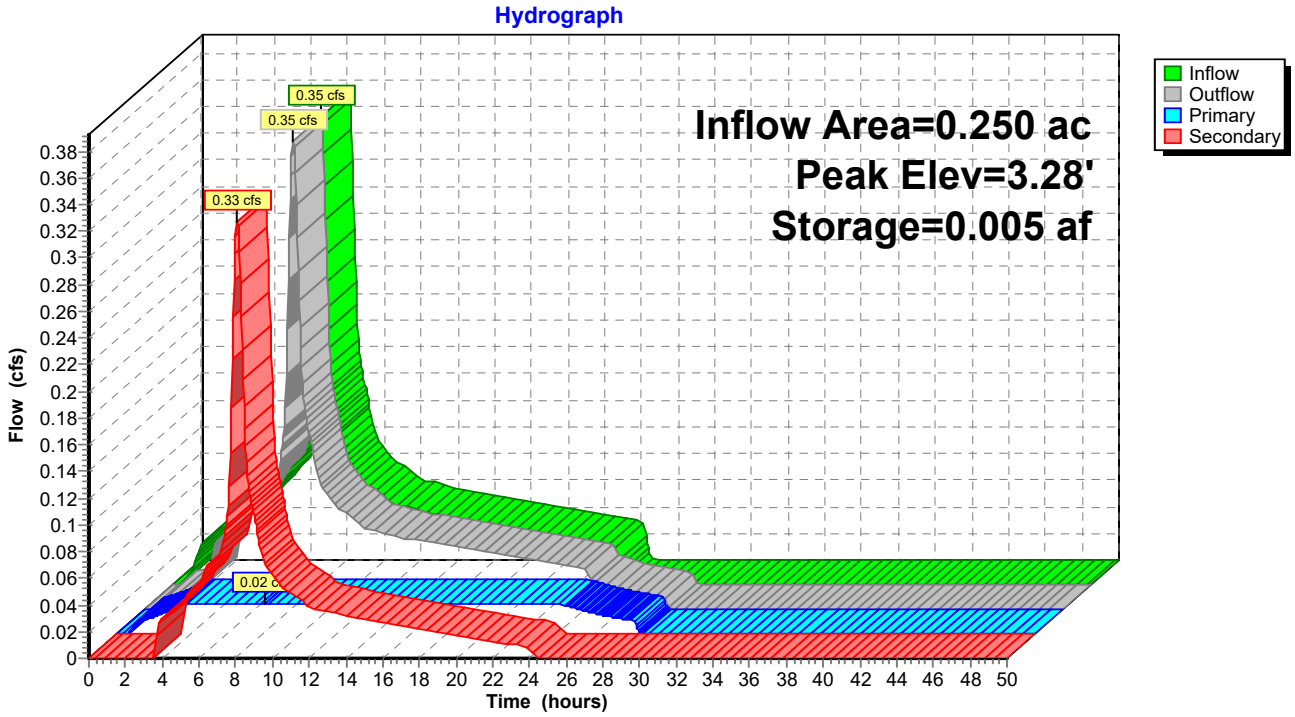
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.008 af	**5.00'W x 40.00'L x 5.00'H Bioretention** 0.023 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.02 cfs @ 8.09 hrs HW=3.28' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Secondary OutFlow Max=0.32 cfs @ 8.09 hrs HW=3.28' (Free Discharge)
↑**2=Orifice/Grate** (Orifice Controls 0.32 cfs @ 1.80 fps)

Pond 10P: Bioretention



Summary for Pond 11P: Bioretention

Inflow Area = 2.176 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 3.05 cfs @ 8.08 hrs, Volume= 1.081 af
Outflow = 3.02 cfs @ 8.12 hrs, Volume= 1.081 af, Atten= 1%, Lag= 2.8 min
Primary = 0.19 cfs @ 8.12 hrs, Volume= 0.364 af
Secondary = 2.82 cfs @ 8.12 hrs, Volume= 0.717 af
Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 5.06' @ 8.12 hrs Surf.Area= 0.031 ac Storage= 0.055 af

Plug-Flow detention time= 61.6 min calculated for 1.080 af (100% of inflow)
Center-of-Mass det. time= 61.8 min (725.8 - 664.0)

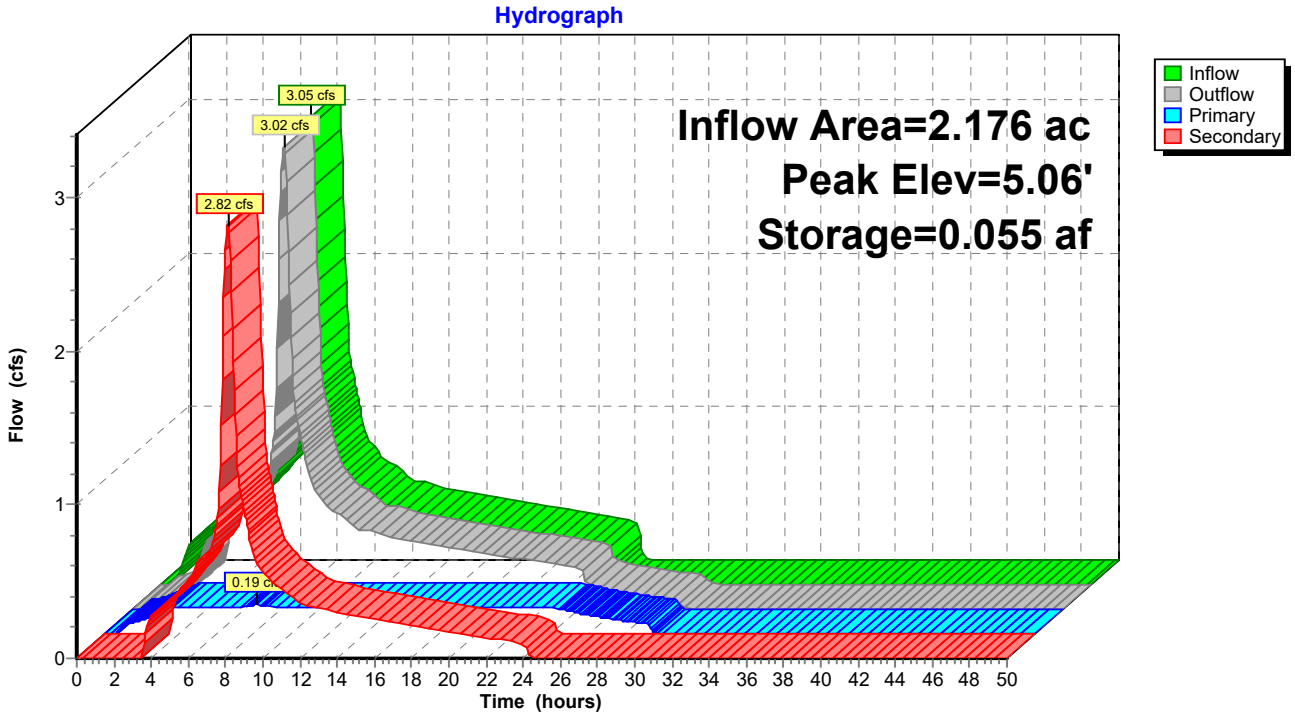
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.065 af	**5.00'W x 270.00'L x 6.00'H Bioretention** 0.186 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.19 cfs @ 8.12 hrs HW=5.06' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.19 cfs)

Secondary OutFlow Max=2.82 cfs @ 8.12 hrs HW=5.06' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 2.82 cfs @ 3.59 fps)

Pond 11P: Bioretention



Summary for Pond 15P: Bioretention

Inflow Area = 0.239 ac, 0.00% Impervious, Inflow Depth = 2.78" for 100-year event
Inflow = 0.14 cfs @ 8.13 hrs, Volume= 0.055 af
Outflow = 0.05 cfs @ 10.22 hrs, Volume= 0.055 af, Atten= 67%, Lag= 125.5 min
Primary = 0.05 cfs @ 10.22 hrs, Volume= 0.055 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 1.52' @ 10.22 hrs Surf.Area= 0.014 ac Storage= 0.007 af

Plug-Flow detention time= 77.6 min calculated for 0.055 af (100% of inflow)
Center-of-Mass det. time= 77.5 min (908.4 - 830.8)

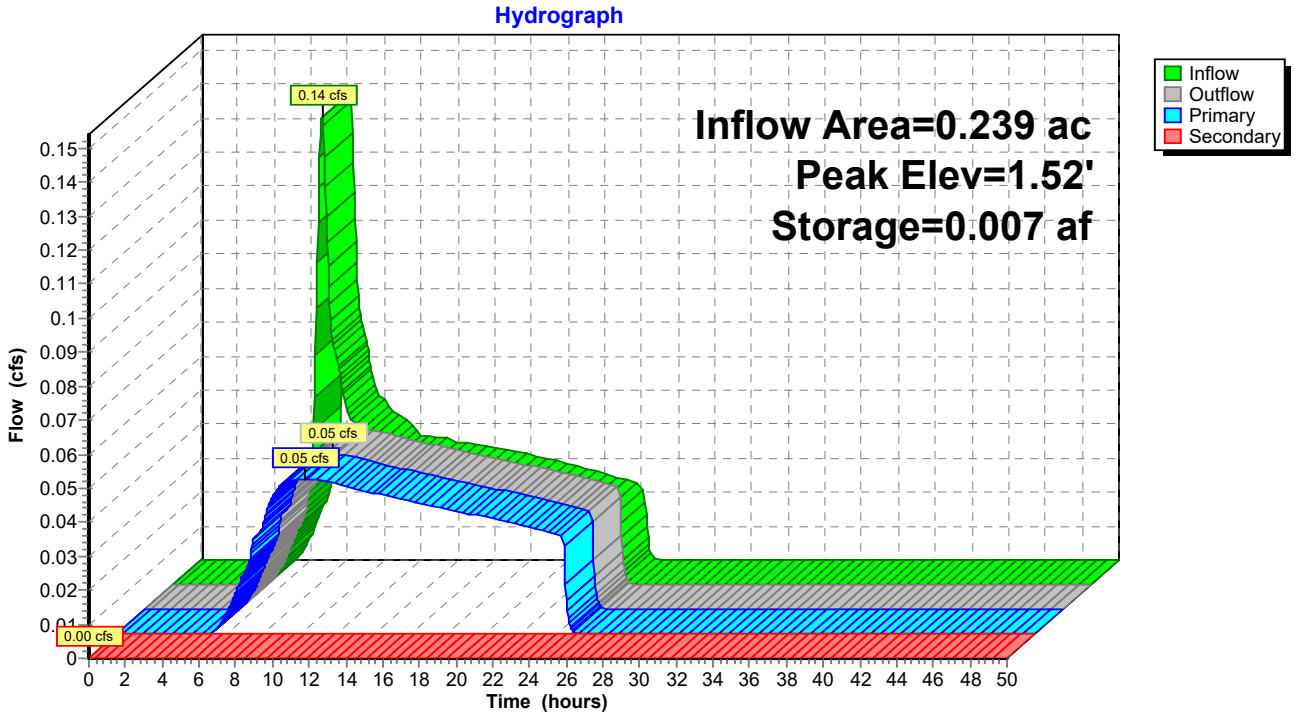
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.024 af	**5.00'W x 120.00'L x 5.00'H Bioretention** 0.069 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.05 cfs @ 10.22 hrs HW=1.52' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.05 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
└**2=Orifice/Grate** (Controls 0.00 cfs)

Pond 15P: Bioretention



Summary for Pond 16P: Infiltration Trench

Inflow Area = 1.378 ac, 77.79% Impervious, Inflow Depth = 5.27" for 100-year event
Inflow = 1.78 cfs @ 8.08 hrs, Volume= 0.605 af
Outflow = 1.77 cfs @ 8.11 hrs, Volume= 0.605 af, Atten= 0%, Lag= 1.7 min
Primary = 0.09 cfs @ 8.11 hrs, Volume= 0.193 af
Secondary = 1.68 cfs @ 8.11 hrs, Volume= 0.411 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 4.70' @ 8.11 hrs Surf.Area= 0.028 ac Storage= 0.045 af

Plug-Flow detention time= 91.8 min calculated for 0.604 af (100% of inflow)
Center-of-Mass det. time= 92.1 min (798.9 - 706.8)

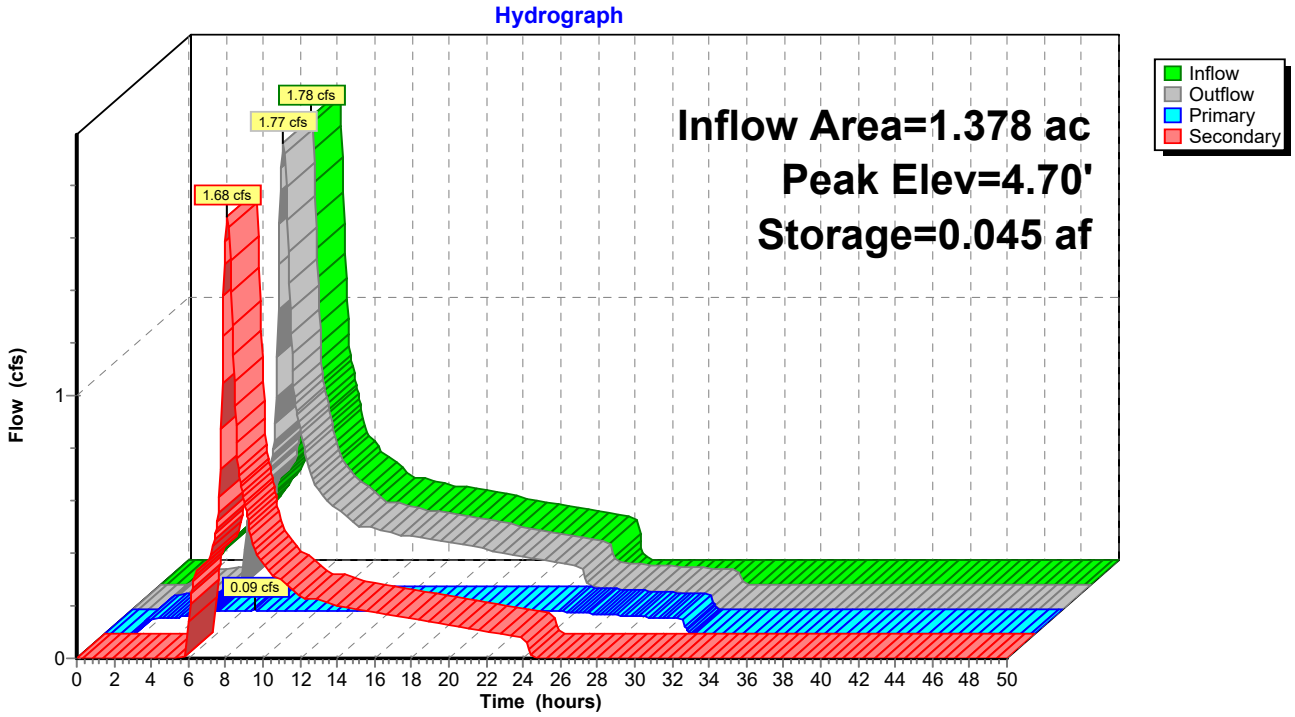
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.058 af	**20.00'W x 60.00'L x 6.00'H Infiltration Trench** 0.165 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.09 cfs @ 8.11 hrs HW=4.70' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Secondary OutFlow Max=1.68 cfs @ 8.11 hrs HW=4.70' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 1.68 cfs @ 2.85 fps)

Pond 16P: Infiltration Trench



Summary for Pond 19P: Infiltration Trench

Inflow Area = 46.237 ac,100.00% Impervious, Inflow Depth > 5.88" for 100-year event
Inflow = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af
Outflow = 38.47 cfs @ 8.60 hrs, Volume= 22.657 af, Atten= 5%, Lag= 10.4 min
Primary = 3.58 cfs @ 8.60 hrs, Volume= 8.734 af
Secondary = 34.89 cfs @ 8.60 hrs, Volume= 13.923 af
Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 4.09' @ 8.60 hrs Surf.Area= 1.674 ac Storage= 2.393 af

Plug-Flow detention time= 123.7 min calculated for 22.657 af (100% of inflow)
Center-of-Mass det. time= 123.7 min (860.1 - 736.4)

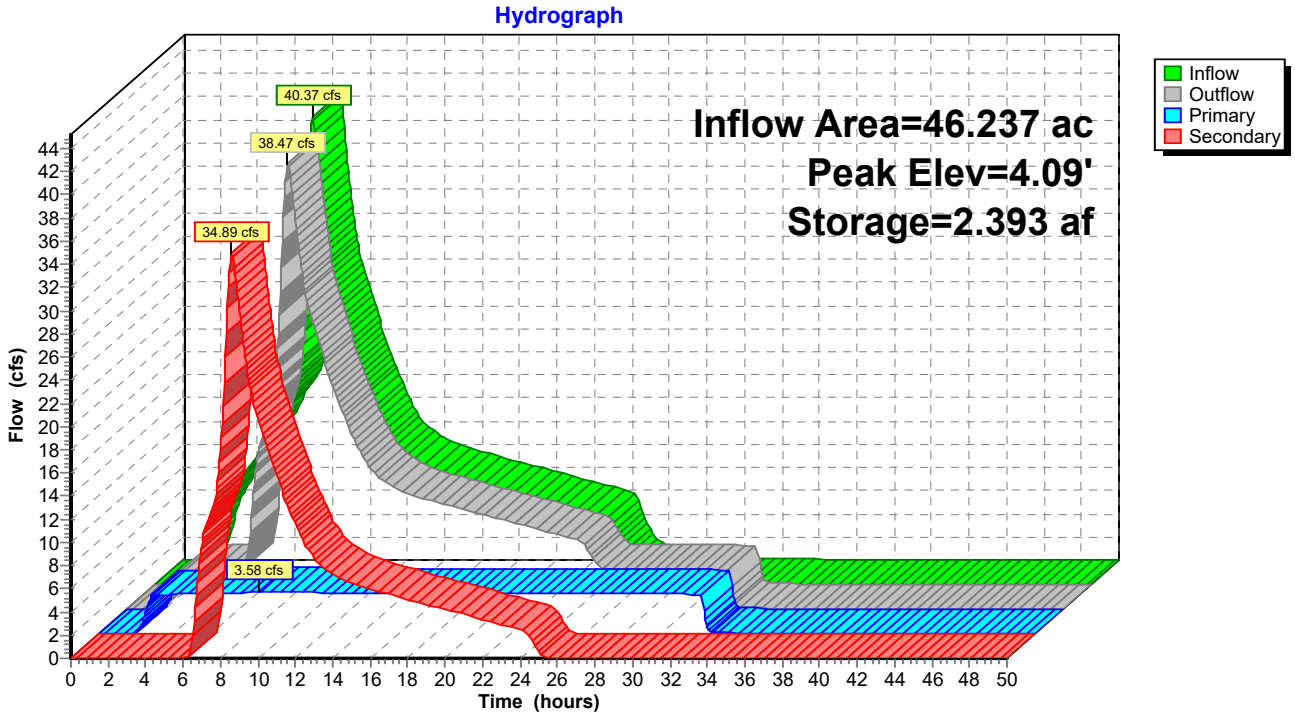
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	2.929 af	**270.00'W x 270.00'L x 5.00'H Infiltration Trench** 8.368 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.58 cfs @ 8.60 hrs HW=4.09' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 3.58 cfs)

Secondary OutFlow Max=34.87 cfs @ 8.60 hrs HW=4.09' (Free Discharge)
↑**2=Orifice/Grate** (Weir Controls 34.87 cfs @ 3.41 fps)

Pond 19P: Infiltration Trench



Summary for Pond N1: Node D

[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=14)
[81] Warning: Exceeded Pond 19P by 39.03' @ 8.60 hrs

Inflow Area = 44.595 ac, 62.85% Impervious, Inflow Depth = 9.31" for 100-year event
Inflow = 84.32 cfs @ 8.14 hrs, Volume= 34.599 af
Outflow = 66.43 cfs @ 8.60 hrs, Volume= 34.599 af, Atten= 21%, Lag= 27.5 min
Primary = 66.43 cfs @ 8.60 hrs, Volume= 34.599 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 43.12' @ 8.60 hrs Surf.Area= 43,113 sf Storage= 42,363 cf

Plug-Flow detention time= 2.0 min calculated for 34.599 af (100% of inflow)
Center-of-Mass det. time= 2.0 min (737.6 - 735.5)

Volume	Invert	Avail.Storage	Storage Description
#1	38.00'	922,840 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

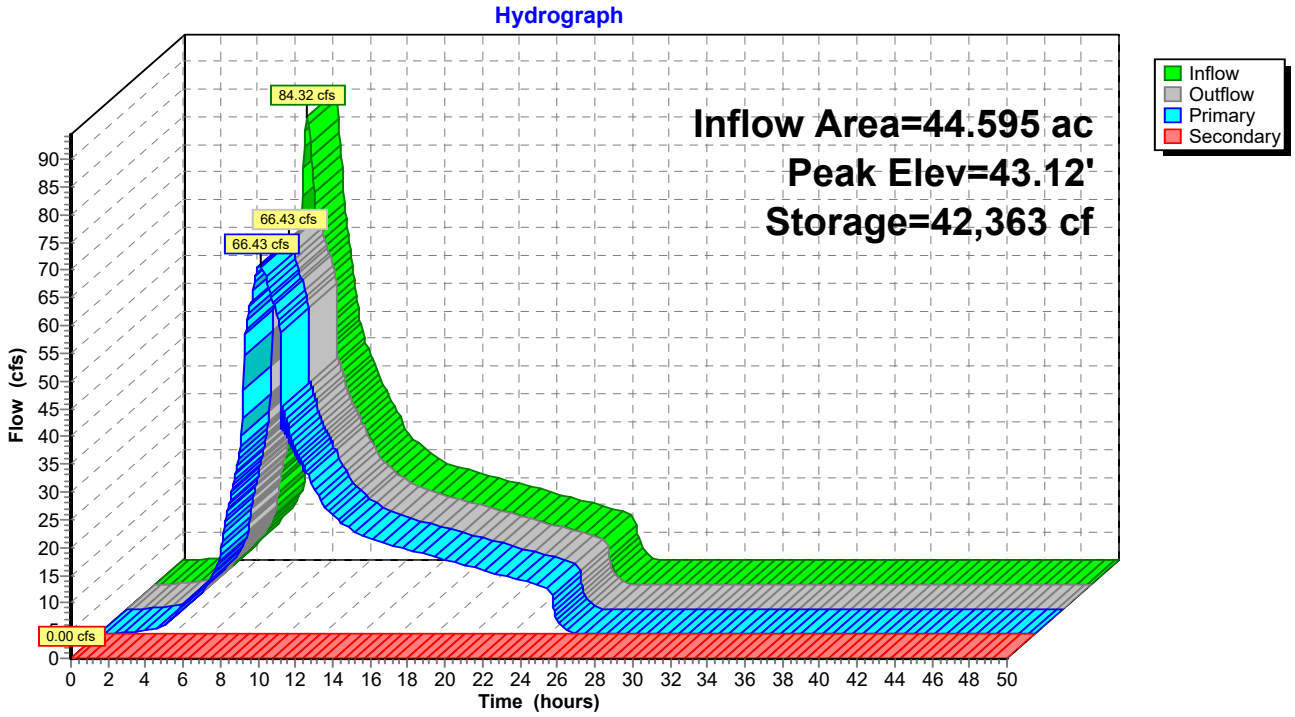
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	50	0	0
41.99	50	200	200
42.00	32,000	160	360
48.00	91,616	370,848	371,208
49.00	270,816	181,216	552,424
50.00	470,016	370,416	922,840

Device	Routing	Invert	Outlet Devices
#1	Secondary	48.00'	**30.0' long + 1.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32
#2	Primary	38.00'	**42.0" Round Culvert** L= 270.3' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 38.00' / 37.50' S= 0.0018 '/' Cc= 0.900 n= 0.012, Flow Area= 9.62 sf

Primary OutFlow Max=66.43 cfs @ 8.60 hrs HW=43.12' (Free Discharge)
└**2=Culvert** (Barrel Controls 66.43 cfs @ 6.90 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=38.00' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond N1: Node D



Summary for Pond N2: Node C

[57] Hint: Peaked at 46.40' (Flood elevation advised)
[81] Warning: Exceeded Pond 7P by 2.80' @ 1.75 hrs
[81] Warning: Exceeded Pond 15P by 45.83' @ 8.05 hrs
[81] Warning: Exceeded Pond 16P by 43.12' @ 1.45 hrs

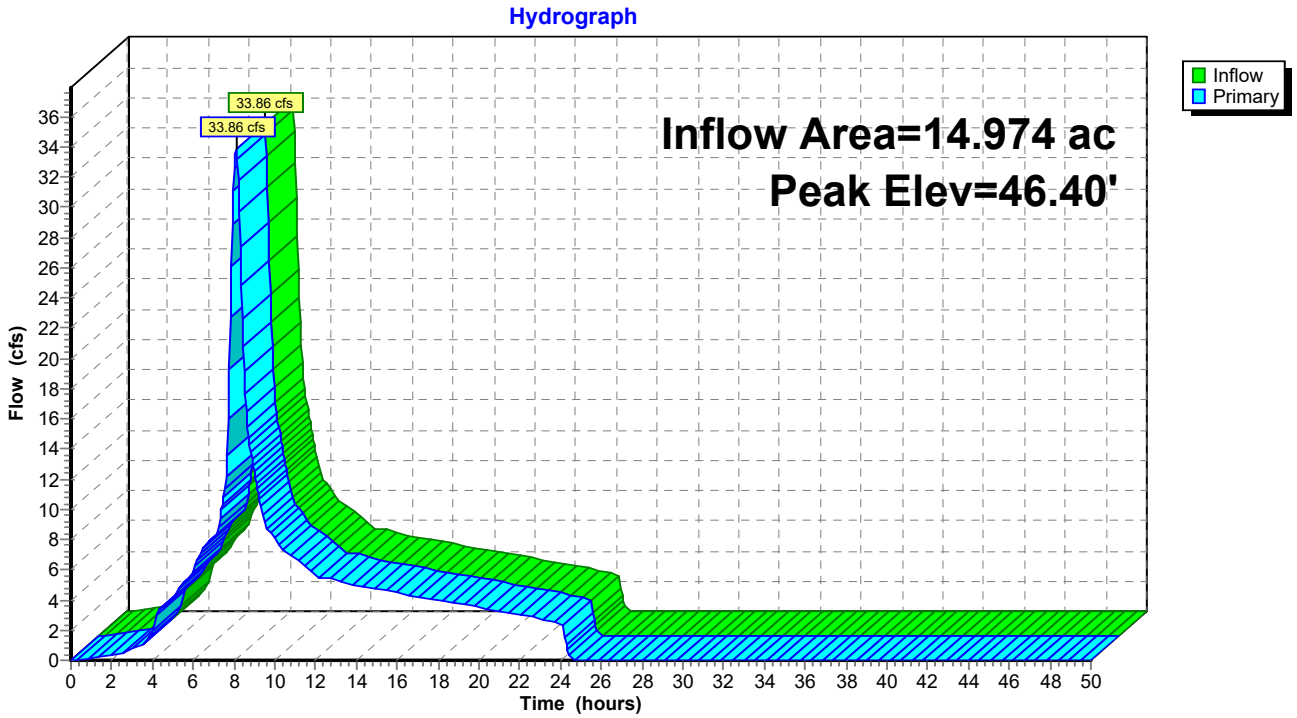
Inflow Area = 14.974 ac, 52.54% Impervious, Inflow Depth = 8.32" for 100-year event
Inflow = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af
Outflow = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af, Atten= 0%, Lag= 0.0 min
Primary = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af
Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 46.40' @ 8.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	39.19'	**30.0" Round Culvert** L= 410.7' Ke= 0.200 Inlet / Outlet Invert= 39.19' / 38.00' S= 0.0029 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 4.91 sf
#2	Primary	48.80'	**36.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=33.80 cfs @ 8.09 hrs HW=46.39' TW=43.12' (Fixed TW Elev= 43.12')
1=Culvert (Outlet Controls 33.80 cfs @ 6.88 fps)
2=Sharp-Crested Rectangular Weir (Controls 0.00 cfs)

Pond N2: Node C



Summary for Pond N3: Node A

[57] Hint: Peaked at 50.56' (Flood elevation advised)
[81] Warning: Exceeded Pond 4P by 49.68' @ 31.55 hrs
[81] Warning: Exceeded Pond 5P by 49.68' @ 35.95 hrs

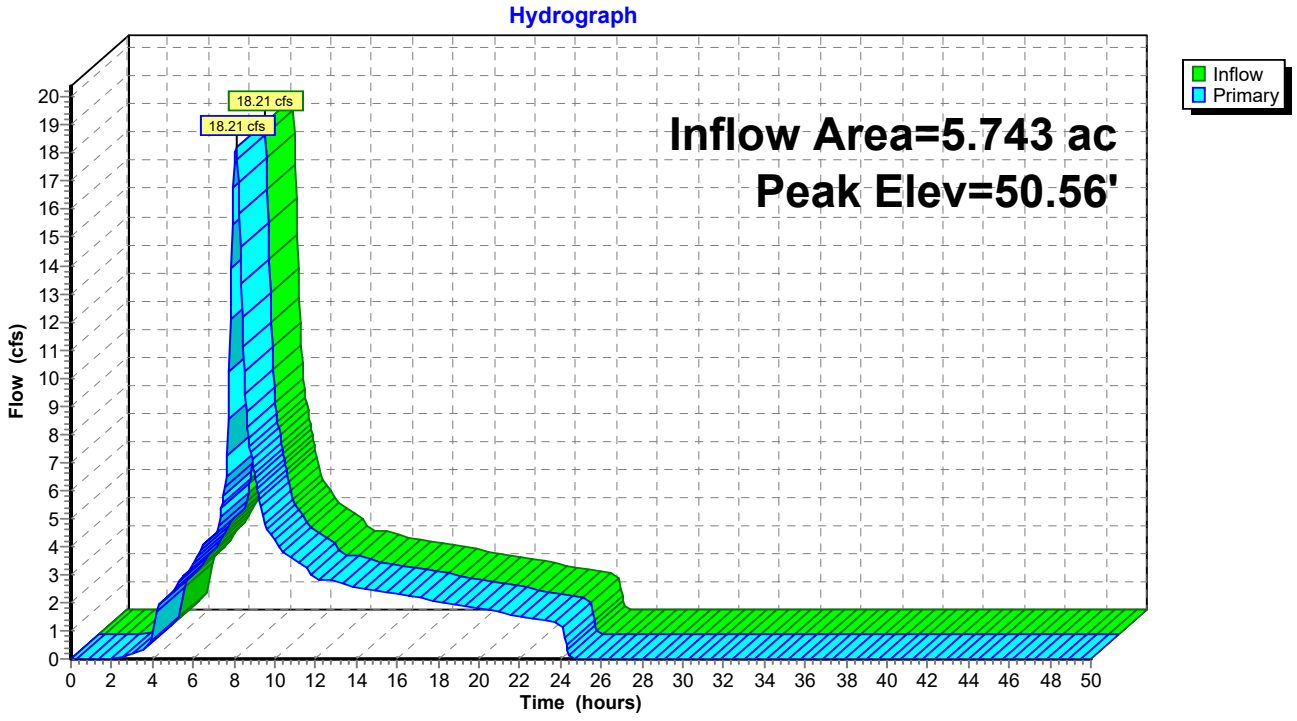
Inflow Area = 5.743 ac, 58.73% Impervious, Inflow Depth = 11.34" for 100-year event
Inflow = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af
Outflow = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af, Atten= 0%, Lag= 0.0 min
Primary = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af
Routed to Pond 7P : Node B

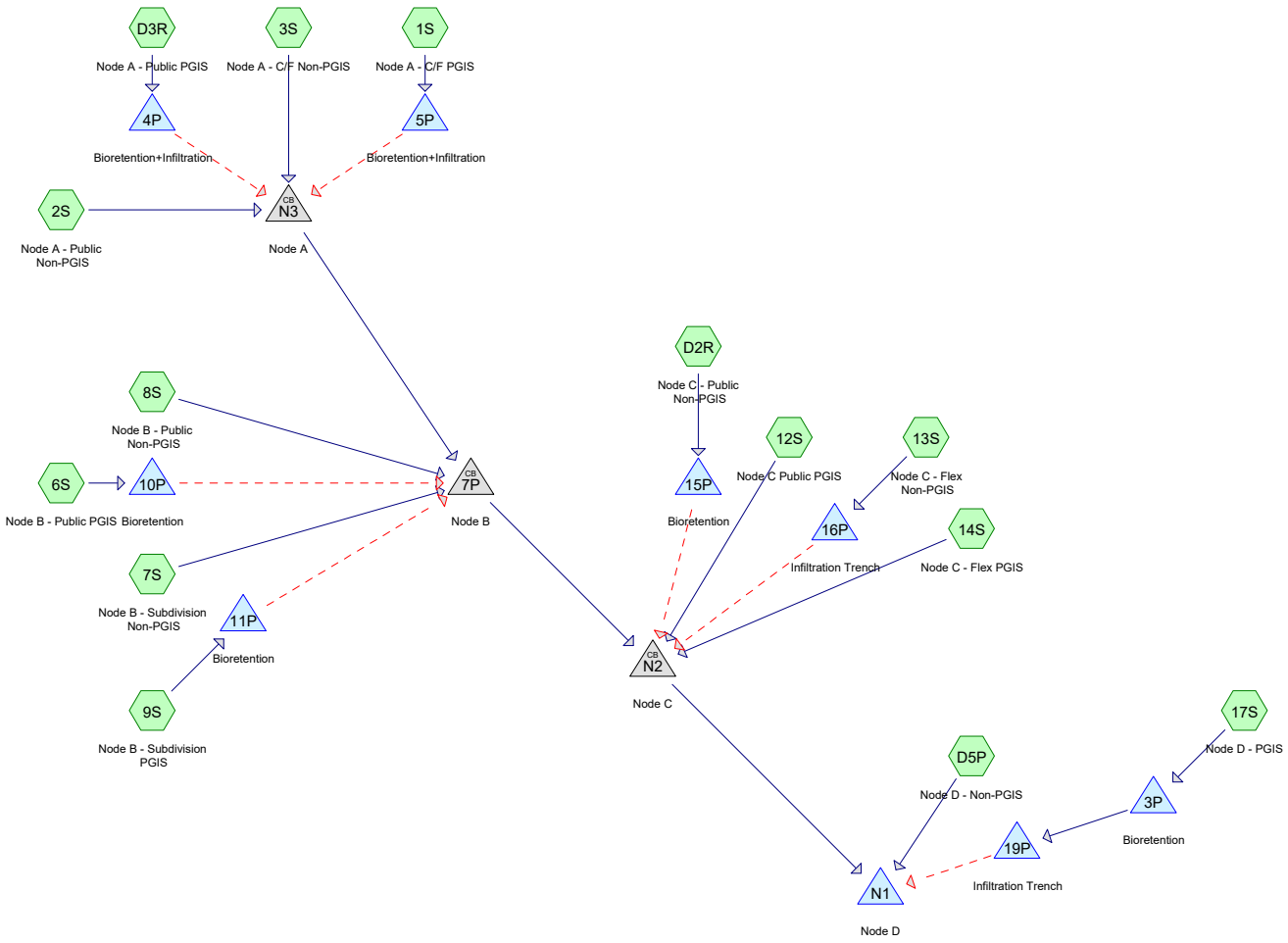
Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 50.56' @ 8.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	41.44'	**24.0" Round Culvert** L= 369.0' Ke= 0.200 Inlet / Outlet Invert= 41.44' / 40.33' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Primary	50.40'	**36.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=17.89 cfs @ 8.09 hrs HW=50.56' TW=49.68' (Fixed TW Elev= 49.68')
1=Culvert (Outlet Controls 10.45 cfs @ 3.33 fps)
2=Sharp-Crested Rectangular Weir (Weir Controls 7.44 cfs @ 1.30 fps)

Pond N3: Node A





Subcat Reach Pond Link

Routing Diagram for ALTERNATE _Onsite 25-Year Storm - Minor Flood

Prepared by MacKay & Sposito, Inc, Printed 3/10/2025

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
9.462	49	50-75% Grass cover, Fair, HSG A (D5P)
2.370	59	50-75% Grass cover, Fair, HSG A/B (avg) (2S, 3S)
0.306	69	50-75% Grass cover, Fair, HSG B (13S)
0.239	68	<50% Grass cover, Poor, HSG A (D2R)
4.736	79	<50% Grass cover, Poor, HSG B (7S, 8S)
48.663	98	Paved parking, HSG A (6S, 9S, 17S)
11.595	98	Paved parking, HSG B (1S, 12S, 14S, D3R)
4.445	98	Roofs, HSG A (3S, 13S)
22.259	98	Roofs, HSG B (7S, D5P)
104.075	**92**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
65.179	HSG A	2S, 3S, 6S, 9S, 13S, 17S, D2R, D5P
38.896	HSG B	1S, 7S, 8S, 12S, 13S, 14S, D3R, D5P
0.000	HSG C	
0.000	HSG D	
0.000	Other	
104.075		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
11.832	0.306	0.000	0.000	0.000	12.138	50-75% Grass cover, Fair	2S, 3S, 13S, D5P
0.239	4.736	0.000	0.000	0.000	4.975	<50% Grass cover, Poor	7S, 8S, D2R
48.663	11.595	0.000	0.000	0.000	60.258	Paved parking	1S, 6S, 9S, 12S, 14S, 17S, D3R
4.445	22.259	0.000	0.000	0.000	26.704	Roofs	3S, 7S, 13S, D5P
65.179	**38.896**	**0.000**	**0.000**	**0.000**	**104.075**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	7P	40.33	39.19	379.7	0.0030	0.012	0.0	24.0	0.0	
2	N1	38.00	37.50	270.3	0.0018	0.012	0.0	42.0	0.0	
3	N2	39.19	38.00	410.7	0.0029	0.012	0.0	30.0	0.0	
4	N3	41.44	40.33	369.0	0.0030	0.012	0.0	24.0	0.0	

Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Node A - C/F PGIS Runoff Area=7.516 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=8.64 cfs 3.046 af

Subcatchment2S: Node A - Public Non-PGIS Runoff Area=1.160 ac 0.00% Impervious Runoff Depth=1.29"
Tc=20.0 min CN=59 Runoff=0.20 cfs 0.125 af

Subcatchment3S: Node A - C/F Non-PGIS Runoff Area=4.583 ac 73.60% Impervious Runoff Depth=3.76"
Tc=20.0 min CN=88 Runoff=4.22 cfs 1.438 af

Subcatchment6S: Node B - Public PGIS Runoff Area=0.250 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=0.29 cfs 0.101 af

Subcatchment7S: Node B - Subdivision Runoff Area=6.745 ac 31.13% Impervious Runoff Depth=3.46"
Tc=20.0 min CN=85 Runoff=5.62 cfs 1.945 af

Subcatchment8S: Node B - Public Non-PGIS Runoff Area=0.091 ac 0.00% Impervious Runoff Depth=2.89"
Tc=20.0 min CN=79 Runoff=0.06 cfs 0.022 af

Subcatchment9S: Node B - Subdivision Runoff Area=2.176 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=2.50 cfs 0.882 af

Subcatchment12S: Node C Public PGIS Runoff Area=0.710 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=0.82 cfs 0.288 af

Subcatchment13S: Node C - Flex Non-PGIS Runoff Area=1.378 ac 77.79% Impervious Runoff Depth=4.19"
Tc=20.0 min CN=92 Runoff=1.42 cfs 0.481 af

Subcatchment14S: Node C - Flex PGIS Runoff Area=1.685 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=1.94 cfs 0.683 af

Subcatchment17S: Node D - PGIS Runoff Area=46.237 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=53.15 cfs 18.738 af

SubcatchmentD2R: Node C - Public Runoff Area=0.239 ac 0.00% Impervious Runoff Depth=1.95"
Tc=20.0 min CN=68 Runoff=0.09 cfs 0.039 af

SubcatchmentD3R: Node A - Public PGIS Runoff Area=1.684 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=1.94 cfs 0.682 af

SubcatchmentD5P: Node D - Non-PGIS Runoff Area=29.621 ac 68.06% Impervious Runoff Depth=3.17"
Tc=20.0 min CN=82 Runoff=22.11 cfs 7.822 af

Pond 3P: Bioretention Peak Elev=54.62' Storage=2.845 af Inflow=53.15 cfs 18.738 af
Outflow=28.78 cfs 18.424 af

Pond 4P: Bioretention+Infiltration Peak Elev=3.73' Storage=0.037 af Inflow=1.94 cfs 0.682 af
Primary=0.15 cfs 0.277 af Secondary=1.78 cfs 0.406 af Outflow=1.93 cfs 0.682 af

Pond 5P: Bioretention+Infiltration Peak Elev=4.97' Storage=0.240 af Inflow=8.64 cfs 3.046 af
Primary=0.36 cfs 0.882 af Secondary=8.26 cfs 2.164 af Outflow=8.62 cfs 3.046 af

Pond 7P: Node B Peak Elev=48.77' Inflow=22.70 cfs 6.681 af
24.0" Round Culvert n=0.012 L=379.7' S=0.0030 '/' Outflow=22.70 cfs 6.681 af

Pond 10P: Bioretention Peak Elev=3.25' Storage=0.005 af Inflow=0.29 cfs 0.101 af
Primary=0.02 cfs 0.045 af Secondary=0.26 cfs 0.056 af Outflow=0.29 cfs 0.101 af

Pond 11P: Bioretention Peak Elev=4.87' Storage=0.053 af Inflow=2.50 cfs 0.882 af
Primary=0.19 cfs 0.356 af Secondary=2.30 cfs 0.526 af Outflow=2.48 cfs 0.882 af

Pond 15P: Bioretention Peak Elev=0.73' Storage=0.004 af Inflow=0.09 cfs 0.039 af
Primary=0.04 cfs 0.039 af Secondary=0.00 cfs 0.000 af Outflow=0.04 cfs 0.039 af

Pond 16P: Infiltration Trench Peak Elev=4.61' Storage=0.044 af Inflow=1.42 cfs 0.481 af
Primary=0.09 cfs 0.189 af Secondary=1.32 cfs 0.292 af Outflow=1.41 cfs 0.481 af

Pond 19P: Infiltration Trench Peak Elev=3.86' Storage=2.259 af Inflow=28.78 cfs 18.424 af
Primary=3.57 cfs 8.564 af Secondary=24.41 cfs 9.860 af Outflow=27.97 cfs 18.424 af

Pond N1: Node D Peak Elev=42.48' Storage=16,980 cf Inflow=65.60 cfs 25.625 af
42.0" Round Culvert n=0.012 L=270.3' S=0.0018 '/' Outflow=56.41 cfs 25.621 af

Pond N2: Node C Peak Elev=44.53' Inflow=26.76 cfs 7.943 af
30.0" Round Culvert n=0.012 L=410.7' S=0.0029 '/' Outflow=26.76 cfs 7.943 af

Pond N3: Node A Peak Elev=50.45' Inflow=14.45 cfs 4.132 af
24.0" Round Culvert n=0.012 L=369.0' S=0.0030 '/' Outflow=14.45 cfs 4.132 af

Total Runoff Area = 104.075 ac Runoff Volume = 36.290 af Average Runoff Depth = 4.18"
16.44% Pervious = 17.113 ac 83.56% Impervious = 86.962 ac

Summary for Subcatchment 1S: Node A - C/F PGIS

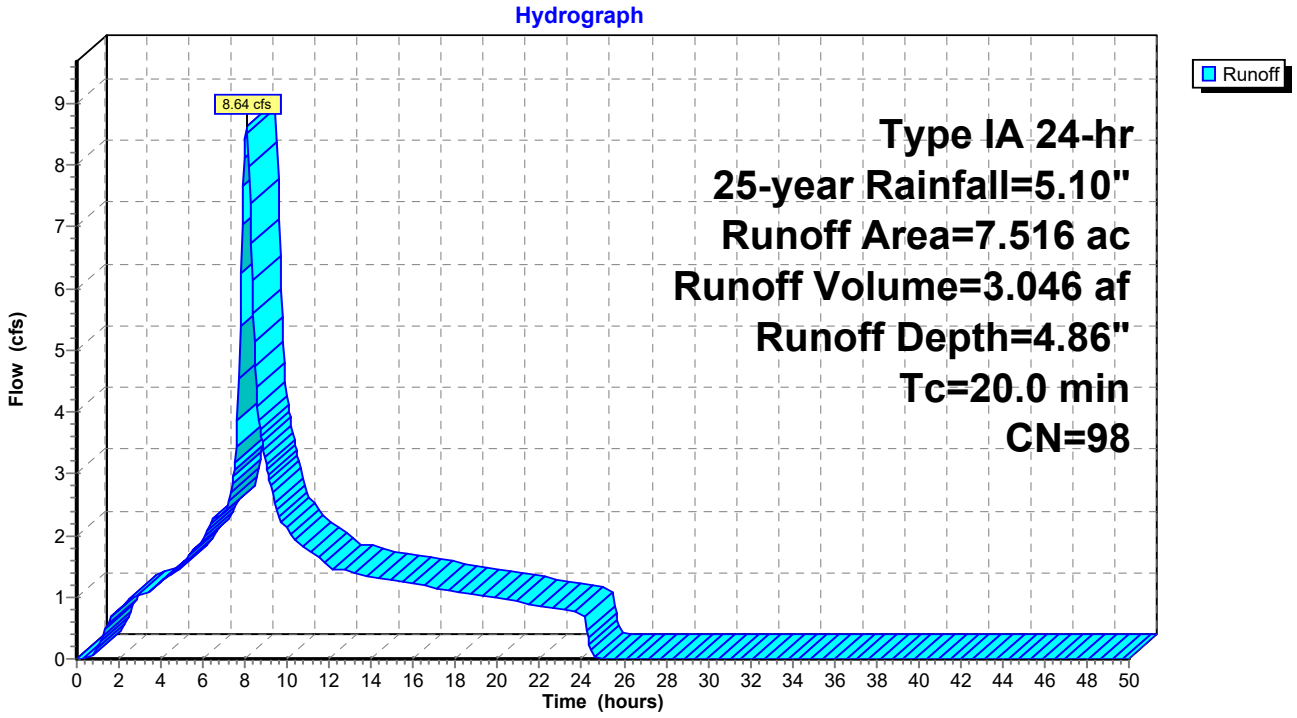
Runoff = 8.64 cfs @ 8.08 hrs, Volume= 3.046 af, Depth= 4.86"
Routed to Pond 5P : Bioretention+Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
7.516	98	Paved parking, HSG B
7.516		100.00% Impervious Area

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

Subcatchment 1S: Node A - C/F PGIS



Summary for Subcatchment 2S: Node A - Public Non-PGIS

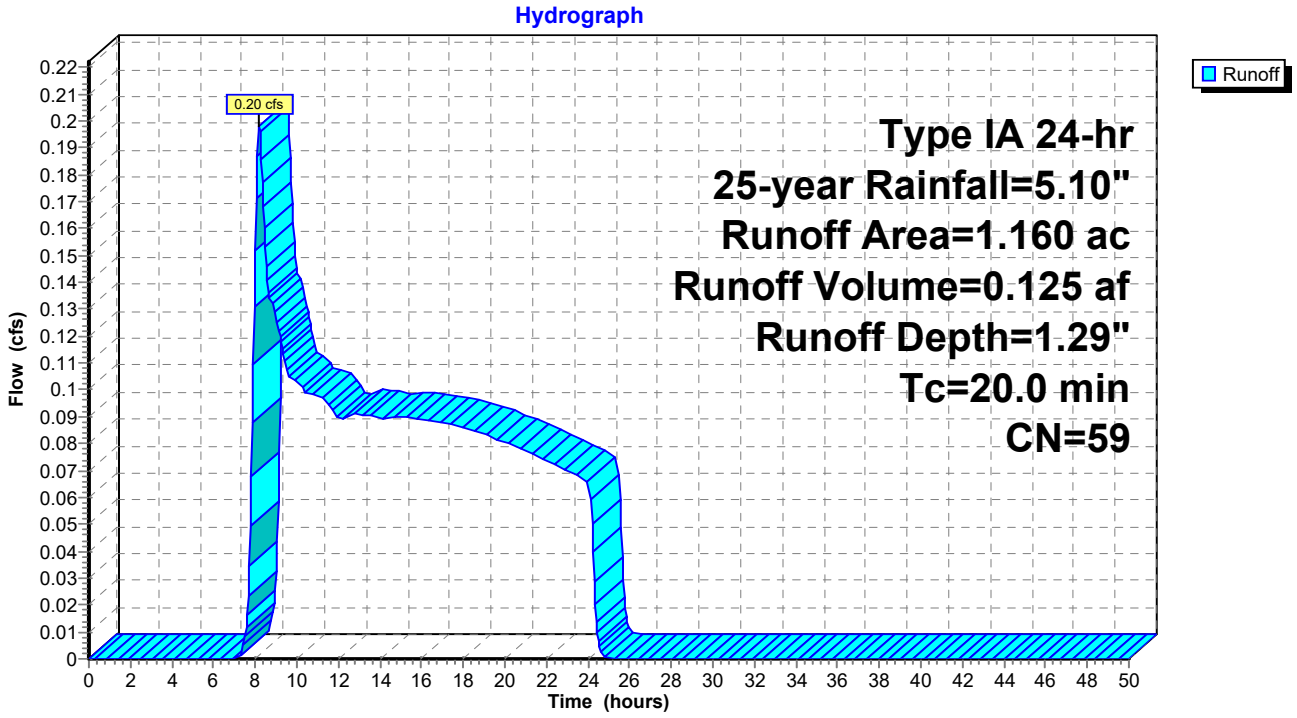
Runoff = 0.20 cfs @ 8.19 hrs, Volume= 0.125 af, Depth= 1.29"
Routed to Pond N3 : Node A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

	Area (ac)	CN	Description
*	1.160	59	50-75% Grass cover, Fair, HSG A/B (avg)
	1.160		100.00% Pervious Area

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

Subcatchment 2S: Node A - Public Non-PGIS



Summary for Subcatchment 3S: Node A - C/F Non-PGIS

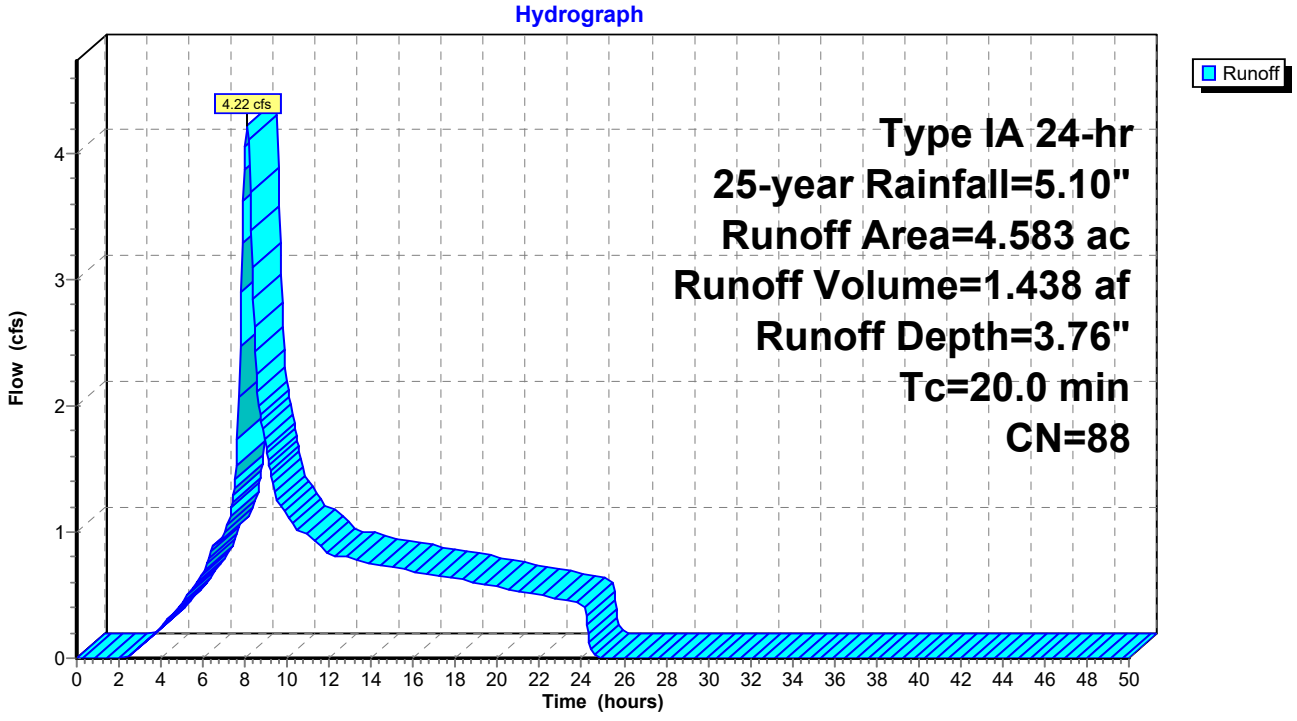
Runoff = 4.22 cfs @ 8.09 hrs, Volume= 1.438 af, Depth= 3.76"
Routed to Pond N3 : Node A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

	Area (ac)	CN	Description
*	1.210	59	50-75% Grass cover, Fair, HSG A/B (avg)
	3.373	98	Roofs, HSG A
	4.583	88	Weighted Average
	1.210		26.40% Pervious Area
	3.373		73.60% Impervious Area

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

Subcatchment 3S: Node A - C/F Non-PGIS



Summary for Subcatchment 6S: Node B - Public PGIS

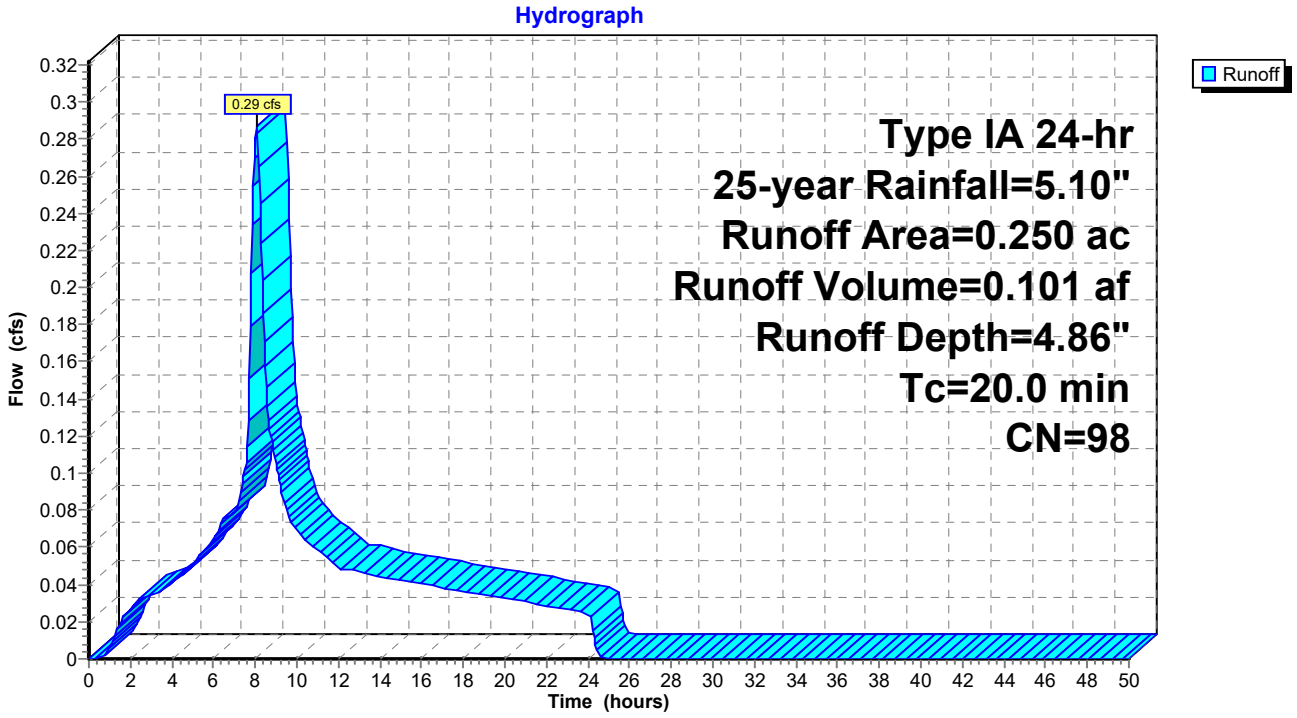
Runoff = 0.29 cfs @ 8.08 hrs, Volume= 0.101 af, Depth= 4.86"
Routed to Pond 10P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.250	98	Paved parking, HSG A
0.250		100.00% Impervious Area

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

Subcatchment 6S: Node B - Public PGIS



Summary for Subcatchment 7S: Node B - Subdivision Non-PGIS

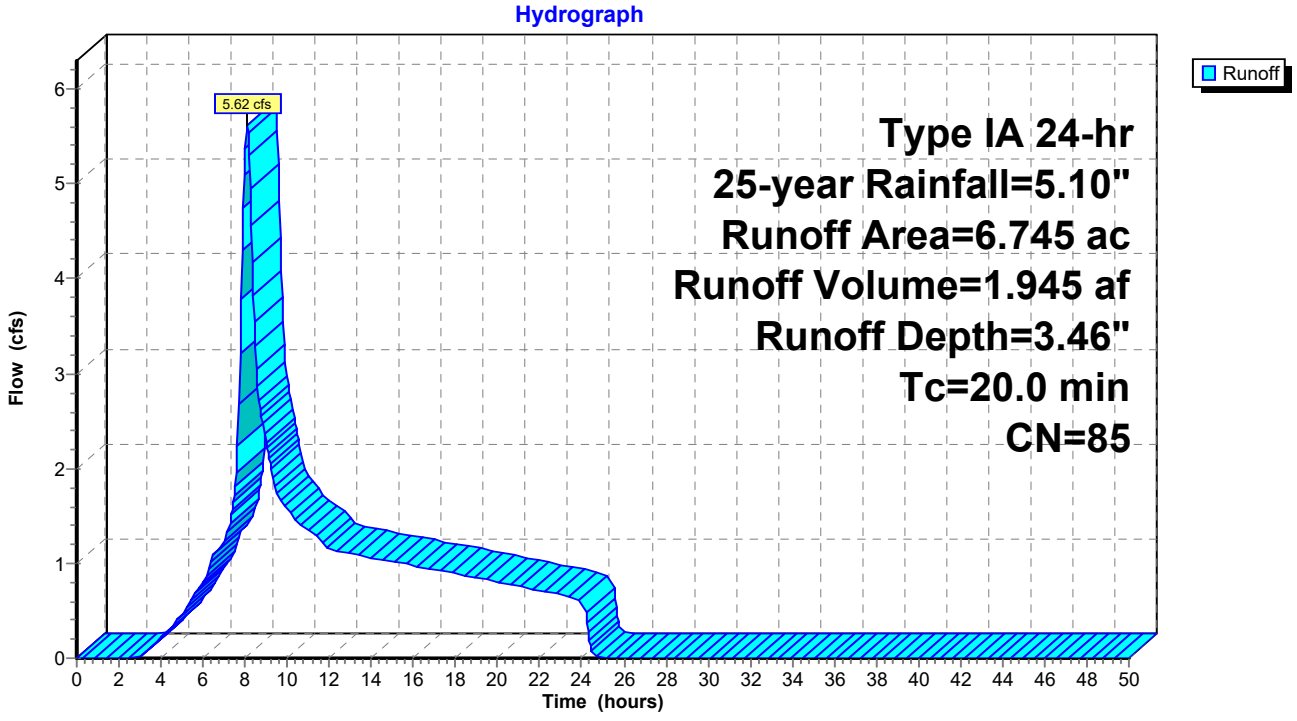
Runoff = 5.62 cfs @ 8.10 hrs, Volume= 1.945 af, Depth= 3.46"
Routed to Pond 7P : Node B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
2.100	98	Roofs, HSG B
4.645	79	<50% Grass cover, Poor, HSG B
6.745	85	Weighted Average
4.645		68.87% Pervious Area
2.100		31.13% Impervious Area

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

Subcatchment 7S: Node B - Subdivision Non-PGIS



Summary for Subcatchment 8S: Node B - Public Non-PGIS

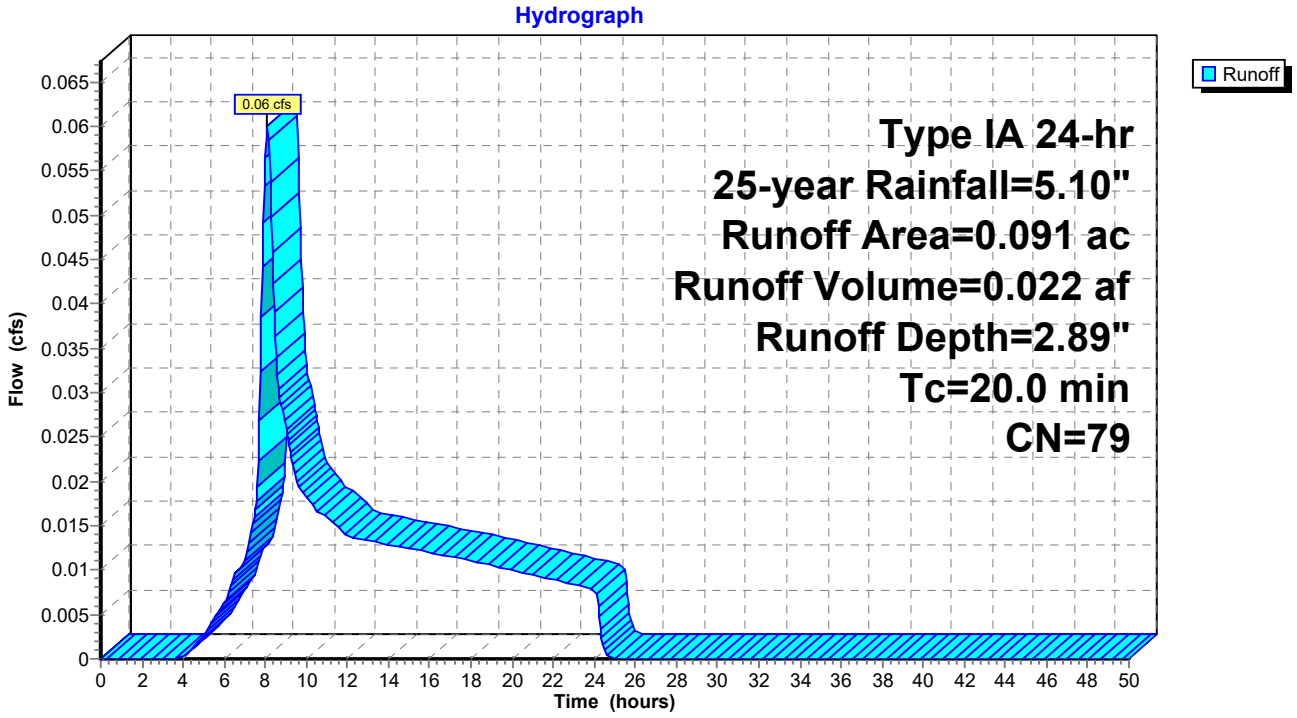
Runoff = 0.06 cfs @ 8.11 hrs, Volume= 0.022 af, Depth= 2.89"
Routed to Pond 7P : Node B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.091	79	<50% Grass cover, Poor, HSG B
0.091		100.00% Pervious Area

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

Subcatchment 8S: Node B - Public Non-PGIS



Summary for Subcatchment 9S: Node B - Subdivision PGIS

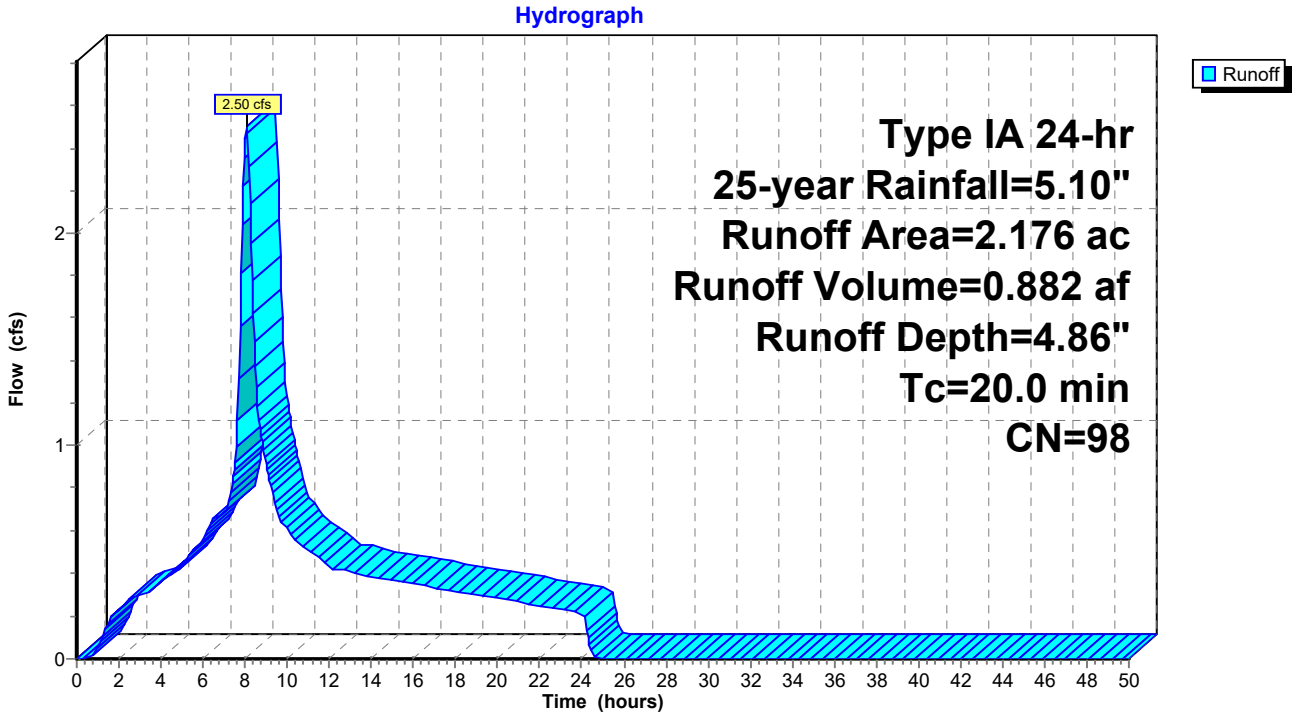
Runoff = 2.50 cfs @ 8.08 hrs, Volume= 0.882 af, Depth= 4.86"
Routed to Pond 11P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
2.176	98	Paved parking, HSG A
2.176		100.00% Impervious Area

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

Subcatchment 9S: Node B - Subdivision PGIS



Summary for Subcatchment 12S: Node C Public PGIS

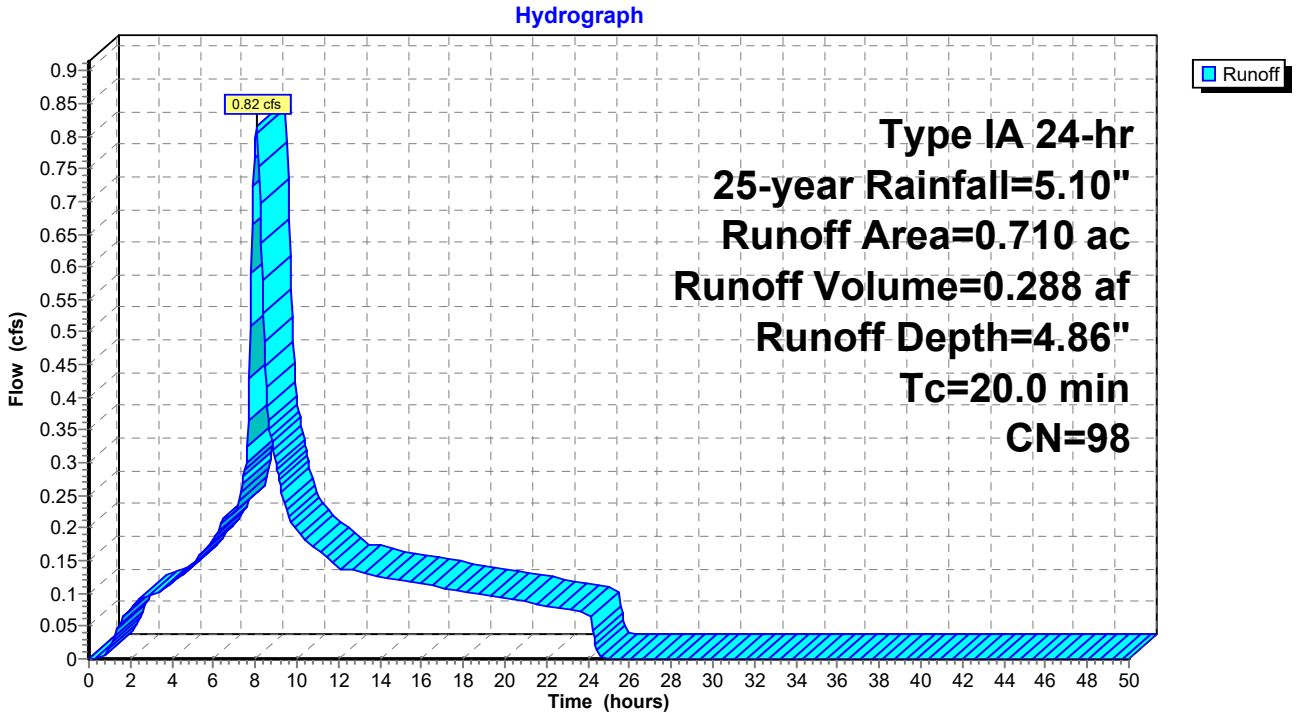
Runoff = 0.82 cfs @ 8.08 hrs, Volume= 0.288 af, Depth= 4.86"
Routed to Pond N2 : Node C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.710	98	Paved parking, HSG B
0.710		100.00% Impervious Area

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

Subcatchment 12S: Node C Public PGIS



Summary for Subcatchment 13S: Node C - Flex Non-PGIS

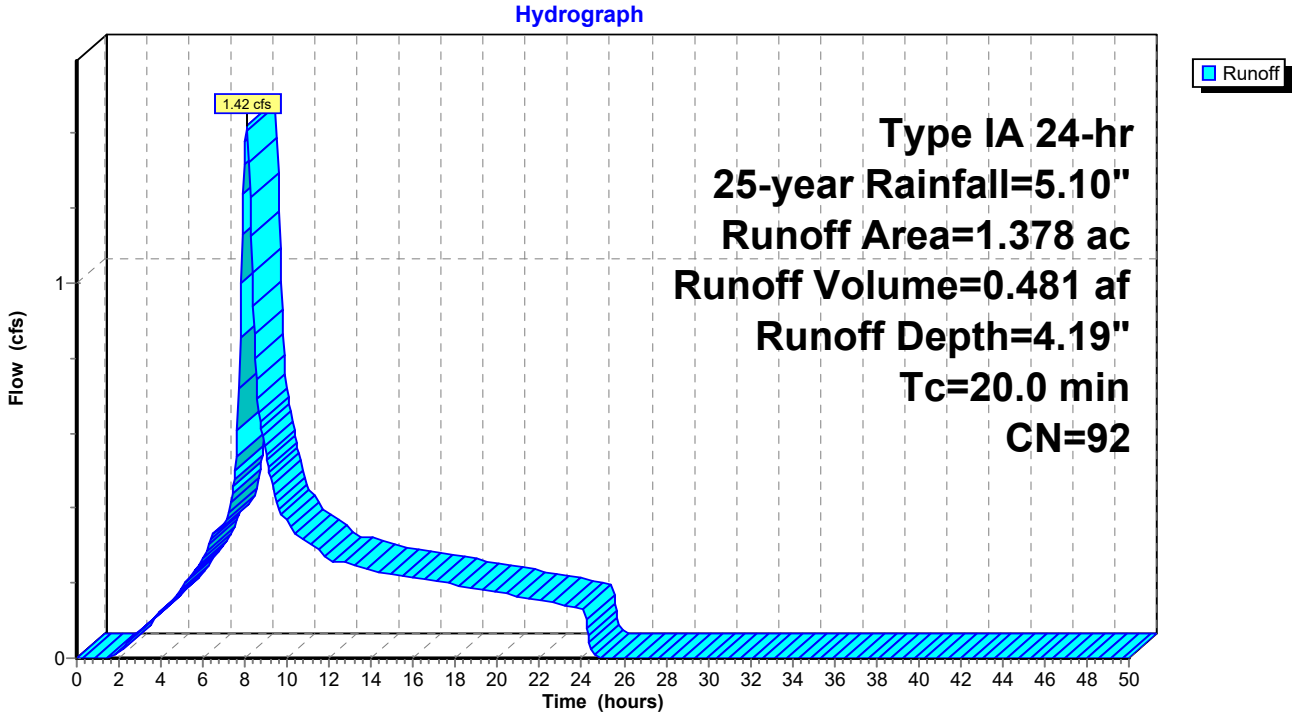
Runoff = 1.42 cfs @ 8.09 hrs, Volume= 0.481 af, Depth= 4.19"
Routed to Pond 16P : Infiltration Trench

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.306	69	50-75% Grass cover, Fair, HSG B
1.072	98	Roofs, HSG A
1.378	92	Weighted Average
0.306		22.21% Pervious Area
1.072		77.79% Impervious Area

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

Subcatchment 13S: Node C - Flex Non-PGIS



Summary for Subcatchment 14S: Node C - Flex PGIS

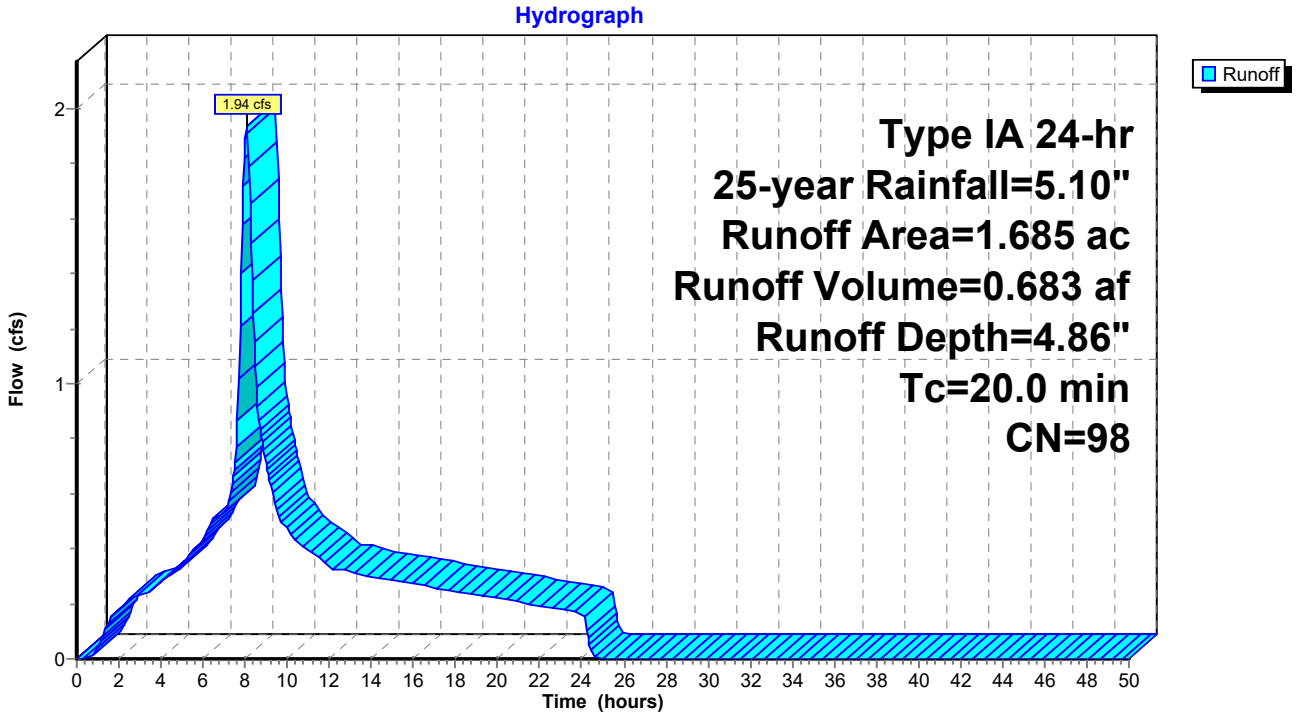
Runoff = 1.94 cfs @ 8.08 hrs, Volume= 0.683 af, Depth= 4.86"
Routed to Pond N2 : Node C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
1.685	98	Paved parking, HSG B
1.685		100.00% Impervious Area

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

Subcatchment 14S: Node C - Flex PGIS



Summary for Subcatchment 17S: Node D - PGIS

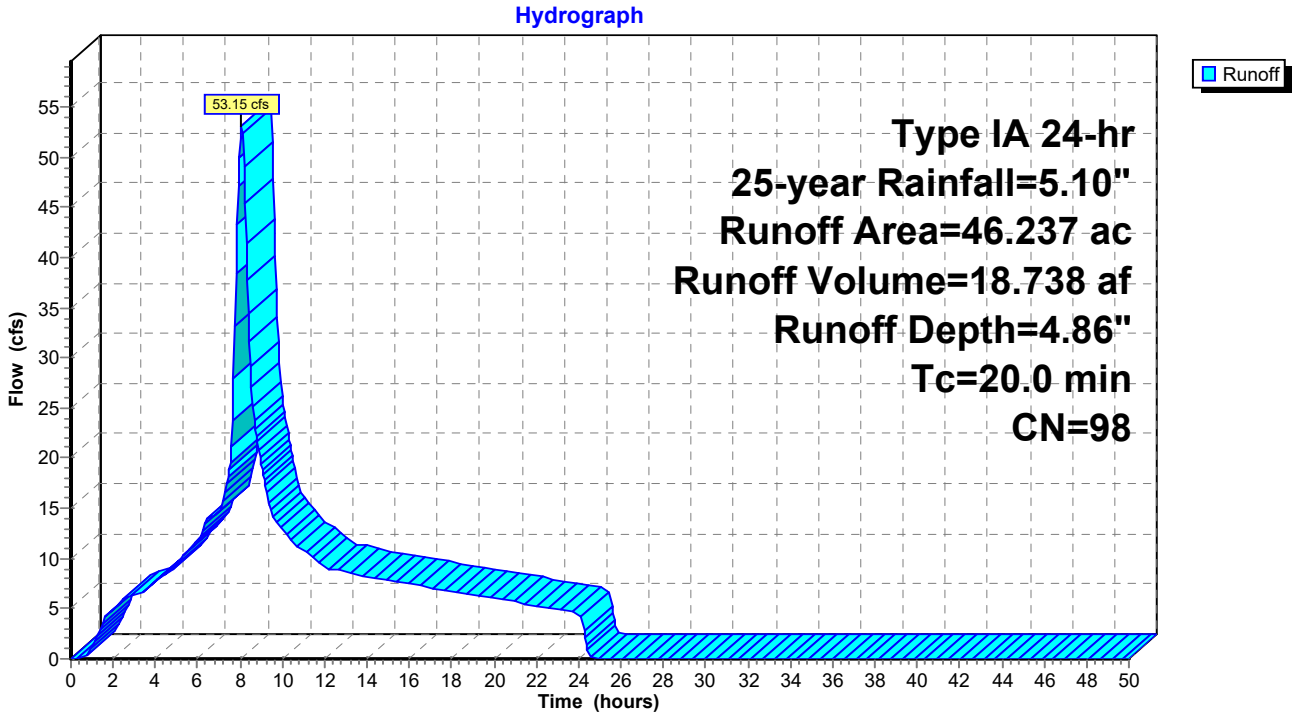
Runoff = 53.15 cfs @ 8.08 hrs, Volume= 18.738 af, Depth= 4.86"
Routed to Pond 3P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
46.237	98	Paved parking, HSG A
46.237		100.00% Impervious Area

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

Subcatchment 17S: Node D - PGIS



Summary for Subcatchment D2R: Node C - Public Non-PGIS

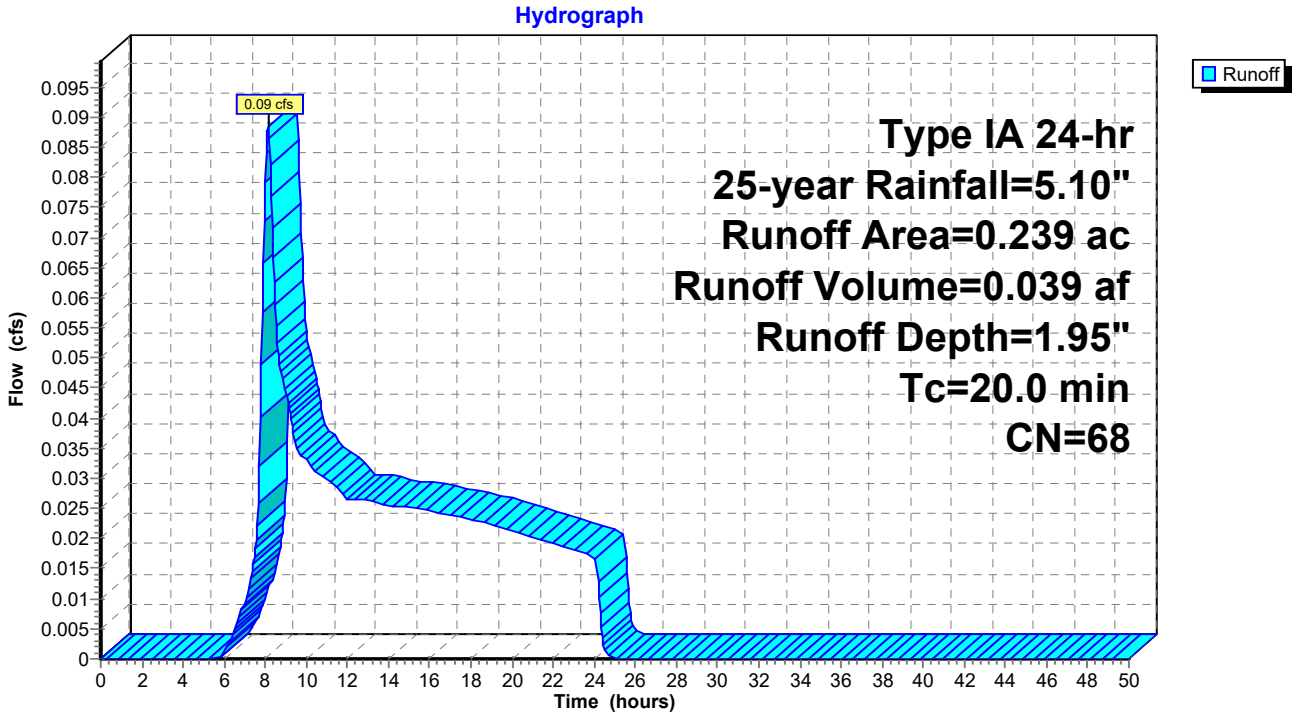
Runoff = 0.09 cfs @ 8.14 hrs, Volume= 0.039 af, Depth= 1.95"
Routed to Pond 15P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.239	68	<50% Grass cover, Poor, HSG A
0.239		100.00% Pervious Area

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

Subcatchment D2R: Node C - Public Non-PGIS



Summary for Subcatchment D3R: Node A - Public PGIS

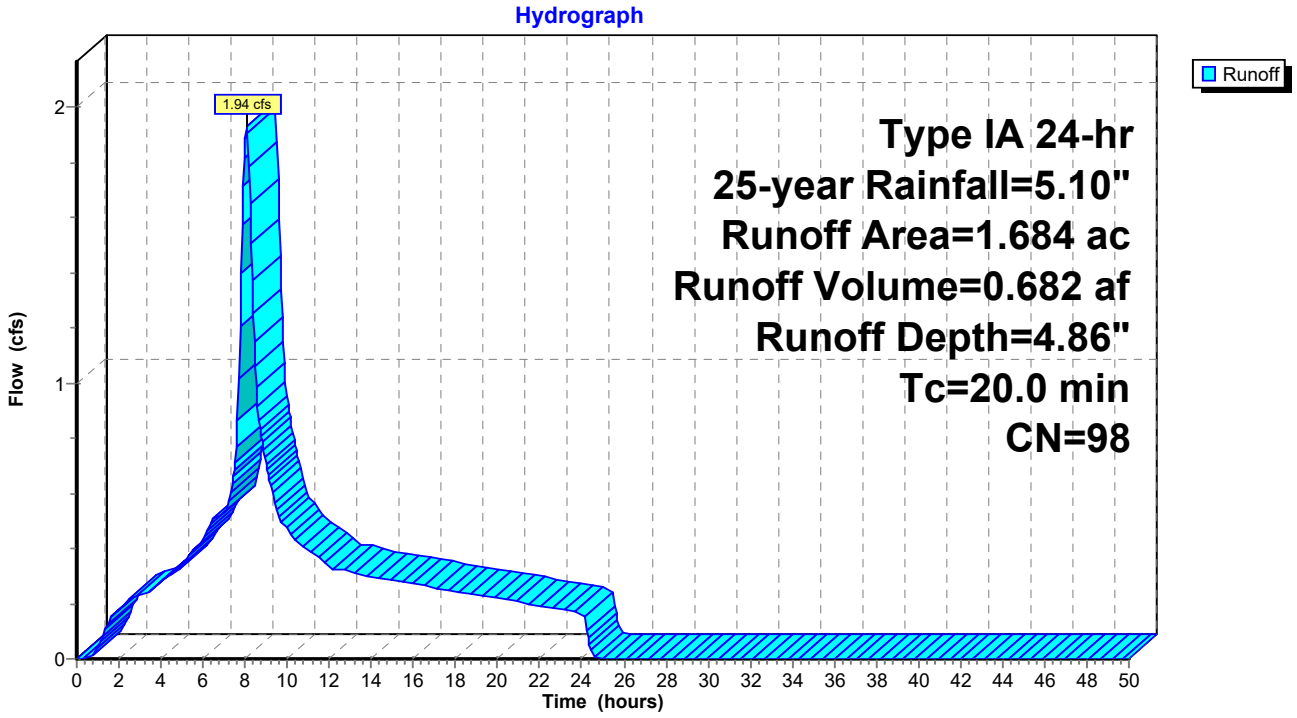
Runoff = 1.94 cfs @ 8.08 hrs, Volume= 0.682 af, Depth= 4.86"
Routed to Pond 4P : Bioretention+Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
1.684	98	Paved parking, HSG B
1.684		100.00% Impervious Area

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

Subcatchment D3R: Node A - Public PGIS



Summary for Subcatchment D5P: Node D - Non-PGIS

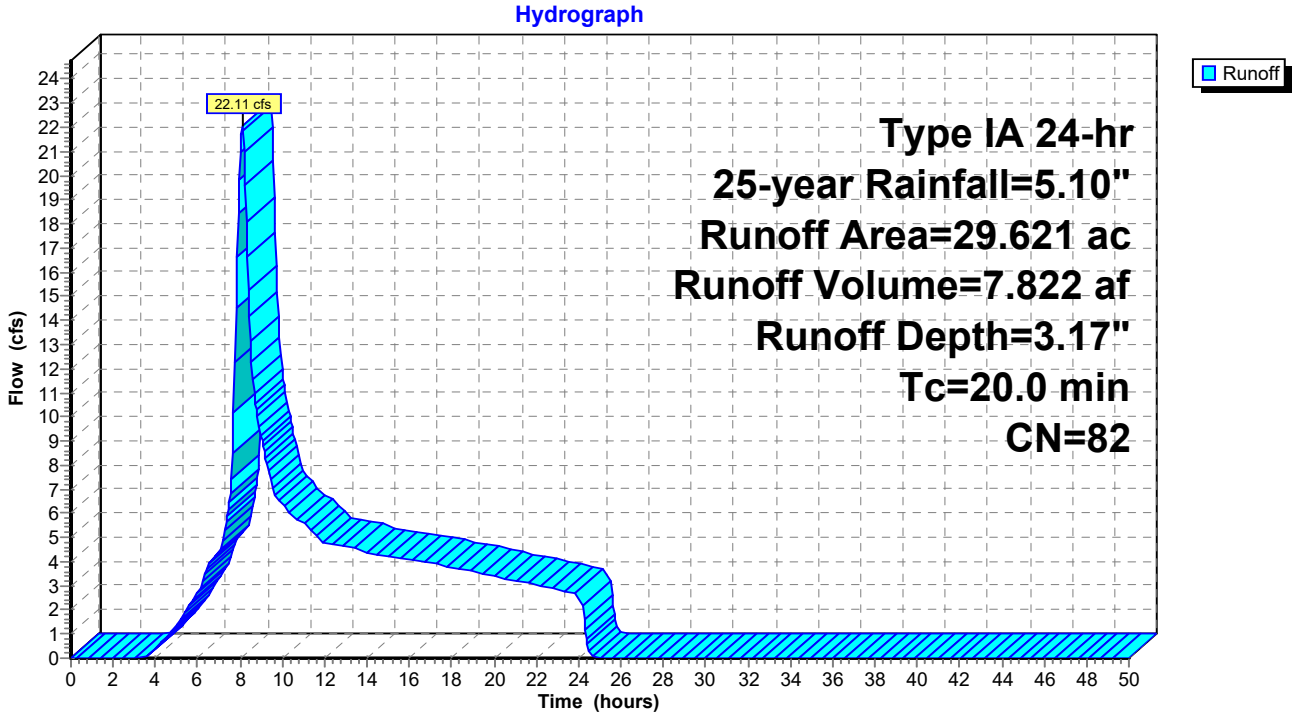
Runoff = 22.11 cfs @ 8.11 hrs, Volume= 7.822 af, Depth= 3.17"
Routed to Pond N1 : Node D

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
9.462	49	50-75% Grass cover, Fair, HSG A
20.159	98	Roofs, HSG B
29.621	82	Weighted Average
9.462		31.94% Pervious Area
20.159		68.06% Impervious Area

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

Subcatchment D5P: Node D - Non-PGIS



Summary for Pond 3P: Bioretention

Inflow Area = 46.237 ac,100.00% Impervious, Inflow Depth = 4.86" for 25-year event
Inflow = 53.15 cfs @ 8.08 hrs, Volume= 18.738 af
Outflow = 28.78 cfs @ 8.51 hrs, Volume= 18.424 af, Atten= 46%, Lag= 25.9 min
Primary = 28.78 cfs @ 8.51 hrs, Volume= 18.424 af
Routed to Pond 19P : Infiltration Trench

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 54.62' @ 8.51 hrs Surf.Area= 1.674 ac Storage= 2.845 af

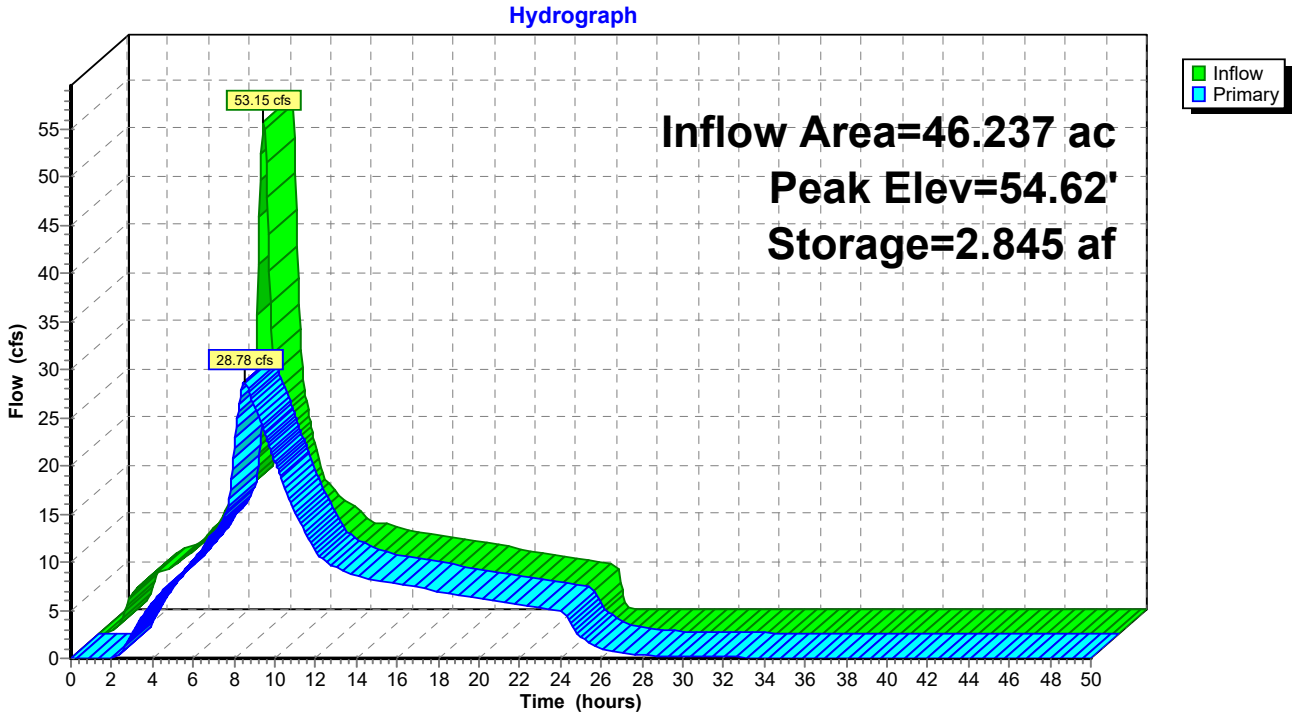
Plug-Flow detention time= 90.8 min calculated for 18.424 af (98% of inflow)
Center-of-Mass det. time= 77.7 min (745.3 - 667.6)

Volume	Invert	Avail.Storage	Storage Description
#1	50.00'	2.629 af	**270.00'W x 270.00'L x 6.50'H Prismatoid** 10.878 af Overall - 3.367 af Embedded = 7.512 af x 35.0% Voids
#2	54.50'	3.347 af	**270.00'W x 270.00'L x 2.00'H Prismatoid** Inside #1
#3	50.50'	0.019 af	**24.0" Round Pipe Storage** Inside #1 L= 269.0'
		5.996 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	54.50'	**60.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	50.50'	**24.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=28.76 cfs @ 8.51 hrs HW=54.62' (Free Discharge)
1=Orifice/Grate (Weir Controls 2.05 cfs @ 1.12 fps)
2=Orifice/Grate (Orifice Controls 26.71 cfs @ 8.50 fps)

Pond 3P: Bioretention



Summary for Pond 4P: Bioretention+Infiltration

Inflow Area = 1.684 ac,100.00% Impervious, Inflow Depth = 4.86" for 25-year event
Inflow = 1.94 cfs @ 8.08 hrs, Volume= 0.682 af
Outflow = 1.93 cfs @ 8.11 hrs, Volume= 0.682 af, Atten= 0%, Lag= 1.7 min
Primary = 0.15 cfs @ 8.11 hrs, Volume= 0.277 af
Secondary = 1.78 cfs @ 8.11 hrs, Volume= 0.406 af
Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 3.73' @ 8.11 hrs Surf.Area= 0.029 ac Storage= 0.037 af

Plug-Flow detention time= 65.8 min calculated for 0.682 af (100% of inflow)
Center-of-Mass det. time= 65.7 min (733.3 - 667.6)

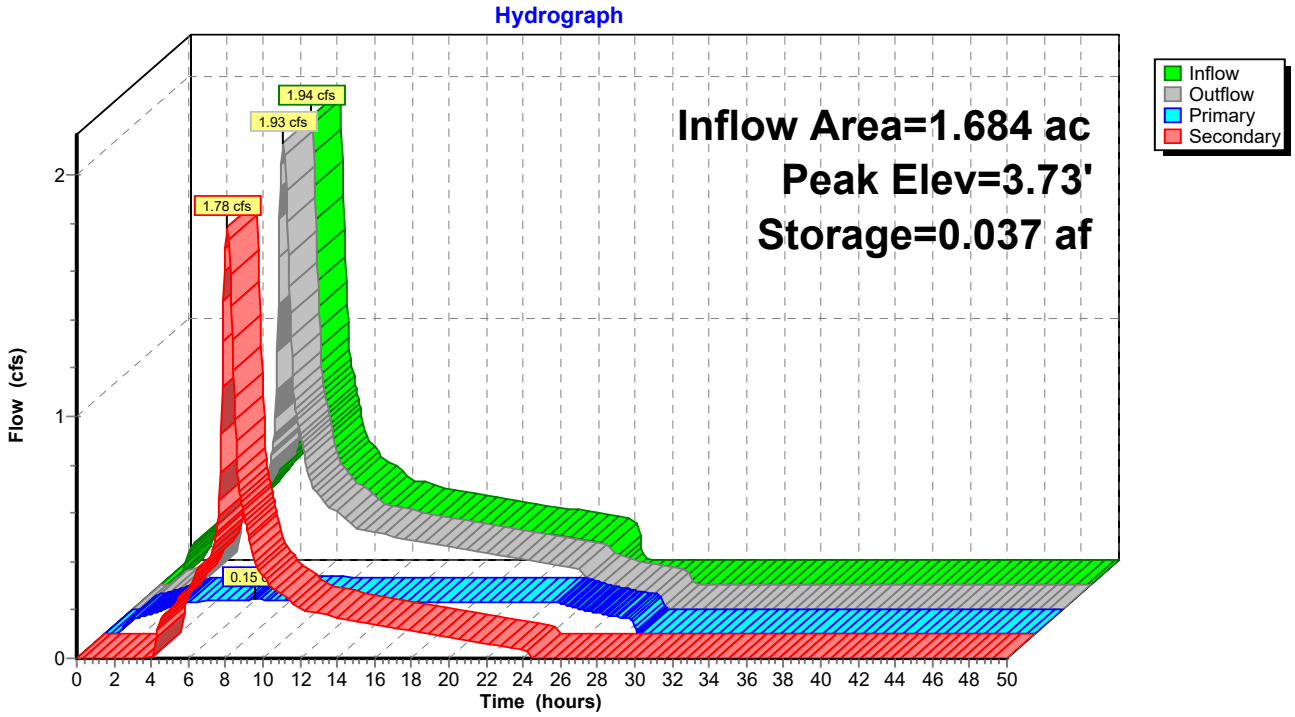
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.050 af	**5.00'W x 250.00'L x 5.00'H Bioretention** 0.143 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.15 cfs @ 8.11 hrs HW=3.73' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.15 cfs)

Secondary OutFlow Max=1.78 cfs @ 8.11 hrs HW=3.73' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 1.78 cfs @ 2.90 fps)

Pond 4P: Bioretention+Infiltration



Summary for Pond 5P: Bioretention+Infiltration

Inflow Area = 7.516 ac,100.00% Impervious, Inflow Depth = 4.86" for 25-year event
Inflow = 8.64 cfs @ 8.08 hrs, Volume= 3.046 af
Outflow = 8.62 cfs @ 8.10 hrs, Volume= 3.046 af, Atten= 0%, Lag= 1.2 min
Primary = 0.36 cfs @ 8.10 hrs, Volume= 0.882 af
Secondary = 8.26 cfs @ 8.10 hrs, Volume= 2.164 af
Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 4.97' @ 8.10 hrs Surf.Area= 0.138 ac Storage= 0.240 af

Plug-Flow detention time= 109.9 min calculated for 3.046 af (100% of inflow)
Center-of-Mass det. time= 109.8 min (777.4 - 667.6)

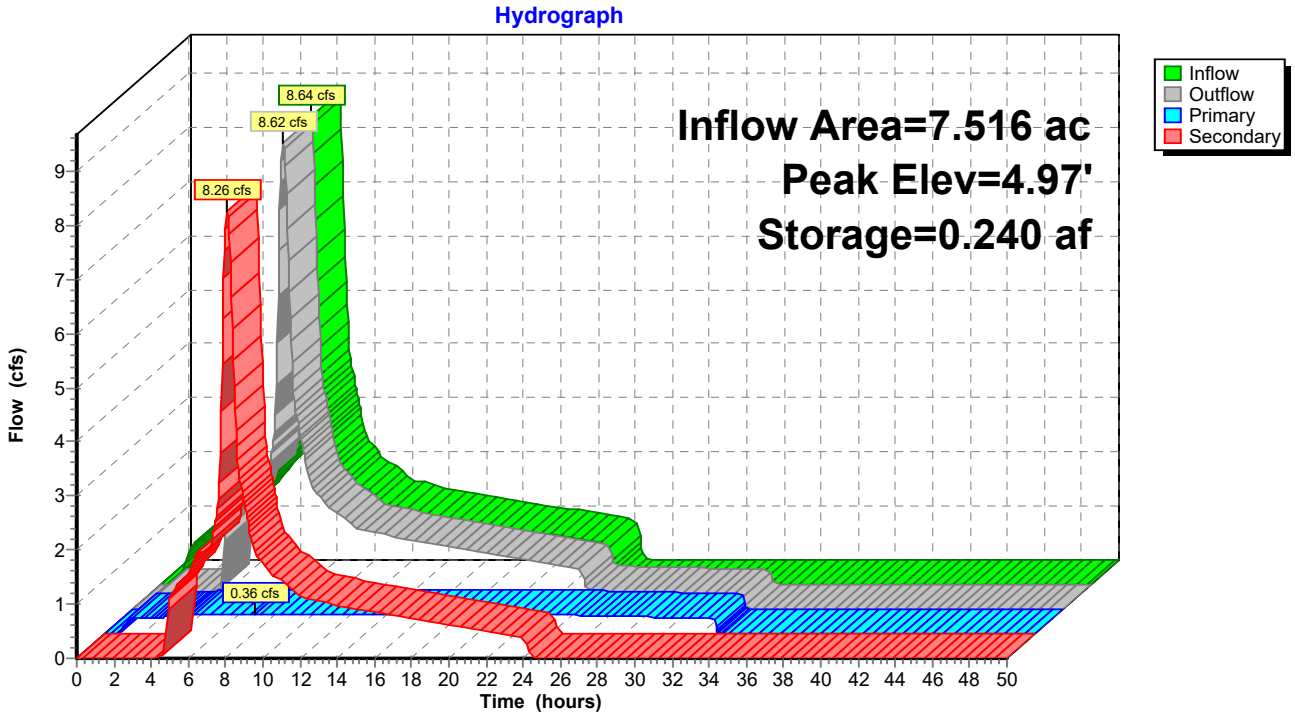
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.241 af	**50.00'W x 120.00'L x 5.00'H Infiltration Trench** 0.689 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.50'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.36 cfs @ 8.10 hrs HW=4.97' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.36 cfs)

Secondary OutFlow Max=8.25 cfs @ 8.10 hrs HW=4.97' (Free Discharge)
↑**2=Orifice/Grate** (Weir Controls 8.25 cfs @ 2.24 fps)

Pond 5P: Bioretention+Infiltration



Summary for Pond 7P: Node B

[57] Hint: Peaked at 48.77' (Flood elevation advised)
[81] Warning: Exceeded Pond 10P by 45.52' @ 8.10 hrs
[81] Warning: Exceeded Pond 11P by 44.53' @ 33.00 hrs
[79] Warning: Submerged Pond N3 Primary device # 1 INLET by 7.33'

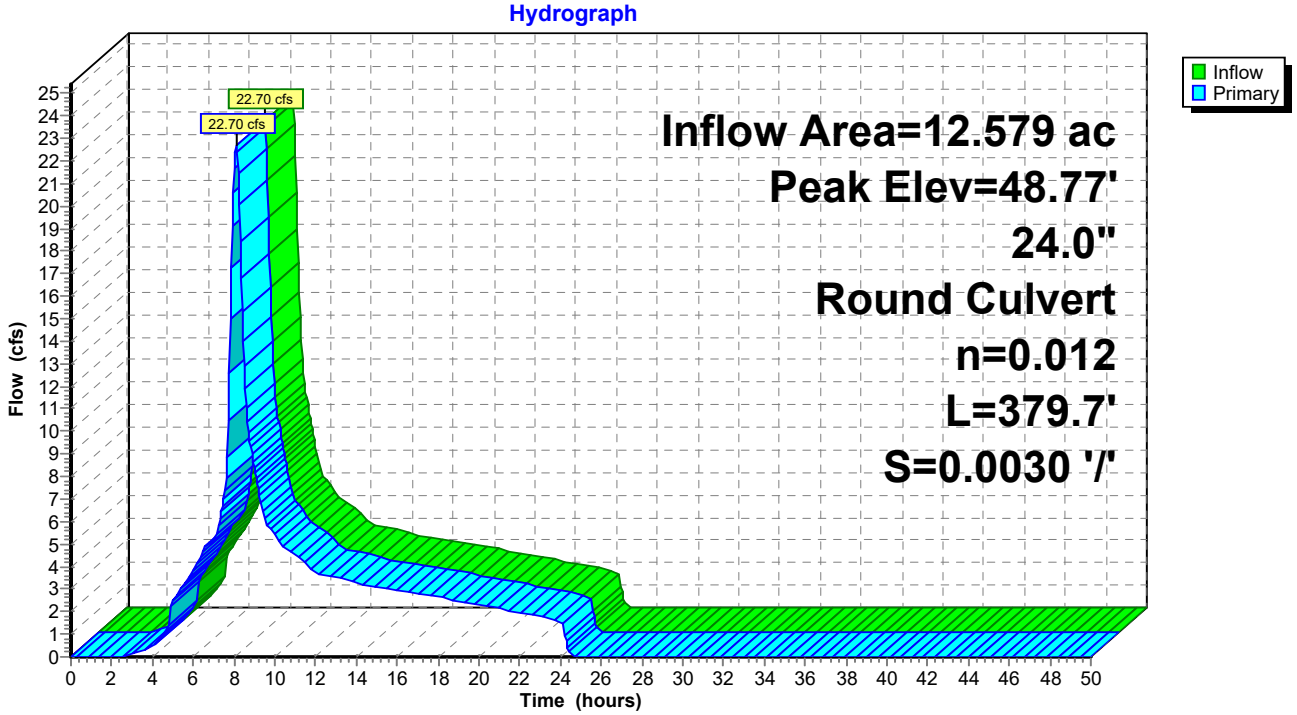
Inflow Area = 12.579 ac, 43.51% Impervious, Inflow Depth = 6.37" for 25-year event
Inflow = 22.70 cfs @ 8.10 hrs, Volume= 6.681 af
Outflow = 22.70 cfs @ 8.10 hrs, Volume= 6.681 af, Atten= 0%, Lag= 0.0 min
Primary = 22.70 cfs @ 8.10 hrs, Volume= 6.681 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 48.77' @ 8.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	40.33'	**24.0" Round Culvert** L= 379.7' Ke= 0.200 Inlet / Outlet Invert= 40.33' / 39.19' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=22.70 cfs @ 8.10 hrs HW=48.77' TW=44.53' (Fixed TW Elev= 44.53')
1=Culvert (Outlet Controls 22.70 cfs @ 7.22 fps)

Pond 7P: Node B



Summary for Pond 10P: Bioretention

Inflow Area = 0.250 ac,100.00% Impervious, Inflow Depth = 4.86" for 25-year event
Inflow = 0.29 cfs @ 8.08 hrs, Volume= 0.101 af
Outflow = 0.29 cfs @ 8.09 hrs, Volume= 0.101 af, Atten= 0%, Lag= 0.5 min
Primary = 0.02 cfs @ 8.09 hrs, Volume= 0.045 af
Secondary = 0.26 cfs @ 8.09 hrs, Volume= 0.056 af
Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 3.25' @ 8.09 hrs Surf.Area= 0.005 ac Storage= 0.005 af

Plug-Flow detention time= 67.0 min calculated for 0.101 af (100% of inflow)
Center-of-Mass det. time= 67.1 min (734.7 - 667.6)

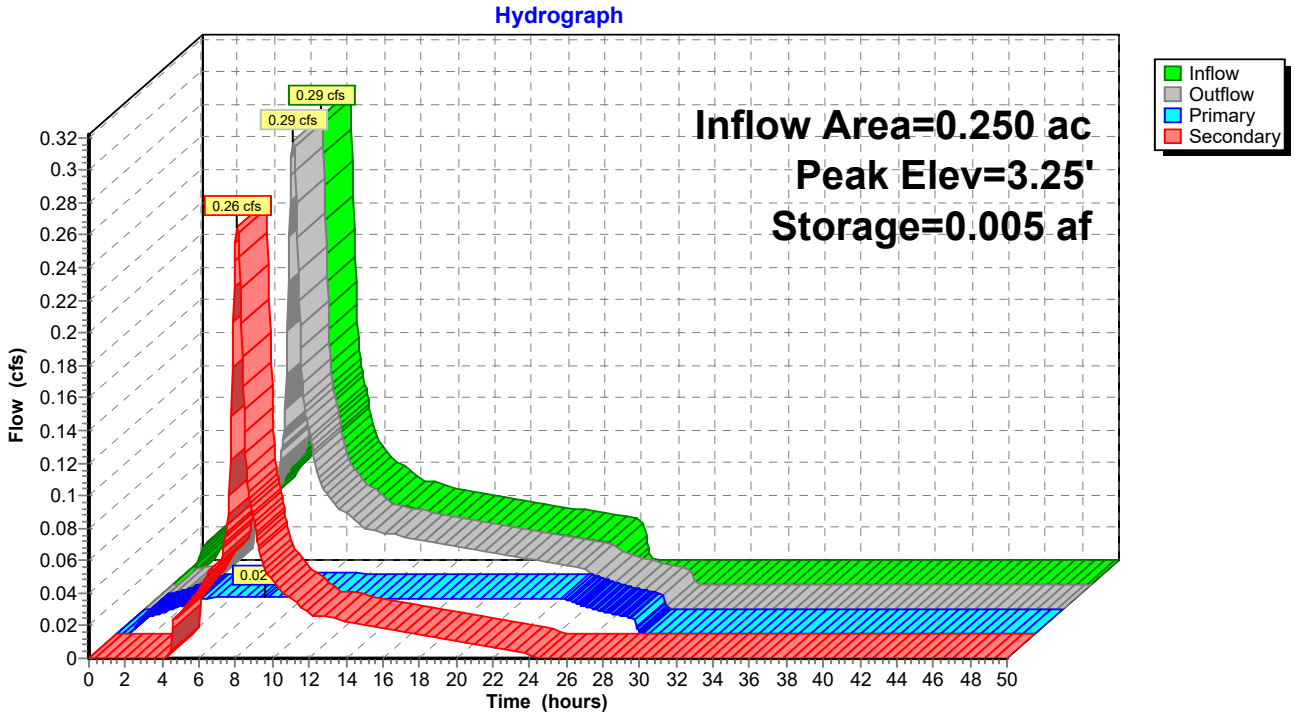
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.008 af	**5.00'W x 40.00'L x 5.00'H Bioretention** 0.023 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.02 cfs @ 8.09 hrs HW=3.25' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Secondary OutFlow Max=0.26 cfs @ 8.09 hrs HW=3.25' (Free Discharge)
↑**2=Orifice/Grate** (Orifice Controls 0.26 cfs @ 1.71 fps)

