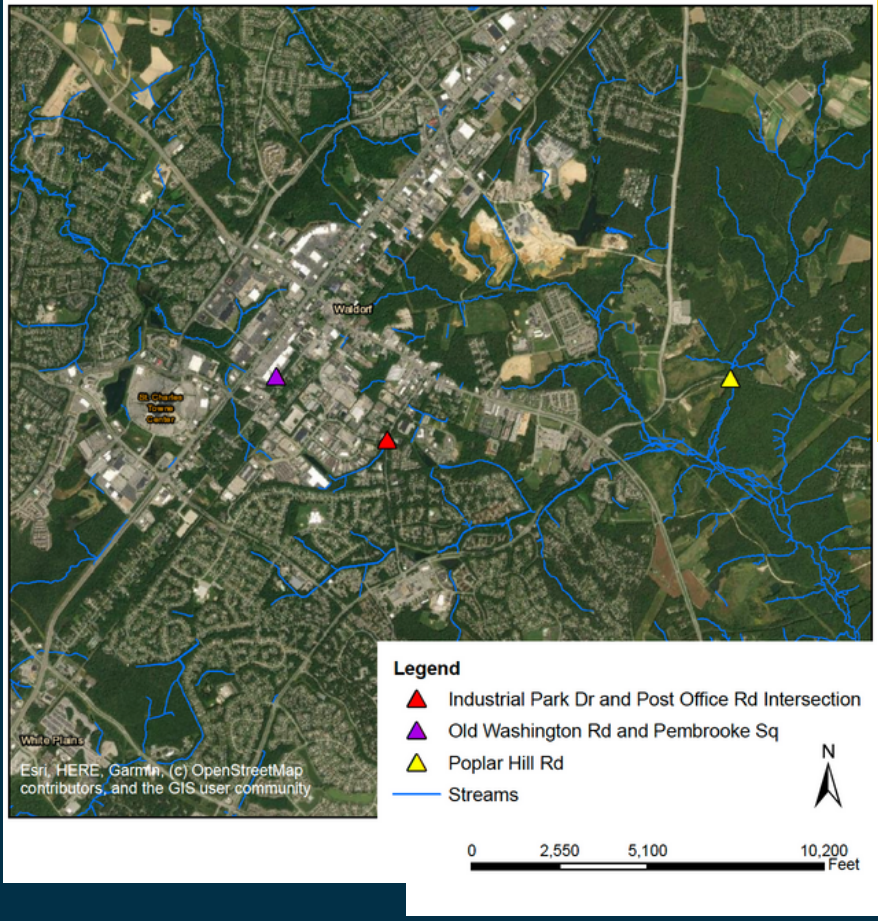
Urban Flood Analysis

Zekiah Watershed

February 2023



CHARLES COUNTY, MARYLAND

AN ADDENDUM TO THE NUISANCE & URBAN FLOOD PLAN

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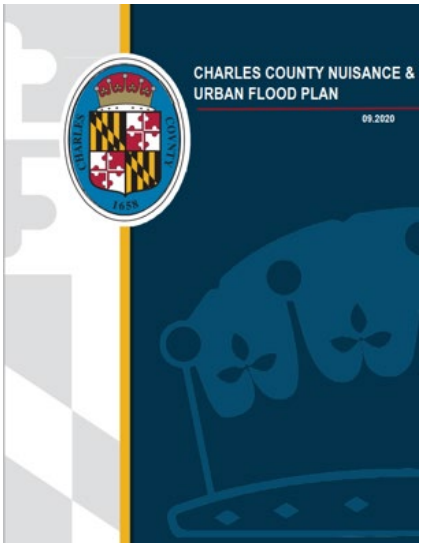
Section 1 - Purpose of Study and Context

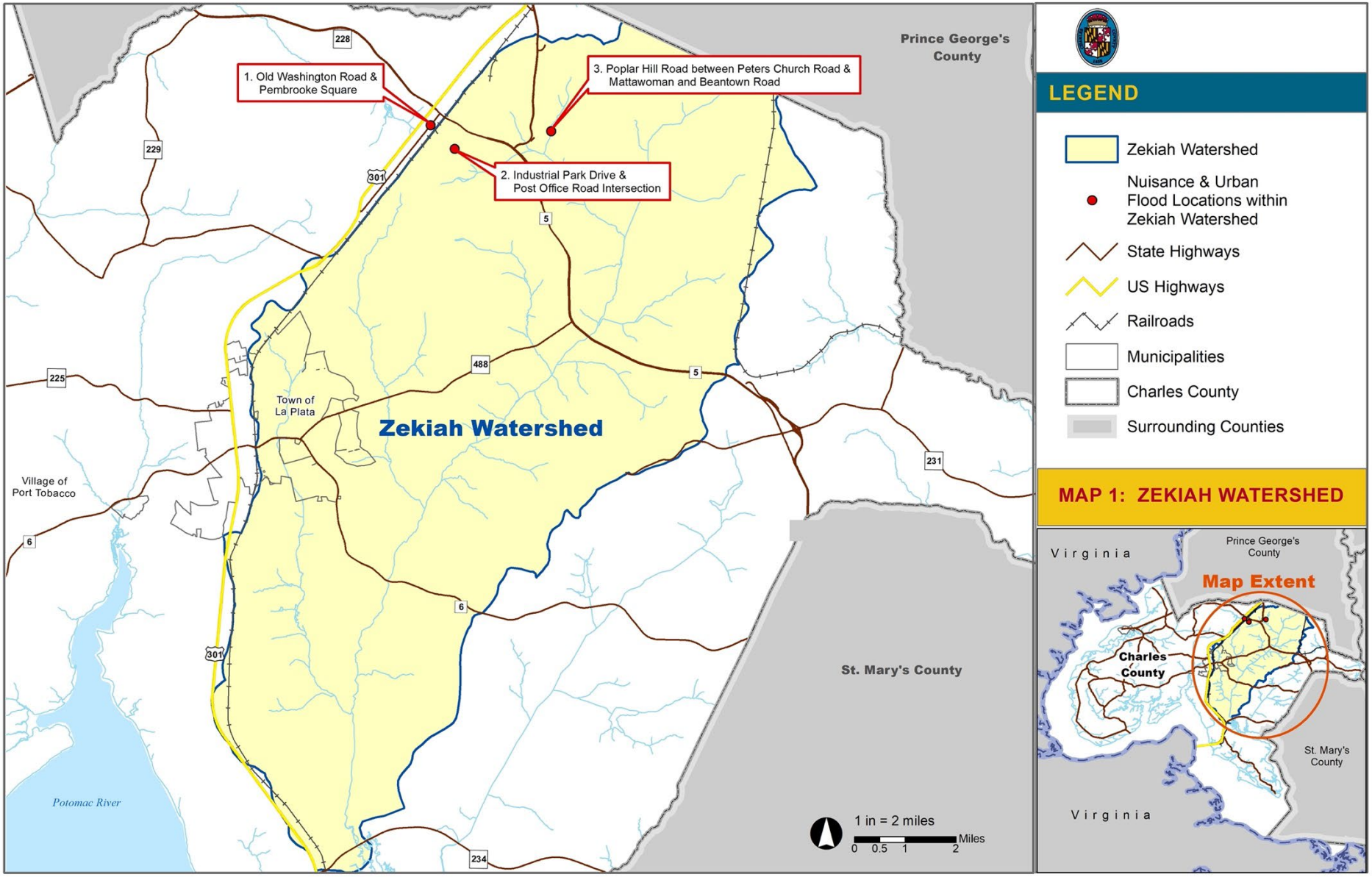
Charles County, Maryland is experiencing flooding outside mapped floodplains with increasing frequency, including both nuisance and urban flooding. Nuisance flooding is associated with high tides that flow back through the stormwater system, increasing/raising the level of groundwater, and overtopping the banks and edge of waterways. Nuisance flooding is an indicator of rising water levels in the Chesapeake Bay and its tributaries. Areas that were previously dry now flood during high tides because the water elevation is high enough to lap over the banks of waterways and to enter stormwater systems through outfalls that were previously high enough to prevent backflow, while allowing outflow. Urban flooding is due to a variety of issues related to development: increased impervious surface, disruption of natural watershed flows and functions, undersized and aged stormwater infrastructure, and changing weather patterns which exacerbate the inadequacies of older stormwater systems and the fragmented watersheds. Urban flooding reflects decades of development that has outstripped the capacity of stormwater infrastructure and disrupted the natural flow and discharge of watersheds. Additionally, many stormwater systems are beyond their expected useful life and in need of repair and replacement. These challenges are compounded by what is becoming the new normal: an increase in the frequency and intensity of storms caused by higher global temperatures that increase evaporation in the ocean and atmosphere, creating more favorable conditions for heavier and more frequent precipitation.

Charles County Nuisance & Urban Flood Plan

To further explore these challenges, forty-eight urban flood locations were identified and prioritized for additional analysis and flood risk reduction solutions in the **2020 CHARLES COUNTY NUISANCE & URBAN FLOOD PLAN.** The purpose of the nuisance flood plan is to identify sources of nuisance and urban flooding, analyze flood hazards, and recommend actions to reduce flooding and increase community resiliency. The plan fulfills the requirements set forth in Maryland House Bill 1427 (2019), §3-1018(b) and (c), which requires that all local jurisdictions that experience nuisance flooding must develop a nuisance flood plan to address that flooding and update the plan every five years. To maintain the mandated update cycle, the plan will be appended to become part of the County's 2018 Hazard Mitigation Plan Update, which must also be updated every five years.



As part of the nuisance flood plan implementation strategy the county has initiated independent watershed studies to address issues identified in the nuisance flood plan that will serve to build upon and expand this analysis to identify and track localized flood events, mitigate localized flooding. Three of the identified locations are within the **Zekiah Watershed** have been targeted for further analysis and will be addressed in this study. These locations are identified on the location map on the following page.


Prince George's County
1. Old Washington Road & Pembrooke Square
2. Industrial Park Drive & Post Office Road Intersection
3. Poplar Hill Road between Peters Church Road & Mattawoman and Beantown Road
Zekiah Watershed
Town of La Plata
Village of Port Tobacco
Potomac River
St. Mary's County
228
229
301
5
488
225
6
231
234
1 in = 2 miles
Miles
0 0.5 1 2
LEGEND
Zekiah Watershed
Nuisance & Urban Flood Locations within Zekiah Watershed
State Highways
US Highways
Railroads
Municipalities
Charles County
Surrounding Counties
MAP 1: ZEKIAH WATERSHED
Virginia
Prince George's County
Map Extent
Charles County
St. Mary's County
Virginia

The frequency and intensity of storms is increasing due to the changing climate that will continue to exacerbate the flood issues at these three locations. The stormwater infrastructure in these areas is aging and was not designed to convey the amount of runoff that is currently occurring and amounts that are predicted to occur in the future. As urbanization and the amount of impervious surface increase the capacity of the existing systems to convey runoff will be reduced. Localized flooding and impaired water quality in these locations are related to untreated stormwater. Without stormwater best management practices or green infrastructure in place to reduce the depth of floodwater and improve water quality, these areas will continue to experience flooding and degraded water quality and habitat in the affected tributaries.

Zekiah Watershed Urban Flood Study Objectives and Expected Outcomes

The Zekiah Watershed Urban Flood Study will be an important tool for future planning capital improvement projects. Principles, policies, and recommendations from County plans are integrated into the study to ensure that a mutually supportive resilience framework exists throughout all County planning efforts. The study concentrates on addressing 4 key objectives:

1. Analyze the cause(s) of flooding at the three locations.
2. Identify solutions that eliminate flooding, improve water quality, and account for future precipitation volumes.
3. Develop conceptual designs to guide implementation of solutions at all three locations.
4. Identify funding opportunities to implement solutions.

The stormwater improvements that are identified in this study will support the goals and policies articulated in the 2018 Charles County Hazard Mitigation Plan Update, the 2020 Charles County Nuisance and Urban Flood Plan, and the Charles County Comprehensive Plan (2016), Charles County Stormwater Management Ordinance and Drainage Ordinance, plus any relevant watershed improvement plans and studies as appropriate for addressing water quantity and quality within the study area.

The solutions identified in this study account for future conditions such as increased volumes of stormwater from more frequent, intense storms and future development in the project areas. The solutions will also integrate a comprehensive approach that will support the implementation of nature-based infrastructure.

Changes in climate are making weather less predictable and generating bigger, stronger storms. Severe storms coupled with increased development in watersheds and an increase in impervious surfaces creates a volume of runoff that is greater than the design capacity of the existing infrastructure throughout the county.

Tools and Resources

This study utilized information gathered from the Charles County Nuisance & Urban Flood Plan, particularly data gathered about the flood characteristics at each location, engaging with County staff who served on the Plan's Stakeholder Group. As part of the ongoing planning process an update to the outreach vehicles used for the Plan (Story Map, web page on County website), will also be updated to include the results of the Zekiah watershed study. Information from Risk Map products, discharge points, and bridges and culverts layers and data contained within MDE's Flood Risk Application and County data resources were used to generate existing and future condition models for this project.

Partner Roles

The study was led by steering committee that is made up of staff from the Department of Emergency Services and Department of Planning and Growth Management. The steering committee will provide overall guidance for the project so that the identified solutions are ones supported by the County, and property owners. The steering committee consisted of the following members:

Zekiah Urban Watershed Study Steering Committee

Name	Title	Department/Contractor
Michelle L. Lilly	Director, Charles County	Charles County Emergency Services
Gary Lewis	Emergency Management Specialist	Charles County Emergency Services
Kerry Kirkwood	Engineer I	Charles County Planning and Growth Management
Beth Groth	Climate Resilience and Sustainability Officer	Resilience Authority of Charles County
Kelly Palmer	Floodplain Manager	Charles County Planning and Growth Management
Karen Wiggen	Planner III	Charles County Planning and Growth Management
Kayla Rhue	Associate Engineer	MES
John Groeger	Senior Engineer	MES
Mark James	Project Manager	Michael Baker
Lori Wade	Department Manager - Environmental Resources Water and Community Planning	Michael Baker
Calt, Elizabeth	Civil Associate – Water	Michael Baker
Virginia Smith	Outreach	Smith Planning and Design

Section 2 - Planning Process

Steering Committee Meetings

Starting in June the Steering Committee began meeting monthly to discuss project development. Copies of meeting slides are provided in Attachment 1. The first steering committee meeting was held virtually on June 9, 2022. This meeting was scheduled to introduce key members of the contracting team, discuss project schedule, and contractor expectations. A data was also made at this time and filled by County GIS resources. Agenda items included:

- Introductions
- Tracking Project to Match Grant
- Project Review and Suggestions
- Data Requests
    - Start off with H&H Analysis
    - Extents of flooding – Inundation Areas and Historic Anticipated Damages
    - Stormwater Infrastructure
    - HMP/NFP Plan
    - Models – DFIRM RiskMAP
    - Utilities / ROW
    - Additional Supplemental Survey Data (may be able to do quick data capture during field meeting or with survey crew)
- Schedule and Project Involvement (Stakeholders)
- Potential Stalls
- Next Steps – Field Meeting (initiate data gathering?)

Data Use Agreements were signed for use of Planning and Growth Management's GIS data. Requested data was transferred and saved to a project teams location. A list of County data resource that were transferred is provided in Attachment 2.

A second team meeting was held in the field on July 28. Staff from Department of Emergency Services and Department of Planning and Growth Management along with consultants conducted a tour of 3 locations where site information was gathered on existing conditions. Field observations and recommendations are summarized and documented in Attachment 3.

During the August 25 steering committee meeting project site review and considerations that were gathered and refined after the field visit. The steering committee were presented site specific data and relevant resources. This included a descriptive analysis of the three project locations, results of the Zekiah Swamp Watershed Assessment - 2018, and a 2015 assessment of Poplar Hill Road. The steering committee were also provided a snapshot of what will be included in the hydrologic and hydraulic analysis at each project site. The hydrologic and hydraulic analysis will be performed at each of the three locations to determine the discharge/flows affecting the area and modeled to calculate the existing and proposed flooding condition at each location for 2050 and 2100 expected conditions.

Modeling results for 25 year and 100-year storm events for current, 2050, and 2100 expected conditions at the three project sites were presented at the September 22 steering committee meeting. Modeling data was compared to in field observations to identify areas of high risk for each site. Modeled results provided the following results:

Old Washington Road and Pembrooke Square

- Poor channel conveyance and undersized pipe under Old Washington Road (24" CMP) backing up over the roadway
- Insufficient drainage to capture overflow in parking lot at the low points

Industrial Park Drive And Post Office Road Intersection

- Flooding occurring at roadway inlets J4 and J7 (Industrial Drive) due to capacity issues
- Flooding also occurring at J1 (18" HDPE) under industrial park Drive

Poplar Hill Road between St. Peters Church Road & Mattawoman Beantown Road

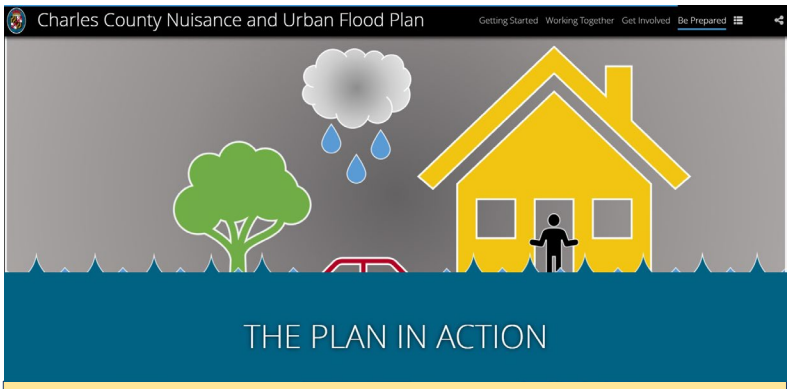
- Overtopping at low point of roadway crossing
- 0-2' of depth over the roadway for all events

During the November 29 steering committee meeting members were presented 5 alternatives and cost estimates for each project location. Alternatives were developed using 25 year and 100-year storm events for current, 2050, and 2100 expected conditions. Selected alternatives were presented to the steering committee to review and approve.

Comments from the November 29 meeting were compiled and taken into consideration in the final design and presentation of the Zekiah Watershed Urban Flood Analysis Hydraulic and Hydrology Report. The report findings and preferred proposed alternatives were presented to the steering committee during the January 20 meeting.

Community Outreach and Project StoryMap

General project information will be conveyed through the County's social media, press releases, and updates to the Nuisance & Urban Flooding Plan ArcGIS StoryMap which will be a major communication vehicle for this and future watershed studies. The StoryMap that was developed for the Nuisance Flood Plan will be modified to include details and results of the Zekiah Urban Watershed Study. This web-based application will continue to enable users to acquire information and engage in project development.



Nuisance and Urban Flooding ArcGIS StoryMap

https://maryland.maps.arcgis.com/apps/Cascade/index.html?appid=7bb024fa03ff46a58e07323e16bdb7f1

Section 3 – Target Urban Flood Locations within Zekiah Watershed

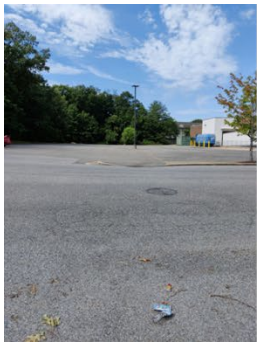
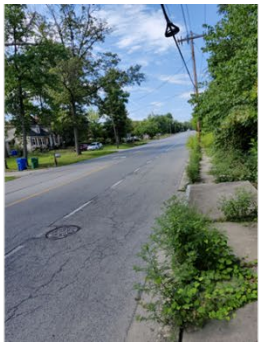
1. Old Washington Road and Pembrooke Square

Old Washington Road and Pembrooke Square flood due to stormwater issues and impervious surface. A tributary to the Piney Branch may also be a possible flood source. Conveyance is poor across MD 925 Old Washington Rd and downstream that leads to backups and topping of swale.

The intersection of Old Washington Road and Shoppers World experience severe flooding caused by poor stormwater conveyance, undersized drainage, and large amounts of impervious surface from parking lots, roof runoff, and loading zones. There are three inlets located at the back of the parking lot that collect runoff from Old Washington Road, roof runoff from the shopping center, and impervious runoff from the truck loading zone. Two of these inlets are shallow and are located at the low point of the parking lot. During storm events, these inlets quickly become inundated and clogged with trash and debris. The outfall pipe that conveys these inlets to the front of the shopping center is recessed and no longer performing as it was designed.

The front of the shopping center contains mostly old, corrugated metal pipes (CMP) that are nearing the end of their service life. The residential area located southeast, upstream of the shopping center drains to a ditch which connects to the 24” CMP that transverses Old Washington Road. This 24” CMP empties into a series of conveyance ditches which are located adjacent to the shopping center. These conveyance ditches are inundated with trash and debris and have poor conveyance caused by cross sectional loss, gullies, erosion, and reverse slopes and the 24” CMP does not meet the capacity to convey the residential drainage area. Additionally, the 36” CMP that conveys these drainage ditches has a negative slope, contributing to backwater and ponding upstream.

This poor conveyance leaves Old Washington Road and the surrounding low-lying areas particularly vulnerable to flooding. The residential area, Shoppers World, and a few adjacent businesses all convey stormwater to the basin adjacent to Rt. 301 which eventually drains to an unnamed tributary (UNT) to Piney Branch.


2. Industrial Park Drive and Post Office Road Intersection

Unnamed tributary enters a culvert north of Post Office Road and exits into channel north of the Southern MD Workforce Services property. Dense urban area associated with MD 301 up-stream leads to high volumes of runoff during rain events. Excessive flows will typically top the culvert on the north side of Post Office Drive and flood the intersection and then discharge into the channel on the south side. Also, a large controlled SWMP is located upstream. Note: This may be related to site #10, Piney Branch Wetland.

The intersection of Industrial Park Dr. and Post office Rd. experience severe flooding caused by poor stormwater conveyance, undersized drainage, and large amounts of runoff from increased development located upstream of the site. The dense urban area associated with MD 301 up-stream leads to high volumes of runoff during rain events. Excessive flows will typically top the culvert on the north side of Post Office Drive and flood the intersection and then discharge into the channel on the south side.

There is a 60” RCP culvert that extends under the intersection and conveys an unnamed tributary to Zekiah Swamp Run. There are four inlets located at this intersection that collect runoff from the roadway and convey it into the culvert. A 24” high density polyethylene (HDPE) pipe conveys runoff from the wooded area located southeast of the intersection towards a shallow ditch which is carried to the unnamed tributary by a crushed 18” CMP.

The site was free of and trash, debris, or blockages and scour and erosion were not identified. The overall system slope from the upstream headwall to the downstream is negative, which may be contributing to backwater affects and ponding upstream. The flooding upstream of the culvert may also indicate that the system does not meet the required design capacity.





3. Poplar Hill Road between Peters Church Road & Mattawoman and Beantown Road

The low point of Poplar Hill Rd. between St. Peters Church Rd. and Mattawoman Beantown Rd. experiences overtopping during larger storm events. Two 60” CMP culverts located near the low point of the roadway convey an unnamed tributary to Zekiah Swamp Run. These culverts are both deformed, and one culvert is almost completely crushed towards the downstream outlet point. Closer to the low point of the roadway is a 22” HDPE that was added to increase conveyance of flow under Poplar Hill Rd. however, the roadway is still experiencing overtopping during large events. Neither the upstream nor downstream end of the twin culverts contain headwall structures.

The upstream end of the culvert shows minimal signs of erosion or scour, but large debris was noted during inspection. The downstream end of the culverts spill into a large, scoured area located a couple of feet below the invert of the culverts. This scour hole is disconnected from the downstream end of the stream causing poor conveyance. The proximity of the scour hole has begun to undermine the culverts and may cause instability of the roadway embankment.

Existing drainage condition maps and stormwater inventory maps for each location can be found in Attachment 4.

Section 4 - Modeling Methodology

Hydrology

All three sites are located within the Zekiah Watershed. Drainage areas were developed for each site. Soil information was obtained using NRCS Web Soils Survey and land use information was obtained from the impervious cover data and the NLCD land use layer. Drainage area, soils, and land use information can be found in Attachment 5.

Six storm events were investigated as part of this analysis. These events include the 25-year 24-hour storm frequency, the 100-year 24-hour storm frequency, and the future projected land use conditions for each event for the years 2050 and 2100. Current rainfall data was obtained using NOAA Atlas 14 for Charles County. Future rainfall conditions were obtained using the RAND Corporation climate projections for Charles County, which incorporate regional atmospheric and topographic variability. High air emission scenarios were used (RCP 8.5) as a conservative approach. Table 1 summarizes the total precipitation for each event.

Table 1: Precipitation Volume

Scenario	Precipitation (In.)
25yr	6.31
25yr + 2050 Prediction	7.07
25yr + 2100 Prediction	7.51
100yr	8.70
100yr + 2050 Prediction	10.01
100yr + 2100 Prediction	10.53

A Type II rainfall distribution was utilized for each site. Site locations 10 and 12 hydrology was done in SWMM in conjunction with the hydraulic modeling. Site location 24 flows were developed using Hydrographs 2004 and are summarized in Table 2.

Table 2: Location 24 Peak Flows

Scenario	Peak Flow (Cfs)
25yr	281
25yr + 2050 Prediction	339
25yr + 2100 Prediction	374
100yr	469
100yr + 2050 Prediction	578
100yr + 2100 Prediction	622

Hydrologic parameters can be found in Attachment 5

Hydraulics

A stormwater analysis was conducted to determine if the existing drainage system is up to design standards and evaluate the most critical locations within the system. The Environmental Protection Agencies (EPA) Stormwater Management Model (SWMM) version 5.2 was used to model the existing conditions and the proposed preferred alternative (PPA) for Locations 10 and 12. SWMM is

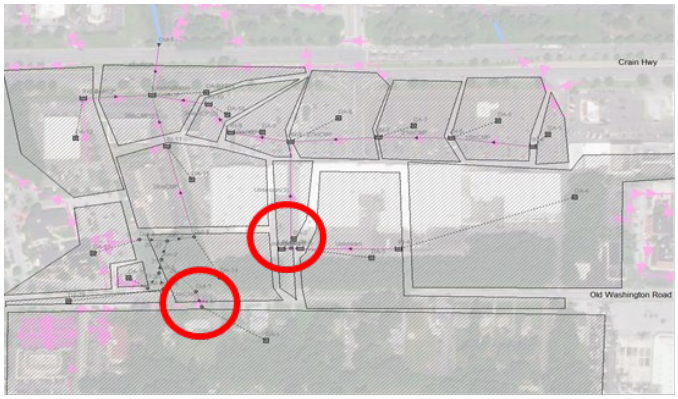
used for analyses related to stormwater runoff, combined systems, and other drainage systems. It is a free software and is very effective for evaluating green/grey hybrid stormwater systems.

The existing hydraulic computations and PPA for Location 24 were performed using a 1-D steady state HEC-RAS (Version 6.2) analysis. HEC-RAS is a standard step backwater hydraulic model that utilizes site specific geometric cross section data of the stream and floodplain analysis to establish the stream hydraulics.

Section 5: Site Evaluation & Proposed Alternatives for Old Washington Road and Pembrooke Square

Site Evaluation

A series of conduit, junction, and storage area connections were used to model the shopping area and associated drainage. Inlets, manholes, and basins were modeled using storage areas based on the area/depth relationship. Pipes and conveyance ditches were modeled utilizing conduit connections and junctions were used at the confluences of these connections and at headwalls.



The existing model was used to identify the most inundated drainage feature within the project area. This included the 24" CMP that transverses Old Washington Rd conveying runoff from the residential area and the two inlets located at the low point in the rear truck loading zone behind Shoppers World. These features were analyzed in addition to basin elevation located downstream and the outfall to Piney Branch UNT. The existing and PPA output is summarized in Tables 3- 5.

Table 3: IN-3 Summary Table (Low Point Inlet)

Storm Event	Existing Node Inflow (Cfs)	Existing Node Depth (Ft)	Proposed Node Inflow (Cfs)	Proposed Node Depth (Ft)
25-Year	30.40	4.39	17.45	3.74
25-Year (2050)	34.39	4.46	19.08	3.79
25-Year (2100)	36.78	4.50	19.67	3.81
100-Year	43.26	4.60	20.79	3.84
100-Year (2050)	50.57	4.70	20.84	3.84
100-Year (2100)	53.58	4.74	20.74	3.84

Table 4: Existing Basin Summary Table

Storm Event	Existing Node Inflow (Cfs)	Existing Node Depth (Ft)	Proposed Node Inflow (Cfs)	Proposed Node Depth (Ft)
25-Year	145.41	3.16	140.54	3.06
25-Year (2050)	151.79	3.30	148.54	3.20
25-Year (2100)	155.94	3.46	151.05	3.28

100-Year	165.62	3.72	160.83	3.59
100-Year (2050)	170.94	3.92	167.30	3.78
100-Year (2100)	172.62	4.02	170.40	3.86

Table 5: OUT-5 Summary Table (Outfall to Piney Branch UNT)

Storm Event	Existing Node Inflow (Cfs)	Existing Node Depth (Ft)	Proposed Node Inflow (Cfs)	Proposed Node Depth (Ft)
25-Year	143.27	3.16	138.45	3.06
25-Year (2050)	148.63	3.28	145.35	3.20
25-Year (2100)	149.64	3.59	148.49	3.28
100-Year	161.61	3.68	156.15	3.64
100-Year (2050)	165.77	3.70	163.46	3.69
100-Year (2100)	165.65	3.70	165.27	3.69

The proposed output is based on an additional 14,000 ft^3 of storage in the system to accommodate the increase in existing pipe capacities. Refer to Attachment 6 for the full SWMM report and model schematic and the hydrologic input parameters.

Proposed Alternatives for Old Washington Road and Pembrooke Square

Proposed alternatives were developed for the Old Washington Road and Pembroke Square project location. Aside from Alternative 1 – No Build, which does not address the purpose and need, the following distinct build alternatives were developed and analyzed for the Old Washington Road and Pembroke Square project location. The final PPA selection is discussed in Section 5.

Alternative 2: Drainage system improvements

Advantages

- Promote positive drainage by upsizing and cleaning old drainage system
- Increase conveyance throughout system

Disadvantages

- May increase flooding downstream
- Roadway may still flood during large events

Alternative 3: Drainage system improvements, revert impervious area to pervious, add GI and/or underground detention

Advantages

- Promote positive drainage by upsizing and cleaning old drainage system
- Increase conveyance throughout system
- Reduce heat island effect, reduce polluted runoff downstream, and provide storage runoff reduction

Disadvantages

- Proposed GI layout will depend on the shopping center
- ROW acquisition will be required

Alternative 4: Drainage system improvements, add GI and/or underground detention

Advantages

- Promote positive drainage by upsizing and cleaning old drainage system
- Increase conveyance throughout system
- Reduce heat island effect, reduce polluted runoff downstream, and provide storage runoff reduction

Disadvantages

- Roadway may still flood during larger events
- ROW acquisition will be required

Alternative 5: Drainage system improvements, revert impervious area to pervious, add GI and/or underground detention, add pump station

Advantages

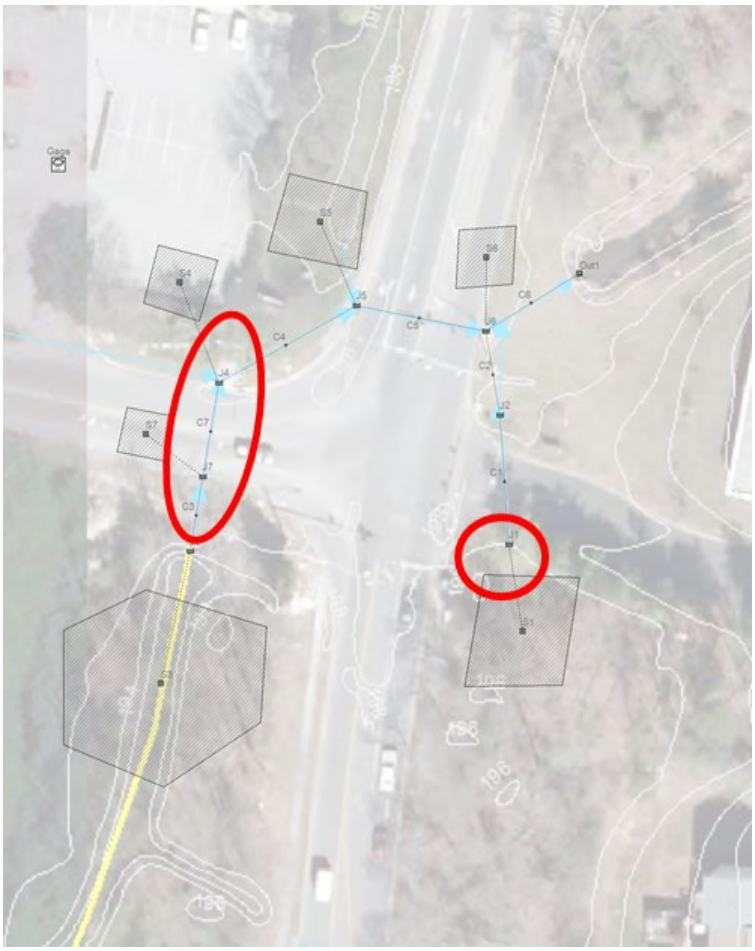
- Promote positive drainage by upsizing and cleaning old drainage system
- Increase conveyance throughout system
- Reduce heat island effect, reduce polluted runoff downstream, and provide storage runoff reduction
- Provides faster drainage and storage during larger, high intensity events

Disadvantages

- ROW acquisition will be required
- Most costly option
- Longer construction duration

Section 6: Site Evaluation & Proposed Alternatives for Industrial Park Drive and Post Office Road

Site Evaluation



Conduit and junction connections were used to model the drainage at the intersection of Industrial Park Drive and Post Office Road. Curb inlets, inlets with headwalls, pipe inlets, and downstream outfall were modeled using junctions. Pipes and streams were modeled using conduits.

Pipe dimensions and inverts were input to the model based on field survey conducted on 10/19/2022. A 60” RCP transverses Post Office Road from southwest to northeast and conveys runoff under the existing roadway from a stream inlet to Outfall 1. There are 4 open grate road inlets that connect to this existing system. There is an additional drainage system on the east side of Post Office Road consisting of a 24” HDPE pipe and 16” CMP which is partially crushed and blocked. The downstream outlet of the 16” CMP pipe could not be located and thus was assumed to connect to the 60” RCP system just upstream of Outfall 1.

The existing model was used to identify the most inundated drainage features within the project area. Multiple pipes have negative slopes, and the system inlet has a lower invert than the outlet which may contribute flooding and backwater effects at the site. Results from the existing model were analyzed to obtain maximum inflow and maximum water depth at key features indicating the system performance.

One preferred proposed alternative (PPA) scenario was modeled. The 60” RCP drainage system was upgraded to 58” x 91” reinforced concrete elliptical pipe (RCEP) with a beveled headwall entrance and re-graded to re-establish positive pipe slopes. Beveling the entrance of the headwall reduces the entrance loss coefficient. Additional Green Infrastructure (GI) surface retention was modeled which provides an additional 10,000 ft^3 of storage in the overall system. The additional drainage system on the east side of Post Office Road was graded to re-establish positive pipe slopes and the old HDPE/CMP were replaced with one 24” HDPE pipe that connects to the bioswale retention basin to reduce the load at Outfall 1 downstream. Refer to Attachment 6 for the full SWMM report and model schematic and the hydrologic input parameters. The existing and PPA output is summarized in Tables 6-8.

Table 6: J3 Summary Table (60" RCP Upstream Headwall)

Storm Event	Existing Max Total Node Inflow (Cfs)	Existing Max Node Depth (Ft)	Proposed Node Inflow (Cfs)	Proposed Node Depth (Ft)
25-Year	616.53	10.70	616.53	6.55
25-Year (2050)	716.83	11.86	716.83	7.03
25-Year (2100)	776.48	12.59	776.48	7.35
100-Year	941.46	14.72	941.46	8.30
100-Year (2050)	1128.20	17.32	1128.20	9.53
100-Year (2100)	1205.48	18.44	1205.48	10.07

*Roadway elevation low point: 198'

Table 7: J4 Summary Table (Inlet at NW Corner Post Office Rd)

Storm Event	Existing Max Total Node Inflow (Cfs)	Existing Max Node Depth (Ft)	Proposed Node Inflow (Cfs)	Proposed Node Depth (Ft)
25-Year	305.20	5.15	339.66	5.00
25-Year (2050)	327.90	5.15	340.03	5.00
25-Year (2100)	341.37	5.15	341.44	5.00
100-Year	378.23	5.15	373.74	5.00
100-Year (2050)	419.67	5.15	414.78	5.00
100-Year (2100)	436.69	5.15	431.72	5.00

Table 8: Out1 Summary Table (Downstream Headwall)

Storm Event	Existing Max Total Node Inflow (Cfs)	Existing Max Node Depth (Ft)	Proposed Node Inflow (Cfs)	Proposed Node Depth (Ft)
25-Year	216.86	4.08	430.05	3.75
25-Year (2050)	206.46	4.09	443.30	3.75
25-Year (2100)	207.02	4.10	428.49	3.75
100-Year	208.54	4.11	429.67	3.75
100-Year (2050)	210.17	4.12	443.36	3.75
100-Year (2100)	210.82	4.13	445.74	3.75

Increasing the capacity of the system may reduce the headwater elevation by 4-8 ft for the evaluated events. The proposed invert of the culvert is at 191.25 ft. A node depth of 6.55 ft for the 25-year event will reduce flooding from 202 ft to just below 198 ft (the low point of the roadway) for the 25-year event. The increase in flow downstream and decrease in depth indicates an increase in velocity and erosion control measures may be required downstream. This may include baffles, weirs, and scour holes to prevent erosion, scour and sedimentation downstream.

Proposed Alternatives for Industrial Park Drive and Post Office Road

Proposed alternatives were developed for the Industrial Park Drive and Post Office Road project location. Aside from Alternative 1 – No Build, which does not address the purpose and need, the following distinct build alternatives were developed and analyzed for Industrial Park Drive and Post Office Road project location. The final PPA selection is discussed in Section 5.

Alternative 2: Drainage System Improvements; replace 60" RCP with dual 48" RCP

Advantages

- Clean existing RCP pipe system and curb inlets
- Upsize pipes
- Re-establish positive pipe slopes
- Stabilize, widen, and clean streams at system inlets

Disadvantages

- Roadway may still flood during, high volume rainfall events
- Will increase flooding downstream near

Alternative 3: Drainage System Improvements; replace 60" RCP with 58" x 91" RCEP

Advantages

- Clean existing RCP pipe system and curb inlets
- Upsize pipes
- Re-establish positive pipe slopes
- Stabilize, widen, and clean streams at system inlets

Disadvantages

- Roadway may still flood during, high volume rainfall events
- Will increase flooding downstream near

Alternative 4: Drainage System Improvements; replace 60" RCP with dual 48" RCP and add Green Infrastructure

Advantages

- Clean existing RCP pipe system and curb inlets
- Upsize pipes
- Re-establish positive pipe slopes
- Stabilize, widen, and clean streams at system inlets
- Install additional GI surface retention and curb cuts to capture runoff close to the source, provide storage, and increase overall system storage capacity

Disadvantages

- Flooding may still occur in larger, high intensity events
- ROW acquisition may be required

Alternative 5: Drainage System Improvements; replace 60" RCP with 58" x 91" RCEP and add Green Infrastructure

Advantages

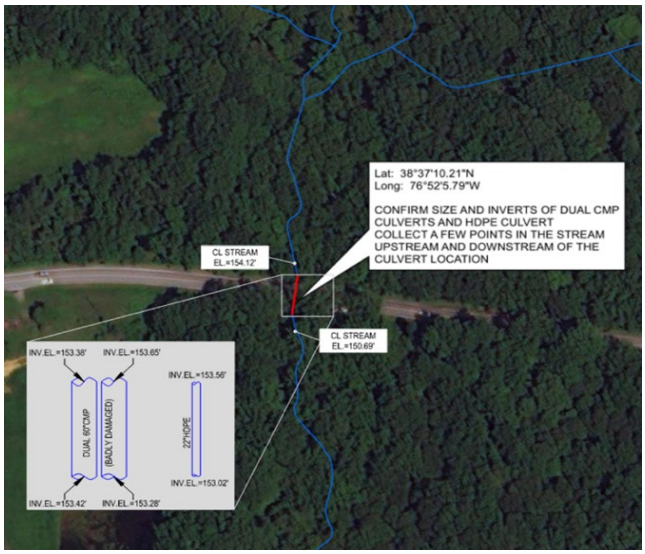
- Clean existing RCP pipe system and curb inlets
- Upsize pipes
- Re-establish positive pipe slopes
- Stabilize, widen, and clean streams at system inlets
- Install additional GI surface retention and curb cuts to capture runoff close to the source, provide storage, and increase overall system storage capacity

Disadvantages

- Flooding may still occur in larger, high intensity events
- ROW acquisition may be required

Section 7: Site Evaluations & Proposed Alternatives for Poplar Hill Road between St. Peters Church Road & Mattawoman Beantown Road

Site Evaluation



Cross section geometric data was derived from the NOAA 1-meter vertical accuracy DEM data using RASMapper. The existing culvert dimensions were obtained from survey. The HEC-RAS model was run using the design event peak flow rate, for each of the analyzed storm events. Peak flows were obtained using Hydrographs 2004 software. Normal depth was used as the downstream boundary condition.

Table 9 summarizes the existing and PPA WSEL just upstream of the culvert location.

Table 9: Existing and Proposed WSEL Upstream of Poplar Rd.

Storm Event	Existing Wsel (Ft)	Proposed Wsel (Ft)
25-Year	159.14	157.75
25-Year (2050)	159.33	158.26
25-Year (2100)	159.46	158.55
100-Year	159.75	159.31
100-Year (2050)	160.01	159.53
100-Year (2100)	160.10	159.64

*Roadway Elevation Low Point: 158.7'

Refer to Attachment 5 and 6 for the complete hydrologic and hydraulic backup data, respectively.

Proposed Alternatives for Poplar Hill Road between St. Peters Church Road & Mattawoman Beantown Road

Proposed alternatives were developed for the Poplar Hill Road between St. Peters Church Road & Mattawoman Beantown Road project location. Aside from Alternative 1 – No Build, which does not address the purpose and need, the following distinct build alternatives were developed and analyzed for Poplar Hill Road between St. Peters Church Road & Mattawoman Beantown Road project location. The final PPA selection is discussed in Section 5.

Alternative 2: Replace dual 60" CMPs with dual 60" RCP and stream restoration

Advantages

- Promote positive drainage by upsizing old drainage system
- Increase conveyance along the stream through restoration and debris removal
- Reduce scour and erosion by stabilizing stream banks and outfalls

Disadvantages

- Roadway will still flood during 25-year event

Alternative 3: Replace dual 60" CMPs with dual 60" RCP, raise the low point of the roadway, and perform stream restoration

Advantages

- Promote positive drainage by upsizing old drainage system
- Increase conveyance along the stream through restoration and debris removal
- Reduce scour and erosion by stabilizing stream banks and outfalls

Disadvantages

- Most costly option with the longest construction duration
- The roadway will need to be a couple of feet to meet 25-year capacity
- Longer construction duration
-

Alternative 4: Replace dual 60" CMPs with dual 72" RCP (beveled entrance), replace 22" HDPE with 36" HDPE and stream restoration

Advantages

- Promote positive drainage by upsizing old drainage system
- Increase conveyance along the stream through restoration and debris removal
- Reduce scour and erosion by stabilizing stream banks and outfalls

Disadvantages

- Roadway will still flood during future, high volume rainfall events (100 Year)

Alternative 5: Replace dual 60" CMPs with single 10' x 5' reinforced concrete box culvert and stream restoration

Advantages

Promote positive drainage by upsizing old drainage system

Increase conveyance along the stream through restoration and debris removal

Reduce scour and erosion by stabilizing stream banks and outfalls

Disadvantages

Roadway will still flood during 25-year event

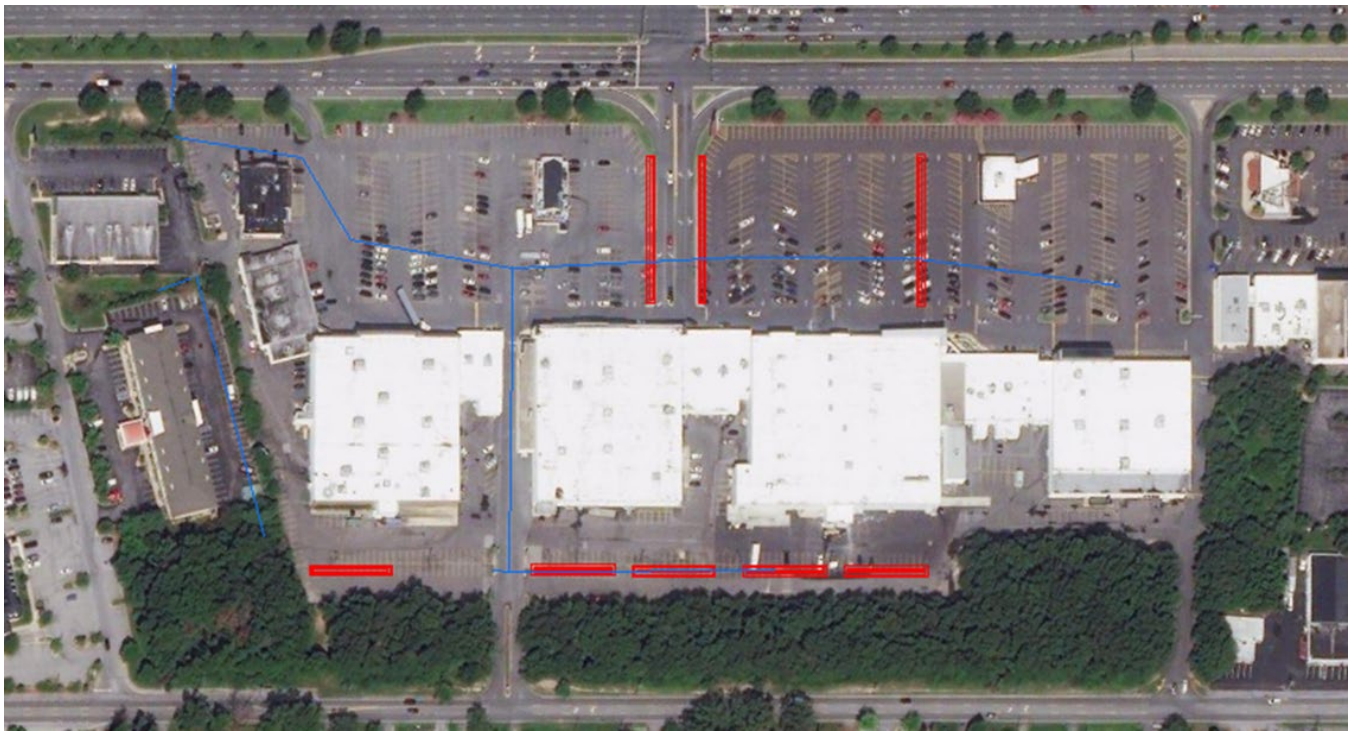
A comparison matrix of the developed alternatives, along with a no-build alternative, is available in Attachment 7.

Section 8: Concept Development Recommendations for Target Urban Flood Locations within Zekiah Watershed

The recommended PPA addresses the established purpose and need. Further coordination will be made with local officials to provide feedback on the selected PPA. No fatal flaws have been identified with the PPA.

1. Old Washington Road and Pembrooke Square

The recommended PPA is Alternative 3, which includes drainage system improvements, reverting impervious area to pervious in the rear lot, and adding GI and/or underground detention to provide additional storage.



2. Industrial Park Drive and Post Office Road Intersection

The recommended PPA is Alternative 5, which includes drainage system improvements, replacing the 60" RCP run with a 58" x 91" RCEP and adding GI in the form of surface retention/infiltration.

3. Poplar Hill Road between St. Peters Church Road & Mattawoman Beantown Road

The recommended PPA is Alternative 4, which includes the replacement of the dual 60” CMP culverts with dual 72” RCP culverts with beveled entrances at the headwall. The existing 22” HDPE adjacent to the dual culverts will be upsized with a 36” HDPE pipe. The channel will be cleaned, stabilized, and cleared of debris and the downstream channel will be re-graded to promote better conveyance.

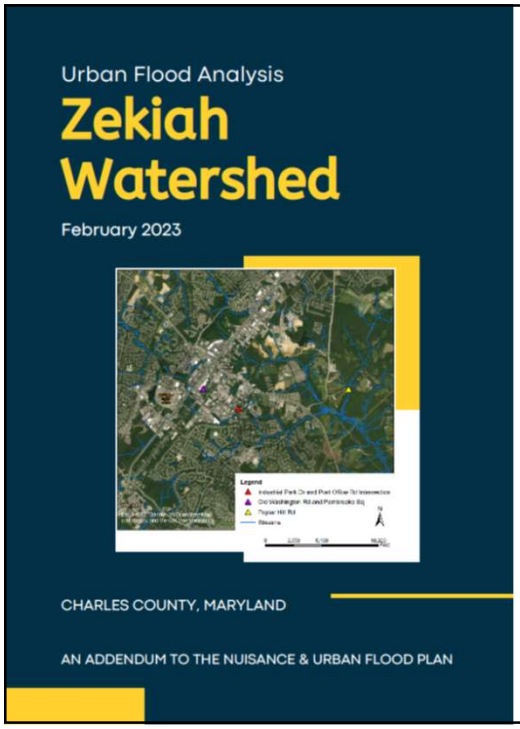
Attachment 1
STEERING COMMITTEE MEETINGS

Zekiah Watershed Study
Project Site Review & Consideration

August 25, 2022

Virtual

1



Zekiah Watershed Study
Project Site Review & Consideration

August 25, 2022

Virtual

2

Urban Flood Analysis

Zekiah Watershed

February 2023

CHARLES COUNTY, MARYLAND

AN ADDENDUM TO THE NUISANCE & URBAN FLOOD PLAN

Agenda

- Project Update
  - Schedule
  - Stakeholder Involvement
  - Outreach and StoryMap
- Relevant Data & Resources
  - Nuisance Flood Plan
  - Poplar Hill Evaluation
  - Zekiah Watershed Assessment
- Field Study Findings & Recommendations Discussion
- Next Steps

3

Urban Flood Analysis

Zekiah Watershed

February 2023

CHARLES COUNTY, MARYLAND

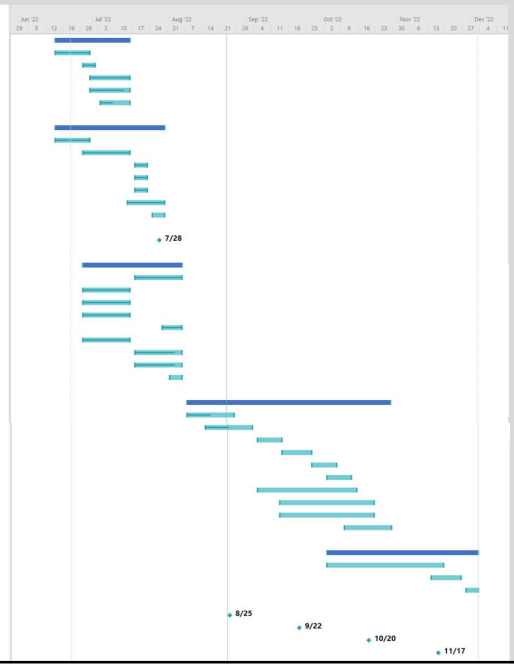
AN ADDENDUM TO THE NUISANCE & URBAN FLOOD PLAN

Project Update

4

Project Schedule

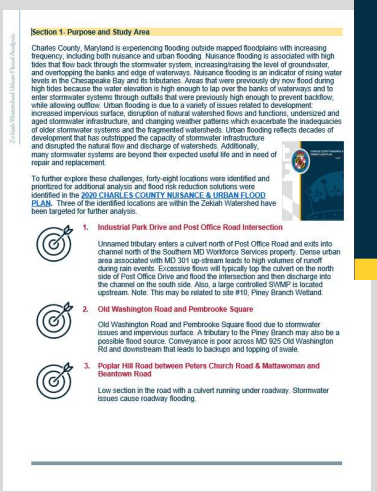
Task Summary Name	Task Name	% Complete	Duration	Start	Finish
	SECTION 1. Purpose of Study and Content	0%	1.1 mons	6/16	7/15
✓	Introduction	100%	2 wks	6/16	6/29
✓	Nuisance Flood Plan	100%	1 wk	6/27	7/1
✓	Consistency with County Programs	100%	2.4 wks	6/30	7/15
	County & State Nature Based Programs	80%	2.4 wks	6/30	7/15
	Compile SECTION 1	50%	10 days	7/4	7/15
	SECTION 2. Data Considerations and Methodology	0%	1.6 mons	6/16	7/29
✓	Request & Compile Data	100%	10 days	6/16	6/29
✓	Data Development	100%	15 days	6/27	7/15
	Data Description - Charles County Mapping Services	90%	1 wk	7/18	7/22
	Data Description - Maryland GIS Data Catalog - iMap	90%	1 wk	7/18	7/22
	Data Description - FEMA	90%	1 wk	7/18	7/22
✓	Data Gap Analysis	100%	2.2 wks	7/15	7/29
	Compile and Submit SECTION 2	0%	1 wk	7/25	7/29
	Field Visit & Workshop	**0%**	**0 days**	**7/28**	**7/28**
	SECTION 3. Existing Conditions	0%	6 wks	6/27	8/5
✓	Sources of Flooding	100%	15 days	7/18	8/5
✓	Rain Data - Gauges / NWS / NOAA	100%	3 wks	6/27	7/15
✓	Topography	100%	3 wks	6/27	7/15
✓	Water Quality Considerations	100%	3 wks	6/27	7/15
✓	Field Study Results	100%	6 days	7/29	8/5
✓	USGS Web Soil Survey	100%	3 wks	6/27	7/15
	Future Conditions - Environmental	80%	15 days	7/18	8/5
	Future Conditions - Land Use	80%	15 days	7/18	8/5
	Compile and Submit SECTION 3	0%	5 days	8/1	8/5
	SECTION 4. Model Development	0%	12 wks	8/8	10/28
	Hydrologic Model Set up	50%	3 wks	8/8	8/26
	Existing Conditions Model Development Set up	50%	3 wks	8/15	9/2
	10 year 24 hour Flood Scenario	0%	1.6 wks	9/5	9/14
	100 year 24 hour Flood Scenario	0%	1.6 wks	9/15	9/26
	2050 Expected Conditions	0%	1.6 wks	9/27	10/6
	2100 Expected Conditions	0%	1.6 wks	10/3	10/12
	Risk Assessment - Flood Scenario Extents	0%	30 days	9/5	10/14
	Vulnerability Analysis	0%	28 days	9/14	10/21
	Flood Mitigation with Nature Based Solutions	0%	28 days	9/14	10/21
	Compile and Submit SECTION 4	0%	3 wks	10/10	10/28
	SECTION 5. Flood Mitigation Strategy & Stormwater Recommendatio	0%	9 wks	10/3	12/2
	Improvement Actions	0%	7 wks	10/3	11/18
	Implementation Schedule	0%	2 wks	11/14	11/25
	Compile and Submit SECTION 5	0%	1 wk	11/28	12/2
	August Stakeholder Meeting	**0%**	**0 days**	**8/25**	**8/25**
	September Stakeholder Meeting	**0%**	**0 days**	**9/22**	**9/22**
	October Stakeholder Meeting	**0%**	**0 days**	**10/20**	**10/20**
	Novemer Stakeholder Meeting	**0%**	**0 days**	**11/17**	**11/17**



5

Other Items to Address

- Stakeholder Involvement
  - Members and Involvement
- Document Format
- Outreach & StoryMap



Section 1- Purpose and Study Area

Charles County, Maryland is experiencing flooding outside mapped floodplains with increasing frequency, including both nuisance and urban flooding. Nuisance flooding is associated with high tides that flow back through the stormwater system, increasing/raising the level of groundwater, and overtopping the banks and edge of waterways. Nuisance flooding is an indicator of rising water levels in the Chesapeake Bay and its tributaries. Areas that were previously dry now flood during high tides because the water elevation is high enough to lap over the banks of waterways and to enter stormwater systems through outfalls that were previously high enough to prevent backflow, while allowing outflow. Urban flooding is due to a variety of issues related to development: increased impervious surface, disruption of natural watershed flows and functions, undersized and aged stormwater infrastructure, and changing weather patterns which exacerbate the inadequacies of older stormwater systems and the fragmented watersheds. Urban flooding reflects decades of development that has outstripped the capacity of stormwater infrastructure and disrupted the natural flow and discharge of watersheds. Additionally, many stormwater systems are beyond their expected useful life and in need of repair and replacement.

To further explore these challenges, forty-eight locations were identified and prioritized for additional analysis and flood risk reduction solutions were identified in the 2020 CHARLES COUNTY NUISANCE & URBAN FLOOD PLAN. Three of the identified locations are within the Zekiah Watershed have been targeted for further analysis.

1. **Industrial Park Drive and Post Office Road Intersection**

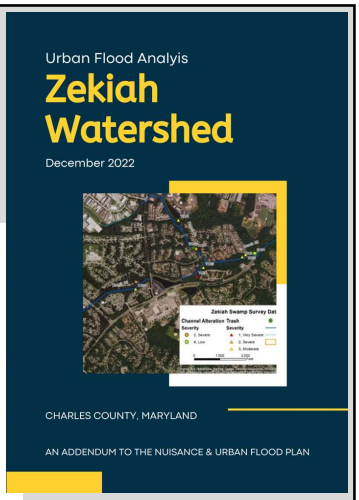
   Unnamed tributary enters a culvert north of Post Office Road and exits into channel north of the Southern MD Workforce Services property. Dense urban area associated with MD 301 up-stream leads to high volumes of runoff during rain events. Excessive flows will typically top the culvert on the north side of Post Office Drive and flood the intersection and then discharge into the channel on the south side. Also, a large controlled SWMP is located upstream. Note: This may be related to site #10, Piney Branch Wetland.

2. **Old Washington Road and Pembrooke Square**

   Old Washington Road and Pembrooke Square flood due to stormwater issues and impervious surface. A tributary to the Piney Branch may also be a possible flood source. Conveyance is poor across MD 925 Old Washington Rd and downstream that leads to backups and topping of swale.

3. **Poplar Hill Road between Peters Church Road & Mattawoman and Beantown Road**

   Low section in the road with a culvert running under roadway. Stormwater issues cause roadway flooding.



Urban Flood Analysis

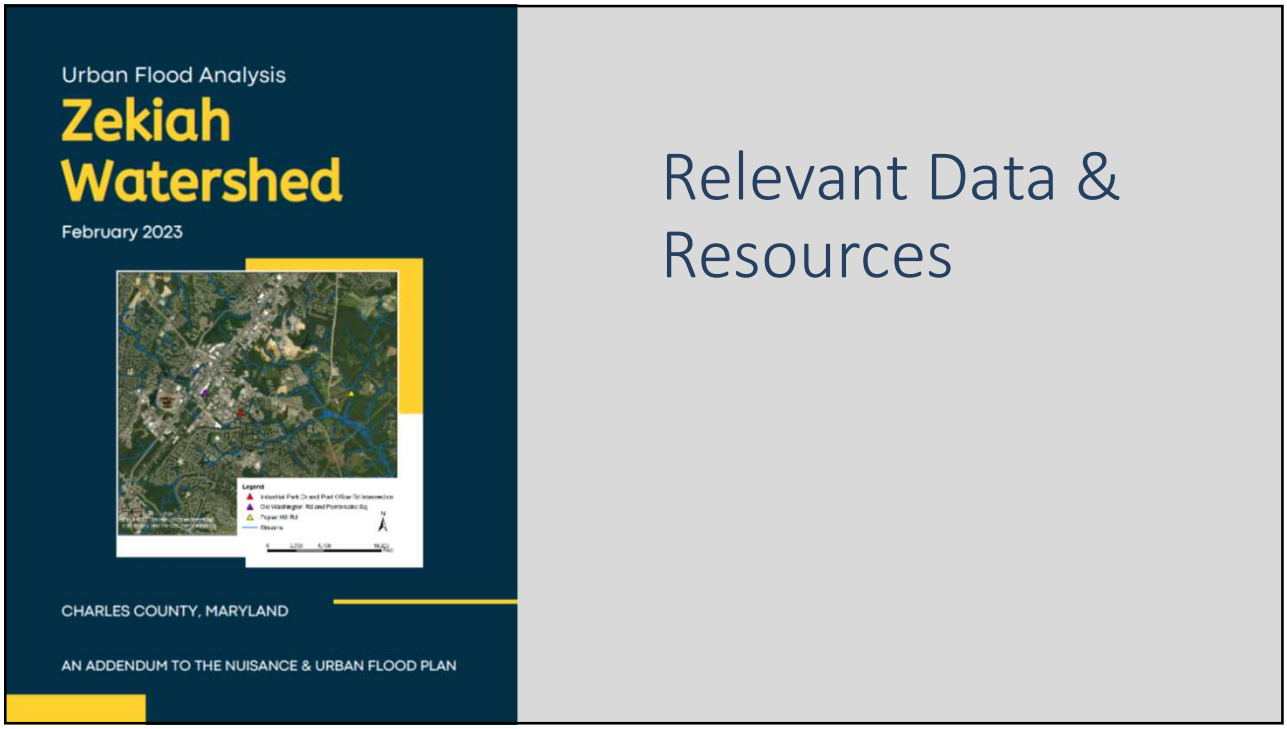
Zekiah Watershed

December 2022

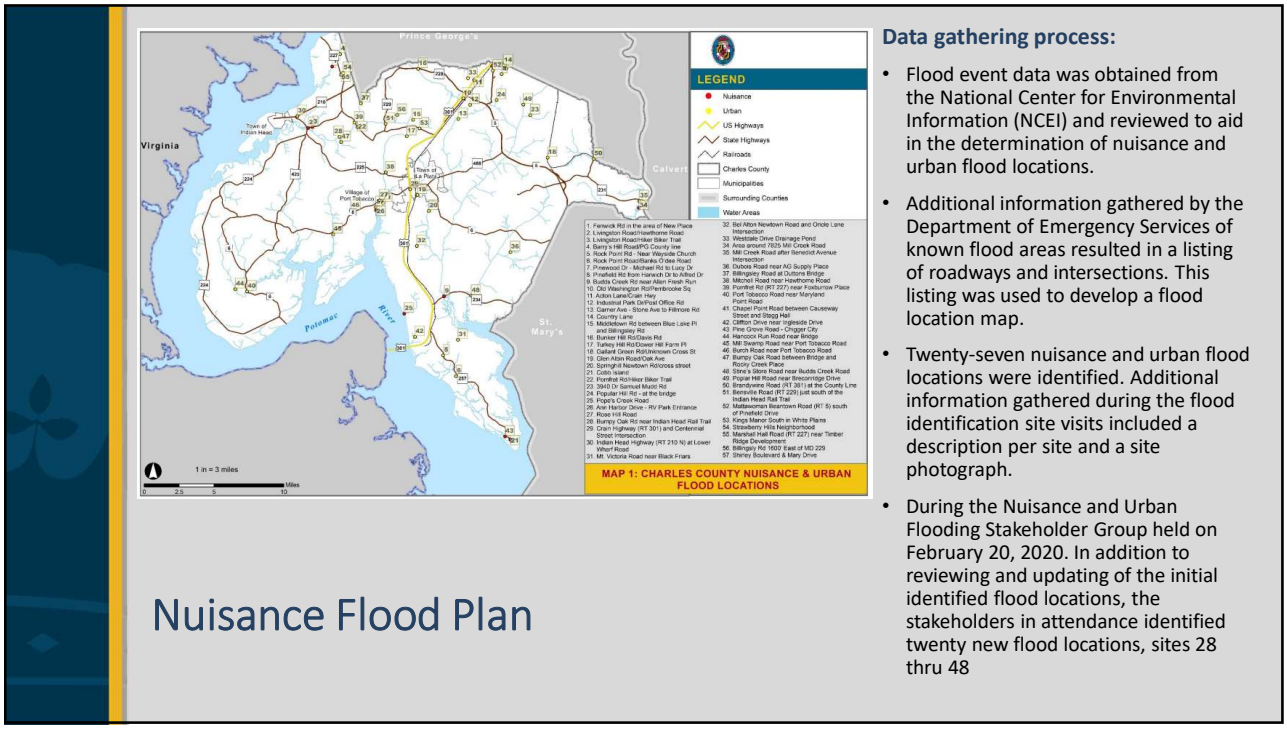
CHARLES COUNTY, MARYLAND

AN ADDENDUM TO THE NUISANCE & URBAN FLOOD PLAN

6

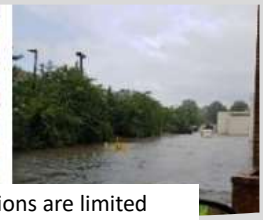

Urban Flood Analysis
Zekiah Watershed
February 2023
CHARLES COUNTY, MARYLAND
AN ADDENDUM TO THE NUISANCE & URBAN FLOOD PLAN
Relevant Data & Resources

7


LEGEND
Nuisance
Urban
US Highways
State Highways
Railroads
Charles County
Municipalities
Surrounding Counties
Water Areas
MAP 1: CHARLES COUNTY NUISANCE & URBAN FLOOD LOCATIONS
Virginia
Potomac
River
Nuisance Flood Plan
Data gathering process:
Flood event data was obtained from the National Center for Environmental Information (NCEI) and reviewed to aid in the determination of nuisance and urban flood locations.
Additional information gathered by the Department of Emergency Services of known flood areas resulted in a listing of roadways and intersections. This listing was used to develop a flood location map.
Twenty-seven nuisance and urban flood locations were identified. Additional information gathered during the flood identification site visits included a description per site and a site photograph.
During the Nuisance and Urban Flooding Stakeholder Group held on February 20, 2020. In addition to reviewing and updating of the initial identified flood locations, the stakeholders in attendance identified twenty new flood locations, sites 28 thru 48

8

Old Washington Road and Pembrooke Square



- Environmental restrictions are limited factors in this area in terms of projects
- Possibility of using stormwater as grey water and pumping to power plant

Description:

- Old Washington Road and Pembrooke Square flood due to stormwater issues and impervious surface. A tributary to the Piney Branch may also be a possible flood source. Conveyance is poor across MD 925 Old Washington Rd and downstream that leads to backups and topping of swale. (Wetland-Piney Branch)

9

Industrial Park Drive and Post Office Rd Intersection

- Evaluate Drain System
- Drainage Improvement Plan

Description:

- Unnamed tributary enters a culvert north of Post Office Road and exits into channel north of the Southern MD Workforce Services property. Dense urban area associated with MD 301 up-stream leads to high volumes of runoff during rain events. Excessive flows will typically top the culvert on the north side of Post Office Drive and flood the intersection and then discharge into the channel on the south side. Also, a large controlled SWMP is located upstream. Note: This may be related to site #10, Piney Branch Wetland.

10

Poplar Hill Road between St. Peters Church Road & Mattawoman Beantown Road

- Culvert replacement project
- Have County SWM engineer review to see if larger pipe is necessary

Description:

- Low section in the road with a culvert running under roadway. Stormwater issues cause roadway flooding.

11

Poplar Hill Road 2015 Evaluation

Project SR-04 - Problem

- 320 foot section of stream that flows from a culvert under Poplar Hill Road.
- Culvert is undermined and the concrete apron is broken with a 1 ½ foot drop to the existing channel invert.
- The culvert appears to be undersized for the drainage area. The channel is a Rosgen G Type channel and is incised with no access to a floodplain.
- Undercut roots are compromising trees which will eventually fall into the channel causing debris jams.
- Bank height decreases as the channel gets closer to its confluence with the main channel.

Solution $240.000

- Repair the broken concrete apron, installing flowable fill underneath the undercut apron, installing a plunge pool to dissipate velocity, and grading back the banks to allow access to a floodplain. Grade control structures are proposed to prevent down cutting and maintain grade.

Constraints

- H& H Study needed
- Potential Environmental Impacts
- Soil Erosion / Sediment Control Measures and Permitting
- The property is situated on two parcels both owned by Archbishop Patrick O'Boyle of St. Peters Church.

12

Zekiah Swamp Watershed Assessment Analysis

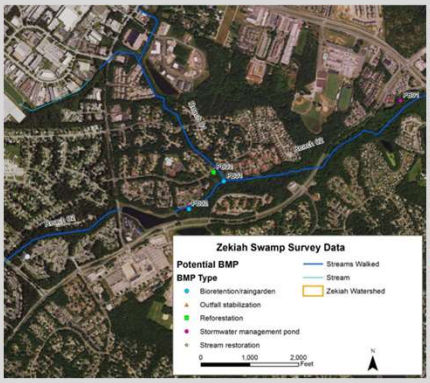
- The primary goal of Zekiah Swamp Watershed Assessment is related to the urban stormwater sector and meeting the restoration goals of the NPDES permit that satisfy section IV.E.1,
- Synoptic water quality sampling was performed across the Zekiah Swamp watershed from April 22-29, 2016. A total of 54 sites were visited for water quality and discharge measurements:

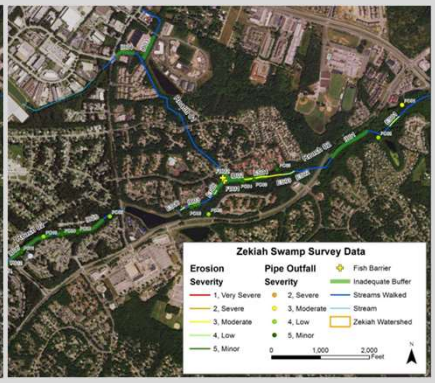
Station	Date	Area (AC)	Discharge(cfs)	Temperature	pH	Dissolved Oxygen(mg/L)	Specific Conductance	Turbidity (NTU)	Optical Brightener (ppm)
ZE-5	3/16/2016	1779.2	0.93	10.3	6.69	10.40	236.4	10.40	1.98
ZE-6	3/16/2016	4524.5	1.76	15.9	7.23	13.44	**358.5**	4.12	1.21
ZE-7	3/16/2016	1779.2	1.14	9.8	**5.98**	11.42	156.9	8.01	1.95
ZE-8	3/17/2016	647.4	0.96	16.7	6.56	9.80	**347.1**	12.50	1.48

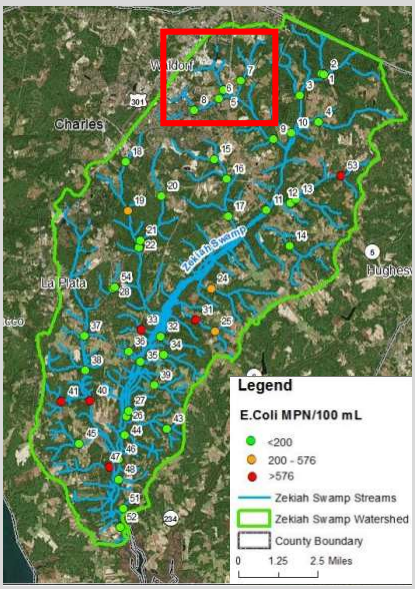
Station	Ortho P(mg/L)	TKN (Mg/L)	Nitrate/Nitrite (mg/L)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L	E. Coli (mg/100 mL	Ortho P (kg/H/day)	TKN (kg/H/day)	Nitrate Nitrite (kg/H/day)	Total Nitrogen (kg/H/day)	Total Phosphorus kg/H/day)
ZE-5	0.005	0.25	0.6	0.8	0.02	35	0.00002	0.00079	0.00190	0.00253	0.00006
ZE-6	0.005	0.25	0.15	0.4	0.01	62.7	0.00001	0.00059	0.00035	0.00094	0.00002
ZE-7	0.005	0.25	1.3	1.3	0.005	72.7	0.00002	0.00097	**0.00502**	0.00502	0.00002
ZE-8	**0.080**	0.25	0.15	0.4	**0.05**	8.6	0.00072	0.00225	**0.00135**	0.00360	0.00045

13

Zekiah Swamp Watershed Assessment Site Evaluation







14

Zekiah Swamp Watershed Assessment Recommendations SWM BMP

Site ID	Existing Conditions	Proposed Improvements
ZE_SR_1	Stream located downstream from development in Waldorf and residential neighborhoods. Channel widened with localized areas of severe bank erosion.	Stream bank and bed stabilization to repair bank erosion.
ZE_BMP_1	Upstream water from residential area is collected through inlet and drains to this outfall grass channel, it eventually drains to the adjacent stream.	Bioretention
ZE_BMP_2	Outfall drains to riprap and storm drain into a stream. Drainage area includes almost the entire community.	Bioretention

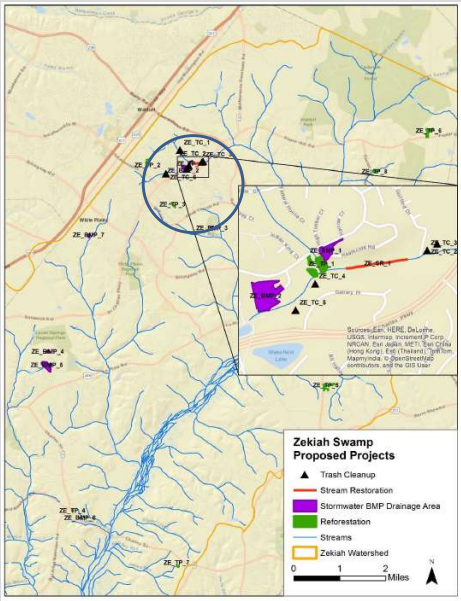
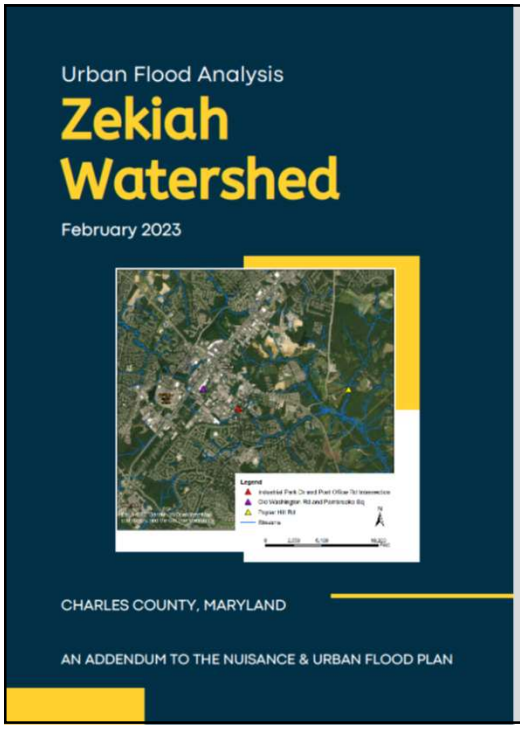


FIGURE 16: LOCATION OF ZEKIAH SWAMP WATERSHED POTENTIAL WATER QUALITY IMPROVEMENT PROJECTS

15



Field Study Findings & Recommendations Discussion

16

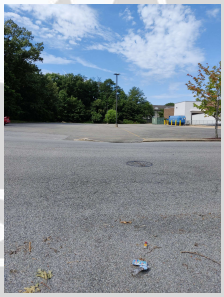
Old Washington Road and Pembrooke Square

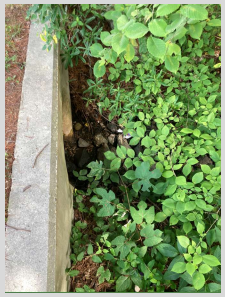
Known Issues:

- Significant flooding in entire parking lot and surrounding roadways
- Poor flow conveyance to downstream culverts

Observed:

- Only two shallow inlets in rear parking area at the low point
- Trash /debris sediment accumulation at the inlets
- Parking lot and drainage system are flat
- Streams/ditches adjacent to parking area have minimal conveyance (stagnant)
- Downstream culverts look clear but likely aren't getting enough flow
- Some overgrowth in the culvert area



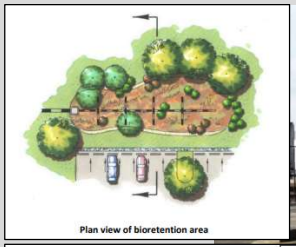


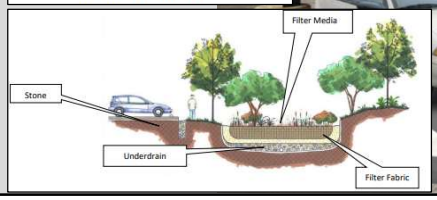
17

Old Washington Road and Pembrooke Square

Potential Recommendations:

- (ROW to be considered) Grade parking area
- Regrades ditches and stabilize to convey flow
- Resize pipes as feasible and pitch to convey positive flow
- Consider providing green infrastructure/stormwater storage in unused portions of parking area (pending ROW)





18

Industrial Park Drive and Post Office Rd Intersection

Known Issues:

- Flooding at Intersection

Observed:

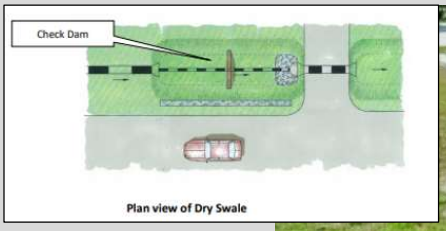
- Culvert at low point appears clear.
- Large drainage area believed to drain to low point. Potentially coming from surrounding new development and upstream.
- No significant erosion apparent
- Capacity of system is likely large part of this issue

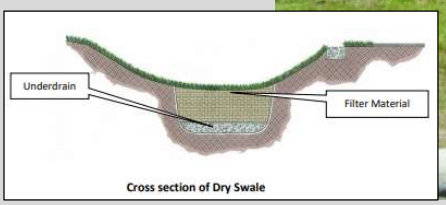
19

Industrial Park Drive and Post Office Rd Intersection

Potential Recommendations:

- Investigate increasing capacity of existing culvert and adjacent drainage system
- Provide storage by adding a basin on downstream culvert at intersection
- Add rip rap and grade off the roadway with curb open to allow flow over rip rap to basin





20

Poplar Hill Road between St. Peters Church Road & Mattawoman Beantown Road

Known Issues:

- Flooding at low point of roadway

Observed:

- 2 culvert crossings identified near low point
- New culvert (1 HDPE pipe) located at the roadway low point
  - Large riprap scour hole causing ponding and obstruction of flow
  - Upstream end is overgrowth
- Original culvert (2 CMP pipes) both deformed but one crushed on downstream outlet
  - Downstream area is disconnected from the stream
  - Tree obstruction noted at the upstream end

21

Poplar Hill Road between St. Peters Church Road & Mattawoman Beantown Road

Potential Recommendations

- Replace CMP pipes
- Clear vegetation and remove tree blocking
- Considering additional slope stabilization and gabion on side slopes
- Channelize both downstream ends to flow to downstream ditch

22

Zekiah Swamp Watershed Assessment Hydrologic and Hydraulic Analysis

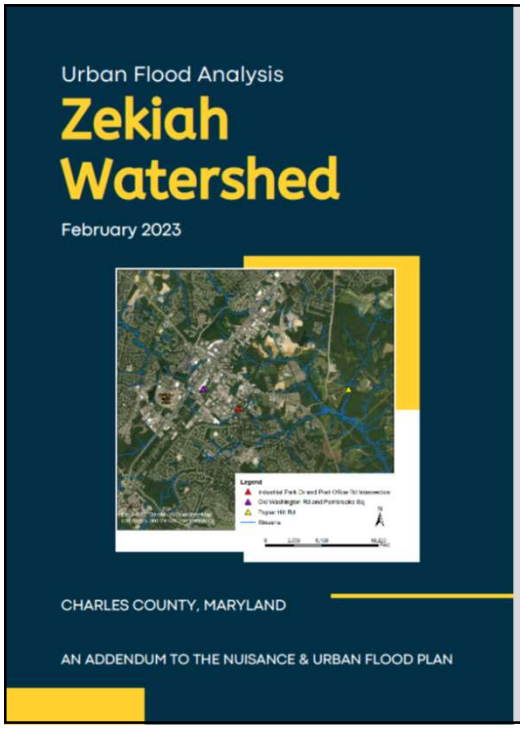
Hydrologic Analysis
The sources of flooding will be identified, and a hydrologic analysis will be performed at each of the three locations to determine the discharge/flows affecting the area. The analysis will include:

- The 25-Year 24-Hour storm frequency (design storm)
- The 100-Year 24-Hour storm frequency
- Future land-use and environmental conditions

Hydraulic Analysis
The modeled discharges will be input into hydraulic models to calculate the existing and proposed flooding condition at each location, including mitigation tactics. The analysis will include:

- 25-Year 24-Hour scenario
- 100-Year 24-Hour scenario
- 2050 Expected Conditions
- 2100 Expected Conditions
- Risk Assessment and Vulnerability Analysis
- Infrastructure upgrades as well as Green Infrastructure will be taken into account

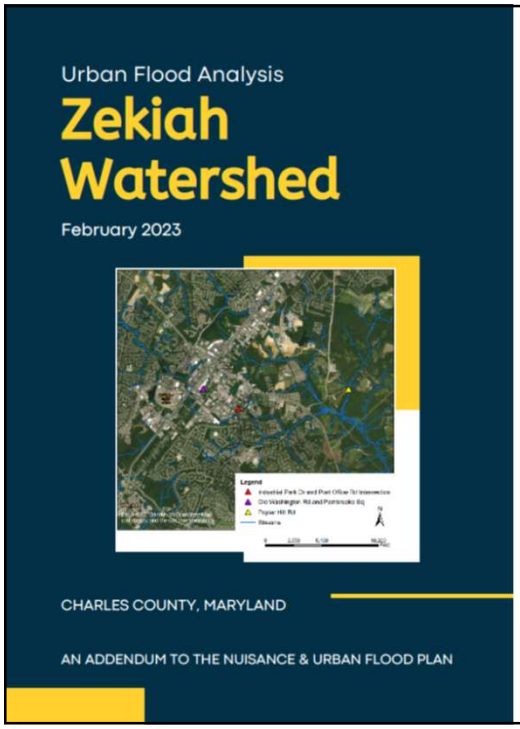
23



Next Steps

- **Hydraulic Analysis For Flood Scenarios**
- **Hydrologic Analysis For Flood Scenarios**
- **Risk Assessment For Each Flood Scenario**
- **Hold Steering Committee Meeting to Present Findings of Each Flood Scenario**
- **Refine Improvement Actions & Develop Implementation Schedule**
- **Modify StoryMap to Include Methodology & Findings of Study**
- **Compile Findings in Report and Present to County for Approval**

24

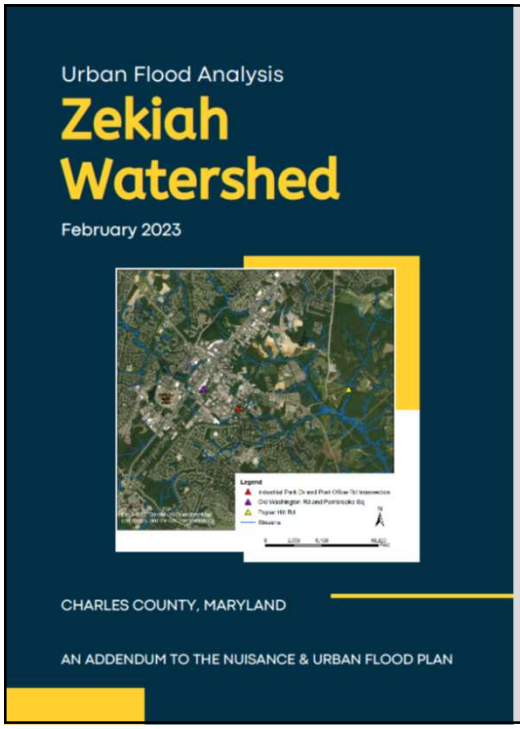


Zekiah Watershed Study
Model Development

September 22, 2022

Virtual

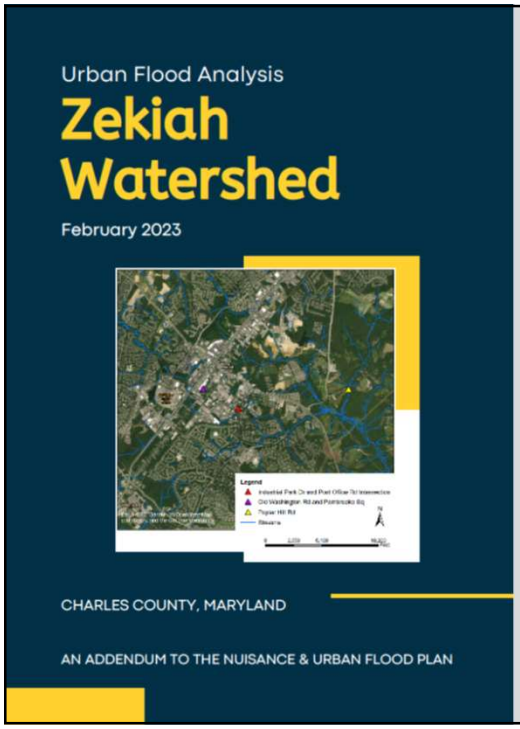
1



Agenda

- Project Update
  - Schedule
  - StoryMap
- Relevant Data & Resources
  - Nuisance Flood Plan
  - Poplar Hill Evaluation
  - Zekiah Watershed Assessment
- Field Study Findings & Recommendations Discussion
- Next Steps

2

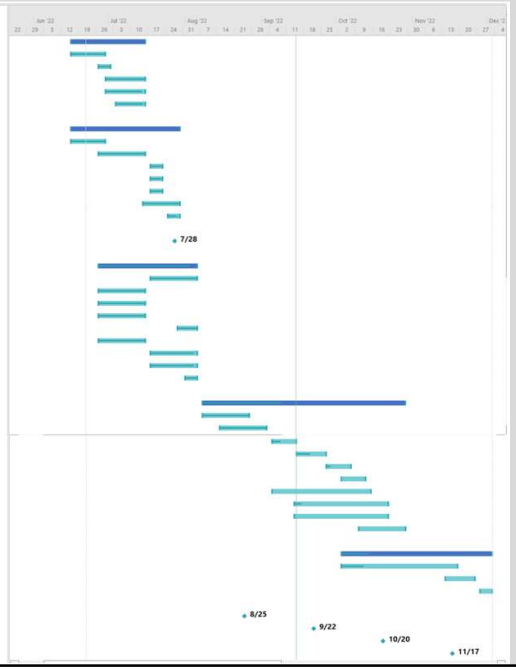


Project Update

3

Project Schedule

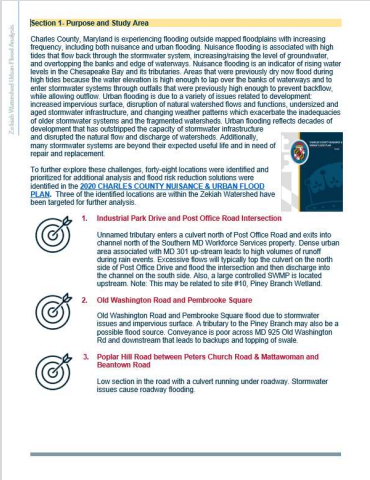
	Task Summary Name	Task Name	% Complete	Duration	Start	Finish
		SECTION 1. Purpose of Study and Content	0%	1.1 mons	6/16	7/15
✓		Introduction	100%	2 wks	6/16	6/29
✓		Nuisance Flood Plan	100%	1 wk	6/27	7/1
✓		Consistency with County Programs	100%	2.4 wks	6/30	7/15
		County & State Nature Based Programs	90%	2.4 wks	6/30	7/15
		Compile SECTION 1	90%	10 days	7/4	7/15
		SECTION 2. Data Considerations and Methodology	0%	1.6 mons	6/16	7/29
✓		Request & Compile Data	100%	10 days	6/16	6/29
✓		Data Development	100%	15 days	6/27	7/15
		Data Description - Charles County Mapping Services	90%	1 wk	7/18	7/22
		Data Description - Maryland GIS Data Catalog - iMap	90%	1 wk	7/18	7/22
		Data Description - FEMA	90%	1 wk	7/18	7/22
✓		Data Gap Analysis	100%	2.2 wks	7/15	7/29
		Compile and Submit SECTION 2	75%	1 wk	7/25	7/29
		Field Visit & Workshop	**0%**	**0 days**	**7/28**	**7/28**
		SECTION 3. Existing Conditions	90%	6 wks	6/27	8/3
✓		Sources of Flooding	100%	15 days	7/18	8/5
✓		Rain Data - Gauges / NWS / NOAA	100%	3 wks	6/27	7/15
✓		Topography	100%	3 wks	6/27	7/15
✓		Water Quality Considerations	100%	3 wks	6/27	7/15
✓		Field Study Results	100%	6 days	7/29	8/5
✓		USGS Web Soil Survey	100%	3 wks	6/27	7/15
		Future Conditions - Environmental	90%	15 days	7/18	8/5
		Future Conditions - Land Use	90%	15 days	7/18	8/5
		Compile and Submit SECTION 3	90%	5 days	8/1	8/5
		SECTION 4. Model Development	40%	12 wks	8/8	10/28
✓		Hydrologic Model Set up	100%	3 wks	8/8	8/26
✓		Existing Conditions Model Development Set up	100%	3 wks	8/15	9/2
		10 year 24 hour Flood Scenario	40%	1.6 wks	9/5	9/14
		100 year 24 hour Flood Scenario	40%	1.6 wks	9/15	9/26
		2050 Expected Conditions	20%	1.6 wks	9/27	10/6
		2100 Expected Conditions	0%	1.6 wks	10/3	10/12
		Risk Assessment - Flood Scenario Extents	0%	30 days	9/5	10/14
		Vulnerability Analysis	10%	28 days	9/14	10/21
		Flood Mitigation with Nature Based Solutions	0%	28 days	9/14	10/21
		Compile and Submit SECTION 4	0%	3 wks	10/10	10/28
		SECTION 5. Flood Mitigation Strategy & Stormwater Recommendatio	20%	9 wks	10/3	12/2
		Improvement Actions	20%	7 wks	10/3	11/18
		Implementation Schedule	0%	2 wks	11/14	11/25
		Compile and Submit SECTION 5	0%	1 wk	11/28	12/2
		August Stakeholder Meeting	**0%**	**0 days**	**8/25**	**8/25**
		September Stakeholder Meeting	**0%**	**0 days**	**9/22**	**9/22**
		October Stakeholder Meeting	**0%**	**0 days**	**10/20**	**10/20**
		Novemer Stakeholder Meeting	**0%**	**0 days**	**11/17**	**11/17**



4

Other Items to Address

- Document Progress
- Outreach & StoryMap
  - Methodology and Findings



Zekiah Watershed Urban Flood Analysis

Section 1: Purpose and Study Area

Charles County, Maryland is experiencing flooding outside mapped floodplains with increasing frequency, including both nuisance and urban flooding. Nuisance flooding is associated with high tides that flow back through the stormwater system, increasing/raising the level of groundwater, and overtopping the banks and edge of waterways. Nuisance flooding is an indicator of rising water levels in the Chesapeake Bay and its tributaries. Areas that were previously dry now flood during high tides because the water elevation is high enough to lap over the banks of waterways and to enter stormwater systems through outfalls that were previously high enough to prevent backflow, while allowing outflow. Urban flooding is due to a variety of issues related to development increased impervious surface, disruption of natural watershed flows and functions, undersized and aged stormwater infrastructure, and changing weather patterns which exacerbate the inadequacies of older stormwater systems and the fragmented watersheds. Urban flooding reflects decades of development that has outstripped the capacity of stormwater infrastructure and disrupted the natural flow and discharge of watersheds. Additionally, many stormwater systems are beyond their expected useful life and in need of repair and replacement.

To further explore these challenges, forty-eight locations were identified and prioritized for additional analysis and flood risk reduction solutions were identified in the 2020 CHARLES COUNTY NUISANCE & URBAN FLOOD PLAN. Three of the identified locations are within the Zekiah Watershed have been targeted for further analysis.

1. **Industrial Park Drive and Post Office Road Intersection**

   Unnamed tributary enters a culvert north of Post Office Road and exits into channel north of the Southern MD Workforce Services property. Dense urban area associated with MD 301 up-stream leads to high volumes of runoff during rain events. Excessive flows will typically top the culvert on the north side of Post Office Drive and flood the intersection and then discharge into the channel on the south side. Also, a large controlled SWMP is located upstream. Note: This may be related to site #10, Piney Branch Wetland.

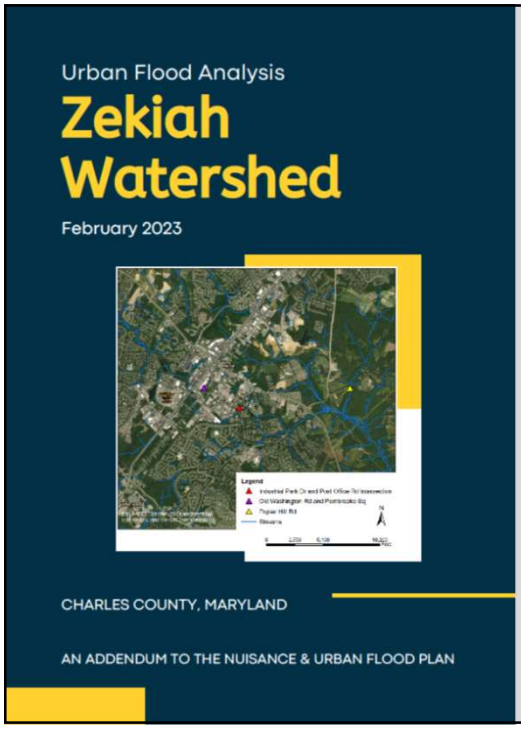
2. **Old Washington Road and Pembrooke Square**

   Old Washington Road and Pembrooke Square flood due to stormwater issues and impervious surface. A tributary to the Piney Branch may also be a possible flood source. Conveyance is poor across MD 925 Old Washington Rd and downstream that leads to backups and topping of swale.

3. **Poplar Hill Road between Peters Church Road & Mattawoman and Beantown Road**

   Low section in the road with a culvert running under roadway. Stormwater issues cause roadway flooding.

