Great Lakes Water Supply Program

GREAT WATER ALLIANCE

6-300 D3 - Stormwater Management Plan: Booster Pumping Station and Water Tower, Waukesha, WI

Waukesha Water Utility
SERVING WAUKESHA SINCE 1886

GREELEY AND HANSEN

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PROGRAM TEAM MEMBER CONSULTANTS:

GREELEY AND HANSEN

GRAEF

WISCONSIN
Ryan P. Van Camp
E-36232
HORTONVILLE, WI
PROFESSIONAL ENGINEER
10/30/2020

EXECUTIVE SUMMARY

The Waukesha Water Utility (WWU) provides water treatment and distribution services to the City of Waukesha (Waukesha), portions of the Town of Waukesha, and the City of Pewaukee. The St. Peter Sandstone aquifer that serves as Waukesha's primary source of drinking water is being simultaneously depleted and subjected to increases in the concentrations of radium and other contaminants. WWU commissioned the Great Water Alliance (Program) to transition Waukesha's water supply from groundwater to Lake Michigan water. The purpose of the Program is to plan, design, construct, and commission infrastructure with a 100-year useful life necessary to transition Waukesha's water supply.

The Program was broken down into seven contract packages. The purpose of this Stormwater Management Plan (Report) is to illustrate the stormwater management and erosion control best management practices (BMPs) that will be implemented at the site of Contract Package 3, the Booster Pumping Station (BPS), and Contract Package 3A, the Water Tower, to comply with all applicable stormwater regulations. **Section 1** of this Report meets all the requirements for a stormwater management plan, as described in Wisconsin Administrative Code Chapter NR 216.47, by illustrating how the design of the site meets the following standards.

- **Performance Standards:** The site design meets the post-construction performance standards for both new development and redevelopment in WAC Chapter NR 151.121 and City of Waukesha Municipal Code Chapter 32.
- **Practices During Construction:** The erosion control plan that meets all the requirements of NR 216.46 and construction site performance standards set forth in NR 151.11. and City of Waukesha Municipal Code Chapter 32.
- **Groundwater Limitations:** The seasonal high groundwater elevation at the site is greater than 5 feet from the bottom of the permanent stormwater infiltration system.
- **Long-Term Maintenance:** Provisions have been made for long-term maintenance for all permanent structures. A copy of the long-term maintenance agreement between the WWU and the City of Waukesha (Waukesha) is included in the **Appendix F**.
- **Management Practices:** The BMPs control impacts from stormwater runoff on the receiving surface water or groundwater. An explanation of the technical basis used to select the BMPs is included in the Report.

The 1-year, 24-hour and the 2-year, 24-hour post-construction peak runoff discharge rates will be reduced to the 1-year, 24-hour and the 2-year, 24-hour pre-development peak runoff discharge rates respectively by the BMPs on-site. This meets the standards set forth in NR 151.123.

The BMPs have been designed to control total suspended solids (TSS) carried in runoff from the post-construction site. The retention basin will reduce the expected TSS concentration in the stormwater runoff from the site by 40-percent for the redevelopment and 80-percent for the new development. In doing so, the design complies with City of Waukesha and Wisconsin Department of Natural Resources (WDNR) performance standards under NR 151.122.

The runoff discharged from the site ultimately drains east to two culverts under Springdale Road. In general, the runoff peak discharge rates are shown by this plan to be reduced from the site and, hence, any hydraulic conditions at the downstream culverts crossings can thereby be presumed improved.

The City of Waukesha's Municipal Code (Section 32.10(d)(3)).and the (WDNR) NR 151.124 Infiltration Performance Standards require moderate impervious development to infiltrate sufficient runoff volume such that the post-

development infiltration volume shall be at least 75% of the pre-development infiltration volume, based on the average annual rainfall. No more than 2% of the post-construction site is required as an effective infiltration area. Subsurface investigation shows a brown gravelly sand substrata is present 3 to 5 feet below ground surface in the area of the proposed infiltration basin, which a design infiltration rate of 3.6 inches/hour was applied (see Geotechnical Report, **Appendix B**).

A 50-foot buffer (City of Waukesha Municipal Code Chapter 32.10H(A) around the wetland adjacent to the site is designated a protective area. The site has been designed such that there will be no impervious surfaces located within the protective area. Wherever land disturbing construction activity takes place in the protective area, a self-sustaining vegetative cover shall be established to provide for bank stability and filtering of pollutants from upslope overland flow areas under sheet flow conditions. This practice meets the standards set forth in NR 151.125.

The Report meets all the requirements for an erosion control plan, as described in NR 216.46, by describing how the construction practices meet the following standards.

- **Performance Standards:** The construction practices meet the erosion control performance standards for new development in NR 151.11.
- **Required Information:** Descriptions of the construction site, the nature of the land disturbing activities, and the intended sequence of major land disturbing construction activities are included in the Report. It also includes estimates of the total area of the construction site and the area impacted by land disturbing construction activities. Available data describing the surface soils and subsoils, the depth to the seasonal high groundwater elevation, and the name of the immediate receiving water are provided in the Report as well.
- **Site Map:** Site maps are provided in **Appendix A** that include all features described in NR 216.46(5).
- **Erosion and Sediment Control Best Management Practices:** Descriptions of the erosion and sediment control BMPs that meets the requirements of NR 216.46(6).
- **Material:** No solid materials will be discharged from the site.
- **Non-Erosive Flow:** Descriptions of any velocity dissipation devices placed at discharge locations to provide non-erosive flow are be included in the Report.
- **Inspections:** The Report provides plans for inspections of the erosion and sediment control BMPs weekly and within 24 hours following a rainfall of 0.5 in or greater. The method for the required documentation of the inspections are provided as well.

For the reasons discussed in the paragraphs above, this Report meets the Wisconsin Department of Natural Resources (WDNR) requirements for a Stormwater Management Plan and Erosion and Sediment Control Plan (NR 151.121-151.128 and NR 151.11).

The Report demonstrates that the BPS and Water Tower site meets City of Waukesha and WDNR requirements for erosion and sediment control during construction and post-construction stormwater management.

SECTION 1 Project Description

1.1 Introduction

The Waukesha Water Utility (WWU) provides water treatment and distribution services to the City of Waukesha (Waukesha), portions of the Town of Waukesha, and the City of Pewaukee. The St. Peter Sandstone aquifer that serves as Waukesha's primary source of drinking water is being simultaneously depleted and subjected to increases in the concentrations of radium and other contaminants. WWU commissioned the Great Water Alliance (Program) to transition Waukesha's water supply from groundwater to Lake Michigan water. The purpose of the Program is to plan, design, construct, and commission infrastructure with a 100-year useful life necessary to transition Waukesha's water supply.

After a lengthy study and public engagement, the WDNR, Department of Justice, and Great Lakes-St. Lawrence River Basin Water Resources Council unanimously approved Waukesha's Application for Lake Michigan Diversion with Return Flow to source water from Lake Michigan and return the required amount of flow to the Great Lakes-St. Lawrence River Basin via the Root River. WWU is implementing The Program to transition Waukesha's water supply from groundwater to Lake Michigan water, now known as the Great Water Alliance. The purpose of the Program is to plan, design, construct, and commission infrastructure with a 100-year useful life necessary to transition Waukesha's water supply.

The Program is the first for a community in a county straddling the Great Lakes-St. Lawrence River Basin to access Great Lakes water through the Great Lakes-St. Lawrence River Basin Water Resources Compact (Compact). Successful implementation of the Program will set industry precedents for solving water quality and water scarcity challenges for at-risk water supplies in other Great Lakes Communities eligible to receive Great Lakes water through the Compact.

In its Final Decision, dated June 21, 2016, the Compact Council unanimously approved Waukesha's Application to source water from Lake Michigan as Waukesha's only reasonable water supply alternative. As part of the Program, a transmission main with pumping facilities, storage and chemical treatment will deliver potable water to Waukesha from a connection to a water system supplied by Lake Michigan. A pressure main with pumping facilities located at Waukesha's Clean Water Plant are required per the Final Decision to achieve a net zero water balance in the Lake Michigan basin by discharging highly treated effluent to the Root River.

The purpose of the Booster Pumping Station (BPS) and Water Tower is to store, treat, and pump potable water received from the water supplier via the Water Supply Pipeline and convey that water to the WWU distribution system. To perform these functions, the BPS has been designed to meet the full range of anticipated demands from Waukesha. The on-site reservoirs provide a delineation between the Milwaukee Water Works (MWW) and WWU systems and provide emergency storage. Chemicals will be added to the water in the reservoirs and/or after the pumps in order to maintain potable water quality standards. **Figure 1-1** shows a simplified diagram of the BPS and Water Tower in reference to other facilities along the supply line.

The BPS site consists of the following four elements:

- The Reservoirs
- Chemical Feed System
- Pumping System
- Water Tower

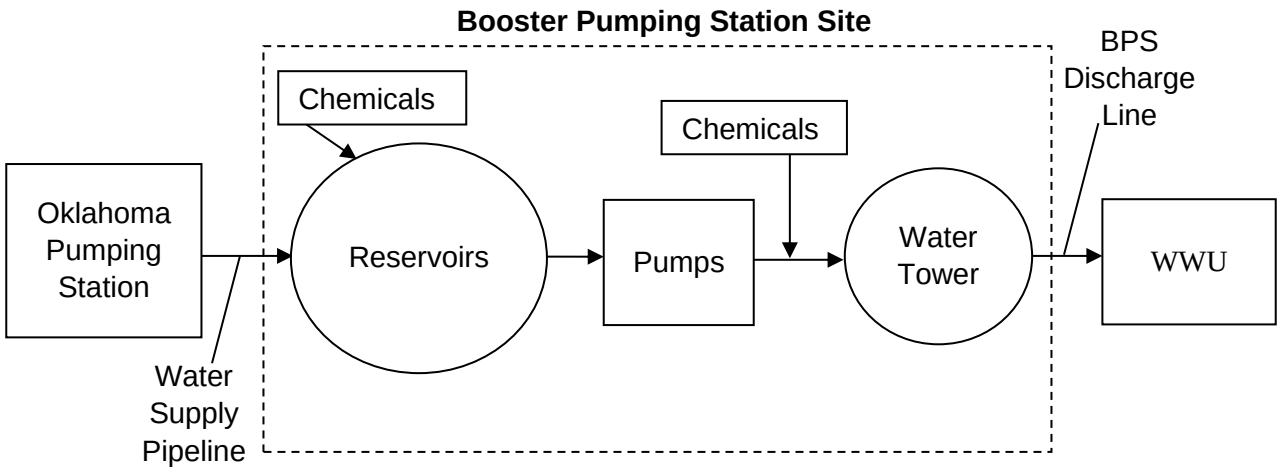


Figure 1-1 Booster Pumping Station and Water Tower Diagram

1.2 Purpose

The purpose of this Report is to determine the existing and proposed hydrologic and hydraulic site conditions, stormwater management system requirements, and the erosion and sediment control BMPs in accordance with the Wisconsin Department of Natural Resources (WDNR) Administrative Code, the Waukesha County Stormwater Management and Erosion Control Ordinance, and the City of Waukesha's Stormwater Management and Erosion Control Municipal Code. This Report incorporates the following sections:

- Project Description
- Regulatory Conditions and Permit Overview
- Methodology and Assumptions
- Existing Conditions
- Construction Practices
- Proposed Conditions
- Wetland Watershed Analysis
- Water Quality
- Post Construction Stormwater Management
- Summary of Results
- Exhibits
- Appendices

This Report summarizes the proposed design and construction practices, and acts as a tool for coordinating between various engineering disciplines and the regulatory entities. This Report is also a convenient milestone to confirm with the regulatory entities that the site concepts align with their requirements.

SECTION 2 Regulatory Conditions and Permit Overview

This section discusses the applicable regulatory entities and conditions for stormwater management; and provides an overview of the required permits at the State, County, and Municipal levels.

2.1 Wisconsin Department of Natural Resources

The Wisconsin Department of Natural Resources (WDNR) has jurisdiction over all construction in the state of Wisconsin. The WDNR has the authority to approve or deny the Program's Water Resources Application for Project Permits (WRAPP) which includes the Construction Site Storm Water Runoff General Permit No. WI-S067831-5. Coordination will be required with the WDNR to obtain approval of these certifications that will cover the construction activities on the BPS site. The WRAPP will act as a Notice of Intent that describes how the site design of the BPS meets the WDNR's erosion control plan requirements (NR 216.46), construction site performance standards (NR 151.11), storm water management plan requirements (NR 216.47), post-construction performance standards (NR 151.121-128), and reporting and monitoring requirements (NR 216.48). A notice of termination will be prepared and submitted at the end of construction and once the site has undergone final stabilization (NR 216.55). Coordination will be held with the WDNR to obtain approval of the Construction Site Storm Water Runoff General Permit in conjunction with the WRAPP prior to construction. The WRAPP will be the last stormwater and erosion control approval that the Program pursues. The post-construction performance standards include the following quantitative requirements:

- 40% TSS reduction in runoff for the redevelopment and 80% TSS reduction in runoff for the new development, as compared to no BMPs and based on average annual rainfall (NR 151.122). The resulting composite goal is 70% TSS reduction for this site.
- Reduce the 1-year, 24-hour post-construction peak runoff discharge rate to the 1-year, 24-hour pre-development peak runoff discharge rate (NR 151.123)
- Reduce the 2-year, 24-hour post-construction peak runoff discharge rate to the 2-year, 24-hour pre-development peak runoff discharge rate (NR 151.123)
- Infiltrate sufficient runoff volume for moderate impervious developments such that the post-development infiltration volume shall be at least 75% of the pre-development infiltration volume, based on the average annual rainfall. No more than 2% of the post-construction site is required as an effective infiltration area (NR 151.124)

During construction, the site cannot discharge sediments more than 5 tons per acre per year from initial grading to final stabilization per NR 151.11. The requirements of this permit do not preempt more stringent erosion and sediment control requirements that may be imposed by any other regulatory agency with jurisdiction.