Pond 10P: Bioretention



Summary for Pond 11P: Bioretention

Inflow Area = 2.176 ac,100.00% Impervious, Inflow Depth = 4.86" for 25-year event
Inflow = 2.50 cfs @ 8.08 hrs, Volume= 0.882 af
Outflow = 2.48 cfs @ 8.11 hrs, Volume= 0.882 af, Atten= 1%, Lag= 2.0 min
Primary = 0.19 cfs @ 8.11 hrs, Volume= 0.356 af
Secondary = 2.30 cfs @ 8.11 hrs, Volume= 0.526 af
Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 4.87' @ 8.11 hrs Surf.Area= 0.031 ac Storage= 0.053 af

Plug-Flow detention time= 73.2 min calculated for 0.881 af (100% of inflow)
Center-of-Mass det. time= 73.4 min (741.0 - 667.6)

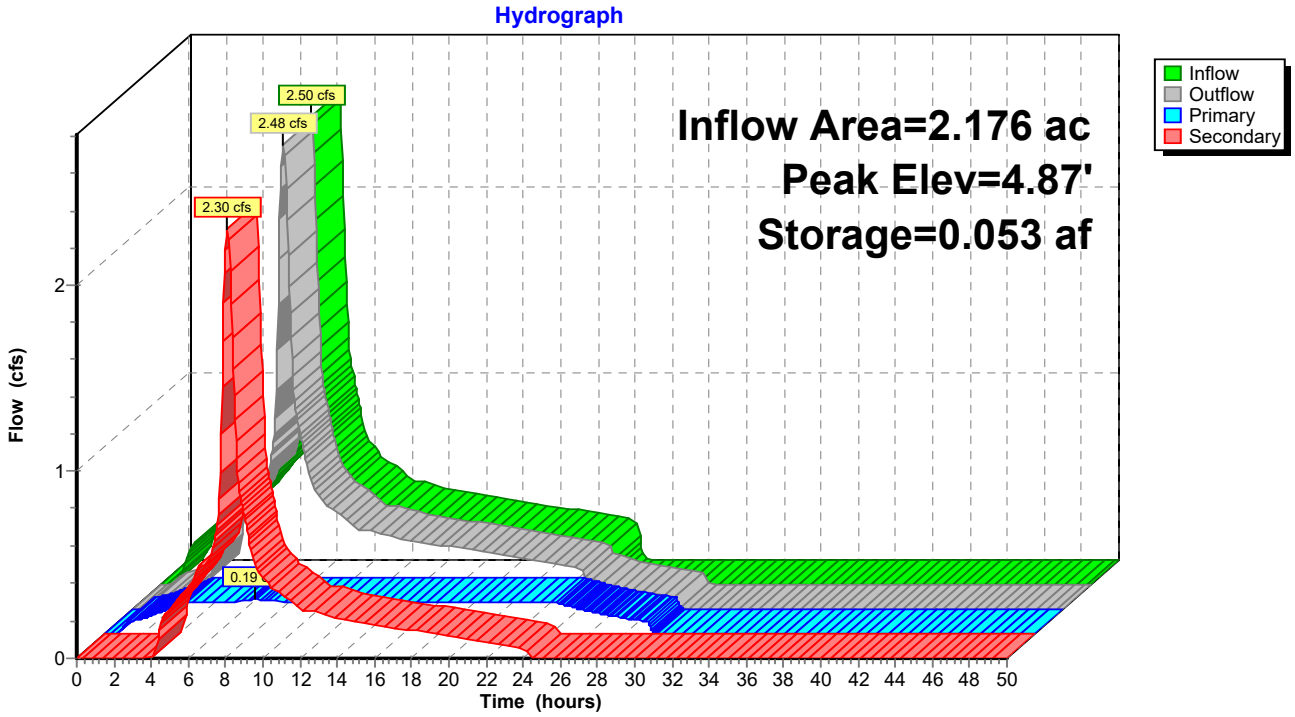
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.065 af	**5.00'W x 270.00'L x 6.00'H Bioretention** 0.186 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.19 cfs @ 8.11 hrs HW=4.87' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.19 cfs)

Secondary OutFlow Max=2.30 cfs @ 8.11 hrs HW=4.87' (Free Discharge)
↑**2=Orifice/Grate** (Orifice Controls 2.30 cfs @ 3.17 fps)

Pond 11P: Bioretention



Summary for Pond 15P: Bioretention

Inflow Area = 0.239 ac, 0.00% Impervious, Inflow Depth = 1.95" for 25-year event
Inflow = 0.09 cfs @ 8.14 hrs, Volume= 0.039 af
Outflow = 0.04 cfs @ 9.47 hrs, Volume= 0.039 af, Atten= 59%, Lag= 79.6 min
Primary = 0.04 cfs @ 9.47 hrs, Volume= 0.039 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 0.73' @ 9.47 hrs Surf.Area= 0.014 ac Storage= 0.004 af

Plug-Flow detention time= 31.1 min calculated for 0.039 af (100% of inflow)
Center-of-Mass det. time= 31.1 min (884.7 - 853.6)

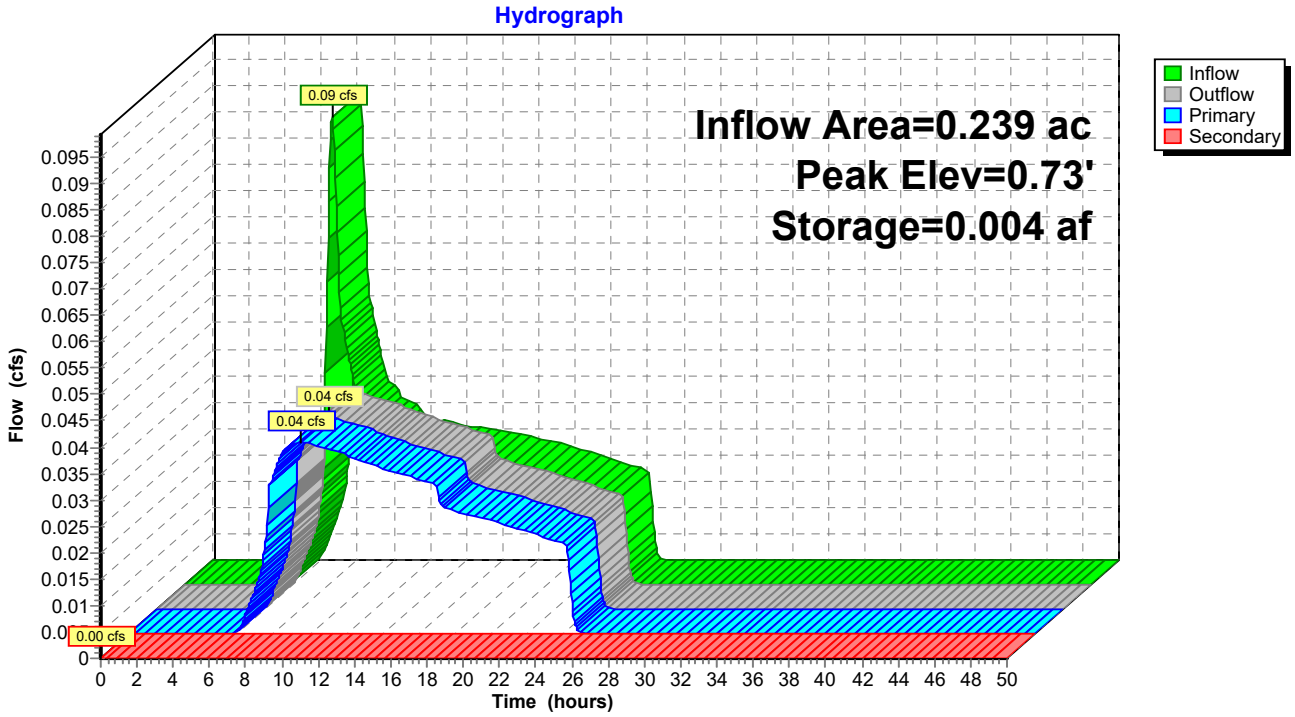
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.024 af	**5.00'W x 120.00'L x 5.00'H Bioretention** 0.069 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.04 cfs @ 9.47 hrs HW=0.73' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
└**2=Orifice/Grate** (Controls 0.00 cfs)

Pond 15P: Bioretention



Summary for Pond 16P: Infiltration Trench

Inflow Area = 1.378 ac, 77.79% Impervious, Inflow Depth = 4.19" for 25-year event
Inflow = 1.42 cfs @ 8.09 hrs, Volume= 0.481 af
Outflow = 1.41 cfs @ 8.12 hrs, Volume= 0.481 af, Atten= 1%, Lag= 1.8 min
Primary = 0.09 cfs @ 8.12 hrs, Volume= 0.189 af
Secondary = 1.32 cfs @ 8.12 hrs, Volume= 0.292 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 4.61' @ 8.12 hrs Surf.Area= 0.028 ac Storage= 0.044 af

Plug-Flow detention time= 110.7 min calculated for 0.480 af (100% of inflow)
Center-of-Mass det. time= 111.0 min (827.2 - 716.3)

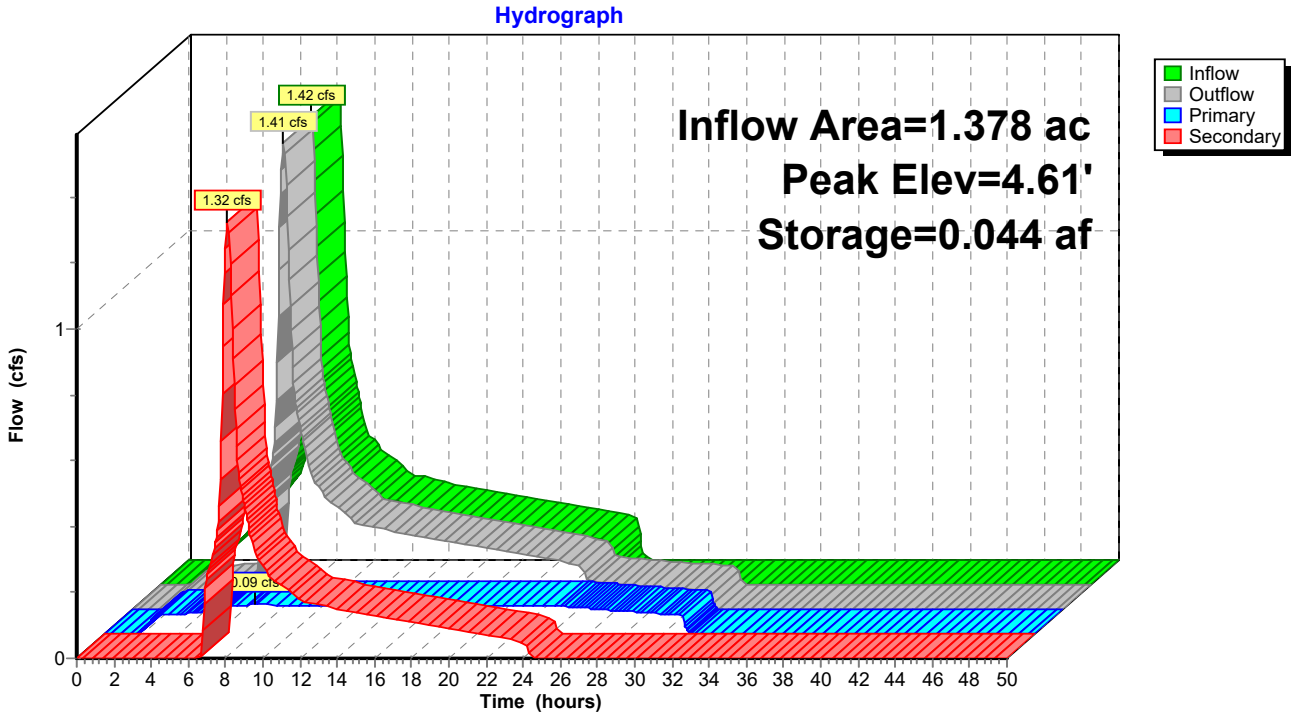
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.058 af	**20.00'W x 60.00'L x 6.00'H Infiltration Trench** 0.165 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.09 cfs @ 8.12 hrs HW=4.61' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Secondary OutFlow Max=1.32 cfs @ 8.12 hrs HW=4.61' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 1.32 cfs @ 2.65 fps)

Pond 16P: Infiltration Trench



Summary for Pond 19P: Infiltration Trench

Inflow Area = 46.237 ac,100.00% Impervious, Inflow Depth > 4.78" for 25-year event
Inflow = 28.78 cfs @ 8.51 hrs, Volume= 18.424 af
Outflow = 27.97 cfs @ 8.70 hrs, Volume= 18.424 af, Atten= 3%, Lag= 11.7 min
Primary = 3.57 cfs @ 8.70 hrs, Volume= 8.564 af
Secondary = 24.41 cfs @ 8.70 hrs, Volume= 9.860 af
Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 3.86' @ 8.70 hrs Surf.Area= 1.674 ac Storage= 2.259 af

Plug-Flow detention time= 143.4 min calculated for 18.424 af (100% of inflow)
Center-of-Mass det. time= 143.3 min (888.6 - 745.3)

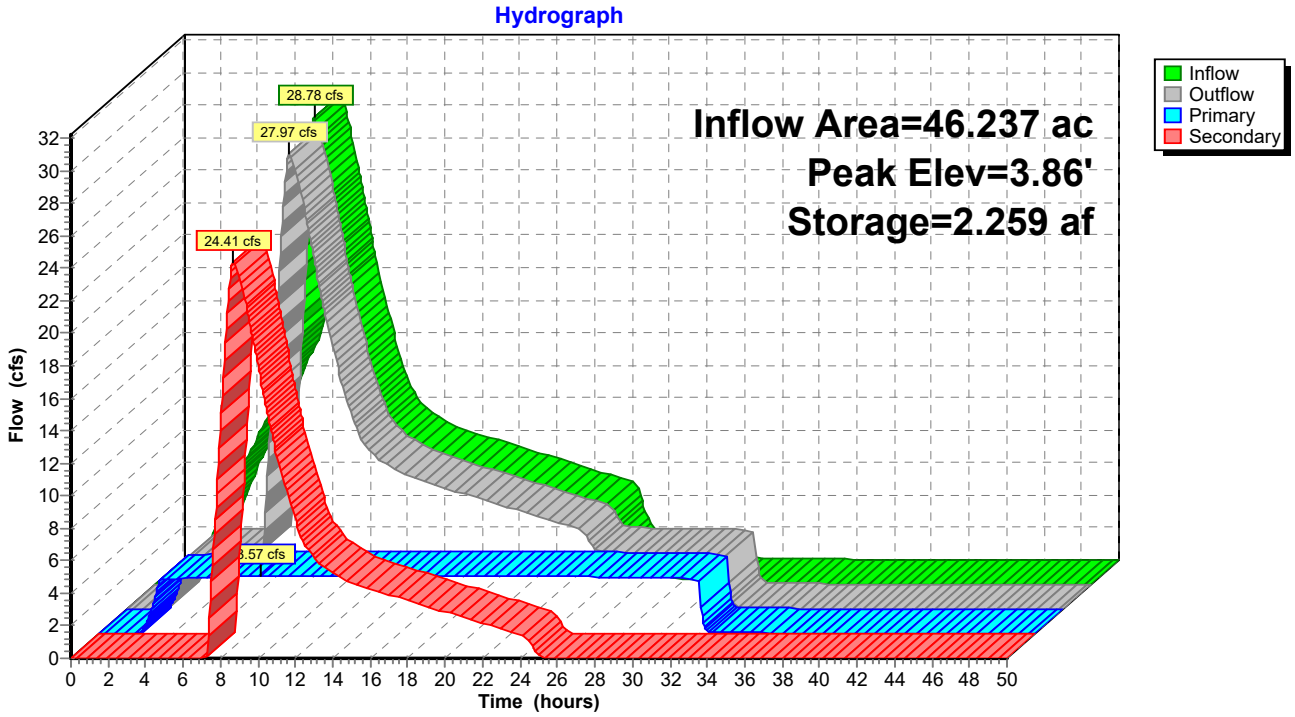
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	2.929 af	**270.00'W x 270.00'L x 5.00'H Infiltration Trench** 8.368 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.57 cfs @ 8.70 hrs HW=3.86' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 3.57 cfs)

Secondary OutFlow Max=24.40 cfs @ 8.70 hrs HW=3.86' (Free Discharge)
↑**2=Orifice/Grate** (Weir Controls 24.40 cfs @ 3.03 fps)

Pond 19P: Infiltration Trench



Summary for Pond N1: Node D

[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=58)
[81] Warning: Exceeded Pond 19P by 41.00' @ 2.00 hrs
[79] Warning: Submerged Pond N2 Primary device # 1 INLET by 3.29'

Inflow Area = 44.595 ac, 62.85% Impervious, Inflow Depth = 6.90" for 25-year event
Inflow = 65.60 cfs @ 8.14 hrs, Volume= 25.625 af
Outflow = 56.41 cfs @ 8.38 hrs, Volume= 25.621 af, Atten= 14%, Lag= 14.0 min
Primary = 56.41 cfs @ 8.38 hrs, Volume= 25.621 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 42.48' @ 8.38 hrs Surf.Area= 36,800 sf Storage= 16,980 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.8 min (743.3 - 742.5)

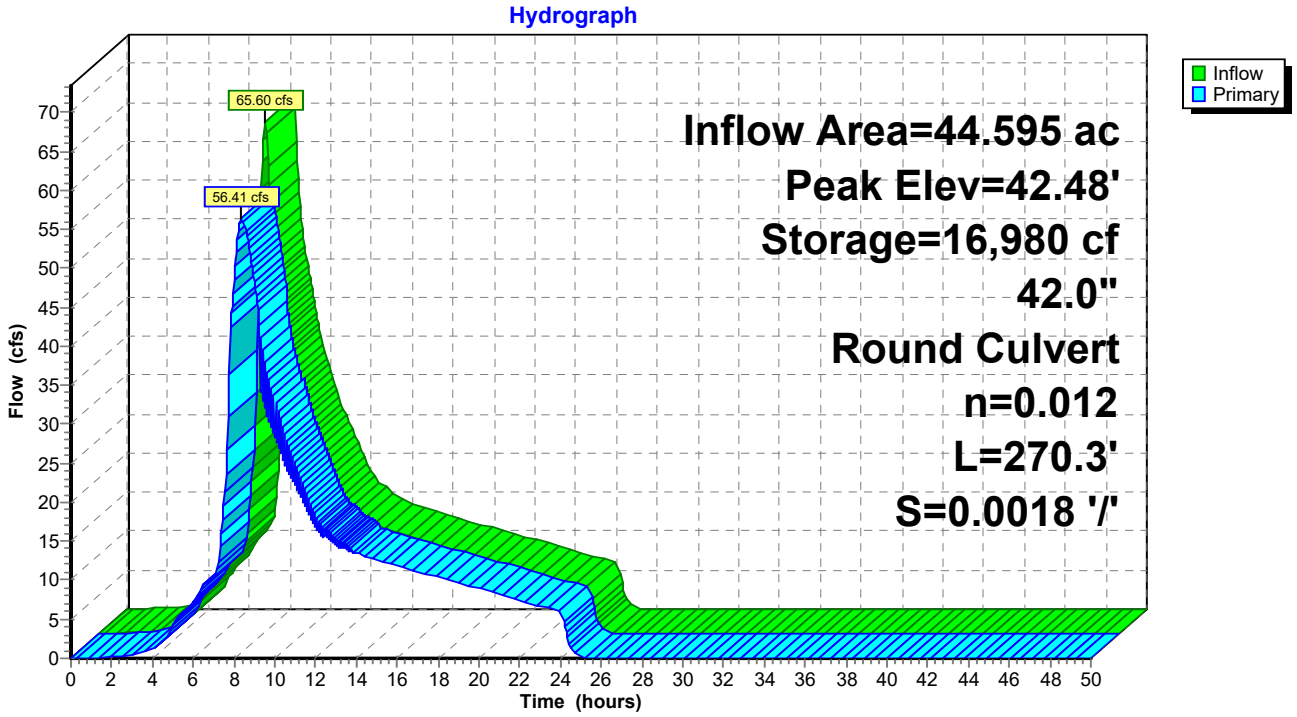
Volume	Invert	Avail.Storage	Storage Description
#1	38.00'	922,840 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	50	0	0
41.99	50	200	200
42.00	32,000	160	360
48.00	91,616	370,848	371,208
49.00	270,816	181,216	552,424
50.00	470,016	370,416	922,840

Device	Routing	Invert	Outlet Devices
#1	Primary	38.00'	**42.0" Round Culvert** L= 270.3' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 38.00' / 37.50' S= 0.0018 '/' Cc= 0.900 n= 0.012, Flow Area= 9.62 sf

Primary OutFlow Max=56.39 cfs @ 8.38 hrs HW=42.48' TW=41.00' (Fixed TW Elev= 41.00')
↑—**1=Culvert** (Inlet Controls 56.39 cfs @ 5.86 fps)

Pond N1: Node D



Summary for Pond N2: Node C

[57] Hint: Peaked at 44.53' (Flood elevation advised)
[81] Warning: Exceeded Pond 7P by 2.15' @ 2.10 hrs
[81] Warning: Exceeded Pond 15P by 44.25' @ 8.05 hrs
[81] Warning: Exceeded Pond 16P by 42.48' @ 1.60 hrs

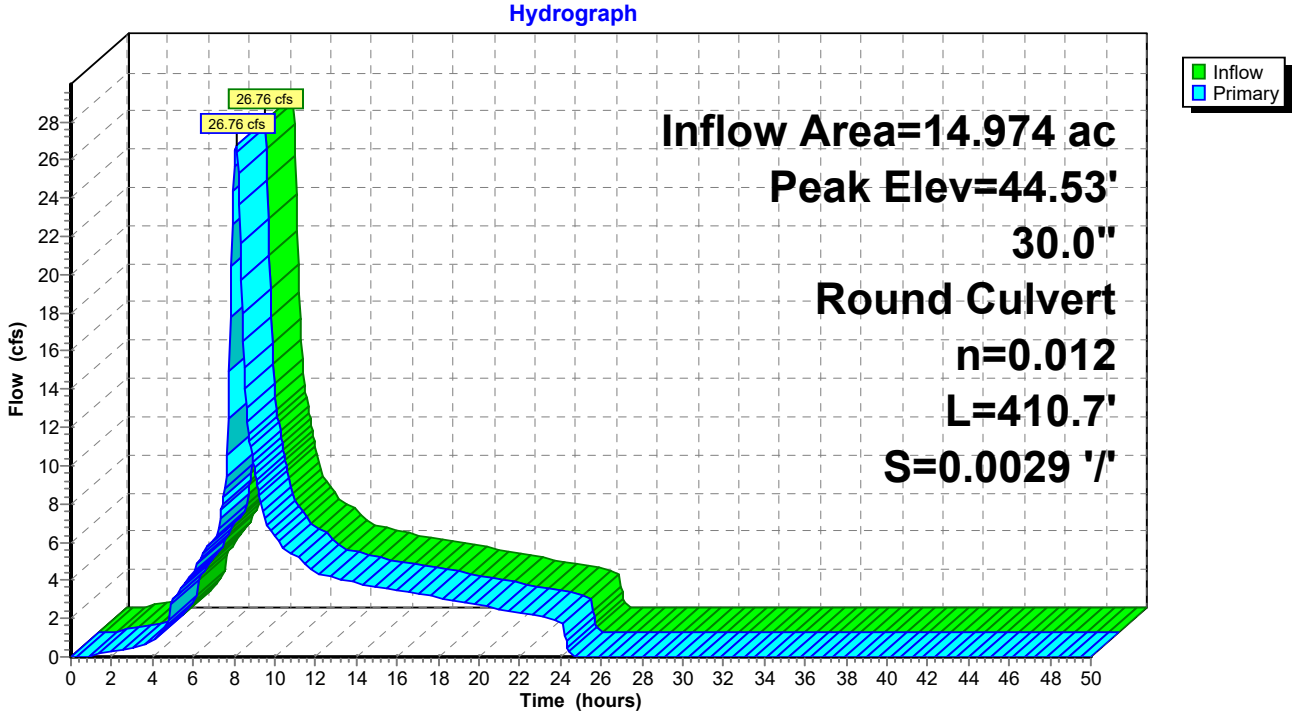
Inflow Area = 14.974 ac, 52.54% Impervious, Inflow Depth = 6.37" for 25-year event
Inflow = 26.76 cfs @ 8.10 hrs, Volume= 7.943 af
Outflow = 26.76 cfs @ 8.10 hrs, Volume= 7.943 af, Atten= 0%, Lag= 0.0 min
Primary = 26.76 cfs @ 8.10 hrs, Volume= 7.943 af
Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 44.53' @ 8.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	39.19'	**30.0" Round Culvert** L= 410.7' Ke= 0.200 Inlet / Outlet Invert= 39.19' / 38.00' S= 0.0029 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 4.91 sf

Primary OutFlow Max=26.76 cfs @ 8.10 hrs HW=44.53' TW=42.48' (Fixed TW Elev= 42.48')
└**1=Culvert** (Outlet Controls 26.76 cfs @ 5.45 fps)

Pond N2: Node C



Summary for Pond N3: Node A

[57] Hint: Peaked at 50.45' (Flood elevation advised)
[81] Warning: Exceeded Pond 4P by 48.70' @ 31.50 hrs
[81] Warning: Exceeded Pond 5P by 48.70' @ 35.90 hrs

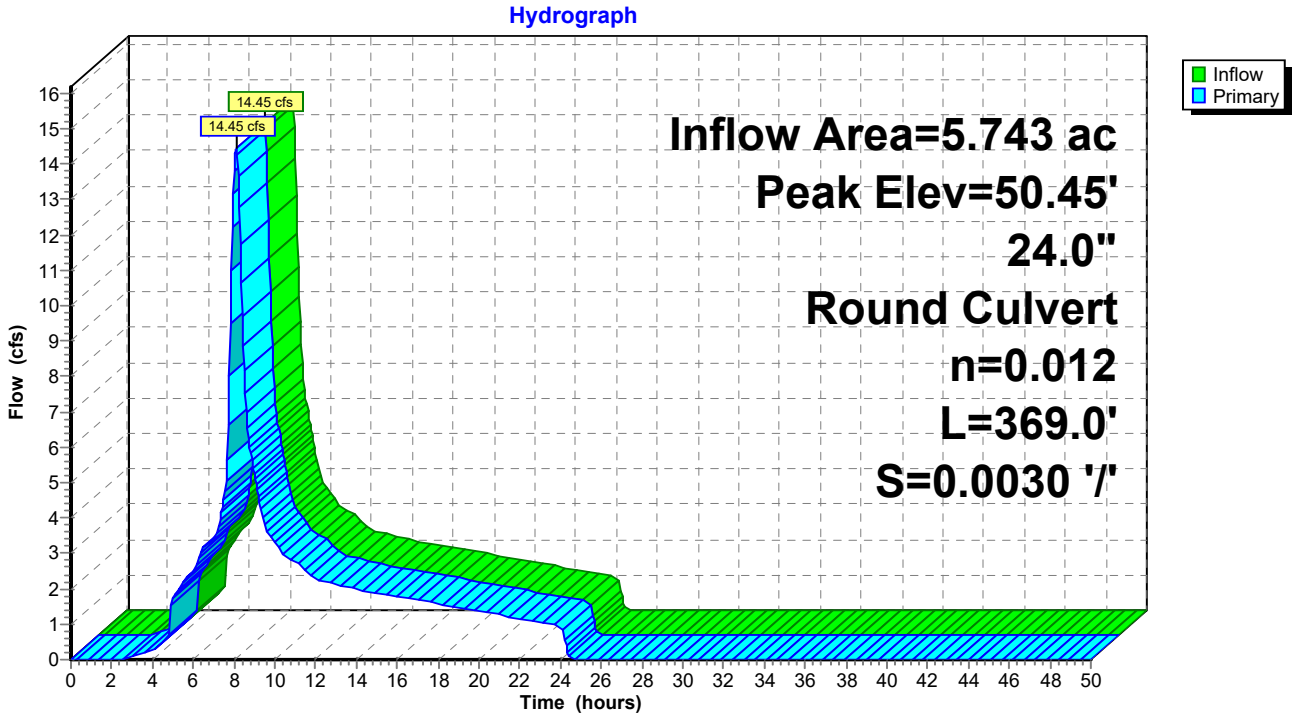
Inflow Area = 5.743 ac, 58.73% Impervious, Inflow Depth = 8.63" for 25-year event
Inflow = 14.45 cfs @ 8.10 hrs, Volume= 4.132 af
Outflow = 14.45 cfs @ 8.10 hrs, Volume= 4.132 af, Atten= 0%, Lag= 0.0 min
Primary = 14.45 cfs @ 8.10 hrs, Volume= 4.132 af
Routed to Pond 7P : Node B

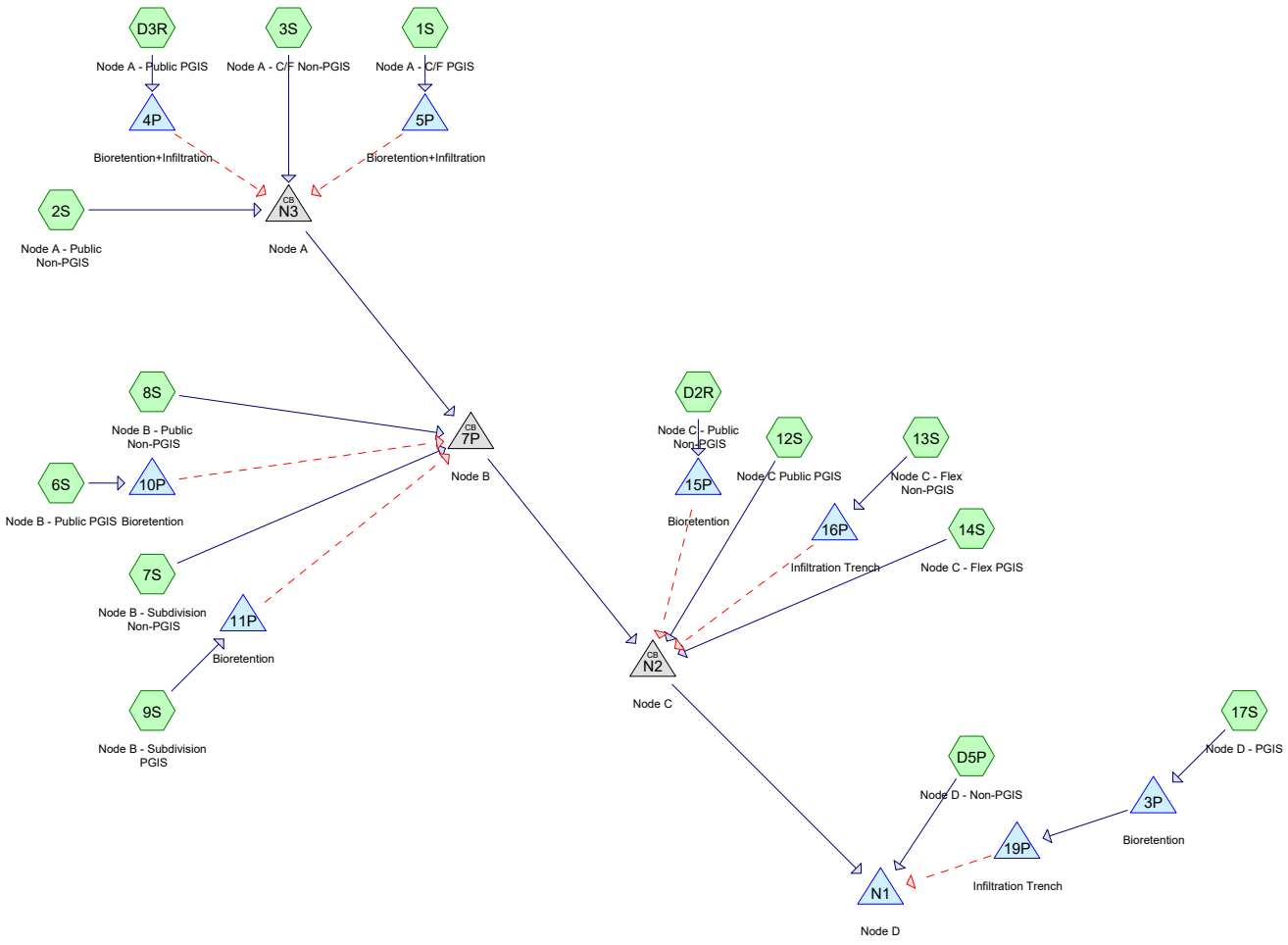
Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 50.45' @ 8.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	41.44'	**24.0" Round Culvert** L= 369.0' Ke= 0.200 Inlet / Outlet Invert= 41.44' / 40.33' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=14.45 cfs @ 8.10 hrs HW=50.45' TW=48.77' (Fixed TW Elev= 48.77')
1=Culvert (Outlet Controls 14.45 cfs @ 4.60 fps)

Pond N3: Node A





Subcat Reach Pond Link

Routing Diagram for ALTERNATE _Onsite 100-Year Storm - Minor Flood

Prepared by MacKay & Sposito, Inc, Printed 3/10/2025

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
9.462	49	50-75% Grass cover, Fair, HSG A (D5P)
2.370	59	50-75% Grass cover, Fair, HSG A/B (avg) (2S, 3S)
0.306	69	50-75% Grass cover, Fair, HSG B (13S)
0.239	68	<50% Grass cover, Poor, HSG A (D2R)
4.736	79	<50% Grass cover, Poor, HSG B (7S, 8S)
48.663	98	Paved parking, HSG A (6S, 9S, 17S)
11.595	98	Paved parking, HSG B (1S, 12S, 14S, D3R)
4.445	98	Roofs, HSG A (3S, 13S)
22.259	98	Roofs, HSG B (7S, D5P)
104.075	**92**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
65.179	HSG A	2S, 3S, 6S, 9S, 13S, 17S, D2R, D5P
38.896	HSG B	1S, 7S, 8S, 12S, 13S, 14S, D3R, D5P
0.000	HSG C	
0.000	HSG D	
0.000	Other	
104.075		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
11.832	0.306	0.000	0.000	0.000	12.138	50-75% Grass cover, Fair	2S, 3S, 13S, D5P
0.239	4.736	0.000	0.000	0.000	4.975	<50% Grass cover, Poor	7S, 8S, D2R
48.663	11.595	0.000	0.000	0.000	60.258	Paved parking	1S, 6S, 9S, 12S, 14S, 17S, D3R
4.445	22.259	0.000	0.000	0.000	26.704	Roofs	3S, 7S, 13S, D5P
65.179	**38.896**	**0.000**	**0.000**	**0.000**	**104.075**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	7P	40.33	39.19	379.7	0.0030	0.012	0.0	24.0	0.0	
2	N1	38.00	37.50	270.3	0.0018	0.012	0.0	42.0	0.0	
3	N2	39.19	38.00	410.7	0.0029	0.012	0.0	30.0	0.0	
4	N3	41.44	40.33	369.0	0.0030	0.012	0.0	24.0	0.0	

Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Node A - C/F PGIS Runoff Area=7.516 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=10.54 cfs 3.734 af

Subcatchment2S: Node A - Public Non-PGIS Runoff Area=1.160 ac 0.00% Impervious Runoff Depth=1.97"
Tc=20.0 min CN=59 Runoff=0.38 cfs 0.190 af

Subcatchment3S: Node A - C/F Non-PGIS Runoff Area=4.583 ac 73.60% Impervious Runoff Depth=4.82"
Tc=20.0 min CN=88 Runoff=5.43 cfs 1.840 af

Subcatchment6S: Node B - Public PGIS Runoff Area=0.250 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=0.35 cfs 0.124 af

Subcatchment7S: Node B - Subdivision Runoff Area=6.745 ac 31.13% Impervious Runoff Depth=4.49"
Tc=20.0 min CN=85 Runoff=7.39 cfs 2.525 af

Subcatchment8S: Node B - Public Non-PGIS Runoff Area=0.091 ac 0.00% Impervious Runoff Depth=3.86"
Tc=20.0 min CN=79 Runoff=0.08 cfs 0.029 af

Subcatchment9S: Node B - Subdivision Runoff Area=2.176 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=3.05 cfs 1.081 af

Subcatchment12S: Node C Public PGIS Runoff Area=0.710 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=1.00 cfs 0.353 af

Subcatchment13S: Node C - Flex Non-PGIS Runoff Area=1.378 ac 77.79% Impervious Runoff Depth=5.27"
Tc=20.0 min CN=92 Runoff=1.78 cfs 0.605 af

Subcatchment14S: Node C - Flex PGIS Runoff Area=1.685 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=2.36 cfs 0.837 af

Subcatchment17S: Node D - PGIS Runoff Area=46.237 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=64.81 cfs 22.971 af

SubcatchmentD2R: Node C - Public Runoff Area=0.239 ac 0.00% Impervious Runoff Depth=2.78"
Tc=20.0 min CN=68 Runoff=0.14 cfs 0.055 af

SubcatchmentD3R: Node A - Public PGIS Runoff Area=1.684 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=2.36 cfs 0.837 af

SubcatchmentD5P: Node D - Non-PGIS Runoff Area=29.621 ac 68.06% Impervious Runoff Depth=4.17"
Tc=20.0 min CN=82 Runoff=29.72 cfs 10.297 af

Pond 3P: Bioretention Peak Elev=54.89' Storage=3.301 af Inflow=64.81 cfs 22.971 af
Outflow=40.37 cfs 22.657 af

Pond 4P: Bioretention+Infiltration Peak Elev=3.84' Storage=0.039 af Inflow=2.36 cfs 0.837 af
Primary=0.15 cfs 0.283 af Secondary=2.20 cfs 0.554 af Outflow=2.35 cfs 0.837 af

Pond 5P: Bioretention+Infiltration Peak Elev=5.04' Storage=0.241 af Inflow=10.54 cfs 3.734 af
Primary=0.36 cfs 0.890 af Secondary=10.21 cfs 2.844 af Outflow=10.57 cfs 3.734 af

Pond 7P: Node B Peak Elev=49.68' Inflow=28.83 cfs 8.778 af
Outflow=28.83 cfs 8.778 af

Pond 10P: Bioretention Peak Elev=3.28' Storage=0.005 af Inflow=0.35 cfs 0.124 af
Primary=0.02 cfs 0.046 af Secondary=0.33 cfs 0.078 af Outflow=0.35 cfs 0.124 af

Pond 11P: Bioretention Peak Elev=5.06' Storage=0.055 af Inflow=3.05 cfs 1.081 af
Primary=0.19 cfs 0.364 af Secondary=2.82 cfs 0.717 af Outflow=3.02 cfs 1.081 af

Pond 15P: Bioretention Peak Elev=1.52' Storage=0.007 af Inflow=0.14 cfs 0.055 af
Primary=0.05 cfs 0.055 af Secondary=0.00 cfs 0.000 af Outflow=0.05 cfs 0.055 af

Pond 16P: Infiltration Trench Peak Elev=4.70' Storage=0.045 af Inflow=1.78 cfs 0.605 af
Primary=0.09 cfs 0.193 af Secondary=1.68 cfs 0.411 af Outflow=1.77 cfs 0.605 af

Pond 19P: Infiltration Trench Peak Elev=4.09' Storage=2.393 af Inflow=40.37 cfs 22.657 af
Primary=3.58 cfs 8.734 af Secondary=34.89 cfs 13.923 af Outflow=38.47 cfs 22.657 af

Pond N1: Node D Peak Elev=43.19' Storage=45,518 cf Inflow=84.32 cfs 34.599 af
Primary=67.56 cfs 34.595 af Secondary=0.00 cfs 0.000 af Outflow=67.56 cfs 34.595 af

Pond N2: Node C Peak Elev=46.47' Inflow=33.86 cfs 10.379 af
Outflow=33.86 cfs 10.379 af

Pond N3: Node A Peak Elev=50.56' Inflow=18.21 cfs 5.428 af
Outflow=18.21 cfs 5.428 af

Total Runoff Area = 104.075 ac Runoff Volume = 45.478 af Average Runoff Depth = 5.24"
16.44% Pervious = 17.113 ac 83.56% Impervious = 86.962 ac

Summary for Subcatchment 1S: Node A - C/F PGIS

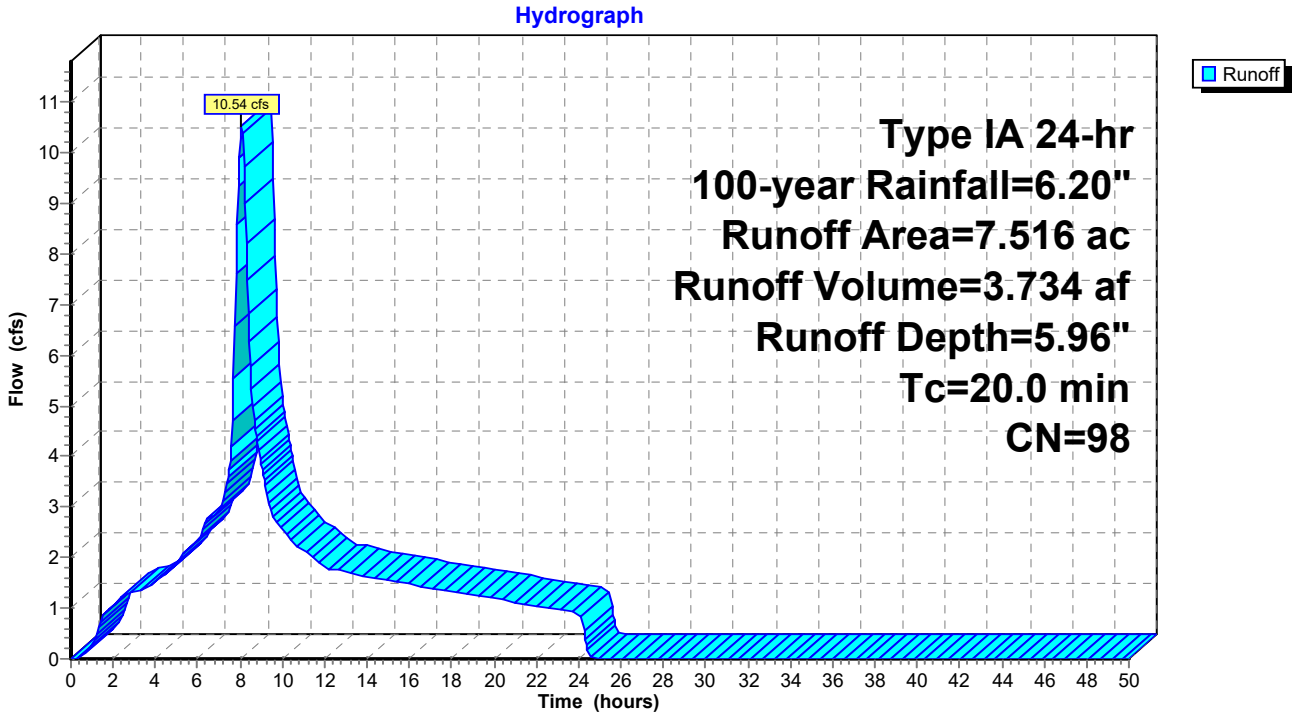
Runoff = 10.54 cfs @ 8.08 hrs, Volume= 3.734 af, Depth= 5.96"
Routed to Pond 5P : Bioretention+Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
7.516	98	Paved parking, HSG B
7.516		100.00% Impervious Area

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

Subcatchment 1S: Node A - C/F PGIS



Summary for Subcatchment 2S: Node A - Public Non-PGIS

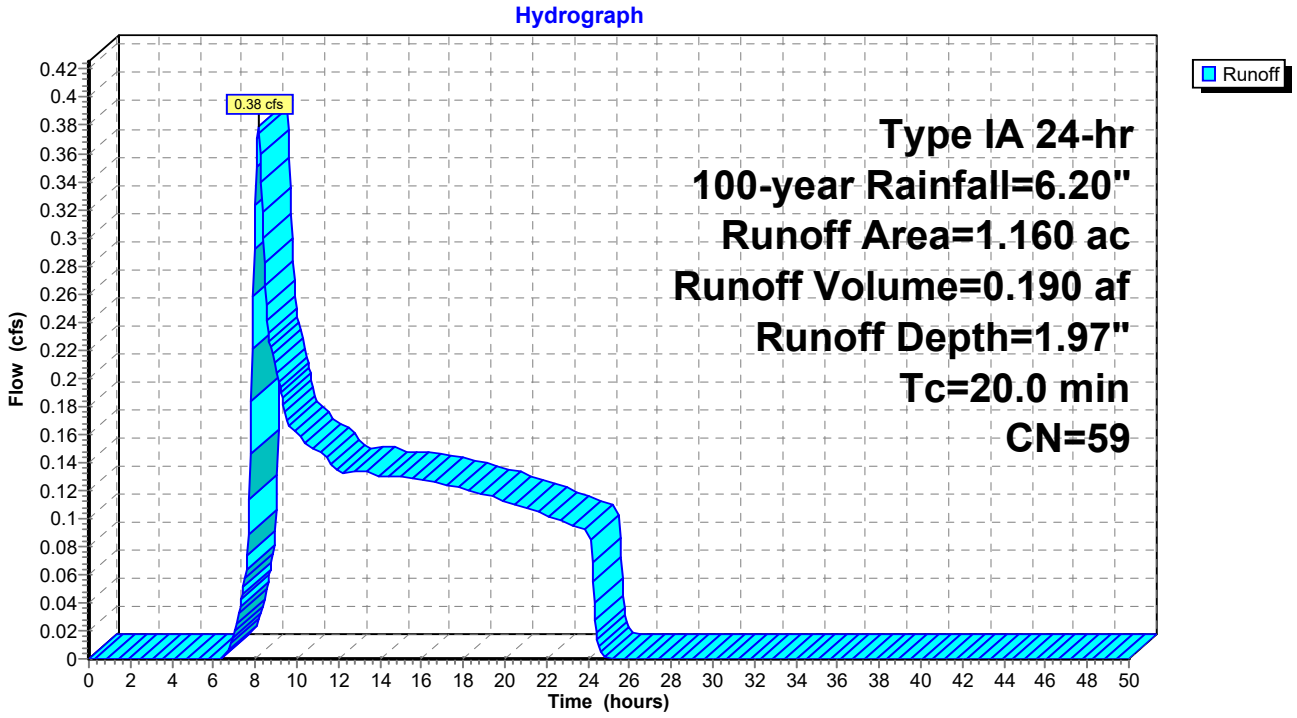
Runoff = 0.38 cfs @ 8.16 hrs, Volume= 0.190 af, Depth= 1.97"
Routed to Pond N3 : Node A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

	Area (ac)	CN	Description
*	1.160	59	50-75% Grass cover, Fair, HSG A/B (avg)
	1.160		100.00% Pervious Area

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

Subcatchment 2S: Node A - Public Non-PGIS



Summary for Subcatchment 3S: Node A - C/F Non-PGIS

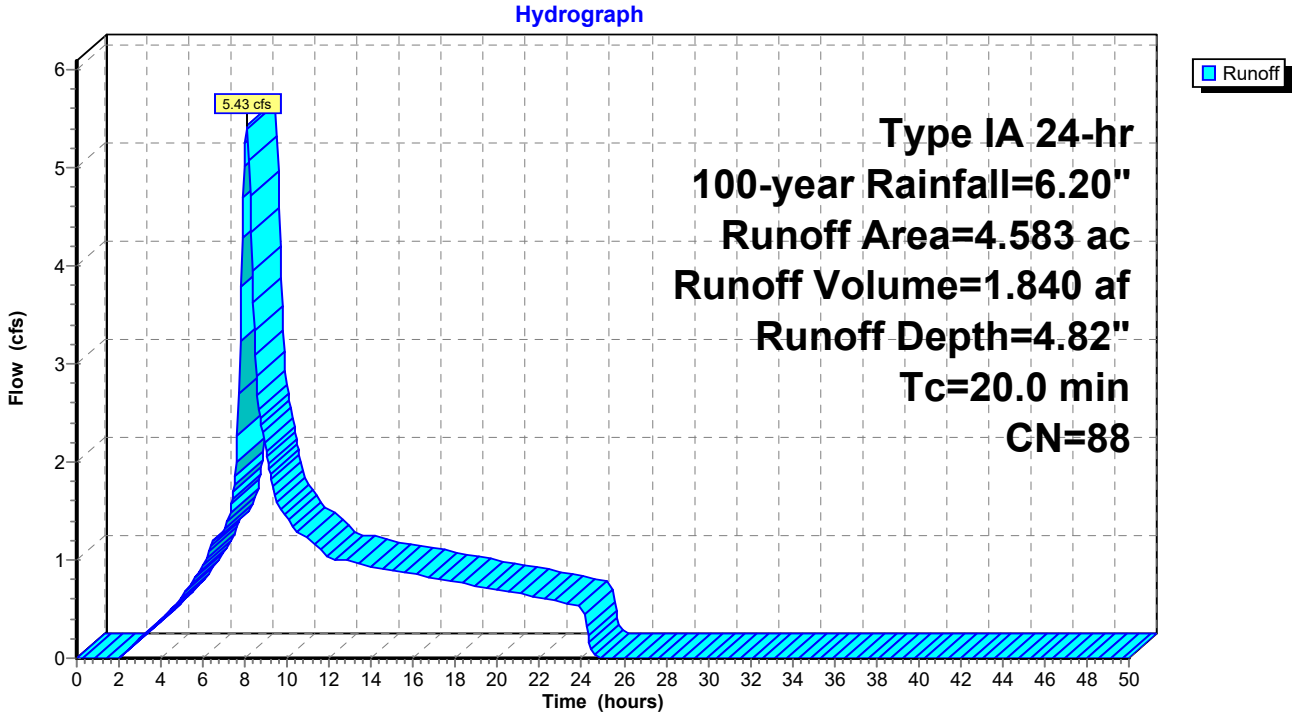
Runoff = 5.43 cfs @ 8.09 hrs, Volume= 1.840 af, Depth= 4.82"
Routed to Pond N3 : Node A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

	Area (ac)	CN	Description
*	1.210	59	50-75% Grass cover, Fair, HSG A/B (avg)
	3.373	98	Roofs, HSG A
	4.583	88	Weighted Average
	1.210		26.40% Pervious Area
	3.373		73.60% Impervious Area

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

Subcatchment 3S: Node A - C/F Non-PGIS



Summary for Subcatchment 6S: Node B - Public PGIS

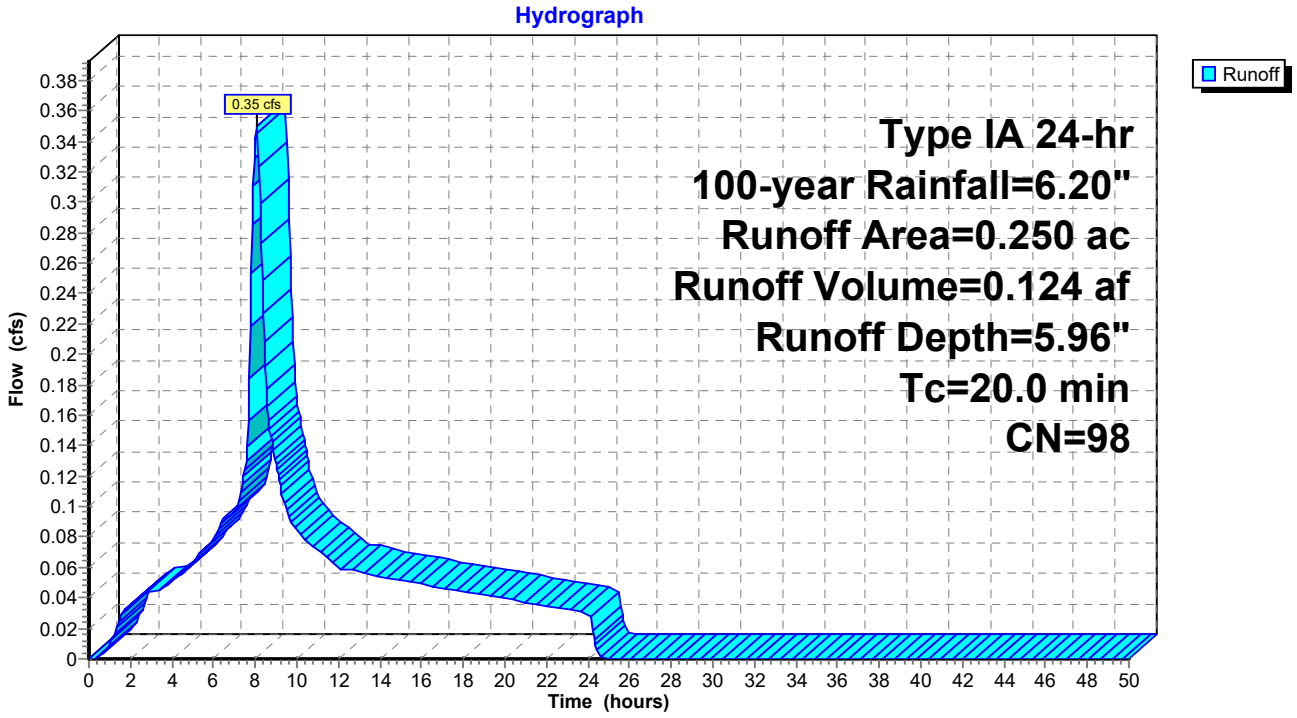
Runoff = 0.35 cfs @ 8.08 hrs, Volume= 0.124 af, Depth= 5.96"
Routed to Pond 10P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.250	98	Paved parking, HSG A
0.250		100.00% Impervious Area

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

Subcatchment 6S: Node B - Public PGIS



Summary for Subcatchment 7S: Node B - Subdivision Non-PGIS

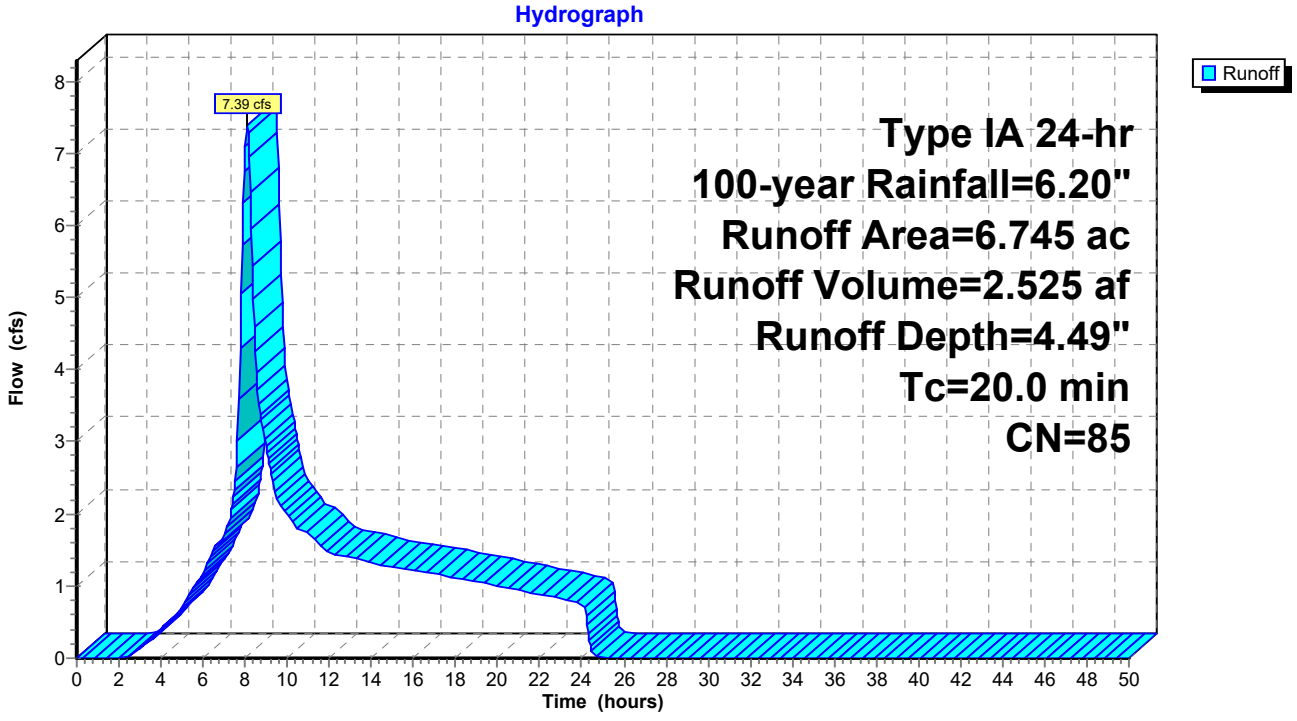
Runoff = 7.39 cfs @ 8.09 hrs, Volume= 2.525 af, Depth= 4.49"
Routed to Pond 7P : Node B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
2.100	98	Roofs, HSG B
4.645	79	<50% Grass cover, Poor, HSG B
6.745	85	Weighted Average
4.645		68.87% Pervious Area
2.100		31.13% Impervious Area

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

Subcatchment 7S: Node B - Subdivision Non-PGIS



Summary for Subcatchment 8S: Node B - Public Non-PGIS

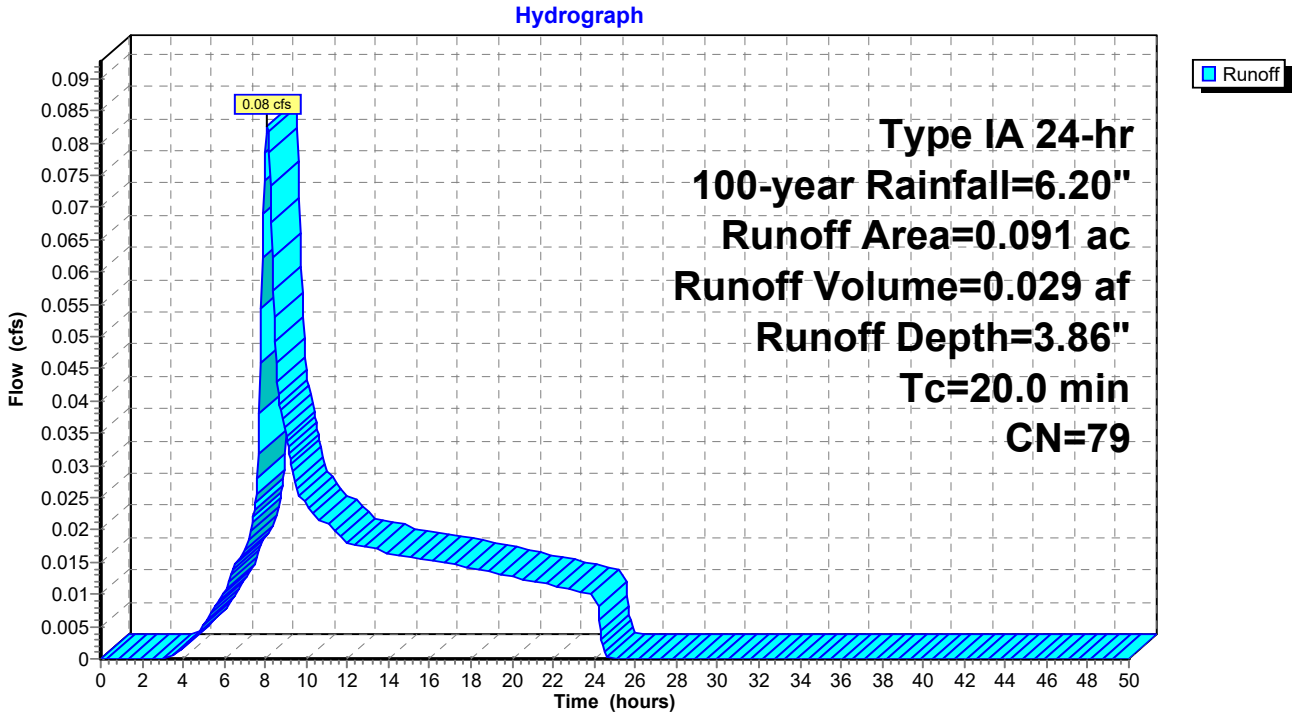
Runoff = 0.08 cfs @ 8.11 hrs, Volume= 0.029 af, Depth= 3.86"
Routed to Pond 7P : Node B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.091	79	<50% Grass cover, Poor, HSG B
0.091		100.00% Pervious Area

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

Subcatchment 8S: Node B - Public Non-PGIS



Summary for Subcatchment 9S: Node B - Subdivision PGIS

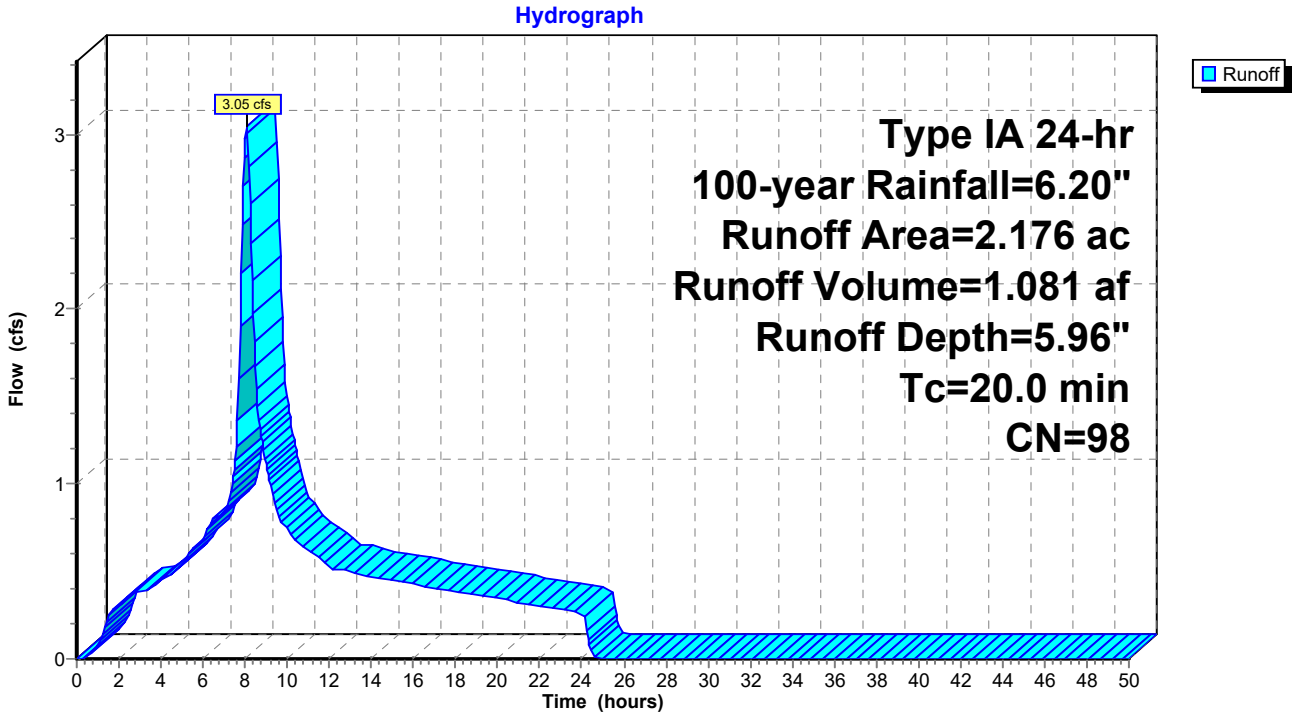
Runoff = 3.05 cfs @ 8.08 hrs, Volume= 1.081 af, Depth= 5.96"
Routed to Pond 11P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
2.176	98	Paved parking, HSG A
2.176		100.00% Impervious Area

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

Subcatchment 9S: Node B - Subdivision PGIS



Summary for Subcatchment 12S: Node C Public PGIS

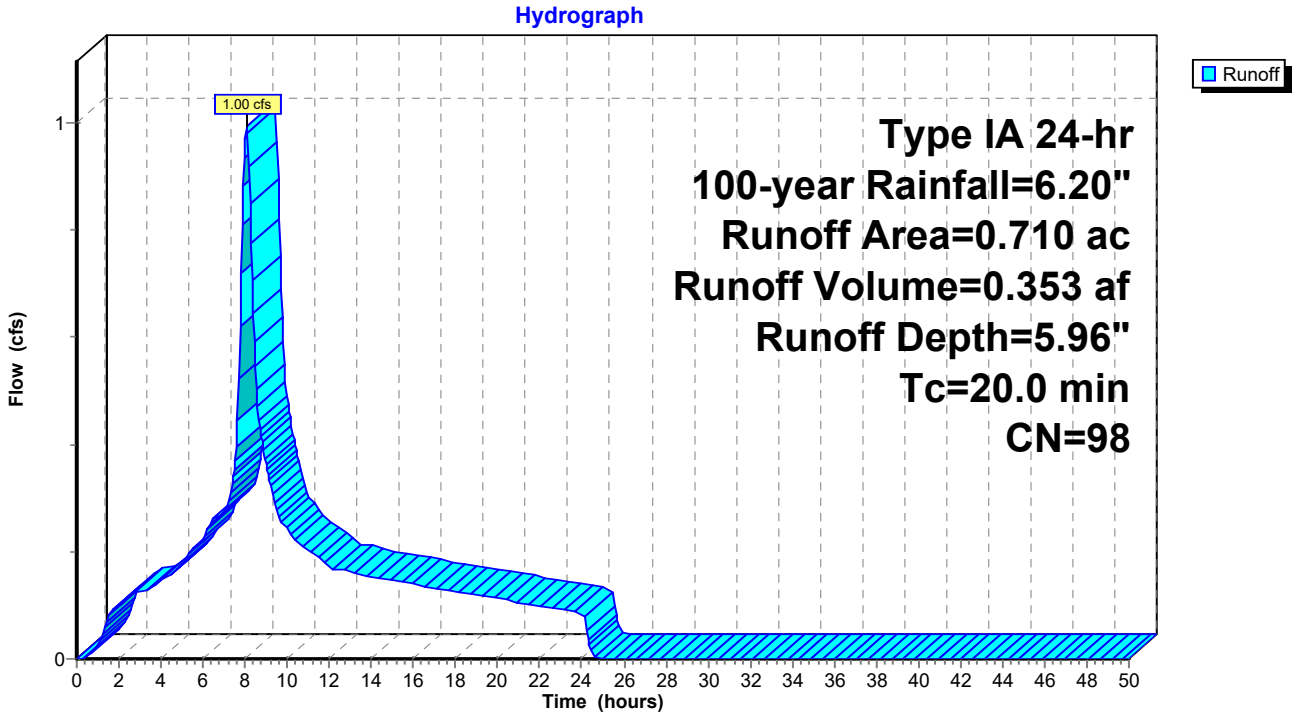
Runoff = 1.00 cfs @ 8.08 hrs, Volume= 0.353 af, Depth= 5.96"
Routed to Pond N2 : Node C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.710	98	Paved parking, HSG B
0.710		100.00% Impervious Area

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

Subcatchment 12S: Node C Public PGIS



Summary for Subcatchment 13S: Node C - Flex Non-PGIS

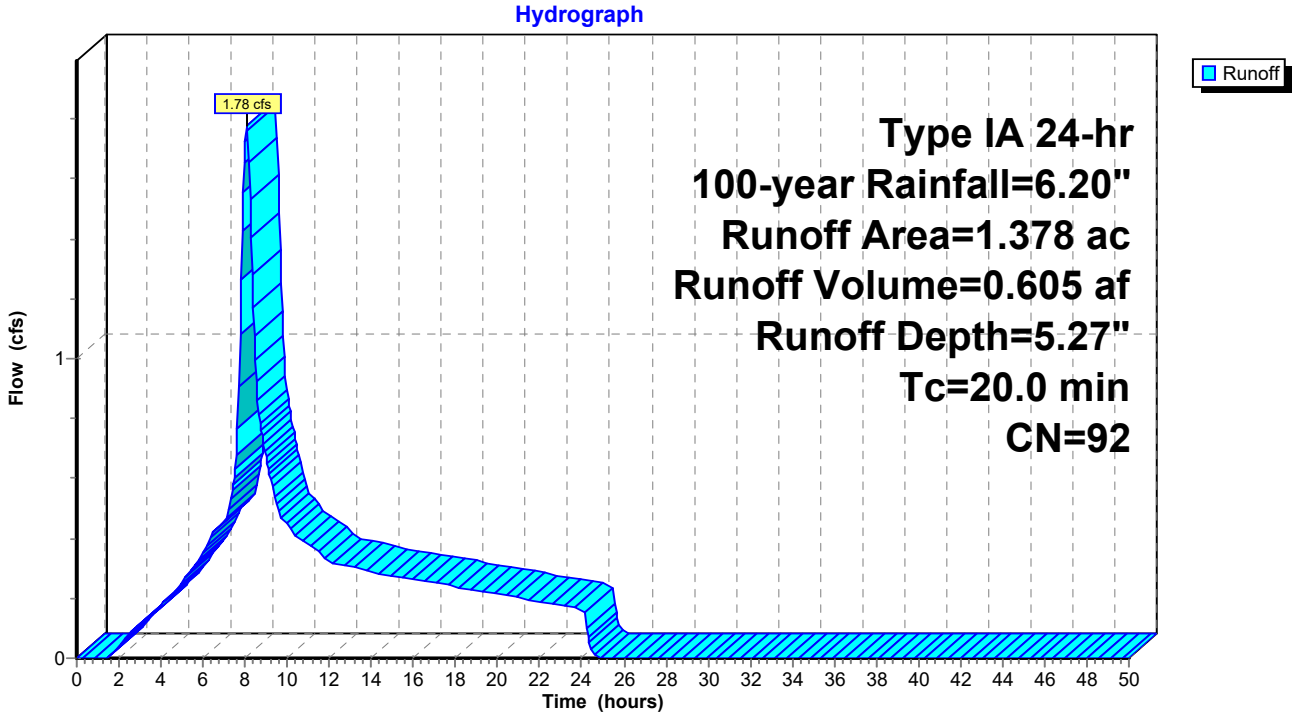
Runoff = 1.78 cfs @ 8.08 hrs, Volume= 0.605 af, Depth= 5.27"
Routed to Pond 16P : Infiltration Trench

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.306	69	50-75% Grass cover, Fair, HSG B
1.072	98	Roofs, HSG A
1.378	92	Weighted Average
0.306		22.21% Pervious Area
1.072		77.79% Impervious Area

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

Subcatchment 13S: Node C - Flex Non-PGIS



Summary for Subcatchment 14S: Node C - Flex PGIS

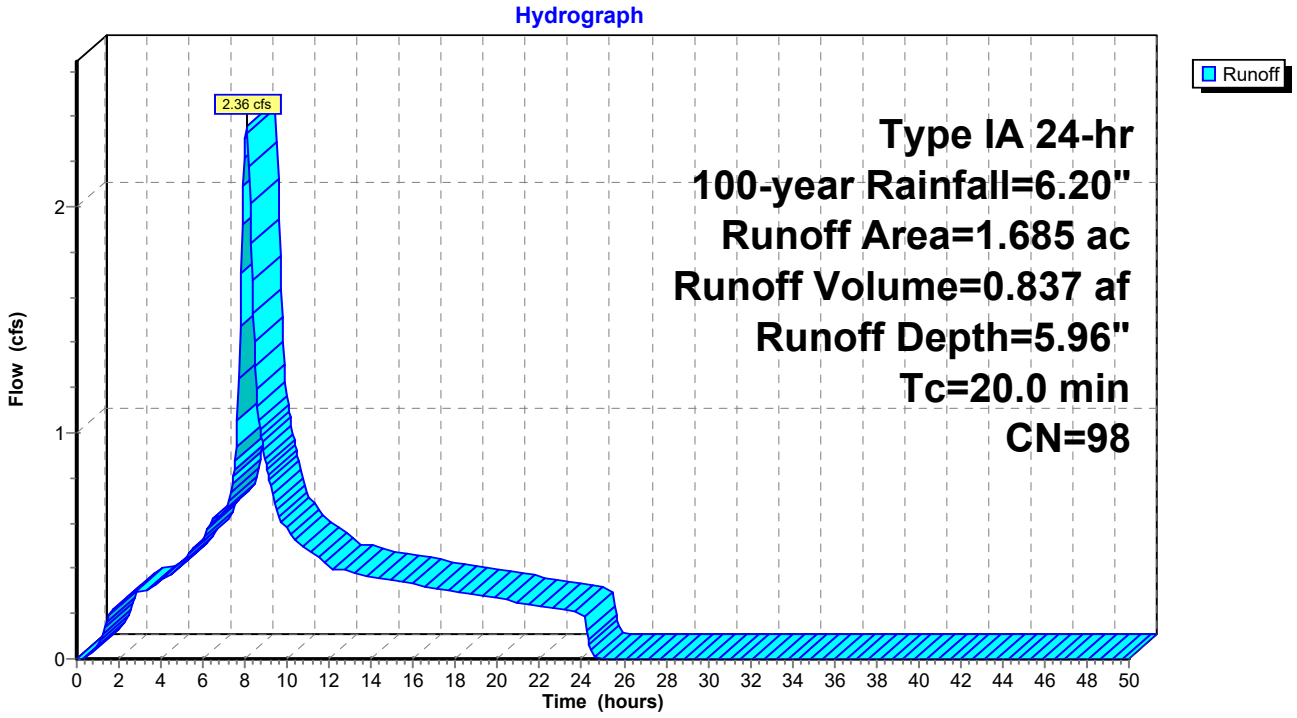
Runoff = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af, Depth= 5.96"
Routed to Pond N2 : Node C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
1.685	98	Paved parking, HSG B
1.685		100.00% Impervious Area

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

Subcatchment 14S: Node C - Flex PGIS



Summary for Subcatchment 17S: Node D - PGIS

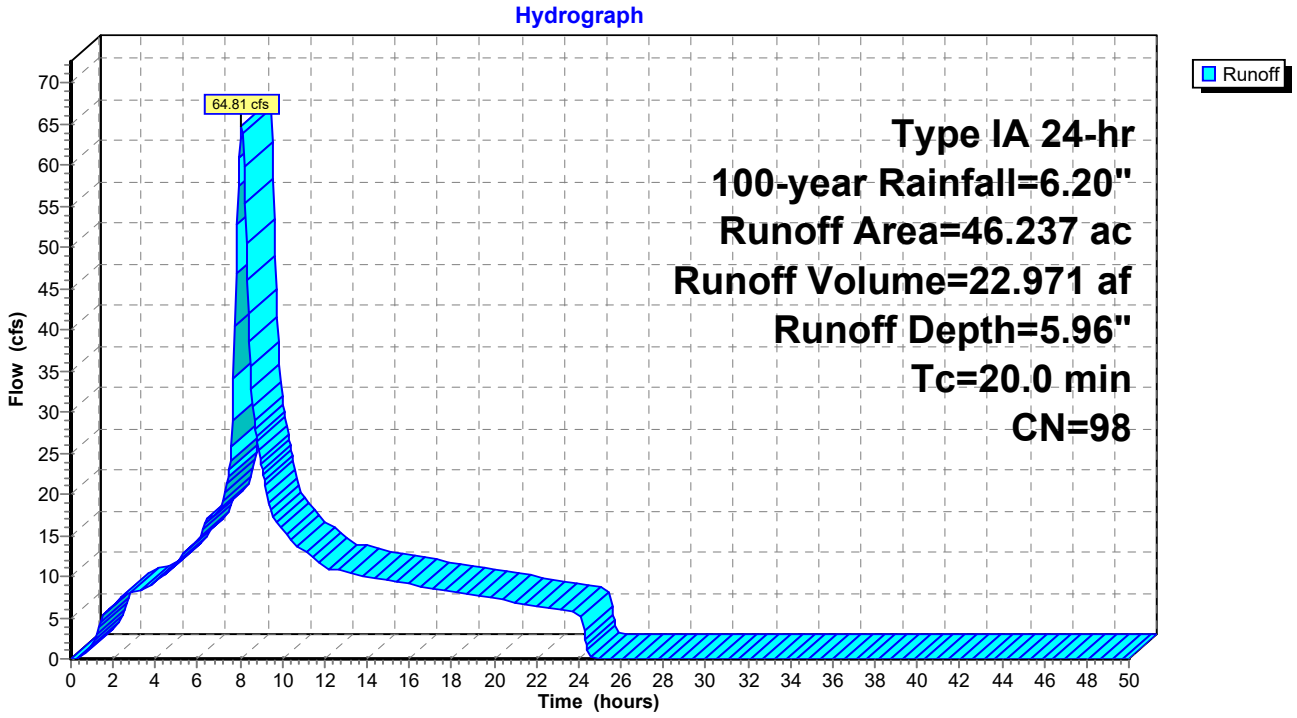
Runoff = 64.81 cfs @ 8.08 hrs, Volume= 22.971 af, Depth= 5.96"
Routed to Pond 3P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
46.237	98	Paved parking, HSG A
46.237		100.00% Impervious Area

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

Subcatchment 17S: Node D - PGIS



Summary for Subcatchment D2R: Node C - Public Non-PGIS

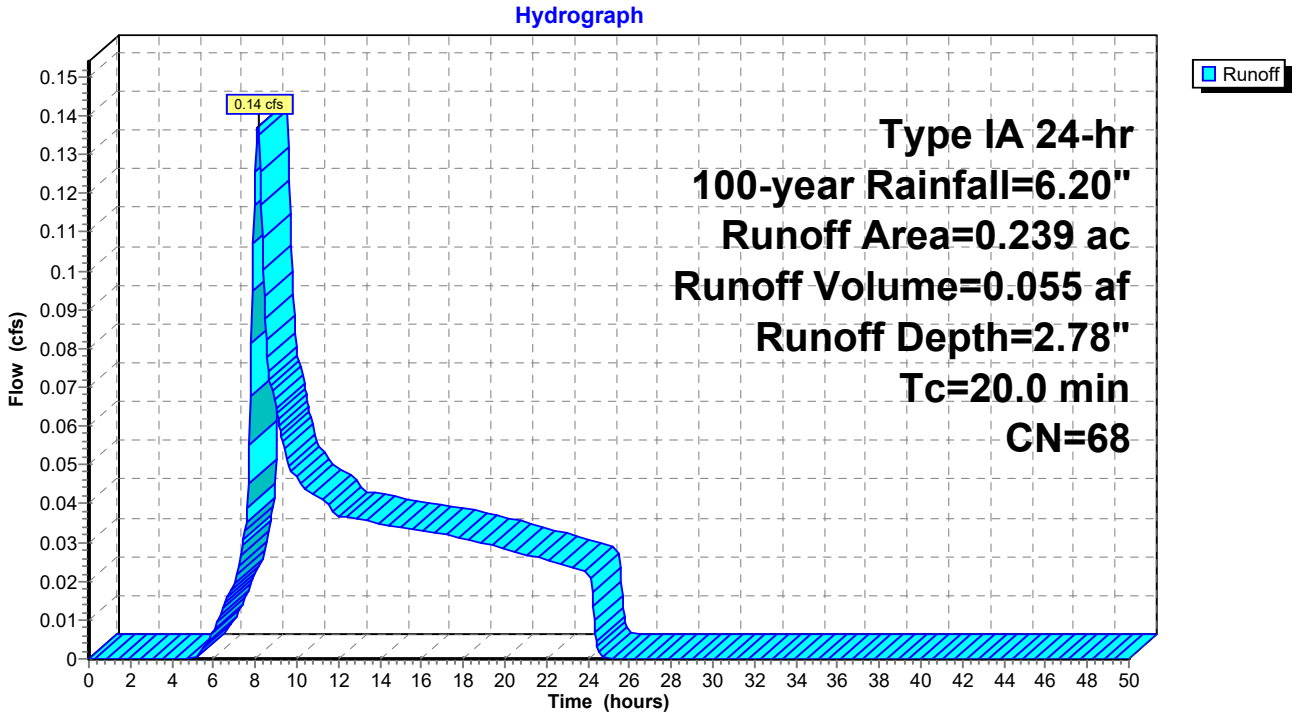
Runoff = 0.14 cfs @ 8.13 hrs, Volume= 0.055 af, Depth= 2.78"
Routed to Pond 15P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.239	68	<50% Grass cover, Poor, HSG A
0.239		100.00% Pervious Area

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

Subcatchment D2R: Node C - Public Non-PGIS



Summary for Subcatchment D3R: Node A - Public PGIS

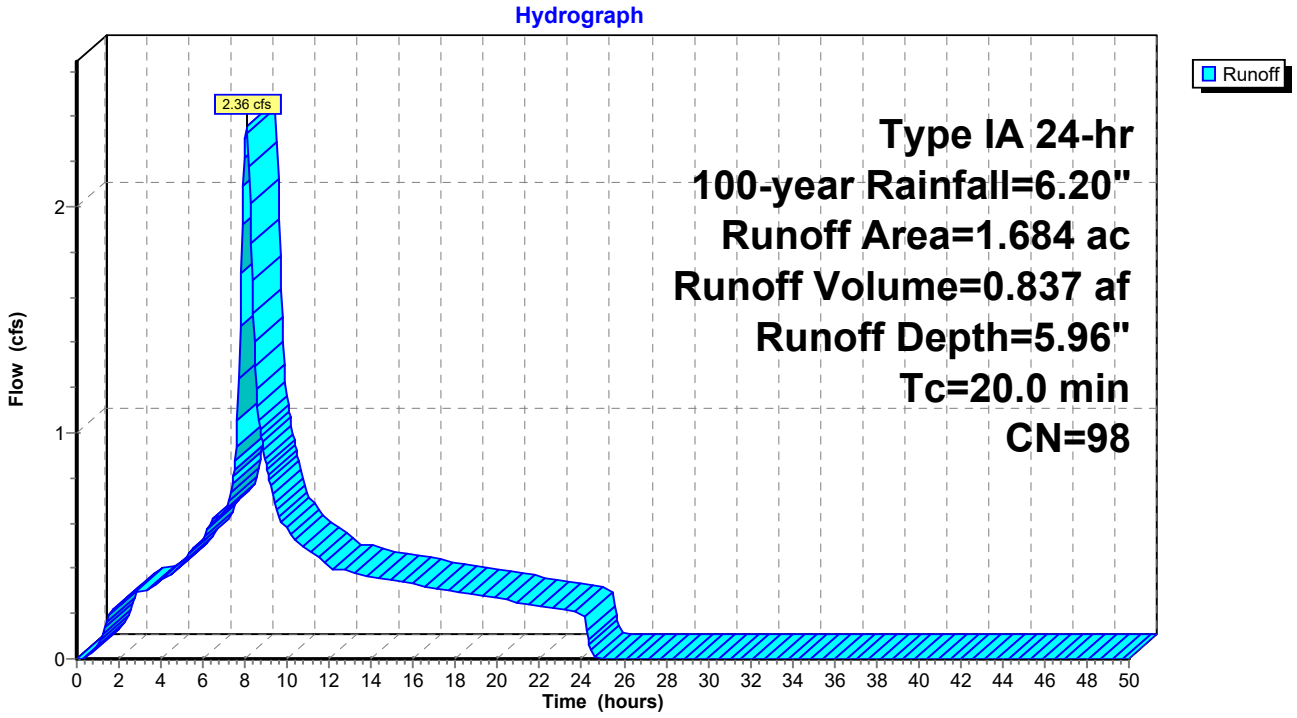
Runoff = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af, Depth= 5.96"
Routed to Pond 4P : Bioretention+Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
1.684	98	Paved parking, HSG B
1.684		100.00% Impervious Area

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

Subcatchment D3R: Node A - Public PGIS



Summary for Subcatchment D5P: Node D - Non-PGIS

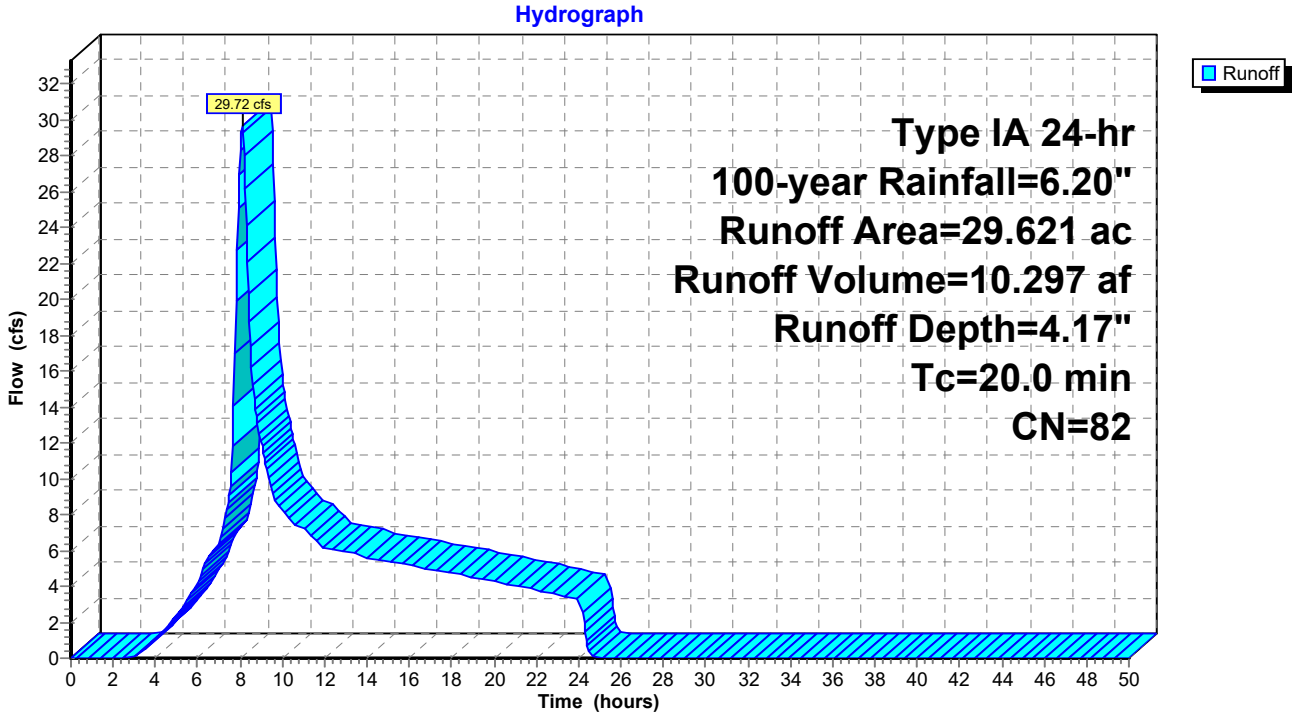
Runoff = 29.72 cfs @ 8.10 hrs, Volume= 10.297 af, Depth= 4.17"
Routed to Pond N1 : Node D

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
9.462	49	50-75% Grass cover, Fair, HSG A
20.159	98	Roofs, HSG B
29.621	82	Weighted Average
9.462		31.94% Pervious Area
20.159		68.06% Impervious Area

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

Subcatchment D5P: Node D - Non-PGIS



Summary for Pond 3P: Bioretention

Inflow Area = 46.237 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 64.81 cfs @ 8.08 hrs, Volume= 22.971 af
Outflow = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af, Atten= 38%, Lag= 20.8 min
Primary = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af
Routed to Pond 19P : Infiltration Trench

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 54.89' @ 8.42 hrs Surf.Area= 1.674 ac Storage= 3.301 af

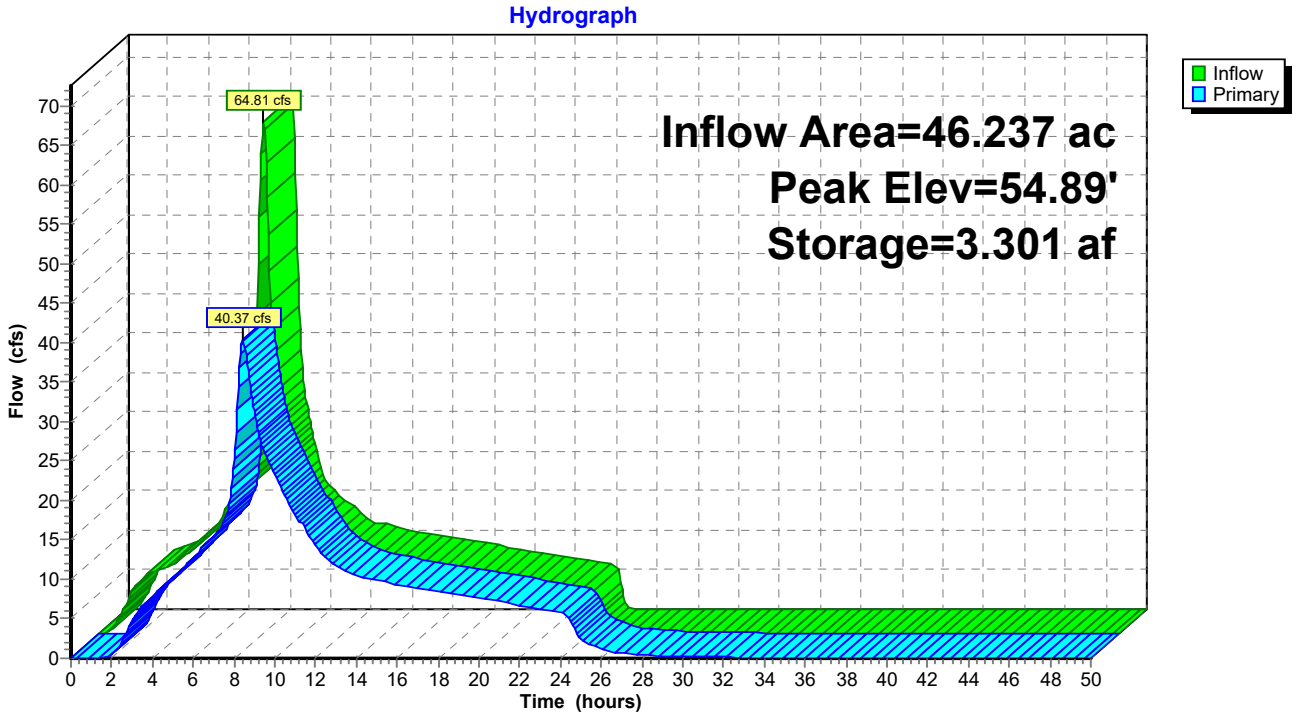
Plug-Flow detention time= 83.2 min calculated for 22.657 af (99% of inflow)
Center-of-Mass det. time= 72.4 min (736.4 - 664.0)

Volume	Invert	Avail.Storage	Storage Description
#1	50.00'	2.629 af	**270.00'W x 270.00'L x 6.50'H Prismatoid** 10.878 af Overall - 3.367 af Embedded = 7.512 af x 35.0% Voids
#2	54.50'	3.347 af	**270.00'W x 270.00'L x 2.00'H Prismatoid** Inside #1
#3	50.50'	0.019 af	**24.0" Round Pipe Storage** Inside #1 L= 269.0'
		5.996 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	54.50'	**60.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	50.50'	**24.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=40.28 cfs @ 8.42 hrs HW=54.89' (Free Discharge)
└─**1=Orifice/Grate** (Weir Controls 12.44 cfs @ 2.04 fps)
└─**2=Orifice/Grate** (Orifice Controls 27.85 cfs @ 8.86 fps)

Pond 3P: Bioretention



Summary for Pond 4P: Bioretention+Infiltration

Inflow Area = 1.684 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af
Outflow = 2.35 cfs @ 8.11 hrs, Volume= 0.837 af, Atten= 1%, Lag= 1.8 min
Primary = 0.15 cfs @ 8.11 hrs, Volume= 0.283 af
Secondary = 2.20 cfs @ 8.11 hrs, Volume= 0.554 af
Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 3.84' @ 8.11 hrs Surf.Area= 0.029 ac Storage= 0.039 af

Plug-Flow detention time= 55.2 min calculated for 0.836 af (100% of inflow)
Center-of-Mass det. time= 55.4 min (719.4 - 664.0)

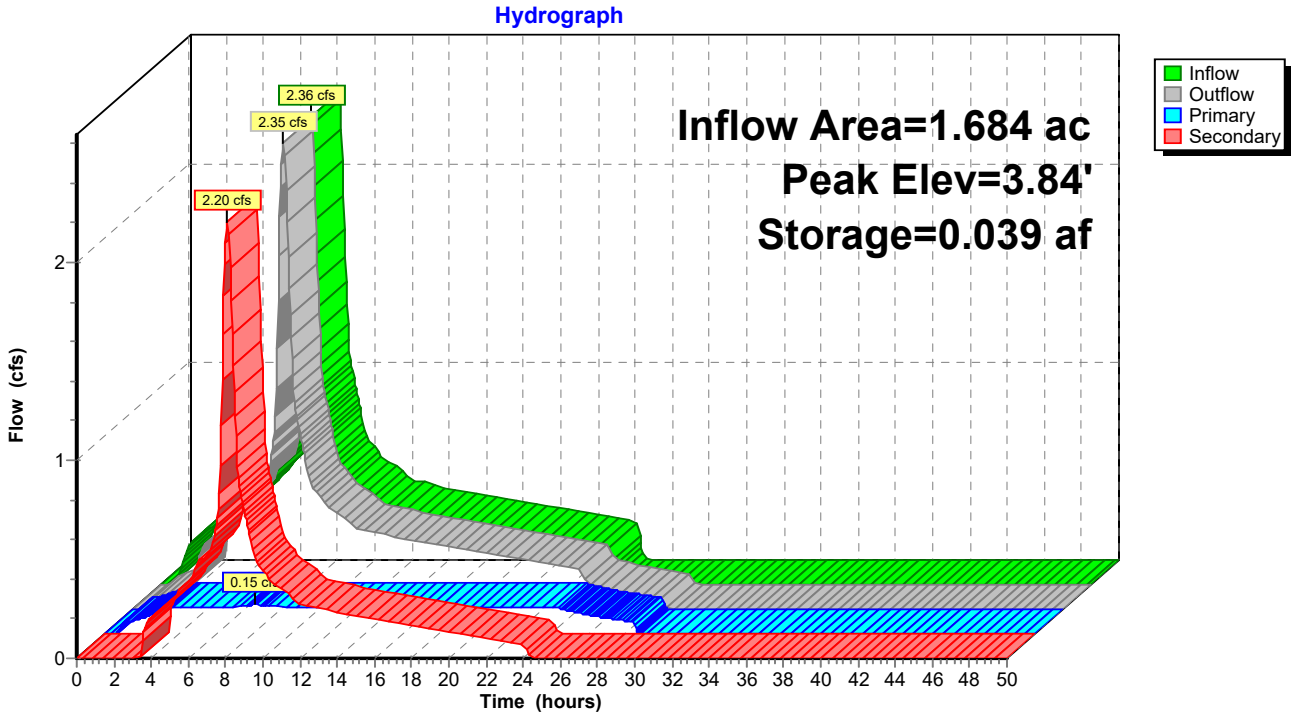
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.050 af	**5.00'W x 250.00'L x 5.00'H Bioretention** 0.143 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.15 cfs @ 8.11 hrs HW=3.84' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.15 cfs)

Secondary OutFlow Max=2.20 cfs @ 8.11 hrs HW=3.84' (Free Discharge)
↑**2=Orifice/Grate** (Orifice Controls 2.20 cfs @ 3.12 fps)

Pond 4P: Bioretention+Infiltration



Summary for Pond 5P: Bioretention+Infiltration

[93] Warning: Storage range exceeded by 0.04'
[88] Warning: Qout>Qin may require smaller dt or Finer Routing

Inflow Area = 7.516 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 10.54 cfs @ 8.08 hrs, Volume= 3.734 af
Outflow = 10.57 cfs @ 8.09 hrs, Volume= 3.734 af, Atten= 0%, Lag= 0.5 min
Primary = 0.36 cfs @ 7.95 hrs, Volume= 0.890 af
Secondary = 10.21 cfs @ 8.09 hrs, Volume= 2.844 af
Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 5.04' @ 8.09 hrs Surf.Area= 0.138 ac Storage= 0.241 af

Plug-Flow detention time= 91.6 min calculated for 3.730 af (100% of inflow)
Center-of-Mass det. time= 92.0 min (756.0 - 664.0)

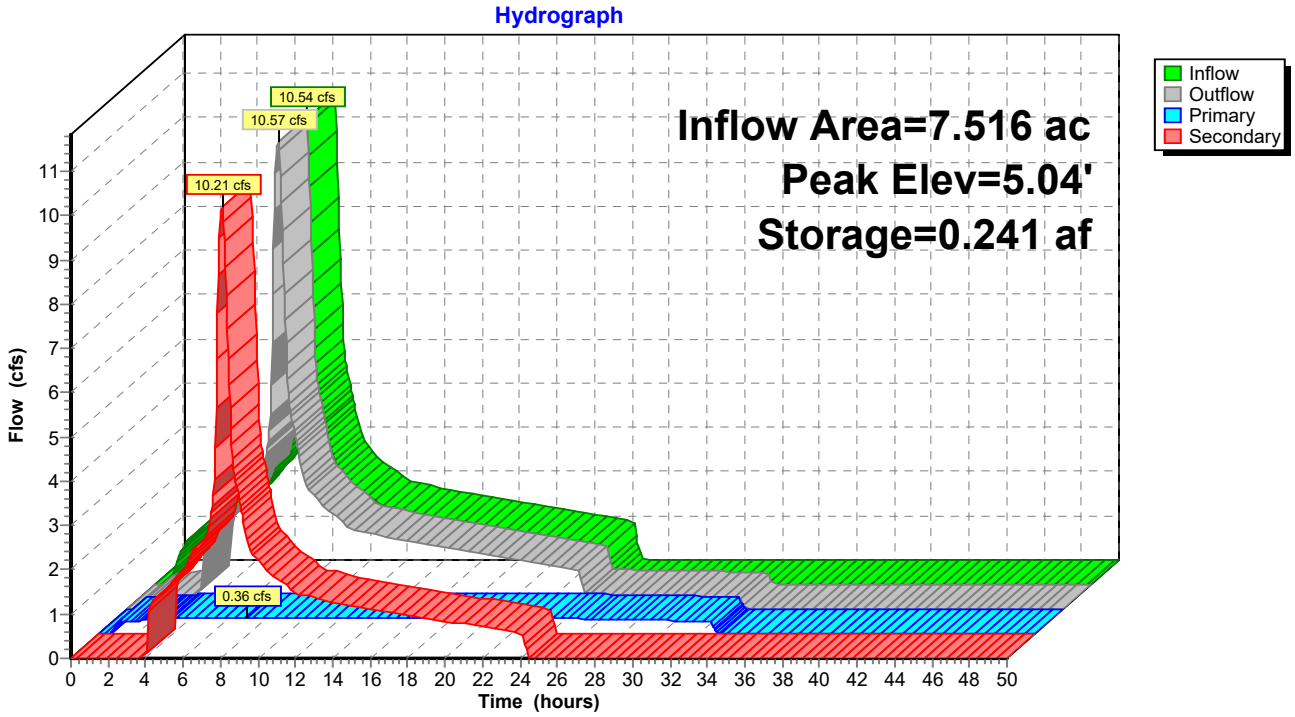
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.241 af	**50.00'W x 120.00'L x 5.00'H Infiltration Trench** 0.689 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.50'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.36 cfs @ 7.95 hrs HW=5.01' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.36 cfs)

Secondary OutFlow Max=10.16 cfs @ 8.09 hrs HW=5.04' (Free Discharge)
└**2=Orifice/Grate** (Weir Controls 10.16 cfs @ 2.40 fps)

Pond 5P: Bioretention+Infiltration



Summary for Pond 7P: Node B

[57] Hint: Peaked at 49.68' (Flood elevation advised)
[81] Warning: Exceeded Pond 10P by 46.47' @ 31.35 hrs
[81] Warning: Exceeded Pond 11P by 46.47' @ 33.05 hrs
[79] Warning: Submerged Pond N3 Primary device # 1 INLET by 8.24'

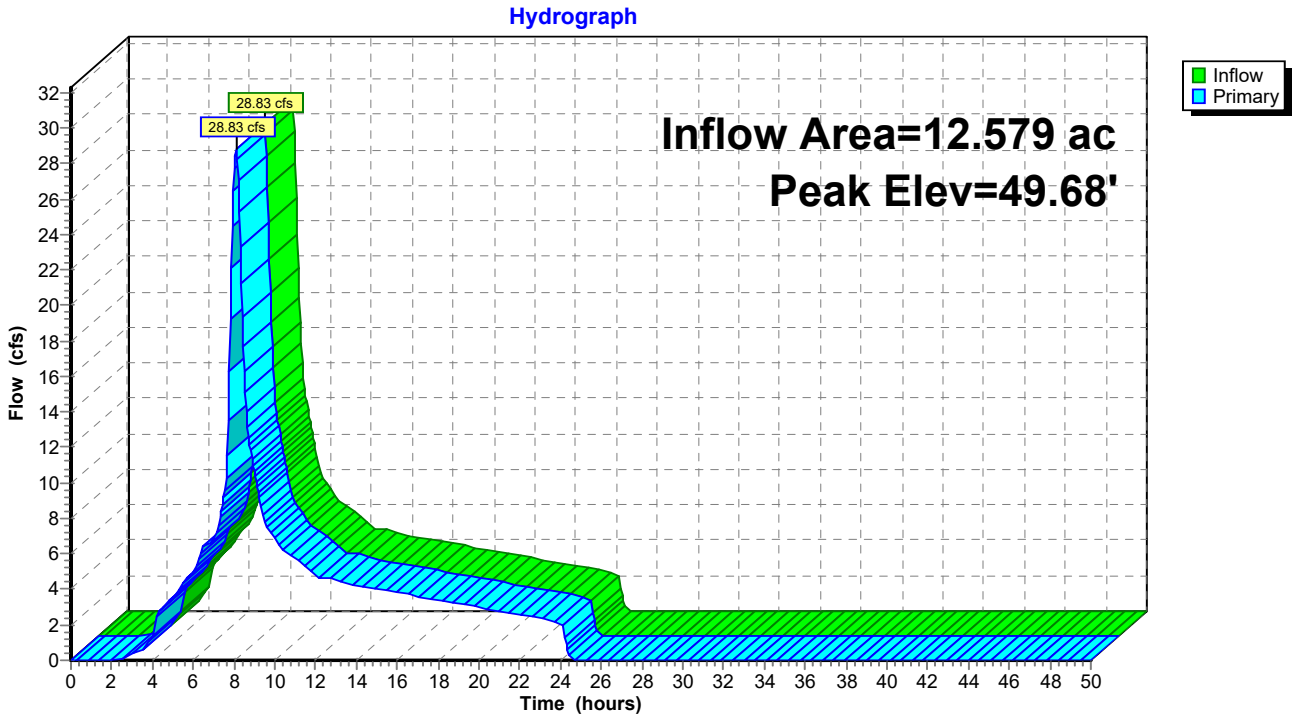
Inflow Area = 12.579 ac, 43.51% Impervious, Inflow Depth = 8.37" for 100-year event
Inflow = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af
Outflow = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af, Atten= 0%, Lag= 0.0 min
Primary = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 49.68' @ 8.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	40.33'	**24.0" Round Culvert** L= 379.7' Ke= 0.200 Inlet / Outlet Invert= 40.33' / 39.19' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Primary	49.50'	**36.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=28.70 cfs @ 8.09 hrs HW=49.68' TW=46.47' (Fixed TW Elev= 46.47')
1=Culvert (Outlet Controls 19.75 cfs @ 6.29 fps)
2=Sharp-Crested Rectangular Weir (Weir Controls 8.95 cfs @ 1.39 fps)

Pond 7P: Node B



Summary for Pond 10P: Bioretention

Inflow Area = 0.250 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 0.35 cfs @ 8.08 hrs, Volume= 0.124 af
Outflow = 0.35 cfs @ 8.09 hrs, Volume= 0.124 af, Atten= 0%, Lag= 0.5 min
Primary = 0.02 cfs @ 8.09 hrs, Volume= 0.046 af
Secondary = 0.33 cfs @ 8.09 hrs, Volume= 0.078 af
Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 3.28' @ 8.09 hrs Surf.Area= 0.005 ac Storage= 0.005 af

Plug-Flow detention time= 56.2 min calculated for 0.124 af (100% of inflow)
Center-of-Mass det. time= 56.3 min (720.4 - 664.0)

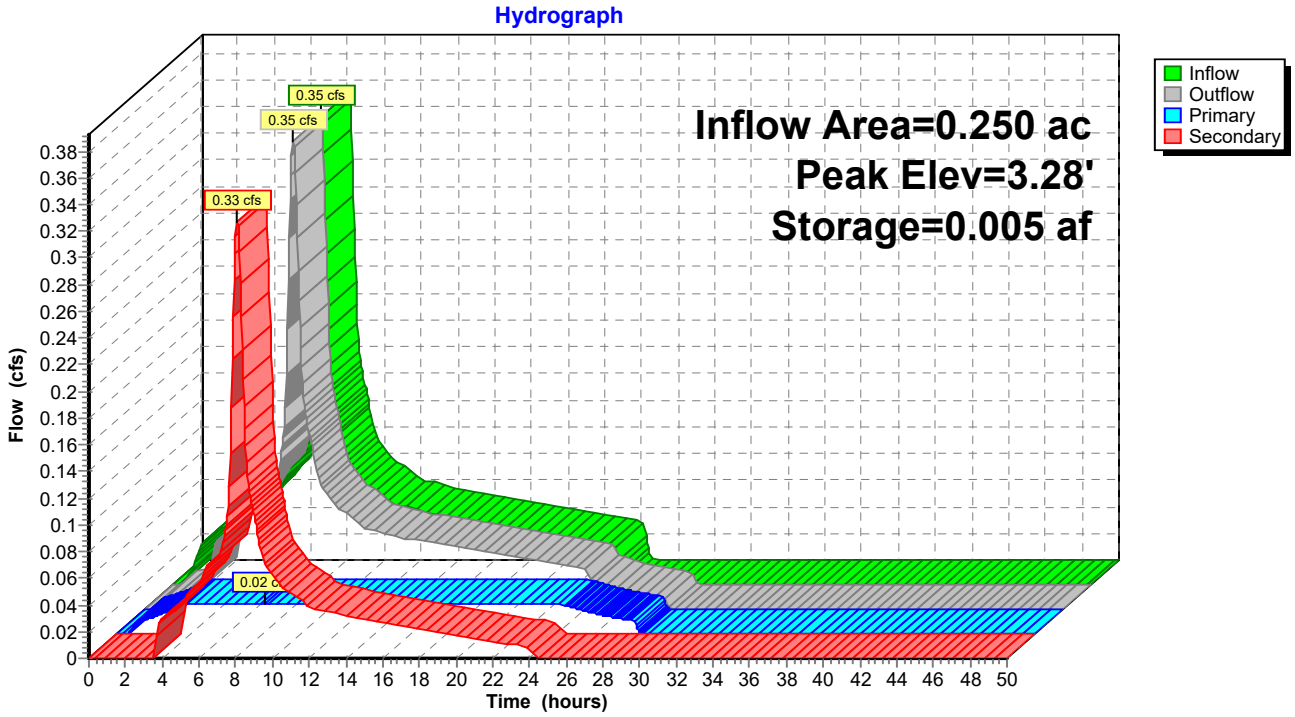
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.008 af	**5.00'W x 40.00'L x 5.00'H Bioretention** 0.023 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.02 cfs @ 8.09 hrs HW=3.28' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.02 cfs)

Secondary OutFlow Max=0.32 cfs @ 8.09 hrs HW=3.28' (Free Discharge)
2=Orifice/Grate (Orifice Controls 0.32 cfs @ 1.80 fps)

Pond 10P: Bioretention



Summary for Pond 11P: Bioretention

Inflow Area = 2.176 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 3.05 cfs @ 8.08 hrs, Volume= 1.081 af
Outflow = 3.02 cfs @ 8.12 hrs, Volume= 1.081 af, Atten= 1%, Lag= 2.8 min
Primary = 0.19 cfs @ 8.12 hrs, Volume= 0.364 af
Secondary = 2.82 cfs @ 8.12 hrs, Volume= 0.717 af
Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 5.06' @ 8.12 hrs Surf.Area= 0.031 ac Storage= 0.055 af

Plug-Flow detention time= 61.6 min calculated for 1.080 af (100% of inflow)
Center-of-Mass det. time= 61.8 min (725.8 - 664.0)

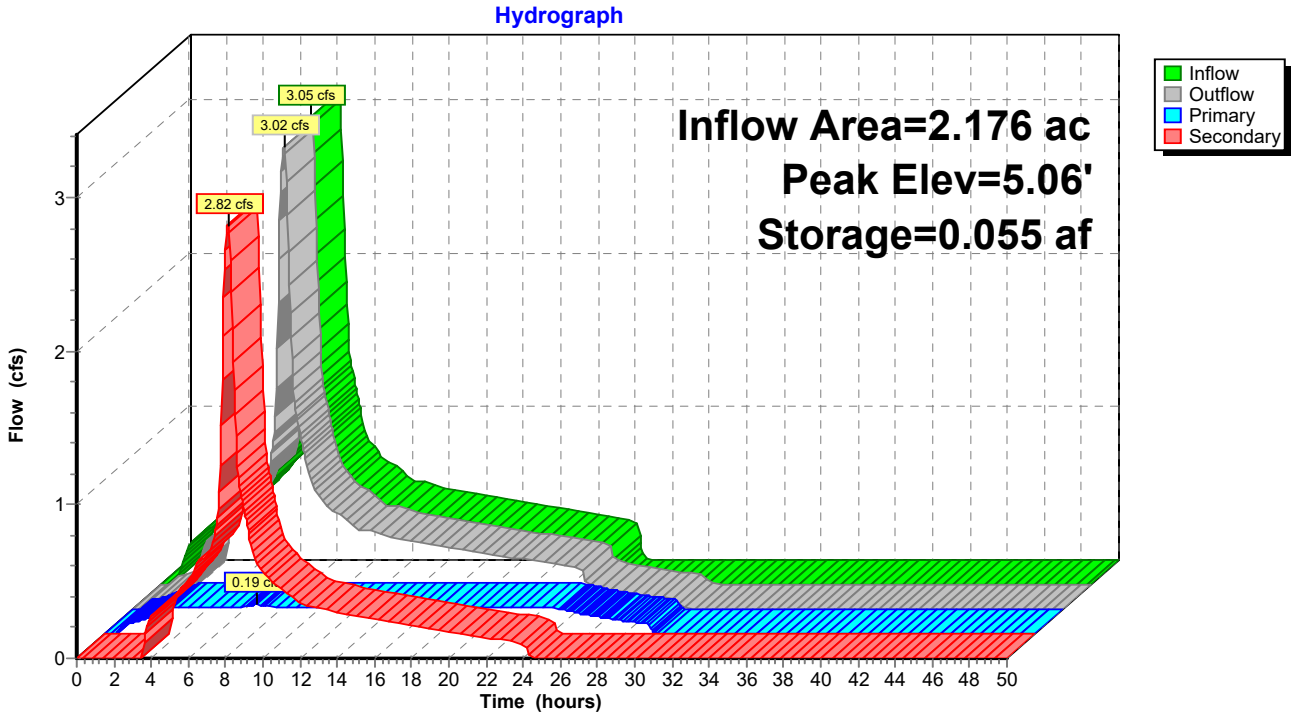
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.065 af	**5.00'W x 270.00'L x 6.00'H Bioretention** 0.186 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.19 cfs @ 8.12 hrs HW=5.06' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.19 cfs)