5



Urban Flood Analysis

Zekiah Watershed

February 2023

Legend

CHARLES COUNTY, MARYLAND

AN ADDENDUM TO THE NUISANCE & URBAN FLOOD PLAN

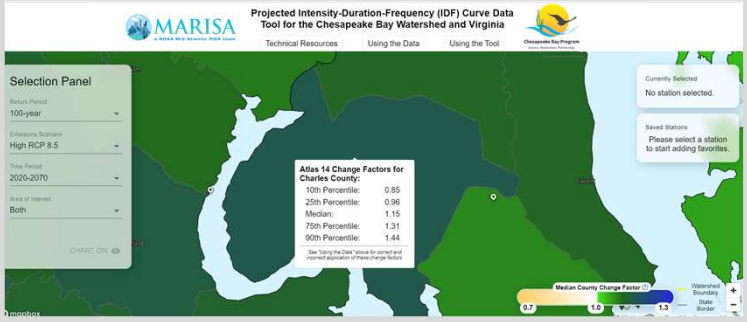
Model Updates

6

Precipitation Data for Charles County

Storm Event	Atlas 14 Precip. (in.)	% Change for 2050	Projected Precip. 2050 (in.)	% Change for 2100	Projected Precip. (2100) (in.)
25 year	6.31	12	7.07	19	7.51
100 year	8.70	15	10.01	21	10.53

- Table developed using Maryland's Stormwater Management Climate Change Action Plan (A-StoRM) A-StorRMreport.pdf (maryland.gov)



Mid-Atlantic IDF Curve Tool (rcc-acis.org)

7

Old Washington Road and Shoppers World (Previously Pembrook Square)

- **Hydrology**
  - **HEC-HMS used to obtain Type II rainfall distribution for each event (six events total) to model in SWMM.**
- **EPA's Stormwater Management Model (SWMM) Version 5.2**
  - **Curve Number Method**
  - **Subcatchment flow directed to inlets, conduits, and streams/ditches**
  - **Proposed BMPs will be modeled as storage units or LID controls**
- **Risk Assessment**
  - **Poor channel conveyance and undersized pipe under Old Washington Road (24" CMP) backing up over the roadway**
  - **Insufficient drainage to capture overflow in parking lot at the low points**

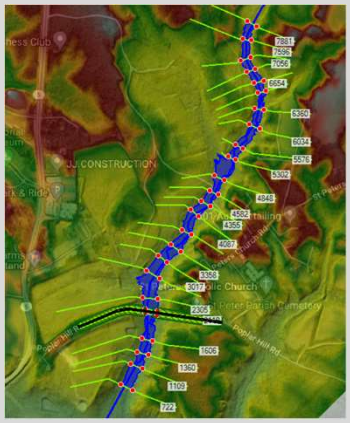
8

Industrial Park Drive and Post Office Rd Intersection

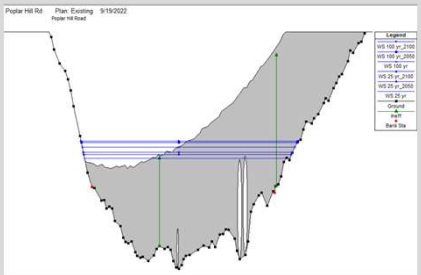
- **Hydrology**
  - **HEC-HMS used to obtain Type II rainfall distribution for each event (six events total) to model in SWMM.**
- **EPA's Stormwater Management Model (SWMM) Version 5.2**
  - **Curve Number Method**
  - **Subcatchment flow directed to inlets, conduits, and streams**
  - **Proposed BMPs will be modeled as storage units or LID controls**
- **Risk Assessment**
  - **Flooding occurring at roadway inlets J4 and J7 (Industrial Drive) due to capacity issues**
  - **Flooding also occurring at J1 (18" HDPE) under industrial park Drive**

9

Poplar Hill Road between St. Peters Church Road & Mattawoman Beantown Road



- **Hydrology**
  - **Hydrographs 2004 used to obtain flow data for each event (six events total)**
- **Hydraulics**
  - **HEC-RAS Version 6.2 (1-D Steady State)**
  - **Both CMP and HDPE culverts are modeled**
- **Risk Assessment**
  - **Overtopping at low point of roadway crossing**
  - **0-2' of depth over the roadway for all events**



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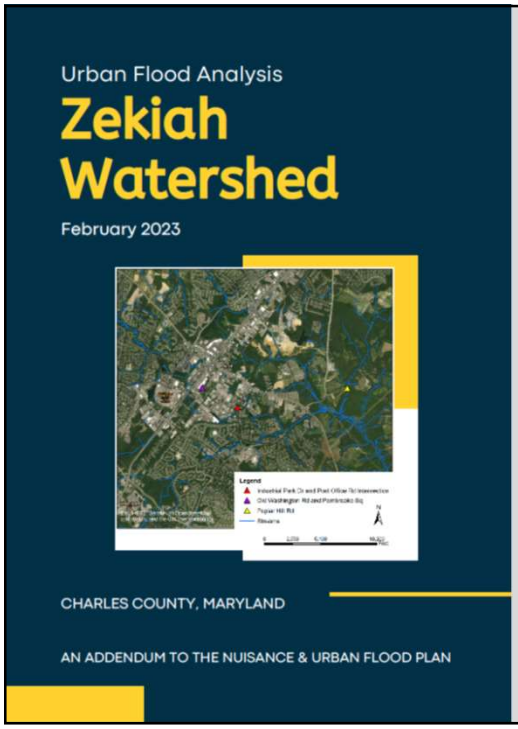
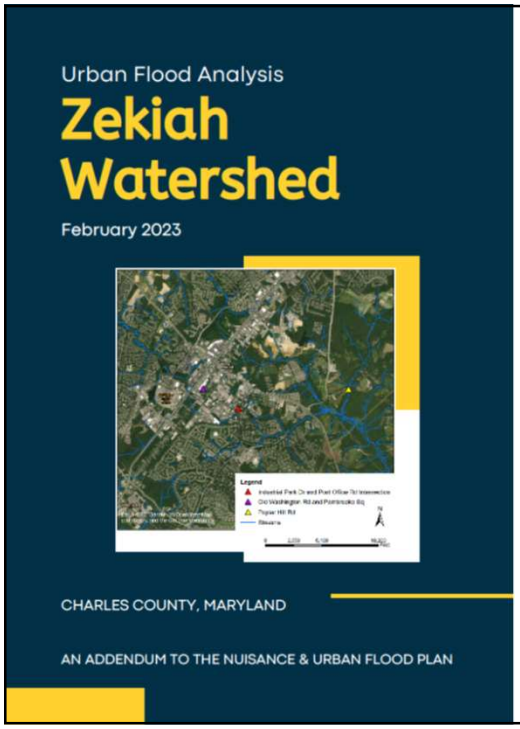


Next Steps

- Hold Steering Committee Meeting to Present Vulnerability Analysis
- Refine Improvement Actions & Develop Implementation Schedule
- Modify StoryMap to Include Methodology & Findings of Study
  - Types of BMPs
  - Proposed pipe sizes
  - Channel/Ditch Restoration
  - Design Storm feasible to address flooding
    - Current design storm ~25 year
- Compile Findings in Report and Present to County for Approval

11

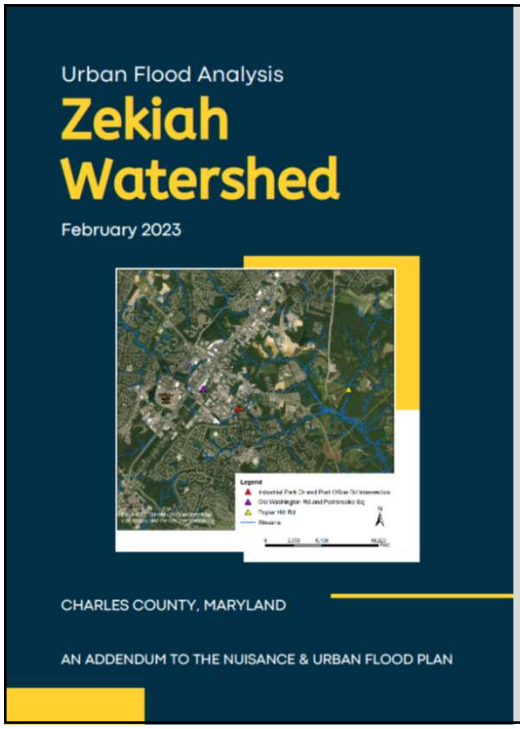


Zekiah Watershed Study
Current and Future Conditions

November 29, 2022

Virtual

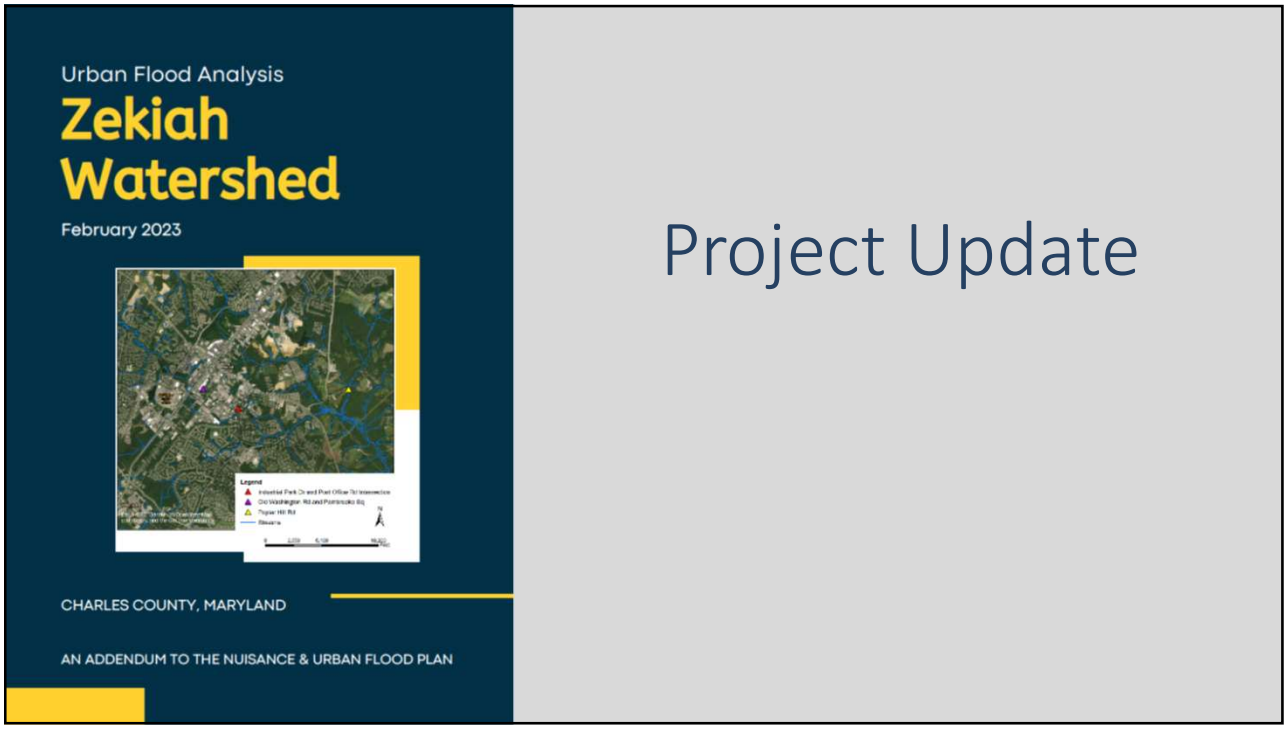
1



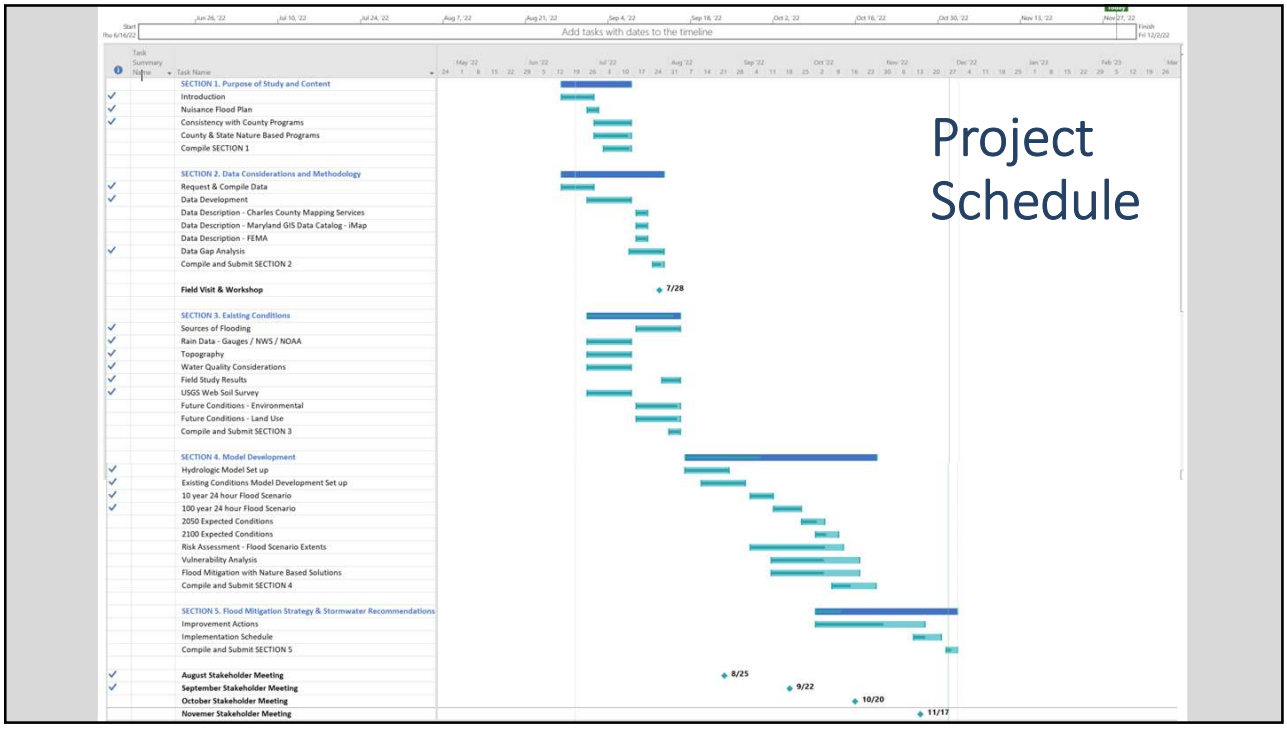
Agenda

- Project Update
  - Schedule
  - StoryMap
- Model Updates
- Next Steps

2


Urban Flood Analysis
Zekiah Watershed
February 2023
CHARLES COUNTY, MARYLAND
AN ADDENDUM TO THE NUISANCE & URBAN FLOOD PLAN
Project Update

3


Project Schedule
Add tasks with dates to the timeline
SECTION 1. Purpose of Study and Content
Introduction
Nuisance Flood Plan
Consistency with County Programs
County & State Nature Based Programs
Compile SECTION 1
SECTION 2. Data Considerations and Methodology
Request & Compile Data
Data Development
Data Description - Charles County Mapping Services
Data Description - Maryland GIS Data Catalog - iMap
Data Description - FEMA
Data Gap Analysis
Compile and Submit SECTION 2
Field Visit & Workshop
7/28
SECTION 3. Existing Conditions
Sources of Flooding
Rain Data - Gauges / NWS / NOAA
Topography
Water Quality Considerations
Field Study Results
USGS Web Soil Survey
Future Conditions - Environmental
Future Conditions - Land Use
Compile and Submit SECTION 3
SECTION 4. Model Development
Hydrologic Model Set up
Existing Conditions Model Development Set up
10 year 24 hour Flood Scenario
100 year 24 hour Flood Scenario
2050 Expected Conditions
2100 Expected Conditions
Risk Assessment - Flood Scenario Extents
Vulnerability Analysis
Flood Mitigation with Nature Based Solutions
Compile and Submit SECTION 4
SECTION 5. Flood Mitigation Strategy & Stormwater Recommendations
Improvement Actions
Implementation Schedule
Compile and Submit SECTION 5
August Stakeholder Meeting
8/25
September Stakeholder Meeting
9/22
October Stakeholder Meeting
10/20
Novemer Stakeholder Meeting
11/17

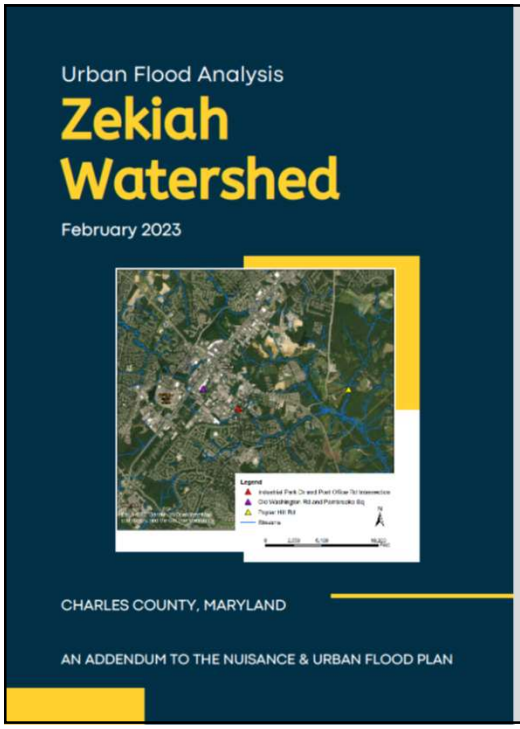
4

Other Items to Address

StoryMap - Include Methodology & Findings of Study

- **Types of BMPs**
- **Proposed pipe sizes**
- **Channel/Ditch Restoration**
- **Design Storm feasible to address flooding**
- **Current design storm ~25 year**

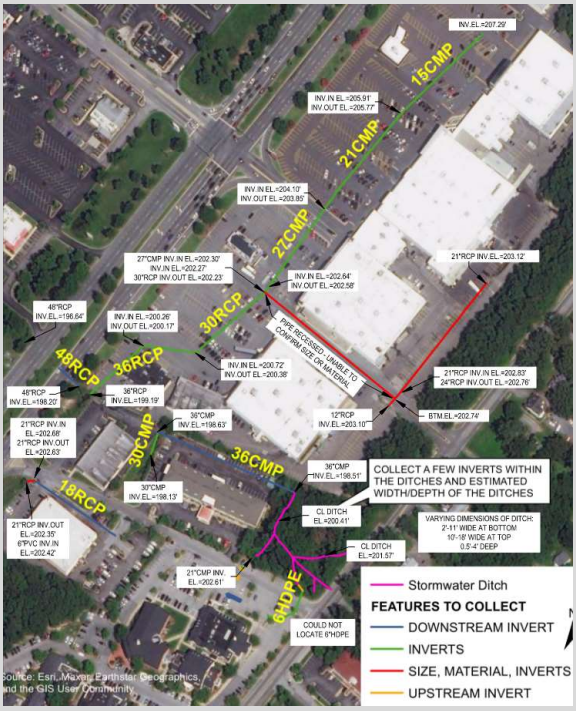
5



Model Updates

6

Old Washington Road and Shoppers World (Previously Pembrook Square)



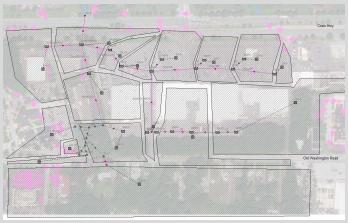
7

Old Washington Road and Shoppers World

- Alternative
  - Alternative 1: No Build
    - Does not address project need
  - Alternative 2: Drainage System Improvements
    - Upsizing to meet the 25 year will flood out the basin downstream
  - **Alternative 3: Drainage System Improvements, restore portion of lot to pervious, add GI and/or underground Detention**
    - **Replace corroded CMP with RCP/HDPE**
    - **Addresses the 25-year current and future conditions, will not flood basin**
  - Alternative 4: Drainage System Improvements, Add GI and/or Underground Detention
    - Addresses the 25-year current and future conditions, will not flood basin
  - Alternative 5: Drainage System Improvements, Add GI, and Install Pump Station
    - Addresses the 25-year current and future conditions, most costly option, will not flood basin
- Cost Estimates
  - Alternative 1: N/A
  - Alternative 2: $1,170,000
  - **Alternative 3: $1,480,000**
  - Alternative 4: $1,450,000
  - Alternative 5: $1,940,000

8

Old Washington Road and Shoppers World



- Model Results

Inlet at low point of Lot

Storm Event	Existing Node Inflow (cfs)	Existing Node Depth (ft)	Proposed Node Inflow (cfs)	Proposed Node Depth (ft)
25-Year	30.40	4.39	17.45	3.74
25-Year (2050)	34.39	4.46	19.08	3.79
25-Year (2100)	36.78	4.50	19.67	3.81
100-Year	43.26	4.60	20.79	3.84
100-Year (2050)	50.57	4.70	20.84	3.84
100-Year (2100)	53.58	4.74	20.74	3.84

Existing Basin

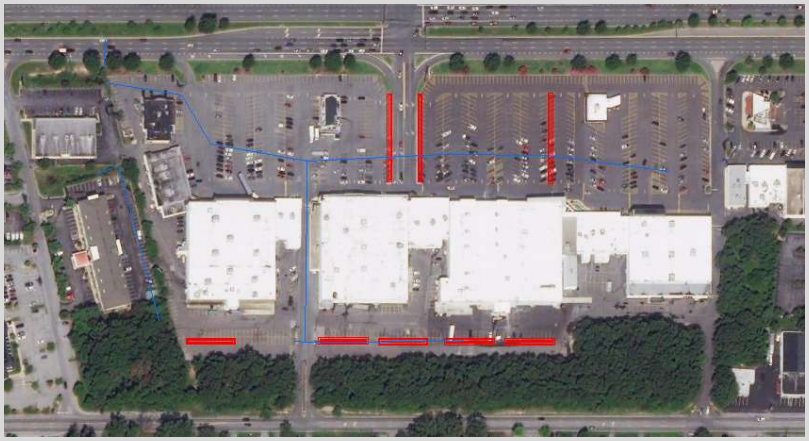
Storm Event	Existing Node Inflow (cfs)	Existing Node Depth (ft)	Proposed Node Inflow (cfs)	Proposed Node Depth (ft)
25-Year	145.41	3.16	140.54	3.06
25-Year (2050)	151.79	3.30	148.54	3.20
25-Year (2100)	155.94	3.46	151.05	3.28
100-Year	165.62	3.72	160.83	3.59
100-Year (2050)	170.94	3.92	167.30	3.78
100-Year (2100)	172.62	4.02	170.40	3.86

Outfall to Piney Branch

Storm Event	Existing Node Inflow (cfs)	Existing Node Depth (ft)	Proposed Node Inflow (cfs)	Proposed Node Depth (ft)
25-Year	143.27	3.16	138.45	3.06
25-Year (2050)	148.63	3.28	145.35	3.20
25-Year (2100)	149.64	3.59	148.49	3.28
100-Year	161.61	3.68	156.15	3.64
100-Year (2050)	165.77	3.70	163.46	3.69
100-Year (2100)	165.65	3.70	165.27	3.69

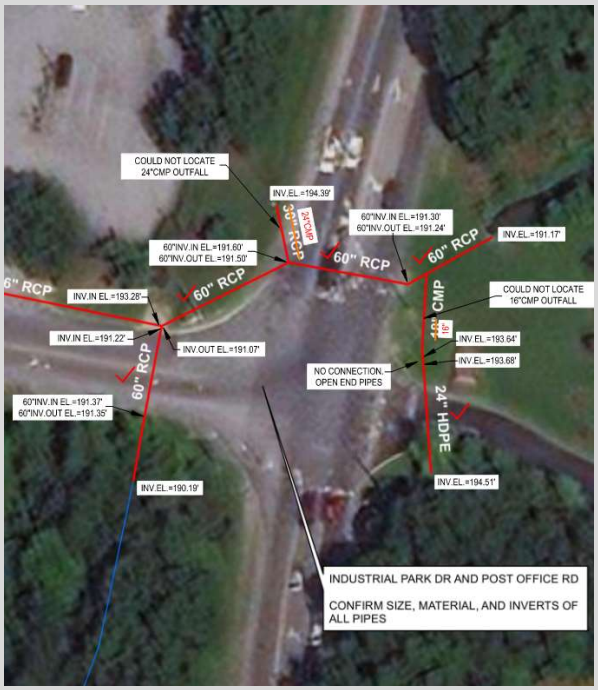
9

Old Washington Road and Shoppers World



10

Industrial Park Drive and Post Office Rd Intersection



11

Industrial Park Drive and Post Office Rd Intersection

- Alternative
  - Alternative 1: No Build
    - Does not address project need
  - Alternative 2: Drainage System Improvements; replace 60" RCP with dual 48" RCP
    - Will Increase downstream flooding
  - Alternative 3: Drainage System Improvements; replace 60" RCP with 58" x 91" RCEP
    - Will Increase downstream flooding
  - Alternative 4: Drainage System Improvements; replace 60" RCP with dual 48" RCP and add GI
    - Addresses the 25-year current and future conditions, will help mitigate downstream flooding
  - **Alternative 5: Drainage System Improvements; replace 60" RCP with 58" x 91" RCEP and add GI**
    - **Addresses the 25-year current and future conditions, will help mitigate downstream flooding**
- Cost Estimates
  - Alternative 1: N/A
  - Alternative 2: $1,020,000
  - Alternative 3: $960,000
  - Alternative 4: $1,090,000
  - **Alternative 5: $1,020,000**

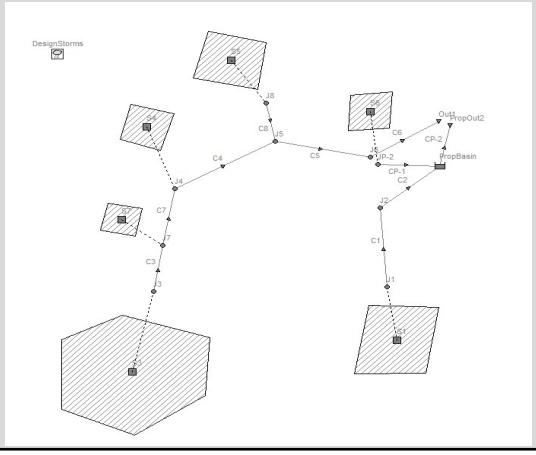
12

Industrial Park Drive and Post Office Rd Intersection

- Model Results

Downstream Headwall

Storm Event	Existing Max Total Node Inflow (cfs)	Existing Max Node Depth (ft)	Proposed Node Inflow (cfs)	Proposed Node Depth (ft)
25-Year	149.76	3.51	335.37	4.97
25-Year (2050)	166.54	3.70	340.70	5.01
25-Year (2100)	177.83	3.82	343.49	5.03
100-Year	202.37	4.06	346.40	5.05
100-Year (2050)	203.08	4.06	346.40	5.05
100-Year (2100)	203.20	4.06	346.40	5.05

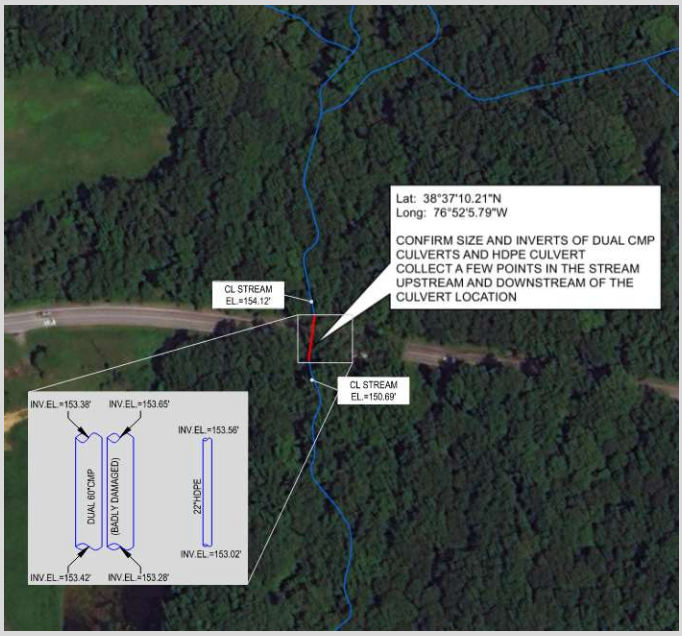


13

Industrial Park Drive and Post Office Rd Intersection

14

Poplar Hill Road between St. Peters Church Road & Mattawoman Beantown Road



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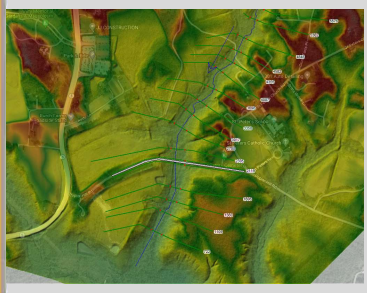
Poplar Hill Road between St. Peters Church Road & Mattawoman Beantown Road



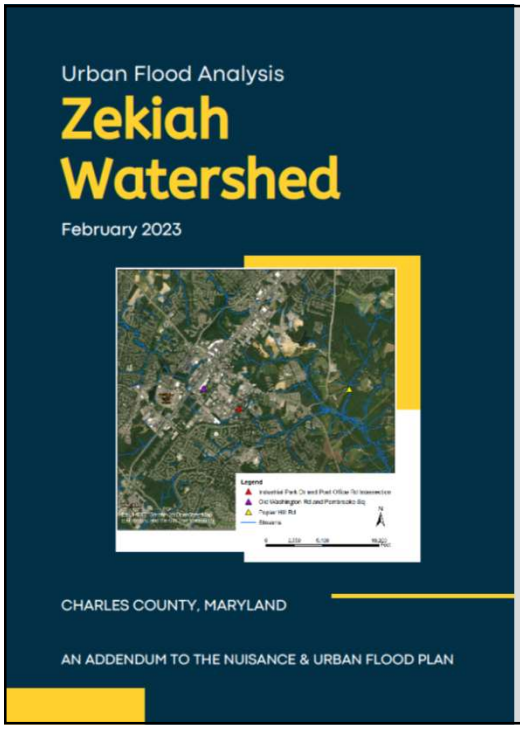
- Alternative
  - Alternative 1: No Build
    - Does not address project need
  - Alternative 2: Replace dual 60" CMP with dual 60" RCP and restore stream
    - Does not meet the 25-year event
  - Alternative 3: Replace dual 60" CMP with dual 60" RCP, raise the roadway profile, and restore stream
    - Most costly option, would require a profile raise of 2-3'
  - **Alternative 4: Replace dual 60" CMPs with dual 72" RCP, replace 22" HDPE with 36" HDPE, restore stream**
    - **Addresses the 25-year current and future conditions**
  - Alternative 5: Replace dual 60" CMP with single 10'x5' reinforced concrete box culvert, restore stream
    - Does not address the 25-year event
- Cost Estimates
  - Alternative 1: N/A
  - Alternative 2: $960,000
  - Alternative 3: $1,020,000
  - **Alternative 4: $980,000**
  - Alternative 5: $1,120,000

Existing and Proposed Water Surface Elevations Upstream of Poplar Rd. (Alternative 4)

Storm Event	Existing WSEL (ft)	Proposed WSEL (ft)
25-Year	159.14	157.75
25-Year (2050)	159.33	158.26
25-Year (2100)	159.46	158.55
100-Year	159.75	159.31
100-Year (2050)	160.01	159.53
100-Year (2100)	160.10	159.64

*Roadway Elevation Low Point: 158.7'

16



Next Steps

- **Hold Steering Committee Meeting to Present Vulnerability Analysis**
- **Refine Improvement Actions & Develop Implementation Schedule**
- **Modify StoryMap to Include Methodology & Findings of Study**
- **Compile Findings in Report and Present to County for Approval**

17

Attachment 2
DESCRIPTION OF DATA

Description of Data

- Extents of flooding, inundation areas and historic anticipated damages
  - The State's Sea Level Rise Vulnerability layers can be viewed as a service from MD's GIS Data catalog at https://data.imap.maryland.gov/. Just search for "Sea Level Rise".
  - If the Flood Plain is needed that can also be viewed as a service or downloaded from the above site, just search for "Flood Plain".
  - Other online sources include: https://mdfloodmaps.net/ or https://www.fema.gov/flood-maps/products-tools/products
  - Emergency Services may also have related data.
- Stormwater Infrastructure
  - PGM to provide the following GIS datasets: Streams, Streams_Hydrojunctions, swBMP, swCulvert, swDrainAreas, swEasements, swPipes, swStructures, and swVirtualDrainline.
- Models – DFIRM RiskMAP
  - PGM to provide DFIRM RiskMAP that we received with the 2015 comprehensive update to the Floodplain Maps, if available or can be obtained.
- Utilities/ROW
  - Water and sewer data would come from Utilities. Pat Anderson (Engineer II) with Utilities is the contact (301-609-5644, andersop@charlescountymd.gov).
  - PGM to provide GIS Parcel Data, from which ROW can be obtained.
- Topography – date of latest topography
  - The latest topography is 2014, 2 foot. We also have 1 foot raw data for 2014. Next LiDAR will be flown in 2023.
  - PGM to provide 2014, 2 foot topography.
- Supplemental survey data for: (1) Old Washington Road behind Waldorf Shoppers World/Burlington Coat Factory, (2) Intersection of Industrial Park Drive/Post Office Road, and (3) Poplar Hill Road between St. Peters Church Road & Mattawoman Beantown Road
  - PGM does not have supplemental survey data.

Attachment 3
FIELD VISIT SUMMARIES

Field Visit Summaries

Old Washington Road and Pembrooke Square

Observed:

- Only two inlets in back parking area- inlets are shallow
- Trash /debris sediment apparent inlets at low area
- Parking lot is flat and drainage system likely no pitch
- Streams/ditches adjacent to parking area have stagnant water – no pitch
- Culverts downstream look pretty clear but likely aren't getting enough flow
- Some overgrowth in the culvert area

Potential Recommendations:

- (ROW to be considered) Grade parking area
- Regrades ditches and stabilize to convey flow
- Resize pipes as feasible and pitch to convey positive flow
- Consider providing green infrastructure/stormwater storage in unused portions of parking area (pending ROW)

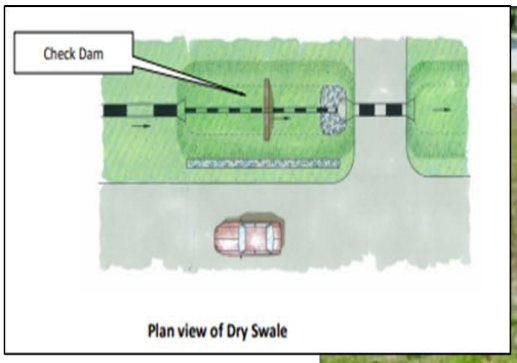
Industrial Park Drive and Post Office Road Intersection

Observed:

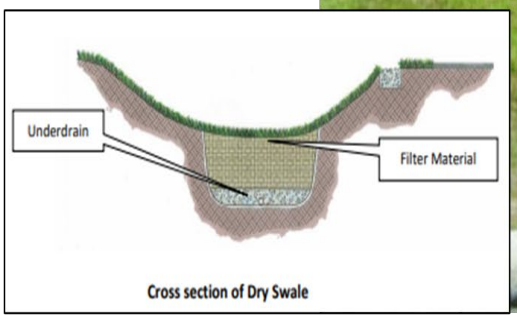
- Culvert at low point appears clear.
- Large drainage area believed to drain to low point. Potentially coming from surrounding new development and upstream.
- No significant erosion apparent
- Capacity of system is likely large part of this issue

Potential Recommendations:

- Investigate increasing capacity of existing culvert and adjacent drainage system
- Provide storage by adding a basin on downstream culvert at intersection
- Add rip rap and grade off the roaday with curb open to allow flow over rip rap to basin



Plan view of Dry Swale



Cross section of Dry Swale

Poplar Hill Road between St. Peters Church Road & Mattawoman Beantown Road

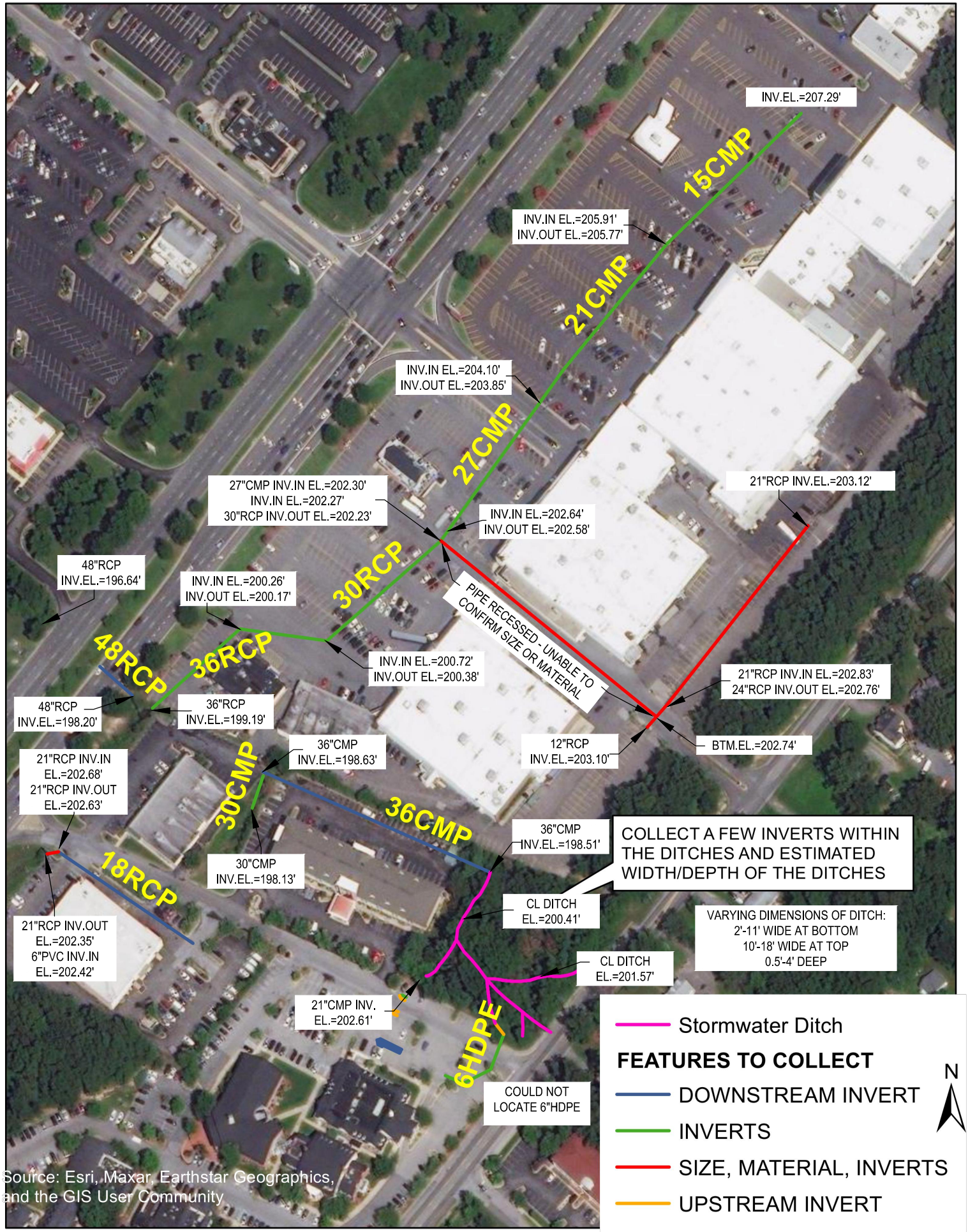
Observed:

- New one (2 HDPE pipes) at what appears to be the most low lying point- riprap in area and scour hole appeared to form flow on downstream ends seems to pond a bit
- On upstream end of the HDPE appears to be overgrowth
- Another appears to be original- 2 CMPs both deformed but one crushed on downstream outlet
- Also downstream appears to have no direct connection to downstream ditch
- On upstream end of CMPs there is a large tree completely blocking one opening

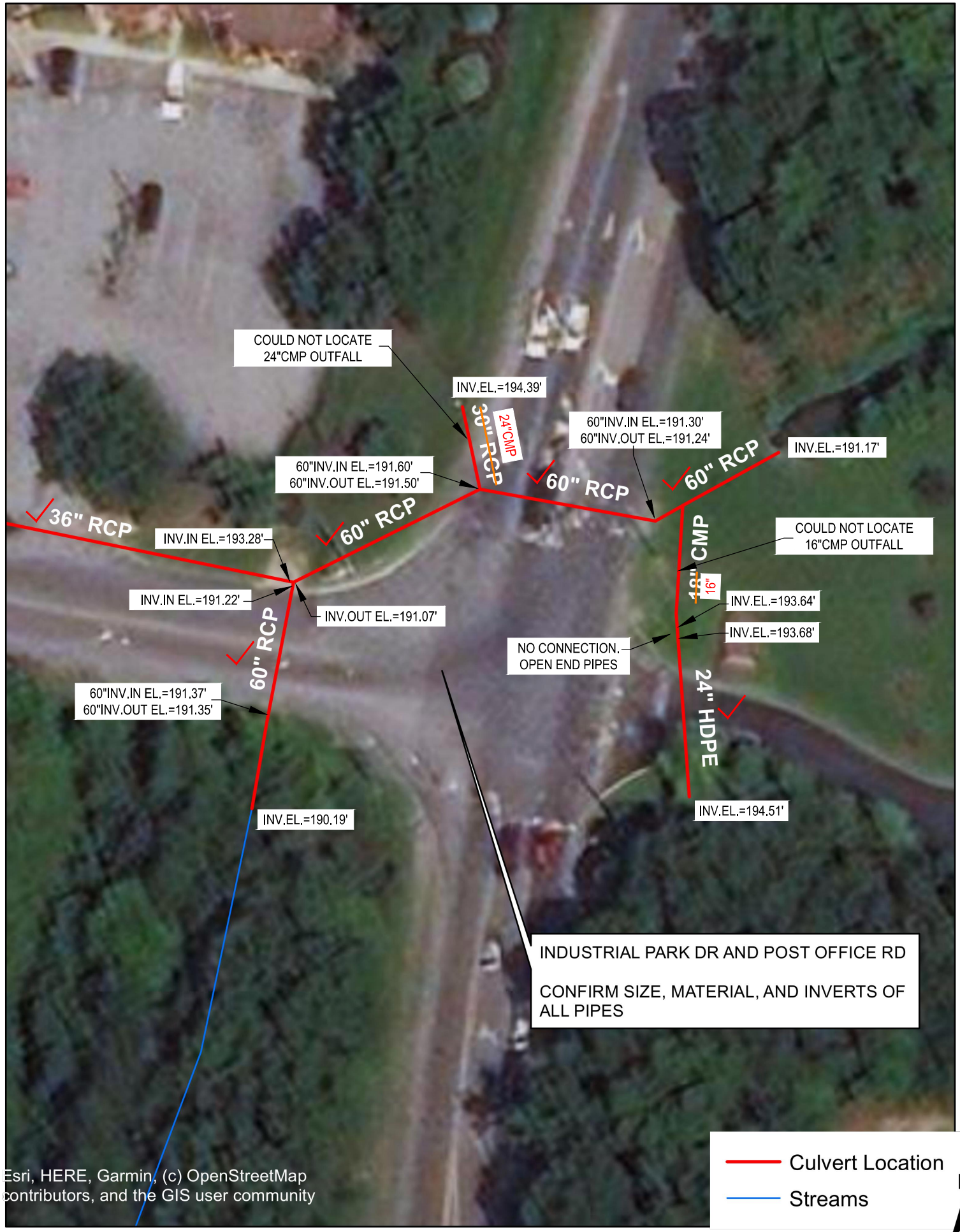
Potential Recommendations

- Replace CMP pipes
- Clear vegetation and remove tree blocking
- Considering additional slope stabilization and gabion on side slopes
- Channelize both downstream ends to flow to downstream ditch

Attachment 4
EXISTING DRAINAGE MAPS & STORMWATER INVENTORY



FIELD SURVEY ELEVATIONS COLLECTED BY MES SURVEY.
SURVEY DATE: 10/19/2022
VERTICAL DATUM: NAVD88



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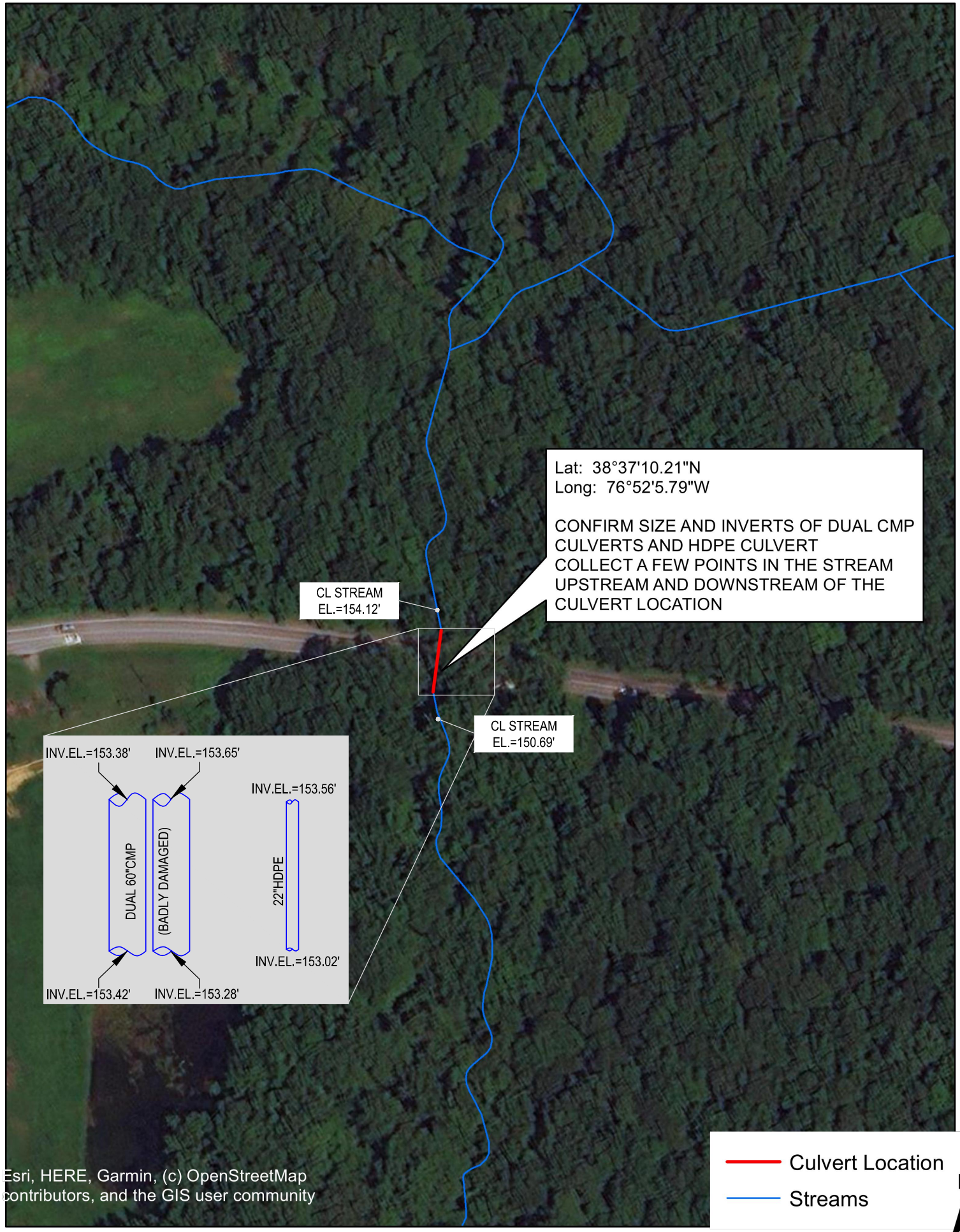

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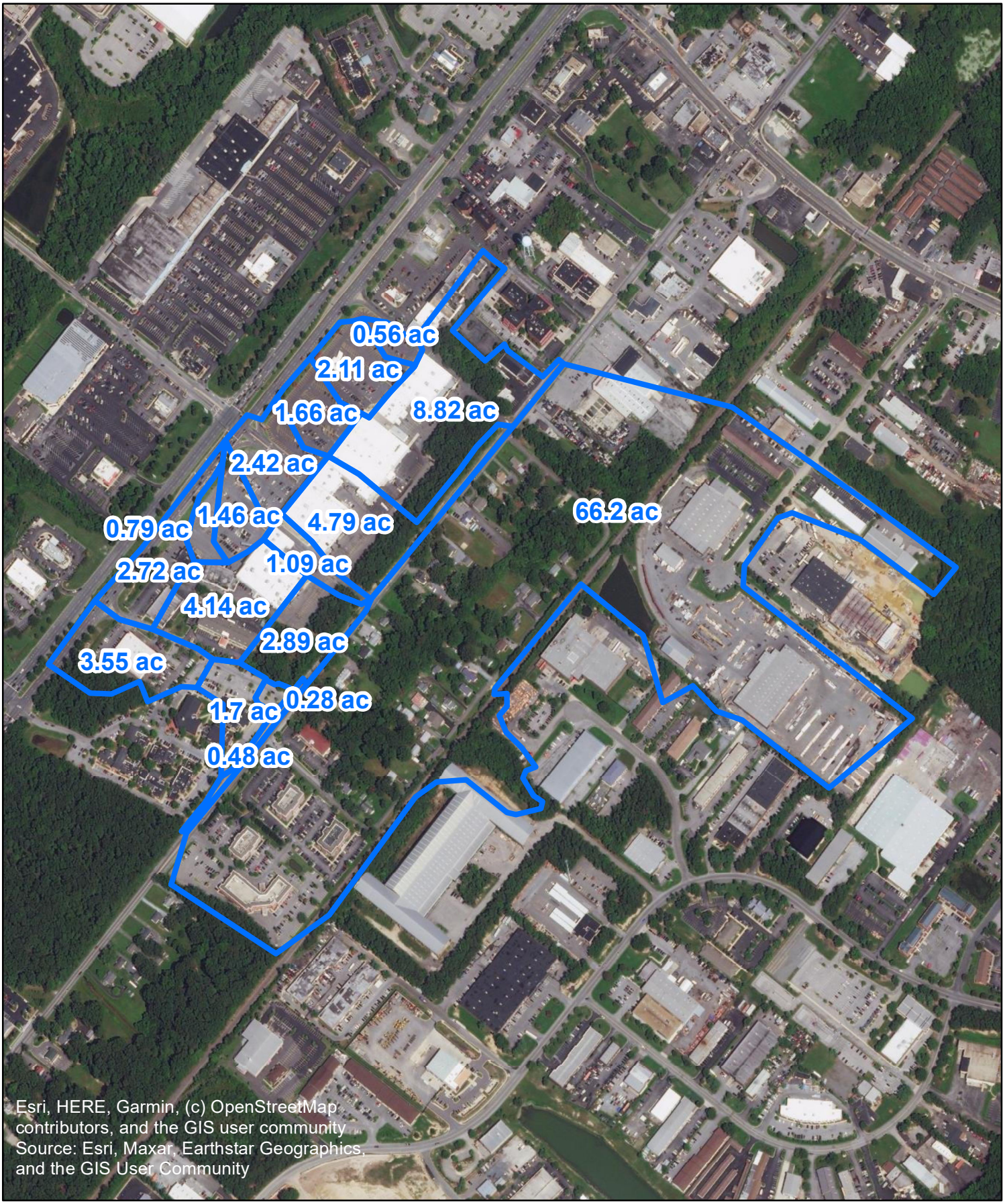

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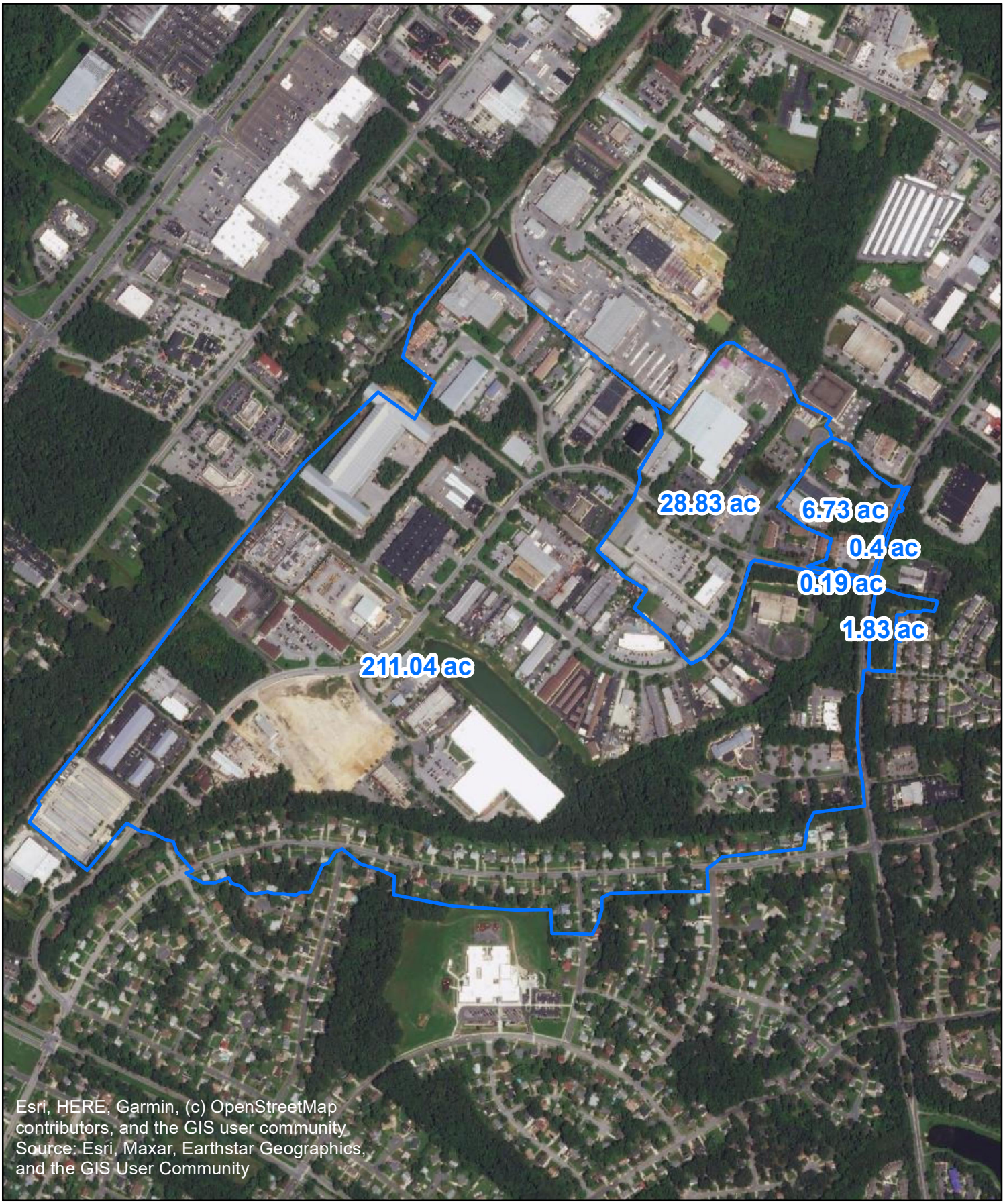
Charles County Zekiah Watershed Study
Location 10: Old Washington Rd at Shoppers World
Drainage Area Map



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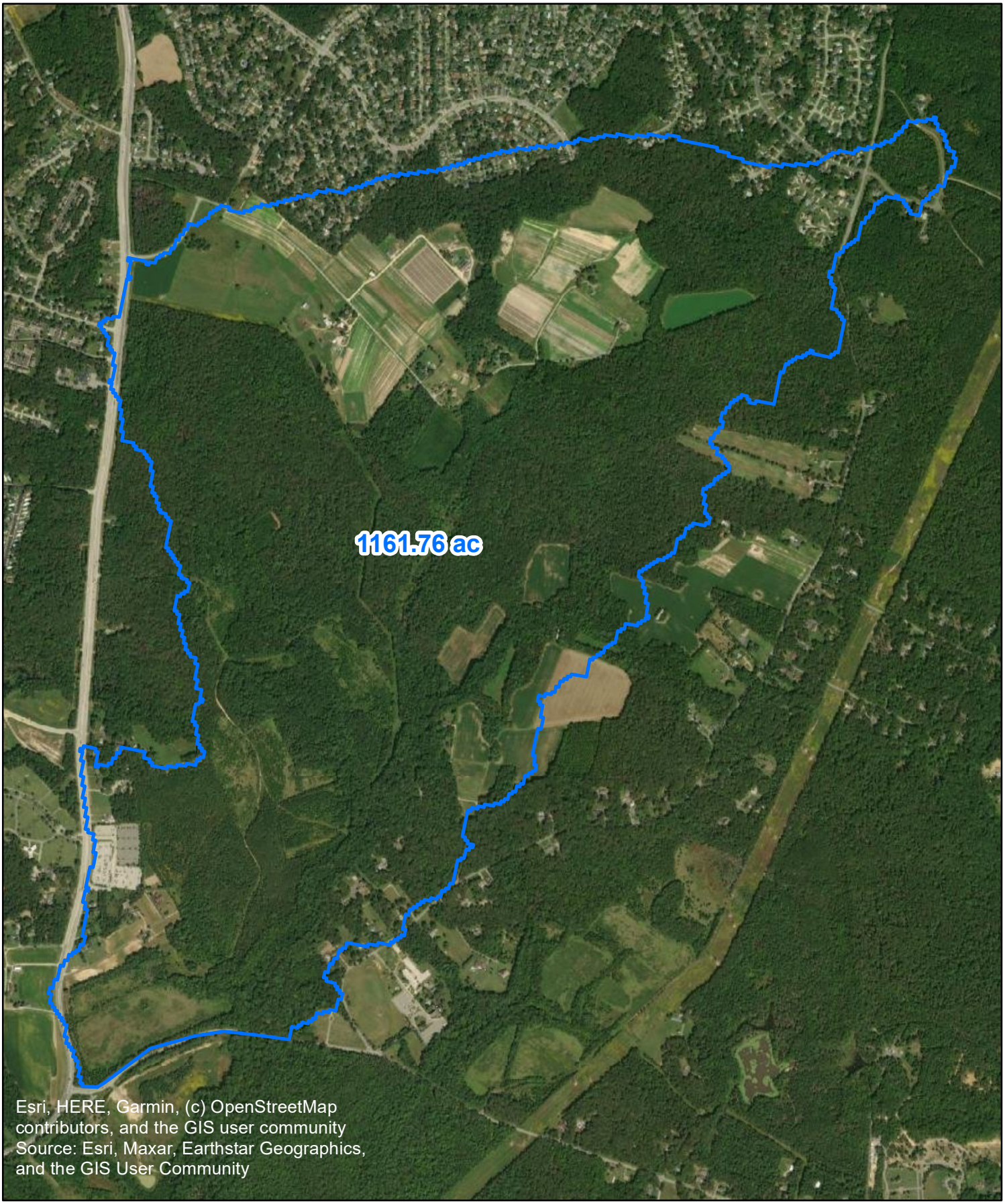
Charles County Zekiah Watershed Study
Location 12: Industrial Park Drive and Post Office Road
Drainage Area Map



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Charles County Zekiah Watershed Study
Location 24: Poplar Hill Road
Drainage Area Map

Maryland Department of Planning Land Use/Land Cover Classification Definitions

Urban Land Uses

11 Low-density residential - Detached single-family/duplex dwelling units, yards and associated areas. Areas of more than 90 percent single-family/duplex dwelling units, with lot sizes of less than five acres but at least one-half acre (.2 dwelling units/acre to 2 dwelling units/acre).

12 Medium-density residential - Detached single-family/duplex, attached single-unit row housing, yards, and associated areas. Areas of more than 90 percent single-family/duplex units and attached single-unit row housing, with lot sizes of less than one-half acre but at least one-eighth acre (2 dwelling units/acre to 8 dwelling units/acre).

13 High-density residential - Attached single-unit row housing, garden apartments, high-rise apartments/condominiums, mobile home and trailer parks; areas of more than 90 percent high-density residential units, with more than 8 dwelling units per acre.
* subsidized housing

14 Commercial - Retail and wholesale services. Areas used primarily for the sale of products and services, including associated yards and parking areas. This category includes:
*Airports
*Welcome houses
*Telecommunication towers
*Boat Marinas

15 Industrial - Manufacturing and industrial parks, including associated warehouses, storage yards, research laboratories, and parking areas. Warehouses that are returned by a commercial query should be categorized as industrial. Also included are power plants.

16 Institutional - Elementary and secondary schools, middle schools, junior and senior high schools, public and private colleges and universities, military installations (built-up areas only, including buildings and storage, training, and similar areas), churches, medical and health facilities, correctional facilities, and government offices and facilities that are clearly separable from the surrounding land cover. This category includes:
*campgrounds owned by groups/community groups (ie girl scouts)
Sports venues

17 Extractive - Surface mining operations, including sand and gravel pits, quarries, coal surface mines, and deep coal mines. Status of activity (active vs. abandoned) is not distinguished.

18 Open urban land - Urban areas whose use does not require structures, or urban areas where non-conforming uses characterized by open land have become isolated. Included are golf courses, parks, recreation areas (except areas associated with schools or other institutions), cemeteries, and entrapped agricultural and undeveloped land within urban areas. When addressing parks, buildings are classified as 18 and ground cover is classified according to imagery.

191 Large lot subdivision (agriculture) - Residential subdivisions with lot sizes of less than 20 acres but at least 5 acres, with a dominant land cover of open fields or pasture.

192 Large lot subdivision (forest) - Residential subdivisions with lot sizes of less than 20 acres but at least 5 acres, with a dominant land cover of deciduous, evergreen or mixed forest.

Agriculture

21 Cropland - Field crops and forage crops.

22 Pasture - Land used for pasture, both permanent and rotated; grass.

23 Orchards/vineyards/horticulture - Areas of intensively managed commercial bush and tree crops, including areas used for fruit production, vineyards, sod and seed farms, nurseries, and green houses.

24 Feeding operations - Cattle feed lots, holding lots for animals, hog feeding lots, poultry houses, and commercial fishing areas (including oyster beds).

241 Feeding operations - Cattle feed lots, holding lots for animals, hog feeding lots, poultry houses.

242 Agricultural building breeding and training facilities, storage facilities, built-up areas associated with a farmstead, small farm ponds, and commercial fishing areas.

25 Row and garden crops - Intensively managed truck and vegetable farms and associated areas.

Forest

41 Deciduous forest - Forested areas in which the trees characteristically lose their leaves at the end of the growing season. Included are such species as oak, hickory, aspen, sycamore, birch, yellow poplar, elm, maple, and cypress. Note that forest classifications may not be reliable as to type (decidiouous versus evergreen).

42 Evergreen forest - Forested areas in which the trees are characterized by persistent foliage throughout the year. Included are such species as white pine, pond pine, hemlock, southern white cedar, and red pine. Note that forest classifications may not be reliable as to type (decidiouous versus evergreen).

43 Mixed forest - Forested areas in which neither deciduous nor evergreen species dominate, but in which there is a combination of both types.

44 Brush - Areas which do not produce timber or other wood products but may have cut-over timber stands, abandoned agriculture fields, or pasture. These areas are characterized by vegetation types such as sumac, vines, rose, brambles, and tree seedlings.

Water

50 Water - Rivers, waterways, reservoirs, ponds, bays, estuaries, and ocean.

Wetlands

60 Wetlands - Forested or non-forested wetlands, including tidal flats, tidal and non-tidal marshes, and upland swamps and wet areas.

Barren Land

70 Barren land

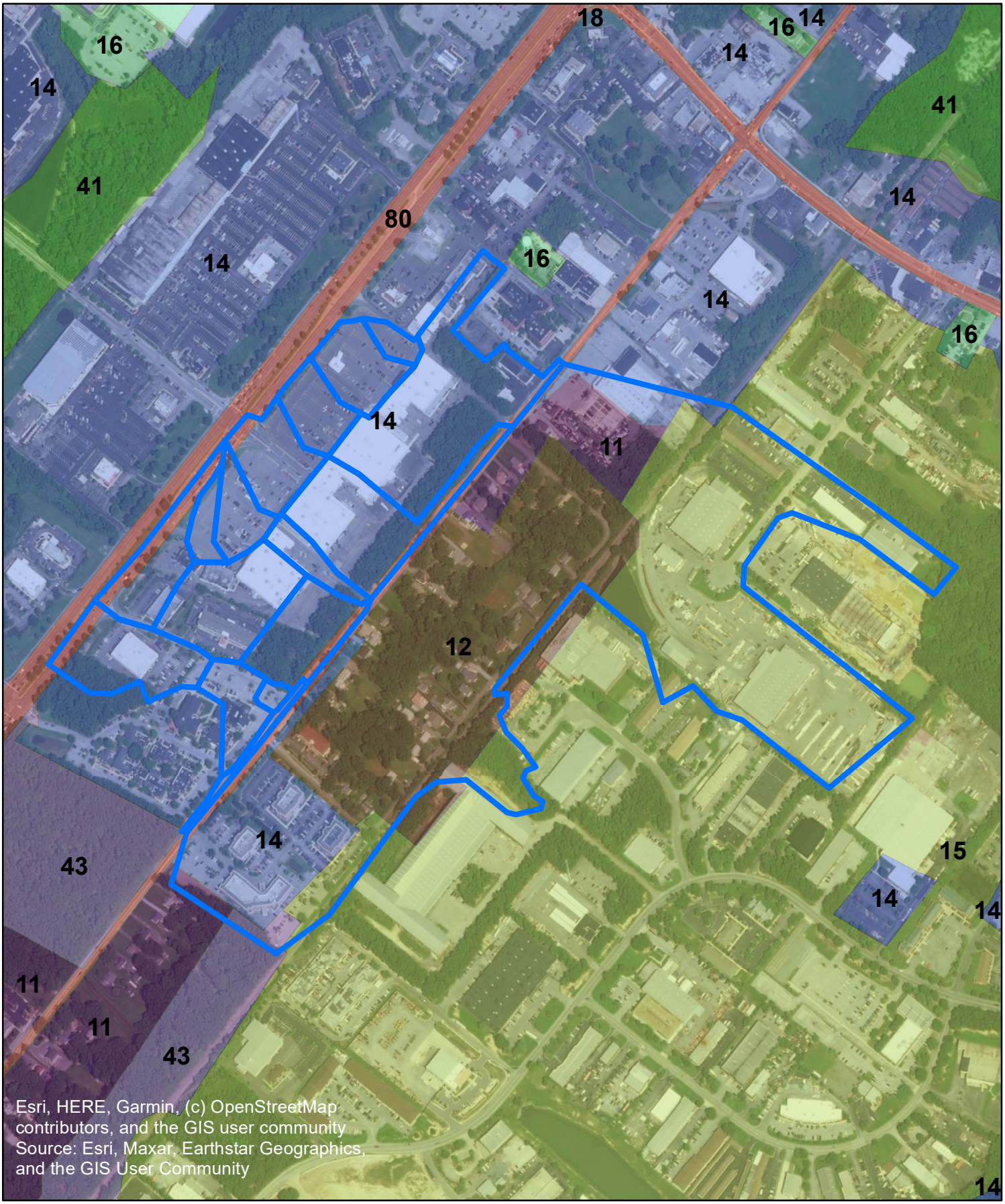
71 Beaches - Extensive shoreline areas of sand and gravel accumulation, with no vegetative cover or other land use.

72 Bare exposed rock - Areas of bedrock exposure, scarps, and other natural accumulations of rock without vegetative cover.

73 Bare ground - Areas of exposed ground caused naturally, by construction, or by other cultural processes. Landfills (cultural process) are included in this category

Transportation

80 Transportation - Transportation features include major highways, light rail or metro stations and large “Park ‘N Ride” lots, generally over ten acres in size. Major highways were defined a those appearing on the State Highway maps as Controlled Access Highways or Primary Highways



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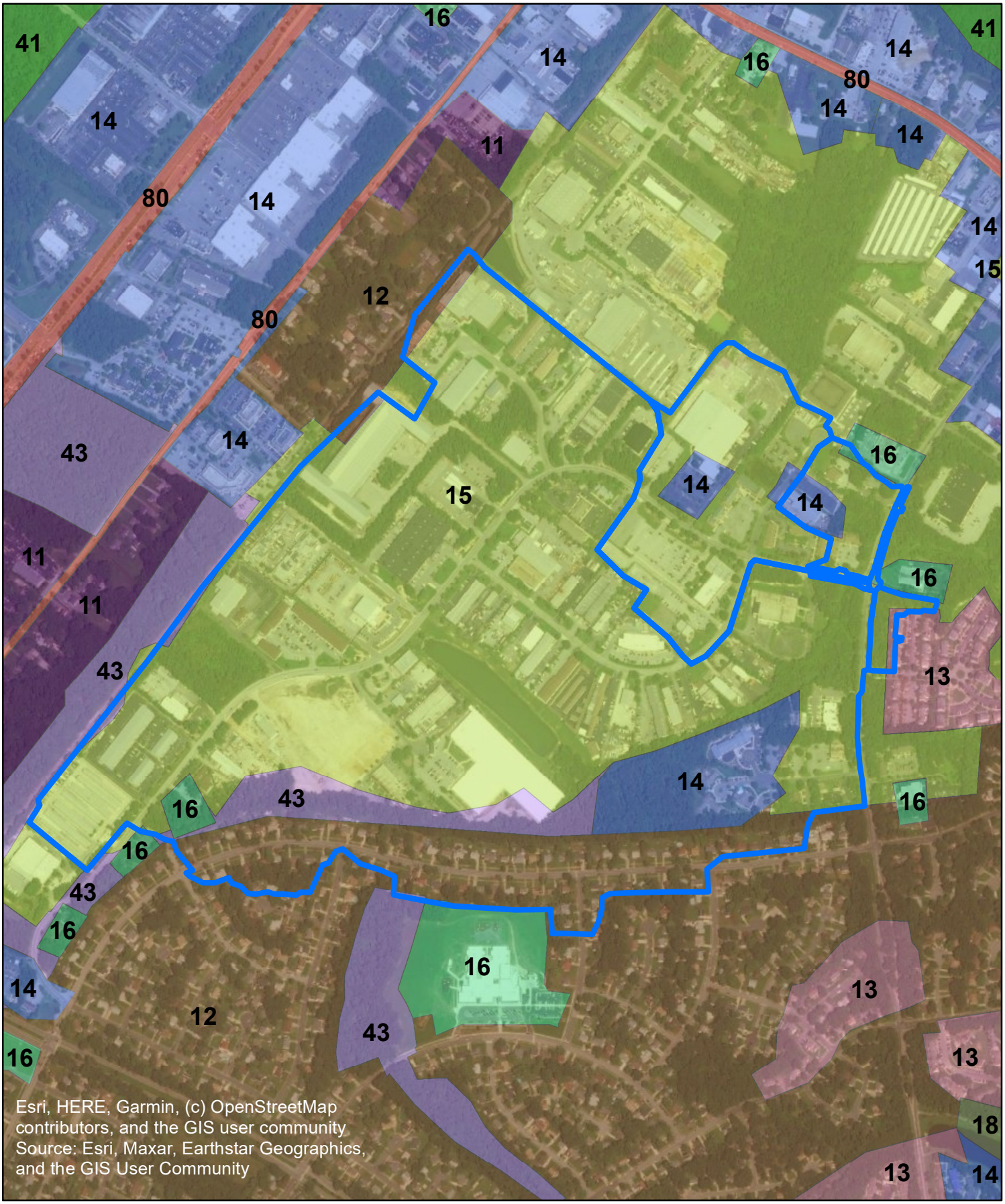
0 375 750 1,500 Feet

Charles County Zekiah Watershed Study
Location 10: Old Washington Rd at Shoppers World
Landuse Map



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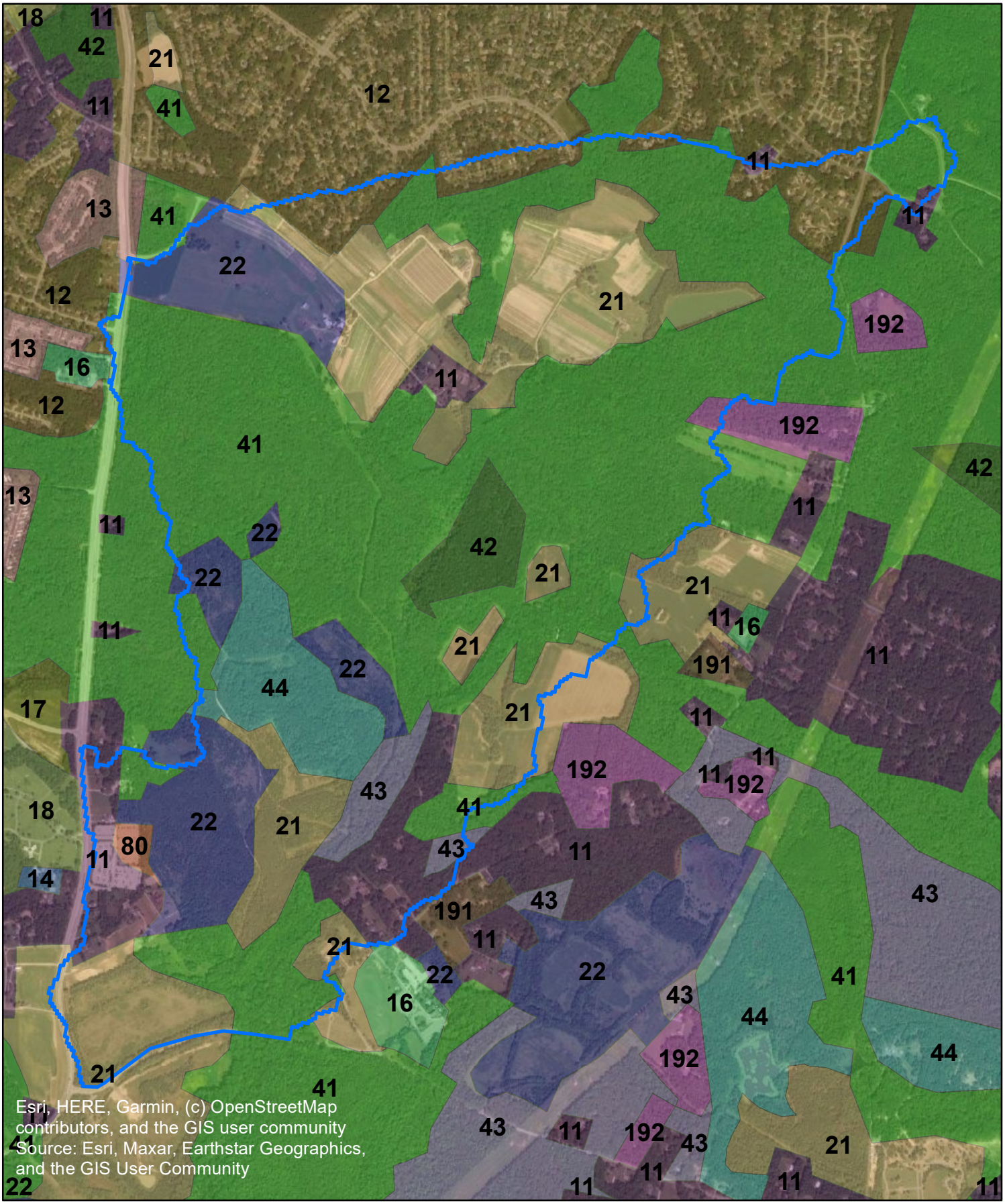
Charles County Zekiah Watershed Study
Location 12: Industrial Park Drive and Post Office Road
Landuse Map



N

0 1,000 2,000 4,000 Feet

Charles County Zekiah Watershed Study
Location 24: Poplar Hill Road
Landuse Map

United States Department of Agriculture

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 Charles County, Maryland

Locations 10 & 12

July 20, 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.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

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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.

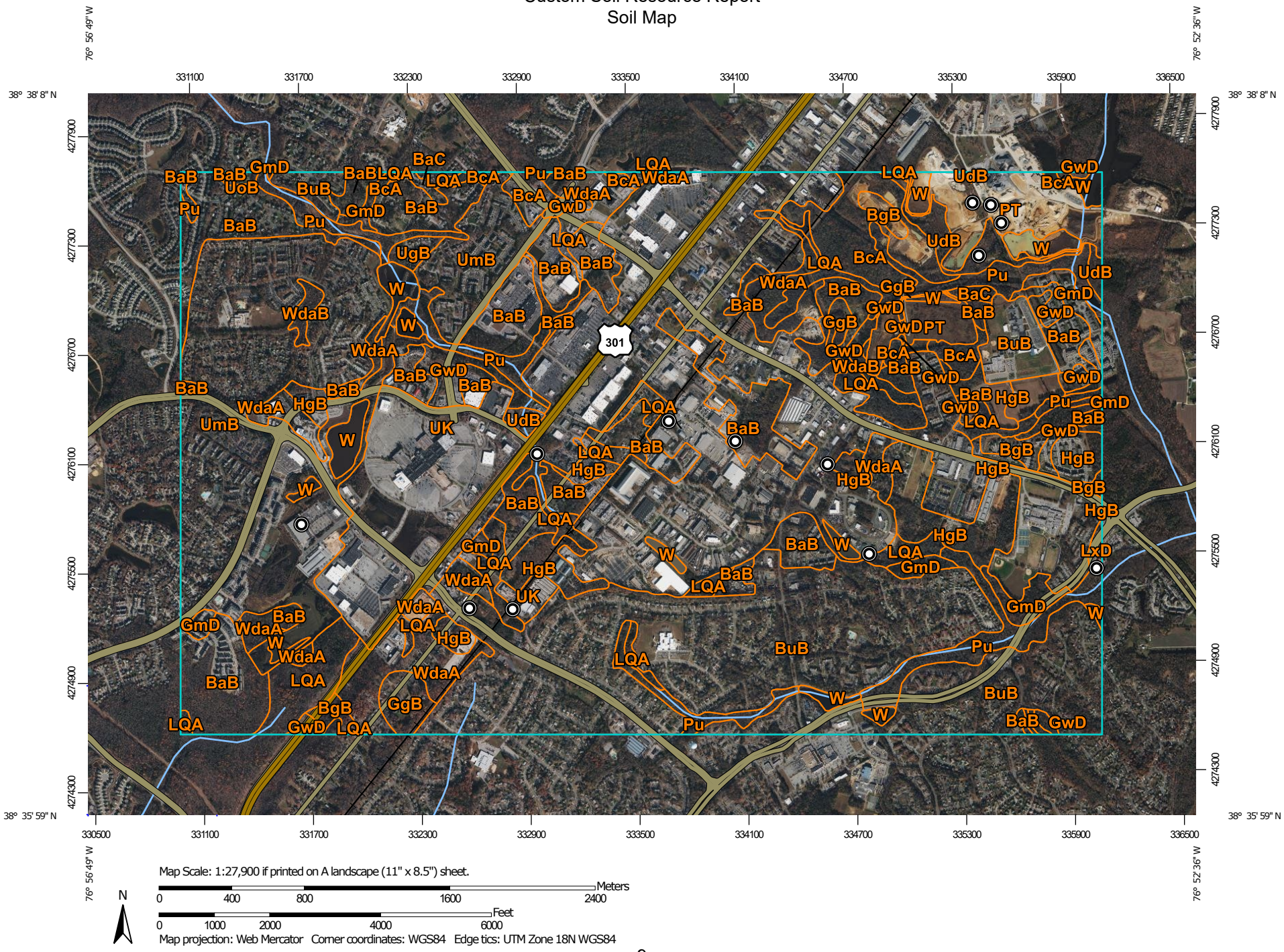
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

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



Map Scale: 1:27,900 if printed on A landscape (11" x 8.5") sheet.

Meters: 0 400 800 1600 2400

Feet: 0 1000 2000 4000 6000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N 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 1:12,000.

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: Charles County, Maryland
Survey Area Data: Version 15, Aug 27, 2021

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

Date(s) aerial images were photographed: Nov 23, 2020—Nov 28, 2020

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BaB	Beltsville silt loam, 2 to 5 percent slopes	471.8	12.1%
BaC	Beltsville silt loam, 5 to 10 percent slopes	8.9	0.2%
BcA	Beltsville-Aquasco complex, 0 to 2 percent slopes	101.8	2.6%
BgB	Beltsville-Grosstown-Woodstown complex, 0 to 5 percent slopes	29.2	0.8%
BuB	Beltsville-Urban land complex, 0 to 5 percent slopes	694.0	17.9%
GgB	Grosstown gravelly silt loam, 2 to 5 percent slopes	25.5	0.7%
GmD	Grosstown-Marr-Hoghole complex, 5 to 15 percent slopes	52.0	1.3%
GwD	Grosstown-Woodstown-Beltsville complex, 5 to 15 percent slopes	69.2	1.8%
HgB	Hoghole-Grosstown complex, 0 to 5 percent slopes	148.9	3.8%
LQA	Lenni and Quindocqua soils, 0 to 2 percent slopes	169.7	4.4%
LxD	Liverpool-Piccowaxen complex, 5 to 15 percent slopes	4.1	0.1%
PT	Pits, gravel	107.6	2.8%
Pu	Potobac-Issue complex, frequently flooded	152.1	3.9%
UdB	Udorthents, loamy, 0 to 5 percent slopes	34.5	0.9%
UgB	Udorthents, reclaimed gravel pits, 0 to 5 percent slopes	8.3	0.2%
UK	Urban land	1,009.3	26.0%
UmB	Urban land-Beltsville complex, 0 to 5 percent slopes	542.6	14.0%
UoB	Urban land-Grosstown complex, 0 to 5 percent slopes	2.8	0.1%
W	Water	75.5	1.9%
WdaA	Woodstown sandy loam, 0 to 2 percent slopes, Northern Coastal Plain	161.4	4.2%
WdaB	Woodstown sandy loam, 2 to 5 percent slopes, Northern Coastal Plain	18.2	0.5%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Totals for Area of Interest		**3,887.6**	**100.0%**

Map Unit Descriptions

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

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

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

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

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

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

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

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

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

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

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

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

Charles County, Maryland

BaB—Beltsville silt loam, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: 1qzx2
Elevation: 10 to 400 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Beltsville and similar soils: 70 percent
Minor components: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Beltsville

Setting

Landform: Broad interstream divides
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty eolian deposits over loamy fluviomarine deposits

Typical profile

A - 0 to 3 inches: silt loam
E - 3 to 8 inches: silt loam
Bt - 8 to 20 inches: silt loam
Btx - 20 to 41 inches: loam
2B't - 41 to 65 inches: sandy clay loam
2BCg - 65 to 71 inches: very gravelly sandy clay loam
2CB - 71 to 76 inches: gravelly coarse sandy loam

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: 20 to 40 inches to fragipan
Drainage class: Moderately well drained
Runoff class: Medium
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 20 to 40 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Aquasco

Percent of map unit: 10 percent
Landform: Broad interstream divides
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Reybold

Percent of map unit: 10 percent
Landform: Broad interstream divides
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Lenni, undrained

Percent of map unit: 5 percent
Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Grosstown

Percent of map unit: 5 percent
Landform: Broad interstream divides
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

BaC—Beltsville silt loam, 5 to 10 percent slopes

Map Unit Setting

National map unit symbol: 1qzx3
Elevation: 10 to 400 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Beltsville and similar soils: 70 percent
Minor components: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Beltsville

Setting

Landform: Broad interstream divides
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty eolian deposits over loamy fluviomarine deposits

Typical profile

A - 0 to 3 inches: silt loam
E - 3 to 8 inches: silt loam
Bt - 8 to 20 inches: silt loam
Btx - 20 to 41 inches: loam
2B't - 41 to 65 inches: sandy clay loam
2BCg - 65 to 71 inches: very gravelly sandy clay loam
2CB - 71 to 76 inches: gravelly coarse sandy loam

Properties and qualities

Slope: 5 to 10 percent
Depth to restrictive feature: 20 to 40 inches to fragipan
Drainage class: Moderately well drained
Runoff class: High
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 20 to 40 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Grosstown

Percent of map unit: 15 percent
Landform: Stream terraces, fluviomarine terraces, broad interstream divides
Landform position (three-dimensional): Interfluve, tread
Down-slope shape: Linear
Across-slope shape: Linear, convex
Hydric soil rating: No

Reybold

Percent of map unit: 5 percent
Landform: Broad interstream divides
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Aquasco

Percent of map unit: 5 percent
Landform: Broad interstream divides

Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Hoghole

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

BcA—Beltsville-Aquasco complex, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 1qzww
Elevation: 10 to 360 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Beltsville and similar soils: 50 percent
Aquasco and similar soils: 40 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Beltsville

Setting

Landform: Broad interstream divides
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Parent material: Silty eolian deposits over loamy fluviomarine deposits

Typical profile

A - 0 to 3 inches: silt loam
E - 3 to 8 inches: silt loam
Bt - 8 to 20 inches: silt loam
Btx - 20 to 41 inches: loam
2B't - 41 to 65 inches: sandy clay loam
2BCg - 65 to 71 inches: very gravelly sandy clay loam
2CB - 71 to 76 inches: gravelly coarse sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 20 to 40 inches to fragipan
Drainage class: Moderately well drained

Runoff class: High
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 20 to 40 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.2 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C
Hydric soil rating: No

Description of Aquasco

Setting
Landform: Broad interstream divides
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty eolian deposits over loamy fluviomarine deposits

Typical profile
A - 0 to 4 inches: silt loam
E - 4 to 10 inches: silt loam
Bt - 10 to 20 inches: silty clay loam
Btx - 20 to 44 inches: loam
BCt - 44 to 72 inches: clay loam

Properties and qualities
Slope: 0 to 2 percent
Depth to restrictive feature: 8 to 40 inches to fragipan
Drainage class: Somewhat poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.01 to 0.20 in/hr)
Depth to water table: About 10 to 16 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.0 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Lenni, undrained
Percent of map unit: 5 percent
Landform: Depressions on broad interstream divides
Hydric soil rating: Yes

Reybold
Percent of map unit: 5 percent
Landform: Fluviomarine terraces, broad interstream divides

Landform position (three-dimensional): Interfluve, tread
Hydric soil rating: No

BgB—Beltsville-Grosstown-Woodstown complex, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 1qzx7
Elevation: 0 to 400 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Beltsville and similar soils: 35 percent
Grosstown and similar soils: 30 percent
Woodstown and similar soils: 15 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Beltsville

Setting

Landform: Broad interstream divides
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Parent material: Silty eolian deposits over loamy fluviomarine deposits

Typical profile

A - 0 to 3 inches: silt loam
E - 3 to 8 inches: silt loam
Bt - 8 to 20 inches: silt loam
Btx - 20 to 41 inches: loam
2B't - 41 to 65 inches: sandy clay loam
2BCg - 65 to 71 inches: very gravelly sandy clay loam
2CB - 71 to 76 inches: gravelly coarse sandy loam

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: 20 to 40 inches to fragipan
Drainage class: Moderately well drained
Runoff class: Medium
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 20 to 40 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Hydric soil rating: No

Description of Grosstown

Setting

Landform: Swales, depressions, drainhead complexes, broad interstream divides
Landform position (three-dimensional): Tread
Down-slope shape: Linear, concave
Across-slope shape: Convex, concave
Parent material: Loamy and gravelly fluviomarine deposits

Typical profile

Ap - 0 to 4 inches: gravelly silt loam
Bt1 - 4 to 20 inches: silt loam
Bt2 - 20 to 26 inches: gravelly loam
2Bt3 - 26 to 71 inches: extremely gravelly silt loam
3BC - 71 to 80 inches: extremely gravelly coarse sand

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 6.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: A
Hydric soil rating: No

Description of Woodstown

Setting

Landform: Depressions, swales, drainageways, drainhead complexes, broad interstream divides
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Parent material: Loamy fluviomarine deposits

Typical profile

Ap - 0 to 8 inches: sandy loam
Bt - 8 to 28 inches: loam
BC - 28 to 42 inches: fine sandy loam
CB - 42 to 60 inches: sandy loam
CBg - 60 to 72 inches: loamy sand

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: About 20 to 40 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 8.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Reybold

Percent of map unit: 10 percent
Landform: Drainhead complexes, broad interstream divides
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Issue

Percent of map unit: 5 percent
Landform: Swales, drainageways, drainhead complexes
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Quindocqua, undrained

Percent of map unit: 5 percent
Landform: Depressions, drainhead complexes
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

BuB—Beltsville-Urban land complex, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 1qzx4
Elevation: 10 to 360 feet
Mean annual precipitation: 40 to 50 inches

Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

Beltsville and similar soils: 50 percent
Urban land: 40 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Beltsville

Setting

Landform: Broad interstream divides
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty eolian deposits over loamy fluviomarine deposits

Typical profile

A - 0 to 3 inches: silt loam
E - 3 to 8 inches: silt loam
Bt - 8 to 20 inches: silt loam
Btx - 20 to 41 inches: loam
2B't - 41 to 65 inches: sandy clay loam
2BCg - 65 to 71 inches: very gravelly sandy clay loam
2CB - 71 to 76 inches: gravelly coarse sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 20 to 40 inches to fragipan
Drainage class: Moderately well drained
Runoff class: Medium
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 20 to 40 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Hydric soil rating: No

Description of Urban Land

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Aquasco

Percent of map unit: 5 percent
Landform: Broad interstream divides
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Lenni, undrained

Percent of map unit: 5 percent
Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

GgB—Grosstown gravelly silt loam, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: 1qzxd
Elevation: 0 to 400 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Grosstown

Setting

Landform: Stream terraces, fluviomarine terraces, broad interstream divides
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Interfluve, tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy and gravelly fluviomarine deposits

Typical profile

Ap - 0 to 4 inches: gravelly silt loam
Bt1 - 4 to 20 inches: silt loam
Bt2 - 20 to 26 inches: gravelly loam
2Bt3 - 26 to 71 inches: extremely gravelly silt loam
3BC - 71 to 80 inches: extremely gravelly coarse sand

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 6.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Woodstown

Percent of map unit: 20 percent
Landform: Depressions on broad interstream divides, stream terraces, swales, fluviomarine terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: No

GmD—Grosstown-Marr-Hoghole complex, 5 to 15 percent slopes

Map Unit Setting

National map unit symbol: 1qzxb
Elevation: 0 to 400 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

Grosstown and similar soils: 31 percent
Marr and similar soils: 29 percent
Hoghole and similar soils: 15 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Grosstown

Setting

Landform: Stream terraces, fluviomarine terraces, broad interstream divides

Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Interfluve, tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy and gravelly fluviomarine deposits

Typical profile

Ap - 0 to 4 inches: gravelly silt loam
Bt1 - 4 to 20 inches: silt loam
Bt2 - 20 to 26 inches: gravelly loam
2Bt3 - 26 to 71 inches: extremely gravelly silt loam
3BC - 71 to 80 inches: extremely gravelly coarse sand

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 6.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Hydric soil rating: No

Description of Marr

Setting

Landform: Knolls
Landform position (three-dimensional): Side slope, nose slope, head slope, interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy fluviomarine deposits

Typical profile

Ap - 0 to 4 inches: fine sandy loam
Bt1 - 4 to 25 inches: fine sandy loam
Bt2 - 25 to 57 inches: sandy clay loam
BC - 57 to 76 inches: loamy fine sand

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 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: High (about 9.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Hydric soil rating: No

Description of Hoghole

Setting

Landform: Stream terraces, fluviomarine terraces, broad interstream divides
Landform position (three-dimensional): Interfluve, tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy and gravelly fluviomarine deposits

Typical profile

A - 0 to 4 inches: sand
Bw1 - 4 to 33 inches: very gravelly sand
Bw2 - 33 to 80 inches: extremely gravelly coarse sand

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (1.98 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 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Beltsville

Percent of map unit: 10 percent
Landform: Knolls, hillslopes, stream terraces, fluviomarine terraces
Landform position (three-dimensional): Side slope, interfluve, riser
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Hydric soil rating: No

Dodon

Percent of map unit: 10 percent
Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Issue

Percent of map unit: 5 percent
Landform: Flood plains, drainageways
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

GwD—Grosstown-Woodstown-Beltsville complex, 5 to 15 percent slopes

Map Unit Setting

National map unit symbol: 1qzx8
Elevation: 0 to 400 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

Grosstown and similar soils: 31 percent
Woodstown and similar soils: 29 percent
Beltsville and similar soils: 20 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Grosstown

Setting

Landform: Stream terraces, fluviomarine terraces, broad interstream divides
Landform position (three-dimensional): Interfluve, tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy and gravelly fluviomarine deposits

Typical profile

Ap - 0 to 4 inches: gravelly silt loam
Bt1 - 4 to 20 inches: silt loam
Bt2 - 20 to 26 inches: gravelly loam
2Bt3 - 26 to 71 inches: extremely gravelly silt loam
3BC - 71 to 80 inches: extremely gravelly coarse sand

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 6.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Hydric soil rating: No

Description of Woodstown

Setting

Landform: Swales, depressions, interfluves, broad interstream divides, fluviomarine terraces, drainhead complexes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear, concave
Across-slope shape: Concave, linear
Parent material: Loamy fluviomarine deposits

Typical profile

Ap - 0 to 8 inches: sandy loam
Bt - 8 to 28 inches: loam
BC - 28 to 42 inches: fine sandy loam
CB - 42 to 60 inches: sandy loam
CBg - 60 to 72 inches: loamy sand

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: About 20 to 40 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 8.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Hydric soil rating: No

Description of Beltsville

Setting

Landform: Broad interstream divides
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Parent material: Silty eolian deposits over loamy fluviomarine deposits

Typical profile

A - 0 to 3 inches: silt loam
E - 3 to 8 inches: silt loam
Bt - 8 to 20 inches: silt loam
Btx - 20 to 41 inches: loam
2B't - 41 to 65 inches: sandy clay loam
2BCg - 65 to 71 inches: very gravelly sandy clay loam
2CB - 71 to 76 inches: gravelly coarse sandy loam

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: 20 to 40 inches to fragipan
Drainage class: Moderately well drained
Runoff class: High
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 20 to 40 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Reybold

Percent of map unit: 10 percent
Landform: Hillslopes, drainhead complexes
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Issue

Percent of map unit: 5 percent
Landform: Flood plains, drainageways, drainhead complexes
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Lenni, undrained

Percent of map unit: 5 percent
Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

HgB—Hoghole-Grosstown complex, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 1qzwm
Elevation: 0 to 400 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Hoghole and similar soils: 45 percent
Grosstown and similar soils: 30 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hoghole

Setting

Landform: Stream terraces, fluviomarine terraces, broad interstream divides
Landform position (three-dimensional): Interfluve, tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy and gravelly fluviomarine deposits

Typical profile

A - 0 to 4 inches: sand
Bw1 - 4 to 33 inches: very gravelly sand
Bw2 - 33 to 80 inches: extremely gravelly coarse sand

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (1.98 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 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Hydric soil rating: No

Description of Grosstown

Setting

Landform: Stream terraces, fluviomarine terraces, broad interstream divides
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy and gravelly fluviomarine deposits

Typical profile

Ap - 0 to 4 inches: gravelly silt loam
Bt1 - 4 to 20 inches: silt loam
Bt2 - 20 to 26 inches: gravelly loam
2Bt3 - 26 to 71 inches: extremely gravelly silt loam
3BC - 71 to 80 inches: extremely gravelly coarse sand

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 6.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Reybold

Percent of map unit: 15 percent
Landform: Stream terraces, fluviomarine terraces, broad interstream divides
Landform position (three-dimensional): Interfluve, tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Woodstown

Percent of map unit: 10 percent
Landform: Depressions, stream terraces, swales, broad interstream divides, fluviomarine terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: No

LQA—Lenni and Quindocqua soils, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 1qzxk
Elevation: 10 to 360 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Lenni, undrained, and similar soils: 50 percent
Quindocqua, undrained, and similar soils: 30 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Lenni, Undrained

Setting

Landform: Depressions on broad interstream divides, fluviomarine terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Parent material: Clayey fluviomarine deposits

Typical profile

A - 0 to 6 inches: silt loam
Eg - 6 to 9 inches: silt loam
Btg1 - 9 to 26 inches: silty clay loam
Btg2 - 26 to 49 inches: clay
2Cg - 49 to 54 inches: loamy sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.60 in/hr)
Depth to water table: About 0 to 10 inches
Frequency of flooding: None
Frequency of ponding: Occasional
Available water supply, 0 to 60 inches: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: C/D
Hydric soil rating: Yes

Description of Quindocqua, Undrained

Setting

Landform: Depressions on broad interstream divides, fluviomarine terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear

Typical profile

Oi - 0 to 4 inches: slightly decomposed plant material
A - 4 to 11 inches: loam
Btg - 11 to 33 inches: loam
2BCg - 33 to 59 inches: very fine sandy loam
2CBg - 59 to 64 inches: very fine sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Very high
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: About 0 to 10 inches
Frequency of flooding: None
Frequency of ponding: Occasional
Available water supply, 0 to 60 inches: Moderate (about 8.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Minor Components

Annemessex

Percent of map unit: 10 percent
Landform: Stream terraces, fluviomarine terraces, broad interstream divides
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: No

Beltsville

Percent of map unit: 5 percent
Landform: Broad interstream divides
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Hydric soil rating: No

Liverpool

Percent of map unit: 5 percent
Landform: Broad interstream divides
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

Hydric soil rating: No

LxD—Liverpool-Piccowaxen complex, 5 to 15 percent slopes

Map Unit Setting

National map unit symbol: 1qzy1
Elevation: 10 to 370 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

Liverpool and similar soils: 45 percent
Piccowaxen and similar soils: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Liverpool

Setting

Landform: Fluviomarine terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty and loamy fluviomarine deposits

Typical profile

A - 0 to 2 inches: silt loam
E - 2 to 5 inches: silt loam
Bt1 - 5 to 13 inches: silt loam
Bt2 - 13 to 35 inches: clay loam
Btg - 35 to 64 inches: sandy clay loam
BC - 64 to 74 inches: sandy clay loam

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.60 in/hr)
Depth to water table: About 20 to 40 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e

Hydrologic Soil Group: D
Hydric soil rating: No

Description of Piccowaxen

Setting

Landform: Fluviomarine terraces
Landform position (three-dimensional): Riser
Down-slope shape: Concave, linear
Across-slope shape: Linear
Parent material: Silty and loamy fluviomarine deposits

Typical profile

A - 0 to 4 inches: loam
Bt - 4 to 16 inches: silt loam
Btg1 - 16 to 28 inches: silt loam
Btg2 - 28 to 56 inches: clay loam
2BCg - 56 to 72 inches: fine sandy loam

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.57 in/hr)
Depth to water table: About 10 to 20 inches
Frequency of flooding: None
Frequency of ponding: Rare
Available water supply, 0 to 60 inches: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C/D
Hydric soil rating: No

Minor Components

Croom

Percent of map unit: 10 percent
Landform: Hillslopes, knolls
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Marr

Percent of map unit: 5 percent
Landform: Fluviomarine terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

PT—Pits, gravel

Map Unit Composition

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

Pu—Potobac-Issue complex, frequently flooded

Map Unit Setting

National map unit symbol: 1qzxf
Elevation: 0 to 250 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 58 degrees F
Frost-free period: 180 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

Potobac and similar soils: 70 percent
Issue and similar soils: 25 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Potobac

Setting

Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear

Typical profile

A - 0 to 8 inches: loam
Bg - 8 to 17 inches: loam
Cg1 - 17 to 39 inches: sandy loam
Cg2 - 39 to 59 inches: very gravelly coarse sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Very high
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: About 0 to 10 inches
Frequency of flooding: Frequent
Frequency of ponding: Frequent
Available water supply, 0 to 60 inches: Moderate (about 6.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Description of Issue

Setting

Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy alluvium

Typical profile

Ap - 0 to 4 inches: silt loam
Bw - 4 to 19 inches: loam
Bg1 - 19 to 30 inches: fine sandy loam
Bg2 - 30 to 58 inches: fine sandy loam
Ab - 58 to 70 inches: silt loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 10 to 20 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 9.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Hydric soil rating: No

Minor Components

Lenni, undrained

Percent of map unit: 5 percent
Landform: Depressions on fluviomarine terraces
Landform position (three-dimensional): Tread
Hydric soil rating: Yes

UdB—Udorthents, loamy, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 1qzwn
Elevation: 0 to 300 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents, loamy, and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents, Loamy

Setting

Landform: Broad interstream divides
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Fluviomarine deposits

Typical profile

AC - 0 to 2 inches: loam
C - 2 to 72 inches: gravelly loam

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to very high (0.01 to 19.98 in/hr)
Depth to water table: About 40 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 8.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Urban land

Percent of map unit: 7 percent

Landform: Flats
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Unranked

Beltsville

Percent of map unit: 3 percent
Landform: Broad interstream divides
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

UgB—Udorthents, reclaimed gravel pits, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 1qzwq
Elevation: 0 to 300 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents, reclaimed gravel pits, and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents, Reclaimed Gravel Pits

Setting

Landform: Terraces, flood plains, broad interstream divides
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mine spoil or earthy fill

Typical profile

AC - 0 to 4 inches: gravelly sandy loam
C - 4 to 72 inches: very gravelly sandy loam

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to high (0.00 to 5.95 in/hr)
Depth to water table: About 0 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Hydric soil rating: No

UK—Urban land

Map Unit Setting

National map unit symbol: 1qzwt
Elevation: 0 to 130 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Landform: Flats
Down-slope shape: Linear
Across-slope shape: Linear

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: Unranked

Minor Components

Udorthents, loamy

Percent of map unit: 7 percent
Landform: Broad interstream divides
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Beltsville

Percent of map unit: 3 percent
Landform: Broad interstream divides
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

UmB—Urban land-Beltsville complex, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 1qzws
Elevation: 0 to 400 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 58 degrees F
Frost-free period: 180 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 50 percent
Beltsville and similar soils: 35 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Landform: Flats
Down-slope shape: Linear
Across-slope shape: Linear

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: Unranked

Description of Beltsville

Setting

Landform: Broad interstream divides
Landform position (three-dimensional): Side slope, interfluve
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Parent material: Silty eolian deposits over loamy fluviomarine deposits

Typical profile

A - 0 to 3 inches: silt loam
E - 3 to 8 inches: silt loam
Bt - 8 to 20 inches: silt loam
Btx - 20 to 41 inches: loam
2B't - 41 to 65 inches: sandy clay loam
2BCg - 65 to 71 inches: very gravelly sandy clay loam
2CB - 71 to 76 inches: gravelly coarse sandy loam

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: 20 to 40 inches to fragipan

Drainage class: Moderately well drained
Runoff class: High
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 20 to 40 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Grosstown

Percent of map unit: 5 percent
Landform: Stream terraces, fluviomarine terraces, broad interstream divides
Landform position (three-dimensional): Tread
Hydric soil rating: No

Aquasco

Percent of map unit: 5 percent
Landform: Broad interstream divides
Landform position (three-dimensional): Interfluve
Hydric soil rating: No

Lenni, undrained

Percent of map unit: 5 percent
Landform: Depressions on fluviomarine terraces
Landform position (three-dimensional): Tread
Hydric soil rating: Yes

UoB—Urban land-Grosstown complex, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 1qzwr
Elevation: 10 to 400 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 80 percent
Grosstown and similar soils: 15 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: No

Description of Grosstown

Setting

Landform: Stream terraces, fluviomarine terraces, broad interstream divides
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy and gravelly fluviomarine deposits

Typical profile

Ap - 0 to 4 inches: gravelly silt loam
Bt1 - 4 to 20 inches: silt loam
Bt2 - 20 to 26 inches: gravelly loam
2Bt3 - 26 to 71 inches: extremely gravelly silt loam
3BC - 71 to 80 inches: extremely gravelly coarse sand

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 6.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Beltsville

Percent of map unit: 5 percent
Landform: Broad interstream divides
Landform position (three-dimensional): Side slope, interfluve
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Hydric soil rating: No

W—Water

Map Unit Composition

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

WdaA—Woodstown sandy loam, 0 to 2 percent slopes, Northern Coastal Plain

Map Unit Setting

National map unit symbol: 2thvw
Elevation: 0 to 280 feet
Mean annual precipitation: 42 to 48 inches
Mean annual air temperature: 52 to 58 degrees F
Frost-free period: 180 to 220 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Woodstown and similar soils: 81 percent
Minor components: 19 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Woodstown

Setting

Landform: Depressions, flats, fluviomarine terraces, broad interstream divides
Landform position (two-dimensional): Footslope, summit
Landform position (three-dimensional): Tread, dip, talf
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Parent material: Loamy fluviomarine deposits

Typical profile

Ap - 0 to 7 inches: sandy loam
E - 7 to 11 inches: sandy loam
Bt - 11 to 29 inches: sandy loam
BCg - 29 to 45 inches: fine sandy loam
Cg - 45 to 80 inches: loamy sand

Properties and qualities

Slope: 0 to 2 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 high to high (0.57 to 1.98 in/hr)
Depth to water table: About 20 to 40 inches

Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 8.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Fallsington

Percent of map unit: 7 percent
Landform: Drainageways, depressions, swales, flats
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Dip, talf
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: Yes

Hammonton

Percent of map unit: 7 percent
Landform: Flats, broad interstream divides
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Hambrook

Percent of map unit: 5 percent
Landform: Flats, fluviomarine terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

WdaB—Woodstown sandy loam, 2 to 5 percent slopes, Northern Coastal Plain

Map Unit Setting

National map unit symbol: 2thvx
Elevation: 0 to 490 feet
Mean annual precipitation: 42 to 48 inches
Mean annual air temperature: 52 to 58 degrees F
Frost-free period: 180 to 220 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Woodstown and similar soils: 81 percent
Minor components: 19 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Woodstown

Setting

Landform: Flats, depressions, fluviomarine terraces, broad interstream divides
Landform position (two-dimensional): Shoulder, footslope
Landform position (three-dimensional): Riser, dip
Down-slope shape: Convex, concave
Across-slope shape: Linear, concave
Parent material: Loamy fluviomarine deposits

Typical profile

Ap - 0 to 7 inches: sandy loam
E - 7 to 11 inches: sandy loam
Bt - 11 to 29 inches: sandy loam
BCg - 29 to 45 inches: fine sandy loam
Cg - 45 to 80 inches: loamy sand

Properties and qualities

Slope: 2 to 5 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 high to high (0.57 to 1.98 in/hr)
Depth to water table: About 20 to 40 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 8.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Hammonton

Percent of map unit: 7 percent
Landform: Flats, broad interstream divides
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Dip
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Fallsington, occasionally ponded

Percent of map unit: 7 percent
Landform: Drainageways, depressions, swales, flats
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Dip, talf

Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: Yes

Hambrook

Percent of map unit: 5 percent
Landform: Flats, fluviomarine terraces
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Riser, dip
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

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United States Department of Agriculture

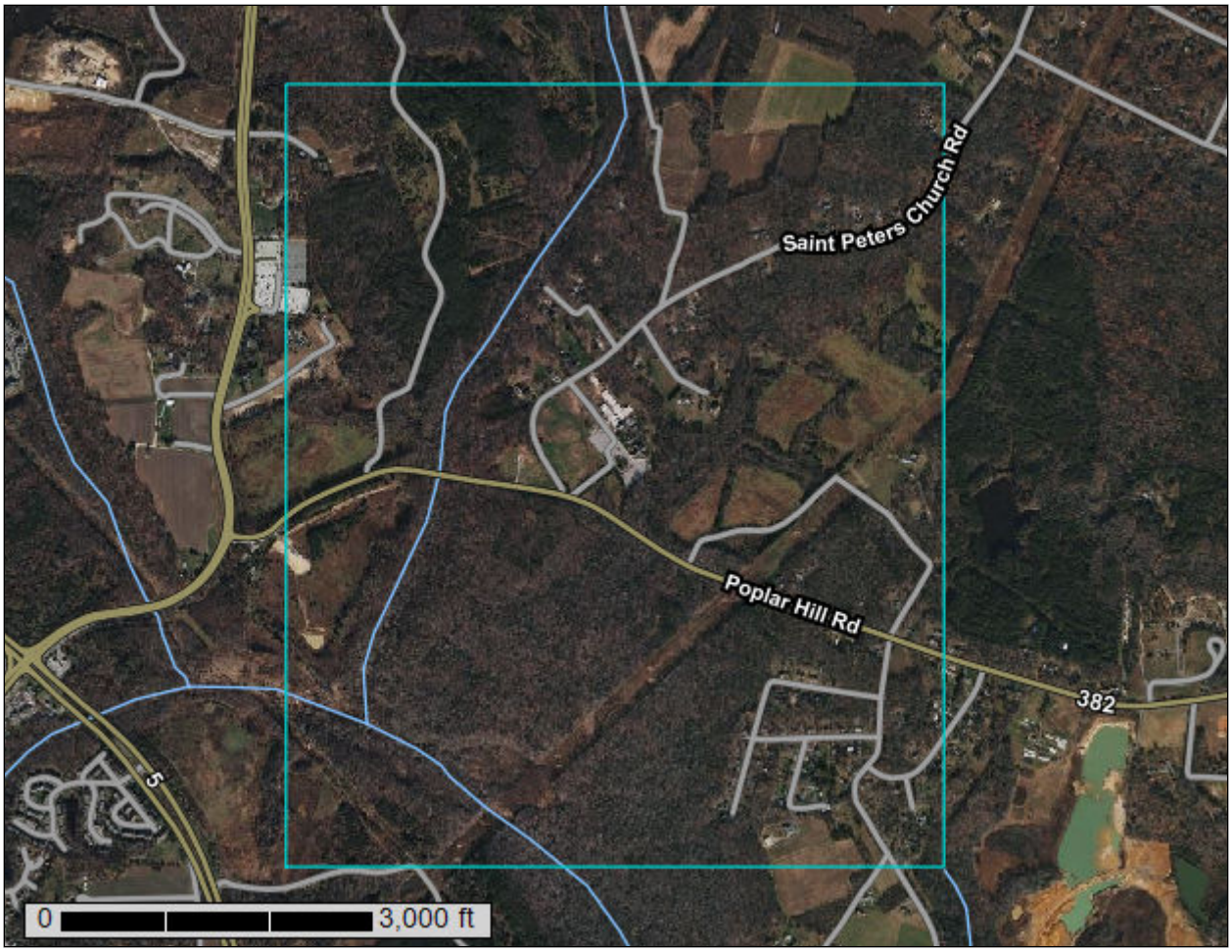
NRCS

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 Charles County, Maryland

Location 24



July 20, 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.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

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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.