2.2 City of Waukesha

The City of Waukesha has jurisdiction over all land within the City limits. Within their jurisdiction, the City has the authority to enforce Municipal Code Chapter 32 Stormwater Management and Erosion Control. Chapter 32 outlines the City's requirements for post-construction stormwater management and construction site erosion control. The City of Waukesha's Code is followed to design a site with BMPs that control the quality and quantity of runoff from the site and minimize erosion and sediment on and off the site. The Program will coordinate with the City of Waukesha to obtain a Storm Water Permit, based on the post-construction stormwater management, and the Grading and Erosion Control Permit, based on the erosion and sediment control BMPs. The Program will pursue the approval of the Storm Water Management Plan before any of the other stormwater permits and approvals.

The post construction performance standards include the following quantitative requirements:

- 40% TSS reduction in runoff for the redevelopment and 80% TSS reduction in runoff for the new development, as compared to no BMPs and based on average annual rainfall ((32.10(d)(2)). The resulting composite goal is 70% TSS reduction for this site.
- Post-development peak discharge shall be equal to or less than existing condition flows for the 1, 2, 10, and 100-year, 24-hour design storms ((32.10(d)(1)).
- Infiltrate sufficient runoff volume for moderate impervious developments such that the post-development infiltration volume shall be at least 75% of the pre-development infiltration volume, based on the average annual rainfall. No more than 2% of the post-construction site is required as an effective infiltration area ((32.10(d)(3)).

The requirements of this permit do not preempt more stringent erosion and sediment control requirements that may be imposed by any other regulatory agency with jurisdiction.

SECTION 3 Methodology and Assumptions

This section discusses the methods and assumptions used for evaluating the existing and proposed hydrologic and hydraulic site conditions.

3.1 Hydrologic Analysis Methods

HydroCAD version 10.00 was used to model the existing and proposed conditions. HydroCAD is a proprietary software which uses Natural Resources Conservation Service (NRCS) TR-20/55 methodologies. Travel paths and times of concentration (TOC) computations are indicated on the existing and proposed conditions exhibits in **Appendix A**. Calculations and summaries for the TOC and Curve Number (CN) values are included in **Appendix C** for existing conditions and **Appendix D** for proposed conditions.

The 1, 2, 10, and 100-year, 24-hour storms were modeled for the existing and proposed conditions using MSE3 rainfall distribution developed by NRCS for use in Wisconsin where MSE is titled for Midwest and Southeast US.

Rainfall values for the hydrologic analysis were taken from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14, Volume 8, Version 2. Point Precipitation Frequency are shown in **Table 3-1.**

Table 3-1 Design Rainfall Values

Storm Recurrence Interval	24-hour Rainfall Volume
1 year	2.42 inches
2-year	2.72 inches
10-year	3.83 inches
100-year	6.18 inches

Peak runoff flow and volume are determined using HydroCAD using parameters for rainfall presented above and presented in **Appendices C** and **D**.

3.2 Hydraulic Analysis Methods

Hydrographs generated in the HydroCAD model were routed through the various hydraulic elements in the HydroCAD models. These include storm sewer, wet detention basins, dry infiltration basin, culverts, and areas where runoff can be impounded under large storm events (e.g. upstream of culverts and/or topographic depressions). Hydrographs were routed through these structures using the HydroCAD model. Proposed storm sewer systems were sized using Rational Method (submitted separately to the appropriate local and state plumbing review).

3.3 Assumptions

Several assumptions were made in the hydrologic and hydraulic (H/H) modeling.

CNs were developed based on a review of land cover / use and soils (Natural Resources Conservation Service (NRCS) Web Soil Survey). The proposed site is located within the city limits of Waukesha. Waukesha has defined maximum pre-development CNs that apply to woodlands, grasslands, and croplands per Waukesha Municipal Code Chapter 32 Stormwater Management and Erosion Control. Where conventional CNs exceed those defined by Waukesha, the Waukesha maximum CN is used. According to NR 151.12(5)(b)1., pre-development conditions shall be land cover in “good” hydrologic condition as defined by TR-55.

SECTION 4 Existing Conditions

This section discusses the existing conditions at the site and the results from the hydrologic and hydraulic study.

4.1 Existing Tributary Area

For the purposes of this Report, the project area studied is broken down into two components:

- Building Site: Area within the property lines of the proposed site.
- Planting Site: Areas outside the grading limits of the proposed project but that is proposed to be stripped of existing vegetation and planted with a prairie seed mixes for meadow conditions.

The existing land cover, drainage subarea boundaries, and flow paths are shown in Exhibit SW1 presented in **Appendix A**. Surface drainage of the site is generally south to southeast to the adjacent wetlands. The site ultimately discharges into Poplar Creek. The project area is about 13.5 acres for the building site and 3.5 acres for the revegetation (planting) area. Across the site, there is relief ranging roughly from elevation 935 to elevation 860 and a maximum slope of about 10% off the north slope and towards the off-site adjacent wetland.

4.1.1 Existing Land Cover and Use

Exhibit SW1 is provided to show the existing land cover of the on-site and off-site area in exhibits presented in **Appendix A.** A broad and flat wet ditch wetland with some depressional storage borders the site to the southeast. East Broadway borders the south side of the site. Wooded area borders the site to the west, north and east. The existing area of the site is mostly sparsely wooded brush area with some remnant structures and pavement from past development. The site was previously used as a missile testing facility in the 1970s and 1980s.

4.1.2 Soil Conditions

The Soils Map (**Appendix B)** shows the primary hydrologic soil groups on-site. The soil survey shows the soils at the site to be predominantly loam to silt loam, all of which range from hydrological soil group B to D soils. Based on the soil boring logs in the Geotechnical report, the soils encountered at the site were mostly silt and sand that extended down to the depth explored. Shallow groundwater was generally observed at least 10 feet below existing grade. Based on the soil borings performed, the appropriate hydrologic soil groups were chosen as the soil type to represent the project site and adjacent tributary areas. Geotechnical report is in **Appendix B**.

4.1.3 Wetlands

A Wetland Delineation Report was issued by TRC Solutions in April 2020 for the Alternate Rempe-Nike BPS site in the City of Waukesha. This Report was submitted to the WDNR and the United States Army Corps of Engineers (USACE).

The wetland limits and the surrounding protective area are shown on the wetland mapping in **Appendix A**. The entirety of the site lies within the wetland's tributary area, as displayed in the exhibit. The wetland lies in a broad and flat depressional area which ultimately discharges east toward other low-lying areas just west of Springdale Road.

4.1.4 Regulatory Floodplain

There is no regulatory floodplain present on or adjacent to the site. This is supported by the Flood Insurance Rate Map (FIRM) 55133C0214G, effective November 5, 2014 **(Appendix A).**

4.2 Existing Hydrologic and Hydraulic Conditions

The existing hydrologic and hydraulic conditions are crucial for evaluating the impacts of development on the site and the surrounding area. Modeling the discharge rate of the pre-developed site is required by NR 151.123 and NR 151.124 in the Wisconsin Administrative Code.

4.2.1 Catchment Area Description

The **Existing Conditions Exhibit SW1** in **Appendix A** shows the existing drainage patterns on-site and within the tributary area. The site drainage areas were determined using 1-foot topographic mapping generated from a field survey. The land cover was determined using the topographic mapping and aerial photography.

Each of the areas is described and delineated into sub-basins as presented in **Table 4-1**.

Table 4-1
Existing Drainage Areas Summary

Description	Sub-Basins	Drainage Area (ac)	Impervious Area (ac)
Building Site	1S	13.53	0.71
Planting Area	2S	3.44	0.00
Total Existing	**--**	**16.97**	**0.71**

Minimal off-site area conveys flow to the low point of the total tributary area, which is the wetland. The sub-basins are delineated separately to define the on-site peak flows to meet the WDNR and City requirements.

4.2.2 Existing Conditions Model Results

HydroCAD was used to model the existing conditions for the 1-year, 2-year, 10-year and 100-year return period for 24-hour duration. The HydroCAD model reports are provided in **Appendix C**. The on-site release rates are summarized in the **Table 4-2**.

Table 4-2
Existing Conditions Results Summary

Subarea or Junction	Description	Area (ac)	CN	Time of Conc. (min)	Peak Flow Rate (cfs)			
					1-year	2-year	10- year	100-year
1S	EX Building Site	13.53	68	49.9	2.30	3.44	8.91	24.21
2S	EX Planting Area	3.44	66	39.6	0.52	0.81	2.31	6.58
3L	**Total Existing**	**16.97**	**68**	**-**	**2.79**	**4.20**	**11.10**	**30.33**

SECTION 5 Construction Practices

This section discusses the construction practices undertaken at the site. The proposed construction activities are anticipated to take place from April 2021 to July 2023. The following is an anticipated sequence of construction activities:

- Mobilization and erosion control installation
- Site preparation
- Earthwork, site grading, excavation, and soil stockpiling
- Reservoir and facility construction
  - Building Foundation
  - Booster Pumping Station Building
  - Reservoirs
  - Utility Connections
- Water Tower Construction
  - Water Tower Foundation
  - Water Tower Structure
- Pavement and stormwater ponds construction
- Site restoration, erosion mat
- Erosion control removal, silt fence and inlet protection following vegetation establishment
- Final Stabilization
- Demobilization

5.1 Erosion and Sediment Control Best Management Practices

Construction sediment control will be provided by the following practices:

- Silt Fence - Silt fence will be placed to reduce slope length of the disturbed area and to intercept and retain sediments from disturbed area. Silt fence will be installed in horseshoe fashion around the soil stockpiles.
- Stone Tracking Pad Entrance - Two Stone Tracking Pad Entrances will be provided on East Broadway to prevent, reduce or mitigate tracking out of sediment.
- Ditch Check and Silt Trap - Erosion Bale Ditch checks will be provided to reduce flow velocity and to promote settling of sediments. One Silt Trap will be used to detain sediment-laden runoff to allow the majority of the sediment to settle out.
- Temporary Sediment Basin - One sediment basin will be built on the south part of the site to intercept sediment-laden runoff and retain the sediment.
- Inlet protection - Filter Fabric will be installed beneath inlet covers to trap sediments.
- Erosion Matting - Sidewalls of the stormwater ponds and slope along the south and east end of the site will have erosion matting. It will help to protect the soil surface from erosive effect of rainfall and prevent erosion during establishment of grass and to reduce the soil moisture loss due to evaporation.
- Soil Stockpiles and Slopes Exceeding 4:1 - will maintain compliance with construction site erosion control requirements through prescriptive compliance. Soil stockpiles will have silt fence on the down slope side. Stockpiles will be stabilized with mulch, temporary vegetation, or tarps if remaining for more than 30 days. Slopes exceeding 4:1 will be covered in erosion mat.

SECTION 6 Proposed Conditions

This section discusses the proposed conditions at the site and the results from the hydrologic and hydraulic study.

6.1 Proposed Conditions

The construction on the BPS site will be completed in a single phase. The proposed construction was modeled in HydroCAD 10.00 to show how the runoff changes from pre-development to post-development. A storm sewer system, wet detention basin, and infiltration basin will be constructed at the site and will be designed to store and treat stormwater runoff in accordance with Waukesha's and WDNR stormwater criteria. The site will be graded to direct runoff away from the building and reservoirs towards vegetated areas and the storm sewer.

6.1.1 Proposed Land Cover and Use

The proposed land cover, grading, drainage subarea boundaries, flow paths, and proposed site and stormwater management improvements are shown in **Exhibit SW2** presented in **Appendix A**. Surface drainage of the site is maintained generally south to southeast to the adjacent wetlands. The site ultimately discharges into Poplar Creek. The proposed project area is approximately 13.5 acres of grading and improvements, and another 3.5 will be stripping existing vegetation and planting with a prairie seed mix for meadow conditions. Across the site, there is relief ranging roughly from elevation 935 to elevation 860 and a maximum slope of about 10% off the north slope and towards the off-site adjacent wetland.

The proposed building site is currently spare woodland with light underbrush, which will be converted for the construction of the BPS site. The grades will be raised approximately 3-7 ft above existing grade to accommodate the access drives, tanks, Water Tower and pump station building. **Table 6-1** summarizes the proposed drainage areas, which include both building site and revegetation areas, both captured by the pond drainage and undetained direct runoff drainage.

Table 6-1
Proposed Drainage Areas Summary

Description	Sub-Basins	Drainage Area (ac)	Impervious Area (ac)
Building Site – To Pond	2S	9.54	3.32
Planting Area – To Pond	3S	3.44	0.00
Building Site – Uncaptured	4S	3.99	0.20
Total Proposed Area	**--**	**16.97**	**3.52**

6.2 Proposed Hydrologic and Hydraulic Conditions

The Proposed Conditions **Exhibit SW2** in **Appendix A** shows the proposed development. The proposed development consists of approximately 17 acres of developed land, delineated into two sub-basins. One wet detention basin, one infiltration basin and vegetated area are proposed to reduce the rate of runoff and enhance the quality of runoff flowing from the site. The proposed development will disturb approximately 13.5 acres and will result in a net increase in impervious area of approximately 2.81 acres.

6.2.1 Catchment Area Description

Proposed conditions catchments are illustrated on **Exhibit SW2** in the **Appendix A**. The proposed conditions are divided into the Sub-basin 2S, Sub-basin 3S, and Sub-basin 4S (Undetained Area). The Sub-basin 2S Area contains most of the proposed conditions site including: a majority of the impervious area, the proposed wet detention basin (1P), and infiltration basin (2P). The Sub-basin 4S (Undetained Area) contains some pavement area in the southwest corner, mostly pervious area along the fringe areas of the building site. The Undetained Area is the undetained portion of the building site being graded and that flows directly offsite to the wetland, bypassing the proposed control practices.