Secondary OutFlow Max=2.82 cfs @ 8.12 hrs HW=5.06' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 2.82 cfs @ 3.59 fps)

Pond 11P: Bioretention



Summary for Pond 15P: Bioretention

Inflow Area = 0.239 ac, 0.00% Impervious, Inflow Depth = 2.78" for 100-year event
Inflow = 0.14 cfs @ 8.13 hrs, Volume= 0.055 af
Outflow = 0.05 cfs @ 10.22 hrs, Volume= 0.055 af, Atten= 67%, Lag= 125.5 min
Primary = 0.05 cfs @ 10.22 hrs, Volume= 0.055 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 1.52' @ 10.22 hrs Surf.Area= 0.014 ac Storage= 0.007 af

Plug-Flow detention time= 77.6 min calculated for 0.055 af (100% of inflow)
Center-of-Mass det. time= 77.5 min (908.4 - 830.8)

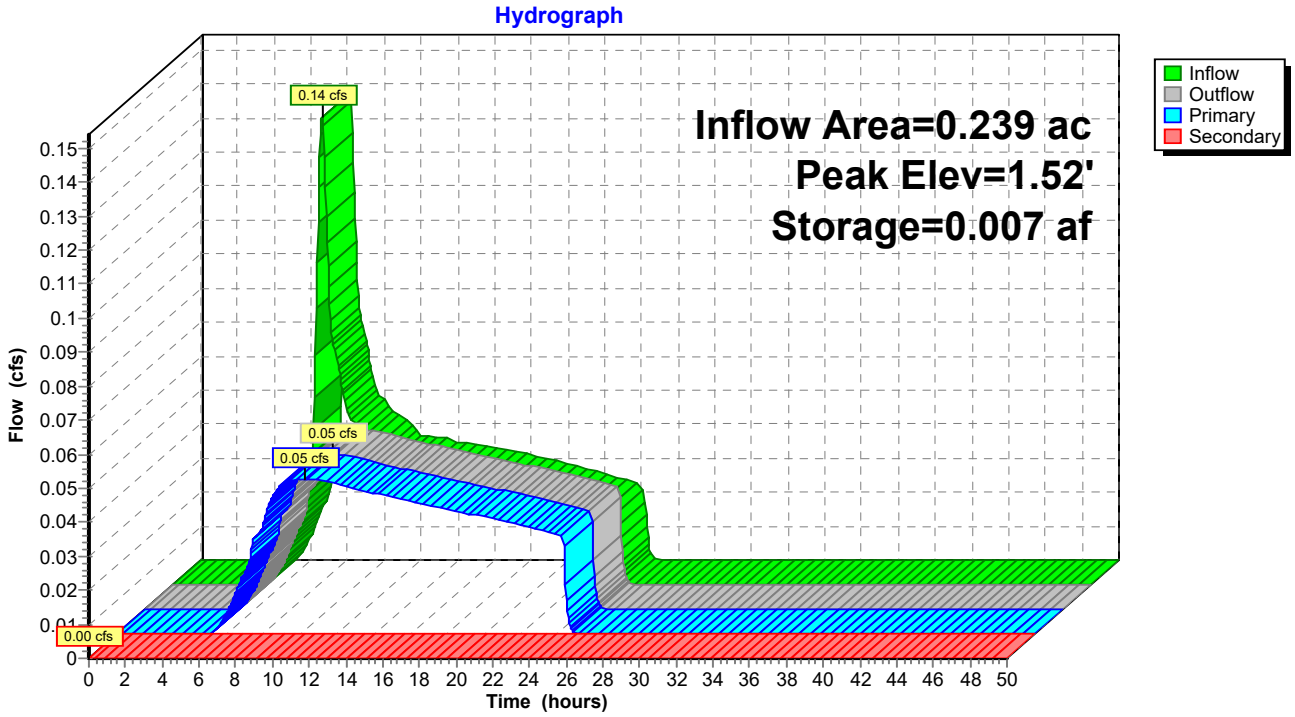
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.024 af	**5.00'W x 120.00'L x 5.00'H Bioretention** 0.069 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.05 cfs @ 10.22 hrs HW=1.52' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.05 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
2=Orifice/Grate (Controls 0.00 cfs)

Pond 15P: Bioretention



Summary for Pond 16P: Infiltration Trench

Inflow Area = 1.378 ac, 77.79% Impervious, Inflow Depth = 5.27" for 100-year event
Inflow = 1.78 cfs @ 8.08 hrs, Volume= 0.605 af
Outflow = 1.77 cfs @ 8.11 hrs, Volume= 0.605 af, Atten= 0%, Lag= 1.7 min
Primary = 0.09 cfs @ 8.11 hrs, Volume= 0.193 af
Secondary = 1.68 cfs @ 8.11 hrs, Volume= 0.411 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 4.70' @ 8.11 hrs Surf.Area= 0.028 ac Storage= 0.045 af

Plug-Flow detention time= 91.8 min calculated for 0.604 af (100% of inflow)
Center-of-Mass det. time= 92.1 min (798.9 - 706.8)

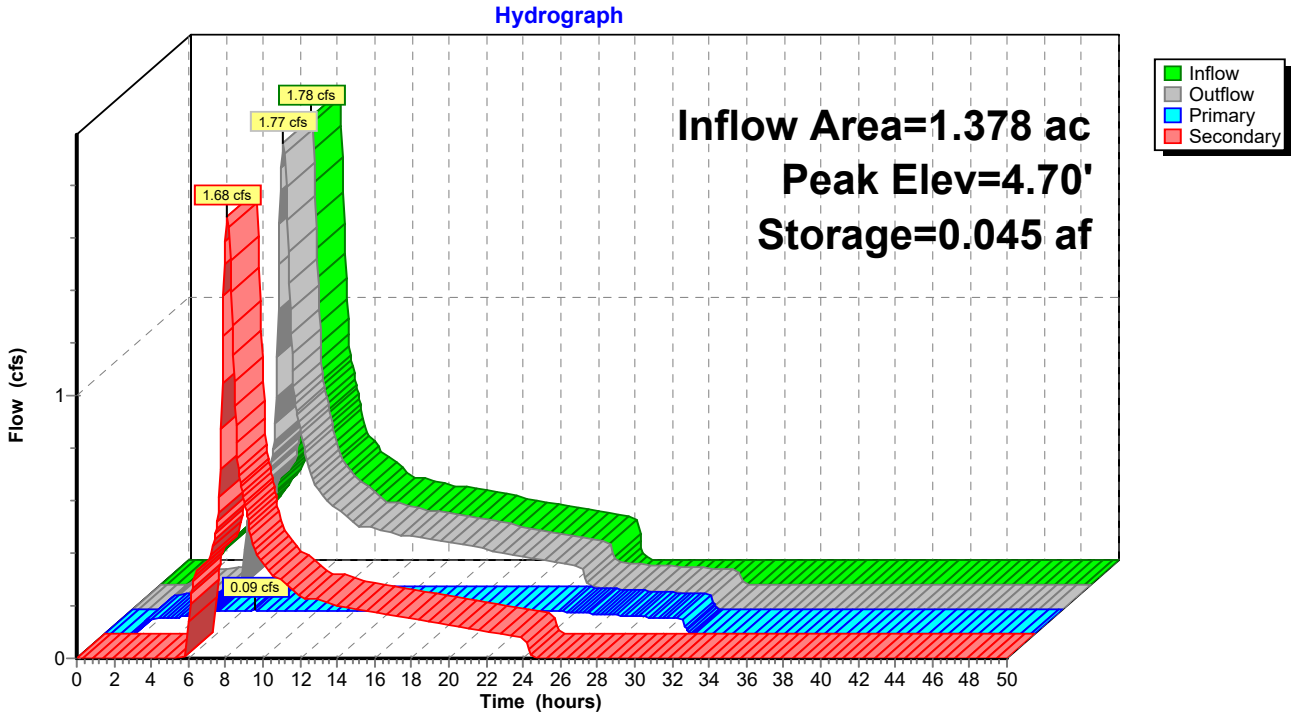
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.058 af	**20.00'W x 60.00'L x 6.00'H Infiltration Trench** 0.165 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.09 cfs @ 8.11 hrs HW=4.70' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Secondary OutFlow Max=1.68 cfs @ 8.11 hrs HW=4.70' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 1.68 cfs @ 2.85 fps)

Pond 16P: Infiltration Trench



Summary for Pond 19P: Infiltration Trench

Inflow Area = 46.237 ac,100.00% Impervious, Inflow Depth > 5.88" for 100-year event
Inflow = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af
Outflow = 38.47 cfs @ 8.60 hrs, Volume= 22.657 af, Atten= 5%, Lag= 10.4 min
Primary = 3.58 cfs @ 8.60 hrs, Volume= 8.734 af
Secondary = 34.89 cfs @ 8.60 hrs, Volume= 13.923 af
Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 4.09' @ 8.60 hrs Surf.Area= 1.674 ac Storage= 2.393 af

Plug-Flow detention time= 123.7 min calculated for 22.657 af (100% of inflow)
Center-of-Mass det. time= 123.7 min (860.1 - 736.4)

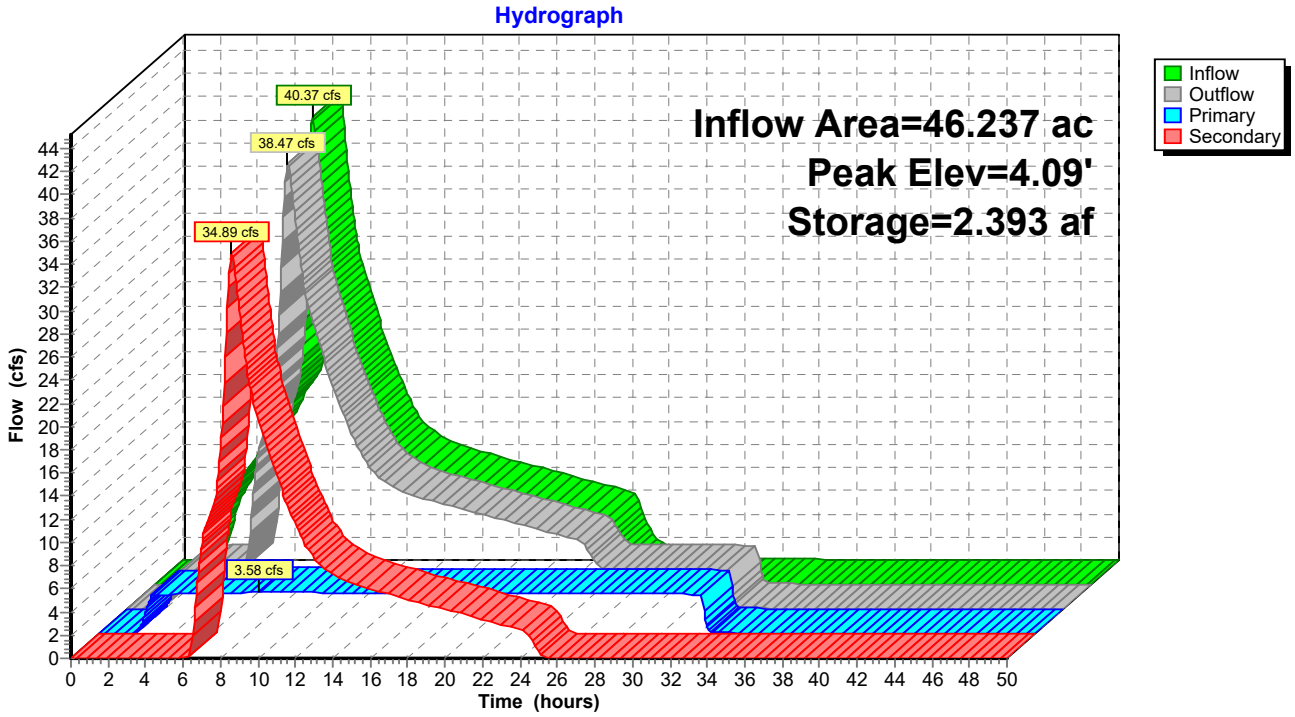
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	2.929 af	**270.00'W x 270.00'L x 5.00'H Infiltration Trench** 8.368 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.58 cfs @ 8.60 hrs HW=4.09' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 3.58 cfs)

Secondary OutFlow Max=34.87 cfs @ 8.60 hrs HW=4.09' (Free Discharge)
↑**2=Orifice/Grate** (Weir Controls 34.87 cfs @ 3.41 fps)

Pond 19P: Infiltration Trench



Summary for Pond N1: Node D

[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=14)
[81] Warning: Exceeded Pond 19P by 41.00' @ 1.75 hrs

Inflow Area = 44.595 ac, 62.85% Impervious, Inflow Depth = 9.31" for 100-year event
Inflow = 84.32 cfs @ 8.14 hrs, Volume= 34.599 af
Outflow = 67.56 cfs @ 8.57 hrs, Volume= 34.595 af, Atten= 20%, Lag= 25.8 min
Primary = 67.56 cfs @ 8.57 hrs, Volume= 34.595 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 43.19' @ 8.57 hrs Surf.Area= 43,834 sf Storage= 45,518 cf

Plug-Flow detention time= 2.4 min calculated for 34.561 af (100% of inflow)
Center-of-Mass det. time= 2.3 min (737.8 - 735.5)

Volume	Invert	Avail.Storage	Storage Description
#1	38.00'	922,840 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

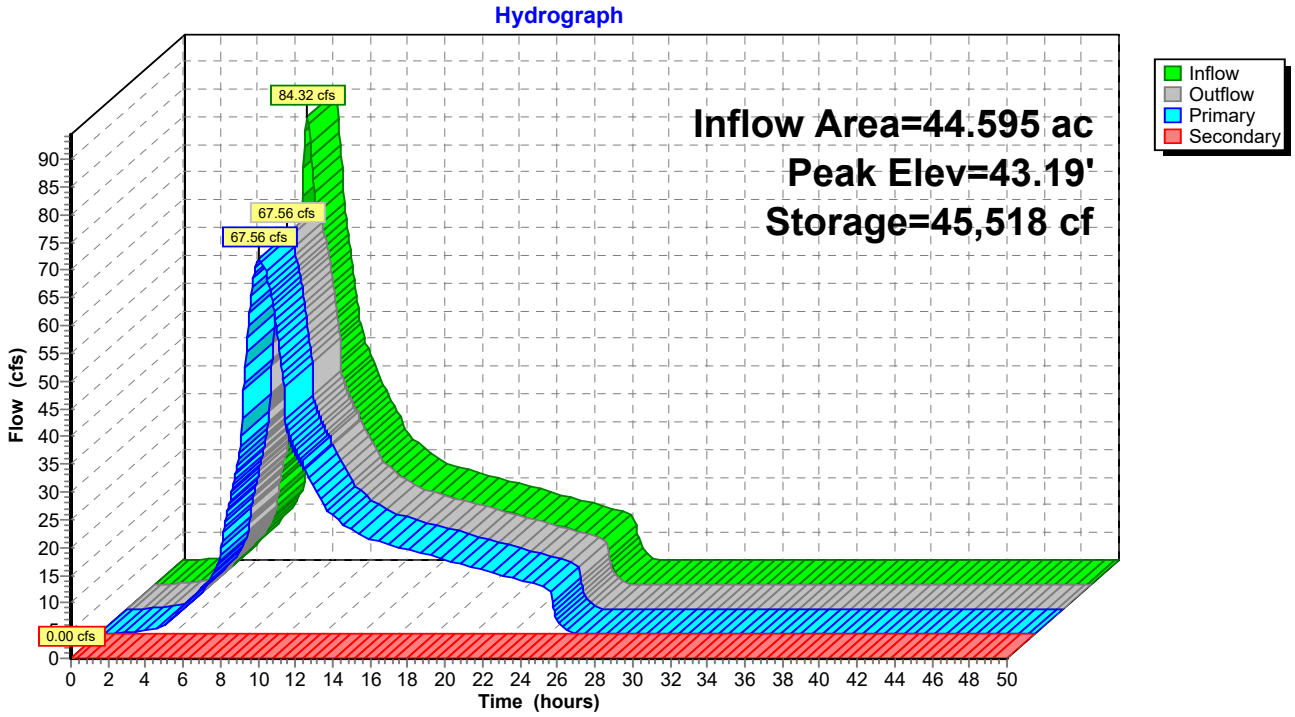
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	50	0	0
41.99	50	200	200
42.00	32,000	160	360
48.00	91,616	370,848	371,208
49.00	270,816	181,216	552,424
50.00	470,016	370,416	922,840

Device	Routing	Invert	Outlet Devices
#1	Secondary	48.00'	**30.0' long + 1.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32
#2	Primary	38.00'	**42.0" Round Culvert** L= 270.3' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 38.00' / 37.50' S= 0.0018 '/' Cc= 0.900 n= 0.012, Flow Area= 9.62 sf

Primary OutFlow Max=67.54 cfs @ 8.57 hrs HW=43.19' TW=41.00' (Fixed TW Elev= 41.00')
└**2=Culvert** (Barrel Controls 67.54 cfs @ 7.02 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=38.00' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond N1: Node D



Summary for Pond N2: Node C

[57] Hint: Peaked at 46.47' (Flood elevation advised)
[81] Warning: Exceeded Pond 7P by 2.86' @ 1.75 hrs
[81] Warning: Exceeded Pond 15P by 45.90' @ 8.05 hrs
[81] Warning: Exceeded Pond 16P by 43.19' @ 1.45 hrs

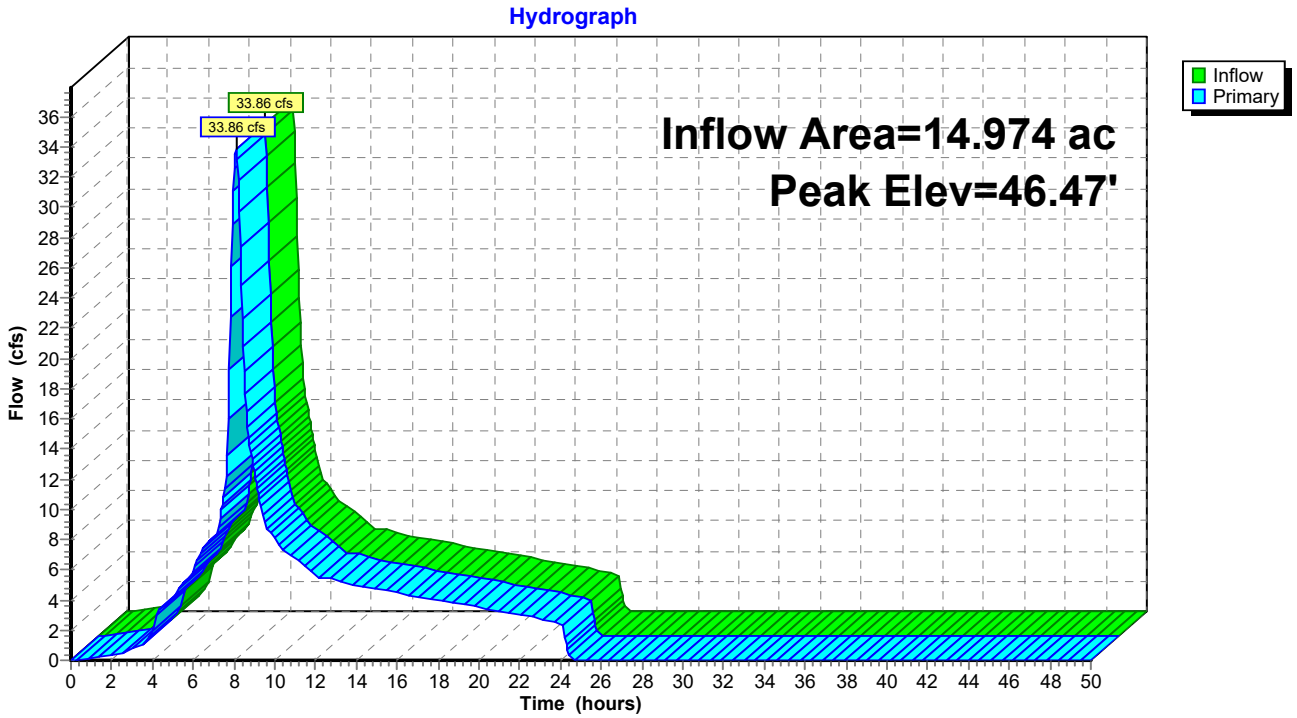
Inflow Area = 14.974 ac, 52.54% Impervious, Inflow Depth = 8.32" for 100-year event
Inflow = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af
Outflow = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af, Atten= 0%, Lag= 0.0 min
Primary = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af
Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 46.47' @ 8.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	39.19'	**30.0" Round Culvert** L= 410.7' Ke= 0.200 Inlet / Outlet Invert= 39.19' / 38.00' S= 0.0029 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 4.91 sf
#2	Primary	48.80'	**36.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=33.80 cfs @ 8.09 hrs HW=46.46' TW=43.19' (Fixed TW Elev= 43.19')
1=Culvert (Outlet Controls 33.80 cfs @ 6.88 fps)
2=Sharp-Crested Rectangular Weir (Controls 0.00 cfs)

Pond N2: Node C



Summary for Pond N3: Node A

[57] Hint: Peaked at 50.56' (Flood elevation advised)
[81] Warning: Exceeded Pond 4P by 49.68' @ 31.55 hrs
[81] Warning: Exceeded Pond 5P by 49.68' @ 35.95 hrs

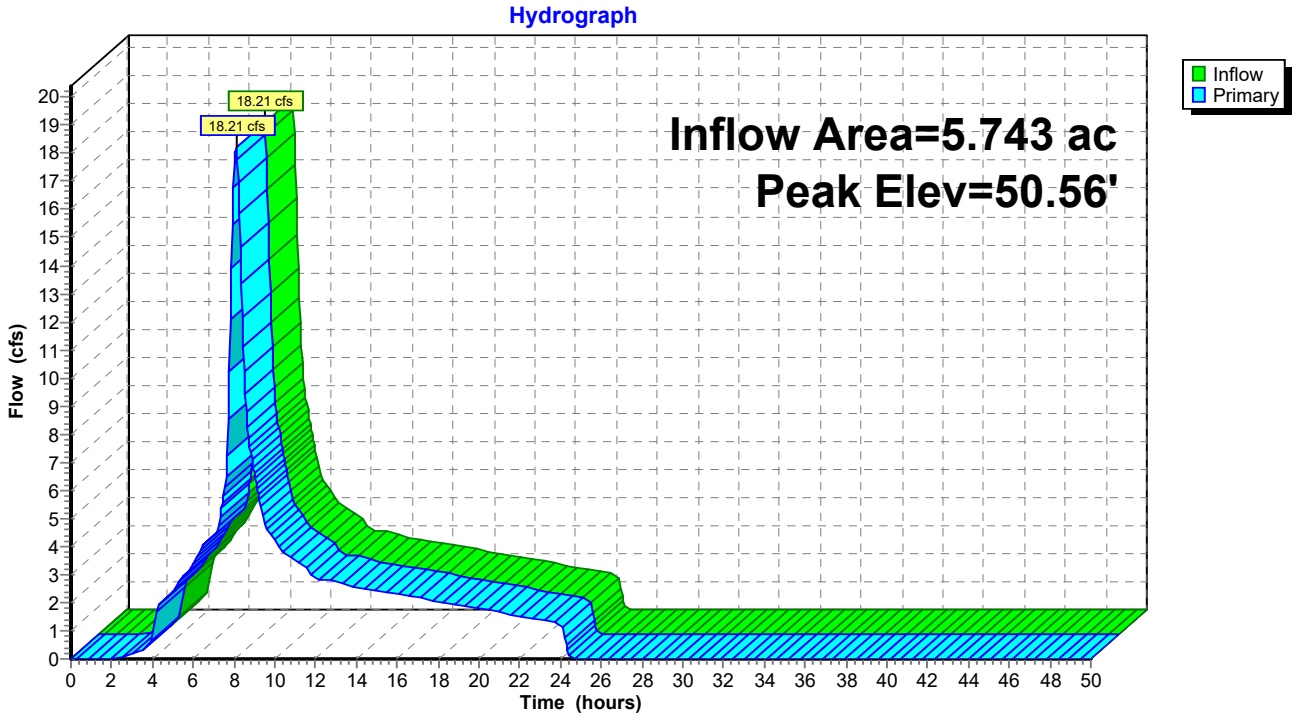
Inflow Area = 5.743 ac, 58.73% Impervious, Inflow Depth = 11.34" for 100-year event
Inflow = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af
Outflow = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af, Atten= 0%, Lag= 0.0 min
Primary = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af
Routed to Pond 7P : Node B

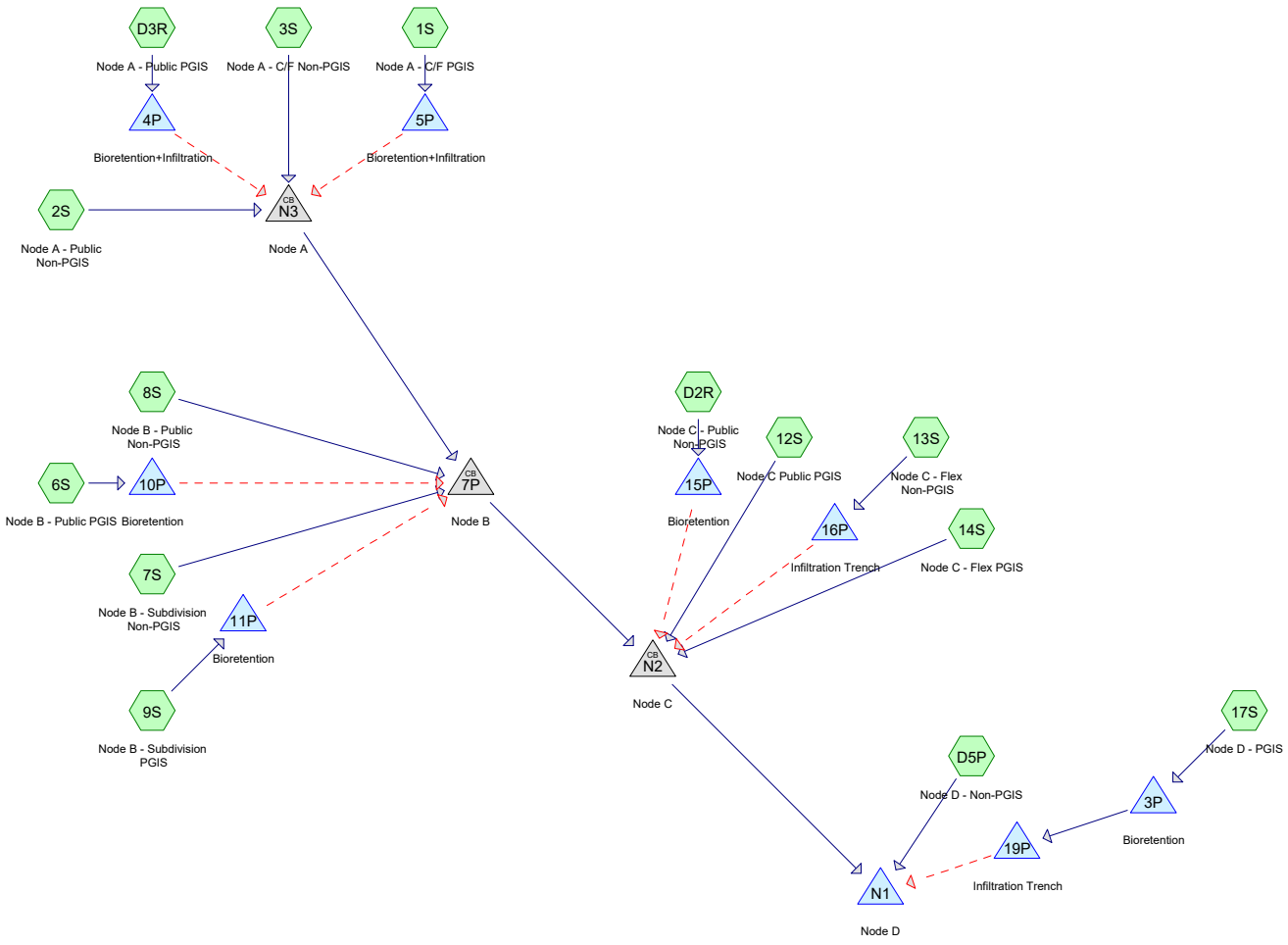
Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 50.56' @ 8.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	41.44'	**24.0" Round Culvert** L= 369.0' Ke= 0.200 Inlet / Outlet Invert= 41.44' / 40.33' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Primary	50.40'	**36.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=17.89 cfs @ 8.09 hrs HW=50.56' TW=49.68' (Fixed TW Elev= 49.68')
1=Culvert (Outlet Controls 10.45 cfs @ 3.33 fps)
2=Sharp-Crested Rectangular Weir (Weir Controls 7.44 cfs @ 1.30 fps)

Pond N3: Node A





Subcat Reach Pond Link

Routing Diagram for ALTERNATE _Onsite 25-Year Storm - Moderate Flood Stage

Prepared by MacKay & Sposito, Inc, Printed 3/10/2025

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
9.462	49	50-75% Grass cover, Fair, HSG A (D5P)
2.370	59	50-75% Grass cover, Fair, HSG A/B (avg) (2S, 3S)
0.306	69	50-75% Grass cover, Fair, HSG B (13S)
0.239	68	<50% Grass cover, Poor, HSG A (D2R)
4.736	79	<50% Grass cover, Poor, HSG B (7S, 8S)
48.663	98	Paved parking, HSG A (6S, 9S, 17S)
11.595	98	Paved parking, HSG B (1S, 12S, 14S, D3R)
4.445	98	Roofs, HSG A (3S, 13S)
22.259	98	Roofs, HSG B (7S, D5P)
104.075	**92**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
65.179	HSG A	2S, 3S, 6S, 9S, 13S, 17S, D2R, D5P
38.896	HSG B	1S, 7S, 8S, 12S, 13S, 14S, D3R, D5P
0.000	HSG C	
0.000	HSG D	
0.000	Other	
104.075		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
11.832	0.306	0.000	0.000	0.000	12.138	50-75% Grass cover, Fair	2S, 3S, 13S, D5P
0.239	4.736	0.000	0.000	0.000	4.975	<50% Grass cover, Poor	7S, 8S, D2R
48.663	11.595	0.000	0.000	0.000	60.258	Paved parking	1S, 6S, 9S, 12S, 14S, 17S, D3R
4.445	22.259	0.000	0.000	0.000	26.704	Roofs	3S, 7S, 13S, D5P
65.179	**38.896**	**0.000**	**0.000**	**0.000**	**104.075**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	7P	40.33	39.19	379.7	0.0030	0.012	0.0	24.0	0.0	
2	N1	38.00	37.50	270.3	0.0018	0.012	0.0	42.0	0.0	
3	N2	39.19	38.00	410.7	0.0029	0.012	0.0	30.0	0.0	
4	N3	41.44	40.33	369.0	0.0030	0.012	0.0	24.0	0.0	

Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Node A - C/F PGIS Runoff Area=7.516 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=8.64 cfs 3.046 af

Subcatchment2S: Node A - Public Non-PGIS Runoff Area=1.160 ac 0.00% Impervious Runoff Depth=1.29"
Tc=20.0 min CN=59 Runoff=0.20 cfs 0.125 af

Subcatchment3S: Node A - C/F Non-PGIS Runoff Area=4.583 ac 73.60% Impervious Runoff Depth=3.76"
Tc=20.0 min CN=88 Runoff=4.22 cfs 1.438 af

Subcatchment6S: Node B - Public PGIS Runoff Area=0.250 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=0.29 cfs 0.101 af

Subcatchment7S: Node B - Subdivision Runoff Area=6.745 ac 31.13% Impervious Runoff Depth=3.46"
Tc=20.0 min CN=85 Runoff=5.62 cfs 1.945 af

Subcatchment8S: Node B - Public Non-PGIS Runoff Area=0.091 ac 0.00% Impervious Runoff Depth=2.89"
Tc=20.0 min CN=79 Runoff=0.06 cfs 0.022 af

Subcatchment9S: Node B - Subdivision Runoff Area=2.176 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=2.50 cfs 0.882 af

Subcatchment12S: Node C Public PGIS Runoff Area=0.710 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=0.82 cfs 0.288 af

Subcatchment13S: Node C - Flex Non-PGIS Runoff Area=1.378 ac 77.79% Impervious Runoff Depth=4.19"
Tc=20.0 min CN=92 Runoff=1.42 cfs 0.481 af

Subcatchment14S: Node C - Flex PGIS Runoff Area=1.685 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=1.94 cfs 0.683 af

Subcatchment17S: Node D - PGIS Runoff Area=46.237 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=53.15 cfs 18.738 af

SubcatchmentD2R: Node C - Public Runoff Area=0.239 ac 0.00% Impervious Runoff Depth=1.95"
Tc=20.0 min CN=68 Runoff=0.09 cfs 0.039 af

SubcatchmentD3R: Node A - Public PGIS Runoff Area=1.684 ac 100.00% Impervious Runoff Depth=4.86"
Tc=20.0 min CN=98 Runoff=1.94 cfs 0.682 af

SubcatchmentD5P: Node D - Non-PGIS Runoff Area=29.621 ac 68.06% Impervious Runoff Depth=3.17"
Tc=20.0 min CN=82 Runoff=22.11 cfs 7.822 af

Pond 3P: Bioretention Peak Elev=54.62' Storage=2.845 af Inflow=53.15 cfs 18.738 af
Outflow=28.78 cfs 18.424 af

Pond 4P: Bioretention+Infiltration Peak Elev=3.73' Storage=0.037 af Inflow=1.94 cfs 0.682 af
Primary=0.15 cfs 0.277 af Secondary=1.78 cfs 0.406 af Outflow=1.93 cfs 0.682 af

Pond 5P: Bioretention+Infiltration Peak Elev=4.97' Storage=0.240 af Inflow=8.64 cfs 3.046 af
Primary=0.36 cfs 0.882 af Secondary=8.26 cfs 2.164 af Outflow=8.62 cfs 3.046 af

Pond 7P: Node B Peak Elev=49.73' Inflow=22.70 cfs 6.681 af
Outflow=22.70 cfs 6.681 af

Pond 10P: Bioretention Peak Elev=3.25' Storage=0.005 af Inflow=0.29 cfs 0.101 af
Primary=0.02 cfs 0.045 af Secondary=0.26 cfs 0.056 af Outflow=0.29 cfs 0.101 af

Pond 11P: Bioretention Peak Elev=4.87' Storage=0.053 af Inflow=2.50 cfs 0.882 af
Primary=0.19 cfs 0.356 af Secondary=2.30 cfs 0.526 af Outflow=2.48 cfs 0.882 af

Pond 15P: Bioretention Peak Elev=0.73' Storage=0.004 af Inflow=0.09 cfs 0.039 af
Primary=0.04 cfs 0.039 af Secondary=0.00 cfs 0.000 af Outflow=0.04 cfs 0.039 af

Pond 16P: Infiltration Trench Peak Elev=4.61' Storage=0.044 af Inflow=1.42 cfs 0.481 af
Primary=0.09 cfs 0.189 af Secondary=1.32 cfs 0.292 af Outflow=1.41 cfs 0.481 af

Pond 19P: Infiltration Trench Peak Elev=3.86' Storage=2.259 af Inflow=28.78 cfs 18.424 af
Primary=3.57 cfs 8.564 af Secondary=24.41 cfs 9.860 af Outflow=27.97 cfs 18.424 af

Pond N1: Node D Peak Elev=47.56' Storage=331,489 cf Inflow=65.60 cfs 25.625 af
Primary=33.98 cfs 19.092 af Secondary=0.00 cfs 0.000 af Outflow=33.98 cfs 19.092 af

Pond N2: Node C Peak Elev=48.92' Inflow=26.76 cfs 7.943 af
Outflow=26.76 cfs 7.943 af

Pond N3: Node A Peak Elev=50.51' Inflow=14.45 cfs 4.132 af
Outflow=14.45 cfs 4.132 af

Total Runoff Area = 104.075 ac Runoff Volume = 36.290 af Average Runoff Depth = 4.18"
16.44% Pervious = 17.113 ac 83.56% Impervious = 86.962 ac

Summary for Subcatchment 1S: Node A - C/F PGIS

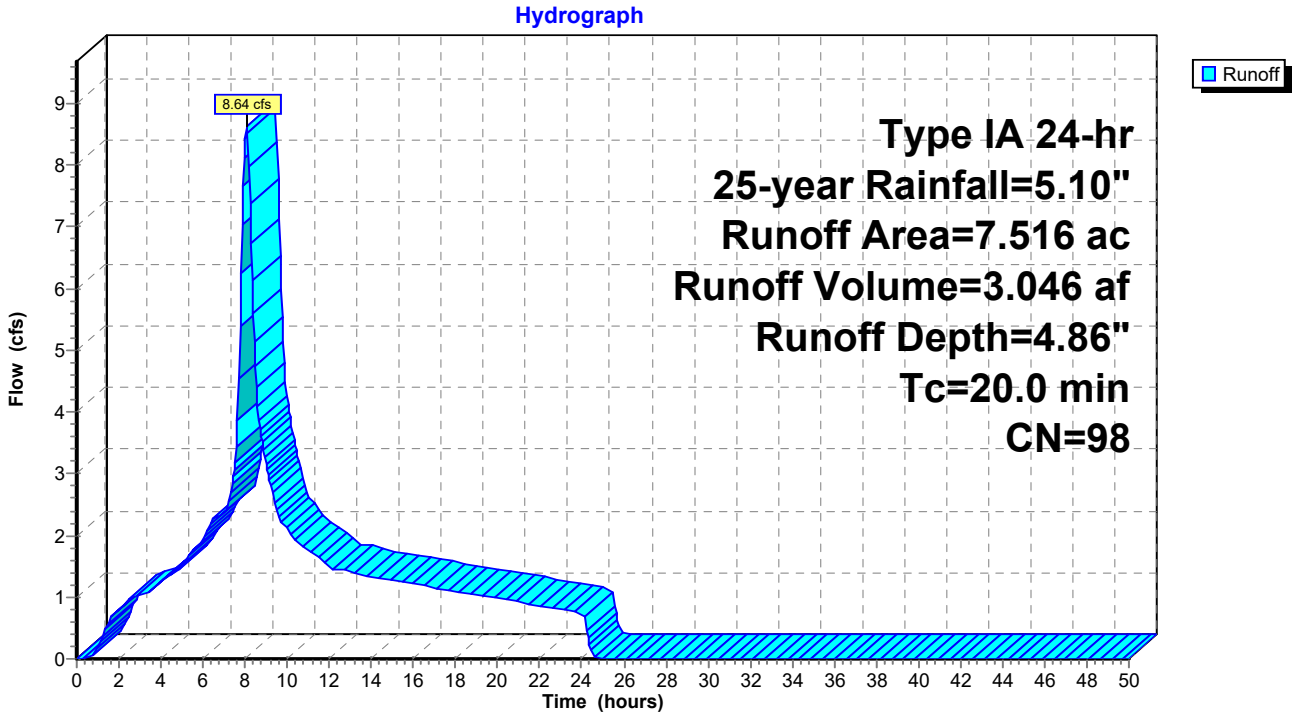
Runoff = 8.64 cfs @ 8.08 hrs, Volume= 3.046 af, Depth= 4.86"
Routed to Pond 5P : Bioretention+Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
7.516	98	Paved parking, HSG B
7.516		100.00% Impervious Area

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

Subcatchment 1S: Node A - C/F PGIS



Summary for Subcatchment 2S: Node A - Public Non-PGIS

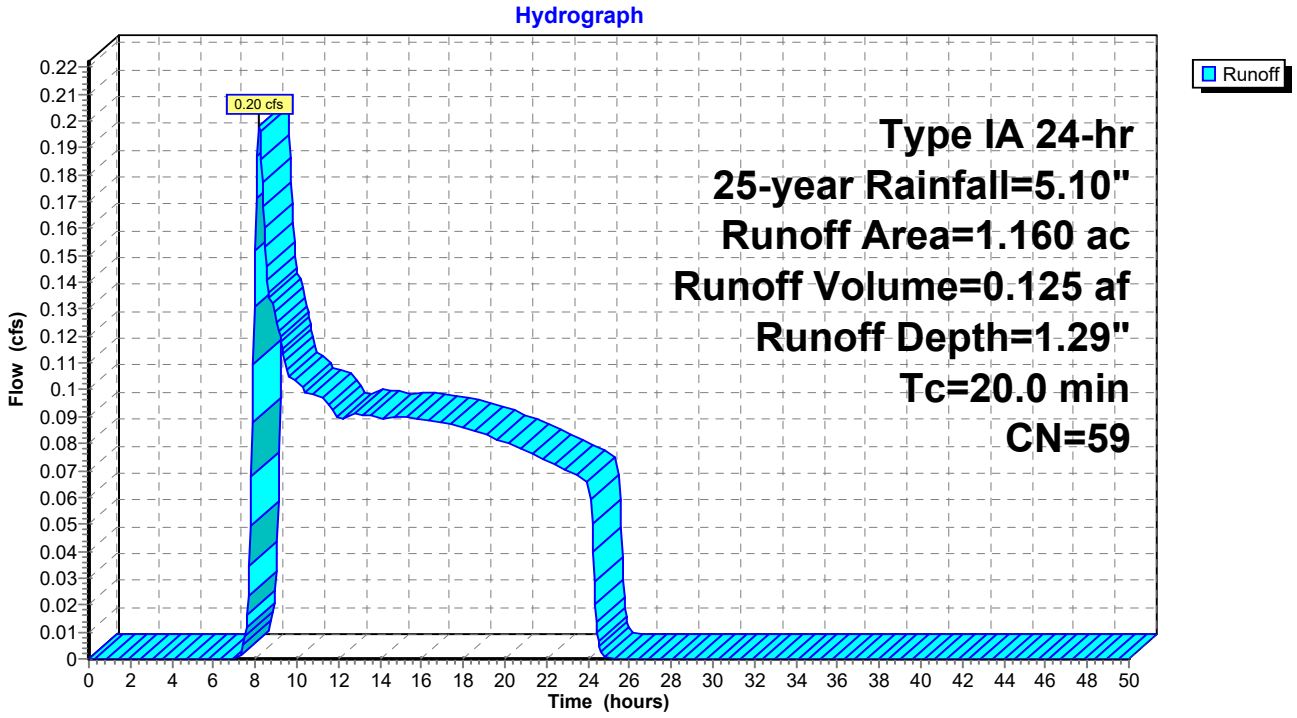
Runoff = 0.20 cfs @ 8.19 hrs, Volume= 0.125 af, Depth= 1.29"
Routed to Pond N3 : Node A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

	Area (ac)	CN	Description
*	1.160	59	50-75% Grass cover, Fair, HSG A/B (avg)
	1.160		100.00% Pervious Area

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

Subcatchment 2S: Node A - Public Non-PGIS



Summary for Subcatchment 3S: Node A - C/F Non-PGIS

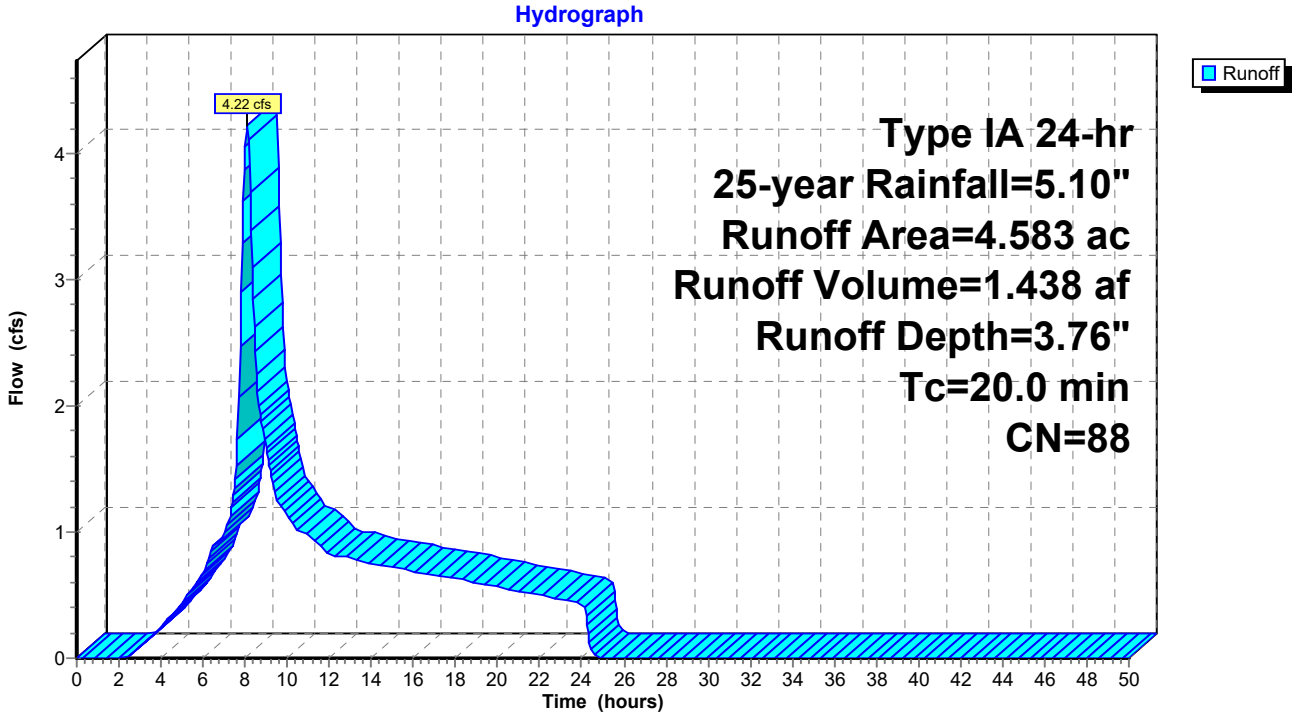
Runoff = 4.22 cfs @ 8.09 hrs, Volume= 1.438 af, Depth= 3.76"
Routed to Pond N3 : Node A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

	Area (ac)	CN	Description
*	1.210	59	50-75% Grass cover, Fair, HSG A/B (avg)
	3.373	98	Roofs, HSG A
	4.583	88	Weighted Average
	1.210		26.40% Pervious Area
	3.373		73.60% Impervious Area

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

Subcatchment 3S: Node A - C/F Non-PGIS



Summary for Subcatchment 6S: Node B - Public PGIS

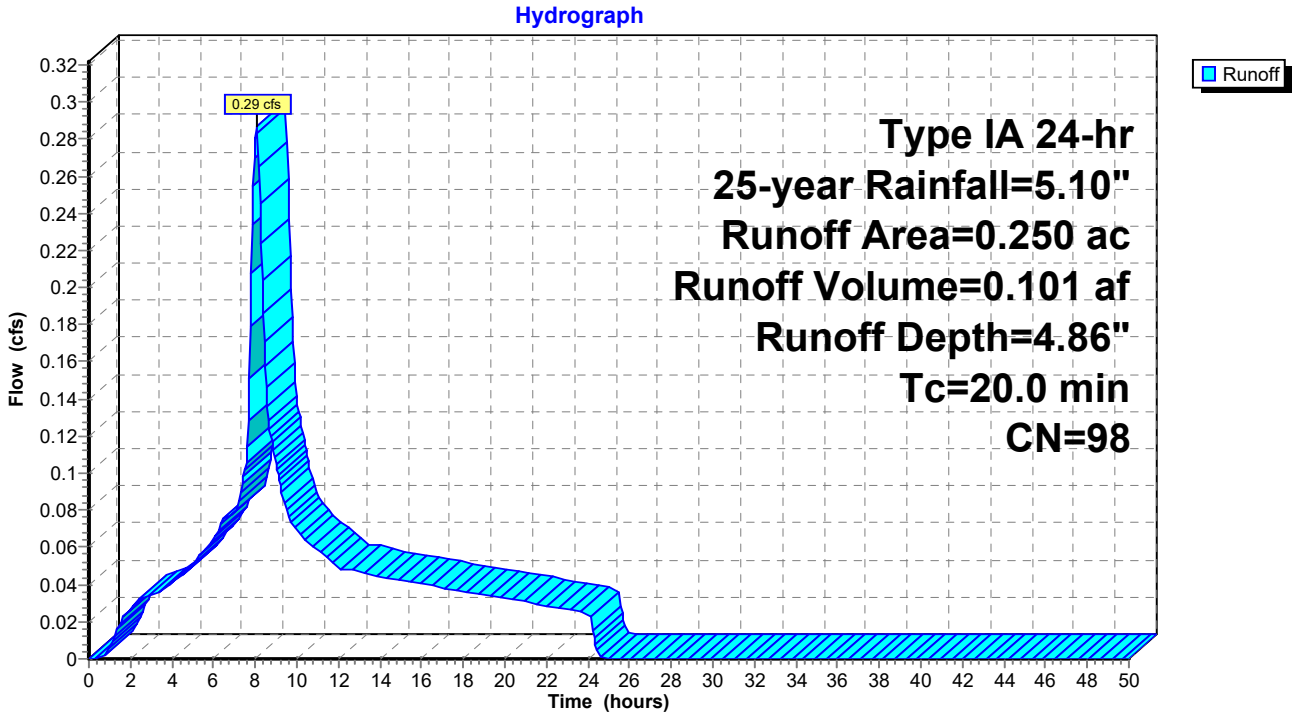
Runoff = 0.29 cfs @ 8.08 hrs, Volume= 0.101 af, Depth= 4.86"
Routed to Pond 10P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.250	98	Paved parking, HSG A
0.250		100.00% Impervious Area

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

Subcatchment 6S: Node B - Public PGIS



Summary for Subcatchment 7S: Node B - Subdivision Non-PGIS

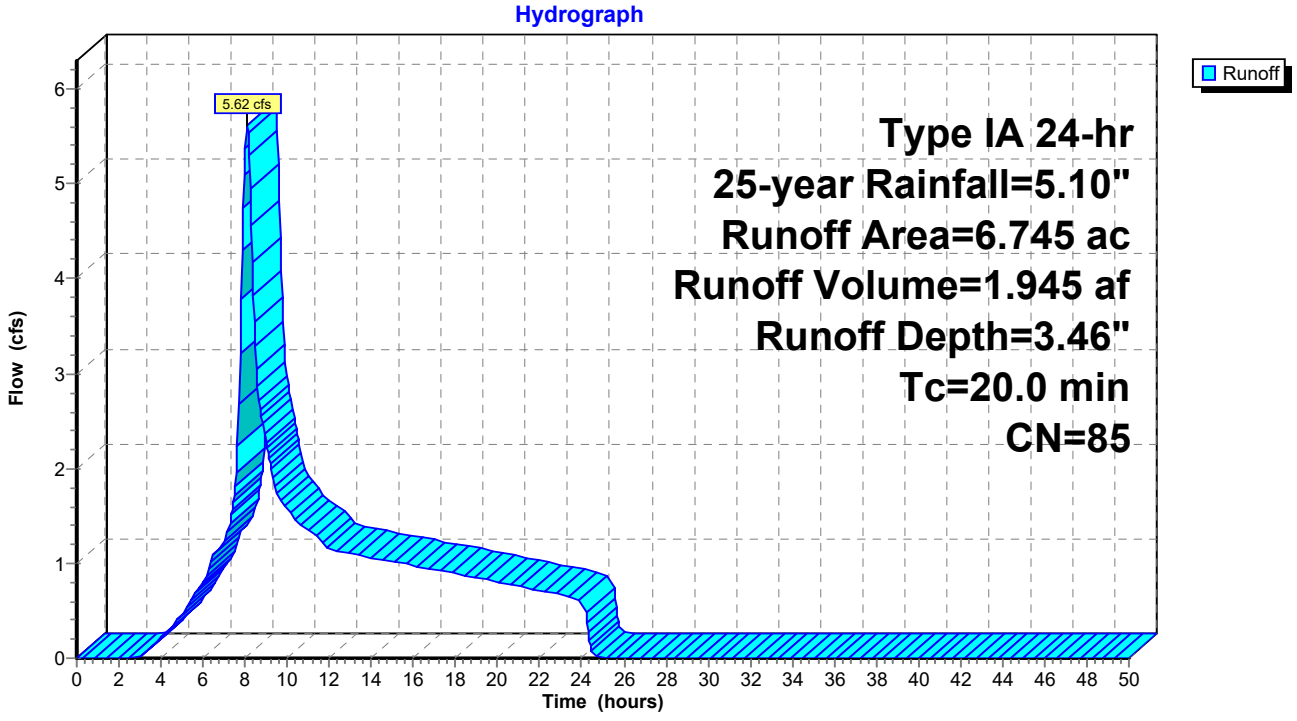
Runoff = 5.62 cfs @ 8.10 hrs, Volume= 1.945 af, Depth= 3.46"
Routed to Pond 7P : Node B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
2.100	98	Roofs, HSG B
4.645	79	<50% Grass cover, Poor, HSG B
6.745	85	Weighted Average
4.645		68.87% Pervious Area
2.100		31.13% Impervious Area

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

Subcatchment 7S: Node B - Subdivision Non-PGIS



Summary for Subcatchment 8S: Node B - Public Non-PGIS

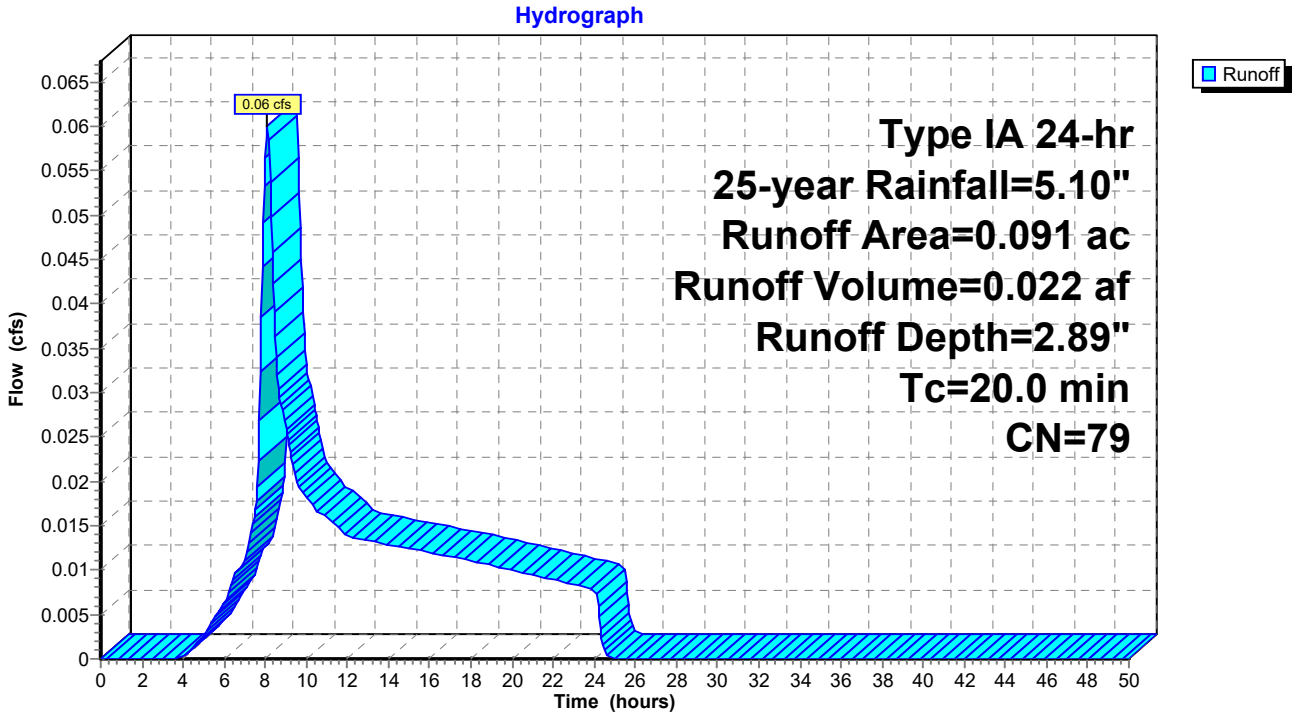
Runoff = 0.06 cfs @ 8.11 hrs, Volume= 0.022 af, Depth= 2.89"
Routed to Pond 7P : Node B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.091	79	<50% Grass cover, Poor, HSG B
0.091		100.00% Pervious Area

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

Subcatchment 8S: Node B - Public Non-PGIS



Summary for Subcatchment 9S: Node B - Subdivision PGIS

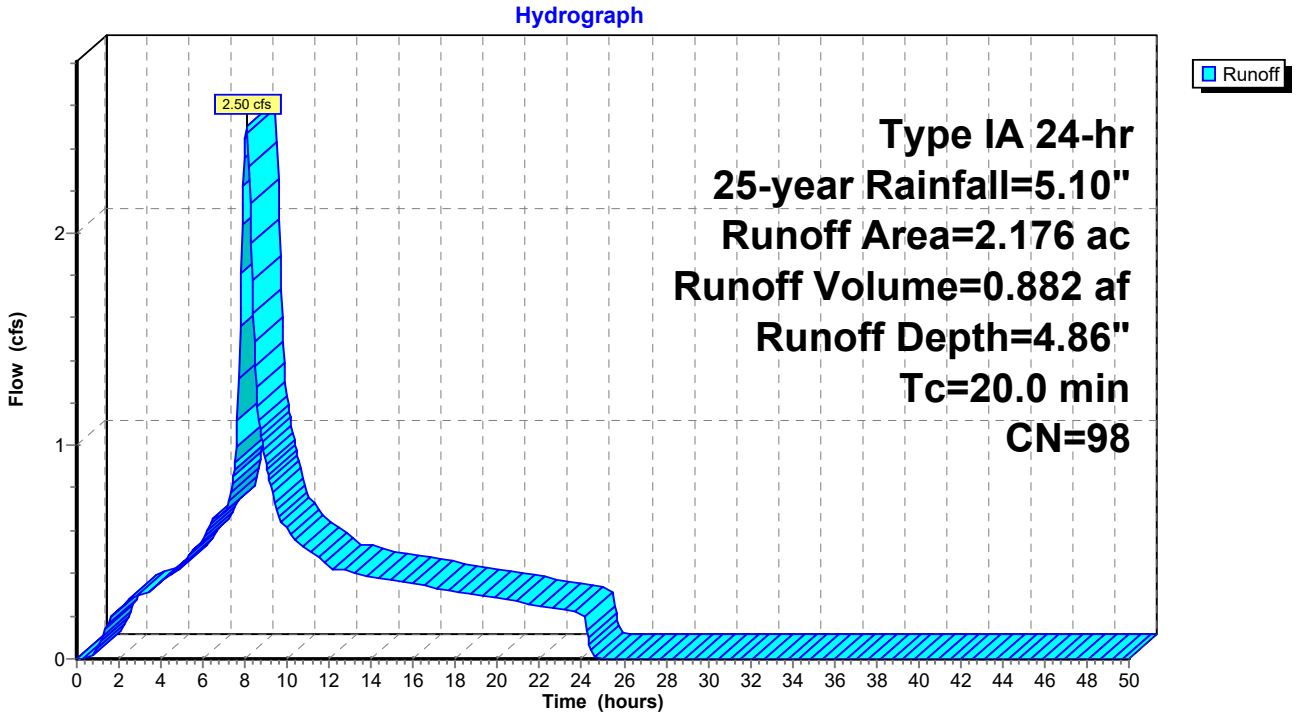
Runoff = 2.50 cfs @ 8.08 hrs, Volume= 0.882 af, Depth= 4.86"
Routed to Pond 11P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
2.176	98	Paved parking, HSG A
2.176		100.00% Impervious Area

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

Subcatchment 9S: Node B - Subdivision PGIS



Summary for Subcatchment 12S: Node C Public PGIS

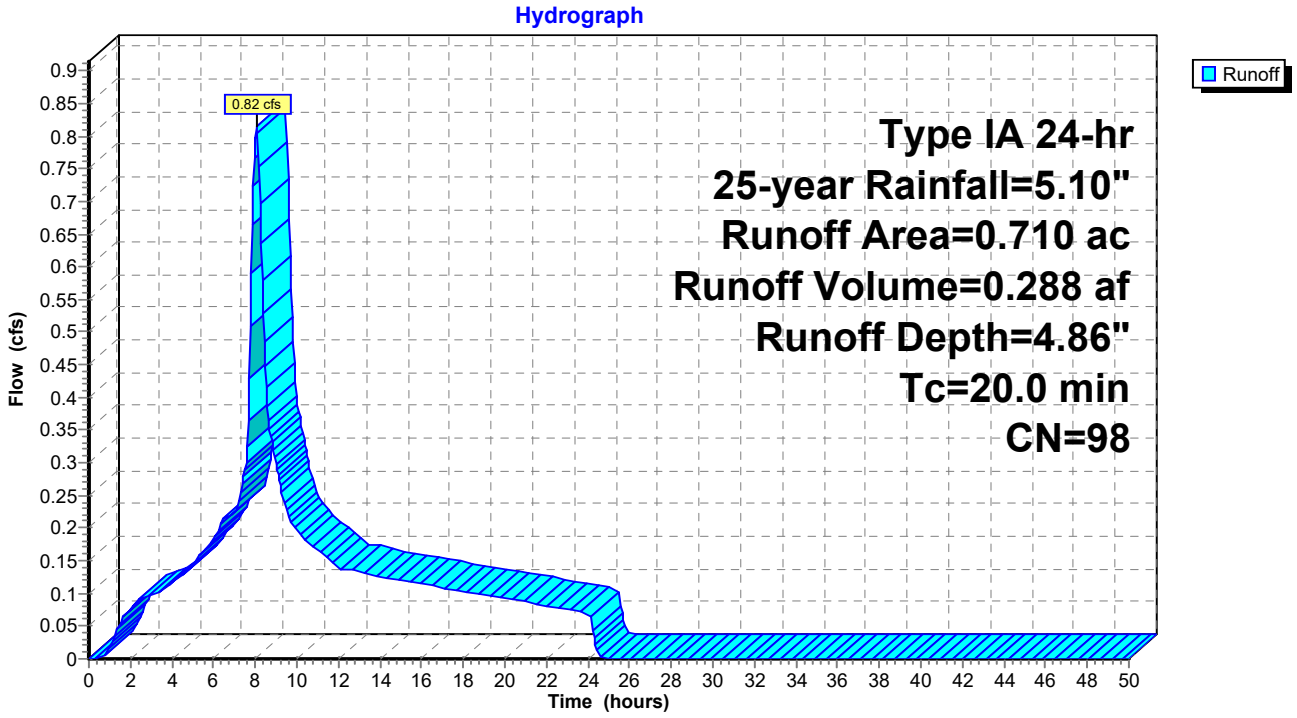
Runoff = 0.82 cfs @ 8.08 hrs, Volume= 0.288 af, Depth= 4.86"
Routed to Pond N2 : Node C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.710	98	Paved parking, HSG B
0.710		100.00% Impervious Area

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

Subcatchment 12S: Node C Public PGIS



Summary for Subcatchment 13S: Node C - Flex Non-PGIS

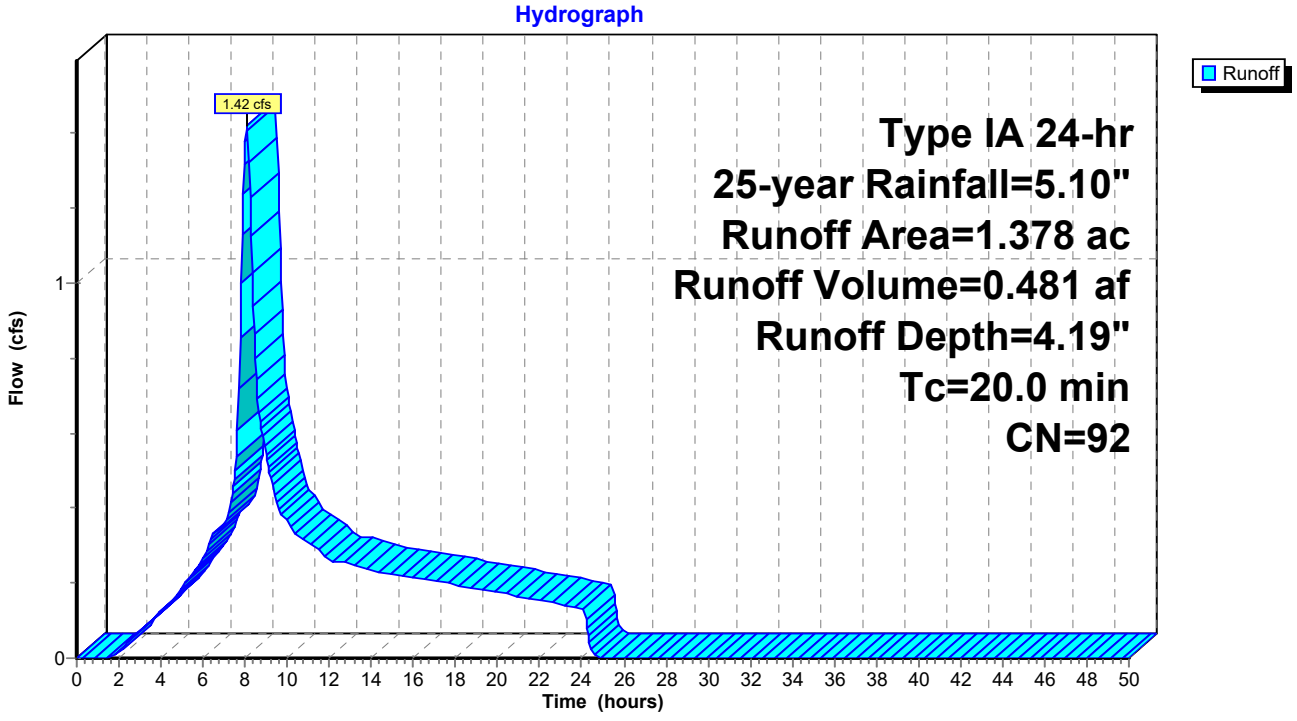
Runoff = 1.42 cfs @ 8.09 hrs, Volume= 0.481 af, Depth= 4.19"
Routed to Pond 16P : Infiltration Trench

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.306	69	50-75% Grass cover, Fair, HSG B
1.072	98	Roofs, HSG A
1.378	92	Weighted Average
0.306		22.21% Pervious Area
1.072		77.79% Impervious Area

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

Subcatchment 13S: Node C - Flex Non-PGIS



Summary for Subcatchment 14S: Node C - Flex PGIS

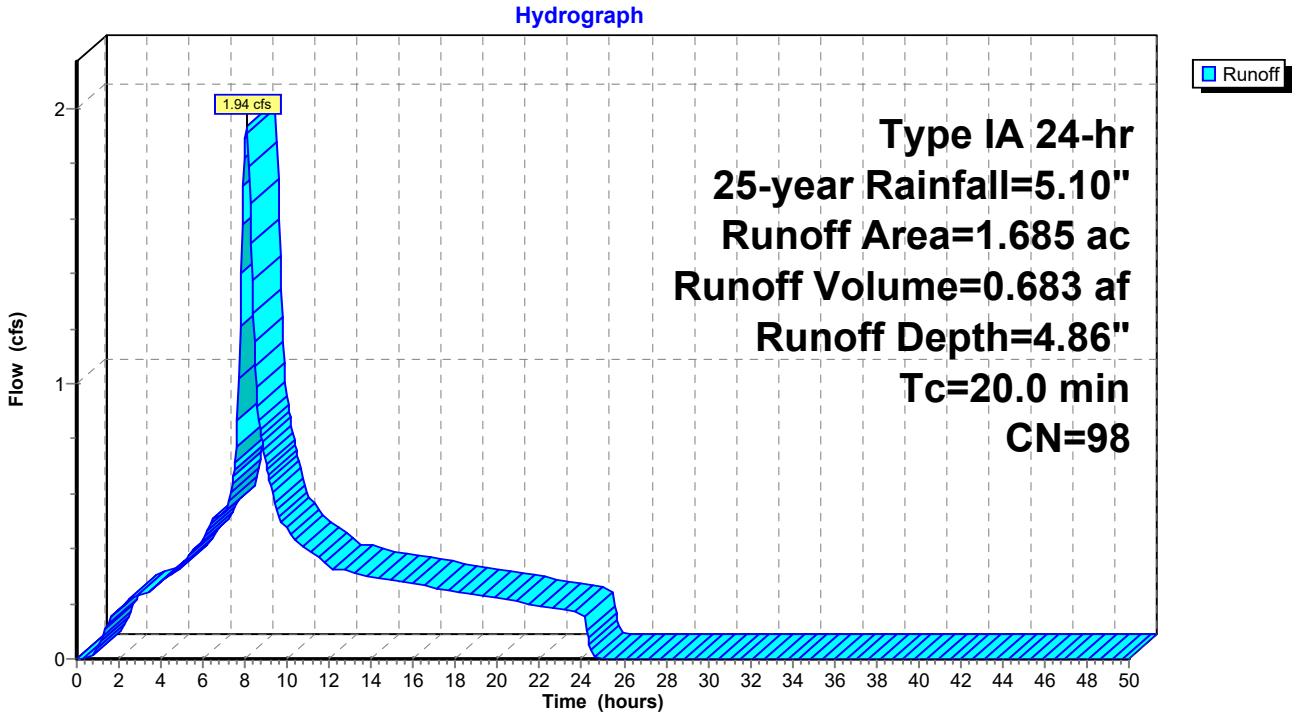
Runoff = 1.94 cfs @ 8.08 hrs, Volume= 0.683 af, Depth= 4.86"
Routed to Pond N2 : Node C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
1.685	98	Paved parking, HSG B
1.685		100.00% Impervious Area

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

Subcatchment 14S: Node C - Flex PGIS



Summary for Subcatchment 17S: Node D - PGIS

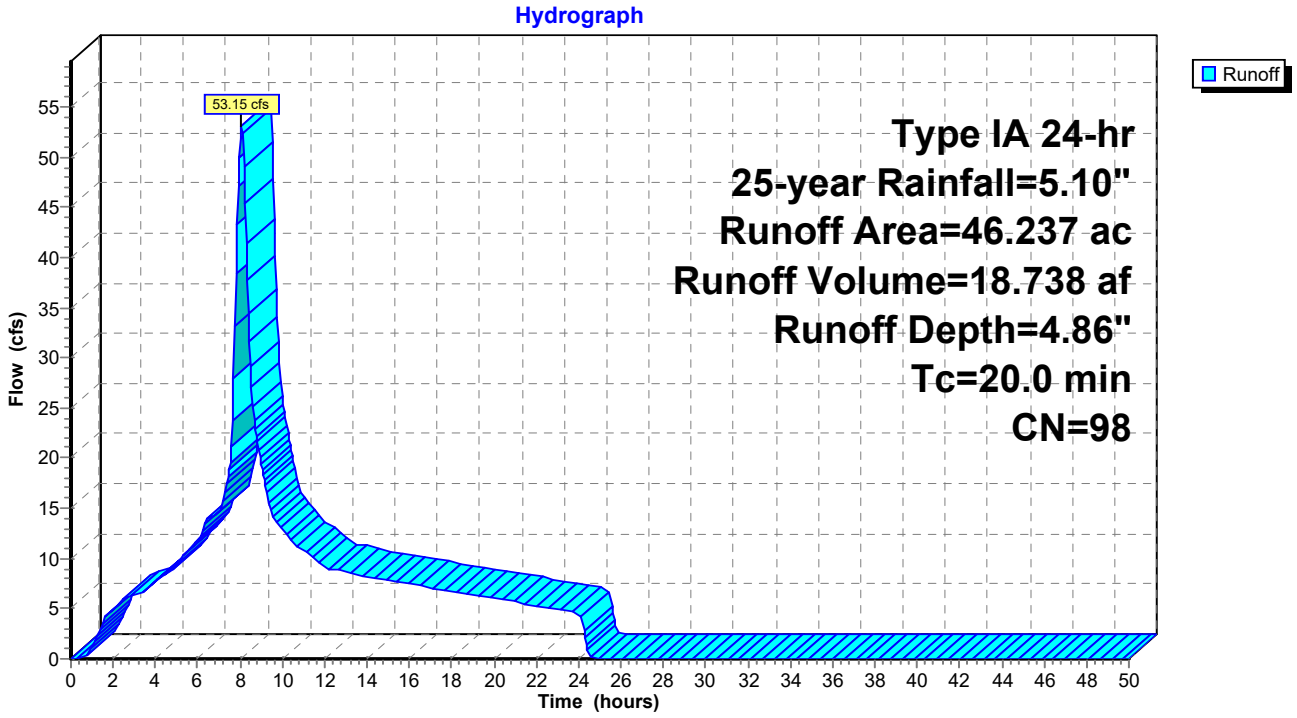
Runoff = 53.15 cfs @ 8.08 hrs, Volume= 18.738 af, Depth= 4.86"
Routed to Pond 3P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
46.237	98	Paved parking, HSG A
46.237		100.00% Impervious Area

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

Subcatchment 17S: Node D - PGIS



Summary for Subcatchment D2R: Node C - Public Non-PGIS

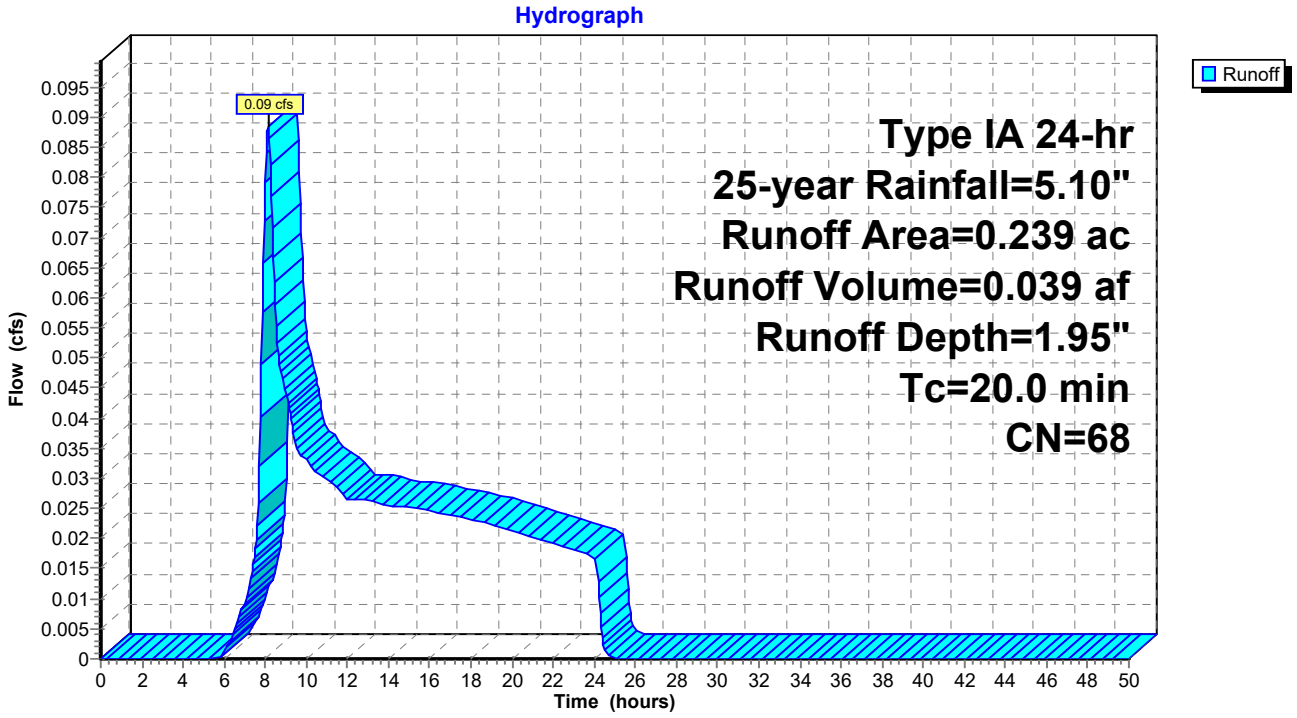
Runoff = 0.09 cfs @ 8.14 hrs, Volume= 0.039 af, Depth= 1.95"
Routed to Pond 15P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
0.239	68	<50% Grass cover, Poor, HSG A
0.239		100.00% Pervious Area

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

Subcatchment D2R: Node C - Public Non-PGIS



Summary for Subcatchment D3R: Node A - Public PGIS

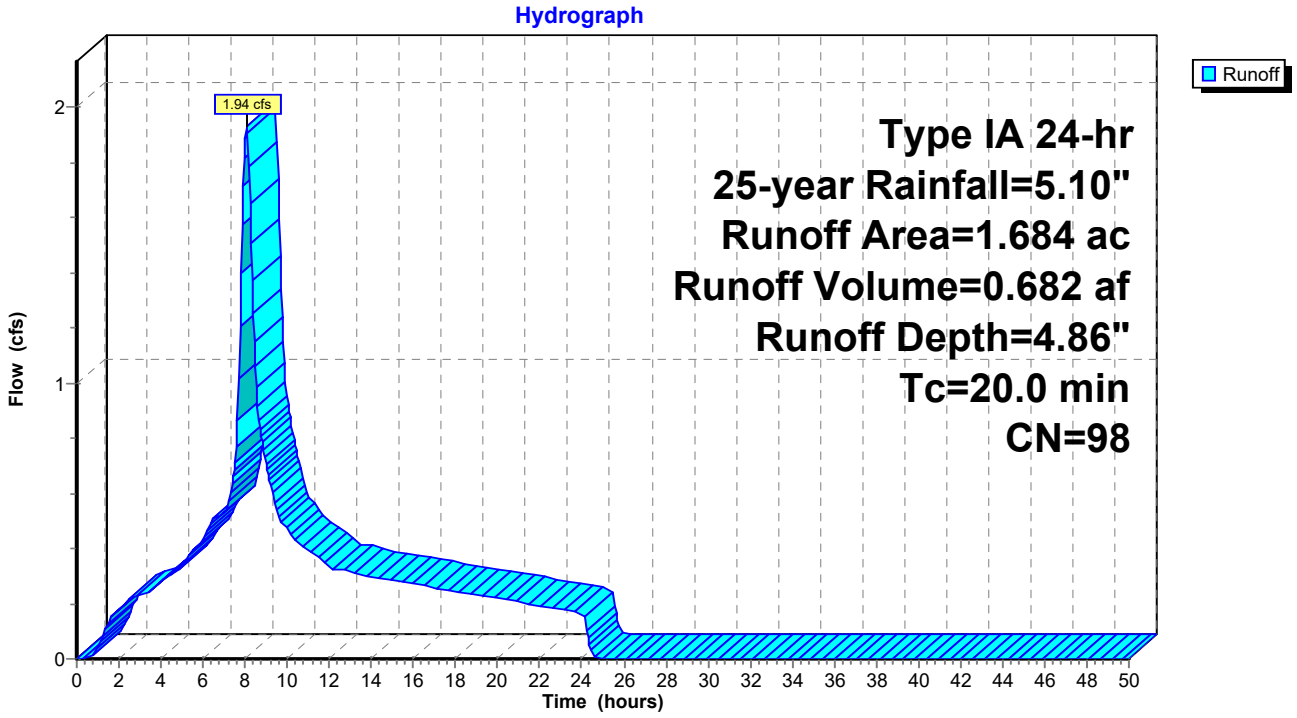
Runoff = 1.94 cfs @ 8.08 hrs, Volume= 0.682 af, Depth= 4.86"
Routed to Pond 4P : Bioretention+Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
1.684	98	Paved parking, HSG B
1.684		100.00% Impervious Area

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

Subcatchment D3R: Node A - Public PGIS



Summary for Subcatchment D5P: Node D - Non-PGIS

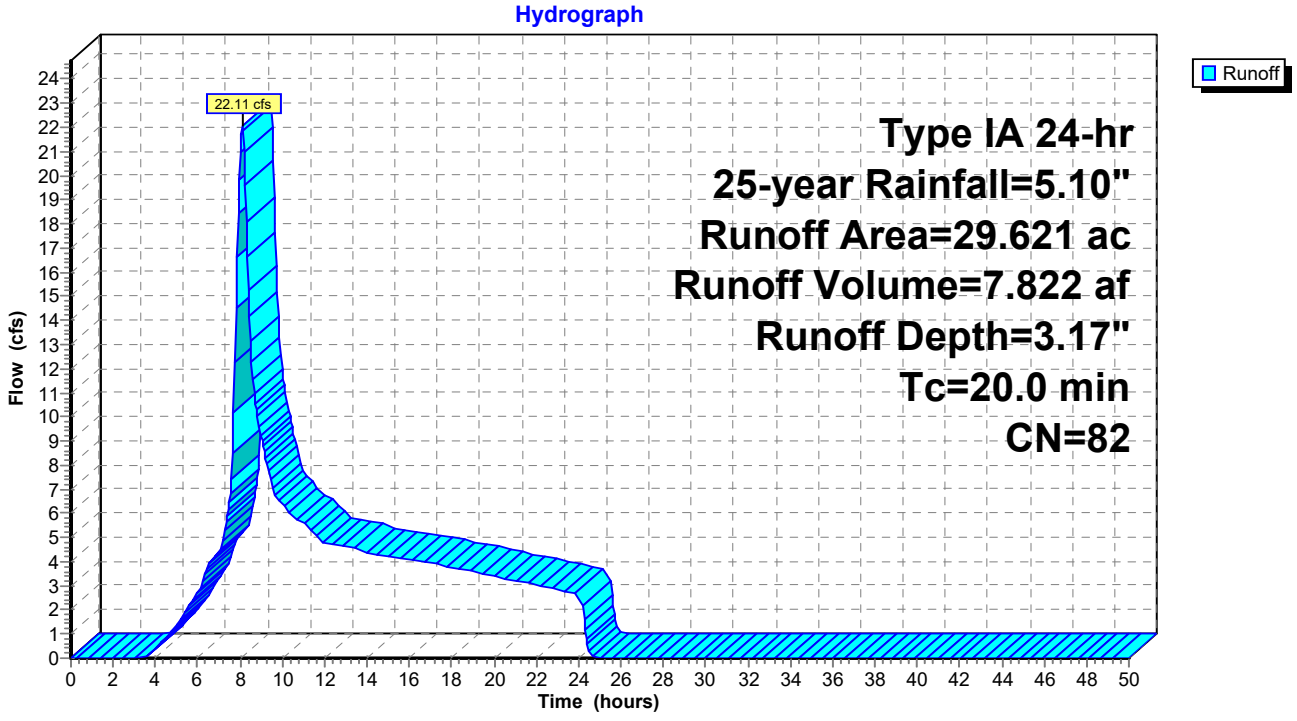
Runoff = 22.11 cfs @ 8.11 hrs, Volume= 7.822 af, Depth= 3.17"
Routed to Pond N1 : Node D

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

Area (ac)	CN	Description
9.462	49	50-75% Grass cover, Fair, HSG A
20.159	98	Roofs, HSG B
29.621	82	Weighted Average
9.462		31.94% Pervious Area
20.159		68.06% Impervious Area

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

Subcatchment D5P: Node D - Non-PGIS



Summary for Pond 3P: Bioretention

Inflow Area = 46.237 ac,100.00% Impervious, Inflow Depth = 4.86" for 25-year event
Inflow = 53.15 cfs @ 8.08 hrs, Volume= 18.738 af
Outflow = 28.78 cfs @ 8.51 hrs, Volume= 18.424 af, Atten= 46%, Lag= 25.9 min
Primary = 28.78 cfs @ 8.51 hrs, Volume= 18.424 af
Routed to Pond 19P : Infiltration Trench

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 54.62' @ 8.51 hrs Surf.Area= 1.674 ac Storage= 2.845 af

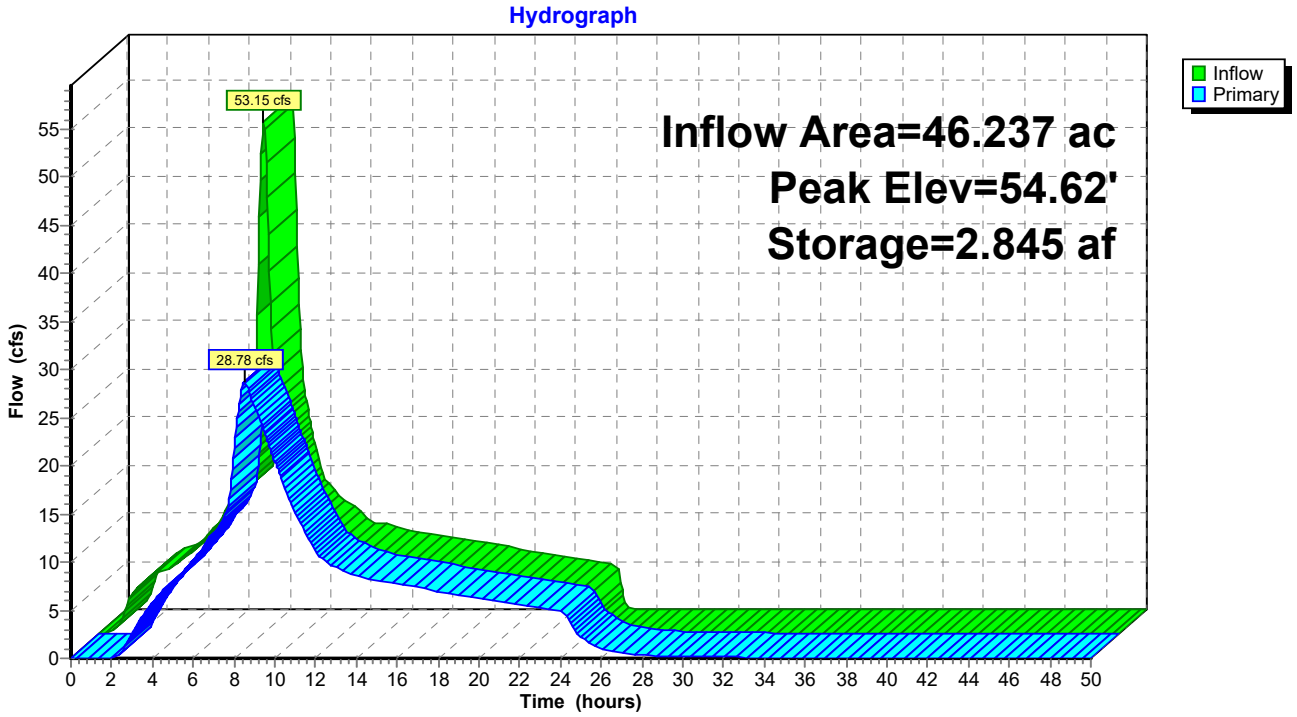
Plug-Flow detention time= 90.8 min calculated for 18.424 af (98% of inflow)
Center-of-Mass det. time= 77.7 min (745.3 - 667.6)

Volume	Invert	Avail.Storage	Storage Description
#1	50.00'	2.629 af	**270.00'W x 270.00'L x 6.50'H Prismatoid** 10.878 af Overall - 3.367 af Embedded = 7.512 af x 35.0% Voids
#2	54.50'	3.347 af	**270.00'W x 270.00'L x 2.00'H Prismatoid** Inside #1
#3	50.50'	0.019 af	**24.0" Round Pipe Storage** Inside #1 L= 269.0'
		5.996 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	54.50'	**60.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	50.50'	**24.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=28.76 cfs @ 8.51 hrs HW=54.62' (Free Discharge)
↑—**1=Orifice/Grate** (Weir Controls 2.05 cfs @ 1.12 fps)
└—**2=Orifice/Grate** (Orifice Controls 26.71 cfs @ 8.50 fps)

Pond 3P: Bioretention



Summary for Pond 4P: Bioretention+Infiltration

Inflow Area = 1.684 ac,100.00% Impervious, Inflow Depth = 4.86" for 25-year event
Inflow = 1.94 cfs @ 8.08 hrs, Volume= 0.682 af
Outflow = 1.93 cfs @ 8.11 hrs, Volume= 0.682 af, Atten= 0%, Lag= 1.7 min
Primary = 0.15 cfs @ 8.11 hrs, Volume= 0.277 af
Secondary = 1.78 cfs @ 8.11 hrs, Volume= 0.406 af
Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 3.73' @ 8.11 hrs Surf.Area= 0.029 ac Storage= 0.037 af

Plug-Flow detention time= 65.8 min calculated for 0.682 af (100% of inflow)
Center-of-Mass det. time= 65.7 min (733.3 - 667.6)

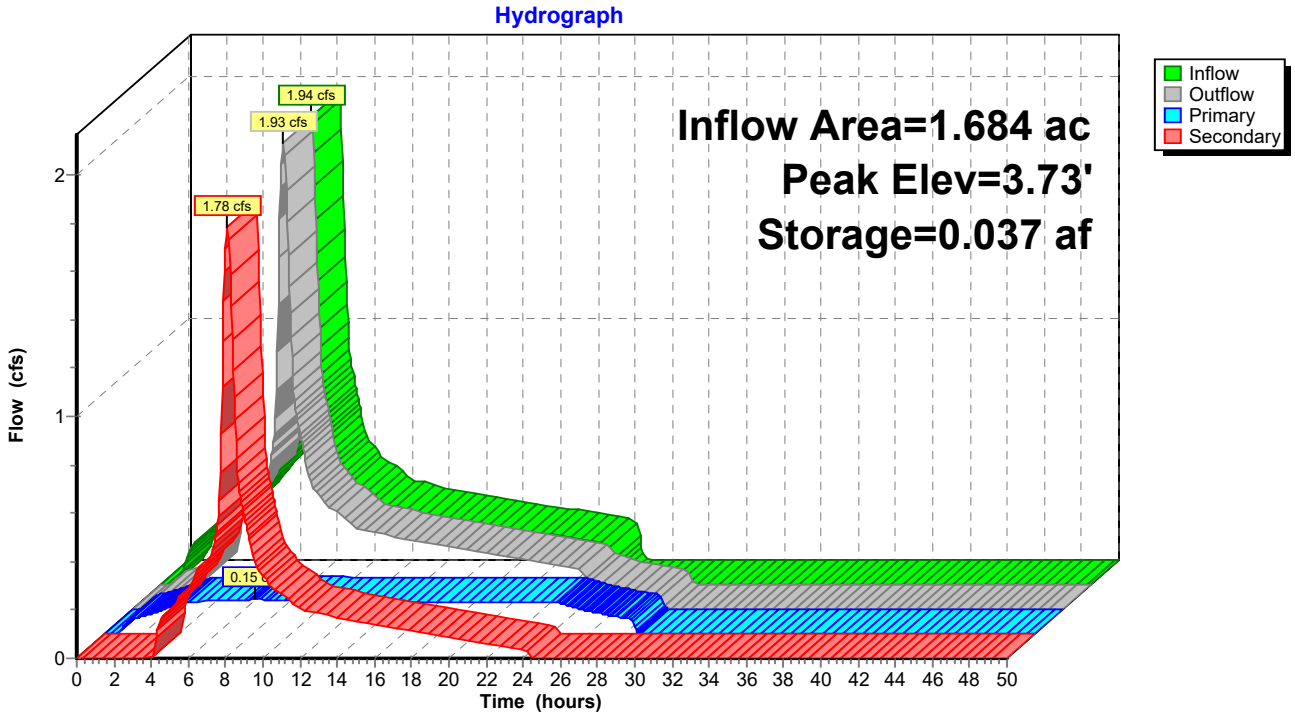
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.050 af	**5.00'W x 250.00'L x 5.00'H Bioretention** 0.143 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.15 cfs @ 8.11 hrs HW=3.73' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.15 cfs)

Secondary OutFlow Max=1.78 cfs @ 8.11 hrs HW=3.73' (Free Discharge)
2=Orifice/Grate (Orifice Controls 1.78 cfs @ 2.90 fps)

Pond 4P: Bioretention+Infiltration



Summary for Pond 5P: Bioretention+Infiltration

Inflow Area = 7.516 ac,100.00% Impervious, Inflow Depth = 4.86" for 25-year event
Inflow = 8.64 cfs @ 8.08 hrs, Volume= 3.046 af
Outflow = 8.62 cfs @ 8.10 hrs, Volume= 3.046 af, Atten= 0%, Lag= 1.2 min
Primary = 0.36 cfs @ 8.10 hrs, Volume= 0.882 af
Secondary = 8.26 cfs @ 8.10 hrs, Volume= 2.164 af
Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 4.97' @ 8.10 hrs Surf.Area= 0.138 ac Storage= 0.240 af

Plug-Flow detention time= 109.9 min calculated for 3.046 af (100% of inflow)
Center-of-Mass det. time= 109.8 min (777.4 - 667.6)

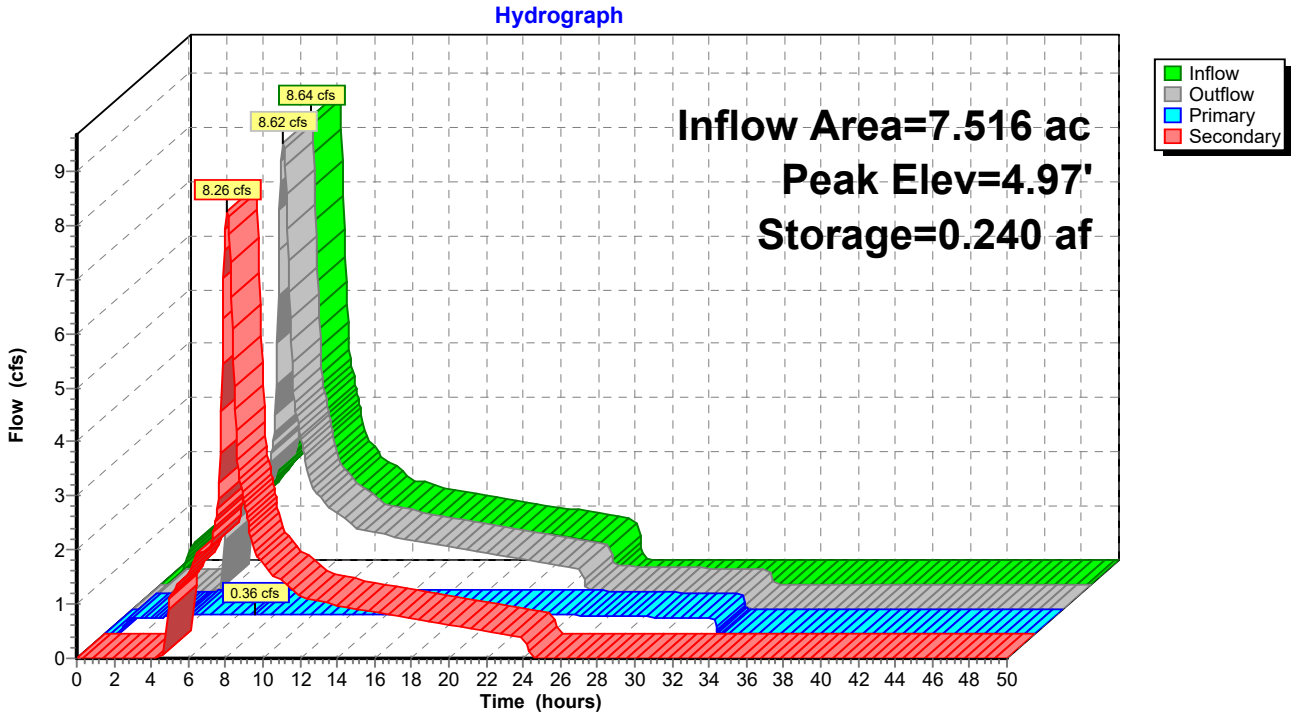
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.241 af	**50.00'W x 120.00'L x 5.00'H Infiltration Trench** 0.689 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.50'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.36 cfs @ 8.10 hrs HW=4.97' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.36 cfs)

Secondary OutFlow Max=8.25 cfs @ 8.10 hrs HW=4.97' (Free Discharge)
↑**2=Orifice/Grate** (Weir Controls 8.25 cfs @ 2.24 fps)

Pond 5P: Bioretention+Infiltration



Summary for Pond 7P: Node B

[57] Hint: Peaked at 49.73' (Flood elevation advised)
[81] Warning: Exceeded Pond 10P by 48.92' @ 31.30 hrs
[81] Warning: Exceeded Pond 11P by 48.92' @ 33.00 hrs

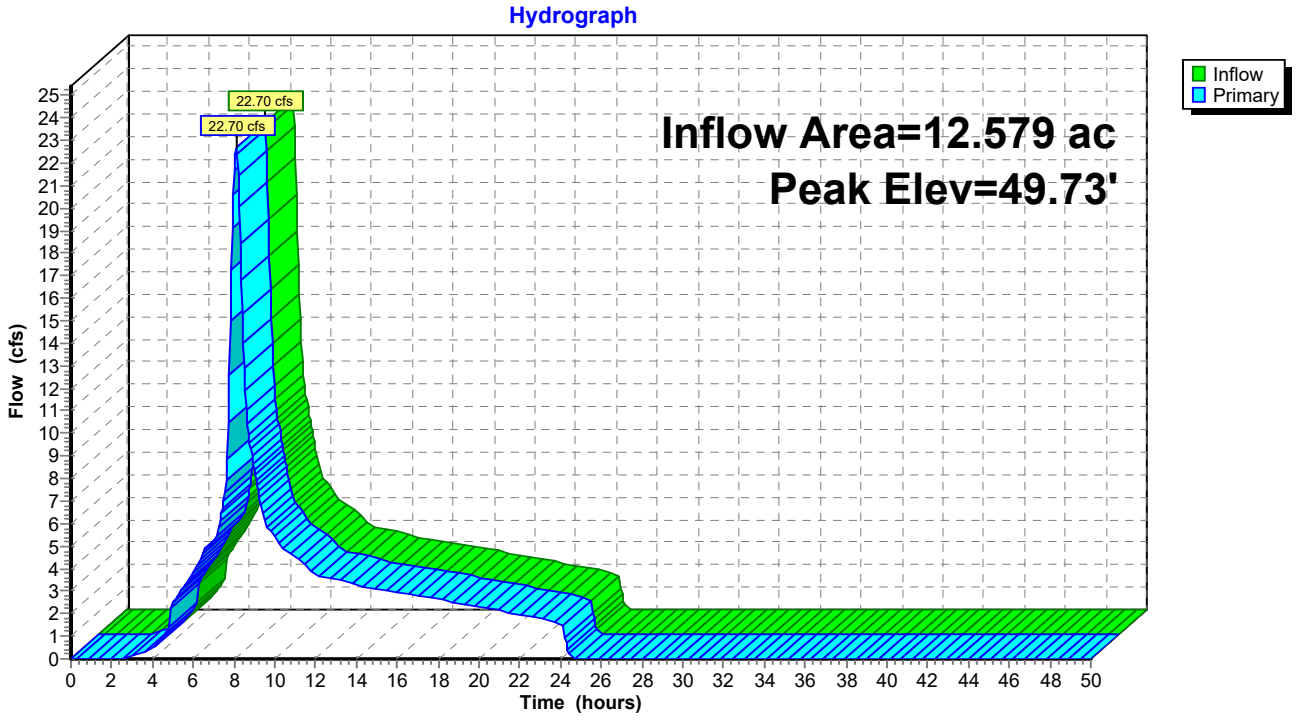
Inflow Area = 12.579 ac, 43.51% Impervious, Inflow Depth = 6.37" for 25-year event
Inflow = 22.70 cfs @ 8.10 hrs, Volume= 6.681 af
Outflow = 22.70 cfs @ 8.10 hrs, Volume= 6.681 af, Atten= 0%, Lag= 0.0 min
Primary = 22.70 cfs @ 8.10 hrs, Volume= 6.681 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 49.73' @ 8.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	40.33'	**24.0" Round Culvert** L= 379.7' Ke= 0.200 Inlet / Outlet Invert= 40.33' / 39.19' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Primary	49.50'	**36.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=22.48 cfs @ 8.10 hrs HW=49.73' TW=48.92' (Fixed TW Elev= 48.92')
└─**1=Culvert** (Outlet Controls 9.89 cfs @ 3.15 fps)
└─**2=Sharp-Crested Rectangular Weir** (Weir Controls 12.59 cfs @ 1.55 fps)

Pond 7P: Node B



Summary for Pond 10P: Bioretention

Inflow Area = 0.250 ac,100.00% Impervious, Inflow Depth = 4.86" for 25-year event
Inflow = 0.29 cfs @ 8.08 hrs, Volume= 0.101 af
Outflow = 0.29 cfs @ 8.09 hrs, Volume= 0.101 af, Atten= 0%, Lag= 0.5 min
Primary = 0.02 cfs @ 8.09 hrs, Volume= 0.045 af
Secondary = 0.26 cfs @ 8.09 hrs, Volume= 0.056 af
Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 3.25' @ 8.09 hrs Surf.Area= 0.005 ac Storage= 0.005 af

Plug-Flow detention time= 67.0 min calculated for 0.101 af (100% of inflow)
Center-of-Mass det. time= 67.1 min (734.7 - 667.6)

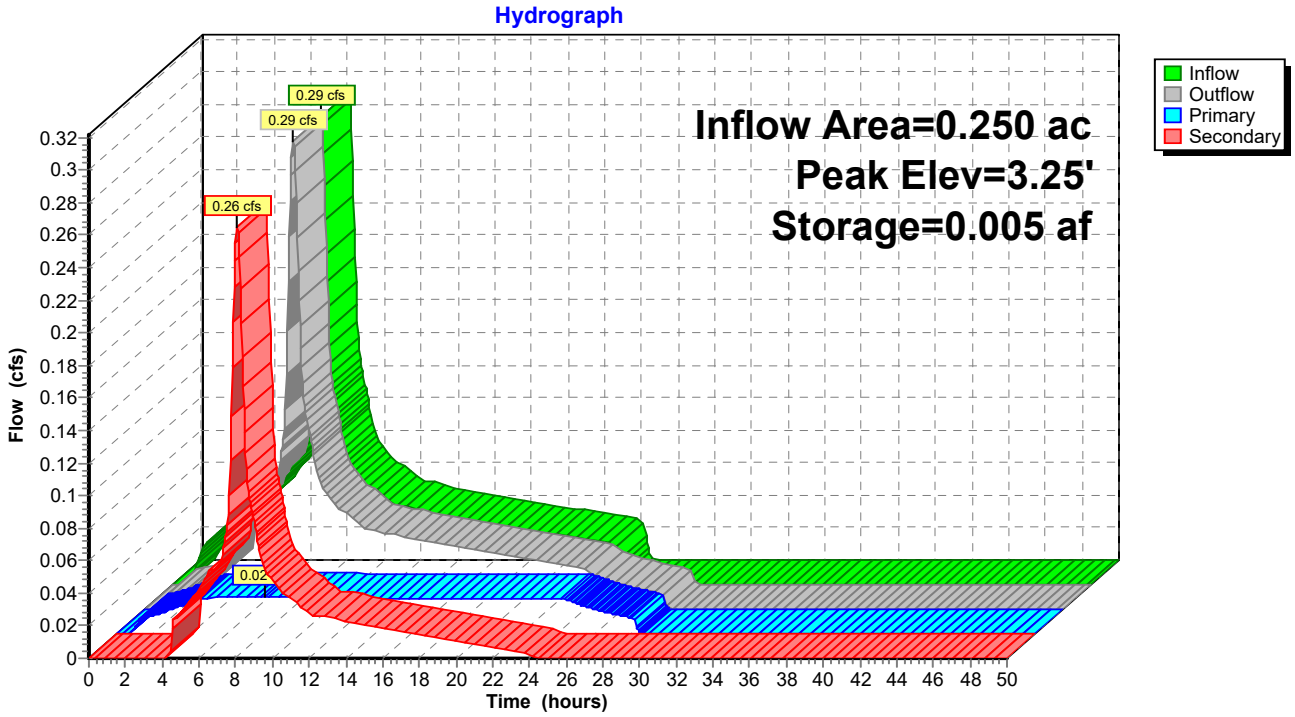
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.008 af	**5.00'W x 40.00'L x 5.00'H Bioretention** 0.023 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.02 cfs @ 8.09 hrs HW=3.25' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Secondary OutFlow Max=0.26 cfs @ 8.09 hrs HW=3.25' (Free Discharge)
↑**2=Orifice/Grate** (Orifice Controls 0.26 cfs @ 1.71 fps)

Pond 10P: Bioretention



Summary for Pond 11P: Bioretention

Inflow Area = 2.176 ac,100.00% Impervious, Inflow Depth = 4.86" for 25-year event
Inflow = 2.50 cfs @ 8.08 hrs, Volume= 0.882 af
Outflow = 2.48 cfs @ 8.11 hrs, Volume= 0.882 af, Atten= 1%, Lag= 2.0 min
Primary = 0.19 cfs @ 8.11 hrs, Volume= 0.356 af
Secondary = 2.30 cfs @ 8.11 hrs, Volume= 0.526 af
Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 4.87' @ 8.11 hrs Surf.Area= 0.031 ac Storage= 0.053 af

Plug-Flow detention time= 73.2 min calculated for 0.881 af (100% of inflow)
Center-of-Mass det. time= 73.4 min (741.0 - 667.6)

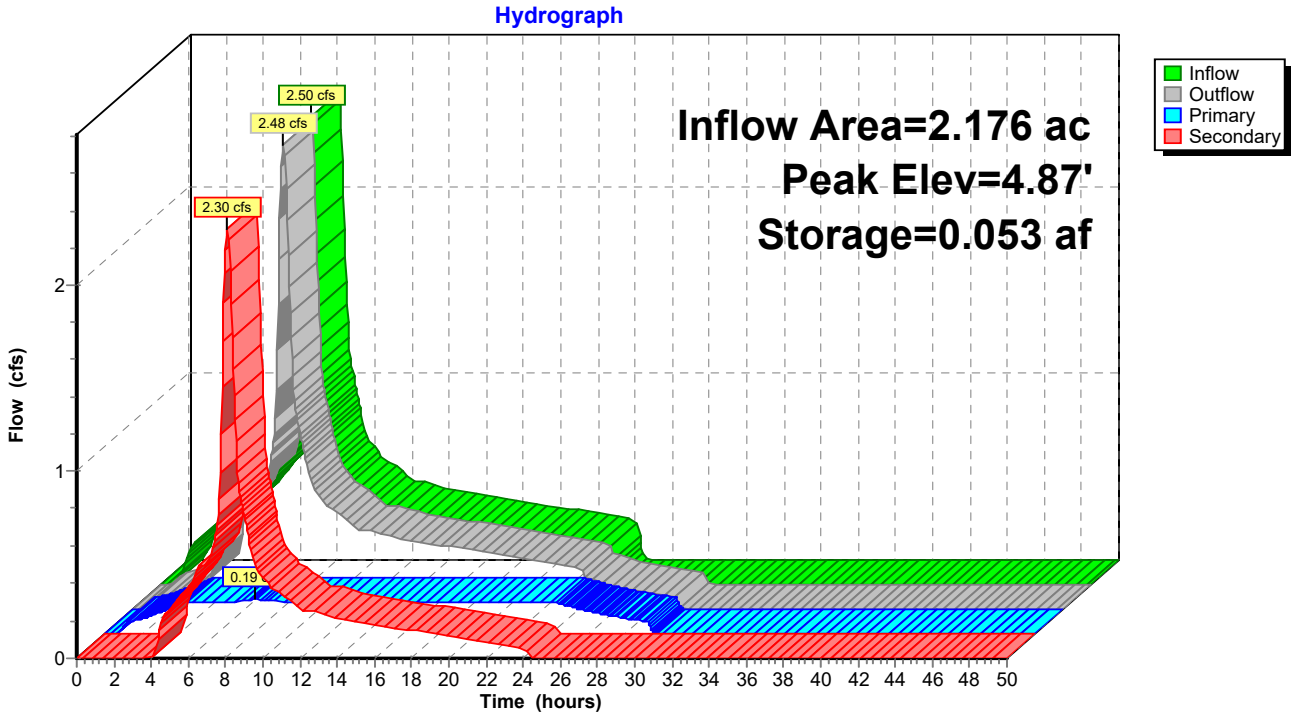
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.065 af	**5.00'W x 270.00'L x 6.00'H Bioretention** 0.186 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.19 cfs @ 8.11 hrs HW=4.87' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.19 cfs)

Secondary OutFlow Max=2.30 cfs @ 8.11 hrs HW=4.87' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 2.30 cfs @ 3.17 fps)

Pond 11P: Bioretention



Summary for Pond 15P: Bioretention

Inflow Area = 0.239 ac, 0.00% Impervious, Inflow Depth = 1.95" for 25-year event
Inflow = 0.09 cfs @ 8.14 hrs, Volume= 0.039 af
Outflow = 0.04 cfs @ 9.47 hrs, Volume= 0.039 af, Atten= 59%, Lag= 79.6 min
Primary = 0.04 cfs @ 9.47 hrs, Volume= 0.039 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 0.73' @ 9.47 hrs Surf.Area= 0.014 ac Storage= 0.004 af

Plug-Flow detention time= 31.1 min calculated for 0.039 af (100% of inflow)
Center-of-Mass det. time= 31.1 min (884.7 - 853.6)