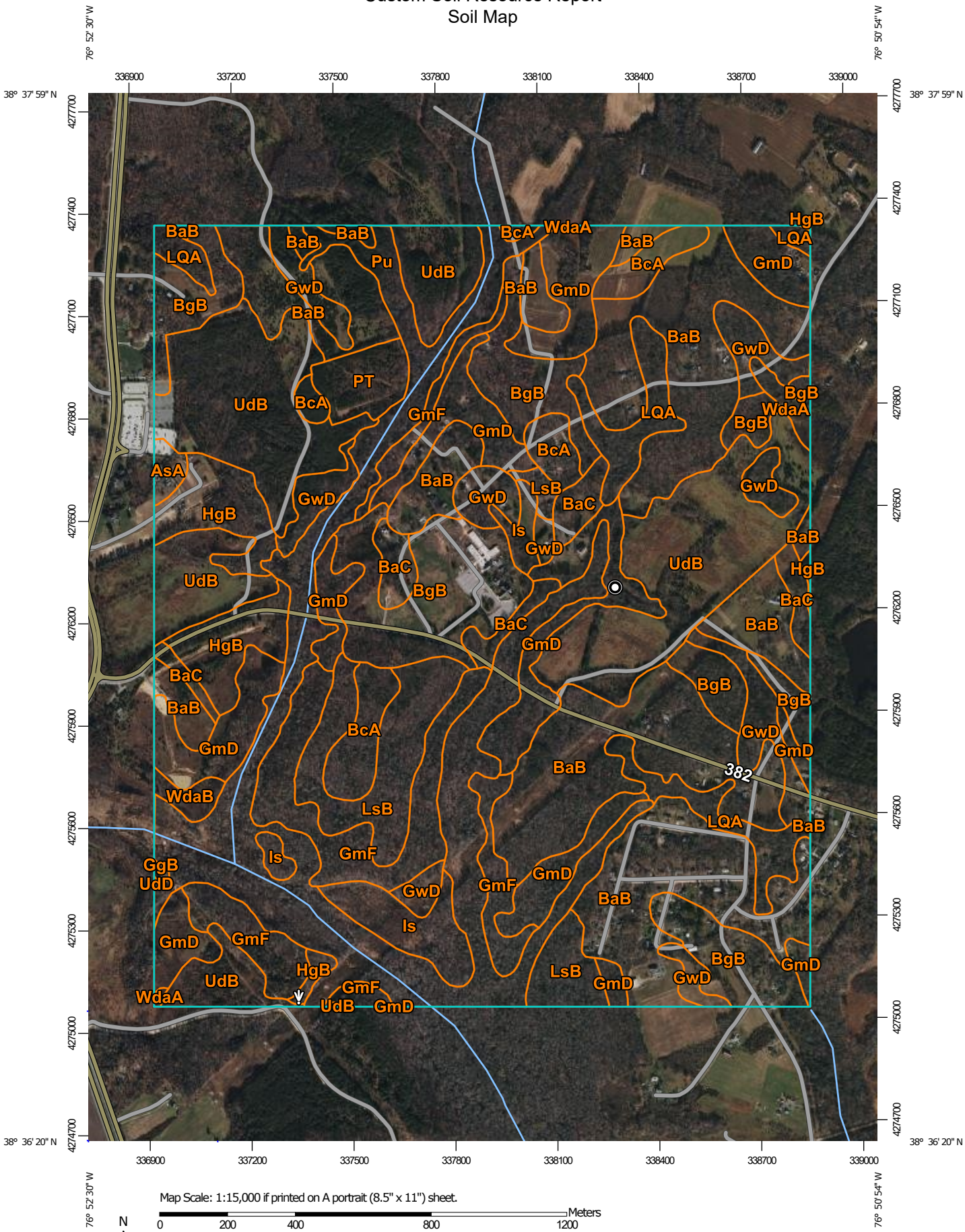
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree 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.



Map Scale: 1:15,000 if printed on A portrait (8.5" x 11") sheet.

N

0 200 400 800 1200 Meters

0 500 1000 2000 3000 Feet

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N 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 1:12,000.

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: Charles County, Maryland
Survey Area Data: Version 15, Aug 27, 2021

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

Date(s) aerial images were photographed: Nov 23, 2020—Nov 28, 2020

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
AsA	Annemessex silt loam, 0 to 2 percent slopes	3.3	0.3%
BaB	Beltsville silt loam, 2 to 5 percent slopes	243.2	22.2%
BaC	Beltsville silt loam, 5 to 10 percent slopes	22.5	2.0%
BcA	Beltsville-Aquasco complex, 0 to 2 percent slopes	28.6	2.6%
BgB	Beltsville-Grosstown-Woodstown complex, 0 to 5 percent slopes	113.3	10.3%
GgB	Grosstown gravelly silt loam, 2 to 5 percent slopes	0.5	0.0%
GmD	Grosstown-Marr-Hoghole complex, 5 to 15 percent slopes	109.3	10.0%
GmF	Grosstown-Marr-Hoghole complex, 15 to 40 percent slopes	65.2	5.9%
GwD	Grosstown-Woodstown-Beltsville complex, 5 to 15 percent slopes	52.9	4.8%
HgB	Hoghole-Grosstown complex, 0 to 5 percent slopes	36.2	3.3%
Is	Issue silt loam, occasionally flooded	22.6	2.1%
LQA	Lenni and Quindocqua soils, 0 to 2 percent slopes	33.0	3.0%
LsB	Liverpool silt loam, 2 to 5 percent slopes	45.6	4.2%
PT	Pits, gravel	12.2	1.1%
Pu	Potobac-Issue complex, frequently flooded	135.9	12.4%
UdB	Udorthents, loamy, 0 to 5 percent slopes	163.5	14.9%
UdD	Udorthents, loamy, 5 to 15 percent slopes	0.2	0.0%
WdaA	Woodstown sandy loam, 0 to 2 percent slopes, Northern Coastal Plain	4.0	0.4%
WdaB	Woodstown sandy loam, 2 to 5 percent slopes, Northern Coastal Plain	4.2	0.4%
Totals for Area of Interest		**1,096.2**	**100.0%**

Map Unit Descriptions

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

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

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

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

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

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

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas

shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

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

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

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

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

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

Charles County, Maryland

AsA—Annemessex silt loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 1qzy2
Elevation: 10 to 50 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Annemessex and similar soils: 60 percent
Dodon and similar soils: 25 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Annemessex

Setting

Landform: Stream terraces, fluviomarine terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Loamy fluviomarine deposits

Typical profile

Ap - 0 to 2 inches: silt loam
E - 2 to 8 inches: silt loam
Bt1 - 8 to 18 inches: silt loam
Bt2 - 18 to 44 inches: loam
BC - 44 to 57 inches: loamy fine sand
2BCg - 57 to 62 inches: loamy very fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.03 to 1.98 in/hr)
Depth to water table: About 10 to 20 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 9.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: B/D
Hydric soil rating: No

Description of Dodon

Setting

Landform: Stream terraces
Landform position (three-dimensional): Interfluve, tread
Parent material: Loamy fluviomarine deposits

Typical profile

Ap - 0 to 9 inches: fine sandy loam
Bt - 9 to 36 inches: sandy clay loam
BC - 36 to 48 inches: sandy clay loam
CB - 48 to 64 inches: fine sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 20 to 40 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 9.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Elkton, undrained

Percent of map unit: 10 percent
Landform: Depressions on fluviomarine terraces
Landform position (three-dimensional): Interfluve, tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Quindocqua, undrained

Percent of map unit: 5 percent
Landform: Depressions on fluviomarine terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

BaB—Beltsville silt loam, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: 1qzx2
Elevation: 10 to 400 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Beltsville and similar soils: 70 percent
Minor components: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Beltsville

Setting

Landform: Broad interstream divides
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty eolian deposits over loamy fluviomarine deposits

Typical profile

A - 0 to 3 inches: silt loam
E - 3 to 8 inches: silt loam
Bt - 8 to 20 inches: silt loam
Btx - 20 to 41 inches: loam
2B't - 41 to 65 inches: sandy clay loam
2BCg - 65 to 71 inches: very gravelly sandy clay loam
2CB - 71 to 76 inches: gravelly coarse sandy loam

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: 20 to 40 inches to fragipan
Drainage class: Moderately well drained
Runoff class: Medium
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 20 to 40 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C

Hydric soil rating: No

Minor Components

Aquasco

Percent of map unit: 10 percent
Landform: Broad interstream divides
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Reybold

Percent of map unit: 10 percent
Landform: Broad interstream divides
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Lenni, undrained

Percent of map unit: 5 percent
Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Grosstown

Percent of map unit: 5 percent
Landform: Broad interstream divides
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

BaC—Beltsville silt loam, 5 to 10 percent slopes

Map Unit Setting

National map unit symbol: 1qzx3
Elevation: 10 to 400 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Beltsville and similar soils: 70 percent
Minor components: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Beltsville

Setting

Landform: Broad interstream divides
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty eolian deposits over loamy fluviomarine deposits

Typical profile

A - 0 to 3 inches: silt loam
E - 3 to 8 inches: silt loam
Bt - 8 to 20 inches: silt loam
Btx - 20 to 41 inches: loam
2B't - 41 to 65 inches: sandy clay loam
2BCg - 65 to 71 inches: very gravelly sandy clay loam
2CB - 71 to 76 inches: gravelly coarse sandy loam

Properties and qualities

Slope: 5 to 10 percent
Depth to restrictive feature: 20 to 40 inches to fragipan
Drainage class: Moderately well drained
Runoff class: High
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 20 to 40 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Grosstown

Percent of map unit: 15 percent
Landform: Stream terraces, fluviomarine terraces, broad interstream divides
Landform position (three-dimensional): Interfluve, tread
Down-slope shape: Linear
Across-slope shape: Linear, convex
Hydric soil rating: No

Reybold

Percent of map unit: 5 percent
Landform: Broad interstream divides
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Aquasco

Percent of map unit: 5 percent
Landform: Broad interstream divides

Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Hoghole

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

BcA—Beltsville-Aquasco complex, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 1qzww
Elevation: 10 to 360 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Beltsville and similar soils: 50 percent
Aquasco and similar soils: 40 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Beltsville

Setting

Landform: Broad interstream divides
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Parent material: Silty eolian deposits over loamy fluviomarine deposits

Typical profile

A - 0 to 3 inches: silt loam
E - 3 to 8 inches: silt loam
Bt - 8 to 20 inches: silt loam
Btx - 20 to 41 inches: loam
2B't - 41 to 65 inches: sandy clay loam
2BCg - 65 to 71 inches: very gravelly sandy clay loam
2CB - 71 to 76 inches: gravelly coarse sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 20 to 40 inches to fragipan
Drainage class: Moderately well drained

Runoff class: High
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 20 to 40 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.2 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C
Hydric soil rating: No

Description of Aquasco

Setting
Landform: Broad interstream divides
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty eolian deposits over loamy fluviomarine deposits

Typical profile
A - 0 to 4 inches: silt loam
E - 4 to 10 inches: silt loam
Bt - 10 to 20 inches: silty clay loam
Btx - 20 to 44 inches: loam
BCt - 44 to 72 inches: clay loam

Properties and qualities
Slope: 0 to 2 percent
Depth to restrictive feature: 8 to 40 inches to fragipan
Drainage class: Somewhat poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.01 to 0.20 in/hr)
Depth to water table: About 10 to 16 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.0 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Lenni, undrained
Percent of map unit: 5 percent
Landform: Depressions on broad interstream divides
Hydric soil rating: Yes

Reybold
Percent of map unit: 5 percent
Landform: Fluviomarine terraces, broad interstream divides

Landform position (three-dimensional): Interfluve, tread
Hydric soil rating: No

BgB—Beltsville-Grosstown-Woodstown complex, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 1qzx7
Elevation: 0 to 400 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Beltsville and similar soils: 35 percent
Grosstown and similar soils: 30 percent
Woodstown and similar soils: 15 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Beltsville

Setting

Landform: Broad interstream divides
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Parent material: Silty eolian deposits over loamy fluviomarine deposits

Typical profile

A - 0 to 3 inches: silt loam
E - 3 to 8 inches: silt loam
Bt - 8 to 20 inches: silt loam
Btx - 20 to 41 inches: loam
2B't - 41 to 65 inches: sandy clay loam
2BCg - 65 to 71 inches: very gravelly sandy clay loam
2CB - 71 to 76 inches: gravelly coarse sandy loam

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: 20 to 40 inches to fragipan
Drainage class: Moderately well drained
Runoff class: Medium
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 20 to 40 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Hydric soil rating: No

Description of Grosstown

Setting

Landform: Swales, depressions, drainhead complexes, broad interstream divides
Landform position (three-dimensional): Tread
Down-slope shape: Linear, concave
Across-slope shape: Convex, concave
Parent material: Loamy and gravelly fluviomarine deposits

Typical profile

Ap - 0 to 4 inches: gravelly silt loam
Bt1 - 4 to 20 inches: silt loam
Bt2 - 20 to 26 inches: gravelly loam
2Bt3 - 26 to 71 inches: extremely gravelly silt loam
3BC - 71 to 80 inches: extremely gravelly coarse sand

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 6.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: A
Hydric soil rating: No

Description of Woodstown

Setting

Landform: Depressions, swales, drainageways, drainhead complexes, broad interstream divides
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Parent material: Loamy fluviomarine deposits

Typical profile

Ap - 0 to 8 inches: sandy loam
Bt - 8 to 28 inches: loam
BC - 28 to 42 inches: fine sandy loam
CB - 42 to 60 inches: sandy loam
CBg - 60 to 72 inches: loamy sand

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: About 20 to 40 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 8.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Reybold

Percent of map unit: 10 percent
Landform: Drainhead complexes, broad interstream divides
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Issue

Percent of map unit: 5 percent
Landform: Swales, drainageways, drainhead complexes
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Quindocqua, undrained

Percent of map unit: 5 percent
Landform: Depressions, drainhead complexes
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

GgB—Grosstown gravelly silt loam, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: 1qzxd
Elevation: 0 to 400 feet
Mean annual precipitation: 40 to 50 inches

Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Grosstown

Setting

Landform: Stream terraces, fluviomarine terraces, broad interstream divides
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Interfluve, tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy and gravelly fluviomarine deposits

Typical profile

Ap - 0 to 4 inches: gravelly silt loam
Bt1 - 4 to 20 inches: silt loam
Bt2 - 20 to 26 inches: gravelly loam
2Bt3 - 26 to 71 inches: extremely gravelly silt loam
3BC - 71 to 80 inches: extremely gravelly coarse sand

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 6.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Woodstown

Percent of map unit: 20 percent
Landform: Depressions on broad interstream divides, stream terraces, swales, fluviomarine terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: No

GmD—Grosstown-Marr-Hoghole complex, 5 to 15 percent slopes

Map Unit Setting

National map unit symbol: 1qzxb
Elevation: 0 to 400 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

Grosstown and similar soils: 31 percent
Marr and similar soils: 29 percent
Hoghole and similar soils: 15 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Grosstown

Setting

Landform: Stream terraces, fluviomarine terraces, broad interstream divides
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Interfluve, tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy and gravelly fluviomarine deposits

Typical profile

Ap - 0 to 4 inches: gravelly silt loam
Bt1 - 4 to 20 inches: silt loam
Bt2 - 20 to 26 inches: gravelly loam
2Bt3 - 26 to 71 inches: extremely gravelly silt loam
3BC - 71 to 80 inches: extremely gravelly coarse sand

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 6.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A

Hydric soil rating: No

Description of Marr

Setting

Landform: Knolls
Landform position (three-dimensional): Side slope, nose slope, head slope, interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy fluviomarine deposits

Typical profile

Ap - 0 to 4 inches: fine sandy loam
Bt1 - 4 to 25 inches: fine sandy loam
Bt2 - 25 to 57 inches: sandy clay loam
BC - 57 to 76 inches: loamy fine sand

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 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: High (about 9.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Hydric soil rating: No

Description of Hoghole

Setting

Landform: Stream terraces, fluviomarine terraces, broad interstream divides
Landform position (three-dimensional): Interfluve, tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy and gravelly fluviomarine deposits

Typical profile

A - 0 to 4 inches: sand
Bw1 - 4 to 33 inches: very gravelly sand
Bw2 - 33 to 80 inches: extremely gravelly coarse sand

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (1.98 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 2.7 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Beltsville
Percent of map unit: 10 percent
Landform: Knolls, hillslopes, stream terraces, fluviomarine terraces
Landform position (three-dimensional): Side slope, interfluve, riser
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Hydric soil rating: No

Dodon
Percent of map unit: 10 percent
Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Issue
Percent of map unit: 5 percent
Landform: Flood plains, drainageways
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

GmF—Grosstown-Marr-Hoghole complex, 15 to 40 percent slopes

Map Unit Setting
National map unit symbol: 1qzxc
Elevation: 0 to 400 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition
Grosstown and similar soils: 31 percent
Marr and similar soils: 29 percent

Hoghole and similar soils: 15 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Grosstown

Setting

Landform: Stream terraces, fluviomarine terraces, broad interstream divides
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Interfluve, tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy and gravelly fluviomarine deposits

Typical profile

Ap - 0 to 4 inches: gravelly silt loam
Bt1 - 4 to 20 inches: silt loam
Bt2 - 20 to 26 inches: gravelly loam
2Bt3 - 26 to 71 inches: extremely gravelly silt loam
3BC - 71 to 80 inches: extremely gravelly coarse sand

Properties and qualities

Slope: 15 to 40 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 6.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Hydric soil rating: No

Description of Marr

Setting

Landform: Knolls
Landform position (three-dimensional): Side slope, nose slope, head slope, interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy fluviomarine deposits

Typical profile

Ap - 0 to 4 inches: fine sandy loam
Bt1 - 4 to 25 inches: fine sandy loam
Bt2 - 25 to 57 inches: sandy clay loam
BC - 57 to 76 inches: loamy fine sand

Properties and qualities

Slope: 15 to 40 percent
Depth to restrictive feature: More than 80 inches

Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 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: High (about 9.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Hydric soil rating: No

Description of Hoghole

Setting

Landform: Stream terraces, fluviomarine terraces, broad interstream divides
Landform position (three-dimensional): Interfluve, tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy and gravelly fluviomarine deposits

Typical profile

A - 0 to 4 inches: sand
Bw1 - 4 to 33 inches: very gravelly sand
Bw2 - 33 to 80 inches: extremely gravelly coarse sand

Properties and qualities

Slope: 15 to 40 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): High to very high (1.98 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 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Potobac

Percent of map unit: 10 percent
Landform: Flood plains, drainageways
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Dodon

Percent of map unit: 10 percent

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Beltsville

Percent of map unit: 5 percent
Landform: Broad interstream divides
Landform position (three-dimensional): Side slope, interfluve
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Hydric soil rating: No

GwD—Grosstown-Woodstown-Beltsville complex, 5 to 15 percent slopes

Map Unit Setting

National map unit symbol: 1qzx8
Elevation: 0 to 400 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

Grosstown and similar soils: 31 percent
Woodstown and similar soils: 29 percent
Beltsville and similar soils: 20 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Grosstown

Setting

Landform: Stream terraces, fluviomarine terraces, broad interstream divides
Landform position (three-dimensional): Interfluve, tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy and gravelly fluviomarine deposits

Typical profile

Ap - 0 to 4 inches: gravelly silt loam
Bt1 - 4 to 20 inches: silt loam
Bt2 - 20 to 26 inches: gravelly loam
2Bt3 - 26 to 71 inches: extremely gravelly silt loam
3BC - 71 to 80 inches: extremely gravelly coarse sand

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 6.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Hydric soil rating: No

Description of Woodstown

Setting

Landform: Swales, depressions, interfluves, broad interstream divides, fluviomarine terraces, drainhead complexes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear, concave
Across-slope shape: Concave, linear
Parent material: Loamy fluviomarine deposits

Typical profile

Ap - 0 to 8 inches: sandy loam
Bt - 8 to 28 inches: loam
BC - 28 to 42 inches: fine sandy loam
CB - 42 to 60 inches: sandy loam
CBg - 60 to 72 inches: loamy sand

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: About 20 to 40 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 8.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Hydric soil rating: No

Description of Beltsville

Setting

Landform: Broad interstream divides
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Parent material: Silty eolian deposits over loamy fluviomarine deposits

Typical profile

A - 0 to 3 inches: silt loam
E - 3 to 8 inches: silt loam
Bt - 8 to 20 inches: silt loam
Btx - 20 to 41 inches: loam
2B't - 41 to 65 inches: sandy clay loam
2BCg - 65 to 71 inches: very gravelly sandy clay loam
2CB - 71 to 76 inches: gravelly coarse sandy loam

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: 20 to 40 inches to fragipan
Drainage class: Moderately well drained
Runoff class: High
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 20 to 40 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Reybold

Percent of map unit: 10 percent
Landform: Hillslopes, drainhead complexes
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Issue

Percent of map unit: 5 percent
Landform: Flood plains, drainageways, drainhead complexes
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Lenni, undrained

Percent of map unit: 5 percent
Landform: Depressions
Down-slope shape: Concave

Across-slope shape: Concave
Hydric soil rating: Yes

HgB—Hoghole-Grosstown complex, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 1qzwm
Elevation: 0 to 400 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Hoghole and similar soils: 45 percent
Grosstown and similar soils: 30 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hoghole

Setting

Landform: Stream terraces, fluviomarine terraces, broad interstream divides
Landform position (three-dimensional): Interfluve, tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy and gravelly fluviomarine deposits

Typical profile

A - 0 to 4 inches: sand
Bw1 - 4 to 33 inches: very gravelly sand
Bw2 - 33 to 80 inches: extremely gravelly coarse sand

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (1.98 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 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s

Hydrologic Soil Group: A
Hydric soil rating: No

Description of Grosstown

Setting

Landform: Stream terraces, fluviomarine terraces, broad interstream divides
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy and gravelly fluviomarine deposits

Typical profile

Ap - 0 to 4 inches: gravelly silt loam
Bt1 - 4 to 20 inches: silt loam
Bt2 - 20 to 26 inches: gravelly loam
2Bt3 - 26 to 71 inches: extremely gravelly silt loam
3BC - 71 to 80 inches: extremely gravelly coarse sand

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 6.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Reybold

Percent of map unit: 15 percent
Landform: Stream terraces, fluviomarine terraces, broad interstream divides
Landform position (three-dimensional): Interfluve, tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Woodstown

Percent of map unit: 10 percent
Landform: Depressions, stream terraces, swales, broad interstream divides, fluviomarine terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: No

Is—Issue silt loam, occasionally flooded

Map Unit Setting

National map unit symbol: 1qzxg
Elevation: 0 to 250 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Issue

Setting

Landform: Flood plains, drainageways
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy alluvium

Typical profile

Ap - 0 to 4 inches: silt loam
Bw - 4 to 19 inches: loam
Bg1 - 19 to 30 inches: fine sandy loam
Bg2 - 30 to 58 inches: fine sandy loam
Ab - 58 to 70 inches: silt loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 10 to 20 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 9.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: B/D
Hydric soil rating: No

Minor Components

Woodstown

Percent of map unit: 10 percent
Landform: Depressions, drainageways, swales
Hydric soil rating: No

Potobac

Percent of map unit: 10 percent
Landform: Flood plains, drainageways
Hydric soil rating: Yes

LQA—Lenni and Quindocqua soils, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 1qzxk
Elevation: 10 to 360 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Lenni, undrained, and similar soils: 50 percent
Quindocqua, undrained, and similar soils: 30 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Lenni, Undrained

Setting

Landform: Depressions on broad interstream divides, fluviomarine terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Parent material: Clayey fluviomarine deposits

Typical profile

A - 0 to 6 inches: silt loam
Eg - 6 to 9 inches: silt loam
Btg1 - 9 to 26 inches: silty clay loam
Btg2 - 26 to 49 inches: clay
2Cg - 49 to 54 inches: loamy sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: High

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.60 in/hr)
Depth to water table: About 0 to 10 inches
Frequency of flooding: None
Frequency of ponding: Occasional
Available water supply, 0 to 60 inches: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: C/D
Hydric soil rating: Yes

Description of Quindocqua, Undrained

Setting

Landform: Depressions on broad interstream divides, fluviomarine terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear

Typical profile

Oi - 0 to 4 inches: slightly decomposed plant material
A - 4 to 11 inches: loam
Btg - 11 to 33 inches: loam
2BCg - 33 to 59 inches: very fine sandy loam
2CBg - 59 to 64 inches: very fine sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Very high
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: About 0 to 10 inches
Frequency of flooding: None
Frequency of ponding: Occasional
Available water supply, 0 to 60 inches: Moderate (about 8.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Minor Components

Annemessex

Percent of map unit: 10 percent
Landform: Stream terraces, fluviomarine terraces, broad interstream divides
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: No

Beltsville

Percent of map unit: 5 percent

Landform: Broad interstream divides
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Hydric soil rating: No

Liverpool

Percent of map unit: 5 percent
Landform: Broad interstream divides
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

LsB—Liverpool silt loam, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: 1qzy0
Elevation: 0 to 210 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Liverpool and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Liverpool

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty and loamy fluviomarine deposits

Typical profile

A - 0 to 2 inches: silt loam
E - 2 to 5 inches: silt loam
Bt1 - 5 to 13 inches: silt loam
Bt2 - 13 to 35 inches: clay loam
Btg - 35 to 64 inches: sandy clay loam
BC - 64 to 74 inches: sandy clay loam

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained

Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.60 in/hr)
Depth to water table: About 20 to 40 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 9.7 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Piccowaxen
Percent of map unit: 10 percent
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Annemessex
Percent of map unit: 10 percent
Landform: Fluviomarine terraces
Landform position (three-dimensional): Tread
Hydric soil rating: No

Elkton, undrained
Percent of map unit: 5 percent
Landform: Depressions
Landform position (three-dimensional): Tread
Hydric soil rating: Yes

PT—Pits, gravel

Map Unit Composition
Pits, gravel: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Pu—Potobac-Issue complex, frequently flooded

Map Unit Setting
National map unit symbol: 1qzxf
Elevation: 0 to 250 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 58 degrees F
Frost-free period: 180 to 210 days

Farmland classification: Not prime farmland

Map Unit Composition

Potobac and similar soils: 70 percent
Issue and similar soils: 25 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Potobac

Setting

Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear

Typical profile

A - 0 to 8 inches: loam
Bg - 8 to 17 inches: loam
Cg1 - 17 to 39 inches: sandy loam
Cg2 - 39 to 59 inches: very gravelly coarse sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Very high
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: About 0 to 10 inches
Frequency of flooding: Frequent
Frequency of ponding: Frequent
Available water supply, 0 to 60 inches: Moderate (about 6.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Description of Issue

Setting

Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy alluvium

Typical profile

Ap - 0 to 4 inches: silt loam
Bw - 4 to 19 inches: loam
Bg1 - 19 to 30 inches: fine sandy loam
Bg2 - 30 to 58 inches: fine sandy loam
Ab - 58 to 70 inches: silt loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained

Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 10 to 20 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 9.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Hydric soil rating: No

Minor Components

Lenni, undrained

Percent of map unit: 5 percent
Landform: Depressions on fluviomarine terraces
Landform position (three-dimensional): Tread
Hydric soil rating: Yes

UdB—Udorthents, loamy, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 1qzwn
Elevation: 0 to 300 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents, loamy, and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents, Loamy

Setting

Landform: Broad interstream divides
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Fluviomarine deposits

Typical profile

AC - 0 to 2 inches: loam
C - 2 to 72 inches: gravelly loam

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to very high (0.01 to 19.98 in/hr)
Depth to water table: About 40 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 8.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Urban land

Percent of map unit: 7 percent
Landform: Flats
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Unranked

Beltsville

Percent of map unit: 3 percent
Landform: Broad interstream divides
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

UdD—Udorthents, loamy, 5 to 15 percent slopes

Map Unit Setting

National map unit symbol: 1qzwp
Elevation: 0 to 300 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 58 degrees F
Frost-free period: 175 to 220 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents, loamy, and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents, Loamy

Setting

Landform: Broad interstream divides
Down-slope shape: Linear, convex
Across-slope shape: Linear
Parent material: Fluviomarine deposits

Typical profile

AC - 0 to 2 inches: loam
C - 2 to 72 inches: gravelly loam

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to very high (0.01 to 19.98 in/hr)
Depth to water table: About 40 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 8.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Urban land

Percent of map unit: 7 percent
Landform: Flats
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Unranked

Beltsville

Percent of map unit: 3 percent
Landform: Broad interstream divides
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

WdaA—Woodstown sandy loam, 0 to 2 percent slopes, Northern Coastal Plain

Map Unit Setting

National map unit symbol: 2thvw
Elevation: 0 to 280 feet
Mean annual precipitation: 42 to 48 inches
Mean annual air temperature: 52 to 58 degrees F
Frost-free period: 180 to 220 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Woodstown and similar soils: 81 percent
Minor components: 19 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Woodstown

Setting

Landform: Depressions, flats, fluviomarine terraces, broad interstream divides
Landform position (two-dimensional): Footslope, summit
Landform position (three-dimensional): Tread, dip, talf
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Parent material: Loamy fluviomarine deposits

Typical profile

Ap - 0 to 7 inches: sandy loam
E - 7 to 11 inches: sandy loam
Bt - 11 to 29 inches: sandy loam
BCg - 29 to 45 inches: fine sandy loam
Cg - 45 to 80 inches: loamy sand

Properties and qualities

Slope: 0 to 2 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 high to high (0.57 to 1.98 in/hr)
Depth to water table: About 20 to 40 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 8.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Fallsington

Percent of map unit: 7 percent
Landform: Drainageways, depressions, swales, flats
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Dip, talf
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: Yes

Hammonton

Percent of map unit: 7 percent
Landform: Flats, broad interstream divides
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Hambrook

Percent of map unit: 5 percent
Landform: Flats, fluviomarine terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

WdaB—Woodstown sandy loam, 2 to 5 percent slopes, Northern Coastal Plain

Map Unit Setting

National map unit symbol: 2thvx
Elevation: 0 to 490 feet
Mean annual precipitation: 42 to 48 inches
Mean annual air temperature: 52 to 58 degrees F
Frost-free period: 180 to 220 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Woodstown and similar soils: 81 percent
Minor components: 19 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Woodstown

Setting

Landform: Flats, depressions, fluviomarine terraces, broad interstream divides
Landform position (two-dimensional): Shoulder, footslope

Landform position (three-dimensional): Riser, dip
Down-slope shape: Convex, concave
Across-slope shape: Linear, concave
Parent material: Loamy fluviomarine deposits

Typical profile

Ap - 0 to 7 inches: sandy loam
E - 7 to 11 inches: sandy loam
Bt - 11 to 29 inches: sandy loam
BCg - 29 to 45 inches: fine sandy loam
Cg - 45 to 80 inches: loamy sand

Properties and qualities

Slope: 2 to 5 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 high to high (0.57 to 1.98 in/hr)
Depth to water table: About 20 to 40 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 8.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Hammonton

Percent of map unit: 7 percent
Landform: Flats, broad interstream divides
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Dip
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Fallsington, occasionally ponded

Percent of map unit: 7 percent
Landform: Drainageways, depressions, swales, flats
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Dip, talf
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: Yes

Hambrook

Percent of map unit: 5 percent
Landform: Flats, fluviomarine terraces
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Riser, dip
Down-slope shape: Convex
Across-slope shape: Linear

Hydric soil rating: No

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Attachment 5
HYDROLOGIC ANALYSIS

NOAA Atlas 14, Volume 2, Version 3
Location name: Port Tobacco, Maryland, USA*
Latitude: 38.5079°, Longitude: -77.0678°
Elevation: 156.5 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.364 (0.330-0.401)	0.437 (0.397-0.481)	0.520 (0.471-0.572)	0.580 (0.524-0.638)	0.656 (0.589-0.723)	0.713 (0.637-0.786)	0.770 (0.684-0.851)	0.825 (0.728-0.915)	0.897 (0.783-1.00)	0.953 (0.825-1.07)
10-min	0.582 (0.527-0.640)	0.700 (0.634-0.769)	0.832 (0.754-0.916)	0.927 (0.838-1.02)	1.05 (0.939-1.15)	1.14 (1.01-1.25)	1.22 (1.09-1.35)	1.31 (1.15-1.45)	1.42 (1.24-1.58)	1.50 (1.30-1.68)
15-min	0.728 (0.659-0.800)	0.879 (0.797-0.967)	1.05 (0.954-1.16)	1.17 (1.06-1.29)	1.33 (1.19-1.46)	1.44 (1.29-1.59)	1.55 (1.37-1.71)	1.65 (1.46-1.83)	1.79 (1.56-1.99)	1.88 (1.63-2.11)
30-min	0.998 (0.904-1.10)	1.22 (1.10-1.34)	1.50 (1.36-1.65)	1.70 (1.54-1.87)	1.96 (1.76-2.16)	2.17 (1.94-2.39)	2.37 (2.11-2.62)	2.57 (2.27-2.85)	2.84 (2.48-3.17)	3.05 (2.64-3.42)
60-min	1.24 (1.13-1.37)	1.52 (1.38-1.68)	1.92 (1.74-2.11)	2.21 (2.00-2.44)	2.61 (2.35-2.88)	2.93 (2.62-3.24)	3.26 (2.90-3.60)	3.60 (3.18-4.00)	4.08 (3.56-4.55)	4.45 (3.86-4.99)
2-hr	1.46 (1.32-1.61)	1.78 (1.61-1.97)	2.25 (2.04-2.49)	2.62 (2.36-2.89)	3.14 (2.81-3.47)	3.57 (3.17-3.94)	4.01 (3.54-4.44)	4.48 (3.93-4.97)	5.15 (4.46-5.74)	5.69 (4.88-6.38)
3-hr	1.58 (1.42-1.76)	1.92 (1.73-2.14)	2.44 (2.19-2.71)	2.84 (2.54-3.16)	3.42 (3.04-3.81)	3.90 (3.44-4.34)	4.41 (3.86-4.91)	4.95 (4.30-5.53)	5.73 (4.91-6.43)	6.38 (5.39-7.19)
6-hr	1.94 (1.75-2.17)	2.35 (2.12-2.63)	2.97 (2.67-3.32)	3.48 (3.11-3.88)	4.22 (3.75-4.71)	4.86 (4.27-5.41)	5.54 (4.83-6.19)	6.29 (5.41-7.04)	7.39 (6.26-8.32)	8.32 (6.94-9.41)
12-hr	2.34 (2.10-2.64)	2.83 (2.54-3.19)	3.60 (3.22-4.04)	4.25 (3.78-4.77)	5.24 (4.61-5.87)	6.10 (5.31-6.84)	7.06 (6.07-7.93)	8.13 (6.90-9.15)	9.76 (8.11-11.0)	11.2 (9.13-12.7)
24-hr	2.67 (2.41-3.01)	3.24 (2.93-3.65)	4.20 (3.80-4.73)	5.04 (4.54-5.66)	6.31 (5.64-7.06)	7.43 (6.59-8.29)	8.70 (7.65-9.67)	10.1 (8.82-11.2)	12.3 (10.6-13.6)	14.2 (12.0-15.7)
2-day	3.07 (2.76-3.45)	3.73 (3.35-4.19)	4.83 (4.34-5.42)	5.77 (5.17-6.48)	7.20 (6.41-8.04)	8.45 (7.47-9.41)	9.84 (8.62-11.0)	11.4 (9.90-12.7)	13.8 (11.8-15.3)	15.8 (13.4-17.6)
3-day	3.25 (2.94-3.65)	3.95 (3.56-4.43)	5.09 (4.59-5.70)	6.07 (5.45-6.79)	7.54 (6.73-8.41)	8.82 (7.83-9.82)	10.2 (9.01-11.4)	11.8 (10.3-13.1)	14.2 (12.3-15.8)	16.3 (13.9-18.1)
4-day	3.44 (3.11-3.85)	4.17 (3.77-4.66)	5.36 (4.84-5.99)	6.37 (5.73-7.11)	7.89 (7.05-8.78)	9.20 (8.18-10.2)	10.7 (9.40-11.8)	12.3 (10.7-13.6)	14.7 (12.7-16.3)	16.8 (14.4-18.6)
7-day	3.99 (3.64-4.39)	4.81 (4.40-5.30)	6.08 (5.57-6.70)	7.17 (6.54-7.88)	8.78 (7.97-9.65)	10.2 (9.17-11.1)	11.7 (10.5-12.8)	13.4 (11.9-14.6)	15.8 (13.9-17.3)	18.0 (15.6-19.7)
10-day	4.56 (4.19-4.98)	5.47 (5.04-5.98)	6.82 (6.28-7.45)	7.95 (7.30-8.67)	9.58 (8.75-10.4)	10.9 (9.95-11.9)	12.4 (11.2-13.5)	14.0 (12.6-15.2)	16.3 (14.5-17.7)	18.2 (16.0-19.8)
20-day	6.12 (5.70-6.60)	7.28 (6.78-7.85)	8.81 (8.19-9.50)	10.0 (9.32-10.8)	11.8 (10.9-12.7)	13.2 (12.1-14.1)	14.6 (13.4-15.7)	16.1 (14.7-17.3)	18.2 (16.5-19.5)	19.9 (17.9-21.4)
30-day	7.55 (7.05-8.09)	8.94 (8.35-9.58)	10.6 (9.94-11.4)	12.0 (11.2-12.9)	13.9 (12.9-14.8)	15.3 (14.2-16.4)	16.8 (15.6-18.0)	18.4 (16.9-19.7)	20.5 (18.7-21.9)	22.1 (20.1-23.7)
45-day	9.48 (8.90-10.1)	11.2 (10.5-11.9)	13.1 (12.3-13.9)	14.6 (13.7-15.5)	16.5 (15.4-17.5)	18.0 (16.8-19.1)	19.4 (18.1-20.6)	20.8 (19.4-22.1)	22.6 (21.0-24.1)	24.0 (22.1-25.6)
60-day	11.3 (10.6-11.9)	13.3 (12.5-14.0)	15.4 (14.5-16.2)	16.9 (15.9-17.9)	18.9 (17.8-20.0)	20.4 (19.1-21.5)	21.8 (20.4-23.0)	23.1 (21.6-24.5)	24.8 (23.1-26.3)	26.0 (24.2-27.6)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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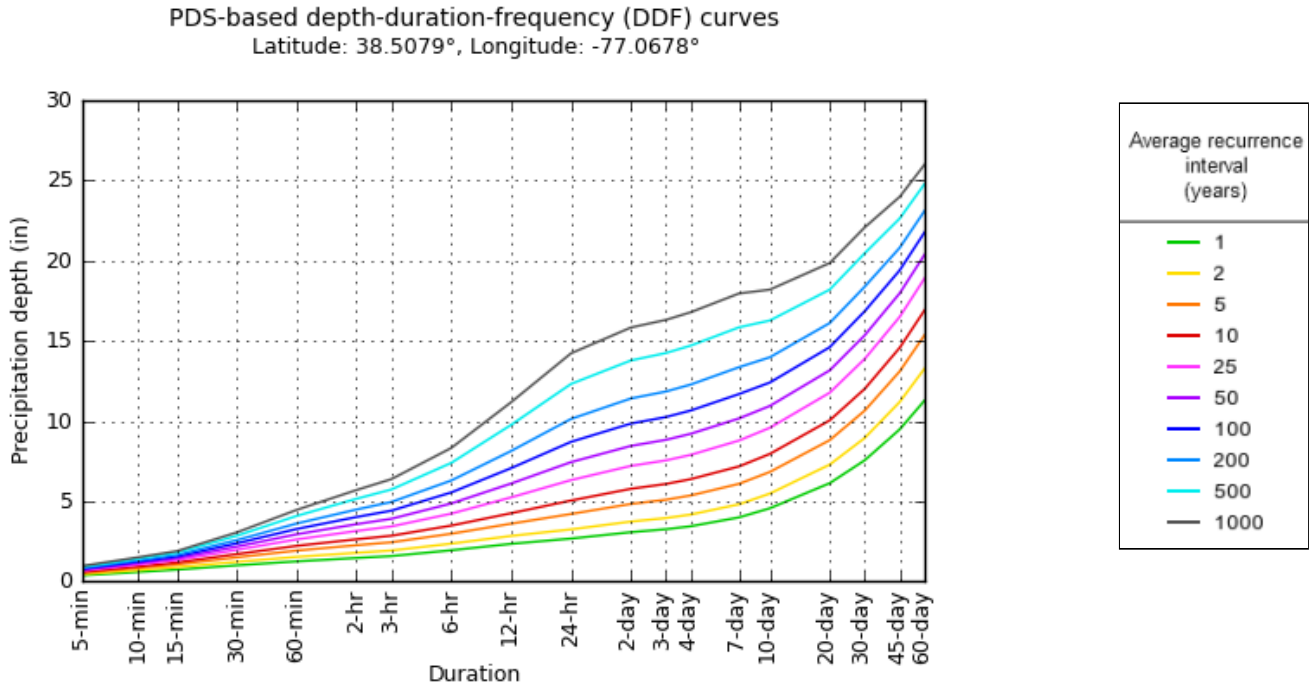
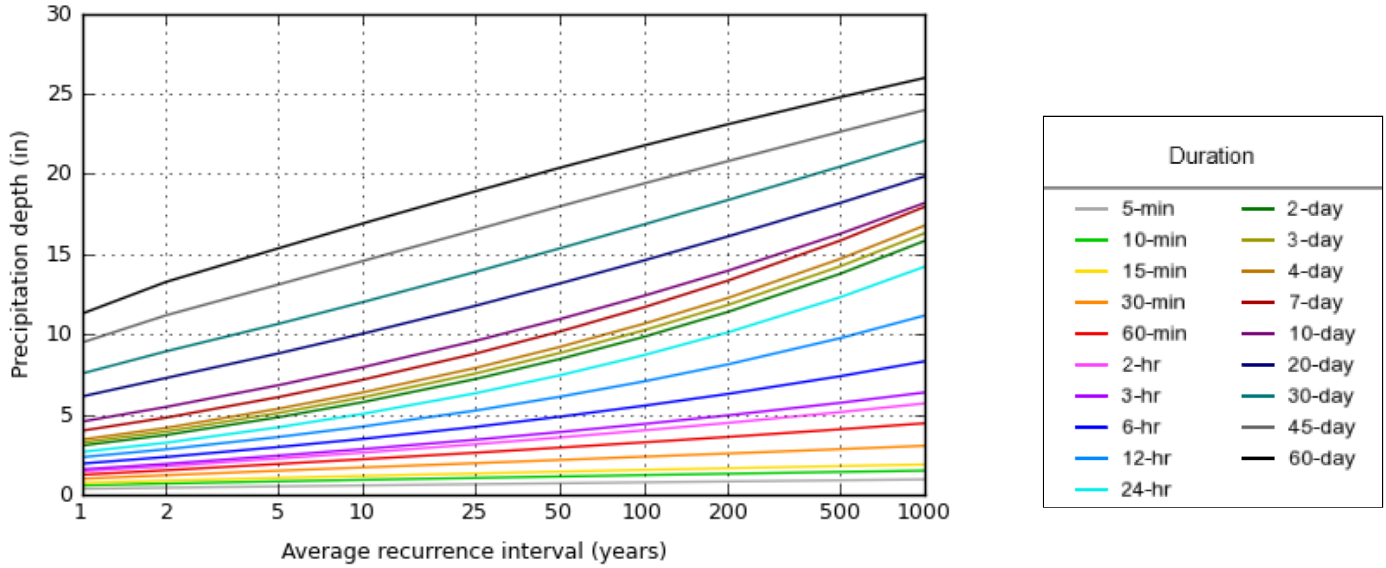
PF graphical





NOAA Atlas 14, Volume 2, Version 3 Created (GMT): Tue Nov 15 21:38:35 2022

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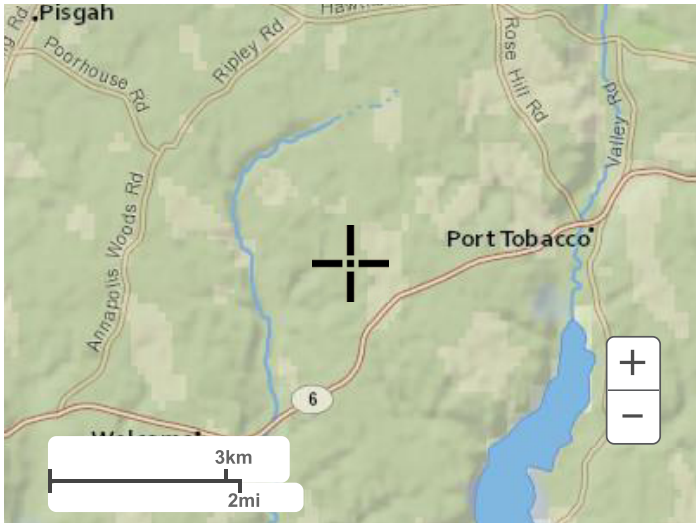
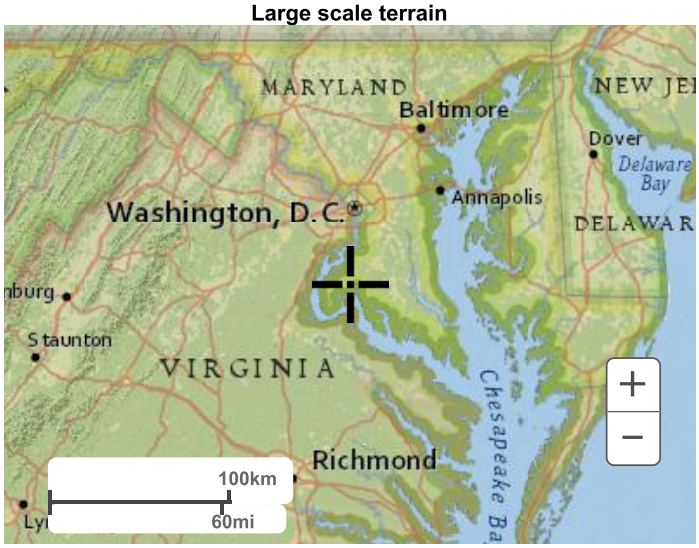
Maps & aerials

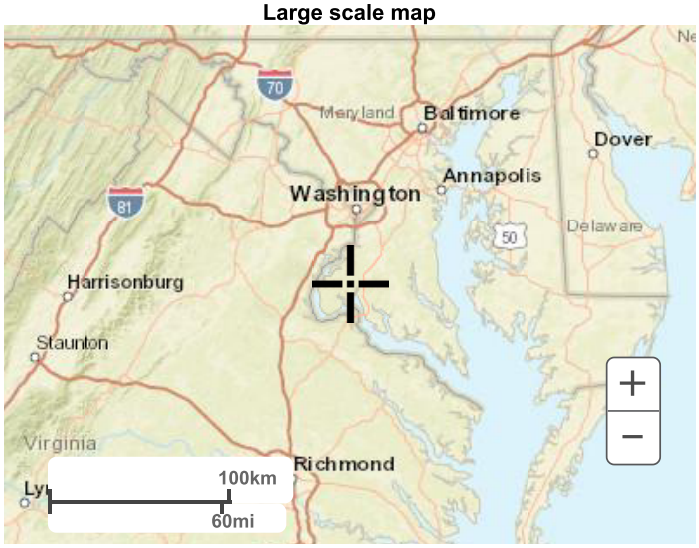
Small scale terrain



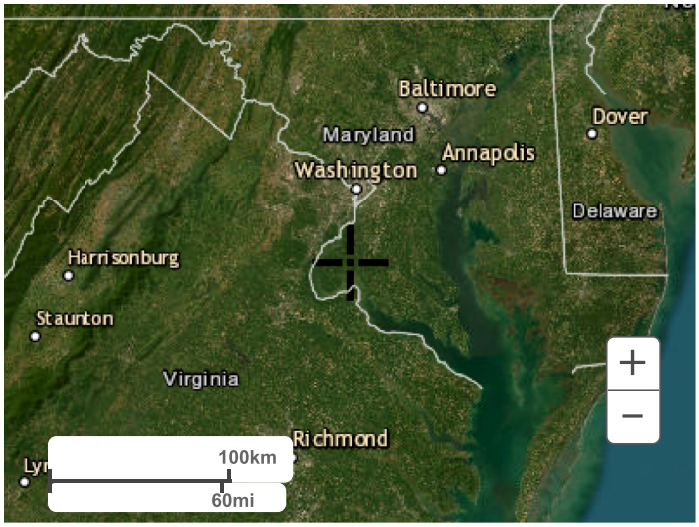
Large scale terrain



Large scale map



Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

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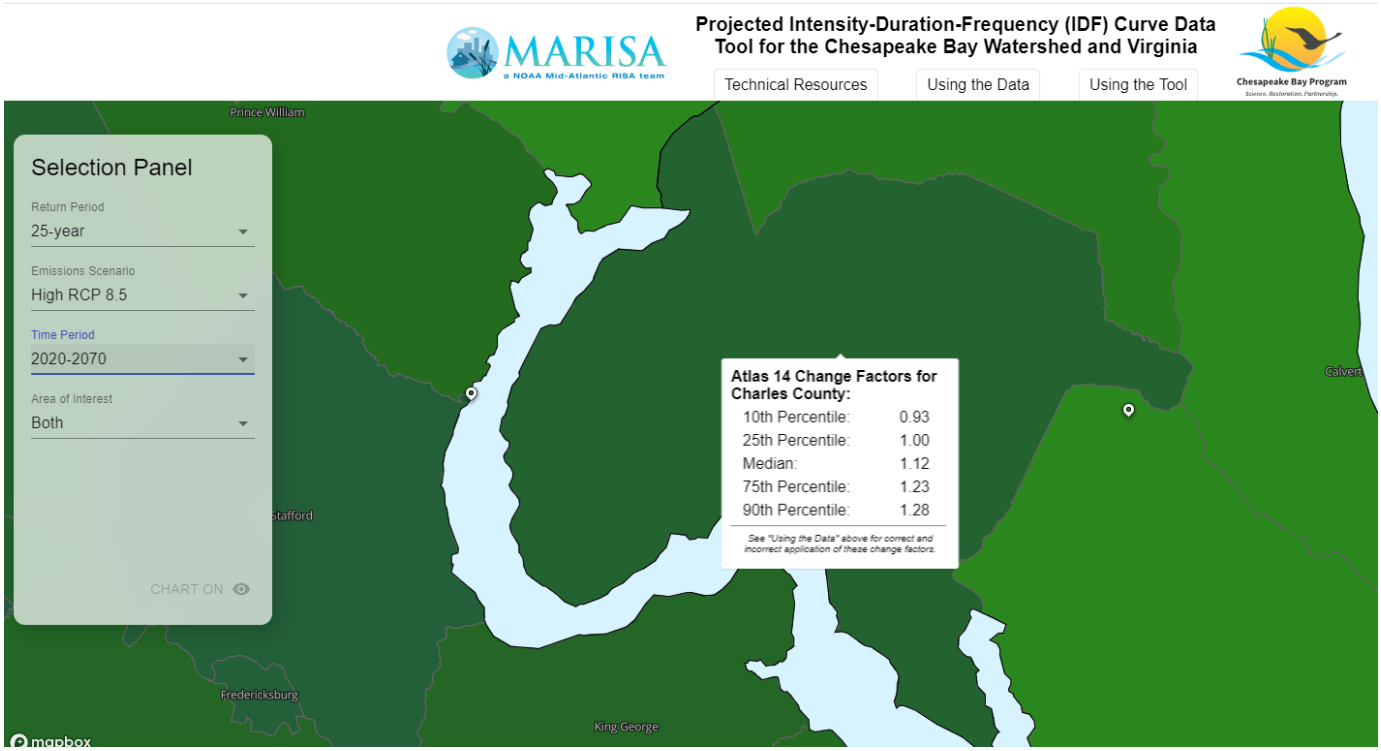
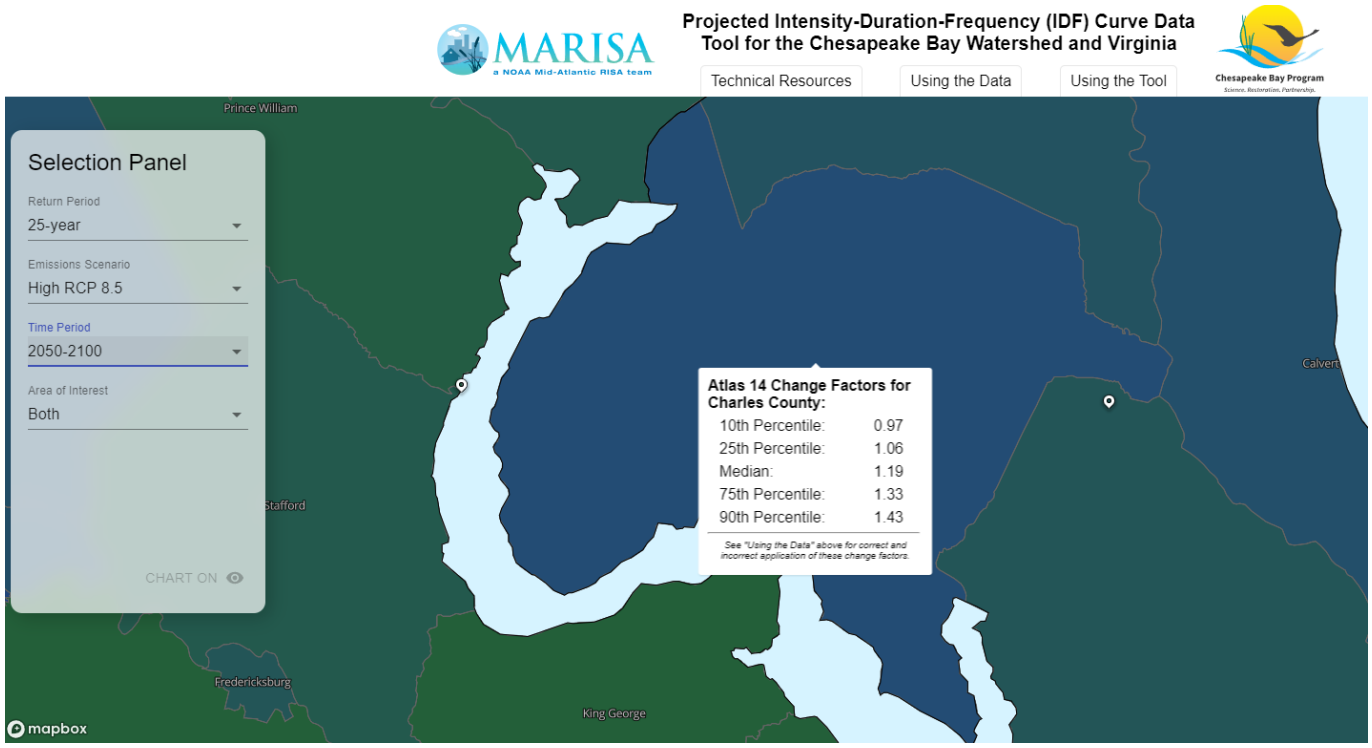

MARISA
a NOAA Mid-Atlantic RISA team
Projected Intensity-Duration-Frequency (IDF) Curve Data Tool for the Chesapeake Bay Watershed and Virginia
Technical Resources
Using the Data
Using the Tool
Chesapeake Bay Program
Science. Restoration. Partnership.
Prince William
Selection Panel
Return Period
25-year
Emissions Scenario
High RCP 8.5
Time Period
2020-2070
Area of Interest
Both
CHART ON
Atlas 14 Change Factors for Charles County:
10th Percentile: 0.93
25th Percentile: 1.00
Median: 1.12
75th Percentile: 1.23
90th Percentile: 1.28
See "Using the Data" above for correct and incorrect application of these change factors.
Stafford
Fredericksburg
King George
mapbox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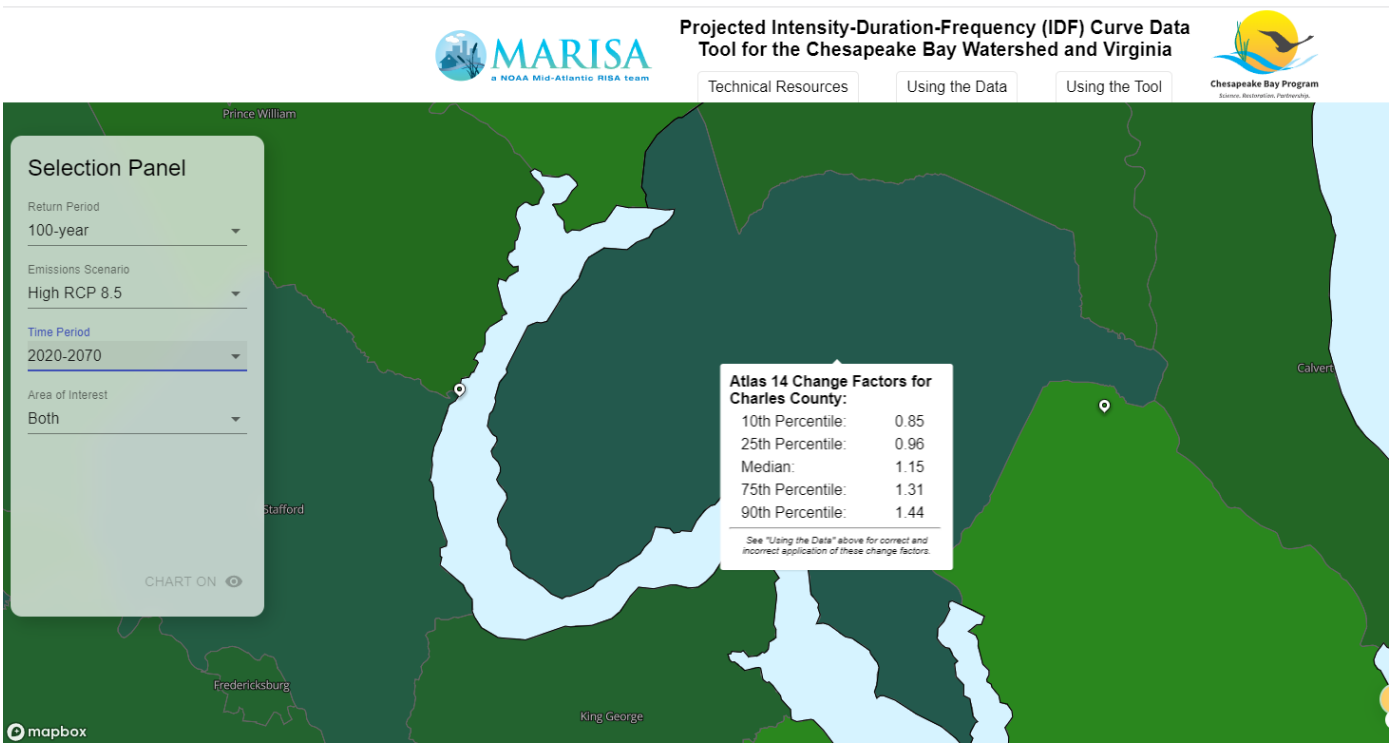
Prince William
Selection Panel
Return Period
25-year
Emissions Scenario
High RCP 8.5
Time Period
2050-2100
Area of Interest
Both
CHART ON
Atlas 14 Change Factors for Charles County:
10th Percentile: 0.97
25th Percentile: 1.06
Median: 1.19
75th Percentile: 1.33
90th Percentile: 1.43
See "Using the Data" above for correct and incorrect application of these change factors.
Stafford
Fredericksburg
King George
mapbox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Technical Resources
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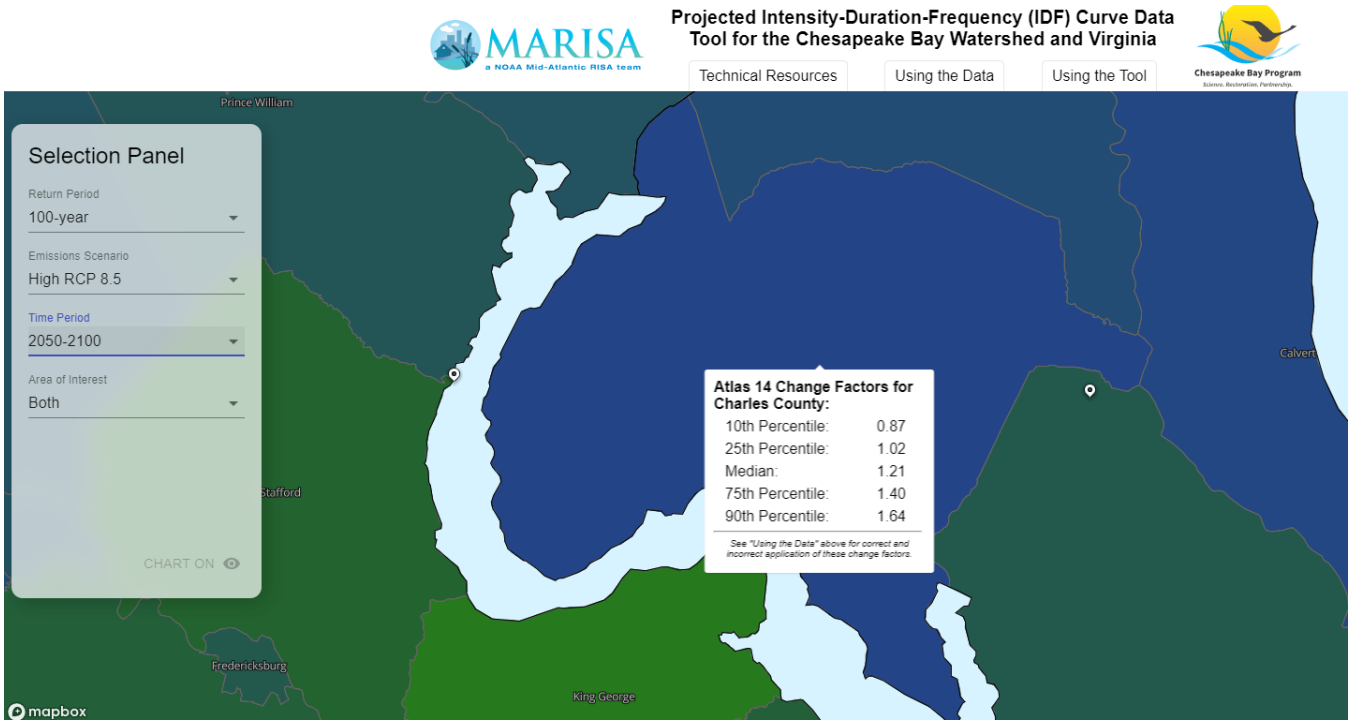
Chesapeake Bay Program
Prince William
Selection Panel
Return Period
100-year
Emissions Scenario
High RCP 8.5
Time Period
2020-2070
Area of Interest
Both
CHART ON
Atlas 14 Change Factors for Charles County:
10th Percentile: 0.85
25th Percentile: 0.96
Median: 1.15
75th Percentile: 1.31
90th Percentile: 1.44
See "Using the Data" above for correct and incorrect application of these change factors.
Calvert
Stafford
Fredericksburg
King George
mapbox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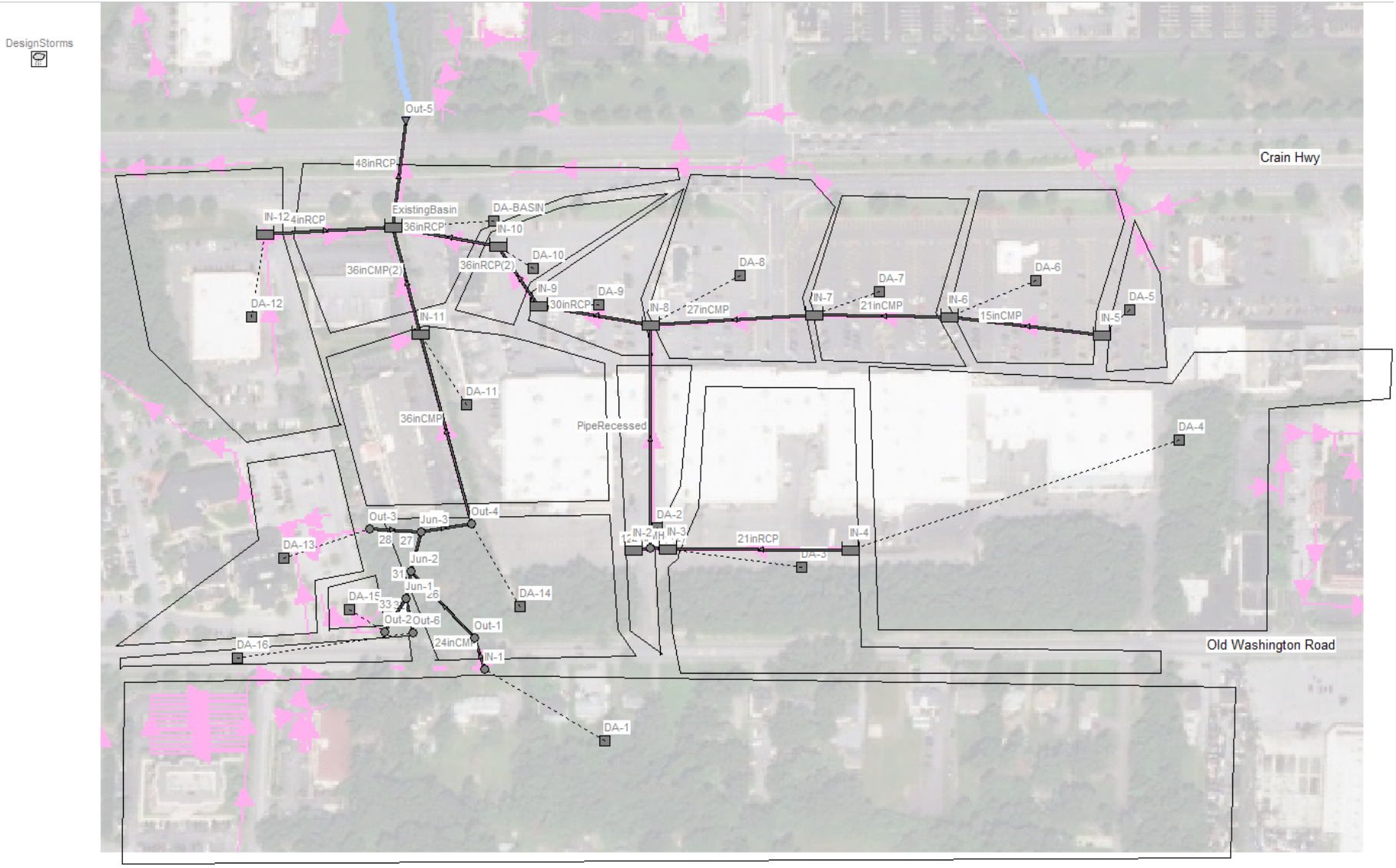
Prince William
Selection Panel
Return Period
100-year
Emissions Scenario
High RCP 8.5
Time Period
2050-2100
Area of Interest
Both
CHART ON
Atlas 14 Change Factors for Charles County:
10th Percentile: 0.87
25th Percentile: 1.02
Median: 1.21
75th Percentile: 1.40
90th Percentile: 1.64
See "Using the Data" above for correct and incorrect application of these change factors.
Calvert
Stafford
Fredericksburg
King George
mapbox

Attachment 6
HYDRAULIC ANALYSIS

Location 10: Old Washington Rd. and Shoppers World SWMM Schematic



```

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.0)
--------------------------------------------------------------
```

Location 10: Old Washington Rd. and Shoppers World (25-Year - EXISTING)

```
****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Surcharge Method ......... EXTRAN
Starting Date ............ 10/01/2022 00:00:00
Ending Date .............. 10/02/2022 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 01:00:00
Routing Time Step ........ 20.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 8
Number of Threads ........ 1
Head Tolerance ........... 0.005000 ft


**************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
**************************     ---------       -------
Total Precipitation ......        54.673         6.303
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         6.531         0.753
Surface Runoff ...........        47.470         5.473
Final Storage ............         0.758         0.087
Continuity Error (%) .....        -0.158


**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......        47.472        15.469
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........        47.429        15.455
Flooding Loss ............         0.020         0.006
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.030         0.010
Continuity Error (%) .....        -0.015


***************************
Time-Step Critical Elements
***************************
Link 24inRcp(2) (62.94%)
Link 12inRCP (27.87%)
Link 27 (5.27%)
Link 36inCMP (2.44%)
```

```
********************************
Highest Flow Instability Indexes
********************************
Link 12inRCP (15)
Link 24inRcp(2) (12)
Link PipeRecessed (7)
Link 31 (1)
Link 33 (1)


*********************************
Most Frequent Nonconverging Nodes
*********************************
Node Out-5 (0.04%)
Node IN-2 (0.02%)
Node IN-1 (0.01%)
Node MH-1 (0.01%)
Node IN-4 (0.01%)


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.50 sec
Average Time Step           :     3.71 sec
Maximum Time Step           :    20.00 sec
% of Time in Steady State   :     0.00
Average Iterations per Step :     2.04
% of Steps Not Converging   :     0.04
Time Step Frequencies       :
   20.000 -  9.564 sec      :     0.21 %
    9.564 -  4.573 sec      :    18.50 %
    4.573 -  2.187 sec      :    70.93 %
    2.187 -  1.046 sec      :     9.27 %
    1.046 -  0.500 sec      :     1.10 %


***************************
Subcatchment Runoff Summary
***************************


--------------------------------------------------------------------------------------------------------------------------------------
                          Total      Total      Total      Total     Imperv
                          Perv      Total       Total     Peak  Runoff
                         Precip      Runon       Evap      Infil     Runoff
                         Runoff     Runoff      Runoff   Runoff   Coeff
Subcatchment                 in         in          in         in         in
in         in    10^6 gal      CFS

--------------------------------------------------------------------------------------------------------------------------------------
DA-1                        6.30       0.00       0.00       0.89       3.19
2.11       5.30        9.30   231.68   0.841
DA-2                        6.30       0.00       0.00       0.15       5.72
0.42       6.13        0.18     9.22   0.973
DA-3                        6.30       0.00       0.00       1.24       1.57
3.44       5.01        0.65    22.50   0.795
DA-4                        6.30       0.00       0.00       0.51       4.33
1.42       5.75        1.38    53.53   0.913
DA-5                        6.30       0.00       0.00       0.02       6.21
0.05       6.26        0.10     4.94   0.993
DA-6                        6.30       0.00       0.00       0.11       5.84
0.32       6.17        0.35    17.38   0.979
DA-7                        6.30       0.00       0.00       0.18       5.59
0.51       6.10        0.28    13.96   0.968
DA-8                        6.30       0.00       0.00       0.16       5.66
```

```
0.46       6.12        0.40    20.16   0.971
DA-9                       6.30       0.00       0.00       0.11       5.84
0.32       6.17        0.24    12.44   0.979
DA-10                      6.30       0.00       0.00       0.28       5.22
0.79       6.00        0.13     6.52   0.952
DA-11                      6.30       0.00       0.00       0.18       5.59
0.51       6.10        0.69    34.10   0.968
DA-12                      6.30       0.00       0.00       0.58       4.08
1.62       5.70        0.55    26.24   0.904
DA-13                      6.30       0.00       0.00       0.40       5.28
0.60       5.88        0.27    13.61   0.933
DA-14                      6.30       0.00       0.00       1.26       2.14
2.87       5.01        0.39    15.82   0.795
DA-15                      6.30       0.00       0.00       0.31       5.08
0.88       5.96        0.05     2.40   0.946
DA-16                      6.30       0.00       0.00       0.45       4.59
1.25       5.83        0.08     3.60   0.925
DA-BASIN                   6.30       0.00       0.00       0.44       4.59
1.25       5.84        0.43    21.48   0.926


******************
Node Depth Summary
******************

--------------------------------------------------------------------------------
                                Average  Maximum  Maximum  Time of Max    Reported
                                  Depth    Depth      HGL   Occurrence   Max Depth
Node                 Type          Feet     Feet     Feet  days hr:min        Feet
--------------------------------------------------------------------------------
MH-1                 JUNCTION      0.95     4.28   207.02     0  12:22        4.27
Out-4                JUNCTION      3.21     6.64   205.15     0  12:14        6.64
IN-1                 JUNCTION      2.87     5.46   206.56     0  14:13        5.46
Out-1                JUNCTION      1.69     4.17   205.17     0  12:14        4.17
Out-3                JUNCTION      0.52     2.55   205.16     0  12:14        2.55
Out-6                JUNCTION      0.78     3.16   205.16     0  12:14        3.16
Out-2                JUNCTION      0.78     3.16   205.16     0  12:14        3.16
Jun-1                JUNCTION      1.44     4.16   205.16     0  12:14        4.16
Jun-2                JUNCTION      1.54     4.26   205.16     0  12:14        4.26
Jun-3                JUNCTION      1.69     4.76   205.16     0  12:14        4.76
Out-5                OUTFALL       0.00     0.00     0.00     0  00:00        0.00
IN-2                 STORAGE       0.60     4.18   207.28     0  12:06        4.13
IN-3                 STORAGE       0.94     4.39   207.15     0  12:19        4.39
ExistingBasin        STORAGE       0.92     3.16   201.36     0  12:01        3.10
IN-4                 STORAGE       0.80     5.00   208.12     0  12:26        5.00
IN-12                STORAGE       0.19     1.84   204.74     0  12:00        1.82
IN-11                STORAGE       2.08     4.47   203.10     0  12:09        4.43
IN-10                STORAGE       0.50     2.81   202.98     0  12:00        2.79
IN-9                 STORAGE       0.69     3.39   203.77     0  12:00        3.38
IN-8                 STORAGE       0.49     3.76   206.03     0  12:00        3.73
IN-5                 STORAGE       0.21     4.15   211.44     0  12:06        4.11
IN-6                 STORAGE       0.35     4.38   210.15     0  12:10        4.37
IN-7                 STORAGE       0.37     4.27   208.12     0  12:06        4.19


*******************
Node Inflow Summary
*******************


--------------------------------------------------------------------------------
----------
                                Maximum  Maximum                  Lateral
                                Total        Flow
                                Lateral    Total  Time of Max      Inflow
                                Inflow     Balance
                                 Inflow   Inflow   Occurrence      Volume
                                 Volume       Error
Node                 Type           CFS      CFS  days hr:min    10^6 gal    10^6
```

```
gal     Percent
---------------------------------------------------------------------------------------
----------
MH-1                 JUNCTION      0.00    26.33     0  12:02           0
2.23      -0.054
Out-4                JUNCTION     15.82    44.91     0  12:00       0.393
10.1       0.038
IN-1                 JUNCTION    231.68   231.68     0  12:05         9.3
9.3      -0.005
Out-1                JUNCTION      0.00    27.96     0  11:38           0
9.31       0.010
Out-3                JUNCTION     13.61    13.61     0  12:00       0.272
0.272      -0.005
Out-6                JUNCTION      3.60     3.60     0  12:00       0.076
0.0765       0.012
Out-2                JUNCTION      2.40     2.40     0  12:00      0.0453
0.0458       0.049
Jun-1                JUNCTION      0.00     8.36     0  22:37           0
0.126       0.166
Jun-2                JUNCTION      0.00    27.89     0  11:40           0
9.43       0.011
Jun-3                JUNCTION      0.00    31.77     0  12:00           0
9.7      -0.007
Out-5                OUTFALL       0.00   143.11     0  12:01           0
15.5       0.000
IN-2                 STORAGE       9.22     9.22     0  12:00       0.182
0.204       0.115
IN-3                 STORAGE      22.50    30.40     0  12:00       0.652
2.02       0.008
ExistingBasin        STORAGE      21.48   145.48     0  12:00       0.431
15.5       0.004
IN-4                 STORAGE      53.53    53.53     0  12:00        1.38
1.38       0.047
IN-12                STORAGE      26.24    26.24     0  12:00       0.549
0.549       0.003
IN-11                STORAGE      34.10    56.30     0  12:00       0.686
10.8       0.008
IN-10                STORAGE       6.52    62.96     0  12:00       0.129
3.7       0.001
IN-9                 STORAGE      12.44    56.60     0  12:00       0.245
3.58      -0.005
IN-8                 STORAGE      20.16    44.92     0  12:00       0.402
3.33       0.013
IN-5                 STORAGE       4.94     4.94     0  12:00      0.0952
0.0952       0.034
IN-6                 STORAGE      17.38    19.82     0  12:00       0.353
0.449       0.114
IN-7                 STORAGE      13.96    21.76     0  12:00       0.275
0.723      -0.037


**********************
Node Surcharge Summary
**********************

Surcharging occurs when water rises above the top of the highest conduit.
-----------------------------------------------------------------------
                                            Max. Height   Min. Depth
                                  Hours     Above Crown    Below Rim
Node                 Type      Surcharged         Feet         Feet
-----------------------------------------------------------------------
MH-1                 JUNCTION        2.81        2.282        0.000
Out-4                JUNCTION       11.27        2.639        0.000
IN-1                 JUNCTION       11.84        3.459        0.000
Out-1                JUNCTION        0.45        0.175        0.825
Jun-1                JUNCTION        0.43        0.164        0.836
Jun-2                JUNCTION        0.57        0.264        0.736
Jun-3                JUNCTION        1.17        0.758        0.242
```

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
MH-1	1.60	15.17	0 12:00	0.106	0.282
Out-4	11.27	22.30	0 12:00	0.216	2.639
IN-1	10.94	212.65	0 12:05	3.429	0.459
IN-4	0.15	3.39	0 12:26	0.006	0.000

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	Evap Loss	Exfil Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CFS
IN-2	0.015	0	0	0	1.698	3	0 12:06	5.44
IN-3	0.156	0	0	0	7.614	15	0 12:19	21.00
ExistingBasin	0.979	6	0	0	6.740	43	0 12:01	143.11
IN-4	1.888	4	0	0	50.041	100	0 12:26	13.48
IN-12	0.002	0	0	0	0.017	0	0 12:00	26.09
IN-11	0.117	0	0	0	10.860	22	0 12:09	39.93
IN-10	0.005	0	0	0	0.025	0	0 12:00	62.92
IN-9	0.006	0	0	0	0.031	0	0 12:00	56.52
IN-8	0.004	0	0	0	0.034	0	0 12:00	44.33
IN-5	0.008	0	0	0	1.172	2	0 12:06	2.52
IN-6	0.071	0	0	0	7.449	15	0 12:10	11.23
IN-7	0.023	0	0	0	3.632	7	0 12:06	17.51

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal

Out-5	99.80	21.00	143.11	15.454
System	99.80	21.00	143.11	15.454

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
24inCMP	CONDUIT	27.96	0 11:38	8.90	5.45	1.00
21inRCP	CONDUIT	13.48	0 13:29	5.61	2.69	1.00
12inRCP	CONDUIT	5.44	0 12:00	6.93	1.08	1.00
24inRcp(2)	CONDUIT	21.00	0 12:03	6.68	2.97	1.00
PipeRecessed	CONDUIT	20.20	0 12:20	6.75	5.30	1.00
15inCMP	CONDUIT	2.52	0 11:54	2.05	1.03	1.00
21inCMP	CONDUIT	11.23	0 12:24	4.67	1.57	1.00
27inCMP	CONDUIT	17.51	0 12:14	4.40	1.49	1.00
30inRCP	CONDUIT	44.33	0 12:00	9.03	1.20	1.00
36inRCP(2)	CONDUIT	56.52	0 12:00	8.14	2.58	0.95
36inRCP	CONDUIT	62.92	0 12:00	9.46	1.17	0.89
36inCMP(2)	CONDUIT	39.93	0 12:11	6.27	4.20	0.98
24inRCP	CONDUIT	26.09	0 12:00	8.81	1.08	0.91
48inRCP	CONDUIT	143.11	0 12:01	13.48	0.96	0.79
36inCMP	CONDUIT	30.24	0 12:40	4.28	4.65	1.00
26	CONDUIT	27.70	0 11:39	1.97	0.52	1.00
27	CONDUIT	27.03	0 11:40	2.44	0.15	1.00
28	CONDUIT	12.99	0 12:00	0.58	0.03	0.82
29	CONDUIT	29.39	0 12:00	1.08	0.10	1.00
31	CONDUIT	8.36	0 22:37	0.64	0.09	1.00
32	CONDUIT	3.06	0 12:00	0.23	0.01	0.90
33	CONDUIT	1.85	0 12:00	0.23	0.01	0.90

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
24inCMP	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
21inRCP	1.00	0.00	0.00	0.00	0.98	0.00	0.00	0.01	0.37	0.00
12inRCP	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.23	0.00
24inRcp(2)	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
PipeRecessed	1.00	0.00	0.00	0.00	0.02	0.00	0.00	0.97	0.00	0.00
15inCMP	1.00	0.00	0.00	0.00	0.74	0.00	0.00	0.25	0.30	0.00
21inCMP	1.00	0.00	0.00	0.00	0.05	0.00	0.00	0.95	0.00	0.00
27inCMP	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.91	0.00
30inRCP	1.00	0.00	0.00	0.00	0.02	0.09	0.00	0.89	0.01	0.00
36inRCP(2)	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
36inRCP	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
36inCMP(2)	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.98	0.00	0.00
24inRCP	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
48inRCP	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
36inCMP	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
26	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
27	1.00	0.00	0.01	0.00	0.99	0.00	0.00	0.00	0.02	0.00
28	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.61	0.00
29	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.58	0.00
31	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.02	0.00
32	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.60	0.00

```
33                      1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.60  0.00


*************************
Conduit Surcharge Summary
*************************

-------------------------------------------------------------------------------
                                                          Hours        Hours
                        --------- Hours Full --------   Above Full   Capacity
Conduit                 Both Ends  Upstream  Dnstream   Normal Flow   Limited
-------------------------------------------------------------------------------
24inCMP                     11.10     11.84     11.10     14.57        11.08
21inRCP                      2.84      2.85      2.85      2.88         2.83
12inRCP                      3.29      3.29      5.46      0.24         0.24
24inRcp(2)                   2.80      2.81      2.81      2.88         2.80
PipeRecessed                 0.37      2.81      0.37      3.75         0.37
15inCMP                      0.69      0.69      0.75      0.09         0.09
21inCMP                      0.65      0.71      0.66      0.74         0.65
27inCMP                      0.45      0.49      0.46      0.72         0.45
30inRCP                      0.24      0.32      0.24      0.52         0.24
36inRCP(2)                   0.01      0.20      0.01      1.77         0.01
36inRCP                      0.01      0.01      0.01      0.20         0.01
36inCMP(2)                   0.01      8.56      0.01     13.05         0.01
24inRCP                      0.01      0.01      0.01      0.05         0.01
36inCMP                      8.56      8.56     11.85     14.07         0.01
26                           0.45      0.45      0.57      0.01         0.01
27                           0.57      0.57      1.17      0.01         0.01
28                           0.01      0.01      1.17      0.01         0.01
29                           1.17      1.17     11.27      0.01         0.01
31                           0.43      0.43      0.57      0.01         0.01
32                           0.01      0.01      0.43      0.01         0.01
33                           0.01      0.01      0.43      0.01         0.01


Analysis begun on:  Tue Nov 15 17:08:12 2022
Analysis ended on:  Tue Nov 15 17:08:13 2022
Total elapsed time: 00:00:01
```

```

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.0)
------------------------------------------------------------
```

Location 10: Old Washington Rd. and Shoppers World (25-Year - 2050 - EXISTING)

```
****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Surcharge Method ......... EXTRAN
Starting Date ............ 10/01/2022 00:00:00
Ending Date .............. 10/02/2022 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 01:00:00
Routing Time Step ........ 20.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 8
Number of Threads ........ 1
Head Tolerance ........... 0.005000 ft


**************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
**************************     ---------       -------
Total Precipitation ......        61.292         7.066
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         6.713         0.774
Surface Runoff ...........        53.895         6.213
Final Storage ............         0.782         0.090
Continuity Error (%) .....        -0.162


**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......        53.896        17.563
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........        53.599        17.466
Flooding Loss ............         0.278         0.090
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.032         0.010
Continuity Error (%) .....        -0.023


***************************
Time-Step Critical Elements
***************************
Link 24inRcp(2) (65.29%)
Link 12inRCP (24.53%)
Link 27 (5.41%)
Link 36inCMP (2.82%)
```

```
********************************
Highest Flow Instability Indexes
********************************
Link 12inRCP (22)
Link 24inRcp(2) (19)
Link PipeRecessed (11)
Link 32 (1)
Link 33 (1)


*********************************
Most Frequent Nonconverging Nodes
*********************************
Node Out-5 (0.04%)
Node IN-2 (0.01%)
Node MH-1 (0.01%)
Node IN-1 (0.01%)
Node IN-3 (0.01%)


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.50 sec
Average Time Step           :     3.57 sec
Maximum Time Step           :    20.00 sec
% of Time in Steady State   :     0.00
Average Iterations per Step :     2.04
% of Steps Not Converging   :     0.04
Time Step Frequencies       :
   20.000 -  9.564 sec      :     0.17 %
    9.564 -  4.573 sec      :    17.69 %
    4.573 -  2.187 sec      :    68.30 %
    2.187 -  1.046 sec      :    12.46 %
    1.046 -  0.500 sec      :     1.37 %


***************************
Subcatchment Runoff Summary
***************************


-----------------------------------------------------------------------------------------------------------------------------------------
                          Total      Total      Total      Total     Imperv
                          Perv      Total       Total     Peak  Runoff
                         Precip      Runon       Evap      Infil     Runoff
                         Runoff     Runoff      Runoff   Runoff   Coeff
Subcatchment                 in         in          in         in         in
in         in    10^6 gal      CFS

-----------------------------------------------------------------------------------------------------------------------------------------
DA-1                         7.07       0.00       0.00       0.92       3.58
2.45       6.04       10.59   268.97   0.854
DA-2                         7.07       0.00       0.00       0.15       6.41
0.48       6.90        0.20    10.39   0.976
DA-3                         7.07       0.00       0.00       1.27       1.76
3.98       5.74        0.75    26.35   0.813
DA-4                         7.07       0.00       0.00       0.53       4.86
1.65       6.51        1.56    61.68   0.921
DA-5                         7.07       0.00       0.00       0.02       6.97
0.05       7.02        0.11     5.54   0.994
DA-6                         7.07       0.00       0.00       0.12       6.55
0.37       6.93        0.40    19.63   0.981
DA-7                         7.07       0.00       0.00       0.19       6.27
0.59       6.86        0.31    15.74   0.971
DA-8                         7.07       0.00       0.00       0.17       6.34
```

```
0.54       6.88        0.45    22.76   0.974
DA-9                       7.07       0.00       0.00       0.12       6.55
0.37       6.93        0.27    14.01   0.981
DA-10                      7.07       0.00       0.00       0.29       5.85
0.91       6.76        0.15     7.37   0.957
DA-11                      7.07       0.00       0.00       0.19       6.27
0.59       6.86        0.77    38.53   0.971
DA-12                      7.07       0.00       0.00       0.59       4.58
1.87       6.45        0.62    29.94   0.913
DA-13                      7.07       0.00       0.00       0.42       5.92
0.71       6.63        0.31    15.42   0.938
DA-14                      7.07       0.00       0.00       1.30       2.40
3.34       5.74        0.45    18.42   0.812
DA-15                      7.07       0.00       0.00       0.32       5.70
1.02       6.72        0.05     2.70   0.951
DA-16                      7.07       0.00       0.00       0.46       5.15
1.44       6.59        0.09     4.11   0.932
DA-BASIN                   7.07       0.00       0.00       0.46       5.15
1.44       6.59        0.49    24.39   0.932


******************
Node Depth Summary
******************

--------------------------------------------------------------------------------
                                Average  Maximum  Maximum  Time of Max    Reported
                                  Depth    Depth      HGL   Occurrence   Max Depth
Node                 Type          Feet     Feet     Feet  days hr:min        Feet
--------------------------------------------------------------------------------
MH-1                 JUNCTION      1.00     4.35   207.09     0  12:26        4.35
Out-4                JUNCTION      3.51     6.93   205.44     0  12:13        6.92
IN-1                 JUNCTION      3.21     5.57   206.67     0  14:28        5.57
Out-1                JUNCTION      1.87     4.46   205.46     0  12:12        4.45
Out-3                JUNCTION      0.62     2.84   205.45     0  12:12        2.83
Out-6                JUNCTION      0.93     3.45   205.45     0  12:12        3.44
Out-2                JUNCTION      0.92     3.45   205.45     0  12:12        3.44
Jun-1                JUNCTION      1.63     4.45   205.45     0  12:12        4.44
Jun-2                JUNCTION      1.73     4.55   205.45     0  12:12        4.54
Jun-3                JUNCTION      1.93     5.05   205.45     0  12:12        5.04
Out-5                OUTFALL       0.00     0.00     0.00     0  00:00        0.00
IN-2                 STORAGE       0.65     4.22   207.32     0  12:07        4.18
IN-3                 STORAGE       0.99     4.46   207.22     0  12:22        4.45
ExistingBasin        STORAGE       0.99     3.30   201.50     0  12:01        3.24
IN-4                 STORAGE       0.85     5.00   208.12     0  12:11        5.00
IN-12                STORAGE       0.20     2.62   205.52     0  12:00        2.57
IN-11                STORAGE       2.24     4.57   203.20     0  12:09        4.55
IN-10                STORAGE       0.53     3.07   203.24     0  12:00        3.03
IN-9                 STORAGE       0.73     3.69   204.07     0  12:00        3.60
IN-8                 STORAGE       0.52     4.01   206.28     0  12:00        3.97
IN-5                 STORAGE       0.23     4.18   211.47     0  12:07        4.14
IN-6                 STORAGE       0.38     4.43   210.20     0  12:10        4.43
IN-7                 STORAGE       0.40     4.32   208.17     0  12:07        4.25


*******************
Node Inflow Summary
*******************


--------------------------------------------------------------------------------
----------
                                Maximum  Maximum                  Lateral
                                Total        Flow
                                Lateral    Total  Time of Max      Inflow
                                Inflow     Balance
                                 Inflow   Inflow   Occurrence      Volume
                                 Volume       Error
Node                 Type           CFS      CFS  days hr:min    10^6 gal    10^6
```

```
gal     Percent
---------------------------------------------------------------------------------------
----------
MH-1                JUNCTION      0.00    27.22     0  12:02           0
2.44      -0.060
Out-4               JUNCTION     18.42    49.74     0  12:03        0.45
11.5       0.035
IN-1                JUNCTION    268.97   268.97     0  12:05        10.6
10.6       0.003
Out-1               JUNCTION      0.00    27.72     0  11:35           0
10.6       0.005
Out-3               JUNCTION     15.42    15.42     0  12:00       0.306
0.306       0.025
Out-6               JUNCTION      4.11     4.11     0  12:00      0.0858
0.0863       0.148
Out-2               JUNCTION      2.70     2.70     0  12:00      0.0511
0.0516       0.316
Jun-1               JUNCTION      0.00     8.80     1  00:29           0
0.141      -0.736
Jun-2               JUNCTION      0.00    27.60     0  11:37           0
10.7       0.005
Jun-3               JUNCTION      0.00    33.75     0  12:03           0
11      -0.021
Out-5               OUTFALL       0.00   148.63     0  12:01           0
17.5       0.000
IN-2                STORAGE      10.39    10.39     0  12:00       0.204
0.229       0.559
IN-3                STORAGE      26.35    34.39     0  12:00       0.747
2.21       0.008
ExistingBasin       STORAGE      24.39   151.92     0  12:00       0.487
17.5       0.004
IN-4                STORAGE      61.68    61.68     0  12:00        1.56
1.56       0.043
IN-12               STORAGE      29.94    29.94     0  12:00       0.622
0.622       0.003
IN-11               STORAGE      38.53    62.22     0  12:00       0.771
12.3       0.008
IN-10               STORAGE       7.37    65.09     0  11:59       0.145
4.1       0.001
IN-9                STORAGE      14.01    58.51     0  12:00       0.275
3.96      -0.003
IN-8                STORAGE      22.76    45.56     0  12:00       0.452
3.68       0.012
IN-5                STORAGE       5.54     5.54     0  12:00       0.107
0.107       0.053
IN-6                STORAGE      19.63    22.06     0  12:00       0.397
0.504       0.092
IN-7                STORAGE      15.74    23.54     0  12:00       0.309
0.813      -0.007


**********************
Node Surcharge Summary
**********************

Surcharging occurs when water rises above the top of the highest conduit.
-----------------------------------------------------------------------
                                            Max. Height   Min. Depth
                                  Hours     Above Crown    Below Rim
Node                Type      Surcharged          Feet         Feet
-----------------------------------------------------------------------
MH-1                JUNCTION        3.03         2.351        0.000
Out-4               JUNCTION       13.28         2.925        0.000
IN-1                JUNCTION       13.96         3.566        0.000
Out-1               JUNCTION        0.74         0.460        0.540
Jun-1               JUNCTION        0.72         0.452        0.548
Jun-2               JUNCTION        0.83         0.551        0.449
Jun-3               JUNCTION        1.46         1.045        0.000
```

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
MH-1	1.88	17.77	0 12:01	0.132	0.351
Out-4	13.28	24.99	0 11:59	0.239	2.925
IN-1	12.87	252.33	0 12:05	4.234	0.566
Jun-3	0.22	6.46	0 12:08	0.004	0.045
IN-4	0.47	22.31	0 12:11	0.090	0.000

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	Evap Loss	Exfil Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CFS
IN-2	0.026	0	0	0	2.490	5	0 12:07	5.47
IN-3	0.248	0	0	0	10.625	21	0 12:22	21.88
ExistingBasin	1.086	7	0	0	7.289	46	0 12:01	148.63
IN-4	2.096	4	0	0	50.041	100	0 12:11	13.49
IN-12	0.002	0	0	0	0.024	0	0 12:00	29.68
IN-11	0.220	0	0	0	16.429	33	0 12:09	40.83
IN-10	0.005	0	0	0	0.028	0	0 12:00	65.02
IN-9	0.007	0	0	0	0.033	0	0 12:00	57.86
IN-8	0.005	0	0	0	0.042	0	0 12:00	44.54
IN-5	0.014	0	0	0	1.624	3	0 12:07	2.52
IN-6	0.112	0	0	0	9.436	19	0 12:10	11.30
IN-7	0.041	0	0	0	5.285	11	0 12:07	17.66

****
Outfall Loading Summary
****

	Flow Freq	Avg Flow	Max Flow	Total Volume

Outfall Node	Pcnt	CFS	CFS	10^6 gal
Out-5	99.81	23.58	148.63	17.465
System	99.81	23.58	148.63	17.465

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
24inCMP	CONDUIT	27.72	0 11:35	8.82	5.40	1.00
21inRCP	CONDUIT	13.49	0 13:44	5.61	2.69	1.00
12inRCP	CONDUIT	5.47	0 11:58	6.96	1.09	1.00
24inRcp(2)	CONDUIT	21.88	0 12:03	6.96	3.09	1.00
PipeRecessed	CONDUIT	20.44	0 12:24	6.82	5.36	1.00
15inCMP	CONDUIT	2.52	0 11:53	2.05	1.03	1.00
21inCMP	CONDUIT	11.30	0 12:37	4.70	1.58	1.00
27inCMP	CONDUIT	17.66	0 12:15	4.44	1.50	1.00
30inRCP	CONDUIT	44.54	0 11:59	9.07	1.21	1.00
36inRCP(2)	CONDUIT	57.86	0 11:59	8.22	2.65	1.00
36inRCP	CONDUIT	65.02	0 12:00	9.51	1.21	0.93
36inCMP(2)	CONDUIT	40.83	0 12:12	6.39	4.30	1.00
24inRCP	CONDUIT	29.68	0 12:00	9.56	1.23	0.96
48inRCP	CONDUIT	148.63	0 12:01	13.50	1.00	0.86
36inCMP	CONDUIT	30.39	0 12:51	4.30	4.67	1.00
26	CONDUIT	27.49	0 11:36	1.91	0.51	1.00
27	CONDUIT	26.90	0 11:37	2.44	0.15	1.00
28	CONDUIT	14.69	0 12:00	0.61	0.04	0.85
29	CONDUIT	33.22	0 12:03	1.04	0.11	1.00
31	CONDUIT	8.80	1 00:29	0.68	0.10	1.00
32	CONDUIT	3.94	0 12:03	0.24	0.01	0.93
33	CONDUIT	2.23	0 11:59	0.24	0.01	0.93

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
24inCMP	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
21inRCP	1.00	0.00	0.00	0.00	0.98	0.00	0.00	0.01	0.36	0.00
12inRCP	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.21	0.00
24inRcp(2)	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
PipeRecessed	1.00	0.00	0.00	0.00	0.02	0.00	0.00	0.97	0.00	0.00
15inCMP	1.00	0.00	0.00	0.00	0.75	0.00	0.00	0.24	0.37	0.00
21inCMP	1.00	0.00	0.00	0.00	0.06	0.00	0.00	0.94	0.00	0.00
27inCMP	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.91	0.00
30inRCP	1.00	0.00	0.00	0.00	0.02	0.09	0.00	0.88	0.01	0.00
36inRCP(2)	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
36inRCP	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
36inCMP(2)	1.00	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.00	0.00
24inRCP	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
48inRCP	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
36inCMP	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
26	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
27	1.00	0.00	0.01	0.00	0.99	0.00	0.00	0.00	0.02	0.00
28	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.55	0.00
29	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.50	0.00
31	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.02	0.00

32	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.54	0.00
33	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.53	0.00

****
Conduit Surcharge Summary
****

Conduit	Hours Full Both Ends	Hours Full Upstream	Hours Full Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
24inCMP	13.10	13.96	13.11	16.75	13.00
21inRCP	3.06	3.08	3.08	3.13	3.06
12inRCP	3.65	3.65	6.20	0.25	0.25
24inRcp(2)	3.03	3.03	3.03	3.14	3.02
PipeRecessed	0.41	3.03	0.41	4.21	0.41
15inCMP	0.83	0.83	0.88	0.08	0.09
21inCMP	0.76	0.84	0.77	0.87	0.76
27inCMP	0.55	0.58	0.55	0.85	0.55
30inRCP	0.27	0.36	0.27	0.61	0.27
36inRCP(2)	0.01	0.23	0.01	2.05	0.01
36inRCP	0.01	0.03	0.01	0.24	0.01
36inCMP(2)	0.01	10.42	0.01	15.47	0.01
24inRCP	0.01	0.07	0.01	0.12	0.01
36inCMP	10.42	10.42	13.92	16.33	0.01
26	0.74	0.74	0.83	0.01	0.01
27	0.83	0.83	1.46	0.01	0.01
28	0.01	0.01	1.46	0.01	0.01
29	1.46	1.46	13.28	0.01	0.01
31	0.72	0.72	0.83	0.01	0.01
32	0.01	0.01	0.72	0.01	0.01
33	0.01	0.01	0.72	0.01	0.01

Analysis begun on: Tue Nov 15 17:10:59 2022
Analysis ended on: Tue Nov 15 17:10:59 2022
Total elapsed time: < 1 sec

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.0)
------------------------------------------------------------
```

Location 10: Old Washington Rd. and Shoppers World (25-Year - 2100 - EXISTING)

```
****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Surcharge Method ......... EXTRAN
Starting Date ............ 10/01/2022 00:00:00
Ending Date .............. 10/02/2022 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 01:00:00
Routing Time Step ........ 20.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 8
Number of Threads ........ 1
Head Tolerance ........... 0.005000 ft


**************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
**************************     ---------       -------
Total Precipitation ......        65.386         7.538
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         6.828         0.787
Surface Runoff ...........        57.873         6.672
Final Storage ............         0.795         0.092
Continuity Error (%) .....        -0.168


**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......        57.876        18.860
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........        57.424        18.713
Flooding Loss ............         0.438         0.143
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.033         0.011
Continuity Error (%) .....        -0.033


*************************
Highest Continuity Errors
*************************
Node Jun-1 (-1.06%)


***************************
Time-Step Critical Elements
```

```
**************************
Link 24inRcp(2) (57.74%)
Link 12inRCP (31.88%)
Link 27 (5.59%)
Link 36inCMP (2.70%)


*******************************
Highest Flow Instability Indexes
*******************************
Link 12inRCP (14)
Link 24inRcp(2) (10)
Link PipeRecessed (6)
Link 33 (1)


*********************************
Most Frequent Nonconverging Nodes
*********************************
Node Out-5 (0.03%)
Node MH-1 (0.01%)
Node IN-2 (0.01%)
Node IN-4 (0.01%)
Node IN-3 (0.01%)


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.50 sec
Average Time Step           :     3.51 sec
Maximum Time Step           :    20.00 sec
% of Time in Steady State   :     0.00
Average Iterations per Step :     2.04
% of Steps Not Converging   :     0.03
Time Step Frequencies       :
   20.000 -  9.564 sec      :     0.17 %
    9.564 -  4.573 sec      :    17.15 %
    4.573 -  2.187 sec      :    68.36 %
    2.187 -  1.046 sec      :    12.98 %
    1.046 -  0.500 sec      :     1.34 %