6.2.2 Time of Concentration and Curve Numbers

The proposed conditions TOC and CN were calculated using the TR-55 methodology. Travel paths for the TOC computations are indicated on the **Exhibit SW2** in **Appendix A**.

6.2.3 Best Management Practices

The following are descriptions of the proposed infrastructure and BMPs that are designed to manage stormwater on the site.

6.2.3.1 Stormwater Conveyance

Proposed storm sewers and overland flow will convey stormwater on-site. The proposed storm sewer, manholes and catch basins are illustrated in **Exhibit SW2** in **Appendix A**.

Storm sewers were sized using the rational method, and inlet capacity and spacing evaluated (assuming 35% clogging). Majority of the site was graded so that runoff will be collected through the storm sewer system that is directed to the proposed wet detention basin. Sub-basin 2S area has the highest percentage of impervious surface on the site due to the pavement, Water Tower, building and the two reservoirs. The limited space and the proximity to the two structures necessitates the storm sewer to convey flow from Sub-basin 2S area to the Wet Detention Basin (1P). The Sub-basin 3S is mostly pervious and also drains to the Wet Detention Basin. The storm inlets collect the stormwater from Sub-basin 3S north of the site. There is a perimeter wall from the north of the building site that runs west to east. These walls will assist in containing most of the stormwater on the site and routing to the ponds. The inlets can be seen on the Proposed Conditions **Exhibit SW2** in **Appendix A**. Under extreme storm events, surcharged runoff will flow to the ponds via overland flow paths.

6.2.3.2 Stormwater Detention and Infiltration

A wet detention basin and a dry infiltration basin will be constructed on-site to control stormwater. The Wet Detention Basin is connected to the Infiltration Basin with 36-inch diameter round culvert. The Infiltration Basin drains into an Overflow Basin and then to the wetland through the outlet. The outlet functions as a multi-stage outlet, with a 4-inch diameter low-flow orifice outlet, and a 24-inch diameter high-flow orifice. As runoff enters the pond, it is held back (detained) and slowly released through the control orifices. If needed, the emergency overflow of these ponds will pass the stormwater to the adjacent roadside ditch on the south side, which ultimately flows to the wetland. Peak elevations for both ponds are designed to be below the emergency spillways in the 100-year rainfall event.

The Wet Detention Basin is in the Sub-Pond 1 Area and collects flow from the site via storm sewer and overland flows. The Wet Detention Basin will be lined with an approximately 2-foot clay liner to impede infiltration into the

subsurface and create a permanent pond. The clay liner specifications will meet WDNR Technical Standard 1001 for Type "B" Clay liner. The Wet Detention Basin will reduce the Total Suspended Solid (TSS) concentration in runoff. It will also dissipate chlorine from clear water discharges.

6.2.4 Proposed Conditions Model Results

HydroCAD was used to model the proposed conditions for the 1- year, 2-year, 10-year and 100-year return period for 24-hour duration similar to the existing conditions model. The HydroCAD modeling reports are located in **Appendix D**. The proposed runoff release rates with and without controls for the 1-year, 2-year, 10-year and 100-year return period are summarized in **Table 6-2.**

TABLE 6-2
Proposed Conditions Results Summary

Subarea or Junction	Description	Area (ac)	CN	Tc (min)	Peak Flow Rate (cfs)			
					1-year	2-year	10-year	100-year
2S	Building Site - To Pond	9.54	82	14.0	11.85	14.78	26.35	52.44
3S	Planting Area - To Pond	3.44	68	35.5	0.72	1.09	2.83	7.63
4S	Building Site - Uncaptured	3.99	74	16.0	2.50	3.40	7.24	16.71
--	Total PROPOSED (no controls)	16.97	77	--	14.37	18.30	34.30	72.26
5L	**Total PROPOSED (with controls)**	**16.97**	**77**	**--**	**2.50**	**3.40**	**7.31**	**17.19**

As stated, the total proposed runoff discharge from the site is shown with and without controls in Table 6.2. Table 6-3 below shows the flow reduction and associated storage volume and maximum water surface for each control practice during the design storm events.

TABLE 6-3
Detention System Routing Analysis Summary

	Normal Water Level	Overflow Elevation	1-Year Discharge	2-Year Discharge	10-Year Discharge	100-Year Discharge
Wet Detention Basin	874.00	878.00				
Peak Inflow (cfs)	-	-	11.97	15.01	27.32	55.82
Peak Outflow (cfs)	-	-	1.40	2.04	4.91	9.85
Max Water Surface Elev. (ft)	-	-	874.71	874.91	875.76	876.84
Max Storage Volume (ac-ft)	-	3.07	0.49	0.64	1.26	2.11
Infiltration Basin	874.00	878.00				
Peak Inflow (cfs)	-	-	1.40	2.04	4.91	9.85
Peak Outflow (cfs)	-	-	0.61	0.69	0.94	9.80
Max Water Surface Elev. (ft)	-	-	874.69	874.91	875.76	876.76
Max Storage Volume (ac-ft)	-	0.36	0.05	0.07	0.13	0.23

6.3 Springdale Road Culverts Impacts

The runoff discharged from the site ultimately drains east to two culverts under Springdale Road as shown by **Exhibit SW3** in **Appendix A**. The City has indicated that these existing culverts may not have adequate capacity to convey the entire tributary drainage under Springdale Road without ponding or overtopping. In general, the runoff peak discharge rates are shown by this plan to be reduced from the site and, hence, any hydraulic conditions at the downstream culverts crossings can thereby be presumed improved.

SECTION 7 Water Quality

Water quality for the site will be achieved through the Wet Detention Basin and Infiltration Basin located on the south side of the site.

In accordance with NR 151.122, 40 percent of total suspended solids (TSS) from stormwater runoff from the redevelopment area (25%) and 80 percent of the TSS from the new development area (75%), which is resulting composite goal of 70 percent removal of TSS is required at the site. WinSLAMM (Source Loading and Management Model for Windows) version 10.4 was used to develop a model to calculate the TSS reduction. The Wet Detention Basin, along with the Infiltration Basin, are proposed to achieve the required pollutant removal. **Table 7-1** describes the sediment removal. The overall results of the WinSLAMM analysis indicate that approximately 75.20 percent of TSS will be removed from stormwater leaving the site, based on an average annual rainfall. The water quality treatment exceeds the required 70% TSS reduction from the site in accordance with the WDNR NR 151.122 Total Suspended Solids Performance Standards. The input and output files of the WinSLAMM modeling are located in **Appendix E**.

Table 7-1
Water Quality Reductions Summary

Parameter	Yield, no controls	Yield, with controls	Percentage reduction
Runoff Volume	424,790 cu ft	174,782 cu ft	58.85%
TSS	2072 lb	513.8 lb	75.20%
TP	8.707 lb	3.108 lb	64.30%

The soil boring logs indicate soils within the area of the infiltration basin to be generally sand with cobble 3 to 5 feet below grade at the proposed infiltration basin location. Groundwater was encountered (> 10 feet) within the borings performed near the proposed infiltration basin and accounted for by the analysis and design, maintaining 5 feet separation. Refer to **Appendix B** for a copy of the soil boring logs.

Based on the WDNR Conservation Practice Standard 1002, a design infiltration rate of 3.6 inches per hour is recommended for sand soil textures.

Infiltration was analyzed using WinSLAMM software. The results of the WinSLAMM analysis indicate a pre-development infiltration volume of 40.23 acre feet. The City and WDNR require moderate impervious developments to infiltrate at least 75 percent of the pre-development infiltration volume, which would be a minimum of 30.17 acre feet.

The results of the post-development WinSLAMM analysis indicate approximately 37.03 acre feet of runoff will infiltrate as a result of the open areas and proposed infiltration basin. This is approximately 92.0 percent of the pre-development infiltration volume which is in accordance with the City and WDNR infiltration requirements. Refer to **Appendix E** (WinSLAMM Summary) for details of the infiltration analysis.

SECTION 8 Post Construction Stormwater Management

8.1 Stormwater Facility Maintenance Practices and Procedures

As with any stormwater BMP device, routine maintenance is critical to proper performance. The owner will enter into an agreement with Waukesha for stormwater facility maintenance. A draft of the agreement is presented in **Appendix F**. The following practices will be implemented:

- **Erosion:** All grassed areas, embankments and flow control devices should be inspected frequently and particularly during high flow events (major rain storms and spring snow melt) for rills, scour and short-circuiting. Areas showing signs of erosion shall be repaired, reinforced and revegetated immediately.

- **Sedimentation:** Accumulated sediment should be removed, and bare areas regraded, seeded or otherwise revegetated. Sediment material, free of trash and debris, may be used to fill and restore small depressions or shallow water pockets and then seeded.

- **Transport:** Silt, sod, stone, and any other material transported as a result of high water volumes, velocities or scour shall be removed, replaced, and reinforced immediately to its proper condition and location occupied prior to the storm event. Trash and other deleterious debris shall be properly disposed of.

- **Storm Sewers and Structures:** Storm sewers and structures should be inspected on an annual basis, cleaned when necessary and repaired immediately upon discovery of any structural defects.

- **Wet Detention Basin:** The wet detention basin is designed to reduce peak flows and reduce runoff total suspended solids (TSS) from the site. It shall be maintained regularly to function correctly. It is required to remove sediment and trash from the pond inlets, outlets, and trash tracks. The embankments and outlet shall be inspected for settlement or signs of slope erosion. Regular inspection is necessary to inspect for animal burrows, sinkholes, wet areas, etc. Non-routine maintenance includes sediment removal from the permanent pool as required.

- **Infiltration Basin:** The infiltration basin is designed to reduce runoff volumes. Regular inspection is necessary to ensure the proper function. Any accumulated sediment or debris shall be removed and properly disposed as needed. The embankments and outlet shall be inspected for settlement or signs of slope erosion. The vegetation shall be visually inspected to ensure healthy growth. Regular mowing of the upper embankment is necessary to control woody vegetation. Excessive ponding duration (greater than 72 hours) shall be address per the maintenance provisions of **Appendix F**.

- **Overflow Relief Dry Basin:** The overflow relief dry basin is designed to handle additional volume of water in the case of an emergency tank overflow. The basin will collect additional overland flow and allows large flows to pass through the pond and outlet pipe to prevent flooding to the southern residents. When the pond overflows it will go through the discharge pipe and be discharged to the wetland. The inlet endwall shall be kept clear of vegetation, trash or any other obstructions. Further, the integrity of the pipe and outlet endwall shall be inspected annually for structural deficiencies or obstructions.

- **Outlet structures**: The outlet structures should be inspected on an annual basis, cleaned when necessary and repaired immediately upon discovery of any structural defects.

SECTION 9 Summary of Results

Table 9.1
Comparison of Peak Discharge Rates for Existing and Proposed Conditions

Conditions	1-year 24-hour	2-year 24-hour	10-year 24-hour	100-year 24-hour
EXISTING	2.79	4.20	11.10	30.33
PROPOSED	2.50	3.40	7.31	17.19

The proposed 1-year, 24-hour and the 2-year, 24-hour runoff rate are no greater than the 1-year, 24-hour and the 2-year, 24-hour existing runoff rates.

The results for peak discharge rates satisfy quantitative requirements according the post construction performance standards.

The TSS reduction for the site is 75.20%. The water quality treatment exceeds the required 70% TSS reduction from the site in accordance with the WDNR NR 151.122 Total Suspended Solids Performance Standards. The site with control practices will achieve over 75% of the predevelopment infiltration volume.

The effects on the hydrologic conditions of the wetland area located downstream of the site was evaluated as part of the plan. A hydraulic analysis of the wetland depressional area adjacent to Springdale Road was reviewed and no significant impacts are anticipated. In general, the runoff peak discharge rates are shown by this plan to be reduced from the site and, hence, any hydraulic conditions at the downstream culverts crossings at Springdale Road can thereby be presumed improved. The total tributary watershed of the wetland area (from the project site) is shown by the exhibit provided in Appendix A.

The proposed development will maintain compliance with the City of Waukesha and the WDNR requirements for stormwater management. We request your approval of this Stormwater Management Plan to allow for the construction of the BPS and Water Tower projects.