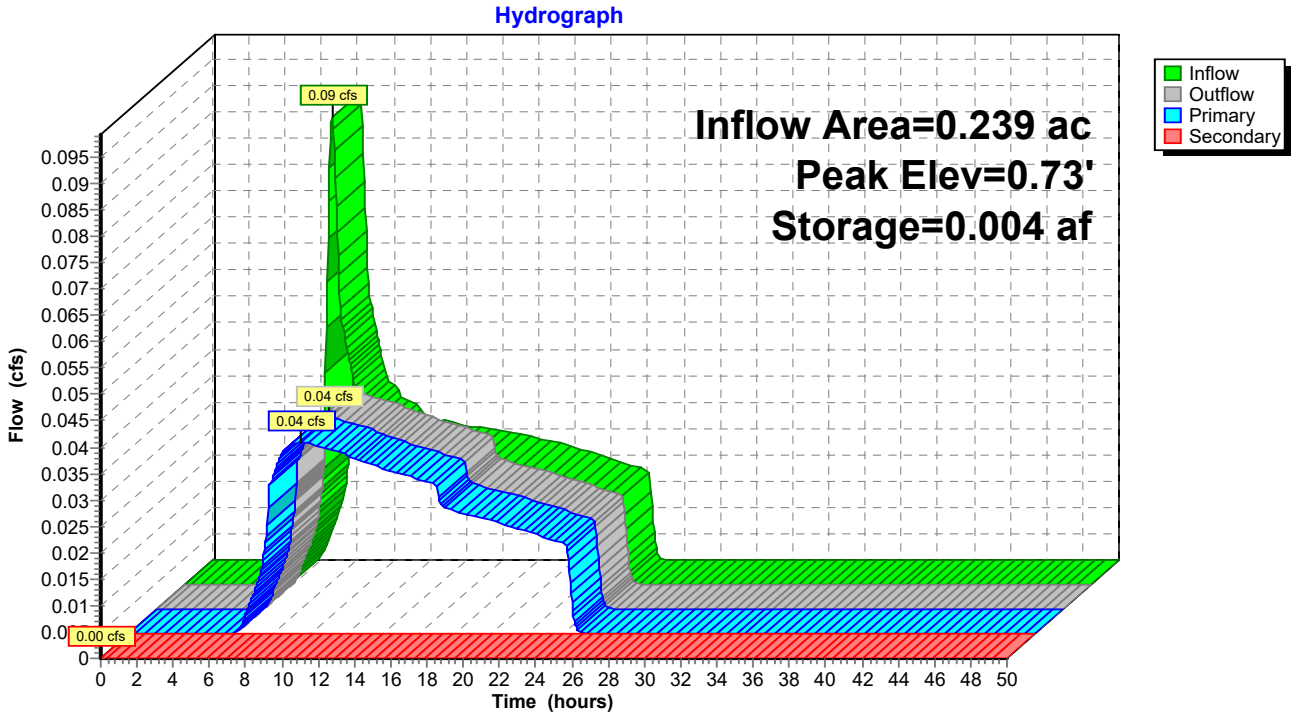
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.024 af	**5.00'W x 120.00'L x 5.00'H Bioretention** 0.069 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.04 cfs @ 9.47 hrs HW=0.73' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
└**2=Orifice/Grate** (Controls 0.00 cfs)

Pond 15P: Bioretention



Summary for Pond 16P: Infiltration Trench

Inflow Area = 1.378 ac, 77.79% Impervious, Inflow Depth = 4.19" for 25-year event
Inflow = 1.42 cfs @ 8.09 hrs, Volume= 0.481 af
Outflow = 1.41 cfs @ 8.12 hrs, Volume= 0.481 af, Atten= 1%, Lag= 1.8 min
Primary = 0.09 cfs @ 8.12 hrs, Volume= 0.189 af
Secondary = 1.32 cfs @ 8.12 hrs, Volume= 0.292 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 4.61' @ 8.12 hrs Surf.Area= 0.028 ac Storage= 0.044 af

Plug-Flow detention time= 110.7 min calculated for 0.480 af (100% of inflow)
Center-of-Mass det. time= 111.0 min (827.2 - 716.3)

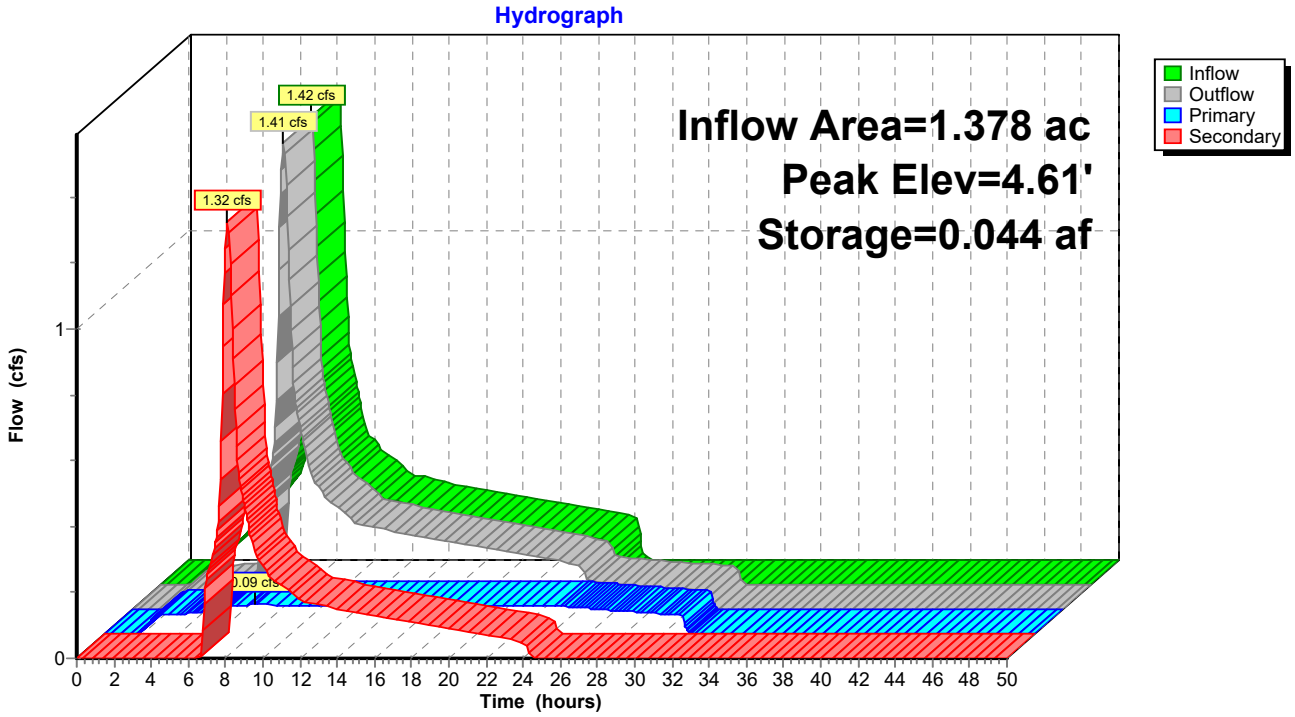
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.058 af	**20.00'W x 60.00'L x 6.00'H Infiltration Trench** 0.165 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.09 cfs @ 8.12 hrs HW=4.61' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Secondary OutFlow Max=1.32 cfs @ 8.12 hrs HW=4.61' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 1.32 cfs @ 2.65 fps)

Pond 16P: Infiltration Trench



Summary for Pond 19P: Infiltration Trench

Inflow Area = 46.237 ac,100.00% Impervious, Inflow Depth > 4.78" for 25-year event
Inflow = 28.78 cfs @ 8.51 hrs, Volume= 18.424 af
Outflow = 27.97 cfs @ 8.70 hrs, Volume= 18.424 af, Atten= 3%, Lag= 11.7 min
Primary = 3.57 cfs @ 8.70 hrs, Volume= 8.564 af
Secondary = 24.41 cfs @ 8.70 hrs, Volume= 9.860 af
Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 3.86' @ 8.70 hrs Surf.Area= 1.674 ac Storage= 2.259 af

Plug-Flow detention time= 143.4 min calculated for 18.424 af (100% of inflow)
Center-of-Mass det. time= 143.3 min (888.6 - 745.3)

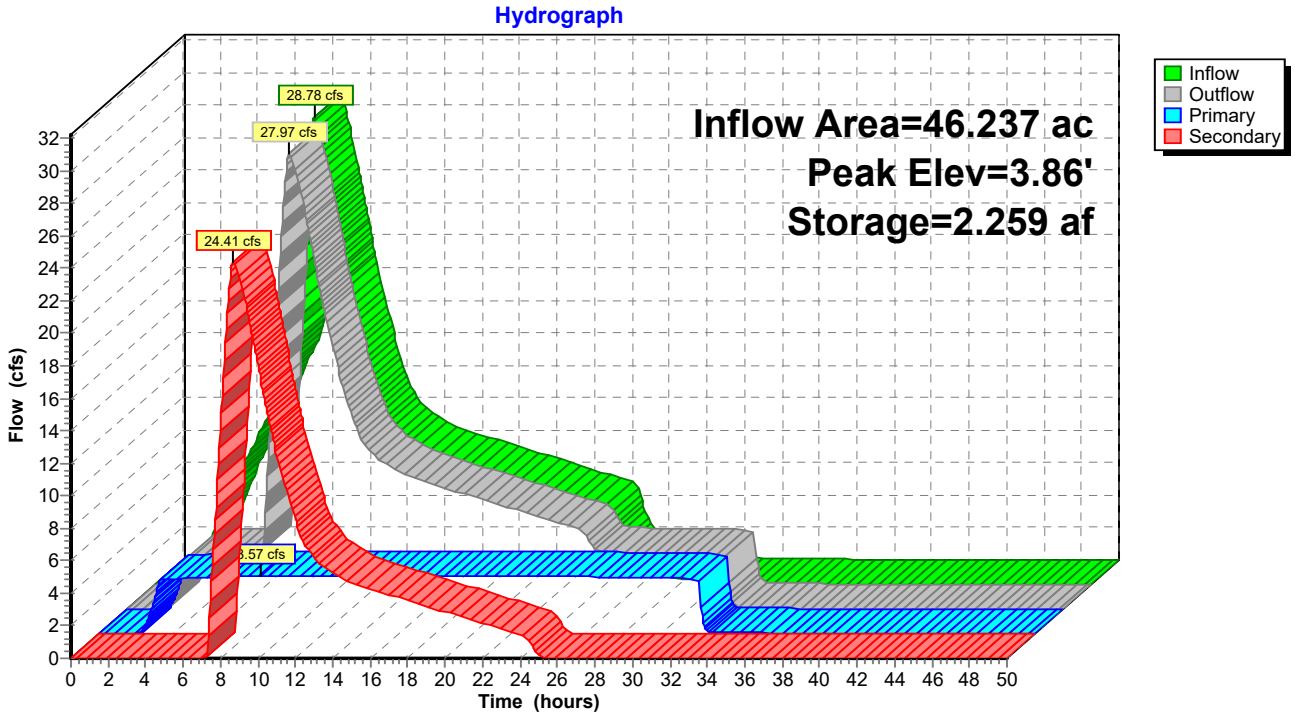
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	2.929 af	**270.00'W x 270.00'L x 5.00'H Infiltration Trench** 8.368 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.57 cfs @ 8.70 hrs HW=3.86' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 3.57 cfs)

Secondary OutFlow Max=24.40 cfs @ 8.70 hrs HW=3.86' (Free Discharge)
└**2=Orifice/Grate** (Weir Controls 24.40 cfs @ 3.03 fps)

Pond 19P: Infiltration Trench



Summary for Pond N1: Node D

[81] Warning: Exceeded Pond 19P by 47.00' @ 49.95 hrs

Inflow Area = 44.595 ac, 62.85% Impervious, Inflow Depth = 6.90" for 25-year event
Inflow = 65.60 cfs @ 8.14 hrs, Volume= 25.625 af
Outflow = 33.98 cfs @ 9.62 hrs, Volume= 19.092 af, Atten= 48%, Lag= 88.8 min
Primary = 33.98 cfs @ 9.62 hrs, Volume= 19.092 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 47.56' @ 9.62 hrs Surf.Area= 87,202 sf Storage= 331,489 cf

Plug-Flow detention time= 260.2 min calculated for 19.092 af (75% of inflow)
Center-of-Mass det. time= 114.9 min (857.4 - 742.5)

Volume	Invert	Avail.Storage	Storage Description
#1	38.00'	922,840 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

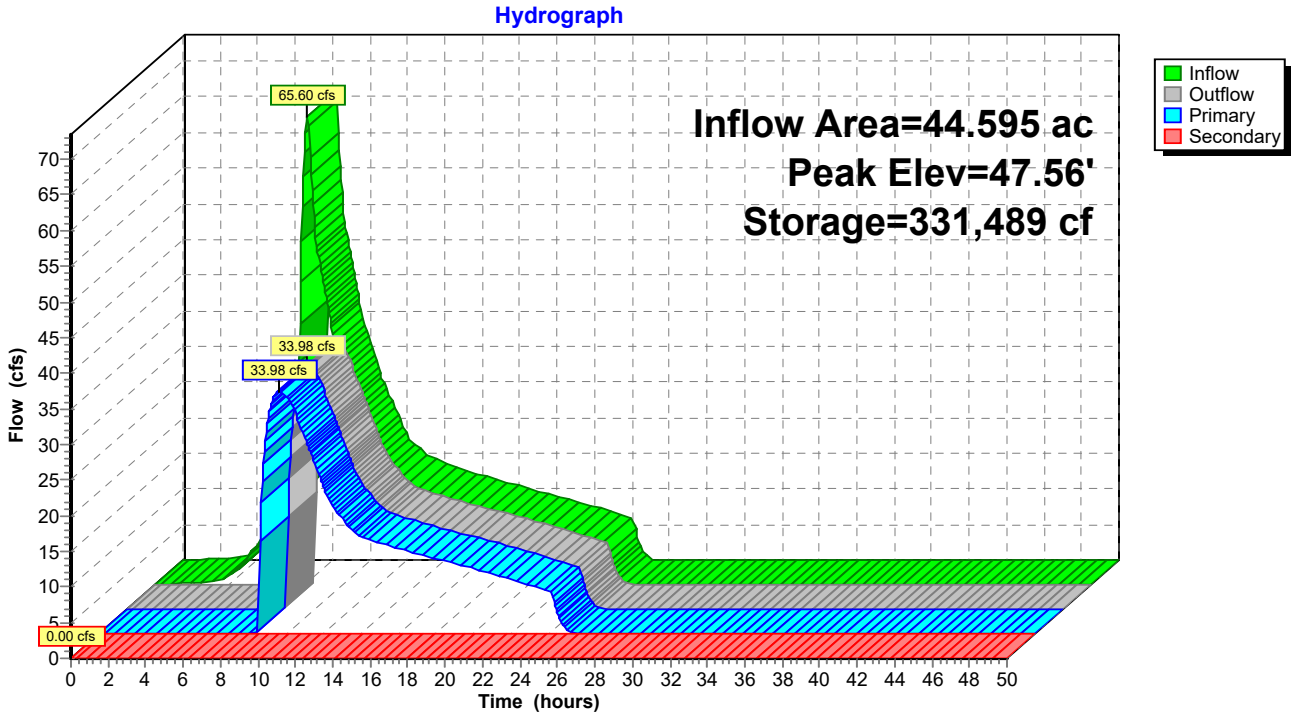
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	50	0	0
41.99	50	200	200
42.00	32,000	160	360
48.00	91,616	370,848	371,208
49.00	270,816	181,216	552,424
50.00	470,016	370,416	922,840

Device	Routing	Invert	Outlet Devices
#1	Primary	38.00'	**42.0" Round Culvert** L= 270.3' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 38.00' / 37.50' S= 0.0018 '/' Cc= 0.900 n= 0.012, Flow Area= 9.62 sf
#2	Secondary	48.00'	**30.0' long + 1.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=34.02 cfs @ 9.62 hrs HW=47.56' TW=47.00' (Fixed TW Elev= 47.00')
└**1=Culvert** (Outlet Controls 34.02 cfs @ 3.54 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=38.00' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond N1: Node D



Summary for Pond N2: Node C

[57] Hint: Peaked at 48.92' (Flood elevation advised)
[81] Warning: Exceeded Pond 7P by 7.23' @ 2.10 hrs
[81] Warning: Exceeded Pond 15P by 48.74' @ 7.90 hrs
[81] Warning: Exceeded Pond 16P by 47.56' @ 1.60 hrs

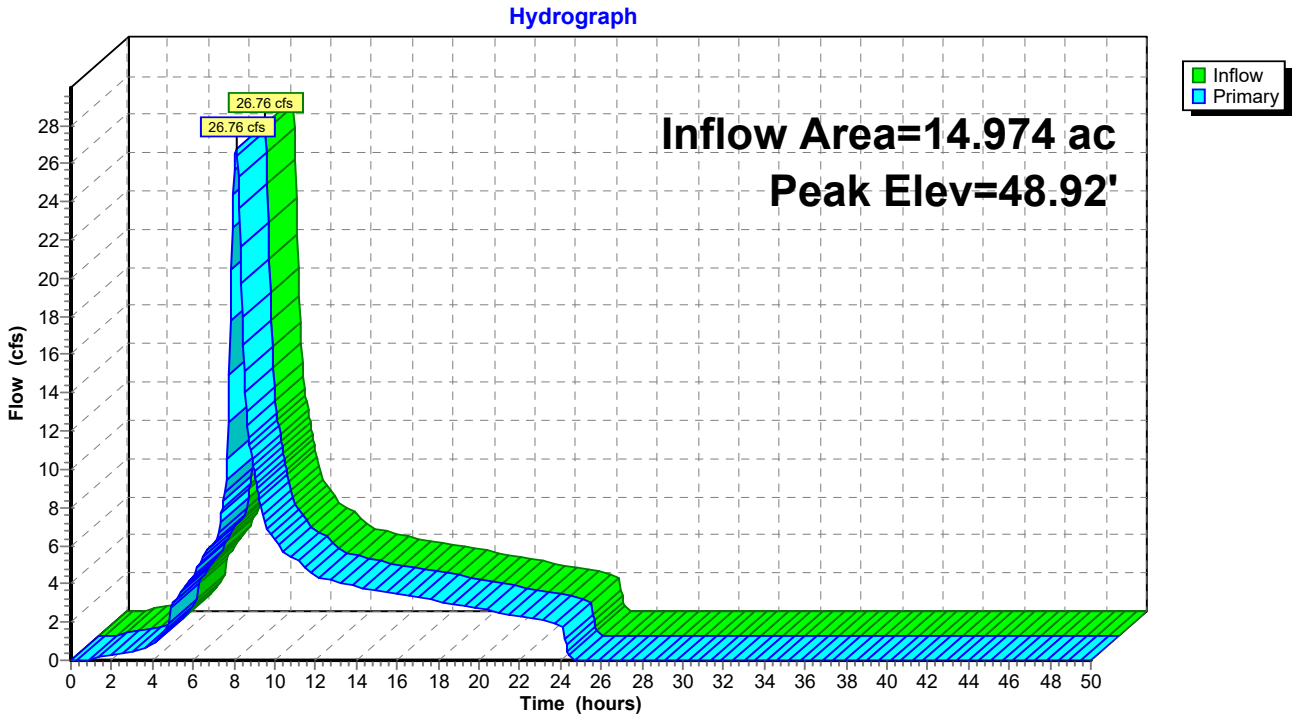
Inflow Area = 14.974 ac, 52.54% Impervious, Inflow Depth = 6.37" for 25-year event
Inflow = 26.76 cfs @ 8.10 hrs, Volume= 7.943 af
Outflow = 26.76 cfs @ 8.10 hrs, Volume= 7.943 af, Atten= 0%, Lag= 0.0 min
Primary = 26.76 cfs @ 8.10 hrs, Volume= 7.943 af
Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 48.92' @ 8.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	39.19'	**30.0" Round Culvert** L= 410.7' Ke= 0.200 Inlet / Outlet Invert= 39.19' / 38.00' S= 0.0029 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 4.91 sf
#2	Primary	48.80'	**36.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=26.41 cfs @ 8.10 hrs HW=48.92' TW=47.56' (Fixed TW Elev= 47.56')
1=Culvert (Outlet Controls 21.77 cfs @ 4.44 fps)
2=Sharp-Crested Rectangular Weir (Weir Controls 4.64 cfs @ 1.11 fps)

Pond N2: Node C



Summary for Pond N3: Node A

[57] Hint: Peaked at 50.51' (Flood elevation advised)
[81] Warning: Exceeded Pond 4P by 49.73' @ 31.50 hrs
[81] Warning: Exceeded Pond 5P by 49.73' @ 35.90 hrs

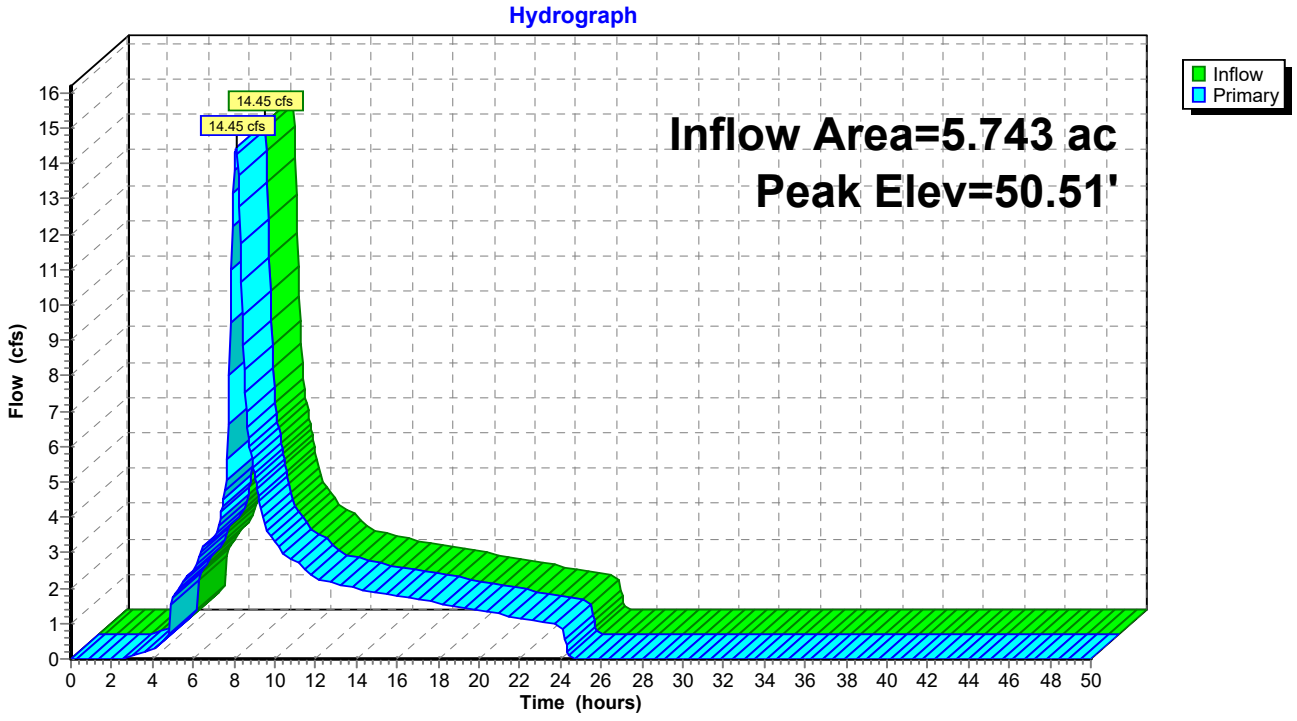
Inflow Area = 5.743 ac, 58.73% Impervious, Inflow Depth = 8.63" for 25-year event
Inflow = 14.45 cfs @ 8.10 hrs, Volume= 4.132 af
Outflow = 14.45 cfs @ 8.10 hrs, Volume= 4.132 af, Atten= 0%, Lag= 0.0 min
Primary = 14.45 cfs @ 8.10 hrs, Volume= 4.132 af
Routed to Pond 7P : Node B

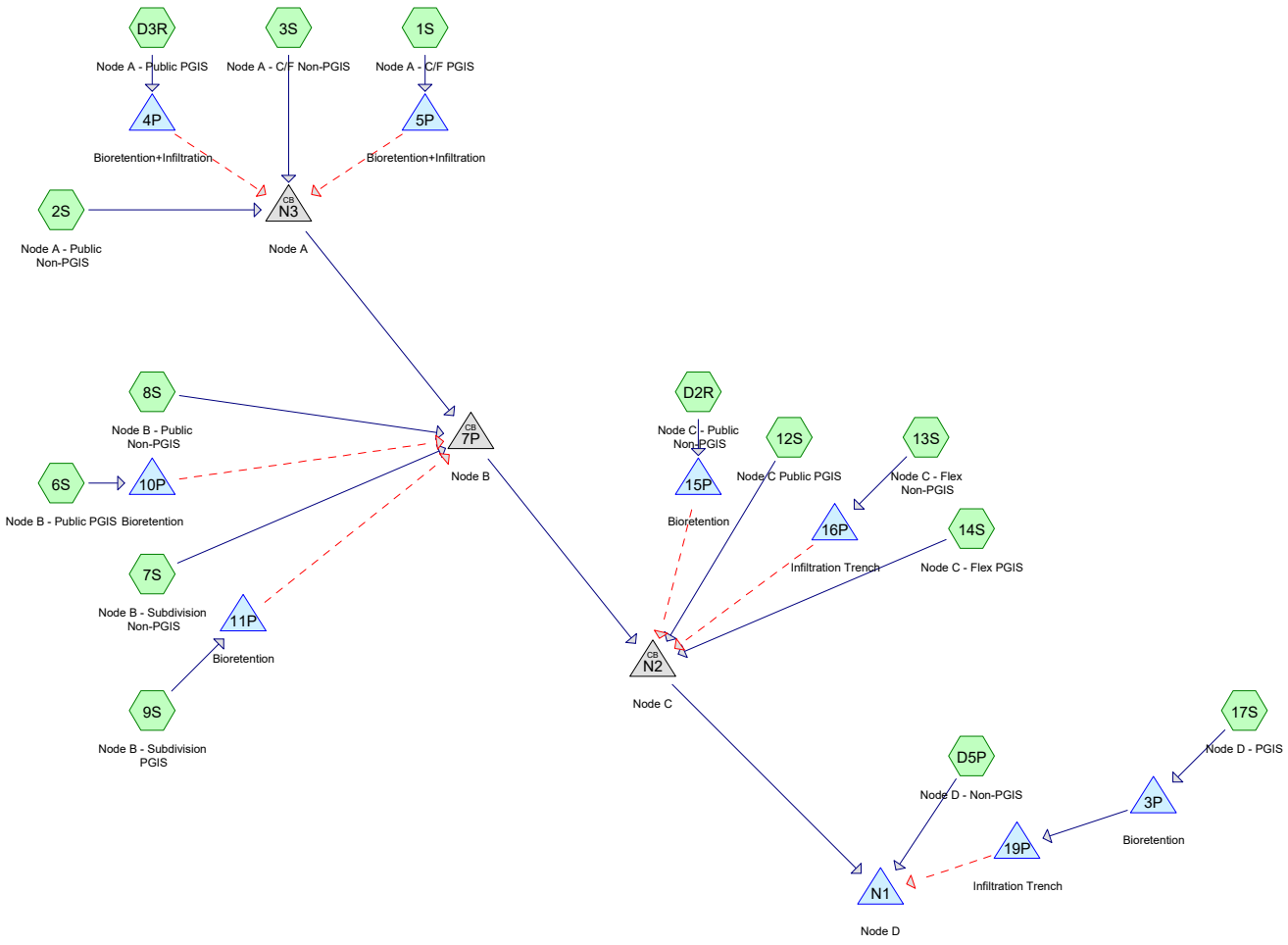
Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 50.51' @ 8.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	41.44'	**24.0" Round Culvert** L= 369.0' Ke= 0.200 Inlet / Outlet Invert= 41.44' / 40.33' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Primary	50.40'	**36.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=14.35 cfs @ 8.10 hrs HW=50.51' TW=49.73' (Fixed TW Elev= 49.73')
1=Culvert (Outlet Controls 9.86 cfs @ 3.14 fps)
2=Sharp-Crested Rectangular Weir (Weir Controls 4.48 cfs @ 1.10 fps)

Pond N3: Node A





Subcat Reach Pond Link

Routing Diagram for ALTERNATE _Onsite 100-Year Storm - Moderate Flood

Prepared by MacKay & Sposito, Inc, Printed 3/10/2025

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
9.462	49	50-75% Grass cover, Fair, HSG A (D5P)
2.370	59	50-75% Grass cover, Fair, HSG A/B (avg) (2S, 3S)
0.306	69	50-75% Grass cover, Fair, HSG B (13S)
0.239	68	<50% Grass cover, Poor, HSG A (D2R)
4.736	79	<50% Grass cover, Poor, HSG B (7S, 8S)
48.663	98	Paved parking, HSG A (6S, 9S, 17S)
11.595	98	Paved parking, HSG B (1S, 12S, 14S, D3R)
4.445	98	Roofs, HSG A (3S, 13S)
22.259	98	Roofs, HSG B (7S, D5P)
104.075	**92**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
65.179	HSG A	2S, 3S, 6S, 9S, 13S, 17S, D2R, D5P
38.896	HSG B	1S, 7S, 8S, 12S, 13S, 14S, D3R, D5P
0.000	HSG C	
0.000	HSG D	
0.000	Other	
104.075		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
11.832	0.306	0.000	0.000	0.000	12.138	50-75% Grass cover, Fair	2S, 3S, 13S, D5P
0.239	4.736	0.000	0.000	0.000	4.975	<50% Grass cover, Poor	7S, 8S, D2R
48.663	11.595	0.000	0.000	0.000	60.258	Paved parking	1S, 6S, 9S, 12S, 14S, 17S, D3R
4.445	22.259	0.000	0.000	0.000	26.704	Roofs	3S, 7S, 13S, D5P
65.179	**38.896**	**0.000**	**0.000**	**0.000**	**104.075**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	7P	40.33	39.19	379.7	0.0030	0.012	0.0	24.0	0.0	
2	N1	38.00	37.50	270.3	0.0018	0.012	0.0	42.0	0.0	
3	N2	39.19	38.00	410.7	0.0029	0.012	0.0	30.0	0.0	
4	N3	41.44	40.33	369.0	0.0030	0.012	0.0	24.0	0.0	

Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Node A - C/F PGIS Runoff Area=7.516 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=10.54 cfs 3.734 af

Subcatchment2S: Node A - Public Non-PGIS Runoff Area=1.160 ac 0.00% Impervious Runoff Depth=1.97"
Tc=20.0 min CN=59 Runoff=0.38 cfs 0.190 af

Subcatchment3S: Node A - C/F Non-PGIS Runoff Area=4.583 ac 73.60% Impervious Runoff Depth=4.82"
Tc=20.0 min CN=88 Runoff=5.43 cfs 1.840 af

Subcatchment6S: Node B - Public PGIS Runoff Area=0.250 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=0.35 cfs 0.124 af

Subcatchment7S: Node B - Subdivision Runoff Area=6.745 ac 31.13% Impervious Runoff Depth=4.49"
Tc=20.0 min CN=85 Runoff=7.39 cfs 2.525 af

Subcatchment8S: Node B - Public Non-PGIS Runoff Area=0.091 ac 0.00% Impervious Runoff Depth=3.86"
Tc=20.0 min CN=79 Runoff=0.08 cfs 0.029 af

Subcatchment9S: Node B - Subdivision Runoff Area=2.176 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=3.05 cfs 1.081 af

Subcatchment12S: Node C Public PGIS Runoff Area=0.710 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=1.00 cfs 0.353 af

Subcatchment13S: Node C - Flex Non-PGIS Runoff Area=1.378 ac 77.79% Impervious Runoff Depth=5.27"
Tc=20.0 min CN=92 Runoff=1.78 cfs 0.605 af

Subcatchment14S: Node C - Flex PGIS Runoff Area=1.685 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=2.36 cfs 0.837 af

Subcatchment17S: Node D - PGIS Runoff Area=46.237 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=64.81 cfs 22.971 af

SubcatchmentD2R: Node C - Public Runoff Area=0.239 ac 0.00% Impervious Runoff Depth=2.78"
Tc=20.0 min CN=68 Runoff=0.14 cfs 0.055 af

SubcatchmentD3R: Node A - Public PGIS Runoff Area=1.684 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=2.36 cfs 0.837 af

SubcatchmentD5P: Node D - Non-PGIS Runoff Area=29.621 ac 68.06% Impervious Runoff Depth=4.17"
Tc=20.0 min CN=82 Runoff=29.72 cfs 10.297 af

Pond 3P: Bioretention Peak Elev=54.89' Storage=3.301 af Inflow=64.81 cfs 22.971 af
Outflow=40.37 cfs 22.657 af

Pond 4P: Bioretention+Infiltration Peak Elev=3.84' Storage=0.039 af Inflow=2.36 cfs 0.837 af
Primary=0.15 cfs 0.283 af Secondary=2.20 cfs 0.554 af Outflow=2.35 cfs 0.837 af

Pond 5P: Bioretention+Infiltration Peak Elev=5.04' Storage=0.241 af Inflow=10.54 cfs 3.734 af
Primary=0.36 cfs 0.890 af Secondary=10.21 cfs 2.844 af Outflow=10.57 cfs 3.734 af

Pond 7P: Node B Peak Elev=49.80' Inflow=28.83 cfs 8.778 af
Outflow=28.83 cfs 8.778 af

Pond 10P: Bioretention Peak Elev=3.28' Storage=0.005 af Inflow=0.35 cfs 0.124 af
Primary=0.02 cfs 0.046 af Secondary=0.33 cfs 0.078 af Outflow=0.35 cfs 0.124 af

Pond 11P: Bioretention Peak Elev=5.06' Storage=0.055 af Inflow=3.05 cfs 1.081 af
Primary=0.19 cfs 0.364 af Secondary=2.82 cfs 0.717 af Outflow=3.02 cfs 1.081 af

Pond 15P: Bioretention Peak Elev=1.52' Storage=0.007 af Inflow=0.14 cfs 0.055 af
Primary=0.05 cfs 0.055 af Secondary=0.00 cfs 0.000 af Outflow=0.05 cfs 0.055 af

Pond 16P: Infiltration Trench Peak Elev=4.70' Storage=0.045 af Inflow=1.78 cfs 0.605 af
Primary=0.09 cfs 0.193 af Secondary=1.68 cfs 0.411 af Outflow=1.77 cfs 0.605 af

Pond 19P: Infiltration Trench Peak Elev=4.09' Storage=2.393 af Inflow=40.37 cfs 22.657 af
Primary=3.58 cfs 8.734 af Secondary=34.89 cfs 13.923 af Outflow=38.47 cfs 22.657 af

Pond N1: Node D Peak Elev=48.12' Storage=383,550 cf Inflow=84.32 cfs 34.599 af
Primary=48.30 cfs 27.890 af Secondary=3.24 cfs 0.176 af Outflow=51.54 cfs 28.066 af

Pond N2: Node C Peak Elev=49.06' Inflow=33.86 cfs 10.379 af
Outflow=33.86 cfs 10.379 af

Pond N3: Node A Peak Elev=50.57' Inflow=18.21 cfs 5.428 af
Outflow=18.21 cfs 5.428 af

Total Runoff Area = 104.075 ac Runoff Volume = 45.478 af Average Runoff Depth = 5.24"
16.44% Pervious = 17.113 ac 83.56% Impervious = 86.962 ac

Summary for Subcatchment 1S: Node A - C/F PGIS

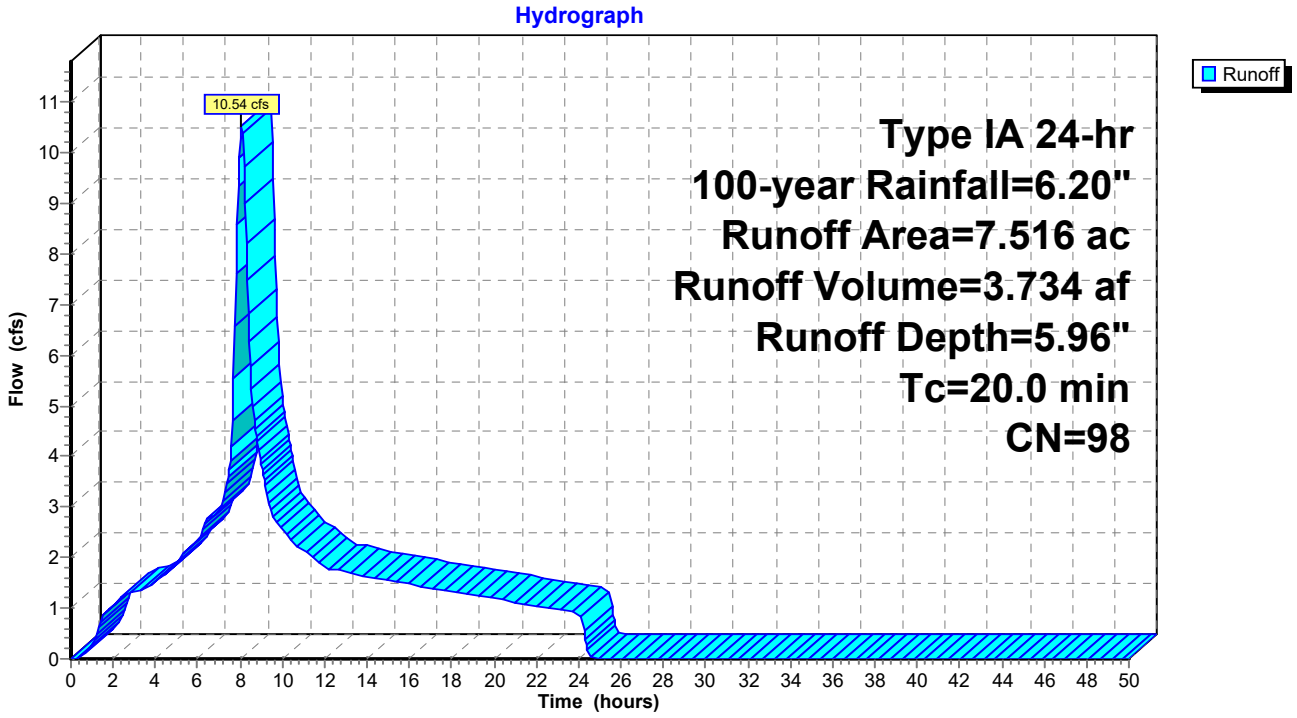
Runoff = 10.54 cfs @ 8.08 hrs, Volume= 3.734 af, Depth= 5.96"
Routed to Pond 5P : Bioretention+Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
7.516	98	Paved parking, HSG B
7.516		100.00% Impervious Area

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

Subcatchment 1S: Node A - C/F PGIS



Summary for Subcatchment 2S: Node A - Public Non-PGIS

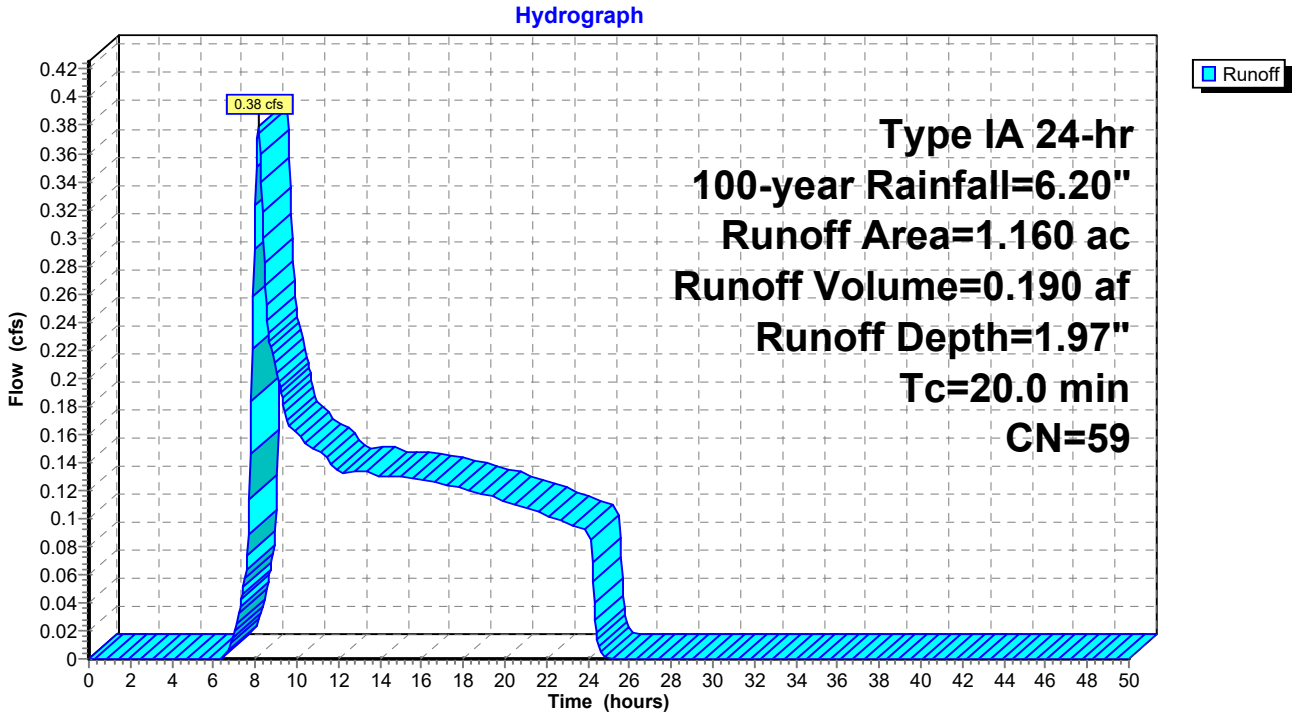
Runoff = 0.38 cfs @ 8.16 hrs, Volume= 0.190 af, Depth= 1.97"
Routed to Pond N3 : Node A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

	Area (ac)	CN	Description
*	1.160	59	50-75% Grass cover, Fair, HSG A/B (avg)
	1.160		100.00% Pervious Area

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

Subcatchment 2S: Node A - Public Non-PGIS



Summary for Subcatchment 3S: Node A - C/F Non-PGIS

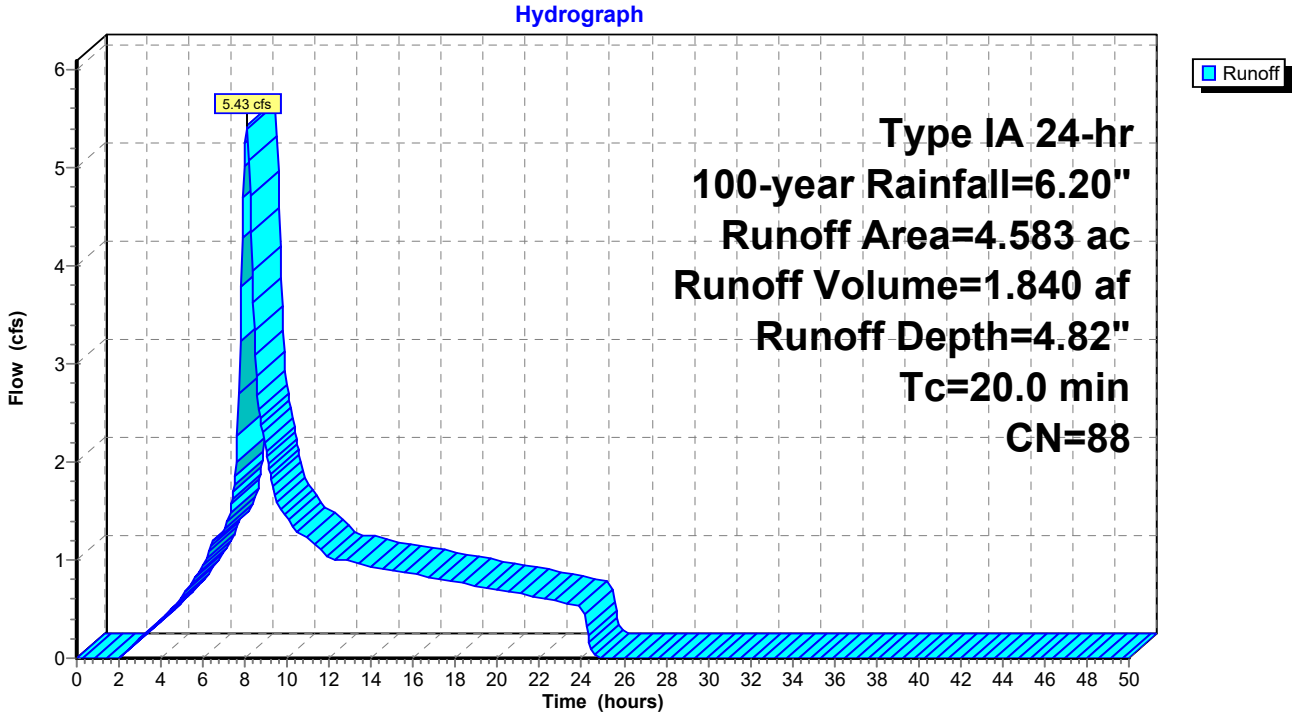
Runoff = 5.43 cfs @ 8.09 hrs, Volume= 1.840 af, Depth= 4.82"
Routed to Pond N3 : Node A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

	Area (ac)	CN	Description
*	1.210	59	50-75% Grass cover, Fair, HSG A/B (avg)
	3.373	98	Roofs, HSG A
	4.583	88	Weighted Average
	1.210		26.40% Pervious Area
	3.373		73.60% Impervious Area

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

Subcatchment 3S: Node A - C/F Non-PGIS



Summary for Subcatchment 6S: Node B - Public PGIS

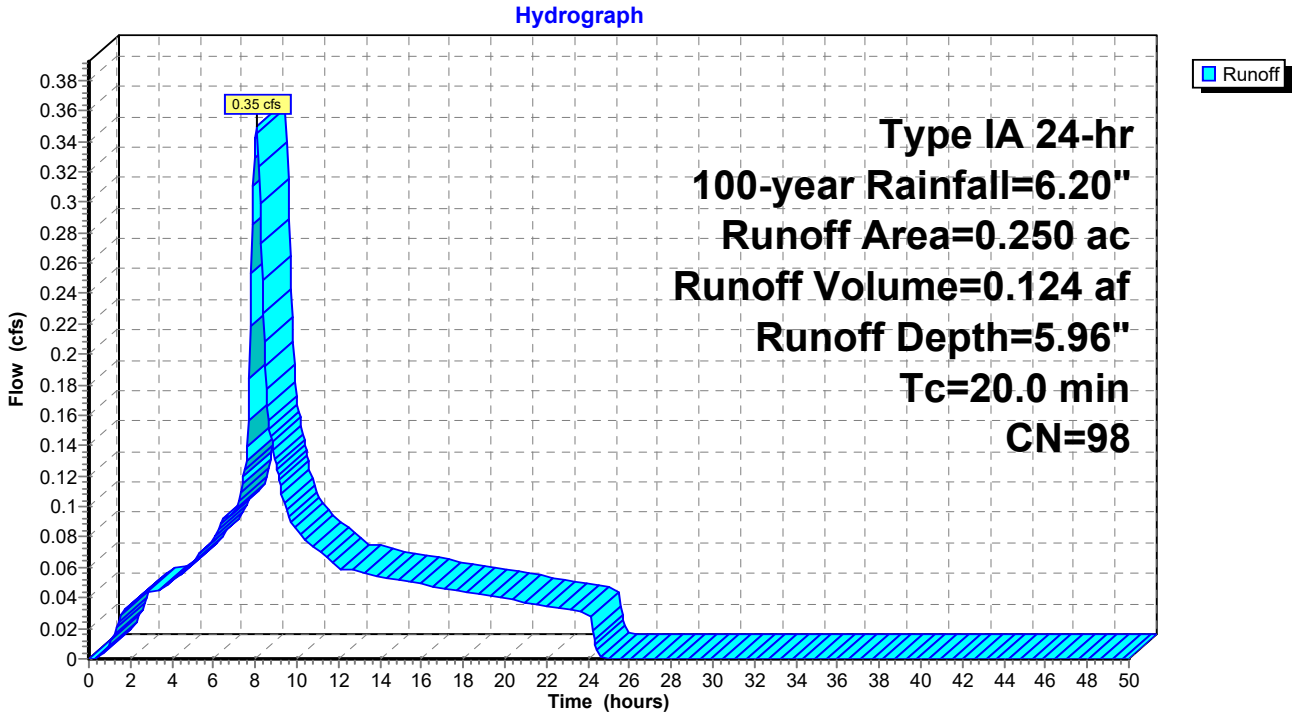
Runoff = 0.35 cfs @ 8.08 hrs, Volume= 0.124 af, Depth= 5.96"
Routed to Pond 10P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.250	98	Paved parking, HSG A
0.250		100.00% Impervious Area

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

Subcatchment 6S: Node B - Public PGIS



Summary for Subcatchment 7S: Node B - Subdivision Non-PGIS

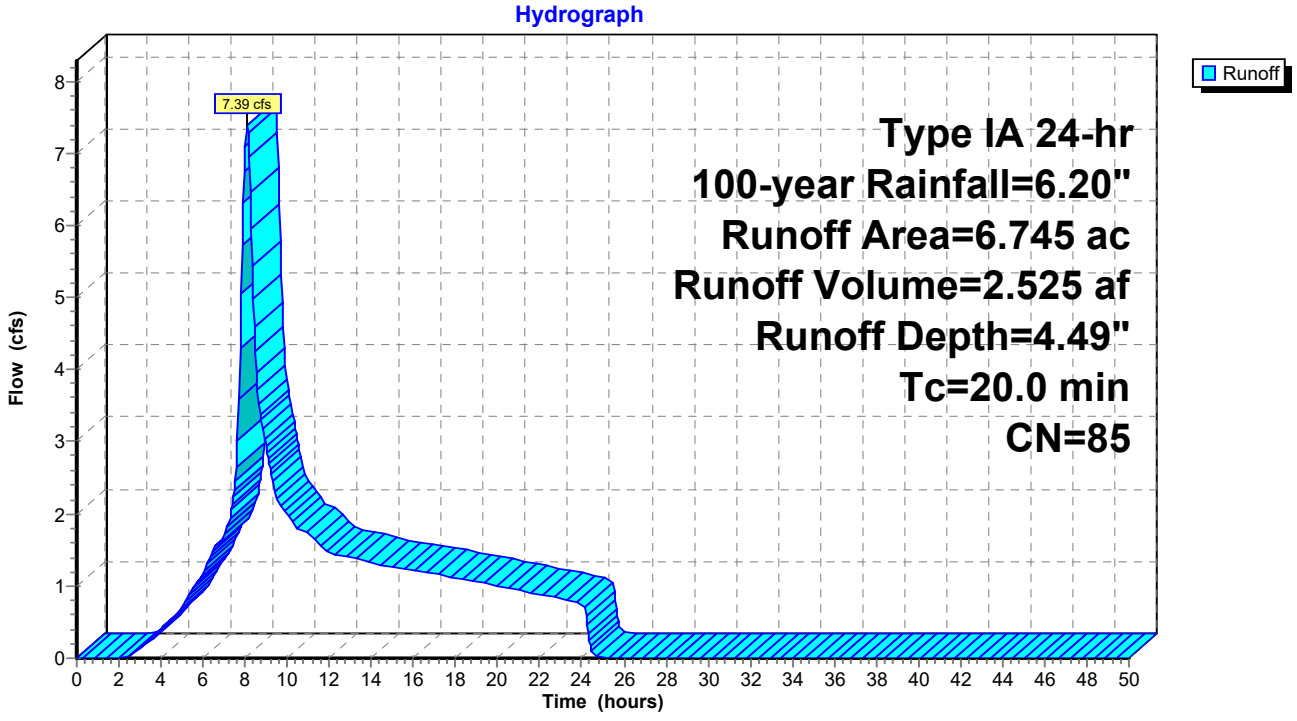
Runoff = 7.39 cfs @ 8.09 hrs, Volume= 2.525 af, Depth= 4.49"
Routed to Pond 7P : Node B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
2.100	98	Roofs, HSG B
4.645	79	<50% Grass cover, Poor, HSG B
6.745	85	Weighted Average
4.645		68.87% Pervious Area
2.100		31.13% Impervious Area

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

Subcatchment 7S: Node B - Subdivision Non-PGIS



Summary for Subcatchment 8S: Node B - Public Non-PGIS

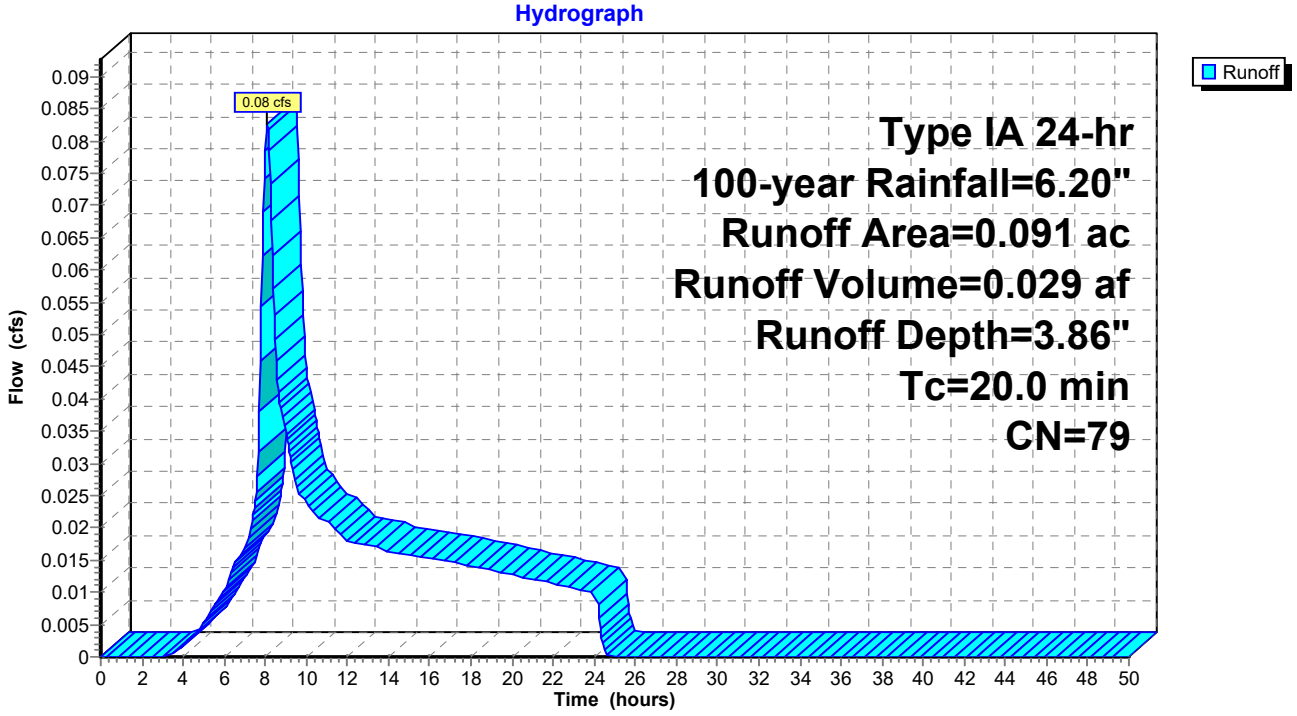
Runoff = 0.08 cfs @ 8.11 hrs, Volume= 0.029 af, Depth= 3.86"
Routed to Pond 7P : Node B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.091	79	<50% Grass cover, Poor, HSG B
0.091		100.00% Pervious Area

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

Subcatchment 8S: Node B - Public Non-PGIS



Summary for Subcatchment 9S: Node B - Subdivision PGIS

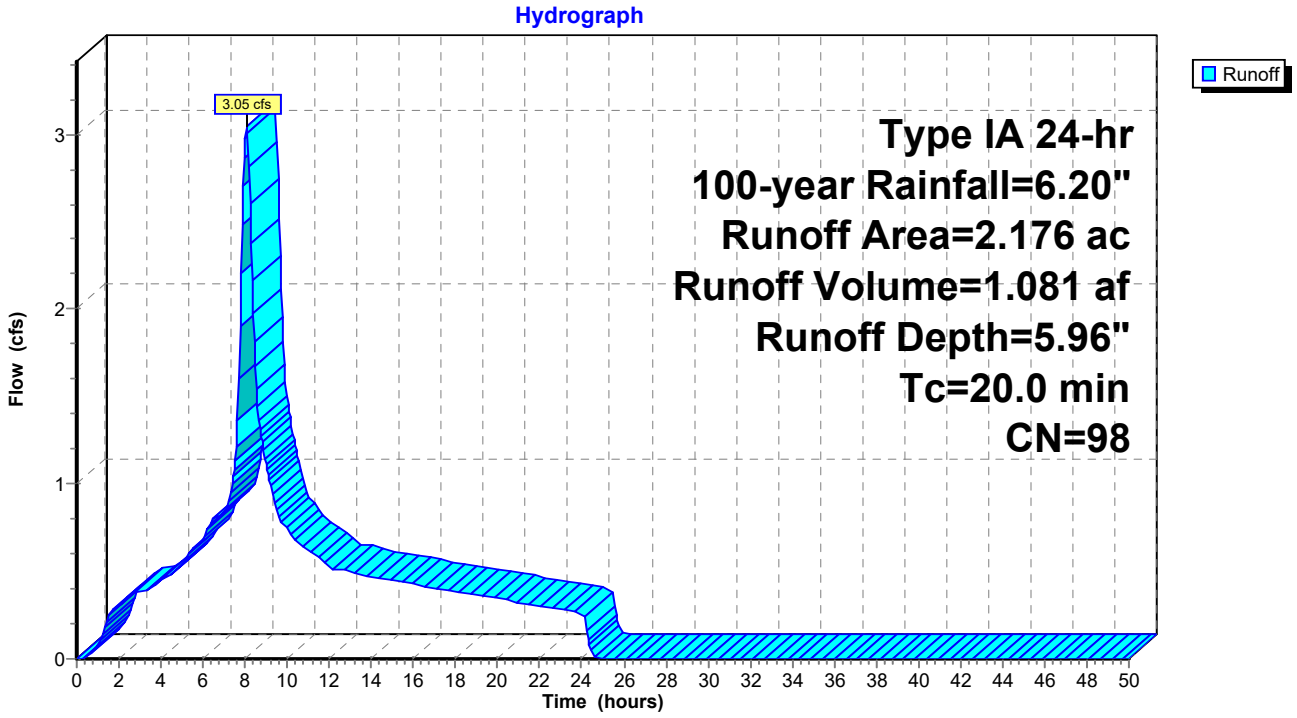
Runoff = 3.05 cfs @ 8.08 hrs, Volume= 1.081 af, Depth= 5.96"
Routed to Pond 11P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
2.176	98	Paved parking, HSG A
2.176		100.00% Impervious Area

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

Subcatchment 9S: Node B - Subdivision PGIS



Summary for Subcatchment 12S: Node C Public PGIS

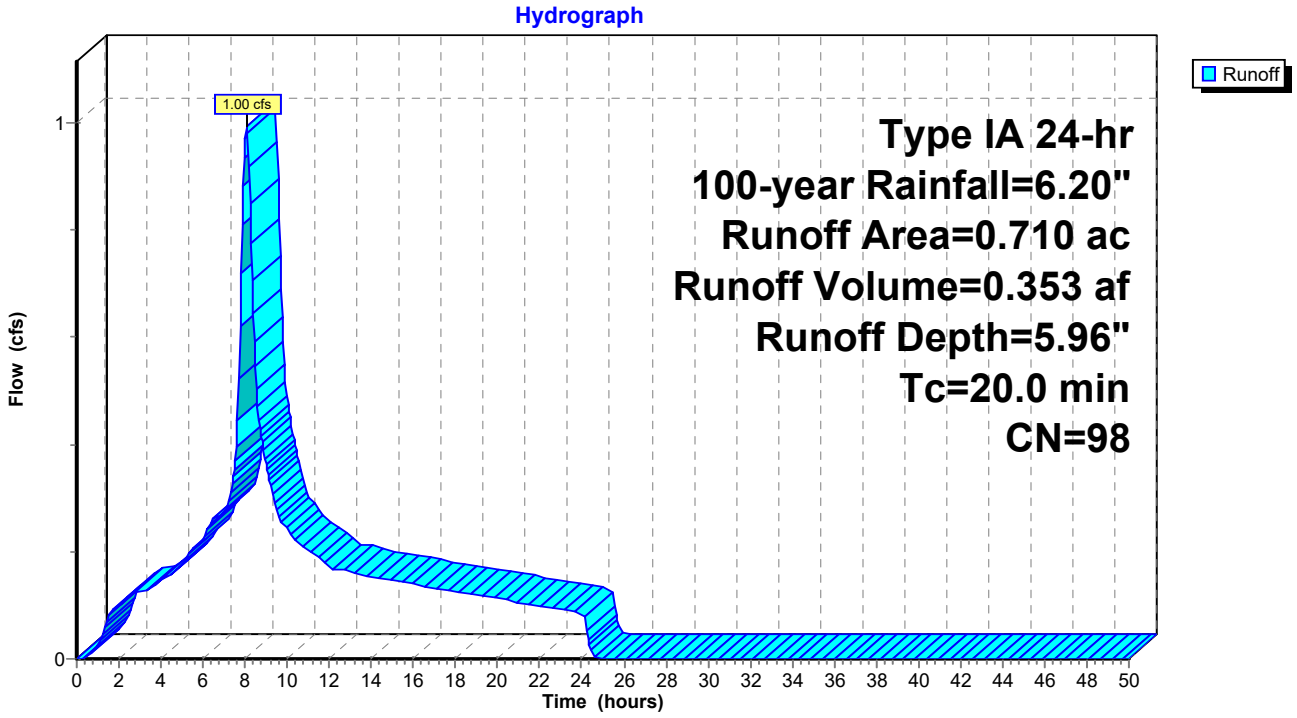
Runoff = 1.00 cfs @ 8.08 hrs, Volume= 0.353 af, Depth= 5.96"
Routed to Pond N2 : Node C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.710	98	Paved parking, HSG B
0.710		100.00% Impervious Area

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

Subcatchment 12S: Node C Public PGIS



Summary for Subcatchment 13S: Node C - Flex Non-PGIS

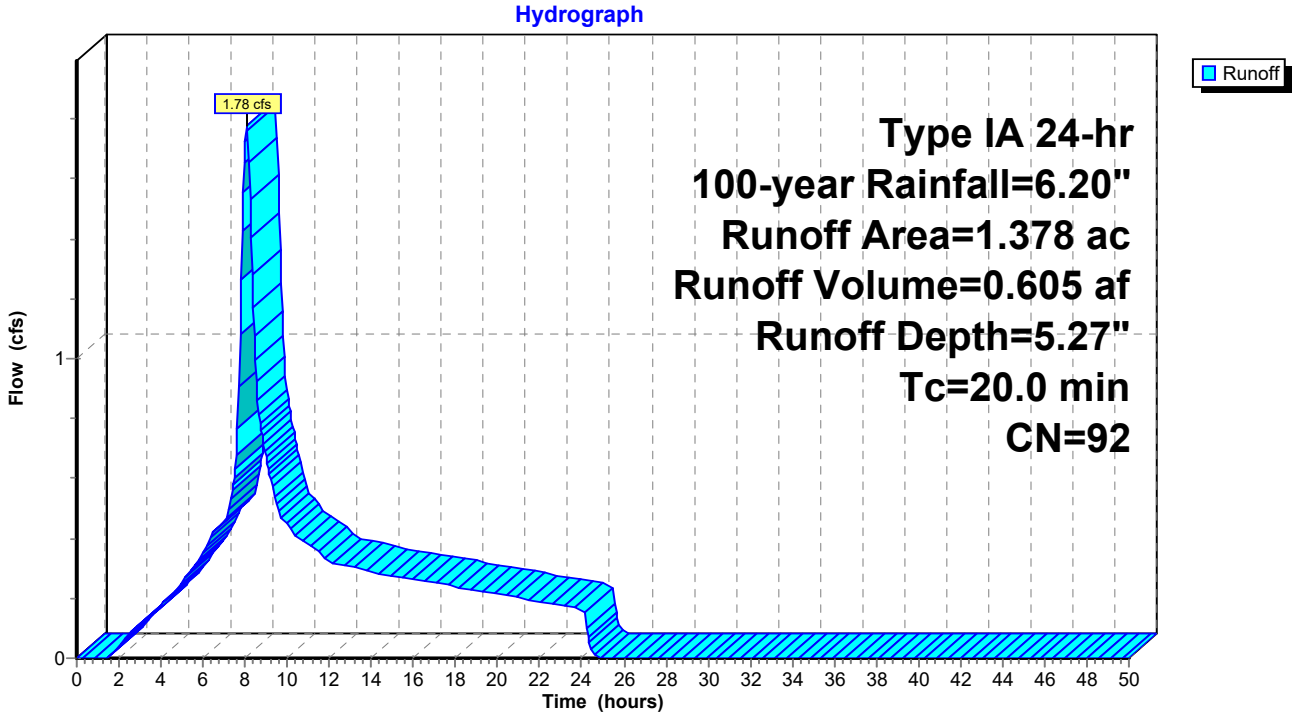
Runoff = 1.78 cfs @ 8.08 hrs, Volume= 0.605 af, Depth= 5.27"
Routed to Pond 16P : Infiltration Trench

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.306	69	50-75% Grass cover, Fair, HSG B
1.072	98	Roofs, HSG A
1.378	92	Weighted Average
0.306		22.21% Pervious Area
1.072		77.79% Impervious Area

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

Subcatchment 13S: Node C - Flex Non-PGIS



Summary for Subcatchment 14S: Node C - Flex PGIS

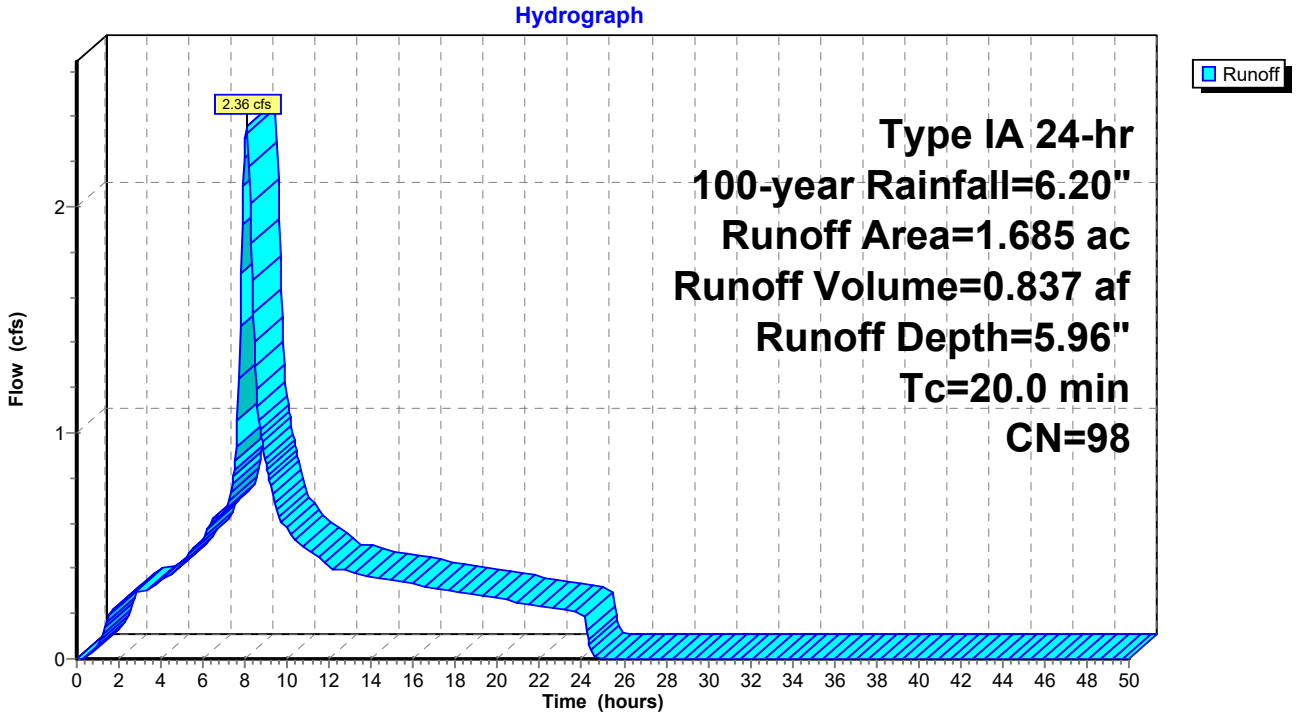
Runoff = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af, Depth= 5.96"
Routed to Pond N2 : Node C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
1.685	98	Paved parking, HSG B
1.685		100.00% Impervious Area

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

Subcatchment 14S: Node C - Flex PGIS



Summary for Subcatchment 17S: Node D - PGIS

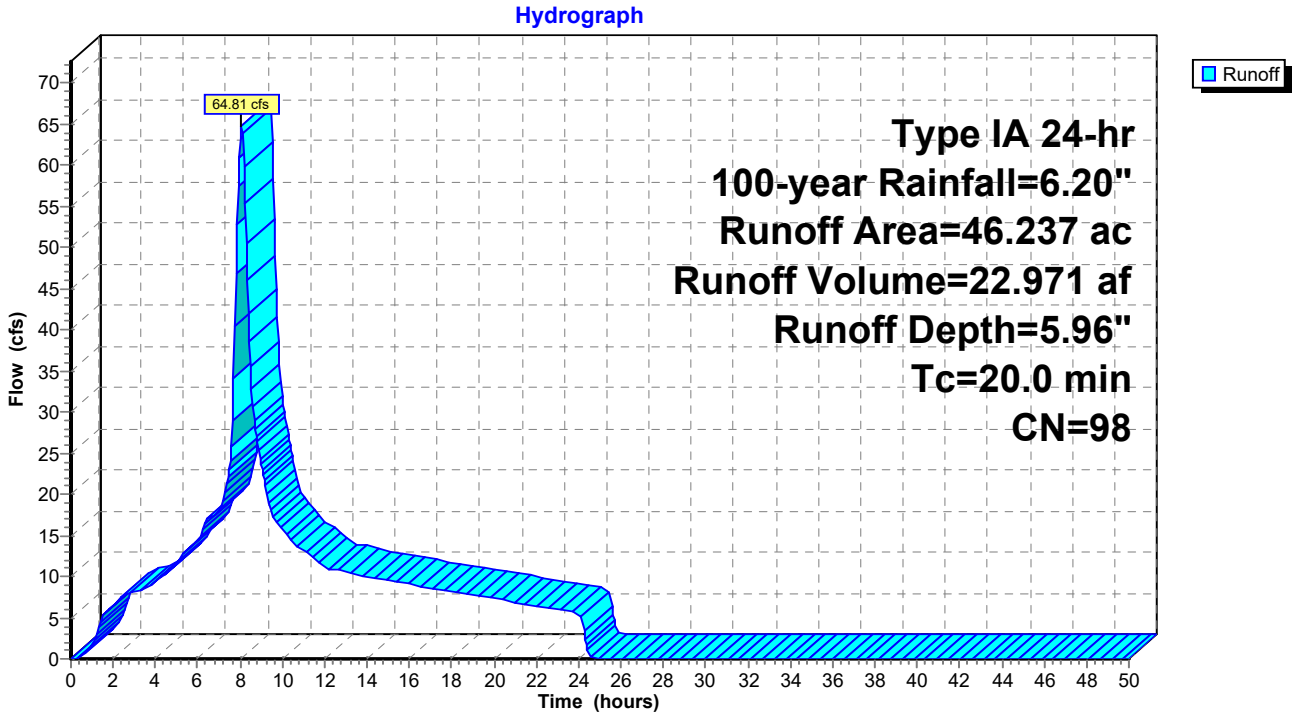
Runoff = 64.81 cfs @ 8.08 hrs, Volume= 22.971 af, Depth= 5.96"
Routed to Pond 3P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
46.237	98	Paved parking, HSG A
46.237		100.00% Impervious Area

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

Subcatchment 17S: Node D - PGIS



Summary for Subcatchment D2R: Node C - Public Non-PGIS

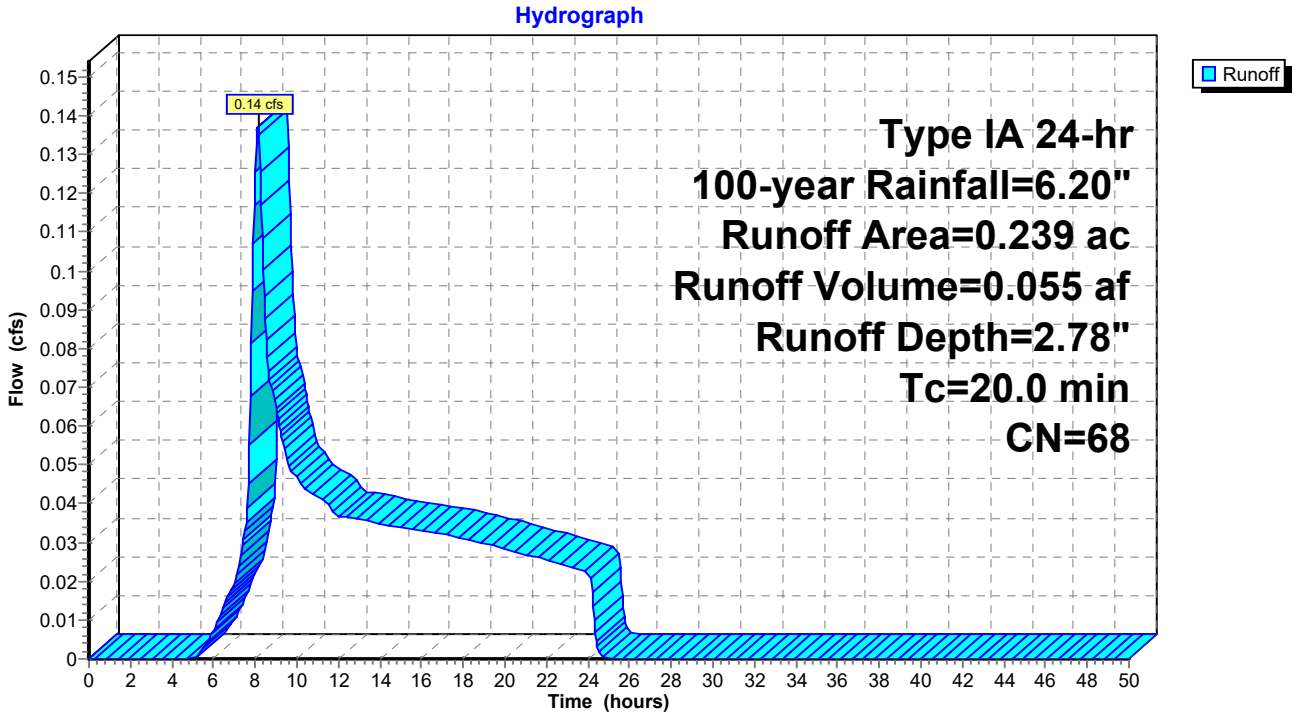
Runoff = 0.14 cfs @ 8.13 hrs, Volume= 0.055 af, Depth= 2.78"
Routed to Pond 15P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.239	68	<50% Grass cover, Poor, HSG A
0.239		100.00% Pervious Area

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

Subcatchment D2R: Node C - Public Non-PGIS



Summary for Subcatchment D3R: Node A - Public PGIS

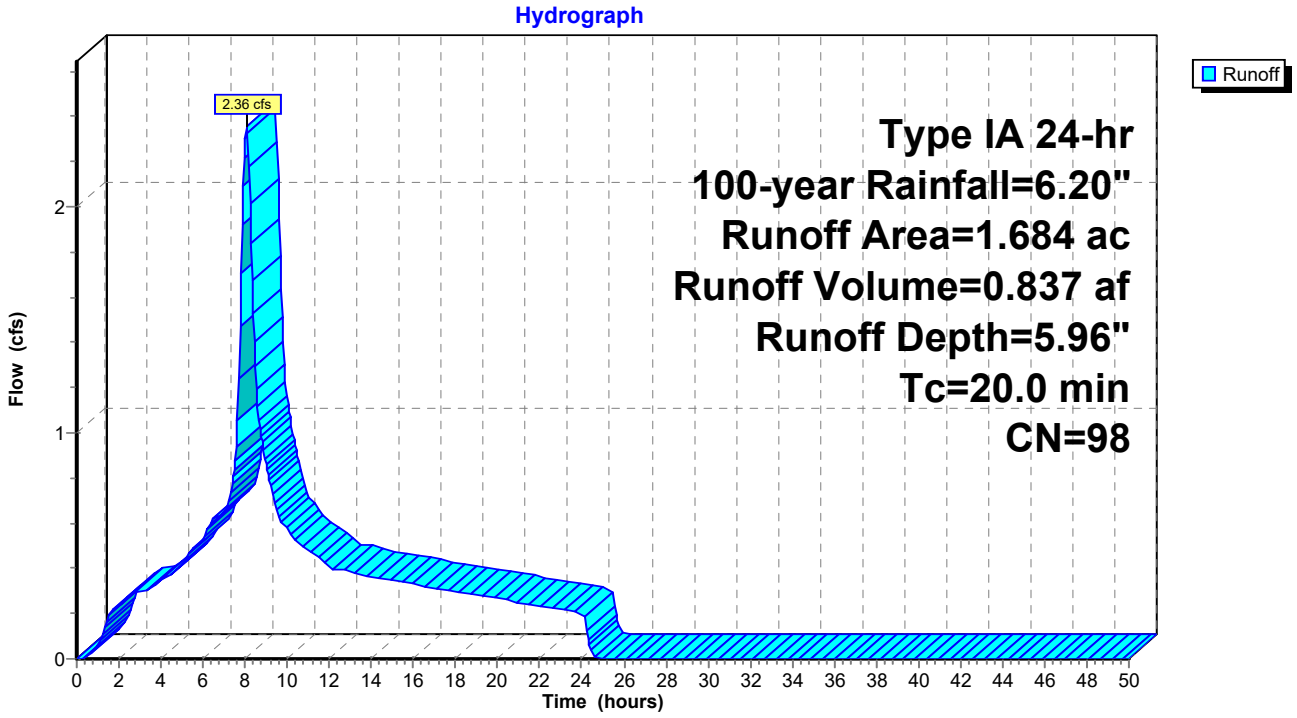
Runoff = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af, Depth= 5.96"
Routed to Pond 4P : Bioretention+Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
1.684	98	Paved parking, HSG B
1.684		100.00% Impervious Area

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

Subcatchment D3R: Node A - Public PGIS



Summary for Subcatchment D5P: Node D - Non-PGIS

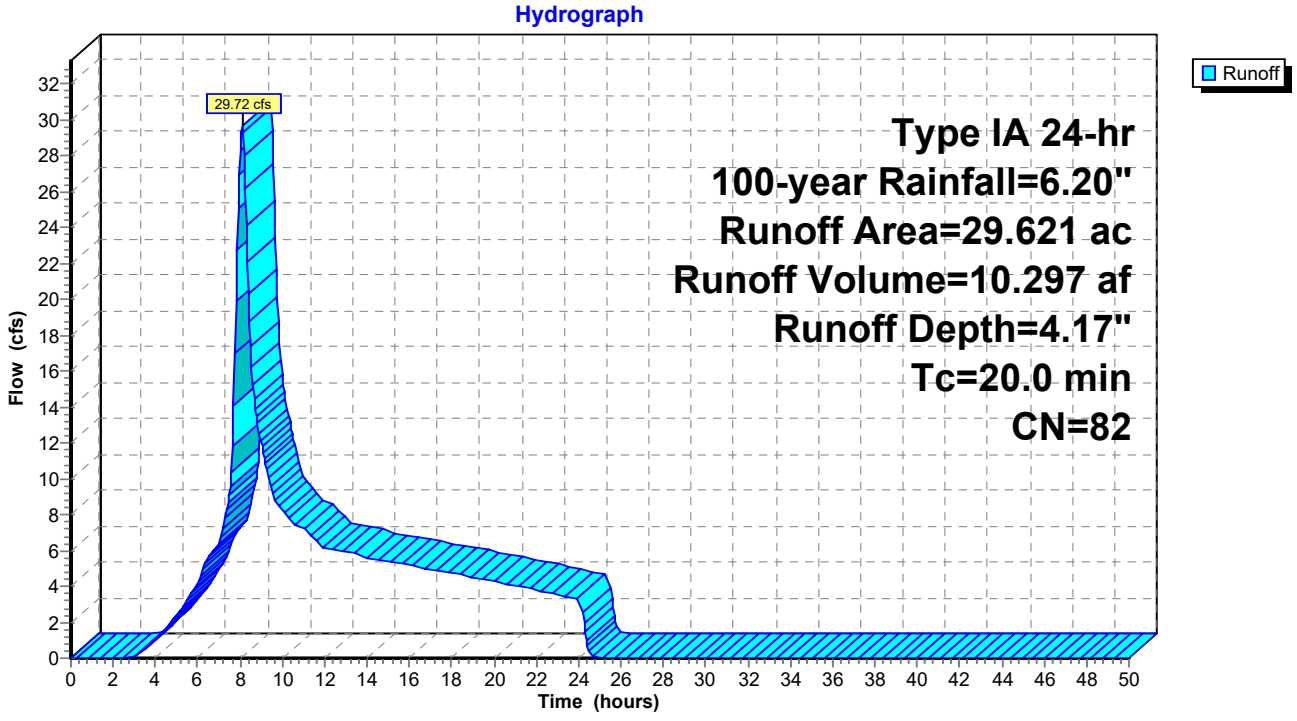
Runoff = 29.72 cfs @ 8.10 hrs, Volume= 10.297 af, Depth= 4.17"
Routed to Pond N1 : Node D

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
9.462	49	50-75% Grass cover, Fair, HSG A
20.159	98	Roofs, HSG B
29.621	82	Weighted Average
9.462		31.94% Pervious Area
20.159		68.06% Impervious Area

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

Subcatchment D5P: Node D - Non-PGIS



Summary for Pond 3P: Bioretention

Inflow Area = 46.237 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 64.81 cfs @ 8.08 hrs, Volume= 22.971 af
Outflow = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af, Atten= 38%, Lag= 20.8 min
Primary = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af
Routed to Pond 19P : Infiltration Trench

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 54.89' @ 8.42 hrs Surf.Area= 1.674 ac Storage= 3.301 af

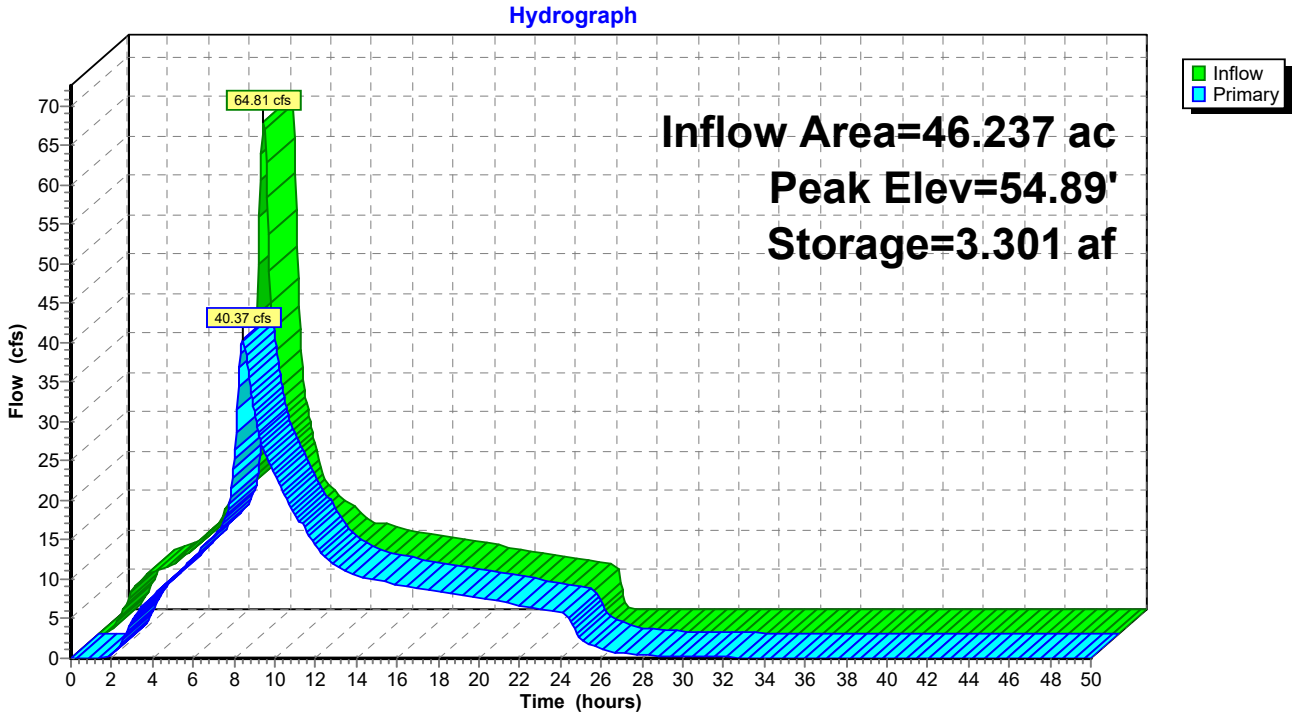
Plug-Flow detention time= 83.2 min calculated for 22.657 af (99% of inflow)
Center-of-Mass det. time= 72.4 min (736.4 - 664.0)

Volume	Invert	Avail.Storage	Storage Description
#1	50.00'	2.629 af	**270.00'W x 270.00'L x 6.50'H Prismatoid** 10.878 af Overall - 3.367 af Embedded = 7.512 af x 35.0% Voids
#2	54.50'	3.347 af	**270.00'W x 270.00'L x 2.00'H Prismatoid** Inside #1
#3	50.50'	0.019 af	**24.0" Round Pipe Storage** Inside #1 L= 269.0'
		5.996 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	54.50'	**60.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	50.50'	**24.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=40.28 cfs @ 8.42 hrs HW=54.89' (Free Discharge)
└─**1=Orifice/Grate** (Weir Controls 12.44 cfs @ 2.04 fps)
└─**2=Orifice/Grate** (Orifice Controls 27.85 cfs @ 8.86 fps)

Pond 3P: Bioretention



Summary for Pond 4P: Bioretention+Infiltration

Inflow Area = 1.684 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af
Outflow = 2.35 cfs @ 8.11 hrs, Volume= 0.837 af, Atten= 1%, Lag= 1.8 min
Primary = 0.15 cfs @ 8.11 hrs, Volume= 0.283 af
Secondary = 2.20 cfs @ 8.11 hrs, Volume= 0.554 af
Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 3.84' @ 8.11 hrs Surf.Area= 0.029 ac Storage= 0.039 af

Plug-Flow detention time= 55.2 min calculated for 0.836 af (100% of inflow)
Center-of-Mass det. time= 55.4 min (719.4 - 664.0)

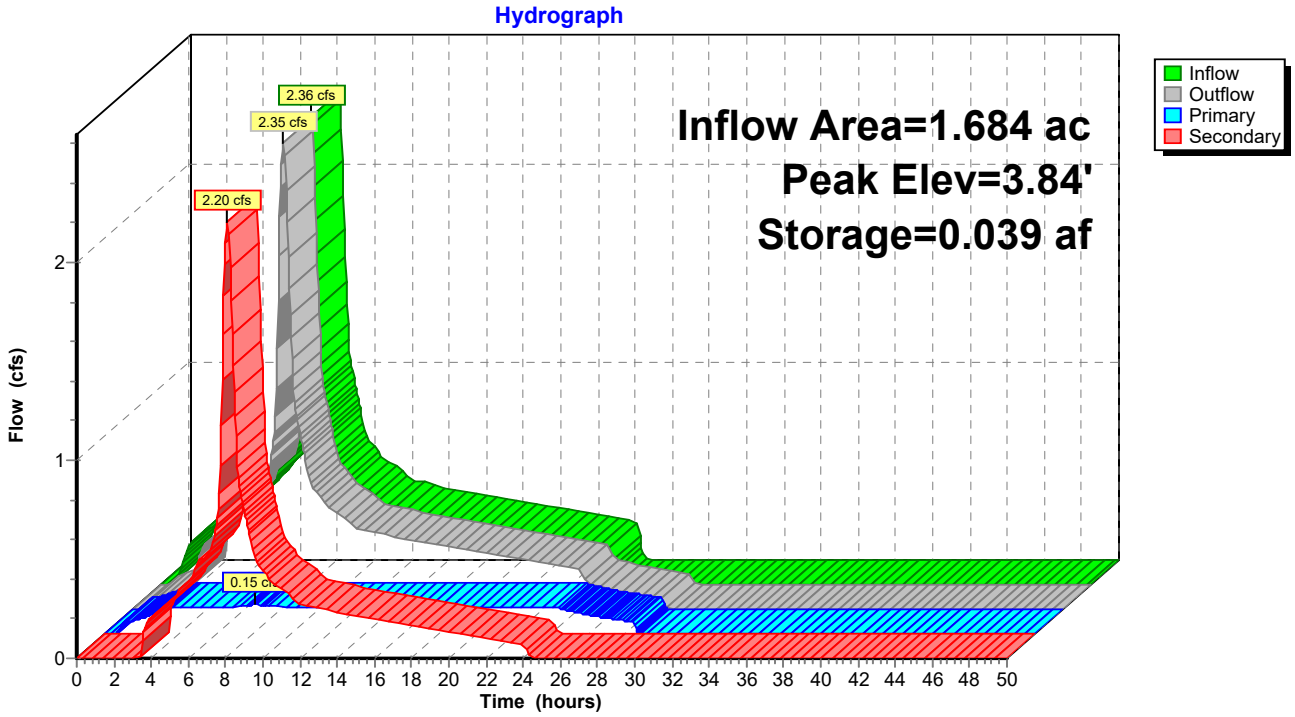
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.050 af	**5.00'W x 250.00'L x 5.00'H Bioretention** 0.143 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.15 cfs @ 8.11 hrs HW=3.84' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.15 cfs)

Secondary OutFlow Max=2.20 cfs @ 8.11 hrs HW=3.84' (Free Discharge)
↑**2=Orifice/Grate** (Orifice Controls 2.20 cfs @ 3.12 fps)

Pond 4P: Bioretention+Infiltration



Summary for Pond 5P: Bioretention+Infiltration

[93] Warning: Storage range exceeded by 0.04'
[88] Warning: Qout>Qin may require smaller dt or Finer Routing

Inflow Area = 7.516 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 10.54 cfs @ 8.08 hrs, Volume= 3.734 af
Outflow = 10.57 cfs @ 8.09 hrs, Volume= 3.734 af, Atten= 0%, Lag= 0.5 min
Primary = 0.36 cfs @ 7.95 hrs, Volume= 0.890 af
Secondary = 10.21 cfs @ 8.09 hrs, Volume= 2.844 af
Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 5.04' @ 8.09 hrs Surf.Area= 0.138 ac Storage= 0.241 af

Plug-Flow detention time= 91.6 min calculated for 3.730 af (100% of inflow)
Center-of-Mass det. time= 92.0 min (756.0 - 664.0)

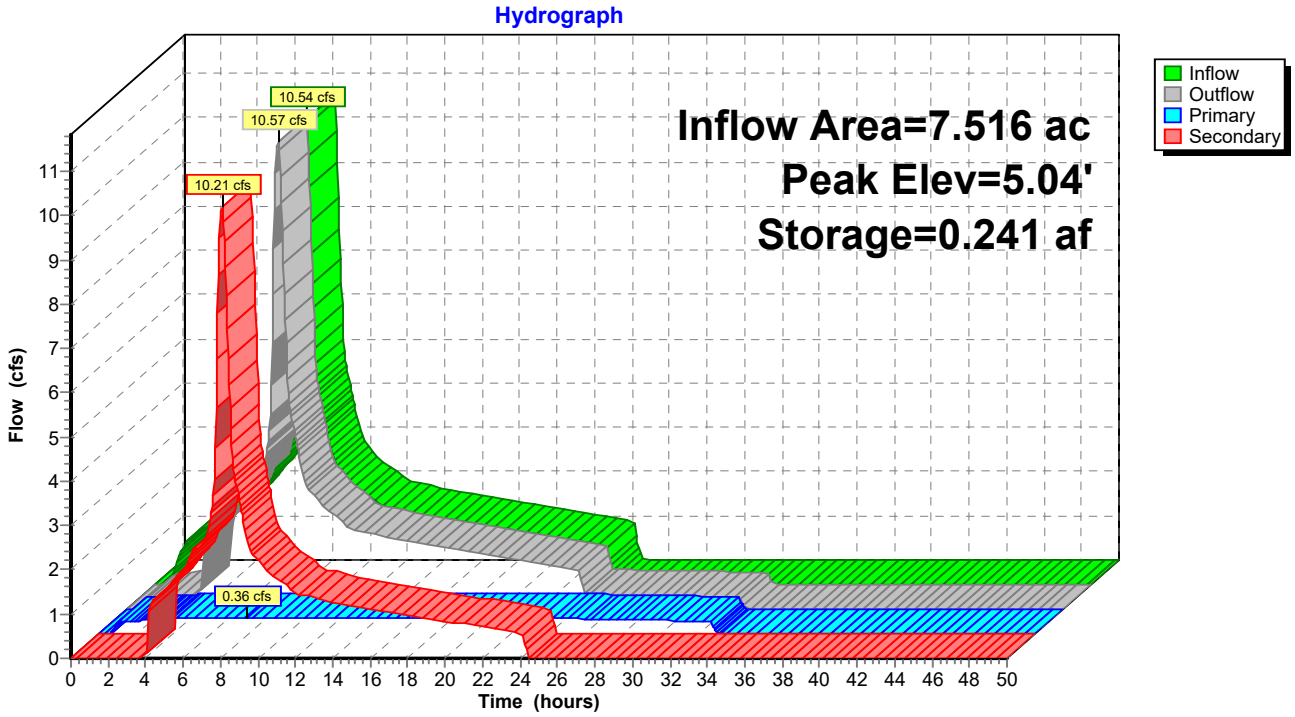
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.241 af	**50.00'W x 120.00'L x 5.00'H Infiltration Trench** 0.689 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.50'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.36 cfs @ 7.95 hrs HW=5.01' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.36 cfs)

Secondary OutFlow Max=10.16 cfs @ 8.09 hrs HW=5.04' (Free Discharge)
└**2=Orifice/Grate** (Weir Controls 10.16 cfs @ 2.40 fps)

Pond 5P: Bioretention+Infiltration



Summary for Pond 7P: Node B

[57] Hint: Peaked at 49.80' (Flood elevation advised)
[81] Warning: Exceeded Pond 10P by 49.06' @ 31.35 hrs
[81] Warning: Exceeded Pond 11P by 49.06' @ 33.05 hrs

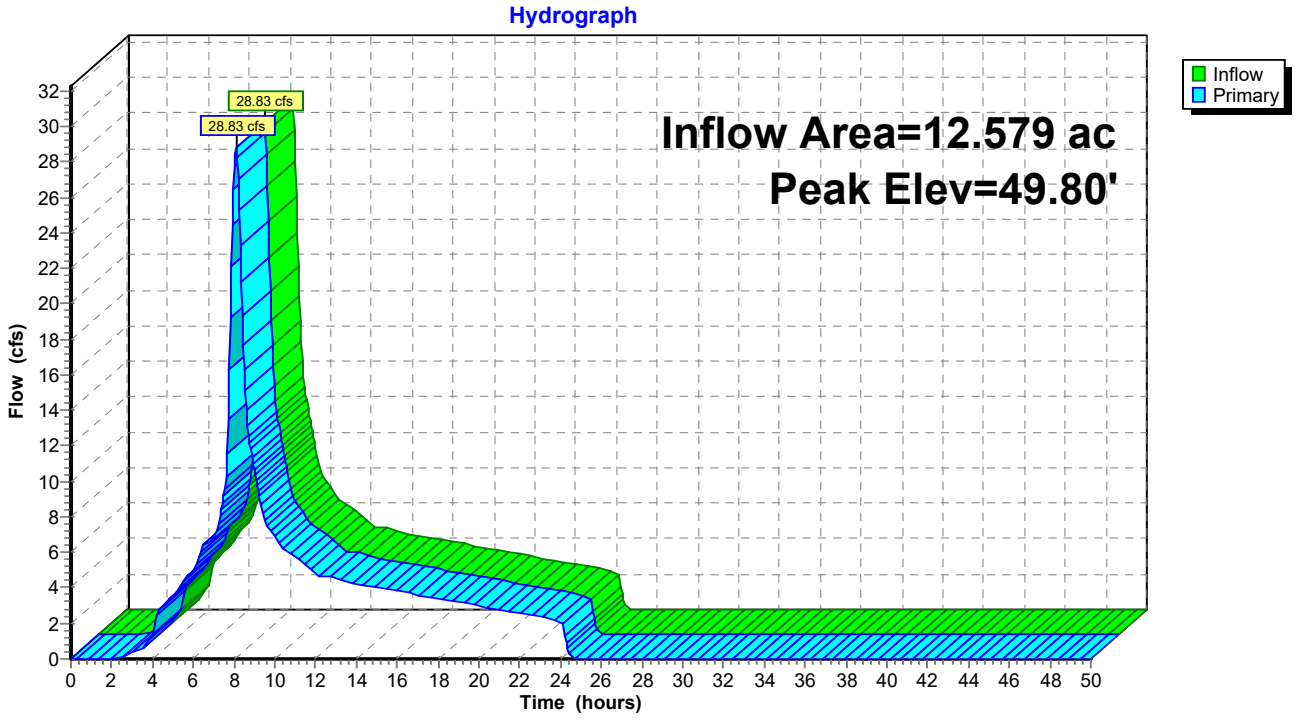
Inflow Area = 12.579 ac, 43.51% Impervious, Inflow Depth = 8.37" for 100-year event
Inflow = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af
Outflow = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af, Atten= 0%, Lag= 0.0 min
Primary = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 49.80' @ 8.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	40.33'	**24.0" Round Culvert** L= 379.7' Ke= 0.200 Inlet / Outlet Invert= 40.33' / 39.19' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Primary	49.50'	**36.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=28.70 cfs @ 8.09 hrs HW=49.80' TW=49.06' (Fixed TW Elev= 49.06')
1=Culvert (Outlet Controls 9.48 cfs @ 3.02 fps)
2=Sharp-Crested Rectangular Weir (Weir Controls 19.22 cfs @ 1.79 fps)

Pond 7P: Node B



Summary for Pond 10P: Bioretention

Inflow Area = 0.250 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 0.35 cfs @ 8.08 hrs, Volume= 0.124 af
Outflow = 0.35 cfs @ 8.09 hrs, Volume= 0.124 af, Atten= 0%, Lag= 0.5 min
Primary = 0.02 cfs @ 8.09 hrs, Volume= 0.046 af
Secondary = 0.33 cfs @ 8.09 hrs, Volume= 0.078 af
Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 3.28' @ 8.09 hrs Surf.Area= 0.005 ac Storage= 0.005 af

Plug-Flow detention time= 56.2 min calculated for 0.124 af (100% of inflow)
Center-of-Mass det. time= 56.3 min (720.4 - 664.0)

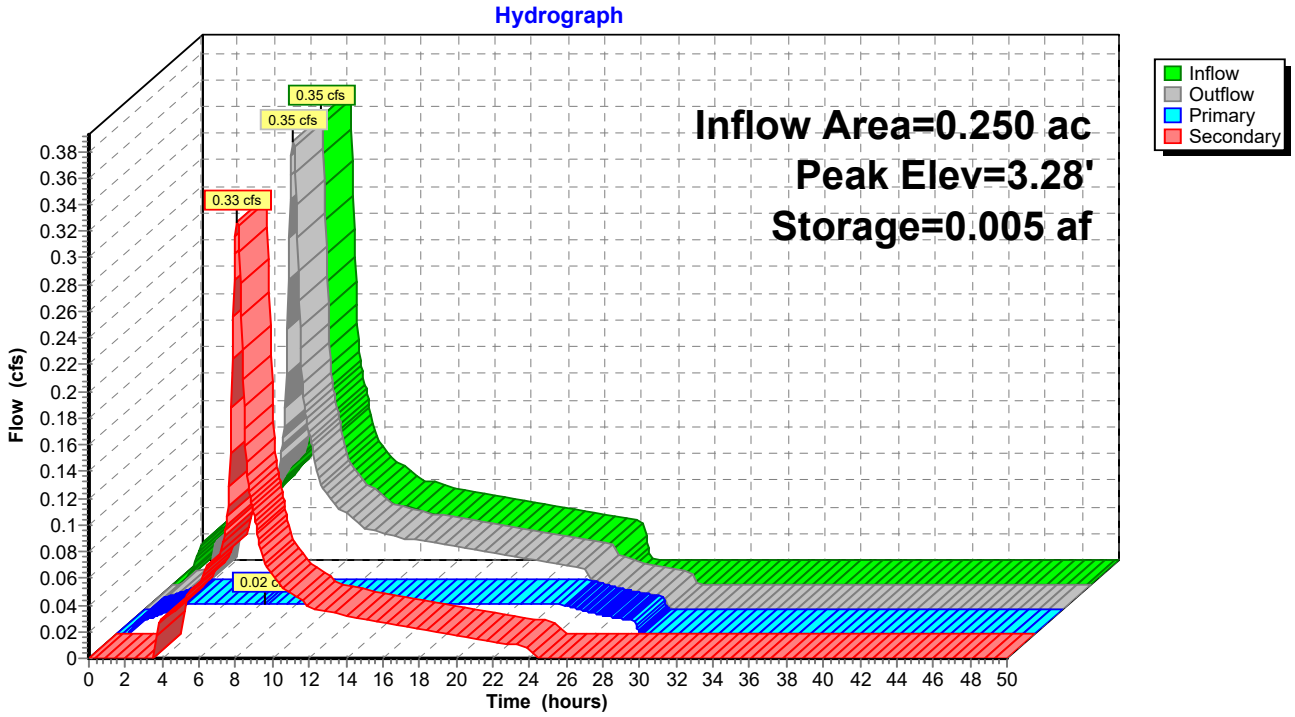
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.008 af	**5.00'W x 40.00'L x 5.00'H Bioretention** 0.023 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.02 cfs @ 8.09 hrs HW=3.28' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.02 cfs)

Secondary OutFlow Max=0.32 cfs @ 8.09 hrs HW=3.28' (Free Discharge)
2=Orifice/Grate (Orifice Controls 0.32 cfs @ 1.80 fps)

Pond 10P: Bioretention



Summary for Pond 11P: Bioretention

Inflow Area = 2.176 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 3.05 cfs @ 8.08 hrs, Volume= 1.081 af
Outflow = 3.02 cfs @ 8.12 hrs, Volume= 1.081 af, Atten= 1%, Lag= 2.8 min
Primary = 0.19 cfs @ 8.12 hrs, Volume= 0.364 af
Secondary = 2.82 cfs @ 8.12 hrs, Volume= 0.717 af
Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 5.06' @ 8.12 hrs Surf.Area= 0.031 ac Storage= 0.055 af

Plug-Flow detention time= 61.6 min calculated for 1.080 af (100% of inflow)
Center-of-Mass det. time= 61.8 min (725.8 - 664.0)

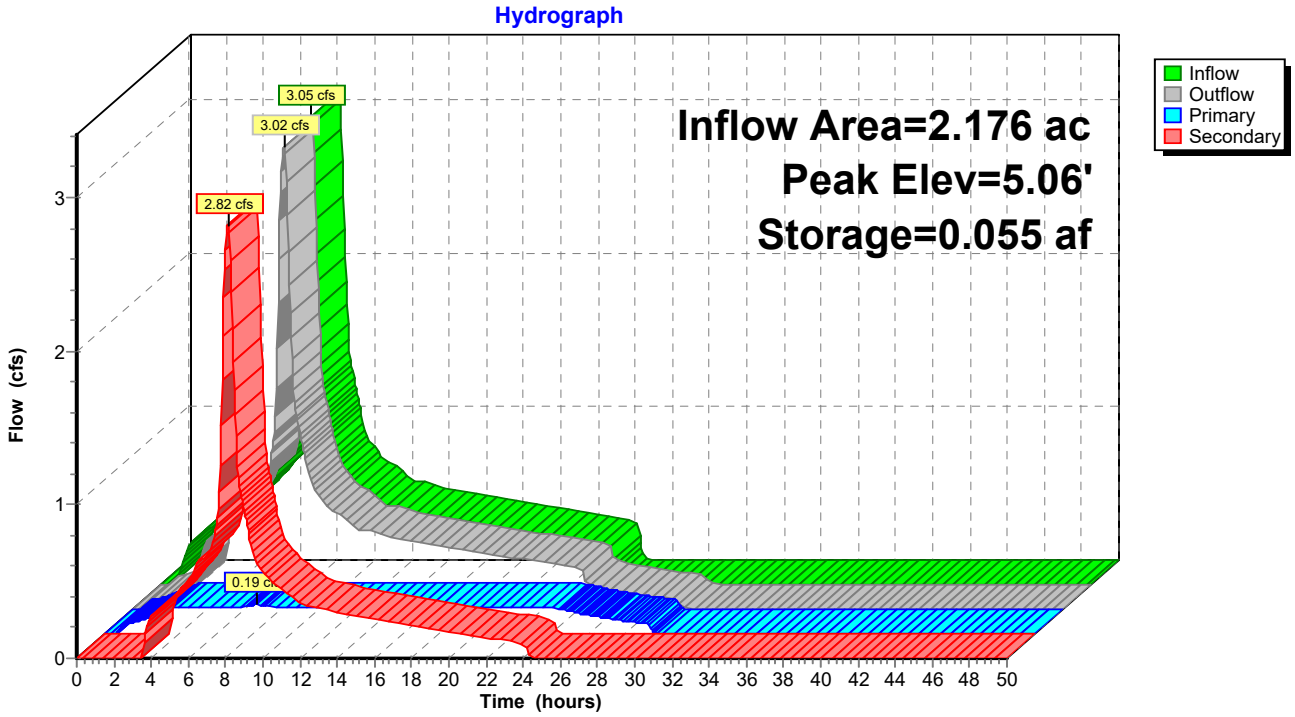
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.065 af	**5.00'W x 270.00'L x 6.00'H Bioretention** 0.186 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.19 cfs @ 8.12 hrs HW=5.06' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.19 cfs)

Secondary OutFlow Max=2.82 cfs @ 8.12 hrs HW=5.06' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 2.82 cfs @ 3.59 fps)

Pond 11P: Bioretention



Summary for Pond 15P: Bioretention

Inflow Area = 0.239 ac, 0.00% Impervious, Inflow Depth = 2.78" for 100-year event
Inflow = 0.14 cfs @ 8.13 hrs, Volume= 0.055 af
Outflow = 0.05 cfs @ 10.22 hrs, Volume= 0.055 af, Atten= 67%, Lag= 125.5 min
Primary = 0.05 cfs @ 10.22 hrs, Volume= 0.055 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 1.52' @ 10.22 hrs Surf.Area= 0.014 ac Storage= 0.007 af

Plug-Flow detention time= 77.6 min calculated for 0.055 af (100% of inflow)
Center-of-Mass det. time= 77.5 min (908.4 - 830.8)

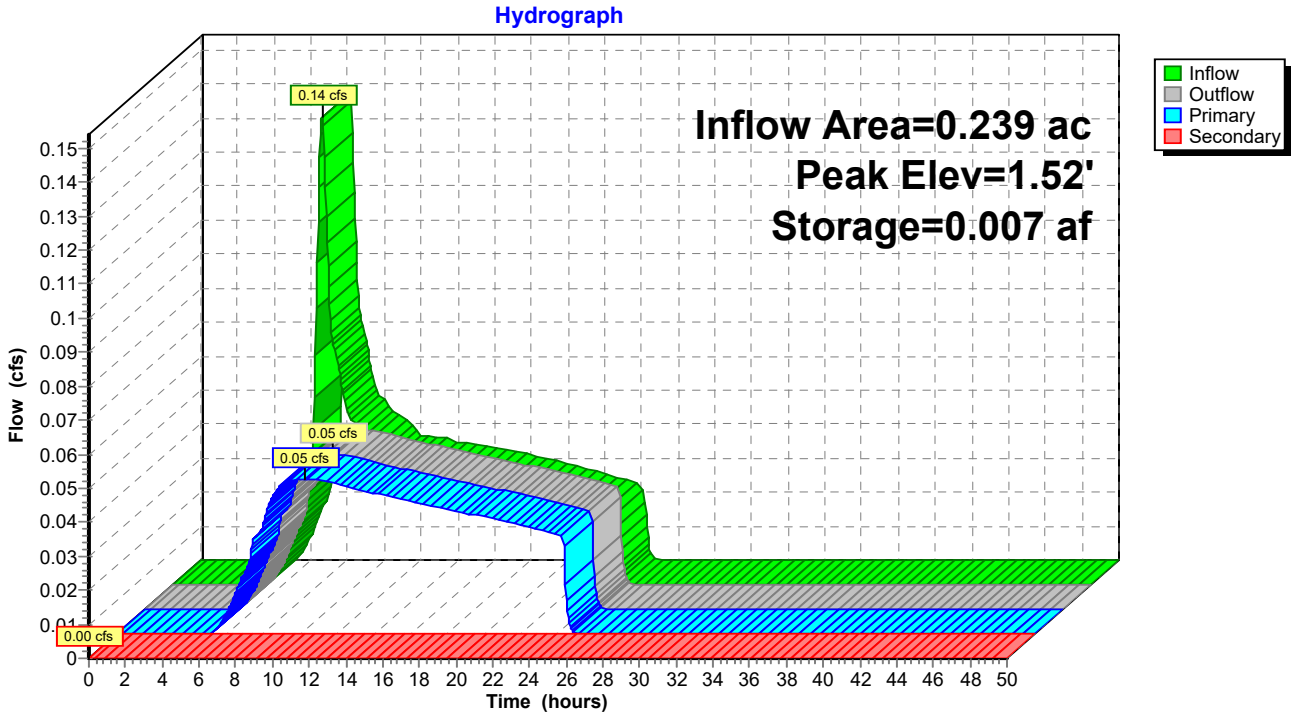
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.024 af	**5.00'W x 120.00'L x 5.00'H Bioretention** 0.069 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.05 cfs @ 10.22 hrs HW=1.52' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.05 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
↑**2=Orifice/Grate** (Controls 0.00 cfs)

Pond 15P: Bioretention



Summary for Pond 16P: Infiltration Trench

Inflow Area = 1.378 ac, 77.79% Impervious, Inflow Depth = 5.27" for 100-year event
Inflow = 1.78 cfs @ 8.08 hrs, Volume= 0.605 af
Outflow = 1.77 cfs @ 8.11 hrs, Volume= 0.605 af, Atten= 0%, Lag= 1.7 min
Primary = 0.09 cfs @ 8.11 hrs, Volume= 0.193 af
Secondary = 1.68 cfs @ 8.11 hrs, Volume= 0.411 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 4.70' @ 8.11 hrs Surf.Area= 0.028 ac Storage= 0.045 af

Plug-Flow detention time= 91.8 min calculated for 0.604 af (100% of inflow)
Center-of-Mass det. time= 92.1 min (798.9 - 706.8)