***************************
Subcatchment Runoff Summary
***************************


---------------------------------------------------------------------------------------------------------------------------------------
                          Total      Total      Total      Total     Imperv
                          Perv      Total       Total     Peak  Runoff
                         Precip      Runon       Evap      Infil     Runoff
                         Runoff     Runoff      Runoff   Runoff   Coeff
Subcatchment                in         in         in         in         in
in         in    10^6 gal      CFS
---------------------------------------------------------------------------------------------------------------------------------------
DA-1                        7.54       0.00       0.00       0.94       3.82
2.67       6.49       11.39   291.05   0.861
DA-2                        7.54       0.00       0.00       0.15       6.84
0.52       7.37        0.22    11.07   0.977
DA-3                        7.54       0.00       0.00       1.29       1.89
4.32       6.20        0.81    28.67   0.823
DA-4                        7.54       0.00       0.00       0.53       5.19
1.78       6.97        1.67    66.48   0.925
DA-5                        7.54       0.00       0.00       0.02       7.44
0.06       7.50        0.11     5.88   0.994
```

```
DA-6                        7.54       0.00       0.00       0.12       7.00
0.41       7.40        0.42    20.94   0.982
DA-7                        7.54       0.00       0.00       0.19       6.69
0.64       7.33        0.33    16.78   0.973
DA-8                        7.54       0.00       0.00       0.17       6.77
0.58       7.35        0.48    24.26   0.975
DA-9                        7.54       0.00       0.00       0.12       6.99
0.41       7.40        0.29    14.92   0.982
DA-10                       7.54       0.00       0.00       0.29       6.24
0.99       7.23        0.16     7.86   0.959
DA-11                       7.54       0.00       0.00       0.19       6.69
0.64       7.33        0.82    41.11   0.973
DA-12                       7.54       0.00       0.00       0.60       4.89
2.02       6.91        0.67    32.10   0.917
DA-13                       7.54       0.00       0.00       0.43       6.32
0.77       7.09        0.33    16.47   0.941
DA-14                       7.54       0.00       0.00       1.32       2.56
3.63       6.19        0.49    19.97   0.821
DA-15                       7.54       0.00       0.00       0.32       6.08
1.10       7.18        0.05     2.88   0.953
DA-16                       7.54       0.00       0.00       0.46       5.49
1.56       7.05        0.09     4.40   0.936
DA-BASIN                    7.54       0.00       0.00       0.46       5.49
1.56       7.05        0.52    26.08   0.936


******************
Node Depth Summary
******************

-------------------------------------------------------------------------------
                              Average  Maximum  Maximum  Time of Max    Reported
                                Depth    Depth      HGL   Occurrence   Max Depth
Node                 Type        Feet     Feet     Feet  days hr:min        Feet
-------------------------------------------------------------------------------
MH-1                 JUNCTION    1.03     4.39   207.13     0  12:27        4.39
Out-4                JUNCTION    3.66     7.04   205.55     0  12:13        7.03
IN-1                 JUNCTION    3.38     5.63   206.73     0  14:36        5.63
Out-1                JUNCTION    1.96     4.58   205.58     0  12:11        4.57
Out-3                JUNCTION    0.67     2.95   205.56     0  12:12        2.94
Out-6                JUNCTION    1.00     3.57   205.57     0  12:11        3.56
Out-2                JUNCTION    0.99     3.57   205.57     0  12:11        3.56
Jun-1                JUNCTION    1.73     4.57   205.57     0  12:11        4.56
Jun-2                JUNCTION    1.83     4.67   205.57     0  12:11        4.66
Jun-3                JUNCTION    2.04     5.16   205.56     0  12:12        5.15
Out-5                OUTFALL     0.00     0.00     0.00     0  00:00        0.00
IN-2                 STORAGE     0.68     4.24   207.34     0  12:07        4.21
IN-3                 STORAGE     1.02     4.50   207.26     0  12:23        4.49
ExistingBasin        STORAGE     1.03     3.45   201.65     0  12:02        3.32
IN-4                 STORAGE     0.88     5.00   208.12     0  12:08        5.00
IN-12                STORAGE     0.21     3.00   205.90     0  12:00        2.93
IN-11                STORAGE     2.32     4.64   203.27     0  12:09        4.62
IN-10                STORAGE     0.55     3.13   203.30     0  12:00        3.12
IN-9                 STORAGE     0.75     3.77   204.15     0  12:00        3.77
IN-8                 STORAGE     0.54     4.06   206.33     0  12:01        4.04
IN-5                 STORAGE     0.24     4.19   211.48     0  12:07        4.16
IN-6                 STORAGE     0.39     4.46   210.23     0  12:11        4.46
IN-7                 STORAGE     0.42     4.35   208.20     0  12:07        4.29


******************
Node Inflow Summary
******************


-------------------------------------------------------------------------------------
----------
                                Maximum  Maximum                  Lateral
                                Total        Flow
```

```
                                  Lateral    Total  Time of Max      Inflow
                                  Inflow     Balance
                                   Inflow   Inflow   Occurrence      Volume
                                   Volume       Error
Node                 Type           CFS      CFS  days hr:min    10^6 gal    10^6
gal     Percent

-------------------------------------------------------------------------------------
----------
MH-1                 JUNCTION      0.00    27.75     0  12:01           0
2.57      -0.045
Out-4                JUNCTION     19.97    52.38     0  12:02       0.485
12.4       0.034
IN-1                 JUNCTION    291.05   291.05     0  12:05        11.4
11.4       0.004
Out-1                JUNCTION      0.00    27.59     0  11:32           0
11.4       0.006
Out-3                JUNCTION     16.47    16.47     0  12:00       0.327
0.327       0.030
Out-6                JUNCTION      4.40     4.40     0  12:00      0.0919
0.0925       0.188
Out-2                JUNCTION      2.88     2.88     0  12:00      0.0546
0.0551       0.371
Jun-1                JUNCTION      0.00     9.33     1  01:33           0
0.151      -1.048
Jun-2                JUNCTION      0.00    27.37     0  11:33           0
11.5       0.001
Jun-3                JUNCTION      0.00    34.05     0  12:02           0
11.9      -0.023
Out-5                OUTFALL       0.00   149.61     0  12:04           0
18.7       0.000
IN-2                 STORAGE      11.07    11.07     0  12:00       0.218
0.235       0.371
IN-3                 STORAGE      28.67    36.78     0  12:00       0.807
2.33       0.006
ExistingBasin        STORAGE      26.08   156.01     0  12:00       0.521
18.7       0.004
IN-4                 STORAGE      66.48    66.48     0  12:00        1.67
1.67      -0.019
IN-12                STORAGE      32.10    32.10     0  12:00       0.666
0.666       0.004
IN-11                STORAGE      41.11    65.69     0  12:00       0.824
13.2       0.008
IN-10                STORAGE       7.86    66.12     0  12:00       0.155
4.35       0.001
IN-9                 STORAGE      14.92    58.53     0  11:59       0.293
4.2      -0.003
IN-8                 STORAGE      24.26    46.16     0  12:00       0.483
3.9       0.013
IN-5                 STORAGE       5.88     5.88     0  12:00       0.114
0.114       0.019
IN-6                 STORAGE      20.94    23.36     0  12:00       0.424
0.538       0.091
IN-7                 STORAGE      16.78    24.57     0  12:00        0.33
0.868      -0.030


**********************
Node Surcharge Summary
**********************

Surcharging occurs when water rises above the top of the highest conduit.
-----------------------------------------------------------------------
                                                Max. Height   Min. Depth
                                   Hours       Above Crown    Below Rim
Node                 Type       Surcharged           Feet          Feet
-----------------------------------------------------------------------
MH-1                 JUNCTION        3.16          2.391        0.000
Out-4                JUNCTION       14.41          3.043        0.000
```

IN-1	JUNCTION	15.15	3.631	0.000
Out-1	JUNCTION	0.90	0.577	0.423
Jun-1	JUNCTION	0.88	0.570	0.430
Jun-2	JUNCTION	0.99	0.669	0.331
Jun-3	JUNCTION	1.65	1.163	0.000

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
MH-1	2.05	18.63	0 12:01	0.147	0.391
Out-4	14.41	26.34	0 12:02	0.249	3.043
IN-1	13.99	275.76	0 12:05	4.722	0.631
Jun-3	0.44	11.73	0 12:05	0.014	0.163
IN-4	0.56	35.70	0 12:08	0.143	0.000

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	Evap Loss	Exfil Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CFS
IN-2	0.033	0	0	0	2.995	6	0 12:07	5.47
IN-3	0.310	1	0	0	12.563	25	0 12:23	22.39
ExistingBasin	1.138	7	0	0	7.920	50	0 12:02	149.61
IN-4	2.195	4	0	0	50.041	100	0 12:08	13.50
IN-12	0.002	0	0	0	0.027	0	0 12:00	31.79
IN-11	0.292	0	0	0	20.250	40	0 12:09	41.34
IN-10	0.005	0	0	0	0.028	0	0 12:00	66.16
IN-9	0.007	0	0	0	0.034	0	0 12:00	58.33
IN-8	0.005	0	0	0	0.228	0	0 12:01	45.26
IN-5	0.018	0	0	0	1.905	4	0 12:07	2.52
IN-6	0.135	0	0	0	10.626	21	0 12:11	11.34
IN-7	0.051	0	0	0	6.328	13	0 12:07	17.69

****
Outfall Loading Summary

****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
Out-5	99.81	24.83	149.61	18.711
System	99.81	24.83	149.61	18.711

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
24inCMP	CONDUIT	27.59	0 11:32	8.78	5.38	1.00
21inRCP	CONDUIT	13.50	0 13:54	5.61	2.69	1.00
12inRCP	CONDUIT	5.47	0 11:58	6.96	1.09	1.00
24inRcp(2)	CONDUIT	22.39	0 12:02	7.13	3.16	1.00
PipeRecessed	CONDUIT	20.58	0 12:26	6.86	5.40	1.00
15inCMP	CONDUIT	2.52	0 11:52	2.07	1.03	1.00
21inCMP	CONDUIT	11.34	0 12:40	4.72	1.59	1.00
27inCMP	CONDUIT	17.69	0 12:16	4.45	1.50	1.00
30inRCP	CONDUIT	45.26	0 12:03	9.22	1.23	1.00
36inRCP(2)	CONDUIT	58.33	0 12:00	8.25	2.67	1.00
36inRCP	CONDUIT	66.16	0 12:00	9.64	1.23	0.93
36inCMP(2)	CONDUIT	41.34	0 12:11	6.45	4.35	1.00
24inRCP	CONDUIT	31.79	0 12:00	10.21	1.32	0.97
48inRCP	CONDUIT	149.61	0 12:04	13.53	1.01	0.88
36inCMP	CONDUIT	30.47	0 12:59	4.31	4.68	1.00
26	CONDUIT	27.35	0 11:33	1.91	0.51	1.00
27	CONDUIT	26.66	0 11:33	2.44	0.14	1.00
28	CONDUIT	16.02	0 12:00	0.64	0.04	0.87
29	CONDUIT	33.69	0 12:02	1.02	0.11	1.00
31	CONDUIT	9.33	1 01:33	0.73	0.10	1.00
32	CONDUIT	3.94	0 12:05	0.25	0.01	0.95
33	CONDUIT	2.29	0 12:01	0.25	0.01	0.95

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
24inCMP	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
21inRCP	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.34	0.00
12inRCP	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.20	0.00
24inRcp(2)	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
PipeRecessed	1.00	0.00	0.00	0.00	0.03	0.00	0.00	0.97	0.00	0.00
15inCMP	1.00	0.00	0.00	0.00	0.76	0.00	0.00	0.23	0.40	0.00
21inCMP	1.00	0.00	0.00	0.00	0.06	0.00	0.00	0.94	0.00	0.00
27inCMP	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.91	0.00
30inRCP	1.00	0.00	0.00	0.00	0.02	0.10	0.00	0.88	0.01	0.00
36inRCP(2)	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
36inRCP	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
36inCMP(2)	1.00	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.00	0.00
24inRCP	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
48inRCP	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
36inCMP	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00

26	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
27	1.00	0.00	0.01	0.00	0.99	0.00	0.00	0.00	0.02	0.00
28	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.51	0.00
29	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.46	0.00
31	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.02	0.00
32	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.50	0.00
33	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.49	0.00

****
Conduit Surcharge Summary
****

Conduit	Hours Full Both Ends	Hours Full Upstream	Hours Full Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
24inCMP	14.22	15.15	14.24	18.31	14.15
21inRCP	3.22	3.25	3.24	3.32	3.22
12inRCP	3.89	3.89	6.70	0.25	0.25
24inRcp(2)	3.16	3.17	3.16	3.34	3.16
PipeRecessed	0.44	3.16	0.44	4.53	0.44
15inCMP	0.91	0.91	0.96	0.09	0.09
21inCMP	0.83	0.92	0.83	0.95	0.82
27inCMP	0.61	0.64	0.62	0.93	0.61
30inRCP	0.28	0.39	0.28	0.67	0.28
36inRCP(2)	0.03	0.24	0.03	2.21	0.03
36inRCP	0.01	0.07	0.01	0.25	0.01
36inCMP(2)	0.09	11.81	0.09	16.76	0.09
24inRCP	0.01	0.11	0.01	0.15	0.01
48inRCP	0.01	0.01	0.01	0.06	0.01
36inCMP	11.81	11.81	15.10	17.76	0.01
26	0.90	0.90	0.99	0.01	0.01
27	0.99	0.99	1.65	0.01	0.01
28	0.01	0.01	1.65	0.01	0.01
29	1.65	1.65	14.41	0.01	0.01
31	0.88	0.88	0.99	0.01	0.01
32	0.01	0.01	0.88	0.01	0.01
33	0.01	0.01	0.88	0.01	0.01

Analysis begun on: Tue Nov 15 17:11:33 2022
Analysis ended on: Tue Nov 15 17:11:34 2022
Total elapsed time: 00:00:01

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.0)
------------------------------------------------------------
```

Location 10: Old Washington Rd. and Shoppers World (100-Year - EXISTING)

```
****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Surcharge Method ......... EXTRAN
Starting Date ............ 10/01/2022 00:00:00
Ending Date .............. 10/02/2022 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 01:00:00
Routing Time Step ........ 20.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 8
Number of Threads ........ 1
Head Tolerance ........... 0.005000 ft


**************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
**************************     ---------       -------
Total Precipitation ......        75.621         8.718
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         7.050         0.813
Surface Runoff ...........        67.880         7.826
Final Storage ............         0.818         0.094
Continuity Error (%) .....        -0.169


**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......        67.882        22.120
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........        67.006        21.835
Flooding Loss ............         0.873         0.285
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.034         0.011
Continuity Error (%) .....        -0.046


*************************
Highest Continuity Errors
*************************
Node Jun-1 (-2.29%)


***************************
Time-Step Critical Elements
```

```
**************************
Link 24inRcp(2) (52.42%)
Link 12inRCP (34.63%)
Link 27 (8.54%)
Link 36inCMP (1.92%)
Link 24inCMP (1.04%)


*******************************
Highest Flow Instability Indexes
*******************************
Link 12inRCP (10)
Link 24inRcp(2) (8)
Link PipeRecessed (5)


********************************
Most Frequent Nonconverging Nodes
********************************
Node Out-5 (0.03%)
Node IN-1 (0.01%)
Node Out-1 (0.01%)
Node MH-1 (0.01%)
Node Jun-2 (0.00%)


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.50 sec
Average Time Step           :     3.37 sec
Maximum Time Step           :    20.00 sec
% of Time in Steady State   :     0.00
Average Iterations per Step :     2.04
% of Steps Not Converging   :     0.03
Time Step Frequencies       :
   20.000 -  9.564 sec      :     0.14 %
    9.564 -  4.573 sec      :    16.95 %
    4.573 -  2.187 sec      :    66.28 %
    2.187 -  1.046 sec      :    14.92 %
    1.046 -  0.500 sec      :     1.71 %


***************************
Subcatchment Runoff Summary
***************************


-----------------------------------------------------------------------------------------------------------------------------------------
                          Total      Total      Total      Total     Imperv
                          Perv      Total       Total     Peak  Runoff
                         Precip      Runon       Evap      Infil     Runoff
                         Runoff     Runoff      Runoff   Runoff   Coeff
Subcatchment                in         in         in         in         in
in         in    10^6 gal      CFS
-----------------------------------------------------------------------------------------------------------------------------------------
DA-1                        8.72       0.00       0.00       0.97       4.43
3.21       7.64       13.41   351.90   0.876
DA-2                        8.72       0.00       0.00       0.16       7.92
0.62       8.54        0.25    12.90   0.980
DA-3                        8.72       0.00       0.00       1.33       2.18
5.16       7.34        0.95    34.98   0.842
DA-4                        8.72       0.00       0.00       0.55       6.00
2.13       8.14        1.95    79.58   0.933
DA-5                        8.72       0.00       0.00       0.02       8.61
0.07       8.68        0.13     6.82   0.995
```

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DA-6                        8.72       0.00       0.00       0.12       8.10
0.49       8.58        0.49    24.47   0.984
DA-7                        8.72       0.00       0.00       0.19       7.75
0.76       8.51        0.38    19.57   0.976
DA-8                        8.72       0.00       0.00       0.18       7.83
0.69       8.53        0.56    28.34   0.978
DA-9                        8.72       0.00       0.00       0.12       8.09
0.48       8.58        0.34    17.38   0.984
DA-10                       8.72       0.00       0.00       0.30       7.22
1.18       8.40        0.18     9.20   0.964
DA-11                       8.72       0.00       0.00       0.19       7.75
0.76       8.51        0.96    48.07   0.976
DA-12                       8.72       0.00       0.00       0.62       5.66
2.42       8.08        0.78    37.96   0.927
DA-13                       8.72       0.00       0.00       0.45       7.31
0.94       8.25        0.38    19.32   0.947
DA-14                       8.72       0.00       0.00       1.36       2.96
4.36       7.32        0.57    24.20   0.840
DA-15                       8.72       0.00       0.00       0.33       7.04
1.32       8.35        0.06     3.35   0.958
DA-16                       8.72       0.00       0.00       0.48       6.35
1.87       8.22        0.11     5.19   0.943
DA-BASIN                    8.72       0.00       0.00       0.48       6.35
1.87       8.22        0.61    30.65   0.943


******************
Node Depth Summary
******************

--------------------------------------------------------------------------------
                                Average  Maximum  Maximum  Time of Max    Reported
                                  Depth    Depth      HGL   Occurrence   Max Depth
Node                  Type         Feet     Feet     Feet  days hr:min        Feet
--------------------------------------------------------------------------------
MH-1                  JUNCTION     1.10     4.49   207.23     0  12:31        4.49
Out-4                 JUNCTION     3.96     7.36   205.87     0  12:11        7.34
IN-1                  JUNCTION     3.73     5.81   206.91     0  14:55        5.81
Out-1                 JUNCTION     2.15     4.89   205.89     0  12:10        4.87
Out-3                 JUNCTION     0.79     3.27   205.88     0  12:10        3.25
Out-6                 JUNCTION     1.14     3.88   205.88     0  12:10        3.86
Out-2                 JUNCTION     1.14     3.88   205.88     0  12:10        3.86
Jun-1                 JUNCTION     1.93     4.88   205.88     0  12:10        4.86
Jun-2                 JUNCTION     2.03     4.98   205.88     0  12:10        4.96
Jun-3                 JUNCTION     2.27     5.48   205.88     0  12:10        5.46
Out-5                 OUTFALL      0.00     0.00     0.00     0  00:00        0.00
IN-2                  STORAGE      0.75     4.30   207.40     0  12:08        4.28
IN-3                  STORAGE      1.09     4.60   207.36     0  12:25        4.60
ExistingBasin         STORAGE      1.10     3.72   201.92     0  12:01        3.63
IN-4                  STORAGE      0.95     5.00   208.12     0  12:04        5.00
IN-12                 STORAGE      0.23     4.03   206.93     0  12:00        4.02
IN-11                 STORAGE      2.49     4.77   203.40     0  12:10        4.76
IN-10                 STORAGE      0.59     3.28   203.45     0  12:00        3.27
IN-9                  STORAGE      0.80     3.96   204.34     0  12:00        3.95
IN-8                  STORAGE      0.58     4.17   206.44     0  12:03        4.12
IN-5                  STORAGE      0.26     4.23   211.52     0  12:08        4.21
IN-6                  STORAGE      0.42     4.53   210.30     0  12:12        4.53
IN-7                  STORAGE      0.45     4.43   208.28     0  12:08        4.38


******************
Node Inflow Summary
******************


--------------------------------------------------------------------------------
----------
                                Maximum  Maximum                  Lateral
                                Total        Flow
```

```
                                  Lateral    Total  Time of Max      Inflow
                                  Inflow     Balance
                                   Inflow   Inflow   Occurrence      Volume
                                   Volume       Error
Node                 Type           CFS      CFS  days hr:min    10^6 gal    10^6
gal     Percent

-------------------------------------------------------------------------------------
----------
MH-1                 JUNCTION      0.00    29.02     0  12:02           0
2.88      -0.039
Out-4                JUNCTION     24.20    63.44     0  11:59       0.575
14.5       0.029
IN-1                 JUNCTION    351.90   351.90     0  12:05        13.4
13.4       0.003
Out-1                JUNCTION      0.00    27.50     0  11:20           0
13.4       0.001
Out-3                JUNCTION     19.32    19.32     0  12:00       0.381
0.381       0.032
Out-6                JUNCTION      5.19     5.19     0  12:00       0.107
0.108       0.317
Out-2                JUNCTION      3.35     3.35     0  12:00      0.0635
0.0641       0.552
Jun-1                JUNCTION      0.00     9.95     1  04:03           0
0.175      -2.239
Jun-2                JUNCTION      0.00    27.26     0  11:21           0
13.6      -0.010
Jun-3                JUNCTION      0.00    41.36     0  11:59           0
14      -0.020
Out-5                OUTFALL       0.00   161.47     0  12:02           0
21.8       0.000
IN-2                 STORAGE      12.90    12.90     0  12:00       0.253
0.265       0.276
IN-3                 STORAGE      34.98    43.27     0  12:00       0.955
2.62       0.011
ExistingBasin        STORAGE      30.65   165.77     0  12:00       0.607
21.8       0.002
IN-4                 STORAGE      79.58    79.58     0  12:00        1.95
1.95       0.002
IN-12                STORAGE      37.96    37.96     0  12:00       0.779
0.779       0.021
IN-11                STORAGE      48.07    75.08     0  12:00       0.957
15.5       0.009
IN-10                STORAGE       9.20    68.82     0  12:00        0.18
4.96       0.006
IN-9                 STORAGE      17.38    59.89     0  12:00        0.34
4.78      -0.003
IN-8                 STORAGE      28.34    49.69     0  12:00        0.56
4.44       0.015
IN-5                 STORAGE       6.82     6.82     0  12:00       0.132
0.132       0.069
IN-6                 STORAGE      24.47    26.87     0  12:00       0.492
0.623       0.031
IN-7                 STORAGE      19.57    27.37     0  12:00       0.384
1.01      -0.018


**********************
Node Surcharge Summary
**********************

Surcharging occurs when water rises above the top of the highest conduit.
-----------------------------------------------------------------------
                                                Max. Height   Min. Depth
                                   Hours       Above Crown    Below Rim
Node                 Type       Surcharged           Feet          Feet
-----------------------------------------------------------------------
MH-1                 JUNCTION        3.55          2.488        0.000
Out-4                JUNCTION       17.16          3.359        0.000
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IN-1                 JUNCTION       18.06          3.810        0.000
Out-1                JUNCTION        1.31          0.886        0.114
Jun-1                JUNCTION        1.29          0.881        0.119
Jun-2                JUNCTION        1.38          0.980        0.020
Jun-3                JUNCTION        2.20          1.476        0.000


*********************
Node Flooding Summary
*********************

Flooding refers to all water that overflows a node, whether it ponds or not.
---------------------------------------------------------------------------
                                                          Total   Maximum
                                Maximum   Time of Max       Flood    Ponded
                      Hours       Rate    Occurrence      Volume     Depth
Node                 Flooded       CFS   days hr:min    10^6 gal      Feet
---------------------------------------------------------------------------
MH-1                    2.47     20.27      0  12:01       0.183     0.488
Out-4                  17.16     37.17      0  11:59       0.275     3.359
IN-1                   16.68    338.90      0  12:05       6.062     0.810
Jun-3                   0.84     23.92      0  12:01       0.041     0.476
IN-4                    0.76     62.58      0  12:04       0.284     0.000


**********************
Storage Volume Summary
**********************


-------------------------------------------------------------------------------------------
                       Average     Avg  Evap Exfil       Maximum     Max    Time of
                       Max    Maximum
                        Volume    Pcnt  Pcnt  Pcnt        Volume    Pcnt
                        Occurrence    Outflow
Storage Unit          1000 ft3    Full  Loss  Loss      1000 ft3    Full    days
hr:min        CFS

-------------------------------------------------------------------------------------------
IN-2                     0.064       0     0     0         4.414       9       0
12:08       5.47
IN-3                     0.501       1     0     0        17.927      36       0
12:25      23.71
ExistingBasin            1.251       8     0     0         9.047      58       0
12:01     161.47
IN-4                     2.438       5     0     0        50.041     100       0
12:04      13.49
IN-12                    0.002       0     0     0         0.094       0       0
12:00      36.37
IN-11                    0.513       1     0     0        29.872      60       0
12:10      42.45
IN-10                    0.005       0     0     0         0.030       0       0
12:00      68.73
IN-9                     0.007       0     0     0         0.036       0       0
12:00      59.65
IN-8                     0.010       0     0     0         1.491       3       0
12:03      47.98
IN-5                     0.028       0     0     0         2.667       5       0
12:08       2.51
IN-6                     0.207       0     0     0        13.944      28       0
12:12      11.41
IN-7                     0.082       0     0     0         9.288      19       0
12:08      17.70


************************
Outfall Loading Summary
```

****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
Out-5	99.83	27.51	161.47	21.833
System	99.83	27.51	161.47	21.833

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
24inCMP	CONDUIT	27.50	0 11:20	8.75	5.36	1.00
21inRCP	CONDUIT	13.49	0 14:17	5.61	2.69	1.00
12inRCP	CONDUIT	5.47	0 11:57	6.97	1.09	1.00
24inRcp(2)	CONDUIT	23.71	0 12:03	7.55	3.35	1.00
PipeRecessed	CONDUIT	20.91	0 12:34	6.95	5.48	1.00
15inCMP	CONDUIT	2.51	0 11:51	2.08	1.02	1.00
21inCMP	CONDUIT	11.41	0 12:38	4.74	1.60	1.00
27inCMP	CONDUIT	17.70	0 12:23	4.45	1.50	1.00
30inRCP	CONDUIT	47.98	0 12:07	9.77	1.30	1.00
36inRCP(2)	CONDUIT	59.65	0 12:00	8.44	2.73	1.00
36inRCP	CONDUIT	68.73	0 12:00	9.94	1.27	0.95
36inCMP(2)	CONDUIT	42.45	0 12:12	6.59	4.47	1.00
24inRCP	CONDUIT	36.37	0 12:01	11.58	1.51	1.00
48inRCP	CONDUIT	161.47	0 12:02	13.55	1.09	0.92
36inCMP	CONDUIT	30.67	0 13:17	4.34	4.71	1.00
26	CONDUIT	27.25	0 11:21	1.90	0.51	1.00
27	CONDUIT	26.95	0 16:51	2.43	0.15	1.00
28	CONDUIT	18.79	0 12:01	0.67	0.05	0.91
29	CONDUIT	40.69	0 11:59	1.13	0.14	1.00
31	CONDUIT	9.95	1 04:03	0.88	0.11	1.00
32	CONDUIT	5.02	0 12:02	0.31	0.02	0.99
33	CONDUIT	3.15	0 12:02	0.31	0.01	0.99

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
24inCMP	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
21inRCP	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.31	0.00
12inRCP	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.19	0.00
24inRcp(2)	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
PipeRecessed	1.00	0.00	0.00	0.00	0.03	0.00	0.00	0.97	0.00	0.00
15inCMP	1.00	0.00	0.00	0.00	0.77	0.00	0.00	0.22	0.45	0.00
21inCMP	1.00	0.00	0.00	0.00	0.07	0.00	0.00	0.92	0.00	0.00
27inCMP	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.91	0.00
30inRCP	1.00	0.00	0.00	0.00	0.03	0.11	0.00	0.86	0.01	0.00
36inRCP(2)	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
36inRCP	1.00	0.00	0.00	0.00	0.07	0.01	0.00	0.91	0.08	0.00
36inCMP(2)	1.00	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.00	0.00
24inRCP	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
48inRCP	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
36inCMP	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00

26	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
27	1.00	0.00	0.01	0.00	0.99	0.00	0.00	0.00	0.02	0.00
28	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.42	0.00
29	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.35	0.00
31	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.02	0.00
32	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.40	0.00
33	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.40	0.00

****
Conduit Surcharge Summary
****

Conduit	Hours Full Both Ends	Hours Full Upstream	Hours Full Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
24inCMP	16.93	18.05	16.95	21.95	16.88
21inRCP	3.70	3.72	3.71	3.78	3.69
12inRCP	4.46	4.46	8.50	0.26	0.26
24inRcp(2)	3.55	3.56	3.55	3.81	3.55
PipeRecessed	0.59	3.55	0.59	5.42	0.59
15inCMP	1.13	1.13	1.17	0.09	0.09
21inCMP	1.01	1.14	1.01	1.17	1.01
27inCMP	0.76	0.79	0.77	1.15	0.76
30inRCP	0.31	0.46	0.31	0.82	0.31
36inRCP(2)	0.12	0.28	0.12	2.63	0.12
36inRCP	0.01	0.15	0.01	0.29	0.01
36inCMP(2)	0.17	13.24	0.17	19.75	0.17
24inRCP	0.05	0.17	0.05	0.21	0.05
48inRCP	0.01	0.01	0.01	0.15	0.01
36inCMP	13.24	13.24	17.96	21.34	0.01
26	1.31	1.31	1.38	0.01	0.01
27	1.38	1.38	2.20	0.01	0.01
28	0.01	0.01	2.20	0.01	0.01
29	2.20	2.20	17.16	0.01	0.01
31	1.29	1.29	1.38	0.01	0.01
32	0.01	0.01	1.29	0.01	0.01
33	0.01	0.01	1.29	0.01	0.01

Analysis begun on: Tue Nov 15 17:12:01 2022
Analysis ended on: Tue Nov 15 17:12:01 2022
Total elapsed time: < 1 sec

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.0)
------------------------------------------------------------
```

Location 10: Old Washington Rd. and Shoppers World (100-Year - 2050 - EXISTING)

```
****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Surcharge Method ......... EXTRAN
Starting Date ............ 10/01/2022 00:00:00
Ending Date .............. 10/02/2022 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 01:00:00
Routing Time Step ........ 20.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 8
Number of Threads ........ 1
Head Tolerance ........... 0.005000 ft


**************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
**************************     ---------       -------
Total Precipitation ......        86.759        10.002
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         7.243         0.835
Surface Runoff ...........        78.827         9.088
Final Storage ............         0.840         0.097
Continuity Error (%) .....        -0.174


**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......        78.824        25.686
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........        75.473        24.594
Flooding Loss ............         1.378         0.449
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         1.995         0.650
Continuity Error (%) .....        -0.028


*************************
Highest Continuity Errors
*************************
Node Jun-1 (3.29%)


***************************
Time-Step Critical Elements
```

```
**************************
Link 24inRcp(2) (45.50%)
Link 12inRCP (37.69%)
Link 27 (9.71%)
Link 36inCMP (4.46%)


*******************************
Highest Flow Instability Indexes
*******************************
Link 12inRCP (9)
Link 24inRcp(2) (7)
Link PipeRecessed (5)


*********************************
Most Frequent Nonconverging Nodes
*********************************
Node Out-5 (0.03%)
Node Out-1 (0.01%)
Node MH-1 (0.01%)
Node IN-2 (0.01%)
Node IN-6 (0.01%)


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.50 sec
Average Time Step           :     3.21 sec
Maximum Time Step           :    20.00 sec
% of Time in Steady State   :     0.00
Average Iterations per Step :     2.03
% of Steps Not Converging   :     0.03
Time Step Frequencies       :
   20.000 -  9.564 sec      :     0.13 %
    9.564 -  4.573 sec      :    16.36 %
    4.573 -  2.187 sec      :    62.89 %
    2.187 -  1.046 sec      :    18.75 %
    1.046 -  0.500 sec      :     1.87 %


***************************
Subcatchment Runoff Summary
***************************


-----------------------------------------------------------------------------------------------------------------------------------------
                          Total      Total      Total      Total     Imperv
                          Perv      Total       Total     Peak  Runoff
                         Precip      Runon       Evap      Infil     Runoff
                         Runoff     Runoff      Runoff   Runoff   Coeff
Subcatchment                in         in         in         in         in
in         in    10^6 gal      CFS

-----------------------------------------------------------------------------------------------------------------------------------------
DA-1                        10.00       0.00       0.00       0.99       5.08
3.81       8.89       15.61   420.35   0.889
DA-2                        10.00       0.00       0.00       0.16       9.09
0.74       9.83        0.29    14.91   0.983
DA-3                        10.00       0.00       0.00       1.37       2.50
6.09       8.59        1.12    42.13   0.859
DA-4                        10.00       0.00       0.00       0.56       6.89
2.52       9.41        2.25    94.18   0.941
DA-5                        10.00       0.00       0.00       0.02       9.88
0.08       9.96        0.15     7.85   0.996
DA-6                        10.00       0.00       0.00       0.13       9.29
```

```
0.57       9.87        0.57    28.35   0.986
DA-7                      10.00       0.00       0.00       0.20       8.89
0.90       9.79        0.44    22.64   0.979
DA-8                      10.00       0.00       0.00       0.18       8.99
0.82       9.81        0.64    32.79   0.981
DA-9                      10.00       0.00       0.00       0.13       9.29
0.57       9.86        0.39    20.06   0.986
DA-10                     10.00       0.00       0.00       0.31       8.29
1.39       9.68        0.21    10.66   0.968
DA-11                     10.00       0.00       0.00       0.20       8.89
0.90       9.79        1.10    55.69   0.979
DA-12                     10.00       0.00       0.00       0.64       6.50
2.85       9.35        0.90    44.41   0.935
DA-13                     10.00       0.00       0.00       0.47       8.39
1.13       9.52        0.44    22.45   0.952
DA-14                     10.00       0.00       0.00       1.40       3.40
5.17       8.57        0.67    28.96   0.857
DA-15                     10.00       0.00       0.00       0.34       8.08
1.55       9.63        0.07     3.86   0.963
DA-16                     10.00       0.00       0.00       0.49       7.29
2.20       9.50        0.12     6.07   0.950
DA-BASIN                  10.00       0.00       0.00       0.49       7.29
2.20       9.50        0.70    35.67   0.950


******************
Node Depth Summary
******************

-------------------------------------------------------------------------------
                              Average  Maximum  Maximum  Time of Max    Reported
                                Depth    Depth      HGL   Occurrence   Max Depth
Node                 Type        Feet     Feet     Feet  days hr:min        Feet
-------------------------------------------------------------------------------
MH-1                 JUNCTION    1.14     4.59   207.33     0  12:34        4.58
Out-4                JUNCTION    4.22     7.54   206.05     0  12:11        7.51
IN-1                 JUNCTION    4.04     6.02   207.12     0  15:17        6.02
Out-1                JUNCTION    2.32     5.06   206.06     0  12:11        5.05
Out-3                JUNCTION    0.90     3.44   206.05     0  12:12        3.43
Out-6                JUNCTION    1.28     4.05   206.05     0  12:09        4.05
Out-2                JUNCTION    1.28     4.05   206.05     0  12:09        4.05
Jun-1                JUNCTION    2.11     5.05   206.05     0  12:09        5.05
Jun-2                JUNCTION    2.21     5.15   206.05     0  12:10        5.15
Jun-3                JUNCTION    2.48     5.65   206.05     0  12:12        5.64
Out-5                OUTFALL     0.00     0.00     0.00     0  00:00        0.00
IN-2                 STORAGE     0.80     4.35   207.45     0  12:09        4.34
IN-3                 STORAGE     1.14     4.70   207.46     0  12:27        4.70
ExistingBasin        STORAGE     1.16     3.91   202.11     0  12:02        3.83
IN-4                 STORAGE     1.00     5.00   208.12     0  12:01        5.00
IN-12                STORAGE     0.24     4.17   207.07     0  12:03        4.11
IN-11                STORAGE     2.63     4.90   203.53     0  12:11        4.89
IN-10                STORAGE     0.61     3.43   203.60     0  12:01        3.40
IN-9                 STORAGE     0.83     4.09   204.47     0  12:02        4.06
IN-8                 STORAGE     0.61     4.28   206.55     0  12:05        4.20
IN-5                 STORAGE     0.28     4.27   211.56     0  12:08        4.25
IN-6                 STORAGE     0.45     4.59   210.36     0  12:13        4.59
IN-7                 STORAGE     0.47     4.50   208.35     0  12:10        4.47


*******************
Node Inflow Summary
*******************


-------------------------------------------------------------------------------------
----------
                                Maximum  Maximum                  Lateral
                                Total        Flow
                                Lateral    Total  Time of Max      Inflow
```

```
                                    Inflow     Balance
                                     Inflow   Inflow   Occurrence      Volume
                                     Volume      Error
Node                 Type              CFS      CFS  days hr:min    10^6 gal    10^6
gal     Percent

-------------------------------------------------------------------------------------
----------
MH-1                 JUNCTION         0.00    30.37     0  12:02           0
3.22      -0.018
Out-4                JUNCTION        28.96    65.06     0  11:58       0.672
16.4       0.159
IN-1                 JUNCTION       420.35   420.35     0  12:05        15.6
15.6       0.005
Out-1                JUNCTION         0.00    27.34     0  11:07           0
15.2       0.086
Out-3                JUNCTION        22.45    22.45     0  12:00        0.44
0.44       0.380
Out-6                JUNCTION         6.07     6.07     0  12:00       0.124
0.124       2.039
Out-2                JUNCTION         3.86     3.86     0  12:00      0.0732
0.0732       3.595
Jun-1                JUNCTION         0.00    14.15     0  12:06           0
0.204       3.404
Jun-2                JUNCTION         0.00    27.34     0  17:31           0
15.4       0.139
Jun-3                JUNCTION         0.00    43.46     0  11:58           0
15.8       0.133
Out-5                OUTFALL          0.00   165.74     0  12:02           0
24.6       0.000
IN-2                 STORAGE         14.91    14.91     0  12:00       0.291
0.302       0.223
IN-3                 STORAGE         42.13    50.57     0  12:00        1.12
2.92       0.010
ExistingBasin        STORAGE         35.67   171.05     0  12:00       0.701
24.6       0.016
IN-4                 STORAGE         94.18    94.18     0  12:00        2.25
2.25      -0.060
IN-12                STORAGE         44.41    44.41     0  12:00       0.901
0.901       0.012
IN-11                STORAGE         55.69    84.14     0  12:00         1.1
17.4       0.105
IN-10                STORAGE         10.66    69.65     0  12:00       0.208
5.61       0.011
IN-9                 STORAGE         20.06    62.18     0  12:00       0.391
5.41       0.002
IN-8                 STORAGE         32.79    53.76     0  12:00       0.645
5.02       0.023
IN-5                 STORAGE          7.85     7.85     0  12:00       0.151
0.151       0.080
IN-6                 STORAGE         28.35    30.72     0  12:00       0.565
0.716       0.050
IN-7                 STORAGE         22.64    30.44     0  12:00       0.441
1.16      -0.016


**********************
Node Surcharge Summary
**********************

Surcharging occurs when water rises above the top of the highest conduit.
-----------------------------------------------------------------------
                                                Max. Height   Min. Depth
                                     Hours      Above Crown    Below Rim
Node                 Type         Surcharged          Feet         Feet
-----------------------------------------------------------------------
MH-1                 JUNCTION           4.06         2.586        0.000
Out-4                JUNCTION          19.26         3.539        0.000
IN-1                 JUNCTION          20.67         4.016        0.000
```

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Out-1                JUNCTION        1.74          1.056        0.000
Out-6                JUNCTION        0.40          0.050        0.950
Out-2                JUNCTION        0.39          0.050        0.950
Jun-1                JUNCTION        1.72          1.050        0.000
Jun-2                JUNCTION        1.83          1.154        0.000
Jun-3                JUNCTION        3.06          1.652        0.000


**********************
Node Flooding Summary
**********************

Flooding refers to all water that overflows a node, whether it ponds or not.
--------------------------------------------------------------------------
                                                          Total   Maximum
                                Maximum   Time of Max       Flood    Ponded
                      Hours       Rate    Occurrence      Volume     Depth
Node                 Flooded       CFS   days hr:min    10^6 gal      Feet
--------------------------------------------------------------------------
MH-1                    2.90     21.93      0  12:02       0.220     0.586
Out-4                  19.26     37.32      0  11:58       0.293     3.539
IN-1                   18.88    409.44      0  12:05       7.602     1.016
Out-1                   0.41      5.32      0  12:06       0.005     0.056
Jun-1                   0.40     14.13      0  12:06       0.021     0.050
Jun-2                   0.57     15.20      0  12:04       0.018     0.154
Jun-3                   1.25     31.83      0  11:59       0.061     0.652
IN-4                    0.95     81.14      0  12:01       0.449     0.000


***********************
Storage Volume Summary
***********************


-----------------------------------------------------------------------------------------------
                       Average     Avg  Evap Exfil       Maximum     Max    Time of
                       Max    Maximum
                        Volume    Pcnt  Pcnt  Pcnt        Volume    Pcnt
                        Occurrence    Outflow
Storage Unit          1000 ft3    Full  Loss  Loss      1000 ft3    Full    days
hr:min        CFS

-----------------------------------------------------------------------------------------------
IN-2                     0.122       0     0     0         6.073      12       0
12:09       5.46
IN-3                     0.757       2     0     0        24.359      49       0
12:27      25.11
ExistingBasin            1.342       9     0     0         9.932      63       0
12:02     165.74
IN-4                     2.674       5     0     0        50.041     100       0
12:01      13.44
IN-12                    0.006       0     0     0         1.449       3       0
12:03      37.03
IN-11                    0.820       2     0     0        40.434      81       0
12:11      43.42
IN-10                    0.005       0     0     0         0.031       0       0
12:01      69.48
IN-9                     0.008       0     0     0         0.454       1       0
12:02      60.52
IN-8                     0.021       0     0     0         3.936       8       0
12:05      49.91
IN-5                     0.044       0     0     0         3.558       7       0
12:08       2.51
IN-6                     0.313       1     0     0        17.714      35       0
12:13      11.47
IN-7                     0.131       0     0     0        12.378      25       0
12:10      17.74
```

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
Out-5	99.85	29.65	165.74	24.592
System	99.85	29.65	165.74	24.592

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
24inCMP	CONDUIT	27.34	0 11:07	8.70	5.33	1.00
21inRCP	CONDUIT	13.44	0 14:41	5.59	2.68	1.00
12inRCP	CONDUIT	5.46	0 11:56	6.95	1.08	1.00
24inRcp(2)	CONDUIT	25.11	0 12:03	7.99	3.55	1.00
PipeRecessed	CONDUIT	21.23	0 12:42	7.04	5.57	1.00
15inCMP	CONDUIT	2.51	0 11:49	2.08	1.02	1.00
21inCMP	CONDUIT	11.47	0 12:46	4.77	1.61	1.00
27inCMP	CONDUIT	17.74	0 12:29	4.46	1.51	1.00
30inRCP	CONDUIT	49.91	0 12:10	10.17	1.36	1.00
36inRCP(2)	CONDUIT	60.52	0 12:05	8.56	2.77	1.00
36inRCP	CONDUIT	69.48	0 12:00	9.99	1.29	0.99
36inCMP(2)	CONDUIT	43.42	0 12:13	6.71	4.57	1.00
24inRCP	CONDUIT	37.03	0 12:03	11.79	1.53	1.00
48inRCP	CONDUIT	165.74	0 12:02	13.58	1.12	0.95
36inCMP	CONDUIT	30.94	0 13:38	4.38	4.76	1.00
26	CONDUIT	27.17	0 17:55	1.89	0.51	1.00
27	CONDUIT	27.37	0 17:30	2.44	0.15	1.00
28	CONDUIT	21.89	0 12:00	0.73	0.05	0.93
29	CONDUIT	40.88	0 11:56	1.14	0.14	1.00
31	CONDUIT	9.32	0 12:03	0.26	0.10	1.00
32	CONDUIT	5.82	0 11:58	0.18	0.02	1.00
33	CONDUIT	3.95	0 11:58	0.18	0.01	1.00

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
24inCMP	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
21inRCP	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.27	0.00
12inRCP	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.18	0.00
24inRcp(2)	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
PipeRecessed	1.00	0.00	0.00	0.00	0.04	0.00	0.00	0.96	0.00	0.00
15inCMP	1.00	0.00	0.00	0.00	0.78	0.00	0.00	0.22	0.56	0.00
21inCMP	1.00	0.00	0.00	0.00	0.09	0.00	0.00	0.91	0.00	0.00
27inCMP	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.90	0.00
30inRCP	1.00	0.00	0.00	0.00	0.03	0.12	0.00	0.84	0.01	0.00
36inRCP(2)	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.98	0.00	0.00
36inRCP	1.00	0.00	0.00	0.00	0.14	0.01	0.00	0.85	0.14	0.00

36inCMP(2)	1.00	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.00	0.00
24inRCP	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
48inRCP	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
36inCMP	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
26	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
27	1.00	0.00	0.01	0.00	0.99	0.00	0.00	0.00	0.02	0.00
28	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.35	0.00
29	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.28	0.00
31	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.01	0.00
32	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.33	0.00
33	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.33	0.00

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Hours Full: Upstream	Hours Full: Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
24inCMP	19.13	20.67	19.13	24.89	19.13
21inRCP	4.21	4.23	4.22	4.31	4.20
12inRCP	5.13	5.13	9.98	0.29	0.29
24inRcp(2)	4.05	4.06	4.05	4.35	4.05
PipeRecessed	0.75	4.05	0.75	6.44	0.75
15inCMP	1.36	1.36	1.41	0.09	0.09
21inCMP	1.23	1.38	1.24	1.40	1.23
27inCMP	0.93	0.96	0.94	1.38	0.93
30inRCP	0.38	0.63	0.38	0.99	0.38
36inRCP(2)	0.18	0.35	0.18	3.07	0.18
36inRCP	0.01	0.21	0.01	0.36	0.01
36inCMP(2)	0.22	15.32	0.22	22.27	0.22
24inRCP	0.17	0.23	0.17	0.26	0.17
48inRCP	0.01	0.01	0.01	0.22	0.01
36inCMP	15.32	15.32	20.18	23.92	0.01
26	1.74	1.74	1.83	0.01	0.01
27	1.83	1.83	3.06	0.01	0.01
28	0.01	0.01	3.06	0.01	0.01
29	3.06	3.06	19.26	0.01	0.01
31	1.72	1.72	1.83	0.01	0.01
32	0.39	0.39	1.72	0.01	0.01
33	0.39	0.39	1.72	0.01	0.01

Analysis begun on: Tue Nov 15 17:12:35 2022
Analysis ended on: Tue Nov 15 17:12:35 2022
Total elapsed time: < 1 sec

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.0)
------------------------------------------------------------
```

Location 10: Old Washington Rd. and Shoppers World (100-Year - 2100 - EXISTING)

```
****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Surcharge Method ......... EXTRAN
Starting Date ............ 10/01/2022 00:00:00
Ending Date .............. 10/02/2022 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 01:00:00
Routing Time Step ........ 20.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 8
Number of Threads ........ 1
Head Tolerance ........... 0.005000 ft


**************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
**************************     ---------       -------
Total Precipitation ......        91.495        10.548
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         7.310         0.843
Surface Runoff ...........        83.493         9.625
Final Storage ............         0.852         0.098
Continuity Error (%) .....        -0.175


**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......        83.490        27.206
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........        77.569        25.277
Flooding Loss ............         1.589         0.518
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         4.353         1.418
Continuity Error (%) .....        -0.025


*************************
Highest Continuity Errors
*************************
Node Jun-1 (3.02%)


***************************
Time-Step Critical Elements
```

```
**************************
Link 24inRcp(2) (43.21%)
Link 12inRCP (39.82%)
Link 27 (9.38%)
Link 36inCMP (4.54%)


*******************************
Highest Flow Instability Indexes
*******************************
Link 12inRCP (8)
Link 24inRcp(2) (7)
Link PipeRecessed (5)


*********************************
Most Frequent Nonconverging Nodes
*********************************
Node Out-5 (0.03%)
Node IN-2 (0.01%)
Node MH-1 (0.01%)
Node IN-12 (0.01%)
Node Out-1 (0.00%)


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.50 sec
Average Time Step           :     3.16 sec
Maximum Time Step           :    20.00 sec
% of Time in Steady State   :     0.00
Average Iterations per Step :     2.03
% of Steps Not Converging   :     0.03
Time Step Frequencies       :
   20.000 -  9.564 sec      :     0.12 %
    9.564 -  4.573 sec      :    16.30 %
    4.573 -  2.187 sec      :    61.31 %
    2.187 -  1.046 sec      :    20.26 %
    1.046 -  0.500 sec      :     2.02 %


***************************
Subcatchment Runoff Summary
***************************


-----------------------------------------------------------------------------------------------------------------------------------------
                          Total      Total      Total      Total     Imperv
                          Perv      Total       Total     Peak  Runoff
                         Precip      Runon       Evap      Infil     Runoff
                         Runoff     Runoff      Runoff   Runoff   Coeff
Subcatchment                in         in         in         in         in
in         in    10^6 gal      CFS

-----------------------------------------------------------------------------------------------------------------------------------------
DA-1                       10.55       0.00       0.00       1.00       5.36
4.07       9.43       16.55   448.55   0.894
DA-2                       10.55       0.00       0.00       0.16       9.59
0.78      10.37        0.31    15.72   0.983
DA-3                       10.55       0.00       0.00       1.38       2.63
6.49       9.13        1.19    45.07   0.865
DA-4                       10.55       0.00       0.00       0.57       7.27
2.68       9.95        2.38   100.15   0.944
DA-5                       10.55       0.00       0.00       0.02      10.42
0.09      10.51        0.16     8.26   0.996
DA-6                       10.55       0.00       0.00       0.13       9.80
```

```
0.61      10.41        0.60    29.92   0.987
DA-7                      10.55       0.00       0.00       0.20       9.38
0.96      10.34        0.47    23.87   0.980
DA-8                      10.55       0.00       0.00       0.18       9.49
0.87      10.36        0.68    34.60   0.982
DA-9                      10.55       0.00       0.00       0.13       9.80
0.61      10.41        0.41    21.15   0.987
DA-10                     10.55       0.00       0.00       0.31       8.75
1.48      10.23        0.22    11.24   0.970
DA-11                     10.55       0.00       0.00       0.20       9.38
0.96      10.34        1.16    58.77   0.980
DA-12                     10.55       0.00       0.00       0.64       6.85
3.04       9.89        0.95    47.02   0.938
DA-13                     10.55       0.00       0.00       0.47       8.85
1.21      10.06        0.46    23.71   0.954
DA-14                     10.55       0.00       0.00       1.42       3.58
5.52       9.10        0.71    30.91   0.863
DA-15                     10.55       0.00       0.00       0.35       8.52
1.65      10.17        0.08     4.07   0.964
DA-16                     10.55       0.00       0.00       0.50       7.69
2.35      10.04        0.13     6.42   0.952
DA-BASIN                  10.55       0.00       0.00       0.49       7.69
2.35      10.04        0.74    37.70   0.952


******************
Node Depth Summary
******************

--------------------------------------------------------------------------------
                                Average  Maximum  Maximum  Time of Max    Reported
                                  Depth    Depth      HGL   Occurrence   Max Depth
Node                  Type         Feet     Feet     Feet  days hr:min        Feet
--------------------------------------------------------------------------------
MH-1                  JUNCTION     1.17     4.62   207.36     0  12:35        4.62
Out-4                 JUNCTION     4.28     7.58   206.09     0  12:10        7.57
IN-1                  JUNCTION     4.11     6.10   207.20     0  15:23        6.10
Out-1                 JUNCTION     2.37     5.10   206.10     0  12:14        5.10
Out-3                 JUNCTION     0.94     3.48   206.09     0  12:11        3.47
Out-6                 JUNCTION     1.32     4.09   206.09     0  12:12        4.08
Out-2                 JUNCTION     1.32     4.09   206.09     0  12:12        4.08
Jun-1                 JUNCTION     2.16     5.09   206.09     0  12:12        5.08
Jun-2                 JUNCTION     2.26     5.19   206.09     0  12:13        5.19
Jun-3                 JUNCTION     2.53     5.69   206.09     0  12:11        5.68
Out-5                 OUTFALL      0.00     0.00     0.00     0  00:00        0.00
IN-2                  STORAGE      0.83     4.37   207.47     0  12:09        4.36
IN-3                  STORAGE      1.17     4.74   207.50     0  12:27        4.74
ExistingBasin         STORAGE      1.18     4.02   202.22     0  12:02        3.90
IN-4                  STORAGE      1.03     5.00   208.12     0  12:01        5.00
IN-12                 STORAGE      0.25     4.21   207.11     0  12:04        4.15
IN-11                 STORAGE      2.66     4.95   203.58     0  12:11        4.94
IN-10                 STORAGE      0.63     3.53   203.70     0  12:02        3.45
IN-9                  STORAGE      0.85     4.15   204.53     0  12:04        4.09
IN-8                  STORAGE      0.62     4.32   206.59     0  12:05        4.23
IN-5                  STORAGE      0.29     4.28   211.57     0  12:08        4.27
IN-6                  STORAGE      0.46     4.62   210.39     0  12:13        4.62
IN-7                  STORAGE      0.49     4.52   208.37     0  12:10        4.51


*******************
Node Inflow Summary
*******************


--------------------------------------------------------------------------------
----------
                                Maximum  Maximum                  Lateral
                                Total        Flow
                                Lateral    Total  Time of Max      Inflow
```

```
                                    Inflow     Balance
                                     Inflow   Inflow   Occurrence      Volume
                                     Volume      Error
Node                 Type              CFS      CFS  days hr:min    10^6 gal    10^6
gal     Percent

-------------------------------------------------------------------------------------
----------
MH-1                 JUNCTION         0.00    30.88     0  12:02           0
3.37      -0.019
Out-4                JUNCTION        30.91    65.74     0  11:57       0.714
16.7       0.156
IN-1                 JUNCTION       448.55   448.55     0  12:05        16.5
16.5       0.004
Out-1                JUNCTION         0.00    27.32     0  17:57           0
15.4       0.087
Out-3                JUNCTION        23.71    23.71     0  12:00       0.464
0.464       0.391
Out-6                JUNCTION         6.42     6.42     0  12:00       0.131
0.131       2.038
Out-2                JUNCTION         4.07     4.07     0  12:00      0.0773
0.0774       3.468
Jun-1                JUNCTION         0.00    22.92     0  12:04           0
0.224       3.111
Jun-2                JUNCTION         0.00    27.51     0  17:33           0
15.6       0.140
Jun-3                JUNCTION         0.00    45.22     0  12:00           0
16       0.138
Out-5                OUTFALL          0.00   165.64     0  12:00           0
25.3       0.000
IN-2                 STORAGE         15.72    15.72     0  12:00       0.307
0.318       0.207
IN-3                 STORAGE         45.07    53.57     0  12:00        1.19
3.05       0.007
ExistingBasin        STORAGE         37.70   172.78     0  12:00       0.742
25.3       0.016
IN-4                 STORAGE        100.15   100.15     0  12:00        2.38
2.38      -0.037
IN-12                STORAGE         47.02    47.02     0  12:00       0.953
0.953       0.058
IN-11                STORAGE         58.77    87.65     0  12:00        1.16
17.7       0.104
IN-10                STORAGE         11.24    69.71     0  11:59       0.219
5.89       0.012
IN-9                 STORAGE         21.15    63.26     0  12:00       0.413
5.67       0.004
IN-8                 STORAGE         34.60    55.43     0  12:00        0.68
5.26       0.021
IN-5                 STORAGE          8.26     8.26     0  12:00        0.16
0.16       0.018
IN-6                 STORAGE         29.92    32.28     0  12:00       0.596
0.756       0.069
IN-7                 STORAGE         23.87    31.68     0  12:00       0.466
1.22      -0.014


**********************
Node Surcharge Summary
**********************

Surcharging occurs when water rises above the top of the highest conduit.
-----------------------------------------------------------------------
                                                Max. Height   Min. Depth
                                     Hours      Above Crown    Below Rim
Node                 Type        Surcharged           Feet         Feet
-----------------------------------------------------------------------
MH-1                 JUNCTION          4.25          2.624        0.000
Out-4                JUNCTION         19.38          3.582        0.000
IN-1                 JUNCTION         20.88          4.102        0.000
```

```
Out-1                JUNCTION        1.94          1.098        0.000
Out-6                JUNCTION        0.59          0.093        0.907
Out-2                JUNCTION        0.59          0.093        0.907
Jun-1                JUNCTION        1.92          1.093        0.000
Jun-2                JUNCTION        2.03          1.192        0.000
Jun-3                JUNCTION        3.60          1.689        0.000


**********************
Node Flooding Summary
**********************

Flooding refers to all water that overflows a node, whether it ponds or not.
---------------------------------------------------------------------------
                                                          Total   Maximum
                                Maximum   Time of Max       Flood    Ponded
                      Hours       Rate    Occurrence      Volume     Depth
Node                 Flooded       CFS   days hr:min    10^6 gal      Feet
---------------------------------------------------------------------------
MH-1                    3.07     22.54      0  12:02       0.234     0.624
Out-4                  19.38     37.90      0  11:57       0.298     3.582
IN-1                   18.97    437.87      0  12:05       8.243     1.102
Out-1                   0.62      7.62      0  12:04       0.010     0.098
Jun-1                   0.59     22.90      0  12:04       0.037     0.093
Jun-2                   0.75     15.52      0  12:03       0.021     0.192
Jun-3                   1.45     32.09      0  11:58       0.066     0.689
IN-4                    1.03     88.73      0  12:01       0.517     0.000


***********************
Storage Volume Summary
***********************


-------------------------------------------------------------------------------------------
                       Average     Avg  Evap Exfil       Maximum     Max    Time of
                       Max    Maximum
                        Volume    Pcnt  Pcnt  Pcnt        Volume    Pcnt
                        Occurrence    Outflow
Storage Unit          1000 ft3    Full  Loss  Loss      1000 ft3    Full    days
hr:min        CFS

-------------------------------------------------------------------------------------------
IN-2                     0.156       0     0     0         6.773      14       0
12:09       5.45
IN-3                     0.884       2     0     0        27.142      54       0
12:27      25.63
ExistingBasin            1.374       9     0     0        10.425      66       0
12:02     165.64
IN-4                     2.797       6     0     0        50.041     100       0
12:01      13.42
IN-12                    0.010       0     0     0         2.341       5       0
12:04      37.26
IN-11                    0.975       2     0     0        44.969      90       0
12:11      43.76
IN-10                    0.006       0     0     0         0.032       0       0
12:02      69.56
IN-9                     0.011       0     0     0         1.171       2       0
12:04      62.26
IN-8                     0.029       0     0     0         5.033      10       0
12:05      50.40
IN-5                     0.052       0     0     0         3.939       8       0
12:08       2.52
IN-6                     0.366       1     0     0        19.220      38       0
12:13      11.49
IN-7                     0.157       0     0     0        13.601      27       0
12:10      17.76
```

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
Out-5	99.85	30.35	165.64	25.275
System	99.85	30.35	165.64	25.275

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
24inCMP	CONDUIT	27.32	0 17:57	8.70	5.32	1.00
21inRCP	CONDUIT	13.42	0 14:51	5.58	2.67	1.00
12inRCP	CONDUIT	5.45	0 11:56	6.94	1.08	1.00
24inRcp(2)	CONDUIT	25.63	0 12:03	8.16	3.62	1.00
PipeRecessed	CONDUIT	21.34	0 12:46	7.06	5.60	1.00
15inCMP	CONDUIT	2.52	0 11:48	2.08	1.03	1.00
21inCMP	CONDUIT	11.49	0 12:50	4.78	1.61	1.00
27inCMP	CONDUIT	17.76	0 12:34	4.47	1.51	1.00
30inRCP	CONDUIT	50.40	0 12:10	10.27	1.37	1.00
36inRCP(2)	CONDUIT	62.26	0 12:07	8.81	2.85	1.00
36inRCP	CONDUIT	69.56	0 11:59	10.01	1.29	1.00
36inCMP(2)	CONDUIT	43.76	0 12:14	6.76	4.61	1.00
24inRCP	CONDUIT	37.26	0 12:04	11.86	1.54	1.00
48inRCP	CONDUIT	165.64	0 12:00	13.59	1.11	0.96
36inCMP	CONDUIT	31.08	0 13:46	4.40	4.78	1.00
26	CONDUIT	27.33	0 17:55	1.89	0.51	1.00
27	CONDUIT	27.53	0 17:30	2.44	0.15	1.00
28	CONDUIT	23.17	0 12:00	0.77	0.06	0.94
29	CONDUIT	41.33	0 11:55	1.15	0.14	1.00
31	CONDUIT	15.56	0 12:04	0.43	0.17	1.00
32	CONDUIT	6.28	0 12:00	0.20	0.02	1.00
33	CONDUIT	4.19	0 11:55	0.19	0.01	1.00

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
24inCMP	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
21inRCP	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.25	0.00
12inRCP	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.17	0.00
24inRcp(2)	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
PipeRecessed	1.00	0.00	0.00	0.00	0.04	0.00	0.00	0.96	0.00	0.00
15inCMP	1.00	0.00	0.00	0.00	0.78	0.00	0.00	0.21	0.61	0.00
21inCMP	1.00	0.00	0.00	0.00	0.09	0.00	0.00	0.90	0.00	0.00
27inCMP	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.91	0.00
30inRCP	1.00	0.00	0.00	0.00	0.04	0.13	0.00	0.83	0.01	0.00
36inRCP(2)	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.98	0.00	0.00
36inRCP	1.00	0.00	0.00	0.00	0.14	0.01	0.00	0.84	0.15	0.00

36inCMP(2)	1.00	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.00	0.00
24inRCP	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
48inRCP	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
36inCMP	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
26	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
27	1.00	0.00	0.01	0.00	0.99	0.00	0.00	0.00	0.02	0.00
28	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.35	0.00
29	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.28	0.00
31	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.01	0.00
32	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.33	0.00
33	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.32	0.00

****
Conduit Surcharge Summary
****

Conduit	Hours Full Both Ends	Hours Full Upstream	Hours Full Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
24inCMP	19.24	20.88	19.24	25.15	19.24
21inRCP	4.42	4.44	4.43	4.53	4.41
12inRCP	5.39	5.39	10.64	0.30	0.30
24inRcp(2)	4.25	4.26	4.25	4.58	4.25
PipeRecessed	0.81	4.25	0.81	6.96	0.81
15inCMP	1.46	1.46	1.51	0.09	0.09
21inCMP	1.33	1.48	1.33	1.50	1.32
27inCMP	1.00	1.03	1.01	1.48	1.00
30inRCP	0.42	0.69	0.42	1.07	0.42
36inRCP(2)	0.23	0.39	0.23	3.28	0.23
36inRCP	0.05	0.23	0.05	0.40	0.05
36inCMP(2)	0.25	16.49	0.25	22.68	0.25
24inRCP	0.21	0.26	0.21	0.28	0.21
48inRCP	0.01	0.04	0.01	0.24	0.01
36inCMP	16.49	16.49	20.43	24.34	0.01
26	1.94	1.94	2.03	0.01	0.01
27	2.03	2.03	3.60	0.01	0.01
28	0.01	0.01	3.60	0.01	0.01
29	3.60	3.60	19.38	0.01	0.01
31	1.92	1.92	2.03	0.01	0.01
32	0.59	0.59	1.92	0.01	0.01
33	0.59	0.59	1.92	0.01	0.01

Analysis begun on: Tue Nov 15 17:13:01 2022
Analysis ended on: Tue Nov 15 17:13:02 2022
Total elapsed time: 00:00:01

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.0)
------------------------------------------------------------
```

Location 10: Old Washington Rd. and Shoppers World (25-Year -PROPOSED)

```
****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Surcharge Method ......... EXTRAN
Starting Date ............ 10/01/2022 00:00:00
Ending Date .............. 10/02/2022 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 01:00:00
Routing Time Step ........ 20.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 8
Number of Threads ........ 1
Head Tolerance ........... 0.005000 ft


**************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
**************************     ---------       -------
Total Precipitation ......        54.673         6.303
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         6.531         0.753
Surface Runoff ...........        47.470         5.473
Final Storage ............         0.758         0.087
Continuity Error (%) .....        -0.158


**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......        47.466        15.468
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........        44.919        14.637
Flooding Loss ............         1.862         0.607
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.658         0.214
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.031         0.010
Continuity Error (%) .....        -0.007


***************************
Time-Step Critical Elements
***************************
Link 34 (74.95%)
Link 38 (13.06%)
Link 12inRCP (5.61%)
Link 24inRcp(2) (1.83%)
Link 36 (1.50%)
```

```
********************************
Highest Flow Instability Indexes
********************************
Link 12inRCP (11)
Link 24inRcp(2) (8)
Link PipeRecessed (5)
Link 28 (2)
Link 31 (1)


*********************************
Most Frequent Nonconverging Nodes
*********************************
Node IN-1 (0.01%)
Node Out-5 (0.01%)


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.50 sec
Average Time Step           :     2.77 sec
Maximum Time Step           :    20.00 sec
% of Time in Steady State   :     0.00
Average Iterations per Step :     2.01
% of Steps Not Converging   :     0.01
Time Step Frequencies       :
   20.000 -  9.564 sec      :     0.16 %
    9.564 -  4.573 sec      :     7.75 %
    4.573 -  2.187 sec      :    60.40 %
    2.187 -  1.046 sec      :    28.72 %
    1.046 -  0.500 sec      :     2.98 %


***************************
Subcatchment Runoff Summary
***************************


-----------------------------------------------------------------------------------------------------------------------------------------
                          Total      Total      Total      Total     Imperv
                          Perv      Total       Total     Peak  Runoff
                         Precip      Runon       Evap      Infil     Runoff
                         Runoff     Runoff      Runoff   Runoff   Coeff
Subcatchment                in         in         in         in         in         in         in    10^6 gal      CFS
-----------------------------------------------------------------------------------------------------------------------------------------
DA-1                        6.30       0.00       0.00       0.89       3.19       2.11       5.30       9.30   231.68   0.841
DA-2                        6.30       0.00       0.00       0.15       5.72       0.42       6.13       0.18     9.22   0.973
DA-3                        6.30       0.00       0.00       1.24       1.57       3.44       5.01       0.65    22.50   0.795
DA-4                        6.30       0.00       0.00       0.51       4.33       1.42       5.75       1.38    53.53   0.913
DA-5                        6.30       0.00       0.00       0.02       6.21       0.05       6.26       0.10     4.94   0.993
DA-6                        6.30       0.00       0.00       0.11       5.84       0.32       6.17       0.35    17.38   0.979
DA-7                        6.30       0.00       0.00       0.18       5.59       0.51       6.10       0.28    13.96   0.968
DA-8                        6.30       0.00       0.00       0.16       5.66       0.46       6.12       0.40    20.16   0.971
DA-9                        6.30       0.00       0.00       0.11       5.84
```

```
0.32       6.17        0.24    12.44   0.979
DA-10                      6.30       0.00       0.00       0.28       5.22
0.79       6.00        0.13     6.52   0.952
DA-11                      6.30       0.00       0.00       0.18       5.59
0.51       6.10        0.69    34.10   0.968
DA-12                      6.30       0.00       0.00       0.58       4.08
1.62       5.70        0.55    26.24   0.904
DA-13                      6.30       0.00       0.00       0.40       5.28
0.60       5.88        0.27    13.61   0.933
DA-14                      6.30       0.00       0.00       1.26       2.14
2.87       5.01        0.39    15.82   0.795
DA-15                      6.30       0.00       0.00       0.31       5.08
0.88       5.96        0.05     2.40   0.946
DA-16                      6.30       0.00       0.00       0.45       4.59
1.25       5.83        0.08     3.60   0.925
DA-BASIN                   6.30       0.00       0.00       0.44       4.59
1.25       5.84        0.43    21.48   0.926


******************
Node Depth Summary
******************

-------------------------------------------------------------------------------
                                Average  Maximum  Maximum  Time of Max    Reported
                                  Depth    Depth      HGL   Occurrence   Max Depth
Node                 Type         Feet     Feet     Feet  days hr:min        Feet
-------------------------------------------------------------------------------
MH-1                 JUNCTION     0.99     3.75   206.49     0  12:00        3.74
Out-4                JUNCTION     3.46     6.17   204.68     0  12:26        6.16
IN-1                 JUNCTION     3.14     5.45   206.55     0  14:14        5.45
Out-1                JUNCTION     1.86     3.73   204.73     0  12:26        3.70
Out-3                JUNCTION     0.64     2.09   204.70     0  12:26        2.06
Out-6                JUNCTION     0.94     2.71   204.71     0  12:26        2.68
Out-2                JUNCTION     0.93     2.71   204.71     0  12:26        2.68
Jun-1                JUNCTION     1.63     3.71   204.71     0  12:26        3.68
Jun-2                JUNCTION     1.73     3.81   204.71     0  12:26        3.78
Jun-3                JUNCTION     1.91     4.30   204.70     0  12:26        4.27
Out-5                OUTFALL      1.00     3.14   199.78     0  12:01        3.07
IN-2                 STORAGE      0.65     4.09   207.19     0  12:02        4.07
IN-3                 STORAGE      0.98     3.73   206.49     0  12:00        3.72
ExistingBasin        STORAGE      1.00     3.14   201.34     0  12:01        3.09
IN-12                STORAGE      0.22     1.84   204.74     0  12:00        1.82
IN-11                STORAGE      2.23     4.41   203.04     0  12:07        4.34
IN-10                STORAGE      0.57     2.76   202.93     0  12:00        2.74
IN-9                 STORAGE      0.77     3.34   203.72     0  12:00        3.33
IN-8                 STORAGE      0.56     3.61   205.88     0  12:00        3.59
IN-5                 STORAGE      0.30     4.15   211.44     0  12:06        4.11
IN-6                 STORAGE      0.46     4.38   210.15     0  12:09        4.37
IN-7                 STORAGE      0.47     4.25   208.10     0  12:06        4.18
BMP1                 STORAGE      0.37     3.00   208.00     0  11:55        3.00
BMP2                 STORAGE      0.41     3.00   207.50     0  11:56        3.00
BMP3                 STORAGE      0.51     3.00   207.00     0  11:53        3.00
BMP4                 STORAGE      0.73     3.00   206.50     0  11:48        3.00
BMP5                 STORAGE      0.40     1.69   204.69     0  12:24        1.66


******************
Node Inflow Summary
******************


-------------------------------------------------------------------------------
----------
                                Maximum  Maximum                  Lateral
                                Total        Flow
                                Lateral    Total  Time of Max      Inflow
                                Inflow     Balance
                                 Inflow   Inflow   Occurrence      Volume
```

```
                                        Volume       Error
Node                 Type            CFS      CFS  days hr:min    10^6 gal    10^6
gal     Percent

--------------------------------------------------------------------------------------
----------
MH-1                 JUNCTION      0.00    14.85     0  11:51           0
1.63      -0.070
Out-4                JUNCTION      0.00    42.41     0  12:05           0
10.2       0.036
IN-1                 JUNCTION    231.68   231.68     0  12:05         9.3
9.3      -0.009
Out-1                JUNCTION      0.00    28.03     0  11:39           0
9.3       0.010
Out-3                JUNCTION     13.61    13.61     0  12:00       0.271
0.272      -0.017
Out-6                JUNCTION      3.60     3.60     0  12:00       0.076
0.0779       0.000
Out-2                JUNCTION      2.40     2.40     0  12:00      0.0453
0.0482       0.004
Jun-1                JUNCTION      0.00     8.21     0  22:27           0
0.148       0.151
Jun-2                JUNCTION      0.00    28.28     0  11:57           0
9.45       0.012
Jun-3                JUNCTION      0.00    38.86     0  11:58           0
9.7       0.006
Out-5                OUTFALL       0.00   142.38     0  12:01           0
14.6       0.000
IN-2                 STORAGE       9.22     9.22     0  12:00       0.182
0.211       0.702
IN-3                 STORAGE       0.00    12.68     0  12:40           0
1.42       0.009
ExistingBasin        STORAGE      21.48   144.50     0  12:00       0.431
14.6       0.005
IN-12                STORAGE      26.24    26.24     0  12:00       0.549
0.549       0.001
IN-11                STORAGE      34.10    53.47     0  12:00       0.686
10.6       0.009
IN-10                STORAGE       6.52    62.03     0  12:00       0.129
3.1       0.002
IN-9                 STORAGE      12.44    55.68     0  12:00       0.245
2.97       0.002
IN-8                 STORAGE      20.16    43.97     0  12:00       0.402
2.73       0.020
IN-5                 STORAGE       4.94     4.94     0  12:00      0.0952
0.0952       0.022
IN-6                 STORAGE      17.38    19.83     0  12:00       0.353
0.449       0.050
IN-7                 STORAGE      13.96    21.78     0  12:00       0.275
0.723      -0.064
BMP1                 STORAGE      53.53    53.53     0  12:00        1.38
1.38       0.000
BMP2                 STORAGE       0.00    35.04     0  11:56           0
1.31      -0.001
BMP3                 STORAGE      22.50    57.13     0  12:00       0.652
1.96       0.000
BMP4                 STORAGE       0.00    34.66     0  12:04           0
1.82       0.002
BMP5                 STORAGE      15.82    21.91     0  12:00       0.393
0.673       0.005


**********************
Node Surcharge Summary
**********************

Surcharging occurs when water rises above the top of the highest conduit.
-------------------------------------------------------------------------
                                                Max. Height   Min. Depth
```

Node	Type	Hours Surcharged	Above Crown Feet	Below Rim Feet
MH-1	JUNCTION	1.41	1.753	0.247
Out-4	JUNCTION	11.10	2.174	0.000
IN-1	JUNCTION	11.71	3.450	0.000
Jun-3	JUNCTION	1.00	0.300	0.700

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
Out-4	11.10	21.09	0 12:05	0.343	2.174
IN-1	10.78	209.09	0 12:05	3.367	0.450
BMP1	0.21	18.79	0 12:00	0.069	0.000
BMP2	0.01	0.35	0 11:56	0.000	0.000
BMP3	0.35	22.42	0 12:00	0.142	0.000
BMP4	0.86	32.39	0 12:01	0.396	0.000

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CFS
IN-2	0.008	0	0	0	0.460	1	0 12:02	7.92
IN-3	0.009	0	0	0	0.034	0	0 12:00	12.68
ExistingBasin	1.123	7	0	0	6.680	43	0 12:01	142.38
IN-12	0.002	0	0	0	0.017	0	0 12:00	26.08
IN-11	0.157	0	0	0	8.415	17	0 12:07	39.40
IN-10	0.005	0	0	0	0.025	0	0 12:00	62.05
IN-9	0.007	0	0	0	0.030	0	0 12:00	55.61
IN-8	0.005	0	0	0	0.032	0	0 12:00	43.41
IN-5	0.017	0	0	0	1.167	2	0 12:06	2.52
IN-6	0.166	0	0	0	7.376	15	0 12:09	11.27
IN-7	0.037	0	0	0	3.242	6	0 12:06	19.26
BMP1	0.054	5	0	0	1.125	100	0 11:55	35.09
BMP2	0.069	6	0	0	1.125	100	0	

```
11:56      34.70
BMP3                     0.097       9     0     0         1.125     100       0
11:53      34.71
BMP4                     0.154      14     0     0         1.125     100       0
11:48      12.72
BMP5                     4.034      13     0    31        16.913      56       0
12:24      17.10


**********************
Outfall Loading Summary
**********************

-------------------------------------------------------------
                       Flow       Avg       Max       Total
                       Freq      Flow      Flow      Volume
Outfall Node           Pcnt       CFS       CFS    10^6 gal
-------------------------------------------------------------
Out-5                 99.84     24.54    142.38      14.636
-------------------------------------------------------------
System                99.84     24.54    142.38      14.636


********************
Link Flow Summary
********************

-------------------------------------------------------------------------------
                                Maximum  Time of Max   Maximum    Max/    Max/
                                 |Flow|   Occurrence   |Veloc|    Full    Full
Link                  Type          CFS  days hr:min    ft/sec    Flow   Depth
-------------------------------------------------------------------------------
24inCMP               CONDUIT     28.03     0  11:39      8.92    5.46    1.00
12inRCP               CONDUIT      7.92     0  12:07     10.08    1.57    1.00
24inRcp(2)            CONDUIT     12.68     0  12:41      4.04    1.79    1.00
PipeRecessed          CONDUIT     14.83     0  11:51      4.94    3.89    1.00
15inCMP               CONDUIT      2.52     0  11:54      2.07    1.03    1.00
21inCMP               CONDUIT     11.27     0  12:20      4.69    1.58    1.00
27inCMP               CONDUIT     19.26     0  12:13      4.94    1.63    1.00
30inRCP               CONDUIT     43.41     0  12:00      8.84    1.18    1.00
36inRCP(2)            CONDUIT     55.61     0  12:00      8.04    2.54    0.94
36inRCP               CONDUIT     62.05     0  12:00      9.41    1.15    0.88
36inCMP(2)            CONDUIT     39.40     0  12:09      6.19    4.15    0.97
24inRCP               CONDUIT     26.08     0  12:00      8.81    1.08    0.91
48inRCP               CONDUIT    142.38     0  12:01     13.46    0.96    0.78
36inCMP               CONDUIT     29.35     0  12:44      4.15    4.51    1.00
26                    CONDUIT     27.79     0  11:39      2.01    0.52    0.94
27                    CONDUIT     30.32     0  12:56      2.49    0.16    0.98
28                    CONDUIT     13.31     0  12:00      0.71    0.03    0.76
29                    CONDUIT     37.68     0  11:58      1.15    0.13    1.00
31                    CONDUIT      8.21     0  22:27      0.61    0.09    0.94
32                    CONDUIT      3.35     0  12:00      0.22    0.01    0.80
33                    CONDUIT      2.14     0  12:00      0.22    0.01    0.80
34                    CONDUIT     35.04     0  11:56     11.15    1.01    1.00
35                    CONDUIT     34.65     0  11:56     11.03    1.00    1.00
36                    CONDUIT     34.66     0  12:04     11.03    1.00    1.00
37                    CONDUIT     12.68     0  12:40      4.03    1.20    1.00
38                    CONDUIT     16.64     0  12:05      6.08    0.16    0.92


***************************
Flow Classification Summary
***************************

-----------------------------------------------------------------------------------------
                     Adjusted    ---------- Fraction of Time in Flow Class ----------
                      /Actual         Up    Down  Sub   Sup   Up    Down  Norm  Inlet
Conduit               Length    Dry  Dry   Dry   Crit  Crit  Crit  Crit  Ltd   Ctrl
-----------------------------------------------------------------------------------------
```

24inCMP	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
12inRCP	1.00	0.00	0.00	0.00	0.98	0.00	0.00	0.01	0.23	0.00
24inRcp(2)	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.01	0.00
PipeRecessed	1.00	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.00	0.00
15inCMP	1.00	0.00	0.00	0.00	0.74	0.00	0.00	0.25	0.30	0.00
21inCMP	1.00	0.00	0.00	0.00	0.05	0.00	0.00	0.95	0.00	0.00
27inCMP	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.91	0.00
30inRCP	1.00	0.00	0.00	0.00	0.01	0.05	0.00	0.93	0.02	0.00
36inRCP(2)	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
36inRCP	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
36inCMP(2)	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.98	0.00	0.00
24inRCP	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
48inRCP	1.00	0.00	0.00	0.00	0.01	0.99	0.00	0.00	0.39	0.00
36inCMP	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
26	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
27	1.00	0.00	0.01	0.00	0.99	0.00	0.00	0.00	0.01	0.00
28	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.62	0.00
29	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.58	0.00
31	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.02	0.00
32	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.61	0.00
33	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.60	0.00
34	1.00	0.00	0.00	0.00	0.04	0.95	0.00	0.00	0.42	0.00
35	1.00	0.00	0.00	0.00	0.05	0.94	0.00	0.00	0.82	0.00
36	1.00	0.00	0.00	0.00	0.24	0.75	0.00	0.00	0.53	0.00
37	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.90	0.00
38	1.00	0.00	0.55	0.00	0.44	0.00	0.00	0.00	0.31	0.00

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Hours Full: Upstream	Hours Full: Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
24inCMP	10.97	11.71	10.97	14.57	10.96
12inRCP	2.59	2.59	5.46	0.25	0.25
24inRcp(2)	1.41	1.42	1.41	1.44	1.17
PipeRecessed	0.26	1.41	0.26	3.56	0.26
15inCMP	0.67	0.67	0.73	0.09	0.09
21inCMP	0.63	0.69	0.63	0.72	0.63
27inCMP	0.28	0.43	0.28	0.70	0.28
30inRCP	0.21	0.25	0.21	0.38	0.21
36inRCP(2)	0.01	0.17	0.01	0.86	0.01
36inRCP	0.01	0.01	0.01	0.18	0.01
36inCMP(2)	0.01	7.76	0.01	12.81	0.01
24inRCP	0.01	0.01	0.01	0.05	0.01
36inCMP	7.76	7.76	11.66	13.83	0.01
27	0.01	0.01	1.00	0.01	0.01
28	0.01	0.01	1.00	0.01	0.01
29	1.00	1.00	11.10	0.01	0.01
34	0.50	0.50	0.96	0.22	0.21
35	0.96	0.96	1.16	0.01	0.01
36	1.16	1.16	1.32	0.01	0.01
37	1.32	1.32	1.42	0.93	0.94
38	0.01	0.01	12.71	0.01	0.01

Analysis begun on: Mon Nov 28 15:00:46 2022
Analysis ended on: Mon Nov 28 15:00:47 2022
Total elapsed time: 00:00:01

```

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.0)
--------------------------------------------------------------
```

Location 10: Old Washington Rd. and Shoppers World (25-Year (2050) -PROPOSED)

```
****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Surcharge Method ......... EXTRAN
Starting Date ............ 10/01/2022 00:00:00
Ending Date .............. 10/02/2022 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 01:00:00
Routing Time Step ........ 20.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 8
Number of Threads ........ 1
Head Tolerance ........... 0.005000 ft


**************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
**************************     ---------       -------
Total Precipitation ......        61.292         7.066
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         6.713         0.774
Surface Runoff ...........        53.895         6.213
Final Storage ............         0.782         0.090
Continuity Error (%) .....        -0.162


**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......        53.888        17.560
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........        50.832        16.564
Flooding Loss ............         2.301         0.750
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.725         0.236
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.033         0.011
Continuity Error (%) .....        -0.005


***************************
Time-Step Critical Elements
***************************
Link 34 (70.85%)
Link 38 (15.19%)
Link 12inRCP (6.33%)
Link 24inRcp(2) (2.31%)
Link 35 (1.63%)
```

```
********************************
Highest Flow Instability Indexes
********************************
Link 12inRCP (11)
Link 24inRcp(2) (8)
Link PipeRecessed (5)
Link 28 (2)
Link 31 (1)


*********************************
Most Frequent Nonconverging Nodes
*********************************
Node Out-5 (0.01%)
Node IN-1 (0.01%)
Node MH-1 (0.00%)
Node IN-5 (0.00%)


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.50 sec
Average Time Step           :     2.67 sec
Maximum Time Step           :    20.00 sec
% of Time in Steady State   :     0.00
Average Iterations per Step :     2.01
% of Steps Not Converging   :     0.01
Time Step Frequencies       :
   20.000 -  9.564 sec      :     0.13 %
    9.564 -  4.573 sec      :     7.35 %
    4.573 -  2.187 sec      :    58.30 %
    2.187 -  1.046 sec      :    31.02 %
    1.046 -  0.500 sec      :     3.20 %


***************************
Subcatchment Runoff Summary
***************************


---------------------------------------------------------------------------------------
                          Total      Total      Total      Total     Imperv
                          Perv      Total       Total     Peak  Runoff
                         Precip      Runon       Evap      Infil     Runoff
                         Runoff     Runoff      Runoff   Runoff   Coeff
Subcatchment                 in         in          in         in         in
in         in    10^6 gal      CFS

---------------------------------------------------------------------------------------
DA-1                         7.07       0.00       0.00       0.92       3.58
2.45       6.04       10.59   268.97   0.854
DA-2                         7.07       0.00       0.00       0.15       6.41
0.48       6.90        0.20    10.39   0.976
DA-3                         7.07       0.00       0.00       1.27       1.76
3.98       5.74        0.75    26.35   0.813
DA-4                         7.07       0.00       0.00       0.53       4.86
1.65       6.51        1.56    61.68   0.921
DA-5                         7.07       0.00       0.00       0.02       6.97
0.05       7.02        0.11     5.54   0.994
DA-6                         7.07       0.00       0.00       0.12       6.55
0.37       6.93        0.40    19.63   0.981
DA-7                         7.07       0.00       0.00       0.19       6.27
0.59       6.86        0.31    15.74   0.971
DA-8                         7.07       0.00       0.00       0.17       6.34
```

```
0.54       6.88        0.45    22.76   0.974
DA-9                       7.07       0.00       0.00       0.12       6.55
0.37       6.93        0.27    14.01   0.981
DA-10                      7.07       0.00       0.00       0.29       5.85
0.91       6.76        0.15     7.37   0.957
DA-11                      7.07       0.00       0.00       0.19       6.27
0.59       6.86        0.77    38.53   0.971
DA-12                      7.07       0.00       0.00       0.59       4.58
1.87       6.45        0.62    29.94   0.913
DA-13                      7.07       0.00       0.00       0.42       5.92
0.71       6.63        0.31    15.42   0.938
DA-14                      7.07       0.00       0.00       1.30       2.40
3.34       5.74        0.45    18.42   0.812
DA-15                      7.07       0.00       0.00       0.32       5.70
1.02       6.72        0.05     2.70   0.951
DA-16                      7.07       0.00       0.00       0.46       5.15
1.44       6.59        0.09     4.11   0.932
DA-BASIN                   7.07       0.00       0.00       0.46       5.15
1.44       6.59        0.49    24.39   0.932


******************
Node Depth Summary
******************

--------------------------------------------------------------------------------
                              Average  Maximum  Maximum  Time of Max    Reported
                                Depth    Depth      HGL   Occurrence   Max Depth
Node                 Type        Feet     Feet     Feet  days hr:min        Feet
--------------------------------------------------------------------------------
MH-1                 JUNCTION    1.04     3.80   206.54     0  12:00        3.79
Out-4                JUNCTION    3.75     6.38   204.89     0  12:26        6.38
IN-1                 JUNCTION    3.45     5.56   206.66     0  14:30        5.56
Out-1                JUNCTION    2.03     3.93   204.93     0  12:26        3.92
Out-3                JUNCTION    0.74     2.30   204.91     0  12:26        2.29
Out-6                JUNCTION    1.08     2.91   204.91     0  12:26        2.91
Out-2                JUNCTION    1.08     2.91   204.91     0  12:26        2.91
Jun-1                JUNCTION    1.82     3.91   204.91     0  12:26        3.91
Jun-2                JUNCTION    1.92     4.01   204.91     0  12:26        4.01
Jun-3                JUNCTION    2.14     4.51   204.91     0  12:26        4.50
Out-5                OUTFALL     1.06     3.28   199.92     0  12:01        3.22
IN-2                 STORAGE     0.69     4.14   207.24     0  12:04        4.10
IN-3                 STORAGE     1.03     3.78   206.54     0  12:00        3.77
ExistingBasin        STORAGE     1.07     3.28   201.48     0  12:01        3.23
IN-12                STORAGE     0.24     2.62   205.52     0  12:00        2.58
IN-11                STORAGE     2.38     4.51   203.14     0  12:08        4.46
IN-10                STORAGE     0.60     3.00   203.17     0  12:00        2.94
IN-9                 STORAGE     0.81     3.56   203.94     0  12:00        3.51
IN-8                 STORAGE     0.59     3.84   206.11     0  12:00        3.82
IN-5                 STORAGE     0.34     4.18   211.47     0  12:07        4.14
IN-6                 STORAGE     0.51     4.43   210.20     0  12:10        4.42
IN-7                 STORAGE     0.50     4.31   208.16     0  12:07        4.22
BMP1                 STORAGE     0.39     3.00   208.00     0  11:54        3.00
BMP2                 STORAGE     0.43     3.00   207.50     0  11:54        3.00
BMP3                 STORAGE     0.53     3.00   207.00     0  11:51        3.00
BMP4                 STORAGE     0.77     3.00   206.50     0  11:47        3.00
BMP5                 STORAGE     0.49     1.90   204.90     0  12:27        1.90


*******************
Node Inflow Summary
*******************


--------------------------------------------------------------------------------
----------
                              Maximum  Maximum                  Lateral
                              Total        Flow
                              Lateral    Total  Time of Max      Inflow
```

Node	Type	Inflow Inflow Volume CFS	Balance Inflow Error CFS	Occurrence days	hr:min	Volume 10^6 gal	10^6 gal	Percent
MH-1	JUNCTION	0.00	14.79	0	11:50	0	1.78	-0.059
Out-4	JUNCTION	0.00	47.52	0	12:01	0	11.5	0.033
IN-1	JUNCTION	268.97	268.97	0	12:05	10.6	10.6	-0.002
Out-1	JUNCTION	0.00	27.83	0	11:35	0	10.6	0.009
Out-3	JUNCTION	15.42	15.42	0	12:00	0.306	0.306	-0.017
Out-6	JUNCTION	4.11	4.11	0	12:00	0.0858	0.0878	-0.002
Out-2	JUNCTION	2.70	2.70	0	12:00	0.0511	0.0538	0.000
Jun-1	JUNCTION	0.00	8.76	1	00:18	0	0.161	0.162
Jun-2	JUNCTION	0.00	28.36	0	16:27	0	10.7	0.011
Jun-3	JUNCTION	0.00	39.00	0	12:04	0	11	0.006
Out-5	OUTFALL	0.00	148.63	0	12:01	0	16.6	0.000
IN-2	STORAGE	10.39	10.39	0	12:00	0.204	0.232	0.612
IN-3	STORAGE	0.00	12.66	0	12:45	0	1.55	0.009
ExistingBasin	STORAGE	24.39	151.66	0	12:00	0.487	16.6	0.004
IN-12	STORAGE	29.94	29.94	0	12:00	0.622	0.622	0.002
IN-11	STORAGE	38.53	58.35	0	12:00	0.771	12	0.008
IN-10	STORAGE	7.37	64.86	0	12:00	0.145	3.44	0.002
IN-9	STORAGE	14.01	57.80	0	12:00	0.275	3.29	0.002
IN-8	STORAGE	22.76	44.65	0	12:00	0.452	3.02	0.018
IN-5	STORAGE	5.54	5.54	0	12:00	0.107	0.107	0.036
IN-6	STORAGE	19.63	22.06	0	12:00	0.397	0.504	0.033
IN-7	STORAGE	15.74	23.56	0	12:00	0.309	0.813	-0.103
BMP1	STORAGE	61.68	61.68	0	12:00	1.56	1.56	0.001
BMP2	STORAGE	0.00	35.04	0	11:54	0	1.45	-0.001
BMP3	STORAGE	26.35	60.99	0	12:00	0.747	2.19	0.002
BMP4	STORAGE	0.00	34.66	0	11:59	0	2.01	0.003
BMP5	STORAGE	18.42	25.33	0	12:03	0.45	0.699	0.004

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
MH-1	JUNCTION	1.54	1.803	0.197
Out-4	JUNCTION	13.10	2.385	0.000
IN-1	JUNCTION	13.78	3.556	0.000
Jun-2	JUNCTION	0.20	0.013	0.987
Jun-3	JUNCTION	1.46	0.506	0.494

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
Out-4	13.10	26.90	0 12:01	0.337	2.385
IN-1	12.69	247.64	0 12:05	4.160	0.556
BMP1	0.25	26.93	0 12:00	0.112	0.000
BMP2	0.01	0.33	0 11:54	0.000	0.000
BMP3	0.39	26.28	0 12:00	0.183	0.000
BMP4	0.96	33.95	0 12:01	0.455	0.000

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Max Occurrence hr:min	Maximum Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CFS
IN-2	0.013	0	0	0	0	0.984	2	0 12:04	8.38
IN-3	0.009	0	0	0	0	0.034	0	0 12:00	13.28
ExistingBasin	1.225	8	0	0	0	7.225	46	0 12:01	148.63
IN-12	0.002	0	0	0	0	0.024	0	0 12:00	29.69
IN-11	0.320	1	0	0	0	12.969	26	0 12:08	40.24
IN-10	0.005	0	0	0	0	0.027	0	0 12:00	64.27
IN-9	0.007	0	0	0	0	0.032	0	0 12:00	57.56
IN-8	0.005	0	0	0	0	0.035	0	0 12:00	43.84
IN-5	0.028	0	0	0	0	1.615	3	0 12:07	2.52
IN-6	0.265	1	0	0	0	9.351	19	0 12:10	11.33
IN-7	0.064	0	0	0	0	4.809	10	0 12:07	19.48

```
BMP1                    0.059       5     0     0         1.125     100       0
11:54      35.09
BMP2                    0.075       7     0     0         1.125     100       0
11:54      34.70
BMP3                    0.105       9     0     0         1.125     100       0
11:51      34.71
BMP4                    0.164      15     0     0         1.125     100       0
11:47      12.71
BMP5                    4.893      16     0    33        18.987      63       0
12:27      16.94


**********************
Outfall Loading Summary
**********************

------------------------------------------------------------
                      Flow       Avg       Max       Total
                      Freq      Flow      Flow      Volume
Outfall Node          Pcnt       CFS       CFS    10^6 gal
------------------------------------------------------------
Out-5                99.85     27.04    148.63      16.563
------------------------------------------------------------
System               99.85     27.04    148.63      16.563


********************
Link Flow Summary
********************

-------------------------------------------------------------------------------
                               Maximum  Time of Max   Maximum    Max/    Max/
                               |Flow|   Occurrence   |Veloc|    Full    Full
Link                 Type        CFS  days hr:min    ft/sec    Flow   Depth
-------------------------------------------------------------------------------
24inCMP              CONDUIT     27.83     0  11:35      8.86    5.42    1.00
12inRCP              CONDUIT      8.38     0  12:09     10.67    1.67    1.00
24inRcp(2)           CONDUIT     13.28     0  12:10      4.23    1.88    1.00
PipeRecessed         CONDUIT     14.76     0  11:50      4.95    3.87    1.00
15inCMP              CONDUIT      2.52     0  11:53      2.08    1.03    1.00
21inCMP              CONDUIT     11.33     0  12:25      4.71    1.59    1.00
27inCMP              CONDUIT     19.48     0  12:15      5.00    1.65    1.00
30inRCP              CONDUIT     43.84     0  12:00      8.93    1.19    1.00
36inRCP(2)           CONDUIT     57.56     0  12:00      8.19    2.63    0.99
36inRCP              CONDUIT     64.27     0  12:00      9.51    1.19    0.93
36inCMP(2)           CONDUIT     40.24     0  12:10      6.30    4.24    1.00
24inRCP              CONDUIT     29.69     0  12:00      9.56    1.23    0.96
48inRCP              CONDUIT    148.63     0  12:01     13.48    1.00    0.86
36inCMP              CONDUIT     30.03     0  12:40      4.25    4.62    1.00
26                   CONDUIT     27.61     0  11:36      1.95    0.52    0.99
27                   CONDUIT     30.84     0  13:33      2.49    0.17    1.00
28                   CONDUIT     15.01     0  12:00      0.75    0.04    0.79
29                   CONDUIT     38.47     0  12:04      1.09    0.13    1.00
31                   CONDUIT      8.76     1  00:18      0.66    0.10    0.99
32                   CONDUIT      3.73     0  12:00      0.24    0.01    0.85
33                   CONDUIT      2.32     0  12:00      0.23    0.01    0.85
34                   CONDUIT     35.04     0  11:54     11.15    1.01    1.00
35                   CONDUIT     34.65     0  11:55     11.03    1.00    1.00
36                   CONDUIT     34.66     0  11:59     11.03    1.00    1.00
37                   CONDUIT     12.66     0  12:45      4.03    1.20    1.00
38                   CONDUIT     16.48     0  12:01      6.08    0.16    0.97


***************************
Flow Classification Summary
***************************

-----------------------------------------------------------------------------------------
                      Adjusted    ---------- Fraction of Time in Flow Class ----------
```

Conduit	/Actual Length	Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
24inCMP	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
12inRCP	1.00	0.00	0.00	0.00	0.98	0.00	0.00	0.01	0.22	0.00
24inRcp(2)	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.01	0.00
PipeRecessed	1.00	0.00	0.00	0.00	0.02	0.00	0.00	0.97	0.00	0.00
15inCMP	1.00	0.00	0.00	0.00	0.75	0.00	0.00	0.24	0.37	0.00
21inCMP	1.00	0.00	0.00	0.00	0.06	0.00	0.00	0.94	0.00	0.00
27inCMP	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.91	0.00
30inRCP	1.00	0.00	0.00	0.00	0.02	0.05	0.00	0.93	0.02	0.00
36inRCP(2)	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
36inRCP	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
36inCMP(2)	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.98	0.00	0.00
24inRCP	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
48inRCP	1.00	0.00	0.00	0.00	0.00	0.99	0.00	0.00	0.39	0.00
36inCMP	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
26	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
27	1.00	0.00	0.01	0.00	0.99	0.00	0.00	0.00	0.02	0.00
28	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.55	0.00
29	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.51	0.00
31	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.02	0.00
32	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.54	0.00
33	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.54	0.00
34	1.00	0.00	0.00	0.00	0.05	0.95	0.00	0.00	0.44	0.00
35	1.00	0.00	0.00	0.00	0.06	0.94	0.00	0.00	0.79	0.00
36	1.00	0.00	0.00	0.00	0.25	0.74	0.00	0.00	0.43	0.00
37	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.89	0.00
38	1.00	0.00	0.49	0.00	0.51	0.00	0.00	0.00	0.26	0.00

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Hours Full: Upstream	Hours Full: Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
24inCMP	12.91	13.78	12.93	16.57	12.80
12inRCP	2.98	2.98	6.20	0.31	0.31
24inRcp(2)	1.54	1.55	1.54	1.58	1.24
PipeRecessed	0.30	1.54	0.30	4.14	0.30
15inCMP	0.80	0.80	0.86	0.09	0.09
21inCMP	0.74	0.82	0.74	0.85	0.74
27inCMP	0.32	0.51	0.32	0.83	0.32
30inRCP	0.24	0.28	0.24	0.41	0.24
36inRCP(2)	0.01	0.20	0.01	0.98	0.01
36inRCP	0.01	0.01	0.01	0.21	0.01
36inCMP(2)	0.01	9.44	0.01	15.13	0.01
24inRCP	0.01	0.07	0.01	0.12	0.01
36inCMP	9.44	9.44	13.71	16.06	0.01
26	0.01	0.01	0.20	0.01	0.01
27	0.20	0.20	1.46	0.01	0.01
28	0.01	0.01	1.46	0.01	0.01
29	1.46	1.46	13.10	0.01	0.01
31	0.01	0.01	0.20	0.01	0.01
34	0.57	0.57	1.06	0.26	0.25
35	1.06	1.06	1.28	0.01	0.01
36	1.28	1.28	1.44	0.01	0.01
37	1.44	1.44	1.55	1.01	1.03
38	0.01	0.01	14.86	0.01	0.01

Analysis begun on: Mon Nov 28 15:00:13 2022
Analysis ended on: Mon Nov 28 15:00:13 2022
Total elapsed time: < 1 sec

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.0)
------------------------------------------------------------
```