Appendix A – Existing and Proposed Conditions Exhibits

SITE LOCATION MAP

Legend

- PNW-ASNRI Sensitive Areas of Lakes
- PNW-ASNRI Wild and Scenic Rivers
- PNW-ASNRI Outstanding and Exceptional Streams
- PNW-ASNRI Trout Streams
- PNW-ASNRI Wild Rice Streams
- PNW-ASNRI Outstanding and Exceptional Lakes
- PNW-ASNRI Special Area Management Plan Streams
- PNW-ASNRI Special Wetlands Inventory Study Streams
- PNW-ASNRI Coastal Wisconsin Wetlands Streams
- PNW-ASNRI Special Area Management Plan Areas
- PNW-ASNRI Special Wetlands Inventory Study Areas
- PNW-ASNRI Coastal Wisconsin Wetlands Areas
- PNW-ASNRI Wild Rice Areas
- PNW-ASNRI Trout Spring Ponds
- PNW-ASNRI State Natural Areas
- PNW-PRF Other Public Rights Features
- PNW Musky Streams
- PNW Sturgeon Streams
- PNW Musky Areas
- PNW Sturgeon Areas
- PNW Walleye Areas

Notes

Great Water Alliance Waukesha

0.3 0 0.13 0.3 Miles

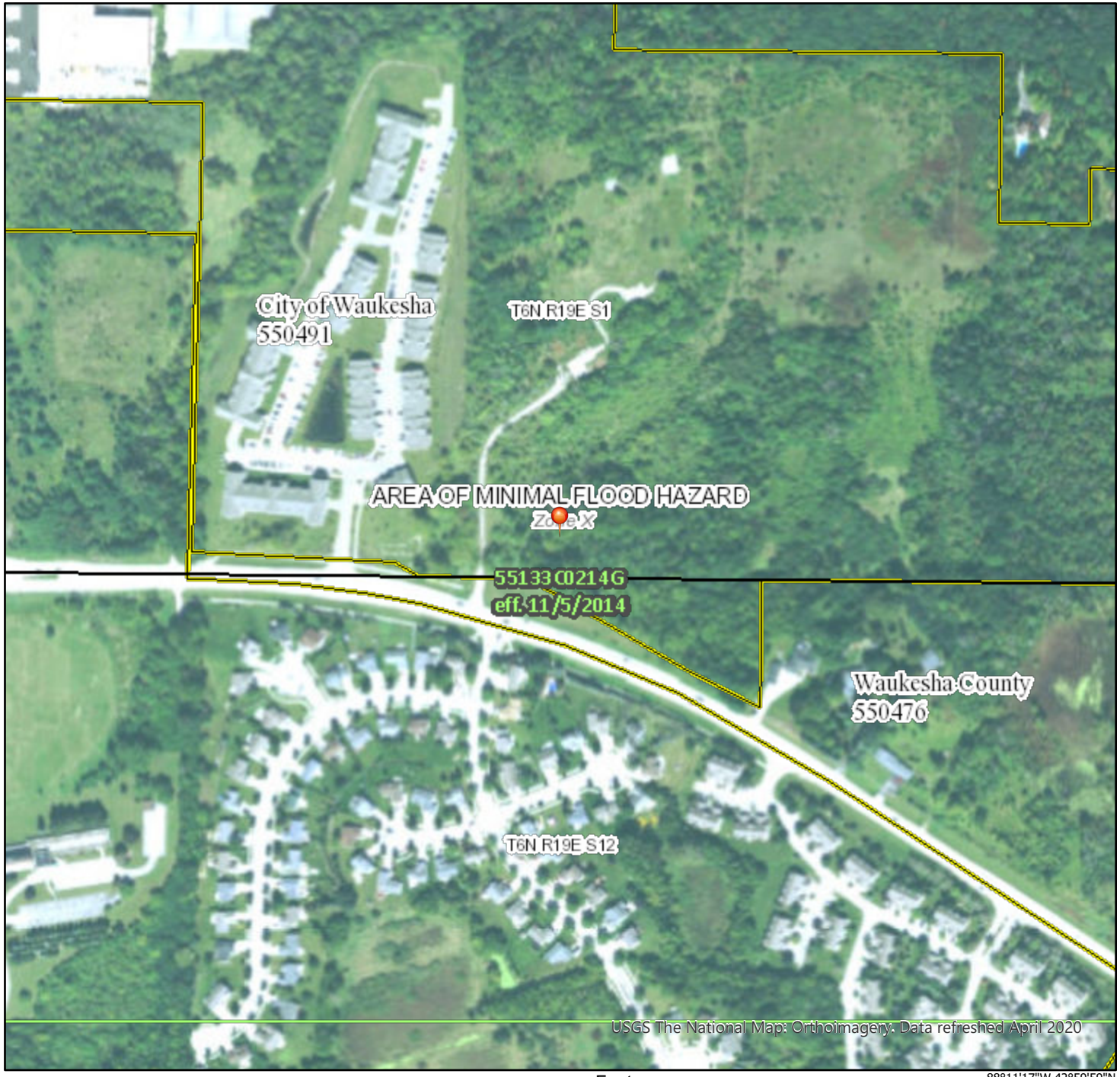
NAD_1983_HARN_Wisconsin_TM

1: 7,920

National Flood Hazard Layer FIRMette

FEMA

88°11'55"W 43°0'25"N



88°11'17"W 42°59'59"N

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

1:6,000

Legend

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

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

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

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

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

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

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

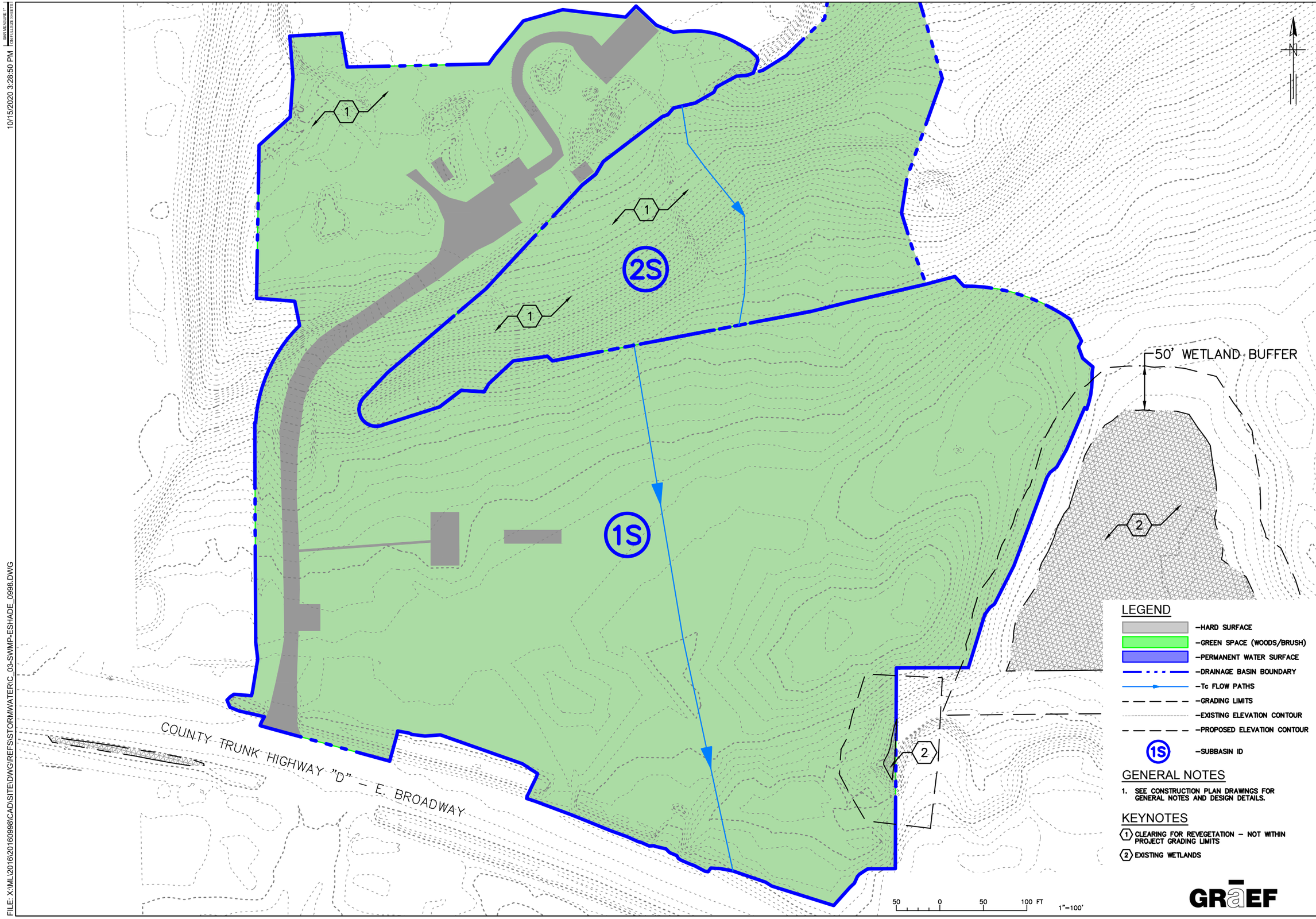
N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 9/24/2020 at 10:40 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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



LEGEND

- HARD SURFACE
- GREEN SPACE (WOODS/BRUSH)
- PERMANENT WATER SURFACE
- DRAINAGE BASIN BOUNDARY
- Tc FLOW PATHS
- GRADING LIMITS
- EXISTING ELEVATION CONTOUR
- PROPOSED ELEVATION CONTOUR
- 1S SUBBASIN ID

GENERAL NOTES

1. SEE CONSTRUCTION PLAN DRAWINGS FOR GENERAL NOTES AND DESIGN DETAILS.

KEYNOTES

1. CLEARING FOR REVEGETATION – NOT WITHIN PROJECT GRADING LIMITS
2. EXISTING WETLANDS

GRÄEF

NO.	DATE	APPD	REVISION

Waukesha Water Utility
BEHRINGWAUKESHA SINCE 1898

GREELEY AND HANSEN
741 N. GRAND AVE. SUITE 308
WAUKESHA, WI 53186

GREAT WATER ALLIANCE™

CONTRACT PACKAGE 3: BOOSTER PUMPING STATION
CONTRACT PACKAGE 3A: WATER TOWER

DRAINAGE BASIN MAP - EXISTING

APPROVED

SEAL AFFIXED
MONTH / DAY / YEAR

SEPTEMBER 2020

JOB NO.: 15310

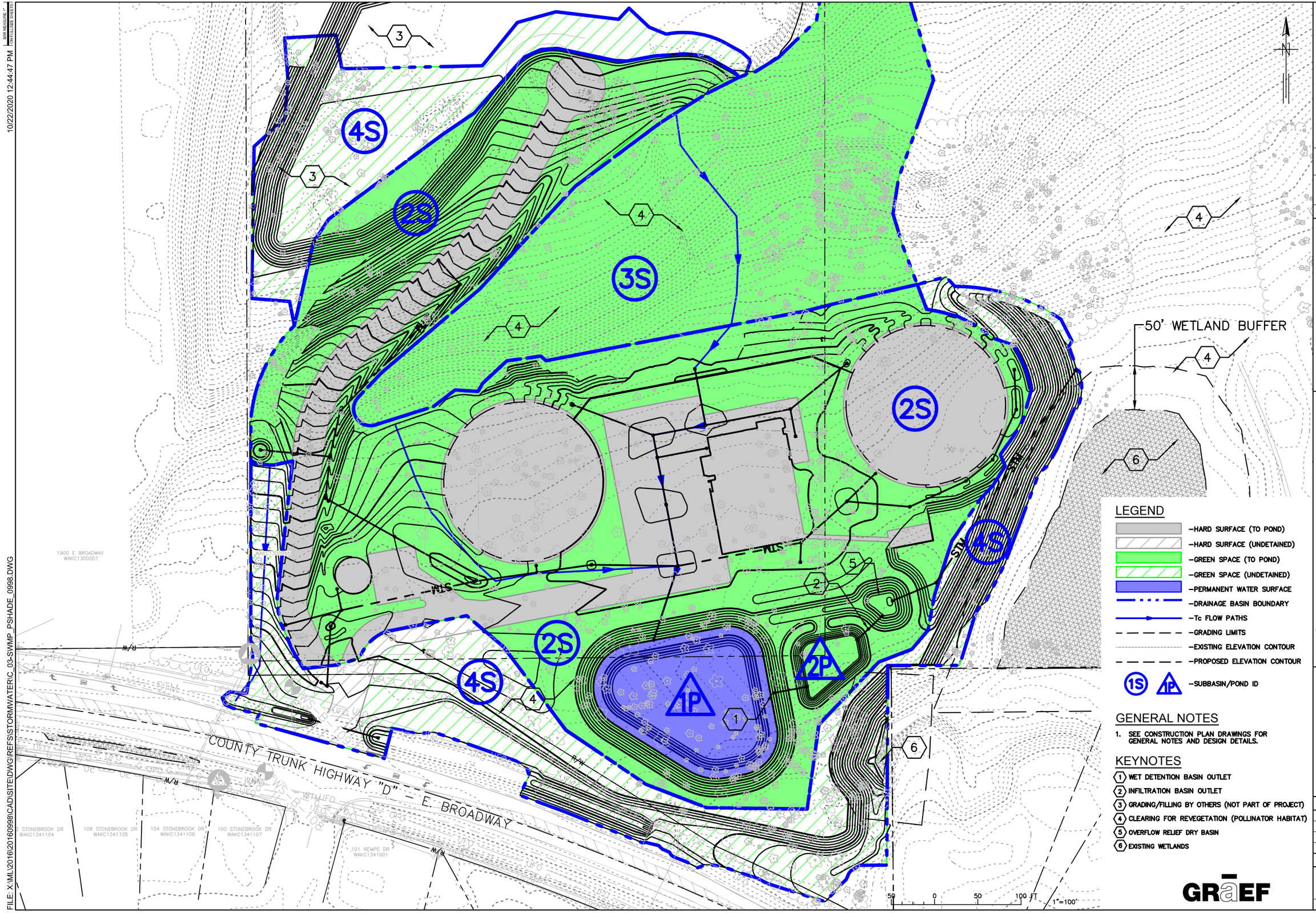
DESGN	DDB	CHCK	PRE
APPRV	MNP	DRWN	TRY

SCALE: AS SHOWN

DRAWING NUMBER

SW1

SHEET OF 188 REV 0



LEGEND

- HARD SURFACE (TO POND)
- HARD SURFACE (UNDETAINED)
- GREEN SPACE (TO POND)
- GREEN SPACE (UNDETAINED)
- PERMANENT WATER SURFACE
- DRAINAGE BASIN BOUNDARY
- Tc FLOW PATHS
- GRADING LIMITS
- EXISTING ELEVATION CONTOUR
- PROPOSED ELEVATION CONTOUR
- SUBBASIN/POND ID

GENERAL NOTES

1. SEE CONSTRUCTION PLAN DRAWINGS FOR GENERAL NOTES AND DESIGN DETAILS.

KEYNOTES

1. WET DETENTION BASIN OUTLET
2. INFILTRATION BASIN OUTLET
3. GRADING/FILLING BY OTHERS (NOT PART OF PROJECT)
4. CLEARING FOR REVEGETATION (POLLINATOR HABITAT)
5. OVERFLOW RELIEF DRY BASIN
6. EXISTING WETLANDS