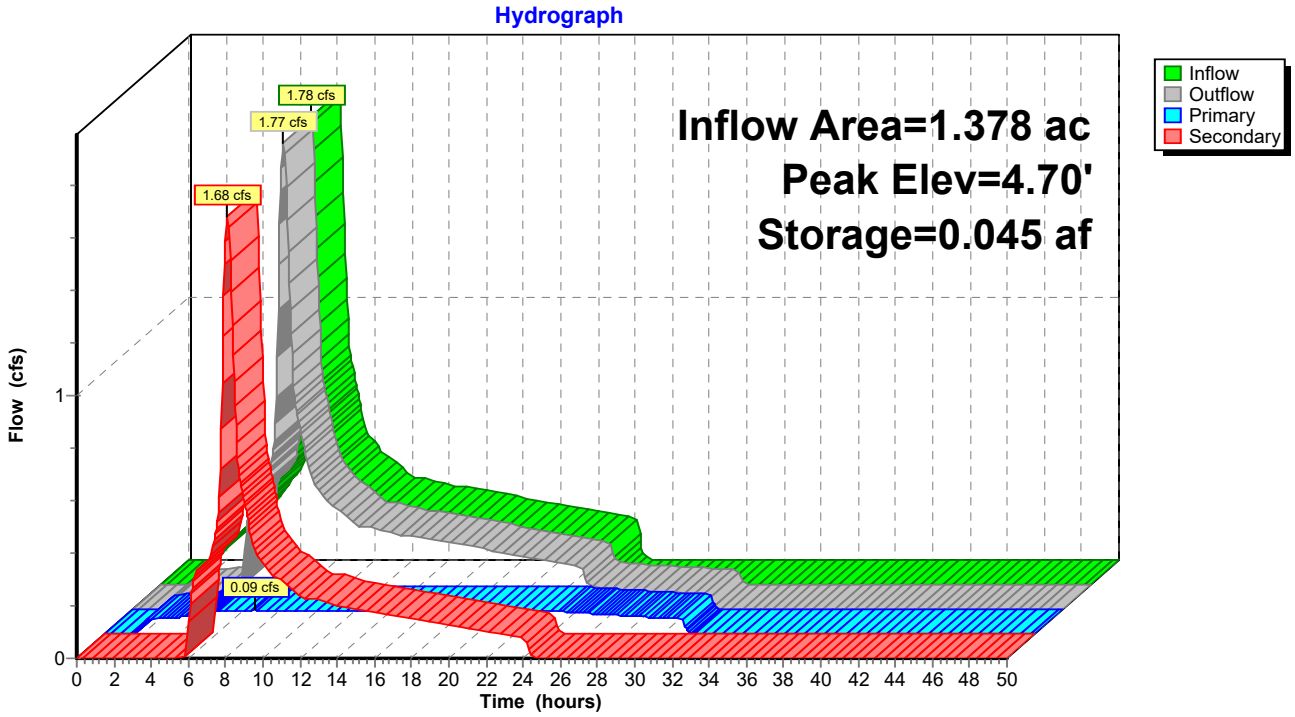
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.058 af	**20.00'W x 60.00'L x 6.00'H Infiltration Trench** 0.165 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.09 cfs @ 8.11 hrs HW=4.70' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Secondary OutFlow Max=1.68 cfs @ 8.11 hrs HW=4.70' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 1.68 cfs @ 2.85 fps)

Pond 16P: Infiltration Trench



Summary for Pond 19P: Infiltration Trench

Inflow Area = 46.237 ac,100.00% Impervious, Inflow Depth > 5.88" for 100-year event
Inflow = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af
Outflow = 38.47 cfs @ 8.60 hrs, Volume= 22.657 af, Atten= 5%, Lag= 10.4 min
Primary = 3.58 cfs @ 8.60 hrs, Volume= 8.734 af
Secondary = 34.89 cfs @ 8.60 hrs, Volume= 13.923 af
Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 4.09' @ 8.60 hrs Surf.Area= 1.674 ac Storage= 2.393 af

Plug-Flow detention time= 123.7 min calculated for 22.657 af (100% of inflow)
Center-of-Mass det. time= 123.7 min (860.1 - 736.4)

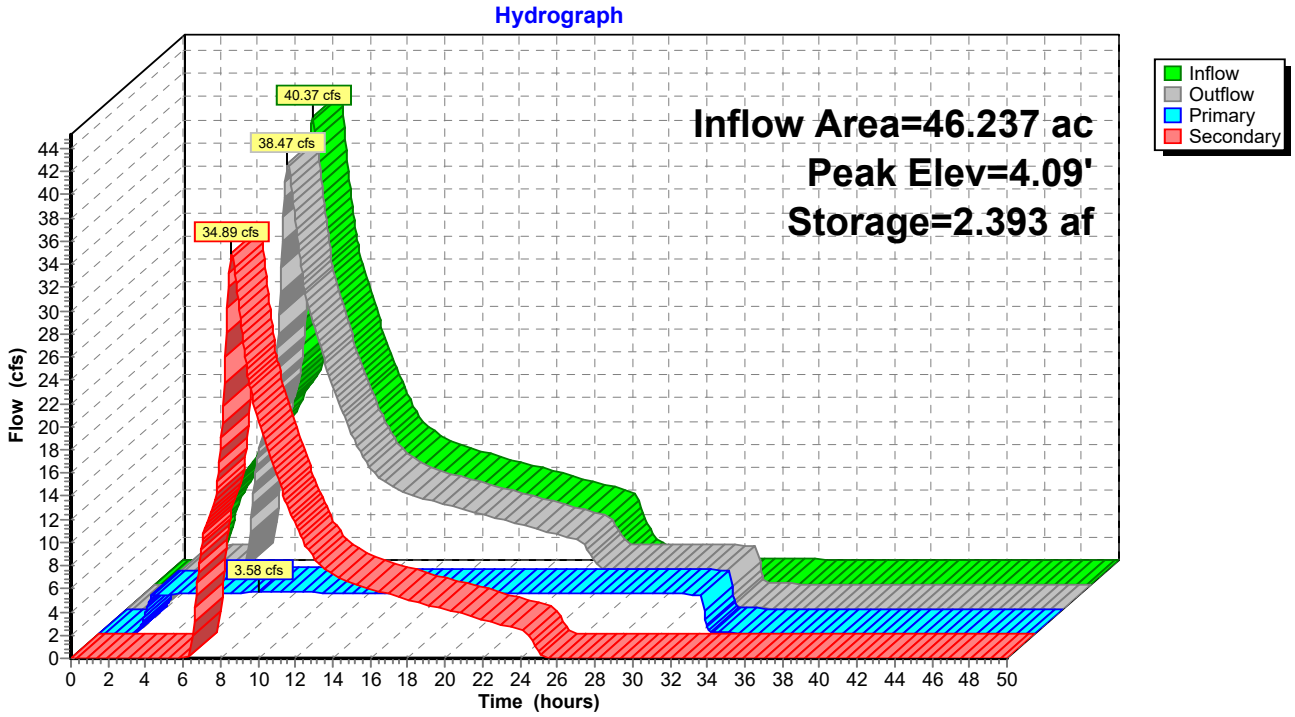
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	2.929 af	**270.00'W x 270.00'L x 5.00'H Infiltration Trench** 8.368 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.58 cfs @ 8.60 hrs HW=4.09' (Free Discharge)
↑└**1=Exfiltration** (Exfiltration Controls 3.58 cfs)

Secondary OutFlow Max=34.87 cfs @ 8.60 hrs HW=4.09' (Free Discharge)
↑└**2=Orifice/Grate** (Weir Controls 34.87 cfs @ 3.41 fps)

Pond 19P: Infiltration Trench



Summary for Pond N1: Node D

[81] Warning: Exceeded Pond 19P by 47.00' @ 49.95 hrs
[79] Warning: Submerged Pond N2 Primary device # 1 INLET by 8.93'

Inflow Area = 44.595 ac, 62.85% Impervious, Inflow Depth = 9.31" for 100-year event
Inflow = 84.32 cfs @ 8.14 hrs, Volume= 34.599 af
Outflow = 51.54 cfs @ 9.11 hrs, Volume= 28.066 af, Atten= 39%, Lag= 58.0 min
Primary = 48.30 cfs @ 9.11 hrs, Volume= 27.890 af
Secondary = 3.24 cfs @ 9.11 hrs, Volume= 0.176 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 48.12' @ 9.11 hrs Surf.Area= 113,213 sf Storage= 383,550 cf

Plug-Flow detention time= 210.3 min calculated for 28.066 af (81% of inflow)
Center-of-Mass det. time= 94.4 min (829.9 - 735.5)

Volume	Invert	Avail.Storage	Storage Description
#1	38.00'	922,840 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

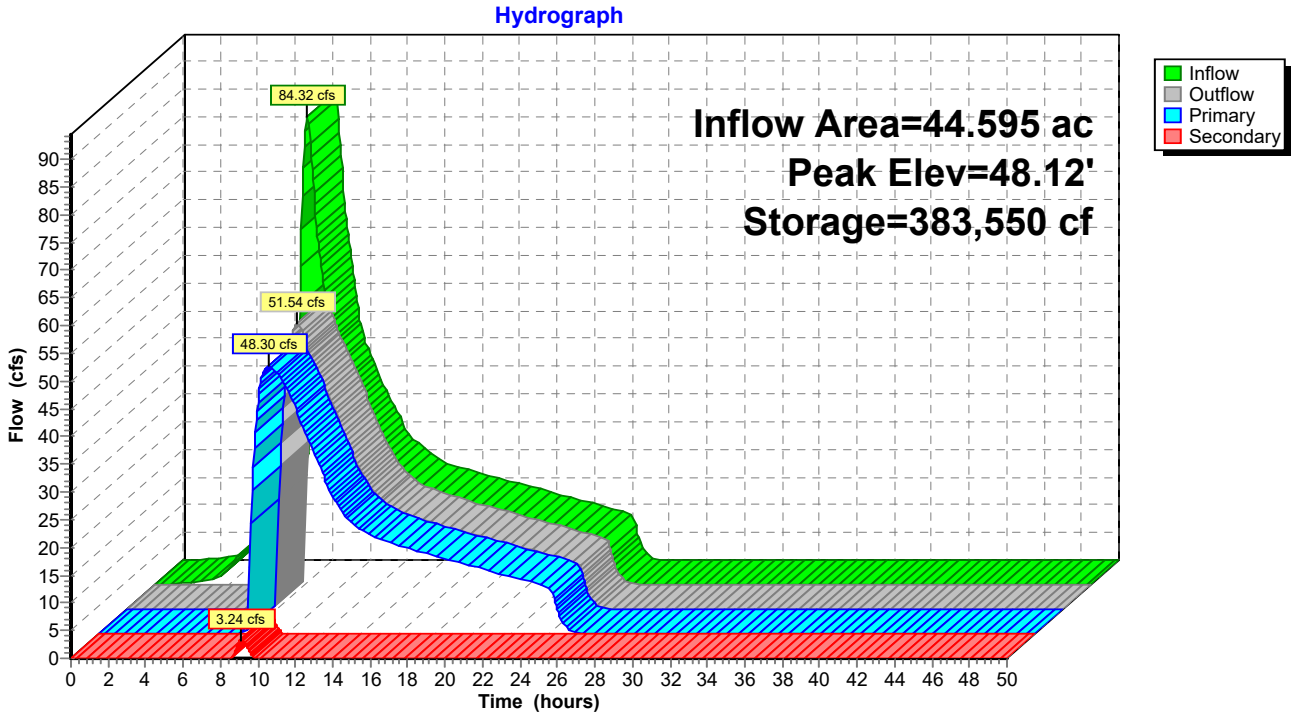
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	50	0	0
41.99	50	200	200
42.00	32,000	160	360
48.00	91,616	370,848	371,208
49.00	270,816	181,216	552,424
50.00	470,016	370,416	922,840

Device	Routing	Invert	Outlet Devices
#1	Secondary	48.00'	**30.0' long + 1.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32
#2	Primary	38.00'	**42.0" Round Culvert** L= 270.3' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 38.00' / 37.50' S= 0.0018 '/' Cc= 0.900 n= 0.012, Flow Area= 9.62 sf

Primary OutFlow Max=48.31 cfs @ 9.11 hrs HW=48.12' TW=47.00' (Fixed TW Elev= 47.00')
└**2=Culvert** (Outlet Controls 48.31 cfs @ 5.02 fps)

Secondary OutFlow Max=2.99 cfs @ 9.11 hrs HW=48.12' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Weir Controls 2.99 cfs @ 0.82 fps)

Pond N1: Node D



Summary for Pond N2: Node C

[57] Hint: Peaked at 49.06' (Flood elevation advised)
[81] Warning: Exceeded Pond 7P by 7.79' @ 1.75 hrs
[81] Warning: Exceeded Pond 15P by 48.77' @ 7.80 hrs
[81] Warning: Exceeded Pond 16P by 48.12' @ 1.45 hrs

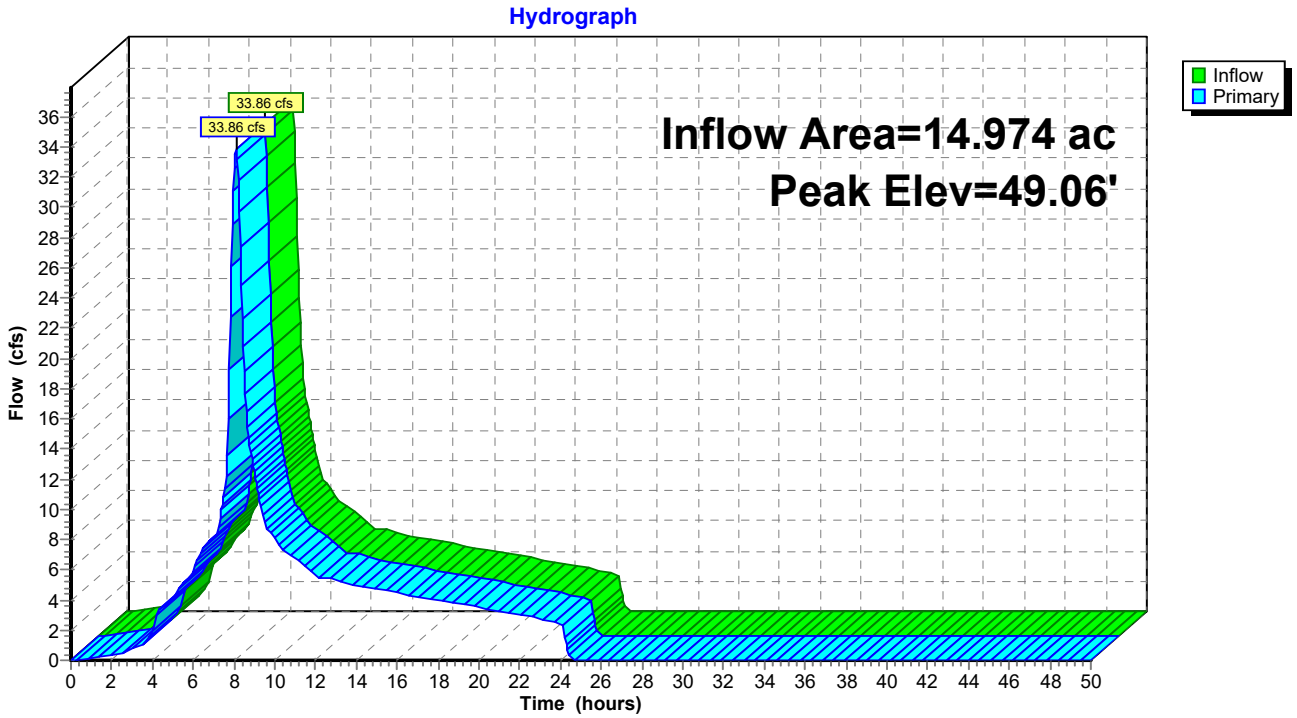
Inflow Area = 14.974 ac, 52.54% Impervious, Inflow Depth = 8.32" for 100-year event
Inflow = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af
Outflow = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af, Atten= 0%, Lag= 0.0 min
Primary = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af
Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 49.06' @ 8.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	39.19'	**30.0" Round Culvert** L= 410.7' Ke= 0.200 Inlet / Outlet Invert= 39.19' / 38.00' S= 0.0029 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 4.91 sf
#2	Primary	48.80'	**36.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=33.77 cfs @ 8.09 hrs HW=49.06' TW=48.12' (Fixed TW Elev= 48.12')
1=Culvert (Outlet Controls 18.13 cfs @ 3.69 fps)
2=Sharp-Crested Rectangular Weir (Weir Controls 15.64 cfs @ 1.67 fps)

Pond N2: Node C



Summary for Pond N3: Node A

[57] Hint: Peaked at 50.57' (Flood elevation advised)
[81] Warning: Exceeded Pond 4P by 49.80' @ 31.55 hrs
[81] Warning: Exceeded Pond 5P by 49.80' @ 35.95 hrs

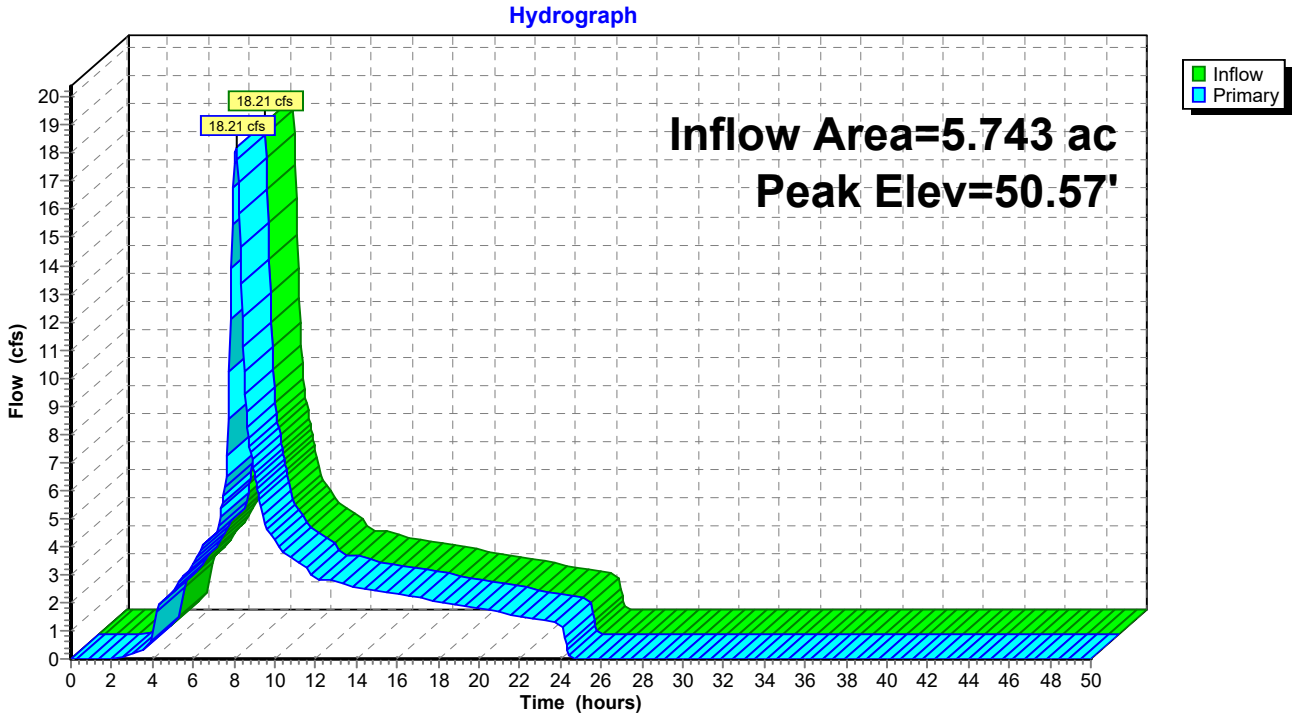
Inflow Area = 5.743 ac, 58.73% Impervious, Inflow Depth = 11.34" for 100-year event
Inflow = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af
Outflow = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af, Atten= 0%, Lag= 0.0 min
Primary = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af
Routed to Pond 7P : Node B

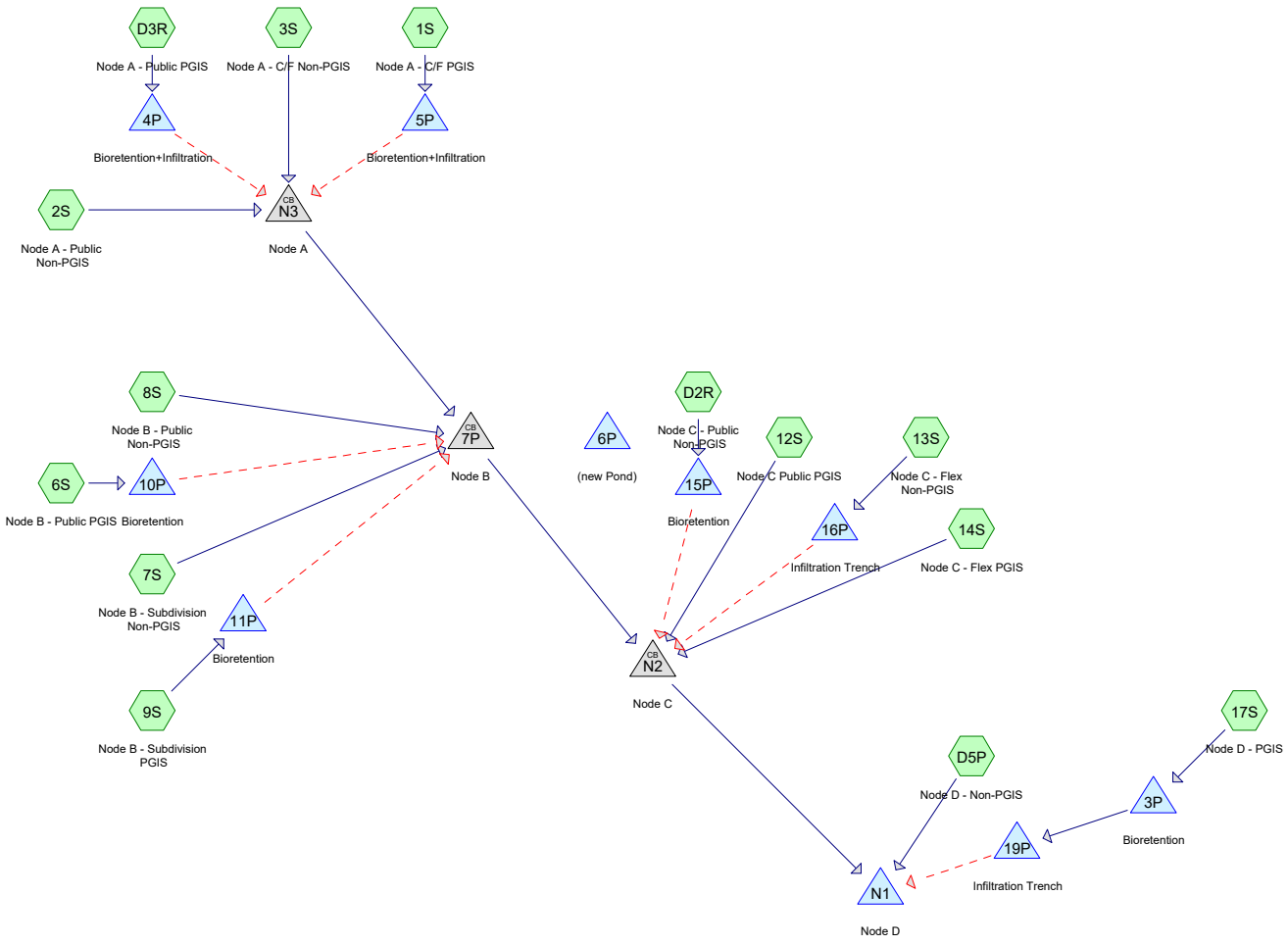
Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 50.57' @ 8.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	41.44'	**24.0" Round Culvert** L= 369.0' Ke= 0.200 Inlet / Outlet Invert= 41.44' / 40.33' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Primary	50.40'	**36.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=17.91 cfs @ 8.09 hrs HW=50.57' TW=49.80' (Fixed TW Elev= 49.80')
1=Culvert (Outlet Controls 9.77 cfs @ 3.11 fps)
2=Sharp-Crested Rectangular Weir (Weir Controls 8.14 cfs @ 1.34 fps)

Pond N3: Node A





Subcat Reach Pond Link

Routing Diagram for ALTERNATE _Onsite 100-Year Storm Flooded and Closed

Prepared by MacKay & Sposito, Inc, Printed 2/10/2025

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
9.462	49	50-75% Grass cover, Fair, HSG A (D5P)
2.370	59	50-75% Grass cover, Fair, HSG A/B (avg) (2S, 3S)
0.306	69	50-75% Grass cover, Fair, HSG B (13S)
0.239	68	<50% Grass cover, Poor, HSG A (D2R)
4.736	79	<50% Grass cover, Poor, HSG B (7S, 8S)
48.663	98	Paved parking, HSG A (6S, 9S, 17S)
11.595	98	Paved parking, HSG B (1S, 12S, 14S, D3R)
4.445	98	Roofs, HSG A (3S, 13S)
22.259	98	Roofs, HSG B (7S, D5P)
104.075	**92**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
65.179	HSG A	2S, 3S, 6S, 9S, 13S, 17S, D2R, D5P
38.896	HSG B	1S, 7S, 8S, 12S, 13S, 14S, D3R, D5P
0.000	HSG C	
0.000	HSG D	
0.000	Other	
104.075		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
11.832	0.306	0.000	0.000	0.000	12.138	50-75% Grass cover, Fair	2S, 3S, 13S, D5P
0.239	4.736	0.000	0.000	0.000	4.975	<50% Grass cover, Poor	7S, 8S, D2R
48.663	11.595	0.000	0.000	0.000	60.258	Paved parking	1S, 6S, 9S, 12S, 14S, 17S, D3R
4.445	22.259	0.000	0.000	0.000	26.704	Roofs	3S, 7S, 13S, D5P
65.179	**38.896**	**0.000**	**0.000**	**0.000**	**104.075**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	7P	40.33	39.19	379.7	0.0030	0.012	0.0	24.0	0.0	
2	N2	39.19	37.96	410.7	0.0030	0.012	0.0	30.0	0.0	
3	N3	41.44	40.33	369.0	0.0030	0.012	0.0	24.0	0.0	

Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Node A - C/F PGIS Runoff Area=7.516 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=10.54 cfs 3.734 af

Subcatchment2S: Node A - Public Non-PGIS Runoff Area=1.160 ac 0.00% Impervious Runoff Depth=1.97"
Tc=20.0 min CN=59 Runoff=0.38 cfs 0.190 af

Subcatchment3S: Node A - C/F Non-PGIS Runoff Area=4.583 ac 73.60% Impervious Runoff Depth=4.82"
Tc=20.0 min CN=88 Runoff=5.43 cfs 1.840 af

Subcatchment6S: Node B - Public PGIS Runoff Area=0.250 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=0.35 cfs 0.124 af

Subcatchment7S: Node B - Subdivision Runoff Area=6.745 ac 31.13% Impervious Runoff Depth=4.49"
Tc=20.0 min CN=85 Runoff=7.39 cfs 2.525 af

Subcatchment8S: Node B - Public Non-PGIS Runoff Area=0.091 ac 0.00% Impervious Runoff Depth=3.86"
Tc=20.0 min CN=79 Runoff=0.08 cfs 0.029 af

Subcatchment9S: Node B - Subdivision Runoff Area=2.176 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=3.05 cfs 1.081 af

Subcatchment12S: Node C Public PGIS Runoff Area=0.710 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=1.00 cfs 0.353 af

Subcatchment13S: Node C - Flex Non-PGIS Runoff Area=1.378 ac 77.79% Impervious Runoff Depth=5.27"
Tc=20.0 min CN=92 Runoff=1.78 cfs 0.605 af

Subcatchment14S: Node C - Flex PGIS Runoff Area=1.685 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=2.36 cfs 0.837 af

Subcatchment17S: Node D - PGIS Runoff Area=46.237 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=64.81 cfs 22.971 af

SubcatchmentD2R: Node C - Public Runoff Area=0.239 ac 0.00% Impervious Runoff Depth=2.78"
Tc=20.0 min CN=68 Runoff=0.14 cfs 0.055 af

SubcatchmentD3R: Node A - Public PGIS Runoff Area=1.684 ac 100.00% Impervious Runoff Depth=5.96"
Tc=20.0 min CN=98 Runoff=2.36 cfs 0.837 af

SubcatchmentD5P: Node D - Non-PGIS Runoff Area=29.621 ac 68.06% Impervious Runoff Depth=4.17"
Tc=20.0 min CN=82 Runoff=29.72 cfs 10.297 af

Pond 3P: Bioretention Peak Elev=54.89' Storage=3.301 af Inflow=64.81 cfs 22.971 af
Outflow=40.37 cfs 22.657 af

Pond 4P: Bioretention+Infiltration Peak Elev=3.84' Storage=0.039 af Inflow=2.36 cfs 0.837 af
Primary=0.15 cfs 0.283 af Secondary=2.20 cfs 0.554 af Outflow=2.35 cfs 0.837 af

Pond 5P: Bioretention+Infiltration Peak Elev=5.04' Storage=0.241 af Inflow=10.54 cfs 3.734 af
Primary=0.36 cfs 0.890 af Secondary=10.21 cfs 2.844 af Outflow=10.57 cfs 3.734 af

Pond 6P: (new Pond)

Pond 7P: Node B Peak Elev=49.80' Inflow=28.83 cfs 8.778 af
Outflow=28.83 cfs 8.778 af

Pond 10P: Bioretention Peak Elev=3.28' Storage=0.005 af Inflow=0.35 cfs 0.124 af
Primary=0.02 cfs 0.046 af Secondary=0.33 cfs 0.078 af Outflow=0.35 cfs 0.124 af

Pond 11P: Bioretention Peak Elev=5.06' Storage=0.055 af Inflow=3.05 cfs 1.081 af
Primary=0.19 cfs 0.364 af Secondary=2.82 cfs 0.717 af Outflow=3.02 cfs 1.081 af

Pond 15P: Bioretention Peak Elev=1.52' Storage=0.007 af Inflow=0.14 cfs 0.055 af
Primary=0.05 cfs 0.055 af Secondary=0.00 cfs 0.000 af Outflow=0.05 cfs 0.055 af

Pond 16P: Infiltration Trench Peak Elev=4.70' Storage=0.045 af Inflow=1.78 cfs 0.605 af
Primary=0.09 cfs 0.193 af Secondary=1.68 cfs 0.411 af Outflow=1.77 cfs 0.605 af

Pond 19P: Infiltration Trench Peak Elev=4.09' Storage=2.393 af Inflow=40.37 cfs 22.657 af
Primary=3.58 cfs 8.734 af Secondary=34.89 cfs 13.923 af Outflow=38.47 cfs 22.657 af

Pond N1: Node D Peak Elev=48.85' Storage=142,568 cf Inflow=84.32 cfs 34.599 af
Outflow=64.36 cfs 34.599 af

Pond N2: Node C Peak Elev=49.14' Inflow=33.86 cfs 10.379 af
Outflow=33.86 cfs 10.379 af

Pond N3: Node A Peak Elev=50.57' Inflow=18.21 cfs 5.428 af
Outflow=18.21 cfs 5.428 af

Total Runoff Area = 104.075 ac Runoff Volume = 45.478 af Average Runoff Depth = 5.24"
16.44% Pervious = 17.113 ac 83.56% Impervious = 86.962 ac

Summary for Subcatchment 1S: Node A - C/F PGIS

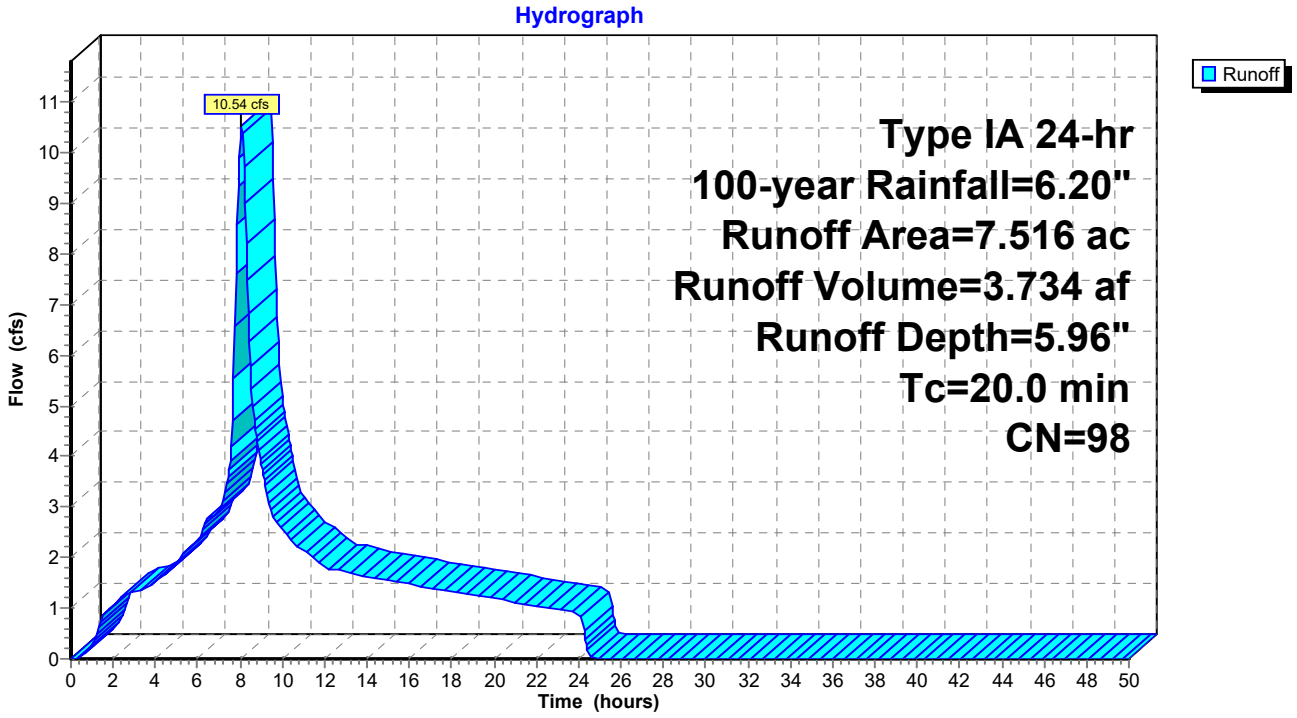
Runoff = 10.54 cfs @ 8.08 hrs, Volume= 3.734 af, Depth= 5.96"
Routed to Pond 5P : Bioretention+Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
7.516	98	Paved parking, HSG B
7.516		100.00% Impervious Area

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

Subcatchment 1S: Node A - C/F PGIS



Summary for Subcatchment 2S: Node A - Public Non-PGIS

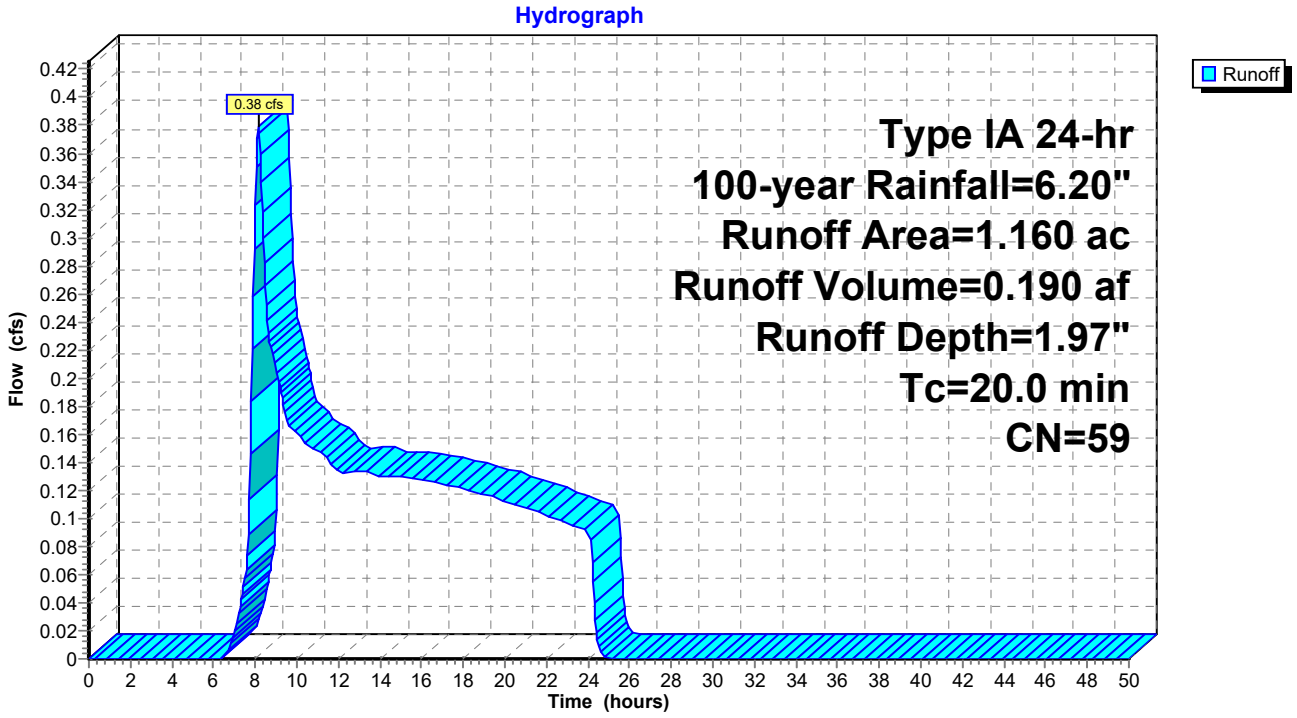
Runoff = 0.38 cfs @ 8.16 hrs, Volume= 0.190 af, Depth= 1.97"
Routed to Pond N3 : Node A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

	Area (ac)	CN	Description
*	1.160	59	50-75% Grass cover, Fair, HSG A/B (avg)
	1.160		100.00% Pervious Area

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

Subcatchment 2S: Node A - Public Non-PGIS



Summary for Subcatchment 3S: Node A - C/F Non-PGIS

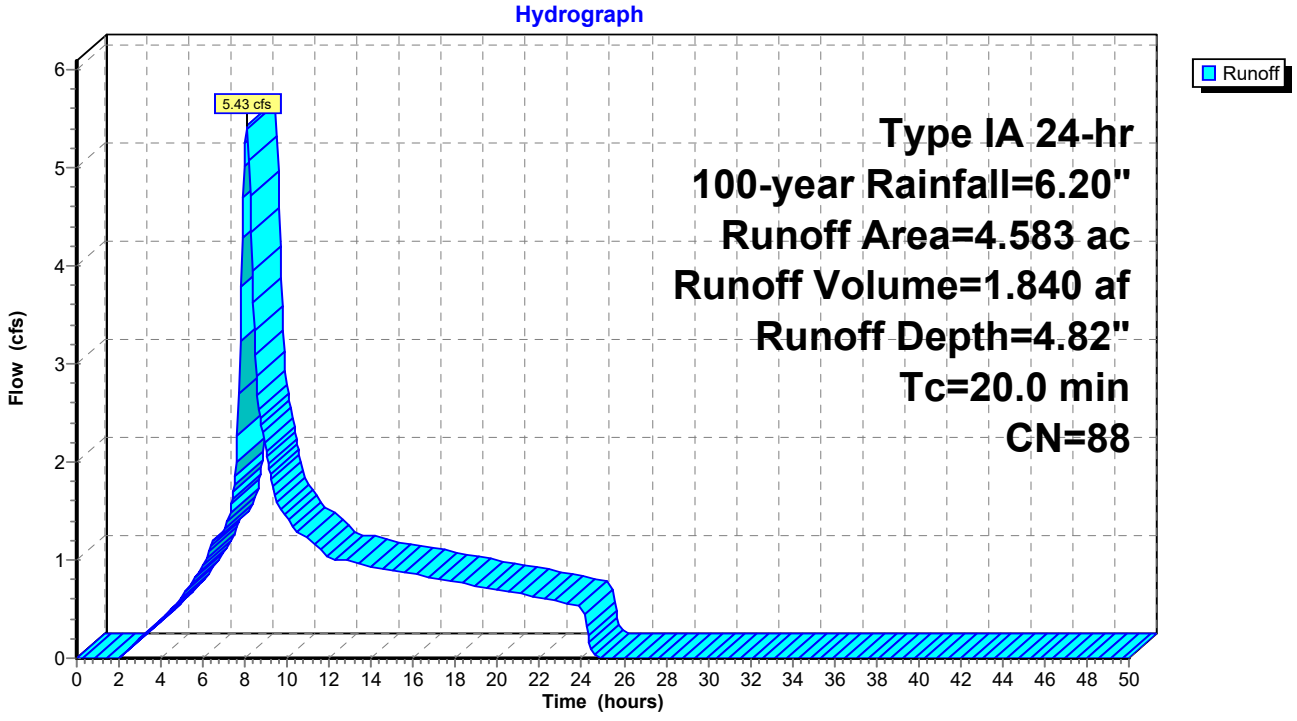
Runoff = 5.43 cfs @ 8.09 hrs, Volume= 1.840 af, Depth= 4.82"
Routed to Pond N3 : Node A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

	Area (ac)	CN	Description
*	1.210	59	50-75% Grass cover, Fair, HSG A/B (avg)
	3.373	98	Roofs, HSG A
	4.583	88	Weighted Average
	1.210		26.40% Pervious Area
	3.373		73.60% Impervious Area

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

Subcatchment 3S: Node A - C/F Non-PGIS



Summary for Subcatchment 6S: Node B - Public PGIS

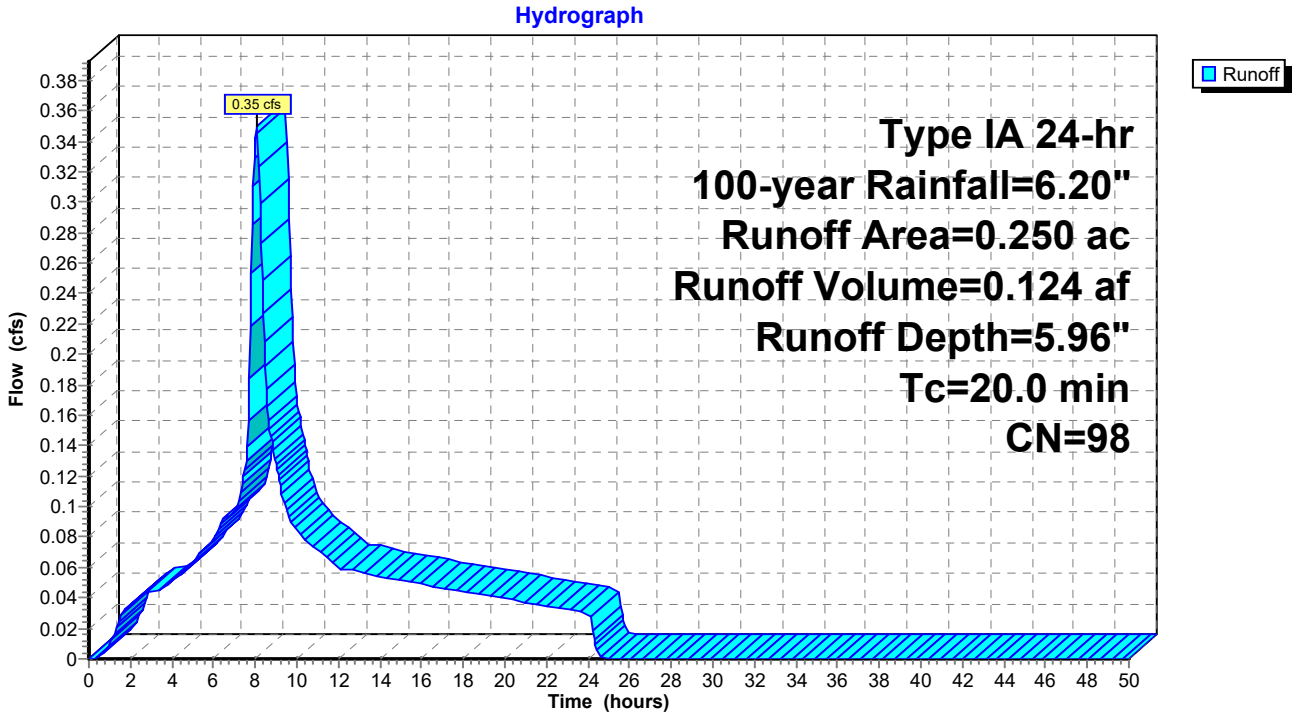
Runoff = 0.35 cfs @ 8.08 hrs, Volume= 0.124 af, Depth= 5.96"
Routed to Pond 10P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.250	98	Paved parking, HSG A
0.250		100.00% Impervious Area

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

Subcatchment 6S: Node B - Public PGIS



Summary for Subcatchment 7S: Node B - Subdivision Non-PGIS

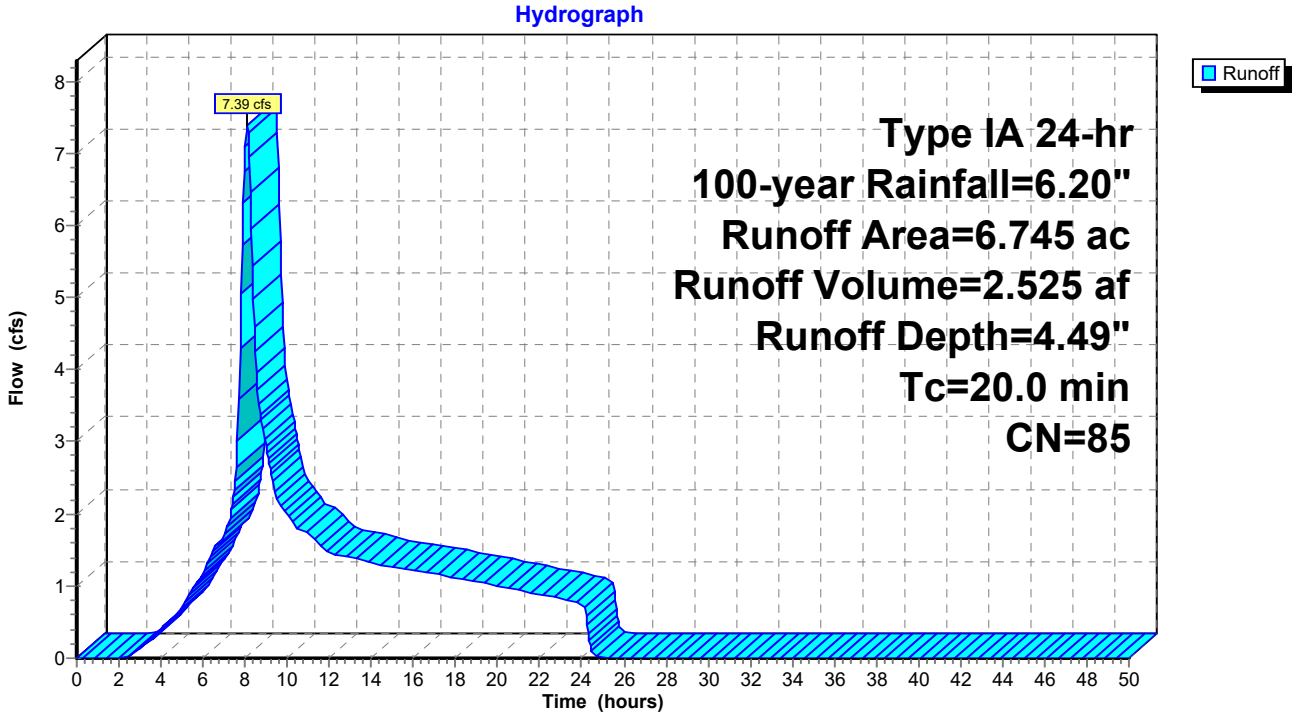
Runoff = 7.39 cfs @ 8.09 hrs, Volume= 2.525 af, Depth= 4.49"
Routed to Pond 7P : Node B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
2.100	98	Roofs, HSG B
4.645	79	<50% Grass cover, Poor, HSG B
6.745	85	Weighted Average
4.645		68.87% Pervious Area
2.100		31.13% Impervious Area

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

Subcatchment 7S: Node B - Subdivision Non-PGIS



Summary for Subcatchment 8S: Node B - Public Non-PGIS

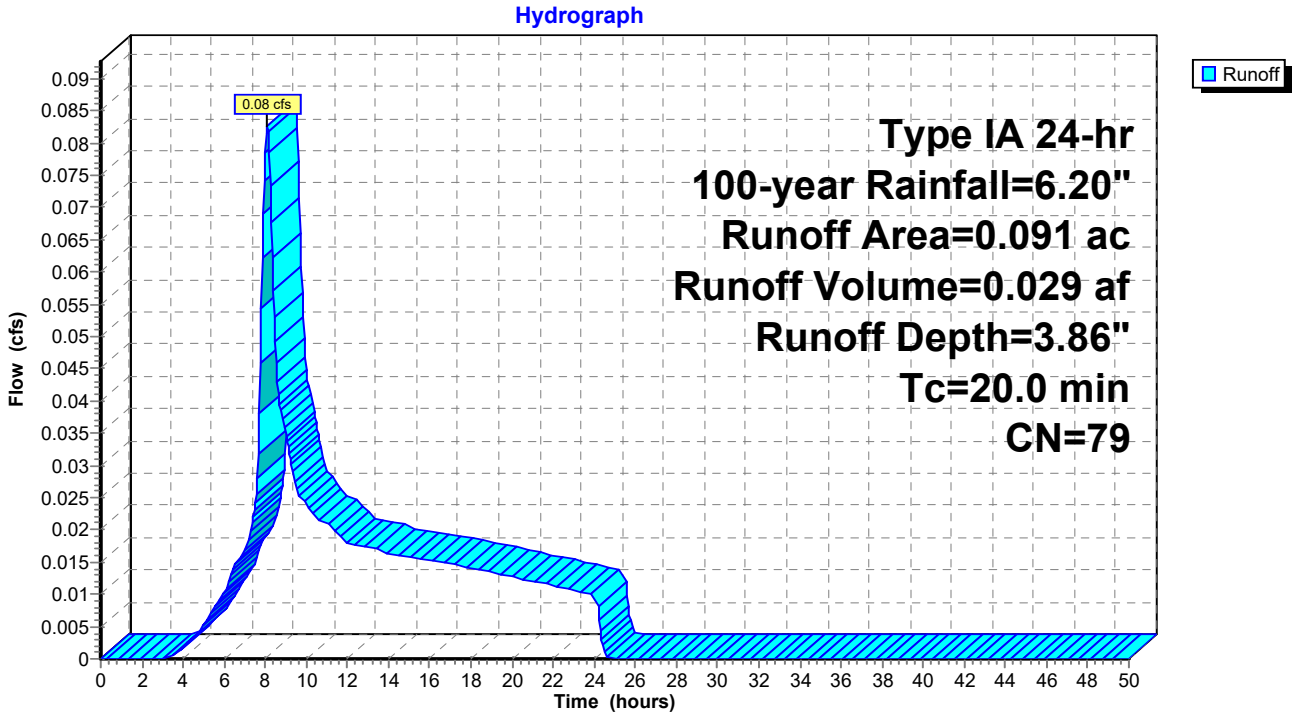
Runoff = 0.08 cfs @ 8.11 hrs, Volume= 0.029 af, Depth= 3.86"
Routed to Pond 7P : Node B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.091	79	<50% Grass cover, Poor, HSG B
0.091		100.00% Pervious Area

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

Subcatchment 8S: Node B - Public Non-PGIS



Summary for Subcatchment 9S: Node B - Subdivision PGIS

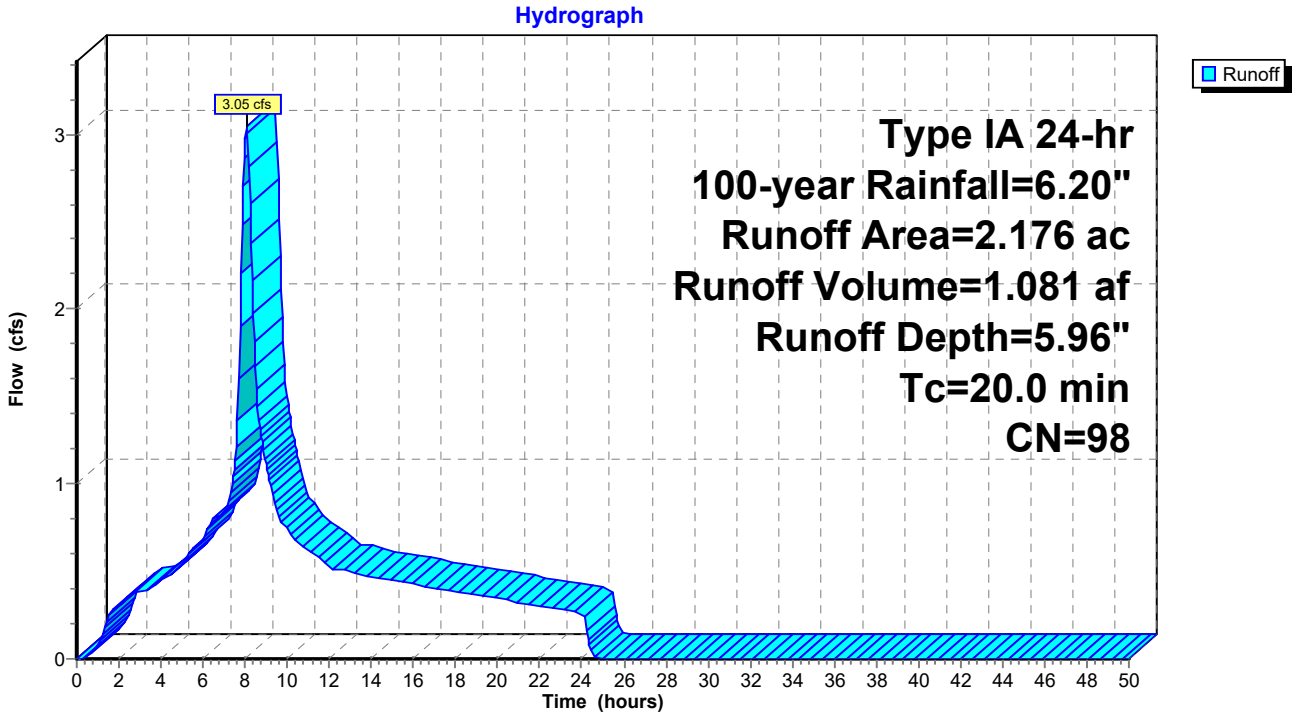
Runoff = 3.05 cfs @ 8.08 hrs, Volume= 1.081 af, Depth= 5.96"
Routed to Pond 11P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
2.176	98	Paved parking, HSG A
2.176		100.00% Impervious Area

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

Subcatchment 9S: Node B - Subdivision PGIS



Summary for Subcatchment 12S: Node C Public PGIS

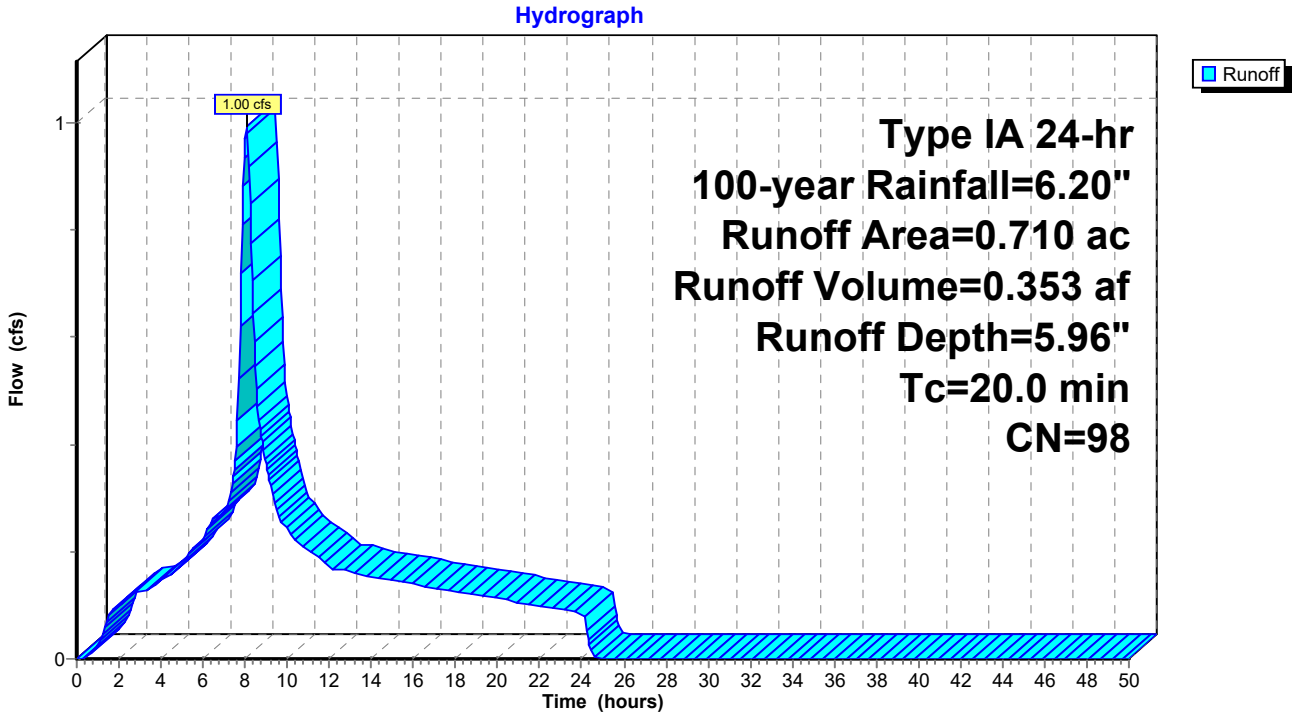
Runoff = 1.00 cfs @ 8.08 hrs, Volume= 0.353 af, Depth= 5.96"
Routed to Pond N2 : Node C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.710	98	Paved parking, HSG B
0.710		100.00% Impervious Area

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

Subcatchment 12S: Node C Public PGIS



Summary for Subcatchment 13S: Node C - Flex Non-PGIS

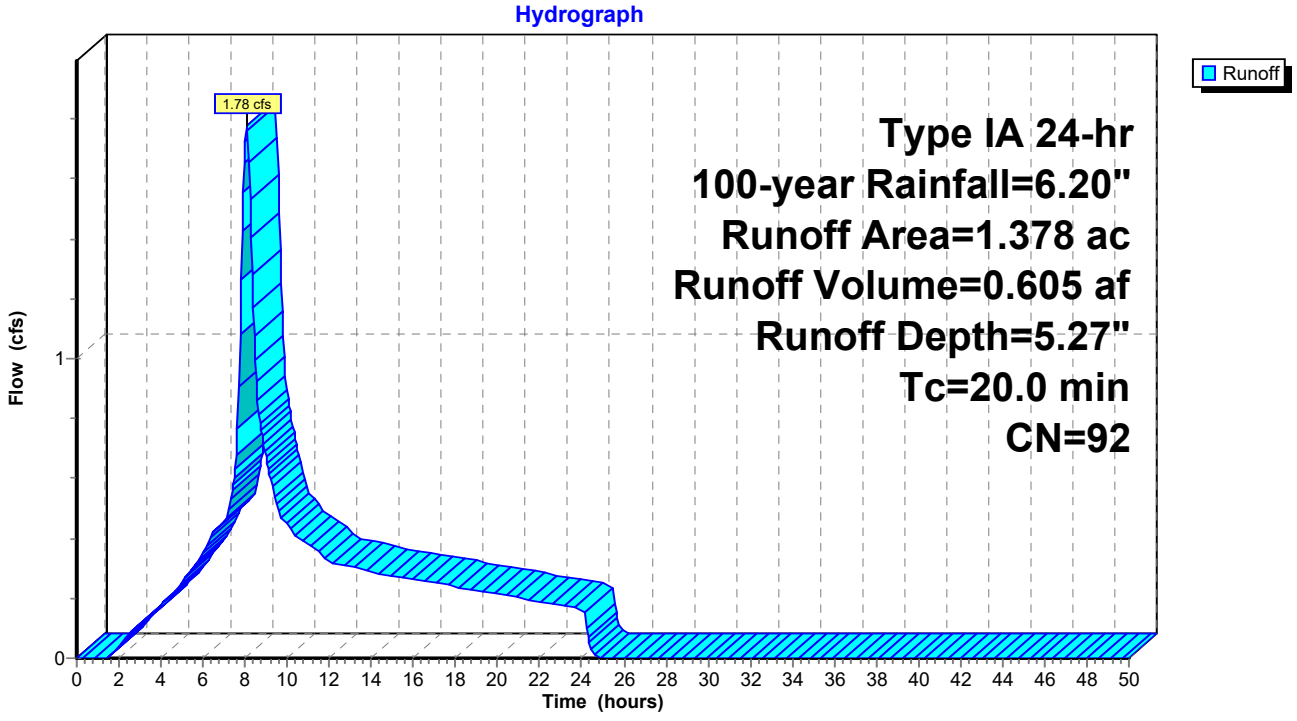
Runoff = 1.78 cfs @ 8.08 hrs, Volume= 0.605 af, Depth= 5.27"
Routed to Pond 16P : Infiltration Trench

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.306	69	50-75% Grass cover, Fair, HSG B
1.072	98	Roofs, HSG A
1.378	92	Weighted Average
0.306		22.21% Pervious Area
1.072		77.79% Impervious Area

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

Subcatchment 13S: Node C - Flex Non-PGIS



Summary for Subcatchment 14S: Node C - Flex PGIS

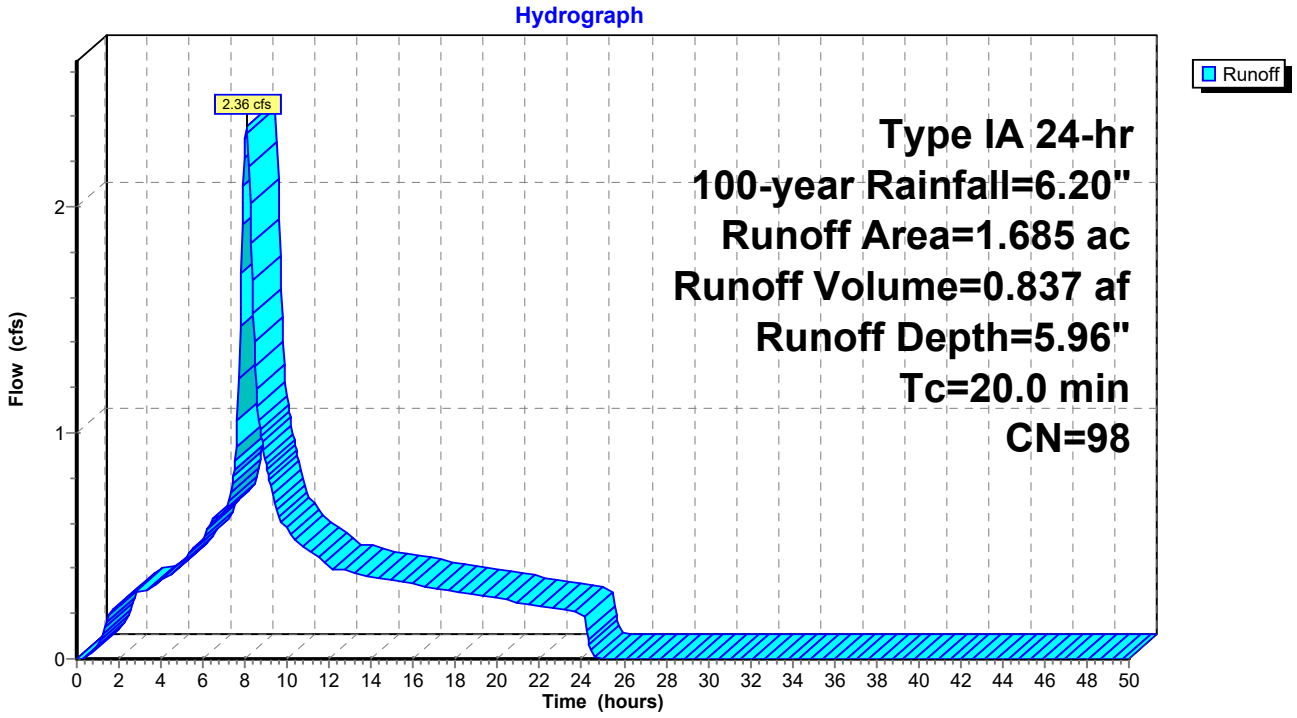
Runoff = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af, Depth= 5.96"
Routed to Pond N2 : Node C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
1.685	98	Paved parking, HSG B
1.685		100.00% Impervious Area

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

Subcatchment 14S: Node C - Flex PGIS



Summary for Subcatchment 17S: Node D - PGIS

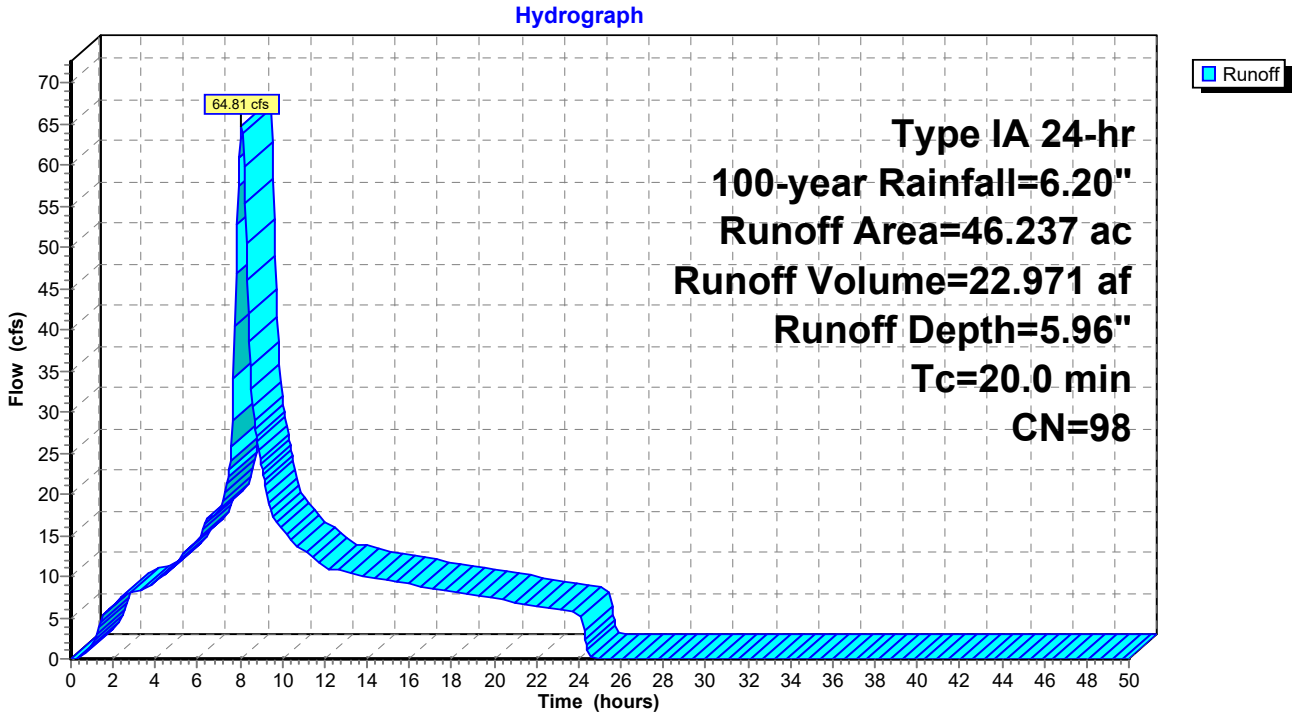
Runoff = 64.81 cfs @ 8.08 hrs, Volume= 22.971 af, Depth= 5.96"
Routed to Pond 3P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
46.237	98	Paved parking, HSG A
46.237		100.00% Impervious Area

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

Subcatchment 17S: Node D - PGIS



Summary for Subcatchment D2R: Node C - Public Non-PGIS

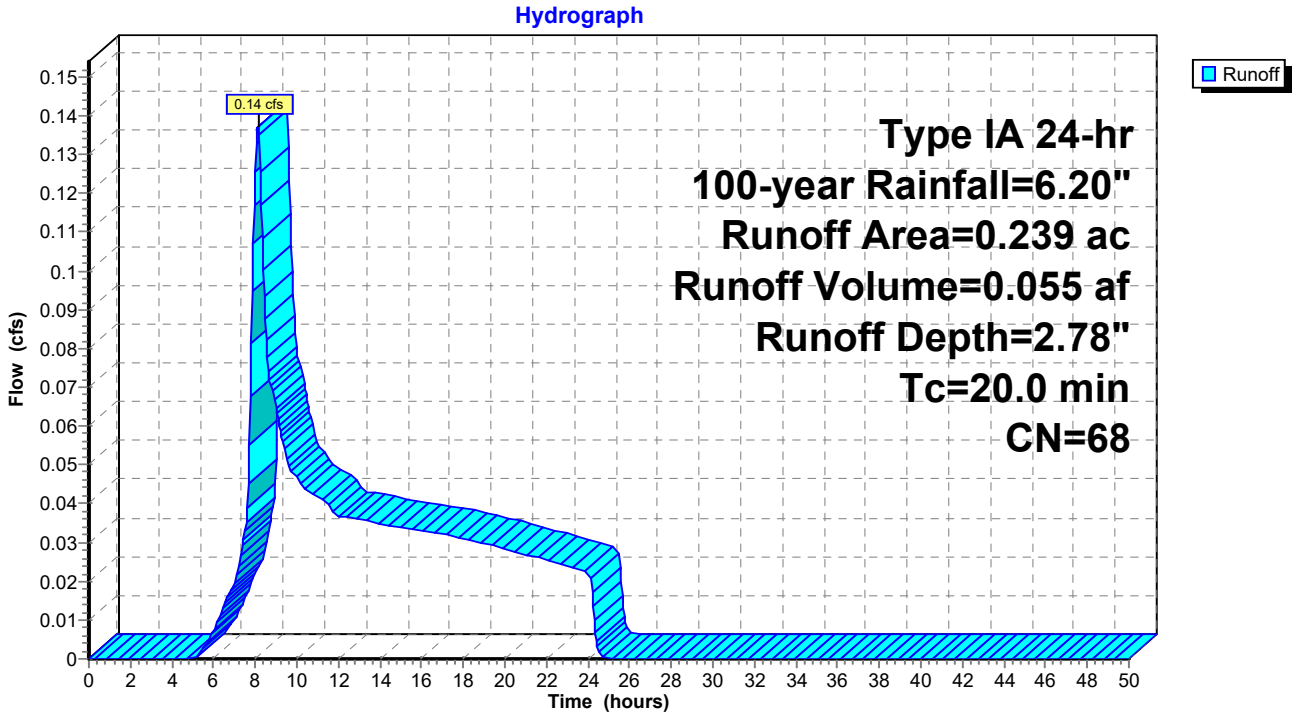
Runoff = 0.14 cfs @ 8.13 hrs, Volume= 0.055 af, Depth= 2.78"
Routed to Pond 15P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
0.239	68	<50% Grass cover, Poor, HSG A
0.239		100.00% Pervious Area

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

Subcatchment D2R: Node C - Public Non-PGIS



Summary for Subcatchment D3R: Node A - Public PGIS

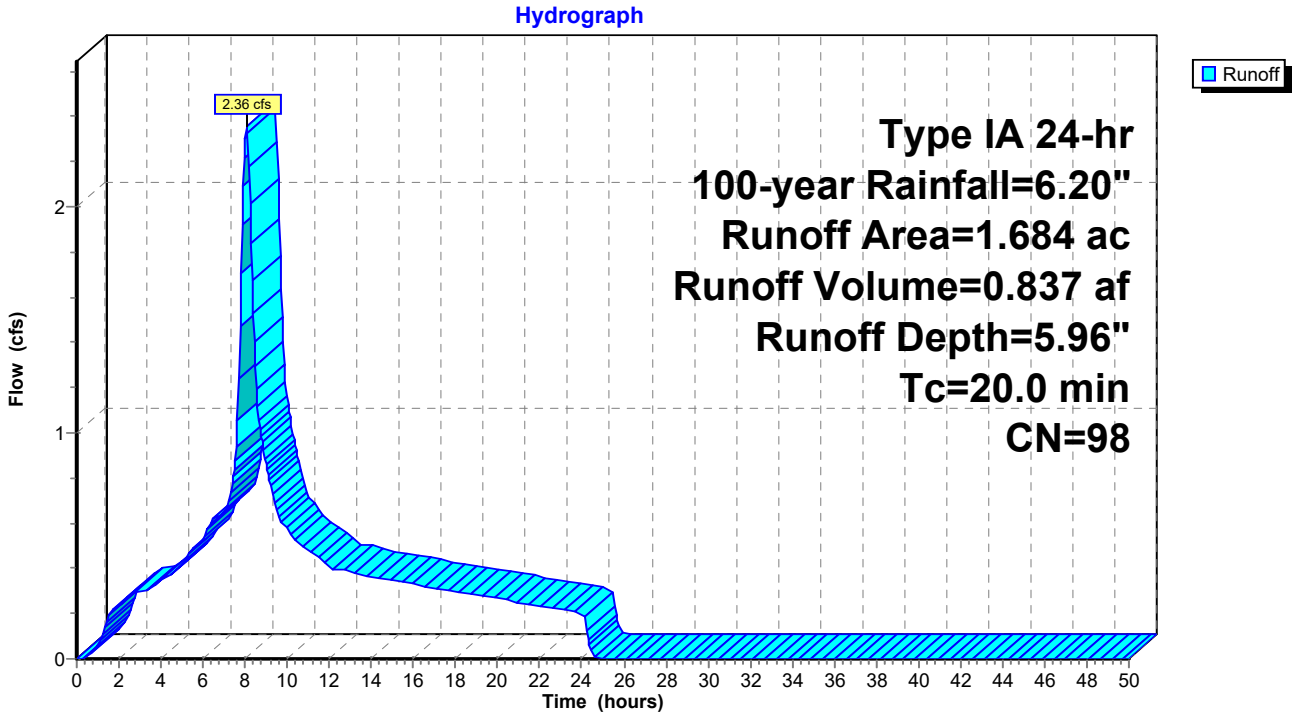
Runoff = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af, Depth= 5.96"
Routed to Pond 4P : Bioretention+Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
1.684	98	Paved parking, HSG B
1.684		100.00% Impervious Area

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

Subcatchment D3R: Node A - Public PGIS



Summary for Subcatchment D5P: Node D - Non-PGIS

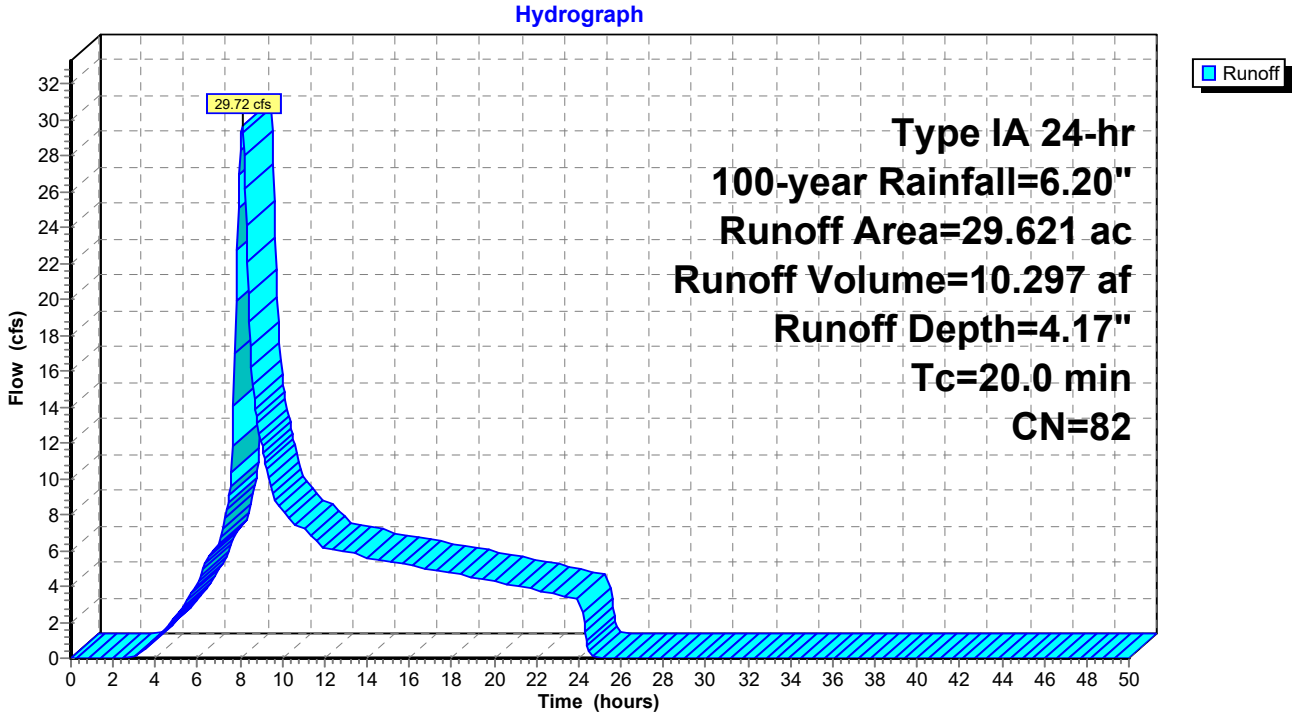
Runoff = 29.72 cfs @ 8.10 hrs, Volume= 10.297 af, Depth= 4.17"
Routed to Pond N1 : Node D

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

Area (ac)	CN	Description
9.462	49	50-75% Grass cover, Fair, HSG A
20.159	98	Roofs, HSG B
29.621	82	Weighted Average
9.462		31.94% Pervious Area
20.159		68.06% Impervious Area

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

Subcatchment D5P: Node D - Non-PGIS



Summary for Pond 3P: Bioretention

Inflow Area = 46.237 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 64.81 cfs @ 8.08 hrs, Volume= 22.971 af
Outflow = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af, Atten= 38%, Lag= 20.8 min
Primary = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af
Routed to Pond 19P : Infiltration Trench

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 54.89' @ 8.42 hrs Surf.Area= 1.674 ac Storage= 3.301 af

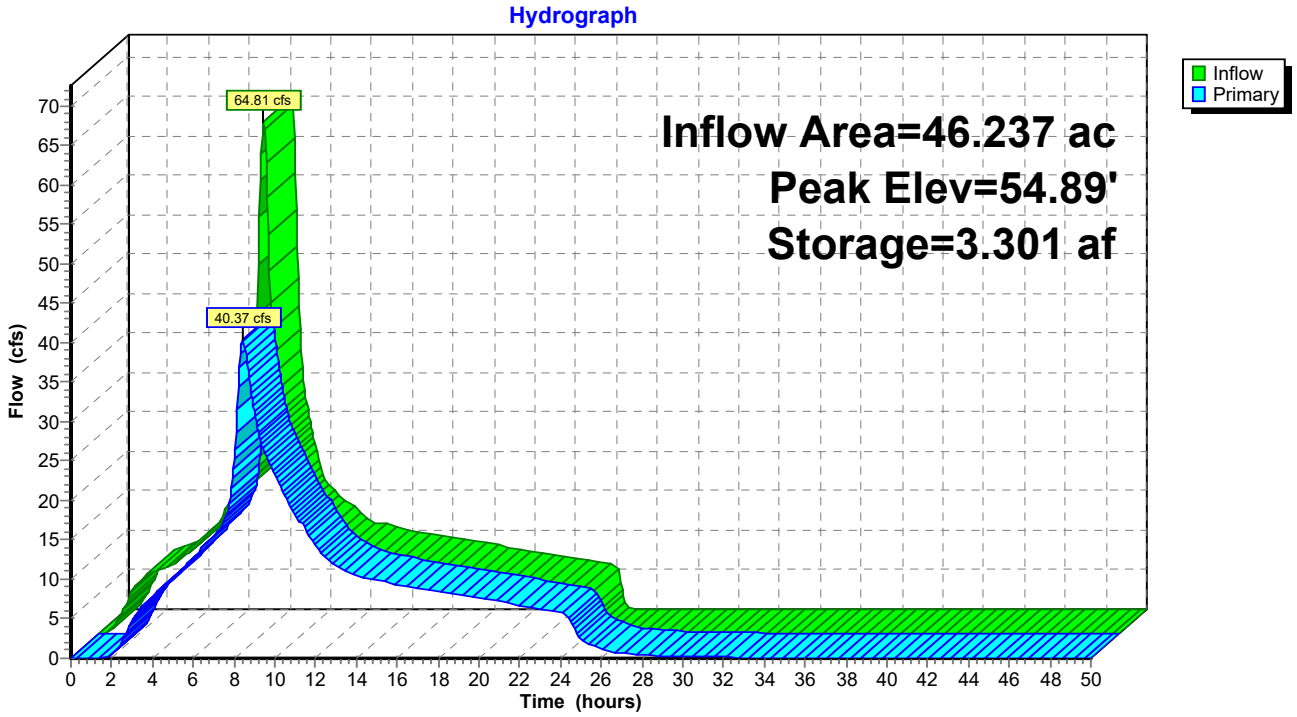
Plug-Flow detention time= 83.2 min calculated for 22.657 af (99% of inflow)
Center-of-Mass det. time= 72.4 min (736.4 - 664.0)

Volume	Invert	Avail.Storage	Storage Description
#1	50.00'	2.629 af	**270.00'W x 270.00'L x 6.50'H Prismatoid** 10.878 af Overall - 3.367 af Embedded = 7.512 af x 35.0% Voids
#2	54.50'	3.347 af	**270.00'W x 270.00'L x 2.00'H Prismatoid** Inside #1
#3	50.50'	0.019 af	**24.0" Round Pipe Storage** Inside #1 L= 269.0'
		5.996 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	54.50'	**60.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	50.50'	**24.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=40.28 cfs @ 8.42 hrs HW=54.89' (Free Discharge)
└─**1=Orifice/Grate** (Weir Controls 12.44 cfs @ 2.04 fps)
└─**2=Orifice/Grate** (Orifice Controls 27.85 cfs @ 8.86 fps)

Pond 3P: Bioretention



Summary for Pond 4P: Bioretention+Infiltration

Inflow Area = 1.684 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 2.36 cfs @ 8.08 hrs, Volume= 0.837 af
Outflow = 2.35 cfs @ 8.11 hrs, Volume= 0.837 af, Atten= 1%, Lag= 1.8 min
Primary = 0.15 cfs @ 8.11 hrs, Volume= 0.283 af
Secondary = 2.20 cfs @ 8.11 hrs, Volume= 0.554 af
Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 3.84' @ 8.11 hrs Surf.Area= 0.029 ac Storage= 0.039 af

Plug-Flow detention time= 55.2 min calculated for 0.836 af (100% of inflow)
Center-of-Mass det. time= 55.4 min (719.4 - 664.0)

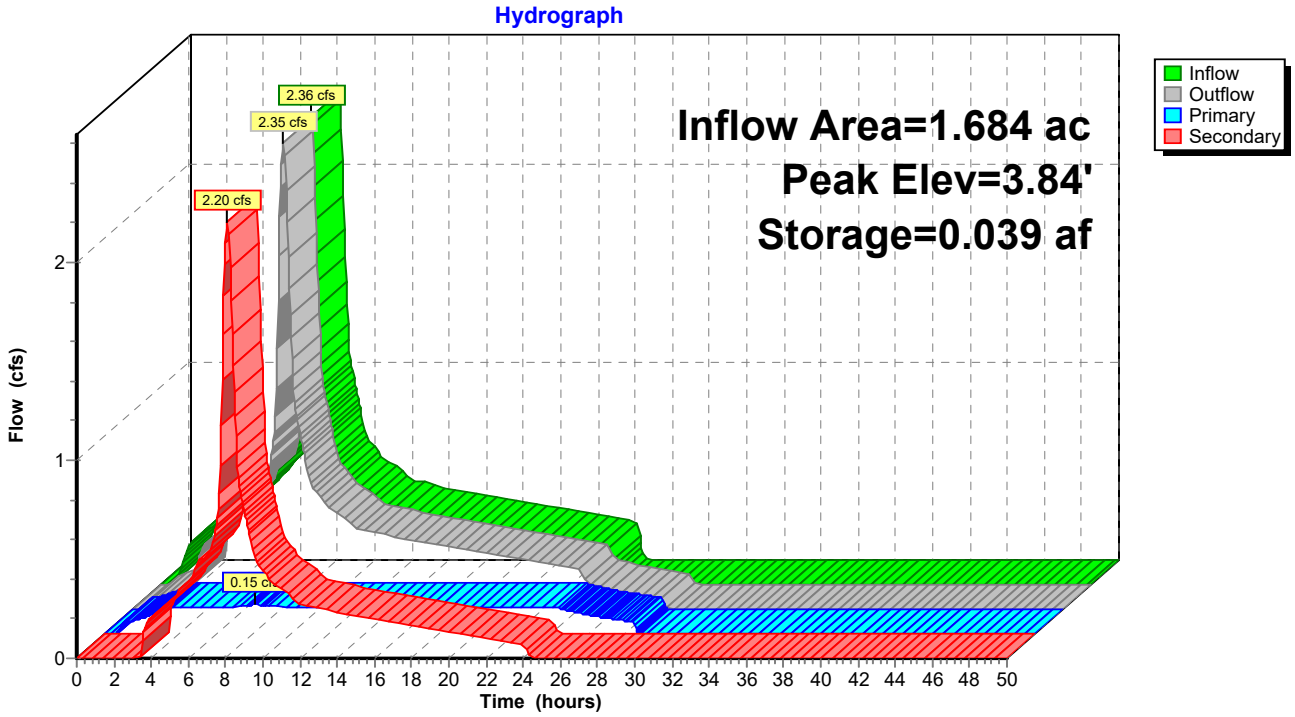
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.050 af	**5.00'W x 250.00'L x 5.00'H Bioretention** 0.143 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.15 cfs @ 8.11 hrs HW=3.84' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.15 cfs)

Secondary OutFlow Max=2.20 cfs @ 8.11 hrs HW=3.84' (Free Discharge)
2=Orifice/Grate (Orifice Controls 2.20 cfs @ 3.12 fps)

Pond 4P: Bioretention+Infiltration



Summary for Pond 5P: Bioretention+Infiltration

[93] Warning: Storage range exceeded by 0.04'
[88] Warning: Qout>Qin may require smaller dt or Finer Routing

Inflow Area = 7.516 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 10.54 cfs @ 8.08 hrs, Volume= 3.734 af
Outflow = 10.57 cfs @ 8.09 hrs, Volume= 3.734 af, Atten= 0%, Lag= 0.5 min
Primary = 0.36 cfs @ 7.95 hrs, Volume= 0.890 af
Secondary = 10.21 cfs @ 8.09 hrs, Volume= 2.844 af
Routed to Pond N3 : Node A

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 5.04' @ 8.09 hrs Surf.Area= 0.138 ac Storage= 0.241 af

Plug-Flow detention time= 91.6 min calculated for 3.730 af (100% of inflow)
Center-of-Mass det. time= 92.0 min (756.0 - 664.0)

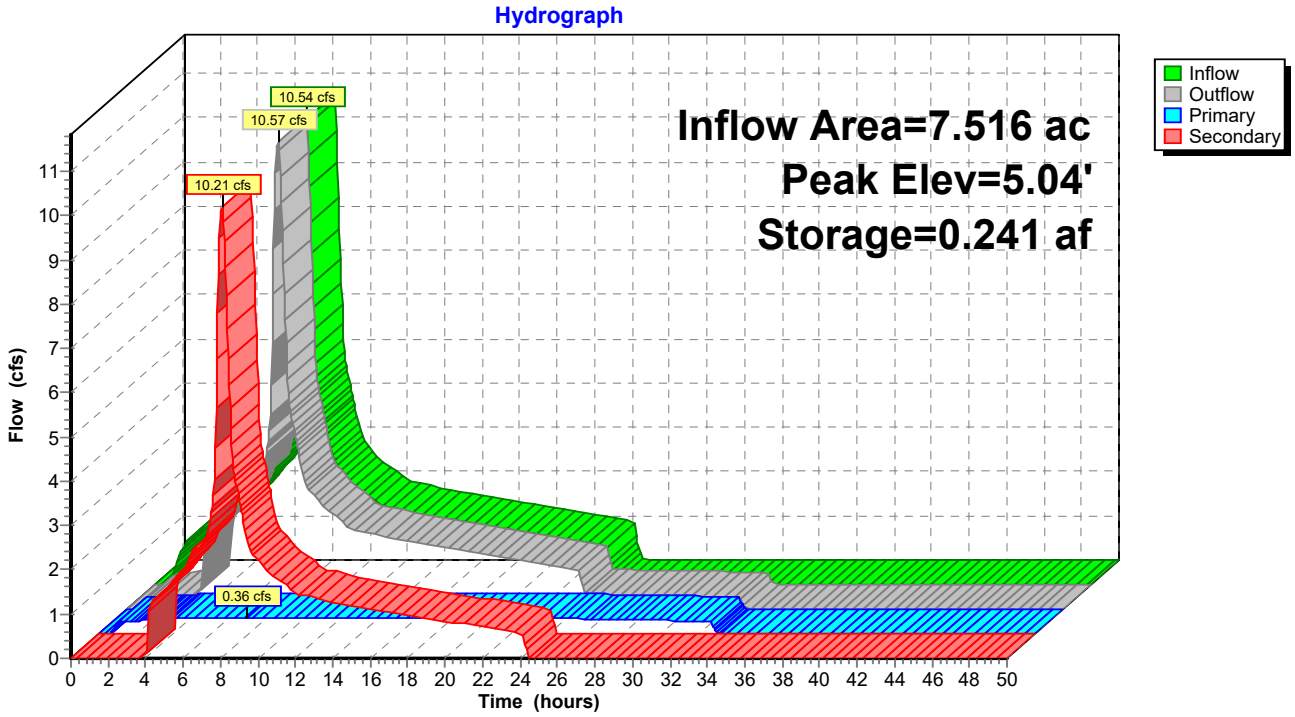
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.241 af	**50.00'W x 120.00'L x 5.00'H Infiltration Trench** 0.689 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.50'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.36 cfs @ 7.95 hrs HW=5.01' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.36 cfs)

Secondary OutFlow Max=10.16 cfs @ 8.09 hrs HW=5.04' (Free Discharge)
└**2=Orifice/Grate** (Weir Controls 10.16 cfs @ 2.40 fps)

Pond 5P: Bioretention+Infiltration



Summary for Pond 6P: (new Pond)

[40] Hint: Not Described (Outflow=Inflow)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' TW=0.00' (Free Discharge)

Summary for Pond 7P: Node B

[57] Hint: Peaked at 49.80' (Flood elevation advised)
[81] Warning: Exceeded Pond 10P by 49.14' @ 31.35 hrs
[81] Warning: Exceeded Pond 11P by 49.14' @ 33.05 hrs
[79] Warning: Submerged Pond N3 Primary device # 1 INLET by 8.36'

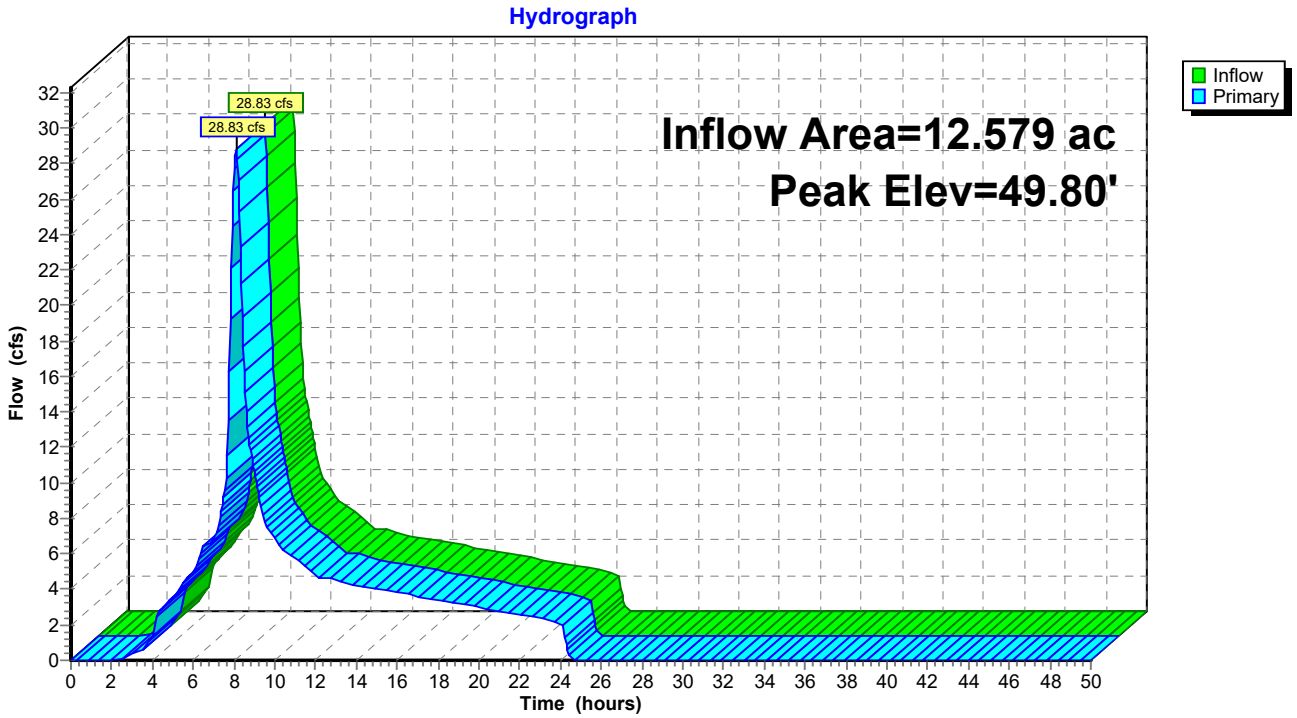
Inflow Area = 12.579 ac, 43.51% Impervious, Inflow Depth = 8.37" for 100-year event
Inflow = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af
Outflow = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af, Atten= 0%, Lag= 0.0 min
Primary = 28.83 cfs @ 8.09 hrs, Volume= 8.778 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 49.80' @ 8.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	40.33'	**24.0" Round Culvert** L= 379.7' Ke= 0.200 Inlet / Outlet Invert= 40.33' / 39.19' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Primary	49.50'	**36.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=28.67 cfs @ 8.09 hrs HW=49.80' TW=49.14' (Fixed TW Elev= 49.14')
1=Culvert (Outlet Controls 8.98 cfs @ 2.86 fps)
2=Sharp-Crested Rectangular Weir (Weir Controls 19.69 cfs @ 1.80 fps)

Pond 7P: Node B



Summary for Pond 10P: Bioretention

Inflow Area = 0.250 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 0.35 cfs @ 8.08 hrs, Volume= 0.124 af
Outflow = 0.35 cfs @ 8.09 hrs, Volume= 0.124 af, Atten= 0%, Lag= 0.5 min
Primary = 0.02 cfs @ 8.09 hrs, Volume= 0.046 af
Secondary = 0.33 cfs @ 8.09 hrs, Volume= 0.078 af
Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 3.28' @ 8.09 hrs Surf.Area= 0.005 ac Storage= 0.005 af

Plug-Flow detention time= 56.2 min calculated for 0.124 af (100% of inflow)
Center-of-Mass det. time= 56.3 min (720.4 - 664.0)

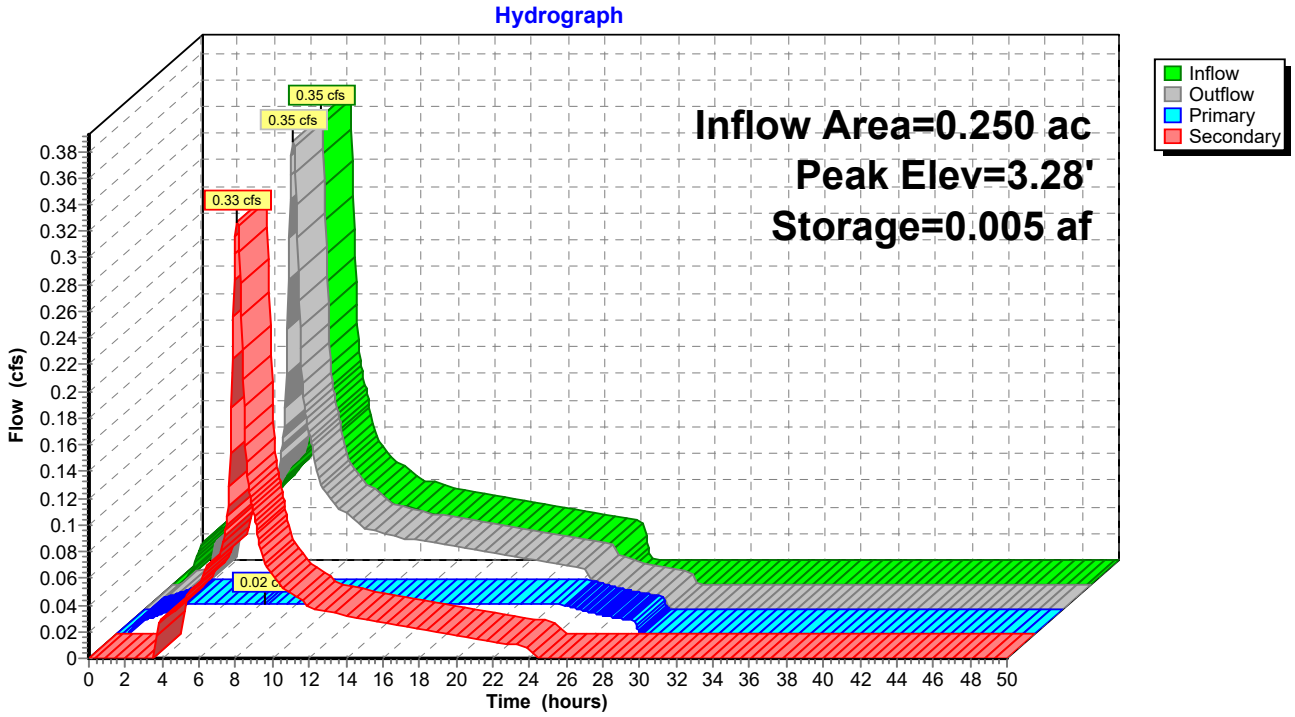
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.008 af	**5.00'W x 40.00'L x 5.00'H Bioretention** 0.023 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.02 cfs @ 8.09 hrs HW=3.28' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Secondary OutFlow Max=0.32 cfs @ 8.09 hrs HW=3.28' (Free Discharge)
↑**2=Orifice/Grate** (Orifice Controls 0.32 cfs @ 1.80 fps)

Pond 10P: Bioretention



Summary for Pond 11P: Bioretention

Inflow Area = 2.176 ac,100.00% Impervious, Inflow Depth = 5.96" for 100-year event
Inflow = 3.05 cfs @ 8.08 hrs, Volume= 1.081 af
Outflow = 3.02 cfs @ 8.12 hrs, Volume= 1.081 af, Atten= 1%, Lag= 2.8 min
Primary = 0.19 cfs @ 8.12 hrs, Volume= 0.364 af
Secondary = 2.82 cfs @ 8.12 hrs, Volume= 0.717 af
Routed to Pond 7P : Node B

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 5.06' @ 8.12 hrs Surf.Area= 0.031 ac Storage= 0.055 af

Plug-Flow detention time= 61.6 min calculated for 1.080 af (100% of inflow)
Center-of-Mass det. time= 61.8 min (725.8 - 664.0)

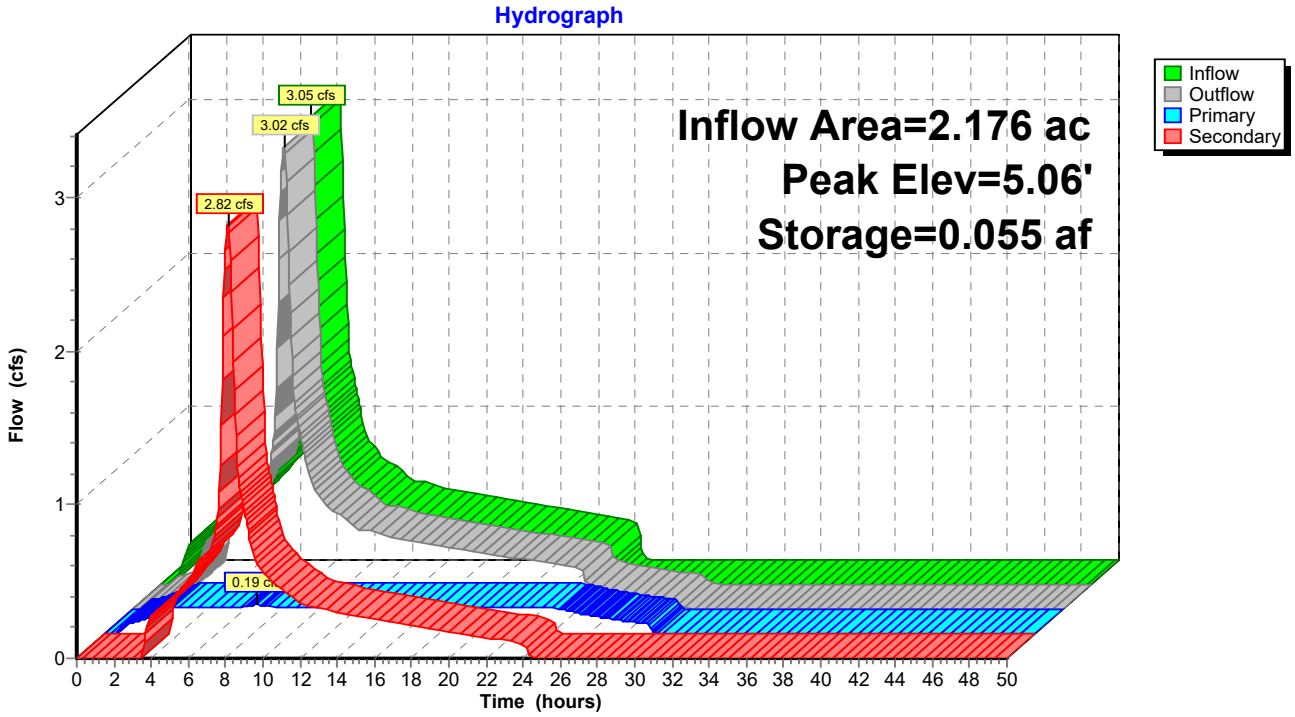
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.065 af	**5.00'W x 270.00'L x 6.00'H Bioretention** 0.186 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.19 cfs @ 8.12 hrs HW=5.06' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.19 cfs)

Secondary OutFlow Max=2.82 cfs @ 8.12 hrs HW=5.06' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 2.82 cfs @ 3.59 fps)

Pond 11P: Bioretention



Summary for Pond 15P: Bioretention

Inflow Area = 0.239 ac, 0.00% Impervious, Inflow Depth = 2.78" for 100-year event
Inflow = 0.14 cfs @ 8.13 hrs, Volume= 0.055 af
Outflow = 0.05 cfs @ 10.22 hrs, Volume= 0.055 af, Atten= 67%, Lag= 125.5 min
Primary = 0.05 cfs @ 10.22 hrs, Volume= 0.055 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 1.52' @ 10.22 hrs Surf.Area= 0.014 ac Storage= 0.007 af

Plug-Flow detention time= 77.6 min calculated for 0.055 af (100% of inflow)
Center-of-Mass det. time= 77.5 min (908.4 - 830.8)

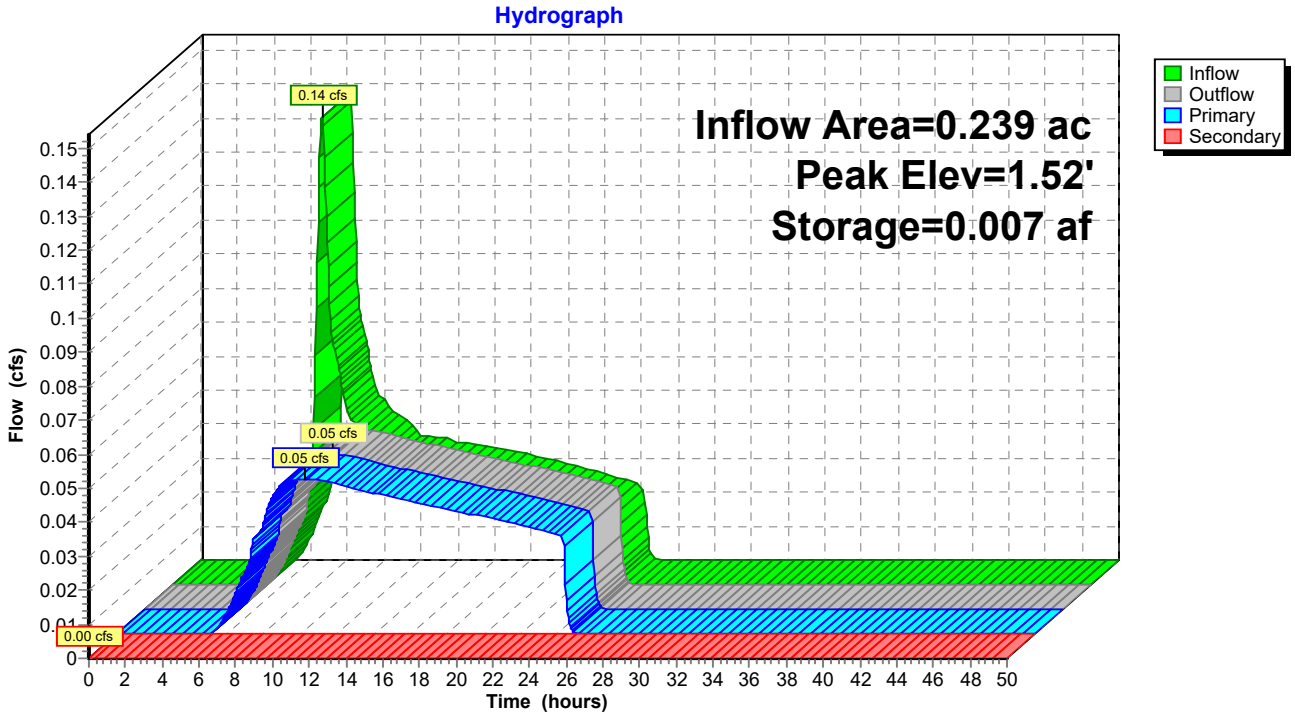
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.024 af	**5.00'W x 120.00'L x 5.00'H Bioretention** 0.069 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.05 cfs @ 10.22 hrs HW=1.52' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.05 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
2=Orifice/Grate (Controls 0.00 cfs)

Pond 15P: Bioretention



Summary for Pond 16P: Infiltration Trench

Inflow Area = 1.378 ac, 77.79% Impervious, Inflow Depth = 5.27" for 100-year event
Inflow = 1.78 cfs @ 8.08 hrs, Volume= 0.605 af
Outflow = 1.77 cfs @ 8.11 hrs, Volume= 0.605 af, Atten= 0%, Lag= 1.7 min
Primary = 0.09 cfs @ 8.11 hrs, Volume= 0.193 af
Secondary = 1.68 cfs @ 8.11 hrs, Volume= 0.411 af
Routed to Pond N2 : Node C

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 4.70' @ 8.11 hrs Surf.Area= 0.028 ac Storage= 0.045 af

Plug-Flow detention time= 91.8 min calculated for 0.604 af (100% of inflow)
Center-of-Mass det. time= 92.1 min (798.9 - 706.8)

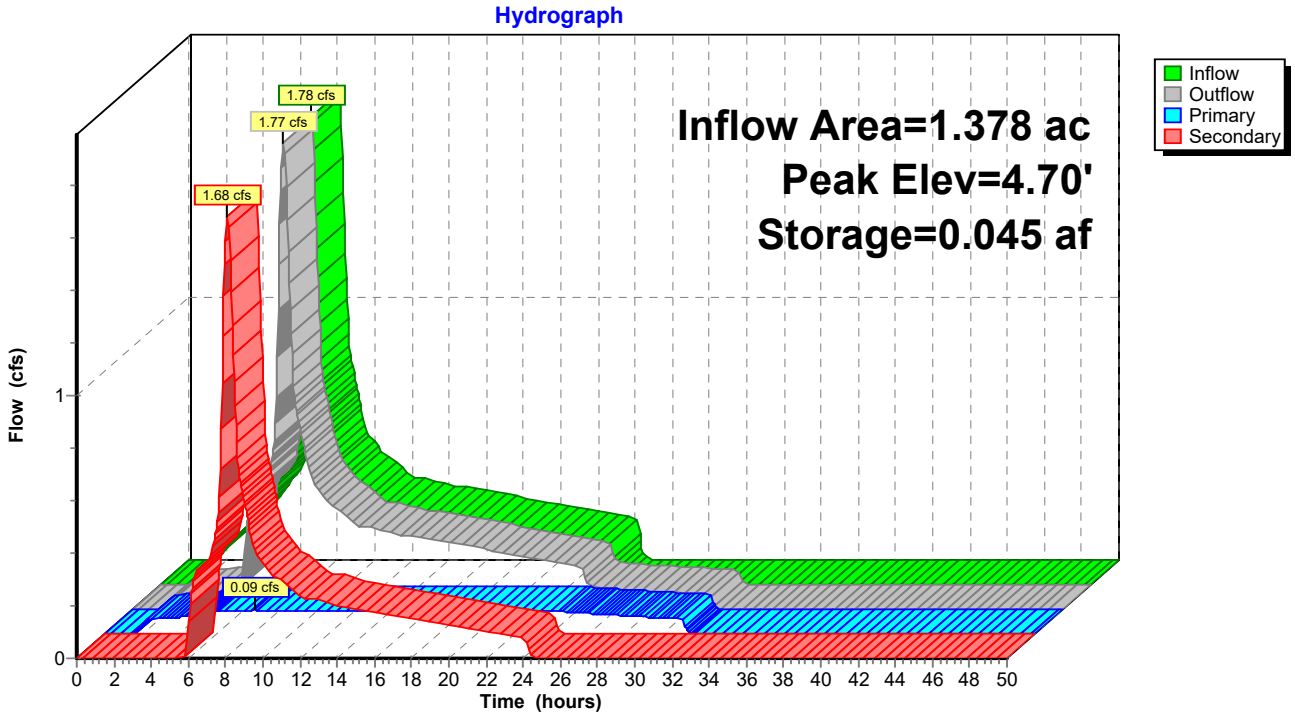
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.058 af	**20.00'W x 60.00'L x 6.00'H Infiltration Trench** 0.165 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	4.00'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.09 cfs @ 8.11 hrs HW=4.70' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Secondary OutFlow Max=1.68 cfs @ 8.11 hrs HW=4.70' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 1.68 cfs @ 2.85 fps)

Pond 16P: Infiltration Trench



Summary for Pond 19P: Infiltration Trench

Inflow Area = 46.237 ac,100.00% Impervious, Inflow Depth > 5.88" for 100-year event
Inflow = 40.37 cfs @ 8.42 hrs, Volume= 22.657 af
Outflow = 38.47 cfs @ 8.60 hrs, Volume= 22.657 af, Atten= 5%, Lag= 10.4 min
Primary = 3.58 cfs @ 8.60 hrs, Volume= 8.734 af
Secondary = 34.89 cfs @ 8.60 hrs, Volume= 13.923 af
Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 4.09' @ 8.60 hrs Surf.Area= 1.674 ac Storage= 2.393 af