Location 10: Old Washington Rd. and Shoppers World (25-Year (2100) -PROPOSED)

```
****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Surcharge Method ......... EXTRAN
Starting Date ............ 10/01/2022 00:00:00
Ending Date .............. 10/02/2022 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 01:00:00
Routing Time Step ........ 20.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 8
Number of Threads ........ 1
Head Tolerance ........... 0.005000 ft


**************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
**************************     ---------       -------
Total Precipitation ......        65.386         7.538
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         6.828         0.787
Surface Runoff ...........        57.873         6.672
Final Storage ............         0.795         0.092
Continuity Error (%) .....        -0.168


**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......        57.868        18.857
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........        54.493        17.757
Flooding Loss ............         2.571         0.838
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.774         0.252
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.034         0.011
Continuity Error (%) .....        -0.006


***************************
Time-Step Critical Elements
***************************
Link 34 (68.11%)
Link 38 (16.53%)
Link 12inRCP (6.69%)
Link 24inRcp(2) (3.13%)
Link 36inCMP (1.62%)
```

```
********************************
Highest Flow Instability Indexes
********************************
Link 12inRCP (10)
Link 24inRcp(2) (8)
Link PipeRecessed (4)
Link 28 (2)
Link 31 (1)


*********************************
Most Frequent Nonconverging Nodes
*********************************
Node Out-5 (0.01%)
Node IN-1 (0.01%)
Node MH-1 (0.00%)


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.50 sec
Average Time Step           :     2.57 sec
Maximum Time Step           :    20.00 sec
% of Time in Steady State   :     0.00
Average Iterations per Step :     2.01
% of Steps Not Converging   :     0.01
Time Step Frequencies       :
   20.000 -  9.564 sec      :     0.13 %
    9.564 -  4.573 sec      :     6.72 %
    4.573 -  2.187 sec      :    57.11 %
    2.187 -  1.046 sec      :    30.27 %
    1.046 -  0.500 sec      :     5.77 %


***************************
Subcatchment Runoff Summary
***************************


---------------------------------------------------------------------------------------
                          Total      Total      Total      Total     Imperv
                          Perv      Total       Total     Peak  Runoff
                         Precip      Runon       Evap      Infil     Runoff
                         Runoff     Runoff      Runoff   Runoff   Coeff
Subcatchment                in         in         in         in         in
in         in    10^6 gal      CFS
---------------------------------------------------------------------------------------
DA-1                        7.54       0.00       0.00       0.94       3.82
2.67       6.49       11.39   291.05   0.861
DA-2                        7.54       0.00       0.00       0.15       6.84
0.52       7.37        0.22    11.07   0.977
DA-3                        7.54       0.00       0.00       1.29       1.89
4.32       6.20        0.81    28.67   0.823
DA-4                        7.54       0.00       0.00       0.53       5.19
1.78       6.97        1.67    66.48   0.925
DA-5                        7.54       0.00       0.00       0.02       7.44
0.06       7.50        0.11     5.88   0.994
DA-6                        7.54       0.00       0.00       0.12       7.00
0.41       7.40        0.42    20.94   0.982
DA-7                        7.54       0.00       0.00       0.19       6.69
0.64       7.33        0.33    16.78   0.973
DA-8                        7.54       0.00       0.00       0.17       6.77
0.58       7.35        0.48    24.26   0.975
```

```
DA-9                        7.54       0.00       0.00       0.12       6.99
0.41       7.40        0.29    14.92   0.982
DA-10                       7.54       0.00       0.00       0.29       6.24
0.99       7.23        0.16     7.86   0.959
DA-11                       7.54       0.00       0.00       0.19       6.69
0.64       7.33        0.82    41.11   0.973
DA-12                       7.54       0.00       0.00       0.60       4.89
2.02       6.91        0.67    32.10   0.917
DA-13                       7.54       0.00       0.00       0.43       6.32
0.77       7.09        0.33    16.47   0.941
DA-14                       7.54       0.00       0.00       1.32       2.56
3.63       6.19        0.49    19.97   0.821
DA-15                       7.54       0.00       0.00       0.32       6.08
1.10       7.18        0.05     2.88   0.953
DA-16                       7.54       0.00       0.00       0.46       5.49
1.56       7.05        0.09     4.40   0.936
DA-BASIN                    7.54       0.00       0.00       0.46       5.49
1.56       7.05        0.52    26.08   0.936


******************
Node Depth Summary
******************

-------------------------------------------------------------------------------
                                Average  Maximum  Maximum  Time of Max    Reported
                                  Depth    Depth      HGL   Occurrence   Max Depth
Node                 Type          Feet     Feet     Feet  days hr:min        Feet
-------------------------------------------------------------------------------
MH-1                 JUNCTION      1.08     3.84   206.58     0  12:00        3.83
Out-4                JUNCTION      3.92     6.52   205.03     0  12:25        6.51
IN-1                 JUNCTION      3.63     5.62   206.72     0  14:37        5.62
Out-1                JUNCTION      2.14     4.06   205.06     0  12:25        4.05
Out-3                JUNCTION      0.81     2.43   205.04     0  12:25        2.42
Out-6                JUNCTION      1.17     3.04   205.04     0  12:25        3.04
Out-2                JUNCTION      1.17     3.04   205.04     0  12:25        3.04
Jun-1                JUNCTION      1.94     4.04   205.04     0  12:24        4.04
Jun-2                JUNCTION      2.04     4.14   205.04     0  12:25        4.14
Jun-3                JUNCTION      2.28     4.64   205.04     0  12:25        4.63
Out-5                OUTFALL       1.11     3.58   200.22     0  12:01        3.28
IN-2                 STORAGE       0.74     4.16   207.26     0  12:04        4.12
IN-3                 STORAGE       1.07     3.82   206.58     0  12:00        3.80
ExistingBasin        STORAGE       1.11     3.43   201.63     0  12:02        3.31
IN-12                STORAGE       0.25     2.99   205.89     0  12:00        2.94
IN-11                STORAGE       2.48     4.57   203.20     0  12:08        4.53
IN-10                STORAGE       0.62     3.11   203.28     0  12:00        3.09
IN-9                 STORAGE       0.84     3.75   204.13     0  12:00        3.73
IN-8                 STORAGE       0.62     4.01   206.28     0  12:00        3.98
IN-5                 STORAGE       0.37     4.19   211.48     0  12:07        4.16
IN-6                 STORAGE       0.55     4.46   210.23     0  12:11        4.45
IN-7                 STORAGE       0.54     4.34   208.19     0  12:07        4.25
BMP1                 STORAGE       0.41     3.00   208.00     0  11:53        3.00
BMP2                 STORAGE       0.46     3.00   207.50     0  11:54        3.00
BMP3                 STORAGE       0.57     3.00   207.00     0  11:51        3.00
BMP4                 STORAGE       0.81     3.00   206.50     0  11:46        3.00
BMP5                 STORAGE       0.55     2.03   205.03     0  12:25        2.03


*******************
Node Inflow Summary
*******************


-------------------------------------------------------------------------------------
----------
                                Maximum  Maximum                  Lateral
                                Total        Flow
                                Lateral    Total  Time of Max      Inflow
                                Inflow     Balance
```

```
                                    Inflow   Inflow   Occurrence      Volume
                                    Volume      Error
Node                 Type             CFS      CFS  days hr:min    10^6 gal    10^6
gal     Percent

--------------------------------------------------------------------------------------
----------
MH-1                 JUNCTION        0.00    15.65     0  12:11           0
1.88      -0.052
Out-4                JUNCTION        0.00    48.99     0  11:59           0
12.3       0.032
IN-1                 JUNCTION      291.05   291.05     0  12:05        11.4
11.4      -0.006
Out-1                JUNCTION        0.00    27.70     0  11:32           0
11.4       0.008
Out-3                JUNCTION       16.47    16.47     0  12:00       0.327
0.328      -0.019
Out-6                JUNCTION        4.40     4.40     0  12:00      0.0919
0.0939      -0.022
Out-2                JUNCTION        2.88     2.88     0  12:00      0.0546
0.0574      -0.030
Jun-1                JUNCTION        0.00     9.51     1  01:22           0
0.17       0.224
Jun-2                JUNCTION        0.00    28.66     0  14:17           0
11.6       0.011
Jun-3                JUNCTION        0.00    41.44     0  12:02           0
11.9       0.007
Out-5                OUTFALL         0.00   149.10     0  12:01           0
17.8       0.000
IN-2                 STORAGE        11.07    11.07     0  12:00       0.218
0.244       0.558
IN-3                 STORAGE         0.00    12.65     0  12:47           0
1.64       0.010
ExistingBasin        STORAGE        26.08   155.20     0  12:00       0.521
17.8       0.004
IN-12                STORAGE        32.10    32.10     0  12:00       0.666
0.666       0.003
IN-11                STORAGE        41.11    62.13     0  12:00       0.824
12.9       0.008
IN-10                STORAGE         7.86    65.78     0  12:00       0.155
3.65       0.002
IN-9                 STORAGE        14.92    58.26     0  11:59       0.293
3.5       0.002
IN-8                 STORAGE        24.26    44.80     0  11:59       0.483
3.2       0.016
IN-5                 STORAGE         5.88     5.88     0  12:00       0.114
0.114       0.036
IN-6                 STORAGE        20.94    23.36     0  12:00       0.424
0.538       0.028
IN-7                 STORAGE        16.78    24.59     0  12:00        0.33
0.868      -0.090
BMP1                 STORAGE        66.48    66.48     0  12:00        1.67
1.67       0.002
BMP2                 STORAGE         0.00    35.06     0  11:53           0
1.53      -0.001
BMP3                 STORAGE        28.67    63.31     0  12:00       0.807
2.34       0.005
BMP4                 STORAGE         0.00    35.44     0  12:01           0
2.13      -0.002
BMP5                 STORAGE        19.97    27.99     0  12:01       0.485
0.727       0.003


**********************
Node Surcharge Summary
**********************

Surcharging occurs when water rises above the top of the highest conduit.
----------------------------------------------------------------------
```

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
MH-1	JUNCTION	1.61	1.841	0.159
Out-4	JUNCTION	14.22	2.518	0.000
IN-1	JUNCTION	14.98	3.621	0.000
Out-1	JUNCTION	0.43	0.058	0.942
Jun-1	JUNCTION	0.37	0.045	0.955
Jun-2	JUNCTION	0.65	0.145	0.855
Jun-3	JUNCTION	1.66	0.638	0.362

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
Out-4	14.22	28.70	0 11:59	0.342	2.518
IN-1	13.81	270.27	0 12:05	4.642	0.621
BMP1	0.28	31.74	0 12:00	0.140	0.000
BMP2	0.01	0.37	0 11:54	0.000	0.000
BMP3	0.42	28.60	0 12:00	0.209	0.000
BMP4	1.01	35.39	0 12:01	0.489	0.000

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Max Volume Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CFS
IN-2	0.018	0	0	0	1.336	3	0 12:04	8.65
IN-3	0.010	0	0	0	0.034	0	0 12:00	14.81
ExistingBasin	1.300	8	0	0	7.823	50	0 12:02	149.10
IN-12	0.002	0	0	0	0.027	0	0 12:00	31.77
IN-11	0.494	1	0	0	16.297	33	0 12:08	40.76
IN-10	0.006	0	0	0	0.028	0	0 12:00	65.84
IN-9	0.008	0	0	0	0.034	0	0 12:00	58.06
IN-8	0.006	0	0	0	0.046	0	0 12:00	43.82
IN-5	0.040	0	0	0	1.889	4	0 12:07	2.52
IN-6	0.339	1	0	0	10.528	21	0 12:11	11.36
IN-7	0.100	0	0	0	5.788	12	0	

```
12:07      19.57
BMP1                    0.065       6     0     0         1.125     100       0
11:53      35.11
BMP2                    0.083       7     0     0         1.125     100       0
11:54      34.70
BMP3                    0.116      10     0     0         1.125     100       0
11:51      34.71
BMP4                    0.179      16     0     0         1.125     100       0
11:46      12.70
BMP5                    5.513      18     0    34        20.346      68       0
12:25      16.43


**********************
Outfall Loading Summary
**********************

------------------------------------------------------------
                      Flow       Avg       Max       Total
                      Freq      Flow      Flow      Volume
Outfall Node          Pcnt       CFS       CFS    10^6 gal
------------------------------------------------------------
Out-5                99.86     28.81    149.10      17.756
------------------------------------------------------------
System               99.86     28.81    149.10      17.756


********************
Link Flow Summary
********************

-------------------------------------------------------------------------------
                               Maximum  Time of Max   Maximum    Max/    Max/
                                |Flow|   Occurrence   |Veloc|    Full    Full
Link                 Type         CFS  days hr:min    ft/sec    Flow   Depth
-------------------------------------------------------------------------------
24inCMP              CONDUIT     27.70     0  11:32      8.82    5.40    1.00
12inRCP              CONDUIT      8.65     0  12:11     11.02    1.72    1.00
24inRcp(2)           CONDUIT     14.81     0  12:11      4.71    2.09    1.00
PipeRecessed         CONDUIT     15.67     0  12:11      5.01    4.11    1.00
15inCMP              CONDUIT      2.52     0  11:52      2.08    1.03    1.00
21inCMP              CONDUIT     11.36     0  12:25      4.72    1.59    1.00
27inCMP              CONDUIT     19.57     0  12:15      5.01    1.66    1.00
30inRCP              CONDUIT     43.82     0  11:59      8.93    1.19    1.00
36inRCP(2)           CONDUIT     58.06     0  12:00      8.21    2.65    1.00
36inRCP              CONDUIT     65.84     0  12:00      9.60    1.22    0.93
36inCMP(2)           CONDUIT     40.76     0  12:10      6.37    4.29    1.00
24inRCP              CONDUIT     31.77     0  12:00     10.21    1.32    0.97
48inRCP              CONDUIT    149.10     0  12:01     13.48    1.00    0.88
36inCMP              CONDUIT     30.32     0  12:47      4.29    4.66    1.00
26                   CONDUIT     27.48     0  11:33      1.95    0.51    1.00
27                   CONDUIT     30.99     0  13:54      2.49    0.17    1.00
28                   CONDUIT     15.79     0  12:00      0.74    0.04    0.80
29                   CONDUIT     41.25     0  12:02      1.15    0.14    1.00
31                   CONDUIT      9.51     1  01:22      0.71    0.11    1.00
32                   CONDUIT      4.05     0  12:01      0.26    0.01    0.88
33                   CONDUIT      2.52     0  12:01      0.26    0.01    0.88
34                   CONDUIT     35.06     0  11:53     11.16    1.01    1.00
35                   CONDUIT     34.65     0  11:54     11.03    1.00    1.00
36                   CONDUIT     34.66     0  12:13     11.03    1.00    1.00
37                   CONDUIT     12.65     0  12:47      4.03    1.20    1.00
38                   CONDUIT     15.97     0  14:06      6.06    0.15    1.00


***************************
Flow Classification Summary
***************************

-------------------------------------------------------------------------------------
```

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
24inCMP	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
12inRCP	1.00	0.00	0.00	0.00	0.98	0.00	0.00	0.01	0.21	0.00
24inRcp(2)	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.01	0.00
PipeRecessed	1.00	0.00	0.00	0.00	0.02	0.00	0.00	0.97	0.00	0.00
15inCMP	1.00	0.00	0.00	0.00	0.76	0.00	0.00	0.23	0.40	0.00
21inCMP	1.00	0.00	0.00	0.00	0.06	0.00	0.00	0.94	0.00	0.00
27inCMP	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.91	0.00
30inRCP	1.00	0.00	0.00	0.00	0.02	0.06	0.00	0.92	0.02	0.00
36inRCP(2)	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
36inRCP	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
36inCMP(2)	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.98	0.00	0.00
24inRCP	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
48inRCP	1.00	0.00	0.00	0.00	0.00	0.99	0.00	0.00	0.40	0.00
36inCMP	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
26	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
27	1.00	0.00	0.01	0.00	0.99	0.00	0.00	0.00	0.02	0.00
28	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.52	0.00
29	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.47	0.00
31	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.02	0.00
32	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.50	0.00
33	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.50	0.00
34	1.00	0.00	0.00	0.00	0.05	0.95	0.00	0.00	0.41	0.00
35	1.00	0.00	0.00	0.00	0.06	0.94	0.00	0.00	0.78	0.00
36	1.00	0.00	0.00	0.00	0.26	0.74	0.00	0.00	0.40	0.00
37	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.89	0.00
38	1.00	0.00	0.45	0.00	0.55	0.00	0.00	0.00	0.22	0.00

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
24inCMP	14.03	14.98	14.06	18.13	13.96
12inRCP	3.20	3.20	6.71	0.34	0.34
24inRcp(2)	1.61	1.63	1.61	1.70	1.29
PipeRecessed	0.32	1.61	0.32	4.51	0.32
15inCMP	0.88	0.88	0.93	0.08	0.09
21inCMP	0.80	0.90	0.80	0.93	0.80
27inCMP	0.34	0.56	0.34	0.91	0.34
30inRCP	0.26	0.30	0.26	0.45	0.26
36inRCP(2)	0.02	0.22	0.02	1.05	0.02
36inRCP	0.01	0.05	0.01	0.23	0.01
36inCMP(2)	0.08	10.73	0.08	16.50	0.08
24inRCP	0.01	0.11	0.01	0.15	0.01
48inRCP	0.01	0.01	0.01	0.06	0.01
36inCMP	10.73	10.73	14.88	17.38	0.01
26	0.43	0.43	0.65	0.01	0.01
27	0.65	0.65	1.66	0.01	0.01
28	0.01	0.01	1.66	0.01	0.01
29	1.66	1.66	14.22	0.01	0.01
31	0.37	0.37	0.65	0.01	0.01
32	0.01	0.01	0.37	0.01	0.01
33	0.01	0.01	0.37	0.01	0.01
34	0.61	0.61	1.12	0.28	0.27
35	1.12	1.12	1.34	0.01	0.01
36	1.34	1.34	1.51	0.01	0.01
37	1.51	1.51	1.63	1.05	1.07
38	0.32	0.32	16.07	0.01	0.01

```
Analysis begun on:  Mon Nov 28 14:59:30 2022
Analysis ended on:  Mon Nov 28 14:59:30 2022
Total elapsed time: < 1 sec
```

```

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.0)
--------------------------------------------------------------
```

Location 10: Old Washington Rd. and Shoppers World (100-Year -PROPOSED)

```
****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Surcharge Method ......... EXTRAN
Starting Date ............ 10/01/2022 00:00:00
Ending Date .............. 10/02/2022 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 01:00:00
Routing Time Step ........ 20.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 8
Number of Threads ........ 1
Head Tolerance ........... 0.005000 ft


**************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
**************************     ---------       -------
Total Precipitation ......        75.621         8.718
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         7.050         0.813
Surface Runoff ...........        67.880         7.826
Final Storage ............         0.818         0.094
Continuity Error (%) .....        -0.169


**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......        67.908        22.129
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........        63.661        20.745
Flooding Loss ............         3.314         1.080
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.894         0.291
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.035         0.011
Continuity Error (%) .....         0.006


***************************
Time-Step Critical Elements
***************************
Link 34 (65.31%)
Link 38 (18.93%)
Link 12inRCP (7.34%)
Link 24inRcp(2) (4.03%)
Link 36 (1.38%)
```

```
********************************
Highest Flow Instability Indexes
********************************
Link 12inRCP (8)
Link 24inRcp(2) (6)
Link PipeRecessed (4)
Link 28 (1)
Link 31 (1)


*********************************
Most Frequent Nonconverging Nodes
*********************************
Node Out-5 (0.02%)
Node IN-1 (0.01%)
Node MH-1 (0.00%)
Node IN-2 (0.00%)
Node IN-3 (0.00%)


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.50 sec
Average Time Step           :     2.44 sec
Maximum Time Step           :    20.00 sec
% of Time in Steady State   :     0.00
Average Iterations per Step :     2.01
% of Steps Not Converging   :     0.02
Time Step Frequencies       :
   20.000 -  9.564 sec      :     0.11 %
    9.564 -  4.573 sec      :     3.31 %
    4.573 -  2.187 sec      :    59.72 %
    2.187 -  1.046 sec      :    32.42 %
    1.046 -  0.500 sec      :     4.45 %


***************************
Subcatchment Runoff Summary
***************************


-------------------------------------------------------------------------------------------
                          Total      Total      Total      Total     Imperv
                          Perv      Total       Total     Peak  Runoff
                         Precip      Runon       Evap      Infil     Runoff
                         Runoff     Runoff      Runoff   Runoff   Coeff
Subcatchment                 in         in         in         in         in
in         in    10^6 gal      CFS

-------------------------------------------------------------------------------------------
DA-1                         8.72       0.00       0.00       0.97       4.43
3.21       7.64       13.41   351.90   0.876
DA-2                         8.72       0.00       0.00       0.16       7.92
0.62       8.54        0.25    12.90   0.980
DA-3                         8.72       0.00       0.00       1.33       2.18
5.16       7.34        0.95    34.98   0.842
DA-4                         8.72       0.00       0.00       0.55       6.00
2.13       8.14        1.95    79.58   0.933
DA-5                         8.72       0.00       0.00       0.02       8.61
0.07       8.68        0.13     6.82   0.995
DA-6                         8.72       0.00       0.00       0.12       8.10
0.49       8.58        0.49    24.47   0.984
DA-7                         8.72       0.00       0.00       0.19       7.75
0.76       8.51        0.38    19.57   0.976
```

```
DA-8                        8.72       0.00       0.00       0.18       7.83
0.69       8.53        0.56    28.34   0.978
DA-9                        8.72       0.00       0.00       0.12       8.09
0.48       8.58        0.34    17.38   0.984
DA-10                       8.72       0.00       0.00       0.30       7.22
1.18       8.40        0.18     9.20   0.964
DA-11                       8.72       0.00       0.00       0.19       7.75
0.76       8.51        0.96    48.07   0.976
DA-12                       8.72       0.00       0.00       0.62       5.66
2.42       8.08        0.78    37.96   0.927
DA-13                       8.72       0.00       0.00       0.45       7.31
0.94       8.25        0.38    19.32   0.947
DA-14                       8.72       0.00       0.00       1.36       2.96
4.36       7.32        0.57    24.20   0.840
DA-15                       8.72       0.00       0.00       0.33       7.04
1.32       8.35        0.06     3.35   0.958
DA-16                       8.72       0.00       0.00       0.48       6.35
1.87       8.22        0.11     5.19   0.943
DA-BASIN                    8.72       0.00       0.00       0.48       6.35
1.87       8.22        0.61    30.65   0.943


******************
Node Depth Summary
******************

-------------------------------------------------------------------------------
                              Average  Maximum  Maximum  Time of Max    Reported
                                Depth    Depth      HGL   Occurrence   Max Depth
Node                 Type        Feet     Feet     Feet  days hr:min        Feet
-------------------------------------------------------------------------------
MH-1                 JUNCTION    1.07     3.85   206.59     0  11:58        3.82
Out-4                JUNCTION    4.18     6.86   205.37     0  12:21        6.84
IN-1                 JUNCTION    3.96     5.80   206.90     0  14:57        5.80
Out-1                JUNCTION    2.31     4.40   205.40     0  12:21        4.37
Out-3                JUNCTION    0.90     2.77   205.38     0  12:21        2.75
Out-6                JUNCTION    1.30     3.39   205.39     0  12:20        3.37
Out-2                JUNCTION    1.29     3.39   205.39     0  12:21        3.37
Jun-1                JUNCTION    2.11     4.39   205.39     0  12:20        4.37
Jun-2                JUNCTION    2.21     4.49   205.39     0  12:21        4.47
Jun-3                JUNCTION    2.48     4.98   205.38     0  12:21        4.96
Out-5                OUTFALL     1.16     3.67   200.31     0  12:01        3.64
IN-2                 STORAGE     0.74     4.22   207.32     0  12:05        4.17
IN-3                 STORAGE     1.07     3.82   206.58     0  11:58        3.79
ExistingBasin        STORAGE     1.16     3.71   201.91     0  12:01        3.63
IN-12                STORAGE     0.26     4.04   206.94     0  12:00        4.02
IN-11                STORAGE     2.62     4.71   203.34     0  12:09        4.69
IN-10                STORAGE     0.62     3.27   203.44     0  12:00        3.26
IN-9                 STORAGE     0.84     3.94   204.32     0  12:00        3.94
IN-8                 STORAGE     0.61     4.11   206.38     0  12:01        4.09
IN-5                 STORAGE     0.33     4.23   211.52     0  12:08        4.21
IN-6                 STORAGE     0.51     4.53   210.30     0  12:12        4.52
IN-7                 STORAGE     0.50     4.41   208.26     0  12:08        4.36
BMP1                 STORAGE     0.39     3.00   208.00     0  11:52        3.00
BMP2                 STORAGE     0.43     3.00   207.50     0  11:52        3.00
BMP3                 STORAGE     0.55     3.00   207.00     0  11:49        3.00
BMP4                 STORAGE     0.80     3.00   206.50     0  11:44        3.00
BMP5                 STORAGE     0.63     2.39   205.39     0  12:21        2.37


******************
Node Inflow Summary
******************


-------------------------------------------------------------------------------------
----------
                              Maximum  Maximum                    Lateral
                              Total        Flow
```

```
                                  Lateral    Total  Time of Max      Inflow
                                  Inflow     Balance
                                   Inflow   Inflow   Occurrence      Volume
                                   Volume       Error
Node                 Type            CFS      CFS  days hr:min    10^6 gal    10^6
gal     Percent
-------------------------------------------------------------------------------------
----------
MH-1                 JUNCTION       0.00    16.01     0  12:14           0
2.1      -0.045
Out-4                JUNCTION       0.00    48.05     0  11:55           0
14.5       0.029
IN-1                 JUNCTION     351.90   351.90     0  12:05        13.4
13.4      -0.001
Out-1                JUNCTION       0.00    27.61     0  11:21           0
13.4       0.007
Out-3                JUNCTION      19.32    19.32     0  12:00       0.381
0.381      -0.031
Out-6                JUNCTION       5.19     5.19     0  12:00       0.107
0.109      -0.086
Out-2                JUNCTION       3.35     3.35     0  12:00      0.0635
0.0661      -0.125
Jun-1                JUNCTION       0.00     9.90     1  03:51           0
0.193       0.685
Jun-2                JUNCTION       0.00    29.76     0  14:39           0
13.6       0.013
Jun-3                JUNCTION       0.00    45.10     0  11:59           0
14       0.013
Out-5                OUTFALL        0.00   161.17     0  12:01           0
20.7       0.000
IN-2                 STORAGE       12.90    12.90     0  12:00       0.253
0.274       0.517
IN-3                 STORAGE        0.00    12.63     0  12:53           0
1.83       0.008
ExistingBasin        STORAGE       30.65   165.21     0  12:00       0.608
20.7       0.004
IN-12                STORAGE       37.96    37.96     0  12:00       0.779
0.779       0.005
IN-11                STORAGE       48.07    70.30     0  12:00       0.957
15.2       0.007
IN-10                STORAGE        9.20    68.64     0  12:00        0.18
4.16       0.007
IN-9                 STORAGE       17.38    59.69     0  12:00        0.34
3.98       0.003
IN-8                 STORAGE       28.34    46.80     0  12:00       0.561
3.64       0.014
IN-5                 STORAGE        6.82     6.82     0  12:00       0.132
0.132       0.035
IN-6                 STORAGE       24.47    26.87     0  12:00       0.492
0.624       0.039
IN-7                 STORAGE       19.57    27.38     0  12:00       0.384
1.01      -0.052
BMP1                 STORAGE       79.58    79.58     0  12:00        1.95
1.95      -0.019
BMP2                 STORAGE        0.00    35.10     0  11:52           0
1.73      -0.000
BMP3                 STORAGE       34.98    69.62     0  12:00       0.955
2.68      -0.013
BMP4                 STORAGE        0.00    37.15     0  12:03           0
2.41      -0.010
BMP5                 STORAGE       24.20    30.67     0  11:58       0.575
0.811       0.002


**********************
Node Surcharge Summary
**********************

```

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
MH-1	JUNCTION	1.83	1.848	0.152
Out-4	JUNCTION	16.94	2.861	0.000
IN-1	JUNCTION	17.87	3.798	0.000
Out-1	JUNCTION	1.07	0.398	0.602
Jun-1	JUNCTION	1.04	0.387	0.613
Jun-2	JUNCTION	1.19	0.487	0.513
Jun-3	JUNCTION	2.28	0.981	0.019

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
Out-4	16.94	27.44	0 11:55	0.356	2.861
IN-1	16.49	333.22	0 12:05	5.971	0.798
BMP1	0.33	44.82	0 12:00	0.222	0.000
BMP2	0.01	0.43	0 11:52	0.000	0.000
BMP3	0.51	34.90	0 12:00	0.278	0.000
BMP4	1.15	37.11	0 12:03	0.578	0.000

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Max Occurrence Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CFS
IN-2	0.024	0	0	0	2.487	5	0 12:05	8.92
IN-3	0.010	0	0	0	0.034	0	0 11:58	14.92
ExistingBasin	1.361	9	0	0	9.007	57	0 12:01	161.17
IN-12	0.002	0	0	0	0.103	0	0 12:00	36.38
IN-11	0.615	1	0	0	25.427	51	0 12:09	41.94
IN-10	0.006	0	0	0	0.029	0	0 12:00	68.54
IN-9	0.008	0	0	0	0.035	0	0 12:00	59.47
IN-8	0.008	0	0	0	0.660	1	0 12:01	45.17
IN-5	0.036	0	0	0	2.668	5	0 12:08	2.52
IN-6	0.325	1	0	0	13.857	28	0	

```
12:12      11.44
IN-7                     0.079       0     0     0         8.603      17       0
12:08      19.87
BMP1                     0.055       5     0     0         1.125     100       0
11:52      35.15
BMP2                     0.072       6     0     0         1.125     100       0
11:52      34.70
BMP3                     0.104       9     0     0         1.125     100       0
11:49      34.71
BMP4                     0.169      15     0     0         1.125     100       0
11:44      12.68
BMP5                     6.277      21     0    35        23.855      80       0
12:21      16.07


************************
Outfall Loading Summary
************************

------------------------------------------------------------
                       Flow       Avg       Max       Total
                       Freq      Flow      Flow      Volume
Outfall Node           Pcnt       CFS       CFS    10^6 gal
------------------------------------------------------------
Out-5                 99.87     30.15    161.17      20.743
------------------------------------------------------------
System                99.87     30.15    161.17      20.743


********************
Link Flow Summary
********************

-------------------------------------------------------------------------------
                                Maximum  Time of Max   Maximum    Max/    Max/
                                 |Flow|   Occurrence   |Veloc|    Full    Full
Link                 Type          CFS  days hr:min    ft/sec    Flow   Depth
-------------------------------------------------------------------------------
24inCMP              CONDUIT     27.61     0  11:21      8.79    5.38    1.00
12inRCP              CONDUIT      8.92     0  12:12     11.36    1.77    1.00
24inRcp(2)           CONDUIT     14.92     0  12:14      4.75    2.11    1.00
PipeRecessed         CONDUIT     16.06     0  12:14      5.16    4.21    1.00
15inCMP              CONDUIT      2.52     0  11:51      2.10    1.03    1.00
21inCMP              CONDUIT     11.44     0  12:32      4.75    1.60    1.00
27inCMP              CONDUIT     19.87     0  12:15      5.09    1.69    1.00
30inRCP              CONDUIT     45.17     0  12:04      9.20    1.23    1.00
36inRCP(2)           CONDUIT     59.47     0  12:00      8.41    2.72    1.00
36inRCP              CONDUIT     68.54     0  12:00      9.92    1.27    0.95
36inCMP(2)           CONDUIT     41.94     0  12:11      6.52    4.41    1.00
24inRCP              CONDUIT     36.38     0  12:01     11.58    1.51    1.00
48inRCP              CONDUIT    161.17     0  12:01     13.48    1.08    0.92
36inCMP              CONDUIT     30.75     0  13:07      4.35    4.73    1.00
26                   CONDUIT     27.57     0  16:24      1.94    0.52    1.00
27                   CONDUIT     32.09     0  14:39      2.49    0.17    1.00
28                   CONDUIT     19.15     0  12:00      0.81    0.05    0.85
29                   CONDUIT     44.84     0  11:59      1.25    0.15    1.00
31                   CONDUIT      9.90     1  03:51      0.74    0.11    1.00
32                   CONDUIT      4.89     0  11:59      0.26    0.02    0.92
33                   CONDUIT      3.15     0  11:58      0.26    0.01    0.92
34                   CONDUIT     35.10     0  11:52     11.17    1.01    1.00
35                   CONDUIT     34.65     0  11:53     11.03    1.00    1.00
36                   CONDUIT     34.66     0  11:59     11.03    1.00    1.00
37                   CONDUIT     12.63     0  12:53      4.02    1.20    1.00
38                   CONDUIT     15.61     0  14:52      5.98    0.15    1.00


***************************
Flow Classification Summary
***************************
```

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
24inCMP	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
12inRCP	1.00	0.00	0.00	0.00	0.98	0.00	0.00	0.01	0.19	0.00
24inRcp(2)	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.01	0.00
PipeRecessed	1.00	0.00	0.00	0.00	0.03	0.00	0.00	0.97	0.00	0.00
15inCMP	1.00	0.00	0.00	0.00	0.77	0.00	0.00	0.22	0.46	0.00
21inCMP	1.00	0.00	0.00	0.00	0.07	0.00	0.00	0.92	0.00	0.00
27inCMP	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.91	0.00
30inRCP	1.00	0.00	0.00	0.00	0.02	0.07	0.00	0.91	0.02	0.00
36inRCP(2)	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
36inRCP	1.00	0.00	0.00	0.00	0.06	0.01	0.00	0.92	0.07	0.00
36inCMP(2)	1.00	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.00	0.00
24inRCP	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
48inRCP	1.00	0.00	0.00	0.00	0.01	0.99	0.00	0.00	0.37	0.00
36inCMP	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
26	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
27	1.00	0.00	0.01	0.00	0.99	0.00	0.00	0.00	0.02	0.00
28	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.43	0.00
29	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.36	0.00
31	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.02	0.00
32	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.41	0.00
33	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.41	0.00
34	1.00	0.00	0.00	0.00	0.06	0.94	0.00	0.00	0.41	0.00
35	1.00	0.00	0.00	0.00	0.07	0.93	0.00	0.00	0.72	0.00
36	1.00	0.00	0.00	0.00	0.28	0.72	0.00	0.00	0.36	0.00
37	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.87	0.00
38	1.00	0.00	0.34	0.00	0.66	0.00	0.00	0.00	0.16	0.00

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
24inCMP	16.72	17.87	16.75	21.76	16.67
12inRCP	3.80	3.80	8.50	0.41	0.41
24inRcp(2)	1.83	1.85	1.83	2.00	1.48
PipeRecessed	0.36	1.83	0.36	5.42	0.36
15inCMP	1.09	1.09	1.14	0.09	0.09
21inCMP	0.97	1.11	0.97	1.13	0.97
27inCMP	0.40	0.69	0.40	1.11	0.40
30inRCP	0.29	0.33	0.29	0.57	0.29
36inRCP(2)	0.10	0.25	0.10	1.26	0.10
36inRCP	0.01	0.14	0.01	0.26	0.01
36inCMP(2)	0.16	12.87	0.16	19.45	0.16
24inRCP	0.05	0.18	0.05	0.21	0.05
48inRCP	0.01	0.01	0.01	0.14	0.01
36inCMP	12.87	12.87	17.70	20.96	0.01
26	1.07	1.07	1.19	0.01	0.01
27	1.19	1.19	2.28	0.01	0.01
28	0.01	0.01	2.28	0.01	0.01
29	2.28	2.28	16.94	0.01	0.01
31	1.04	1.04	1.19	0.01	0.01
32	0.01	0.01	1.04	0.01	0.01
33	0.01	0.01	1.04	0.01	0.01
34	0.70	0.70	1.26	0.34	0.33
35	1.26	1.26	1.50	0.01	0.01
36	1.50	1.50	1.70	0.01	0.01
37	1.70	1.70	1.85	1.13	1.13
38	1.03	1.03	19.36	0.01	0.01

```
Analysis begun on:  Mon Nov 28 14:58:59 2022
Analysis ended on:  Mon Nov 28 14:59:00 2022
Total elapsed time: 00:00:01
```

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.0)
------------------------------------------------------------
```

Location 10: Old Washington Rd. and Shoppers World (100-Year (2050) -PROPOSED)

```
****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Surcharge Method ......... EXTRAN
Starting Date ............ 10/01/2022 00:00:00
Ending Date .............. 10/02/2022 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 01:00:00
Routing Time Step ........ 20.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 8
Number of Threads ........ 1
Head Tolerance ........... 0.005000 ft


**************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
**************************     ---------       -------
Total Precipitation ......        86.759        10.002
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         7.243         0.835
Surface Runoff ...........        78.827         9.088
Final Storage ............         0.840         0.097
Continuity Error (%) .....        -0.174


**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......        78.864        25.699
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........        72.094        23.493
Flooding Loss ............         4.155         1.354
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.975         0.318
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         1.628         0.531
Continuity Error (%) .....         0.015


*************************
Highest Continuity Errors
*************************
Node Jun-1 (6.36%)


***************************
Time-Step Critical Elements
```

```
**************************
Link 34 (60.31%)
Link 38 (21.96%)
Link 12inRCP (8.90%)
Link 24inRcp(2) (2.76%)
Link 36 (2.01%)


*******************************
Highest Flow Instability Indexes
*******************************
Link 12inRCP (6)
Link 24inRcp(2) (5)
Link PipeRecessed (3)


********************************
Most Frequent Nonconverging Nodes
********************************
Node Out-5 (0.01%)
Node MH-1 (0.00%)
Node IN-2 (0.00%)
Node IN-3 (0.00%)
Node IN-12 (0.00%)


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.50 sec
Average Time Step           :     2.30 sec
Maximum Time Step           :    20.00 sec
% of Time in Steady State   :     0.00
Average Iterations per Step :     2.01
% of Steps Not Converging   :     0.01
Time Step Frequencies       :
   20.000 -  9.564 sec      :     0.10 %
    9.564 -  4.573 sec      :     1.28 %
    4.573 -  2.187 sec      :    59.20 %
    2.187 -  1.046 sec      :    34.82 %
    1.046 -  0.500 sec      :     4.59 %


**************************
Subcatchment Runoff Summary
**************************


-----------------------------------------------------------------------------------------
---------------------------------------
                          Total      Total      Total      Total     Imperv
                          Perv      Total       Total     Peak  Runoff
                         Precip      Runon       Evap      Infil     Runoff
                         Runoff     Runoff      Runoff   Runoff   Coeff
Subcatchment                in         in         in         in         in
in         in    10^6 gal      CFS

-----------------------------------------------------------------------------------------
---------------------------------------
DA-1                        10.00       0.00       0.00       0.99       5.08
3.81       8.89       15.61   420.35   0.889
DA-2                        10.00       0.00       0.00       0.16       9.09
0.74       9.83        0.29    14.91   0.983
DA-3                        10.00       0.00       0.00       1.37       2.50
6.09       8.59        1.12    42.13   0.859
DA-4                        10.00       0.00       0.00       0.56       6.89
2.52       9.41        2.25    94.18   0.941
DA-5                        10.00       0.00       0.00       0.02       9.88
0.08       9.96        0.15     7.85   0.996
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DA-6                    10.00       0.00       0.00       0.13       9.29
0.57       9.87        0.57    28.35   0.986
DA-7                    10.00       0.00       0.00       0.20       8.89
0.90       9.79        0.44    22.64   0.979
DA-8                    10.00       0.00       0.00       0.18       8.99
0.82       9.81        0.64    32.79   0.981
DA-9                    10.00       0.00       0.00       0.13       9.29
0.57       9.86        0.39    20.06   0.986
DA-10                   10.00       0.00       0.00       0.31       8.29
1.39       9.68        0.21    10.66   0.968
DA-11                   10.00       0.00       0.00       0.20       8.89
0.90       9.79        1.10    55.69   0.979
DA-12                   10.00       0.00       0.00       0.64       6.50
2.85       9.35        0.90    44.41   0.935
DA-13                   10.00       0.00       0.00       0.47       8.39
1.13       9.52        0.44    22.45   0.952
DA-14                   10.00       0.00       0.00       1.40       3.40
5.17       8.57        0.67    28.96   0.857
DA-15                   10.00       0.00       0.00       0.34       8.08
1.55       9.63        0.07     3.86   0.963
DA-16                   10.00       0.00       0.00       0.49       7.29
2.20       9.50        0.12     6.07   0.950
DA-BASIN                10.00       0.00       0.00       0.49       7.29
2.20       9.50        0.70    35.67   0.950


******************
Node Depth Summary
******************

-------------------------------------------------------------------------------
                                Average  Maximum  Maximum  Time of Max    Reported
                                  Depth    Depth      HGL   Occurrence   Max Depth
Node                  Type         Feet     Feet     Feet  days hr:min        Feet
-------------------------------------------------------------------------------
MH-1                  JUNCTION     1.09     3.86   206.60     0  11:56        3.83
Out-4                 JUNCTION     4.44     7.15   205.66     0  12:19        7.14
IN-1                  JUNCTION     4.28     6.00   207.10     0  15:18        6.00
Out-1                 JUNCTION     2.49     4.69   205.69     0  12:19        4.67
Out-3                 JUNCTION     1.03     3.06   205.67     0  12:20        3.05
Out-6                 JUNCTION     1.44     3.68   205.68     0  12:20        3.66
Out-2                 JUNCTION     1.44     3.68   205.68     0  12:19        3.66
Jun-1                 JUNCTION     2.30     4.68   205.68     0  12:19        4.66
Jun-2                 JUNCTION     2.39     4.79   205.69     0  12:19        4.76
Jun-3                 JUNCTION     2.69     5.27   205.67     0  12:20        5.26
Out-5                 OUTFALL      1.21     3.70   200.34     0  12:02        3.69
IN-2                  STORAGE      0.76     4.28   207.38     0  12:06        4.21
IN-3                  STORAGE      1.09     3.83   206.59     0  11:56        3.81
ExistingBasin         STORAGE      1.21     3.90   202.10     0  12:02        3.83
IN-12                 STORAGE      0.26     4.17   207.07     0  12:03        4.12
IN-11                 STORAGE      2.76     4.85   203.48     0  12:10        4.84
IN-10                 STORAGE      0.64     3.42   203.59     0  12:01        3.40
IN-9                  STORAGE      0.86     4.08   204.46     0  12:02        4.05
IN-8                  STORAGE      0.63     4.21   206.48     0  12:03        4.16
IN-5                  STORAGE      0.36     4.27   211.56     0  12:08        4.25
IN-6                  STORAGE      0.54     4.59   210.36     0  12:13        4.59
IN-7                  STORAGE      0.53     4.49   208.34     0  12:08        4.45
BMP1                  STORAGE      0.40     3.00   208.00     0  11:51        3.00
BMP2                  STORAGE      0.44     3.00   207.50     0  11:51        3.00
BMP3                  STORAGE      0.56     3.00   207.00     0  11:47        3.00
BMP4                  STORAGE      0.82     3.00   206.50     0  11:42        3.00
BMP5                  STORAGE      0.74     2.68   205.68     0  12:17        2.68


*******************
Node Inflow Summary
*******************
```

Node	Type	Maximum Total Lateral Inflow CFS	Maximum Flow Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Flow Balance Error 10^6 gal	Percent
MH-1	JUNCTION	0.00	16.16	0 12:16	0	2.34	-0.029
Out-4	JUNCTION	0.00	50.57	0 11:58	0	16.4	0.163
IN-1	JUNCTION	420.35	420.35	0 12:05	15.6	15.6	0.005
Out-1	JUNCTION	0.00	27.47	0 11:07	0	15.3	0.089
Out-3	JUNCTION	22.45	22.45	0 12:00	0.44	0.44	0.307
Out-6	JUNCTION	6.07	6.07	0 12:00	0.124	0.124	1.583
Out-2	JUNCTION	3.86	3.86	0 12:00	0.0733	0.0742	2.706
Jun-1	JUNCTION	0.00	9.26	0 12:00	0	0.203	6.795
Jun-2	JUNCTION	0.00	30.61	0 16:49	0	15.5	0.154
Jun-3	JUNCTION	0.00	45.21	0 12:01	0	15.9	0.153
Out-5	OUTFALL	0.00	165.66	0 12:02	0	23.5	0.000
IN-2	STORAGE	14.91	14.91	0 12:00	0.291	0.309	0.392
IN-3	STORAGE	0.00	12.61	0 13:00	0	2.05	0.007
ExistingBasin	STORAGE	35.67	170.59	0 12:00	0.702	23.5	0.011
IN-12	STORAGE	44.41	44.41	0 12:00	0.902	0.902	0.050
IN-11	STORAGE	55.69	79.57	0 12:00	1.1	17.2	0.105
IN-10	STORAGE	10.66	69.61	0 12:00	0.208	4.71	0.014
IN-9	STORAGE	20.06	61.83	0 12:00	0.391	4.5	0.004
IN-8	STORAGE	32.79	50.29	0 12:00	0.645	4.11	0.014
IN-5	STORAGE	7.85	7.85	0 12:00	0.152	0.152	0.035
IN-6	STORAGE	28.35	30.73	0 12:00	0.566	0.717	0.033
IN-7	STORAGE	22.64	30.45	0 12:00	0.442	1.16	-0.072
BMP1	STORAGE	94.18	94.18	0 12:00	2.26	2.26	-0.025
BMP2	STORAGE	0.00	35.15	0 11:51	0	1.94	-0.000
BMP3	STORAGE	42.13	76.76	0 12:00	1.12	3.05	-0.015
BMP4	STORAGE	0.00	38.22	0 12:05	0	2.7	-0.010
BMP5	STORAGE	28.96	29.68	0 11:56	0.673	0.849	0.008

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
MH-1	JUNCTION	2.16	1.856	0.144
Out-4	JUNCTION	19.21	3.148	0.000
IN-1	JUNCTION	20.67	4.003	0.000
Out-1	JUNCTION	1.59	0.693	0.307
Jun-1	JUNCTION	1.56	0.678	0.322
Jun-2	JUNCTION	1.72	0.786	0.214
Jun-3	JUNCTION	3.15	1.268	0.000

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
Out-4	19.21	27.39	0 11:58	0.332	3.148
IN-1	18.87	404.06	0 12:05	7.501	1.003
Jun-3	0.94	12.16	0 12:06	0.023	0.268
BMP1	0.38	59.44	0 12:00	0.321	0.000
BMP2	0.01	0.48	0 11:51	0.000	0.000
BMP3	0.59	42.05	0 12:00	0.361	0.000
BMP4	1.30	38.18	0 12:05	0.671	0.000

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CFS
IN-2	0.029	0	0	0	3.869	8	0 12:06	9.98
IN-3	0.010	0	0	0	0.034	0	0 11:56	15.12
ExistingBasin	1.442	9	0	0	9.886	63	0 12:02	165.66
IN-12	0.007	0	0	0	1.456	3	0 12:03	37.04
IN-11	1.052	2	0	0	36.039	72	0 12:10	43.03
IN-10	0.006	0	0	0	0.031	0	0 12:01	69.45
IN-9	0.008	0	0	0	0.372	1	0 12:02	60.17

```
IN-8                    0.014       0     0     0         2.272       5       0
12:03      47.89
IN-5                    0.052       0     0     0         3.566       7       0
12:08       2.52
IN-6                    0.463       1     0     0        17.644      35       0
12:13      11.52
IN-7                    0.101       0     0     0        11.934      24       0
12:08      19.95
BMP1                    0.057       5     0     0         1.125     100       0
11:51      35.20
BMP2                    0.073       7     0     0         1.125     100       0
11:51      34.70
BMP3                    0.107       9     0     0         1.125     100       0
11:47      34.71
BMP4                    0.175      16     0     0         1.125     100       0
11:42      12.66
BMP5                    7.373      25     0    37        26.816      89       0
12:17      15.91


**********************
Outfall Loading Summary
**********************

------------------------------------------------------------
                      Flow       Avg       Max       Total
                      Freq      Flow      Flow      Volume
Outfall Node          Pcnt       CFS       CFS    10^6 gal
------------------------------------------------------------
Out-5                99.89     32.10    165.66      23.491
------------------------------------------------------------
System               99.89     32.10    165.66      23.491


********************
Link Flow Summary
********************

-------------------------------------------------------------------------------
                                Maximum  Time of Max   Maximum    Max/    Max/
                                 |Flow|   Occurrence   |Veloc|    Full    Full
Link                 Type          CFS  days hr:min    ft/sec    Flow   Depth
-------------------------------------------------------------------------------
24inCMP              CONDUIT     27.47     0  11:07      8.74    5.35    1.00
12inRCP              CONDUIT      9.98     0  12:09     12.71    1.98    1.00
24inRcp(2)           CONDUIT     15.12     0  12:18      4.81    2.14    1.00
PipeRecessed         CONDUIT     16.17     0  12:16      5.19    4.24    1.00
15inCMP              CONDUIT      2.52     0  11:49      2.10    1.03    1.00
21inCMP              CONDUIT     11.52     0  12:39      4.79    1.61    1.00
27inCMP              CONDUIT     19.95     0  12:19      5.10    1.69    1.00
30inRCP              CONDUIT     47.89     0  12:08      9.76    1.30    1.00
36inRCP(2)           CONDUIT     60.17     0  12:04      8.51    2.75    1.00
36inRCP              CONDUIT     69.45     0  12:00      9.97    1.29    0.99
36inCMP(2)           CONDUIT     43.03     0  12:12      6.66    4.53    1.00
24inRCP              CONDUIT     37.04     0  12:03     11.79    1.53    1.00
48inRCP              CONDUIT    165.66     0  12:02     13.49    1.11    0.95
36inCMP              CONDUIT     31.09     0  13:28      4.40    4.78    1.00
26                   CONDUIT     28.33     0  17:06      1.93    0.53    1.00
27                   CONDUIT     32.77     0  16:02      2.49    0.18    1.00
28                   CONDUIT     21.61     0  12:00      0.84    0.05    0.88
29                   CONDUIT     44.75     0  12:01      1.24    0.15    1.00
31                   CONDUIT      8.62     0  12:01      0.25    0.10    1.00
32                   CONDUIT      5.73     0  12:00      0.20    0.02    0.96
33                   CONDUIT      3.54     0  12:01      0.18    0.01    0.96
34                   CONDUIT     35.15     0  11:51     11.19    1.01    1.00
35                   CONDUIT     34.65     0  11:51     11.03    1.00    1.00
36                   CONDUIT     34.66     0  12:06     11.03    1.00    1.00
37                   CONDUIT     12.61     0  13:00      4.01    1.20    1.00
38                   CONDUIT     15.44     0  11:53      5.92    0.15    1.00
```

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
		---------- Fraction of Time in Flow Class ----------								
24inCMP	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
12inRCP	1.00	0.00	0.00	0.00	0.98	0.00	0.00	0.01	0.18	0.00
24inRcp(2)	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.01	0.00
PipeRecessed	1.00	0.00	0.00	0.00	0.03	0.00	0.00	0.97	0.00	0.00
15inCMP	1.00	0.00	0.00	0.00	0.78	0.00	0.00	0.22	0.56	0.00
21inCMP	1.00	0.00	0.00	0.00	0.09	0.00	0.00	0.91	0.00	0.00
27inCMP	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.90	0.00
30inRCP	1.00	0.00	0.00	0.00	0.03	0.08	0.00	0.89	0.02	0.00
36inRCP(2)	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
36inRCP	1.00	0.00	0.00	0.00	0.14	0.01	0.00	0.85	0.14	0.00
36inCMP(2)	1.00	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.00	0.00
24inRCP	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
48inRCP	1.00	0.00	0.00	0.00	0.01	0.99	0.00	0.00	0.33	0.00
36inCMP	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
26	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
27	1.00	0.00	0.01	0.00	0.99	0.00	0.00	0.00	0.02	0.00
28	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.35	0.00
29	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.28	0.00
31	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.01	0.00
32	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.33	0.00
33	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.33	0.00
34	1.00	0.00	0.00	0.00	0.06	0.93	0.00	0.00	0.39	0.00
35	1.00	0.00	0.00	0.00	0.08	0.92	0.00	0.00	0.67	0.00
36	1.00	0.00	0.00	0.00	0.30	0.70	0.00	0.00	0.33	0.00
37	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.85	0.00
38	1.00	0.00	0.28	0.00	0.72	0.00	0.00	0.00	0.10	0.00

****
Conduit Surcharge Summary
****

Conduit	Hours Full Both Ends	Hours Full Upstream	Hours Full Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
24inCMP	19.11	20.67	19.11	24.89	19.11
12inRCP	4.63	4.63	9.98	0.51	0.51
24inRcp(2)	2.16	2.18	2.16	2.36	1.76
PipeRecessed	0.41	2.16	0.41	6.44	0.41
15inCMP	1.32	1.32	1.36	0.09	0.09
21inCMP	1.18	1.34	1.18	1.36	1.18
27inCMP	0.45	0.83	0.45	1.34	0.45
30inRCP	0.32	0.36	0.32	0.67	0.32
36inRCP(2)	0.18	0.30	0.18	1.50	0.18
36inRCP	0.01	0.20	0.01	0.31	0.01
36inCMP(2)	0.22	14.62	0.22	21.99	0.22
24inRCP	0.18	0.23	0.18	0.26	0.18
48inRCP	0.01	0.01	0.01	0.21	0.01
36inCMP	14.62	14.62	20.06	23.69	0.01
26	1.59	1.59	1.72	0.01	0.01
27	1.72	1.72	3.15	0.01	0.01
28	0.01	0.01	3.15	0.01	0.01
29	3.15	3.15	19.21	0.01	0.01
31	1.56	1.56	1.72	0.01	0.01
32	0.01	0.01	1.56	0.01	0.01
33	0.01	0.01	1.56	0.01	0.01

```
34                          0.79      0.79      1.42      0.38         0.38
35                          1.42      1.42      1.70      0.01         0.01
36                          1.70      1.70      1.97      0.01         0.01
37                          1.97      1.97      2.18      1.25         1.26
38                          1.54      1.54     21.65      0.01         0.01


Analysis begun on:  Mon Nov 28 14:56:18 2022
Analysis ended on:  Mon Nov 28 14:56:18 2022
Total elapsed time: < 1 sec
```

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.0)
------------------------------------------------------------
```

Location 10: Old Washington Rd. and Shoppers World (100-Year (2100) -PROPOSED)

```
****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Surcharge Method ......... EXTRAN
Starting Date ............ 10/01/2022 00:00:00
Ending Date .............. 10/02/2022 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 01:00:00
Routing Time Step ........ 20.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 8
Number of Threads ........ 1
Head Tolerance ........... 0.005000 ft


**************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
**************************     ---------       -------
Total Precipitation ......        91.495        10.548
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         7.310         0.843
Surface Runoff ...........        83.493         9.625
Final Storage ............         0.852         0.098
Continuity Error (%) .....        -0.175


**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......        83.536        27.221
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........        74.037        24.126
Flooding Loss ............         4.506         1.468
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.986         0.321
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         3.995         1.302
Continuity Error (%) .....         0.015


*************************
Highest Continuity Errors
*************************
Node Jun-1 (6.31%)


***************************
Time-Step Critical Elements
```

```
**************************
Link 34 (63.11%)
Link 38 (17.40%)
Link 12inRCP (9.93%)
Link 24inRcp(2) (2.67%)
Link 36 (2.47%)


*******************************
Highest Flow Instability Indexes
*******************************
Link 12inRCP (6)
Link 24inRcp(2) (5)
Link PipeRecessed (3)


********************************
Most Frequent Nonconverging Nodes
********************************
Node Out-5 (0.01%)
Node MH-1 (0.00%)
Node IN-2 (0.00%)
Node IN-3 (0.00%)
Node IN-12 (0.00%)


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.50 sec
Average Time Step           :     2.27 sec
Maximum Time Step           :    20.00 sec
% of Time in Steady State   :     0.00
Average Iterations per Step :     2.01
% of Steps Not Converging   :     0.01
Time Step Frequencies       :
   20.000 -  9.564 sec      :     0.08 %
    9.564 -  4.573 sec      :     1.23 %
    4.573 -  2.187 sec      :    58.65 %
    2.187 -  1.046 sec      :    35.06 %
    1.046 -  0.500 sec      :     4.97 %


**************************
Subcatchment Runoff Summary
**************************


---------------------------------------------------------------------------------------------
                          Total      Total      Total      Total     Imperv
                          Perv      Total       Total     Peak  Runoff
                         Precip      Runon       Evap      Infil     Runoff
                         Runoff     Runoff      Runoff   Runoff   Coeff
Subcatchment                in         in         in         in         in
in         in    10^6 gal      CFS

---------------------------------------------------------------------------------------------
DA-1                        10.55       0.00       0.00       1.00       5.36
4.07       9.43       16.55   448.55   0.894
DA-2                        10.55       0.00       0.00       0.16       9.59
0.78      10.37        0.31    15.72   0.983
DA-3                        10.55       0.00       0.00       1.38       2.63
6.49       9.13        1.19    45.07   0.865
DA-4                        10.55       0.00       0.00       0.57       7.27
2.68       9.95        2.38   100.15   0.944
DA-5                        10.55       0.00       0.00       0.02      10.42
0.09      10.51        0.16     8.26   0.996
```

```
DA-6                      10.55       0.00       0.00       0.13       9.80
0.61      10.41        0.60    29.92   0.987
DA-7                      10.55       0.00       0.00       0.20       9.38
0.96      10.34        0.47    23.87   0.980
DA-8                      10.55       0.00       0.00       0.18       9.49
0.87      10.36        0.68    34.60   0.982
DA-9                      10.55       0.00       0.00       0.13       9.80
0.61      10.41        0.41    21.15   0.987
DA-10                     10.55       0.00       0.00       0.31       8.75
1.48      10.23        0.22    11.24   0.970
DA-11                     10.55       0.00       0.00       0.20       9.38
0.96      10.34        1.16    58.77   0.980
DA-12                     10.55       0.00       0.00       0.64       6.85
3.04       9.89        0.95    47.02   0.938
DA-13                     10.55       0.00       0.00       0.47       8.85
1.21      10.06        0.46    23.71   0.954
DA-14                     10.55       0.00       0.00       1.42       3.58
5.52       9.10        0.71    30.91   0.863
DA-15                     10.55       0.00       0.00       0.35       8.52
1.65      10.17        0.08     4.07   0.964
DA-16                     10.55       0.00       0.00       0.50       7.69
2.35      10.04        0.13     6.42   0.952
DA-BASIN                  10.55       0.00       0.00       0.49       7.69
2.35      10.04        0.74    37.70   0.952


******************
Node Depth Summary
******************

-------------------------------------------------------------------------------
                                Average  Maximum  Maximum  Time of Max    Reported
                                  Depth    Depth      HGL   Occurrence   Max Depth
Node                  Type         Feet     Feet     Feet  days hr:min        Feet
-------------------------------------------------------------------------------
MH-1                  JUNCTION     1.12     3.87   206.61     0  12:04        3.84
Out-4                 JUNCTION     4.50     7.26   205.77     0  12:18        7.26
IN-1                  JUNCTION     4.36     6.09   207.19     0  15:24        6.09
Out-1                 JUNCTION     2.54     4.81   205.81     0  12:20        4.79
Out-3                 JUNCTION     1.07     3.17   205.78     0  12:19        3.17
Out-6                 JUNCTION     1.49     3.79   205.79     0  12:18        3.78
Out-2                 JUNCTION     1.49     3.79   205.79     0  12:18        3.78
Jun-1                 JUNCTION     2.35     4.79   205.79     0  12:18        4.78
Jun-2                 JUNCTION     2.45     4.90   205.80     0  12:21        4.88
Jun-3                 JUNCTION     2.75     5.38   205.78     0  12:19        5.38
Out-5                 OUTFALL      1.23     3.70   200.34     0  12:00        3.70
IN-2                  STORAGE      0.78     4.30   207.40     0  12:07        4.22
IN-3                  STORAGE      1.11     3.84   206.60     0  12:04        3.82
ExistingBasin         STORAGE      1.23     4.01   202.21     0  12:02        3.90
IN-12                 STORAGE      0.27     4.22   207.12     0  12:04        4.15
IN-11                 STORAGE      2.79     4.90   203.53     0  12:10        4.89
IN-10                 STORAGE      0.65     3.53   203.70     0  12:01        3.45
IN-9                  STORAGE      0.88     4.14   204.52     0  12:03        4.08
IN-8                  STORAGE      0.65     4.25   206.52     0  12:04        4.19
IN-5                  STORAGE      0.37     4.28   211.57     0  12:08        4.27
IN-6                  STORAGE      0.56     4.62   210.39     0  12:13        4.62
IN-7                  STORAGE      0.55     4.51   208.36     0  12:09        4.48
BMP1                  STORAGE      0.41     3.00   208.00     0  11:50        3.00
BMP2                  STORAGE      0.45     3.00   207.50     0  11:50        3.00
BMP3                  STORAGE      0.58     3.00   207.00     0  11:46        3.00
BMP4                  STORAGE      0.84     3.00   206.50     0  11:41        3.00
BMP5                  STORAGE      0.79     2.80   205.80     0  12:14        2.80


*******************
Node Inflow Summary
*******************
```

Node	Type	Maximum Total Lateral Inflow CFS	Maximum Flow Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Balance Error 10^6 gal	Percent
MH-1	JUNCTION	0.00	16.15	0 12:16	0	2.44	-0.028
Out-4	JUNCTION	0.00	53.87	0 12:00	0	16.5	0.161
IN-1	JUNCTION	448.55	448.55	0 12:05	16.6	16.6	0.005
Out-1	JUNCTION	0.00	27.47	0 18:16	0	15.5	0.091
Out-3	JUNCTION	23.71	23.71	0 12:00	0.465	0.465	0.327
Out-6	JUNCTION	6.42	6.42	0 12:00	0.131	0.131	1.634
Out-2	JUNCTION	4.07	4.07	0 12:00	0.0774	0.0774	2.823
Jun-1	JUNCTION	0.00	10.35	0 12:00	0	0.204	6.736
Jun-2	JUNCTION	0.00	29.14	0 11:56	0	15.7	0.159
Jun-3	JUNCTION	0.00	49.11	0 12:00	0	16.1	0.154
Out-5	OUTFALL	0.00	165.65	0 12:00	0	24.1	0.000
IN-2	STORAGE	15.72	15.72	0 12:00	0.307	0.325	0.403
IN-3	STORAGE	0.00	12.60	0 13:03	0	2.14	0.007
ExistingBasin	STORAGE	37.70	172.37	0 12:00	0.742	24.1	0.010
IN-12	STORAGE	47.02	47.02	0 12:00	0.954	0.954	0.046
IN-11	STORAGE	58.77	83.25	0 12:00	1.16	17.5	0.103
IN-10	STORAGE	11.24	69.69	0 11:59	0.22	4.94	0.017
IN-9	STORAGE	21.15	62.91	0 12:00	0.413	4.72	0.011
IN-8	STORAGE	34.60	51.79	0 12:00	0.681	4.31	0.019
IN-5	STORAGE	8.26	8.26	0 12:00	0.16	0.16	0.060
IN-6	STORAGE	29.92	32.28	0 12:00	0.597	0.757	0.031
IN-7	STORAGE	23.87	31.69	0 12:00	0.466	1.22	-0.074
BMP1	STORAGE	100.15	100.15	0 12:00	2.39	2.39	-0.028
BMP2	STORAGE	0.00	35.06	0 11:50	0	2.02	-0.000
BMP3	STORAGE	45.07	79.71	0 12:00	1.19	3.21	-0.015
BMP4	STORAGE	0.00	38.57	0 12:06	0	2.83	-0.009
BMP5	STORAGE	30.91	30.91	0 12:00	0.715	0.796	0.009

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
MH-1	JUNCTION	2.28	1.871	0.129
Out-4	JUNCTION	19.33	3.265	0.000
IN-1	JUNCTION	20.88	4.088	0.000
Out-1	JUNCTION	1.80	0.809	0.191
Jun-1	JUNCTION	1.78	0.788	0.212
Jun-2	JUNCTION	1.94	0.895	0.105
Jun-3	JUNCTION	3.61	1.384	0.000

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
Out-4	19.33	29.08	0 12:00	0.281	3.265
IN-1	18.97	432.86	0 12:05	8.139	1.088
Jun-3	1.16	16.11	0 12:04	0.033	0.384
BMP1	0.40	65.41	0 12:00	0.363	0.000
BMP2	0.01	0.39	0 11:50	0.000	0.000
BMP3	0.62	45.00	0 12:00	0.396	0.000
BMP4	1.37	38.53	0 12:06	0.709	0.000

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CFS
IN-2	0.034	0	0	0	4.450	9	0 12:07	10.37
IN-3	0.010	0	0	0	0.035	0	0 12:04	14.92
ExistingBasin	1.475	9	0	0	10.378	66	0 12:02	165.65
IN-12	0.010	0	0	0	2.382	5	0 12:04	37.27
IN-11	1.311	3	0	0	40.657	81	0 12:10	43.43
IN-10	0.006	0	0	0	0.032	0	0 12:01	69.54
IN-9	0.010	0	0	0	1.031	2	0 12:03	61.78

```
IN-8                    0.018       0     0     0         3.080       6       0
12:04      48.81
IN-5                    0.063       0     0     0         3.937       8       0
12:08       2.52
IN-6                    0.543       1     0     0        19.206      38       0
12:13      11.55
IN-7                    0.121       0     0     0        13.254      26       0
12:09      20.00
BMP1                    0.059       5     0     0         1.125     100       0
11:50      35.10
BMP2                    0.076       7     0     0         1.125     100       0
11:50      34.70
BMP3                    0.112      10     0     0         1.125     100       0
11:46      34.71
BMP4                    0.181      16     0     0         1.125     100       0
11:41      12.65
BMP5                    7.879      26     0    40        28.037      93       0
12:14      15.47


**********************
Outfall Loading Summary
**********************

------------------------------------------------------------
                      Flow       Avg       Max       Total
                      Freq      Flow      Flow      Volume
Outfall Node          Pcnt       CFS       CFS    10^6 gal
------------------------------------------------------------
Out-5                99.89     32.87    165.65      24.124
------------------------------------------------------------
System               99.89     32.87    165.65      24.124


********************
Link Flow Summary
********************

-------------------------------------------------------------------------------
                                Maximum  Time of Max   Maximum    Max/    Max/
                                 |Flow|   Occurrence   |Veloc|    Full    Full
Link                 Type          CFS  days hr:min    ft/sec    Flow   Depth
-------------------------------------------------------------------------------
24inCMP              CONDUIT     27.47     0  18:16      8.74    5.35    1.00
12inRCP              CONDUIT     10.37     0  12:10     13.21    2.06    1.00
24inRcp(2)           CONDUIT     14.92     0  12:20      4.75    2.11    1.00
PipeRecessed         CONDUIT     16.16     0  12:17      5.19    4.24    1.00
15inCMP              CONDUIT      2.52     0  11:49      2.10    1.03    1.00
21inCMP              CONDUIT     11.55     0  12:41      4.80    1.62    1.00
27inCMP              CONDUIT     20.00     0  12:21      5.11    1.70    1.00
30inRCP              CONDUIT     48.81     0  12:09      9.94    1.33    1.00
36inRCP(2)           CONDUIT     61.78     0  12:07      8.74    2.83    1.00
36inRCP              CONDUIT     69.54     0  11:59      9.99    1.29    1.00
36inCMP(2)           CONDUIT     43.43     0  12:13      6.71    4.57    1.00
24inRCP              CONDUIT     37.27     0  12:04     11.86    1.54    1.00
48inRCP              CONDUIT    165.65     0  12:00     13.48    1.11    0.96
36inCMP              CONDUIT     31.24     0  13:37      4.42    4.80    1.00
26                   CONDUIT     27.66     0  17:32      1.93    0.52    1.00
27                   CONDUIT     28.57     0  17:26      2.49    0.15    1.00
28                   CONDUIT     23.13     0  11:59      0.89    0.06    0.90
29                   CONDUIT     48.53     0  12:00      1.35    0.16    1.00
31                   CONDUIT     10.41     0  12:00      0.29    0.12    1.00
32                   CONDUIT      6.34     0  12:00      0.21    0.02    0.97
33                   CONDUIT      4.01     0  12:00      0.19    0.01    0.97
34                   CONDUIT     35.06     0  11:50     11.16    1.01    1.00
35                   CONDUIT     34.65     0  11:51     11.03    1.00    1.00
36                   CONDUIT     34.66     0  11:52     11.03    1.00    1.00
37                   CONDUIT     12.60     0  13:03      4.01    1.20    1.00
38                   CONDUIT     15.01     0  11:53      5.57    0.14    1.00
```

****
Flow Classification Summary
****

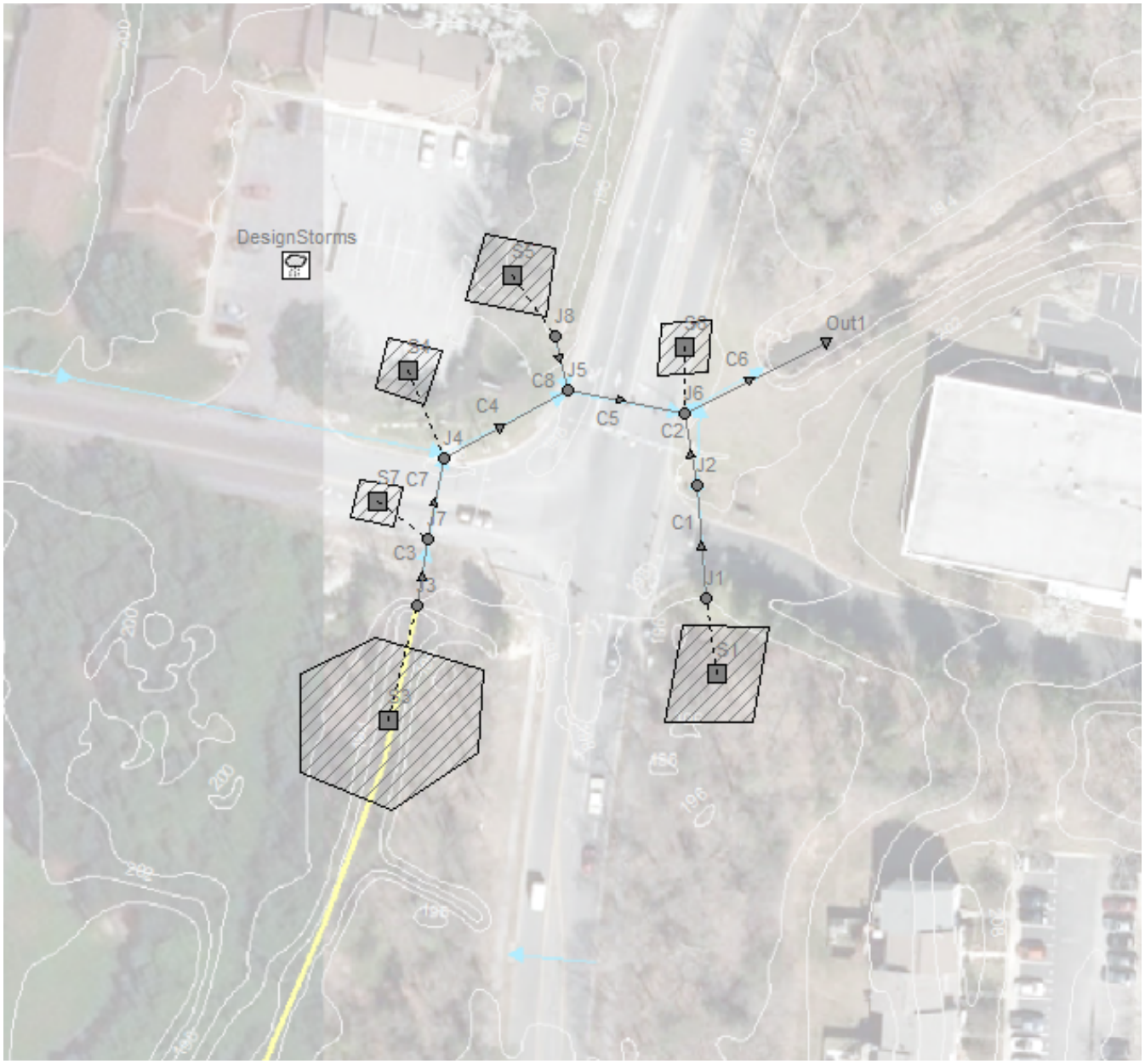
Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
24inCMP	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
12inRCP	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.18	0.00
24inRcp(2)	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.01	0.00
PipeRecessed	1.00	0.00	0.00	0.00	0.03	0.00	0.00	0.96	0.00	0.00
15inCMP	1.00	0.00	0.00	0.00	0.78	0.00	0.00	0.21	0.62	0.00
21inCMP	1.00	0.00	0.00	0.00	0.09	0.00	0.00	0.90	0.00	0.00
27inCMP	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.91	0.00
30inRCP	1.00	0.00	0.00	0.00	0.03	0.08	0.00	0.88	0.03	0.00
36inRCP(2)	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.98	0.00	0.00
36inRCP	1.00	0.00	0.00	0.00	0.14	0.01	0.00	0.85	0.14	0.00
36inCMP(2)	1.00	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.00	0.00
24inRCP	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
48inRCP	1.00	0.00	0.00	0.00	0.01	0.99	0.00	0.00	0.33	0.00
36inCMP	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
26	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
27	1.00	0.00	0.01	0.00	0.99	0.00	0.00	0.00	0.02	0.00
28	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.35	0.00
29	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.28	0.00
31	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.01	0.00
32	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.33	0.00
33	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.33	0.00
34	1.00	0.00	0.00	0.00	0.07	0.93	0.00	0.00	0.39	0.00
35	1.00	0.00	0.00	0.00	0.08	0.91	0.00	0.00	0.65	0.00
36	1.00	0.00	0.00	0.00	0.31	0.69	0.00	0.00	0.31	0.00
37	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.84	0.00
38	1.00	0.00	0.27	0.00	0.73	0.00	0.00	0.00	0.10	0.00

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
24inCMP	19.21	20.88	19.21	25.15	19.21
12inRCP	4.91	4.91	10.65	0.55	0.55
24inRcp(2)	2.28	2.30	2.28	2.50	1.84
PipeRecessed	0.41	2.28	0.41	6.91	0.35
15inCMP	1.42	1.42	1.46	0.09	0.09
21inCMP	1.27	1.43	1.27	1.45	1.27
27inCMP	0.47	0.89	0.47	1.43	0.47
30inRCP	0.35	0.37	0.35	0.71	0.35
36inRCP(2)	0.21	0.32	0.21	1.60	0.21
36inRCP	0.04	0.22	0.04	0.33	0.04
36inCMP(2)	0.25	15.64	0.25	22.46	0.25
24inRCP	0.21	0.26	0.21	0.28	0.21
48inRCP	0.01	0.03	0.01	0.24	0.01
36inCMP	15.64	15.64	20.24	24.12	0.01
26	1.80	1.80	1.94	0.01	0.01
27	1.94	1.94	3.61	0.01	0.01
28	0.01	0.01	3.61	0.01	0.01
29	3.61	3.61	19.33	0.01	0.01
31	1.78	1.78	1.94	0.01	0.01
32	0.01	0.01	1.78	0.01	0.01
33	0.01	0.01	1.78	0.01	0.01

```
34                          0.82      0.82      1.49      0.40         0.39
35                          1.49      1.49      1.79      0.01         0.01
36                          1.79      1.79      2.10      0.01         0.01
37                          2.10      2.10      2.30      1.32         1.33
38                          1.74      1.74     21.82      0.01         0.01


Analysis begun on:  Mon Nov 28 14:55:35 2022
Analysis ended on:  Mon Nov 28 14:55:36 2022
Total elapsed time: 00:00:01
```

Location 12: Existing Industrial Drive and Post Office Road SWMM Schematic



```

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.0)
--------------------------------------------------------------
```
Location 12: Location 12: Industrial Drive and Post Office Road SWMM Schematic (25-Year - EXISTING)
```
WARNING 02: maximum depth increased for Node J4
WARNING 02: maximum depth increased for Node J5
WARNING 02: maximum depth increased for Node J6
WARNING 02: maximum depth increased for Node J7

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Surcharge Method ......... EXTRAN
Starting Date ............ 01/01/2000 00:00:00
Ending Date .............. 01/02/2000 00:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 01:00:00
Routing Time Step ........ 20.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 8
Number of Threads ........ 1
Head Tolerance ........... 0.005000 ft


**************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
**************************     ---------       -------
Total Precipitation ......       130.610         6.297
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........        20.220         0.975
Surface Runoff ...........       102.606         4.947
Final Storage ............         7.976         0.385
Continuity Error (%) .....        -0.147


**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......       102.533        33.412
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........        83.923        27.348
Flooding Loss ............        18.579         6.054
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.032         0.010
Continuity Error (%) .....        -0.001


***************************
Time-Step Critical Elements
***************************
Link C3 (89.68%)
```

```
Link C6 (5.46%)
Link C7 (4.24%)


********************************
Highest Flow Instability Indexes
********************************
All links are stable.


*********************************
Most Frequent Nonconverging Nodes
*********************************
Node Out1 (0.02%)
Node J2 (0.01%)
Node J1 (0.01%)
Node J3 (0.00%)
Node J8 (0.00%)


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.50 sec
Average Time Step           :     1.97 sec
Maximum Time Step           :    20.00 sec
% of Time in Steady State   :     0.00
Average Iterations per Step :     2.00
% of Steps Not Converging   :     0.02
Time Step Frequencies       :
   20.000 -  9.564 sec      :     0.12 %
    9.564 -  4.573 sec      :     1.16 %
    4.573 -  2.187 sec      :    32.17 %
    2.187 -  1.046 sec      :    57.44 %
    1.046 -  0.500 sec      :     9.11 %


***************************
Subcatchment Runoff Summary
***************************


-------------------------------------------------------------------------------------------
                          Total      Total      Total      Total     Imperv
                          Perv      Total       Total     Peak  Runoff
                         Precip      Runon       Evap      Infil     Runoff
                         Runoff     Runoff      Runoff   Runoff   Coeff
Subcatchment                in         in         in         in         in
in         in    10^6 gal      CFS
-------------------------------------------------------------------------------------------
S1                          6.30       0.00       0.00       2.10       0.27
3.77       4.04        0.20     6.24   0.641
S5                          6.30       0.00       0.00       1.04       3.04
2.11       5.15        0.94    37.99   0.818
S3                          6.30       0.00       0.00       1.02       2.81
2.05       4.86       27.87   616.53   0.772
S6                          6.30       0.00       0.00       0.02       5.87
0.34       6.21        0.07     3.20   0.986
S4                          6.30       0.00       0.00       0.60       3.83
1.70       5.54        4.33   144.08   0.879
S7                          6.30       0.00       0.00       0.12       5.24
0.89       6.13        0.03     1.70   0.973


******************
Node Depth Summary
```

****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
J1	JUNCTION	0.34	2.67	197.18	0 12:06	2.64
J2	JUNCTION	0.99	3.50	197.14	0 12:03	3.50
J3	JUNCTION	4.03	10.70	200.89	0 12:12	10.61
J4	JUNCTION	2.74	5.15	196.22	0 11:46	5.15
J5	JUNCTION	1.96	4.31	195.81	0 12:11	4.29
J6	JUNCTION	2.02	4.26	195.50	0 12:11	4.26
J7	JUNCTION	2.49	5.02	196.37	0 11:46	5.02
J8	JUNCTION	0.36	2.94	197.33	0 12:05	2.72
Out1	OUTFALL	1.95	4.08	195.25	0 12:03	4.08

****
Node Inflow Summary
****

Node	Type	Maximum Total Lateral Inflow CFS	Maximum Flow Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Inflow Balance Error 10^6 gal	Percent
J1	JUNCTION	6.24	6.24	0 12:05	0.197	0.197	0.011
J2	JUNCTION	0.00	6.21	0 12:07	0	0.197	0.109
J3	JUNCTION	616.53	616.53	0 12:05	27.8	27.8	0.004
J4	JUNCTION	144.08	305.20	0 12:00	4.33	27.4	0.012
J5	JUNCTION	0.00	200.39	0 12:07	0	27.1	0.007
J6	JUNCTION	3.20	205.51	0 12:03	0.0674	27.3	0.005
J7	JUNCTION	1.70	436.09	0 12:12	0.0332	27.9	0.007
J8	JUNCTION	37.99	37.99	0 12:00	0.937	0.937	-0.002
Out1	OUTFALL	0.00	205.51	0 12:03	0	27.3	0.000

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
J1	JUNCTION	1.01	0.671	0.000
J2	JUNCTION	1.27	1.460	0.000
J3	JUNCTION	2.57	5.695	0.000

J4	JUNCTION	0.98	0.000	0.000
J7	JUNCTION	1.27	0.000	0.000
J8	JUNCTION	0.31	0.940	0.000

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
J1	0.99	3.39	0 12:03	0.012	0.171
J2	0.37	3.50	0 12:07	0.014	0.000
J3	1.30	266.83	0 12:00	1.512	3.885
J4	0.98	134.83	0 12:00	1.266	0.000
J7	1.27	274.98	0 12:12	4.773	0.000
J8	0.27	8.94	0 12:00	0.020	0.440

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
Out1	99.91	60.97	205.51	27.345
System	99.91	60.97	205.51	27.345

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
C1	CONDUIT	6.21	0 12:07	1.98	0.22	1.00
C3	CONDUIT	435.73	0 12:12	22.19	0.77	1.00
C4	CONDUIT	190.85	0 13:03	10.19	0.77	0.92
C5	CONDUIT	200.40	0 12:07	11.32	1.21	0.85
C6	CONDUIT	205.51	0 12:03	11.74	1.87	0.83
C2	CONDUIT	2.87	0 12:11	4.14	0.88	1.00
C7	CONDUIT	171.43	0 13:02	8.73	1.14	1.00
C8	CONDUIT	31.34	0 12:05	9.98	0.74	1.00

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
C1	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.91	0.00
C3	1.00	0.00	0.01	0.00	0.98	0.00	0.00	0.00	0.00	0.00

```
C4                      1.00   0.00  0.02  0.00  0.93  0.00  0.05  0.00  0.00  0.00
C5                      1.00   0.00  0.00  0.00  0.15  0.78  0.00  0.07  0.00  0.00
C6                      1.00   0.00  0.00  0.00  0.99  0.01  0.00  0.00  0.00  0.00
C2                      1.00   0.08  0.00  0.00  0.91  0.00  0.00  0.02  0.81  0.00
C7                      1.00   0.00  0.00  0.00  0.99  0.00  0.00  0.01  0.01  0.00
C8                      1.00   0.00  0.00  0.00  0.97  0.01  0.00  0.02  0.90  0.00


*************************
Conduit Surcharge Summary
*************************

-------------------------------------------------------------------------------
                                                          Hours        Hours
                       --------- Hours Full --------   Above Full   Capacity
Conduit                Both Ends  Upstream  Dnstream   Normal Flow   Limited
-------------------------------------------------------------------------------
C1                          1.01      1.01      1.27      0.01         0.01
C3                          1.27      1.27      2.57      0.01         0.01
C4                          0.01      0.01      1.33      0.01         0.01
C5                          0.01      0.01      0.01      1.36         0.01
C6                          0.01      0.01      0.01      2.28         0.01
C2                          1.63      1.63     14.10      0.01         0.01
C7                          0.98      1.29      0.98      1.31         0.98
C8                          0.31      0.31      4.95      0.01         0.01


Analysis begun on:  Wed Nov 30 11:13:20 2022
Analysis ended on:  Wed Nov 30 11:13:20 2022
Total elapsed time: < 1 sec
```

```

    EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.0)
    --------------------------------------------------------------
```
Location 12: Location 12: Industrial Drive and Post Office Road SWMM Schematic (25-Year (2050) - EXISTING)
```
    WARNING 02: maximum depth increased for Node J4
    WARNING 02: maximum depth increased for Node J5
    WARNING 02: maximum depth increased for Node J6
    WARNING 02: maximum depth increased for Node J7

    ****************
    Analysis Options
    ****************
    Flow Units ............... CFS
    Process Models:
      Rainfall/Runoff ........ YES
      RDII ................... NO
      Snowmelt ............... NO
      Groundwater ............ NO
      Flow Routing ........... YES
      Ponding Allowed ........ YES
      Water Quality .......... NO
    Infiltration Method ...... CURVE_NUMBER
    Flow Routing Method ...... DYNWAVE
    Surcharge Method ......... EXTRAN
    Starting Date ............ 01/01/2000 00:00:00
    Ending Date .............. 01/02/2000 00:00:00
    Antecedent Dry Days ...... 0.0
    Report Time Step ......... 00:15:00
    Wet Time Step ............ 00:05:00
    Dry Time Step ............ 01:00:00
    Routing Time Step ........ 20.00 sec
    Variable Time Step ....... YES
    Maximum Trials ........... 8
    Number of Threads ........ 1
    Head Tolerance ........... 0.005000 ft


    **************************        Volume         Depth
    Runoff Quantity Continuity     acre-feet        inches
    **************************     ---------       -------
    Total Precipitation ......       146.436         7.060
    Evaporation Loss .........         0.000         0.000
    Infiltration Loss ........        20.887         1.007
    Surface Runoff ...........       117.361         5.658
    Final Storage ............         8.408         0.405
    Continuity Error (%) .....        -0.150


    **************************        Volume        Volume
    Flow Routing Continuity        acre-feet      10^6 gal
    **************************     ---------     ---------
    Dry Weather Inflow .......         0.000         0.000
    Wet Weather Inflow .......       117.281        38.218
    Groundwater Inflow .......         0.000         0.000
    RDII Inflow ..............         0.000         0.000
    External Inflow ..........         0.000         0.000
    External Outflow .........        92.699        30.207
    Flooding Loss ............        24.550         8.000
    Evaporation Loss .........         0.000         0.000
    Exfiltration Loss ........         0.000         0.000
    Initial Stored Volume ....         0.000         0.000
    Final Stored Volume ......         0.033         0.011
    Continuity Error (%) .....        -0.001


    ***************************
    Time-Step Critical Elements
    ***************************
    Link C3 (88.31%)
```

```
Link C6 (6.03%)
Link C7 (5.16%)


********************************
Highest Flow Instability Indexes
********************************
Link C7 (1)
Link C4 (1)


*********************************
Most Frequent Nonconverging Nodes
*********************************
Node Out1 (0.02%)
Node J2 (0.02%)
Node J1 (0.02%)
Node J8 (0.00%)
Node J3 (0.00%)


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.50 sec
Average Time Step           :     1.88 sec
Maximum Time Step           :    20.00 sec
% of Time in Steady State   :     0.00
Average Iterations per Step :     2.01
% of Steps Not Converging   :     0.02
Time Step Frequencies       :
   20.000 -  9.564 sec      :     0.07 %
    9.564 -  4.573 sec      :     1.01 %
    4.573 -  2.187 sec      :    24.99 %
    2.187 -  1.046 sec      :    62.94 %
    1.046 -  0.500 sec      :    10.99 %


***************************
Subcatchment Runoff Summary
***************************


-----------------------------------------------------------------------------------------------------------------------------------------
                          Total      Total      Total      Total     Imperv
                          Perv      Total       Total     Peak  Runoff
                         Precip      Runon       Evap      Infil     Runoff
                         Runoff     Runoff      Runoff   Runoff   Coeff
Subcatchment                 in         in          in         in         in
in         in    10^6 gal      CFS

-----------------------------------------------------------------------------------------------------------------------------------------
S1                          7.06       0.00       0.00       2.19       0.30
4.41       4.71        0.23     7.54   0.667
S5                          7.06       0.00       0.00       1.07       3.42
2.46       5.87        1.07    43.86   0.832
S3                          7.06       0.00       0.00       1.05       3.16
2.41       5.57       31.92   716.83   0.789
S6                          7.06       0.00       0.00       0.02       6.59
0.39       6.97        0.08     3.63   0.988
S4                          7.06       0.00       0.00       0.62       4.30
1.97       6.28        4.91   166.78   0.889
S7                          7.06       0.00       0.00       0.13       5.88
1.01       6.89        0.04     1.91   0.976


******************
```

Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
J1	JUNCTION	0.37	2.69	197.20	0 12:05	2.65
J2	JUNCTION	1.03	3.50	197.14	0 12:01	3.50
J3	JUNCTION	4.23	11.86	202.05	0 12:12	11.79
J4	JUNCTION	2.86	5.15	196.22	0 11:45	5.15
J5	JUNCTION	2.07	4.32	195.82	0 12:14	4.30
J6	JUNCTION	2.13	4.27	195.51	0 12:04	4.27
J7	JUNCTION	2.61	5.02	196.37	0 11:45	5.02
J8	JUNCTION	0.39	3.28	197.67	0 12:05	2.92
Out1	OUTFALL	2.06	4.09	195.26	0 12:04	4.09

****
Node Inflow Summary
****

Node	Type	Maximum Total Lateral Inflow Inflow Volume CFS	Maximum Flow Total Balance Inflow Error CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	10^6 gal	Percent
J1	JUNCTION	7.54	7.54	0 12:05	0.23	0.23	0.009
J2	JUNCTION	0.00	7.52	0 12:06	0	0.23	0.094
J3	JUNCTION	716.83	716.83	0 12:05	31.9	31.9	0.004
J4	JUNCTION	166.78	327.90	0 12:00	4.91	30.4	0.011
J5	JUNCTION	0.00	201.22	0 12:07	0	29.9	0.007
J6	JUNCTION	3.63	206.46	0 12:04	0.0757	30.2	0.005
J7	JUNCTION	1.91	489.02	0 12:12	0.0374	31.9	0.007
J8	JUNCTION	43.86	43.86	0 12:00	1.07	1.07	-0.005
Out1	OUTFALL	0.00	206.46	0 12:04	0	30.2	0.000

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
J1	JUNCTION	1.11	0.687	0.000
J2	JUNCTION	1.41	1.460	0.000

```
J3                    JUNCTION        3.02          6.858        0.000
J4                    JUNCTION        1.10          0.000        0.000
J7                    JUNCTION        1.49          0.000        0.000
J8                    JUNCTION        0.38          1.284        0.000


*********************
Node Flooding Summary
*********************

Flooding refers to all water that overflows a node, whether it ponds or not.
--------------------------------------------------------------------------
                                                          Total   Maximum
                                Maximum   Time of Max       Flood    Ponded
                       Hours       Rate    Occurrence      Volume     Depth
Node                  Flooded       CFS   days hr:min    10^6 gal      Feet
--------------------------------------------------------------------------
J1                       1.09      4.42      0  12:01       0.013     0.187
J2                       0.49      4.82      0  12:06       0.027     0.000
J3                       1.53    331.09      0  12:00       1.965     5.048
J4                       1.10    159.26      0  12:00       1.577     0.000
J7                       1.49    327.90      0  12:12       6.396     0.000
J8                       0.34     12.79      0  12:00       0.035     0.784


************************
Outfall Loading Summary
************************

------------------------------------------------------------
                       Flow       Avg       Max       Total
                       Freq      Flow      Flow      Volume
Outfall Node           Pcnt       CFS       CFS    10^6 gal
------------------------------------------------------------
Out1                  99.94     66.60    206.46      30.205
------------------------------------------------------------
System                99.94     66.60    206.46      30.205



********************
Link Flow Summary
********************

-------------------------------------------------------------------------------
                                Maximum  Time of Max   Maximum    Max/    Max/
                                 |Flow|   Occurrence   |Veloc|    Full    Full
Link                  Type          CFS  days hr:min    ft/sec    Flow   Depth
-------------------------------------------------------------------------------
C1                    CONDUIT      7.52     0  12:06      2.39    0.26    1.00
C3                    CONDUIT    488.64     0  12:12     24.89    0.86    1.00
C4                    CONDUIT    190.93     0  13:14     10.20    0.77    0.92
C5                    CONDUIT    201.23     0  12:07     11.32    1.21    0.85
C6                    CONDUIT    206.46     0  12:04     11.77    1.88    0.84
C2                    CONDUIT      2.86     0  12:14      4.13    0.87    1.00
C7                    CONDUIT    172.50     0  13:14      8.79    1.15    1.00
C8                    CONDUIT     34.56     0  12:05     11.00    0.82    1.00


***************************
Flow Classification Summary
***************************

-----------------------------------------------------------------------------------------
                      Adjusted    ---------- Fraction of Time in Flow Class ----------
                       /Actual         Up    Down  Sub   Sup   Up    Down  Norm  Inlet
Conduit                 Length    Dry  Dry   Dry   Crit  Crit  Crit  Crit  Ltd   Ctrl
-----------------------------------------------------------------------------------------
C1                        1.00   0.00  0.00  0.00  0.99  0.00  0.00  0.01  0.90  0.00
```

C3	1.00	0.00	0.01	0.00	0.98	0.00	0.00	0.00	0.00	0.00
C4	1.00	0.00	0.02	0.00	0.94	0.00	0.04	0.00	0.00	0.00
C5	1.00	0.00	0.00	0.00	0.17	0.76	0.00	0.06	0.00	0.00
C6	1.00	0.00	0.00	0.00	0.99	0.01	0.00	0.00	0.00	0.00
C2	1.00	0.07	0.00	0.00	0.92	0.00	0.00	0.01	0.81	0.00
C7	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.00	0.00
C8	1.00	0.01	0.00	0.00	0.97	0.01	0.00	0.02	0.88	0.00

****
Conduit Surcharge Summary
****

Conduit	Hours Full Both Ends	Hours Full Upstream	Hours Full Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
C1	1.11	1.11	1.41	0.01	0.01
C3	1.49	1.49	3.02	0.01	0.01
C4	0.01	0.01	1.56	0.01	0.01
C5	0.01	0.01	0.01	1.63	0.01
C6	0.01	0.01	0.01	2.66	0.01
C2	1.91	1.91	15.40	0.01	0.01
C7	1.11	1.50	1.11	1.55	1.11
C8	0.38	0.38	5.66	0.01	0.01

Analysis begun on: Wed Nov 30 11:13:47 2022
Analysis ended on: Wed Nov 30 11:13:47 2022
Total elapsed time: < 1 sec

```

    EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.0)
    --------------------------------------------------------------
```
Location 12: Location 12: Industrial Drive and Post Office Road SWMM Schematic (25-Year (2100) - EXISTING)
```
    WARNING 02: maximum depth increased for Node J4
    WARNING 02: maximum depth increased for Node J5
    WARNING 02: maximum depth increased for Node J6
    WARNING 02: maximum depth increased for Node J7

    ****************
    Analysis Options
    ****************
    Flow Units ............... CFS
    Process Models:
      Rainfall/Runoff ........ YES
      RDII ................... NO
      Snowmelt ............... NO
      Groundwater ............ NO
      Flow Routing ........... YES
      Ponding Allowed ........ YES
      Water Quality .......... NO
    Infiltration Method ...... CURVE_NUMBER
    Flow Routing Method ...... DYNWAVE
    Surcharge Method ......... EXTRAN
    Starting Date ............ 01/01/2000 00:00:00
    Ending Date .............. 01/02/2000 00:00:00
    Antecedent Dry Days ...... 0.0
    Report Time Step ......... 00:15:00
    Wet Time Step ............ 00:05:00
    Dry Time Step ............ 01:00:00
    Routing Time Step ........ 20.00 sec
    Variable Time Step ....... YES
    Maximum Trials ........... 8
    Number of Threads ........ 1
    Head Tolerance ........... 0.005000 ft


    **************************        Volume         Depth
    Runoff Quantity Continuity     acre-feet        inches
    **************************     ---------       -------
    Total Precipitation ......       156.205         7.531
    Evaporation Loss .........         0.000         0.000
    Infiltration Loss ........        21.248         1.024
    Surface Runoff ...........       126.355         6.092
    Final Storage ............         8.843         0.426
    Continuity Error (%) .....        -0.154


    **************************        Volume        Volume
    Flow Routing Continuity        acre-feet      10^6 gal
    **************************     ---------     ---------
    Dry Weather Inflow .......         0.000         0.000
    Wet Weather Inflow .......       126.266        41.146
    Groundwater Inflow .......         0.000         0.000
    RDII Inflow ..............         0.000         0.000
    External Inflow ..........         0.000         0.000
    External Outflow .........        97.887        31.898
    Flooding Loss ............        28.346         9.237
    Evaporation Loss .........         0.000         0.000
    Exfiltration Loss ........         0.000         0.000
    Initial Stored Volume ....         0.000         0.000
    Final Stored Volume ......         0.036         0.012
    Continuity Error (%) .....        -0.002


    ***************************
    Time-Step Critical Elements
    ***************************
    Link C3 (87.51%)
```

```
  Link C6 (6.25%)
  Link C7 (5.72%)


  ********************************
  Highest Flow Instability Indexes
  ********************************
  Link C7 (1)
  Link C4 (1)
  Link C5 (1)


  *********************************
  Most Frequent Nonconverging Nodes
  *********************************
  Node Out1 (0.02%)
  Node J2 (0.01%)
  Node J1 (0.01%)
  Node J3 (0.00%)
  Node J8 (0.00%)


  *************************
  Routing Time Step Summary
  *************************
  Minimum Time Step           :     0.50 sec
  Average Time Step           :     1.84 sec
  Maximum Time Step           :    20.00 sec
  % of Time in Steady State   :     0.00
  Average Iterations per Step :     2.00
  % of Steps Not Converging   :     0.02
  Time Step Frequencies       :
     20.000 -  9.564 sec      :     0.07 %
      9.564 -  4.573 sec      :     0.93 %
      4.573 -  2.187 sec      :    22.51 %
      2.187 -  1.046 sec      :    64.49 %
      1.046 -  0.500 sec      :    12.00 %


  ***************************
  Subcatchment Runoff Summary
  ***************************


  ----------------------------------------------------------------------------------------
  --------------------------------------
                            Total      Total      Total      Total     Imperv
                            Perv      Total       Total     Peak  Runoff
                           Precip      Runon       Evap      Infil     Runoff
                           Runoff     Runoff      Runoff   Runoff   Coeff
  Subcatchment                 in         in         in         in         in
  in         in    10^6 gal      CFS

  ----------------------------------------------------------------------------------------
  --------------------------------------
  S1                           7.53       0.00       0.00       2.23       0.32
  4.80       5.13        0.25     8.32   0.681
  S5                           7.53       0.00       0.00       1.09       3.65
  2.67       6.32        1.15    47.35   0.839
  S3                           7.53       0.00       0.00       1.07       3.37
  2.63       6.00       34.39   776.48   0.797
  S6                           7.53       0.00       0.00       0.02       7.03
  0.42       7.44        0.08     3.87   0.988
  S4                           7.53       0.00       0.00       0.63       4.59
  2.14       6.73        5.26   180.25   0.894
  S7                           7.53       0.00       0.00       0.13       6.27
  1.09       7.36        0.04     2.04   0.977
```

```
******************
Node Depth Summary
******************

--------------------------------------------------------------------------------
                                Average  Maximum  Maximum  Time of Max    Reported
                                  Depth    Depth      HGL   Occurrence   Max Depth
Node                  Type         Feet     Feet     Feet  days hr:min        Feet
--------------------------------------------------------------------------------
J1                    JUNCTION     0.38     2.70   197.21     0  12:05        2.66
J2                    JUNCTION     1.05     3.50   197.14     0  12:00        3.50
J3                    JUNCTION     4.35    12.59   202.78     0  12:13       12.53
J4                    JUNCTION     2.93     5.15   196.22     0  11:44        5.15
J5                    JUNCTION     2.13     4.32   195.82     0  12:16        4.30
J6                    JUNCTION     2.20     4.28   195.52     0  12:04        4.27
J7                    JUNCTION     2.68     5.02   196.37     0  11:44        5.02
J8                    JUNCTION     0.42     3.50   197.89     0  12:05        3.06
Out1                  OUTFALL      2.12     4.10   195.27     0  12:04        4.09


*******************
Node Inflow Summary
*******************


--------------------------------------------------------------------------------------------------
                                Maximum  Maximum                  Lateral
                                Total        Flow
                                Lateral    Total  Time of Max      Inflow
                                Inflow     Balance
                                 Inflow   Inflow   Occurrence      Volume
                                 Volume       Error
Node                  Type          CFS      CFS  days hr:min    10^6 gal    10^6 gal     Percent
--------------------------------------------------------------------------------------------------
J1                    JUNCTION      8.32     8.32     0  12:05        0.25        0.25       0.011
J2                    JUNCTION      0.00     8.19     0  12:05           0        0.25       0.088
J3                    JUNCTION    776.48   776.48     0  12:05        34.4        34.4       0.004
J4                    JUNCTION    180.25   341.37     0  12:00        5.26        32.2       0.010
J5                    JUNCTION      0.00   201.70     0  12:08           0        31.6       0.007
J6                    JUNCTION      3.87   207.02     0  12:04      0.0808        31.9       0.004
J7                    JUNCTION      2.04   519.52     0  12:13      0.0399        34.4       0.007
J8                    JUNCTION     47.35    47.35     0  12:00        1.15        1.15       0.000
Out1                  OUTFALL       0.00   207.02     0  12:04           0        31.9       0.000


**********************
Node Surcharge Summary
**********************

Surcharging occurs when water rises above the top of the highest conduit.
-----------------------------------------------------------------------
                                              Max. Height   Min. Depth
                                    Hours     Above Crown    Below Rim
Node                  Type      Surcharged           Feet         Feet
-----------------------------------------------------------------------
J1                    JUNCTION        1.17          0.698        0.000
```

J2	JUNCTION	1.49	1.460	0.000
J3	JUNCTION	3.26	7.589	0.000
J4	JUNCTION	1.18	0.000	0.000
J7	JUNCTION	1.61	0.000	0.000
J8	JUNCTION	0.41	1.502	0.000

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
J1	1.15	5.09	0 12:00	0.014	0.198
J2	0.54	5.50	0 12:05	0.036	0.000
J3	1.67	370.31	0 12:00	2.249	5.779
J4	1.18	173.80	0 12:00	1.766	0.000
J7	1.61	358.41	0 12:13	7.435	0.000
J8	0.37	14.97	0 12:00	0.045	1.002

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
Out1	99.94	69.85	207.02	31.896
System	99.94	69.85	207.02	31.896

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
C1	CONDUIT	8.19	0 12:05	2.61	0.28	1.00
C3	CONDUIT	519.14	0 12:13	26.44	0.91	1.00
C4	CONDUIT	190.96	0 13:20	10.20	0.77	0.92
C5	CONDUIT	201.72	0 12:08	11.34	1.22	0.85
C6	CONDUIT	207.02	0 12:04	11.79	1.88	0.84
C2	CONDUIT	2.86	0 12:15	4.13	0.87	1.00
C7	CONDUIT	173.09	0 13:20	8.82	1.15	1.00
C8	CONDUIT	36.47	0 12:05	11.61	0.86	1.00