GRÄEF

NO.	DATE	APPD	REVISION

Waukesha Water Utility
SERVING WAUKESHA SINCE 1898

GREELEY AND HANSEN
741 N. GRAND AVE. SUITE 308
WAUKESHA, WI 53186

GREAT WATER ALLIANCE™

CONTRACT PACKAGE 3: BOOSTER PUMPING STATION
CONTRACT PACKAGE 3A: WATER TOWER

DRAINAGE BASIN MAP - PROPOSED

APPROVED

SEAL AFFIXED
MONTH / DAY / YEAR

SEPTEMBER 2020

JOB NO.: 15310

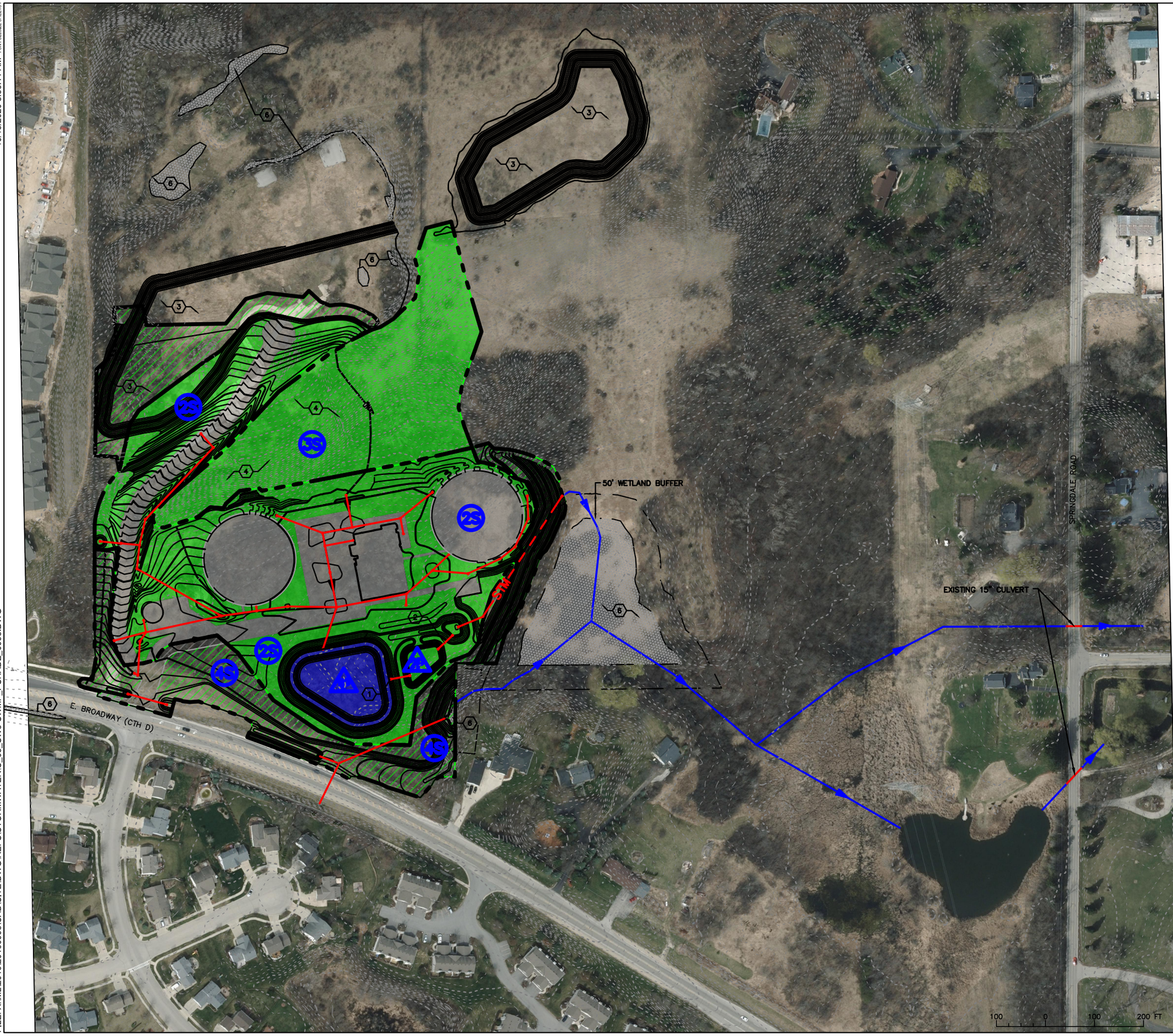
DESGN	DDB	CHCK	PRE
APPRV	MNP	DRWN	TRY

SCALE: AS SHOWN

DRAWING NUMBER

SW2

SHEET 57 OF 188 | REV 0



LEGEND

- –HARD SURFACE (TO POND)
- –HARD SURFACE (UNDETAINED)
- –GREEN SPACE (TO POND)
- –GREEN SPACE (UNDETAINED)
- –PERMANENT WATER SURFACE
- –DRAINAGE BASIN BOUNDARY
- –Tc FLOW PATHS
- –GRADING LIMITS
- –EXISTING ELEVATION CONTOUR
- –PROPOSED ELEVATION CONTOUR
- –SUBBASIN/POND ID

GENERAL NOTES

1. SEE CONSTRUCTION PLAN DRAWINGS FOR GENERAL NOTES AND DESIGN DETAILS.

KEYNOTES

1. WET DETENTION BASIN OUTLET
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4. CLEARING FOR REVEGETATION (POLLINATOR HABITAT)
5. OVERFLOW RELIEF DRY BASIN
6. EXISTING WETLANDS

GRÄEF

NO.	DATE	APPD	REVISION

Waukesha Water Utility
SERVING WAUKESHA SINCE 1898

GREELEY AND HANSEN
741 N. GRAND AVE. SUITE 308
WAUKESHA, WI 53186

GREAT WATER ALLIANCE™

CONTRACT PACKAGE 3: BOOSTER PUMPING STATION
CONTRACT PACKAGE 3A: WATER TOWER

OFFSITE DRAINAGE PATTERN MAP

APPROVED

SEAL AFFIXED
MONTH / DAY / YEAR

SEPTEMBER 2020

JOB NO.: 15310			
DESGN	DDB	CHCK	PRE
APPRV	MNP	DRWN	TRY
SCALE:	AS SHOWN		

DRAWING NUMBER

SW3

SHEET 57 OF 188 | REV 0

Appendix B – Geotechnical Report

and Soil Map

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 Milwaukee and Waukesha Counties, Wisconsin

Great Water Alliance

April 20, 2020

Preface

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

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

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

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

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

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

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Contents

How Soil Surveys Are Made

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

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

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

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

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

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

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

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

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

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

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

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

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

Soil Map

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

Custom Soil Resource Report
Soil Map

Map Scale: 1:1,190 if printed on B portrait (11" x 17") sheet.

N

Meters: 0 15 30 60 90

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N 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 1:15,800.

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

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

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

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

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

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

Soil Survey Area: Milwaukee and Waukesha Counties, Wisconsin
Survey Area Data: Version 15, Sep 16, 2019

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

Date(s) aerial images were photographed: Aug 1, 2019—Oct 20, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND

MAP INFORMATION

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
CeD2	Casco loam, 12 to 20 percent slopes, eroded	3.1	23.8%
FoB	Fox loam, 2 to 6 percent slopes	0.0	0.2%
FoC2	Fox loam, 6 to 12 percent slopes, eroded	0.9	6.6%
HmB2	Hochheim loam, 2 to 6 percent slopes, eroded	1.8	13.9%
HmC2	Hochheim loam, 6 to 12 percent slopes, eroded	1.2	9.1%
HoC3	Hochheim soils, 6 to 12 percent slopes, severely eroded	3.7	28.0%
HtA	Houghton muck, 0 to 2 percent slopes	0.0	0.0%
LmB	Lamartine silt loam, 0 to 3 percent slopes	2.4	18.5%
Totals for Area of Interest		**13.2**	**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.

Milwaukee and Waukesha Counties, Wisconsin

CeD2—Casco loam, 12 to 20 percent slopes, eroded

Map Unit Setting

National map unit symbol: 2tjwd
Elevation: 640 to 1,150 feet
Mean annual precipitation: 31 to 37 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 134 to 193 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Casco, Eroded

Setting

Landform: Moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy alluvium over calcareous, stratified sandy and gravelly outwash

Typical profile

Ap - 0 to 5 inches: loam
Bt - 5 to 15 inches: clay loam
2C - 15 to 79 inches: stratified sand to gravel

Properties and qualities

Slope: 12 to 20 percent
Depth to restrictive feature: 10 to 20 inches to strongly contrasting textural stratification
Natural drainage class: Somewhat excessively drained
Runoff class: Medium
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: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 25 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Forage suitability group: Low AWC, adequately drained with limitations (G095BY003WI)

Hydric soil rating: No

Minor Components

Fox

Percent of map unit: 8 percent
Landform: Moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: No

Rodman

Percent of map unit: 7 percent
Landform: Moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: No

FoB—Fox loam, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: 2szgj
Elevation: 740 to 1,140 feet
Mean annual precipitation: 31 to 35 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 124 to 190 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Fox and similar soils: 93 percent
Minor components: 7 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fox

Setting

Landform: Outwash plains
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Fine-loamy glaciofluvial deposits over sandy and gravelly outwash

Typical profile

Ap - 0 to 7 inches: loam
Bt1 - 7 to 22 inches: clay loam

2Bt2 - 22 to 36 inches: gravelly loam
2C - 36 to 79 inches: stratified sand to gravel

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: 20 to 26 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 25 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 2.0
Available water storage in profile: Low (about 4.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Forage suitability group: Mod AWC, adequately drained (G095BY005WI)
Hydric soil rating: No

Minor Components

Casco

Percent of map unit: 4 percent
Landform: Outwash plains
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Fox

Percent of map unit: 3 percent
Landform: Outwash plains
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

FoC2—Fox loam, 6 to 12 percent slopes, eroded

Map Unit Setting

National map unit symbol: 2szgk
Elevation: 830 to 1,090 feet

Mean annual precipitation: 31 to 35 inches
Mean annual air temperature: 43 to 48 degrees F
Frost-free period: 130 to 190 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Fox, eroded, and similar soils: 92 percent
Minor components: 8 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fox, Eroded

Setting

Landform: Outwash plains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Fine-loamy glaciofluvial deposits over sandy and gravelly outwash

Typical profile

Ap - 0 to 5 inches: loam
Bt1 - 5 to 21 inches: clay loam
2Bt2 - 21 to 33 inches: sandy clay loam
2C - 33 to 79 inches: stratified sand to gravel

Properties and qualities

Slope: 6 to 12 percent
Depth to restrictive feature: 20 to 26 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 25 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 2.0
Available water storage in profile: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Forage suitability group: Mod AWC, adequately drained (G095BY005WI)
Hydric soil rating: No

Minor Components

Casco, eroded

Percent of map unit: 5 percent
Landform: Moraines
Landform position (two-dimensional): Backslope

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

Boyer

Percent of map unit: 3 percent
Landform: Outwash plains
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

HmB2—Hochheim loam, 2 to 6 percent slopes, eroded

Map Unit Setting

National map unit symbol: 2t03w
Elevation: 820 to 1,330 feet
Mean annual precipitation: 29 to 36 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 135 to 175 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Hochheim, Eroded

Setting

Landform: Drumlins
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Loamy till and/or calcareous, dense loamy till

Typical profile

Ap - 0 to 7 inches: loam
Bt - 7 to 16 inches: loam
C - 16 to 33 inches: gravelly sandy loam
Cd - 33 to 79 inches: gravelly sandy loam

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: 20 to 40 inches to densic material
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)

Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 60 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: D
Forage suitability group: Mod AWC, adequately drained (G095BY005WI)
Hydric soil rating: No

Minor Components

Theresa, eroded

Percent of map unit: 10 percent
Landform: Till plains
Landform position (two-dimensional): Summit, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Lamartine

Percent of map unit: 5 percent
Landform: Drumlins
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

HmC2—Hochheim loam, 6 to 12 percent slopes, eroded

Map Unit Setting

National map unit symbol: 2t03r
Elevation: 900 to 1,340 feet
Mean annual precipitation: 31 to 33 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 135 to 175 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Hochheim, Eroded

Setting

Landform: Drumlins
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Loamy till and/or calcareous, dense loamy till

Typical profile

Ap - 0 to 7 inches: loam
Bt - 7 to 16 inches: clay loam
C - 16 to 33 inches: gravelly sandy loam
Cd - 33 to 79 inches: gravelly sandy loam

Properties and qualities

Slope: 6 to 12 percent
Depth to restrictive feature: 20 to 40 inches to densic material
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 60 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 4.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Forage suitability group: Mod AWC, adequately drained (G095BY005WI)
Hydric soil rating: No

Minor Components

Theresa

Percent of map unit: 5 percent
Landform: Drumlins
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Hochheim

Percent of map unit: 5 percent
Landform: Drumlins
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Side slope, head slope
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

HoC3—Hochheim soils, 6 to 12 percent slopes, severely eroded

Map Unit Setting

National map unit symbol: g948
Elevation: 670 to 1,100 feet
Mean annual precipitation: 28 to 36 inches
Mean annual air temperature: 37 to 55 degrees F
Frost-free period: 135 to 170 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Hochheim

Setting

Landform: Ground moraines, drumlins
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Calcareous, dense loamy till

Typical profile

A,E - 0 to 6 inches: clay loam
Bt1,Bt2,BC - 6 to 17 inches: clay loam
C - 17 to 60 inches: gravelly loam