Plug-Flow detention time= 123.7 min calculated for 22.657 af (100% of inflow)
Center-of-Mass det. time= 123.7 min (860.1 - 736.4)

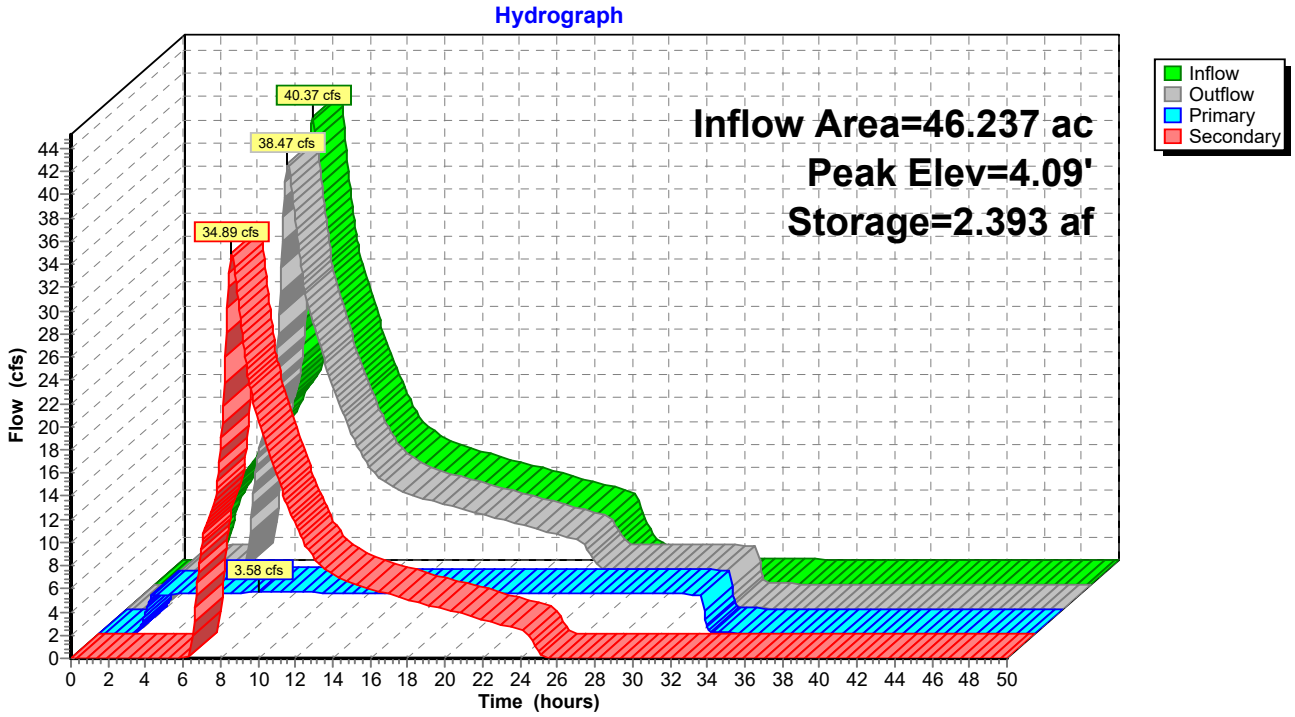
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	2.929 af	**270.00'W x 270.00'L x 5.00'H Infiltration Trench** 8.368 af Overall x 35.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**2.000 in/hr Exfiltration over Wetted area**
#2	Secondary	3.00'	**36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.58 cfs @ 8.60 hrs HW=4.09' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 3.58 cfs)

Secondary OutFlow Max=34.87 cfs @ 8.60 hrs HW=4.09' (Free Discharge)
↑**2=Orifice/Grate** (Weir Controls 34.87 cfs @ 3.41 fps)

Pond 19P: Infiltration Trench



Summary for Pond N1: Node D

[81] Warning: Exceeded Pond 19P by 48.01' @ 1.90 hrs
[81] Warning: Exceeded Pond N2 by 8.81' @ 0.00 hrs

Inflow Area = 44.595 ac, 62.85% Impervious, Inflow Depth = 9.31" for 100-year event
Inflow = 84.32 cfs @ 8.14 hrs, Volume= 34.599 af
Outflow = 64.36 cfs @ 8.66 hrs, Volume= 34.599 af, Atten= 24%, Lag= 30.9 min
Primary = 64.36 cfs @ 8.66 hrs, Volume= 34.599 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 48.85' @ 8.66 hrs Surf.Area= 243,905 sf Storage= 142,568 cf

Plug-Flow detention time= 43.8 min calculated for 34.599 af (100% of inflow)
Center-of-Mass det. time= 43.3 min (778.9 - 735.5)

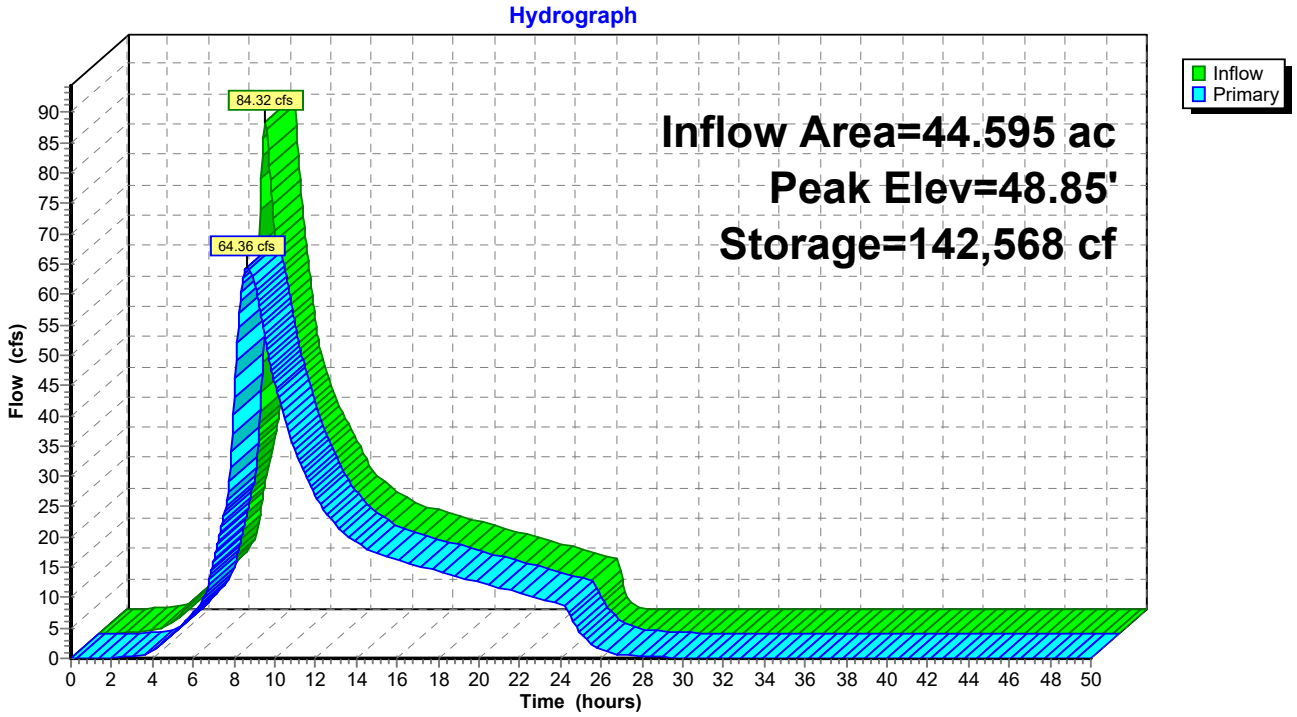
Volume	Invert	Avail.Storage	Storage Description
#1	48.00'	551,632 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
48.00	91,616	0	0
49.00	270,816	181,216	181,216
50.00	470,016	370,416	551,632

Device	Routing	Invert	Outlet Devices
#1	Primary	48.00'	**30.0' long + 1.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=64.34 cfs @ 8.66 hrs HW=48.85' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 64.34 cfs @ 2.45 fps)

Pond N1: Node D



Summary for Pond N2: Node C

[57] Hint: Peaked at 49.14' (Flood elevation advised)
[81] Warning: Exceeded Pond 7P by 8.52' @ 1.75 hrs
[81] Warning: Exceeded Pond 15P by 48.89' @ 7.75 hrs
[81] Warning: Exceeded Pond 16P by 48.85' @ 1.40 hrs

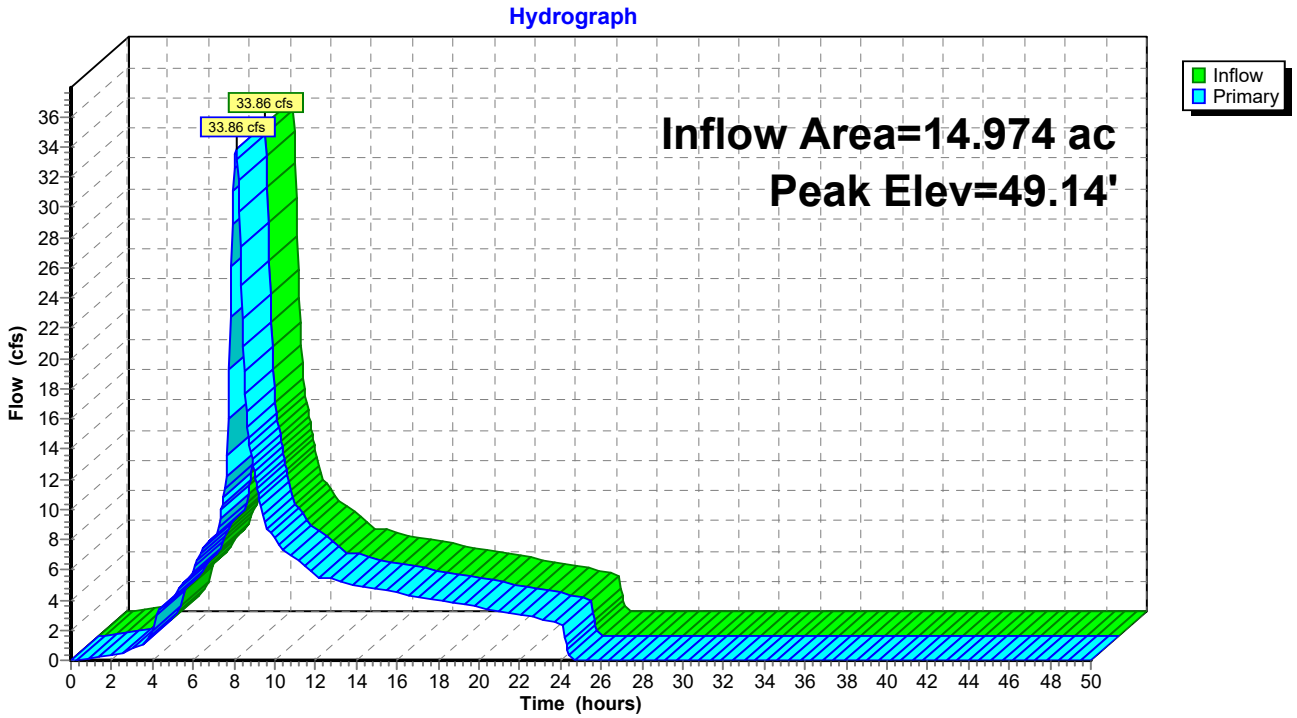
Inflow Area = 14.974 ac, 52.54% Impervious, Inflow Depth = 8.32" for 100-year event
Inflow = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af
Outflow = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af, Atten= 0%, Lag= 0.0 min
Primary = 33.86 cfs @ 8.09 hrs, Volume= 10.379 af
Routed to Pond N1 : Node D

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 49.14' @ 8.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	39.19'	**30.0" Round Culvert** L= 410.7' Ke= 0.200 Inlet / Outlet Invert= 39.19' / 37.96' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 4.91 sf
#2	Primary	48.80'	**36.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=33.70 cfs @ 8.09 hrs HW=49.14' TW=48.85' (Fixed TW Elev= 48.85')
1=Culvert (Outlet Controls 10.14 cfs @ 2.07 fps)
2=Sharp-Crested Rectangular Weir (Weir Controls 23.55 cfs @ 1.90 fps)

Pond N2: Node C



Summary for Pond N3: Node A

[57] Hint: Peaked at 50.57' (Flood elevation advised)
[81] Warning: Exceeded Pond 4P by 49.80' @ 31.55 hrs
[81] Warning: Exceeded Pond 5P by 49.80' @ 35.95 hrs

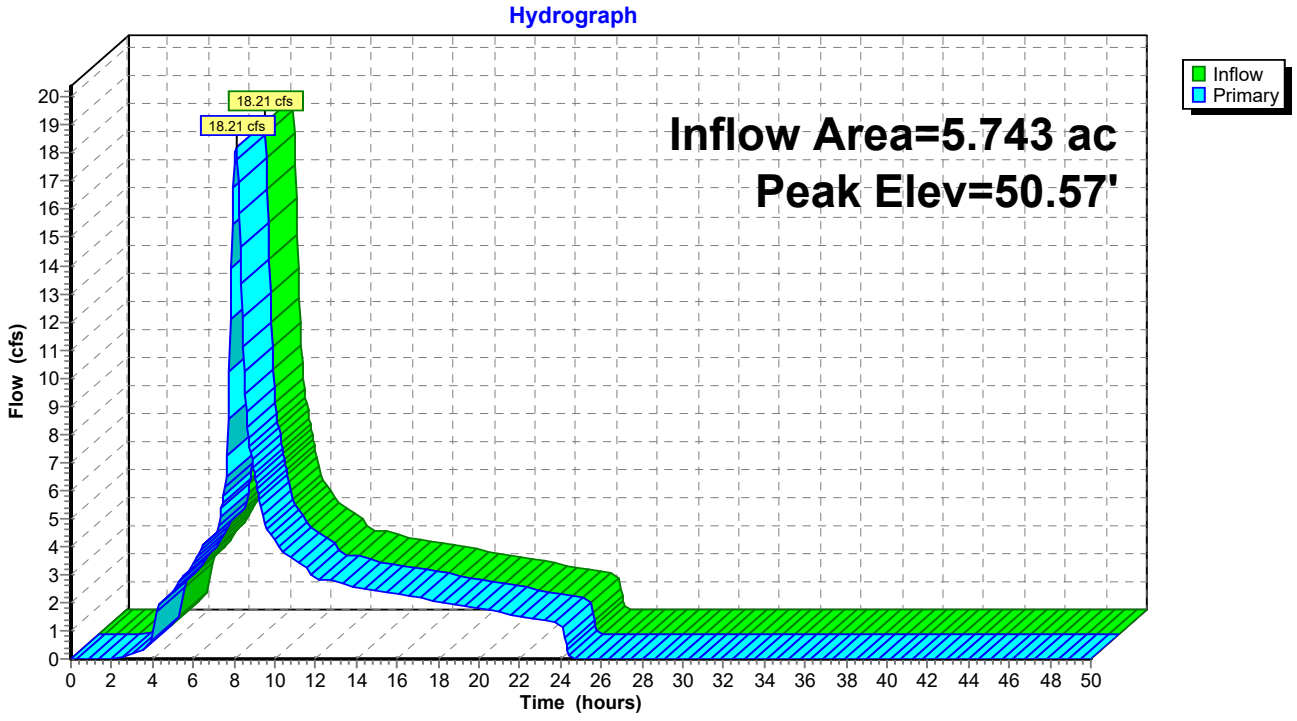
Inflow Area = 5.743 ac, 58.73% Impervious, Inflow Depth = 11.34" for 100-year event
Inflow = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af
Outflow = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af, Atten= 0%, Lag= 0.0 min
Primary = 18.21 cfs @ 8.09 hrs, Volume= 5.428 af
Routed to Pond 7P : Node B

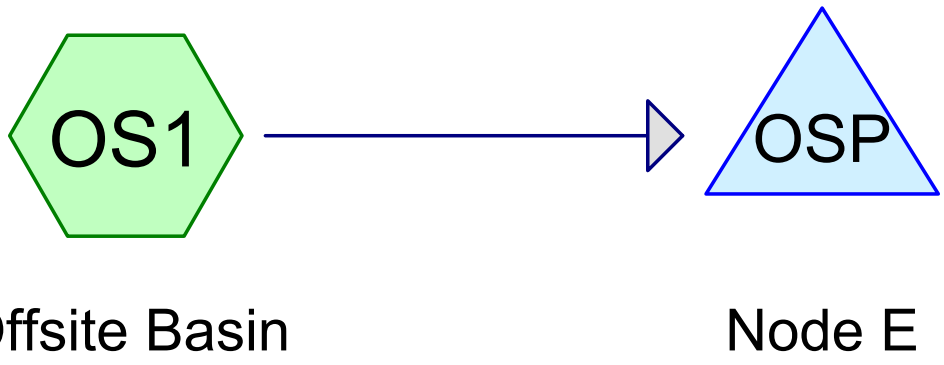
Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 50.57' @ 8.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	41.44'	**24.0" Round Culvert** L= 369.0' Ke= 0.200 Inlet / Outlet Invert= 41.44' / 40.33' S= 0.0030 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Primary	50.40'	**36.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=17.91 cfs @ 8.09 hrs HW=50.57' TW=49.80' (Fixed TW Elev= 49.80')
1=Culvert (Outlet Controls 9.77 cfs @ 3.11 fps)
2=Sharp-Crested Rectangular Weir (Weir Controls 8.14 cfs @ 1.34 fps)

Pond N3: Node A





Subcat Reach Pond Link

Routing Diagram for Offsite 25-Year Storm - Water @ OHWM or Below
Prepared by MacKay & Sposito, Inc, Printed 3/10/2025
HydroCAD® 10.20-5c s/n 01662 © 2023 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
25.493	74	50-75% Grass cover, Poor/Fair, HSG B (OS1)
6.502	98	Paved parking, HSG A (OS1)
31.995	**79**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
6.502	HSG A	OS1
25.493	HSG B	OS1
0.000	HSG C	
0.000	HSG D	
0.000	Other	
31.995		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	25.493	0.000	0.000	0.000	25.493	50-75% Grass cover, Poor/Fair	OS 1
6.502	0.000	0.000	0.000	0.000	6.502	Paved parking	OS 1
6.502	**25.493**	**0.000**	**0.000**	**0.000**	**31.995**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	OSP	38.00	37.50	270.3	0.0018	0.012	0.0	30.0	0.0	

Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment OS1: Offsite Basin Runoff Area=31.995 ac 20.32% Impervious Runoff Depth=2.89"
Tc=20.0 min CN=79 Runoff=21.13 cfs 7.700 af

Pond OSP: Node E Peak Elev=40.30' Storage=22,776 cf Inflow=21.13 cfs 7.700 af
Primary=16.75 cfs 7.699 af Secondary=0.00 cfs 0.000 af Outflow=16.75 cfs 7.699 af

Total Runoff Area = 31.995 ac Runoff Volume = 7.700 af Average Runoff Depth = 2.89"
79.68% Pervious = 25.493 ac 20.32% Impervious = 6.502 ac

Summary for Subcatchment OS1: Offsite Basin

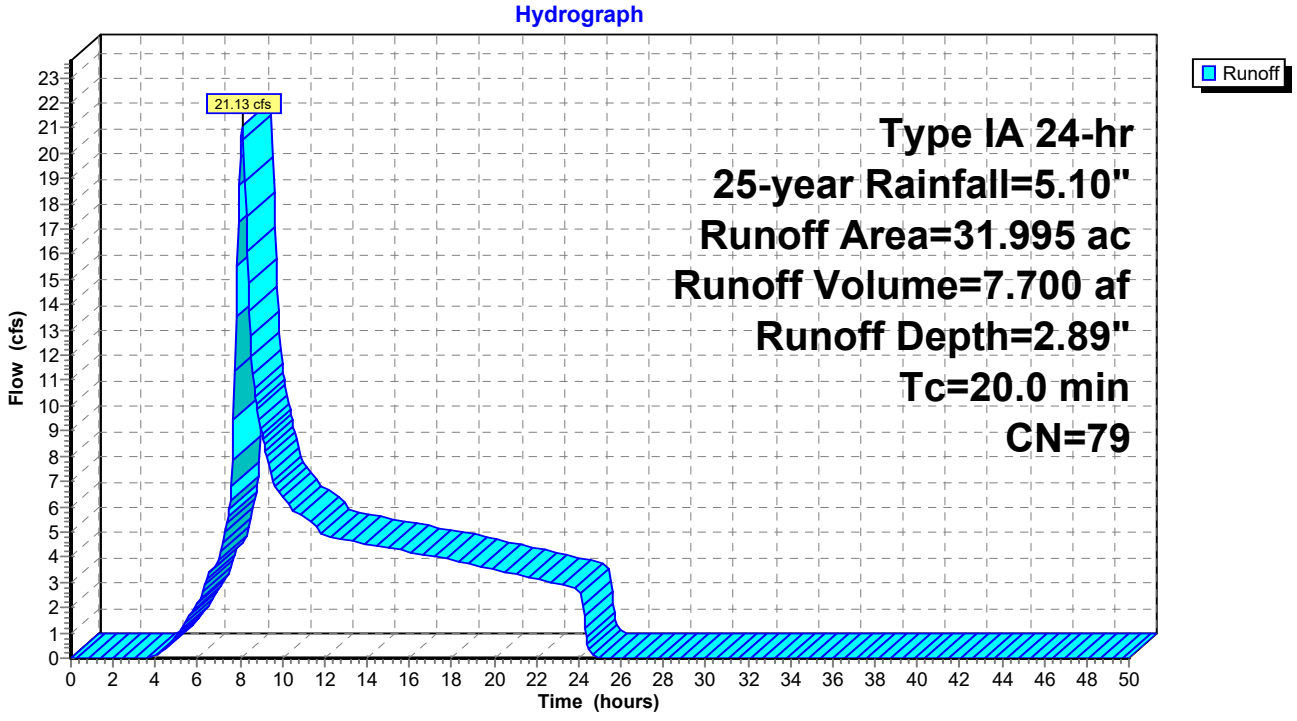
Runoff = 21.13 cfs @ 8.11 hrs, Volume= 7.700 af, Depth= 2.89"
Routed to Pond OSP : Node E

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

	Area (ac)	CN	Description
*	25.493	74	50-75% Grass cover, Poor/Fair, HSG B
	6.502	98	Paved parking, HSG A
	31.995	79	Weighted Average
	25.493		79.68% Pervious Area
	6.502		20.32% Impervious Area

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

Subcatchment OS1: Offsite Basin



Summary for Pond OSP: Node E

[92] Warning: Device #1 is above defined storage

Inflow Area = 31.995 ac, 20.32% Impervious, Inflow Depth = 2.89" for 25-year event
Inflow = 21.13 cfs @ 8.11 hrs, Volume= 7.700 af
Outflow = 16.75 cfs @ 8.33 hrs, Volume= 7.699 af, Atten= 21%, Lag= 12.9 min
Primary = 16.75 cfs @ 8.33 hrs, Volume= 7.699 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 40.30' @ 8.33 hrs Surf.Area= 13,869 sf Storage= 22,776 cf

Plug-Flow detention time= 31.7 min calculated for 7.691 af (100% of inflow)
Center-of-Mass det. time= 32.4 min (825.9 - 793.5)

Volume	Invert	Avail.Storage	Storage Description
#1	38.00'	51,730 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

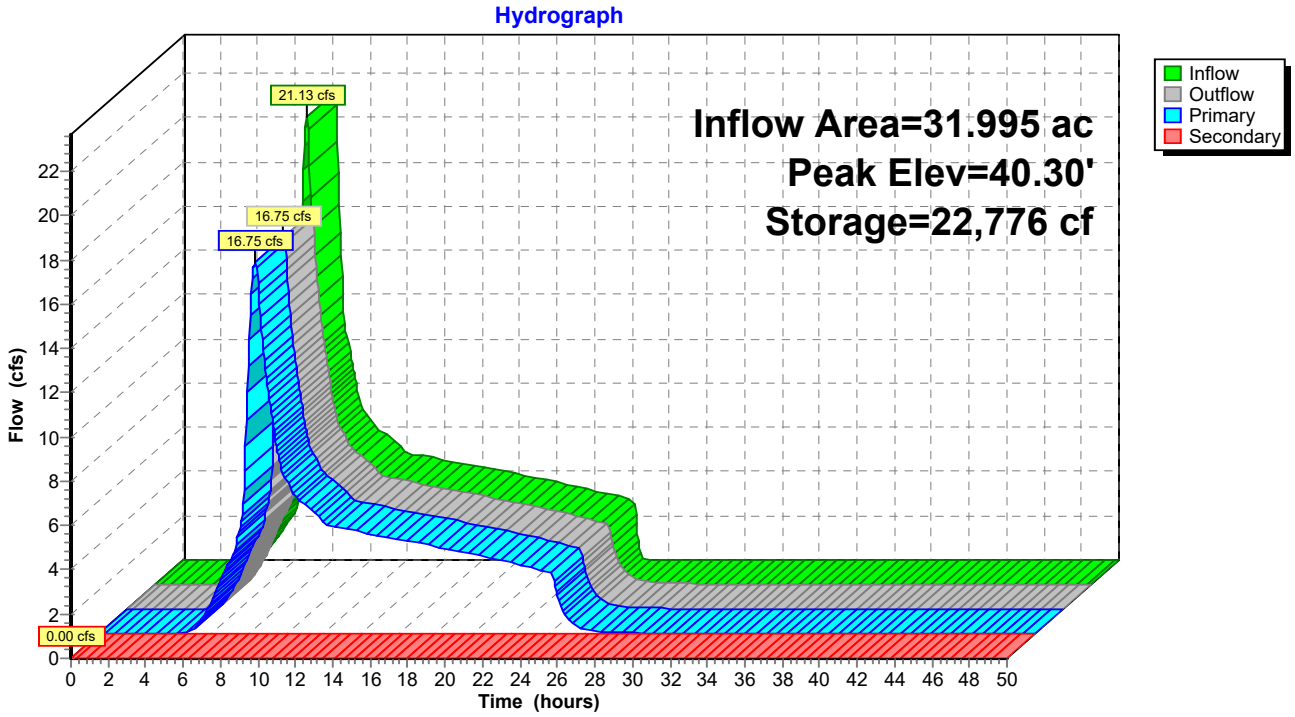
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	6,450	0	0
39.00	9,192	7,821	7,821
40.00	12,778	10,985	18,806
41.00	16,440	14,609	33,415
42.00	20,190	18,315	51,730

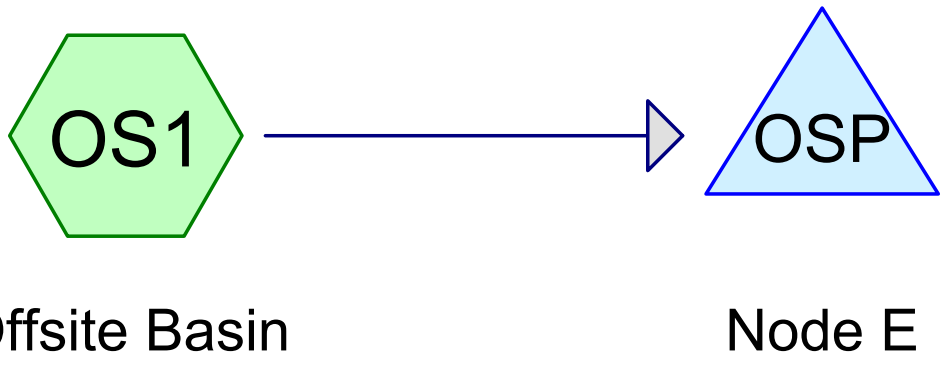
Device	Routing	Invert	Outlet Devices
#1	Secondary	45.00'	**3.000 cfs Constant Flow/Skimmer** Phase-In= 0.10'
#2	Primary	38.00'	**30.0" Round Culvert** L= 270.3' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 38.00' / 37.50' S= 0.0018 '/' Cc= 0.900 n= 0.012, Flow Area= 4.91 sf

Primary OutFlow Max=16.73 cfs @ 8.33 hrs HW=40.30' (Free Discharge)
↑—**2=Culvert** (Barrel Controls 16.73 cfs @ 4.64 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=38.00' (Free Discharge)
↑—**1=Constant Flow/Skimmer** (Controls 0.00 cfs)

Pond OSP: Node E





Subcat Reach Pond Link

Routing Diagram for Offsite 100-Year Storm - Water @ OHWM or Below
Prepared by MacKay & Sposito, Inc, Printed 3/10/2025
HydroCAD® 10.20-5c s/n 01662 © 2023 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
25.493	74	50-75% Grass cover, Poor/Fair, HSG B (OS1)
6.502	98	Paved parking, HSG A (OS1)
31.995	**79**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
6.502	HSG A	OS1
25.493	HSG B	OS1
0.000	HSG C	
0.000	HSG D	
0.000	Other	
31.995		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	25.493	0.000	0.000	0.000	25.493	50-75% Grass cover, Poor/Fair	OS 1
6.502	0.000	0.000	0.000	0.000	6.502	Paved parking	OS 1
6.502	**25.493**	**0.000**	**0.000**	**0.000**	**31.995**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	OSP	38.00	37.50	270.3	0.0018	0.012	0.0	30.0	0.0	

Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment OS1: Offsite Basin Runoff Area=31.995 ac 20.32% Impervious Runoff Depth=3.86"
Tc=20.0 min CN=79 Runoff=29.10 cfs 10.288 af

Pond OSP: Node E Peak Elev=40.85' Storage=31,017 cf Inflow=29.10 cfs 10.288 af
30.0" Round Culvert n=0.012 L=270.3' S=0.0018 '/' Outflow=22.26 cfs 10.286 af

Total Runoff Area = 31.995 ac Runoff Volume = 10.288 af Average Runoff Depth = 3.86"
79.68% Pervious = 25.493 ac 20.32% Impervious = 6.502 ac

Summary for Subcatchment OS1: Offsite Basin

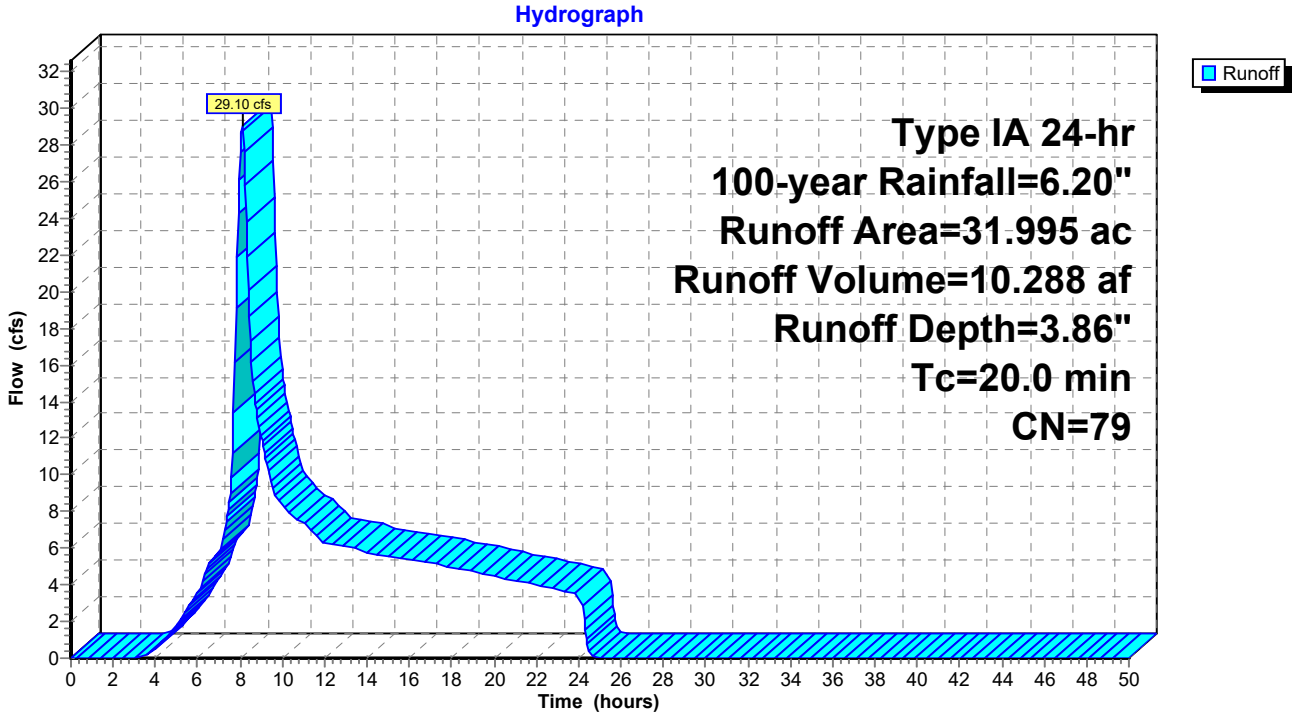
Runoff = 29.10 cfs @ 8.11 hrs, Volume= 10.288 af, Depth= 3.86"
Routed to Pond OSP : Node E

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

	Area (ac)	CN	Description
*	25.493	74	50-75% Grass cover, Poor/Fair, HSG B
	6.502	98	Paved parking, HSG A
	31.995	79	Weighted Average
	25.493		79.68% Pervious Area
	6.502		20.32% Impervious Area

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

Subcatchment OS1: Offsite Basin



Summary for Pond OSP: Node E

Inflow Area = 31.995 ac, 20.32% Impervious, Inflow Depth = 3.86" for 100-year event
Inflow = 29.10 cfs @ 8.11 hrs, Volume= 10.288 af
Outflow = 22.26 cfs @ 8.34 hrs, Volume= 10.286 af, Atten= 23%, Lag= 14.2 min
Primary = 22.26 cfs @ 8.34 hrs, Volume= 10.286 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 40.85' @ 8.34 hrs Surf.Area= 15,897 sf Storage= 31,017 cf

Plug-Flow detention time= 28.9 min calculated for 10.276 af (100% of inflow)
Center-of-Mass det. time= 29.5 min (806.2 - 776.7)

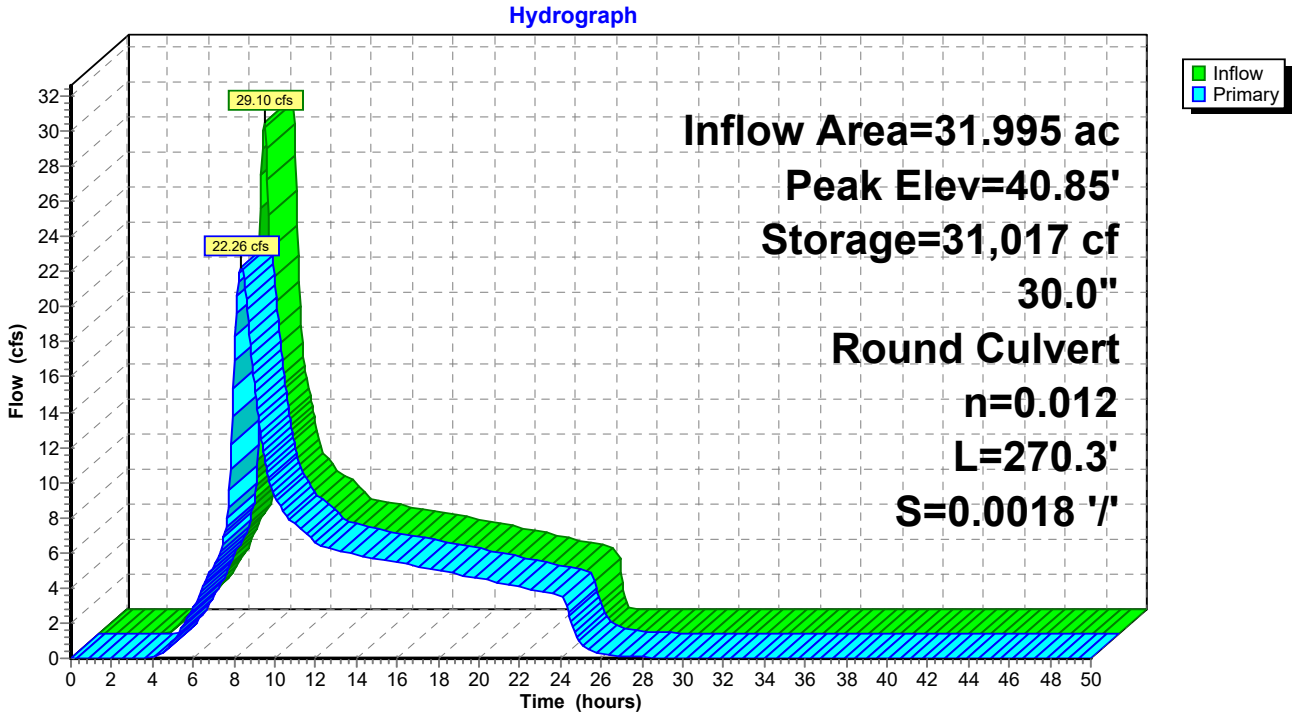
Volume	Invert	Avail.Storage	Storage Description
#1	38.00'	102,732 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

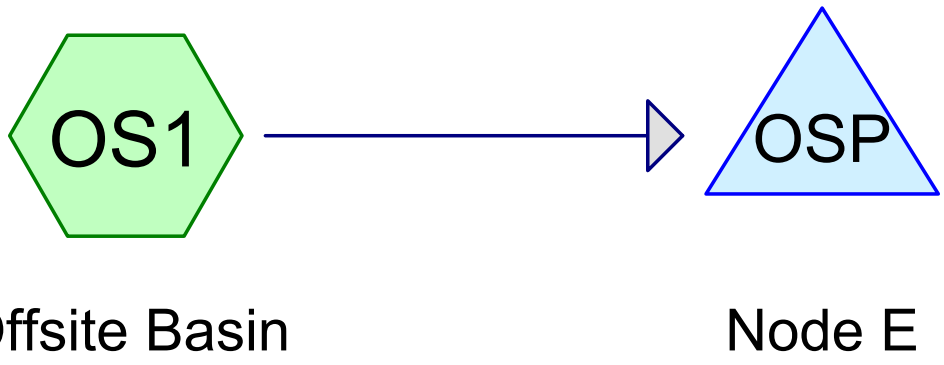
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	6,450	0	0
39.00	9,192	7,821	7,821
40.00	12,778	10,985	18,806
41.00	16,440	14,609	33,415
42.00	38,154	27,297	60,712
43.00	45,886	42,020	102,732

Device	Routing	Invert	Outlet Devices
#1	Primary	38.00'	**30.0" Round Culvert** L= 270.3' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 38.00' / 37.50' S= 0.0018 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 4.91 sf

Primary OutFlow Max=22.25 cfs @ 8.34 hrs HW=40.85' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 22.25 cfs @ 4.98 fps)

Pond OSP: Node E





Subcat Reach Pond Link

Routing Diagram for Offsite 25-Year w Vavle Closed
Prepared by MacKay & Sposito, Inc, Printed 3/10/2025
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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
25.493	74	50-75% Grass cover, Poor/Fair, HSG B (OS1)
6.502	98	Paved parking, HSG A (OS1)
31.995	**79**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
6.502	HSG A	OS1
25.493	HSG B	OS1
0.000	HSG C	
0.000	HSG D	
0.000	Other	
31.995		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	25.493	0.000	0.000	0.000	25.493	50-75% Grass cover, Poor/Fair	OS 1
6.502	0.000	0.000	0.000	0.000	6.502	Paved parking	OS 1
6.502	**25.493**	**0.000**	**0.000**	**0.000**	**31.995**	**TOTAL AREA**	

Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentOS1: Offsite Basin Runoff Area=31.995 ac 20.32% Impervious Runoff Depth=2.89"
Tc=20.0 min CN=79 Runoff=21.13 cfs 7.700 af

Pond OSP: Node E Peak Elev=42.45' Storage=78,763 cf Inflow=21.13 cfs 7.700 af
Outflow=5.00 cfs 7.268 af

Total Runoff Area = 31.995 ac Runoff Volume = 7.700 af Average Runoff Depth = 2.89"
79.68% Pervious = 25.493 ac 20.32% Impervious = 6.502 ac

Summary for Subcatchment OS1: Offsite Basin

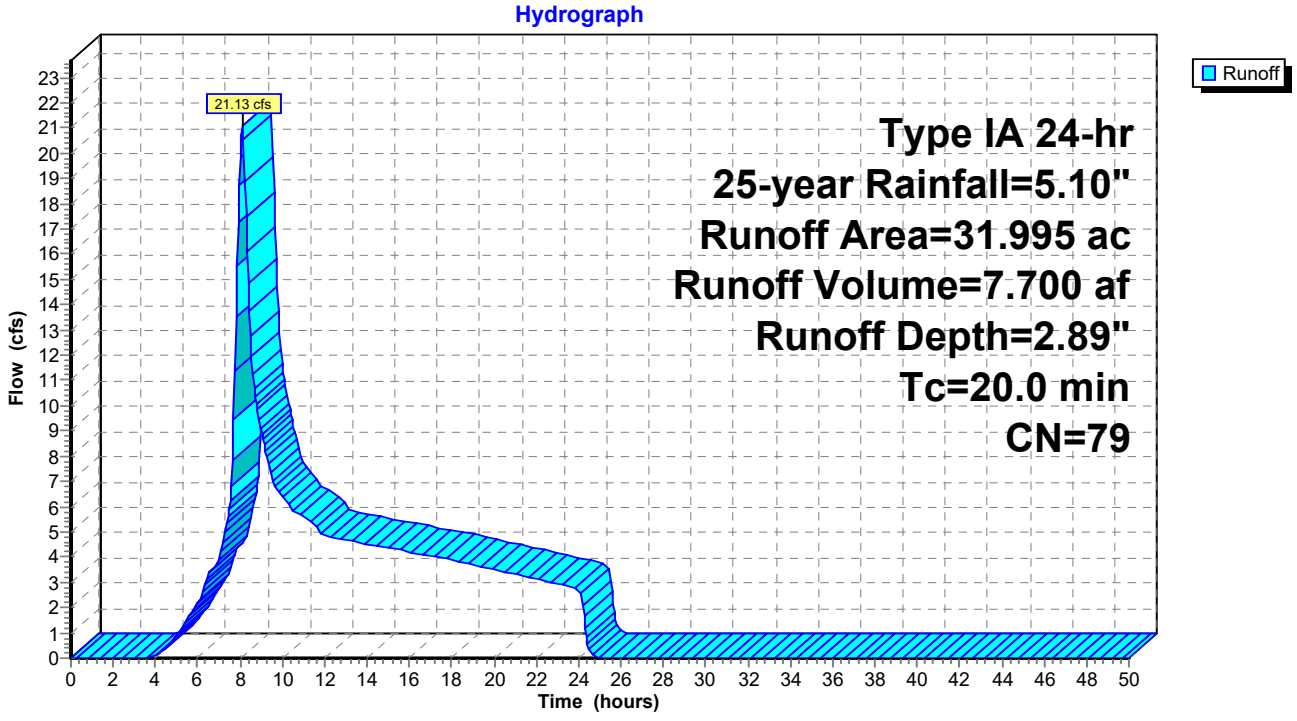
Runoff = 21.13 cfs @ 8.11 hrs, Volume= 7.700 af, Depth= 2.89"
Routed to Pond OSP : Node E

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Rainfall=5.10"

	Area (ac)	CN	Description
*	25.493	74	50-75% Grass cover, Poor/Fair, HSG B
	6.502	98	Paved parking, HSG A
	31.995	79	Weighted Average
	25.493		79.68% Pervious Area
	6.502		20.32% Impervious Area

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

Subcatchment OS1: Offsite Basin



Summary for Pond OSP: Node E

Inflow Area = 31.995 ac, 20.32% Impervious, Inflow Depth = 2.89" for 25-year event
Inflow = 21.13 cfs @ 8.11 hrs, Volume= 7.700 af
Outflow = 5.00 cfs @ 7.45 hrs, Volume= 7.268 af, Atten= 76%, Lag= 0.0 min
Primary = 5.00 cfs @ 7.45 hrs, Volume= 7.268 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 42.45' @ 11.76 hrs Surf.Area= 41,652 sf Storage= 78,763 cf

Plug-Flow detention time= 197.9 min calculated for 7.268 af (94% of inflow)
Center-of-Mass det. time= 161.8 min (955.3 - 793.5)

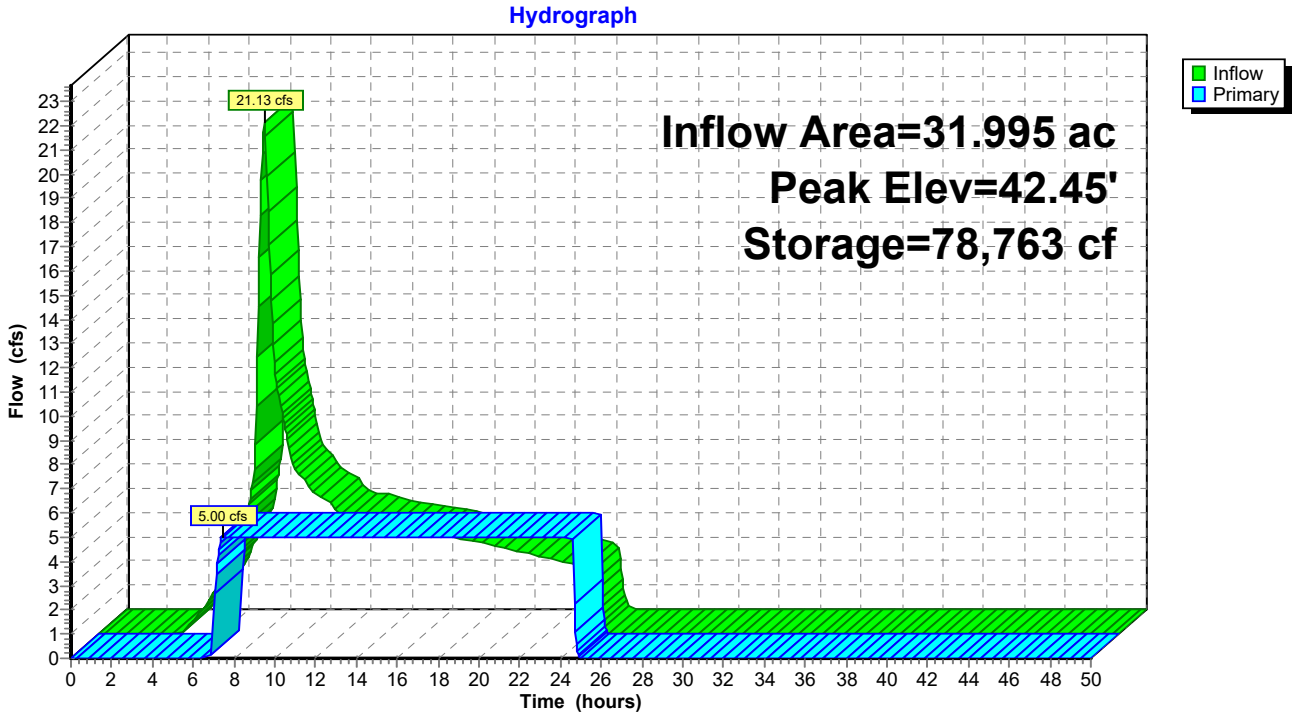
Volume	Invert	Avail.Storage	Storage Description
#1	38.00'	102,732 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

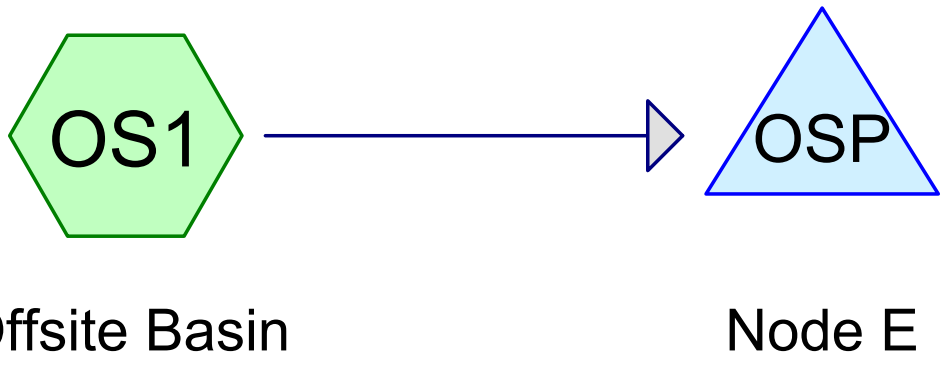
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	6,450	0	0
39.00	9,192	7,821	7,821
40.00	12,778	10,985	18,806
41.00	16,440	14,609	33,415
42.00	38,154	27,297	60,712
43.00	45,886	42,020	102,732

Device	Routing	Invert	Outlet Devices
#1	Primary	40.00'	**5.000 cfs Constant Flow/Skimmer** Phase-In= 0.10'

Primary OutFlow Max=5.00 cfs @ 7.45 hrs HW=40.11' (Free Discharge)
↑—**1=Constant Flow/Skimmer** (Constant Controls 5.00 cfs)

Pond OSP: Node E





Subcat Reach Pond Link

Routing Diagram for Offsite 100-Year Storm w Valve Closed
Prepared by MacKay & Sposito, Inc, Printed 3/10/2025
HydroCAD® 10.20-5c s/n 01662 © 2023 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
25.493	74	50-75% Grass cover, Poor/Fair, HSG B (OS1)
6.502	98	Paved parking, HSG A (OS1)
31.995	**79**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
6.502	HSG A	OS1
25.493	HSG B	OS1
0.000	HSG C	
0.000	HSG D	
0.000	Other	
31.995		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	25.493	0.000	0.000	0.000	25.493	50-75% Grass cover, Poor/Fair	OS 1
6.502	0.000	0.000	0.000	0.000	6.502	Paved parking	OS 1
6.502	**25.493**	**0.000**	**0.000**	**0.000**	**31.995**	**TOTAL AREA**	

Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment OS1: Offsite Basin Runoff Area=31.995 ac 20.32% Impervious Runoff Depth=3.86"
Tc=20.0 min CN=79 Runoff=29.10 cfs 10.288 af

Pond OSP: Node E Peak Elev=43.65' Storage=143,898 cf Inflow=29.10 cfs 10.288 af
Outflow=5.00 cfs 9.857 af

Total Runoff Area = 31.995 ac Runoff Volume = 10.288 af Average Runoff Depth = 3.86"
79.68% Pervious = 25.493 ac 20.32% Impervious = 6.502 ac

Summary for Subcatchment OS1: Offsite Basin

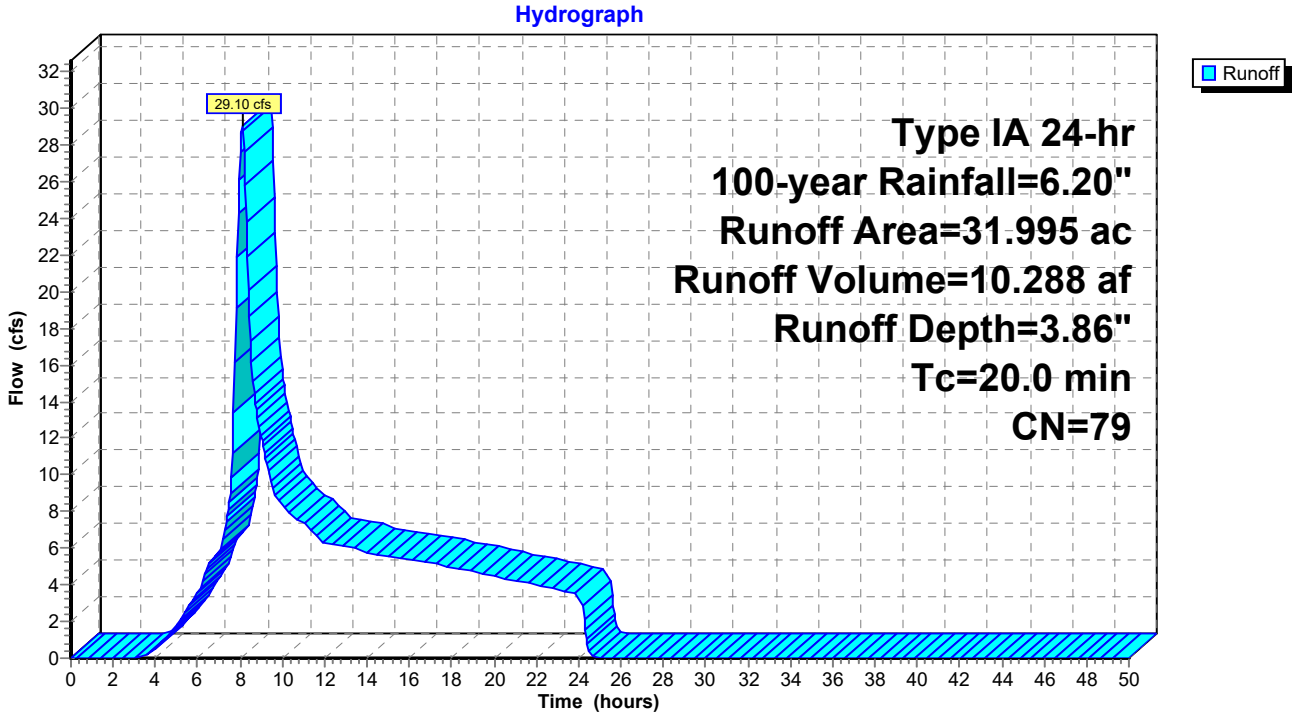
Runoff = 29.10 cfs @ 8.11 hrs, Volume= 10.288 af, Depth= 3.86"
Routed to Pond OSP : Node E

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=6.20"

	Area (ac)	CN	Description
*	25.493	74	50-75% Grass cover, Poor/Fair, HSG B
	6.502	98	Paved parking, HSG A
	31.995	79	Weighted Average
	25.493		79.68% Pervious Area
	6.502		20.32% Impervious Area

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

Subcatchment OS1: Offsite Basin



Summary for Pond OSP: Node E

Inflow Area = 31.995 ac, 20.32% Impervious, Inflow Depth = 3.86" for 100-year event
Inflow = 29.10 cfs @ 8.11 hrs, Volume= 10.288 af
Outflow = 5.00 cfs @ 6.60 hrs, Volume= 9.857 af, Atten= 83%, Lag= 0.0 min
Primary = 5.00 cfs @ 6.60 hrs, Volume= 9.857 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 43.65' @ 17.77 hrs Surf.Area= 81,478 sf Storage= 143,898 cf

Plug-Flow detention time= 348.7 min calculated for 9.847 af (96% of inflow)
Center-of-Mass det. time= 321.0 min (1,097.7 - 776.7)

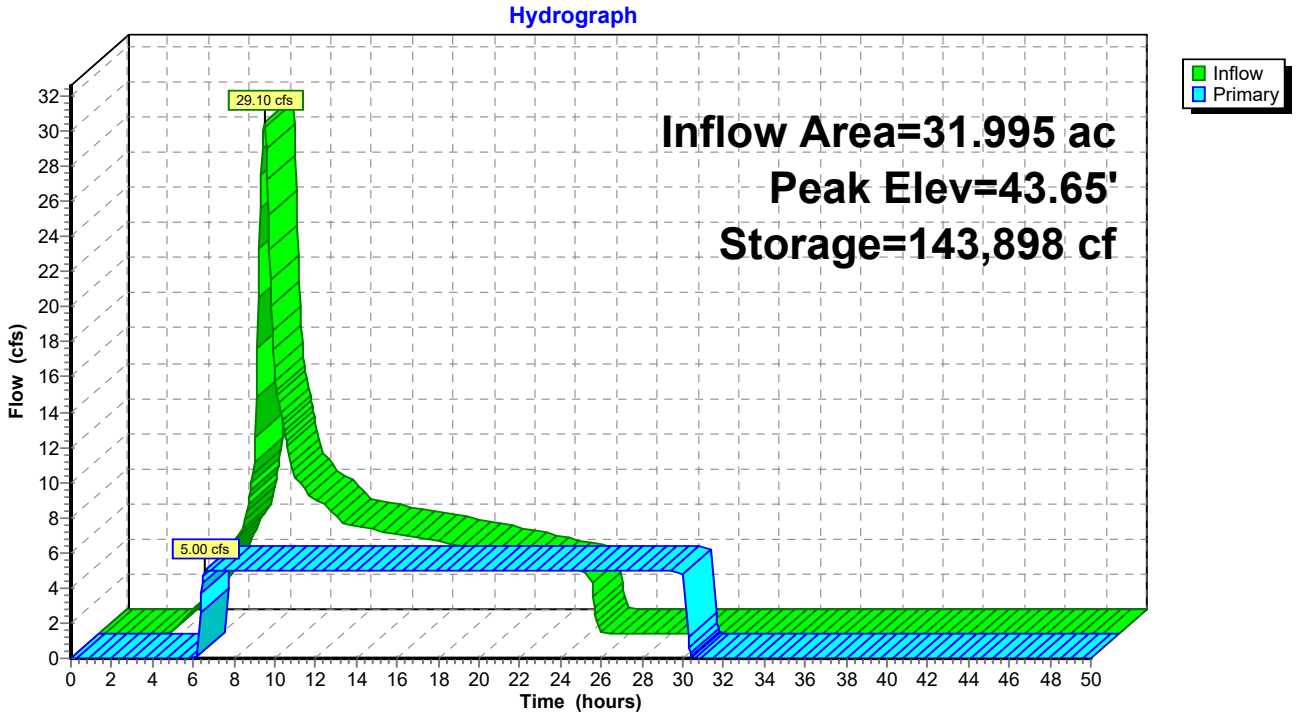
Volume	Invert	Avail.Storage	Storage Description
#1	38.00'	176,147 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	6,450	0	0
39.00	9,192	7,821	7,821
40.00	12,778	10,985	18,806
41.00	16,440	14,609	33,415
42.00	38,154	27,297	60,712
43.00	45,886	42,020	102,732
44.00	100,944	73,415	176,147

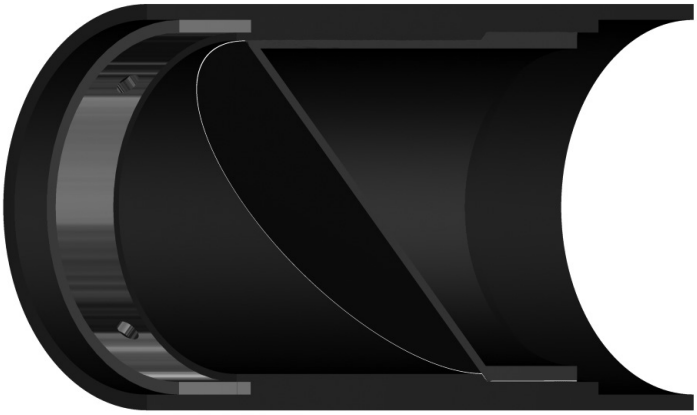
Device	Routing	Invert	Outlet Devices
#1	Primary	40.00'	**5.000 cfs Constant Flow/Skimmer** Phase-In= 0.10'

Primary OutFlow Max=5.00 cfs @ 6.60 hrs HW=40.10' (Free Discharge)
1=Constant Flow/Skimmer (Constant Controls 5.00 cfs)

Pond OSP: Node E



Tideflex® CheckMate UltraFlex® Inline Check Valve Installation, Operation and Maintenance Manual



The revolutionary design of the CheckMate® Inline Check Valve provides superior backflow prevention and odor mitigation in stormwater, CSO and SSO outfalls. The CheckMate's® custom-engineered, all-rubber unibody design eliminates costly backflow from oceans, rivers and interceptors. The valve's unique elastomer fabric and wire reinforced design provides a proven record of maintenance-free performance, cost savings and results that no other inline check valve can match. The CheckMate® is built to suit all your site-specific and flow needs.

The CheckMate® has a 100% fabric and elastomer construction that eliminates corrosion problems. Because the CheckMate® is made with a unibody construction, there are no mechanical components that trap debris, corrode or fail.

The CheckMate® Valve's inherent flexibility virtually eliminates seating problems. The CheckMate® remains in the closed position until forward differential pressure opens it. The fabric-reinforced elastomer CheckMate® Valve seals around silt and small debris, preventing unwanted backflow.

The major advantage of the CheckMate® Valve is its extremely low headloss. The CheckMate® can open to a near full pipe diameter. This maximizes flow capacity of the outfall, which is particularly beneficial in low-lying areas where limited driving head is available.

Tideflex® recommends pinning all CheckMate® Valves for added security and stability. CheckMate's® effectively have a zero face-to-face dimension because they fit completely inside of the pipe. No modification of piping is required provided adequate pipe length exists.

IMPORTANT

Please take a moment to review this manual. The improper installation or use of this product may result in personal injury, product failure, or reduced product life. Tideflex® can accept NO liability resulting from the improper use or installation of this product. If you have any questions or problems, please call the customer service department at (412) 279-0044. We appreciate your comments. Thank you for choosing Tideflex®.

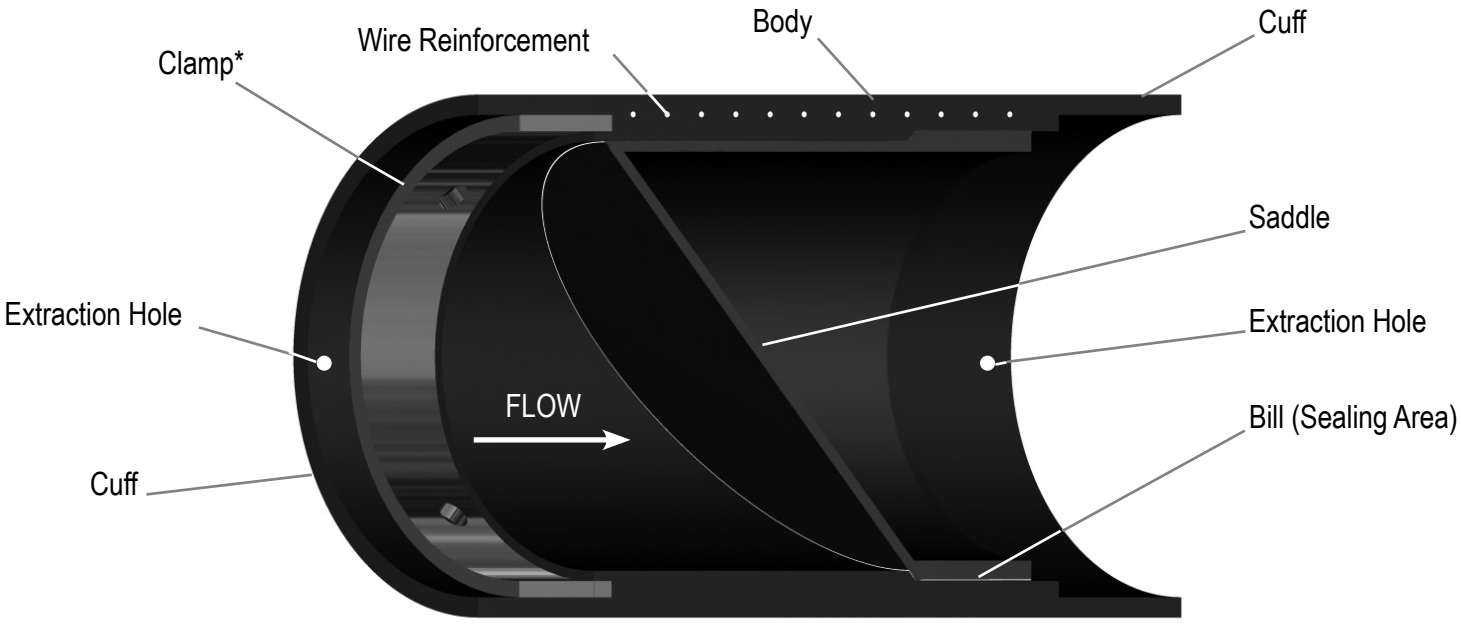
CheckMate® Installation Procedure

NEVER...
Install the valve at an angle

NEVER...
Use Sharp Tools on Rubber

NEVER...
Exceed Design Back Pressure

NEVER...
Install the Valve Backwards



*Clamps are installed in the upstream or downstream cuff, depending upon the application.
The illustration above is shown clamped upstream.

CHECKMATE® INSTALLATION

1. Product Shipping

Valve sizes 3" - 18" are furnished with one clamp. Valves 20" - 60" ship with two clamps. 72" valves ship with three clamps.

NOTE: A clamp is installed on each end of the valve to keep the valve's shape during transit and storage. Once the installation orientation is determined the CheckMate® valve will be clamped from either the upstream or downstream side. **For valves with two or three clamps, they can be installed onto the same side of the valve and offset from each other, as illustrated in Figure 1.**

2. Unpacking & Lifting

Do not use sharp tools when unpacking this product as it may damage the valve.

For larger CheckMate® valves, the valve should be lifted with either a sling or with supports around the O.D. at each side of the valve to ease the installation procedure. Do not place an object through the valve in order to lift.

CAUTION: Do not try to bend, collapse or fold the valve in order to facilitate the installation as this will cause permanent damage and will not allow the valve to return to a fully round shape.

3. Inspection of Pipe I.D.

Check the inside diameter (I.D.) of the pipe section for rough or damaged areas. The inside surface should be uniform and relatively smooth. Long gouges or cracks in the pipe may allow water to pass and should be filled prior to installation. Do not attempt to install a CheckMate® in a smaller pipe I.D.

4. Pipe I.D. Measurements

The pipe I.D. is to be checked in the field. It should be a consistent diameter for the length of valve and should not be out of round. When there is a +/- tolerance on the pipe I.D., the CheckMate® Valve should be ordered to the smallest pipe I.D.. Then, rubber adhesive strip can be applied to both CheckMate® cuffs to build the cuff O.D. up to the actual pipe I.D. See procudure in #5.

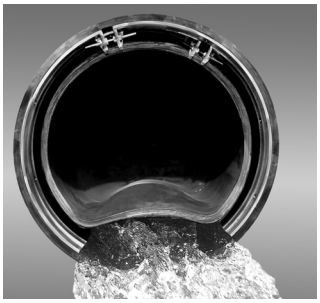


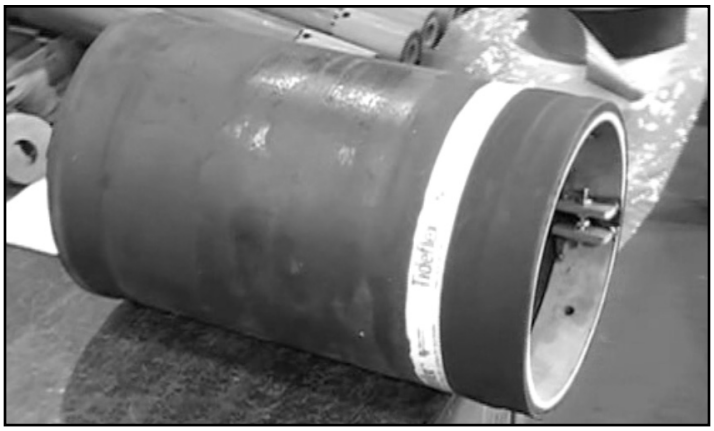
Figure 1 – Clamps shown installed on the same side of valve

CheckMate® Rubber Adhesive Strip Build Up Procedure

5. Rubber Adhesive Strip Build up

When valve O.D. is smaller than the pipe I.D., one-sided rubber adhesive strip is used to build up the O.D. of both CheckMate® cuffs to the actual pipe I.D.

NOTICE: Clean and dry the exterior of the valve prior to beginning rubber adhesive strip build up procedure.



STEP A: Place the valve on a solid, flat surface with the clamped end hanging slightly over the edge of the surface.



STEP B: Slowly rotate the valve while firmly pressing the rubber adhesive strip onto itself in concentric layers until valve O.D. is equal to or a fraction smaller than pipe I.D.



STEP C: Repeat steps A and B on the opposite side of the valve to ensure uniformity of the CheckMate's® O.D. is consistent and matches the pipe I.D.



STEP D: Lubricate the valve and rubber adhesive strip surface. Slide valve into pipe. Ensure the area marked TOP is in the 12:00 position.



STEP E: Check O.D. of the valve to ensure it fits snugly into the I.D. of pipe. If loose, add another layer(s) of the rubber adhesive strip.



STEP F: Once in place, tighten the clamp to secure it against the pipe and compress the rubber ahesive strip.

CheckMate® Installation Procedure

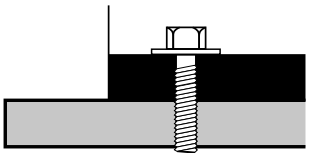
6. Preparation

The CheckMate® Valve uses expanding clamp(s) to exert pressure outwards on the walls of the valve to wedge it in place within the pipe. The walls of the pipe should be clean and free of debris prior to installation.

The valve should be inserted fully into the pipe so that no part of the cuff or bill extends outside the pipe. Ensure that the valve is not slanted at an angle with the bill pointing upwards or downwards. The valve centerline should be parallel to the pipe centerline.

Tideflex® Technologies recommends pinning the CheckMate® Valve on all installations. See below.

Four pre-drilled holes are provided in each expansion clamp. At least one clamp should be pinned. On exposed pipe, holes can be drilled through the valve and pipe, and a bolt run through secured with a nut. For buried pipe, silicon or similar sealant should be used to seal bolts.



7. Lubrication

The outside of the valve can be lubricated with a water-based lubricant prior to inserting the valve into the pipe. If the taping procedure has been used, the surface of the tape can be lubricate to aid insertion.

CAUTION: **Do not use petroleum-based lubricants** on this product or on the vulcanized rubber tape.

8. Plumb Lines and Arrows

The CheckMate® Valve arrives with a “top” arrow, “flow” arrow and plumb lines, marked in white, at the 12:00 and 6:00 position of the valve. Utilize this marking to orient the valve in the pipe, as well as to ensure the valve is oriented correctly in pipe section.

9. Valve Orientation

The CheckMate® Valve must be installed in a horizontal pipe. Valves 4" – 18" (nominal) are supplied with a single clamp. The clamp turnbuckle should be oriented at top dead center as delinated by the plumb line.

Valves 20” – 60” (nominal) are supplied with two clamps. The turnbuckles should be oriented 45° from the top center plumb line.

The 72” is supplied with three clamps. The turnbuckle for one clamp to be at top center. The other clamps to be 45° to each side of top center.

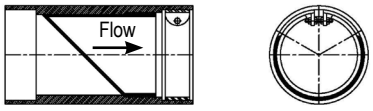
10. Insertion Into Pipe

Clamp to support the shape of the cuff should be hand tight and should be extended outward, but only tight enough to loosely keep the shape of the cuff during installation.

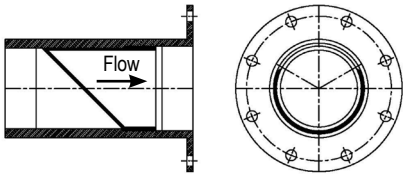
CAUTION: If you expand the clamp excessively at this step it will hinder or prevent the CheckMate® valve being fully inserted into the pipe.

CheckMate® Clamping Diagrams

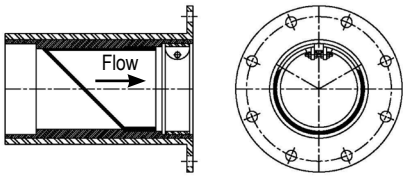
Downstream Clamp



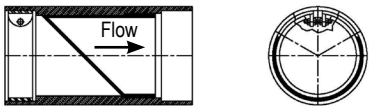
Downstream Flanged



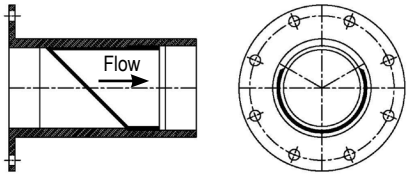
Downstream Flanged Thimble Insert



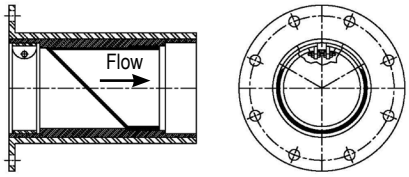
Upstream Clamp



Upstream Flanged



Upstream Flanged Thimble Insert



11. Pallet Push for Larger CheckMate® Valves

Larger CheckMate® valves can be pushed into the pipe utilizing the shipping pallet. The pallet should be placed perpendicular to the valve being inserted into the pipe. Then, with assistance from an excavator, push with consistent even force against the shipping pallet to insert the CheckMate® valve into the pipe.

See the image to the right for the suggested positioning and usage of the excavator's shovel assistance for larger-sized CheckMate® valves. Clamps must be installed to prevent damage to cuff.

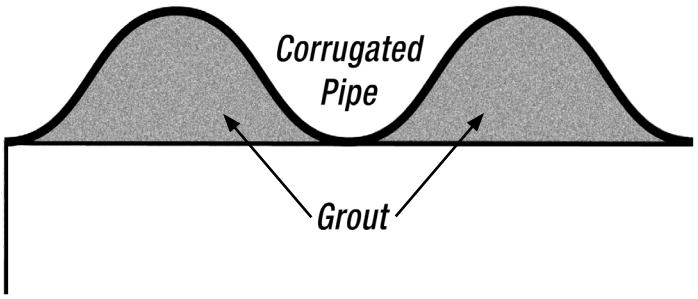


Pallet Push method for installing CheckMate® Valve

12. Corrugated Pipe and Smooth Wall (PVC, HDPE) Pipe Installation

For installation on corrugated pipe, it is recommended that the corrugations be filled with hydraulic cement (or similar material) that will provide a smooth I.D.

For smooth wall pipe, it is recommended that the valve be pinned.



CheckMate® can be made for any pipe I.D. Built to fit in sizes from 3-72" (75-1800mm).

Flange shape and bolt pattern can be customized. Flangeless thimble inserts are available.

	DIMENSIONS										
	NOMINAL PIPE SIZE I.D.		OVERALL LENGTH*		NUMBER OF CLAMPS	CUFF DEPTH		BACK PRESSURE RATING**		WEIGHT***	
	Inches	Millimeters	Inches	Millimeters		Inches	Millimeters	Feet	Meters	lbs	Kg
Low Pressure	3	75	5.1	130	1	1.5	38	10	3.0	0.7	0.3
	4	100	7.9	201	1	**1.5**	38	10	3.0	1.5	0.7
Standard Pressure	4	100	7.9	201	1	1.5	38	85	26.0	3	1.5
	5	125	9.5	241	1	1.5	38	83	25.3	4	2
	6	150	11.0	279	1	2.0	51	83	25.3	9	4
	7	175	12.8	325	1	2.0	51	79	24.1	11	5
	8	200	15.2	386	1	2.0	51	79	24.1	13	6
	9	225	15.4	391	1	2.0	51	75	22.9	17	8
	10	250	16.1	409	1	2.0	51	71	21.6	20	10
	12	300	19.8	503	1	2.0	51	68	20.1	37	17
	14	350	25.8	655	1	4.0	102	64	20.0	110	50
	15	381	25.8	655	1	4.0	102	62	18.9	120	55
	16	400	28.6	726	1	4.0	102	60	18.3	133	52
	18	450	31.0	787	1	4.0	102	56	17.1	143	65
	20	500	42.1	1069	2	8.0	203	53	16.2	223	102
	24	600	47.5	1207	2	8.0	203	45	13.7	304	137
	26	650	50.0	1270	2	8.0	203	42	12.8	370	168
	28	700	52.0	1321	2	8.0	203	40	12.2	434	197
	30	750	54.9	1395	2	8.0	203	38	11.6	500	227
	36	900	62.3	1582	2	8.0	203	30	9.1	828	376
	42	1050	70.6	1793	2	8.0	203	28	8.5	1423	646
	48	1200	79.0	2007	2	8.0	203	26	7.9	1801	817
	54	1350	86.4	2195	2	8.0	203	20	6.1	2700	1225
	60	1500	96.8	2459	2	9.0	229	18	5.5	3315	1504
	72	1800	119.0	3023	3	12.0	305	15	4.6	6100	2767

*Shorter lengths available.

**Back pressure measured from pipe invert.
Higher back pressure ratings available. Consult factory.

***Weights are approximate and do not include crating.

13. Flanged Valve Bolt Torques

The valve end with the rubber flange shall be installed using the backup rings provided. The sleeve split should be installed facing downstream, with the split in the vertical position.

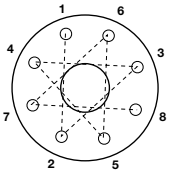
The installation bolt torque on the end flange bolts are listed in the table below.

RECOMMENDED MINIMUM BOLT TORQUE

Valve Size	Bolt Size	Torque (ft*lb.)
1”	1/2” - 13NC	20
1-1/2”	1/2” - 13NC	20
2”	5/8” - 11NC	30
2-1/2”	5/8” - 11NC	40
3”	5/8” - 11NC	40
4”	5/8” - 11NC	30
5”	3/4” - 10NC	40
6”	3/4” - 10NC	30
8”	3/4” - 10NC	40
10”	7/8” - 9NC	40
12”	7/8” - 9NC	50
14”	1” - 8NC	50
16”	1” - 8NC	50
18”	1-1/8” - 7NC	30
20”	1-1/8” - 7NC	30
24”	1-1/4” - 7NC	40
30”	1-1/4” – 7NC	30
36”	1-1/2” – 6NC	40
42”	1-1/2” – 6NC	50
48”	1-1/2” – 6NC	55
54”	1-3/4”– 5NC	60
60”	1-3/4”– 5NC	80
72”	1-3/4”– 5NC	100

Torque values are suggested minimum values.

Torque all flange bolts in a star pattern, first to 50% of tabulated values, then retorque to 100% of tabulated values. If greater torque is required, continue retorquing in increments of 50% of tabulated values. Use of a high quality anti–seize compound on all bolt threads is recommended.



Always use a “star” pattern when bolting a check valve.

Variables such as the surface finish on bolt threads, type of anti–seize compound used, and surface finish of the mating flanges all have an effect on the minimum torque required to obtain a leak–tight flange seal.

During installation you may need to retorque the flange bolts several times for a proper seal. This will overcome any leaks due to the cold flow of the rubber sleeve flange.

CheckMate® Installation Notes

1. It is important that the CheckMate® is installed level within the pipe. The CheckMate® may "gap open" if installed improperly.

2. The sealing area of the CheckMate® must have room to expand outwards, while bottom of the sealing area rises. The area around the sealing area must be kept free of debris to allow the bill to close in order for the valve to seal properly.

3. The CheckMate® effectively reduces the inside diameter of the pipe in which it is installed, creating a restriction. It may also create a "ledge" inside the pipe, causing standing water.

4. Back pressure in excess of the back pressure rating may cause valve failure.

5. Should the conditions that the CheckMate® was designed for change, (line pressure, back pressure, chemical compatibility) the performance of the valve may suffer.

6. CheckMate® Valves must be installed in true round pipe which is concentric across the entire length. Out of round pipe may cause the sealing area of the valve to distort and gap, which will cause the valve to leak.

MAINTENANCE

Inspection
Valves should occasionally be inspected for damage, wear, and buildup of debris. The frequency of the inspections should be determined by the severity of the service and the environment in which it operates.

The clamps should be checked for proper tension, and be sure that the inside of the valve is free of debris. Soft marine growth is normal on valves in submerged applications. Because hard marine growth such as barnacles will not bond well to the CheckMate®, they can be easily removed. Also insert pins to ensure they are tight.

STORAGE

If your CheckMate®, is to be stored for a period of time prior to installation, the following storage guidelines will help to preserve the valve and assure a trouble-free installation:

1. Store in a clean, cool, dry location. Avoid exposure to light, electric motors, dirt, or chemicals.
2. Store valve vertically on floor or pallet.
3. Store valve to prevent other items from contacting check sleeve to prevent possible damage.
4. Store this manual with the valve, so that it is readily available at time of installation.

TROUBLESHOOTING GUIDE

Sleeve Inverted or Distorted
1. Excessive back pressure, water surge, or water hammer.

Leaking Around Perimeter of Valve
1. Tighten clamp.
2. Check for cracks and holes in surface of pipe.
3. If taped, check tape to ensure the pipe I.D. has been fully sealed

Backflow
1. Debris lodged inside bill.

Red Valve®

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Limited Warranty

Red Valve Company (“Seller”) manufactured products, auxiliaries and parts thereof that we manufacture for a period of twenty-four (24) months from date of shipment from Seller’s factory, are warranted to the original purchaser only against defective workmanship and material, but only if properly stored, installed, operated, and serviced in accordance with Seller’s recommendations and instructions.

For items proven to be defective within the warranty period, your exclusive remedy under this limited warranty is repair or replacement of the defective item, at Seller’s option, FCA Incoterms 2020 Seller’s facility with removal, transportation, and installation at your cost.

Products or parts manufactured by others but furnished by Seller are not covered by this limited warranty. Seller may provide repair or replacement for other’s products or parts only to the extent provided in and honored by the original manufacturer’s warranty to Seller, in each case subject to the limitations contained in the original manufacturer’s warranty.

No claim for transportation, labor, or special or consequential damages or any other loss, cost or damage is being provided in this limited warranty. You shall be solely responsible for determining suitability for use and in no event shall Seller be liable in this respect.

This limited warranty does not warrant that any Seller product or part is resistant to corrosion, erosion, abrasion or other sources of failure, nor does Seller warrant a minimum length of service.

Your failure to give written notice to us of any alleged defect under this warranty within twenty (20) days of its discovery, or attempts by someone other than Seller or its authorized representatives to remedy the alleged defects therein, or failure to return product or parts for repair or replacement as herein provided, or failure to store, install, or operate said products and parts according to the recommendations and instructions furnished by Seller shall be a waiver by you of all rights under this limited warranty.

This limited warranty is voided by any misuse, modification, abuse or alteration of Seller’s product or part, accident, fire, flood or other Act of God, or your failure to pay entire contract price when due.

The foregoing limited warranty shall be null and void if, after shipment from our factory, the item is modified in any way or a component of another manufacturer, such as but not limited to; an actuator is attached to the item by anyone other than a Seller factory authorized service personnel.

All orders accepted shall be deemed accepted subject to this limited warranty, which shall be exclusive of any other or previous warranty, and this shall be the only effective guarantee or warranty binding on Seller, despite anything to the contrary contained in the purchase order or represented by any agent or employee of Seller in writing or otherwise, notwithstanding, including but not limited to implied warranties.

THE FOREGOING REPAIR AND REPLACEMENT LIMITED WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, OBLIGATIONS AND LIABILITIES, INCLUDING, BUT NOT LIMITED TO, ALL WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE OR OF MERCHANTABILITY OR OTHERWISE, EXPRESSED OR IMPLIED IN FACT OR BY LAW, AND STATE SELLER’S ENTIRE AND EXCLUSIVE LIABILITY AND YOUR EXCLUSIVE REMEDY FOR ANY CLAIM IN CONNECTION WITH THE SALE AND FURNISHING OF SERVICES, GOODS OR PARTS, THEIR DESIGN, SUITABILITY FOR USE, INSTALLATION OR OPERATIONS. NEITHER ANY PERFORMANCE OR OTHER CONDUCT, NOR ANY ORAL OR WRITTEN INFORMATION, STATEMENT, OR ADVICE PREPARED BY SELLER OR ANY OF OUR EMPLOYEES OR AGENTS WILL CREATE A WARRANTY, OR IN ANY WAY INCREASE THE SCOPE OR DURATION OF THIE LIMITED WARRANTY.

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IN NO EVENT SHALL SELLER BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, PUNITIVE, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, DAMAGE TO OR LOSS OF OTHER PROPERTY OR EQUIPMENT, BUSINESS INTERUPTION, COST OF SUBSTITUTE PRODUCTS, LOSS OF TIME, LOSS PROFITS OR REVENUE, COST OF CAPITAL, LOSS OF USE, OR DIMINUTION IN VALUE) WHATSOEVER, AND SELLER’S LIABILITY, UNDER NO CIRCUMSTANCES, WILL EXCEED THE CONTRACT PRICE FOR THE GOODS AND/OR SERVICES FOR WHICH LIABILITY IS CLAIMED. ANY ACTION FOR BREACH OF CONTRACT BY YOU, OTHER THAN RIGHTS RESPECTING OUR LIMITED WARRANTY DESCRIBED ABOVE, MUST BE COMMENCED WITHIN 12 MONTHS AFTER THE DATE OF SALE.

Sales and Service

For information about our worldwide locations, approvals, certifications and local representative:

Web site: RedValve.com E-Mail: support@redvalve.com

Red Valve®

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Red Valve Company reserves the right to incorporate our latest design and material changes without notice or obligation. Design features, materials of construction and dimensional data, as described in this manual, are provided for your information only and should not be relied upon unless confirmed in writing by Red Valve Company. Certified drawings are available upon request.

February 2023

CD150M Dri-Prime® Pump

WITH FINAL TIER 4 (FT4) DIESEL ENGINE

The Godwin Dri-Prime CD150M pump offers flow rates to 2290 USGPM and has the capability of handling solids up to 3.0" in diameter.

The CD150M is able to automatically prime to 28' of suction lift from dry. Automatic or manual starting/stopping available through integral mounted control panel or optional wireless-remote access.

Indefinite dry-running is no problem due to the unique Godwin liquid bath mechanical seal design. Solids handling, dry-running, and portability make the CD150M the perfect choice for dewatering and bypass applications.



Features and Benefits

- Simple maintenance normally limited to checking fluid levels and filters.
- Dri-Prime (continuously operated Venturi air ejector priming device) requiring no periodic adjustment. Optional compressor clutch available.
- Extensive application flexibility handling sewage, slurries, and liquids with solids up to 3.0" in diameter.
- Dry-running high pressure liquid bath mechanical seal with high abrasion resistant solid silicon carbide faces.
- Close-coupled centrifugal pump with Dri-Prime system coupled to a diesel engine or electric motor.
- All cast iron construction (stainless steel construction option available) with cast steel impeller.
- Also available in a critically silenced unit which reduces noise levels to less than 70 dBA at 30'.
- Standard engine JCB TCAE-55 (FT4). Also available with John Deere 4045TFC03 (FT4).

Specifications

Suction connection	6" 150# ANSI B16.5
Delivery connection	6" 150# ANSI B16.5
Max capacity	2290 USGPM †
Max solids handling	3.0"
Max impeller diameter	11.0"
Max operating temp	176°F*
Max working pressure	70 psi
Max suction pressure	58 psi
Max casing pressure	104 psi
Max operating speed	2200 rpm

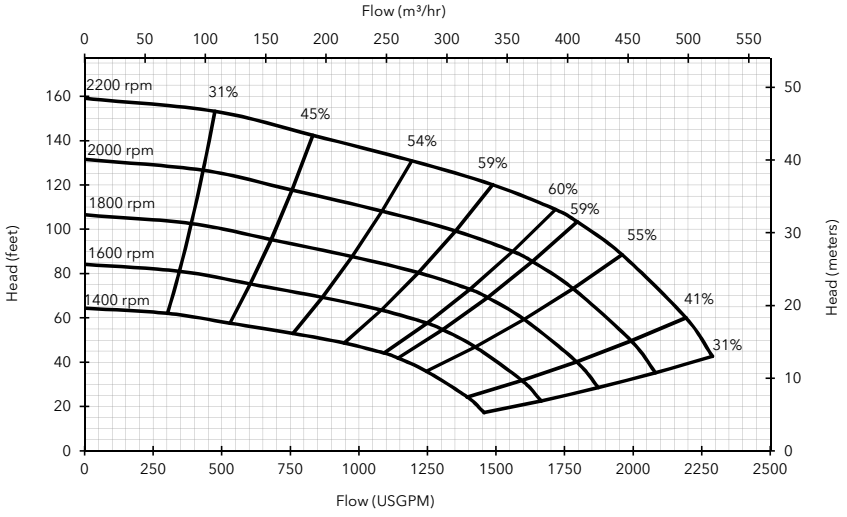
* Please contact our office for applications in excess of 176°F.

† Larger diameter pipes may be required for maximum flows.

Please contact the factory or office for further details. A typical picture of the pump is shown.
All information is approximate and for general guidance only.

godwin
a xylem brand

Performance Curve



Materials

Pump casing & suction cover	Cast iron BS EN 1561 - 1997
Wearplates	Cast iron BS EN 1561 - 1997
Pump Shaft	Carbon steel BS 970 - 1991 817M40T
Impeller	Cast Steel BS3100 A5 Hardness to 200 HB Brinell
Non-return valve body	Cast iron BS EN 1561 - 1997
Mechanical seal	Silicon carbide face; Viton elastomers; Stainless steel body

Engine option 1

JCB TCAE-55 (FT4), 74 HP @ 2200 rpm

Impeller diameter 11.0"

Pump speed 2200 rpm

Suction Lift Table

Total Suction Head (feet)	Total Delivery Head (feet)				
	30	46	62	81	121
	Output (USGPM)				
10	2179	2131	2083	1889	1356
15	2058	1937	1816	1574	1162
20	1453	1453	1453	1332	848
25	1259	1211	1114	969	484

Fuel capacity: 60 US Gal

Max fuel consumption @ 2200 rpm: 4.5 US Gal/hr

Max fuel consumption @ 1800 rpm: 2.4 US Gal/hr

Weight (Dry): 3,200 lbs

Weight (Wet): 3,630 lbs

Dim.: (L) 119" x (W) 66" x (H) 77"

Performance data provided in tables is based on water tests at sea level and 20°C ambient. All information is approximate and for general guidance only. Please contact the factory or office for further details.

Engine option 2

John Deere 4045TFC03 (FT4), 74 HP @ 2200 rpm

Impeller diameter 11.0"

Pump speed 2200 rpm

Suction Lift Table

Total Suction Head (feet)	Total Delivery Head (feet)				
	30	46	62	81	121
	Output (USGPM)				
10	2179	2131	2083	1889	1356
15	2058	1937	1816	1574	1162
20	1453	1453	1453	1332	848
25	1259	1211	1114	969	484

Fuel capacity: 60 US Gal

Max fuel consumption @ 2200 rpm: 5.2 US Gal/hr

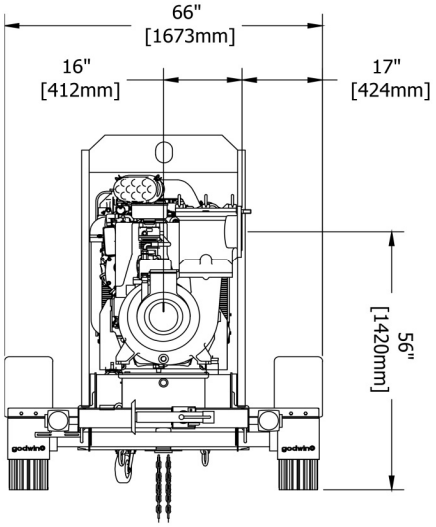
Max fuel consumption @ 1800 rpm: 2.6 US Gal/hr

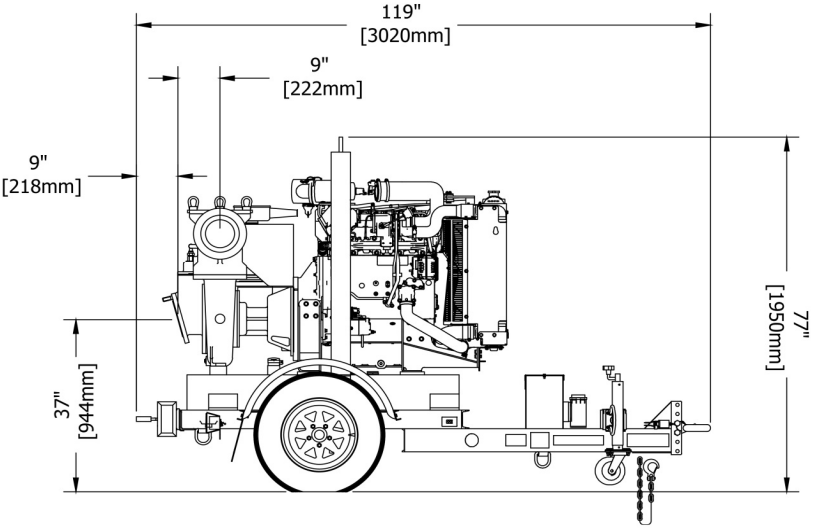
Weight (Dry): 3,180 lbs

Weight (Wet): 3,610 lbs

Dim.: (L) 119" x (W) 66" x (H) 91"

Performance data provided in tables is based on water tests at sea level and 20°C ambient. All information is approximate and for general guidance only. Please contact the factory or office for further details.





xylem
Let's Solve Water

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Reference number : 200GPA0000980
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Issue : -

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Appendix E: Geotechnical Report

Geotechnical Report (prepared by Columbia West)

Initial Infiltration Testing Map and Results

Additional Infiltration Testing Preliminary Results

Additional Infiltration Test Pit Logs

Additional Infiltration Testing Map and Results

Geotechnical Site Investigation

Landing on the Cowlitz

Castle Rock, Washington

March 30, 2023

Geotechnical ■ Environmental ■ Special Inspections

Columbia West

Engineering, Inc

11917 NE 95th Street
Vancouver, Washington
98682
Phone: 360-823-2900



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GEOTECHNICAL SITE INVESTIGATION
LANDING ON THE COWLITZ
CASTLE ROCK, WASHINGTON

Prepared For:

CT6, LLC
Attn: Janette Pipkin
PO Box 1419
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Site Location:

2542 SW Larson Lane
Parcel Nos. 3092824, 3040258, 3040259, 3040322, 3014867, & 3045031
Castle Rock, Washington

Prepared By:

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Date Prepared:

March 30, 2023

EXECUTIVE SUMMARY

This executive summary presents the primary geotechnical considerations associated with the proposed Landing on the Cowlitz project located in Castle Rock, Washington. Our conclusions and recommendations are based upon the subsurface information presented in this report and proposed development information provided by the design team. Detailed discussion of the geotechnical considerations summarized here is presented in respective sections of the report.

- Based on subsurface exploration and testing, liquefiable soil is present at the site. Maximum total liquefaction settlement is estimated to range from approximately 4 to 7 inches. Differential settlement is estimated to be approximately one-half of the total over a 50-foot span. Detailed discussion of site liquefaction potential is presented in Section 6.1, *Liquefaction*.
- Review of *Table 12.13-3* of *ASCE 7-16* indicates that anticipated seismic differential settlement will be near the upper bound, tolerable limit for typical structures that may be proposed on the site. Provided that proposed structures can tolerate the estimated seismic settlement, the buildings can be supported on conventional spread footings bearing on firm native soil or engineered structural fill. Shallow foundations, if proposed, will require foundations ties if differential settlement exceeds one-quarter of the thresholds presented in *Table 12.13-3*. Ground improvement or deep foundations may be necessary if buildings cannot tolerate the estimated seismic settlement or if project stakeholders desire to minimize risk of building damage following a seismic event.
- Groundwater was observed in site explorations at depths ranging from 9 to 35 feet below ground surface (bgs). The shallow depth to groundwater may impact site cuts for foundations, utilities, pump stations, and stormwater detention ponds. Dewatering should be assumed where proposed excavations extend more than a few feet below existing grade. Significant excavation depths for the proposed pump station and potential for rapid groundwater flow through permeable sand and gravel deposits will dictate the need for a robust dewatering plan designed by a licensed professional engineer.
- Based on groundwater conditions and expected site grading, cut off drains may be required to intercept water in areas of significant cut. Our experience indicates that installation of cut-off drains prior to site grading activity will assist in dewatering during site construction, particularly during the wet-weather season.
- Perimeter building foundation drains can reduce the potential for water intrusion below structures. Perimeter footing drains are recommended for shallow foundations constructed 5 or more feet below existing site grades. Foundations constructed less than 5 feet below existing grades do not require drains, however,

it may be prudent to install foundations drains to collect incidental or perched water. The final decision for foundations drains should be made by the owner and architect.

- Moisture conditioning will be required to use onsite soil as structural fill. If moisture conditioning is not feasible due to weather conditions or other factors, soils may require cement-amendment to be used as structural fill.
- Near-surface native soils will be sensitive to disturbance and softening when at a moisture content that is above optimum. Haul roads and staging areas will be necessary to minimize damage to exposed subgrade soils during construction. Subgrade protection is discussed in Section 8.2, *Construction Traffic and Staging*.
- Design and construction of proposed stormwater management facilities should account for shallow groundwater conditions observed at the site.
- This report has been prepared to provide general recommendations for overall site development. We recommend additional explorations and geotechnical reports be completed for specific developments/structures prior to design and construction.

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GEOTECHNICAL SITE INVESTIGATION
LANDING ON THE COWLITZ
CASTLE ROCK, WASHINGTON

1.0 INTRODUCTION

Columbia West Engineering, Inc. (Columbia West) was retained by CT6, LLC to conduct a geotechnical site investigation for the proposed Landing on the Cowlitz master development project located in Castle Rock, Washington. The purpose of the investigation was to provide geotechnical engineering recommendations for use during design and construction of the proposed development. This report summarizes the investigation and provides field assessment documentation. This report is subject to the limitations expressed in Section 9.0, *Conclusion and Limitations*, and Appendix D, *Report Limitations and Important Information*.

1.1 General Site Information

As indicated on Figures 1 and 2, the subject site is located at 2542 Larson Lane in Castle Rock, Washington. The site is comprised of tax parcels 3092824, 3040258, 3040259, 3040322, 3014867, and 3045031 totaling approximately 118.2 acres. The approximate latitude and longitude are N 45° 15' 25" and W 122° 53' 30", and the legal description includes portions of the SE ¼ of Section 14, the NE ¼ of Section 23, and the NW ¼ of Section 24, T9N, R2W, Willamette Meridian. The regulatory jurisdictional agency is the City of Castle Rock.

1.2 Project Understanding

Based on client correspondence and review of the preliminary master development plan shown on Figure 3, Columbia West understands that proposed development consists of a mixed-use district with approximately 7.8 acres of residential zoning, 9.5 acres of commercial zoning, 18.3 acres of recreational zoning, and 55.9 acres of light industrial and office space zoning. Proposed development also includes public roadway construction, installation of underground utilities, and stormwater management facilities. A sanitary sewer pump station is also proposed approximately 35 feet below ground surface. The *Phase 1 Rough Grading Plan*, presented on Figure 4, includes cuts and fills up to 10 feet.

Lot- and zoning-specific building plans were not available at the time this report was prepared. In general, buildings on the site are expected to be lightly-loaded and less than three stories in height. We anticipate that commercial, recreational, and light industrial areas will include concrete tilt-up or metal-framed buildings. Residential structures will likely be of wood-framed construction. We should be contacted to revise our recommendations if the assumptions stated above are incorrect.

1.3 Site Background Information

Columbia West was retained by CT6, LLC in October, 2022 to provide on-call geotechnical construction monitoring and material testing services during Phase I rough grading as shown

on Figure 4. On-call geotechnical services conducted between October, 2022 and January, 2023 included organic stripping observations, moisture-density testing of structural fill, proof-roll observations, bearing probe analysis, and laboratory testing. Field reports documenting Phase I grading activity were submitted to project team members under separate cover. Columbia West also prepared preliminary grading recommendations for the Phase I rough grading plan which is presented in a technical memorandum dated November 8, 2022 (Columbia West, 2022). At the time this report was prepared, Phase I rough grading was in progress with expected completion in summer of 2023.

To characterize site groundwater conditions and facilitate stormwater management design by others, Columbia West oversaw five borings at the site with piezometer installations (BP-1 through BP-5) on January 31, February 1, and February 2, 2023. Piezometers extended up to 35 feet below existing grade, were backfilled with silica sand, sealed with bentonite, and completed with flush mount monuments. Monitoring of the piezometers commenced in February, 2023 and continues on a bi-weekly basis at the direction of the design team. Piezometer monitoring results are discussed in greater detail in Section 5.2.2, *Groundwater*.

Prior to Phase I rough grading, a geotechnical due-diligence study of the site was conducted by others in 2020. Field exploration and testing conducted as part of the due-diligence study included six test pits (TP-1 through TP-6), two borings (B-1 and B-2), and five cone penetration tests (CPT-1 through CPT-5) extending to a maximum depth of 81.5 feet bgs. Exploration locations are shown on Figure 2. Exploration logs and CPT soundings are presented in Appendix C, *Pertinent Subsurface Information Collected by Others*. Subsurface conditions observed by others during the due-diligence study are discussed in Section 5.2.1, *Soil Type Description*.

2.0 SCOPE OF SERVICES

Columbia West's scope of services was outlined in a proposal dated November 8, 2022. In accordance with our proposal, we performed the following geotechnical services:

- Reviewed information available in our files from previous geological and geotechnical studies conducted at and in the vicinity of the site. Our review included the following site explorations conducted by others and presented in Appendix C, *Pertinent Subsurface Information Collected by Others*:
    - Five CPT soundings explored to a maximum depth of 35.43 feet bgs.
    - Two borings explored to a maximum depth of 81.5 feet bgs.
    - Six test pits explored to a maximum depth of 13 feet bgs.
- Reviewed the preliminary master development plan, the Phase I rough grading plan, and a conceptual stormwater management plan provided by the design team.
- Conducted subsurface exploration at the site, to include:
    - Drilled five borings to a maximum depth of 45 feet bgs and installed piezometers in each borehole.
- Classified and logged observed soil and groundwater conditions.

- Prepared this geotechnical site investigation report for the proposed development, which includes:
  - Summary of soil index properties, regional geology, soil conditions, and observed groundwater conditions
  - Summary of geologic and seismic literature research used to evaluate relevant seismic risks, including locations of faults, earthquake magnitudes, and seismic factors from the *2018 IBC* and *ASCE 7-16*
  - Liquefaction analysis, predicted seismic settlement, and mitigation discussion
  - Foundation settlement potential
  - Geotechnical design and construction recommendations for:
    - Shallow foundations
    - Slab subgrade preparation
    - Retaining walls, including drainage, backfill, and lateral earth pressures
    - Site preparation and grading, organic stripping, fill placement and compaction, over-excavation, wet/dry weather earthwork, and construction monitoring and testing
    - Structural fill materials, onsite soil suitability, and import aggregate specifications
    - Utility trench excavation and backfill
    - Drainage and management of groundwater conditions
    - Asphaltic concrete pavement construction for private access roads and parking lots, including section thicknesses for base aggregate and asphalt layers
    - Portland cement concrete pavement construction for loading docks, including section thicknesses for base aggregate and PCC layers
    - Code-based seismic design parameters in accordance with *ASCE 7-16*

3.0 REGIONAL GEOLOGY AND SOIL CONDITIONS

The subject site lies within the Cowlitz River drainage basin, a physiographic river valley flanked to the east and west by mountainous foothills of the western Cascade Range. The site is located along the east bank of the Cowlitz River, approximately 11 miles north of the confluence with the Columbia River in Longview, Washington.

According to the *Geologic Map of the Mount St. Helens Quadrangle, Washington and Oregon* (Phillips, USGS Open File Report 87-4, 1987), near-surface soils are expected to consist of Quaternary-aged alluvium of silt, sand, and gravel deposited by the Cowlitz River. The Cowlitz Formation is mapped below the alluvium and consists of Eocene-aged sandstone, siltstone, and shale with interbeds of basalt and conglomerate.

In areas proposed for development, the *Web Soil Survey* (USDA, NRCS, 2023 Website) identifies various loamy sands, fine sandy loams, and gravelly sands of the Newberg, Carrolls, Pilchuck, Panamaker, and Cowlitz soil series. The mapped soils generally consist of silts, sands, and gravels with moderately rapid to rapid permeability, low to moderate

water capacity, and low shrink-swell potential. These soils exhibit a slight to severe erosion hazard based primarily on slope grade. As discussed in Section 1.3, *Site Background Information*, surface soils at the site have been disturbed, moved, or manipulated as part of Phase I rough grading activity and may no longer be representative of the NRCS soil survey mapping.

4.0 REGIONAL SEISMOLOGY

Recent research and subsurface mapping investigations within the Pacific Northwest appear to suggest the historic potential risk for a large earthquake event with strong localized ground movement may be underestimated. Past earthquakes in the Pacific Northwest appear to have caused landslides and ground subsidence, in addition to severe flooding near coastal areas. Earthquakes may also induce soil liquefaction, which occurs when elevated horizontal ground acceleration and velocity cause soil particles to interact as a fluid as opposed to a solid. Liquefaction of soil can result in lateral spreading and temporary loss of bearing capacity and shear strength. Liquefaction is discussed later in Section 5.9, *Liquefaction*.

Three scenario earthquakes are possible with the local seismic setting. Two of the possible earthquake sources are associated with the CSZ, and the third event is a shallow, local crustal earthquake that could occur in the North American Plate. The three earthquake scenarios are discussed below.

Cascadia Subduction Zone

The Cascadia Subduction Zone is a potential source of strong earthquake activity in the Portland/Vancouver Basin. This phenomenon is the result of the earth's large tectonic plate movement. Geologic evidence indicates that volcanic ocean floor activity along the Juan de Fuca ridge in the Pacific Ocean causes the Juan de Fuca Plate to perpetually move east and subduct under the North American Continental Plate. The subduction zone results in historic volcanic and potential earthquake activity in proximity to the plate interface, believed to lie approximately 20 to 50 miles west of the general location of the Oregon and Washington coast (Geomatrix Consultants, 1995).

Evidence suggests that this subduction zone has generated eight great earthquakes in the last 4,000 years, with the most recent event occurring approximately 300 years ago (Weaver and Shedlock, 1991).

Two types of subduction zone earthquakes are possible and considered in this report:

1. An interface event earthquake on the seismogenic part of the interface between the Juan de Fuca Plate and the North American Plate on the CSZ. This source is capable of generating earthquakes with a moment magnitude of 9.0.
2. A deep intraplate earthquake on the seismogenic part of the subducting Juan de Fuca Plate. These events typically occur at depths of between 30 and 60 km. This source is capable of generating an event with a moment magnitude of up to 8.0.

Crustal Events

An earthquake could also occur on a local fault within the North American Plate. The nearest mapped crustal faults are more than 40 miles from the site, and based on deaggregation at the anticipated fundamental period of planned structures, contribute less than one percent of the overall seismic hazard at the site. Therefore, significant ground shaking as a result of crustal faults is anticipated to be minimal.

5.0 GEOTECHNICAL AND GEOLOGIC FIELD INVESTIGATION

This geotechnical site investigation is based upon five borings drilled by Columbia West (BP-1 through BP-5), visual site reconnaissance, construction monitoring observations as previously described, and review of pertinent subsurface information collected by others. Borings BP-1 through BP-5 were explored with a track-mounted drill rig on January 31, February 1, and February 2, 2023. Subsurface soil profiles were logged in accordance with Unified Soil Classification System (USCS) specifications. Disturbed soil samples were collected at representative depth intervals. Exploration locations are shown on Figure 2. Subsurface exploration logs are presented in Appendix A, *Subsurface Exploration Logs*. Soil descriptions and classification information are provided in Appendix B, *Soil Classification Information*.

Subsurface information collected by others and reviewed as part of this investigation included six test pit logs (TP-1 through TP-6), two boring logs (B-1 and B-2), and results from five cone penetrations tests (CPT-1 through CPT-5). As reported on the logs provided in Appendix C, *Pertinent Subsurface Information Collected by Others*, test pits TP-1 through TP-6 were explored with a mini-excavator on January 14, 2020. Borings B-1 and B-2 were explored with a truck-mounted, mud-rotary drill rig on February 13 and 14, 2020. CPT-1 through CPT-5 were explored on January 13 and 14, 2020 with a cone penetrometer rig.

5.1 Surface Investigation and Site Description

The approximate 108.2-acre subject site consists of six tax parcels located at 2542 Larson Lane in Castle Rock, Washington. The site is generally flat to gently rolling and situated on an alluvial plain between the Cowlitz River and Interstate 5. As discussed in Section 1.3, *Site Background Information*, the site is currently under construction and being actively graded per the Phase I rough grading plan shown on Figure 4.

Surface conditions in large portions of the site consist of exposed sand and gravel associated with recent cuts and fills throughout the property. Other areas of the site remain unstripped and covered with grass. Observed trees on the site were generally limited to the site perimeter or wetland area. In the central portion of the site, a single-family residential structure and several agricultural outbuildings were observed. Stockpiles of soil, organic material, and demolition debris were observed in the vicinity of the existing structures.

As indicated on Figures 3 and 4, the proposed stormwater conveyance channel along the southern and eastern portion of the site is currently under construction. Surface water flow was observed in the channel during drilling of BP-1 through BP-5. Surface water flow appeared to trend east and north towards a temporary sediment pond located adjacent to

the wetland. Standing water was observed within the pond cells at the time of drilling. Stockpiles of organic material and disturbed soil were also observed near the temporary ponds.

5.2 Subsurface Conditions

Borings were advanced to a maximum depth of 81.5 feet bgs. CPTs were advanced to a maximum depth of 35.43 feet bgs. Test pits were advanced to a maximum depth of 13 feet bgs. Exploration locations are shown on Figure 2. Field logs and observed stratigraphy for encountered materials are presented in Appendix A, *Subsurface Exploration Logs* and Appendix C*, Pertinent Subsurface Information Collected by Others*.

5.2.1 Soil Type Description

As previously described, large portions of the site have been stripped of vegetation as part of Phase I rough grading activity. Boring BP-1 was explored through fill material consisting of sand with gravel. Borings BP-2, BP-3, and BP-5 were explored through apparent native soil consisting of sand with gravel. Boring BP-4 was explored through grass and a three-inch-thick root zone underlain by approximately 12 inches of topsoil. Below surface soil, fill material, and the topsoil layer, alluvial silt, sand, and gravel was observed to an approximate depth 45 feet. Review of boring logs B-1 and B-2 indicates that the alluvium extends up to 81.5 feet bgs. Subsurface lithology may generally be described by the soil units identified in the following text.

Topsoil

Topsoil below the vegetation root zone generally consists of silty sand with a low organic content. Review of test pits logs TP-1 through TP-6 indicates that organic topsoil may extend up to 36 inches below existing grade in unstripped portions of the site.

Structural Fill

Structural fill associated with Phase I rough grading is present on the site and generally consists of dense sand with gravel. The depth of fill is variable and actively changing during site improvements construction. Upon completion of Phase I rough grading, fill thickness, site topography, and finished grade elevations may be represented by the contours shown on Figure 4. As the on-call construction monitoring and material testing firm for the project, Columbia West has conducted moisture-density testing, proof-roll observations, and third-party oversight during Phase I rough grading. Observed and tested fill materials meet typical specifications for engineering structural fill and were placed in general conformance with the recommendations outlined in Columbia West's preliminary grading memorandum (Columbia West, 2022).

Upper Sand

Underlying surface soils, topsoil layers, and structural fill, loose to medium dense sand was encountered and extended to approximate depths of 17 to 35 feet bgs. The sand is moist to wet and contains interbedded layers and lenses of silt and clay. The silt and clay interbeds range from very soft to medium stiff in consistency.