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl

```
C1                      1.00   0.00  0.00  0.00  0.99  0.00  0.00  0.01  0.89  0.00
C3                      1.00   0.00  0.01  0.00  0.98  0.00  0.00  0.00  0.00  0.00
C4                      1.00   0.00  0.02  0.00  0.94  0.00  0.04  0.00  0.00  0.00
C5                      1.00   0.00  0.00  0.00  0.19  0.75  0.00  0.06  0.00  0.00
C6                      1.00   0.00  0.00  0.00  0.99  0.01  0.00  0.00  0.00  0.00
C2                      1.00   0.07  0.00  0.00  0.92  0.00  0.00  0.01  0.81  0.00
C7                      1.00   0.00  0.00  0.00  0.99  0.00  0.00  0.01  0.00  0.00
C8                      1.00   0.01  0.00  0.00  0.97  0.01  0.00  0.02  0.88  0.00


*************************
Conduit Surcharge Summary
*************************

-------------------------------------------------------------------------------
                                                          Hours        Hours
                        --------- Hours Full --------   Above Full   Capacity
Conduit                 Both Ends  Upstream  Dnstream   Normal Flow   Limited
-------------------------------------------------------------------------------
C1                           1.17      1.17      1.49      0.01         0.01
C3                           1.61      1.61      3.26      0.01         0.01
C4                           0.01      0.01      1.70      0.01         0.01
C5                           0.01      0.01      0.01      1.80         0.01
C6                           0.01      0.01      0.01      2.88         0.01
C2                           2.08      2.08     15.70      0.01         0.01
C7                           1.19      1.64      1.19      1.71         1.19
C8                           0.41      0.41      6.14      0.01         0.01


Analysis begun on:  Wed Nov 30 11:14:17 2022
Analysis ended on:  Wed Nov 30 11:14:17 2022
Total elapsed time: < 1 sec
```

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.0)
--------------------------------------------------------------
```

Location 12: Location 12: Industrial Drive and Post Office Road SWMM Schematic (100-Year - EXISTING)

```
WARNING 02: maximum depth increased for Node J4
WARNING 02: maximum depth increased for Node J5
WARNING 02: maximum depth increased for Node J6
WARNING 02: maximum depth increased for Node J7

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Surcharge Method ......... EXTRAN
Starting Date ............ 01/01/2000 00:00:00
Ending Date .............. 01/02/2000 00:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 01:00:00
Routing Time Step ........ 20.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 8
Number of Threads ........ 1
Head Tolerance ........... 0.005000 ft


**************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
**************************     ---------       -------
Total Precipitation ......       180.660         8.710
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........        22.022         1.062
Surface Runoff ...........       149.464         7.206
Final Storage ............         9.462         0.456
Continuity Error (%) .....        -0.160


**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......       149.362        48.672
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........       109.977        35.838
Flooding Loss ............        39.349        12.822
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.038         0.012
Continuity Error (%) .....        -0.002


***************************
Time-Step Critical Elements
***************************
Link C3 (85.29%)
```

```
Link C7 (7.21%)
Link C6 (6.90%)


********************************
Highest Flow Instability Indexes
********************************
Link C7 (1)
Link C4 (1)
Link C5 (1)


*********************************
Most Frequent Nonconverging Nodes
*********************************
Node Out1 (0.01%)
Node J2 (0.01%)
Node J3 (0.00%)
Node J1 (0.00%)


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.50 sec
Average Time Step           :     1.74 sec
Maximum Time Step           :    20.00 sec
% of Time in Steady State   :     0.00
Average Iterations per Step :     2.00
% of Steps Not Converging   :     0.01
Time Step Frequencies       :
   20.000 -  9.564 sec      :     0.08 %
    9.564 -  4.573 sec      :     0.75 %
    4.573 -  2.187 sec      :    20.27 %
    2.187 -  1.046 sec      :    64.77 %
    1.046 -  0.500 sec      :    14.12 %


***************************
Subcatchment Runoff Summary
***************************


---------------------------------------------------------------------------------------------------------------------------------------
                          Total      Total      Total      Total     Imperv
                          Perv      Total       Total     Peak  Runoff
                         Precip      Runon       Evap      Infil     Runoff
                         Runoff     Runoff      Runoff   Runoff   Coeff
Subcatchment                 in         in         in         in         in
in         in    10^6 gal      CFS

---------------------------------------------------------------------------------------------------------------------------------------
S1                          8.71       0.00       0.00       2.33       0.37
5.82       6.20        0.30    10.47   0.712
S5                          8.71       0.00       0.00       1.14       4.22
3.23       7.45        1.36    56.90   0.855
S3                          8.71       0.00       0.00       1.11       3.90
3.21       7.11       40.74   941.46   0.816
S6                          8.71       0.00       0.00       0.02       8.14
0.49       8.62        0.09     4.53   0.990
S4                          8.71       0.00       0.00       0.64       5.32
2.56       7.88        6.16   217.11   0.905
S7                          8.71       0.00       0.00       0.13       7.26
1.28       8.53        0.05     2.38   0.980


******************
```

Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
J1	JUNCTION	0.42	2.73	197.24	0 12:05	2.70
J2	JUNCTION	1.09	3.50	197.14	0 11:57	3.50
J3	JUNCTION	4.63	14.72	204.91	0 12:13	14.69
J4	JUNCTION	3.08	5.15	196.22	0 11:41	5.15
J5	JUNCTION	2.27	4.33	195.83	0 12:05	4.32
J6	JUNCTION	2.33	4.29	195.53	0 12:04	4.29
J7	JUNCTION	2.84	5.02	196.37	0 11:41	5.02
J8	JUNCTION	0.47	4.15	198.54	0 12:06	3.46
Out1	OUTFALL	2.25	4.11	195.28	0 12:05	4.10

****
Node Inflow Summary
****

Node	Type	Maximum Total Lateral Inflow CFS	Maximum Flow Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Balance Error 10^6 gal	Percent
J1	JUNCTION	10.47	10.47	0 12:05	0.303	0.303	0.017
J2	JUNCTION	0.00	10.13	0 12:06	0	0.303	0.073
J3	JUNCTION	941.46	941.46	0 12:05	40.7	40.7	0.003
J4	JUNCTION	217.11	378.23	0 12:00	6.16	36.4	0.010
J5	JUNCTION	0.00	203.00	0 12:08	0	35.5	0.007
J6	JUNCTION	4.53	208.54	0 12:05	0.0936	35.8	0.004
J7	JUNCTION	2.38	599.62	0 12:13	0.0463	40.8	0.007
J8	JUNCTION	56.90	56.90	0 12:00	1.35	1.35	-0.001
Out1	OUTFALL	0.00	208.54	0 12:05	0	35.8	0.000

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
J1	JUNCTION	1.31	0.733	0.000
J2	JUNCTION	1.70	1.460	0.000

```
J3                    JUNCTION        3.96          9.719        0.000
J4                    JUNCTION        1.37          0.000        0.000
J7                    JUNCTION        1.96          0.000        0.000
J8                    JUNCTION        0.50          2.147        0.000


**********************
Node Flooding Summary
**********************

Flooding refers to all water that overflows a node, whether it ponds or not.
--------------------------------------------------------------------------
                                                          Total   Maximum
                                Maximum   Time of Max       Flood    Ponded
                       Hours       Rate    Occurrence      Volume     Depth
Node                  Flooded       CFS   days hr:min    10^6 gal      Feet
--------------------------------------------------------------------------
J1                       1.29      5.56      0  11:58       0.016     0.233
J2                       0.66      7.45      0  12:06       0.059     0.000
J3                       2.03    482.10      0  12:00       3.078     7.909
J4                       1.37    213.67      0  12:00       2.287     0.000
J7                       1.96    438.51      0  12:13      10.476     0.000
J8                       0.47     20.87      0  12:00       0.073     1.647


************************
Outfall Loading Summary
************************

-------------------------------------------------------------
                       Flow       Avg       Max       Total
                       Freq      Flow      Flow      Volume
Outfall Node           Pcnt       CFS       CFS    10^6 gal
-------------------------------------------------------------
Out1                  99.92     76.99    208.54      35.835
-------------------------------------------------------------
System                99.92     76.99    208.54      35.835



********************
Link Flow Summary
********************

-------------------------------------------------------------------------------
                                Maximum  Time of Max   Maximum    Max/    Max/
                                 |Flow|   Occurrence   |Veloc|    Full    Full
Link                  Type          CFS  days hr:min    ft/sec    Flow   Depth
-------------------------------------------------------------------------------
C1                    CONDUIT     10.13     0  12:06      3.23    0.35    1.00
C3                    CONDUIT    599.23     0  12:13     30.52    1.05    1.00
C4                    CONDUIT    191.03     0  13:38     10.21    0.77    0.92
C5                    CONDUIT    203.01     0  12:08     11.38    1.23    0.86
C6                    CONDUIT    208.54     0  12:05     11.84    1.89    0.84
C2                    CONDUIT      2.86     0  12:19      4.13    0.87    1.00
C7                    CONDUIT    174.39     0  13:38      8.89    1.16    1.00
C8                    CONDUIT     41.59     0  12:06     13.24    0.98    1.00


***************************
Flow Classification Summary
***************************

-----------------------------------------------------------------------------------------
                     Adjusted    ---------- Fraction of Time in Flow Class ----------
                      /Actual         Up    Down  Sub   Sup   Up    Down  Norm  Inlet
Conduit                Length    Dry  Dry   Dry   Crit  Crit  Crit  Crit  Ltd   Ctrl
-----------------------------------------------------------------------------------------
C1                       1.00   0.00  0.00  0.00  0.99  0.00  0.00  0.01  0.88  0.00
```

C3	1.00	0.00	0.01	0.00	0.98	0.00	0.00	0.00	0.00	0.00
C4	1.00	0.00	0.01	0.00	0.95	0.00	0.03	0.00	0.00	0.00
C5	1.00	0.00	0.00	0.00	0.22	0.72	0.00	0.05	0.00	0.00
C6	1.00	0.00	0.00	0.00	0.99	0.01	0.00	0.00	0.00	0.00
C2	1.00	0.06	0.00	0.00	0.93	0.00	0.00	0.00	0.80	0.00
C7	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.00	0.00
C8	1.00	0.00	0.00	0.00	0.97	0.01	0.00	0.02	0.86	0.00

****
Conduit Surcharge Summary
****

Conduit	Hours Full Both Ends	Hours Full Upstream	Hours Full Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
C1	1.31	1.31	1.70	0.01	0.01
C3	1.96	1.96	3.96	0.26	0.01
C4	0.01	0.01	2.05	0.01	0.01
C5	0.01	0.01	0.01	2.17	0.01
C6	0.01	0.01	0.01	3.48	0.01
C2	2.48	2.48	16.85	0.01	0.01
C7	1.38	1.98	1.38	2.12	1.38
C8	0.50	0.50	7.20	0.01	0.01

Analysis begun on: Wed Nov 30 11:14:43 2022
Analysis ended on: Wed Nov 30 11:14:43 2022
Total elapsed time: < 1 sec

```

    EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.0)
    --------------------------------------------------------------
```
Location 12: Location 12: Industrial Drive and Post Office Road SWMM Schematic (100-Year (2050) - EXISTING)
```
    WARNING 02: maximum depth increased for Node J4
    WARNING 02: maximum depth increased for Node J5
    WARNING 02: maximum depth increased for Node J6
    WARNING 02: maximum depth increased for Node J7

    ****************
    Analysis Options
    ****************
    Flow Units ............... CFS
    Process Models:
      Rainfall/Runoff ........ YES
      RDII ................... NO
      Snowmelt ............... NO
      Groundwater ............ NO
      Flow Routing ........... YES
      Ponding Allowed ........ YES
      Water Quality .......... NO
    Infiltration Method ...... CURVE_NUMBER
    Flow Routing Method ...... DYNWAVE
    Surcharge Method ......... EXTRAN
    Starting Date ............ 01/01/2000 00:00:00
    Ending Date .............. 01/02/2000 00:00:00
    Antecedent Dry Days ...... 0.0
    Report Time Step ......... 00:15:00
    Wet Time Step ............ 00:05:00
    Dry Time Step ............ 01:00:00
    Routing Time Step ........ 20.00 sec
    Variable Time Step ....... YES
    Maximum Trials ........... 8
    Number of Threads ........ 1
    Head Tolerance ........... 0.005000 ft


    **************************        Volume         Depth
    Runoff Quantity Continuity     acre-feet        inches
    **************************     ---------       -------
    Total Precipitation ......       207.271         9.993
    Evaporation Loss .........         0.000         0.000
    Infiltration Loss ........        22.701         1.094
    Surface Runoff ...........       174.879         8.431
    Final Storage ............        10.032         0.484
    Continuity Error (%) .....        -0.164


    **************************        Volume        Volume
    Flow Routing Continuity        acre-feet      10^6 gal
    **************************     ---------     ---------
    Dry Weather Inflow .......         0.000         0.000
    Wet Weather Inflow .......       174.766        56.950
    Groundwater Inflow .......         0.000         0.000
    RDII Inflow ..............         0.000         0.000
    External Inflow ..........         0.000         0.000
    External Outflow .........       122.122        39.795
    Flooding Loss ............        52.605        17.142
    Evaporation Loss .........         0.000         0.000
    Exfiltration Loss ........         0.000         0.000
    Initial Stored Volume ....         0.000         0.000
    Final Stored Volume ......         0.041         0.013
    Continuity Error (%) .....        -0.001


    ***************************
    Time-Step Critical Elements
    ***************************
    Link C3 (83.38%)
```

```
Link C7 (8.53%)
Link C6 (7.59%)


********************************
Highest Flow Instability Indexes
********************************
Link C4 (2)
Link C7 (2)
Link C5 (1)
Link C8 (1)


*********************************
Most Frequent Nonconverging Nodes
*********************************
Node Out1 (0.01%)
Node J2 (0.01%)
Node J3 (0.00%)
Node J1 (0.00%)
Node J8 (0.00%)


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.50 sec
Average Time Step           :     1.66 sec
Maximum Time Step           :    20.00 sec
% of Time in Steady State   :     0.00
Average Iterations per Step :     2.00
% of Steps Not Converging   :     0.01
Time Step Frequencies       :
   20.000 -  9.564 sec      :     0.07 %
    9.564 -  4.573 sec      :     0.63 %
    4.573 -  2.187 sec      :    16.99 %
    2.187 -  1.046 sec      :    65.85 %
    1.046 -  0.500 sec      :    16.46 %


***************************
Subcatchment Runoff Summary
***************************


-----------------------------------------------------------------------------------------------------------------------------------------
                          Total      Total      Total      Total     Imperv
                          Perv      Total       Total     Peak  Runoff
                         Precip      Runon       Evap      Infil     Runoff
                         Runoff     Runoff      Runoff   Runoff   Coeff
Subcatchment                in         in         in         in         in
in         in    10^6 gal      CFS

-----------------------------------------------------------------------------------------------------------------------------------------
S1                          9.99       0.00       0.00       2.42       0.43
6.96       7.39        0.36    12.89   0.739
S5                          9.99       0.00       0.00       1.17       4.85
3.84       8.69        1.58    67.61   0.870
S3                          9.99       0.00       0.00       1.14       4.49
3.84       8.33       47.73  1128.20   0.834
S6                          9.99       0.00       0.00       0.02       9.34
0.56       9.91        0.11     5.26   0.991
S4                          9.99       0.00       0.00       0.66       6.11
3.03       9.14        7.15   258.55   0.915
S7                          9.99       0.00       0.00       0.13       8.33
1.48       9.82        0.05     2.74   0.982
```

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
J1	JUNCTION	0.45	2.78	197.29	0 12:05	2.74
J2	JUNCTION	1.13	3.50	197.14	0 11:55	3.50
J3	JUNCTION	4.93	17.32	207.51	0 12:14	17.31
J4	JUNCTION	3.21	5.15	196.22	0 11:40	5.15
J5	JUNCTION	2.40	4.35	195.85	0 12:05	4.33
J6	JUNCTION	2.46	4.31	195.55	0 12:04	4.30
J7	JUNCTION	2.98	5.02	196.37	0 11:40	5.02
J8	JUNCTION	0.52	4.93	199.32	0 12:06	3.96
Out1	OUTFALL	2.38	4.12	195.29	0 12:05	4.11

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Flow Balance Error Percent	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
J1	JUNCTION	12.89	12.89	0	12:05	0.361	0.361
J2	JUNCTION	0.00	12.32	0	12:06	0	0.361
J3	JUNCTION	1128.20	1128.20	0	12:05	47.7	47.7
J4	JUNCTION	258.55	419.67	0	12:00	7.14	40.7
J5	JUNCTION	0.00	204.41	0	12:09	0	39.4
J6	JUNCTION	5.26	210.17	0	12:05	0.108	39.8
J7	JUNCTION	2.74	684.71	0	12:14	0.0533	47.8
J8	JUNCTION	67.61	67.61	0	12:00	1.58	1.58
Out1	OUTFALL	0.00	210.17	0	12:05	0	39.8

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet

J1	JUNCTION	1.45	0.782	0.000
J2	JUNCTION	1.91	1.460	0.000
J3	JUNCTION	4.64	12.316	0.000
J4	JUNCTION	1.56	0.000	0.000
J7	JUNCTION	2.29	0.000	0.000
J8	JUNCTION	0.60	2.930	0.000

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
J1	1.42	5.69	0 11:56	0.020	0.282
J2	0.76	9.65	0 12:06	0.087	0.000
J3	2.38	614.28	0 12:00	4.088	10.506
J4	1.55	258.44	0 12:00	2.878	0.000
J7	2.29	523.59	0 12:14	14.177	0.000
J8	0.55	27.51	0 12:00	0.108	2.430

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
Out1	99.93	83.84	210.17	39.792
System	99.93	83.84	210.17	39.792

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
C1	CONDUIT	12.32	0 12:06	3.92	0.43	1.00
C3	CONDUIT	684.30	0 12:14	34.85	1.20	1.00
C4	CONDUIT	191.04	0 13:56	10.21	0.77	0.92
C5	CONDUIT	204.43	0 12:09	11.41	1.23	0.86
C6	CONDUIT	210.17	0 12:05	11.90	1.91	0.84
C2	CONDUIT	2.86	0 12:23	4.13	0.87	1.00
C7	CONDUIT	175.31	0 13:57	8.93	1.17	1.00
C8	CONDUIT	47.08	0 12:06	14.99	1.11	1.00

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Dry	Fraction of Time in Flow Class: Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl

```
--------------------------------------------------------------------------------
C1                      1.00   0.00  0.00  0.00  0.99  0.00  0.00  0.01  0.85  0.00
C3                      1.00   0.00  0.01  0.00  0.99  0.00  0.00  0.00  0.00  0.00
C4                      1.00   0.00  0.01  0.00  0.95  0.00  0.03  0.00  0.00  0.00
C5                      1.00   0.00  0.00  0.00  0.26  0.69  0.00  0.04  0.00  0.00
C6                      1.00   0.00  0.00  0.00  0.99  0.01  0.00  0.00  0.00  0.00
C2                      1.00   0.05  0.00  0.00  0.94  0.00  0.00  0.00  0.78  0.00
C7                      1.00   0.00  0.00  0.00  0.99  0.00  0.00  0.01  0.00  0.00
C8                      1.00   0.00  0.00  0.00  0.97  0.01  0.00  0.02  0.84  0.00


*************************
Conduit Surcharge Summary
*************************

---------------------------------------------------------------------------
                                                        Hours        Hours
                        --------- Hours Full --------   Above Full   Capacity
Conduit                 Both Ends  Upstream  Dnstream   Normal Flow   Limited
---------------------------------------------------------------------------
C1                           1.45      1.45      1.91      0.01         0.01
C3                           2.29      2.29      4.64      0.55         0.01
C4                           0.01      0.01      2.41      0.01         0.01
C5                           0.01      0.01      0.01      2.56         0.01
C6                           0.01      0.01      0.01      4.15         0.01
C2                           2.91      2.91     17.76      0.01         0.01
C7                           1.57      2.32      1.57      2.49         1.57
C8                           0.60      0.60      8.32      0.19         0.19


Analysis begun on:  Wed Nov 30 11:15:09 2022
Analysis ended on:  Wed Nov 30 11:15:10 2022
Total elapsed time: 00:00:01
```

```

  EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.0)
  --------------------------------------------------------------
```
Location 12: Location 12: Industrial Drive and Post Office Road SWMM Schematic (100-Year (2100) - EXISTING)
```
  WARNING 02: maximum depth increased for Node J4
  WARNING 02: maximum depth increased for Node J5
  WARNING 02: maximum depth increased for Node J6
  WARNING 02: maximum depth increased for Node J7

  ****************
  Analysis Options
  ****************
  Flow Units ............... CFS
  Process Models:
    Rainfall/Runoff ........ YES
    RDII ................... NO
    Snowmelt ............... NO
    Groundwater ............ NO
    Flow Routing ........... YES
    Ponding Allowed ........ YES
    Water Quality .......... NO
  Infiltration Method ...... CURVE_NUMBER
  Flow Routing Method ...... DYNWAVE
  Surcharge Method ......... EXTRAN
  Starting Date ............ 01/01/2000 00:00:00
  Ending Date .............. 01/02/2000 00:00:00
  Antecedent Dry Days ...... 0.0
  Report Time Step ......... 00:15:00
  Wet Time Step ............ 00:05:00
  Dry Time Step ............ 01:00:00
  Routing Time Step ........ 20.00 sec
  Variable Time Step ....... YES
  Maximum Trials ........... 8
  Number of Threads ........ 1
  Head Tolerance ........... 0.005000 ft


  **************************        Volume         Depth
  Runoff Quantity Continuity     acre-feet        inches
  **************************     ---------       -------
  Total Precipitation ......       207.271         9.993
  Evaporation Loss .........         0.000         0.000
  Infiltration Loss ........        22.701         1.094
  Surface Runoff ...........       174.879         8.431
  Final Storage ............        10.032         0.484
  Continuity Error (%) .....        -0.164


  **************************        Volume        Volume
  Flow Routing Continuity        acre-feet      10^6 gal
  **************************     ---------     ---------
  Dry Weather Inflow .......         0.000         0.000
  Wet Weather Inflow .......       174.766        56.950
  Groundwater Inflow .......         0.000         0.000
  RDII Inflow ..............         0.000         0.000
  External Inflow ..........         0.000         0.000
  External Outflow .........       122.122        39.795
  Flooding Loss ............        52.605        17.142
  Evaporation Loss .........         0.000         0.000
  Exfiltration Loss ........         0.000         0.000
  Initial Stored Volume ....         0.000         0.000
  Final Stored Volume ......         0.041         0.013
  Continuity Error (%) .....        -0.001


  ***************************
  Time-Step Critical Elements
  ***************************
  Link C3 (83.38%)
```

```
Link C7 (8.53%)
Link C6 (7.59%)


********************************
Highest Flow Instability Indexes
********************************
Link C4 (2)
Link C7 (2)
Link C5 (1)
Link C8 (1)


*********************************
Most Frequent Nonconverging Nodes
*********************************
Node Out1 (0.01%)
Node J2 (0.01%)
Node J3 (0.00%)
Node J1 (0.00%)
Node J8 (0.00%)


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.50 sec
Average Time Step           :     1.66 sec
Maximum Time Step           :    20.00 sec
% of Time in Steady State   :     0.00
Average Iterations per Step :     2.00
% of Steps Not Converging   :     0.01
Time Step Frequencies       :
   20.000 -  9.564 sec      :     0.07 %
    9.564 -  4.573 sec      :     0.63 %
    4.573 -  2.187 sec      :    16.99 %
    2.187 -  1.046 sec      :    65.85 %
    1.046 -  0.500 sec      :    16.46 %


***************************
Subcatchment Runoff Summary
***************************


-----------------------------------------------------------------------------------------------------------------------------------------
                          Total      Total      Total      Total     Imperv
                          Perv      Total       Total     Peak  Runoff
                         Precip      Runon       Evap      Infil     Runoff
                         Runoff     Runoff      Runoff   Runoff   Coeff
Subcatchment                in         in         in         in         in
in         in    10^6 gal      CFS

-----------------------------------------------------------------------------------------------------------------------------------------
S1                          9.99       0.00       0.00       2.42       0.43
6.96       7.39        0.36    12.89   0.739
S5                          9.99       0.00       0.00       1.17       4.85
3.84       8.69        1.58    67.61   0.870
S3                          9.99       0.00       0.00       1.14       4.49
3.84       8.33       47.73  1128.20   0.834
S6                          9.99       0.00       0.00       0.02       9.34
0.56       9.91        0.11     5.26   0.991
S4                          9.99       0.00       0.00       0.66       6.11
3.03       9.14        7.15   258.55   0.915
S7                          9.99       0.00       0.00       0.13       8.33
1.48       9.82        0.05     2.74   0.982
```

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
J1	JUNCTION	0.45	2.78	197.29	0 12:05	2.74
J2	JUNCTION	1.13	3.50	197.14	0 11:55	3.50
J3	JUNCTION	4.93	17.32	207.51	0 12:14	17.31
J4	JUNCTION	3.21	5.15	196.22	0 11:40	5.15
J5	JUNCTION	2.40	4.35	195.85	0 12:05	4.33
J6	JUNCTION	2.46	4.31	195.55	0 12:04	4.30
J7	JUNCTION	2.98	5.02	196.37	0 11:40	5.02
J8	JUNCTION	0.52	4.93	199.32	0 12:06	3.96
Out1	OUTFALL	2.38	4.12	195.29	0 12:05	4.11

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Flow Balance Error Percent	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
J1	JUNCTION	12.89	12.89	0	12:05	0.361	0.361
J2	JUNCTION	0.00	12.32	0	12:06	0	0.361
J3	JUNCTION	1128.20	1128.20	0	12:05	47.7	47.7
J4	JUNCTION	258.55	419.67	0	12:00	7.14	40.7
J5	JUNCTION	0.00	204.41	0	12:09	0	39.4
J6	JUNCTION	5.26	210.17	0	12:05	0.108	39.8
J7	JUNCTION	2.74	684.71	0	12:14	0.0533	47.8
J8	JUNCTION	67.61	67.61	0	12:00	1.58	1.58
Out1	OUTFALL	0.00	210.17	0	12:05	0	39.8

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet

J1	JUNCTION	1.45	0.782	0.000
J2	JUNCTION	1.91	1.460	0.000
J3	JUNCTION	4.64	12.316	0.000
J4	JUNCTION	1.56	0.000	0.000
J7	JUNCTION	2.29	0.000	0.000
J8	JUNCTION	0.60	2.930	0.000

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
J1	1.42	5.69	0 11:56	0.020	0.282
J2	0.76	9.65	0 12:06	0.087	0.000
J3	2.38	614.28	0 12:00	4.088	10.506
J4	1.55	258.44	0 12:00	2.878	0.000
J7	2.29	523.59	0 12:14	14.177	0.000
J8	0.55	27.51	0 12:00	0.108	2.430

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
Out1	99.93	83.84	210.17	39.792
System	99.93	83.84	210.17	39.792

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
C1	CONDUIT	12.32	0 12:06	3.92	0.43	1.00
C3	CONDUIT	684.30	0 12:14	34.85	1.20	1.00
C4	CONDUIT	191.04	0 13:56	10.21	0.77	0.92
C5	CONDUIT	204.43	0 12:09	11.41	1.23	0.86
C6	CONDUIT	210.17	0 12:05	11.90	1.91	0.84
C2	CONDUIT	2.86	0 12:23	4.13	0.87	1.00
C7	CONDUIT	175.31	0 13:57	8.93	1.17	1.00
C8	CONDUIT	47.08	0 12:06	14.99	1.11	1.00

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Dry	Fraction of Time in Flow Class: Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl

```
--------------------------------------------------------------------------------
C1                      1.00   0.00  0.00  0.00  0.99  0.00  0.00  0.01  0.85  0.00
C3                      1.00   0.00  0.01  0.00  0.99  0.00  0.00  0.00  0.00  0.00
C4                      1.00   0.00  0.01  0.00  0.95  0.00  0.03  0.00  0.00  0.00
C5                      1.00   0.00  0.00  0.00  0.26  0.69  0.00  0.04  0.00  0.00
C6                      1.00   0.00  0.00  0.00  0.99  0.01  0.00  0.00  0.00  0.00
C2                      1.00   0.05  0.00  0.00  0.94  0.00  0.00  0.00  0.78  0.00
C7                      1.00   0.00  0.00  0.00  0.99  0.00  0.00  0.01  0.00  0.00
C8                      1.00   0.00  0.00  0.00  0.97  0.01  0.00  0.02  0.84  0.00


*************************
Conduit Surcharge Summary
*************************

---------------------------------------------------------------------------
                                                        Hours        Hours
                        --------- Hours Full --------   Above Full   Capacity
Conduit                 Both Ends  Upstream  Dnstream   Normal Flow   Limited
---------------------------------------------------------------------------
C1                           1.45      1.45      1.91      0.01         0.01
C3                           2.29      2.29      4.64      0.55         0.01
C4                           0.01      0.01      2.41      0.01         0.01
C5                           0.01      0.01      0.01      2.56         0.01
C6                           0.01      0.01      0.01      4.15         0.01
C2                           2.91      2.91     17.76      0.01         0.01
C7                           1.57      2.32      1.57      2.49         1.57
C8                           0.60      0.60      8.32      0.19         0.19


Analysis begun on:  Wed Nov 30 11:15:09 2022
Analysis ended on:  Wed Nov 30 11:15:10 2022
Total elapsed time: 00:00:01
```

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.0)
------------------------------------------------------------

WARNING 02: maximum depth increased for Node J4
WARNING 02: maximum depth increased for Node J5
WARNING 02: maximum depth increased for Node J6
WARNING 02: maximum depth increased for Node J7

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Surcharge Method ......... EXTRAN
Starting Date ............ 01/01/2000 00:00:00
Ending Date .............. 01/02/2000 00:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 01:00:00
Routing Time Step ........ 20.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 8
Number of Threads ........ 1
Head Tolerance ........... 0.005000 ft


**************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
**************************     ---------       -------
Total Precipitation ......       218.596        10.539
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........        22.949         1.106
Surface Runoff ...........       185.655         8.951
Final Storage ............        10.356         0.499
Continuity Error (%) .....        -0.166


**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......       185.535        60.459
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........       127.238        41.462
Flooding Loss ............        58.258        18.984
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.042         0.014
Continuity Error (%) .....        -0.002


***************************
Time-Step Critical Elements
***************************
Link C3 (82.75%)
```

```
Link C7 (8.96%)
Link C6 (7.81%)


*******************************
Highest Flow Instability Indexes
*******************************
Link C4 (2)
Link C7 (2)
Link C5 (1)
Link C8 (1)
Link C6 (1)


********************************
Most Frequent Nonconverging Nodes
********************************
Node Out1 (0.05%)
Node J2 (0.04%)
Node J1 (0.00%)
Node J8 (0.00%)
Node J3 (0.00%)


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.50 sec
Average Time Step           :     1.63 sec
Maximum Time Step           :    20.00 sec
% of Time in Steady State   :     0.00
Average Iterations per Step :     2.01
% of Steps Not Converging   :     0.05
Time Step Frequencies       :
   20.000 -  9.564 sec      :     0.06 %
    9.564 -  4.573 sec      :     0.56 %
    4.573 -  2.187 sec      :    15.78 %
    2.187 -  1.046 sec      :    66.11 %
    1.046 -  0.500 sec      :    17.49 %


***************************
Subcatchment Runoff Summary
***************************


-----------------------------------------------------------------------------------------------------------------------------------------
                          Total      Total      Total      Total     Imperv
                          Perv      Total       Total     Peak  Runoff
                         Precip      Runon       Evap      Infil     Runoff
                         Runoff     Runoff      Runoff   Runoff   Coeff
Subcatchment                in         in         in         in         in
in         in    10^6 gal      CFS

-----------------------------------------------------------------------------------------------------------------------------------------
S1                          10.54       0.00       0.00       2.45       0.45
7.44       7.90        0.39    13.88   0.749
S5                          10.54       0.00       0.00       1.19       5.11
4.11       9.22        1.68    72.01   0.875
S3                          10.54       0.00       0.00       1.16       4.74
4.11       8.85       50.69  1205.48   0.840
S6                          10.54       0.00       0.00       0.02       9.86
0.59      10.45        0.11     5.56   0.992
S4                          10.54       0.00       0.00       0.67       6.45
3.23       9.68        7.57   275.58   0.918
S7                          10.54       0.00       0.00       0.13       8.79
1.57      10.36        0.06     2.89   0.983
```

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
J1	JUNCTION	0.46	2.80	197.31	0 12:05	2.75
J2	JUNCTION	1.14	3.50	197.14	0 11:38	3.50
J3	JUNCTION	5.05	18.44	208.63	0 12:14	18.44
J4	JUNCTION	3.27	5.15	196.22	0 11:39	5.15
J5	JUNCTION	2.45	4.36	195.86	0 12:05	4.34
J6	JUNCTION	2.51	4.32	195.56	0 12:05	4.31
J7	JUNCTION	3.03	5.02	196.37	0 11:39	5.02
J8	JUNCTION	0.54	5.27	199.66	0 12:06	4.18
Out1	OUTFALL	2.43	4.13	195.30	0 12:05	4.12

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Flow Balance Error Percent	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
J1	JUNCTION	13.88	13.88	0	12:05	0.386	0.386
J2	JUNCTION	0.00	13.21	0	12:06	0	0.386
J3	JUNCTION	1205.48	1205.48	0	12:05	50.7	50.7
J4	JUNCTION	275.58	436.69	0	12:00	7.56	42.5
J5	JUNCTION	0.00	204.98	0	12:09	0	41.1
J6	JUNCTION	5.56	210.82	0	12:05	0.113	41.5
J7	JUNCTION	2.89	718.39	0	12:14	0.0563	50.7
J8	JUNCTION	72.01	72.01	0	12:00	1.68	1.68
Out1	OUTFALL	0.00	210.82	0	12:05	0	41.5

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet

```
  ----------------------------------------------------------------------
  J1                    JUNCTION        1.50          0.805        0.000
  J2                    JUNCTION        2.00          1.460        0.000
  J3                    JUNCTION        4.88         13.439        0.000
  J4                    JUNCTION        1.64          0.000        0.000
  J7                    JUNCTION        2.42          0.000        0.000
  J8                    JUNCTION        0.63          3.266        0.000


  *********************
  Node Flooding Summary
  *********************

  Flooding refers to all water that overflows a node, whether it ponds or not.
  ---------------------------------------------------------------------------
                                                                 Total   Maximum
                                 Maximum   Time of Max          Flood    Ponded
                       Hours       Rate    Occurrence         Volume     Depth
  Node                 Flooded      CFS   days hr:min       10^6 gal      Feet
  ---------------------------------------------------------------------------
  J1                      1.47      5.64      0  11:55          0.021     0.305
  J2                      0.81     10.54      0  12:06          0.098     0.000
  J3                      2.51    670.66      0  12:00          4.526    11.629
  J4                      1.63    276.80      0  12:00          3.123     0.000
  J7                      2.42    557.27      0  12:14         15.762     0.000
  J8                      0.58     30.30      0  12:00          0.123     2.766


  ************************
  Outfall Loading Summary
  ************************

  ------------------------------------------------------------
                        Flow       Avg       Max       Total
                        Freq      Flow      Flow      Volume
  Outfall Node          Pcnt       CFS       CFS    10^6 gal
  ------------------------------------------------------------
  Out1                  99.94     86.53    210.82      41.459
  ------------------------------------------------------------
  System                99.94     86.53    210.82      41.459



  ********************
  Link Flow Summary
  ********************

  ------------------------------------------------------------------------------
                                 Maximum  Time of Max   Maximum    Max/    Max/
                                  |Flow|   Occurrence   |Veloc|    Full    Full
  Link                 Type          CFS  days hr:min    ft/sec    Flow   Depth
  ------------------------------------------------------------------------------
  C1                   CONDUIT     13.21     0  12:06      4.20    0.46    1.00
  C3                   CONDUIT    717.98     0  12:14     36.57    1.26    1.00
  C4                   CONDUIT    191.04     0  14:03     10.21    0.77    0.93
  C5                   CONDUIT    205.00     0  12:09     11.43    1.24    0.86
  C6                   CONDUIT    210.82     0  12:05     11.92    1.92    0.84
  C2                   CONDUIT      2.86     0  12:25      4.13    0.87    1.00
  C7                   CONDUIT    175.53     0  14:04      8.95    1.17    1.00
  C8                   CONDUIT     49.26     0  12:06     15.68    1.16    1.00


  ***************************
  Flow Classification Summary
  ***************************

  ---------------------------------------------------------------------------------------
                       Adjusted    ---------- Fraction of Time in Flow Class ----------
                        /Actual         Up    Down  Sub   Sup   Up    Down  Norm  Inlet
```

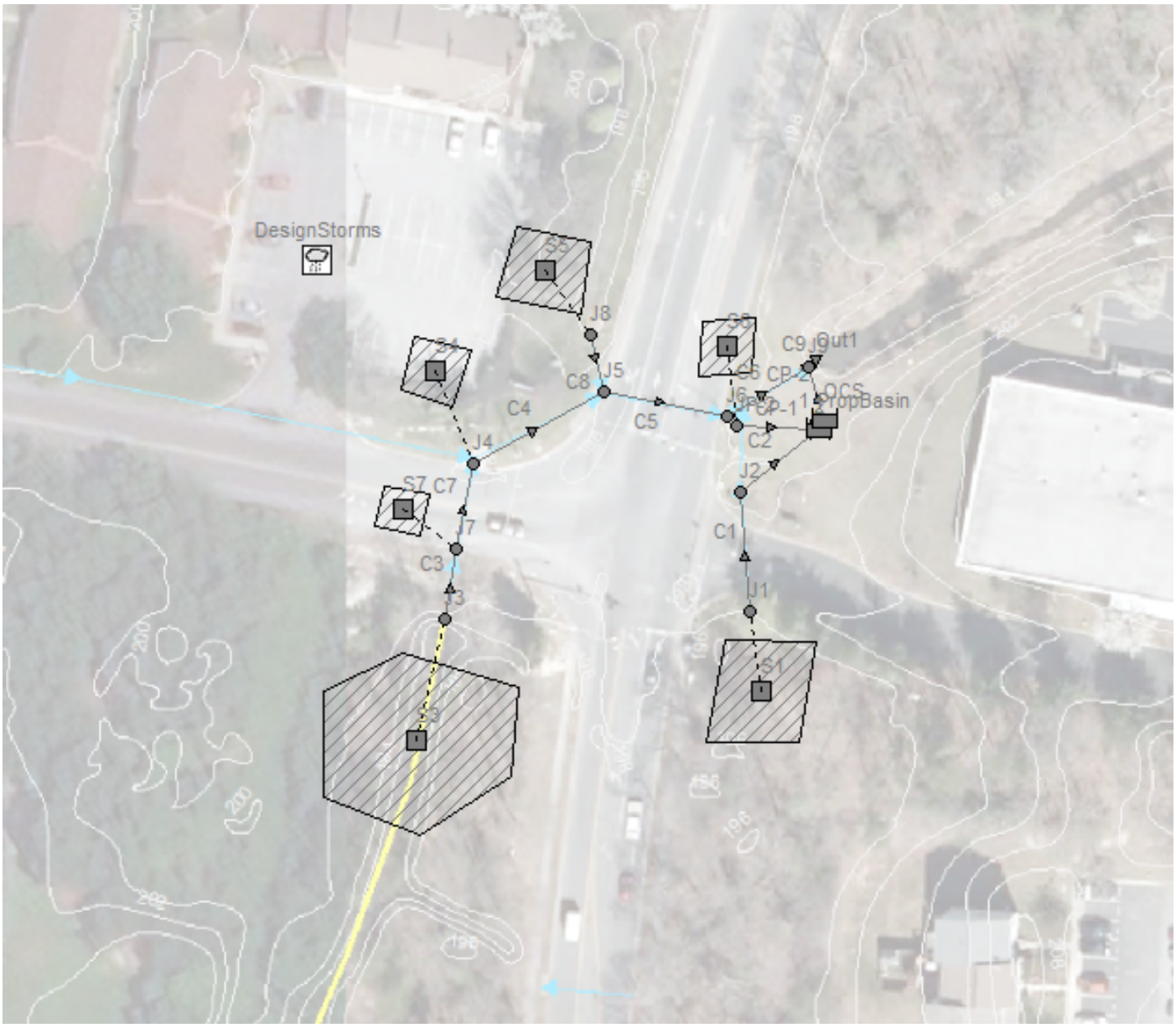
Conduit	Length	Dry	Dry	Dry	Crit	Crit	Crit	Crit	Ltd	Ctrl
C1	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.85	0.00
C3	1.00	0.00	0.01	0.00	0.99	0.00	0.00	0.00	0.00	0.00
C4	1.00	0.00	0.01	0.00	0.96	0.00	0.03	0.00	0.00	0.00
C5	1.00	0.00	0.00	0.00	0.27	0.68	0.00	0.04	0.00	0.00
C6	1.00	0.00	0.00	0.00	0.99	0.01	0.00	0.00	0.00	0.00
C2	1.00	0.05	0.00	0.00	0.95	0.00	0.00	0.00	0.77	0.00
C7	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.00	0.00
C8	1.00	0.00	0.00	0.00	0.98	0.01	0.00	0.01	0.83	0.00

****
Conduit Surcharge Summary
****

Conduit	Hours Full Both Ends	Hours Full Upstream	Hours Full Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
C1	1.50	1.50	2.00	0.01	0.01
C3	2.42	2.42	4.88	0.64	0.01
C4	0.01	0.01	2.55	0.01	0.01
C5	0.01	0.01	0.01	2.72	0.01
C6	0.01	0.01	0.01	4.38	0.01
C2	3.12	3.12	18.20	0.01	0.01
C7	1.64	2.46	1.64	2.65	1.64
C8	0.63	0.63	8.81	0.23	0.23

Analysis begun on: Wed Nov 30 11:15:36 2022
Analysis ended on: Wed Nov 30 11:15:37 2022
Total elapsed time: 00:00:01

Location 12: Proposed Industrial Drive and Post Office Road SWMM Schematic



```

    EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.0)
    --------------------------------------------------------------
```
Location 12: Location 12: Industrial Drive and Post Office Road SWMM Schematic (25-Year - PROPOSED)
```
    WARNING 03: negative offset ignored for Link C2
    WARNING 03: negative offset ignored for Link CP-1
    WARNING 04: minimum elevation drop used for Conduit C9
    WARNING 02: maximum depth increased for Node J9

    ****************
    Analysis Options
    ****************
    Flow Units ............... CFS
    Process Models:
      Rainfall/Runoff ........ YES
      RDII ................... NO
      Snowmelt ............... NO
      Groundwater ............ NO
      Flow Routing ........... YES
      Ponding Allowed ........ YES
      Water Quality .......... NO
    Infiltration Method ...... CURVE_NUMBER
    Flow Routing Method ...... DYNWAVE
    Surcharge Method ......... EXTRAN
    Starting Date ............ 01/01/2000 00:00:00
    Ending Date .............. 01/02/2000 00:00:00
    Antecedent Dry Days ...... 0.0
    Report Time Step ......... 00:15:00
    Wet Time Step ............ 00:05:00
    Dry Time Step ............ 01:00:00
    Routing Time Step ........ 20.00 sec
    Variable Time Step ....... YES
    Maximum Trials ........... 8
    Number of Threads ........ 1
    Head Tolerance ........... 0.005000 ft


    **************************        Volume         Depth
    Runoff Quantity Continuity     acre-feet        inches
    **************************     ---------       -------
    Total Precipitation ......       130.610         6.297
    Evaporation Loss .........         0.000         0.000
    Infiltration Loss ........        20.220         0.975
    Surface Runoff ...........       102.606         4.947
    Final Storage ............         7.976         0.385
    Continuity Error (%) .....        -0.147


    **************************        Volume        Volume
    Flow Routing Continuity        acre-feet      10^6 gal
    **************************     ---------     ---------
    Dry Weather Inflow .......         0.000         0.000
    Wet Weather Inflow .......       102.535        33.412
    Groundwater Inflow .......         0.000         0.000
    RDII Inflow ..............         0.000         0.000
    External Inflow ..........         0.000         0.000
    External Outflow .........        89.627        29.206
    Flooding Loss ............        11.670         3.803
    Evaporation Loss .........         0.000         0.000
    Exfiltration Loss ........         0.000         0.000
    Initial Stored Volume ....         0.000         0.000
    Final Stored Volume ......         0.046         0.015
    Continuity Error (%) .....         1.162


    *************************
    Highest Continuity Errors
    *************************
    Node JP-2 (4.16%)
```

```
Node J9 (1.39%)


***************************
Time-Step Critical Elements
***************************
Link C9 (99.98%)


********************************
Highest Flow Instability Indexes
********************************
Link C9 (51)
Link C6 (45)
Link C3 (16)
Link C7 (13)
Link CP-2 (7)


**********************************
Most Frequent Nonconverging Nodes
**********************************
Node Out1 (8.32%)
Node J9 (8.16%)
Node J6 (0.21%)
Node J5 (0.14%)
Node J4 (0.11%)


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.17 sec
Average Time Step           :     0.50 sec
Maximum Time Step           :    20.00 sec
% of Time in Steady State   :     0.00
Average Iterations per Step :     2.83
% of Steps Not Converging   :     8.32
Time Step Frequencies       :
   20.000 -  9.564 sec      :     0.01 %
    9.564 -  4.573 sec      :     0.00 %
    4.573 -  2.187 sec      :     0.00 %
    2.187 -  1.046 sec      :     0.00 %
    1.046 -  0.500 sec      :    99.98 %


***************************
Subcatchment Runoff Summary
***************************


-------------------------------------------------------------------------------------------
                          Total      Total      Total      Total     Imperv
                          Perv      Total       Total     Peak  Runoff
                         Precip      Runon       Evap      Infil     Runoff
                         Runoff     Runoff      Runoff   Runoff   Coeff
Subcatchment                in         in         in         in         in
in         in    10^6 gal      CFS

-------------------------------------------------------------------------------------------
S1                          6.30       0.00       0.00       2.10       0.27
3.77       4.04        0.20     6.24   0.641
S5                          6.30       0.00       0.00       1.04       3.04
2.11       5.15        0.94    37.99   0.818
S3                          6.30       0.00       0.00       1.02       2.81
2.05       4.86       27.87   616.53   0.772
S6                          6.30       0.00       0.00       0.02       5.87
```

```
0.34       6.21        0.07     3.20   0.986
S4                        6.30       0.00       0.00       0.60       3.83
1.70       5.54        4.33   144.08   0.879
S7                        6.30       0.00       0.00       0.12       5.24
0.89       6.13        0.03     1.70   0.973


******************
Node Depth Summary
******************

-------------------------------------------------------------------------------
                                Average  Maximum  Maximum  Time of Max    Reported
                                  Depth    Depth      HGL   Occurrence   Max Depth
Node                  Type         Feet     Feet     Feet  days hr:min        Feet
-------------------------------------------------------------------------------
J1                    JUNCTION     1.86     2.48   196.99     0  12:00        2.48
J2                    JUNCTION     1.92     2.50   196.95     0  07:47        2.50
J3                    JUNCTION     1.71     6.55   197.80     0  12:06        6.05
J4                    JUNCTION     1.53     5.00   196.17     0  11:52        5.00
J5                    JUNCTION     1.47     5.00   196.11     0  11:53        5.00
J6                    JUNCTION     1.42     5.00   196.05     0  11:56        4.24
J7                    JUNCTION     1.53     5.00   196.22     0  11:52        5.00
J8                    JUNCTION     0.24     2.99   197.38     0  12:05        2.75
JP-2                  JUNCTION     1.76     2.00   200.00     0  04:41        2.00
J9                    JUNCTION     1.35     4.01   195.01     0  12:01        3.85
Out1                  OUTFALL      1.31     3.75   194.75     0  11:50        3.75
PropBasin             STORAGE      0.00     0.00   200.00     0  00:00        0.00
OCS                   STORAGE      0.48     3.31   195.31     0  12:36        2.96


*******************
Node Inflow Summary
*******************


-------------------------------------------------------------------------------------
----------
                                Maximum  Maximum                  Lateral
                                Total        Flow
                                Lateral    Total  Time of Max      Inflow
                                Inflow     Balance
                                 Inflow   Inflow   Occurrence      Volume
                                 Volume       Error
Node                  Type          CFS      CFS  days hr:min    10^6 gal    10^6
gal     Percent

-------------------------------------------------------------------------------------
----------
J1                    JUNCTION      6.24     6.24     0  12:05       0.197
0.197       0.372
J2                    JUNCTION      0.00     6.25     0  12:05           0
0.196       0.743
J3                    JUNCTION    616.53   616.53     0  12:05        27.8
27.8       0.021
J4                    JUNCTION    144.08   339.66     0  12:13        4.33
28.9      -0.008
J5                    JUNCTION      0.00   360.24     0  12:01           0
29.7      -0.035
J6                    JUNCTION      0.00   367.68     0  12:01           0
29.6      -0.014
J7                    JUNCTION      1.70   570.72     0  12:06      0.0332
27.9      -0.013
J8                    JUNCTION     37.99    37.99     0  12:00       0.937
0.937      -0.031
JP-2                  JUNCTION      3.20     3.20     0  12:00      0.0674
0.0674       4.340
J9                    JUNCTION      0.00   389.03     0  12:02           0
29.6       1.413
```

```
Out1                 OUTFALL       0.00   430.05     0  12:01           0
29.2       0.000
PropBasin            STORAGE       0.00     0.00     0  00:00           0
0       0.000 gal
OCS                  STORAGE       0.00     4.02     0  12:51           0
0.0193       0.053


**********************
Node Surcharge Summary
**********************

Surcharging occurs when water rises above the top of the highest conduit.
-------------------------------------------------------------------------
                                              Max. Height   Min. Depth
                                   Hours      Above Crown    Below Rim
Node                 Type       Surcharged          Feet         Feet
-------------------------------------------------------------------------
J1                   JUNCTION       16.24         0.482        0.018
J2                   JUNCTION       16.26         0.500        0.000
J3                   JUNCTION        0.91         1.716        0.000
J4                   JUNCTION        0.51         0.167        0.000
J5                   JUNCTION        0.15         0.167        0.000
J6                   JUNCTION        0.01         0.167        0.000
J7                   JUNCTION        0.64         0.167        0.000
J8                   JUNCTION        0.32         0.994        0.000
JP-2                 JUNCTION       19.30         0.000        0.000


**********************
Node Flooding Summary
**********************

Flooding refers to all water that overflows a node, whether it ponds or not.
---------------------------------------------------------------------------
                                                          Total   Maximum
                                 Maximum   Time of Max     Flood    Ponded
                       Hours       Rate    Occurrence    Volume     Depth
Node                 Flooded        CFS   days hr:min   10^6 gal      Feet
---------------------------------------------------------------------------
J2                     16.21       6.25      0  12:05     0.195     0.000
J3                      0.47     111.15      0  12:00     0.346     0.799
J4                      0.34      89.64      0  12:25     0.136     0.000
J5                      0.10     110.44      0  12:12     0.073     0.000
J6                      0.01      72.02      0  12:02     0.006     0.000
J7                      0.62     397.94      0  12:05     3.327     0.000
J8                      0.30      11.89      0  12:00     0.023     0.494
JP-2                   19.30       3.20      0  12:00     0.065     0.000


**********************
Storage Volume Summary
**********************


-------------------------------------------------------------------------------------------
                        Average     Avg  Evap Exfil       Maximum     Max    Time of
                        Max    Maximum
                         Volume    Pcnt  Pcnt  Pcnt        Volume    Pcnt
                         Occurrence    Outflow
Storage Unit          1000 ft3    Full  Loss  Loss      1000 ft3    Full    days
hr:min        CFS

-------------------------------------------------------------------------------------------
PropBasin                0.000       0     0     0         0.000       0       0
00:00       0.00
OCS                      0.008       5     0     0         0.053      33       0
```

12:36 4.59

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
Out1	99.93	45.44	430.05	29.204
System	99.93	45.44	430.05	29.204

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
C1	CONDUIT	6.25	0 12:05	1.99	0.81	1.00
C3	CONDUIT	569.79	0 12:06	19.32	3.74	1.00
C4	CONDUIT	340.76	0 12:13	11.64	2.42	1.00
C5	CONDUIT	367.68	0 12:01	12.90	2.42	1.00
C6	CONDUIT	388.81	0 12:02	14.58	2.49	0.91
C2	CONDUIT	0.00	0 00:00	0.00	0.00	0.50
C7	CONDUIT	288.18	0 12:22	9.78	1.85	1.00
C8	CONDUIT	35.10	0 12:05	11.17	0.83	1.00
CP-1	CONDUIT	0.00	0 00:00	0.00	0.00	0.50
CP-2	CONDUIT	4.59	0 12:50	2.60	0.28	1.00
C9	CONDUIT	430.05	0 12:01	17.17	2.87	0.80
1	WEIR	0.00	0 00:00			0.00
2	WEIR	0.00	0 00:00			0.00

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
C1	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.02	0.00
C3	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.38
C4	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
C5	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
C6	1.00	0.00	0.00	0.00	0.98	0.02	0.00	0.00	0.00	0.00
C2	1.00	0.01	0.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C7	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.03	0.00
C8	1.00	0.00	0.00	0.00	0.87	0.04	0.00	0.09	0.88	0.00
CP-1	1.00	0.00	0.19	0.00	0.80	0.00	0.00	0.00	0.00	0.00
CP-2	1.00	0.00	0.35	0.00	0.64	0.00	0.00	0.00	0.00	0.00
C9	1.00	0.00	0.00	0.00	0.34	0.65	0.00	0.00	0.40	0.00

****
Conduit Surcharge Summary
****

Conduit	Hours Full Both Ends	Hours Full Upstream	Hours Full Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
C1	16.24	16.24	16.26	0.01	0.01
C3	0.63	0.91	0.64	1.25	0.63
C4	0.14	0.51	0.14	1.64	0.04
C5	0.01	0.14	0.01	1.52	0.01
C6	0.01	0.01	0.01	1.48	0.01
C7	0.51	0.64	0.51	1.20	0.17
C8	0.32	0.32	2.36	0.01	0.01
CP-1	0.01	0.01	19.30	0.01	0.01
CP-2	2.04	2.04	7.82	0.01	0.01
C9	0.01	0.01	0.01	1.54	0.01

Analysis begun on: Wed Nov 30 11:02:20 2022
Analysis ended on: Wed Nov 30 11:02:22 2022
Total elapsed time: 00:00:02

```

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.0)
--------------------------------------------------------------
```
Location 12: Location 12: Industrial Drive and Post Office Road SWMM Schematic (25-Year (2050) - PROPOSED)
```
WARNING 03: negative offset ignored for Link C2
WARNING 03: negative offset ignored for Link CP-1
WARNING 04: minimum elevation drop used for Conduit C9
WARNING 02: maximum depth increased for Node J9

**********
Analysis Options
**********
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Surcharge Method ......... EXTRAN
Starting Date ............ 01/01/2000 00:00:00
Ending Date .............. 01/02/2000 00:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 01:00:00
Routing Time Step ........ 20.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 8
Number of Threads ........ 1
Head Tolerance ........... 0.005000 ft


| ********** | Volume | Depth |
|---|---|---|
| Runoff Quantity Continuity | acre-feet | inches |
| ********** | --- | --- |
| Total Precipitation ..... | 146.436 | 7.060 |
| Evaporation Loss ..... | 0.000 | 0.000 |
| Infiltration Loss ..... | 20.887 | 1.007 |
| Surface Runoff ..... | 117.361 | 5.658 |
| Final Storage ..... | 8.408 | 0.405 |
| Continuity Error (%) ..... | -0.150 | |


| ********** | Volume | Volume |
|---|---|---|
| Flow Routing Continuity | acre-feet | 10^6 gal |
| ********** | --- | --- |
| Dry Weather Inflow ..... | 0.000 | 0.000 |
| Wet Weather Inflow ..... | 117.283 | 38.218 |
| Groundwater Inflow ..... | 0.000 | 0.000 |
| RDII Inflow ..... | 0.000 | 0.000 |
| External Inflow ..... | 0.000 | 0.000 |
| External Outflow ..... | 99.793 | 32.519 |
| Flooding Loss ..... | 16.171 | 5.270 |
| Evaporation Loss ..... | 0.000 | 0.000 |
| Exfiltration Loss ..... | 0.000 | 0.000 |
| Initial Stored Volume .... | 0.000 | 0.000 |
| Final Stored Volume ..... | 0.048 | 0.016 |
| Continuity Error (%) ..... | 1.084 | |


**********
Highest Continuity Errors
**********
Node JP-2 (3.70%)
```

```
Node J9 (1.35%)


**************************
Time-Step Critical Elements
**************************
Link C9 (99.98%)


********************************
Highest Flow Instability Indexes
********************************
Link C9 (56)
Link C6 (49)
Link C3 (18)
Link C7 (15)
Link CP-2 (8)


*********************************
Most Frequent Nonconverging Nodes
*********************************
Node Out1 (9.67%)
Node J9 (9.48%)
Node J6 (0.24%)
Node J5 (0.15%)
Node J4 (0.11%)


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.47 sec
Average Time Step           :     0.50 sec
Maximum Time Step           :    20.00 sec
% of Time in Steady State   :     0.00
Average Iterations per Step :     2.95
% of Steps Not Converging   :     9.67
Time Step Frequencies       :
   20.000 -  9.564 sec      :     0.01 %
    9.564 -  4.573 sec      :     0.00 %
    4.573 -  2.187 sec      :     0.00 %
    2.187 -  1.046 sec      :     0.00 %
    1.046 -  0.500 sec      :    99.98 %


***************************
Subcatchment Runoff Summary
***************************


--------------------------------------------------------------------------------------------------------------------------------------
                         Total      Total      Total      Total     Imperv
                         Perv      Total       Total     Peak  Runoff
                        Precip      Runon       Evap      Infil     Runoff
                        Runoff     Runoff      Runoff   Runoff   Coeff
Subcatchment               in         in         in         in         in
in          in    10^6 gal      CFS
--------------------------------------------------------------------------------------------------------------------------------------
S1                          7.06       0.00       0.00       2.19       0.30
4.41       4.71        0.23     7.54   0.667
S5                          7.06       0.00       0.00       1.07       3.42
2.46       5.87        1.07    43.86   0.832
S3                          7.06       0.00       0.00       1.05       3.16
2.41       5.57       31.92   716.83   0.789
S6                          7.06       0.00       0.00       0.02       6.59
```

```
0.39       6.97        0.08     3.63   0.988
S4                        7.06       0.00       0.00       0.62       4.30
1.97       6.28        4.91   166.78   0.889
S7                        7.06       0.00       0.00       0.13       5.88
1.01       6.89        0.04     1.91   0.976


******************
Node Depth Summary
******************

-------------------------------------------------------------------------------
                                Average  Maximum  Maximum  Time of Max    Reported
                                  Depth    Depth      HGL   Occurrence   Max Depth
Node                  Type         Feet     Feet     Feet  days hr:min        Feet
-------------------------------------------------------------------------------
J1                    JUNCTION     1.91     2.50   197.01     0  12:05        2.50
J2                    JUNCTION     1.96     2.50   196.95     0  07:12        2.50
J3                    JUNCTION     1.83     7.03   198.28     0  12:06        6.35
J4                    JUNCTION     1.62     5.00   196.17     0  11:49        5.00
J5                    JUNCTION     1.56     5.00   196.11     0  11:51        5.00
J6                    JUNCTION     1.50     5.00   196.05     0  11:52        4.41
J7                    JUNCTION     1.62     5.00   196.22     0  11:49        5.00
J8                    JUNCTION     0.26     3.34   197.73     0  12:05        2.96
JP-2                  JUNCTION     1.78     2.00   200.00     0  04:18        2.00
J9                    JUNCTION     1.44     4.02   195.02     0  12:02        3.98
Out1                  OUTFALL      1.39     3.75   194.75     0  11:48        3.74
PropBasin             STORAGE      0.00     0.00   200.00     0  00:00        0.00
OCS                   STORAGE      0.55     3.32   195.32     0  12:42        2.82


*******************
Node Inflow Summary
*******************


-------------------------------------------------------------------------------
----------
                                Maximum  Maximum                  Lateral
                                Total        Flow
                                Lateral    Total  Time of Max      Inflow
                                Inflow     Balance
                                 Inflow   Inflow   Occurrence      Volume
                                 Volume       Error
Node                  Type          CFS      CFS  days hr:min    10^6 gal    10^6
gal     Percent

-------------------------------------------------------------------------------
----------
J1                    JUNCTION      7.54     7.54     0  12:05        0.23
0.23       0.300
J2                    JUNCTION      0.00     7.58     0  12:05           0
0.229       0.635
J3                    JUNCTION    716.83   716.83     0  12:05        31.9
31.9       0.016
J4                    JUNCTION    166.78   340.03     0  12:15        4.91
32.2      -0.007
J5                    JUNCTION      0.00   359.49     0  12:02           0
33      -0.042
J6                    JUNCTION      0.00   364.47     0  12:05           0
33      -0.014
J7                    JUNCTION      1.91   652.52     0  12:07      0.0374
31.9      -0.010
J8                    JUNCTION     43.86    43.86     0  12:00        1.07
1.07      -0.031
JP-2                  JUNCTION      3.63     3.63     0  12:00      0.0757
0.0757       3.847
J9                    JUNCTION      0.00   382.23     0  12:05           0
33       1.365
```

```
Out1                 OUTFALL       0.00   443.30     0  12:02           0
32.5       0.000
PropBasin            STORAGE       0.00     0.00     0  00:00           0
0       0.000 gal
OCS                  STORAGE       0.00     3.91     0  13:04           0
0.0253       0.000


**********************
Node Surcharge Summary
**********************

Surcharging occurs when water rises above the top of the highest conduit.
-------------------------------------------------------------------------
                                              Max. Height   Min. Depth
                                   Hours      Above Crown    Below Rim
Node                 Type       Surcharged          Feet         Feet
-------------------------------------------------------------------------
J1                   JUNCTION       16.82         0.500        0.000
J2                   JUNCTION       16.84         0.500        0.000
J3                   JUNCTION        1.11         2.201        0.000
J4                   JUNCTION        0.63         0.167        0.000
J5                   JUNCTION        0.19         0.167        0.000
J6                   JUNCTION        0.02         0.167        0.000
J7                   JUNCTION        0.79         0.167        0.000
J8                   JUNCTION        0.40         1.341        0.000
JP-2                 JUNCTION       19.70         0.000        0.000


**********************
Node Flooding Summary
**********************

Flooding refers to all water that overflows a node, whether it ponds or not.
---------------------------------------------------------------------------
                                                          Total   Maximum
                                 Maximum   Time of Max     Flood    Ponded
                       Hours       Rate    Occurrence    Volume     Depth
Node                 Flooded        CFS   days hr:min   10^6 gal      Feet
---------------------------------------------------------------------------
J1                      0.01       0.03      0  12:05     0.000     0.000
J2                     16.79       7.58      0  12:05     0.228     0.000
J3                      0.58     155.37      0  12:00     0.539     1.284
J4                      0.44      59.57      0  11:49     0.184     0.000
J5                      0.14     112.21      0  12:14     0.093     0.000
J6                      0.01      84.62      0  12:14     0.009     0.000
J7                      0.76     487.72      0  12:05     4.682     0.000
J8                      0.38      15.30      0  12:00     0.038     0.841
JP-2                   19.70       3.63      0  12:00     0.073     0.000


**********************
Storage Volume Summary
**********************


-------------------------------------------------------------------------------------
-----------
                        Average     Avg  Evap Exfil       Maximum     Max    Time of
                        Max    Maximum
                         Volume    Pcnt  Pcnt  Pcnt        Volume    Pcnt
                         Occurrence    Outflow
Storage Unit          1000 ft3    Full  Loss  Loss      1000 ft3    Full    days
hr:min        CFS

-------------------------------------------------------------------------------------
-----------
PropBasin                0.000       0     0     0         0.000       0       0
00:00       0.00
```

```
OCS                      0.009       5     0     0         0.053      33       0
12:42       4.74


************************
Outfall Loading Summary
************************

----------------------------------------------------------
                      Flow       Avg       Max       Total
                      Freq      Flow      Flow      Volume
Outfall Node          Pcnt       CFS       CFS    10^6 gal
----------------------------------------------------------
Out1                 99.94     50.59    443.30      32.517
----------------------------------------------------------
System               99.94     50.59    443.30      32.517



********************
Link Flow Summary
********************

-------------------------------------------------------------------------------
                                Maximum  Time of Max   Maximum    Max/    Max/
                                 |Flow|   Occurrence   |Veloc|    Full    Full
Link                 Type          CFS  days hr:min    ft/sec    Flow   Depth
-------------------------------------------------------------------------------
C1                   CONDUIT      7.58     0  12:05      2.41    0.98    1.00
C3                   CONDUIT    651.53     0  12:07     22.09    4.28    1.00
C4                   CONDUIT    342.37     0  12:24     11.67    2.43    1.00
C5                   CONDUIT    364.47     0  12:05     12.82    2.39    1.00
C6                   CONDUIT    381.35     0  12:05     14.26    2.44    0.91
C2                   CONDUIT      0.00     0  00:00      0.00    0.00    0.50
C7                   CONDUIT    292.55     0  12:28      9.93    1.87    1.00
C8                   CONDUIT     37.83     0  12:05     12.04    0.89    1.00
CP-1                 CONDUIT      0.00     0  00:00      0.00    0.00    0.50
CP-2                 CONDUIT      4.74     0  13:04      2.68    0.29    1.00
C9                   CONDUIT    443.30     0  12:02     17.41    2.96    0.80
1                    WEIR         0.00     0  00:00                      0.00
2                    WEIR         0.00     0  00:00                      0.00


***************************
Flow Classification Summary
***************************

-----------------------------------------------------------------------------------------
                    Adjusted    ---------- Fraction of Time in Flow Class ----------
                     /Actual         Up    Down  Sub   Sup   Up    Down  Norm  Inlet
Conduit               Length    Dry  Dry   Dry   Crit  Crit  Crit  Crit  Ltd   Ctrl
-----------------------------------------------------------------------------------------
C1                      1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.01  0.00
C3                      1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00  0.43
C4                      1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00  0.00
C5                      1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00  0.00
C6                      1.00   0.00  0.00  0.00  0.98  0.02  0.00  0.00  0.00  0.00
C2                      1.00   0.01  0.99  0.00  0.00  0.00  0.00  0.00  0.00  0.00
C7                      1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.02  0.00
C8                      1.00   0.00  0.00  0.00  0.89  0.03  0.00  0.08  0.88  0.00
CP-1                    1.00   0.00  0.17  0.00  0.82  0.00  0.00  0.00  0.00  0.00
CP-2                    1.00   0.00  0.32  0.00  0.67  0.00  0.00  0.00  0.00  0.00
C9                      1.00   0.00  0.00  0.00  0.38  0.62  0.00  0.00  0.40  0.00


*************************
Conduit Surcharge Summary
*************************
```

Conduit	Hours Full Both Ends	Hours Full Upstream	Hours Full Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
C1	16.82	16.82	16.84	0.01	0.02
C3	0.79	1.11	0.79	1.51	0.78
C4	0.19	0.63	0.19	1.95	0.05
C5	0.01	0.19	0.02	1.82	0.01
C6	0.01	0.02	0.01	1.77	0.01
C7	0.63	0.79	0.63	1.46	0.19
C8	0.40	0.40	2.86	0.01	0.01
CP-1	0.01	0.01	19.70	0.01	0.01
CP-2	2.43	2.43	8.86	0.01	0.01
C9	0.01	0.01	0.01	1.83	0.01

Analysis begun on: Wed Nov 30 11:02:51 2022
Analysis ended on: Wed Nov 30 11:02:52 2022
Total elapsed time: 00:00:01

```

    EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.0)
    --------------------------------------------------------------
```
Location 12: Location 12: Industrial Drive and Post Office Road SWMM Schematic (25-Year (2100) - PROPOSED)
```
    WARNING 03: negative offset ignored for Link C2
    WARNING 03: negative offset ignored for Link CP-1
    WARNING 04: minimum elevation drop used for Conduit C9
    WARNING 02: maximum depth increased for Node J9

    ****************
    Analysis Options
    ****************
    Flow Units ............... CFS
    Process Models:
      Rainfall/Runoff ........ YES
      RDII ................... NO
      Snowmelt ............... NO
      Groundwater ............ NO
      Flow Routing ........... YES
      Ponding Allowed ........ YES
      Water Quality .......... NO
    Infiltration Method ...... CURVE_NUMBER
    Flow Routing Method ...... DYNWAVE
    Surcharge Method ......... EXTRAN
    Starting Date ............ 01/01/2000 00:00:00
    Ending Date .............. 01/02/2000 00:00:00
    Antecedent Dry Days ...... 0.0
    Report Time Step ......... 00:15:00
    Wet Time Step ............ 00:05:00
    Dry Time Step ............ 01:00:00
    Routing Time Step ........ 20.00 sec
    Variable Time Step ....... YES
    Maximum Trials ........... 8
    Number of Threads ........ 1
    Head Tolerance ........... 0.005000 ft


    **************************        Volume         Depth
    Runoff Quantity Continuity     acre-feet        inches
    **************************     ---------       -------
    Total Precipitation ......       156.205         7.531
    Evaporation Loss .........         0.000         0.000
    Infiltration Loss ........        21.248         1.024
    Surface Runoff ...........       126.355         6.092
    Final Storage ............         8.843         0.426
    Continuity Error (%) .....        -0.154


    **************************        Volume        Volume
    Flow Routing Continuity        acre-feet      10^6 gal
    **************************     ---------     ---------
    Dry Weather Inflow .......         0.000         0.000
    Wet Weather Inflow .......       126.268        41.146
    Groundwater Inflow .......         0.000         0.000
    RDII Inflow ..............         0.000         0.000
    External Inflow ..........         0.000         0.000
    External Outflow .........       105.847        34.492
    Flooding Loss ............        19.050         6.208
    Evaporation Loss .........         0.000         0.000
    Exfiltration Loss ........         0.000         0.000
    Initial Stored Volume ....         0.000         0.000
    Final Stored Volume ......         0.050         0.016
    Continuity Error (%) .....         1.046


    *************************
    Highest Continuity Errors
    *************************
    Node JP-2 (3.47%)
```

```
Node J9 (1.32%)


***************************
Time-Step Critical Elements
***************************
Link C9 (99.98%)


********************************
Highest Flow Instability Indexes
********************************
Link C9 (62)
Link C6 (54)
Link C3 (16)
Link C7 (14)
Link CP-2 (8)


**********************************
Most Frequent Nonconverging Nodes
**********************************
Node Out1 (10.45%)
Node J9 (10.24%)
Node J6 (0.29%)
Node J5 (0.20%)
Node J4 (0.11%)


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.47 sec
Average Time Step           :     0.50 sec
Maximum Time Step           :    20.00 sec
% of Time in Steady State   :     0.00
Average Iterations per Step :     3.03
% of Steps Not Converging   :    10.45
Time Step Frequencies       :
   20.000 -  9.564 sec      :     0.01 %
    9.564 -  4.573 sec      :     0.00 %
    4.573 -  2.187 sec      :     0.00 %
    2.187 -  1.046 sec      :     0.00 %
    1.046 -  0.500 sec      :    99.98 %


***************************
Subcatchment Runoff Summary
***************************


-----------------------------------------------------------------------------------------------------------------------------------------
                          Total      Total      Total      Total     Imperv
                          Perv      Total       Total     Peak  Runoff
                         Precip      Runon       Evap      Infil     Runoff
                         Runoff     Runoff      Runoff   Runoff   Coeff
Subcatchment                in         in         in         in         in
in         in    10^6 gal      CFS
-----------------------------------------------------------------------------------------------------------------------------------------
S1                          7.53       0.00       0.00       2.23       0.32
4.80       5.13        0.25     8.32   0.681
S5                          7.53       0.00       0.00       1.09       3.65
2.67       6.32        1.15    47.35   0.839
S3                          7.53       0.00       0.00       1.07       3.37
2.63       6.00       34.39   776.48   0.797
S6                          7.53       0.00       0.00       0.02       7.03
```

```
0.42       7.44        0.08     3.87   0.988
S4                         7.53       0.00       0.00       0.63       4.59
2.14       6.73        5.26   180.25   0.894
S7                         7.53       0.00       0.00       0.13       6.27
1.09       7.36        0.04     2.04   0.977


******************
Node Depth Summary
******************

-------------------------------------------------------------------------------
                                Average  Maximum  Maximum  Time of Max    Reported
                                  Depth    Depth      HGL   Occurrence   Max Depth
Node                  Type         Feet     Feet     Feet  days hr:min        Feet
-------------------------------------------------------------------------------
J1                    JUNCTION     1.93     2.51   197.02     0  12:05        2.50
J2                    JUNCTION     1.99     2.50   196.95     0  06:56        2.50
J3                    JUNCTION     1.90     7.35   198.60     0  12:07        6.61
J4                    JUNCTION     1.67     5.00   196.17     0  11:47        5.00
J5                    JUNCTION     1.61     5.00   196.11     0  11:50        4.80
J6                    JUNCTION     1.55     5.00   196.05     0  11:51        4.42
J7                    JUNCTION     1.68     5.00   196.22     0  11:47        5.00
J8                    JUNCTION     0.27     3.56   197.95     0  12:05        3.10
JP-2                  JUNCTION     1.80     2.00   200.00     0  04:05        2.00
J9                    JUNCTION     1.49     4.01   195.01     0  11:58        3.89
Out1                  OUTFALL      1.43     3.75   194.75     0  11:47        3.75
PropBasin             STORAGE      0.00     0.00   200.00     0  00:00        0.00
OCS                   STORAGE      0.59     3.16   195.16     0  12:36        2.91


*******************
Node Inflow Summary
*******************


-------------------------------------------------------------------------------
----------
                                Maximum  Maximum                  Lateral
                                Total        Flow
                                Lateral    Total  Time of Max      Inflow
                                Inflow     Balance
                                 Inflow   Inflow   Occurrence      Volume
                                 Volume       Error
Node                  Type          CFS      CFS  days hr:min    10^6 gal    10^6
gal     Percent

-------------------------------------------------------------------------------
----------
J1                    JUNCTION      8.32     8.32     0  12:05        0.25
0.25       0.278
J2                    JUNCTION      0.00     8.13     0  12:05           0
0.25       0.583
J3                    JUNCTION    776.48   776.48     0  12:05        34.4
34.4       0.015
J4                    JUNCTION    180.25   341.44     0  12:26        5.26
34.1      -0.005
J5                    JUNCTION      0.00   365.23     0  12:00           0
35      -0.044
J6                    JUNCTION      0.00   369.45     0  12:00           0
35      -0.013
J7                    JUNCTION      2.04   700.43     0  12:07      0.0399
34.4      -0.008
J8                    JUNCTION     47.35    47.35     0  12:00        1.15
1.15      -0.024
JP-2                  JUNCTION      3.87     3.87     0  12:00      0.0808
0.0808       3.596
J9                    JUNCTION      0.00   389.64     0  12:00           0
35       1.337
```

```
Out1                 OUTFALL       0.00   428.49     0  12:00           0
34.5       0.000
PropBasin            STORAGE       0.00     0.00     0  00:00           0
0       0.000 gal
OCS                  STORAGE       0.00     3.89     0  13:05           0
0.0251       0.088


**********************
Node Surcharge Summary
**********************

Surcharging occurs when water rises above the top of the highest conduit.
-------------------------------------------------------------------------
                                              Max. Height   Min. Depth
                                   Hours      Above Crown    Below Rim
Node                 Type       Surcharged          Feet         Feet
-------------------------------------------------------------------------
J1                   JUNCTION       17.09         0.506        0.000
J2                   JUNCTION       17.11         0.500        0.000
J3                   JUNCTION        1.24         2.516        0.000
J4                   JUNCTION        0.69         0.167        0.000
J5                   JUNCTION        0.23         0.167        0.000
J6                   JUNCTION        0.02         0.167        0.000
J7                   JUNCTION        0.84         0.167        0.000
J8                   JUNCTION        0.44         1.562        0.000
JP-2                 JUNCTION       19.90         0.000        0.000


**********************
Node Flooding Summary
**********************

Flooding refers to all water that overflows a node, whether it ponds or not.
---------------------------------------------------------------------------
                                                          Total   Maximum
                                Maximum   Time of Max      Flood    Ponded
                       Hours       Rate    Occurrence     Volume     Depth
Node                 Flooded        CFS   days hr:min   10^6 gal      Feet
---------------------------------------------------------------------------
J1                      0.16       0.48      0  12:07      0.000     0.006
J2                     17.06       8.13      0  12:05      0.248     0.000
J3                      0.67     181.06      0  12:00      0.666     1.599
J4                      0.50      76.20      0  12:01      0.235     0.000
J5                      0.16     115.86      0  12:02      0.100     0.000
J6                      0.01     106.35      0  11:54      0.012     0.000
J7                      0.83     543.53      0  12:06      5.535     0.000
J8                      0.41      16.43      0  11:59      0.048     1.062
JP-2                   19.90       3.87      0  12:00      0.078     0.000


**********************
Storage Volume Summary
**********************


-------------------------------------------------------------------------------------
-----------
                        Average     Avg  Evap Exfil       Maximum     Max    Time of
                        Max    Maximum
                         Volume    Pcnt  Pcnt  Pcnt        Volume    Pcnt
                         Occurrence    Outflow
Storage Unit          1000 ft3    Full  Loss  Loss      1000 ft3    Full    days
hr:min        CFS

-------------------------------------------------------------------------------------
-----------
PropBasin                0.000       0     0     0         0.000       0       0
00:00       0.00
```

```
OCS                      0.009       6     0     0         0.051      32       0
12:36       4.75


************************
Outfall Loading Summary
************************

----------------------------------------------------------
                      Flow       Avg       Max       Total
                      Freq      Flow      Flow      Volume
Outfall Node          Pcnt       CFS       CFS    10^6 gal
----------------------------------------------------------
Out1                 99.94     53.66    428.49      34.489
----------------------------------------------------------
System               99.94     53.66    428.49      34.489



********************
Link Flow Summary
********************

--------------------------------------------------------------------------------
                                Maximum  Time of Max   Maximum    Max/    Max/
                                 |Flow|   Occurrence   |Veloc|    Full    Full
Link                 Type          CFS  days hr:min    ft/sec    Flow   Depth
--------------------------------------------------------------------------------
C1                   CONDUIT      8.13     0  12:05      2.59    1.05    1.00
C3                   CONDUIT    699.40     0  12:07     23.71    4.59    1.00
C4                   CONDUIT    339.87     0  12:24     11.60    2.42    1.00
C5                   CONDUIT    369.45     0  12:00     12.85    2.43    1.00
C6                   CONDUIT    389.51     0  12:00     14.61    2.50    0.91
C2                   CONDUIT      0.00     0  00:00      0.00    0.00    0.50
C7                   CONDUIT    291.68     0  12:31      9.89    1.87    1.00
C8                   CONDUIT     39.66     0  12:07     12.62    0.94    1.00
CP-1                 CONDUIT      0.00     0  00:00      0.00    0.00    0.50
CP-2                 CONDUIT      4.75     0  13:05      2.69    0.29    1.00
C9                   CONDUIT    428.49     0  12:00     17.11    2.86    0.80
1                    WEIR         0.00     0  00:00                      0.00
2                    WEIR         0.00     0  00:00                      0.00


***************************
Flow Classification Summary
***************************

------------------------------------------------------------------------------------
                    Adjusted    ---------- Fraction of Time in Flow Class ----------
                     /Actual         Up    Down  Sub   Sup   Up    Down  Norm  Inlet
Conduit               Length    Dry  Dry   Dry   Crit  Crit  Crit  Crit  Ltd   Ctrl
------------------------------------------------------------------------------------
C1                      1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.01  0.00
C3                      1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00  0.44
C4                      1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00  0.00
C5                      1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00  0.00
C6                      1.00   0.00  0.00  0.00  0.97  0.02  0.00  0.00  0.00  0.00
C2                      1.00   0.01  0.99  0.00  0.00  0.00  0.00  0.00  0.00  0.00
C7                      1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.02  0.00
C8                      1.00   0.00  0.00  0.00  0.90  0.03  0.00  0.07  0.88  0.00
CP-1                    1.00   0.00  0.17  0.00  0.83  0.00  0.00  0.00  0.00  0.00
CP-2                    1.00   0.00  0.30  0.00  0.69  0.00  0.00  0.00  0.00  0.00
C9                      1.00   0.00  0.00  0.00  0.39  0.61  0.00  0.00  0.40  0.00


*************************
Conduit Surcharge Summary
*************************
```

Conduit	Hours Full: Both Ends	Hours Full: Upstream	Hours Full: Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
C1	17.09	17.09	17.11	0.12	0.17
C3	0.84	1.24	0.84	1.68	0.84
C4	0.23	0.69	0.23	2.13	0.07
C5	0.02	0.23	0.02	1.98	0.01
C6	0.01	0.02	0.01	1.92	0.01
C7	0.69	0.84	0.69	1.62	0.19
C8	0.44	0.44	3.09	0.01	0.01
CP-1	0.01	0.01	19.90	0.01	0.01
CP-2	2.62	2.62	9.47	0.01	0.01
C9	0.01	0.01	0.01	2.01	0.01

Analysis begun on: Wed Nov 30 11:03:17 2022
Analysis ended on: Wed Nov 30 11:03:19 2022
Total elapsed time: 00:00:02

```

  EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.0)
  --------------------------------------------------------------
```
Location 12: Location 12: Industrial Drive and Post Office Road SWMM Schematic (100-Year - PROPSED)
```

  WARNING 03: negative offset ignored for Link C2
  WARNING 03: negative offset ignored for Link CP-1
  WARNING 04: minimum elevation drop used for Conduit C9
  WARNING 02: maximum depth increased for Node J9

  ****************
  Analysis Options
  ****************
  Flow Units ............... CFS
  Process Models:
    Rainfall/Runoff ........ YES
    RDII ................... NO
    Snowmelt ............... NO
    Groundwater ............ NO
    Flow Routing ........... YES
    Ponding Allowed ........ YES
    Water Quality .......... NO
  Infiltration Method ...... CURVE_NUMBER
  Flow Routing Method ...... DYNWAVE
  Surcharge Method ......... EXTRAN
  Starting Date ............ 01/01/2000 00:00:00
  Ending Date .............. 01/02/2000 00:00:00
  Antecedent Dry Days ...... 0.0
  Report Time Step ......... 00:15:00
  Wet Time Step ............ 00:05:00
  Dry Time Step ............ 01:00:00
  Routing Time Step ........ 20.00 sec
  Variable Time Step ....... YES
  Maximum Trials ........... 8
  Number of Threads ........ 1
  Head Tolerance ........... 0.005000 ft


  **************************        Volume         Depth
  Runoff Quantity Continuity     acre-feet        inches
  **************************     ---------       -------
  Total Precipitation ......       180.660         8.710
  Evaporation Loss .........         0.000         0.000
  Infiltration Loss ........        22.022         1.062
  Surface Runoff ...........       149.464         7.206
  Final Storage ............         9.462         0.456
  Continuity Error (%) .....        -0.160


  **************************        Volume        Volume
  Flow Routing Continuity        acre-feet      10^6 gal
  **************************     ---------     ---------
  Dry Weather Inflow .......         0.000         0.000
  Wet Weather Inflow .......       149.365        48.673
  Groundwater Inflow .......         0.000         0.000
  RDII Inflow ..............         0.000         0.000
  External Inflow ..........         0.000         0.000
  External Outflow .........       120.434        39.245
  Flooding Loss ............        27.599         8.993
  Evaporation Loss .........         0.000         0.000
  Exfiltration Loss ........         0.000         0.000
  Initial Stored Volume ....         0.000         0.000
  Final Stored Volume ......         0.053         0.017
  Continuity Error (%) .....         0.856


  *************************
  Highest Continuity Errors
  *************************
  Node JP-2 (3.00%)
```

```
Node J9 (1.14%)


***************************
Time-Step Critical Elements
***************************
Link C9 (99.98%)


********************************
Highest Flow Instability Indexes
********************************
Link C9 (76)
Link C6 (69)
Link C3 (19)
Link C7 (17)
Link CP-2 (11)


*********************************
Most Frequent Nonconverging Nodes
*********************************
Node Out1 (12.31%)
Node J9 (12.06%)
Node J6 (0.34%)
Node J5 (0.23%)
Node J4 (0.15%)


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.13 sec
Average Time Step           :     0.50 sec
Maximum Time Step           :    20.00 sec
% of Time in Steady State   :     0.00
Average Iterations per Step :     3.22
% of Steps Not Converging   :    12.31
Time Step Frequencies       :
   20.000 -  9.564 sec      :     0.01 %
    9.564 -  4.573 sec      :     0.00 %
    4.573 -  2.187 sec      :     0.00 %
    2.187 -  1.046 sec      :     0.00 %
    1.046 -  0.500 sec      :    99.98 %


***************************
Subcatchment Runoff Summary
***************************


---------------------------------------------------------------------------------------
---------------------------------------
                          Total      Total      Total      Total     Imperv
                          Perv      Total       Total     Peak  Runoff
                         Precip      Runon       Evap      Infil     Runoff
                         Runoff     Runoff      Runoff   Runoff   Coeff
Subcatchment                 in         in         in         in         in
in         in    10^6 gal      CFS
---------------------------------------------------------------------------------------
---------------------------------------
S1                           8.71       0.00       0.00       2.33       0.37
5.82       6.20        0.30    10.47   0.712
S5                           8.71       0.00       0.00       1.14       4.22
3.23       7.45        1.36    56.90   0.855
S3                           8.71       0.00       0.00       1.11       3.90
3.21       7.11       40.74   941.46   0.816
S6                           8.71       0.00       0.00       0.02       8.14
```

```
0.49       8.62        0.09     4.53   0.990
S4                         8.71       0.00       0.00       0.64       5.32
2.56       7.88        6.16   217.11   0.905
S7                         8.71       0.00       0.00       0.13       7.26
1.28       8.53        0.05     2.38   0.980


******************
Node Depth Summary
******************

-------------------------------------------------------------------------------
                                Average  Maximum  Maximum  Time of Max    Reported
                                  Depth    Depth      HGL   Occurrence   Max Depth
Node                  Type         Feet     Feet     Feet  days hr:min        Feet
-------------------------------------------------------------------------------
J1                    JUNCTION     1.98     2.54   197.05     0  12:05        2.52
J2                    JUNCTION     2.04     2.50   196.95     0  06:15        2.50
J3                    JUNCTION     2.06     8.30   199.55     0  12:07        7.41
J4                    JUNCTION     1.79     5.00   196.17     0  11:45        5.00
J5                    JUNCTION     1.73     5.00   196.11     0  11:47        4.81
J6                    JUNCTION     1.66     5.00   196.05     0  11:50        4.26
J7                    JUNCTION     1.80     5.00   196.22     0  11:45        5.00
J8                    JUNCTION     0.31     4.20   198.59     0  12:06        3.52
JP-2                  JUNCTION     1.82     2.00   200.00     0  03:39        2.00
J9                    JUNCTION     1.59     4.04   195.04     0  12:00        3.94
Out1                  OUTFALL      1.54     3.75   194.75     0  11:45        3.75
PropBasin             STORAGE      0.00     0.00   200.00     0  00:00        0.00
OCS                   STORAGE      0.68     3.63   195.63     0  12:51        3.16


*******************
Node Inflow Summary
*******************


-------------------------------------------------------------------------------------
----------
                                Maximum  Maximum                  Lateral
                                Total        Flow
                                Lateral    Total  Time of Max      Inflow
                                Inflow     Balance
                                 Inflow   Inflow   Occurrence      Volume
                                 Volume       Error
Node                  Type          CFS      CFS  days hr:min    10^6 gal    10^6
gal     Percent

-------------------------------------------------------------------------------------
----------
J1                    JUNCTION     10.47    10.47     0  12:05       0.303
0.303       0.239
J2                    JUNCTION      0.00    10.12     0  12:06           0
0.302       0.482
J3                    JUNCTION    941.46   941.46     0  12:05        40.7
40.7       0.017
J4                    JUNCTION    217.11   373.74     0  12:00        6.16
38.9      -0.010
J5                    JUNCTION      0.00   360.93     0  11:56           0
39.8      -0.043
J6                    JUNCTION      0.00   363.23     0  12:04           0
39.7      -0.017
J7                    JUNCTION      2.38   829.14     0  12:07      0.0463
40.8      -0.009
J8                    JUNCTION     56.90    56.90     0  12:00        1.35
1.35      -0.041
JP-2                  JUNCTION      4.53     4.53     0  12:00      0.0936
0.0936       3.089
J9                    JUNCTION      0.00   388.22     0  12:00           0
39.7       1.157
```

```
Out1                 OUTFALL       0.00   429.67     0  12:00           0
39.2       0.000
PropBasin            STORAGE       0.00     0.00     0  00:00           0
0       0.000 gal
OCS                  STORAGE       0.00     5.64     0  12:51           0
0.0295       0.180


**********************
Node Surcharge Summary
**********************

Surcharging occurs when water rises above the top of the highest conduit.
-------------------------------------------------------------------------
                                                Max. Height   Min. Depth
                                   Hours       Above Crown    Below Rim
Node                 Type      Surcharged           Feet          Feet
-------------------------------------------------------------------------
J1                   JUNCTION       17.77          0.543        0.000
J2                   JUNCTION       17.78          0.500        0.000
J3                   JUNCTION        1.56          3.471        0.000
J4                   JUNCTION        0.85          0.167        0.000
J5                   JUNCTION        0.25          0.167        0.000
J6                   JUNCTION        0.02          0.167        0.000
J7                   JUNCTION        1.07          0.167        0.000
J8                   JUNCTION        0.53          2.204        0.000
JP-2                 JUNCTION       20.33          0.000        0.000


**********************
Node Flooding Summary
**********************

Flooding refers to all water that overflows a node, whether it ponds or not.
---------------------------------------------------------------------------
                                                            Total   Maximum
                                 Maximum   Time of Max       Flood    Ponded
                       Hours       Rate    Occurrence      Volume     Depth
Node                 Flooded        CFS   days hr:min    10^6 gal      Feet
---------------------------------------------------------------------------
J1                      0.27       1.53      0  12:00       0.003     0.043
J2                     17.74      10.12      0  12:06       0.301     0.000
J3                      0.88     253.18      0  12:00       1.072     2.554
J4                      0.60     106.65      0  12:01       0.451     0.000
J5                      0.17     121.33      0  11:57       0.116     0.000
J6                      0.01      91.35      0  12:13       0.011     0.000
J7                      1.05     673.08      0  12:07       8.024     0.000
J8                      0.51      22.58      0  11:59       0.077     1.704
JP-2                   20.33       4.53      0  12:00       0.091     0.000


**********************
Storage Volume Summary
**********************


-------------------------------------------------------------------------------------
-----------
                       Average     Avg  Evap Exfil       Maximum     Max    Time of
                       Max    Maximum
                        Volume    Pcnt  Pcnt  Pcnt        Volume    Pcnt
                        Occurrence    Outflow
Storage Unit          1000 ft3    Full  Loss  Loss      1000 ft3    Full    days
hr:min        CFS

-------------------------------------------------------------------------------------
-----------
PropBasin                0.000       0     0     0         0.000       0       0
00:00       0.00
```

```
OCS                      0.011       7     0     0         0.058      36       0
12:51       4.64


************************
Outfall Loading Summary
************************

-------------------------------------------------------------
                        Flow       Avg       Max       Total
                        Freq      Flow      Flow      Volume
Outfall Node            Pcnt       CFS       CFS    10^6 gal
-------------------------------------------------------------
Out1                   99.94     61.05    429.67      39.242
-------------------------------------------------------------
System                 99.94     61.05    429.67      39.242



********************
Link Flow Summary
********************

-----------------------------------------------------------------------------
                                Maximum  Time of Max   Maximum    Max/    Max/
                                 |Flow|   Occurrence   |Veloc|    Full    Full
Link                  Type          CFS  days hr:min    ft/sec    Flow   Depth
-----------------------------------------------------------------------------
C1                    CONDUIT     10.12     0  12:06      3.22    1.31    1.00
C3                    CONDUIT    828.04     0  12:07     28.07    5.44    1.00
C4                    CONDUIT    347.79     0  12:27     11.81    2.47    1.00
C5                    CONDUIT    363.23     0  12:04     12.79    2.39    1.00
C6                    CONDUIT    388.20     0  12:00     14.46    2.49    0.91
C2                    CONDUIT      0.00     0  00:00      0.00    0.00    0.50
C7                    CONDUIT    298.87     0  12:38     10.15    1.92    1.00
C8                    CONDUIT     44.02     0  12:08     14.01    1.04    1.00
CP-1                  CONDUIT      0.00     0  00:00      0.00    0.00    0.50
CP-2                  CONDUIT      5.64     0  12:51      3.19    0.35    1.00
C9                    CONDUIT    429.67     0  12:00     17.13    2.87    0.81
1                     WEIR         0.00     0  00:00                      0.00
2                     WEIR         0.00     0  00:00                      0.00


***************************
Flow Classification Summary
***************************

-------------------------------------------------------------------------------------
                     Adjusted    ---------- Fraction of Time in Flow Class ----------
                      /Actual         Up    Down  Sub   Sup   Up    Down  Norm  Inlet
Conduit                Length    Dry  Dry   Dry   Crit  Crit  Crit  Crit  Ltd   Ctrl
-------------------------------------------------------------------------------------
C1                       1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.01  0.00
C3                       1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00  0.48
C4                       1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00  0.00
C5                       1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00  0.00
C6                       1.00   0.00  0.00  0.00  0.97  0.03  0.00  0.00  0.00  0.00
C2                       1.00   0.01  0.99  0.00  0.00  0.00  0.00  0.00  0.00  0.00
C7                       1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.01  0.00
C8                       1.00   0.00  0.00  0.00  0.91  0.02  0.00  0.06  0.88  0.00
CP-1                     1.00   0.00  0.15  0.00  0.85  0.00  0.00  0.00  0.00  0.00
CP-2                     1.00   0.00  0.25  0.00  0.74  0.00  0.00  0.00  0.00  0.00
C9                       1.00   0.00  0.00  0.00  0.42  0.57  0.00  0.00  0.38  0.00


*************************
Conduit Surcharge Summary
*************************

```

Conduit	Hours Full Both Ends	Hours Full Upstream	Hours Full Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
C1	17.77	17.77	17.78	0.23	0.27
C3	1.07	1.56	1.07	2.08	1.06
C4	0.25	0.84	0.25	2.54	0.07
C5	0.02	0.25	0.02	2.38	0.01
C6	0.01	0.02	0.01	2.31	0.01
C7	0.84	1.07	0.84	2.03	0.24
C8	0.53	0.53	3.61	0.02	0.02
CP-1	0.01	0.01	20.33	0.01	0.01
CP-2	3.17	3.17	10.90	0.01	0.01
C9	0.01	0.01	0.01	2.39	0.01

Analysis begun on: Wed Nov 30 11:05:06 2022
Analysis ended on: Wed Nov 30 11:05:08 2022
Total elapsed time: 00:00:02

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.0)
--------------------------------------------------------------
```

Location 12: Location 12: Industrial Drive and Post Office Road SWMM Schematic (100-Year (2050) - PROPSED)

```
WARNING 03: negative offset ignored for Link C2
WARNING 03: negative offset ignored for Link CP-1
WARNING 04: minimum elevation drop used for Conduit C9
WARNING 02: maximum depth increased for Node J9

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Surcharge Method ......... EXTRAN
Starting Date ............ 01/01/2000 00:00:00
Ending Date .............. 01/02/2000 00:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 01:00:00
Routing Time Step ........ 20.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 8
Number of Threads ........ 1
Head Tolerance ........... 0.005000 ft


**************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
**************************     ---------       -------
Total Precipitation ......       207.271         9.993
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........        22.701         1.094
Surface Runoff ...........       174.879         8.431
Final Storage ............        10.032         0.484
Continuity Error (%) .....        -0.164


**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......       174.769        56.951
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........       134.800        43.927
Flooding Loss ............        38.579        12.572
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.057         0.018
Continuity Error (%) .....         0.763


*************************
Highest Continuity Errors
*************************
Node JP-2 (2.61%)
```

```
Node J9 (1.09%)


***************************
Time-Step Critical Elements
***************************
Link C9 (99.98%)


********************************
Highest Flow Instability Indexes
********************************
Link C9 (77)
Link C6 (68)
Link C3 (22)
Link C7 (19)
Link CP-2 (12)


**********************************
Most Frequent Nonconverging Nodes
**********************************
Node Out1 (14.20%)
Node J9 (13.89%)
Node J6 (0.43%)
Node J5 (0.29%)
Node J4 (0.18%)


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.30 sec
Average Time Step           :     0.50 sec
Maximum Time Step           :    20.00 sec
% of Time in Steady State   :     0.00
Average Iterations per Step :     3.37
% of Steps Not Converging   :    14.20
Time Step Frequencies       :
   20.000 -  9.564 sec      :     0.01 %
    9.564 -  4.573 sec      :     0.00 %
    4.573 -  2.187 sec      :     0.00 %
    2.187 -  1.046 sec      :     0.00 %
    1.046 -  0.500 sec      :    99.99 %


***************************
Subcatchment Runoff Summary
***************************


-----------------------------------------------------------------------------------------
                          Total      Total      Total      Total     Imperv
                          Perv      Total       Total     Peak  Runoff
                         Precip      Runon       Evap      Infil     Runoff
                         Runoff     Runoff      Runoff   Runoff   Coeff
Subcatchment                in         in         in         in         in
in         in    10^6 gal      CFS
-----------------------------------------------------------------------------------------
S1                          9.99       0.00       0.00       2.42       0.43
6.96       7.39        0.36    12.89   0.739
S5                          9.99       0.00       0.00       1.17       4.85
3.84       8.69        1.58    67.61   0.870
S3                          9.99       0.00       0.00       1.14       4.49
3.84       8.33       47.73  1128.20   0.834
S6                          9.99       0.00       0.00       0.02       9.34
```

```
0.56       9.91        0.11     5.26   0.991
S4                         9.99       0.00       0.00       0.66       6.11
3.03       9.14        7.15   258.55   0.915
S7                         9.99       0.00       0.00       0.13       8.33
1.48       9.82        0.05     2.74   0.982


******************
Node Depth Summary
******************

-------------------------------------------------------------------------------
                                Average  Maximum  Maximum  Time of Max    Reported
                                  Depth    Depth      HGL   Occurrence   Max Depth
Node                  Type         Feet     Feet     Feet  days hr:min        Feet
-------------------------------------------------------------------------------
J1                    JUNCTION     2.03     2.59   197.10     0  12:05        2.55
J2                    JUNCTION     2.09     2.50   196.95     0  05:40        2.50
J3                    JUNCTION     2.23     9.53   200.78     0  12:07        8.48
J4                    JUNCTION     1.91     5.00   196.17     0  11:44        5.00
J5                    JUNCTION     1.84     5.00   196.11     0  11:46        5.00
J6                    JUNCTION     1.77     5.00   196.05     0  11:50        4.69
J7                    JUNCTION     1.92     5.00   196.22     0  11:42        5.00
J8                    JUNCTION     0.35     4.98   199.37     0  12:06        4.01
JP-2                  JUNCTION     1.83     2.00   200.00     0  03:17        2.00
J9                    JUNCTION     1.70     4.02   195.02     0  11:59        3.90
Out1                  OUTFALL      1.64     3.75   194.75     0  11:42        3.75
PropBasin             STORAGE      0.00     0.00   200.00     0  00:00        0.00
OCS                   STORAGE      0.76     3.41   195.41     0  13:06        2.98


*******************
Node Inflow Summary
*******************


-------------------------------------------------------------------------------------
----------
                                Maximum  Maximum                  Lateral
                                Total        Flow
                                Lateral    Total  Time of Max      Inflow
                                Inflow     Balance
                                 Inflow   Inflow   Occurrence      Volume
                                 Volume       Error
Node                  Type          CFS      CFS  days hr:min    10^6 gal    10^6
gal     Percent

-------------------------------------------------------------------------------------
----------
J1                    JUNCTION     12.89    12.89     0  12:05       0.361
0.361       0.200
J2                    JUNCTION      0.00    12.32     0  12:06           0
0.36       0.404
J3                    JUNCTION   1128.20  1128.20     0  12:05        47.7
47.7       0.014
J4                    JUNCTION    258.55   414.78     0  12:00        7.14
43.7      -0.012
J5                    JUNCTION      0.00   364.96     0  11:58           0
44.5      -0.056
J6                    JUNCTION      0.00   363.98     0  11:55           0
44.4      -0.020
J7                    JUNCTION      2.74   969.14     0  12:07      0.0533
47.7      -0.009
J8                    JUNCTION     67.61    67.61     0  12:00        1.58
1.58      -0.041
JP-2                  JUNCTION      5.26     5.26     0  12:00       0.108
0.108       2.678
J9                    JUNCTION      0.00   386.48     0  12:06           0
44.4       1.102
```

```
Out1                 OUTFALL       0.00   443.36     0  11:59           0
43.9       0.000
PropBasin            STORAGE       0.00     0.00     0  00:00           0
0       0.000 gal
OCS                  STORAGE       0.00     4.06     0  13:32           0
0.0314       0.265


**********************
Node Surcharge Summary
**********************

Surcharging occurs when water rises above the top of the highest conduit.
-------------------------------------------------------------------------
                                              Max. Height   Min. Depth
                                   Hours      Above Crown    Below Rim
Node                 Type       Surcharged          Feet         Feet
-------------------------------------------------------------------------
J1                   JUNCTION       18.35         0.592        0.000
J2                   JUNCTION       18.36         0.500        0.000
J3                   JUNCTION        1.91         4.693        0.000
J4                   JUNCTION        1.04         0.167        0.000
J5                   JUNCTION        0.34         0.167        0.000
J6                   JUNCTION        0.03         0.167        0.000
J7                   JUNCTION        1.33         0.167        0.000
J8                   JUNCTION        0.64         2.983        0.000
JP-2                 JUNCTION       20.71         0.000        0.000