Properties and qualities

Slope: 6 to 12 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 60 percent
Available water storage in profile: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Forage suitability group: Mod AWC, adequately drained (G095BY005WI)
Hydric soil rating: No

HtA—Houghton muck, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2szff
Elevation: 600 to 1,090 feet
Mean annual precipitation: 31 to 35 inches
Mean annual air temperature: 43 to 48 degrees F
Frost-free period: 124 to 192 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Houghton, Muck

Setting

Landform: Depressions
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Herbaceous organic material

Typical profile

Oap - 0 to 6 inches: muck
Oa - 6 to 79 inches: muck

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 5.95 in/hr)
Depth to water table: About 0 to 4 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very high (about 23.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A/D
Hydric soil rating: Yes

Minor Components

Houghton, ponded

Percent of map unit: 4 percent

Landform: Depressions
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Palms

Percent of map unit: 2 percent
Landform: Lakebeds (relict)
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Adrian

Percent of map unit: 2 percent
Landform: Lakebeds (relict)
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Willette, muck

Percent of map unit: 1 percent
Landform: Depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: Yes

Edwards

Percent of map unit: 1 percent
Landform: Depressions
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

LmB—Lamartine silt loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2t043
Elevation: 590 to 1,140 feet
Mean annual precipitation: 29 to 35 inches
Mean annual air temperature: 37 to 46 degrees F
Frost-free period: 135 to 170 days
Farmland classification: Prime farmland if drained

Map Unit Composition

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

Description of Lamartine

Setting

Landform: Interdrumlins
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Loess over loamy till

Typical profile

Ap - 0 to 8 inches: silt loam
Bt1 - 8 to 20 inches: silty clay loam
2Bt2 - 20 to 28 inches: clay loam
2C - 28 to 79 inches: gravelly sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Negligible
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 12 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 8.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: B/D
Forage suitability group: High AWC, high water table (G095BY007WI)
Hydric soil rating: No

Minor Components

Pella

Percent of map unit: 8 percent
Landform: Drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Ossian

Percent of map unit: 7 percent

Landform: Depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

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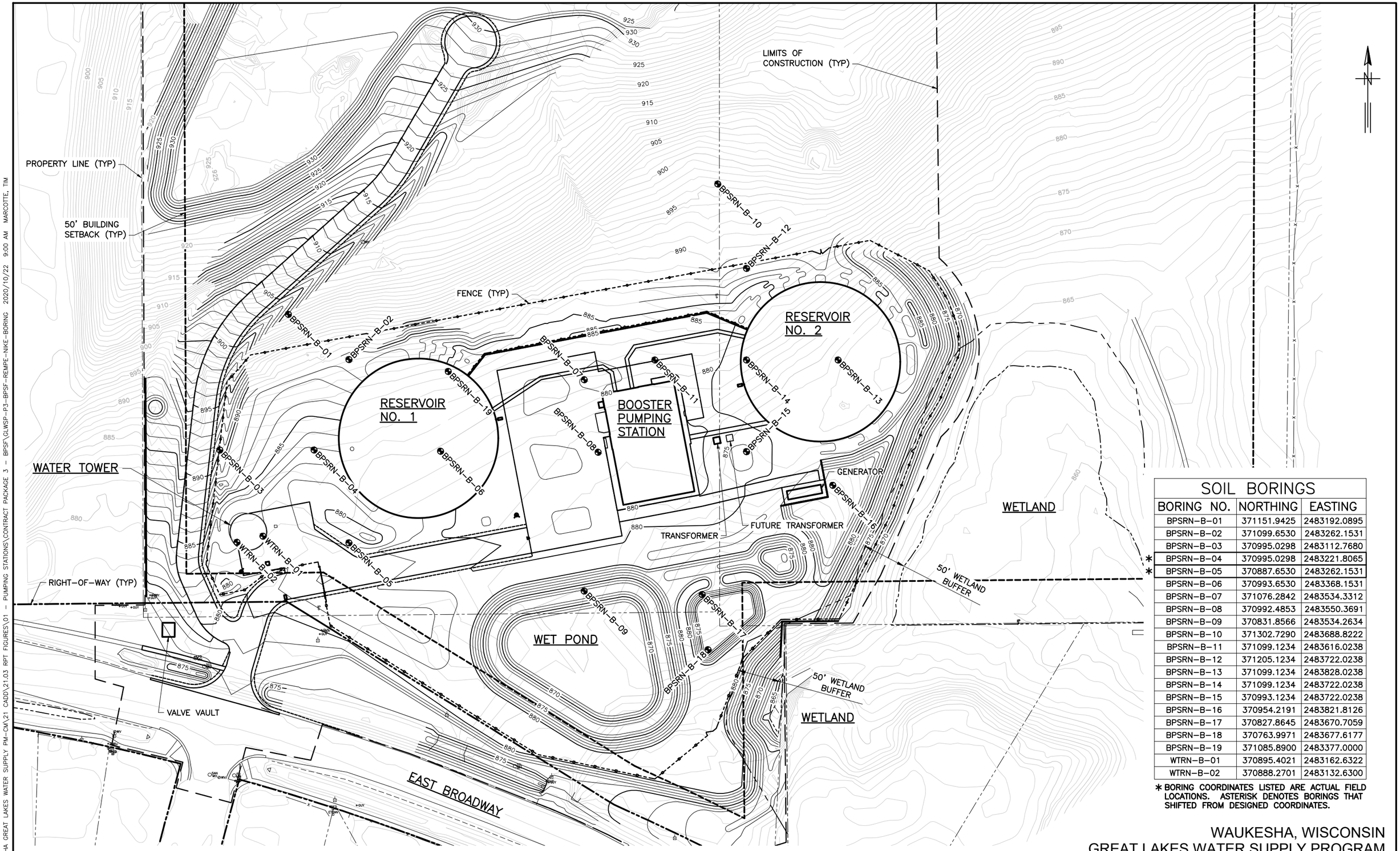


SOIL BORINGS		
BORING NO.	NORTHING	EASTING
BPSRN-B-01	371151.9425	2483192.0895
BPSRN-B-02	371099.6530	2483262.1531
BPSRN-B-03	370995.0298	2483112.7680
BPSRN-B-04 *	370995.0298	2483221.8065
BPSRN-B-05 *	370887.6530	2483262.1531
BPSRN-B-06	370993.6530	2483368.1531
BPSRN-B-07	371076.2842	2483534.3312
BPSRN-B-08	370992.4853	2483550.3691
BPSRN-B-09	370831.8566	2483534.2634
BPSRN-B-10	371302.7290	2483688.8222
BPSRN-B-11	371099.1234	2483616.0238
BPSRN-B-12	371205.1234	2483722.0238
BPSRN-B-13	371099.1234	2483828.0238
BPSRN-B-14	371099.1234	2483722.0238
BPSRN-B-15	370993.1234	2483722.0238
BPSRN-B-16	370954.2191	2483821.8126
BPSRN-B-17	370827.8645	2483670.7059
BPSRN-B-18	370763.9971	2483677.6177
BPSRN-B-19	371085.8900	2483377.0000
WTRN-B-01	370895.4021	2483162.6322
WTRN-B-02	370888.2701	2483132.6300

* BORING COORDINATES LISTED ARE ACTUAL FIELD LOCATIONS. ASTERISK DENOTES BORINGS THAT SHIFTED FROM DESIGNED COORDINATES.

WAUKESHA, WISCONSIN
GREAT LAKES WATER SUPPLY PROGRAM
BOOSTER PUMPING STATION REMPE-NIKE
PRELIMINARY SOIL BORING PLAN - DRAFT
2020-10-22

GREAT WATER ALLIANCE™ | Waukesha Water Utility SERVING WAUKESHA SINCE 1888 | GREELEY AND HANSEN

G:\15310-WAUKESHA GREAT LAKES WATER SUPPLY PM-CM\21 CADD\21.03 RPT FIGURES\01 - PUMPING STATIONS\CONTRACT PACKAGE 3 - BPSF\GLWSP-P3-BPSF-REMPE-NIKE-BORING 2020/10/22 9:00 AM MARCOTTE, TIM

PROJECT NAME: GWA - Alternative BPS Site 2	GREAT WATER ALLIANCE	**BORING LOG**	Intertek psi	**BORING No BPSRN-B-01**	
PROJECT No: 00521741				PAGE No: 1 of 1	
CONSULTANT: Greeley-Hansen	CONSULTANT PROJECT No:	DATE STARTED: 4/15/20		HORIZONTAL DATUM	VERTICAL DATUM
DRILLING CONTRACTOR: PSI	DRILLING CONTRACTOR PROJECT No:	DATE COMPLETED: 4/15/20		LATITUDE:	
CREW CHIEF: P. Rotaru	DRILLING RIG: HD ATV #419	BORING OFFSET:		LONGITUDE:	
FIELD LOG BY: D. Buchman	DRILLING METHOD / HOLE SIZE:	ROADWAY NAME:		NORTHING:	
LOG QC BY:	HAMMER TYPE: / EFFICIENCY:	STATION: / OFFSET:		EASTING:	
COUNTY:	TOWNSHIP: / RANGE: / SECTION:	1/4 SECTION: / 1/4 SECTION:		SURFACE ELEVATION:	

Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q_t (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
						Topsoil (12"± Thick), Dark Brown Silty Clay, Very Moist	OL							27	
1 SS	8	4 13 14	27			0.99								5	
						Possible Fill, Brown Silty Sand With Gravel and Dark Brown Lean Clay Pockets, Moist									
2 SS	12	4 7 10	17			5.5								7	
						Brown Lean Clay, Trace Gravel, Moist	CL								
3 SS	7	4 4 5	9			8				2.0	1.81			15	
4 SS	14	5 7 10	17	10		Brown Sandy Silt With Gravel, Moist	ML							7	
5 SS		4 7 7	14			17								7	
						Brown Silt, Moist	ML								
6 SS	14	18 15 13	28	20		22									
						Brown Sandy Silt With Gravel, Very Moist	ML								
7 SS	12	4 14 24	38			27								15	
						Brown Sand, Trace Gravel, Moist	SP								
8 SS	12	12 20 31	51	30										4	
9 SS	18	21 31 40	71			37								4	
						Brown Silty Fine Sand, Wet	SM								
10 SS	12	23 29 32	61	40		40								6	
						End of Boring at 40.0 ft.									

WATER & CAVE-IN OBSERVATION DATA

▽	WATER ENCOUNTERED DURING DRILLING: 38.5ft.	▨	CAVE DEPTH AT COMPLETION: 22ft.	WET ☐ DRY ☐
▼	WATER LEVEL AT COMPLETION: NE	■	CAVE DEPTH AFTER 0 HOURS: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AFTER 0 HOURS: N/A		NE = Not Encountered; NMR = No Measurement Recorded	

NOTE: Stratification lines between soil types represent the approximate boundary; gradual transition between in-situ soil layers should be expected.

PROJECT NAME: GWA - Alternative BPS Site 2	GREAT WATER ALLIANCE	**BORING LOG** Intertek psi		**BORING No BPSRN-B-02**
PROJECT No: 00521741				PAGE No: 1 of 2
CONSULTANT: Greeley-Hansen	CONSULTANT PROJECT No:	DATE STARTED: 3/31/20	HORIZONTAL DATUM	VERTICAL DATUM
DRILLING CONTRACTOR: PSI	DRILLING CONTRACTOR PROJECT No:	DATE COMPLETED: 3/31/20	LATITUDE:	
CREW CHIEF: P. Rotaru	DRILLING RIG: HD ATV #419	BORING OFFSET:	LONGITUDE:	
FIELD LOG BY: R. Sayles	DRILLING METHOD / HOLE SIZE:	ROADWAY NAME:	NORTHING:	
LOG QC BY:	HAMMER TYPE: / EFFICIENCY:	STATION: / OFFSET:	EASTING:	
COUNTY:	TOWNSHIP: / RANGE: / SECTION:	1/4 SECTION: / 1/4 SECTION:	SURFACE ELEVATION:	

Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q_t (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
						Topsoil (15"± Thick), Dark Brown Silty Clay, Very Moist	OL							32	
1 SS	6	3 3 3	6			1.1								8	
2 SS	4	4 4 4	8			Brown Sandy Silt With Gravel, Very Moist	ML							9	
3 SS	10	23 17 12	29			5.5 Brown Medium Sand and Gravel, Moist to Wet (Possible Perched Water)								5	
4 SS	8	19 19 16	35	10		▽								4	
5 SS	9	23 23 19	42											2	
6 SS	4	50/4"	R	20			SP							1	
7 SS	11	35 34 42	76											9	
8 SS	8	32 38 50	88	30										15	
9 SS	5	50/5"	R											17	
						37 Brown Lean Clay, Trace Gravel, Moist									
10 SS	10	22 20 29	49	40						4.5	7.63			12	
11 SS	11	23 22 47	69				CL			4.5	4.33			12	
12 SS		18 38 42	80	50						4.5	7.21			12	
13	17		71												

WATER & CAVE-IN OBSERVATION DATA

▽	WATER ENCOUNTERED DURING DRILLING: 12ft.		CAVE DEPTH AT COMPLETION: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AT COMPLETION: NE		CAVE DEPTH AFTER 0 HOURS: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AFTER 0 HOURS: N/A		NE = Not Encountered; NMR = No Measurement Recorded	

NOTE: Stratification lines between soil types represent the approximate boundary; gradual transition between in-situ soil layers should be expected.