Upper Gravel

The upper sand layer is underlain by medium dense to very dense gravel with varying proportions of sand, silt, and clay. The gravel is wet and rounded to sub-rounded. Review of boring logs B-1 and B-2 indicate that the gravel layer is approximately 20 to 25 feet thick and extends to depths of 38 to 40 feet bgs in the drilled locations. Cone penetration tests CPT-1 through CPT-5 encountered practical refusal on the upper gravel unit.

Lower Sand and Gravel

The upper gravel layer is underlain by medium dense to dense sand with gravel and trace silt. The sand is fine-textured and wet and extends to depths of 66 and 55.5 feet bgs respectively in borings B-1 and B-2. The sand is underlain by dense to very dense gravel with sand and trace silt. The gravel extends to the maximum explored depth of 81.5 feet bgs in B-1 and to a depth of 63.5 feet bgs in B-2.

Silt

Underlying the lower gravel layer in B-2, medium stiff to very stiff silt was encountered and extended to the maximum explored depth of 81.5 feet bgs. The silt is wet with trace clay and organic debris.

5.2.2 Groundwater

Groundwater was encountered in borings BP-1 through BP-5 at depths ranging from 15 to 35 feet bgs. Groundwater was reported at depths between 9 and 15 feet bgs on the exploration logs prepared by others and presented in Appendix C, *Pertinent Subsurface Information Collected by Others*. As discussed in Section 1.3, *Site Background Information*, Columbia West installed open standpipe piezometers in BP-1 through BP-5 to further characterize site groundwater conditions. Monitoring of the piezometers commenced in February, 2023 and continues on a bi-weekly basis at the direction of the design team. Groundwater monitoring results collected to date are presented in Table 1. Groundwater elevations are based upon piezometer rim survey data provided by Mackay Sposito. Upon completion of groundwater monitoring, the piezometers should be decommissioned by a licensed contractor in accordance with Washington Department of Ecology regulations.

Table 1. Piezometer Monitoring Data

Location	Measurement Date			
	2-13-23	2-20-23	3-2-23	3-20-23
BP-1	18.8 ft bgs Elev. 27.6 ft	18.1 ft bgs Elev. 28.3 ft	18.0 ft bgs Elev. 28.4 ft	18.0 ft bgs Elev. 28.4 ft
BP-2	36.5 ft bgs Elev. 28.1 ft	36.6 ft bgs Elev. 28.0 ft	36.6 ft bgs Elev. 28.0 ft	37.7 ft bgs Elev. 26.9 ft
BP-3	12.3 ft bgs Elev. 28.4 ft	12.4 ft bgs Elev. 28.3 ft	12.3 ft bgs Elev. 28.4 ft	12.2 ft bgs Elev. 28.5 ft

BP-4	12.1 ft bgs Elev. 29.3 ft	12.3 ft bgs Elev. 29.1 ft	12.5 ft bgs Elev. 28.9 ft	12.5 ft bgs Elev. 28.9 ft
BP-5	18.8 ft bgs Elev. 27.4 ft	17.3 ft bgs Elev. 28.9 ft	16.3 ft bgs Elev. 29.9 ft	17.3 ft bgs Elev. 28.9 ft

Note that groundwater levels are subject to seasonal variance and may rise during extended periods of increased precipitation. Groundwater elevations may also be influenced by fluctuations of the adjacent Cowlitz River. Perched groundwater may also be present in localized areas. Seeps and springs may become evident during site grading, primarily along slopes or in areas cut below existing grade. Structures, pavements, and drainage design should be planned accordingly.

6.0 SEISMIC HAZARDS

6.1 Liquefaction

Liquefaction is caused by a rapid increase in pore water pressure that reduces the effective stress between soil particles to near zero. Granular soil, which relies on interparticle friction for strength, is susceptible to liquefaction until the excess pore pressures can dissipate. In general, loose, saturated sand with low silt and clay content is most susceptible to liquefaction. Silty soil with low plasticity is moderately susceptible to liquefaction under relatively higher levels of ground shaking.

Liquefaction analysis at the site was performed by evaluating CPT data in the upper sand layer and standard penetration test (SPT) data in the lower sand layer. Results were combined to estimate the total anticipated seismic settlement. Analysis was conducted using methods developed by Boulanger and Idriss (2014) and Robertson (2009) with application of the depth weighting method published by Cetin (2009). A static groundwater level of 9 feet bgs was used in the liquefaction analysis.

Liquefaction analysis indicates that the upper sand layer and portions of the lower sand layer are susceptible to liquefaction under design levels of ground shaking. Total estimated seismic settlement at ground surface in the locations of CPT-1 through CPT-3 and CPT-5 is 4 to 5 inches. Total estimated seismic settlement at the location of CPT-4 is 7 inches. Differential settlement is estimated to be approximately one-half of the total settlement over a 50-foot span. Most of the seismic settlement is in the upper sand layer with the lower sand layer contributing approximately 0.5 to 1.0 inch to the total estimate. Note that the increased magnitude of settlement at CPT-4 reflects that the upper sand layer was observed to be approximately 10 to 15 feet thicker than elsewhere on the site.

Total seismic settlement estimates are likely near the upper bound tolerable limit for typical buildings that may be proposed on the site. Differential settlement thresholds for various building types and risk categories are provided in *Table 12.13-3* of *ASCE 7-16*. The thresholds presented in *Table 12.13-3* are code-specified minimum requirements and buildings may remain susceptible to damage if designed near the upper limits. Structural engineers on the project should calculate the allowable settlement tolerance and expected

performance based upon the specific building types proposed. Provided a building can tolerate the seismic settlement presented above, the structure may be supported by conventional spread footings bearing on firm native soil or engineered structural fill. Shallow foundations, if proposed, will require foundation ties if differential seismic settlement exceeds one-quarter of the thresholds presented in *Table 12.13-3*.

6.1.1 Liquefaction Mitigation

If proposed buildings cannot tolerate the estimated seismic settlement or project stakeholders desire to minimize risk of building damage, the upper sand layer may be improved to reduce the total seismic settlement. Rammed aggregate piers (RAPs) that extend to, and bear on the upper gravel layer are a viable option for ground improvement. RAPs are proprietary technology that are designed and constructed by design-build specialty contractors. The RAPs would need to be at least 17 to 35 feet long to penetrate through the upper sand layer and bear on the upper gravel unit. Additionally, the design-build contractor should provide analysis that shows rammed aggregate piers will support the structures when surrounding soil strength is reduced as a result of liquefaction. A design-build contractor should be contacted to provide the actual RAP configurations based on building serviceability and performance requirements. We anticipate that a RAP foundation system can be installed to meet the settlement criteria for site buildings. Installation of driven grout piles or standard steel or concrete piles may also be considered to mitigate seismic settlement at the site.

Soil improvements may reduce potential seismic settlement to an acceptable level of risk. If ground improvement utilizing RAPs is selected, additional in-situ testing and liquefaction analysis should be conducted following installation to determine the level of improvement achieved. Improved seismic settlement in the upper sand layer should be combined with results from the unimproved lower sand layer to determine the total seismic settlement following mitigation.

Selection of an appropriate mitigation plan may depend upon site planning, architectural, and structural engineering factors in addition to geotechnical concerns. All parties involved should work closely together to develop a suitable improvement plan with a clear understanding of the risks.

6.2 Lateral Spreading

Lateral spreading is a liquefaction-related seismic hazard that occurs on gently sloping or flat sites underlain by liquefiable sediment adjacent to an open face, such as a riverbank. Liquefied soil adjacent to an open face can flow toward the open face, resulting in lateral ground displacement.

Due to the presence of liquefiable soils at the site, lateral spreading is possible near the Cowlitz River. The magnitude of lateral spreading will be based on the depth of the river channel and distance between proposed structural improvements and the river. Tolerable lateral spread limits for shallow foundations in specific risk categories are presented in *ASCE 7-16, Table 12.13-2*. Lateral spreading is not anticipated to be a design consideration within approximately 300 feet of the riverbank because structures are not proposed in this

area. If structures are planned within 300 feet of the riverbank, Columbia West should be contacted to conduct additional analysis.

7.0 DESIGN RECOMMENDATIONS

The geotechnical site investigation suggests the proposed development is generally compatible with surface and subsurface soils, provided the recommendations presented in this report are incorporated in design and implemented during construction. The primary geotechnical considerations for the project were summarized previously in the *Executive Summary*. Specific design and construction recommendations are presented in the following sections.

7.1 Shallow Foundation Support

As discussed in Section 1.2, *Project Understanding*, lot- and zoning-specific building plans were not available at the time this report was prepared. We anticipate that future buildings will be lightly-loaded, less than three stories in height, and will consist of metal-framed, wood-framed, or concrete tilt-up construction. Provided that proposed buildings can tolerate the seismic settlement estimates presented in Section 6.1, *Liquefaction*, structures may be supported by shallow foundations bearing on firm native soil or engineered structural fill.

We anticipate maximum column and wall loads for future buildings will be less than 200 kips and 5 kips per foot, respectively. Floor slab loading is expected to be less than 200 psf. If actual loading exceeds anticipated loading, additional analysis should be conducted for the specific load conditions and proposed footing dimensions.

Foundations should not be supported by topsoil, agricultural till zones, or undocumented fill material. If encountered, these materials should be improved or removed and replaced with structural fill. If footings are constructed during wet-weather conditions or when footing subgrade soils are above their optimum moisture content, we recommend that a minimum of 6 inches of compacted aggregate be placed over exposed subgrade soils. The aggregate pad should extend 6 inches beyond the edge of the foundations and consist of imported granular material as described in Section 8.1.1, *Structural Fill*. Columbia West should observe exposed subgrade conditions prior to placement of crushed aggregate to verify adequate subgrade support.

Perimeter foundation drains are recommended for shallow foundations constructed five or more feet below existing site grades. Foundation drainage is discussed later in Section 7.5, *Drainage*.

7.1.1 Footing Dimensions and Bearing Capacity

Continuous perimeter wall and isolated spread footings should have minimum width dimensions of 18 and 24 inches, respectively. The base of exterior footings should bear at least 18 inches below the lowest adjacent exterior grade. The base of interior footings should bear at least 12 inches below the base of the floor slab.

Footings bearing on subgrade prepared as recommended above should be sized based on an allowable bearing pressure of 2,500 psf. As the allowable bearing pressure is a net bearing pressure, the weight of the footing and associated backfill may be ignored when

calculating footing sizes. The recommended allowable bearing pressure applies to the total of dead plus long-term live loads and may be increased by 50 percent for transient lateral forces such as seismic or wind.

7.1.2 Shallow Foundation Settlement

Foundation settlement is a significant structural design consideration. Provided subgrade soils are prepared as described in Section 8.1, *Site Preparation and Grading*, we anticipate that total post-construction static foundation settlement will be less than approximately 1 inch. Differential settlement between comparably-loaded footing elements is not expected to exceed approximately 0.5 inch over a span of 50 feet.

Estimated post-construction settlement assumes that settlement will occur after site grading and slab construction and before establishing structural connections between the building roof and foundation elements. In areas of large column spacing (greater than 50 feet) or where building footprints span significant differences in cut and fill, the potential for differential settlement exceeding the predicted settlement should be understood.

As discussed in Section 6.1, *Liquefaction*, site soils are also susceptible to settlement during a seismic event. Total seismic settlement at the analyzed locations is expected to range from 4 to 7 inches. Differential settlement is estimated to be approximately one-half the total settlement over a 50-foot span. If shallow foundations are proposed and meet the differential settlement thresholds of ASCE 7-16, project stakeholders and the structural engineer should discuss risk associated with seismic settlement and be willing to accept the potential for building damage during a seismic event. If the risk of damage cannot be accepted, liquefaction mitigation through soil improvements or deep foundations will be required.

7.1.3 Resistance to Sliding

Lateral foundation loads can be resisted by passive earth pressure on the sides of the footing and by friction at the base of the footings. Recommended passive earth pressure for footings confined by native soil or engineered structural fill is 350 pcf. The upper 12 inches of soil should be neglected when calculating passive pressure resistance. Adjacent floor slabs and pavement, if present, should also be neglected from the analysis. The recommended passive pressure resistance assumes that a minimum horizontal clearance of 10 feet is maintained between the footing face and adjacent downgradient slopes.

The estimated coefficient of friction between in situ native soil or engineered structural fill and in-place poured concrete is 0.35. The estimated coefficient of friction between compacted crushed aggregate and in-place poured concrete is 0.4.

7.1.4 Subgrade Observation

Footing and floor slab subgrade soils should be evaluated by Columbia West prior to placing forms or reinforcing bar to verify subgrade support conditions are as anticipated in this report. Subgrade observation should confirm that all disturbed material, organic debris, unsuitable fill, remnant topsoil zones, and softened subgrades (if present) have been removed. Over-excavation of footing subgrade soils may be required to remove deleterious material, particularly if footings are constructed during wet-weather conditions.

7.1.5 Floor Slabs

Floor slabs can be supported on firm, competent, native soil or engineered structural fill prepared as described in this report. Disturbed soils and unsuitable fills in proposed slab locations, if encountered, should be removed and replaced with structural fill.

To reduce slab shifting and moisture transmission, slabs should be underlain by at least 6 inches of compacted crushed aggregate. Geotextile may be used below the crushed aggregate layer to increase subgrade support. Recommendations for floor slab base aggregate and subgrade geotextile are discussed in Section 8.6, *Materials*.

Elevated soil moisture was observed within near-surface soil at the time of exploration. In areas where moisture-sensitive flooring will be installed, slab waterproofing or a vapor barrier should be installed according to the flooring manufacturers' recommendations. In our experience, 10- to 15-mil vapor barriers are often required by flooring manufacturers to maintain product warranties. Selection and design of an appropriate vapor barrier should be determined by architectural and structural design team members.

Slab thickness and reinforcement should be designed by an experienced structural engineer in accordance with anticipated loads. Load-bearing concrete slabs with maximum loading of 200 psf may be designed assuming a modulus of subgrade reaction, k, of 150 pci. If slab subgrade soil is cement-amended to a minimum depth of 12 inches, the modulus of subgrade reaction can be increased to 200 pci.

7.2 Seismic Design Considerations

Seismic design for proposed structures is prescribed by *ASCE 7-16.* Based upon site-specific test results, site soils meet the criteria for Site Class E. Seismic design parameters for Site Class E are presented in Table 2.

Table 2. ASCE 7-16 Seismic Design Parameters[1]

	Short Period (T_s = 0.2 s)	1 Second Period (T_1 = 1.0 s)
MCE Spectral Acceleration	0.84	0.40
Site Class	E[2]	
Site Coefficient	Fa = 1.3	Fv = 2.4
Adjusted Spectral Response Acceleration	S_{MS} = 1.1	S_{M1} = 0.96
Design Spectral Response Acceleration	S_{DS} = 0.73	S_{D1} = 0.64

1. The structural engineer should evaluate *ASCE 7-16* code requirements and exceptions to determine if these parameters are valid for design.
2. Seismic site class, site coefficients, and spectral acceleration parameters assume that the fundamental period for proposed structures will be less than 0.5 second.

For Site Class E sites with mapped maximum considered earthquake spectral response acceleration parameter S_S greater than or equal to 1.0 or S_1 greater than or equal to 0.2, a ground motion hazard analysis may be required according to *ASCE 7-16, Section 11.4.8* unless exemption criteria are met. According to *ASCE 7-16, Section 11.4.8 Exception 3,* a ground

motion hazard analysis is not required for Site Class E sites with S_1 greater than or equal to 0.2, provided that T is less than or equal to T_S, where T is the fundamental period of the structure and T_S is equal to the design spectral response acceleration parameter at a one second period (SD_1) divided by the design spectral response acceleration parameter at short periods (SD_S).

Columbia West recommends that structural engineers on the project evaluate code requirements and exceptions to determine if a site-specific ground motion hazard evaluation will be required for proposed structures.

Due to the presence of liquefiable soils at the site and potential for bearing capacity loss at ground surface, Site Class F criteria may be met if the fundamental period of vibration for proposed structures is greater than 0.5 second. If Site Class F criteria is met, a site-specific ground motion response analysis is required in accordance with *Section 21.1* of *ASCE 7-16*. If structures have a fundamental period of less than 0.5 second, seismic design parameters may be determined using the pre-liquefaction seismic site class. In our experience, conventional structures less than three-stories in height will likely have a fundamental period less than 0.5 second, and seismic design parameters may be based on the pre-liquefaction site class designation as provided in Table 2.

7.3 Retaining Structures

Lateral earth pressures should be considered during design of retaining walls and below-grade structures. Hydrostatic pressure and additional surcharge loading should also be considered. Wall foundation construction and bearing capacity should adhere to specifications provided previously in Section 7.1, *Shallow Foundation Support*.

Permanent retaining walls that are not restrained from rotation should be designed for active earth pressures using an equivalent fluid pressure of 35 pcf. Walls that are restrained from rotation should be designed for an at-rest, equivalent fluid pressure of 55 pcf. The recommended earth pressures assume a maximum wall height of 10 feet with well-drained, level backfill. These values also assume that adequate drainage is provided behind retaining walls to prevent hydrostatic pressures from developing. Lateral earth pressures induced by surcharge loads may be estimated using the criteria presented on Figure 5.

Seismic forces may be calculated by superimposing a uniform lateral force of $7H^2$ pounds per lineal foot of wall, where H is the total wall height in feet. The force should be applied as a distributed load with the resultant located at 0.6H from the base of the wall.

7.3.1 Wall Drainage and Backfill

A minimum 6-inch-diameter, perforated collector pipe should be placed at the base of retaining walls. The pipe should be embedded in a minimum 2-foot-wide zone of angular drain rock that is wrapped in a drainage geotextile fabric and extends up the back of the wall to within 1 foot of finished grade. The drain rock and geotextile drainage fabric should meet the specifications provided in Section 8.6, *Materials*. The perforated collector pipes should discharge at an appropriate location away from the base of the wall. The discharge pipe(s) should not be tied directly into stormwater drainage systems, unless measures are taken to prevent backflow into the drainage system of the wall.

Backfill material placed behind the walls and extending a horizontal distance of ½ H, where H is the height of the retaining wall, should consist of select granular material placed and compacted as described in Section 8.6.1, *Structural Fill.*

Settlement of up to 1 percent of the wall height commonly occurs immediately adjacent to the wall as the wall rotates and develops active lateral earth pressures. Consequently, we recommend that construction of flatwork adjacent to retaining walls be delayed at least four weeks after placement of wall backfill, unless survey data indicates that settlement is complete prior to that time.

7.4 Pavement Design

7.4.1 Design Parameters and Traffic

Private asphalt concrete access drives and parking areas may be proposed on individual lots within the master development. Columbia West recommends adherence to City of Castle Rock roadway standards for street improvements in the public right-of-way. Pavement should be installed on firm, competent native subgrade soil or engineered structural fill prepared as described in this report. Our recommendations for private pavement are based on the following design parameters and assumptions:

- 12 inches of subgrade soil directly below the pavement sections are compacted to at least 95 percent of maximum dry density, as determined by *ASTM D1557*.
- Resilient moduli for subgrade soil and aggregate base materials were assumed to be 4,500 psi and 20,000 psi, respectively.
- Pavement design life of 20 years with no expected traffic growth.
- Initial and terminal serviceability indices of 4.2 and 2.5, respectively.
- Reliability of 85 percent and standard deviation of 0.4.
- Pavement may be exposed to a fire apparatus load of 75,000 pounds on an infrequent basis.

The specific type and frequency of traffic was not available at the time we prepared this report. Based on experience, we assume that heavy truck traffic will consist of approximately 40 percent FHWA Class Group 7 type trucks (4-axle, single unit) and 60 percent FHWA Class Group 8 type trucks (tractor/trailer 2- to 3-axle). Lightly-loaded drive aisles and parking stalls are expected to service typical passenger vehicle traffic.

7.4.2 Asphaltic Concrete (AC) Pavement Design Sections

Design recommendations for private pavement across a range of traffic conditions and loading scenarios are presented in Table 3. Material properties and compaction recommendations for asphalt surfacing and crushed aggregate base layers are presented in Section 8.6, *Materials*.

Table 3. Recommended AC Pavement Sections Constructed over Native Soil or Engineered Fill

Traffic	Trucks Per Day	Equivalent Single-Axle Loads (ESALs)	AC Thickness (in)	Base Aggregate Thickness (in)
Passenger Vehicle Parking	0	10,000	2.5	8
Passenger Vehicle Drive Aisles	0	20,000	3	9
Heavy Truck Areas	10	92,000	4	10.5
	25	229,000	4.5	12.5
	50	458,000	5	14
	100	916,000	5.5	16.5

Pavement sections may be reduced in areas where subgrade soils are cement-amended to a minimum depth of 12 inches with a minimum of 6 percent cement by weight. Provided the cement-amended subgrade soil achieves a seven-day unconfined compressive strength of 100 psi, AC pavement sections may be constructed as presented in Table 4.

Table 4. Recommended AC Pavement Sections Constructed over Cement-Amended Subgrade Soil

Traffic	Trucks Per Day	Equivalent Single-Axle Loads (ESALs)	AC Thickness (in)	Base Aggregate Thickness (in)	Cement-Amendment Thickness (in)
Passenger Vehicle Parking	0	10,000	2.5	4	**12**
Passenger Vehicle Drive Aisles	0	20,000	3	4	
Heavy Truck Areas	10	92,000	4	4	
	25	229,000	4.5	4	
	50	458,000	5	4.5	
	100	916,000	5.5	6.5	

7.4.3 Portland Cement Concrete (PCC) Pavement Design Sections

Portland cement concrete pavements may be proposed in future loading dock areas. Loading docks are expected to primarily service heavy truck traffic. Material properties and recommendations for PCC, base aggregate, and cement-amended subgrade layers are presented in Section 8.6, *Materials*. Pavement design recommendations for PCC loading docks constructed over firm native soil or engineered structural fill are presented in Table 5.

Table 5. Recommended PCC Pavement Sections Constructed over Native Soil or Engineered Fill

Traffic	Trucks Per Day	PCC Thickness (in)	Base Aggregate Thickness (in)
Loading Dock Areas	Up to 25	6.5	7
	Up to 50	7	8
	Up to 100	7.5	8

Recommended PCC pavement sections constructed over cement-amended soil meeting the treatment depth, cement content, and strength requirements outlined above are presented in Table 6.

Table 6. Recommended PCC Pavement Sections Constructed over Cement-Amended Subgrade Soil

Traffic	Trucks Per Day	PCC Thickness (in)	Base Aggregate Thickness (in)	Cement-Amendment Thickness (in)
Loading Dock Areas	Up to 25	6.5	4	**12**
	Up to 50	7	4	
	Up to 100	7.5	4	

7.4.4 General Pavement Recommendations

Recommended pavement section thicknesses are intended to be minimum acceptable values and do not include construction traffic loading. The recommendations assume that pavement construction will be completed during an extended period of warm, dry weather. Wet weather construction may require an increased thickness of base aggregate as discussed later in Section 8.2, *Construction Traffic and Staging*.

Cement-amended soil should be allowed to cure for at least four days prior to aggregate base placement or exposure to construction traffic. Prior to construction traffic access, the cement-amended subgrade should be protected by a minimum 4-inch-thick layer of compacted crushed aggregate. Construction traffic should be limited to dedicated haul roads or non-structural, unpaved portions of the site. Construction traffic should not be permitted on new pavement, unless accounted for in the pavement design section. Base aggregate and cement-amended soils supporting pavement are also not intended for construction traffic. Haul roads and staging areas supporting construction traffic are discussed later in Section 8.2, *Construction Traffic and Staging*.

Asphalt paving is generally not recommended during cold weather conditions where ambient air temperatures are less than 40 degrees Fahrenheit. Compacting asphalt in low-temperature conditions can result in low relative density of the asphalt layer and premature pavement distress.

Asphalt mix designs have a recommended compaction temperature range that is specific to the AC binder used. In low-temperature conditions, maintaining the temperature of the AC mix is difficult as heat can be lost during transport, placement, and compaction. The ambient air temperature during paving should be at least 40 degrees Fahrenheit for a lift thickness greater than 2.5 inches and at least 50 degrees Fahrenheit for a lift thickness between 2 and 2.5 inches. If AC paving must take place during cold-weather construction as defined in this section, the contractor and design team should discuss options for minimizing risk to pavement serviceability.

7.5 Drainage

At a minimum, site drainage should include surface water collection and conveyance to properly designed stormwater management structures and facilities. Drainage design in

general should conform to City of Castle Rock regulations. Finished site grading should be conducted with positive drainage away from structures at a minimum 2 percent slope for a distance of at least 10 feet. Depressions or shallow areas that may retain ponding water should be avoided.

Recommendations for foundation drains, subdrains, and drainage mats are presented in the following sections. Drain rock and geotextile drainage fabric should meet the requirements presented in Section 8.6, *Materials*. Drains should be closely monitored after construction to assess their effectiveness. If additional surface or shallow subsurface seeps become evident, the drainage provisions may require modification or additional drains. We should be consulted to provide appropriate recommendations.

7.5.1 Foundation Drains

Roof drains are recommended for all structures. Perimeter building foundation drains can reduce the potential for water intrusion below structures. Perimeter footing drains are recommended for shallow foundations constructed 5 or more feet below existing site grades. Foundations constructed less than 5 feet below existing grades do not require drains, however, it may be prudent to install foundations drains to collect incidental or perched water. The final decision for foundations drains should be made by the owner and architect.

Foundation and roof drains, where installed, should consist of separate systems that gravity flow away from foundations to an approved discharge location. Perimeter foundation drains, where installed, should consist of 4-inch perforated PVC pipe surrounded by a minimum 2-foot-wide zone of clean, washed drain rock wrapped with geotextile drainage fabric. The wrapped drain rock zone should extend up the sides of embedded walls to within 12 inches of proposed finished grade. Foundation drains should be constructed with a minimum slope of ½ percent. The drainpipe's invert elevation should be at least 18 inches below the elevation of the floor slab. Figure 6 presents a typical foundation drain detail.

7.5.2 Subdrains

Subdrains should be considered if portions of the site are cut below surrounding grades. Shallow groundwater, springs, or seeps should be conveyed via drainage channel or perforated pipe into an approved discharge. Recommendations for design and installation of perforated drainage pipe may be performed on a case-by-case basis by Columbia West during construction. Failure to provide adequate surface and sub-surface drainage may result in soil slumping or unanticipated settlement of structures exceeding tolerable limits. A typical perforated drainpipe trench detail is presented in Figure 7.

7.5.3 Drainage Mat

Site improvements construction in some areas may occur at or near the shallow groundwater table, particularly if work is conducted during wet-weather conditions. Dewatering may be necessary, and a drainage mat may be required to achieve sufficient elevation for fill placement. A typical drainage mat is shown on Figure 8. Columbia West should determine drainage mat location, extent, and thickness when subsurface conditions are exposed.

Drainage mats may need to be constructed in conjunction with subdrains to convey captured water to an approved discharge location.

8.0 CONSTRUCTION RECOMMENDATIONS

8.1 Site Preparation and Grading

Vegetation, organic material, unsuitable fill, and deleterious material that may be encountered should be cleared from areas identified for structures and site grading. Vegetation, root zones, organic material, and debris should be removed from the site. Stripped topsoil should also be removed, or used only as landscape fill in nonstructural areas with slopes less than 25 percent. The stripping depth for sod and highly organic topsoil is anticipated to be approximately 4 inches. Following removal of surface vegetation and topsoil, underlying low-organic till zone soils, if present, may be acceptable for stockpiling and reuse as structural fill. Actual stripping depths and suitability of till zone soil for reuse should be determined based upon visual observations made during construction when soil conditions are exposed. The post-construction maximum depth of landscape fill placed or spread at any location onsite should not exceed one foot.

Previously disturbed soil, debris, or undocumented fill encountered during grading or construction activities should be removed completely and thoroughly from structural areas. This includes old remnant foundations, basement walls, utilities, associated soft soils, and debris. Excavation areas should be backfilled with engineered structural fill.

Trees, stumps, and associated roots should also be removed from structural areas, individually and carefully. Resulting cavities and excavation areas should be backfilled with engineered structural fill.

Site grading activities should be performed in accordance with requirements specified in the *2018 International Building Code* (IBC), Chapter 18 and Appendix J, with exceptions noted in the text herein. Site preparation, soil stripping, and grading activities should be observed and documented by Columbia West.

8.1.1 Subgrade Evaluation

Upon completion of stripping and prior to the placement of structural fill or pavement improvements, exposed subgrade soil should be evaluated by proof rolling with a fully-loaded dump truck or similar heavy, rubber tire construction equipment. When the subgrade is too wet for proof rolling, a foundation probe may be used to identify areas of soft, loose, or unsuitable soil. Subgrade evaluation should be performed by Columbia West. If soft or yielding subgrade areas are identified during evaluation, we recommend the subgrade be over-excavated and backfilled with compacted imported granular fill.

8.2 Construction Traffic and Staging

Near-surface silty soil will be easily disturbed during construction. If not carefully executed, site preparation, excavation, and grading can create extensive soft areas resulting in significant repair costs. Earthwork planning should include considerations for minimizing subgrade disturbance, particularly during wet-weather conditions.

If construction occurs during wet-weather conditions, or if the moisture content of the surficial soil is more than a few percentage points above optimum, site stripping and cutting may need to be accomplished using track-mounted equipment. Under these conditions, granular haul roads and staging areas will also be necessary provide a firm support base and sustain construction equipment.

The recommended base aggregate thickness for pavement sections is intended to support post-construction design traffic loads and will not provide adequate support for construction traffic. Staging areas and haul roads will require an increased base thickness during wet weather conditions. The configuration of staging and haul road areas, as well as the required thickness of granular material, will vary with the contractor's means and methods. Therefore, design and construction of staging areas and haul roads should be the responsibility of the contractor. Based on our experience, between 12 and 18 inches of imported granular material is generally required in staging areas and between 18 and 24 inches in haul road areas. In areas of heavy construction traffic, geotextile separation fabric may be placed between the subgrade soil and imported granular material to increase subgrade support and minimize silt migration into the base aggregate layer.

As an alternative to thickened aggregate sections, haul roads and staging areas may be constructed using a combination of cement-amended subgrade and crushed aggregate surfacing. If cement-amendment is used, the base aggregate thickness for staging areas and haul roads can typically be reduced to between 6 and 9 inches, respectively. This recommendation is based on a minimum seven-day unconfined compressive strength of 100 psi for the cement-amended soil with a treatment depth of 12 to 16 inches. Based on experience, 6 to 7 percent cement by weight is typically required to achieve the indicated compressive strength.

Project stakeholders should understand that wet weather construction is risky and costly. Proper construction methods and techniques are critical to overall project integrity and should be observed and documented by Columbia West.

8.3 Cut and Fill Slopes

Fill slopes should consist of structural fill material as discussed in Section 8.1.1, *Structural Fill*. Fill placed on existing grades steeper than 5H:1V should be horizontally benched at least 10 feet into the slope. Fill slopes greater than six feet in height should be vertically keyed into existing subsurface soil. A typical fill slope cross-section is shown in Figure 9. Drainage implementations, including subdrains or perforated drainpipe trenches, may also be necessary in proximity to cut and fill slopes if seeps or springs are encountered. Drainage design may be performed on a case-by-case basis. Extent, depth, and location of drainage may be determined in the field by Columbia West during construction when soil conditions are exposed. Failure to provide adequate drainage may result in soil sloughing, settlement, or erosion.

Final cut or fill slopes at the site should not exceed 2H:1V or 20 feet in height without individual slope stability analysis. The values above assume a minimum horizontal setback for loads of 10 feet from top of cut or fill slope face or overall slope height divided by three

(H/3), whichever is greater. A minimum slope setback detail for structures is presented in Figure 10.

Concentrated drainage or water flow over the face of slopes should be prohibited, and adequate protection against erosion is required. Fill slopes should be overbuilt, compacted, and trimmed at least two feet horizontally to provide adequate compaction of the outer slope face. Proper cut and fill slope construction is critical to overall project stability and should be observed and documented by Columbia West.

8.4 Excavation

The site was explored by Columbia West and others to a maximum depth of 81.5 feet with a drill rig. Conventional earthmoving equipment in proper working condition should be capable of making necessary site excavations.

Groundwater was encountered at depths ranging from 9 and 35 feet bgs in site explorations. Perched groundwater at shallower depths may also be present. Recommendations as described in Section 8.5, *Dewatering,* should be considered where subsurface construction activities intersect the shallow groundwater table.

Excavations in near-surface sandy soil will likely slough and cave, even at shallow depths. Open-cut excavation techniques may be used to excavate trenches between 4 and 8 feet deep, provided the walls of the excavation are cut at a maximum slope of 1H:1V and groundwater seepage is not present. Excavation slopes should be reduced to 1.5H:1V or 2H:1V if excessive sloughing or raveling occurs.

Shoring may be required if open-cut excavations are infeasible or if excavations are proposed adjacent to existing infrastructure. Typical methods for stabilizing excavations consist of solider piles and timber lagging, sheet pile walls, tiebacks and shotcrete, or pre-fabricated hydraulic shoring. As a wide variety of shoring and dewatering systems are available, we recommend that the contractor be responsible for selecting the appropriate shoring and dewatering systems.

The contractor should be held responsible for site safety, sloping, and shoring. All excavation activity should be conducted in accordance with applicable OSHA requirements. Columbia West is not responsible for contractor activities and in no case should excavation be conducted in excess of applicable local, state, and federal laws.

8.5 Dewatering

Based on site observations and piezometer monitoring data, groundwater will likely be encountered in utility trenches, pump station excavations, and in areas of significant cut. Generalized recommendations for temporary construction dewatering are presented in the following section.

8.5.1 Construction Dewatering

The contractor should be responsible for temporary drainage of surface water, perched water, and groundwater. Dewatering should be performed to the extent necessary to prevent standing water and/or erosion of exposed site soils. During rough and finished grading of

building pad areas, the contractor should keep all footing excavations and slab subgrade soils free of standing water.

The contractor's proposed dewatering plan should be capable of maintaining groundwater levels at least two feet below the base of proposed excavations. Without adequate excavation dewatering, running soil, caving, and sloughing will increase backfill volumes and may result in damage to adjacent structures or utilities. Significant pumping and dewatering may be required to temporarily reduce the groundwater elevation to the recommended depth. Dewatering via a sump within excavation zones may be insufficient to control groundwater and provide excavation side slope stability. Dewatering may be more feasibly conducted by installing a system of temporary well points and pumps around proposed excavation areas or utility trenches.

As indicated previously, a sanitary sewer pump station is proposed up to 35 feet below existing grade. Due to the significant depth of excavation and potential for rapid groundwater flow through permeable sand and gravel deposits, the contractor should be required to prepare and present a detailed dewatering plan. The contractor should consult with a licensed professional engineer to provide an adequate dewatering plan for site conditions. If additional subsurface information not provided in this geotechnical report is necessary to complete the dewatering plan, the contractor shall be responsible for securing all the required information necessary for the design of the system.

If groundwater is present at the base of excavations, we recommend placing 18 to 24 inches of stabilization material at the base of the excavation. Subgrade geotextile placed directly over trench subgrade soils may reduce the required thickness of the stabilization material. The actual thickness of stabilization material should be determined at the time of construction based on observed field conditions. The stabilization material should be placed in one lift and compacted until well keyed. Stabilization material and geotextile fabric should meet the requirements presented in Section 8.6, *Materials*.

8.6 Materials

8.6.1 Structural Fill

Areas proposed for fill placement should be appropriately prepared as described in Section 8.1, *Site Preparation and Grading*. Engineered fill placement should be observed by Columbia West. Compaction of engineered structural fill should be verified by nuclear gauge field compaction testing performed in accordance with *ASTM D6938*. Field compaction testing should be performed for each vertical foot of engineered fill placed.

Various materials may be acceptable for use as structural fill. Structural fill should be free of organic material or other unsuitable material and meet specifications provided in the following sections. Representative samples of proposed engineered structural fill should be submitted for laboratory analysis and approval by Columbia West prior to placement.

8.6.1.1 Onsite Soil

Most onsite native soil (silt, sand, and gravel) will be suitable for use as structural fill if adequately dried or moisture-conditioned to achieve recommended compaction

specifications. Moisture conditioning will likely be necessary to achieve the optimum moisture content required for compaction. In addition, near-surface silty soil will be moisture sensitive and difficult to compact during wet weather conditions. Therefore, structural fill placement using onsite soil should be performed during dry summer months if possible. Onsite soil may also require addition of moisture during extended periods of dry weather.

Onsite soil used as structural fill should be placed in loose lifts not exceeding 8 inches in depth and compacted using standard conventional compaction equipment. The soil moisture content should be within a few percentage points of optimum conditions. The soil should be compacted to at least 95 percent of maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557).* Compacted onsite fill soils should be covered shortly after placement.

Onsite soil will likely expand during excavation and transport and consolidate during compaction. Development of site-specific expansion and consolidation factors is beyond the scope of this investigation. We can provide site-specific factors upon request.

8.6.1.2 Imported Granular Material

Imported granular material should consist of pit- or quarry-run rock, crushed rock, or crushed gravel and sand meeting *WSDOT 9-03.14(1)* specifications for *Gravel Borrow*. Imported granular material should be placed in loose lifts not exceeding 12 inches in depth and compacted to at least 95 percent of maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557).* During wet-weather conditions or where wet subgrade conditions are present, the initial loose lift of granular fill should be approximately 18 inches thick and should be compacted with a smooth-drum roller operating in static mode.

8.6.1.3 Stabilization Material

Stabilization material should consist of durable, 4- or 6-inch-minus pit- or quarry-run rock, crushed rock, or crushed gravel and sand that is free of organics and other deleterious material. The material should have a maximum particle size of 6 inches with less than 5 percent by dry weight passing the U.S. Standard No. 4 sieve. The material should have at least two mechanically-fractured faces.

Stabilization material should be placed in loose lifts between 12 and 24 inches thick and be compacted to a firm, unyielding condition. Equipment with vibratory action should not be used when compacting stabilization material over wet, fine-textured soils. If stabilization material is used to stabilize soft subgrade below pavement or construction haul roads, a subgrade geotextile should be placed as a separation barrier between the soil subgrade and the stabilization material.

8.6.1.4 Trench Backfill

Trench backfill placed below, adjacent to, and up to at least 12 inches above utility lines (i.e., the pipe zone) should consist of well-graded granular material meeting *WSDOT 9-03.12(3)* specifications for *Gravel Backfill for Pipe Zone Bedding.* Pipe zone backfill should be compacted to at least 90 percent of maximum dry density, as determined by the modified

Proctor moisture-density relationship test *(ASTM D1557),* or as required by the local jurisdictional agency or pipe manufacturer.

Within structural areas (below pavement and building pads), trench backfill above the pipe zone should consist of *WSDOT 9-03.19 Bank Run Gravel for Trench Backfill* or *WSDOT 9-03.14(2) Select Borrow* with a maximum particle size of 2 ½-inches. Trench backfill material within 18 inches of the top of utility pipes should be hand compacted (i.e., no heavy compaction equipment). Remaining trench backfill should be compacted to at least 95 percent of the maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557),* or as required by the local jurisdictional agency or pipe manufacturer.

Outside of structural areas, trench backfill placed above the pipe zone should be compacted to at least 90 percent of the maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557),* or as required by the local jurisdictional agency or pipe manufacturer.

8.6.1.5 Floor Slab Base Aggregate

Base aggregate for building floor slabs should consist of 1 ¼"-minus crushed aggregate meeting *WSDOT 9-03.9(3)* specifications for *Crushed Surfacing*. Slab base aggregate should be compacted to at least at least 95 percent of the maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557).*

8.6.1.6 Pavement Base Aggregate

Base aggregate for pavement should consist of 1 ¼"-minus crushed aggregate meeting *WSDOT 9-03.9(3)* specifications for *Crushed Surfacing*. Pavement base aggregate should be compacted to at least at least 95 percent of the maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557).*

8.6.1.7 Retaining Wall Backfill

Backfill material placed behind retaining walls and extending a horizontal distance of ½ H, where H is the height of the retaining wall, should consist of free-draining granular material meeting *WSDOT 9-03.12(2)* specifications for *Gravel Backfill for Walls*. The wall backfill should be separated from structural fill, native soil, and/or topsoil using a geotextile fabric that meets the specifications provided below for drainage geotextiles.

Wall backfill located within a horizontal distance of 3 feet from the face of a retaining wall should be compacted to 90 percent of the maximum dry density, as determined by *ASTM D1557*. Backfill placed within 3 feet of the wall should be compacted in loose lifts less than 6 inches thick using hand-operated tamping equipment (such as a jumping jack or vibratory plate compactor). Remaining wall backfill should be compacted to at least 95 percent of the maximum dry density, as determined by *ASTM D1557*.

8.6.1.8 Retaining Wall Leveling Pad

Crushed aggregate used as a leveling pad for retaining wall footings should consist of 1 ¼"-minus crushed aggregate meeting *WSDOT 9-03.9(3)* specifications for *Crushed Surfacing*. The leveling pad material should be compacted to at least 95 percent of the

maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557).*

8.6.1.9 Drain Rock

Drain rock should consist of open-graded, angular aggregate meeting WSDOT 9-03.12(4), *Gravel Backfill for Drains*. Drain rock should be free of roots, organic debris, and other unsuitable material and should have at least two mechanically-fractured faces. Drain rock should be compacted to a firm, unyielding condition. Drain rock should be completely wrapped in a geotextile drainage fabric meeting the requirements presented below.

8.6.2 Geotextile Fabric

8.6.2.1 Subgrade Geotextile

Subgrade geotextile should meet the specifications provided in *WSDOT 9-33.2(1), Table 3, Geotextile for Separation or Soil Stabilization*. The geotextile should be installed in accordance with the manufacturer's recommendations. A minimum initial aggregate base lift of 6 inches is required over geotextiles. All stabilization material should be underlain by a subgrade geotextile.

8.6.2.2 Drainage Geotextile

Subgrade geotextile should meet the specifications provided in *WSDOT 9-33.2(1), Table 2, Geotextile for Underground Drainage Filtration Properties*. The AOS should be between the No. 70 and No. 100 sieve. The water permittivity should be greater than 1.5/sec. The geotextile should be installed in accordance with the manufacturer's recommendations. A minimum initial aggregate base lift of 6 inches is required over geotextiles.

8.6.3 Soil Amendment with Cement

The on-site soil can be amended with Portland cement to obtain suitable properties for use as wet-weather structural fill or subbase for pavement. The effectiveness of soil amendment is highly dependent on proper mixing techniques, soil moisture conditioning, and the quantity of cement. The quantity of cement applied during amendment should be based on an assumed dry unit weight of 100 pcf for site soil.

8.6.3.1 Subbase Stabilization

Specific recommendations for soil amendment should be based on exposed site conditions at the time of construction. For preliminary design purposes, we recommend cement-amended subgrade for building pads and pavement subbase (below the base aggregate layer) achieve a target strength of 100 psi. The quantity of cement required to achieve the target strength will vary with moisture content and soil type. Laboratory testing of cement-amended soil should be used to confirm design expectations.

Based on our experience, near-surface silt and sand will require approximately 6 to 7 percent cement by weight to achieve the target strength of 100 psi. This cement percentage assumes that the soil moisture content does not exceed 20 percent at the time of amendment. If the soil moisture content is in the range of 25 to 35 percent, 7 to 8 percent cement by weight may be required to achieve the target strength. The amount of cement

added to the soil at the time of construction should be based on observed field conditions and subgrade performance. During extended periods of dry weather, water may need to be applied during the amendment and tilling process to achieve the optimum moisture content required for compaction.

Cement-amendment equipment should have balloon tires to minimize softening, rutting, and disturbance of fine-grained site soil. A sheepsfoot or segmented pad roller with a minimum static weight of 40,000 pounds should be used for initial compaction. Rollers with vibratory action should not be used to compact fine-grained, cement-amended soil. Final compaction should be conducted with a smooth-drum roller with a minimum applied linear force of 700 pounds per inch. The amended soil should be compacted to at least 95 percent of the maximum dry density as determined by *ASTM D558*.

Following cement amendment, a minimum curing time of four days is required prior to exposure to construction traffic. Construction traffic should not be allowed on unprotected, cement-amended subgrade. To protect cement-amended areas from damage, the finished surface should be covered with 4 to 6 inches of imported granular material. The protective layer of crushed rock often becomes contaminated with soil during construction, particularly in staging and haul road areas. Contaminated aggregate, where present, should be removed and replaced with clean crushed aggregate prior to construction of pavement or other permanent site improvements supported by base aggregate.

Cement amendment should not be attempted during moderate to heavy precipitation or when the ambient air temperature is below 40 degrees Fahrenheit. Cement should not be placed in areas of standing water or where saturated subgrade conditions exist.

8.6.3.2 Cement-Amended Structural Fill

If adequate compaction is not achievable with onsite soil due to moisture or weather conditions, the soil may be cement-amended and placed as general structural fill. Prior to placement of cement-amended fill, subgrade soils should be prepared as described in Section 8.1, *Site Preparation and Grading*. Where multiple lifts of cement-amended fill are necessary to meet finished grade, consecutive lifts may be placed immediately following amendment and compaction of the underlying lift. However, where the final lift of cement-amended fill will serve as building pad or pavement subbase material, the four-day cure period as discussed above is recommended.

8.6.3.3 QA/QC Testing and Inspection

Cement-amendment of site soils should be observed and tested by Columbia West to document conformance with design recommendations. Cement spread rate should be verified with a pan sample test conducted at one random location per lift per 20,000 square-feet of cement-amended fill. Treatment depth should be verified through excavation of a small test pit and measurement at one random location per lift of cement-amended fill. Adequate compaction and moisture content should be verified by conducting nuclear gauge density testing at a frequency of approximately one test per 5,000 square feet of cement-amended fill in accordance with ASTM D6938. At least one representative sample should be collected per day of cement-amendment, cured for 7 days, and tested for

unconfined compressive strength in accordance with ASTM D1633. The tested samples should have a minimum 7-day, unconfined compressive strength of 100 psi.

8.6.3.4 Drainage Considerations

Cement-amended soil will be poorly-drained and will not be suitable for planting areas. The material may also be difficult to excavate with light-duty landscaping equipment. Proposed landscape areas should not be cement-amended unless accommodations are made for drainage and planting.

Cement-amendment within building pad areas should consider the potential for trapped water below the floor slab. Columbia West should be consulted to provide appropriate recommendations if cement-amendment is proposed within building pad areas.

8.6.4 Pavement

8.6.4.1 Asphaltic Concrete

Asphaltic concrete should consist of HMA Class ½" adhering to *WSDOT 9-03.8(6), HMA Proportions of Materials*. The asphalt binder should consist of PG 58-22 meeting *WSDOT 9-02.1(4), Performance Graded (PG) Asphalt Binder*. Asphalt should be compacted to 91 percent of the theoretical maximum density as determined by *ASTM D2041*. Minimum and maximum asphalt lift thicknesses should be 2 and 3 inches, respectively. Nuclear gauge density testing should be conducted to verify adherence to recommended specifications. Testing frequency should be in accordance with WSDOT and City of Castle Rock specifications.

8.6.4.2 Portland Cement Concrete

Portland cement concrete should meet *WSDOT 5-05, Cement Concrete Pavement* with a minimum 28-day compressive strength of 4,000 psi and an air content between 3 and 7 percent. PCC should be placed in general accordance with *WSDOT 5-05.3(7), Placing, Spreading, and Compacting Concrete*. Dowel bars and placement should adhere to *WSDOT 5-05.3(10), Tie Bars and Corrosion Resistant Dowel Bars*. Joints should be constructed in general accordance with *WSDOT 5-05.3(8), Joints* with a maximum transverse joint spacing of 15 feet. The length-to-width ratio for any PCC panel should be between 0.80 and 1.25.

Concrete should be tested during installation in accordance with ASTM C171, C138, C231, C143, C1064, and C31. This includes casting of cylinder specimen at a frequency of four cylinders per 100 cubic yards of poured concrete. Recommended field concrete testing includes slump, air entrainment, temperature, and unit weight.

8.7 Erosion Control Measures

Soil at this site is susceptible to erosion by wind and water; therefore, erosion control measures should be carefully planned and installed. Surface water runoff should be collected and directed away from sloped areas to prevent water from running down the slope face. Measures that can be employed to reduce erosion include the use of silt fences, hay bales, buffer zones of natural growth, sedimentation ponds, and granular haul roads. All erosion control methods should be in accordance with local jurisdiction standards.

9.0 CONCLUSION AND LIMITATIONS

This geotechnical site investigation report was prepared in accordance with accepted standard conventional principles and practices of geotechnical engineering. This investigation pertains only to material tested and observed as of the date of this report and is based upon proposed site development as described in the text herein. This report is a professional opinion containing recommendations established by engineering interpretations of subsurface soils based upon conditions observed during site exploration. Soil conditions may differ between tested locations or over time. Slight variations may produce impacts to the performance of structural facilities if not adequately addressed. This underscores the importance of diligent QA/QC construction observation and testing to verify soil conditions are as anticipated in this report.

Therefore, this report contains several recommendations for field observation and testing by Columbia West personnel during construction activities. Columbia West cannot accept responsibility for deviations from recommendations described in this report. Future performance of structural facilities is often related to the degree of construction observation by qualified personnel. These services should be performed to the full extent recommended.

This report is not an environmental assessment and should not be construed as a representative warranty of site subsurface conditions. The discovery of adverse environmental conditions, or subsurface soils that deviate from those described in this report, should immediately prompt further investigation. The above statements are in lieu of all other statements expressed or implied.

This report was prepared solely for the client and is not to be reproduced without prior authorization from Columbia West. Final engineering plans and specifications for the project should be reviewed and approved by Columbia West as they relate to geotechnical and grading issues prior to final design approval. Columbia West is not responsible for independent conclusions or recommendations made by other parties based upon information presented in this report. Unless a particular service was expressly included in the scope, it was not performed and there should be no assumptions based upon services not provided. Additional report limitations and important information about this document are presented in Appendix D, *Report Limitations and Important Information*. This information should be carefully read and understood by the client and other parties reviewing this document.

Sincerely,

COLUMBIA WEST ENGINEERING, Inc.

Lance V. Lehto, PE, GE
President

LANCE V. LEHTO
STATE OF WASHINGTON
36301
REGISTERED
PROFESSIONAL ENGINEER

3-30-2023

REFERENCES

Annual Book of ASTM Standards, Soil and Rock (I), v04.08, American Society for Testing and Materials, 1999.

ASCE 7-16, Minimum Design Loads for Buildings and Other Structures, American Society of Civil Engineers, 2016.

Beeson, M.H., Tolan, T.L., Madin, I.P., *Geologic Map of the Lake Oswego Quadrangle, Clackamas, Multnomah, and Washington Counties, Oregon*; Oregon Department of Geology and Mineral Industries; Geological Map Series GMS-59, 1989.

Cetin, et al., *Probabilistic Model for the Assessment of Cyclically Induced Reconsolidation (Volumetric) Settlements*, Journal of Geotechnical and Environmental Engineering, ASCE, March, 2009.

Columbia West Engineering, Inc., *Preliminary Grading Recommendations, Landing on the Cowlitz, Castle Rock, Washington,* November 8, 2022.

Geomatrix Consultants, *Seismic Design Mapping, State of Oregon*, January 1995.

International Building Code: *2018 International Building Code, 2018 edition*, International Code Council, 2018.

Idriss, I.M and Boulanger, R.W, CPT and SPT Based Liquefaction Triggering Procedures, Center for Geotechnical Modeling, Report No. UCD/CGM-14/01, April, 2014.

Phillips, W. M., *Geologic Map of the Mount St. Helens Quadrangle, Washington and Oregon*, USGS Open File Report 87-4, 1987.

Robertson, P.K., 2009*. CPT interpretation – a unified approach, Canadian Geotechnical Journal, 46: 1-19*

Safety and Health Regulations for Construction, 29 CFR Part 1926, Occupational Safety and Health Administration (OSHA), revised July 1, 2001.

State of Washington Department of Ecology, *Washington State Well Log Viewer (apps.exy.wa.gov/wellog/).*

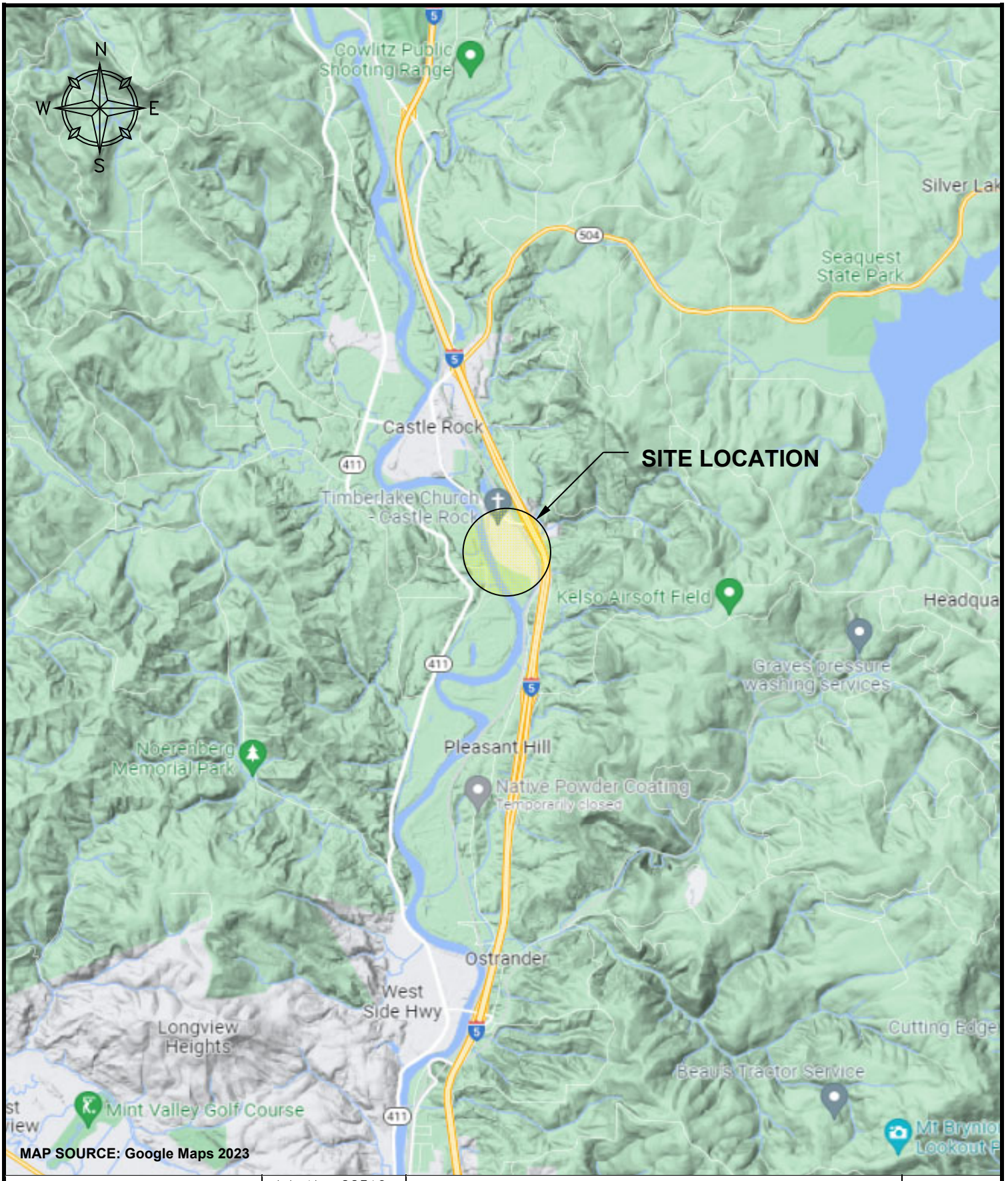
USGS, *Geologic Map of the Greater Portland Metropolitan Area and Surrounding Region, Oregon and Washington*, Scientific Investigations Map 3443, 2020.

Washington Department of Transportation (WSDOT), *Standard Specifications for Road, Bridge, and Municipal Construction*, 2023

Web Soil Survey, Natural Resources Conservation Service, United States Department of Agriculture, website (http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm).

Wong, Ivan, et al, *Earthquake Scenario and Probabilistic Earthquake Ground Shaking Maps for the Portland, Oregon, Metropolitan Area*, IMS-16, Oregon Department of Geology and Mineral Industries, 2000.

FIGURES



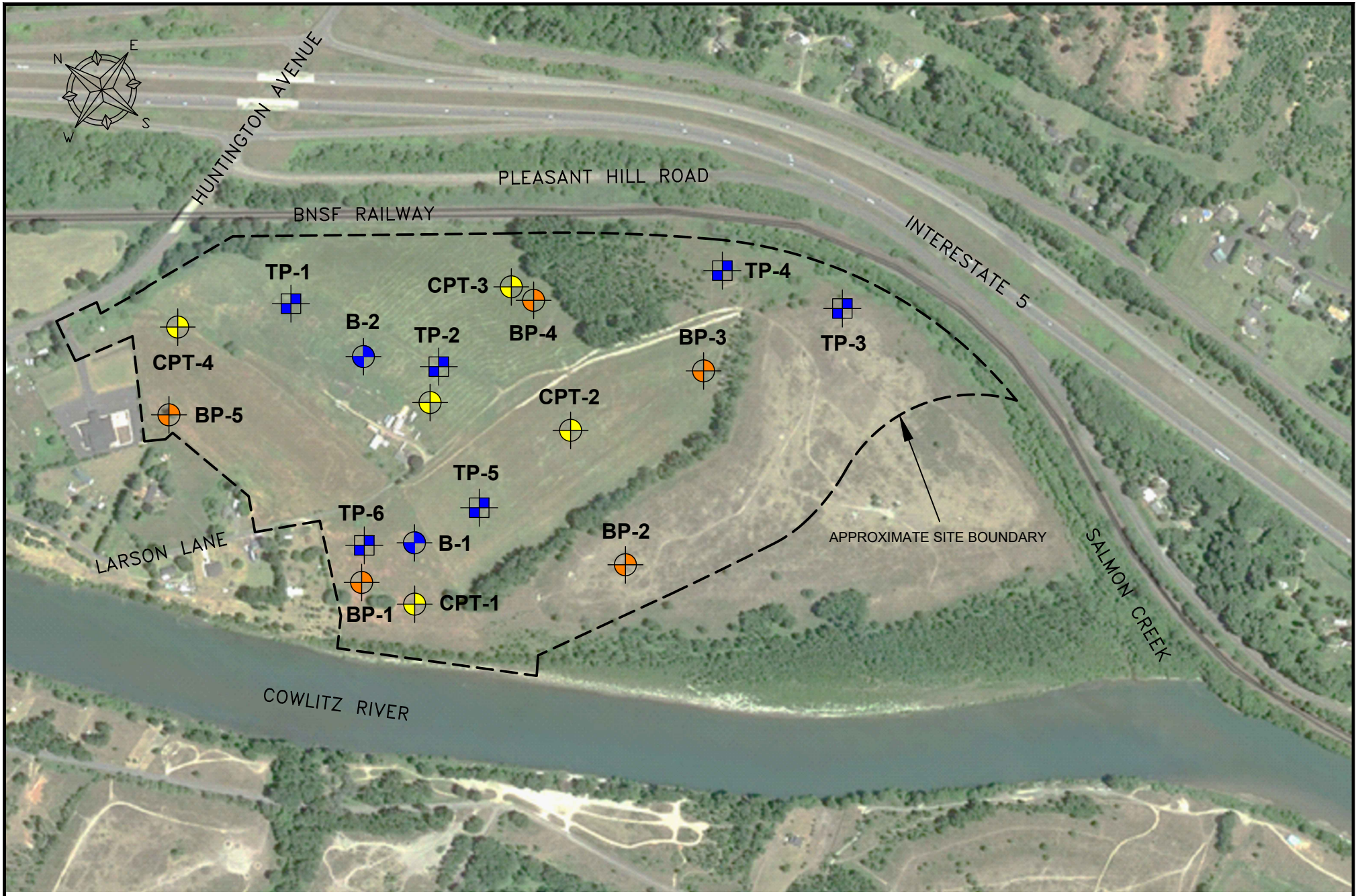
MAP SOURCE: Google Maps 2023

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Job No: 22310
Date: 03/17/23
Drawn: GLW
Checked: LVL

SITE LOCATION MAP
LANDING ON THE COWLITZ
CASTLE ROCK, WASHINGTON

FIGURE
1



BORING AND PIEZOMETER (COLUMBIA WEST, 2023) | BORING (BY OTHERS, 2020) | CONE PENETRATION TEST (BY OTHERS, 2020) | TEST PIT (BY OTHERS, 2020)

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Columbia West Engineering, Inc

Project: 22310
Date: 03/17/23
Drawn: GLW
Checked: LVL

EXPLORATION LOCATION MAP
LANDING ON THE COWLITZ

NOTES:
1. SITE LOCATION: 2542 SW LARSON LANE, CASTLE ROCK, WASHINGTON.
2. SITE CONSISTS OF PORTIONS OF TAX PARCEL NOS. 3092824, 3040258, 3040259, 3040322, 3014867, & 3045031 TOTALING APPROXIMATELY 118.2 ACRES.
3. DRAWING IS NOT TO SCALE.
4. BASE MAP OBTAINED FROM GOOGLE EARTH, 2023.
5. EXPLORATION LOCATIONS ARE APPROXIMATE AND NOT SURVEYED.
6. BORINGS BP-1 THROUGH BP-5 COMPLETED WITH PIEZOMETER INSTALLATIONS AND FLUSH MOUNT MONUMENTS ON JANUARY 31, FEBRUARY 1, AND FEBRUARY 2, 2023.

FIGURE
2



LEGEND

- RECREATIONAL
- RESIDENTIAL
- COMMERCIAL
- EMPLOYMENT
- FLEX (COM/IND)
- COMMERCIAL OVERLAY
- OPEN SPACE
- DRAINAGE/UTILITIES
- WETLAND BUFFER
- WETLAND
- DEVELOPMENT BOUNDARY
- D.N.R. PROPERTY BOUNDARY
- PROPOSED LOT LINE
- ORDINARY HIGH WATER MARK
- ORDINARY HIGH WATER MARK BUFFER
- CRITICAL AREAS BUFFER

LAND USE SYNOPSIS

	COMMERCIAL	EMPLOYMENT	RES	FLEX	REC	DRAIN	ROW	TOTAL
TOTAL ACREAGE	9.0 - 9.5	46.4	7.8	9.5	18.3			
# OF LOTS	N/A	13	1	4	N/A	N/A	N/A	

LANDING ON THE COWLITZ - DYNAMIC MASTER PLAN

OCTOBER 2022

MacKay Sposito

ENERGY PUBLIC WORKS LAND DEVELOPMENT

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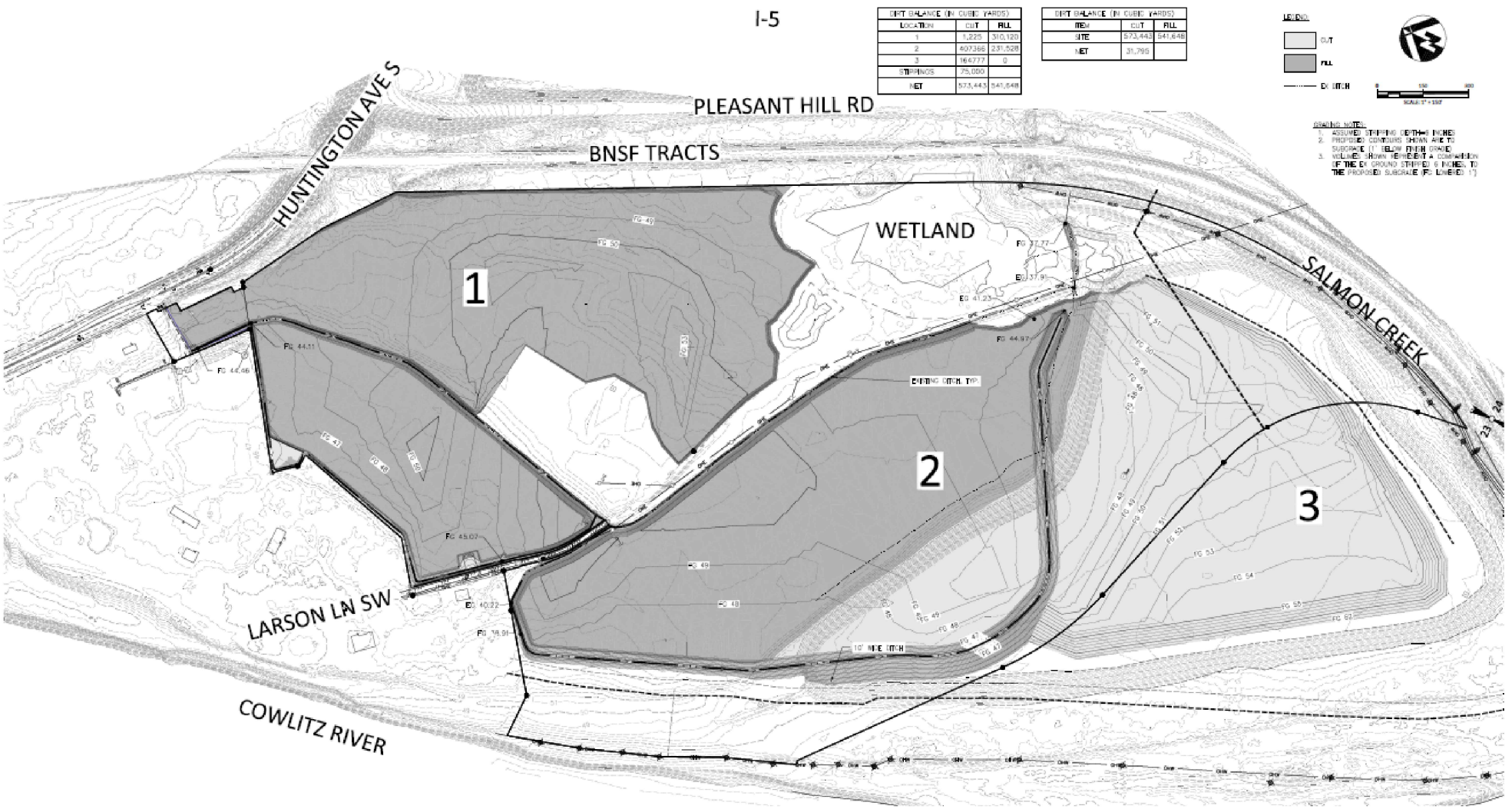
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Columbia West Engineering, Inc

Project: 22310
Date: 03/20/23
Drawn: GLW
Checked: LVL

PRELIMINARY MASTER DEVELOPMENT PLAN
LANDING ON THE COWLITZ

NOTES:
1. SITE LOCATION: 2542 SW LARSON LANE, CASTLE ROCK, WASHINGTON.
2. SITE CONSISTS OF PORTIONS OF TAX PARCEL NOS. 3092824, 3040258, 3040259, 3040322, 3014867, & 3045031 TOTALING APPROXIMATELY 118.2 ACRES.
3. DRAWING IS NOT TO SCALE.
4. BASE MAP PROVIDED BY CLIENT.

FIGURE
3



CASTLE ROCK LANDING ON THE COWLITZ - PHASE 1 ROUGH GRADING PLAN

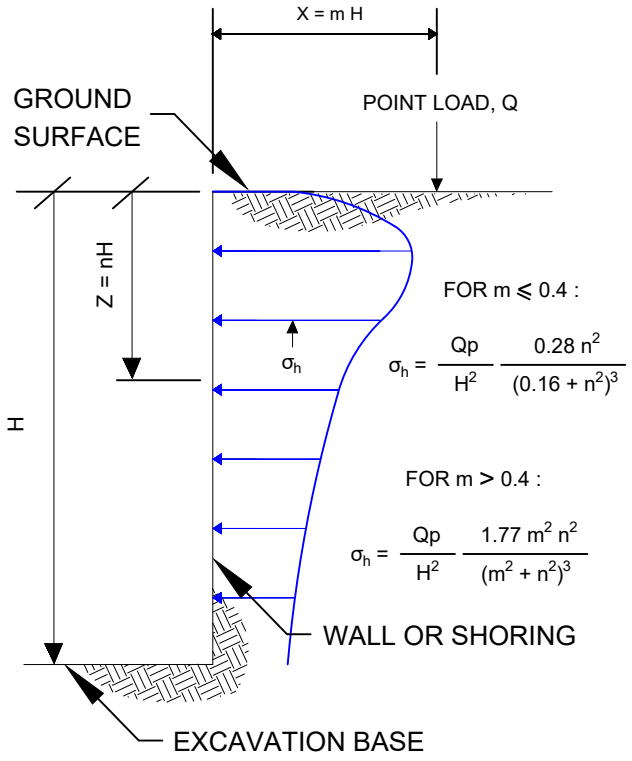
MacKay Sposito

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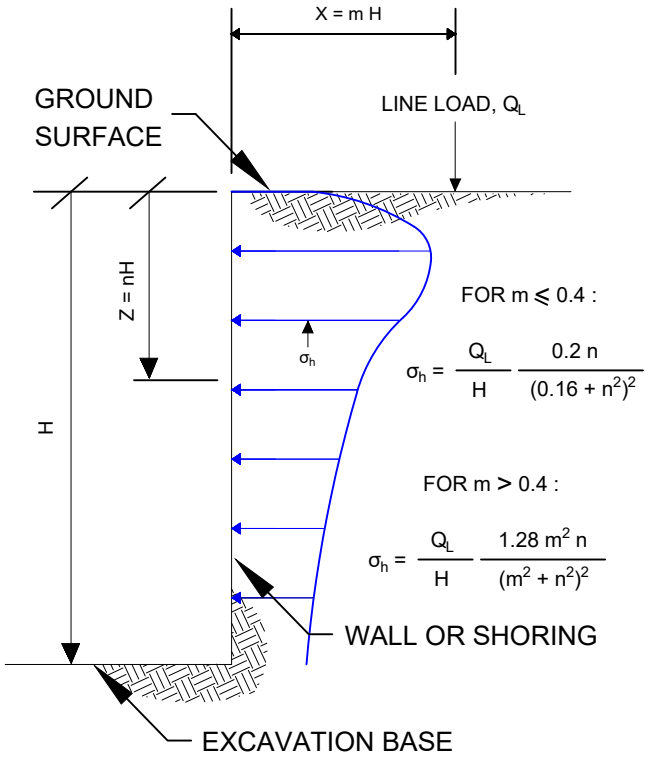
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Geotechnical ▪ Environmental ▪ Special Inspections Columbia West Engineering, Inc	Project: 22310 Date: 03/23/23 Drawn: GLW Checked: LVL	PHASE I ROUGH GRADING PLAN LANDING ON THE COWLITZ	NOTES: 1. SITE LOCATION: 2542 SW LARSON LANE, CASTLE ROCK, WASHINGTON. 2. SITE CONSISTS OF PORTIONS OF TAX PARCEL NOS. 3092824, 3040258, 3040259, 3040322, 3014867, & 3045031 TOTALING APPROXIMATELY 118.2 ACRES. 3. DRAWING IS NOT TO SCALE. 4. BASE MAP PROVIDED BY CLIENT.	FIGURE 4

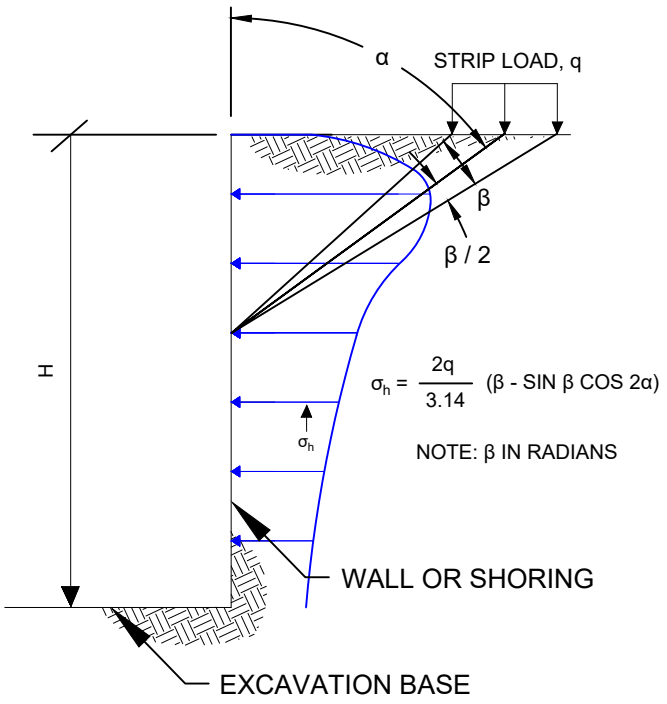
VERTICAL POINT LOAD



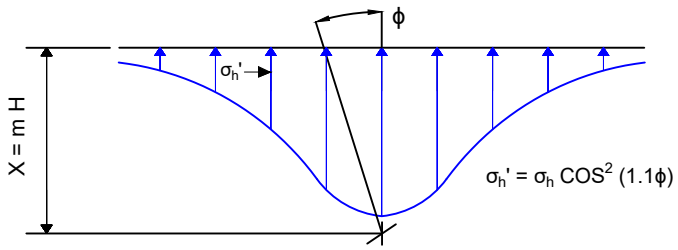
LINE LOAD PARALLEL TO WALL



STRIP LOAD PARALLEL TO WALL

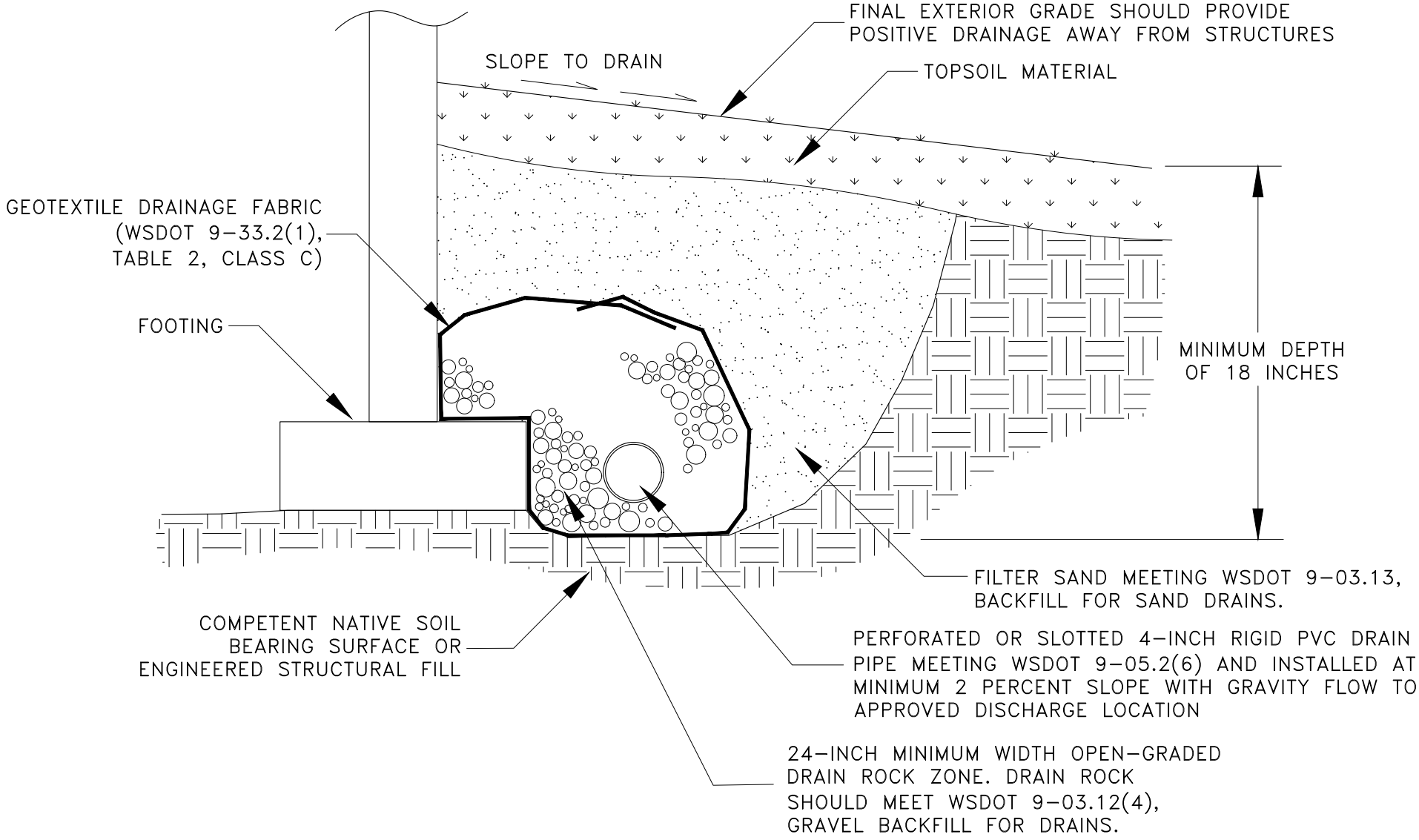


VERTICAL POINT LOAD HORIZONTAL PRESSURE DISTRIBUTION



NOTES:

1. FIGURE SHOULD BE USED JOINTLY WITH RECOMMENDATIONS PRESENTED IN THE REPORT TEXT.
2. LATERAL EARTH PRESSURES ASSUME RIGID WALLS WITH BACKFILL MATERIALS HAVING A POISSON'S RATIO OF 0.5.
3. TOTAL LATERAL EARTH PRESSURES RESULTING FROM COMBINED LOADS MAY BE CALCULATED USING SUPERPOSITION.
4. DRAWING IS NOT TO SCALE.

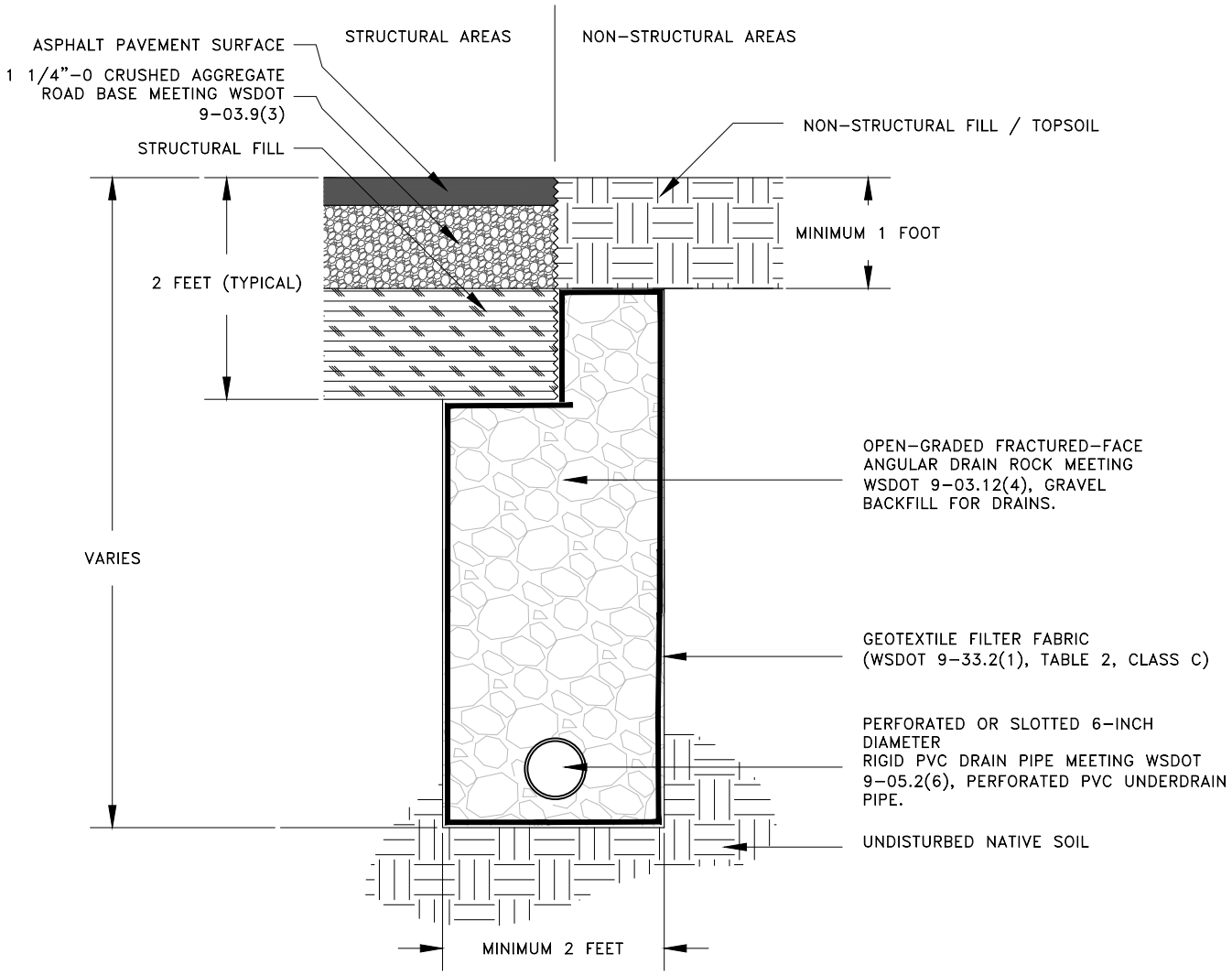


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TYPICAL PERIMETER FOOTING DRAIN DETAIL

NOTES:
1. DRAWING IS NOT TO SCALE.
2. DRAWING REPRESENTS TYPICAL PERIMETER FOOTING DRAIN DETAIL AND MAY NOT BE SITE-SPECIFIC.

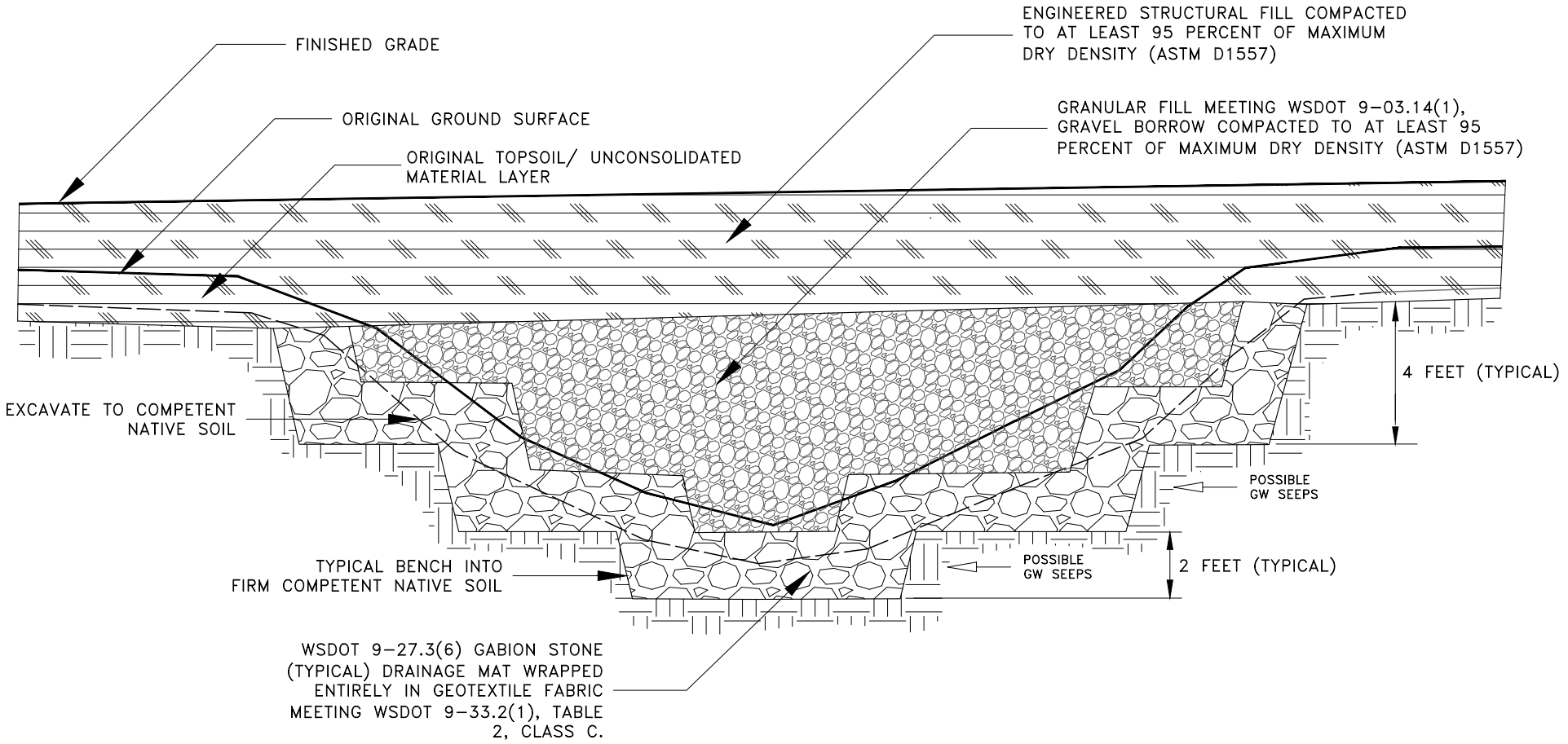
FIGURE 6



NOTE: LOCATION, INVERT ELEVATION, DEPTH OF TRENCH, AND EXTENT OF PERFORATED PIPE REQUIRED MAY BE MODIFIED BY THE GEOTECHNICAL ENGINEER DURING CONSTRUCTION BASED UPON FIELD OBSERVATION AND SITE-SPECIFIC SOIL CONDITIONS.

Geotechnical ▪ Environmental ▪ Special Inspections Columbia West Engineering, Inc	TYPICAL PERFORATED DRAINPIPE TRENCH DETAIL	NOTES: 1. DRAWING IS NOT TO SCALE. 2. DRAWING REPRESENTS TYPICAL PERFORATED DRAIN PIPE TRENCH DETAIL AND MAY NOT BE SITE-SPECIFIC.	FIGURE 7

TYPICAL DRAINAGE MAT CROSS-SECTION

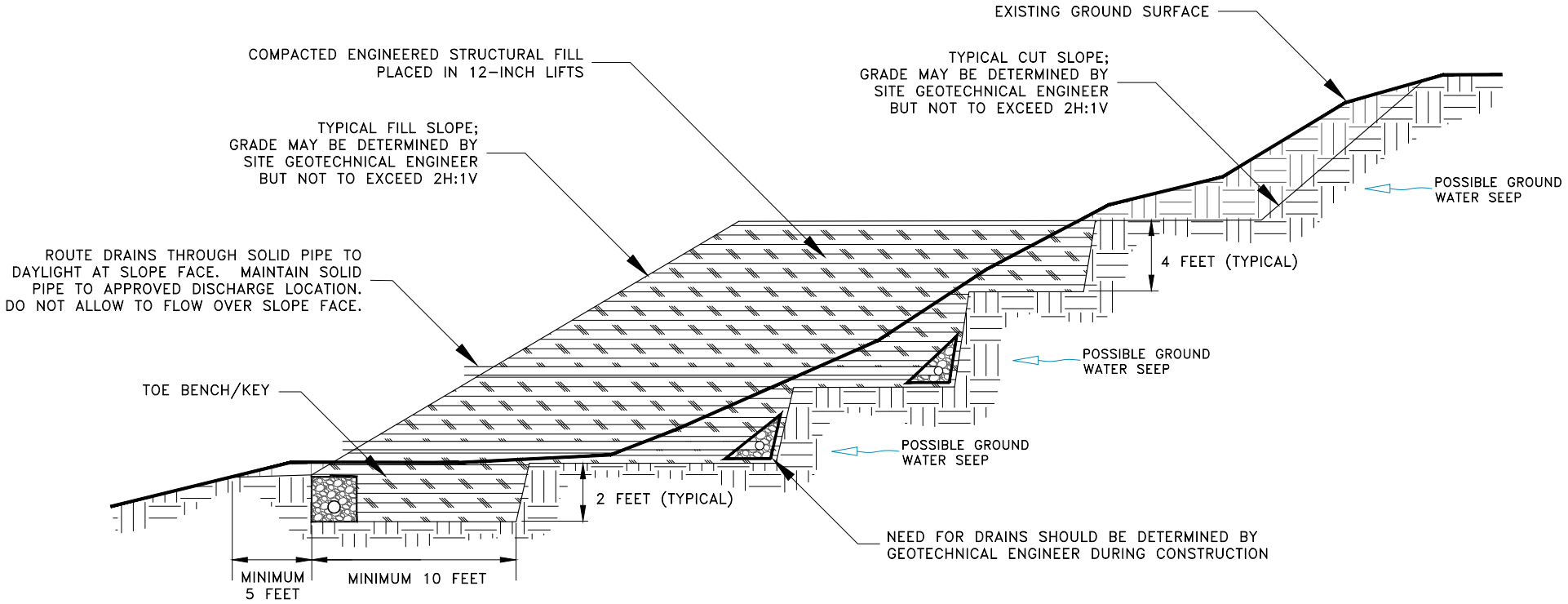


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TYPICAL DRAINAGE MAT CROSS SECTION

NOTES:
1. DRAWING IS NOT TO SCALE.
2. DRAWING REPRESENTS TYPICAL DRAINAGE MAT SECTION AND MAY NOT BE SITE-SPECIFIC.

FIGURE 8



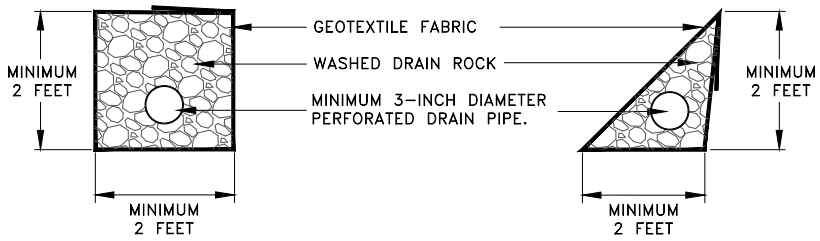
DRAIN SPECIFICATIONS

GEOTEXTILE FABRIC SHALL MEET WSDOT 9–33.2(1), TABLE 2, CLASS C.

WASHED DRAIN ROCK SHALL BE OPEN–GRADED ANGULAR DRAIN ROCK MEETING WSDOT 9–03.12(4), GRAVEL BACKFILL FOR DRAINS.

DRAIN PIPE SHOULD MEET WSDOT 9–05.2(6), PERFORATED PVC UNDERDRAIN PIPE.

TYPICAL DRAIN SECTION DETAIL

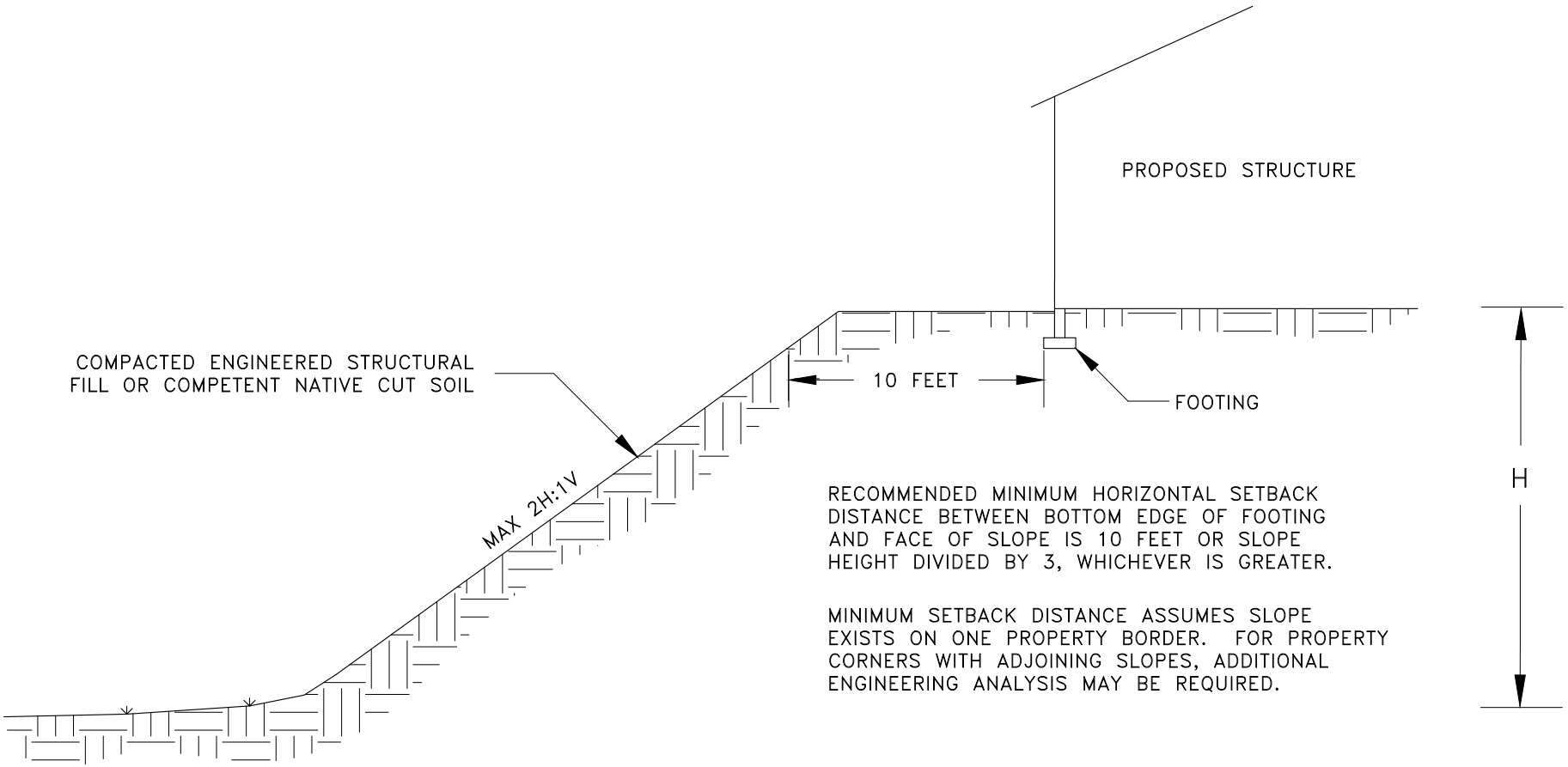


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TYPICAL CUT AND FILL SLOPE CROSS SECTION

NOTES:
1. DRAWING IS NOT TO SCALE.
2. DRAWING REPRESENTS TYPICAL CUT AND FILL SLOPE CROSS SECTION AND MAY NOT BE SITE–SPECIFIC.

FIGURE 9



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TYPICAL MINIMUM FOUNDATION SLOPE SETBACK DETAIL

NOTES:
1. DRAWING IS NOT TO SCALE.
2. SLOPES AND PROFILES SHOWN ARE APPROXIMATE.
3. DRAWING REPRESENTS TYPICAL FOUNDATION SETBACK DETAIL AND MAY NOT BE SITE-SPECIFIC.

FIGURE 10

APPENDIX A
SUBSURFACE EXPLORATION LOGS

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BORING LOG

PROJECT NAME	CLIENT		PROJECT NO.	BORING NO.
Landing on the Cowlitz	CT6, LLC		22310	BP-1
PROJECT LOCATION	**DRILLING CONTRACTOR**	**DRILL RIG**	**TECHNICIAN**	**PAGE NO.**
Castle Rock, Washington	Western States	CME Track	MAC	1 of 1
BORING LOCATION	**DRILLING METHOD**	**SAMPLING METHOD**	**START DATE**	**START TIME**
See Figure 2	HSA	SPT	1/31/23	0900
REMARKS	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**FINISH DATE**	**FINISH TIME**
None	Not surveyed	20 feet bgs on 1/31/23	1/31/23	1030

Depth (ft)	Field ID + Sample Type	SPT N-value (uncorrected) 0 20 40 60 80	USCS Soil Type	AASHTO Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Wet Density (PCF)	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index
0			SP-SM			Fill. Gray poorly-graded SAND with silt and trace gravel, moist, fine-textured.					
6	SPT BP1.1	5	SP-SM			Brown poorly-graded SAND with silt, loose, moist, fine-textured.					
10	SPT BP1.2	4				Becomes very loose.					
16	SPT BP1.3	9				Becomes loose.					
20	SPT BP1.4	16				Becomes medium dense, wet.					
30						Bottom of boring at 30 feet bgs. Groundwater encountered at 20 feet bgs on 1/31/23. Piezometer installed at 30 feet and completed with flush mount monument on 1/31/23.					

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BORING LOG

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Columbia West Engineering, Inc

PROJECT NAME	CLIENT		PROJECT NO.	BORING NO.
Landing on the Cowlitz	CT6, LLC		22310	BP-2
PROJECT LOCATION	**DRILLING CONTRACTOR**	**DRILL RIG**	**TECHNICIAN**	**PAGE NO.**
Castle Rock, Washington	Western States	CME Track	MAC	1 of 1
BORING LOCATION	**DRILLING METHOD**	**SAMPLING METHOD**	**START DATE**	**START TIME**
See Figure 2	HSA	SPT	1/31/23	1200
REMARKS	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**FINISH DATE**	**FINISH TIME**
None	Not surveyed	35 feet bgs on 1/31/23	1/31/23	1600

Depth (ft)	Field ID + Sample Type	SPT N-value (uncorrected) 0 20 40 60 80	USCS Soil Type	AASHTO Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Wet Density (PCF)	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index
0			SP-SM			Brown poorly-graded SAND with silt, moist, fine-textured.					
20	SPT BP2.1	57				Becomes very dense with reduced silt content and trace to some gravel.					
26	SPT BP2.2	11				Becomes medium dense, very moist.					
30	SPT BP2.3	10									
35			GP-GM			Gray to reddish gray poorly-graded GRAVEL with silt and sand, medium dense, wet.					
36	SPT BP2.4	30									
40	SPT BP2.5	REFUSAL 50(3")				Becomes very dense.					
45						Bottom of soil boring at 45 feet bgs. Groundwater encountered at 35 feet bgs on 1/31/23. Piezometer installed at 45 feet and completed with flush mount monument on 1/31/23.					

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BORING LOG

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Columbia West Engineering, Inc

PROJECT NAME	CLIENT		PROJECT NO.	BORING NO.
Landing on the Cowlitz	CT6, LLC		22310	BP-3
PROJECT LOCATION	**DRILLING CONTRACTOR**	**DRILL RIG**	**TECHNICIAN**	**PAGE NO.**
Castle Rock, Washington	Western States	CME Track	MAC	1 of 1
BORING LOCATION	**DRILLING METHOD**	**SAMPLING METHOD**	**START DATE**	**START TIME**
See Figure 2	HSA	SPT	2/1/23	0900
REMARKS	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**FINISH DATE**	**FINISH TIME**
None	Not surveyed	15 feet bgs on 2/1/23	2/1/23	1245

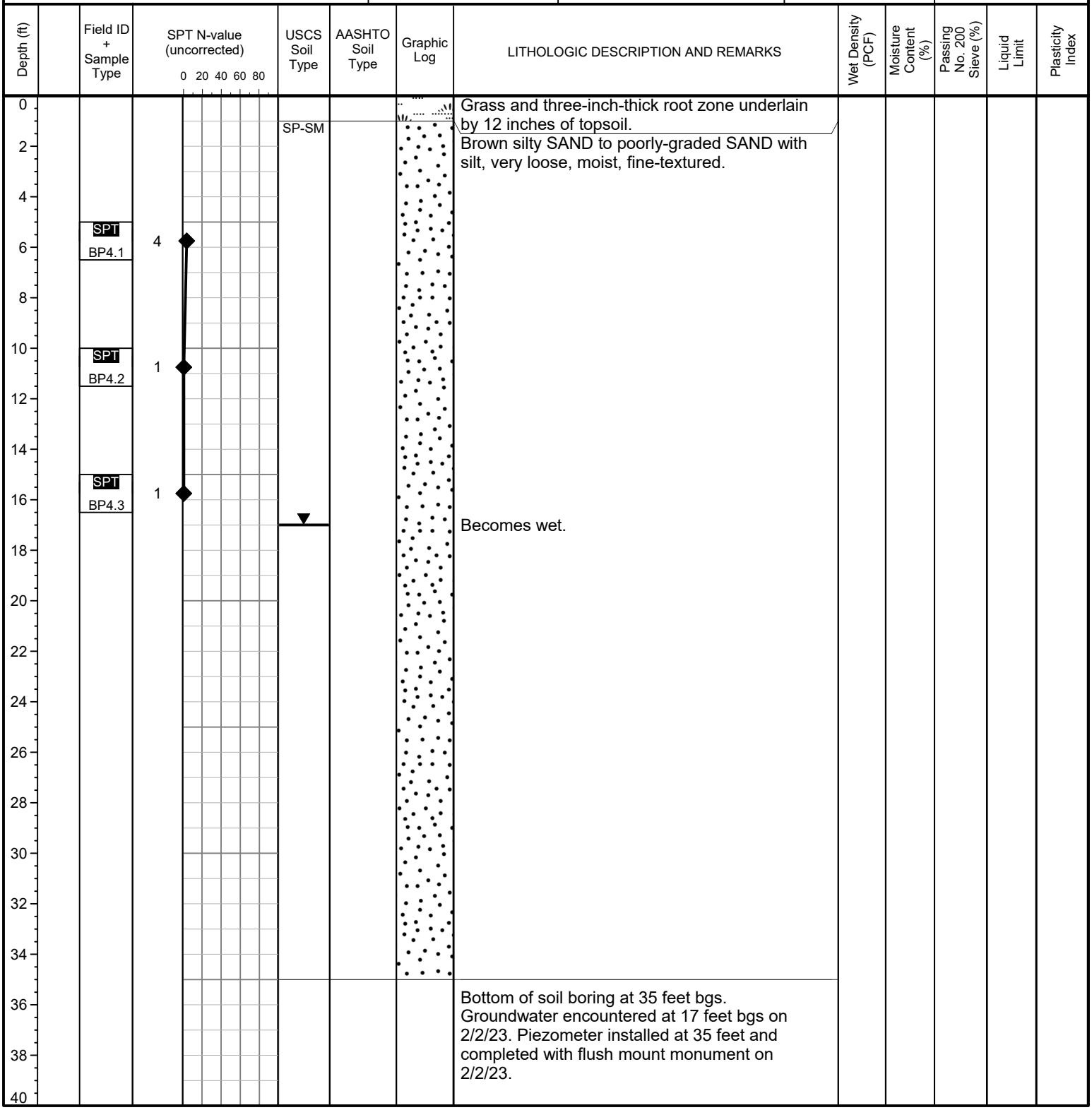
Depth (ft)	Field ID + Sample Type	SPT N-value (uncorrected) 0 20 40 60 80	USCS Soil Type	AASHTO Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Wet Density (PCF)	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index
0			SP-SM			Brown poorly-graded SAND with silt, loose, moist, fine-textured.					
6	SPT BP3.1	6									
10	SPT BP3.2	0				Becomes very loose.					
15			ML			Dark gray SILT with sand, very soft, wet, low plasticity.					
16	SPT BP3.3	1									
20	SPT BP3.4	37	SP			Gray poorly-graded SAND, medium dense, wet.					
25						Bottom of soil boring at 25 feet bgs. Groundwater encountered at 15 feet bgs on 2/1/23. Piezometer installed at 25 feet and completed with flush mount monument on 2/1/23.					

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

BORING LOG

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

PROJECT NAME	CLIENT		PROJECT NO.	BORING NO.
Landing on the Cowlitz	CT6, LLC		22310	BP-4
PROJECT LOCATION	**DRILLING CONTRACTOR**	**DRILL RIG**	**TECHNICIAN**	**PAGE NO.**
Castle Rock, Washington	Western States	CME Track	MAC	1 of 1
BORING LOCATION	**DRILLING METHOD**	**SAMPLING METHOD**	**START DATE**	**START TIME**
See Figure 2	HSA	SPT	2/1/23	1300
REMARKS	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**FINISH DATE**	**FINISH TIME**
None	Not surveyed	17 feet bgs on 2/2/23	2/2/23	1045



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BORING LOG

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

PROJECT NAME	CLIENT		PROJECT NO.	BORING NO.
Landing on the Cowlitz	CT6, LLC		22310	BP-5
PROJECT LOCATION	**DRILLING CONTRACTOR**	**DRILL RIG**	**TECHNICIAN**	**PAGE NO.**
Castle Rock, Washington	Western States	CME Track	MAC	1 of 1
BORING LOCATION	**DRILLING METHOD**	**SAMPLING METHOD**	**START DATE**	**START TIME**
See Figure 2	HSA	SPT	2/2/23	1100
REMARKS	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**FINISH DATE**	**FINISH TIME**
None	Not surveyed	17.5 feet bgs on 2/2/23	2/2/23	1600

Depth (ft)	Field ID + Sample Type	SPT N-value (uncorrected) 0 20 40 60 80	USCS Soil Type	AASHTO Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Wet Density (PCF)	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index
0			SP-SM			Brown poorly-graded SAND with silt, loose, moist, fine-textured.					
6	SPT BP5.1	7									
10	SPT BP5.2	10				Becomes medium dense.					
15	SPT BP5.3	5				Becomes loose.					
17.5						Becomes wet.					
20	SPT BP5.4	REFUSAL 50(3")	GP-GM			Gray to reddish gray poorly-graded GRAVEL with silt and sand, very dense, wet.					
25.5	SPT BP5.5	REFUSAL 50(5")									
30	SPT BP5.6	16				Becomes medium dense.					
31.5						Bottom of soil boring at 31.5 feet bgs. Groundwater encountered at 17.5 feet bgs on 2/2/23. Piezometer installed at 30 feet and completed with flush mount monument on 2/2/23.					

APPENDIX B
SOIL CLASSIFICATION INFORMATION

SOIL DESCRIPTION AND CLASSIFICATION GUIDELINES

Particle-Size Classification

COMPONENT	ASTM/USCS		AASHTO	
	size range	sieve size range	size range	sieve size range
Cobbles	> 75 mm	greater than 3 inches	> 75 mm	greater than 3 inches
Gravel	75 mm – 4.75 mm	3 inches to No. 4 sieve	75 mm – 2.00 mm	3 inches to No. 10 sieve
Coarse	75 mm – 19.0 mm	3 inches to 3/4-inch sieve	-	-
Fine	19.0 mm – 4.75 mm	3/4-inch to No. 4 sieve	-	-
Sand	4.75 mm – 0.075 mm	No. 4 to No. 200 sieve	2.00 mm – 0.075 mm	No. 10 to No. 200 sieve
Coarse	4.75 mm – 2.00 mm	No. 4 to No. 10 sieve	2.00 mm – 0.425 mm	No. 10 to No. 40 sieve
Medium	2.00 mm – 0.425 mm	No. 10 to No. 40 sieve	-	-
Fine	0.425 mm – 0.075 mm	No. 40 to No. 200 sieve	0.425 mm – 0.075 mm	No. 40 to No. 200 sieve
Fines (Silt and Clay)	< 0.075 mm	Passing No. 200 sieve	< 0.075 mm	Passing No. 200 sieve

Consistency for Cohesive Soil

CONSISTENCY	SPT N-VALUE (BLOWS PER FOOT)	D&M N-VALUE (BLOWS PER FOOT)	POCKET PENETROMETER (UNCONFINED COMPRESSIVE STRENGTH, tsf)
Very Soft	Less than 2	Less than 3	less than 0.25
Soft	2 to 4	3 to 6	0.25 to 0.50
Medium Stiff	4 to 8	6 to 12	0.50 to 1.0
Stiff	8 to 15	12 to 25	1.0 to 2.0
Very Stiff	15 to 30	25 to 65	2.0 to 4.0
Hard	30 to 60	65 to 145	greater than 4.0
Very Hard	greater than 60	greater than 145	-

RELATIVE DENSITY	SPT N-VALUE (BLOWS PER FOOT)	D&M N-VALUE (BLOWS PER FOOT)
Very Loose	0 to 4	0 to 11
Loose	4 to 10	11 to 26
Medium Dense	10 to 30	26 to 74
Dense	30 to 50	74 to 120
Very Dense	more than 50	More than 120

Relative Density for Granular Soil

Moisture Designations

TERM	FIELD IDENTIFICATION
Dry	No moisture. Dusty or dry.
Damp	Some moisture. Cohesive soils are usually below plastic limit and are moldable.
Moist	Grains appear darkened, but no visible water is present. Cohesive soils will clump. Sand will bulk. Soils are often at or near plastic limit.
Wet	Visible water on larger grains. Sand and silt exhibit dilatancy. Cohesive soil can be readily remolded. Soil leaves wetness on the hand when squeezed. Soil is much wetter than optimum moisture content and is above plastic limit.

Additional Constituents

Percent	Silt and Clay In:		Percent	Sand and Gravel In:	
	Fine-Grained Soil	Coarse-Grained Soil		Fine-Grained Soil	Coarse-Grained Soil
< 5	trace	trace	< 5	trace	trace
5 – 12	minor	with	5 – 15	minor	minor
> 12	some	silty/clayey	15 – 30	with	with
			> 30	sandy/gravelly	with Indicate approx. percentage

AASHTO SOIL CLASSIFICATION SYSTEM

TABLE 1. Classification of Soils and Soil-Aggregate Mixtures

General Classification	Granular Materials (35 Percent or Less Passing .075 mm)				Silt-Clay Materials (More than 35 Percent Passing 0.075)		
Group Classification	A-1	A-3	A-2	A-4	A-5	A-6	A-7
Sieve analysis, percent passing:							
2.00 mm (No. 10)	-	-	-				
0.425 mm (No. 40)	50 max	51 min	-	-	-	-	-
0.075 mm (No. 200)	25 max	10 max	35 max	36 min	36 min	36 min	36 min
Characteristics of fraction passing 0.425 mm (No. 40)							
Liquid limit				40 max	41 min	40 max	41 min
Plasticity index	6 max	N.P.		10 max	10 max	11 min	11 min
General rating as subgrade	Excellent to good				Fair to poor		

Note: The placing of A-3 before A-2 is necessary in the "left to right elimination process" and does not indicate superiority of A-3 over A-2.