**********************
Node Flooding Summary
**********************

Flooding refers to all water that overflows a node, whether it ponds or not.
---------------------------------------------------------------------------
                                                          Total   Maximum
                                Maximum   Time of Max      Flood    Ponded
                       Hours       Rate    Occurrence     Volume     Depth
Node                 Flooded        CFS   days hr:min   10^6 gal      Feet
---------------------------------------------------------------------------
J1                      0.35       2.49      0  12:00      0.007     0.092
J2                     18.32      12.32      0  12:06      0.359     0.000
J3                      1.08     340.57      0  12:00      1.564     3.776
J4                      0.77     156.82      0  12:01      0.746     0.000
J5                      0.23     111.47      0  12:27      0.151     0.000
J6                      0.02      90.43      0  12:03      0.020     0.000
J7                      1.31     813.07      0  12:07     11.191     0.000
J8                      0.61      29.01      0  12:00      0.112     2.483
JP-2                   20.71       5.26      0  12:00      0.105     0.000


**********************
Storage Volume Summary
**********************


-------------------------------------------------------------------------------------
-----------
                       Average     Avg  Evap Exfil       Maximum     Max    Time of
                       Max    Maximum
                        Volume    Pcnt  Pcnt  Pcnt        Volume    Pcnt
                        Occurrence    Outflow
Storage Unit          1000 ft3    Full  Loss  Loss      1000 ft3    Full    days
hr:min        CFS

-------------------------------------------------------------------------------------
-----------
PropBasin                0.000       0     0     0         0.000       0       0
00:00       0.00
```

```
OCS                      0.012       8     0     0         0.055      34       0
13:06       4.33


************************
Outfall Loading Summary
************************

------------------------------------------------------------
                       Flow       Avg       Max       Total
                       Freq      Flow      Flow      Volume
Outfall Node           Pcnt       CFS       CFS    10^6 gal
------------------------------------------------------------
Out1                  99.94     68.32    443.36      43.923
------------------------------------------------------------
System                99.94     68.32    443.36      43.923



********************
Link Flow Summary
********************

-------------------------------------------------------------------------------
                                Maximum  Time of Max   Maximum    Max/    Max/
                                 |Flow|   Occurrence   |Veloc|    Full    Full
Link                  Type          CFS  days hr:min    ft/sec    Flow   Depth
-------------------------------------------------------------------------------
C1                    CONDUIT     12.32     0  12:06      3.92    1.59    1.00
C3                    CONDUIT    967.96     0  12:07     32.81    6.36    1.00
C4                    CONDUIT    340.05     0  12:50     11.65    2.42    1.00
C5                    CONDUIT    363.98     0  11:55     12.83    2.39    1.00
C6                    CONDUIT    386.48     0  12:06     14.55    2.48    0.91
C2                    CONDUIT      0.00     0  00:00      0.00    0.00    0.50
C7                    CONDUIT    302.71     0  12:49     10.26    1.94    1.00
C8                    CONDUIT     48.71     0  12:07     15.51    1.15    1.00
CP-1                  CONDUIT      0.00     0  00:00      0.00    0.00    0.50
CP-2                  CONDUIT      4.33     0  13:33      2.45    0.27    1.00
C9                    CONDUIT    443.36     0  11:59     17.42    2.96    0.80
1                     WEIR         0.00     0  00:00                      0.00
2                     WEIR         0.00     0  00:00                      0.00


***************************
Flow Classification Summary
***************************

-----------------------------------------------------------------------------------------
                     Adjusted    ---------- Fraction of Time in Flow Class ----------
                      /Actual         Up    Down  Sub   Sup   Up    Down  Norm  Inlet
Conduit                Length    Dry  Dry   Dry   Crit  Crit  Crit  Crit  Ltd   Ctrl
-----------------------------------------------------------------------------------------
C1                       1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.01  0.00
C3                       1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00  0.47
C4                       1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00  0.00
C5                       1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00  0.00
C6                       1.00   0.00  0.00  0.00  0.96  0.03  0.00  0.00  0.00  0.00
C2                       1.00   0.01  0.99  0.00  0.00  0.00  0.00  0.00  0.00  0.00
C7                       1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.02  0.00
C8                       1.00   0.00  0.00  0.00  0.92  0.02  0.00  0.05  0.87  0.00
CP-1                     1.00   0.00  0.13  0.00  0.86  0.00  0.00  0.00  0.00  0.00
CP-2                     1.00   0.00  0.21  0.00  0.78  0.00  0.00  0.00  0.00  0.00
C9                       1.00   0.00  0.00  0.00  0.41  0.58  0.00  0.00  0.40  0.00


*************************
Conduit Surcharge Summary
*************************

```

Conduit	Hours Full: Both Ends	Hours Full: Upstream	Hours Full: Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
C1	18.35	18.35	18.36	0.32	0.36
C3	1.33	1.91	1.33	2.45	1.32
C4	0.33	1.04	0.33	2.98	0.10
C5	0.03	0.33	0.03	2.80	0.01
C6	0.01	0.03	0.01	2.72	0.01
C7	1.04	1.33	1.04	2.37	0.27
C8	0.64	0.64	4.29	0.18	0.18
CP-1	0.01	0.01	20.71	0.01	0.01
CP-2	3.71	3.71	12.67	0.01	0.01
C9	0.01	0.01	0.01	2.82	0.01

Analysis begun on: Wed Nov 30 11:05:34 2022
Analysis ended on: Wed Nov 30 11:05:35 2022
Total elapsed time: 00:00:01

```

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.0)
--------------------------------------------------------------
```
Location 12: Location 12: Industrial Drive and Post Office Road SWMM Schematic (100-Year (2100) - PROPSED)
```
WARNING 03: negative offset ignored for Link C2
WARNING 03: negative offset ignored for Link CP-1
WARNING 04: minimum elevation drop used for Conduit C9
WARNING 02: maximum depth increased for Node J9

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Surcharge Method ......... EXTRAN
Starting Date ............ 01/01/2000 00:00:00
Ending Date .............. 01/02/2000 00:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 01:00:00
Routing Time Step ........ 20.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 8
Number of Threads ........ 1
Head Tolerance ........... 0.005000 ft


| ********** | Volume | Depth |
|---|---|---|
| Runoff Quantity Continuity | acre-feet | inches |
| ********** | --- | --- |
| Total Precipitation ..... | 218.596 | 10.539 |
| Evaporation Loss ..... | 0.000 | 0.000 |
| Infiltration Loss ..... | 22.949 | 1.106 |
| Surface Runoff ..... | 185.655 | 8.951 |
| Final Storage ..... | 10.356 | 0.499 |
| Continuity Error (%) ..... | -0.166 | |


| ********** | Volume | Volume |
|---|---|---|
| Flow Routing Continuity | acre-feet | 10^6 gal |
| ********** | --- | --- |
| Dry Weather Inflow ..... | 0.000 | 0.000 |
| Wet Weather Inflow ..... | 185.538 | 60.460 |
| Groundwater Inflow ..... | 0.000 | 0.000 |
| RDII Inflow ..... | 0.000 | 0.000 |
| External Inflow ..... | 0.000 | 0.000 |
| External Outflow ..... | 141.057 | 45.965 |
| Flooding Loss ..... | 42.988 | 14.008 |
| Evaporation Loss ..... | 0.000 | 0.000 |
| Exfiltration Loss ..... | 0.000 | 0.000 |
| Initial Stored Volume .... | 0.000 | 0.000 |
| Final Stored Volume ..... | 0.058 | 0.019 |
| Continuity Error (%) ..... | 0.774 | |


**********
Highest Continuity Errors
**********
Node JP-2 (2.47%)
```

```
Node J9 (1.11%)


***************************
Time-Step Critical Elements
***************************
Link C9 (99.98%)


********************************
Highest Flow Instability Indexes
********************************
Link C9 (77)
Link C6 (67)
Link C3 (20)
Link C7 (18)
Link CP-2 (13)


*********************************
Most Frequent Nonconverging Nodes
*********************************
Node Out1 (14.91%)
Node J9 (14.60%)
Node J6 (0.44%)
Node J5 (0.27%)
Node J4 (0.19%)


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.17 sec
Average Time Step           :     0.50 sec
Maximum Time Step           :    20.00 sec
% of Time in Steady State   :     0.00
Average Iterations per Step :     3.44
% of Steps Not Converging   :    14.91
Time Step Frequencies       :
   20.000 -  9.564 sec      :     0.01 %
    9.564 -  4.573 sec      :     0.00 %
    4.573 -  2.187 sec      :     0.00 %
    2.187 -  1.046 sec      :     0.00 %
    1.046 -  0.500 sec      :    99.99 %


***************************
Subcatchment Runoff Summary
***************************


-----------------------------------------------------------------------------------------
                          Total      Total      Total      Total     Imperv
                          Perv      Total       Total     Peak  Runoff
                         Precip      Runon       Evap      Infil     Runoff
                         Runoff     Runoff      Runoff   Runoff   Coeff
Subcatchment                in         in         in         in         in
in         in    10^6 gal      CFS
-----------------------------------------------------------------------------------------
S1                        10.54       0.00       0.00       2.45       0.45
7.44       7.90        0.39    13.88   0.749
S5                        10.54       0.00       0.00       1.19       5.11
4.11       9.22        1.68    72.01   0.875
S3                        10.54       0.00       0.00       1.16       4.74
4.11       8.85       50.69  1205.48   0.840
S6                        10.54       0.00       0.00       0.02       9.86
```

```
0.59      10.45        0.11     5.56   0.992
S4                        10.54       0.00       0.00       0.67       6.45
3.23       9.68        7.57   275.58   0.918
S7                        10.54       0.00       0.00       0.13       8.79
1.57      10.36        0.06     2.89   0.983


******************
Node Depth Summary
******************

-------------------------------------------------------------------------------
                                Average  Maximum  Maximum  Time of Max    Reported
                                  Depth    Depth      HGL   Occurrence   Max Depth
Node                  Type         Feet     Feet     Feet  days hr:min        Feet
-------------------------------------------------------------------------------
J1                    JUNCTION     2.05     2.61   197.12     0  12:05        2.56
J2                    JUNCTION     2.10     2.50   196.95     0  05:28        2.50
J3                    JUNCTION     2.30    10.07   201.32     0  12:07        8.97
J4                    JUNCTION     1.96     5.00   196.17     0  11:44        5.00
J5                    JUNCTION     1.89     5.00   196.11     0  11:45        5.00
J6                    JUNCTION     1.82     5.00   196.05     0  11:45        4.35
J7                    JUNCTION     1.97     5.00   196.22     0  11:44        5.00
J8                    JUNCTION     0.37     5.32   199.71     0  12:06        4.23
JP-2                  JUNCTION     1.84     2.00   200.00     0  03:07        2.00
J9                    JUNCTION     1.74     4.03   195.03     0  12:05        3.85
Out1                  OUTFALL      1.68     3.75   194.75     0  11:42        3.75
PropBasin             STORAGE      0.00     0.00   200.00     0  00:00        0.00
OCS                   STORAGE      0.80     3.43   195.43     0  13:13        3.18


*******************
Node Inflow Summary
*******************


-------------------------------------------------------------------------------------
----------
                                Maximum  Maximum                  Lateral
                                Total        Flow
                                Lateral    Total  Time of Max      Inflow
                                Inflow     Balance
                                 Inflow   Inflow   Occurrence      Volume
                                 Volume       Error
Node                  Type          CFS      CFS  days hr:min    10^6 gal    10^6
gal     Percent

-------------------------------------------------------------------------------------
----------
J1                    JUNCTION     13.88    13.88     0  12:05       0.386
0.386       0.181
J2                    JUNCTION      0.00    13.20     0  12:06           0
0.385       0.377
J3                    JUNCTION   1205.48  1205.48     0  12:05        50.7
50.7       0.014
J4                    JUNCTION    275.58   431.72     0  12:00        7.56
45.8      -0.014
J5                    JUNCTION      0.00   366.96     0  12:08           0
46.6      -0.046
J6                    JUNCTION      0.00   366.23     0  12:04           0
46.5      -0.019
J7                    JUNCTION      2.89  1025.38     0  12:07      0.0563
50.7      -0.007
J8                    JUNCTION     72.01    72.01     0  12:00        1.68
1.68      -0.051
JP-2                  JUNCTION      5.56     5.56     0  12:00       0.113
0.113       2.534
J9                    JUNCTION      0.00   391.93     0  12:04           0
46.5       1.120
```

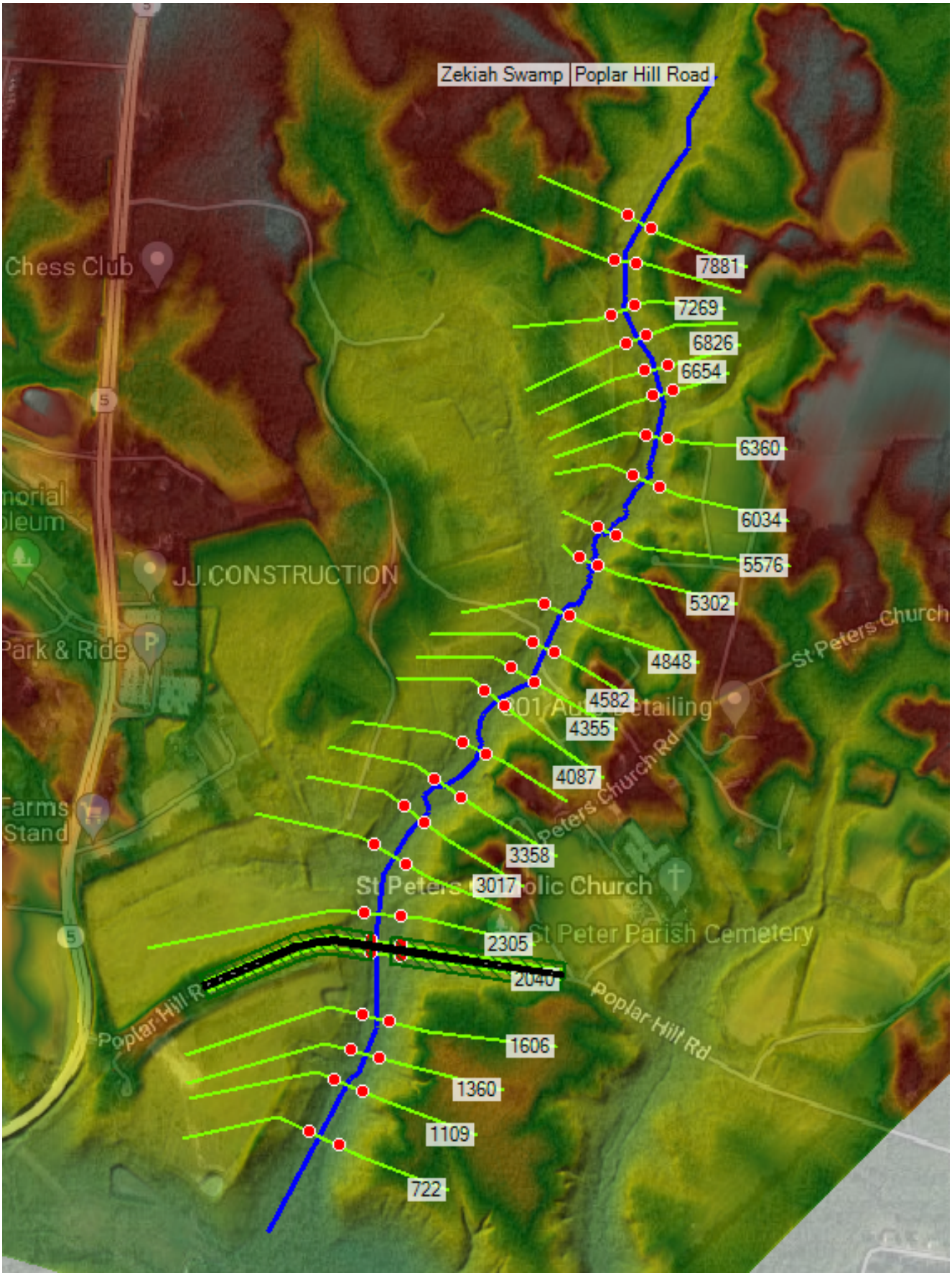
```
Out1                 OUTFALL       0.00   445.74     0  12:05           0
46       0.000
PropBasin            STORAGE       0.00     0.00     0  00:00           0
0       0.000 gal
OCS                  STORAGE       0.00     4.21     0  12:59           0
0.0328       0.300


**********************
Node Surcharge Summary
**********************

Surcharging occurs when water rises above the top of the highest conduit.
-------------------------------------------------------------------------
                                              Max. Height   Min. Depth
                                   Hours      Above Crown    Below Rim
Node                 Type       Surcharged          Feet         Feet
-------------------------------------------------------------------------
J1                   JUNCTION       18.55         0.615        0.000
J2                   JUNCTION       18.56         0.500        0.000
J3                   JUNCTION        2.04         5.238        0.000
J4                   JUNCTION        1.10         0.167        0.000
J5                   JUNCTION        0.34         0.167        0.000
J6                   JUNCTION        0.03         0.167        0.000
J7                   JUNCTION        1.42         0.167        0.000
J8                   JUNCTION        0.68         3.317        0.000
JP-2                 JUNCTION       20.87         0.000        0.000


**********************
Node Flooding Summary
**********************

Flooding refers to all water that overflows a node, whether it ponds or not.
---------------------------------------------------------------------------
                                                          Total   Maximum
                                 Maximum   Time of Max     Flood    Ponded
                       Hours       Rate    Occurrence    Volume     Depth
Node                 Flooded        CFS   days hr:min   10^6 gal      Feet
---------------------------------------------------------------------------
J1                      0.41       2.86      0  12:00     0.008     0.115
J2                     18.52      13.20      0  12:06     0.384     0.000
J3                      1.15     378.29      0  12:00     1.793     4.321
J4                      0.78     168.55      0  12:03     0.851     0.000
J5                      0.24     125.98      0  12:07     0.156     0.000
J6                      0.02      96.77      0  12:06     0.017     0.000
J7                      1.39     869.31      0  12:07    12.489     0.000
J8                      0.64      31.18      0  12:00     0.126     2.817
JP-2                   20.87       5.56      0  12:00     0.111     0.000


**********************
Storage Volume Summary
**********************


-------------------------------------------------------------------------------------
-----------
                       Average     Avg  Evap Exfil       Maximum     Max    Time of
                       Max    Maximum
                        Volume    Pcnt  Pcnt  Pcnt        Volume    Pcnt
                        Occurrence    Outflow
Storage Unit          1000 ft3    Full  Loss  Loss      1000 ft3    Full    days
hr:min        CFS

-------------------------------------------------------------------------------------
-----------
PropBasin                0.000       0     0     0         0.000       0       0
00:00       0.00
```

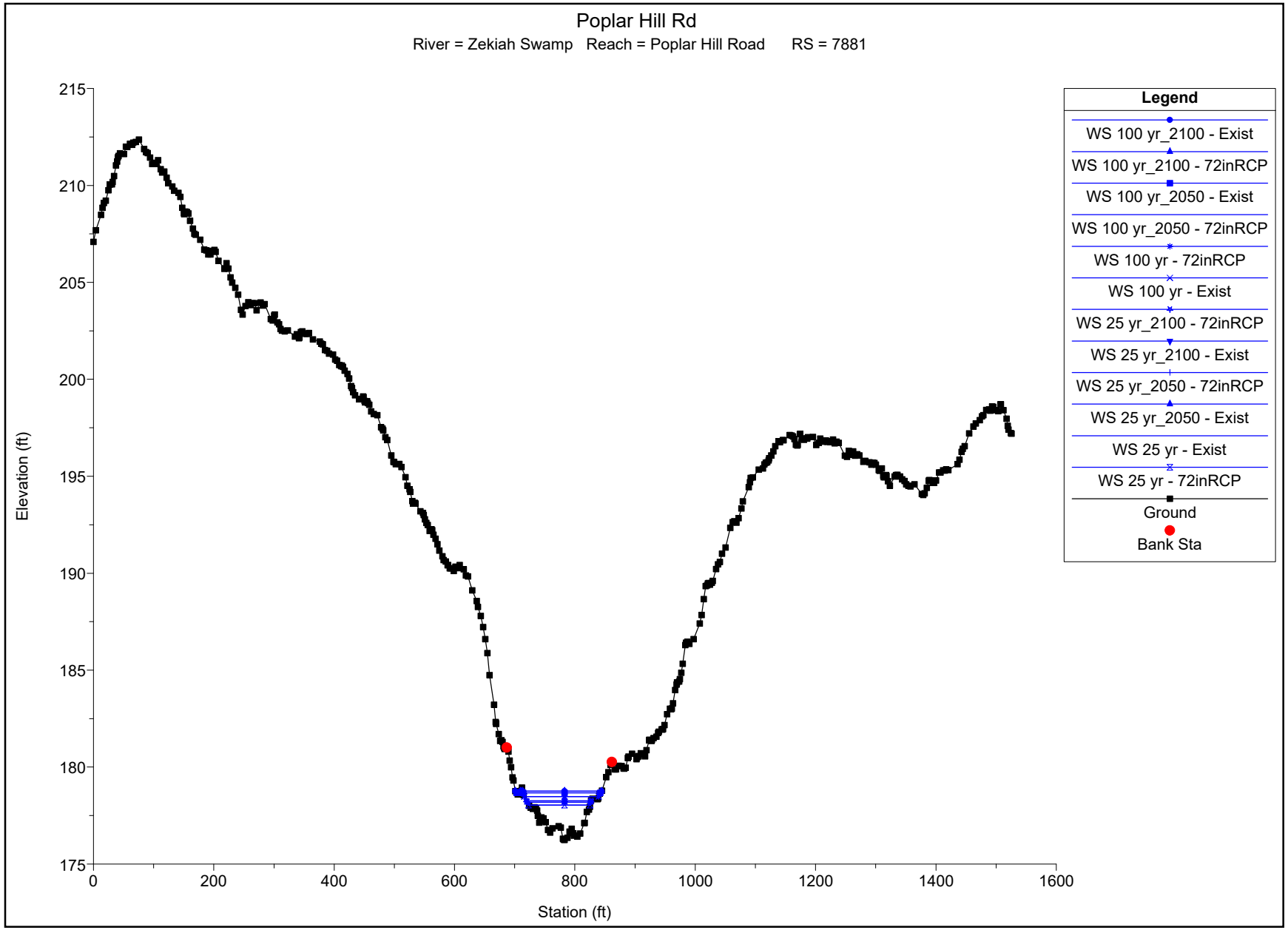
```
OCS                      0.013       8     0     0         0.055      34       0
13:13       3.57


************************
Outfall Loading Summary
************************

----------------------------------------------------------
                       Flow       Avg       Max       Total
                       Freq      Flow      Flow      Volume
Outfall Node           Pcnt       CFS       CFS    10^6 gal
----------------------------------------------------------
Out1                  99.94     71.49    445.74      45.962
----------------------------------------------------------
System                99.94     71.49    445.74      45.962



********************
Link Flow Summary
********************

--------------------------------------------------------------------------------
                                Maximum  Time of Max   Maximum    Max/    Max/
                                 |Flow|   Occurrence   |Veloc|    Full    Full
Link                  Type          CFS  days hr:min    ft/sec    Flow   Depth
--------------------------------------------------------------------------------
C1                    CONDUIT     13.20     0  12:06      4.20    1.70    1.00
C3                    CONDUIT   1024.18     0  12:07     34.72    6.73    1.00
C4                    CONDUIT    346.47     0  12:31     11.75    2.46    1.00
C5                    CONDUIT    366.23     0  12:04     12.89    2.41    1.00
C6                    CONDUIT    390.54     0  12:04     14.56    2.50    0.91
C2                    CONDUIT      0.00     0  00:00      0.00    0.00    0.50
C7                    CONDUIT    302.33     0  12:53     10.26    1.94    1.00
C8                    CONDUIT     51.40     0  12:09     16.36    1.22    1.00
CP-1                  CONDUIT      0.00     0  00:00      0.00    0.00    0.50
CP-2                  CONDUIT      4.21     0  12:59      2.38    0.26    1.00
C9                    CONDUIT    445.74     0  12:05     17.52    2.98    0.80
1                     WEIR         0.00     0  00:00                      0.00
2                     WEIR         0.00     0  00:00                      0.00


***************************
Flow Classification Summary
***************************

-----------------------------------------------------------------------------------------
                     Adjusted    ---------- Fraction of Time in Flow Class ----------
                      /Actual         Up    Down  Sub   Sup   Up    Down  Norm  Inlet
Conduit                Length    Dry  Dry   Dry   Crit  Crit  Crit  Crit  Ltd   Ctrl
-----------------------------------------------------------------------------------------
C1                       1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.01  0.00
C3                       1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00  0.48
C4                       1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00  0.00
C5                       1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00  0.00
C6                       1.00   0.00  0.00  0.00  0.96  0.03  0.00  0.00  0.00  0.00
C2                       1.00   0.00  1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
C7                       1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.02  0.00
C8                       1.00   0.00  0.00  0.00  0.93  0.02  0.00  0.05  0.87  0.00
CP-1                     1.00   0.00  0.13  0.00  0.87  0.00  0.00  0.00  0.00  0.00
CP-2                     1.00   0.00  0.20  0.00  0.80  0.00  0.00  0.00  0.00  0.00
C9                       1.00   0.00  0.00  0.00  0.41  0.58  0.00  0.00  0.41  0.00