PROJECT NAME: GWA - Alternative BPS Site 2	GREAT WATER ALLIANCE	**BORING LOG** Intertek psi		**BORING No BPSRN-B-02**
PROJECT No: 00521741				PAGE No: 2 of 2
CONSULTANT: Greeley-Hansen	CONSULTANT PROJECT No	DATE STARTED: 3/31/20	HORIZONTAL DATUM	VERTICAL DATUM
DRILLING CONTRACTOR: PSI	DRILLING CONTRACTOR PROJECT No	DATE COMPLETED: 3/31/20	LATITUDE	
CREW CHIEF: P. Rotaru	DRILLING RIG: HD ATV #419	BORING OFFSET	LONGITUDE	
FIELD LOG BY: R. Sayles	DRILLING METHOD / HOLE SIZE	ROADWAY NAME	NORTHING	
LOG QC BY	HAMMER TYPE / EFFICIENCY	STATION / OFFSET	EASTING	
COUNTY	TOWNSHIP / RANGE / SECTION / 1/4 SECTION / 1/4 SECTION		SURFACE ELEVATION	

Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft) / Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q_t (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
SS		18 28 43			Brown Lean Clay, Trace Gravel, Moist				4.5	2.23			12	
14 SS	15	17 28 45	73	**60**					4.5	6.39			11	
15 SS	18	16 26 34	60						3.75	3.79			13	
16 SS	18	21 24 28	52	**70**					4.5	4.95			12	
17 SS	18	23 31 39	70			CL			4.5	6.39			12	
18 SS	15	24 38 50	88	**80**					4.5	8.24			11	
19 SS	2	50/2"	R						4.5	5.98			12	
20 SS	4	50/4"	R	**90**					4.5	5.56			13	
21 SS	2	50/2"	R						4.5					
22 SS	2	50/2"	R	**100**	100				4.5				10	

Boring offset 13' to the West due to large trees
End of Boring at 100.0 ft.

WATER & CAVE-IN OBSERVATION DATA

▽	WATER ENCOUNTERED DURING DRILLING: 12ft.		CAVE DEPTH AT COMPLETION: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AT COMPLETION: NE		CAVE DEPTH AFTER 0 HOURS: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AFTER 0 HOURS: N/A		NE = Not Encountered; NMR = No Measurement Recorded	

NOTE: Stratification lines between soil types represent the approximate boundary; gradual transition between in-situ soil layers should be expected.

PROJECT NAME: GWA - Alternative BPS Site 2	GREAT WATER ALLIANCE	**BORING LOG**	Intertek psi	**BORING No BPSRN-B-03**
PROJECT No: 00521741				PAGE No: 1 of 2
CONSULTANT: Greeley-Hansen	CONSULTANT PROJECT No:	DATE STARTED: 3/30/20		HORIZONTAL DATUM / VERTICAL DATUM
DRILLING CONTRACTOR: PSI	DRILLING CONTRACTOR PROJECT No:	DATE COMPLETED: 3/30/20		LATITUDE
CREW CHIEF: P. Rotaru	DRILLING RIG: HD ATV #419	BORING OFFSET:		LONGITUDE
FIELD LOG BY: R. Sayles	DRILLING METHOD / HOLE SIZE:	ROADWAY NAME:		NORTHING
LOG QC BY:	HAMMER TYPE: / EFFICIENCY:	STATION: / OFFSET:		EASTING
COUNTY:	TOWNSHIP: / RANGE: / SECTION:	1/4 SECTION: / 1/4 SECTION:		SURFACE ELEVATION

Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q_t (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
						Topsoil (12"± Thick), Dark Brown Silty Clay, Very Moist	OL							17	
1 SS	7	3 2 4	6			0.99				4.0				21	
2 SS	11	6 5 6	11			Brown Lean Clay, Very Moist to Moist	CL			2.0				17	
3 SS	6	4 6 9	15			5.5								5	
4 SS	7	43 27 18	45	10		Brown Sand and Gravel, Moist to Wet (Possible Perched Water 12'-17')	SP							2	
5 SS	5	24 12 6	18			17								15	
6 SS	6	15 18 28	46	20		Brown Medium Sand, Wet (Possible Perched Water)	SP							17	
7 SS	4	50/4"	R			22									
						Brown Sand and Gravel, Wet (Possible Perched Water)	SW								
						27									
8 SS	4	21 27 23	50	30		Brown Lean Clay, Moist to Very Moist				4.5				10	
9 SS	12	14 26 32	58							4.5				11	
10 SS	13	16 21 31	52	40			CL			4.5	6.18			12	
11 SS	10	15 23 33	56							4.5	8.24			11	
12 SS	10	19 25 35	60	50						4.5+	7.42			10	
13	11		66												

WATER & CAVE-IN OBSERVATION DATA

▽	WATER ENCOUNTERED DURING DRILLING: 12ft.	▩	CAVE DEPTH AT COMPLETION: 11ft.	WET ☐ DRY ☐
▼	WATER LEVEL AT COMPLETION: NE	■	CAVE DEPTH AFTER 0 HOURS: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AFTER 0 HOURS: N/A		NE = Not Encountered; NMR = No Measurement Recorded	

NOTE: Stratification lines between soil types represent the approximate boundary; gradual transition between in-situ soil layers should be expected.

PROJECT NAME: GWA - Alternative BPS Site 2	GREAT WATER ALLIANCE	**BORING LOG**	Intertek psi	**BORING No BPSRN-B-03**
PROJECT No: 00521741				PAGE No: 2 of 2
CONSULTANT: Greeley-Hansen	CONSULTANT PROJECT No:	DATE STARTED: 3/30/20	HORIZONTAL DATUM	VERTICAL DATUM
DRILLING CONTRACTOR: PSI	DRILLING CONTRACTOR PROJECT No:	DATE COMPLETED: 3/30/20	LATITUDE	
CREW CHIEF: P. Rotaru	DRILLING RIG: HD ATV #419	BORING OFFSET	LONGITUDE	
FIELD LOG BY: R. Sayles	DRILLING METHOD / HOLE SIZE	ROADWAY NAME	NORTHING	
LOG QC BY	HAMMER TYPE / EFFICIENCY	STATION / OFFSET	EASTING	
COUNTY	TOWNSHIP / RANGE / SECTION / 1/4 SECTION / 1/4 SECTION		SURFACE ELEVATION	

Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q_t (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
SS		11 30 36				Brown Lean Clay, Moist to Very Moist				4.5+	4.53			11	
14 SS	13	15 24 46	70	60						4.0				12	
15 SS	11	13 24 31	55							4.0	3.71			13	
16 SS	13	13 20 31	51	70						3.5	2.47			13	
17 SS	12	12 27 35	62							4.5	3.96			12	
18 SS	14	15 24 37	61	80			CL			3.0	2.89			13	
19 SS	5	50/5"	R							3.5	2.14			22	
20 SS	4	50/4"	R	90						4.5+	4.53			18	
21 SS	4.5	50/5"	R							4.5+	5.36			21	
22 SS		28 28 38	66	100		100 End of Boring at 100.0 ft.				4.5+	9.07			17	

WATER & CAVE-IN OBSERVATION DATA

▽	WATER ENCOUNTERED DURING DRILLING: 12ft.		CAVE DEPTH AT COMPLETION: 11ft.	WET ☐ DRY ☐
▼	WATER LEVEL AT COMPLETION: NE		CAVE DEPTH AFTER 0 HOURS: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AFTER 0 HOURS: N/A		NE = Not Encountered; NMR = No Measurement Recorded	

NOTE: Stratification lines between soil types represent the approximate boundary; gradual transition between in-situ soil layers should be expected.

PROJECT NAME: GWA - Alternative BPS Site 2	GREAT WATER ALLIANCE	**BORING LOG**	Intertek	psi	**BORING No BPSRN-B-04**
PROJECT No: 00521741					PAGE No: 1 of 2
CONSULTANT: Greeley-Hansen	CONSULTANT PROJECT No:	DATE STARTED: 4/07/20			HORIZONTAL DATUM / VERTICAL DATUM
DRILLING CONTRACTOR: PSI	DRILLING CONTRACTOR PROJECT No:	DATE COMPLETED: 4/07/20			LATITUDE
CREW CHIEF: P. Rotaru	DRILLING RIG: HD ATV #419	BORING OFFSET:			LONGITUDE
FIELD LOG BY: D. Buchman	DRILLING METHOD / HOLE SIZE:	ROADWAY NAME:			NORTHING
LOG QC BY	HAMMER TYPE / EFFICIENCY:	STATION / OFFSET:			EASTING
COUNTY	TOWNSHIP / RANGE / SECTION:	1/4 SECTION / 1/4 SECTION:			SURFACE ELEVATION

Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q_t (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
						Topsoil (11"± Thick), Dark Brown Silt, Very Moist	OL							25	
1 SS	10	6 4 4	8			0.9 Possible Fill, Brown and Dark Brown Lean Clay, Trace Sand and Gravel, Very Moist to Moist				1.25				22	
2 SS	10	4 6 5	11			5.5 Brown Sand and Gravel, Damp				2				15	
3 SS	8	8 39 31	70			8 Brown Fine to Medium Sand, Moist to Wet	SP							5	
4 SS	12	9 12 14	26	10										9	
5 SS	10	26 16 19	35			17 Brown Sand With Gravel, Possible Cobbles, Wet	SP							21	
6 SS	14	23 10 20	30	20										12	
7 SS	12	20 17 29	46											14	
8 SS	14	23 31 50	81	30			SP							19	
9 SS	10	23 40 50	90			37 Brown Lean Clay, Trace Gravel, Moist									
10 SS	8	12 26 32	58	40						4.25	4.53			12	
11 SS	8	17 26 40	66				CL			4.5	9.48			11	
12 SS	14	20 24 38	62	50						4.5	7.63			10	
13	18		51												

WATER & CAVE-IN OBSERVATION DATA

▽	WATER ENCOUNTERED DURING DRILLING: 13.5ft.		CAVE DEPTH AT COMPLETION: NE	WET ☐ DRY ☐
▼	WATER LEVEL AT COMPLETION: NE		CAVE DEPTH AFTER 0 HOURS: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AFTER 0 HOURS: N/A		NE = Not Encountered; NMR = No Measurement Recorded	

NOTE: Stratification lines between soil types represent the approximate boundary; gradual transition between in-situ soil layers should be expected.

PROJECT NAME: GWA - Alternative BPS Site 2	GREAT WATER ALLIANCE	**BORING LOG** Intertek psi		**BORING No BPSRN-B-04**
PROJECT No: 00521741				PAGE No: 2 of 2
CONSULTANT: Greeley-Hansen	CONSULTANT PROJECT No	DATE STARTED: 4/07/20	HORIZONTAL DATUM	VERTICAL DATUM
DRILLING CONTRACTOR: PSI	DRILLING CONTRACTOR PROJECT No	DATE COMPLETED: 4/07/20	LATITUDE	
CREW CHIEF: P. Rotaru	DRILLING RIG: HD ATV #419	BORING OFFSET	LONGITUDE	
FIELD LOG BY: D. Buchman	DRILLING METHOD / HOLE SIZE	ROADWAY NAME	NORTHING	
LOG QC BY	HAMMER TYPE / EFFICIENCY	STATION / OFFSET	EASTING	
COUNTY	TOWNSHIP / RANGE / SECTION / 1/4 SECTION / 1/4 SECTION		SURFACE ELEVATION	

Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q_t (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
SS		22 26 25				Brown Lean Clay, Trace Gravel, Moist				4.0				12	
14 SS	18	19 24 36	60	**60**						4.5	6.18			12	
15 SS	18	18 21 32	53							4.5				12	
16 SS	18	16 25 38	63	**70**						4.5				12	
17 SS	10	15 25 32	57							4.5	4.74			12	
18 SS	12	14 28 40	68	**80**			CL			4.5	4.53			14	
19 SS	12	26 31 33	64							4.5	10.3+			10	
20 SS	18	23 29 32	61	**90**						4.5+				12	
21 SS	18	25 31 34	65							4.5	9.07			9	
22 SS	5	50/5"	R	**100**		100				4.0	4.12			19	

End of Boring at 100.0 ft.

WATER & CAVE-IN OBSERVATION DATA

▽	WATER ENCOUNTERED DURING DRILLING: 13.5ft.		CAVE DEPTH AT COMPLETION: NE	WET ☐ DRY ☐
▼	WATER LEVEL AT COMPLETION: NE		CAVE DEPTH AFTER 0 HOURS: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AFTER 0 HOURS: N/A		NE = Not Encountered; NMR = No Measurement Recorded	

NOTE: Stratification lines between soil types represent the approximate boundary; gradual transition between in-situ soil layers should be expected.

PROJECT NAME: GWA - Alternative BPS Site 2	GREAT WATER ALLIANCE	**BORING LOG**	Intertek	psi	**BORING No BPSRN-B-05**
PROJECT No: 00521741					PAGE No: 1 of 2
CONSULTANT: Greeley-Hansen	CONSULTANT PROJECT No:	DATE STARTED: 4/08/20			HORIZONTAL DATUM / VERTICAL DATUM
DRILLING CONTRACTOR: PSI	DRILLING CONTRACTOR PROJECT No:	DATE COMPLETED: 4/08/20			LATITUDE
CREW CHIEF: P. Rotaru	DRILLING RIG: HD ATV #419	BORING OFFSET:			LONGITUDE
FIELD LOG BY: D. Buchman	DRILLING METHOD / HOLE SIZE:	ROADWAY NAME:			NORTHING
LOG QC BY	HAMMER TYPE / EFFICIENCY:	STATION / OFFSET:			EASTING
COUNTY	TOWNSHIP / RANGE / SECTION:	1/4 SECTION / 1/4 SECTION:			SURFACE ELEVATION

Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q_t (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
						Topsoil (12"± Thick), Dark Brown Silty Clay, Very Moist	OL								
1 SS	8	3 3 3	6			0.99								11	
2 SS	10	4 5 5	10			Brown Lean Clay, Very Moist									
						3									
						Brown Silty Sand With Gravel, Moist	SM							10	
3 SS	8	6 5 6	11			8								11	
4 SS	14	5 7 12	19	10		Brown Silt, Moist	ML							10	
						▽ 12									
						Brown Sandy With Gravel, Wet (Possible Perched Water)									
5 SS	12	3 5 13	18				SP							12	
6 SS	12	9 28 35	63	20										12	
						22									
						Brown Lean Clay, Trace Gravel, Moist									
7 SS	8	11 22 20	42							3.75	4.53			12	
8 SS	18	9 17 24	41	30						3.5	2.64			14	
9 SS	15	9 16 23	39							4.5	4.04			12	
10 SS	18	11 14 21	35	40			CL			3.75	3.63			12	
11 SS	18	10 15 26	41							4.25	4.33			13	
12 SS	18	8 17 27	44	50						4.5	5.36			12	
13	18		42												

WATER & CAVE-IN OBSERVATION DATA

▽	WATER ENCOUNTERED DURING DRILLING: 12ft.	CAVE DEPTH AT COMPLETION: NE	WET ☐ DRY ☐
▼	WATER LEVEL AT COMPLETION: NE	CAVE DEPTH AFTER 0 HOURS: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AFTER 0 HOURS: N/A	NE = Not Encountered; NMR = No Measurement Recorded	

NOTE: Stratification lines between soil types represent the approximate boundary; gradual transition between in-situ soil layers should be expected.