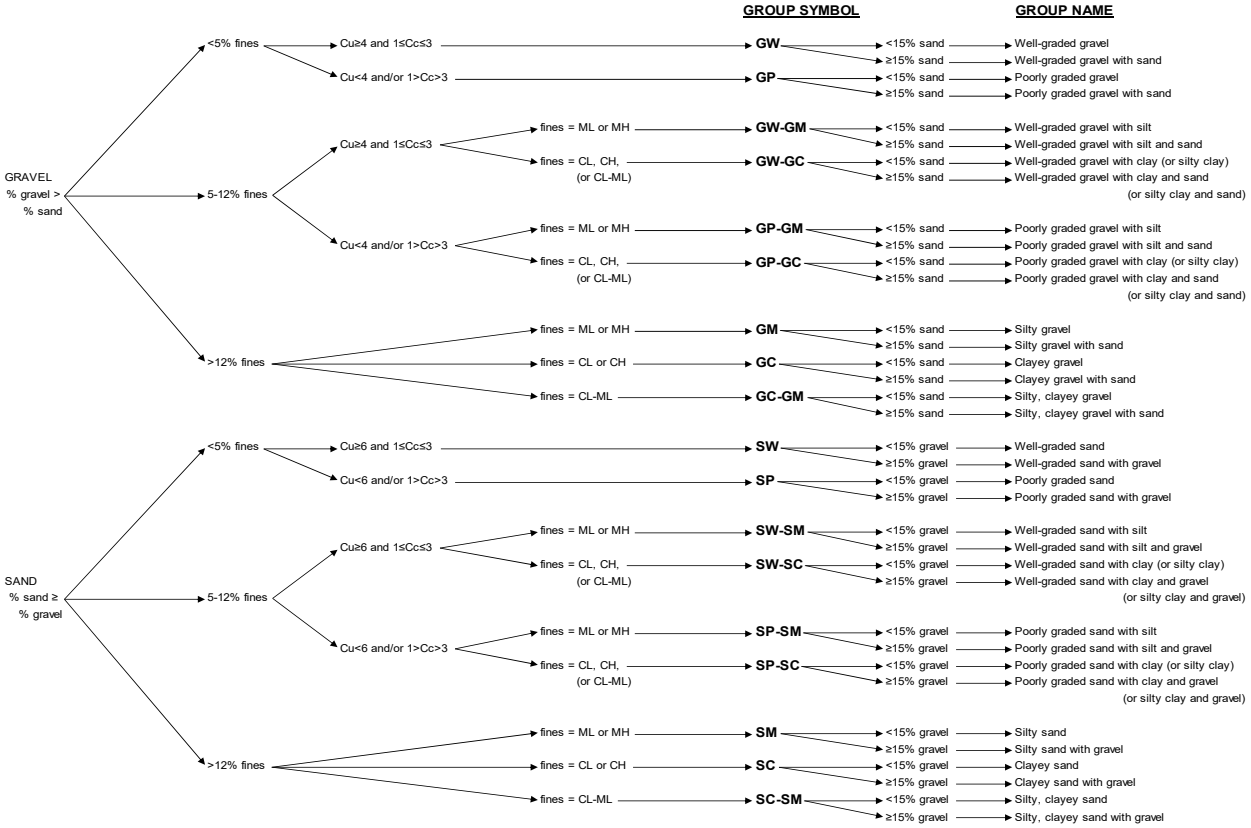
TABLE 2. Classification of Soils and Soil-Aggregate Mixtures

General Classification	Granular Materials (35 Percent or Less Passing 0.075 mm)							Silt-Clay Materials (More than 35 Percent Passing 0.075 mm)			
	A-1			A-2							A-7
Group Classification	A-1-a	A-1-b	A-3	A-2-4	A-2-5	A-2-6	A-2-7	A-4	A-5	A-6	A-7-5, A-7-6
Sieve analysis, percent passing:											
2.00 mm (No. 10)	50 max	-	-	-	-	-	-	-	-	-	-
0.425 mm (No. 40)	30 max	50 max	51 min	-	-	-	-	-	-	-	-
0.075 mm (No. 200)	15 max	25 max	10 max	35 max	35 max	35 max	35 max	36 min	36 min	36 min	36 min
Characteristics of fraction passing 0.425 mm (No. 40)											
Liquid limit				40 max	41 min	40 max	41 min	40 max	41 min	40 max	41 min
Plasticity index	6 max		N.P.	10 max	10 max	11 min	11 min	10 max	10 max	11 min	11min
Usual types of significant constituent materials	Stone fragments, gravel and sand		Fine sand	Silty or clayey gravel and sand				Silty soils		Clayey soils	
General ratings as subgrade	Excellent to Good							Fair to poor			

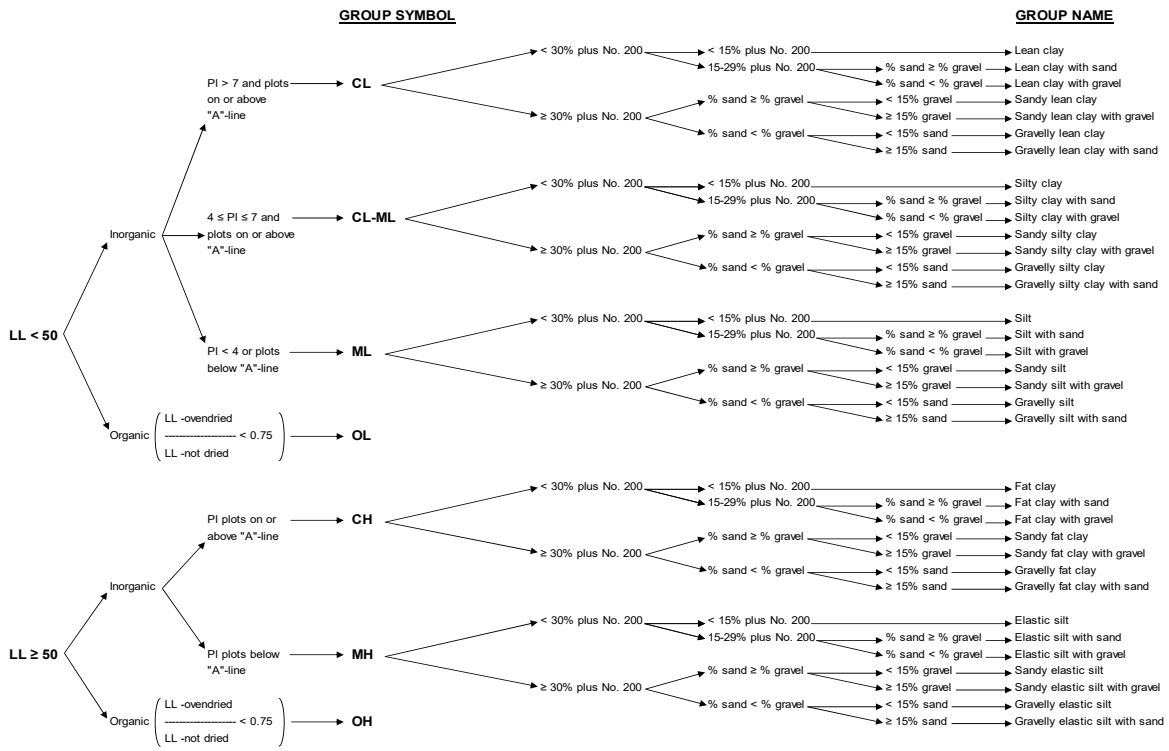
Note: Plasticity index of A-7-5 subgroup is equal to or less than LL minus 30. Plasticity index of A-7-6 subgroup is greater than LL minus 30 (see Figure 2).

AASHTO = American Association of State Highway and Transportation Officials

USCS SOIL CLASSIFICATION SYSTEM



Flow Chart for Classifying Coarse-Grained Soils (More Than 50% Retained on No. 200 Sieve)

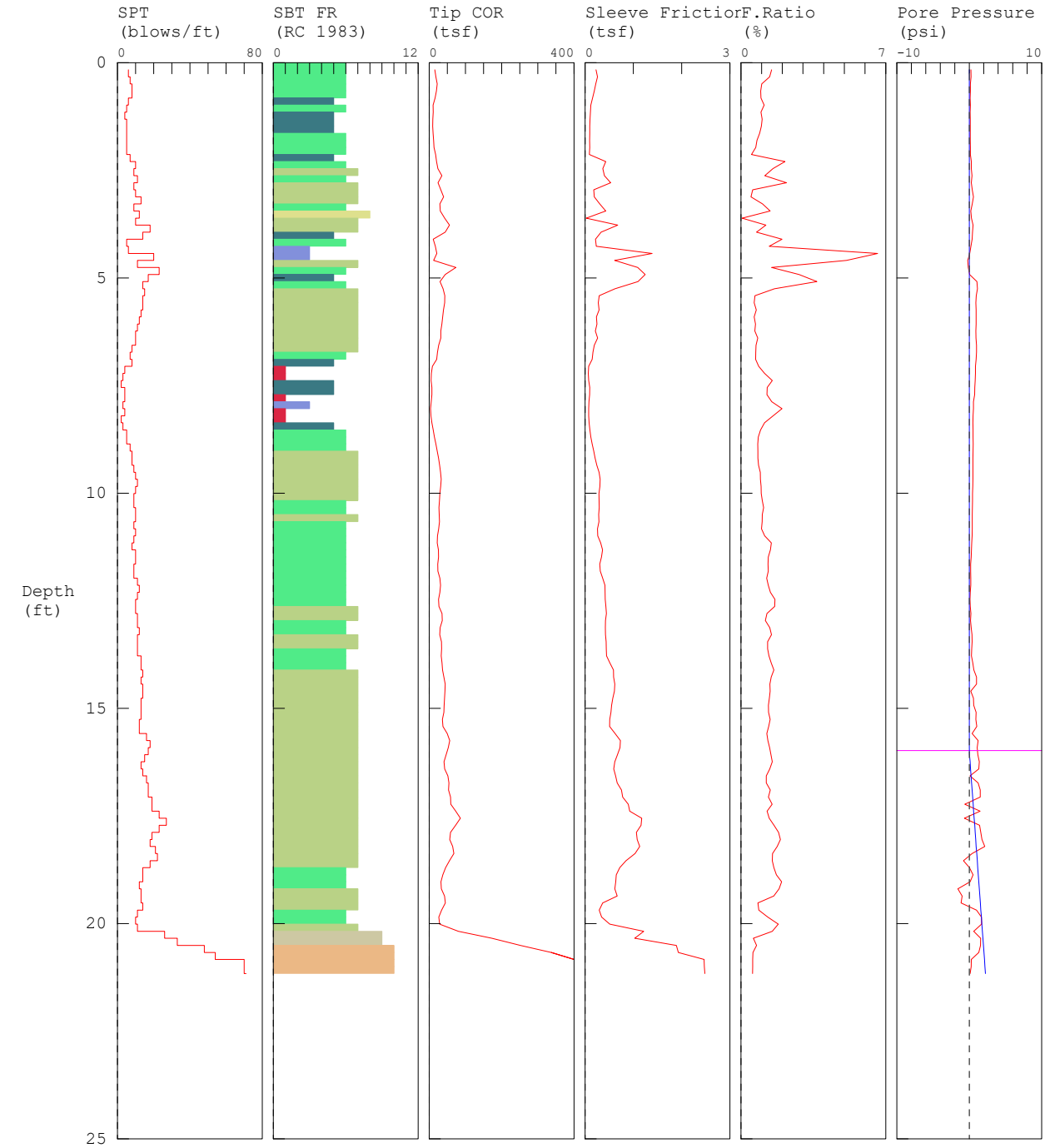


Flow Chart for Classifying Fine-Grained Soil (50% or More Passes No. 200 Sieve)

APPENDIX C
PERTINENT SUBSURFACE INFORMATION COLLECTED BY OTHERS

GeoDesign / CPT-1 / SW Larson Lane Castle Rock

OPERATOR: OGE BAK
CONE ID: DDG1296
HOLE NUMBER: CPT-1
TEST DATE: 1/13/2020 10:33:34 AM
TOTAL DEPTH: 21.161 ft

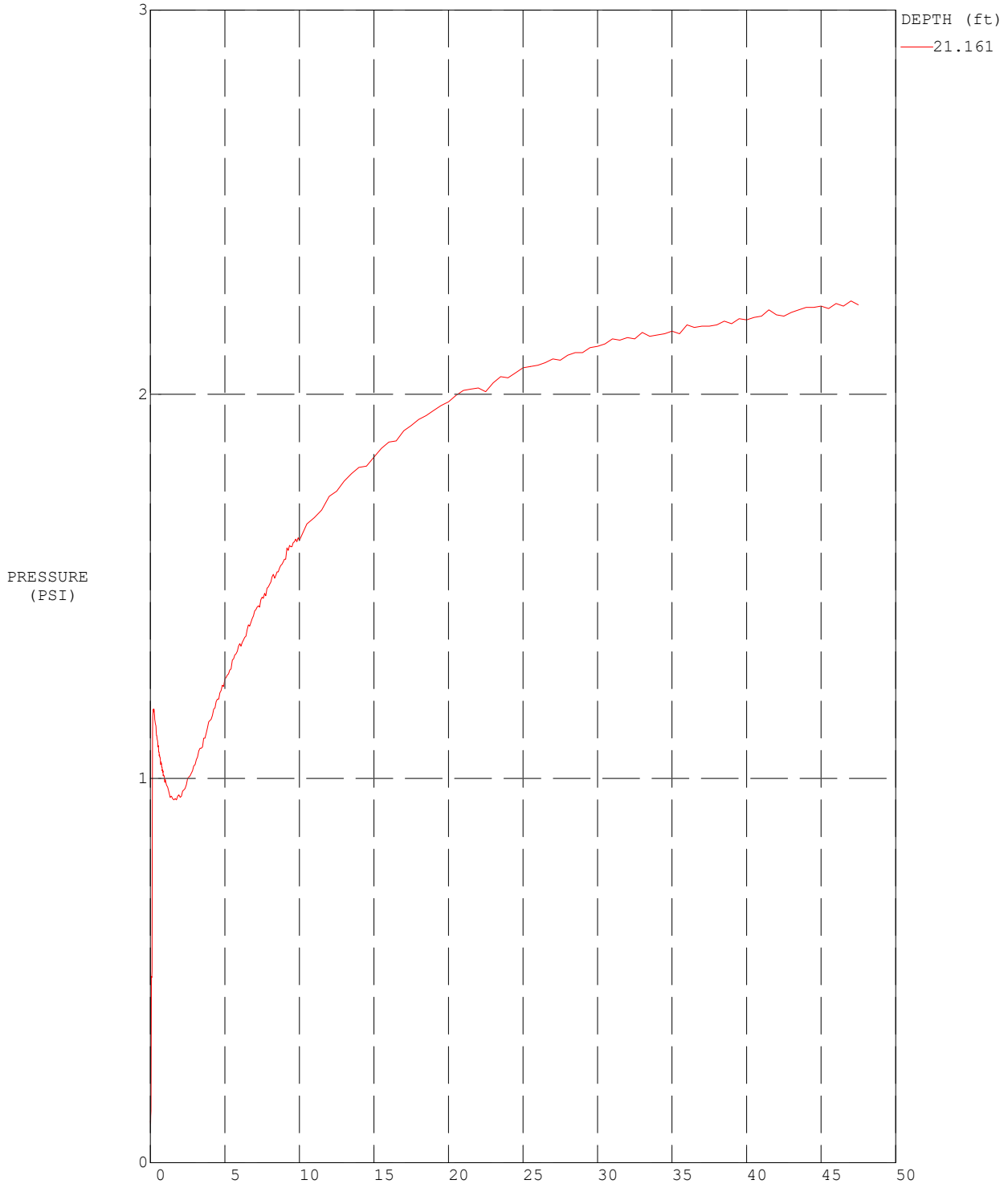


1 sensitive fine gra
2 organic materia
3 clay
4 silty clay to cl
5 clayey silt to silt
6 sandy silt to claye
7 silty sand to sandy
8 sand to silty sa
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

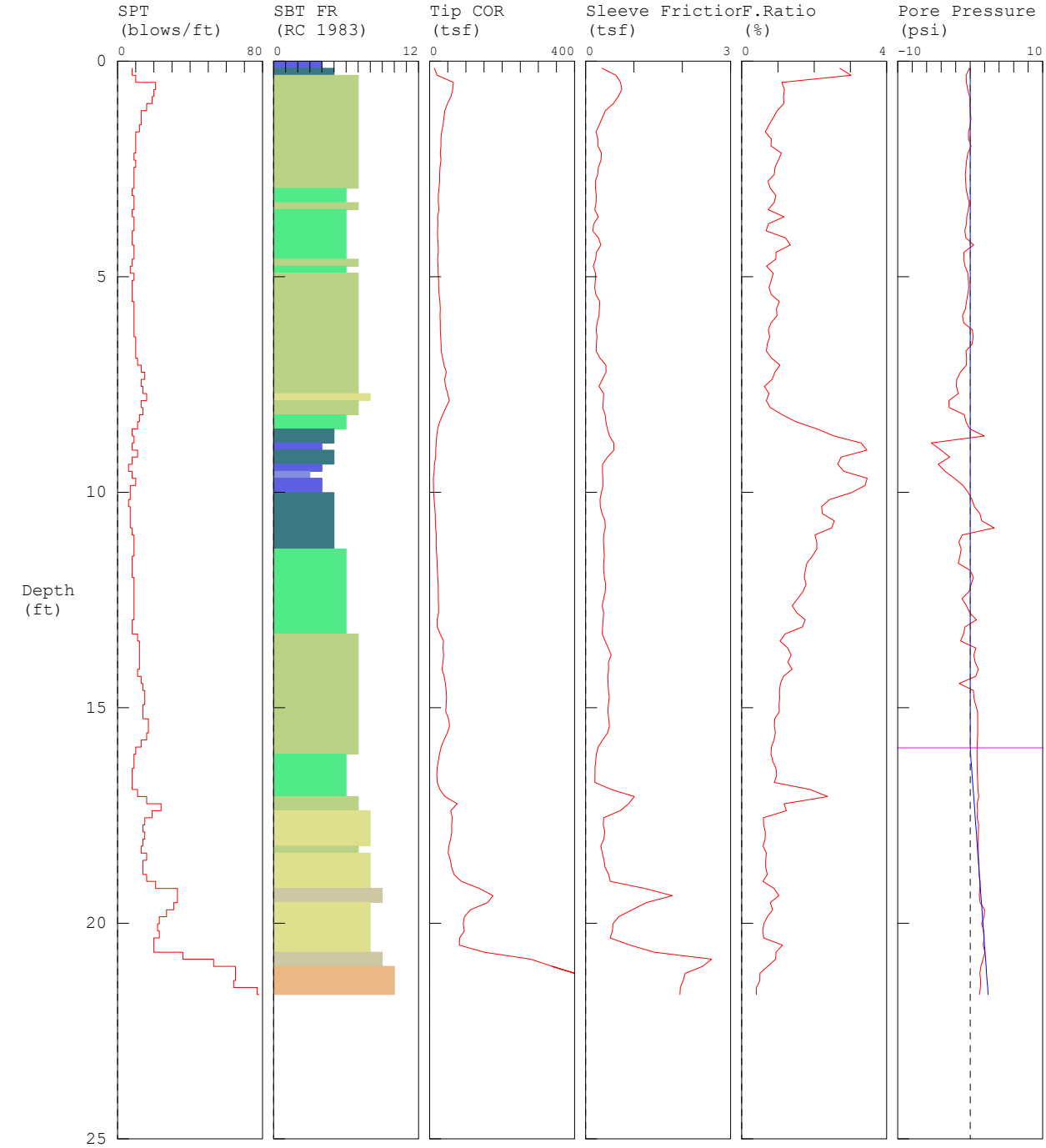
COMMENT: GeoDesign / CPT-1 / SW Larson Lane Castle Rock

TEST DATE: 1/13/2020 10:33:34 AM



GeoDesign / CPT-2 / SW Larson Lane Castle Rock

OPERATOR: OGE BAK
CONE ID: DDG1296
HOLE NUMBER: CPT-2
TEST DATE: 1/13/2020 12:14:29 PM
TOTAL DEPTH: 21.654 ft

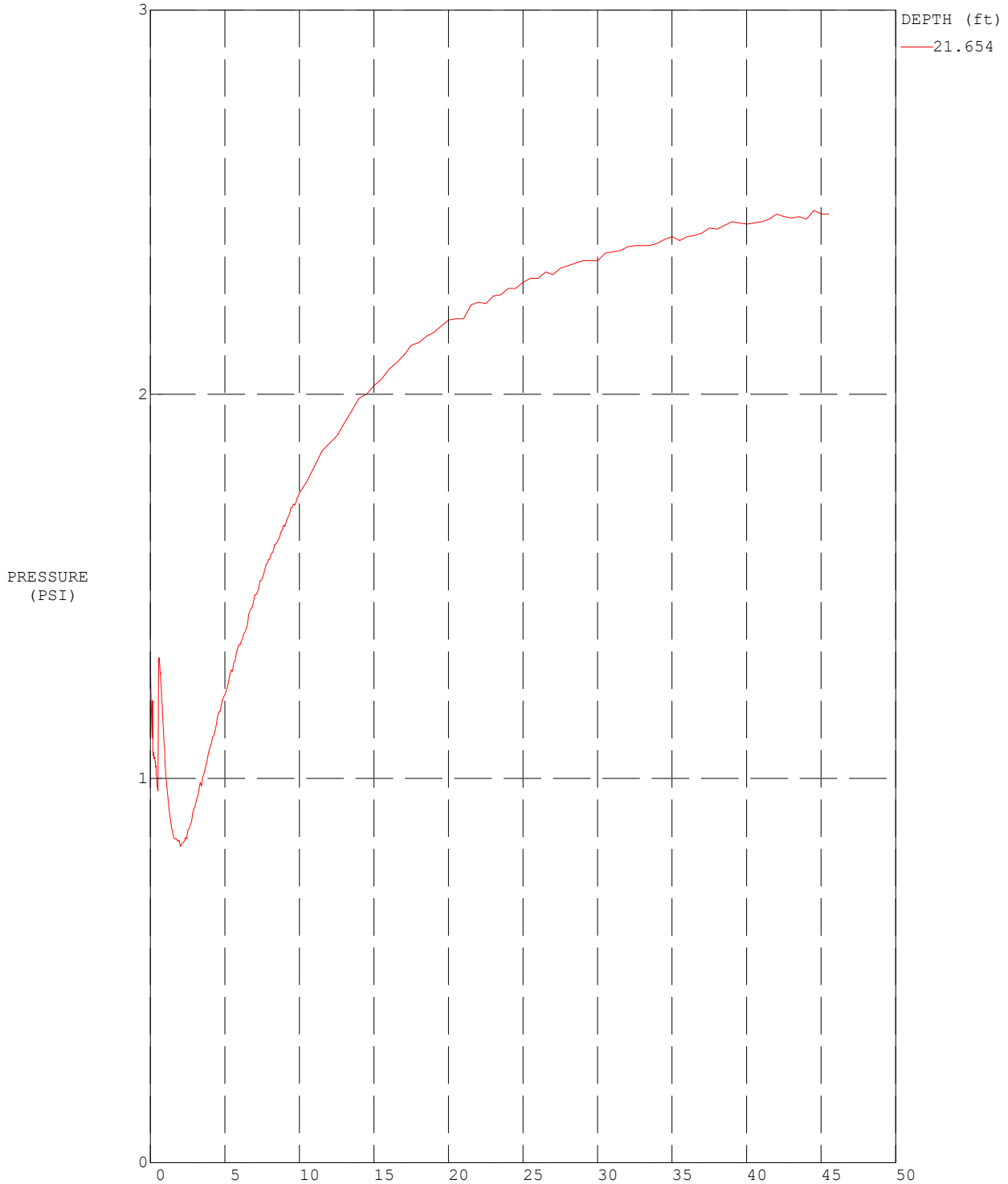


1 sensitive fine gra
2 organic materia
3 clay
4 silty clay to cl
5 clayey silt to silt
6 sandy silt to claye
7 silty sand to sandy
8 sand to silty sa
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

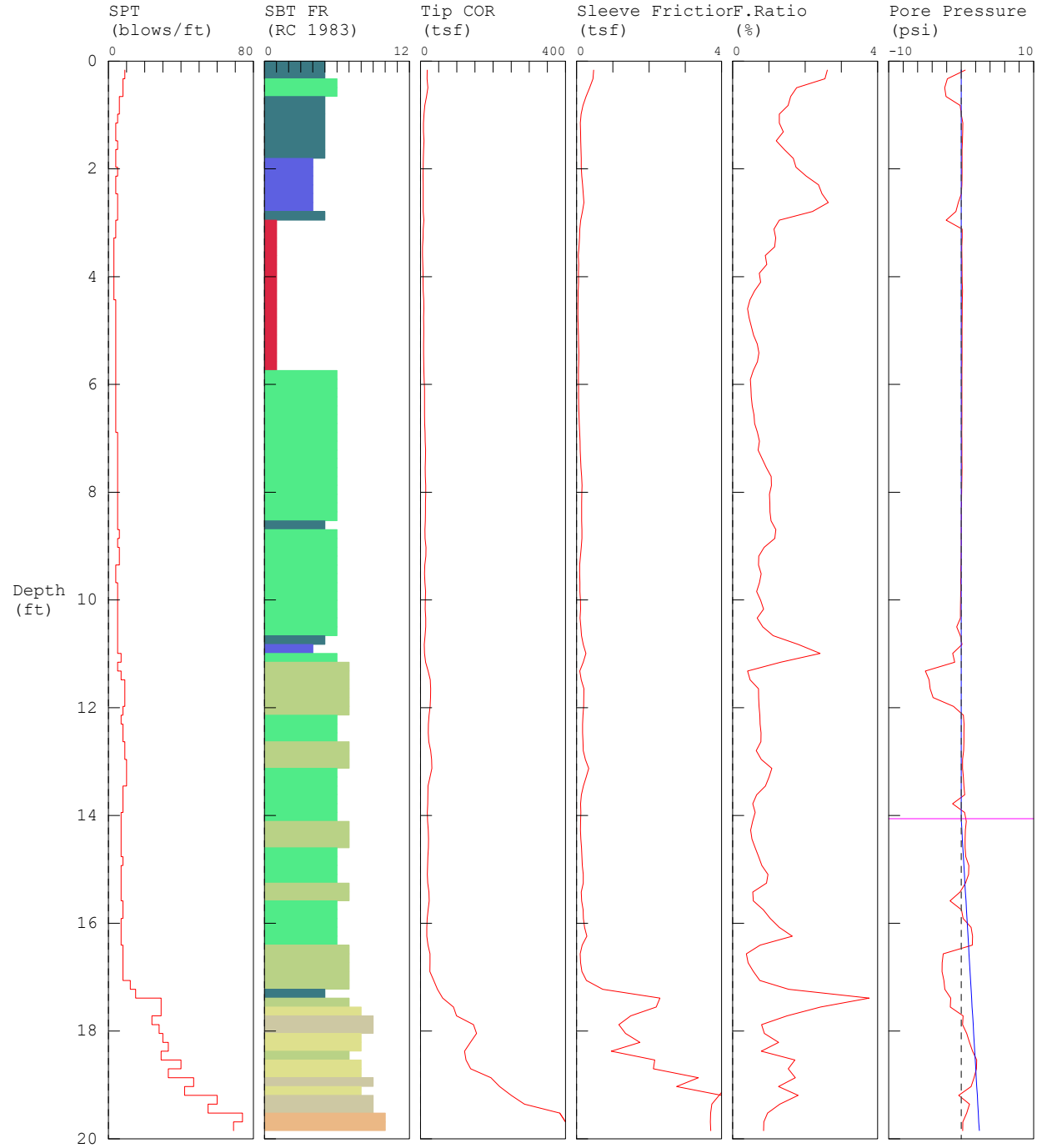
COMMENT: GeoDesign / CPT-2 / SW Larson Lane Castle Rock

TEST DATE: 1/13/2020 12:14:29 PM



GeoDesign / CPT-3 / SW Larson Lane Castle Rock

OPERATOR: OGE BAK
CONE ID: DDG1296
HOLE NUMBER: CPT-3
TEST DATE: 1/13/2020 1:40:18 PM
TOTAL DEPTH: 19.849 ft

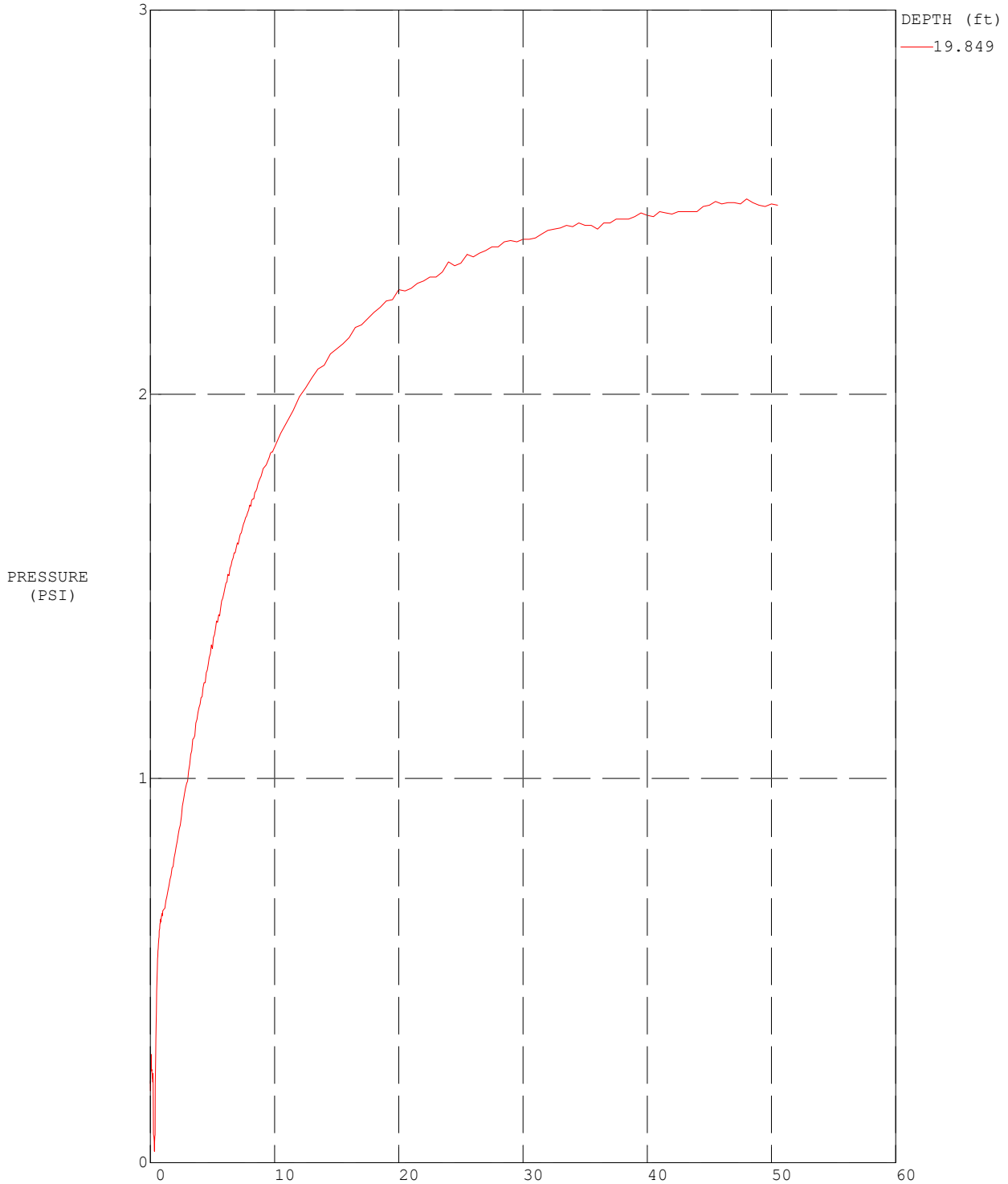


1 sensitive fine gra
2 organic materia
3 clay
4 silty clay to cl
5 clayey silt to silt
6 sandy silt to claye
7 silty sand to sandy
8 sand to silty sa
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

COMMENT: GeoDesign / CPT-3 / SW Larson Lane Castle Rock

TEST DATE: 1/13/2020 10:33:34 AM

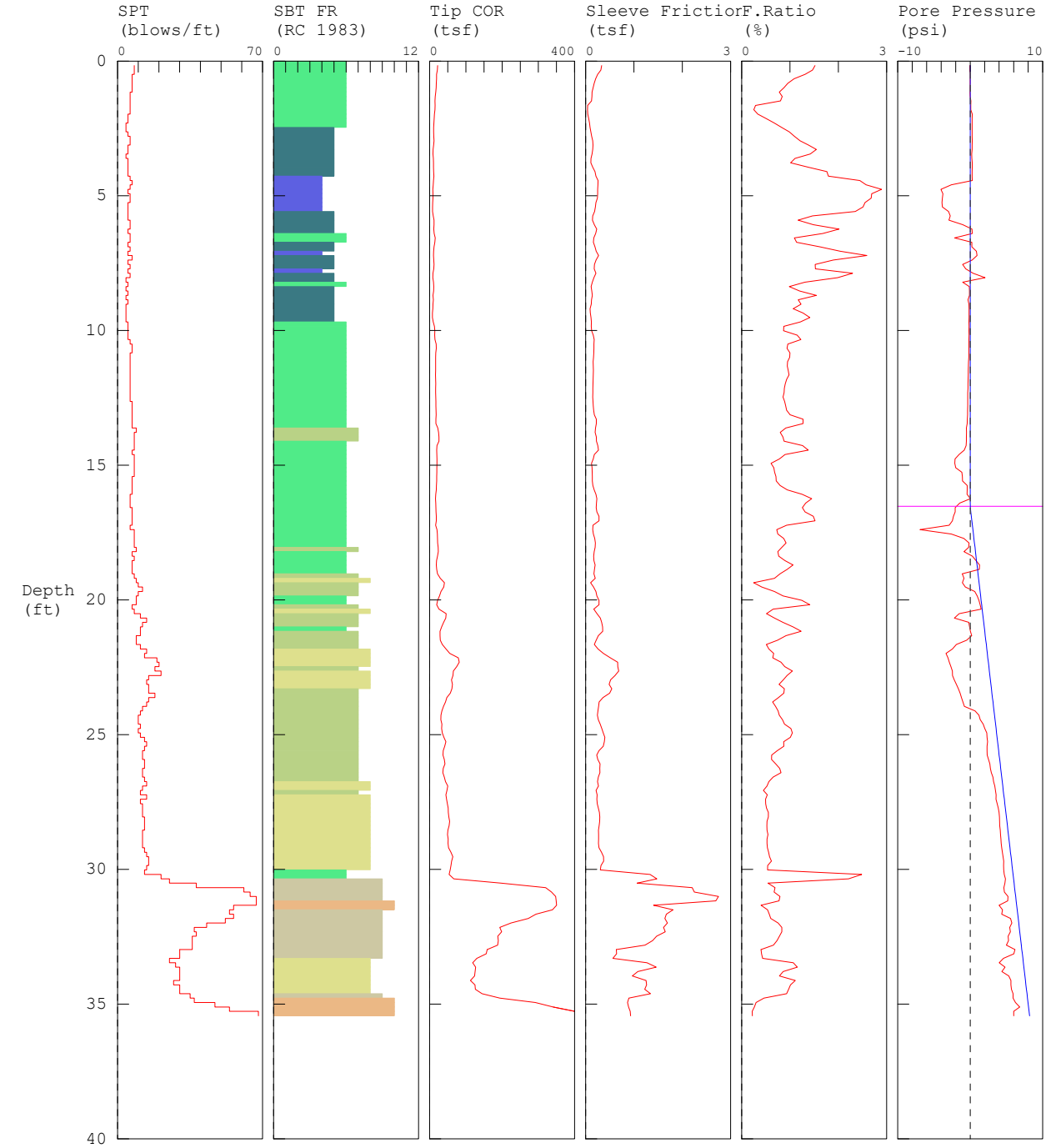


MAXIMUM PRESSURE = 2.508 (PSI)IME: (MINUTES)

HYDROSTATIC PRESSURE = 2.51 (PSI), WATER TABLE: 14.06 ft

GeoDesign / CPT-4 / SW Larson Lane Castle Rock

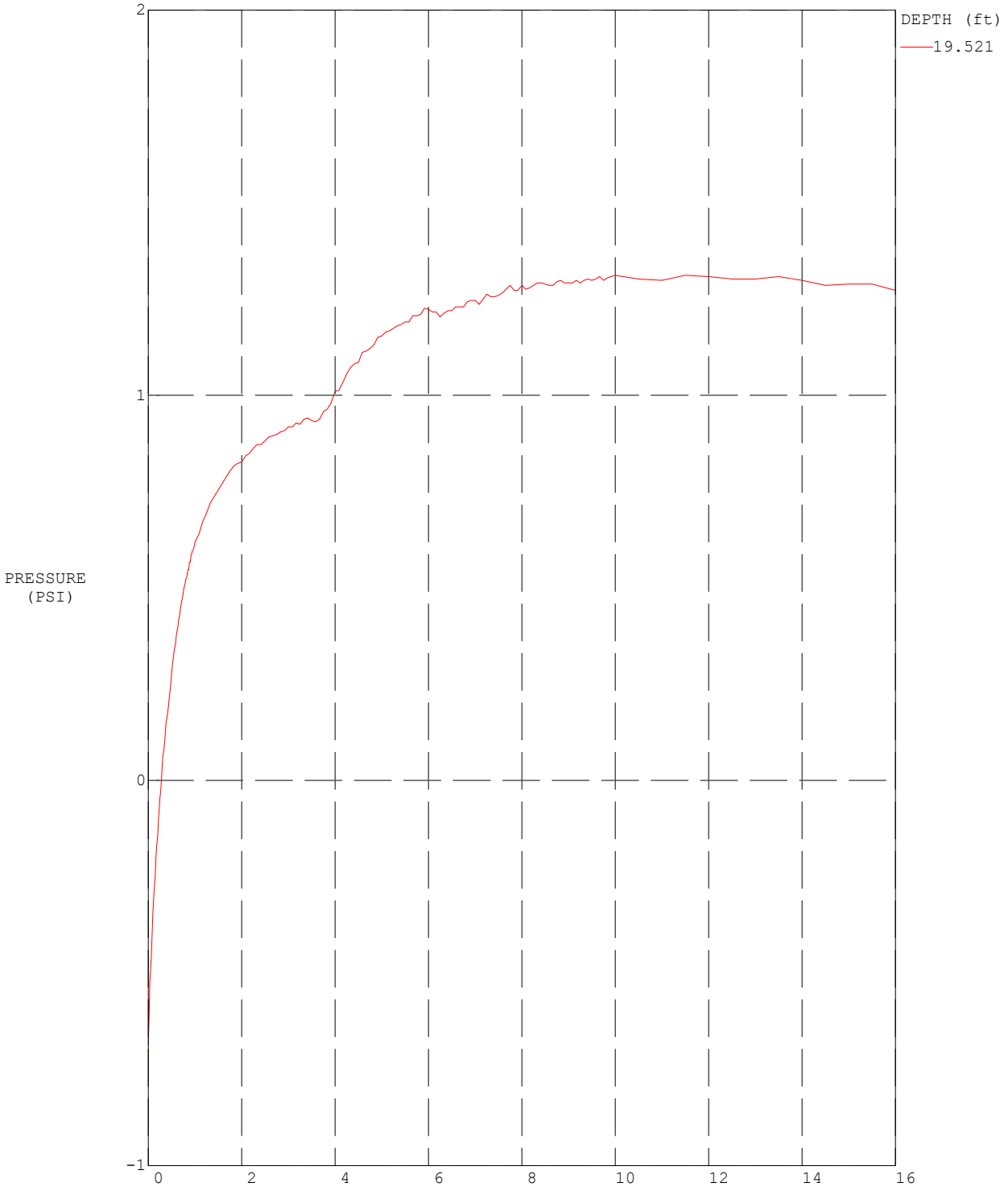
OPERATOR: OGE BAK
CONE ID: DDG1296
HOLE NUMBER: CPT-4
TEST DATE: 1/13/2020 3:11:15 PM
TOTAL DEPTH: 35.433 ft



*SBT/SPT CORRELATION: UBC-1983

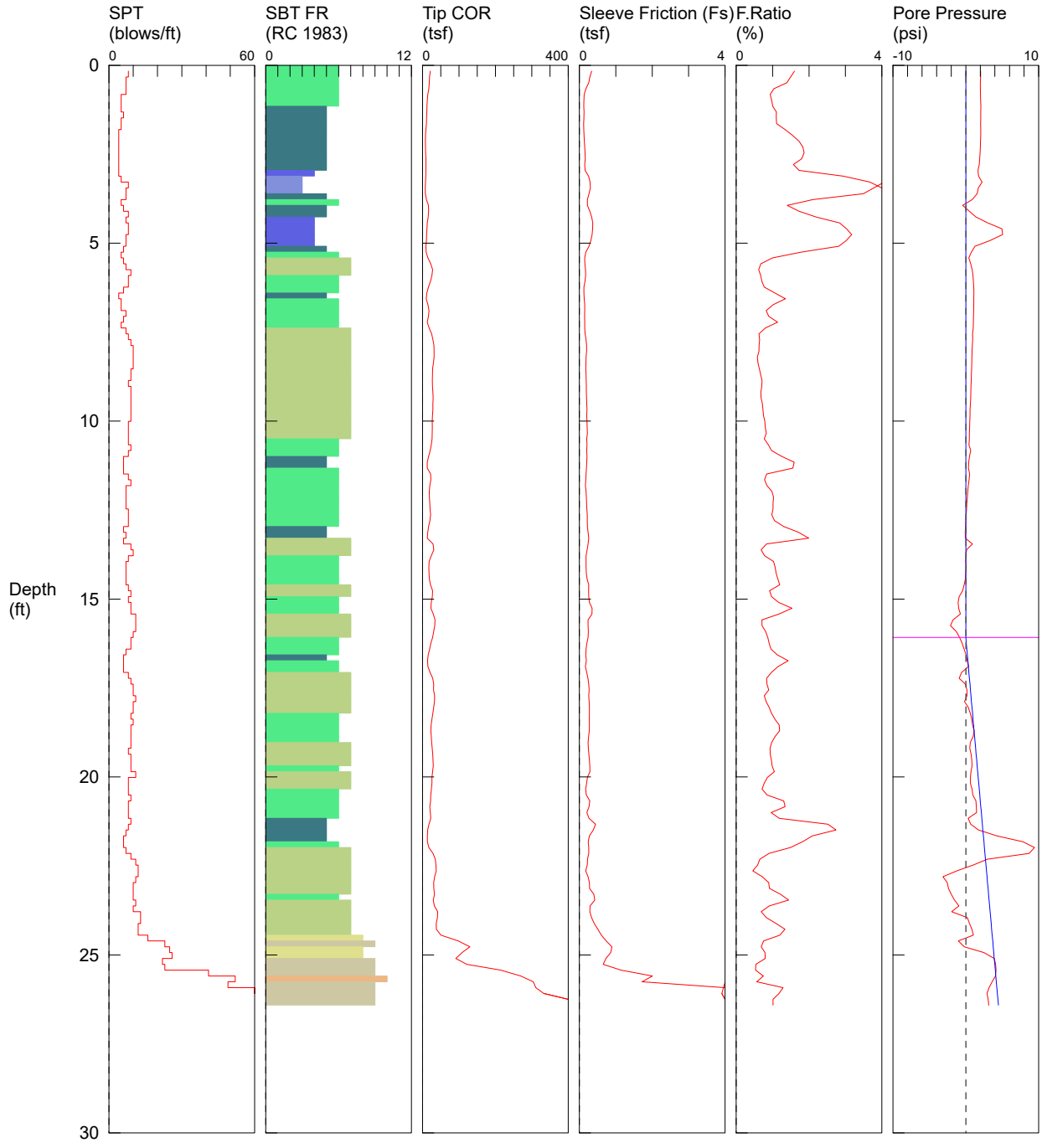
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TEST DATE: 1/13/2020 3:11:15 PM



GeoDesign / CPT-5 / SW Larson Lane Castle Rock

OPERATOR: OGE BAK
CONE ID: DDG1296
HOLE NUMBER: CPT-5
TEST DATE: 1/14/2020 8:44:26 AM
TOTAL DEPTH: 26.411 ft

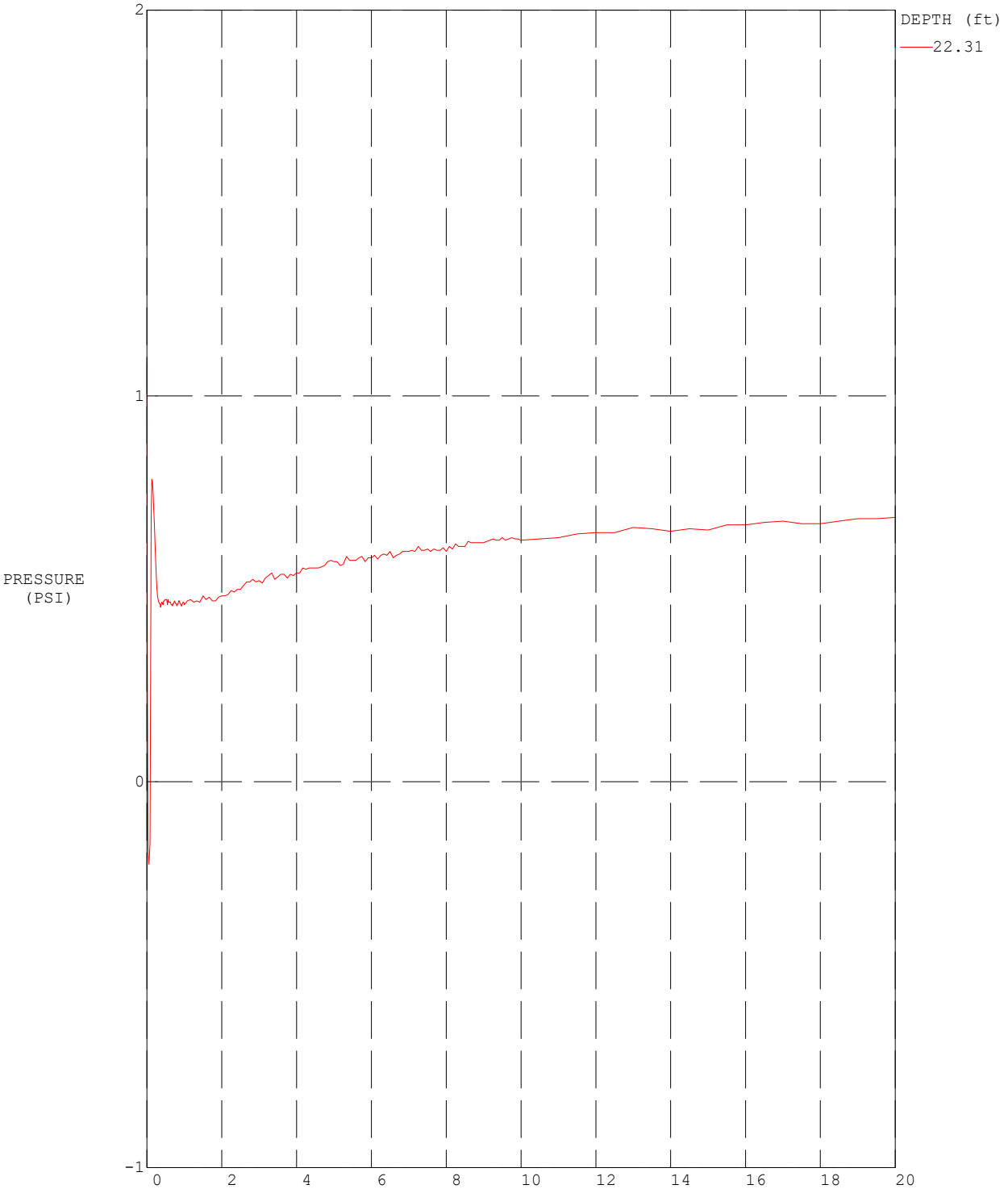


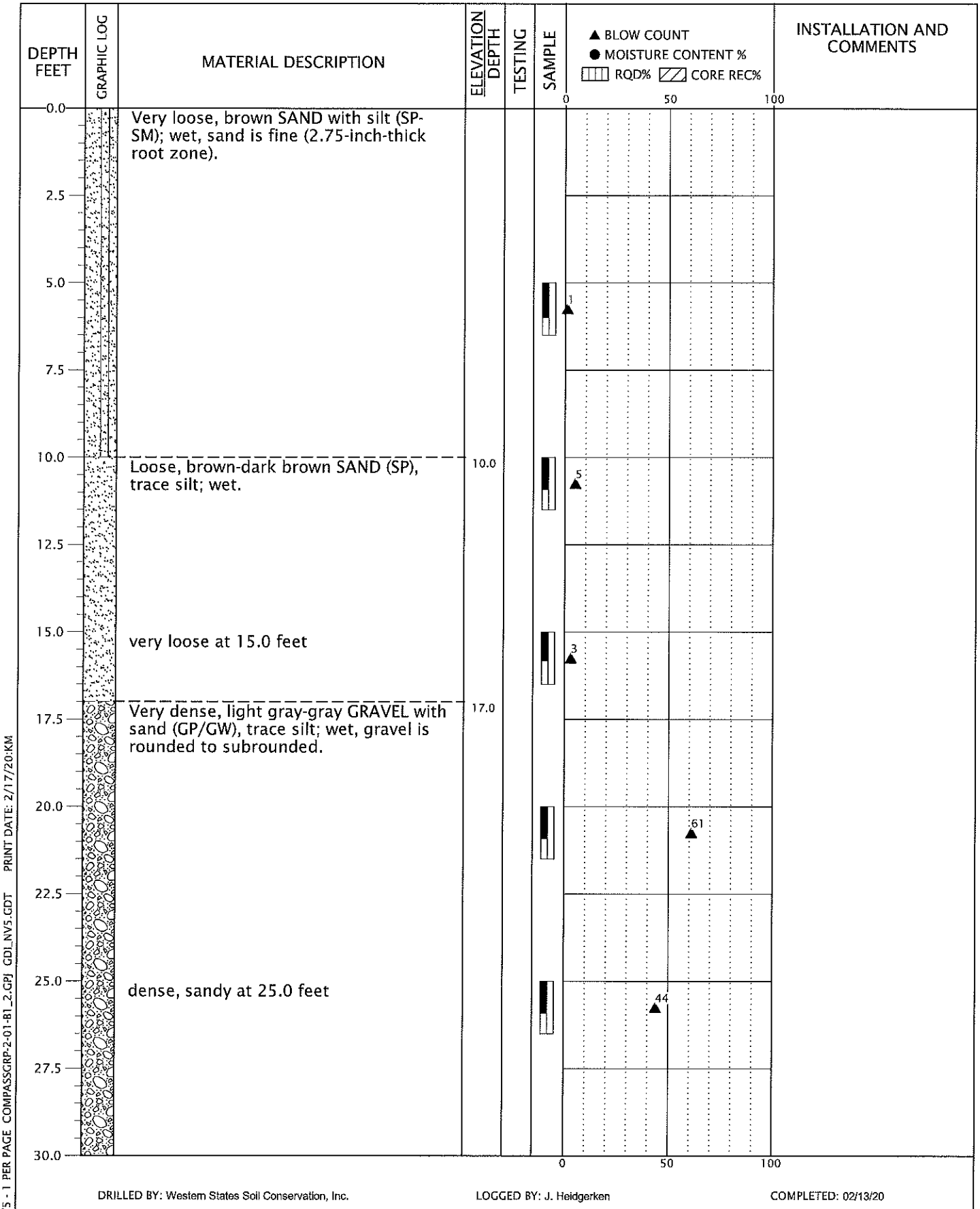
1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

COMMENT: GeoDesign / CPT-5 / SW Larson Lane Castle Rock

TEST DATE: 1/14/2020 8:44:26 AM





DRILLED BY: Western States Soil Conservation, Inc. LOGGED BY: J. Heidgerken COMPLETED: 02/13/20

BORING METHOD: mud rotary (see document text) BORING BIT DIAMETER: 4 7/8 inches

GEODESIGN INC
AN NV5 COMPANY

COMPASSGRP-2-01

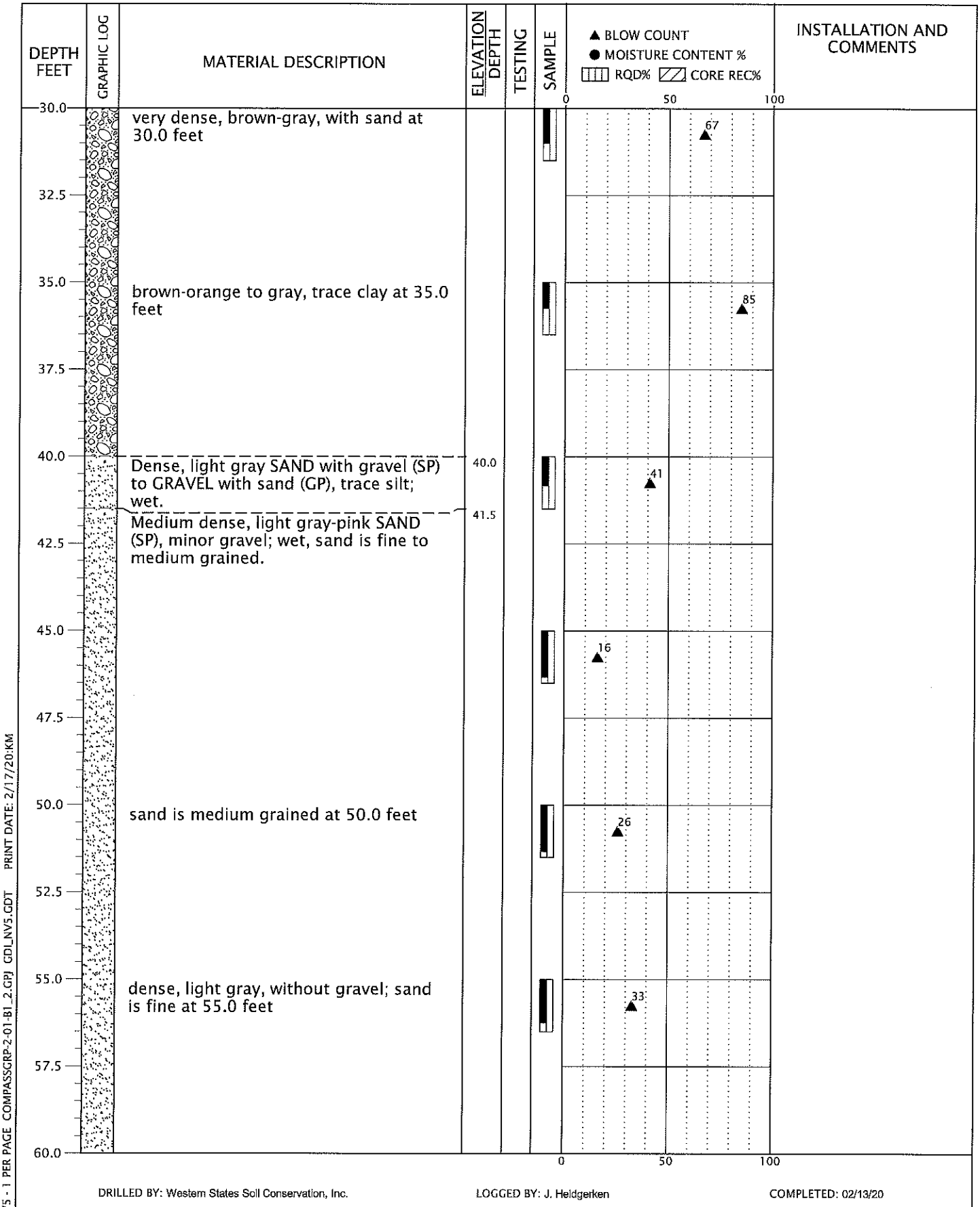
FEBRUARY 2020

BORING B-1

LARSON LANE SITE
CASTLE ROCK, WA

FIGURE A-1

BORING LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2.GPJ GDI_NV5.GDT PRINT DATE: 2/17/20:KM



DRILLED BY: Western States Soil Conservation, Inc. LOGGED BY: J. Heldgerken COMPLETED: 02/13/20

BORING METHOD: mud rotary (see document text) BORING BIT DIAMETER: 4 7/8 inches

BORING LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2.GPJ GDI_NV5.GDT PRINT DATE: 2/17/20:KM

GEODESIGN INC AN NV5 COMPANY

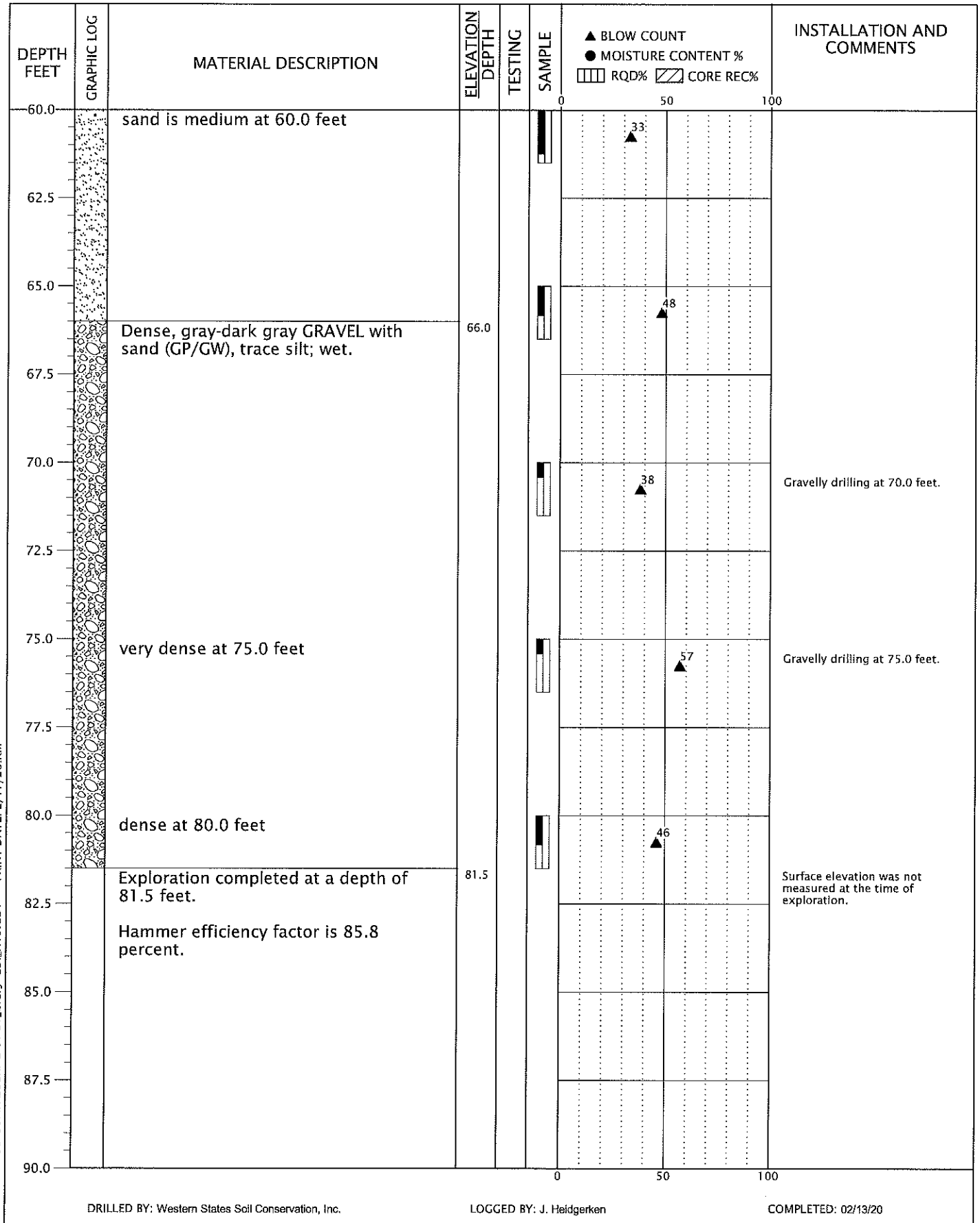
COMPASSGRP-2-01

FEBRUARY 2020

BORING B-1
(continued)

LARSON LANE SITE
CASTLE ROCK, WA

FIGURE A-1



DRILLED BY: Western States Soil Conservation, Inc. LOGGED BY: J. Heidgerken COMPLETED: 02/13/20

BORING METHOD: mud rotary (see document text) BORING BIT DIAMETER: 4 7/8 inches

GEODESIGN INC
AN NV5 COMPANY

COMPASSGRP-2-01

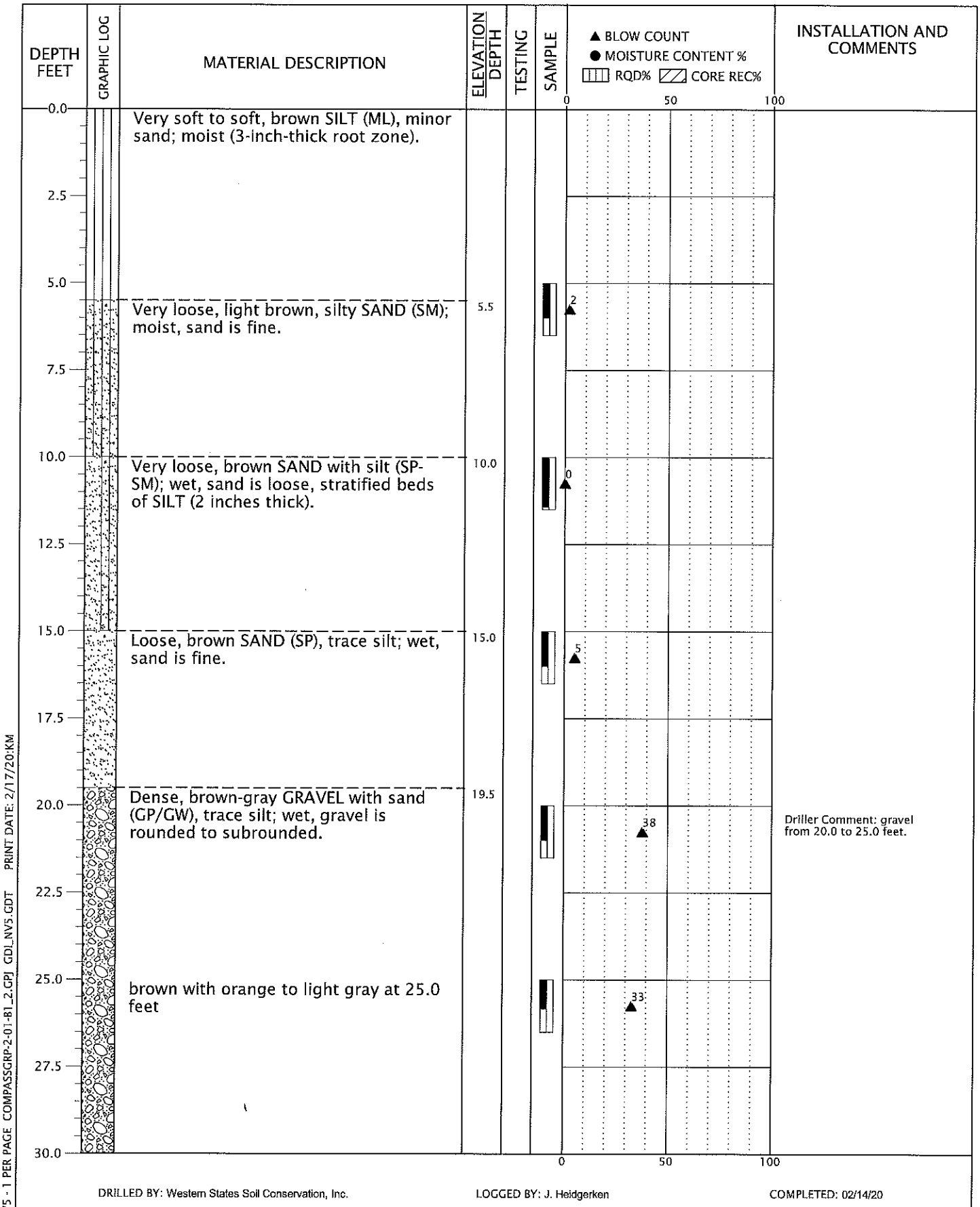
FEBRUARY 2020

BORING B-1
(continued)

LARSON LANE SITE
CASTLE ROCK, WA

FIGURE A-1

BORING LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2.GPJ GDI_NV5.GDT PRINT DATE: 2/17/20:KM



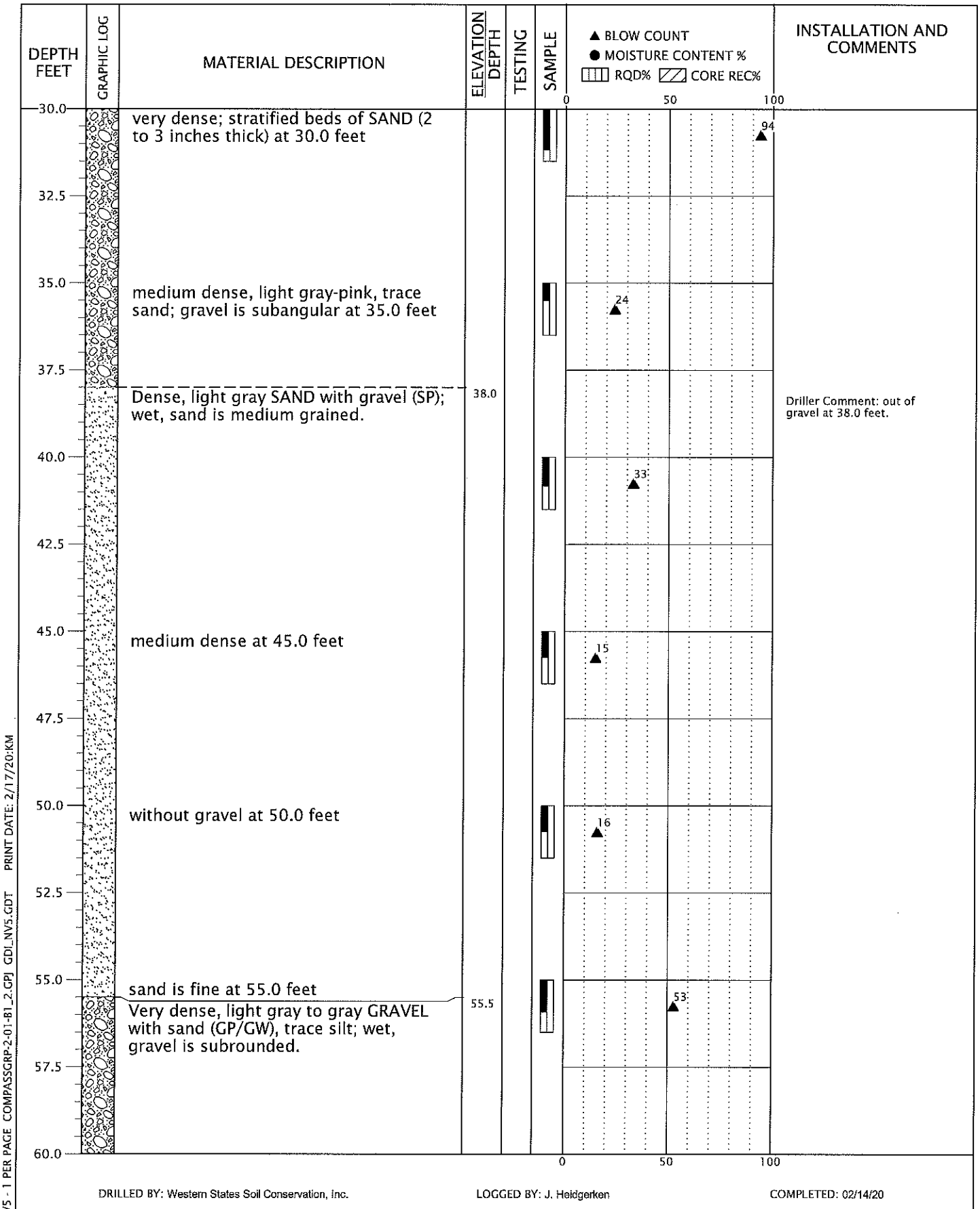
DRILLED BY: Western States Soil Conservation, Inc. LOGGED BY: J. Heidgerken COMPLETED: 02/14/20

BORING METHOD: mud rotary (see document text) BORING BIT DIAMETER: 4 7/8 inches

GEODESIGN INC
AN NV5 COMPANY

COMPASSGRP-2-01	**BORING B-2**	
FEBRUARY 2020	LARSON LANE SITE CASTLE ROCK, WA	**FIGURE A-2**

BORING LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2.GPJ GDI_NV5.GDT PRINT DATE: 2/17/20:KM



DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: J. Heidgerken

COMPLETED: 02/14/20

BORING METHOD: mud rotary (see document text)

BORING BIT DIAMETER: 4 7/8 inches

GeoDesign Inc
AN NV5 COMPANY

COMPASSGRP-2-01

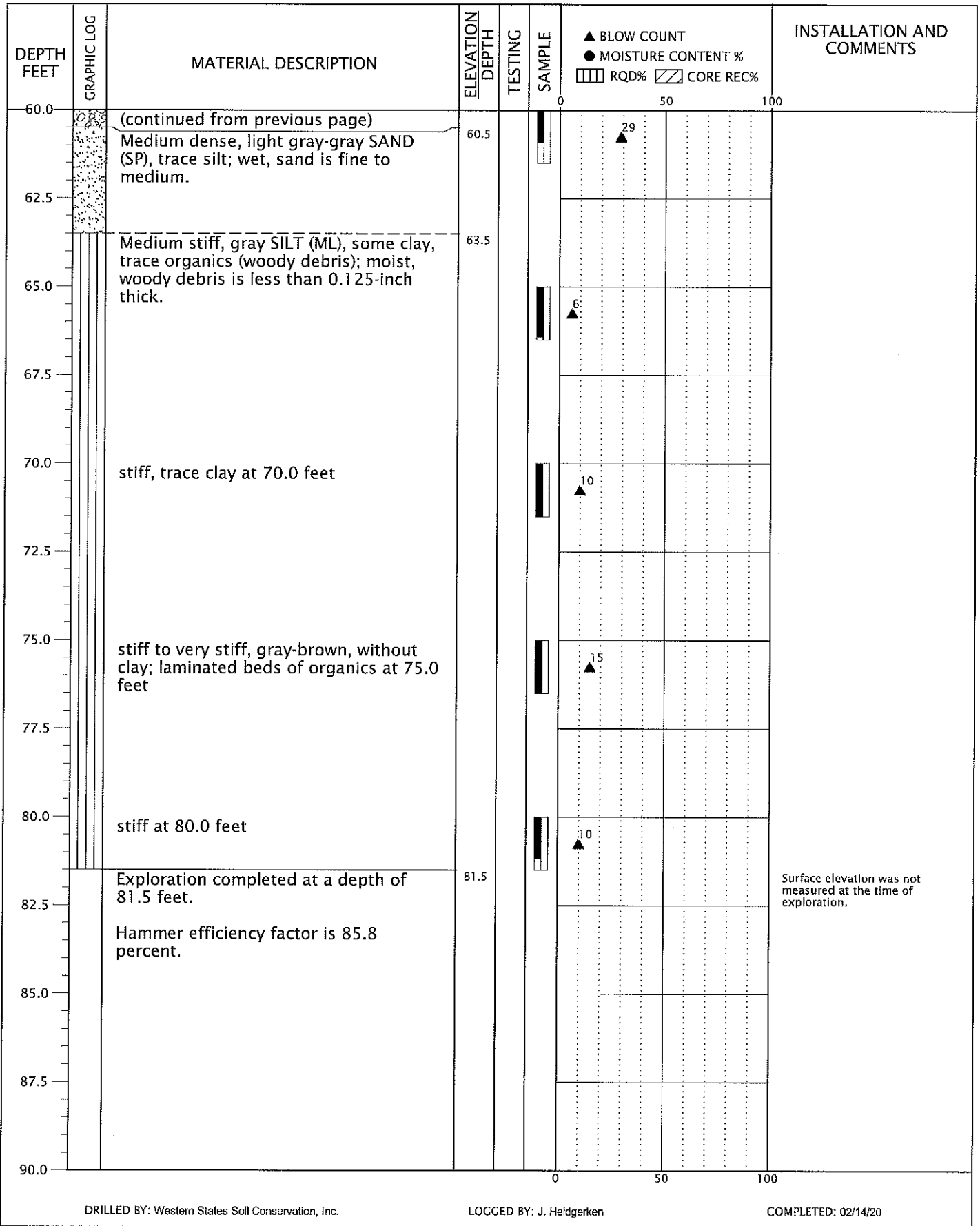
FEBRUARY 2020

BORING B-2
(continued)

LARSON LANE SITE
CASTLE ROCK, WA

FIGURE A-2

BORING LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2.GPJ GDI_NV5.GDT PRINT DATE: 2/17/20:KM



DRILLED BY: Western States Soil Conservation, Inc. LOGGED BY: J. Heidgerken COMPLETED: 02/14/20

BORING METHOD: mud rotary (see document text) BORING BIT DIAMETER: 4 7/8 inches

GEODESIGN INC AN NV5 COMPANY

COMPASSGRP-2-01

BORING B-2
(continued)

FEBRUARY 2020

LARSON LANE SITE
CASTLE ROCK, WA

FIGURE A-2

BORING LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2.GPJ GDI_NV5.GDT PRINT DATE: 2/17/20:KM

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION / DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT % (0 50 100)	COMMENTS
0.0		Loose, dark brown, silty SAND (SM), trace organics; moist to wet, sand is fine (3-inch-thick root zone).					
			0.8				
		Loose, brown SAND with silt (SP-SM), trace organics; moist, sand is fine. without organics at 1.5 feet					
2.5							
5.0							
7.5							
							Severe caving observed at 9.5 feet.
10.0		Loose, brown SAND (SP), trace silt; wet, sand is medium.	10.0				Rapid groundwater seepage observed at 10.5 feet.
12.5		Exploration completed at a depth of 12.5 feet.	12.5				Surface elevation was not measured at the time of exploration.
15.0							
17.5							
20.0						0 50 100	

EXCAVATED BY: Tapani, Inc. LOGGED BY: J. Guenther COMPLETED: 01/14/20

EXCAVATION METHOD: mini excavator (see document text)

GEODESIGN INC AN NV5 COMPANY

COMPASSGRP-2-01

TEST PIT TP-1

MARCH 2020

LARSON LANE SITE
CASTLE ROCK, WA

FIGURE A-3

TEST PIT LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2-TP1_6.GPJ GDI_NV5.GDT PRINT DATE: 3/3/20:KM

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION / DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT % (0 50 100)	COMMENTS
0.0		Loose, dark brown, silty SAND (SM), trace organics; moist, sand is fine (3-inch-thick root zone).			☒		
		Loose, light brown SAND with silt (SP-SM), trace organics; moist, sand is fine.	1.5				
2.5		without organics at 2.5 feet			☒		
5.0							
7.5							Severe caving observed at 8.2 feet.
10.0							
		Loose, brown SAND (SP), trace silt; moist, sand is medium.	11.5		☒		
12.5		Exploration completed at a depth of 13.0 feet.	13.0				No groundwater seepage observed to the depth explored. Surface elevation was not measured at the time of exploration.
15.0							
17.5							
20.0							

EXCAVATED BY: Tapani, Inc. LOGGED BY: J. Guenther COMPLETED: 01/14/20

EXCAVATION METHOD: mini excavator (see document text)

GEODESIGN INC AN NV5 COMPANY

COMPASSGRP-2-01

TEST PIT TP-2

MARCH 2020

LARSON LANE SITE
CASTLE ROCK, WA

FIGURE A-4

TEST PIT LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2-TP1_6.GPJ GDI_NV5.GDT PRINT DATE: 3/3/20:KM

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION / DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT % (0 50 100)	COMMENTS
0.0		Medium dense, dark brown SAND with silt (SP-SM), trace gravel and organics; moist to wet, sand is fine to coarse, gravel is fine and subrounded (4-inch-thick root zone).			☒		Minor caving observed between 1.0 and 4.0 feet.
2.5		gray-brown, minor gravel; sand is medium to coarse at 0.4 foot without organics at 1.5 feet			☒		
5.0		gray at 5.5 feet			☒		
7.5					☒		Slow groundwater seepage observed at 9.0 feet.
10.0					☒		
		Stiff, dark brown, sandy SILT (MH), trace organics; moist, silt has medium plasticity, sand is fine.	10.5				
		Exploration completed at a depth of 11.5 feet.	11.5				Surface elevation was not measured at the time of exploration.
12.5							
15.0							
17.5							
20.0							

EXCAVATED BY: Tapani, Inc. LOGGED BY: J. Guenther COMPLETED: 01/14/20

EXCAVATION METHOD: mini excavator (see document text)

GEODESIGN INC AN NV5 COMPANY

COMPASSGRP-2-01

TEST PIT TP-3

MARCH 2020

LARSON LANE SITE
CASTLE ROCK, WA

FIGURE A-5

TEST PIT LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2-TP1_6.GPJ GDI_NV5.GDT PRINT DATE: 3/3/20:KM

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION / DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT % (0 50 100)	COMMENTS
0.0		Very loose to loose, gray-brown SAND with silt (SP-SM), minor gravel, trace organics; moist to wet, sand is medium to coarse.					Severe caving observed from 0.0 to 10.5 feet.
		without organics at 1.5 feet			☒		
2.5							
5.0							
7.5							
		gray at 9.5 feet			☒		Slow groundwater seepage observed at 10.0 feet.
10.0		Medium stiff, dark brown, sandy SILT (MH), trace organics; moist, silt has medium plasticity, sand is fine.	10.5		☒		
12.5		Exploration completed at a depth of 12.0 feet.	12.0				Surface elevation was not measured at the time of exploration.
15.0							
17.5							
20.0							

EXCAVATED BY: Tapani, Inc. LOGGED BY: J. Guenther COMPLETED: 01/14/20

EXCAVATION METHOD: mini excavator (see document text)

GEODESIGN INC AN NV5 COMPANY

COMPASSGRP-2-01

TEST PIT TP-4

MARCH 2020

LARSON LANE SITE
CASTLE ROCK, WA

FIGURE A-6

TEST PIT LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2-TP1_6.GPJ GDI_NV5.GDT PRINT DATE: 3/3/20:KM

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION / DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT % (0 50 100)	COMMENTS
0.0		Loose, gray-brown SAND with silt (SP-SM), minor gravel, trace organics; moist to wet, sand is fine to coarse, gravel is fine to coarse and subrounded (4-inch-thick root zone). without organics at 1.5 feet			☒		Severe caving observed from 0.0 to 8.0 feet.
7.5		Soft to very soft, dark brown, sandy SILT (MH), trace organics; moist, silt has medium plasticity, sand is fine.	7.5		☒		Numerous sticks and roots from 8.0 to 9.0 feet.
12.5							Moderate groundwater seepage observed at 12.0 feet.
		Exploration completed at a depth of 13.0 feet.	13.0				Surface elevation was not measured at the time of exploration.
20.0							

EXCAVATED BY: Tapani, Inc. LOGGED BY: J. Guenther COMPLETED: 01/14/20

EXCAVATION METHOD: mini excavator (see document text)

GEODESIGN INC AN NV5 COMPANY

COMPASSGRP-2-01

TEST PIT TP-5

MARCH 2020

LARSON LANE SITE
CASTLE ROCK, WA

FIGURE A-7

TEST PIT LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2-TP1_6.GPJ GDI_NV5.GDT PRINT DATE: 3/3/20:KM

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION / DEPTH	TESTING	SAMPLE	● MOISTURE CONTENT % (0 50 100)	COMMENTS
0.0		Medium dense to dense, gray-brown SAND with silt (SP-SM), minor gravel, trace organics; moist to wet, sand is fine to coarse, gravel is fine to coarse and subrounded.					Severe caving observed from 0.0 to 11.0 feet.
2.5					☒		
		brown, without gravel and organics; sand is fine at 3.0 feet					
5.0					☒		
7.5							
10.0		Loose, dark brown SAND (SP), trace silt; wet, sand is medium.	10.0		☒		Rapid groundwater seepage observed at 10.0 feet.
		Exploration terminated at a depth of 11.0 feet due to caving.	11.0				Surface elevation was not measured at the time of exploration.
12.5							
15.0							
17.5							
20.0							

EXCAVATED BY: Tapani, Inc. LOGGED BY: J. Guenther COMPLETED: 01/14/20

EXCAVATION METHOD: mini excavator (see document text)

GeoDesign Inc
AN NV5 COMPANY

COMPASSGRP-2-01

TEST PIT TP-6

MARCH 2020

LARSON LANE SITE
CASTLE ROCK, WA

FIGURE A-8

TEST PIT LOG - GDI-NV5 - 1 PER PAGE COMPASSGRP-2-01-B1_2-TP1_6.GPJ GDI_NV5.GDT PRINT DATE: 3/3/20:KM

APPENDIX D
REPORT LIMITATIONS AND IMPORTANT INFORMATION

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

Date: March 30, 2023
Project: Landing on the Cowlitz
Castle Rock, Washington

Geotechnical and Environmental Report Limitations and Important Information

Report Purpose, Use, and Standard of Care

This report has been prepared in accordance with standard fundamental principles and practices of geotechnical engineering and/or environmental consulting, and in a manner consistent with the level of care and skill typical of currently practicing local engineers and consultants. This report has been prepared to meet the specific needs of specific individuals for the indicated site. It may not be adequate for use by other consultants, contractors, or engineers, or if change in project ownership has occurred. It should not be used for any other reason than its stated purpose without prior consultation with Columbia West Engineering, Inc. (Columbia West). It is a unique report and not applicable for any other site or project. If site conditions are altered, or if modifications to the project description or proposed plans are made after the date of this report, it may not be valid. Columbia West cannot accept responsibility for use of this report by other individuals for unauthorized purposes, or if problems occur resulting from changes in site conditions for which Columbia West was not aware or informed.

Report Conclusions and Preliminary Nature

This geotechnical or environmental report should be considered preliminary and summary in nature. The recommendations contained herein have been established by engineering interpretations of subsurface soils based upon conditions observed during site exploration. The exploration and associated laboratory analysis of collected representative samples identifies soil conditions at specific discreet locations. It is assumed that these conditions are indicative of actual conditions throughout the subject property. However, soil conditions may differ between tested locations at different seasonal times of the year, either by natural causes or human activity. Distinction between soil types may be more abrupt or gradual than indicated on the soil logs. This report is not intended to stand alone without understanding of concomitant instructions, correspondence, communication, or potential supplemental reports that may have been provided to the client.

Because this report is based upon observations obtained at the time of exploration, its adequacy may be compromised with time. This is particularly relevant in the case of natural disasters, earthquakes, floods, or other significant events. Report conclusions or interpretations may also be subject to revision if significant development or other manmade impacts occur within or in proximity to the subject property. Groundwater conditions, if presented in this report, reflect observed conditions at the time of investigation. These conditions may change annually, seasonally or as a result of adjacent development.

Additional Investigation and Construction QA/QC

Columbia West should be consulted prior to construction to assess whether additional investigation above and beyond that presented in this report is necessary. Even slight variations in soil or site conditions may produce impacts to the performance of structural facilities if not adequately addressed. This underscores the importance of diligent QA/QC construction observation and testing to verify soil conditions do not differ materially or significantly from the interpreted conditions utilized for preparation of this report.

Therefore, this report contains several recommendations for field observation and testing by Columbia West personnel during construction activities. Actual subsurface conditions are more readily observed and discerned during the earthwork phase of construction when soils are exposed. Columbia West cannot accept responsibility for deviations from recommendations described in this report or future

performance of structural facilities if another consultant is retained during the construction phase or Columbia West is not engaged to provide construction observation to the full extent recommended.

Collected Samples

Uncontaminated samples of soil or rock collected in connection with this report will be retained for thirty days. Retention of such samples beyond thirty days will occur only at client's request and in return for payment of storage charges incurred. All contaminated or environmentally impacted materials or samples are the sole property of the client. Client maintains responsibility for proper disposal.

Report Contents

This geotechnical or environmental report should not be copied or duplicated unless in full, and even then only under prior written consent by Columbia West, as indicated in further detail in the following text section entitled *Report Ownership*. The recommendations, interpretations, and suggestions presented in this report are only understandable in context of reference to the whole report. Under no circumstances should the soil boring or test pit excavation logs, monitor well logs, or laboratory analytical reports be separated from the remainder of the report. The logs or reports should not be redrawn or summarized by other entities for inclusion in architectural or civil drawings, or other relevant applications.

Report Limitations for Contractors

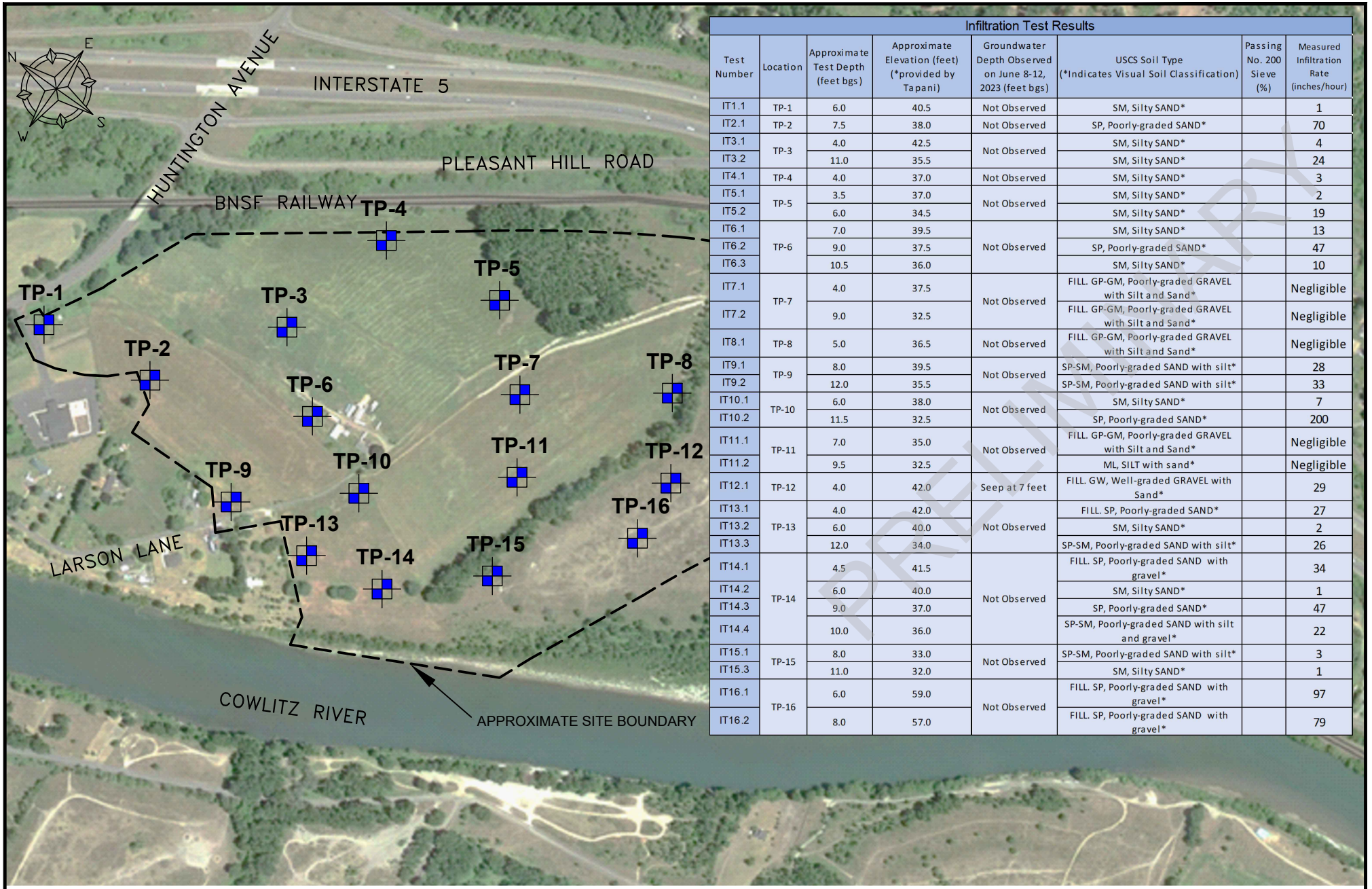
Geotechnical or environmental reports, unless otherwise specifically noted, are not prepared for the purpose of developing cost estimates or bids by contractors. The extent of exploration or investigation conducted as part of this report is usually less than that necessary for contractor's needs. Contractors should be advised of these report limitations, particularly as they relate to development of cost estimates. Contractors may gain valuable information from this report, but should rely upon their own interpretations as to how subsurface conditions may affect cost, feasibility, accessibility and other components of the project work. If believed necessary or relevant, contractors should conduct additional exploratory investigation to obtain satisfactory data for the purposes of developing adequate cost estimates. Clients or developers cannot insulate themselves from attendant liability by disclaiming accuracy for subsurface ground conditions without advising contractors appropriately and providing the best information possible to limit potential for cost overruns, construction problems, or misunderstandings.

Report Ownership

Columbia West retains the ownership and copyright property rights to this entire report and its contents, which may include, but may not be limited to, figures, text, logs, electronic media, drawings, laboratory reports, and appendices. This report was prepared solely for the client, and other relevant approved users or parties, and its distribution must be contingent upon prior express written consent by Columbia West. Furthermore, client or approved users may not use, lend, sell, copy, or distribute this document without express written consent by Columbia West. Client does not own nor have rights to electronic media files that constitute this report, and under no circumstances should said electronic files be distributed or copied. Electronic media is susceptible to unauthorized manipulation or modification, and may not be reliable.

Consultant Responsibility

Geotechnical and environmental engineering and consulting is much less exact than other scientific or engineering disciplines, and relies heavily upon experience, judgment, interpretation, and opinion often based upon media (soils) that are variable, anisotropic, and non-homogenous. This often results in unrealistic expectations, unwarranted claims, and uninformed disputes against a geotechnical or environmental consultant. To reduce potential for these problems and assist relevant parties in better understanding of risk, liability, and responsibility, geotechnical and environmental reports often provide definitive statements or clauses defining and outlining consultant responsibility. The client is encouraged to read these statements carefully and request additional information from Columbia West if necessary.



Infiltration Test Results

Test Number	Location	Approximate Test Depth (feet bgs)	Approximate Elevation (feet) (*provided by Tapani)	Groundwater Depth Observed on June 8-12, 2023 (feet bgs)	USCS Soil Type (*Indicates Visual Soil Classification)	Passing No. 200 Sieve (%)	Measured Infiltration Rate (inches/hour)
IT1.1	TP-1	6.0	40.5	Not Observed	SM, Silty SAND*		1
IT2.1	TP-2	7.5	38.0	Not Observed	SP, Poorly-graded SAND*		70
IT3.1	TP-3	4.0	42.5	Not Observed	SM, Silty SAND*		4
IT3.2		11.0	35.5		SM, Silty SAND*		24
IT4.1	TP-4	4.0	37.0	Not Observed	SM, Silty SAND*		3
IT5.1	TP-5	3.5	37.0	Not Observed	SM, Silty SAND*		2
IT5.2		6.0	34.5		SM, Silty SAND*		19
IT6.1	TP-6	7.0	39.5	Not Observed	SM, Silty SAND*		13
IT6.2		9.0	37.5		SP, Poorly-graded SAND*		47
IT6.3		10.5	36.0		SM, Silty SAND*		10
IT7.1	TP-7	4.0	37.5	Not Observed	FILL. GP-GM, Poorly-graded GRAVEL with Silt and Sand*		Negligible
IT7.2		9.0	32.5		FILL. GP-GM, Poorly-graded GRAVEL with Silt and Sand*		Negligible
IT8.1	TP-8	5.0	36.5	Not Observed	FILL. GP-GM, Poorly-graded GRAVEL with Silt and Sand*		Negligible
IT9.1	TP-9	8.0	39.5	Not Observed	SP-SM, Poorly-graded SAND with silt*		28
IT9.2		12.0	35.5		SP-SM, Poorly-graded SAND with silt*		33
IT10.1	TP-10	6.0	38.0	Not Observed	SM, Silty SAND*		7
IT10.2		11.5	32.5		SP, Poorly-graded SAND*		200
IT11.1	TP-11	7.0	35.0	Not Observed	FILL. GP-GM, Poorly-graded GRAVEL with Silt and Sand*		Negligible
IT11.2		9.5	32.5		ML, SILT with sand*		Negligible
IT12.1	TP-12	4.0	42.0	Seep at 7 feet	FILL. GW, Well-graded GRAVEL with Sand*		29
IT13.1	TP-13	4.0	42.0	Not Observed	FILL. SP, Poorly-graded SAND*		27
IT13.2		6.0	40.0		SM, Silty SAND*		2
IT13.3		12.0	34.0		SP-SM, Poorly-graded SAND with silt*		26
IT14.1	TP-14	4.5	41.5	Not Observed	FILL. SP, Poorly-graded SAND with gravel*		34
IT14.2		6.0	40.0		SM, Silty SAND*		1
IT14.3		9.0	37.0		SP, Poorly-graded SAND*		47
IT14.4		10.0	36.0		SP-SM, Poorly-graded SAND with silt and gravel*		22
IT15.1	TP-15	8.0	33.0	Not Observed	SP-SM, Poorly-graded SAND with silt*		3
IT15.3		11.0	32.0		SM, Silty SAND*		1
IT16.1	TP-16	6.0	59.0	Not Observed	FILL. SP, Poorly-graded SAND with gravel*		97
IT16.2		8.0	57.0		FILL. SP, Poorly-graded SAND with gravel*		79

PRELIMINARY

TEST PIT WITH INFILTRATION TESTING

Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West Engineering, Inc

Project: 22310
Date: 06/20/23
Drawn: MAC
Checked: GLW

EXPLORATION LOCATION MAP
LANDING ON THE COWLITZ

NOTES:
1. SITE LOCATION: 2542 SW LARSON LANE, CASTLE ROCK, WASHINGTON.
2. SITE CONSISTS OF PORTIONS OF TAX PARCEL NOS. 3092824, 3040258, 3040259, 3040322, 3014867, & 3045031 TOTALING APPROXIMATELY 118.2 ACRES.
3. DRAWING IS NOT TO SCALE.
4. BASE MAP OBTAINED FROM GOOGLE EARTH, 2023.
5. EXPLORATION LOCATIONS ARE APPROXIMATE AND NOT SURVEYED.
6. TEST PITS BACKFILLED LOOSELY WITH ONSITE SOILS ON JUNE 8, JUNE 9, AND JUNE 12, 2023.

FIGURE 2

A1
k = 18 in/hr at 6 feet
Sand with silt layer: 5 to 12 feet BGS

A2
k = 20 in/hr at 9 feet
Sand with silt layer: 9 to 12 feet BGS

A3
No IT conducted.
SILT profile observed

A13
k = 60 in/hr at 9 feet
Sand layer: 9 to 13 feet BGS

A12
No IT conducted.
Poorly drained profile.

A11
No IT conducted.
Poorly drained profile.

Not explored. Canal area.

A8
No IT conducted.
~13 feet of FILL.

A4
k = 65 in/hr at 10 feet
Sand with silt layer: 8 to 13 feet BGS

A5
No IT conducted.
~13 feet of FILL over SILT

A6
No IT conducted.
~11 feet of FILL over SILT

A7
No IT conducted.
~11 feet of FILL. Groundwater at 11 feet BGS.

HUNTINGTON AVENUE S.
BNSF TRACKS
PLEASANT HILL ROAD
SALMON CREEK
LARSEN LN SW
COWLITZ RIVER
COMMERCIAL
FLEX (EMP/COM)
OPEN SPACE
EMPLOYMENT
RESIDENTIAL
RECREATION
LANDING ON THE COWLITZ PROPERTY
D.N.R. PROPERTY
250' HABITAT BUFFER
200' SHORELINE PUBLIC ACCESS MGMT AREA
150' HIGH INTENSITY SHORELINE - OHWM BUFFER
SHORELINE
OHW

TP1 TP2 TP3 TP4 TP5 TP6 TP7 TP8 TP9 TP10 TP11 TP12 TP13 TP14 TP15 TP16
A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12 A13

0 150 300
SCALE: 1" = 150'

LEGEND

PROPERTY TESTED LOCATION

PROPOSED LOCATION

Know what's below. Call before you dig.

PRELIMINARY RESULTS FROM TESTING CONDUCTED ON MARCH 13, 2024

FILE: W:\17783 CASTLE ROCK ENVIRO AND FILL PERMITS\500 DESIGN\502 DRAWINGS\EXHIBITS\2024-03-06 ADDITIONAL INFILTRATION TEST LOCATIONS.DWG

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

LANDING ON THE COWLITZ
CASTLE ROCK, COWLITZ

INFILTRATION TEST LOCATIONS

REVISIONS:

JOB NO.:	23-463
DATE:	MARCH 2024
SCALE:	1" = 150'
DESIGNED BY:	MDR
DRAWN BY:	MDR
CHECKED BY:	TAW

EX1.0

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Landing at Cowlitz	CT6, LLC		22310	TP-17
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Castle Rock, Washington	Tapani	CAT 215 Excavator	MAC	3/13/24
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	Not Surveyed	Not Observed	0800	0905

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						FILL. Gray poorly-graded SAND and gravel, dense.					
				ML		Orange-tan sandy SILT, moist to wet, medium dense, sand is fine.					
5	TP17.1			SP-SM		Light brown poorly-graded SAND with silt, moist, loose, sand is medium-grained and subangular.					
10						Bottom of test pit at 12 feet bgs. Groundwater not encountered on 3/13/24.					
15											

Preliminary
03/20/2024 3:58:36 PM

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TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Landing at Cowlitz	CT6, LLC		22310	TP-18
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Castle Rock, Washington	Tapani	CAT 215 Excavator	MAC	3/13/24
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	Not Surveyed	Not Observed	0905	0935

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						FILL. Gray poorly-graded SAND and gravel, dense.					
				ML		Gray SILT with sand, moist, soft, sand is fine.					
				SM		Brown silty SAND, moist, loose to medium dense, sand is fine-to medium-grained and subangular.					
5											
				SP-SM		Light brown poorly-graded SAND with silt, moist, loose, sand is medium-grained and subangular.					
10	TP18.1										
						Bottom of test pit at 12 feet bgs. Groundwater not encountered on 3/13/24.					
15											

Preliminary
03/20/2024 3:58:48 PM

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TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Landing at Cowlitz	CT6, LLC		22310	TP-19
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Castle Rock, Washington	Tapani	CAT 215 Excavator	MAC	3/13/24
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	Not Surveyed	Not Observed	1010	1040

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						Organic strippings.					
				ML		Brown SILT, moist, soft, low to medium plasticity.					
5				SM		Brown silty SAND, moist, loose to medium dense, sand is fine-grained and subangular.					
10											
15						Bottom of test pit at 14.5 feet bgs. Groundwater not encountered on 3/13/24.					

Preliminary
03/20/2024 3:58:48 PM

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Columbia West Engineering, Inc

TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Landing at Cowlitz	CT6, LLC		22310	TP-20
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Castle Rock, Washington	Tapani	CAT 215 Excavator	MAC	3/13/24
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	Not Surveyed	Not Observed	0935	1010

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						FILL. Gray poorly-graded SAND and gravel, dense.					
5				SM		Brown silty SAND, moist, loose to medium dense, sand is fine-grained and subangular.					
10	TP20.1			SP-SM		Gray and brown poorly-graded SAND with silt, moist, loose, sand is medium-grained and subangular.					
15						Bottom of test pit at 13 feet bgs. Groundwater not encountered on 3/13/24.					

Preliminary
03/20/2024 3:58:48 PM

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Columbia West Engineering, Inc

TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Landing at Cowlitz	CT6, LLC		22310	TP-21
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Castle Rock, Washington	Tapani	CAT 215 Excavator	MAC	3/13/24
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	Not Surveyed	Not Observed	1040	1105

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						FILL. Gray poorly-graded SAND and gravel, dense.					
5						FILL. Light gray, poorly-graded GRAVEL with silt and sand, moist, very dense dense.					
10						FILL. Gray poorly-graded SAND and gravel, dense.					
				OH		Black organic SILT, moist, soft.					
15						Bottom of test pit at 14.5 feet bgs. Groundwater not encountered on 3/13/24.					

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TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Landing at Cowlitz	CT6, LLC		22310	TP-22
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Castle Rock, Washington	Tapani	CAT 215 Excavator	MAC	3/13/24
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	Not Surveyed	Not Observed	1105	1130

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						FILL. Gray poorly-graded SAND and gravel, dense.					
5						FILL. Light gray, poorly-graded GRAVEL with silt and sand, moist, very dense dense.					
10						FILL. Gray poorly-graded SAND and gravel, dense.					
				OH		Black organic SILT, moist, soft.					
15						Bottom of test pit at 13 feet bgs. Groundwater not encountered on 3/13/24.					

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TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Landing at Cowlitz	CT6, LLC		22310	TP-23
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Castle Rock, Washington	Tapani	CAT 215 Excavator	MAC	3/13/24
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	Not Surveyed	Observed at 11 feet BGS	1330	1500

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						3 inch root zone contained in 10 inches of sandy silt topsoil.					
						FILL. Light gray, poorly-graded GRAVEL with silt and sand, moist, very dense dense.					
5											
10						Becomes wet.					▼
						Bottom of test pit at 11 feet bgs. Groundwater encountered at 11 feet on 3/13/24.					
15											

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TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Landing at Cowlitz	CT6, LLC		22310	TP-24
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Castle Rock, Washington	Tapani	CAT 215 Excavator	MAC	3/13/24
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	Not Surveyed	Not Observed	1500	1555

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						3 inch root zone contained in 10 inches of sandy silt topsoil.					
						FILL. Light gray, poorly-graded GRAVEL with silt and sand, moist, very dense dense.					
5											
10											
						Bottom of test pit at 13 feet bgs. Groundwater not encountered on 3/13/24.					
15											

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TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Landing at Cowlitz	CT6, LLC		22310	TP-25
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Castle Rock, Washington	Tapani	CAT 215 Excavator	MAC	3/13/24
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	Not Surveyed	Not Observed	1130	1215

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						FILL. Gray poorly-graded SAND and gravel, dense.					
				SM		Brown silty SAND, moist, loose to medium dense, sand is fine-grained and subangular.					
5											
10											
						Bottom of test pit at 12 feet bgs. Groundwater not encountered on 3/13/24.					
15											

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TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Landing at Cowlitz	CT6, LLC		22310	TP-26
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Castle Rock, Washington	Tapani	CAT 215 Excavator	MAC	3/13/24
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	Not Surveyed	Not Observed	1245	1330

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						FILL. Gray poorly-graded SAND and gravel, dense.					
				SM		Brown silty SAND, moist, loose to medium dense, sand is fine-grained and subangular.					
5											
10											
						Bottom of test pit at 14.5 feet bgs. Groundwater not encountered on 3/13/24.					
15											

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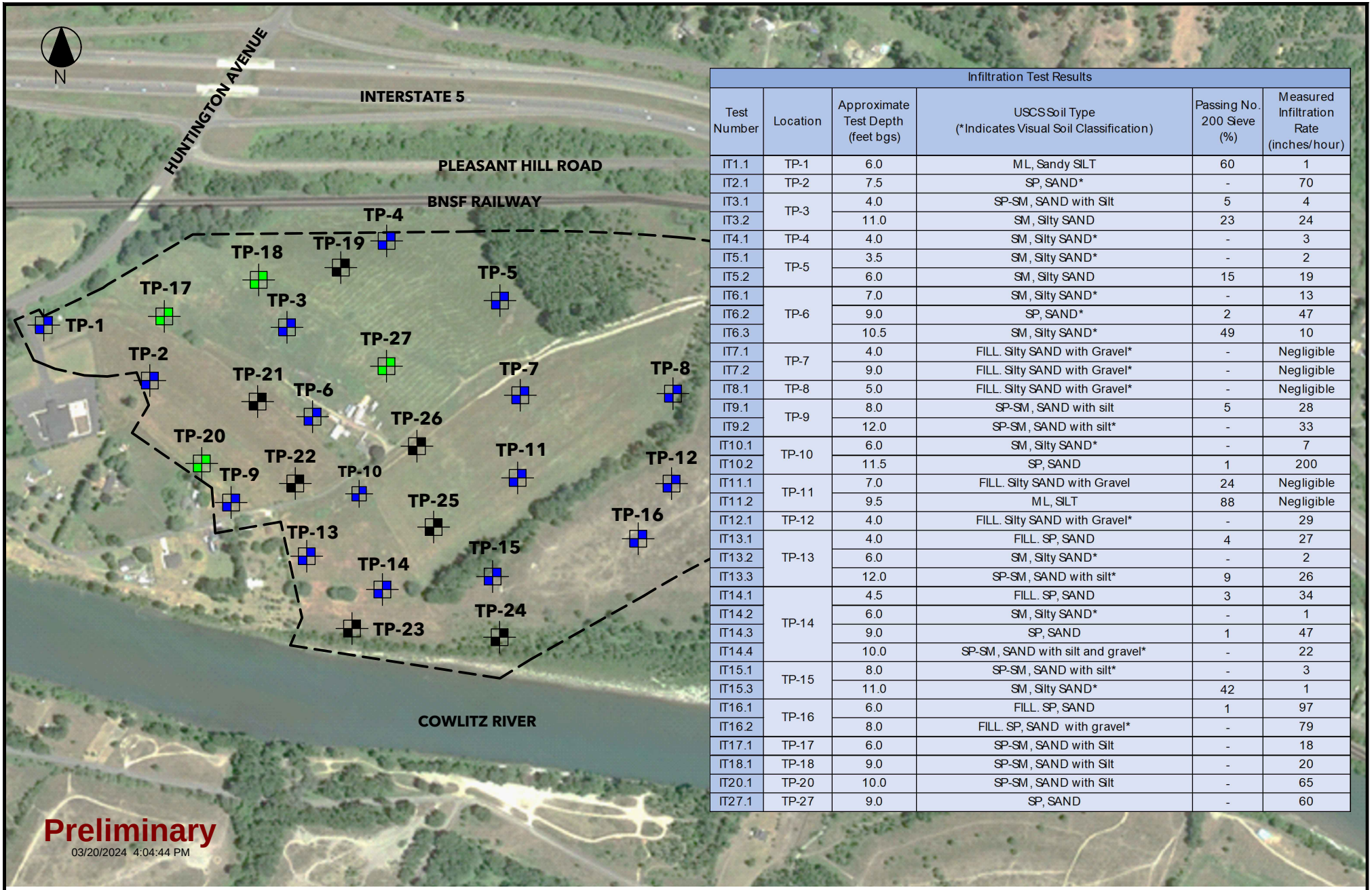
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TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Landing at Cowlitz	CT6, LLC		22310	TP-27
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Castle Rock, Washington	Tapani	CAT 215 Excavator	MAC	3/13/24
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	Not Surveyed	Not Observed	1215	1245

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Groundwater Depth
0						FILL. Gray poorly-graded SAND and gravel, dense.					
				ML		Orange-tan sandy SILT, moist to wet, medium dense, sand is fine.					
5				SM		Brown silty SAND, moist, loose to medium dense, sand is fine-grained and subangular.					
	TP27.1										
10				SP-SM		Gray and brown poorly-graded SAND with silt, moist, loose, sand is medium-grained and subangular.					
						Bottom of test pit at 13 feet bgs. Groundwater not encountered on 3/13/24.					
15											

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Infiltration Test Results

Test Number	Location	Approximate Test Depth (feet bgs)	USCS Soil Type (*Indicates Visual Soil Classification)	Passing No. 200 Sieve (%)	Measured Infiltration Rate (inches/hour)
IT1.1	TP-1	6.0	ML, Sandy SILT	60	1
IT2.1	TP-2	7.5	SP, SAND*	-	70
IT3.1	TP-3	4.0	SP-SM, SAND with Silt	5	4
IT3.2		11.0	SM, Silty SAND	23	24
IT4.1	TP-4	4.0	SM, Silty SAND*	-	3
IT5.1	TP-5	3.5	SM, Silty SAND*	-	2
IT5.2		6.0	SM, Silty SAND	15	19
IT6.1	TP-6	7.0	SM, Silty SAND*	-	13
IT6.2		9.0	SP, SAND*	2	47
IT6.3		10.5	SM, Silty SAND*	49	10
IT7.1	TP-7	4.0	FILL. Silty SAND with Gravel*	-	Negligible
IT7.2		9.0	FILL. Silty SAND with Gravel*	-	Negligible
IT8.1	TP-8	5.0	FILL. Silty SAND with Gravel*	-	Negligible
IT9.1	TP-9	8.0	SP-SM, SAND with silt	5	28
IT9.2		12.0	SP-SM, SAND with silt*	-	33
IT10.1	TP-10	6.0	SM, Silty SAND*	-	7
IT10.2		11.5	SP, SAND	1	200
IT11.1	TP-11	7.0	FILL. Silty SAND with Gravel	24	Negligible
IT11.2		9.5	ML, SILT	88	Negligible
IT12.1	TP-12	4.0	FILL. Silty SAND with Gravel*	-	29
IT13.1	TP-13	4.0	FILL. SP, SAND	4	27
IT13.2		6.0	SM, Silty SAND*	-	2
IT13.3		12.0	SP-SM, SAND with silt*	9	26
IT14.1	TP-14	4.5	FILL. SP, SAND	3	34
IT14.2		6.0	SM, Silty SAND*	-	1
IT14.3		9.0	SP, SAND	1	47
IT14.4		10.0	SP-SM, SAND with silt and gravel*	-	22
IT15.1	TP-15	8.0	SP-SM, SAND with silt*	-	3
IT15.3		11.0	SM, Silty SAND*	42	1
IT16.1	TP-16	6.0	FILL. SP, SAND	1	97
IT16.2		8.0	FILL. SP, SAND with gravel*	-	79
IT17.1	TP-17	6.0	SP-SM, SAND with Silt	-	18
IT18.1	TP-18	9.0	SP-SM, SAND with Silt	-	20
IT20.1	TP-20	10.0	SP-SM, SAND with Silt	-	65
IT27.1	TP-27	9.0	SP, SAND	-	60

SITE BOUNDARY | TEST PIT WITH INFILTRATION TEST (2023) | TEST PIT WITH INFILTRATION TEST (2024) | TEST PIT (2024)

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PROJECT: 22310
DATE: 03-20-24
DRAWN: GLW
CHECKED: NNP

EXPLORATION MAP
LANDING ON THE COWLITZ
CASTLE ROCK, WASHINGTON

NOTES:
1. SITE LOCATION: 2542 SW LARSON LANE, CASTLE ROCK, WASHINGTON.
2. SITE CONSISTS OF PORTIONS OF TAX PARCEL NOS. 3092824, 3040258, 3040259, 3040322, 3014867, & 3045031 TOTALING APPROXIMATELY 118.2 ACRES.
3. DRAWING IS NOT TO SCALE.
4. BASE MAP OBTAINED FROM GOOGLE EARTH, 2023.
5. EXPLORATION LOCATIONS ARE APPROXIMATE AND NOT SURVEYED.
6. TEST PITS TP-1 TO TP-16 BACKFILLED LOOSELY WITH ONSITE SOILS ON JUNE 8, JUNE 9, AND JUNE 12, 2023.
7. TEST PITS TP-17 TO TP-27 BACKFILLED LOOSELY WITH ONSITE SOILS ON MARCH 13, 2024.

FIGURE
2