*************************
Conduit Surcharge Summary
*************************
```

Conduit	Hours Full: Both Ends	Hours Full: Upstream	Hours Full: Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
C1	18.55	18.55	18.56	0.35	0.42
C3	1.42	2.04	1.42	2.61	1.42
C4	0.33	1.10	0.33	3.19	0.09
C5	0.03	0.33	0.03	2.97	0.01
C6	0.01	0.03	0.01	2.88	0.01
C7	1.10	1.42	1.10	2.51	0.31
C8	0.68	0.68	4.53	0.23	0.23
CP-1	0.01	0.01	20.87	0.01	0.01
CP-2	3.93	3.93	13.77	0.01	0.01
C9	0.01	0.01	0.01	3.00	0.01

Analysis begun on: Wed Nov 30 11:06:07 2022
Analysis ended on: Wed Nov 30 11:06:09 2022
Total elapsed time: 00:00:02

Location 24: Poplar Hill Rd. HEC-RAS Schematic

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River = Zekiah Swamp Reach = Poplar Hill Road RS = 7881
Elevation (ft)
Station (ft)
215
210
205
200
195
190
185
180
175
0
200
400
600
800
1000
1200
1400
1600
Legend
WS 100 yr_2100 - Exist
WS 100 yr_2100 - 72inRCP
WS 100 yr_2050 - Exist
WS 100 yr_2050 - 72inRCP
WS 100 yr - 72inRCP
WS 100 yr - Exist
WS 25 yr_2100 - 72inRCP
WS 25 yr_2100 - Exist
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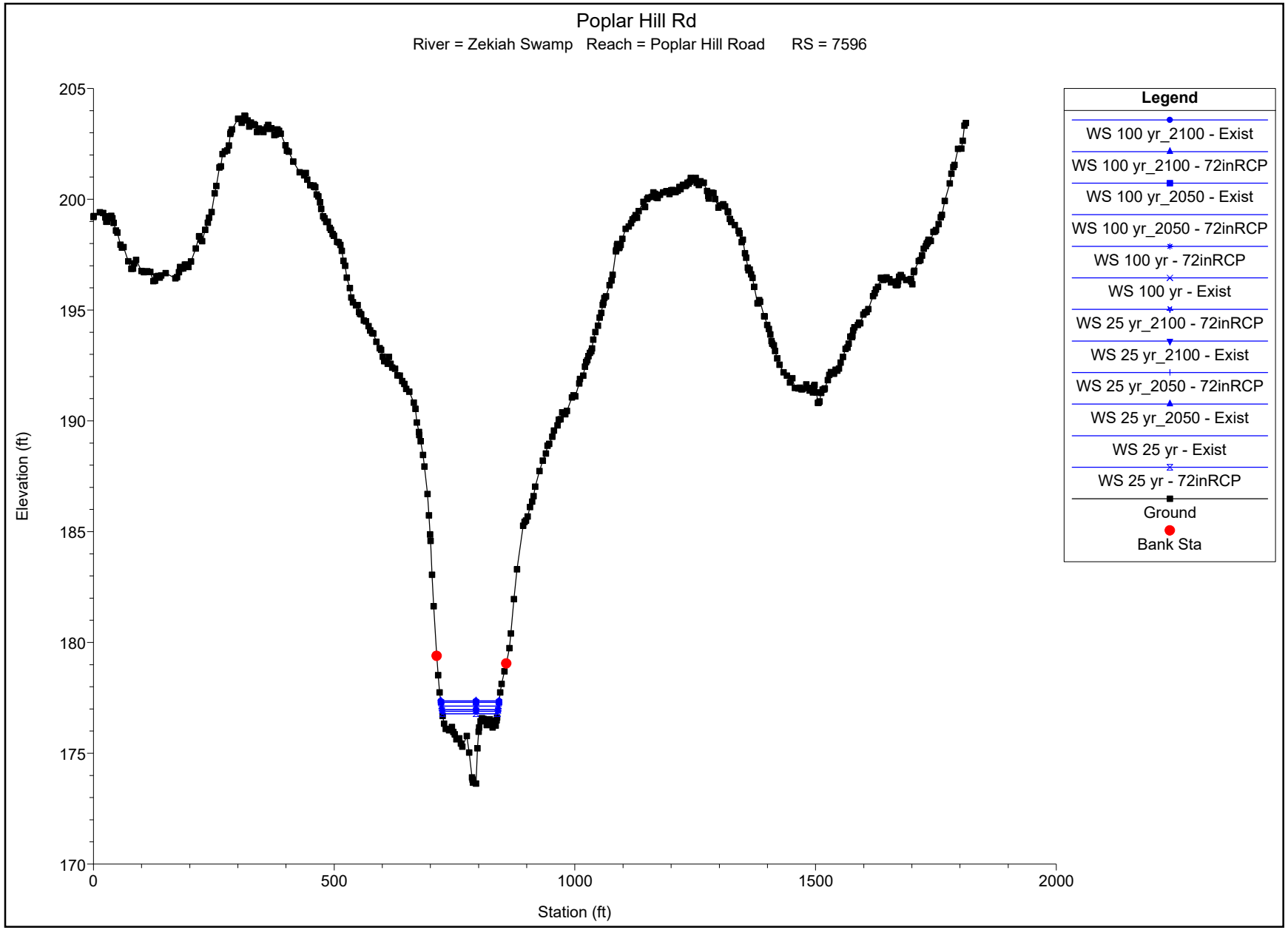
WS 25 yr - Exist
WS 25 yr - 72inRCP
Ground
Bank Sta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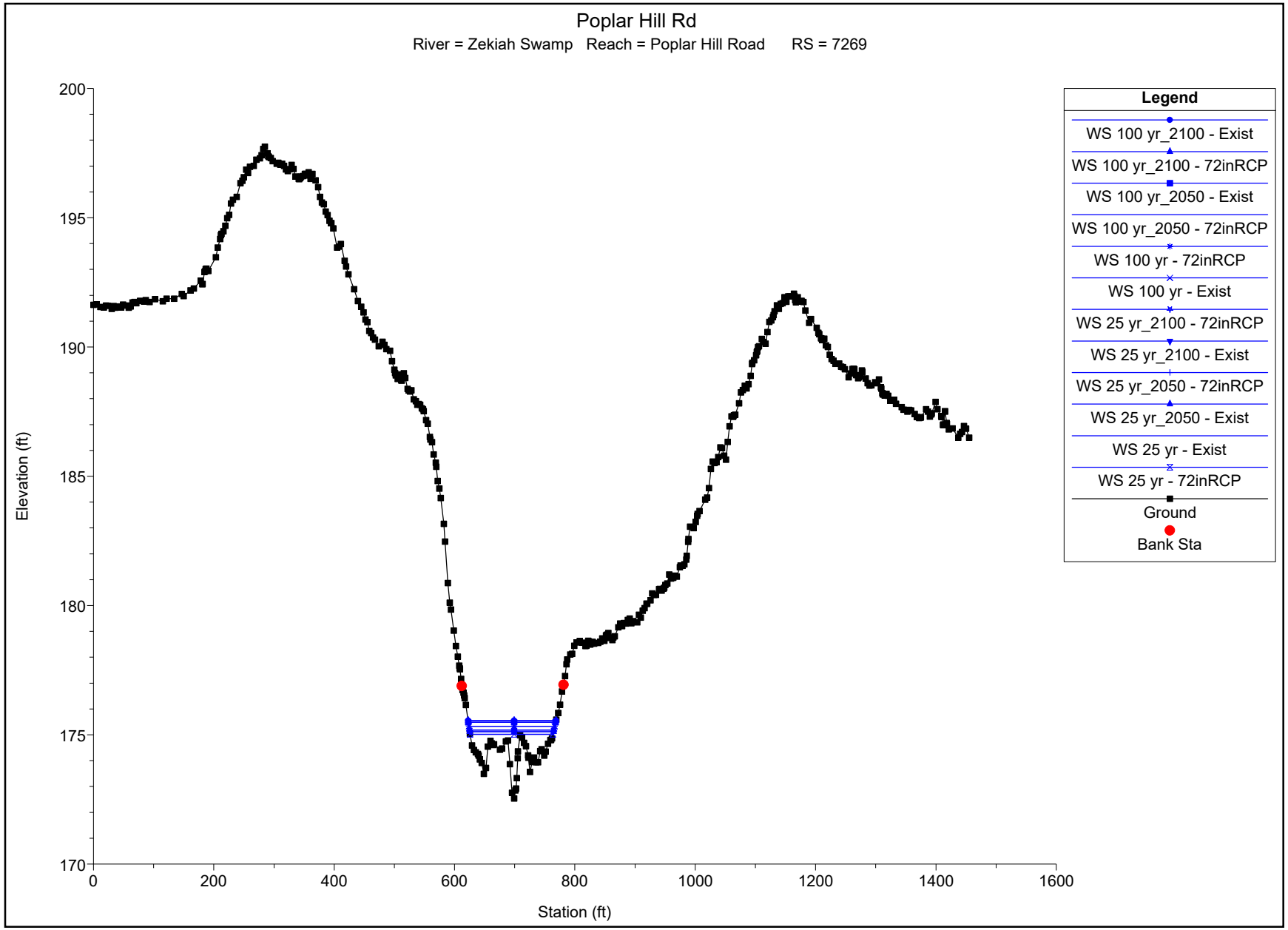
Elevation (ft)
Station (ft)
205
200
195
190
185
180
175
170
0
500
1000
1500
2000
Legend
WS 100 yr_2100 - Exist
WS 100 yr_2100 - 72inRCP
WS 100 yr_2050 - Exist
WS 100 yr_2050 - 72inRCP
WS 100 yr - 72inRCP
WS 100 yr - Exist
WS 25 yr_2100 - 72inRCP
WS 25 yr_2100 - Exist
WS 25 yr_2050 - 72inRCP
WS 25 yr_2050 - Exist
WS 25 yr - Exist
WS 25 yr - 72inRCP
Ground
Bank Sta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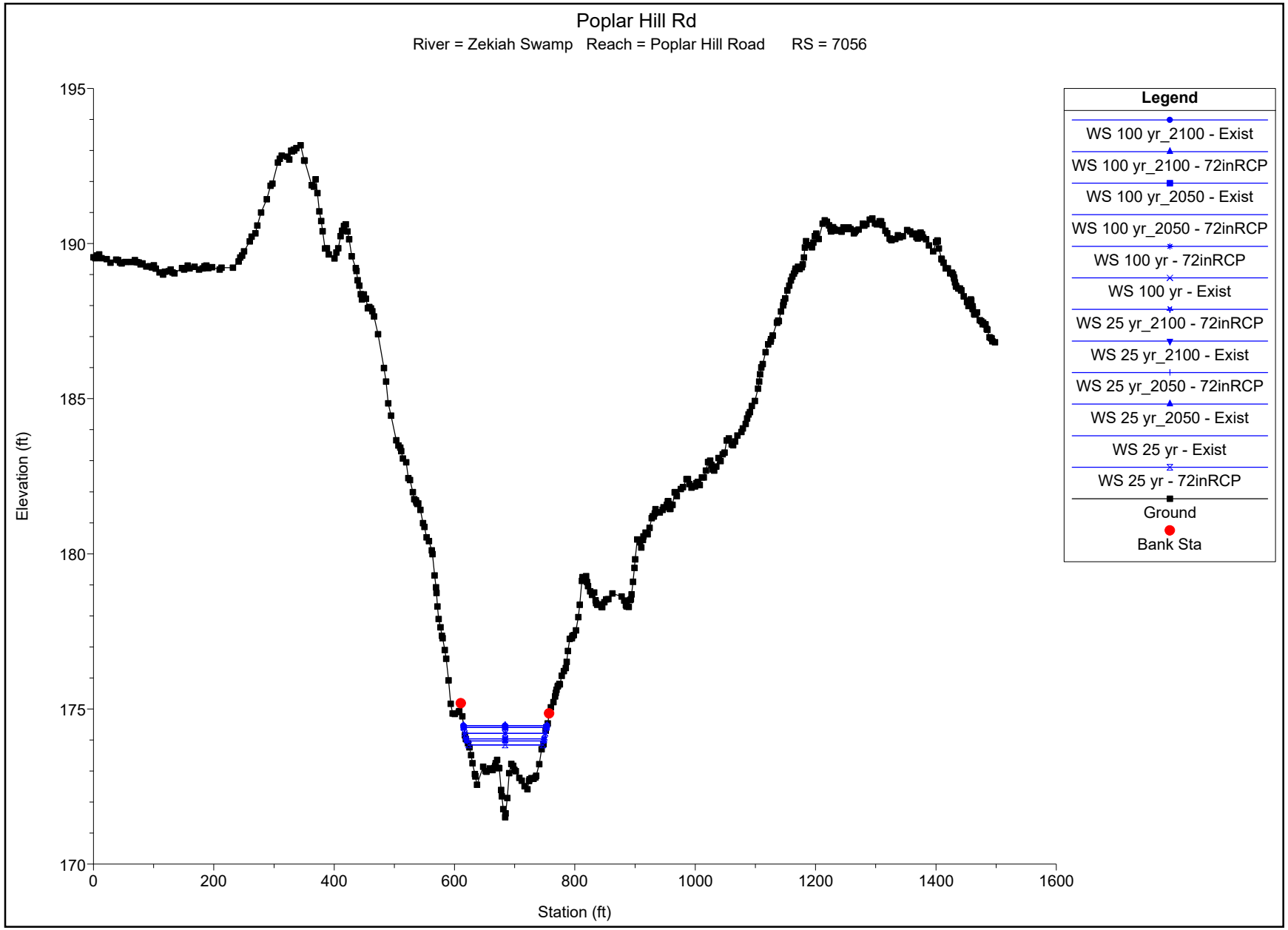
Elevation (ft)
Station (ft)
200
195
190
185
180
175
170
0
200
400
600
800
1000
1200
1400
1600
Legend
WS 100 yr_2100 - Exist
WS 100 yr_2100 - 72inRCP
WS 100 yr_2050 - Exist
WS 100 yr_2050 - 72inRCP
WS 100 yr - 72inRCP
WS 100 yr - Exist
WS 25 yr_2100 - 72inRCP
WS 25 yr_2100 - Exist
WS 25 yr_2050 - 72inRCP
WS 25 yr_2050 - Exist
WS 25 yr - Exist
WS 25 yr - 72inRCP
Ground
Bank Sta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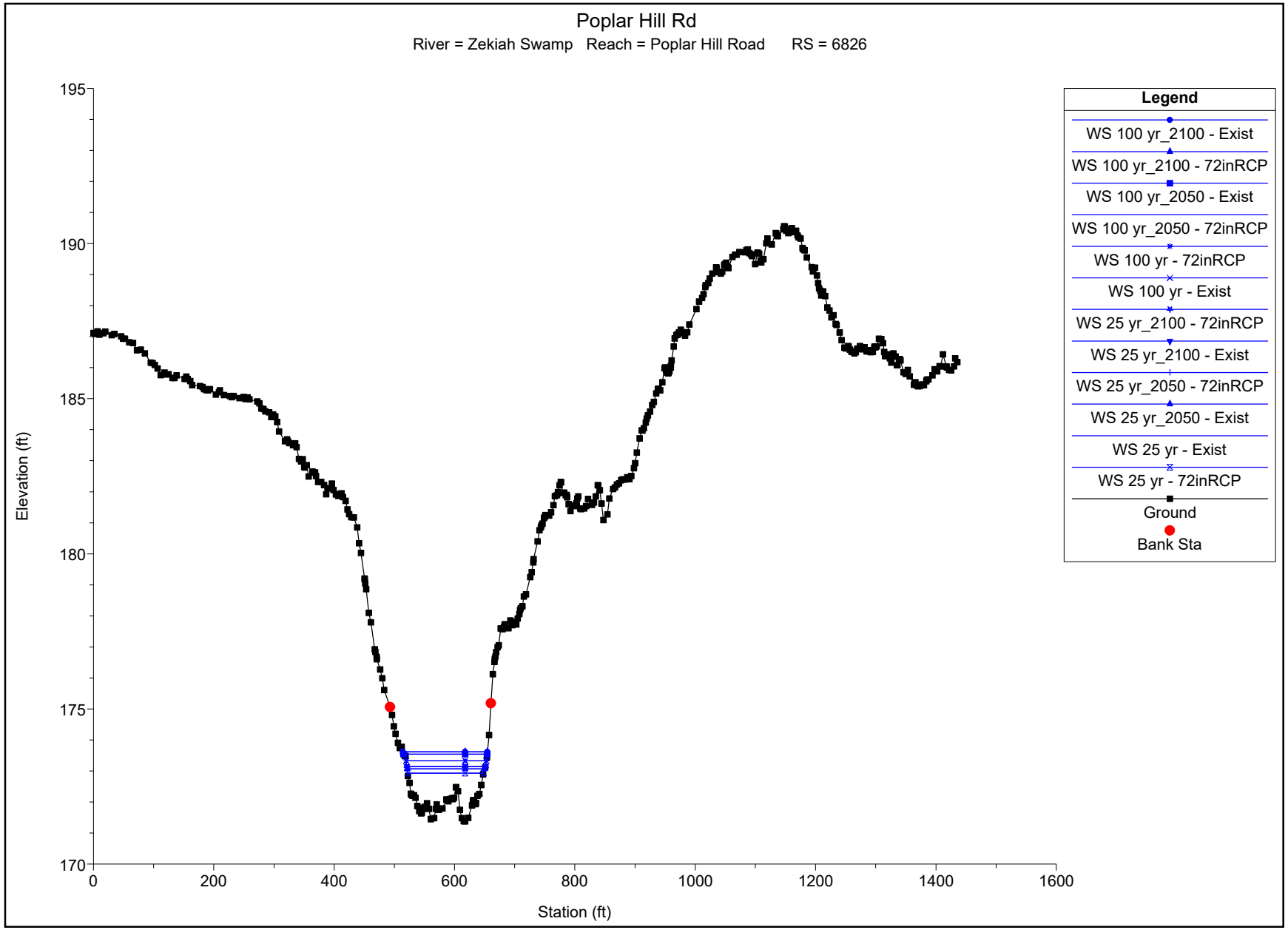
Elevation (ft)
Station (ft)
195
190
185
180
175
170
0
200
400
600
800
1000
1200
1400
1600
Legend
WS 100 yr_2100 - Exist
WS 100 yr_2100 - 72inRCP
WS 100 yr_2050 - Exist
WS 100 yr_2050 - 72inRCP
WS 100 yr - 72inRCP
WS 100 yr - Exist
WS 25 yr_2100 - 72inRCP
WS 25 yr_2100 - Exist
WS 25 yr_2050 - 72inRCP
WS 25 yr_2050 - Exist
WS 25 yr - Exist
WS 25 yr - 72inRCP
Ground
Bank Sta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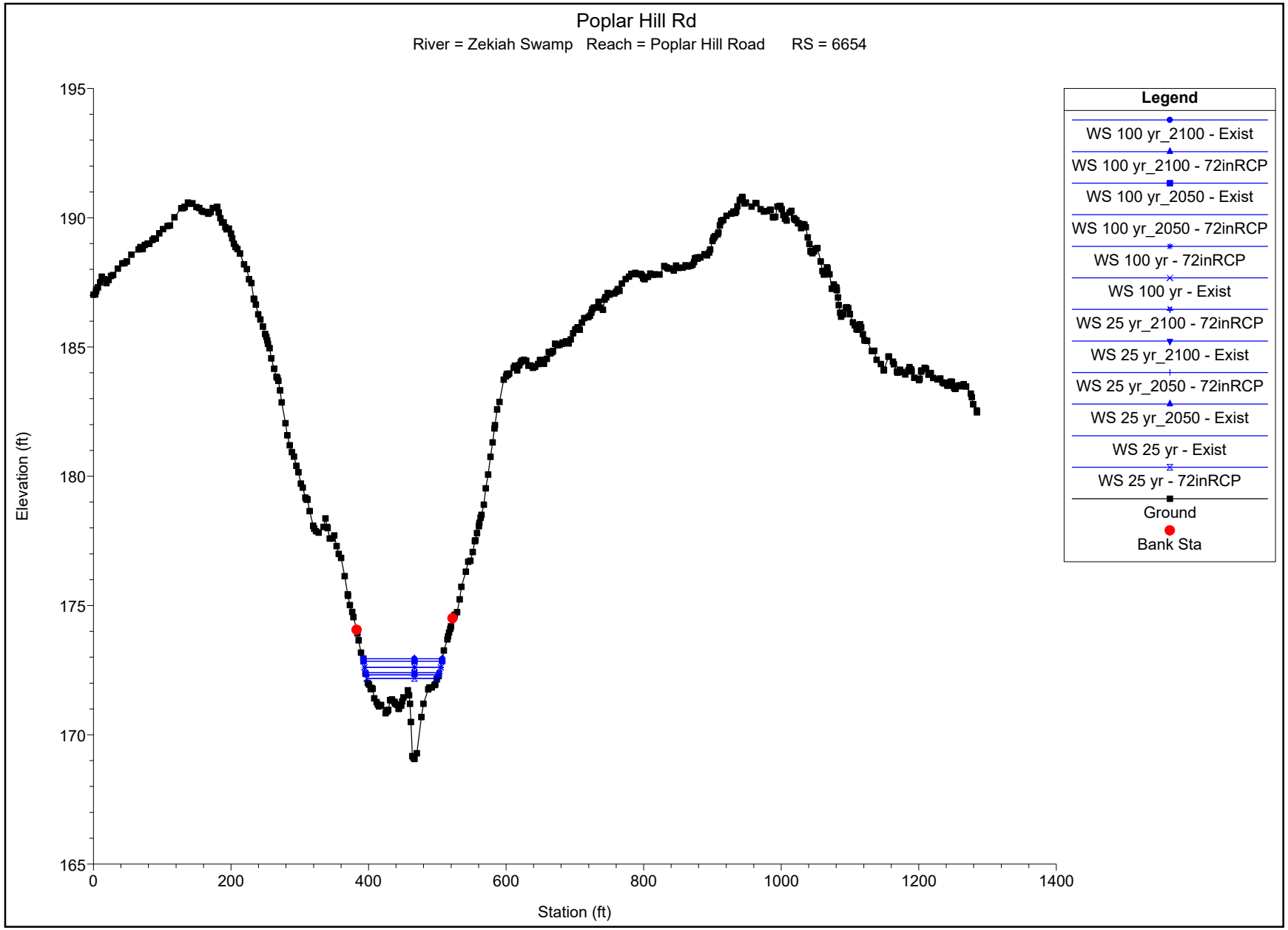
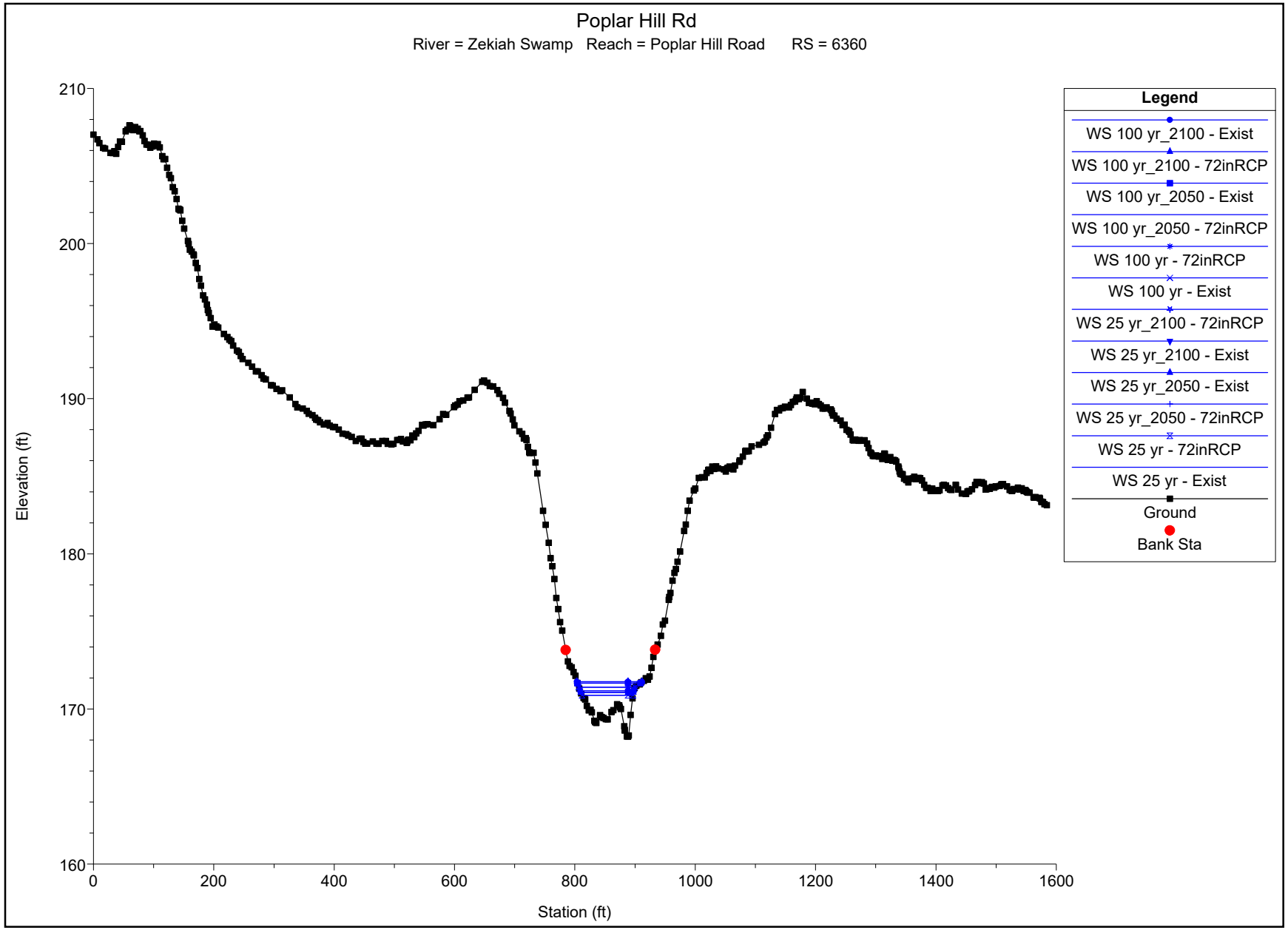
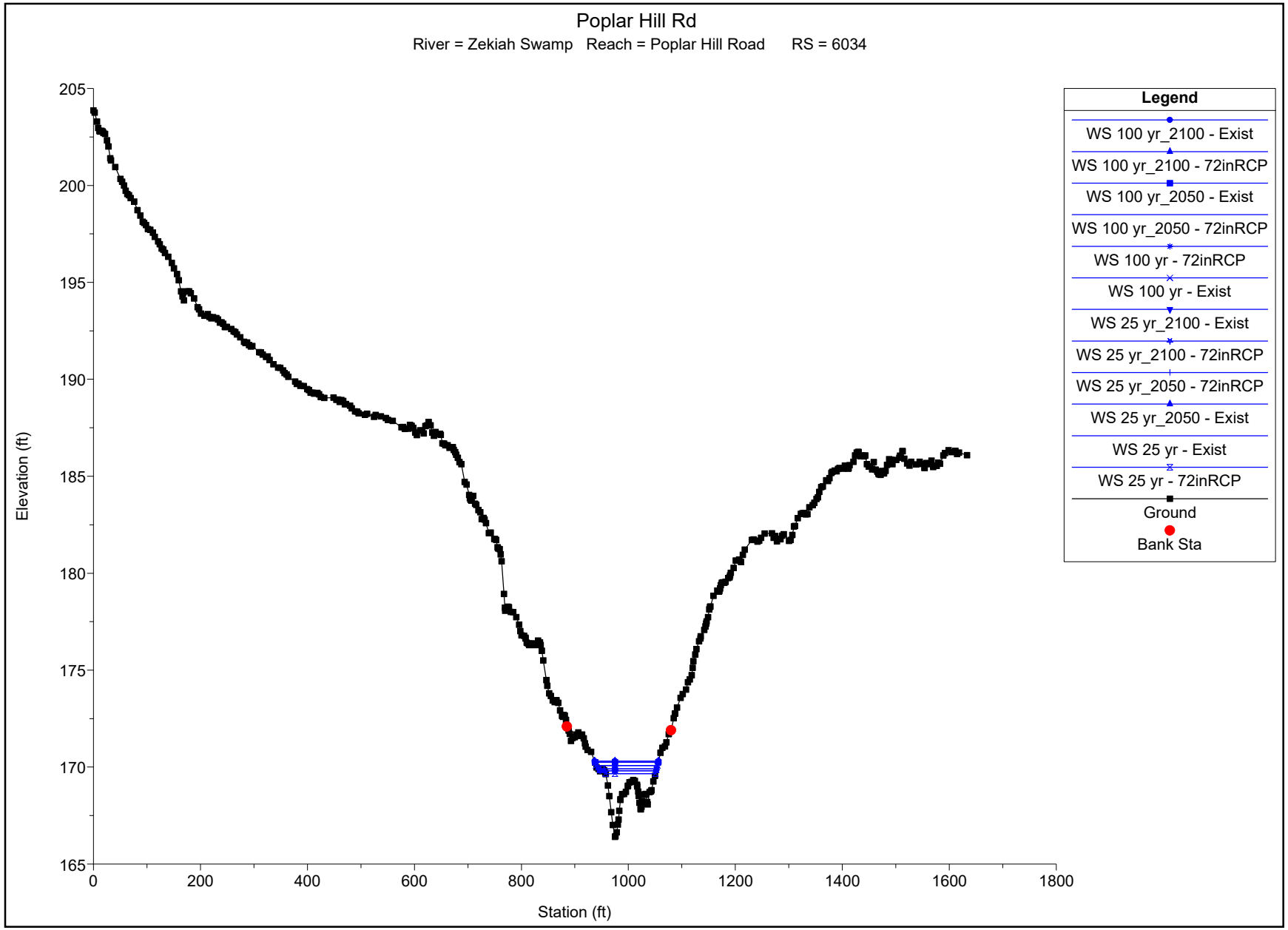
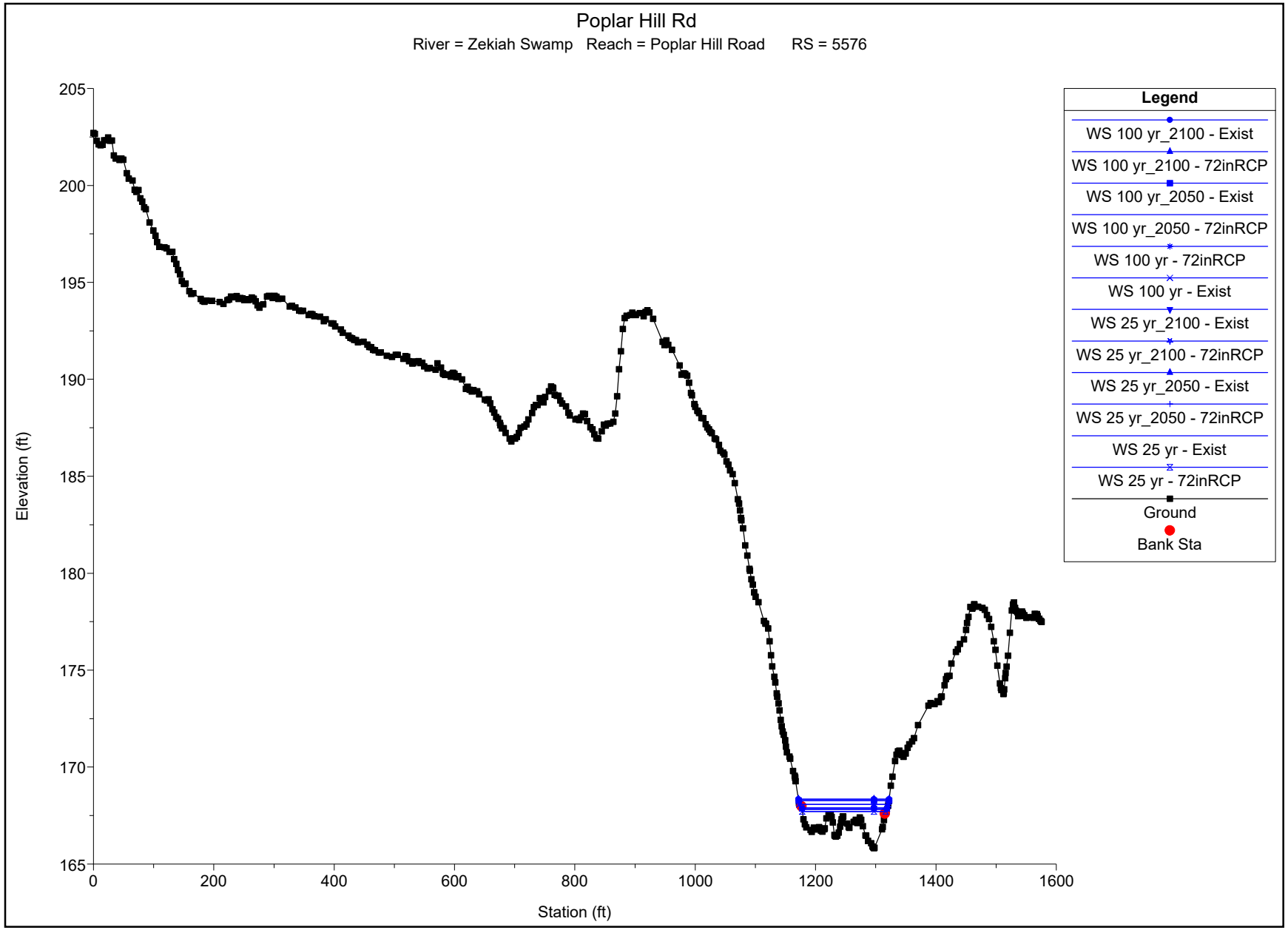
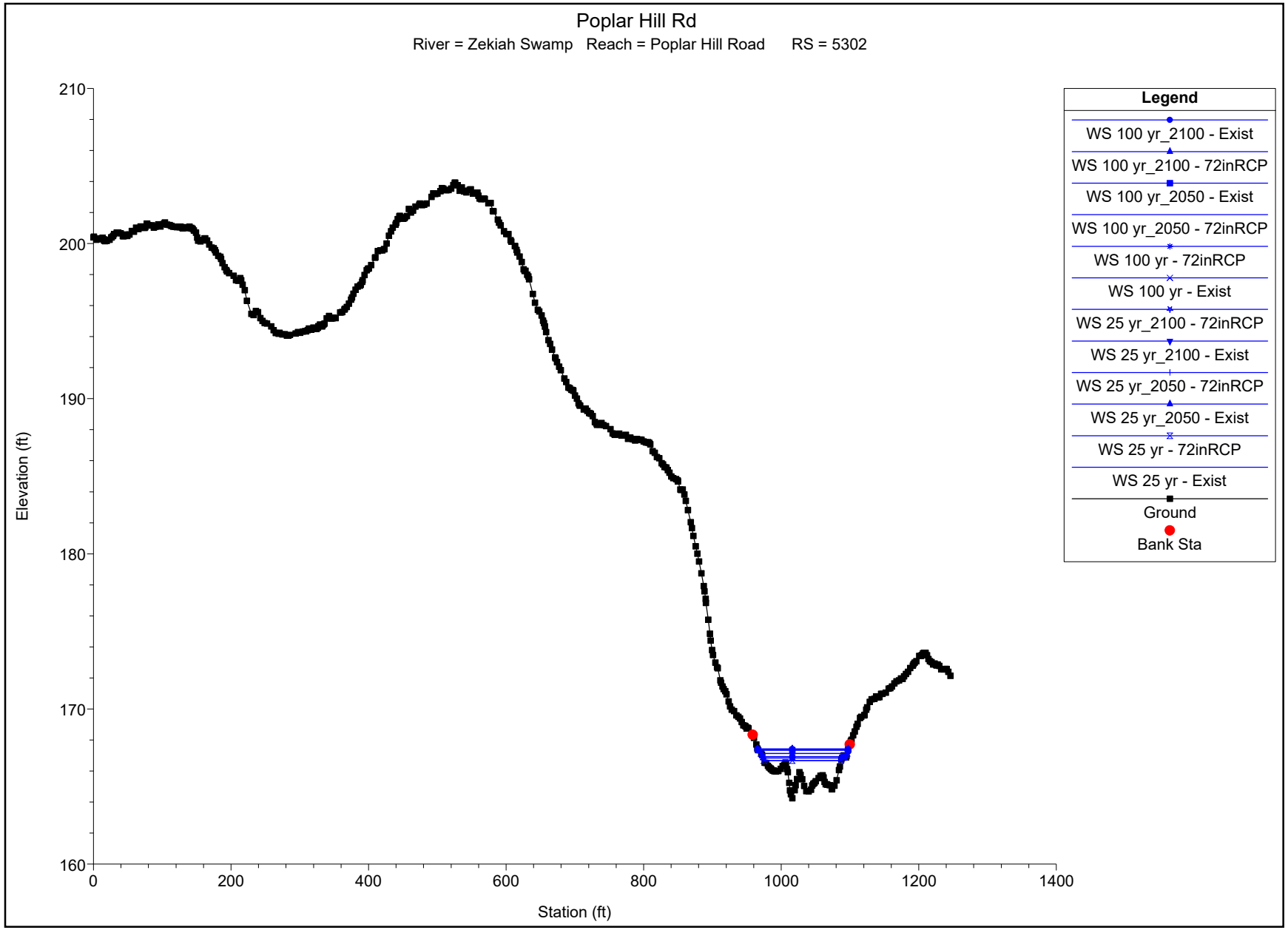
River = Zekiah Swamp Reach = Poplar Hill Road RS = 6826
Elevation (ft)
Station (ft)
195
190
185
180
175
170
0
200
400
600
800
1000
1200
1400
1600
Legend
WS 100 yr_2100 - Exist
WS 100 yr_2100 - 72inRCP
WS 100 yr_2050 - Exist
WS 100 yr_2050 - 72inRCP
WS 100 yr - 72inRCP
WS 100 yr - Exist
WS 25 yr_2100 - 72inRCP
WS 25 yr_2100 - Exist
WS 25 yr_2050 - 72inRCP
WS 25 yr_2050 - Exist
WS 25 yr - Exist
WS 25 yr - 72inRCP
Ground
Bank Sta

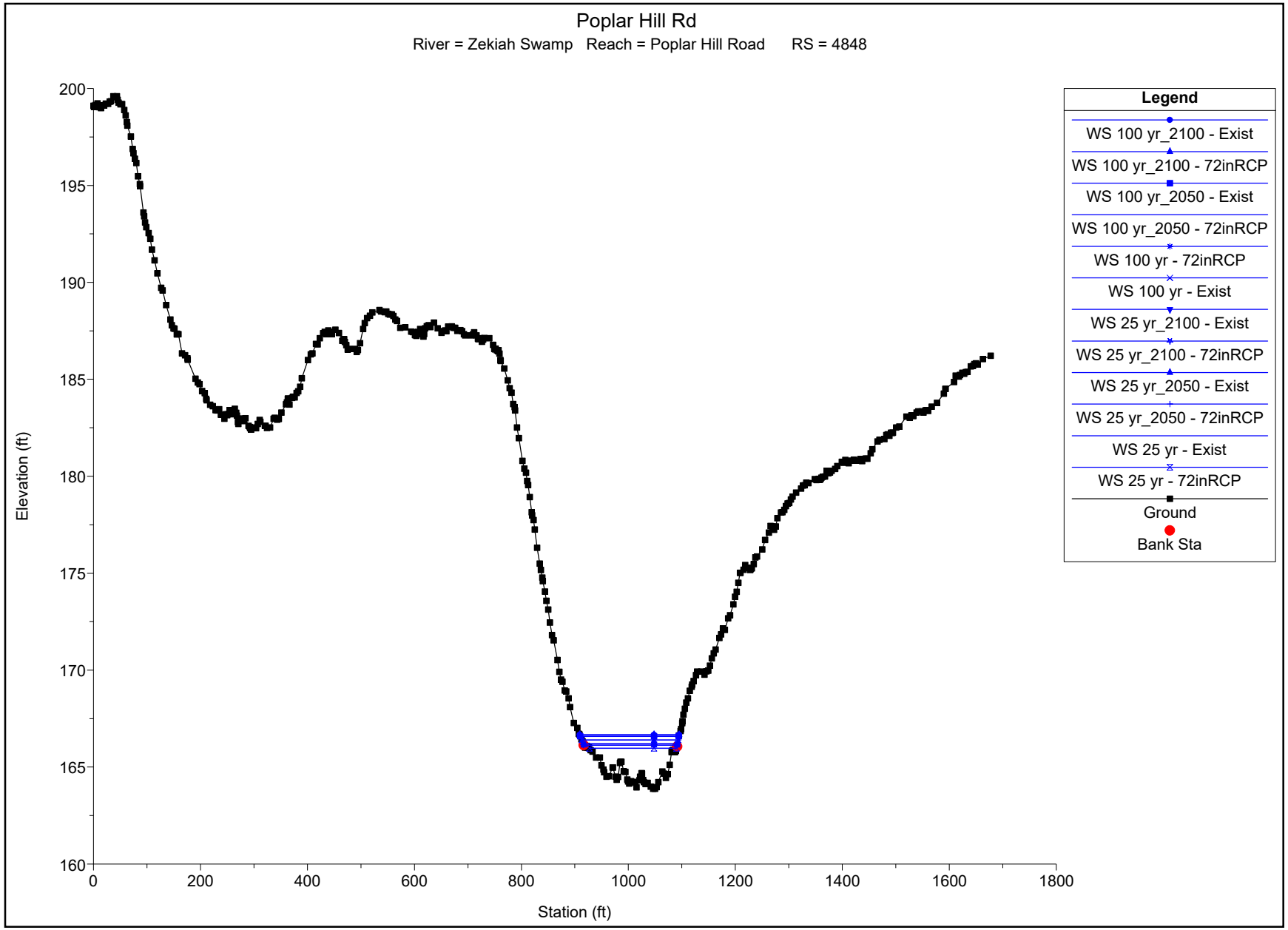

Poplar Hill Rd
River = Zekiah Swamp Reach = Poplar Hill Road RS = 6654
Elevation (ft)
Station (ft)
195
190
185
180
175
170
165
0
200
400
600
800
1000
1200
1400
Legend
WS 100 yr_2100 - Exist
WS 100 yr_2100 - 72inRCP
WS 100 yr_2050 - Exist
WS 100 yr_2050 - 72inRCP
WS 100 yr - 72inRCP
WS 100 yr - Exist
WS 25 yr_2100 - 72inRCP
WS 25 yr_2100 - Exist
WS 25 yr_2050 - 72inRCP
WS 25 yr_2050 - Exist
WS 25 yr - Exist
WS 25 yr - 72inRCP
Ground
Bank Sta

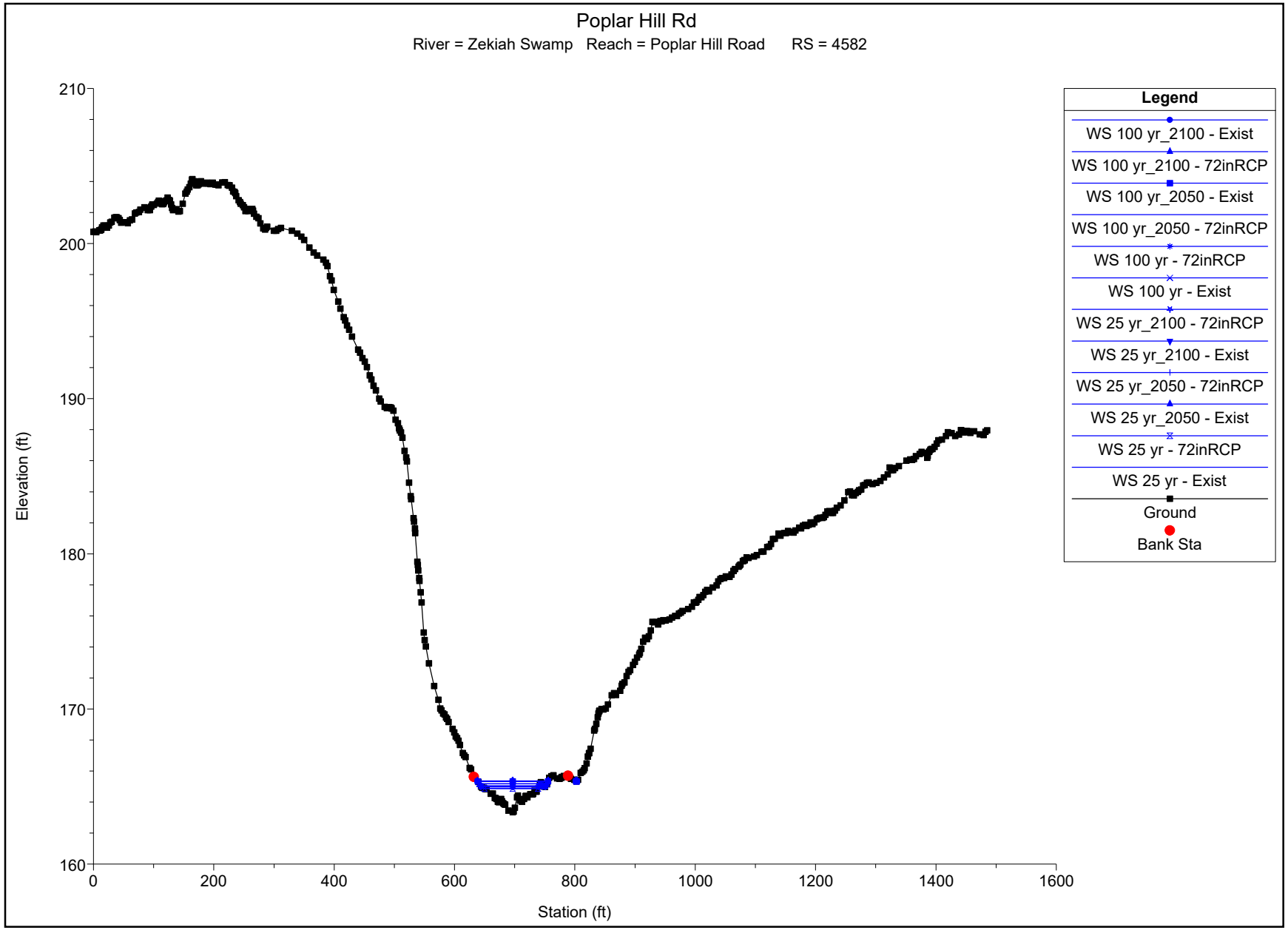

Poplar Hill Rd
River = Zekiah Swamp Reach = Poplar Hill Road RS = 6360
Elevation (ft)
Station (ft)
210
200
190
180
170
160
0
200
400
600
800
1000
1200
1400
1600
Legend
WS 100 yr_2100 - Exist
WS 100 yr_2100 - 72inRCP
WS 100 yr_2050 - Exist
WS 100 yr_2050 - 72inRCP
WS 100 yr - 72inRCP
WS 100 yr - Exist
WS 25 yr_2100 - 72inRCP
WS 25 yr_2100 - Exist
WS 25 yr_2050 - Exist
WS 25 yr_2050 - 72inRCP
WS 25 yr - 72inRCP
WS 25 yr - Exist
Ground
Bank Sta

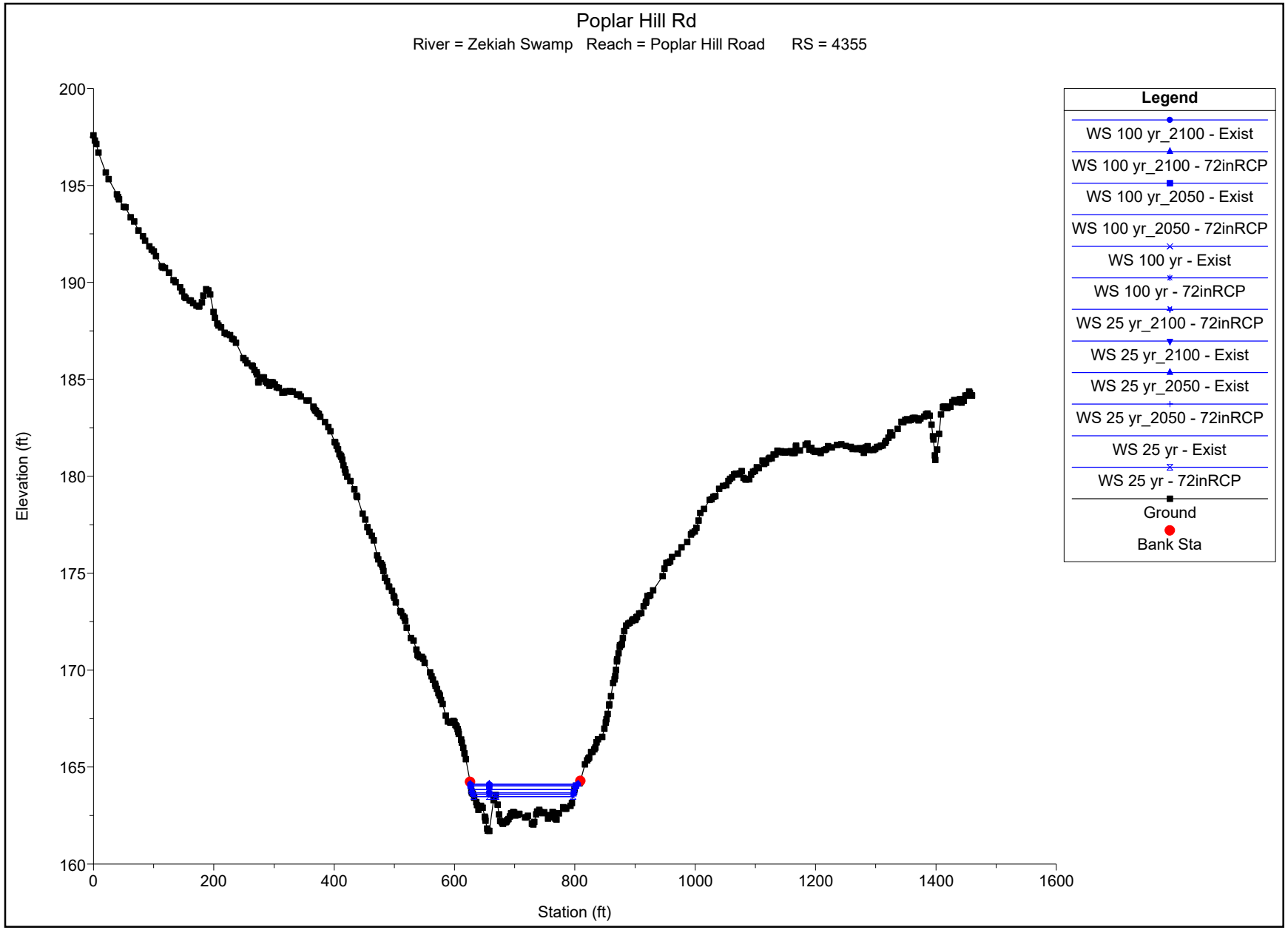

Poplar Hill Rd
River = Zekiah Swamp Reach = Poplar Hill Road RS = 6034
Elevation (ft)
Station (ft)
205
200
195
190
185
180
175
170
165
0
200
400
600
800
1000
1200
1400
1600
1800
Legend
WS 100 yr_2100 - Exist
WS 100 yr_2100 - 72inRCP
WS 100 yr_2050 - Exist
WS 100 yr_2050 - 72inRCP
WS 100 yr - 72inRCP
WS 100 yr - Exist
WS 25 yr_2100 - Exist
WS 25 yr_2100 - 72inRCP
WS 25 yr_2050 - 72inRCP
WS 25 yr_2050 - Exist
WS 25 yr - Exist
WS 25 yr - 72inRCP
Ground
Bank Sta

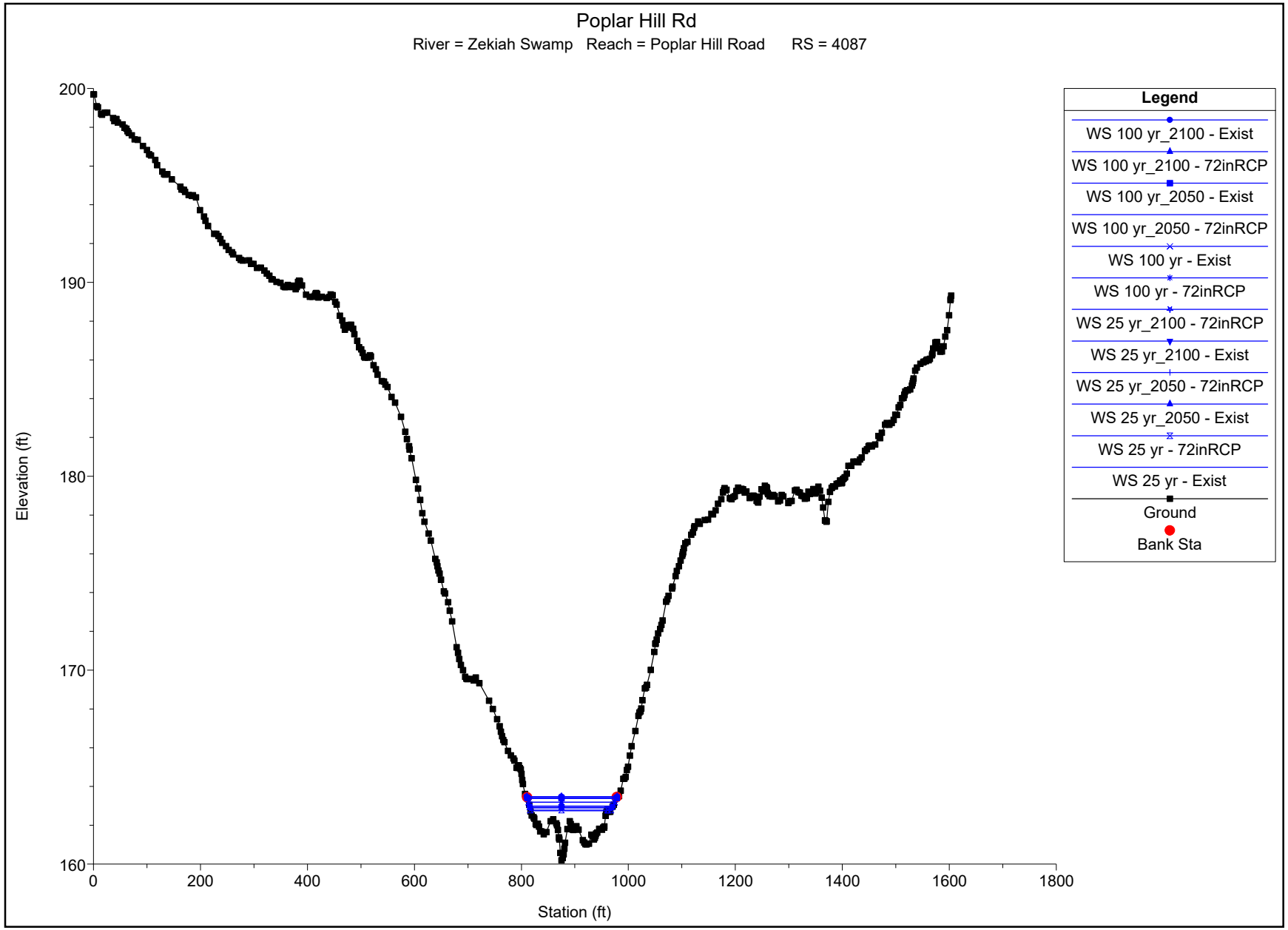

Poplar Hill Rd
River = Zekiah Swamp Reach = Poplar Hill Road RS = 5576
Elevation (ft)
Station (ft)
205
200
195
190
185
180
175
170
165
0
200
400
600
800
1000
1200
1400
1600
Legend
WS 100 yr_2100 - Exist
WS 100 yr_2100 - 72inRCP
WS 100 yr_2050 - Exist
WS 100 yr_2050 - 72inRCP
WS 100 yr - 72inRCP
WS 100 yr - Exist
WS 25 yr_2100 - Exist
WS 25 yr_2100 - 72inRCP
WS 25 yr_2050 - Exist
WS 25 yr_2050 - 72inRCP
WS 25 yr - Exist
WS 25 yr - 72inRCP
Ground
Bank Sta

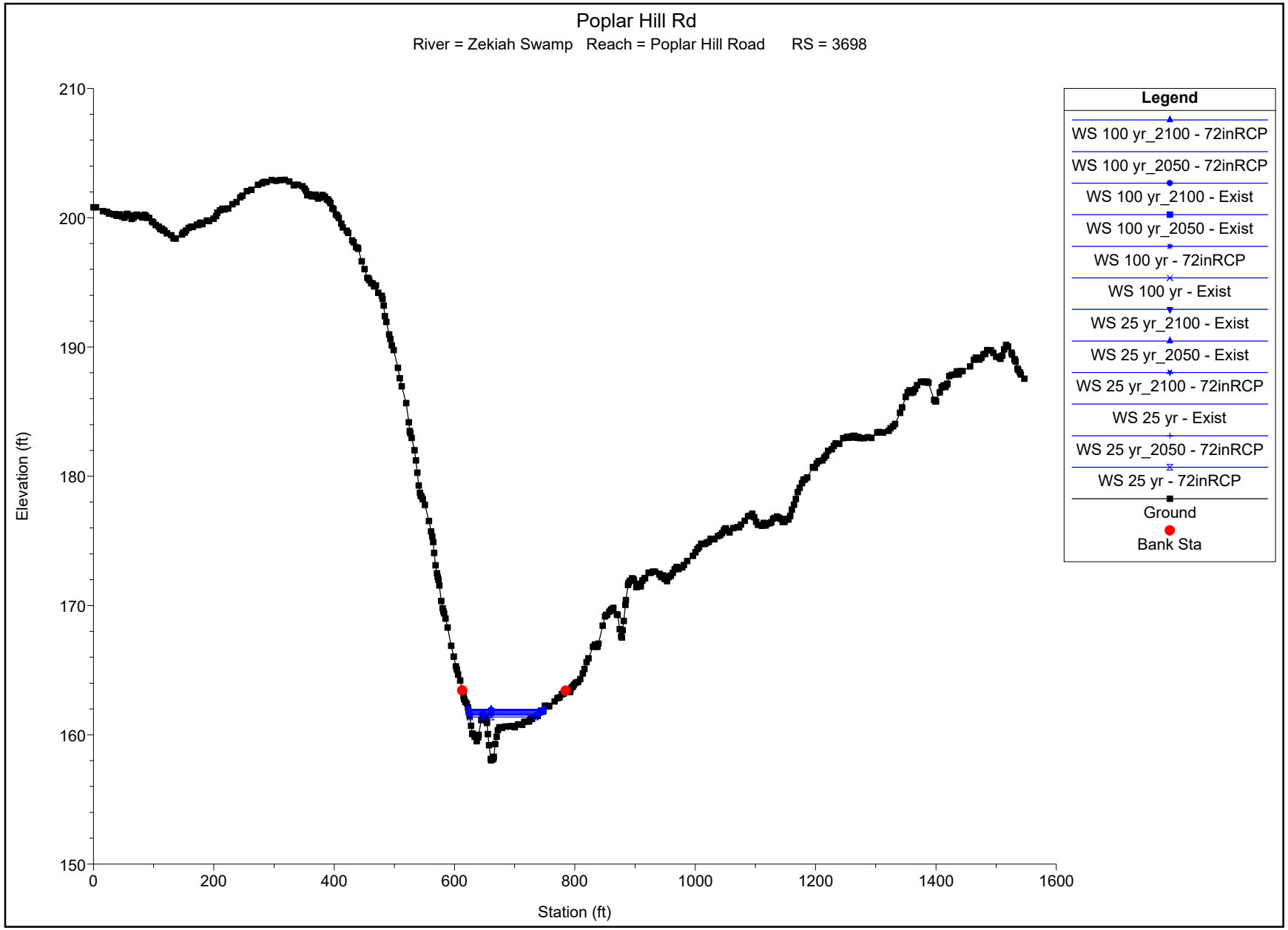

Poplar Hill Rd
River = Zekiah Swamp Reach = Poplar Hill Road RS = 5302
Elevation (ft)
Station (ft)
210
200
190
180
170
160
0
200
400
600
800
1000
1200
1400
Legend
WS 100 yr_2100 - Exist
WS 100 yr_2100 - 72inRCP
WS 100 yr_2050 - Exist
WS 100 yr_2050 - 72inRCP
WS 100 yr - 72inRCP
WS 100 yr - Exist
WS 25 yr_2100 - 72inRCP
WS 25 yr_2100 - Exist
WS 25 yr_2050 - 72inRCP
WS 25 yr_2050 - Exist
WS 25 yr - 72inRCP
WS 25 yr - Exist
Ground
Bank Sta

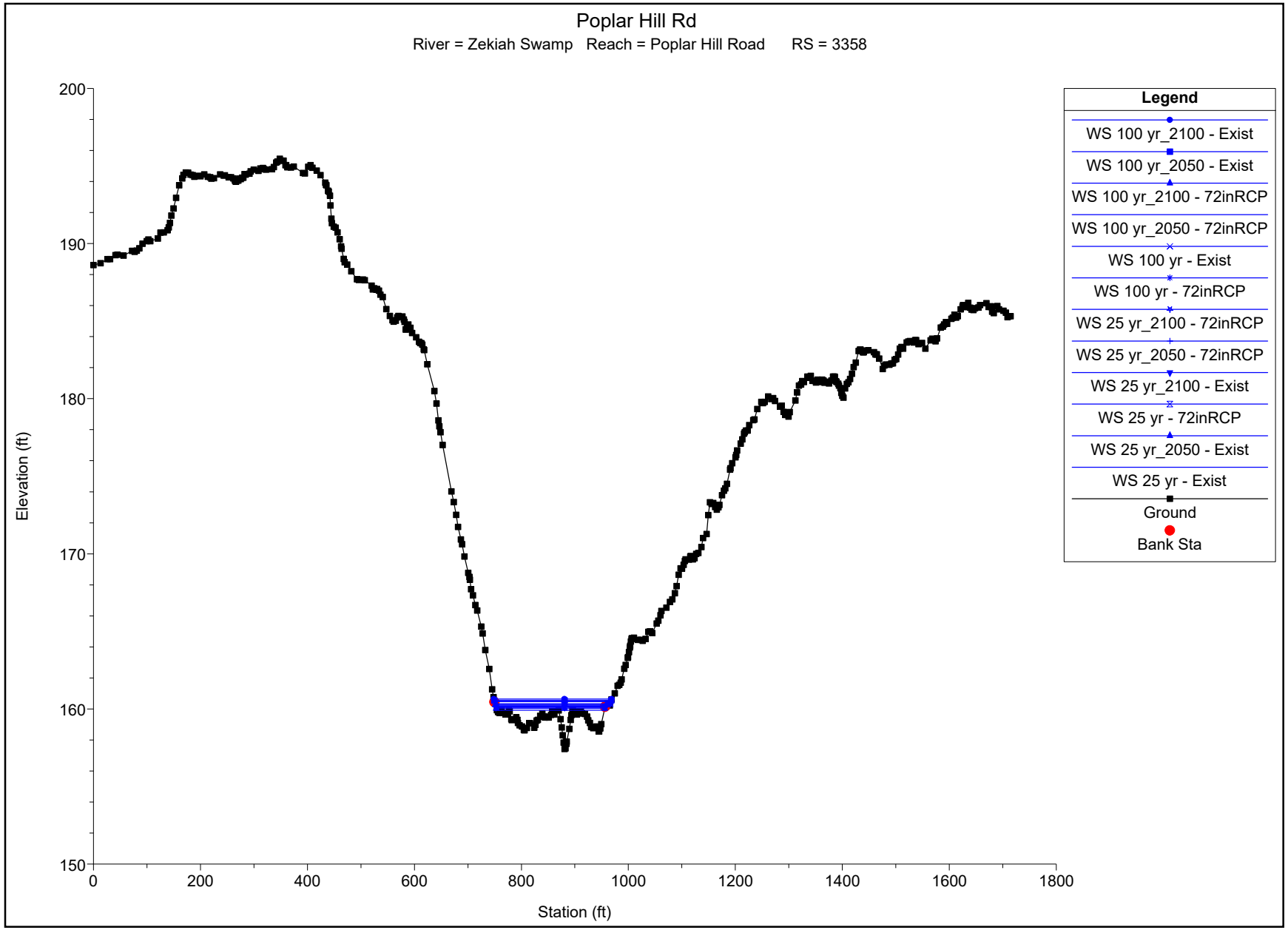

Poplar Hill Rd
River = Zekiah Swamp Reach = Poplar Hill Road RS = 4848
Elevation (ft)
Station (ft)
200
195
190
185
180
175
170
165
160
0
200
400
600
800
1000
1200
1400
1600
1800
Legend
WS 100 yr_2100 - Exist
WS 100 yr_2100 - 72inRCP
WS 100 yr_2050 - Exist
WS 100 yr_2050 - 72inRCP
WS 100 yr - 72inRCP
WS 100 yr - Exist
WS 25 yr_2100 - Exist
WS 25 yr_2100 - 72inRCP
WS 25 yr_2050 - Exist
WS 25 yr_2050 - 72inRCP
WS 25 yr - Exist
WS 25 yr - 72inRCP
Ground
Bank Sta

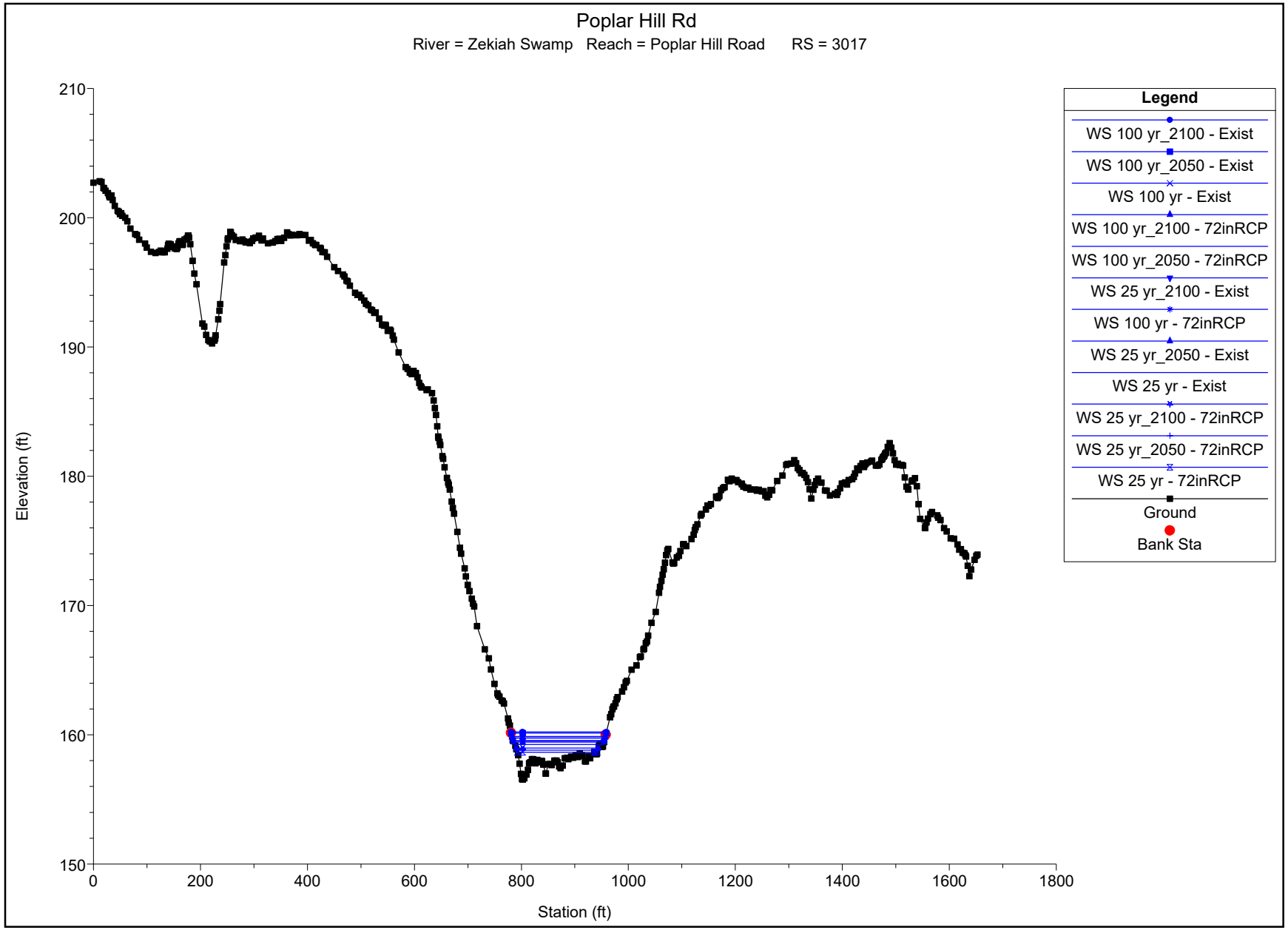

Poplar Hill Rd
River = Zekiah Swamp Reach = Poplar Hill Road RS = 4582
Elevation (ft)
Station (ft)
210
200
190
180
170
160
0
200
400
600
800
1000
1200
1400
1600
Legend
WS 100 yr_2100 - Exist
WS 100 yr_2100 - 72inRCP
WS 100 yr_2050 - Exist
WS 100 yr_2050 - 72inRCP
WS 100 yr - 72inRCP
WS 100 yr - Exist
WS 25 yr_2100 - 72inRCP
WS 25 yr_2100 - Exist
WS 25 yr_2050 - 72inRCP
WS 25 yr_2050 - Exist
WS 25 yr - 72inRCP
WS 25 yr - Exist
Ground
Bank Sta

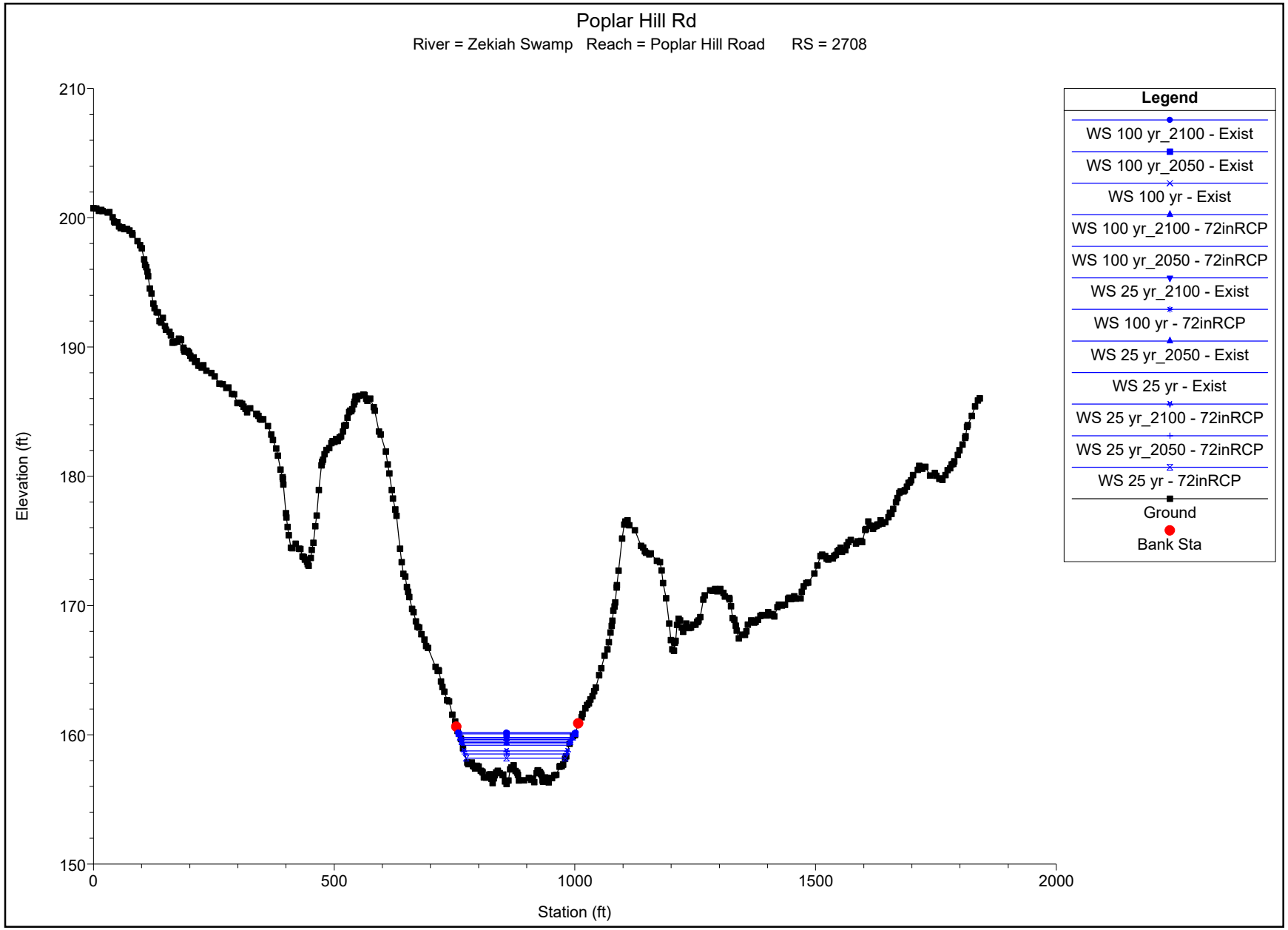

Poplar Hill Rd
River = Zekiah Swamp Reach = Poplar Hill Road RS = 4355
Elevation (ft)
Station (ft)
200
195
190
185
180
175
170
165
160
0
200
400
600
800
1000
1200
1400
1600
Legend
WS 100 yr_2100 - Exist
WS 100 yr_2100 - 72inRCP
WS 100 yr_2050 - Exist
WS 100 yr_2050 - 72inRCP
WS 100 yr - Exist
WS 100 yr - 72inRCP
WS 25 yr_2100 - 72inRCP
WS 25 yr_2100 - Exist
WS 25 yr_2050 - Exist
WS 25 yr_2050 - 72inRCP
WS 25 yr - Exist
WS 25 yr - 72inRCP
Ground
Bank Sta

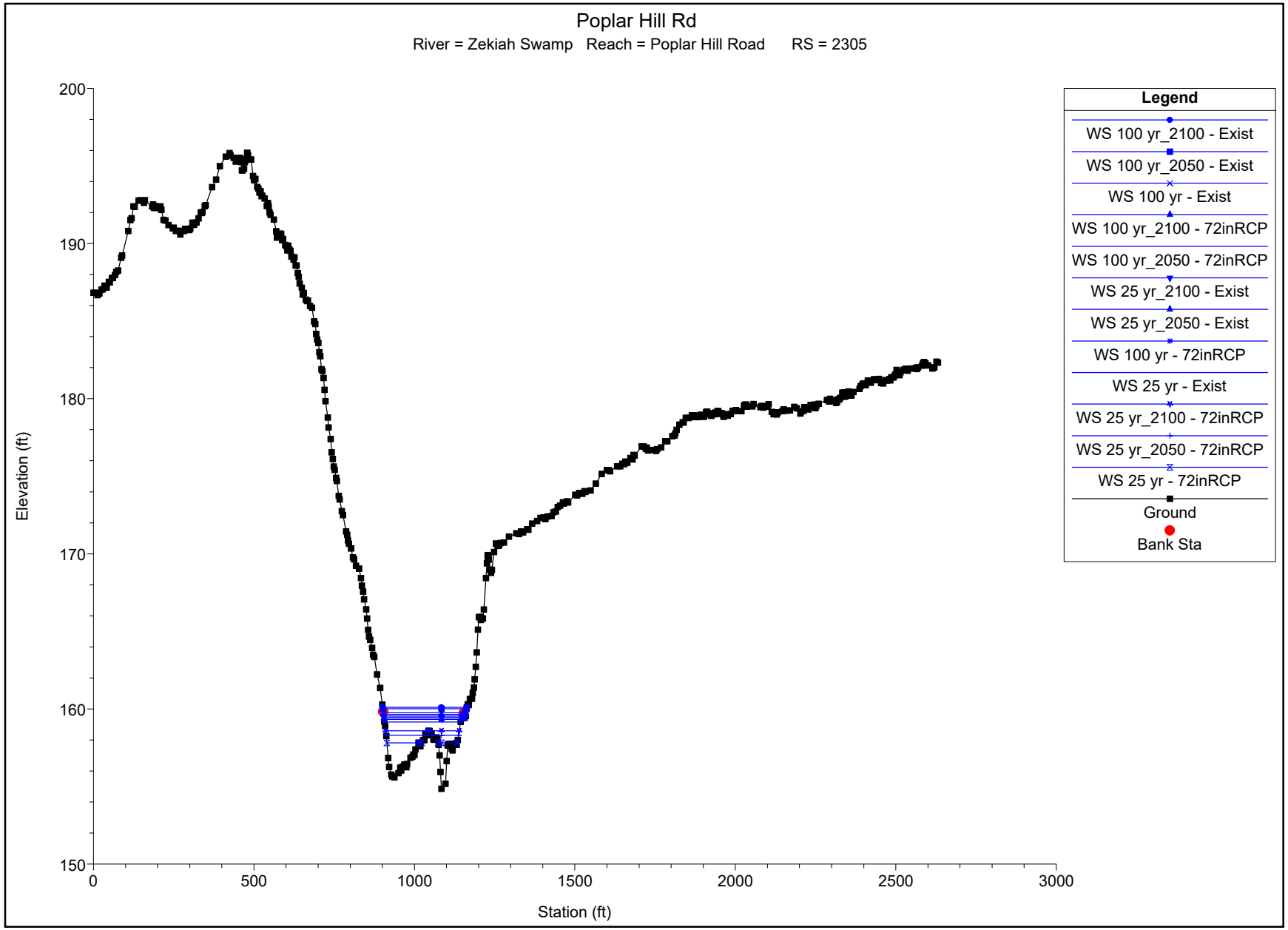

Poplar Hill Rd
River = Zekiah Swamp Reach = Poplar Hill Road RS = 4087
Elevation (ft)
Station (ft)
200
190
180
170
160
0
200
400
600
800
1000
1200
1400
1600
1800
Legend
WS 100 yr_2100 - Exist
WS 100 yr_2100 - 72inRCP
WS 100 yr_2050 - Exist
WS 100 yr_2050 - 72inRCP
WS 100 yr - Exist
WS 100 yr - 72inRCP
WS 25 yr_2100 - 72inRCP
WS 25 yr_2100 - Exist
WS 25 yr_2050 - 72inRCP
WS 25 yr_2050 - Exist
WS 25 yr - 72inRCP
WS 25 yr - Exist
Ground
Bank Sta

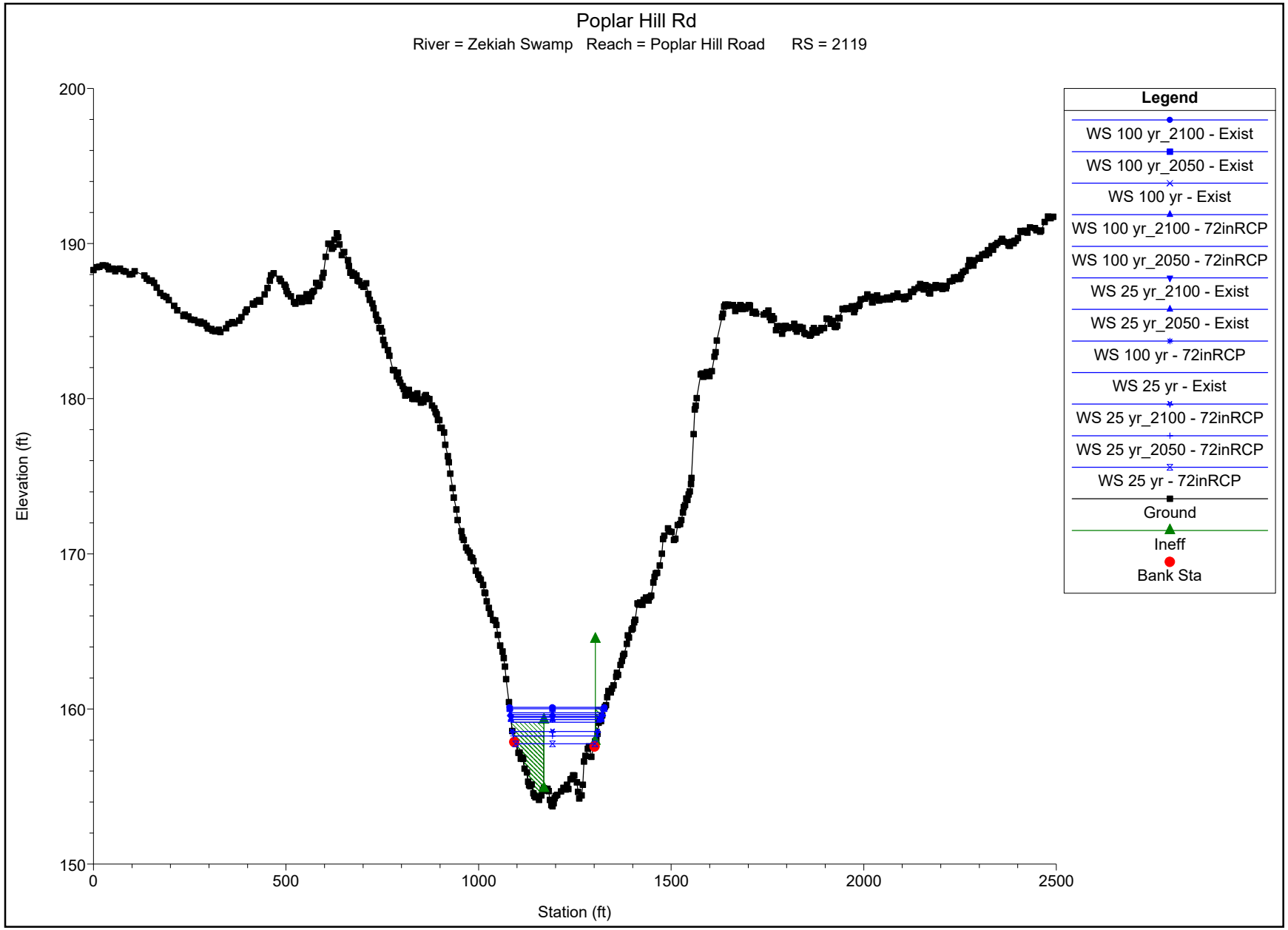

Poplar Hill Rd
River = Zekiah Swamp Reach = Poplar Hill Road RS = 3698
Elevation (ft)
Station (ft)
210
200
190
180
170
160
150
0
200
400
600
800
1000
1200
1400
1600
Legend
WS 100 yr_2100 - 72inRCP
WS 100 yr_2050 - 72inRCP
WS 100 yr_2100 - Exist
WS 100 yr_2050 - Exist
WS 100 yr - 72inRCP
WS 100 yr - Exist
WS 25 yr_2100 - Exist
WS 25 yr_2050 - Exist
WS 25 yr_2100 - 72inRCP
WS 25 yr - Exist
WS 25 yr_2050 - 72inRCP
WS 25 yr - 72inRCP
Ground
Bank Sta

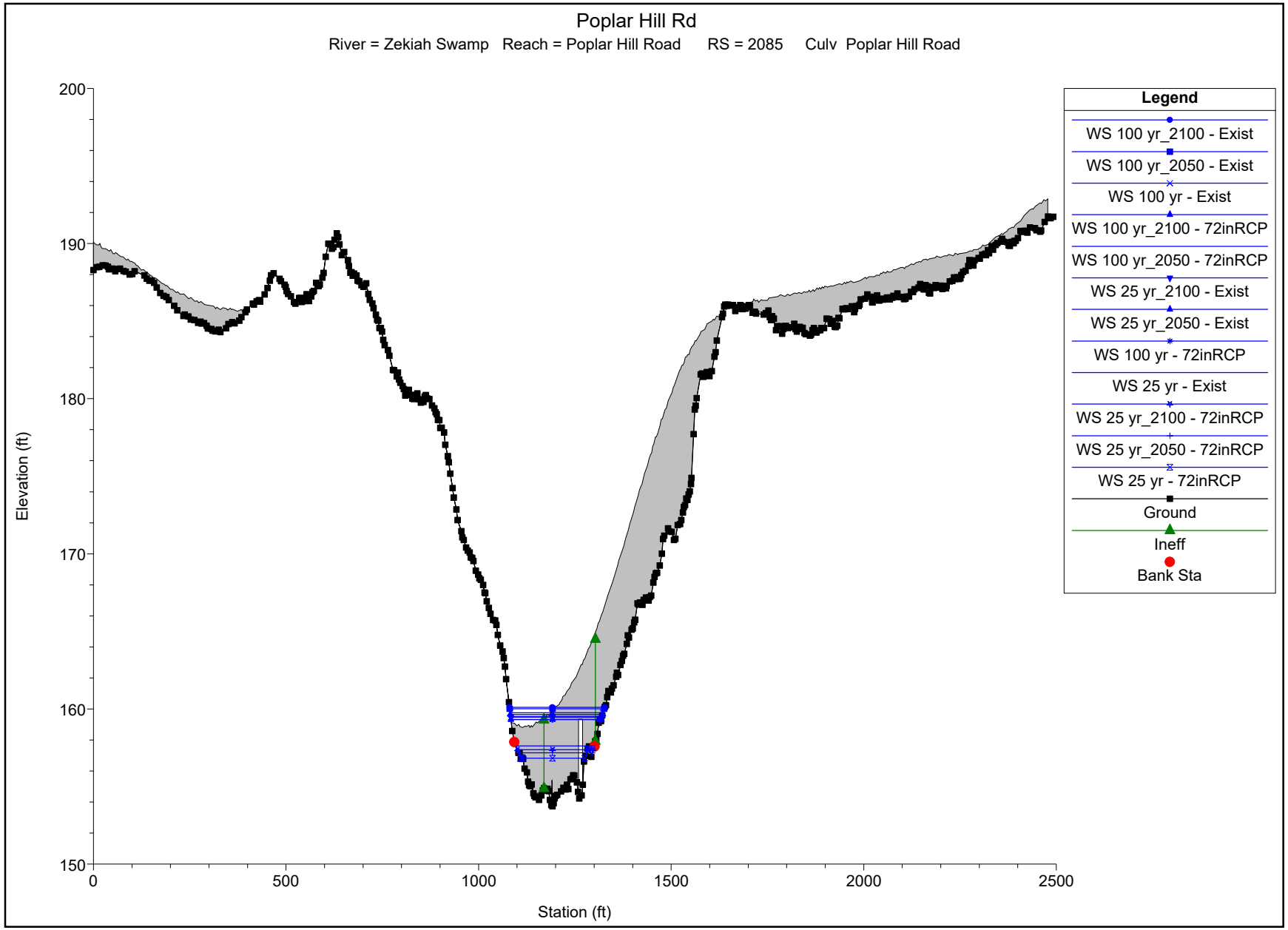

Poplar Hill Rd
River = Zekiah Swamp Reach = Poplar Hill Road RS = 3358
Elevation (ft)
Station (ft)
200
190
180
170
160
150
0
200
400
600
800
1000
1200
1400
1600
1800
Legend
WS 100 yr_2100 - Exist
WS 100 yr_2050 - Exist
WS 100 yr_2100 - 72inRCP
WS 100 yr_2050 - 72inRCP
WS 100 yr - Exist
WS 100 yr - 72inRCP
WS 25 yr_2100 - 72inRCP
WS 25 yr_2050 - 72inRCP
WS 25 yr_2100 - Exist
WS 25 yr - 72inRCP
WS 25 yr_2050 - Exist
WS 25 yr - Exist
Ground
Bank Sta

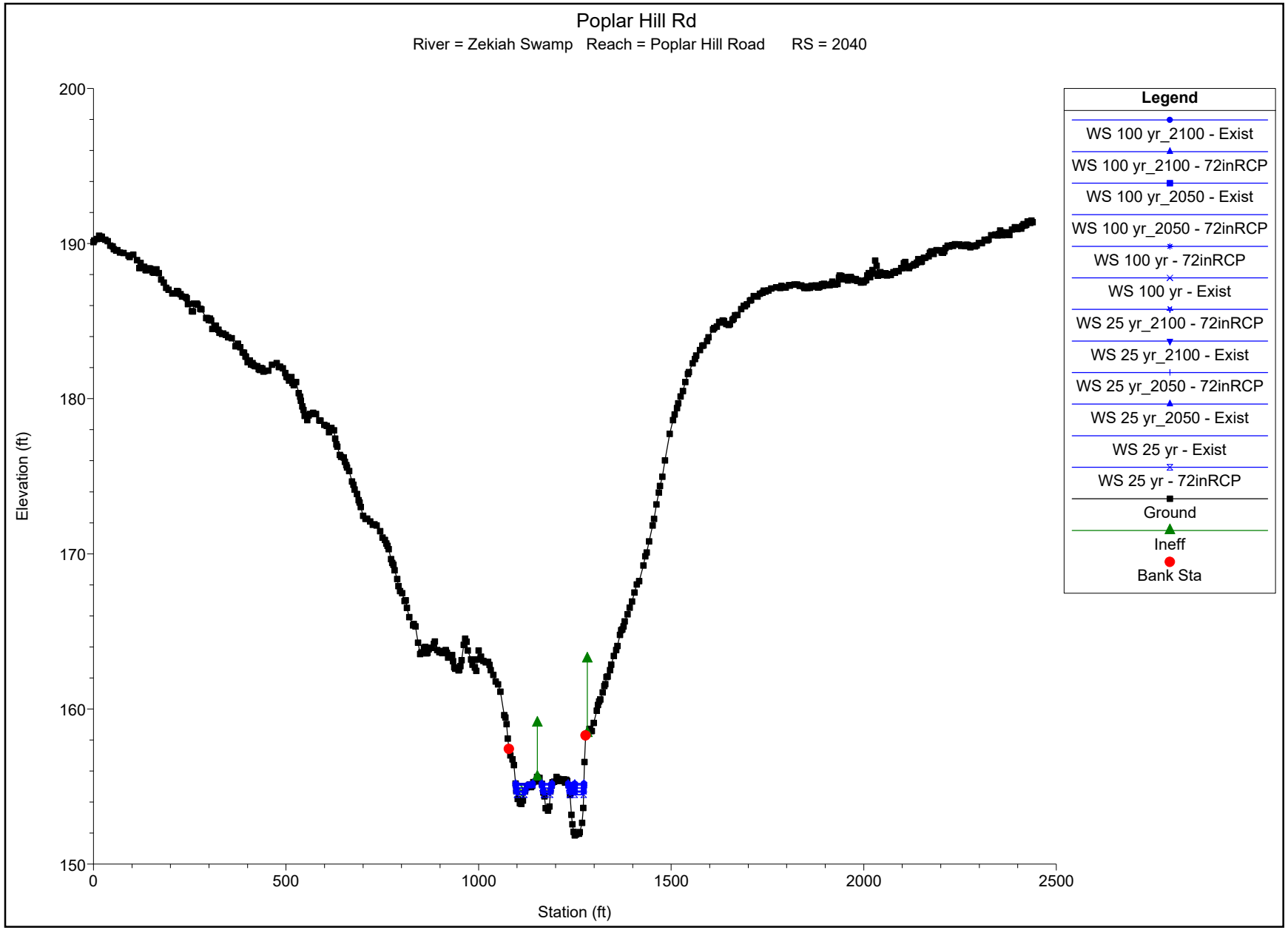

Poplar Hill Rd
River = Zekiah Swamp Reach = Poplar Hill Road RS = 3017
Elevation (ft)
Station (ft)
210
200
190
180
170
160
150
0
200
400
600
800
1000
1200
1400
1600
1800
Legend
WS 100 yr_2100 - Exist
WS 100 yr_2050 - Exist
WS 100 yr - Exist
WS 100 yr_2100 - 72inRCP
WS 100 yr_2050 - 72inRCP
WS 25 yr_2100 - Exist
WS 100 yr - 72inRCP
WS 25 yr_2050 - Exist
WS 25 yr - Exist
WS 25 yr_2100 - 72inRCP
WS 25 yr_2050 - 72inRCP
WS 25 yr - 72inRCP
Ground
Bank Sta

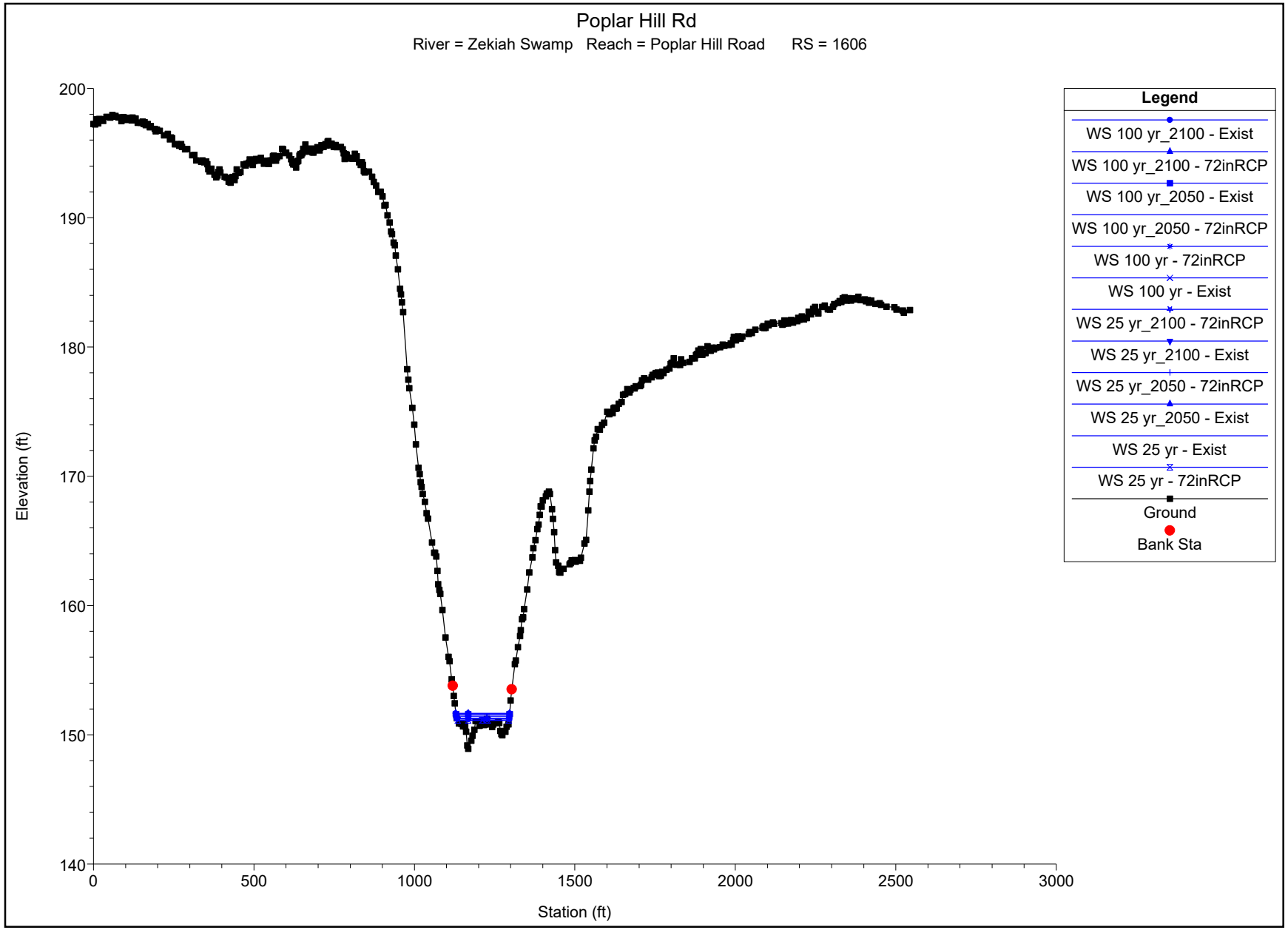

Poplar Hill Rd
River = Zekiah Swamp Reach = Poplar Hill Road RS = 2708
Elevation (ft)
Station (ft)
210
200
190
180
170
160
150
0
500
1000
1500
2000
Legend
WS 100 yr_2100 - Exist
WS 100 yr_2050 - Exist
WS 100 yr - Exist
WS 100 yr_2100 - 72inRCP
WS 100 yr_2050 - 72inRCP
WS 25 yr_2100 - Exist
WS 100 yr - 72inRCP
WS 25 yr_2050 - Exist
WS 25 yr - Exist
WS 25 yr_2100 - 72inRCP
WS 25 yr_2050 - 72inRCP
WS 25 yr - 72inRCP
Ground
Bank Sta

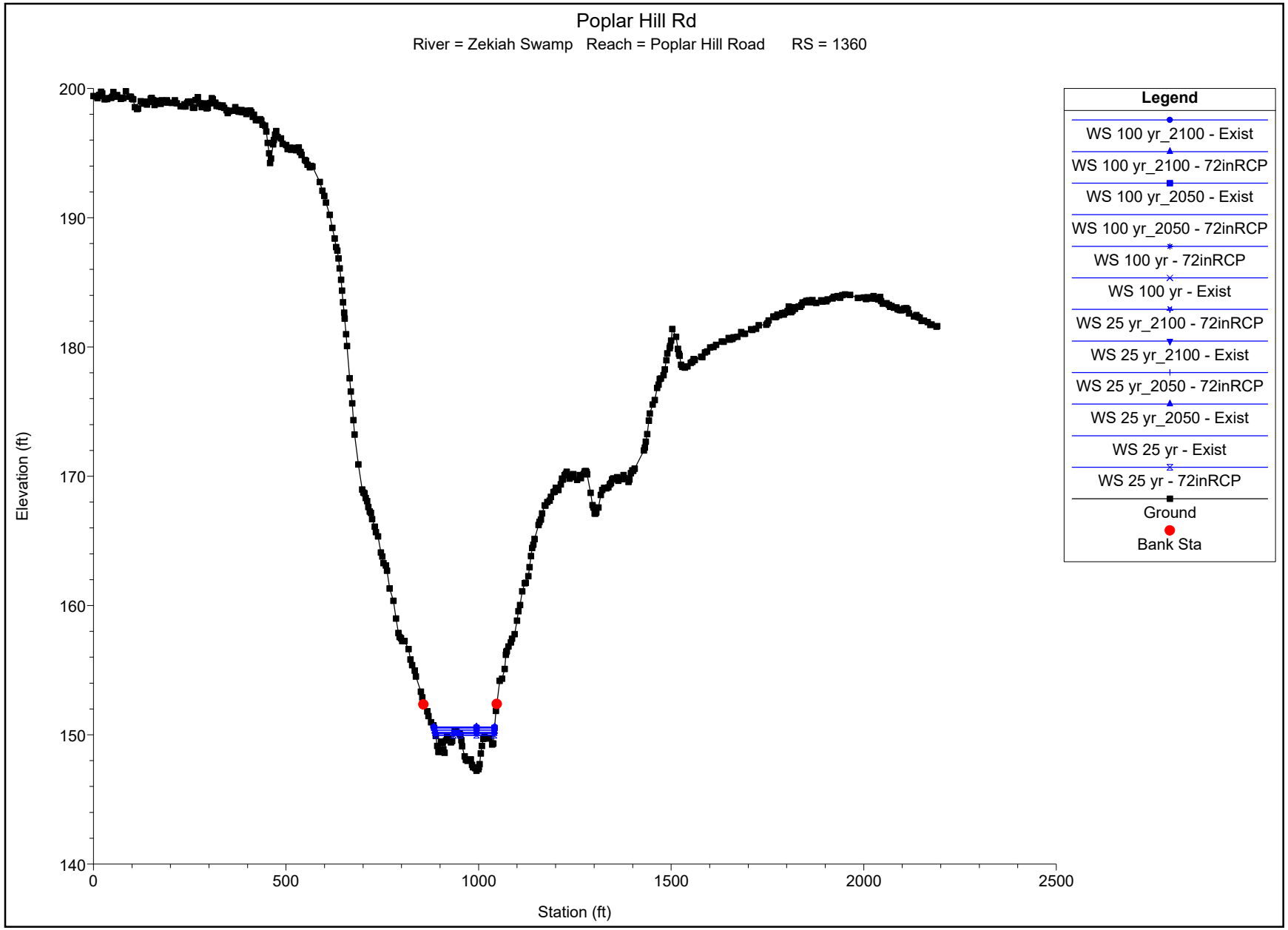

Poplar Hill Rd
River = Zekiah Swamp Reach = Poplar Hill Road RS = 2305
Elevation (ft)
Station (ft)
200
190
180
170
160
150
0
500
1000
1500
2000
2500
3000
Legend
WS 100 yr_2100 - Exist
WS 100 yr_2050 - Exist
WS 100 yr - Exist
WS 100 yr_2100 - 72inRCP
WS 100 yr_2050 - 72inRCP
WS 25 yr_2100 - Exist
WS 25 yr_2050 - Exist
WS 100 yr - 72inRCP
WS 25 yr - Exist
WS 25 yr_2100 - 72inRCP
WS 25 yr_2050 - 72inRCP
WS 25 yr - 72inRCP
Ground
Bank Sta

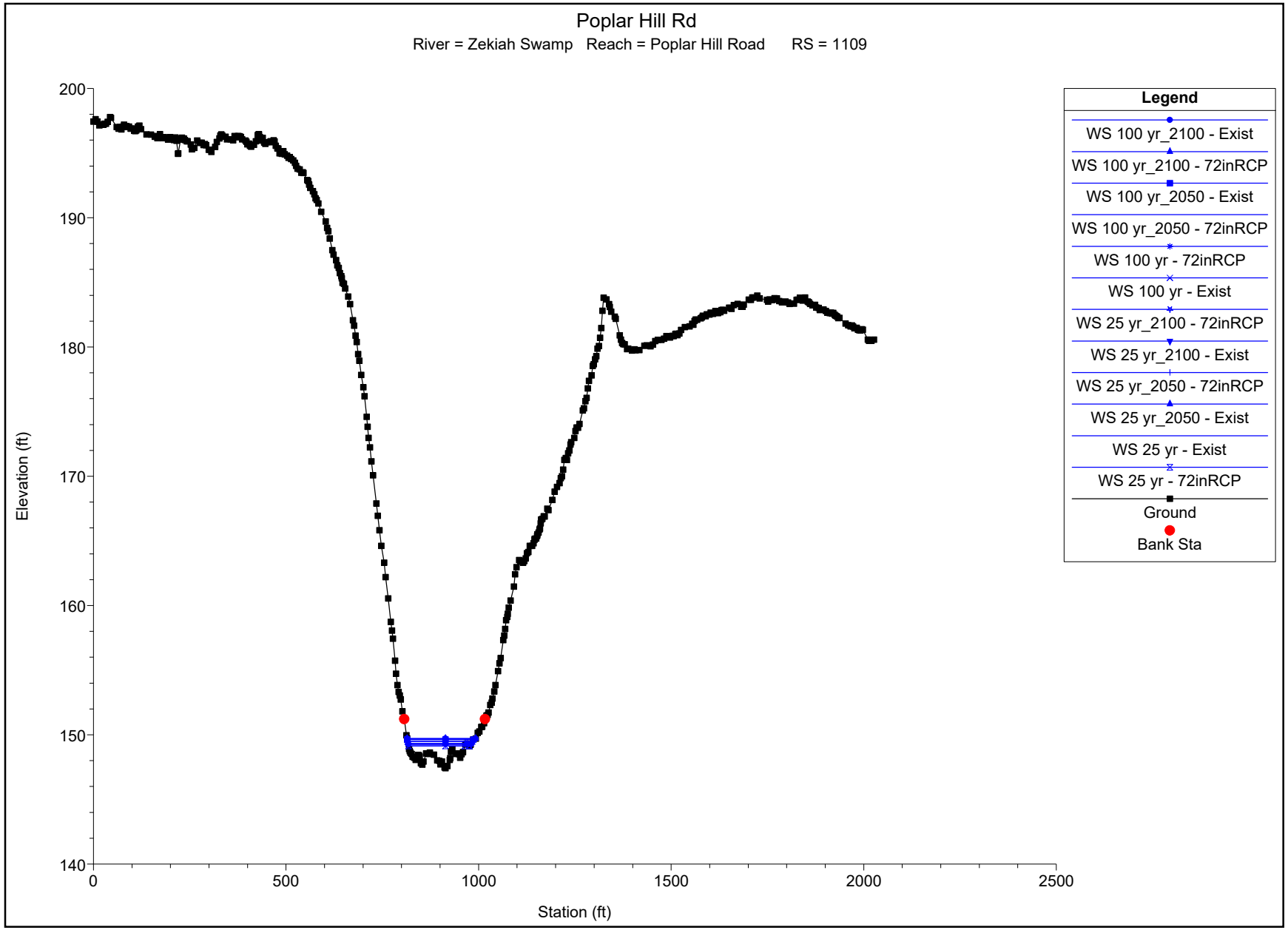

Poplar Hill Rd
River = Zekiah Swamp Reach = Poplar Hill Road RS = 2119
Elevation (ft)
Station (ft)
200
190
180
170
160
150
0
500
1000
1500
2000
2500
Legend
WS 100 yr_2100 - Exist
WS 100 yr_2050 - Exist
WS 100 yr - Exist
WS 100 yr_2100 - 72inRCP
WS 100 yr_2050 - 72inRCP
WS 25 yr_2100 - Exist
WS 25 yr_2050 - Exist
WS 100 yr - 72inRCP
WS 25 yr - Exist
WS 25 yr_2100 - 72inRCP
WS 25 yr_2050 - 72inRCP
WS 25 yr - 72inRCP
Ground
Ineff
Bank Sta

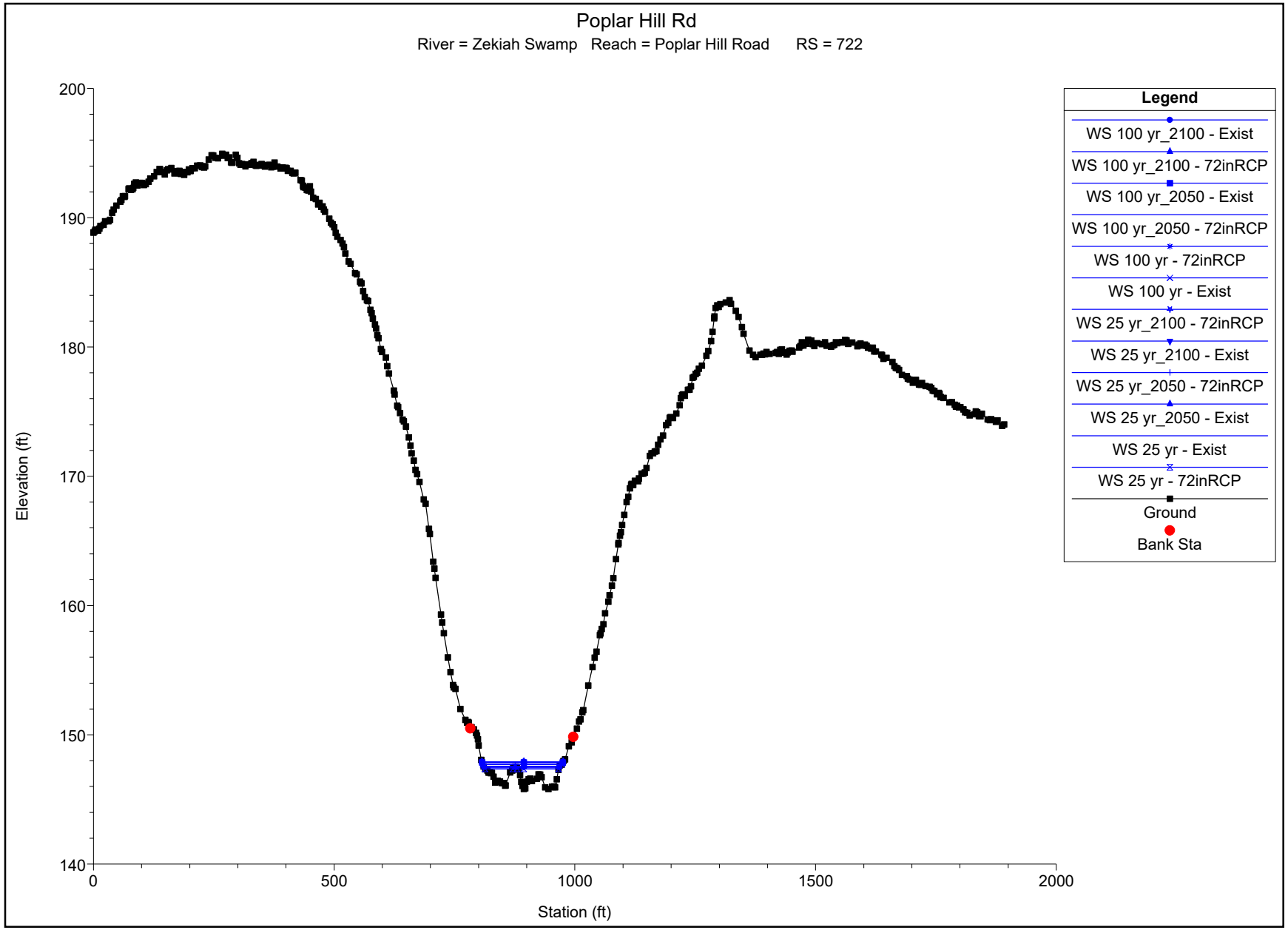

Poplar Hill Rd
River = Zekiah Swamp Reach = Poplar Hill Road RS = 2085 Culv Poplar Hill Road
Elevation (ft)
Station (ft)
200
190
180
170
160
150
0
500
1000
1500
2000
2500
Legend
WS 100 yr_2100 - Exist
WS 100 yr_2050 - Exist
WS 100 yr - Exist
WS 100 yr_2100 - 72inRCP
WS 100 yr_2050 - 72inRCP
WS 25 yr_2100 - Exist
WS 25 yr_2050 - Exist
WS 100 yr - 72inRCP
WS 25 yr - Exist
WS 25 yr_2100 - 72inRCP
WS 25 yr_2050 - 72inRCP
WS 25 yr - 72inRCP
Ground
Ineff
Bank Sta


Poplar Hill Rd
River = Zekiah Swamp Reach = Poplar Hill Road RS = 2040
Elevation (ft)
Station (ft)
200
190
180
170
160
150
0
500
1000
1500
2000
2500
Legend
WS 100 yr_2100 - Exist
WS 100 yr_2100 - 72inRCP
WS 100 yr_2050 - Exist
WS 100 yr_2050 - 72inRCP
WS 100 yr - 72inRCP
WS 100 yr - Exist
WS 25 yr_2100 - 72inRCP
WS 25 yr_2100 - Exist
WS 25 yr_2050 - 72inRCP
WS 25 yr_2050 - Exist
WS 25 yr - Exist
WS 25 yr - 72inRCP
Ground
Ineff
Bank Sta


Poplar Hill Rd
River = Zekiah Swamp Reach = Poplar Hill Road RS = 1606
Elevation (ft)
Station (ft)
200
190
180
170
160
150
140
0
500
1000
1500
2000
2500
3000
Legend
WS 100 yr_2100 - Exist
WS 100 yr_2100 - 72inRCP
WS 100 yr_2050 - Exist
WS 100 yr_2050 - 72inRCP
WS 100 yr - 72inRCP
WS 100 yr - Exist
WS 25 yr_2100 - 72inRCP
WS 25 yr_2100 - Exist
WS 25 yr_2050 - 72inRCP
WS 25 yr_2050 - Exist
WS 25 yr - Exist
WS 25 yr - 72inRCP
Ground
Bank Sta


Poplar Hill Rd
River = Zekiah Swamp Reach = Poplar Hill Road RS = 1360
Elevation (ft)
Station (ft)
200
190
180
170
160
150
140
0
500
1000
1500
2000
2500
Legend
WS 100 yr_2100 - Exist
WS 100 yr_2100 - 72inRCP
WS 100 yr_2050 - Exist
WS 100 yr_2050 - 72inRCP
WS 100 yr - 72inRCP
WS 100 yr - Exist
WS 25 yr_2100 - 72inRCP
WS 25 yr_2100 - Exist
WS 25 yr_2050 - 72inRCP
WS 25 yr_2050 - Exist
WS 25 yr - Exist
WS 25 yr - 72inRCP
Ground
Bank Sta


Poplar Hill Rd
River = Zekiah Swamp Reach = Poplar Hill Road RS = 1109
Elevation (ft)
Station (ft)
200
190
180
170
160
150
140
0
500
1000
1500
2000
2500
Legend
WS 100 yr_2100 - Exist
WS 100 yr_2100 - 72inRCP
WS 100 yr_2050 - Exist
WS 100 yr_2050 - 72inRCP
WS 100 yr - 72inRCP
WS 100 yr - Exist
WS 25 yr_2100 - 72inRCP
WS 25 yr_2100 - Exist
WS 25 yr_2050 - 72inRCP
WS 25 yr_2050 - Exist
WS 25 yr - Exist
WS 25 yr - 72inRCP
Ground
Bank Sta


Poplar Hill Rd
River = Zekiah Swamp Reach = Poplar Hill Road RS = 722
Elevation (ft)
Station (ft)
200
190
180
170
160
150
140
0
500
1000
1500
2000
Legend
WS 100 yr_2100 - Exist
WS 100 yr_2100 - 72inRCP
WS 100 yr_2050 - Exist
WS 100 yr_2050 - 72inRCP
WS 100 yr - 72inRCP
WS 100 yr - Exist
WS 25 yr_2100 - 72inRCP
WS 25 yr_2100 - Exist
WS 25 yr_2050 - 72inRCP
WS 25 yr_2050 - Exist
WS 25 yr - Exist
WS 25 yr - 72inRCP
Ground
Bank Sta

HEC-RAS River: Zekiah Swamp Reach: Poplar Hill Road

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Poplar Hill Road	7881	25 yr	Exist	281.00	176.25	178.04		178.16	0.005162	2.70	104.13	102.14	0.47
Poplar Hill Road	7881	25 yr	72inRCP	281.00	176.25	178.04		178.16	0.005162	2.70	104.13	102.14	0.47
Poplar Hill Road	7881	25 yr_2050	Exist	339.00	176.25	178.18		178.31	0.005082	2.86	118.56	105.38	0.48
Poplar Hill Road	7881	25 yr_2050	72inRCP	339.00	176.25	178.18		178.31	0.005082	2.86	118.56	105.38	0.48
Poplar Hill Road	7881	25 yr_2100	Exist	374.00	176.25	178.26		178.39	0.005066	2.95	126.73	107.17	0.48
Poplar Hill Road	7881	25 yr_2100	72inRCP	374.00	176.25	178.26		178.39	0.005066	2.95	126.73	107.17	0.48
Poplar Hill Road	7881	100 yr	Exist	469.00	176.25	178.48		178.63	0.005182	3.07	152.75	123.86	0.49
Poplar Hill Road	7881	100 yr	72inRCP	469.00	176.25	178.48		178.63	0.005182	3.07	152.75	123.86	0.49
Poplar Hill Road	7881	100 yr_2050	Exist	578.00	176.25	178.68		178.84	0.005186	3.26	177.45	131.72	0.49
Poplar Hill Road	7881	100 yr_2050	72inRCP	578.00	176.25	178.68		178.84	0.005186	3.26	177.45	131.72	0.49
Poplar Hill Road	7881	100 yr_2100	Exist	622.00	176.25	178.77		178.93	0.005240	3.28	189.57	140.29	0.50
Poplar Hill Road	7881	100 yr_2100	72inRCP	622.00	176.25	178.77		178.93	0.005240	3.28	189.57	140.29	0.50
Poplar Hill Road	7596	25 yr	Exist	281.00	173.63	176.78		176.87	0.003944	2.37	118.51	114.81	0.41
Poplar Hill Road	7596	25 yr	72inRCP	281.00	173.63	176.78		176.87	0.003944	2.37	118.51	114.81	0.41
Poplar Hill Road	7596	25 yr_2050	Exist	339.00	173.63	176.90		177.00	0.004116	2.58	131.54	116.10	0.43
Poplar Hill Road	7596	25 yr_2050	72inRCP	339.00	173.63	176.90		177.00	0.004116	2.58	131.54	116.10	0.43
Poplar Hill Road	7596	25 yr_2100	Exist	374.00	173.63	176.96		177.07	0.004182	2.69	139.23	116.86	0.43
Poplar Hill Road	7596	25 yr_2100	72inRCP	374.00	173.63	176.96		177.07	0.004182	2.69	139.23	116.86	0.43
Poplar Hill Road	7596	100 yr	Exist	469.00	173.63	177.12		177.26	0.004377	2.96	158.32	118.72	0.45
Poplar Hill Road	7596	100 yr	72inRCP	469.00	173.63	177.12		177.26	0.004377	2.96	158.32	118.72	0.45
Poplar Hill Road	7596	100 yr_2050	Exist	578.00	173.63	177.29		177.46	0.004542	3.24	178.65	120.67	0.47
Poplar Hill Road	7596	100 yr_2050	72inRCP	578.00	173.63	177.29		177.46	0.004542	3.24	178.65	120.67	0.47
Poplar Hill Road	7596	100 yr_2100	Exist	622.00	173.63	177.36		177.53	0.004620	3.34	186.18	121.38	0.48
Poplar Hill Road	7596	100 yr_2100	72inRCP	622.00	173.63	177.36		177.53	0.004620	3.34	186.18	121.38	0.48
Poplar Hill Road	7269	25 yr	Exist	281.00	172.54	175.02		175.13	0.007602	2.68	104.74	137.84	0.54
Poplar Hill Road	7269	25 yr	72inRCP	281.00	172.54	175.02		175.13	0.007602	2.68	104.74	137.84	0.54
Poplar Hill Road	7269	25 yr_2050	Exist	339.00	172.54	175.12		175.25	0.007305	2.84	119.19	139.48	0.54
Poplar Hill Road	7269	25 yr_2050	72inRCP	339.00	172.54	175.12		175.25	0.007305	2.84	119.19	139.48	0.54
Poplar Hill Road	7269	25 yr_2100	Exist	374.00	172.54	175.18		175.31	0.007168	2.93	127.48	140.39	0.54
Poplar Hill Road	7269	25 yr_2100	72inRCP	374.00	172.54	175.18		175.31	0.007168	2.93	127.48	140.39	0.54
Poplar Hill Road	7269	100 yr	Exist	469.00	172.54	175.33		175.48	0.006965	3.16	148.23	142.65	0.55
Poplar Hill Road	7269	100 yr	72inRCP	469.00	172.54	175.33		175.48	0.006965	3.16	148.23	142.65	0.55
Poplar Hill Road	7269	100 yr_2050	Exist	578.00	172.54	175.48		175.66	0.006742	3.38	170.82	145.07	0.55
Poplar Hill Road	7269	100 yr_2050	72inRCP	578.00	172.54	175.48		175.66	0.006742	3.38	170.82	145.07	0.55
Poplar Hill Road	7269	100 yr_2100	Exist	622.00	172.54	175.55		175.73	0.006630	3.46	179.89	146.03	0.55
Poplar Hill Road	7269	100 yr_2100	72inRCP	622.00	172.54	175.55		175.73	0.006630	3.46	179.89	146.03	0.55
Poplar Hill Road	7056	25 yr	Exist	281.00	171.51	173.84		173.93	0.004288	2.36	118.96	123.85	0.42
Poplar Hill Road	7056	25 yr	72inRCP	281.00	171.51	173.84		173.93	0.004288	2.36	118.96	123.85	0.42
Poplar Hill Road	7056	25 yr_2050	Exist	339.00	171.51	173.97		174.06	0.004313	2.52	134.69	128.04	0.43
Poplar Hill Road	7056	25 yr_2050	72inRCP	339.00	171.51	173.97		174.06	0.004313	2.52	134.69	128.04	0.43
Poplar Hill Road	7056	25 yr_2100	Exist	374.00	171.51	174.04		174.14	0.004313	2.60	143.92	130.40	0.44
Poplar Hill Road	7056	25 yr_2100	72inRCP	374.00	171.51	174.04		174.14	0.004313	2.60	143.92	130.40	0.44
Poplar Hill Road	7056	100 yr	Exist	469.00	171.51	174.21		174.33	0.004290	2.81	166.92	133.98	0.44
Poplar Hill Road	7056	100 yr	72inRCP	469.00	171.51	174.21		174.33	0.004290	2.81	166.92	133.98	0.44
Poplar Hill Road	7056	100 yr_2050	Exist	578.00	171.51	174.40		174.54	0.004175	3.00	192.56	137.15	0.45
Poplar Hill Road	7056	100 yr_2050	72inRCP	578.00	171.51	174.40		174.54	0.004175	3.00	192.56	137.15	0.45
Poplar Hill Road	7056	100 yr_2100	Exist	622.00	171.51	174.47		174.62	0.004192	3.08	201.95	138.80	0.45
Poplar Hill Road	7056	100 yr_2100	72inRCP	622.00	171.51	174.47		174.62	0.004192	3.08	201.95	138.80	0.45
Poplar Hill Road	6826	25 yr	Exist	281.00	171.37	172.93		173.01	0.003696	2.24	125.29	126.31	0.40
Poplar Hill Road	6826	25 yr	72inRCP	281.00	171.37	172.93		173.01	0.003696	2.24	125.29	126.31	0.40
Poplar Hill Road	6826	25 yr_2050	Exist	339.00	171.37	173.07		173.16	0.003590	2.38	142.72	129.16	0.40
Poplar Hill Road	6826	25 yr_2050	72inRCP	339.00	171.37	173.07		173.16	0.003590	2.38	142.72	129.16	0.40
Poplar Hill Road	6826	25 yr_2100	Exist	374.00	171.37	173.14		173.24	0.003566	2.46	152.34	130.54	0.40
Poplar Hill Road	6826	25 yr_2100	72inRCP	374.00	171.37	173.14		173.24	0.003566	2.46	152.34	130.54	0.40
Poplar Hill Road	6826	100 yr	Exist	469.00	171.37	173.33		173.44	0.003499	2.65	176.93	133.20	0.41
Poplar Hill Road	6826	100 yr	72inRCP	469.00	171.37	173.33		173.44	0.003499	2.65	176.93	133.20	0.41
Poplar Hill Road	6826	100 yr_2050	Exist	578.00	171.37	173.54		173.66	0.003432	2.82	205.23	139.02	0.41
Poplar Hill Road	6826	100 yr_2050	72inRCP	578.00	171.37	173.54		173.66	0.003432	2.82	205.23	139.02	0.41
Poplar Hill Road	6826	100 yr_2100	Exist	622.00	171.37	173.62		173.75	0.003393	2.88	216.16	140.58	0.41
Poplar Hill Road	6826	100 yr_2100	72inRCP	622.00	171.37	173.62		173.75	0.003393	2.88	216.16	140.58	0.41
Poplar Hill Road	6654	25 yr	Exist	281.00	169.07	172.18		172.29	0.004904	2.65	106.22	102.60	0.46
Poplar Hill Road	6654	25 yr	72inRCP	281.00	169.07	172.18		172.29	0.004904	2.65	106.22	102.60	0.46
Poplar Hill Road	6654	25 yr_2050	Exist	339.00	169.07	172.32		172.44	0.004852	2.80	120.97	106.34	0.46
Poplar Hill Road	6654	25 yr_2050	72inRCP	339.00	169.07	172.32		172.44	0.004851	2.80	120.97	106.34	0.46
Poplar Hill Road	6654	25 yr_2100	Exist	374.00	169.07	172.40		172.53	0.004810	2.89	129.26	107.60	0.47
Poplar Hill Road	6654	25 yr_2100	72inRCP	374.00	169.07	172.40		172.53	0.004810	2.89	129.26	107.60	0.47
Poplar Hill Road	6654	100 yr	Exist	469.00	169.07	172.61		172.75	0.004546	3.08	152.25	110.59	0.46
Poplar Hill Road	6654	100 yr	72inRCP	469.00	169.07	172.61		172.75	0.004546	3.08	152.25	110.59	0.46
Poplar Hill Road	6654	100 yr_2050	Exist	578.00	169.07	172.85		173.01	0.004144	3.22	179.65	114.06	0.45
Poplar Hill Road	6654	100 yr_2050	72inRCP	578.00	169.07	172.85		173.01	0.004144	3.22	179.65	114.06	0.45
Poplar Hill Road	6654	100 yr_2100	Exist	622.00	169.07	172.94		173.10	0.004071	3.28	189.45	115.13	0.45
Poplar Hill Road	6654	100 yr_2100	72inRCP	622.00	169.07	172.94		173.10	0.004071	3.28	189.45	115.13	0.45
Poplar Hill Road	6360	25 yr	Exist	281.00	168.21	170.89		171.00	0.003935	2.67	105.08	84.66	0.42
Poplar Hill Road	6360	25 yr	72inRCP	281.00	168.21	170.89		171.00	0.003935	2.67	105.08	84.66	0.42
Poplar Hill Road	6360	25 yr_2050	Exist	339.00	168.21	171.06		171.18	0.003854	2.82	120.07	87.80	0.43
Poplar Hill Road	6360	25 yr_2050	72inRCP	339.00	168.21	171.06		171.18	0.003854	2.82	120.07	87.80	0.43
Poplar Hill Road	6360	25 yr_2100	Exist	374.00	168.21	171.17		171.30	0.003690	2.88	130.00	89.46	0.42
Poplar Hill Road	6360	25 yr_2100	72inRCP	374.00	168.21	171.17		171.30	0.003690	2.88	130.00	89.46	0.42

HEC-RAS River: Zekiah Swamp Reach: Poplar Hill Road (Continued)

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Poplar Hill Road	6360	100 yr	Exist	469.00	168.21	171.40		171.55	0.003754	3.11	150.78	93.48	0.43
Poplar Hill Road	6360	100 yr	72inRCP	469.00	168.21	171.40		171.55	0.003754	3.11	150.78	93.48	0.43
Poplar Hill Road	6360	100 yr_2050	Exist	578.00	168.21	171.66		171.82	0.003939	3.28	176.32	104.84	0.45
Poplar Hill Road	6360	100 yr_2050	72inRCP	578.00	168.21	171.66		171.82	0.003939	3.28	176.32	104.84	0.45
Poplar Hill Road	6360	100 yr_2100	Exist	622.00	168.21	171.75		171.92	0.003986	3.35	185.81	108.06	0.45
Poplar Hill Road	6360	100 yr_2100	72inRCP	622.00	168.21	171.75		171.92	0.003986	3.35	185.81	108.06	0.45
Poplar Hill Road	6034	25 yr	Exist	281.00	166.40	169.67		169.77	0.003637	2.51	111.98	93.55	0.40
Poplar Hill Road	6034	25 yr	72inRCP	281.00	166.40	169.67		169.77	0.003637	2.51	111.97	93.55	0.40
Poplar Hill Road	6034	25 yr_2050	Exist	339.00	166.40	169.81		169.93	0.003865	2.69	125.79	98.88	0.42
Poplar Hill Road	6034	25 yr_2050	72inRCP	339.00	166.40	169.81		169.93	0.003865	2.69	125.80	98.88	0.42
Poplar Hill Road	6034	25 yr_2100	Exist	374.00	166.40	169.91		170.03	0.004129	2.75	135.94	108.95	0.43
Poplar Hill Road	6034	25 yr_2100	72inRCP	374.00	166.40	169.91		170.03	0.004130	2.75	135.94	108.95	0.43
Poplar Hill Road	6034	100 yr	Exist	469.00	166.40	170.08		170.22	0.004487	3.02	155.11	114.88	0.46
Poplar Hill Road	6034	100 yr	72inRCP	469.00	166.40	170.08		170.22	0.004487	3.02	155.11	114.88	0.46
Poplar Hill Road	6034	100 yr_2050	Exist	578.00	166.40	170.25		170.42	0.004752	3.31	174.78	118.13	0.48
Poplar Hill Road	6034	100 yr_2050	72inRCP	578.00	166.40	170.25		170.42	0.004752	3.31	174.78	118.13	0.48
Poplar Hill Road	6034	100 yr_2100	Exist	622.00	166.40	170.31		170.49	0.004844	3.41	182.48	119.58	0.49
Poplar Hill Road	6034	100 yr_2100	72inRCP	622.00	166.40	170.31		170.49	0.004844	3.41	182.48	119.58	0.49
Poplar Hill Road	5576	25 yr	Exist	281.00	165.82	167.71		167.80	0.005120	2.39	117.55	138.54	0.46
Poplar Hill Road	5576	25 yr	72inRCP	281.00	165.82	167.71		167.80	0.005121	2.39	117.54	138.54	0.46
Poplar Hill Road	5576	25 yr_2050	Exist	339.00	165.82	167.83		167.93	0.004915	2.54	133.69	141.33	0.46
Poplar Hill Road	5576	25 yr_2050	72inRCP	339.00	165.82	167.83		167.93	0.004916	2.54	133.69	141.33	0.46
Poplar Hill Road	5576	25 yr_2100	Exist	374.00	165.82	167.90		168.00	0.004691	2.60	144.22	142.39	0.45
Poplar Hill Road	5576	25 yr_2100	72inRCP	374.00	165.82	167.90		168.00	0.004691	2.60	144.21	142.39	0.45
Poplar Hill Road	5576	100 yr	Exist	469.00	165.82	168.08		168.20	0.004320	2.78	170.45	147.88	0.44
Poplar Hill Road	5576	100 yr	72inRCP	469.00	165.82	168.08		168.20	0.004320	2.78	170.45	147.88	0.44
Poplar Hill Road	5576	100 yr_2050	Exist	578.00	165.82	168.27		168.41	0.004026	2.95	198.89	150.18	0.44
Poplar Hill Road	5576	100 yr_2050	72inRCP	578.00	165.82	168.27		168.41	0.004026	2.95	198.89	150.18	0.44
Poplar Hill Road	5576	100 yr_2100	Exist	622.00	165.82	168.34		168.48	0.003949	3.02	209.63	150.82	0.44
Poplar Hill Road	5576	100 yr_2100	72inRCP	622.00	165.82	168.34		168.48	0.003949	3.02	209.63	150.82	0.44
Poplar Hill Road	5302	25 yr	Exist	281.00	164.25	166.68		166.75	0.002952	2.19	128.20	112.47	0.36
Poplar Hill Road	5302	25 yr	72inRCP	281.00	164.25	166.68		166.75	0.002951	2.19	128.21	112.47	0.36
Poplar Hill Road	5302	25 yr_2050	Exist	339.00	164.25	166.84		166.92	0.002803	2.31	146.99	114.93	0.36
Poplar Hill Road	5302	25 yr_2050	72inRCP	339.00	164.25	166.84		166.92	0.002803	2.31	146.99	114.93	0.36
Poplar Hill Road	5302	25 yr_2100	Exist	374.00	164.25	166.93		167.01	0.002841	2.39	156.81	117.76	0.36
Poplar Hill Road	5302	25 yr_2100	72inRCP	374.00	164.25	166.93		167.01	0.002841	2.39	156.81	117.76	0.36
Poplar Hill Road	5302	100 yr	Exist	469.00	164.25	167.13		167.24	0.002934	2.57	182.23	125.10	0.38
Poplar Hill Road	5302	100 yr	72inRCP	469.00	164.25	167.13		167.24	0.002934	2.57	182.23	125.10	0.38
Poplar Hill Road	5302	100 yr_2050	Exist	578.00	164.25	167.34		167.46	0.002979	2.76	209.08	130.45	0.38
Poplar Hill Road	5302	100 yr_2050	72inRCP	578.00	164.25	167.34		167.46	0.002979	2.76	209.08	130.45	0.38
Poplar Hill Road	5302	100 yr_2100	Exist	622.00	164.25	167.42		167.55	0.002986	2.84	219.33	131.90	0.39
Poplar Hill Road	5302	100 yr_2100	72inRCP	622.00	164.25	167.42		167.55	0.002986	2.84	219.32	131.90	0.39
Poplar Hill Road	4848	25 yr	Exist	281.00	163.88	165.98		166.01	0.001016	1.37	204.57	163.25	0.22
Poplar Hill Road	4848	25 yr	72inRCP	281.00	163.88	165.97		166.00	0.001019	1.37	204.37	163.21	0.22
Poplar Hill Road	4848	25 yr_2050	Exist	339.00	163.88	166.13		166.17	0.001069	1.46	231.53	174.85	0.22
Poplar Hill Road	4848	25 yr_2050	72inRCP	339.00	163.88	166.13		166.17	0.001069	1.46	231.50	174.85	0.22
Poplar Hill Road	4848	25 yr_2100	Exist	374.00	163.88	166.21		166.24	0.001090	1.53	244.25	176.13	0.23
Poplar Hill Road	4848	25 yr_2100	72inRCP	374.00	163.88	166.21		166.24	0.001090	1.53	244.21	176.12	0.23
Poplar Hill Road	4848	100 yr	Exist	469.00	163.88	166.40		166.44	0.001116	1.69	278.42	180.12	0.24
Poplar Hill Road	4848	100 yr	72inRCP	469.00	163.88	166.40		166.44	0.001116	1.69	278.42	180.12	0.24
Poplar Hill Road	4848	100 yr_2050	Exist	578.00	163.88	166.59		166.64	0.001166	1.86	312.79	184.06	0.25
Poplar Hill Road	4848	100 yr_2050	72inRCP	578.00	163.88	166.59		166.64	0.001166	1.86	312.76	184.05	0.25
Poplar Hill Road	4848	100 yr_2100	Exist	622.00	163.88	166.66		166.72	0.001173	1.92	326.90	185.88	0.25
Poplar Hill Road	4848	100 yr_2100	72inRCP	622.00	163.88	166.66		166.72	0.001173	1.92	326.89	185.88	0.25
Poplar Hill Road	4582	25 yr	Exist	281.00	163.35	164.87	164.86	165.21	0.026762	4.68	60.03	88.62	1.00
Poplar Hill Road	4582	25 yr	72inRCP	281.00	163.35	164.87	164.86	165.21	0.026268	4.65	60.42	88.81	0.99
Poplar Hill Road	4582	25 yr_2050	Exist	339.00	163.35	164.98	164.98	165.34	0.026240	4.85	69.84	96.21	1.00
Poplar Hill Road	4582	25 yr_2050	72inRCP	339.00	163.35	164.98	164.98	165.34	0.026208	4.85	69.90	96.31	1.00
Poplar Hill Road	4582	25 yr_2100	Exist	374.00	163.35	165.03	165.03	165.41	0.026888	4.97	75.29	102.02	1.02
Poplar Hill Road	4582	25 yr_2100	72inRCP	374.00	163.35	165.03	165.03	165.41	0.026767	4.96	75.41	102.09	1.02
Poplar Hill Road	4582	100 yr	Exist	469.00	163.35	165.17	165.17	165.59	0.025770	5.22	89.82	109.39	1.02
Poplar Hill Road	4582	100 yr	72inRCP	469.00	163.35	165.17	165.17	165.59	0.025770	5.22	89.82	109.39	1.02
Poplar Hill Road	4582	100 yr_2050	Exist	578.00	163.35	165.32	165.32	165.77	0.023403	5.38	107.43	116.53	0.99
Poplar Hill Road	4582	100 yr_2050	72inRCP	578.00	163.35	165.32	165.32	165.77	0.023403	5.38	107.43	116.53	0.99
Poplar Hill Road	4582	100 yr_2100	Exist	622.00	163.35	165.36	165.36	165.84	0.023881	5.55	112.10	119.89	1.00
Poplar Hill Road	4582	100 yr_2100	72inRCP	622.00	163.35	165.36	165.36	165.84	0.023881	5.55	112.10	119.89	1.00
Poplar Hill Road	4355	25 yr	Exist	281.00	161.71	163.48		163.54	0.003166	1.93	145.55	163.36	0.36
Poplar Hill Road	4355	25 yr	72inRCP	281.00	161.71	163.48		163.54	0.003178	1.93	145.37	163.32	0.36
Poplar Hill Road	4355	25 yr_2050	Exist	339.00	161.71	163.60		163.67	0.003047	2.04	166.29	167.14	0.36
Poplar Hill Road	4355	25 yr_2050	72inRCP	339.00	161.71	163.60		163.67	0.003057	2.04	166.13	167.12	0.36
Poplar Hill Road	4355	25 yr_2100	Exist	374.00	161.71	163.67		163.74	0.003004	2.10	177.90	168.93	0.36
Poplar Hill Road	4355	25 yr_2100	72inRCP	374.00	161.71	163.67		163.74	0.003003	2.10	177.92	168.94	0.36
Poplar Hill Road	4355	100 yr	Exist	469.00	161.71	163.85		163.93	0.002864	2.25	208.18	171.91	0.36
Poplar Hill Road	4355	100 yr	72inRCP	469.00	161.71	163.85		163.93	0.002866	2.25	208.12	171.90	0.36
Poplar Hill Road	4355	100 yr_2050	Exist	578.00	161.71	164.04		164.13	0.002757	2.40	240.39	174.97	0.36
Poplar Hill Road	4355	100 yr_2050	72inRCP	578.00	161.71	164.03		164.12	0.002772	2.41	239.98	174.93	0.36
Poplar Hill Road	4355	100 yr_2100	Exist	622.00	161.71	164.11		164.21	0.002744	2.45	253.75	178.80	0.36
Poplar Hill Road	4355	100 yr_2100	72inRCP	622.00	161.71	164.11		164.20	0.002754	2.45	253.42	178.71	0.36

HEC-RAS River: Zekiah Swamp Reach: Poplar Hill Road (Continued)

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Poplar Hill Road	4087	25 yr	Exist	281.00	160.19	162.75		162.80	0.002389	1.85	151.99	147.29	0.32
Poplar Hill Road	4087	25 yr	72inRCP	281.00	160.19	162.78		162.83	0.002211	1.80	156.37	149.24	0.31
Poplar Hill Road	4087	25 yr_2050	Exist	339.00	160.19	162.90		162.96	0.002328	1.95	174.27	153.47	0.32
Poplar Hill Road	4087	25 yr_2050	72inRCP	339.00	160.19	162.92		162.98	0.002198	1.91	177.53	153.96	0.31
Poplar Hill Road	4087	25 yr_2100	Exist	374.00	160.19	162.98		163.04	0.002293	2.00	186.61	155.39	0.32
Poplar Hill Road	4087	25 yr_2100	72inRCP	374.00	160.19	162.99		163.05	0.002203	1.98	189.13	155.91	0.32
Poplar Hill Road	4087	100 yr	Exist	469.00	160.19	163.19		163.26	0.002195	2.13	219.85	161.33	0.32
Poplar Hill Road	4087	100 yr	72inRCP	469.00	160.19	163.18		163.25	0.002219	2.14	219.08	161.21	0.32
Poplar Hill Road	4087	100 yr_2050	Exist	578.00	160.19	163.40		163.48	0.002128	2.27	254.92	166.76	0.32
Poplar Hill Road	4087	100 yr_2050	72inRCP	578.00	160.19	163.39		163.47	0.002188	2.29	252.59	166.41	0.33
Poplar Hill Road	4087	100 yr_2100	Exist	622.00	160.19	163.48		163.56	0.002117	2.32	267.56	169.43	0.32
Poplar Hill Road	4087	100 yr_2100	72inRCP	622.00	160.19	163.46		163.55	0.002177	2.34	265.29	168.77	0.33
Poplar Hill Road	3698	25 yr	Exist	281.00	158.02	161.53	160.89	161.62	0.003974	2.39	117.60	112.62	0.41
Poplar Hill Road	3698	25 yr	72inRCP	281.00	158.02	161.37		161.49	0.006122	2.82	99.76	103.14	0.50
Poplar Hill Road	3698	25 yr_2050	Exist	339.00	158.02	161.62	161.00	161.73	0.004505	2.64	128.23	115.95	0.44
Poplar Hill Road	3698	25 yr_2050	72inRCP	339.00	158.02	161.51		161.65	0.006036	2.93	115.69	111.60	0.51
Poplar Hill Road	3698	25 yr_2100	Exist	374.00	158.02	161.67	161.07	161.79	0.004858	2.80	133.35	116.77	0.46
Poplar Hill Road	3698	25 yr_2100	72inRCP	374.00	158.02	161.60		161.74	0.005817	2.97	125.81	115.56	0.50
Poplar Hill Road	3698	100 yr	Exist	469.00	158.02	161.76	161.23	161.92	0.005988	3.25	144.31	118.50	0.52
Poplar Hill Road	3698	100 yr	72inRCP	469.00	158.02	161.78	161.23	161.94	0.005646	3.19	147.09	118.94	0.51
Poplar Hill Road	3698	100 yr_2050	Exist	578.00	158.02	161.87	161.37	162.08	0.007213	3.67	157.68	124.37	0.57
Poplar Hill Road	3698	100 yr_2050	72inRCP	578.00	158.02	161.93	161.37	162.12	0.006275	3.51	164.77	125.04	0.54
Poplar Hill Road	3698	100 yr_2100	Exist	622.00	158.02	161.91	161.45	162.14	0.007606	3.83	162.42	124.82	0.59
Poplar Hill Road	3698	100 yr_2100	72inRCP	622.00	158.02	161.97	161.45	162.18	0.006543	3.65	170.33	125.57	0.55
Poplar Hill Road	3358	25 yr	Exist	281.00	157.42	159.93		160.00	0.005796	2.14	131.40	198.92	0.46
Poplar Hill Road	3358	25 yr	72inRCP	281.00	157.42	160.10	159.50	160.15	0.002681	1.68	167.11	203.50	0.33
Poplar Hill Road	3358	25 yr_2050	Exist	339.00	157.42	160.05		160.12	0.004922	2.18	155.61	202.66	0.44
Poplar Hill Road	3358	25 yr_2050	72inRCP	339.00	157.42	160.18		160.23	0.002958	1.86	181.94	206.86	0.35
Poplar Hill Road	3358	25 yr_2100	Exist	374.00	157.42	160.12		160.20	0.004426	2.19	170.77	203.77	0.42
Poplar Hill Road	3358	25 yr_2100	72inRCP	374.00	157.42	160.21		160.27	0.003233	1.99	188.09	207.54	0.37
Poplar Hill Road	3358	100 yr	Exist	469.00	157.42	160.33		160.40	0.003383	2.20	213.70	215.40	0.38
Poplar Hill Road	3358	100 yr	72inRCP	469.00	157.42	160.29		160.37	0.003773	2.28	206.42	213.79	0.40
Poplar Hill Road	3358	100 yr_2050	Exist	578.00	157.42	160.55		160.63	0.002681	2.23	262.22	218.84	0.35
Poplar Hill Road	3358	100 yr_2050	72inRCP	578.00	157.42	160.47		160.55	0.003398	2.39	243.54	217.60	0.39
Poplar Hill Road	3358	100 yr_2100	Exist	622.00	157.42	160.63		160.71	0.002506	2.25	280.34	220.26	0.34
Poplar Hill Road	3358	100 yr_2100	72inRCP	622.00	157.42	160.54		160.63	0.003236	2.43	258.84	218.62	0.38
Poplar Hill Road	3017	25 yr	Exist	281.00	156.54	159.25		159.28	0.001055	1.38	202.93	164.29	0.22
Poplar Hill Road	3017	25 yr	72inRCP	281.00	156.54	158.64		158.75	0.007137	2.56	109.71	148.09	0.52
Poplar Hill Road	3017	25 yr_2050	Exist	339.00	156.54	159.44		159.47	0.000980	1.44	235.09	169.44	0.22
Poplar Hill Road	3017	25 yr_2050	72inRCP	339.00	156.54	158.82		158.91	0.005311	2.50	135.50	151.77	0.47
Poplar Hill Road	3017	25 yr_2100	Exist	374.00	156.54	159.57		159.60	0.000901	1.45	257.11	171.74	0.21
Poplar Hill Road	3017	25 yr_2100	72inRCP	374.00	156.54	158.97		159.06	0.003853	2.35	159.05	153.67	0.41
Poplar Hill Road	3017	100 yr	Exist	469.00	156.54	159.86		159.90	0.000793	1.52	308.22	174.72	0.20
Poplar Hill Road	3017	100 yr	72inRCP	469.00	156.54	159.51		159.57	0.001610	1.90	246.89	170.72	0.28
Poplar Hill Road	3017	100 yr_2050	Exist	578.00	156.54	160.14		160.18	0.000756	1.62	356.04	177.55	0.20
Poplar Hill Road	3017	100 yr_2050	72inRCP	578.00	156.54	159.75		159.81	0.001493	2.01	288.15	173.55	0.27
Poplar Hill Road	3017	100 yr_2100	Exist	622.00	156.54	160.23		160.27	0.000754	1.67	372.60	178.48	0.20
Poplar Hill Road	3017	100 yr_2100	72inRCP	622.00	156.54	159.86		159.92	0.001404	2.02	307.57	174.68	0.27
Poplar Hill Road	2708	25 yr	Exist	281.00	156.19	159.19		159.20	0.000100	0.61	464.23	221.74	0.07
Poplar Hill Road	2708	25 yr	72inRCP	281.00	156.19	158.19		158.21	0.000721	1.13	248.98	206.20	0.18
Poplar Hill Road	2708	25 yr_2050	Exist	339.00	156.19	159.38		159.39	0.000111	0.67	506.26	224.78	0.08
Poplar Hill Road	2708	25 yr_2050	72inRCP	339.00	156.19	158.52		158.54	0.000478	1.06	318.67	211.93	0.15
Poplar Hill Road	2708	25 yr_2100	Exist	374.00	156.19	159.51		159.52	0.000113	0.70	535.48	227.29	0.08
Poplar Hill Road	2708	25 yr_2100	72inRCP	374.00	156.19	158.75		158.77	0.000368	1.02	368.22	215.44	0.14
Poplar Hill Road	2708	100 yr	Exist	469.00	156.19	159.80		159.81	0.000124	0.78	603.05	233.47	0.09
Poplar Hill Road	2708	100 yr	72inRCP	469.00	156.19	159.40		159.41	0.000206	0.92	510.81	225.17	0.11
Poplar Hill Road	2708	100 yr_2050	Exist	578.00	156.19	160.07		160.08	0.000142	0.87	666.52	241.93	0.09
Poplar Hill Road	2708	100 yr_2050	72inRCP	578.00	156.19	159.63		159.65	0.000231	1.03	563.70	229.68	0.12
Poplar Hill Road	2708	100 yr_2100	Exist	622.00	156.19	160.16		160.17	0.000149	0.90	688.67	243.61	0.09
Poplar Hill Road	2708	100 yr_2100	72inRCP	622.00	156.19	159.75		159.76	0.000234	1.05	589.82	232.14	0.12
Poplar Hill Road	2305	25 yr	Exist	281.00	154.86	159.15		159.16	0.000096	0.58	483.54	237.83	0.07
Poplar Hill Road	2305	25 yr	72inRCP	281.00	154.86	157.81		157.84	0.001193	1.42	197.29	167.47	0.23
Poplar Hill Road	2305	25 yr_2050	Exist	339.00	154.86	159.34		159.34	0.000106	0.64	527.65	241.12	0.08
Poplar Hill Road	2305	25 yr_2050	72inRCP	339.00	154.86	158.30		158.32	0.000637	1.18	288.14	203.73	0.17
Poplar Hill Road	2305	25 yr_2100	Exist	374.00	154.86	159.47		159.47	0.000108	0.67	558.77	244.65	0.08
Poplar Hill Road	2305	25 yr_2100	72inRCP	374.00	154.86	158.59		158.60	0.000467	1.07	351.15	228.40	0.15
Poplar Hill Road	2305	100 yr	Exist	469.00	154.86	159.76		159.76	0.000118	0.74	631.54	258.03	0.08
Poplar Hill Road	2305	100 yr	72inRCP	469.00	154.86	159.32		159.33	0.000209	0.90	522.82	240.77	0.11
Poplar Hill Road	2305	100 yr_2050	Exist	578.00	154.86	160.02		160.03	0.000129	0.83	699.38	261.18	0.09
Poplar Hill Road	2305	100 yr_2050	72inRCP	578.00	154.86	159.54		159.56	0.000234	1.00	577.08	248.57	0.12
Poplar Hill Road	2305	100 yr_2100	Exist	622.00	154.86	160.11		160.12	0.000135	0.87	722.63	262.29	0.09
Poplar Hill Road	2305	100 yr_2100	72inRCP	622.00	154.86	159.65		159.67	0.000234	1.03	605.37	252.83	0.12
Poplar Hill Road	2119	25 yr	Exist	281.00	153.73	159.14	155.29	159.15	0.000037	0.55	508.66	227.30	0.05
Poplar Hill Road	2119	25 yr	72inRCP	281.00	153.73	157.75	155.29	157.76	0.000167	0.87	323.13	205.46	0.10
Poplar Hill Road	2119	25 yr_2050	Exist	339.00	153.73	159.33	155.40	159.34	0.000020	0.42	825.22	234.65	0.04
Poplar Hill Road	2119	25 yr_2050	72inRCP	339.00	153.73	158.26	155.40	158.27	0.000130	0.87	390.17	217.45	0.09
Poplar Hill Road	2119	25 yr_2100	Exist	374.00	153.73	159.46	155.45	159.46	0.000022	0.44	853.29	236.59	0.04

HEC-RAS River: Zekiah Swamp Reach: Poplar Hill Road (Continued)

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Poplar Hill Road	2119	25 yr_2100	72inRCP	374.00	153.73	158.55	155.45	158.56	0.000116	0.87	429.49	221.57	0.09
Poplar Hill Road	2119	100 yr	Exist	469.00	153.73	159.75	155.60	159.75	0.000028	0.52	916.75	240.84	0.04
Poplar Hill Road	2119	100 yr	72inRCP	469.00	153.73	159.31	155.60	159.31	0.000040	0.58	819.68	233.31	0.05
Poplar Hill Road	2119	100 yr_2050	Exist	578.00	153.73	160.01	155.75	160.01	0.000035	0.60	974.33	245.06	0.05
Poplar Hill Road	2119	100 yr_2050	72inRCP	578.00	153.73	159.53	155.75	159.53	0.000050	0.67	868.00	237.44	0.06
Poplar Hill Road	2119	100 yr_2100	Exist	622.00	153.73	160.10	155.81	160.10	0.000038	0.64	993.93	246.49	0.05
Poplar Hill Road	2119	100 yr_2100	72inRCP	622.00	153.73	159.64	155.81	159.65	0.000053	0.71	892.70	239.08	0.06
Poplar Hill Road	2085			Culvert									
Poplar Hill Road	2040	25 yr	Exist	281.00	151.84	154.47	153.72	154.65	0.004665	3.41	82.52	71.11	0.48
Poplar Hill Road	2040	25 yr	72inRCP	281.00	151.84	154.47	153.72	154.65	0.004665	3.41	82.52	71.11	0.48
Poplar Hill Road	2040	25 yr_2050	Exist	339.00	151.84	154.63	153.88	154.85	0.005247	3.71	91.29	76.86	0.51
Poplar Hill Road	2040	25 yr_2050	72inRCP	339.00	151.84	154.63	153.88	154.85	0.005247	3.71	91.29	76.86	0.51
Poplar Hill Road	2040	25 yr_2100	Exist	374.00	151.84	154.71	153.97	154.95	0.005684	3.92	95.39	79.42	0.53
Poplar Hill Road	2040	25 yr_2100	72inRCP	374.00	151.84	154.71	153.97	154.95	0.005684	3.92	95.39	79.42	0.53
Poplar Hill Road	2040	100 yr	Exist	469.00	151.84	154.89	154.21	155.20	0.006801	4.41	106.26	86.80	0.59
Poplar Hill Road	2040	100 yr	72inRCP	469.00	151.84	154.89	154.21	155.20	0.006801	4.41	106.26	86.80	0.59
Poplar Hill Road	2040	100 yr_2050	Exist	578.00	151.84	155.10	154.44	155.47	0.007803	4.86	119.03	105.42	0.63
Poplar Hill Road	2040	100 yr_2050	72inRCP	578.00	151.84	155.10	154.44	155.47	0.007803	4.86	119.03	105.42	0.63
Poplar Hill Road	2040	100 yr_2100	Exist	622.00	151.84	155.19	154.54	155.57	0.008182	4.98	124.94	112.86	0.65
Poplar Hill Road	2040	100 yr_2100	72inRCP	622.00	151.84	155.19	154.54	155.57	0.008182	4.98	124.94	112.86	0.65
Poplar Hill Road	1606	25 yr	Exist	281.00	148.92	151.12		151.27	0.015265	3.18	88.32	152.44	0.74
Poplar Hill Road	1606	25 yr	72inRCP	281.00	148.92	151.12		151.27	0.015265	3.18	88.32	152.44	0.74
Poplar Hill Road	1606	25 yr_2050	Exist	339.00	148.92	151.22		151.38	0.013237	3.22	105.32	160.54	0.70
Poplar Hill Road	1606	25 yr_2050	72inRCP	339.00	148.92	151.22		151.38	0.013237	3.22	105.32	160.54	0.70
Poplar Hill Road	1606	25 yr_2100	Exist	374.00	148.92	151.29		151.45	0.011914	3.22	116.03	163.10	0.67
Poplar Hill Road	1606	25 yr_2100	72inRCP	374.00	148.92	151.29		151.45	0.011914	3.22	116.03	163.10	0.67
Poplar Hill Road	1606	100 yr	Exist	469.00	148.92	151.45		151.62	0.009751	3.30	141.94	165.39	0.63
Poplar Hill Road	1606	100 yr	72inRCP	469.00	148.92	151.45		151.62	0.009751	3.30	141.94	165.39	0.63
Poplar Hill Road	1606	100 yr_2050	Exist	578.00	148.92	151.60		151.78	0.008792	3.46	166.85	167.56	0.61
Poplar Hill Road	1606	100 yr_2050	72inRCP	578.00	148.92	151.60		151.78	0.008792	3.46	166.85	167.56	0.61
Poplar Hill Road	1606	100 yr_2100	Exist	622.00	148.92	151.65		151.85	0.008554	3.53	175.97	167.95	0.61
Poplar Hill Road	1606	100 yr_2100	72inRCP	622.00	148.92	151.65		151.85	0.008554	3.53	175.97	167.95	0.61
Poplar Hill Road	1360	25 yr	Exist	281.00	147.21	149.96		150.02	0.002425	1.93	145.64	133.46	0.33
Poplar Hill Road	1360	25 yr	72inRCP	281.00	147.21	149.96		150.02	0.002425	1.93	145.64	133.46	0.33
Poplar Hill Road	1360	25 yr_2050	Exist	339.00	147.21	150.10		150.17	0.002485	2.06	164.29	138.65	0.33
Poplar Hill Road	1360	25 yr_2050	72inRCP	339.00	147.21	150.10		150.17	0.002485	2.06	164.29	138.65	0.33
Poplar Hill Road	1360	25 yr_2100	Exist	374.00	147.21	150.19		150.26	0.002544	2.12	176.72	146.14	0.34
Poplar Hill Road	1360	25 yr_2100	72inRCP	374.00	147.21	150.19		150.26	0.002544	2.12	176.72	146.14	0.34
Poplar Hill Road	1360	100 yr	Exist	469.00	147.21	150.36		150.45	0.002736	2.31	203.02	155.50	0.36
Poplar Hill Road	1360	100 yr	72inRCP	469.00	147.21	150.36		150.45	0.002736	2.31	203.02	155.50	0.36
Poplar Hill Road	1360	100 yr_2050	Exist	578.00	147.21	150.53		150.63	0.002829	2.53	228.85	157.18	0.37
Poplar Hill Road	1360	100 yr_2050	72inRCP	578.00	147.21	150.53		150.63	0.002829	2.53	228.85	157.18	0.37
Poplar Hill Road	1360	100 yr_2100	Exist	622.00	147.21	150.60		150.70	0.002822	2.59	239.77	157.89	0.37
Poplar Hill Road	1360	100 yr_2100	72inRCP	622.00	147.21	150.60		150.70	0.002822	2.59	239.77	157.89	0.37
Poplar Hill Road	1109	25 yr	Exist	281.00	147.42	149.14		149.22	0.004423	2.23	126.22	147.22	0.42
Poplar Hill Road	1109	25 yr	72inRCP	281.00	147.42	149.14		149.22	0.004423	2.23	126.22	147.22	0.42
Poplar Hill Road	1109	25 yr_2050	Exist	339.00	147.42	149.26		149.35	0.004473	2.34	144.71	157.69	0.43
Poplar Hill Road	1109	25 yr_2050	72inRCP	339.00	147.42	149.26		149.35	0.004473	2.34	144.71	157.69	0.43
Poplar Hill Road	1109	25 yr_2100	Exist	374.00	147.42	149.33		149.42	0.004471	2.40	156.08	164.33	0.43
Poplar Hill Road	1109	25 yr_2100	72inRCP	374.00	147.42	149.33		149.42	0.004471	2.40	156.08	164.33	0.43
Poplar Hill Road	1109	100 yr	Exist	469.00	147.42	149.48		149.58	0.004432	2.59	180.78	167.85	0.44
Poplar Hill Road	1109	100 yr	72inRCP	469.00	147.42	149.48		149.58	0.004432	2.59	180.78	167.85	0.44
Poplar Hill Road	1109	100 yr_2050	Exist	578.00	147.42	149.63		149.75	0.004449	2.80	206.48	171.55	0.45
Poplar Hill Road	1109	100 yr_2050	72inRCP	578.00	147.42	149.63		149.75	0.004449	2.80	206.48	171.55	0.45
Poplar Hill Road	1109	100 yr_2100	Exist	622.00	147.42	149.70		149.83	0.004450	2.84	218.86	177.78	0.45
Poplar Hill Road	1109	100 yr_2100	72inRCP	622.00	147.42	149.70		149.83	0.004450	2.84	218.86	177.78	0.45
Poplar Hill Road	722	25 yr	Exist	281.00	145.80	147.37	146.90	147.45	0.004686	2.28	123.06	144.12	0.44
Poplar Hill Road	722	25 yr	72inRCP	281.00	145.80	147.37	146.90	147.45	0.004686	2.28	123.06	144.12	0.44
Poplar Hill Road	722	25 yr_2050	Exist	339.00	145.80	147.50	146.98	147.58	0.004685	2.39	141.98	155.51	0.44
Poplar Hill Road	722	25 yr_2050	72inRCP	339.00	145.80	147.50	146.98	147.58	0.004685	2.39	141.98	155.51	0.44
Poplar Hill Road	722	25 yr_2100	Exist	374.00	145.80	147.56	147.04	147.65	0.004685	2.47	151.40	157.56	0.44
Poplar Hill Road	722	25 yr_2100	72inRCP	374.00	145.80	147.56	147.04	147.65	0.004685	2.47	151.40	157.56	0.44
Poplar Hill Road	722	100 yr	Exist	469.00	145.80	147.71	147.16	147.82	0.004689	2.66	176.10	163.84	0.45
Poplar Hill Road	722	100 yr	72inRCP	469.00	145.80	147.71	147.16	147.82	0.004689	2.66	176.10	163.84	0.45
Poplar Hill Road	722	100 yr_2050	Exist	578.00	145.80	147.86	147.29	147.99	0.004682	2.87	201.37	167.26	0.46
Poplar Hill Road	722	100 yr_2050	72inRCP	578.00	145.80	147.86	147.29	147.99	0.004682	2.87	201.37	167.26	0.46
Poplar Hill Road	722	100 yr_2100	Exist	622.00	145.80	147.92	147.34	148.06	0.004687	2.95	211.02	168.54	0.46
Poplar Hill Road	722	100 yr_2100	72inRCP	622.00	145.80	147.92	147.34	148.06	0.004687	2.95	211.02	168.54	0.46

Attachment 7
ALTERNATIVES MATRIX

Charles County, Maryland

Alternatives Matrix - Location 10: Old Washington Rd and Shoppers World

December 2022

Alternatives			1: No Build	2: Drainage System Improvements	3: Drainage System Improvements, restore portion of lot to pervious, add GI and/or underground Detention	4: Drainage System Improvements, Add GI and/or Underground Detention	5: Drainage System Improvements, Add GI, and Install Pump Station	**PPA** *pending SME and local official feedback: 3: Drainage System Improvements, restore portion of lot to pervious, add GI and/or underground Detention
Overview								
Advantages	*1*	Description	• No advantages.	• Upsize and replace old CMP, recessed pipes, and inlets • Re-establish positive pipe slopes • Clean existing system • Stabilize, widen, and clean streams	• Upsize and replace old CMP, recessed pipes, and inlets • Re-establish positive pipe slopes • Clean existing system • Stabilize, widen, and clean streams • Remove portion of impervious area at loading zone • Install GI and subsurface detention at multiple parking locations to capture runoff close to the source to provide storage to increase overall system capacity	• Upsize and replace old CMP, recessed pipes, and inlets • Re-establish positive pipe slopes • Clean existing system • Stabilize, widen, and clean streams • Install GI at multiple parking locations to capture runoff close to the source	• Upsize and replace old CMP, recessed pipes, and inlets • Re-establish positive pipe slopes • Clean existing system • Stabilize, widen, and clean streams • Install GI at multiple parking locations at multiple locations to capture runoff close to the source • Install pump station near Old Washington Rd	• Upsize and replace old CMP, recessed pipes, and inlets • Re-establish positive pipe slopes • Clean existing system • Stabilize, widen, and clean streams • Remove portion of impervious area at loading zone • Install GI and subsurface detention at multiple parking locations to capture runoff close to the source to provide storage to increase overall system capacity
Disadvantages	*2*	Description	• Does not address Purpose and Need	• Roadway may still flood during larger, high volume rainfall events. • May increase flooding downstream near existing basin	• Will provide storage and flow attenuation • Flooding may still occur in larger, high intensity events • ROW acquisition will be required.	• Will provide storage and flow attenuation • Flooding may still occur in larger, high intensity events • ROW acquisition will be required.	• Provides faster drainage during large, high intensity events. • Provides storage to alleviate roadway flooding in larger rain events. • Most costly option. • ROW acquisition will be required.	• Will provide storage and flow attenuation • Flooding may still occur in larger, high intensity events • ROW acquisition will be required.
Purpose & Need								
Address chronic flooding	*3*	Y/N	N	N	Y	Y	Y	Y
Level of Protection Provided	*4*	Description	None	25 year rainfall event	25 year rainfall event	25 year rainfall event	25 year rainfall event	25 year rainfall event
Goals & Objectives								
Minimize present day flooding while implementing a resilient design to account for future flooding condition	*5*	Y/N	N	N	Y	Y	Y	Y
Avoid and/or minimize environmental impacts	*6*	Y/N	N/A	N	Y	Y	Y	Y
Minimize right-of-way impacts	*7*	Y/N	N/A	Y	N	N	N	N
Minimize utility impacts and relocations	*8*	Y/N	N/A	Y	N	N	N	N
Environmental								
Approximate Wetland and Waterway Impacts	*9*	Y/N	N/A	Y	Y	Y	Y	Y
Rights-of-Way								
Within ROW	*10*	Y/N	N/A	N	N	N	N	N
Construction Duration and Cost								
Construction Duration	*11*	months	N/A	5	6	6	7	6
Total Project Cost	*12*	$	N/A	$1,170,000	$1,480,000	$1,450,000	$1,940,000	$1,480,000

Notes:
1. Assumed $160/LF of pipe to be replaced
2. Approximately 10 drainage structures (inlets/manhole) need to be replaced/reconstructed assumed at $2,000
3. Assumed $100,000 for mobilization, traffic control, and access
4. Assumed $300,000 for pavement work
5. $15/ft^3 assumed for detention storage cost
6. $350,000 assumed for pump station
7. $25,000 assumed for re-vegetation
8. 30% added contingency

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Alternatives Matrix - Location 12: Industrial Park Drive and Post Office Road

December 2022

PPA

***pending SME and local official feedback**

Alternatives			1: No Build	2: Drainage System Improvements; replace 60" RCP with dual 48" RCP	3: Drainage System Improvements; replace 60" RCP with 58" x 91" RCEP	4: Drainage System Improvements; replace 60" RCP with dual 48" RCP and add GI	5: Drainage System Improvements; replace 60" RCP with 58" x 91" RCEP and add GI	5: Drainage System Improvements; replace 60" RCP with 58" x 91" RCEP and add GI
Overview								
Advantages	*1*	Description	• No advantages.	• Clean existing RCP pipe system and curb inlets • Upsize pipes • Re-establish positive pipe slopes • Stabilize, widen, and clean streams at system inlets	• Clean existing RCP pipe system and curb inlets • Upsize pipes • Re-establish positive pipe slopes •Stabilize, widen, and clean streams at system inlets • Install additional GI surface retention and curb cuts to capture runoff close to the source, provide storage, and increase overall system storage capacity	• Clean existing RCP pipe system and curb inlets • Upsize pipes • Re-establish positive pipe slopes •Stabilize, widen, and clean streams at system inlets • Install additional GI surface retention and curb cuts to capture runoff close to the source, provide storage, and increase overall system storage capacity	• Clean existing RCP pipe system and curb inlets • Upsize pipes • Re-establish positive pipe slopes •Stabilize, widen, and clean streams at system inlets • Install additional GI surface retention and curb cuts to capture runoff close to the source, provide storage, and increase overall system storage capacity	• Clean existing RCP pipe system and curb inlets • Upsize pipes • Re-establish positive pipe slopes •Stabilize, widen, and clean streams at system inlets • Install additional GI surface retention and curb cuts to capture runoff close to the source, provide storage, and increase overall system storage capacity
Disadvantages	*2*	Description	• Does not address Purpose and Need	• Roadway may still flood during larger, high volume rainfall events. • Will increase flooding downstream	• Roadway may still flood during larger, high volume rainfall events. • Will increase flooding downstream	• Flooding may still occur in larger, high intensity events • ROW acquisition may be required.	• Flooding may still occur in larger, high intensity events • ROW acquisition may be required.	• Flooding may still occur in larger, high intensity events • ROW acquisition may be required.
Purpose & Need								
Address chronic flooding	*3*	Y/N	N	Y	Y	Y	Y	Y
Level of Protection Provided	*4*	Description	None	25 year storm event	25 year storm event	25 year storm event	25 year storm event	25 year storm event
Goals & Objectives								
Minimize present day flooding while implementing a resilient design to account for future flooding conditions	*5*	Y/N	N	Y	Y	Y	Y	Y
Avoid and/or minimize environmental impacts	*6*	Y/N	N/A	Y	Y	Y	Y	
Minimize right-of-way impacts	*7*	Y/N	N/A	Y	Y	N	N	N
Minimize utility impacts and relocations	*8*	Y/N	N/A	Y	Y	N	N	N
Environmental								
Approximate Wetland and Waterway Impacts	*9*	Y/N	N/A	Y	Y	Y	Y	Y
Rights-of-Way								
Within ROW	*10*	Y/N	N/A	Y	Y	N	N	N
Construction Duration and Cost								
Construction Duration	*11*	months	N/A	2	2	3	3	3
Total Project Cost	*12*	$	N/A	$1,020,000	$960,000	$1,090,000	$1,020,000	$1,020,000

Notes:
1. 48" RCP assumed $500/LF
2. 58" x 91" RCEP assumed $800/LF
3. Ancillary drainage assumed $150/LF
4. Approximately 6 drainage structures (inlets/manhole) need to be replaced/reconstructed assumed at $2,000/ea
5. Assumed $100,000 for mobilization, traffic control, and access
6. Assumed $50,000 for pavement work
7. Assumed $50,000 assumed for GI/basin
8. Headwalls assumed $75,000/ea
9. Excavation and stream diversion assumed $200,000
9. 30% added contingency

Charles County, Maryland

Alternatives Matrix - Location 24: Poplar Hill Rd between St. Peters Church Rd & Mattawoman Beantown Rd

December 2022

PPA

***pending SME and local official feedback**

Alternatives			1: No Build	2: Replace with dual 60" RCP and restore stream	3: Replace dual 60" CMPs with dual 60" RCP, raise the low point of the roadway, and perform stream restoration	4: Replace dual 60" CMPs with dual 72" RCP (beveled entrance), replace 22" HDPE with 36" HDPE and stream restoration	5: Replace dual 60" CMPs with single 10' x 5' reinforced concrete box culvert and stream restoration	PPA: 4: Replace dual 60" CMPs with dual 72" RCP (beveled entrance), replace 22" HDPE with 36" HDPE and stream restoration
Overview								
Advantages	*1*	Description	• No advantages.	• Promote positive drainage by upsizing old drainage system •Increase conveyance along the stream through restoration and debris removal •Reduce scour and erosion by stabilizing stream banks and outfalls	• Promote positive drainage by upsizing old drainage system •Increase conveyance along the stream through restoration and debris removal •Reduce scour and erosion by stabilizing stream banks and outfalls	• Promote positive drainage by upsizing old drainage system •Increase conveyance along the stream through restoration and debris removal •Reduce scour and erosion by stabilizing stream banks and outfalls	• Promote positive drainage by upsizing old drainage system •Increase conveyance along the stream through restoration and debris removal •Reduce scour and erosion by stabilizing stream banks and outfalls	• Promote positive drainage by upsizing old drainage system •Increase conveyance along the stream through restoration and debris removal •Reduce scour and erosion by stabilizing stream banks and outfalls
Disadvantages	*2*	Description	• Does not address Purpose and Need	• Does not meet the 25 year flood capacity	• Most costly option • Longest construction duration • Roadway will need to be raised a couple of feet to meeet 25 year capacity	• Roadway will still flood during larger, high volume rainfall events.	• Does not meet the 25 year flood capacity	• Roadway will still flood during larger, high volume rainfall events.
Purpose & Need								
Address chronic flooding	*3*	Y/N	N	N	Y	Y	N	Y
Level of Protection Provided	*4*	Description	Does not meet 25 year rainfall event	Does not meet 25 year rainfall event	25 year rainfall event	25 year rainfall event (2050, 2100)	Does not meet 25 year rainfall event	25 year rainfall event (2050, 2100)
Goals & Objectives								
Minimize present day flooding while implementing a resilient design to account for future flooding conditions	*5*	Y/N	N	N	Y	Y	N	Y
Avoid and/or minimize environmental impacts	*6*	Y/N	N/A	Y	Y	Y	Y	Y
Minimize right-of-way impacts	*7*	Y/N	N/A	Y	Y	Y	Y	Y
Minimize utility impacts and relocations	*8*	Y/N	N/A	Y	Y	Y	Y	Y
Environmental								
Approximate Wetland and Waterway Impacts	*9*	Y/N	N/A	Y	Y	Y	Y	Y
Rights-of-Way								
Within ROW	*10*	Y/N	N/A	Y	Y	Y	Y	Y
Construction Duration and Cost								
Construction Duration	*11*	months	N/A	3	5	4	3	4
Total Project Cost	*12*	$	N/A	$960,000	$1,020,000	$980,000	$1,120,000	$980,000

Notes:
1. 60" RCP assumed $400/LF
2. 72" RCP assumed $600/LF
3. Pipe Excavation assumed $100,000
4. 10'x5' Box Culvert assumed $2,000/LF
5. 36" HDPE assumed $120/LF
6. Stream restoration assumed $200,000
7. Stream diversion assumed $150,000
8. Headwall assumed $100,000/ea
9. Assumed $50,000 for mobilization, access, and traffic control
10. Profile rasie assume $50,000
11. 30% added contingency

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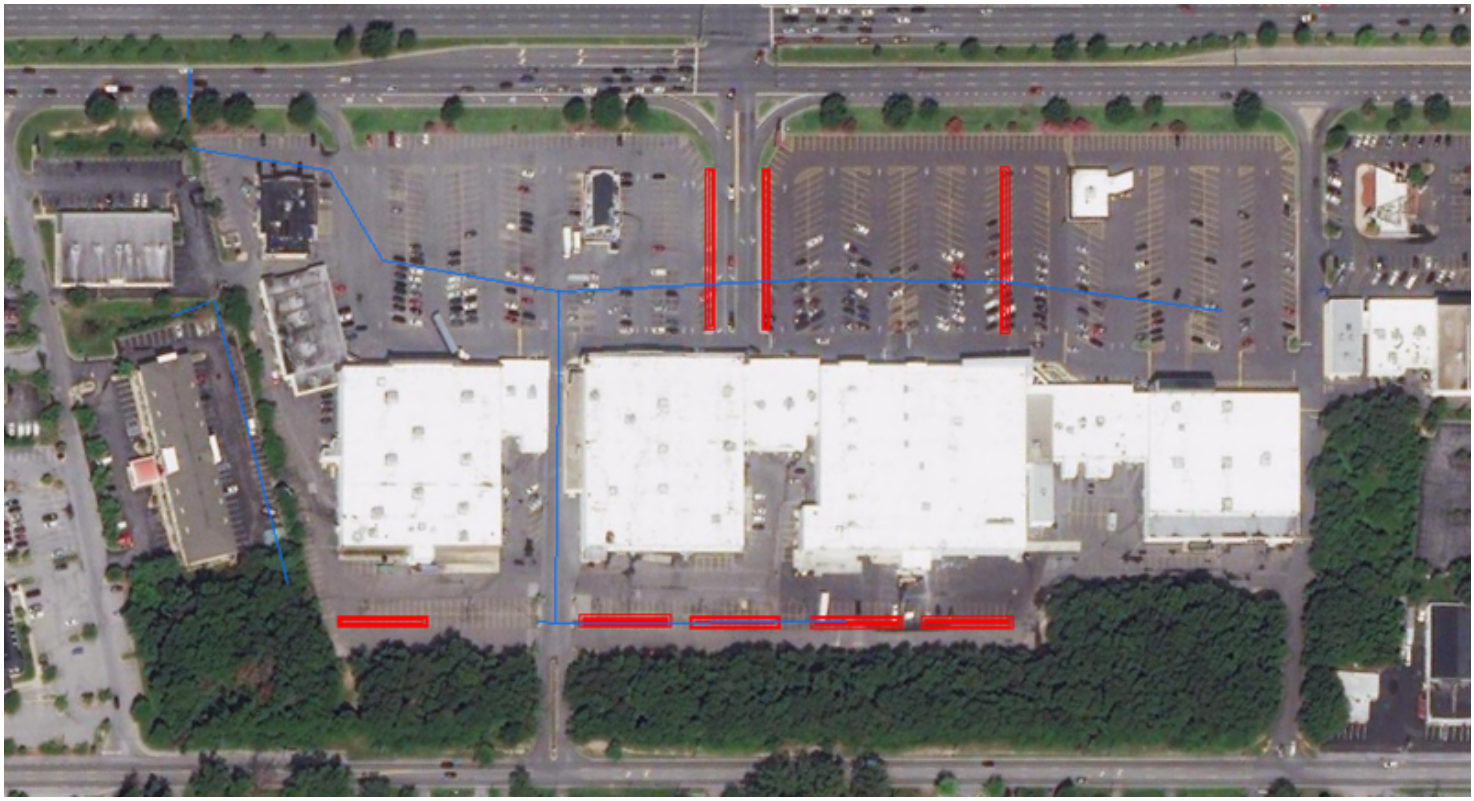
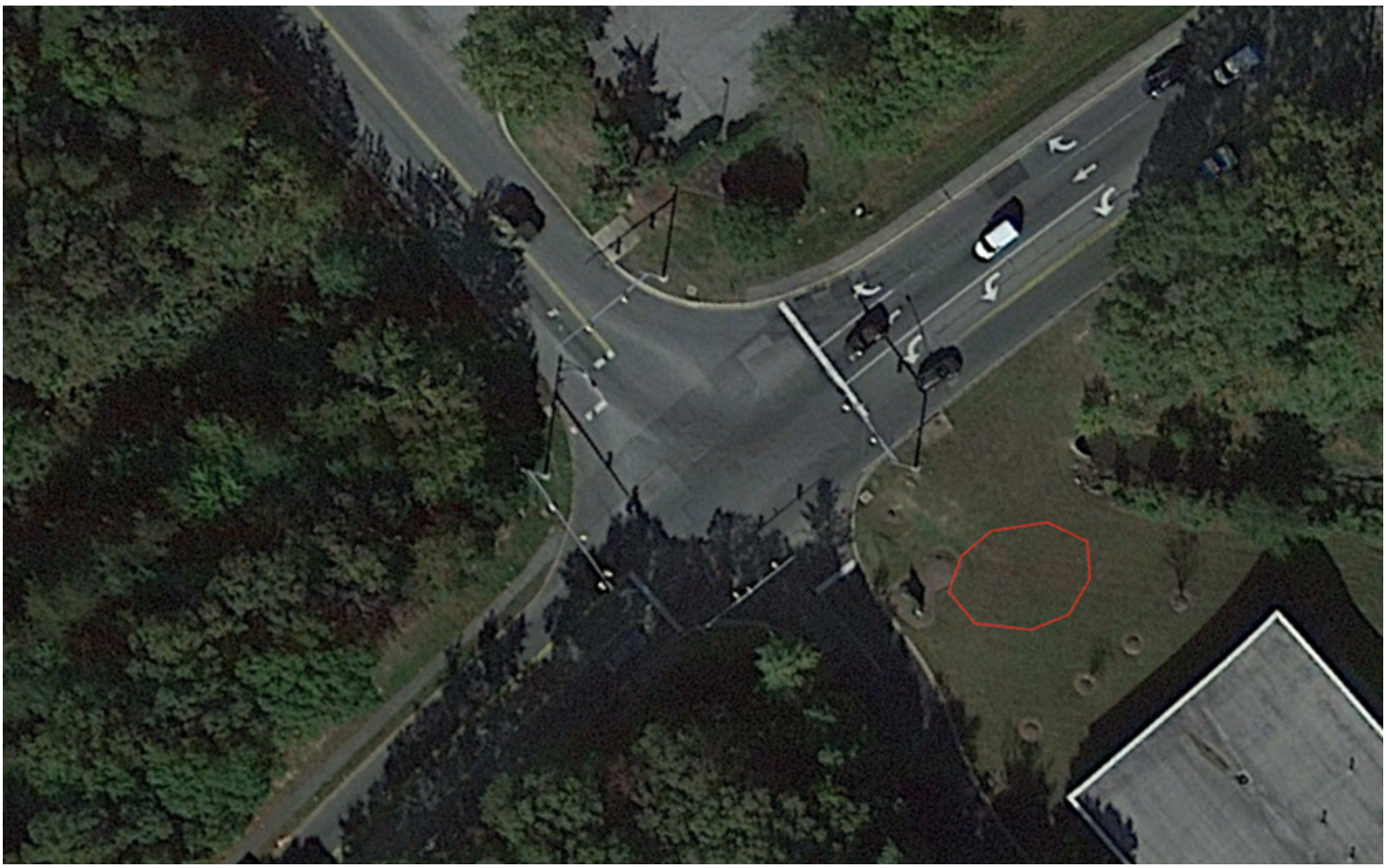


Location 10: Old Washington Rd and Shoppers World Potential Basin Locations



Location 12: Industrial Park and Post office Road Potential Basin Location