PROJECT NAME: GWA - Alternative BPS Site 2	GREAT WATER ALLIANCE	**BORING LOG**	Intertek	psi	**BORING No BPSRN-B-05**
PROJECT No: 00521741					PAGE No: 2 of 2
CONSULTANT: Greeley-Hansen	CONSULTANT PROJECT No:	DATE STARTED: 4/08/20			HORIZONTAL DATUM / VERTICAL DATUM
DRILLING CONTRACTOR: PSI	DRILLING CONTRACTOR PROJECT No:	DATE COMPLETED: 4/08/20			LATITUDE
CREW CHIEF: P. Rotaru	DRILLING RIG: HD ATV #419	BORING OFFSET:			LONGITUDE
FIELD LOG BY: D. Buchman	DRILLING METHOD / HOLE SIZE:	ROADWAY NAME:			NORTHING
LOG QC BY	HAMMER TYPE / EFFICIENCY:	STATION / OFFSET:			EASTING
COUNTY	TOWNSHIP / RANGE / SECTION:	1/4 SECTION / 1/4 SECTION:			SURFACE ELEVATION

Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q_t (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
SS		10 18 24				Brown Lean Clay, Trace Gravel, Moist				4.5+	7.21			12	
14 SS	18	11 19 26	45	60						4.5	6.39			12	
15 SS	14	10 16 22	38							4.5	4.53			12	
16 SS	18	12 14 24	38	70						4.5+	5.15			12	
17 SS	14	14 38 25	63				CL			4.5				6	
18 SS	12	16 42 38	80	80						4.5				14	
19 SS	18	18 39 36	75							4.5				9	
20 SS	18	14 36 37	73	90		92				4.5				5	
						Brown Clayey Sand and Gravel, Wet									
21 SS	3	50/3"	R				SC							5	
22 SS	2	50/2"	R	100		100								19	

End of Boring at 100.0 ft.

WATER & CAVE-IN OBSERVATION DATA

▽	WATER ENCOUNTERED DURING DRILLING: 12ft.		CAVE DEPTH AT COMPLETION: NE	WET ☐ DRY ☐
▼	WATER LEVEL AT COMPLETION: NE		CAVE DEPTH AFTER 0 HOURS: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AFTER 0 HOURS: N/A		NE = Not Encountered; NMR = No Measurement Recorded	

NOTE: Stratification lines between soil types represent the approximate boundary; gradual transition between in-situ soil layers should be expected.

PROJECT NAME					BORING No BPSRN-B-06
GWA - Alternative BPS Site 2	GREAT WATER ALLIANCE	**BORING LOG**	Intertek	psi	
PROJECT No: 00521741					PAGE No: 1 of 2
CONSULTANT: Greeley-Hansen	CONSULTANT PROJECT No:	DATE STARTED: 4/10/20			HORIZONTAL DATUM / VERTICAL DATUM
DRILLING CONTRACTOR: PSI	DRILLING CONTRACTOR PROJECT No:	DATE COMPLETED: 4/10/20			LATITUDE
CREW CHIEF: P. Rotaru	DRILLING RIG: HD ATV #419	BORING OFFSET:			LONGITUDE
FIELD LOG BY: D. Buchman	DRILLING METHOD / HOLE SIZE:	ROADWAY NAME:			NORTHING
LOG QC BY	HAMMER TYPE / EFFICIENCY:	STATION / OFFSET:			EASTING
COUNTY	TOWNSHIP / RANGE / SECTION:	1/4 SECTION / 1/4 SECTION:			SURFACE ELEVATION

Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q_t (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
						Topsoil (12"± Thick), Dark Brown Silty Clay, Very Moist	OL							50	
1 SS	8	3 4 5	9			0.99				4.0				21	
2 SS	8	3 6 12	18			Brown Lean Clay, Very Moist	CL							22	
3 SS	8	10 21 29	50			5.5								3	
4 SS	11	9 15 20	35	10		Brown Sand With Gravel, Moist to Wet (Possible Perched Water 12'-22')								4	
5 SS	10	5 7 8	15				SP							14	
6 SS	10	16 17 18	35	20		22								7	
7 SS	8	10 10 15	25			Brown Lean Clay, Moist	CL							13	
8 SS	14	5 12 19	31	30		27								16	
9 SS	15	8 13 19	32			Brown Coarse Sand and Gravel, Wet (Possible Perched Water)	SP			4.5	7.83			12	
10 SS	15	10 15 22	37	40		32				4.5	7.01			12	
11 SS	12	16 21 28	49			Brown Lean Clay, Trace Gravel, Moist	CL			4.5	5.77			12	
12 SS	14	18 21 30	51	50						4.5	5.15			13	
13	14		51												

WATER & CAVE-IN OBSERVATION DATA

▽	WATER ENCOUNTERED DURING DRILLING: 12ft.		CAVE DEPTH AT COMPLETION: NE	WET ☐ DRY ☐
▼	WATER LEVEL AT COMPLETION: NE		CAVE DEPTH AFTER 0 HOURS: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AFTER 0 HOURS: N/A		NE = Not Encountered; NMR = No Measurement Recorded	

NOTE: Stratification lines between soil types represent the approximate boundary; gradual transition between in-situ soil layers should be expected.

PROJECT NAME			BORING No BPSRN-B-06
GWA - Alternative BPS Site 2	GREAT WATER ALLIANCE	**BORING LOG** Intertek PSI	
PROJECT No: 00521741			PAGE No: 2 of 2

CONSULTANT: Greeley-Hansen	CONSULTANT PROJECT No:	DATE STARTED: 4/10/20	HORIZONTAL DATUM	VERTICAL DATUM
DRILLING CONTRACTOR: PSI	DRILLING CONTRACTOR PROJECT No:	DATE COMPLETED: 4/10/20	LATITUDE:	
CREW CHIEF: P. Rotaru	DRILLING RIG: HD ATV #419	BORING OFFSET:	LONGITUDE:	
FIELD LOG BY: D. Buchman	DRILLING METHOD / HOLE SIZE:	ROADWAY NAME:	NORTHING:	
LOG QC BY:	HAMMER TYPE: / EFFICIENCY:	STATION: / OFFSET:	EASTING:	
COUNTY:	TOWNSHIP: / RANGE: / SECTION:	1/4 SECTION: / 1/4 SECTION:	SURFACE ELEVATION:	

Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q_t (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
SS		16 20 31				Brown Lean Clay, Trace Gravel, Moist				4.5	7.01			11	
14 SS	12	15 22 34	56	60						4.5	6.6			11	
15 SS	10	17 27 39	66				CL			4.5	5.98			13	
16 SS	12	18 27 43	70	70						4.5	6.6			13	
17 SS	12	18 30 39	69							4.5	7.21			14	
						77									
18 SS	8	16 18 19	37	80		Grayish Brown Silty Sand, Very Moist								16	
19 SS	6	17 16 15	31				SM							16	
20 SS	0.5	50/1"	R	90											
						92									

End of Boring at 92' Due to Auger Refusal on Possible Cobbles, Boulders, or Bedrock
End of Boring at 92.0 ft.

WATER & CAVE-IN OBSERVATION DATA

▽	WATER ENCOUNTERED DURING DRILLING: 12ft.		CAVE DEPTH AT COMPLETION: NE	WET ☐ DRY ☐
▼	WATER LEVEL AT COMPLETION: NE		CAVE DEPTH AFTER 0 HOURS: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AFTER 0 HOURS: N/A		NE = Not Encountered; NMR = No Measurement Recorded	

NOTE: Stratification lines between soil types represent the approximate boundary; gradual transition between in-situ soil layers should be expected.

PROJECT NAME: GWA - Alternative BPS Site 2	GREAT WATER ALLIANCE	**BORING LOG**	Intertek psi	**BORING No BPSRN-B-07**
PROJECT No: 00521741				PAGE No: 1 of 1
CONSULTANT: Greeley-Hansen	CONSULTANT PROJECT No:	DATE STARTED: 4/27/20	HORIZONTAL DATUM	VERTICAL DATUM
DRILLING CONTRACTOR: PSI	DRILLING CONTRACTOR PROJECT No:	DATE COMPLETED: 4/27/20	LATITUDE	
CREW CHIEF: V. Jones	DRILLING RIG: Marooka #395	BORING OFFSET	LONGITUDE	
FIELD LOG BY: N. Canning	DRILLING METHOD / HOLE SIZE	ROADWAY NAME	NORTHING	
LOG QC BY	HAMMER TYPE / EFFICIENCY	STATION / OFFSET	EASTING	
COUNTY	TOWNSHIP / RANGE / SECTION / 1/4 SECTION / 1/4 SECTION		SURFACE ELEVATION	

Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q_t (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
1 SS	4	50/4"	R			Topsoil (3"± Thick), Dark Brown Silty Clay With Root Matter, Very Moist	OL							22	
						0.3									
2 SS	7	10 10 11	21			Brown Sand With Gravel and Silt Seams, Moist	SP							5	
3 SS	6	12 22 24	46			8								7	
4 SS	15	11 13 9	22	10		Brown Silty Sand, Moist	SM							12	
						12								16	
5 SS	9	9 15 22	37			Brown Sand and Gravel, Moist to Wet								3	
6 SS	7	11 7 11	18	20			SW							10	
7 SS	13	26 37 25	62											6	
8 SS	9	22 30 29	59	30										7	
						32									
9 SS	11	9 13 16	29			Gray Silty Sand and Gravel, Wet	SM							8	
						37									
10 SS	9	15 19 24	43	40		Gray Sandy Lean Clay With Gravel, Wet	CL							8	
						40									
						End of Boring at 40.0 ft.									

WATER & CAVE-IN OBSERVATION DATA

▽	WATER ENCOUNTERED DURING DRILLING: 18.5ft.	▩	CAVE DEPTH AT COMPLETION: 12ft.	WET ☐ DRY ☐
▼	WATER LEVEL AT COMPLETION: NE	■	CAVE DEPTH AFTER 0 HOURS: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AFTER 0 HOURS: N/A		NE = Not Encountered; NMR = No Measurement Recorded	

NOTE: Stratification lines between soil types represent the approximate boundary; gradual transition between in-situ soil layers should be expected.

PROJECT NAME: GWA - Alternative BPS Site 2	GREAT WATER ALLIANCE	**BORING LOG**	Intertek psi	**BORING No BPSRN-B-08**	
PROJECT No: 00521741				PAGE No: 1 of 1	
CONSULTANT: Greeley-Hansen	CONSULTANT PROJECT No		DATE STARTED: 4/23/20	HORIZONTAL DATUM	VERTICAL DATUM
DRILLING CONTRACTOR: PSI	DRILLING CONTRACTOR PROJECT No		DATE COMPLETED: 4/23/20	LATITUDE	
CREW CHIEF: V. Jones	DRILLING RIG: Marooka #395		BORING OFFSET	LONGITUDE	
FIELD LOG BY: D. Buchman	DRILLING METHOD / HOLE SIZE		ROADWAY NAME	NORTHING	
LOG QC BY	HAMMER TYPE	EFFICIENCY	STATION	OFFSET	EASTING
COUNTY	TOWNSHIP	RANGE	SECTION	1/4 SECTION / 1/4 SECTION	SURFACE ELEVATION

Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q_t (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
						Topsoil (8"± Thick), Dark Brown Silty Clay, Very Moist	OL							18	
						0.6									
1 SS	6	3 3 3	6			Brown Lean Clay, Very Moist				2.0				21	
2 SS	8	3 4 5	9				CL			3.0				24	
3 SS	12	3 3 3	6			8				3.0	3.05			26	
4 SS	12	3 3 9	12	10		Brown Silty Sand, Very Moist	SM							14	
						12									
5 SS	10	16 16 14	30			Brown Sand and Gravel, Wet	SP							8	
6 SS	13	4 8 11	19	20		22								9	
7 SS	15	8 6 5	11			Brown Medium Sand, Wet								16	
8 SS	9	7 10 12	22	30			SP							22	
9 SS	12	8 15 22	37											16	
10 SS	10	9 16 27	43	40		40								20	
						End of Boring at 40.0 ft.									

WATER & CAVE-IN OBSERVATION DATA

▽	WATER ENCOUNTERED DURING DRILLING: 12ft.	▨	CAVE DEPTH AT COMPLETION: 12ft.	WET ☐ DRY ☐
▼	WATER LEVEL AT COMPLETION: NE	■	CAVE DEPTH AFTER 0 HOURS: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AFTER 0 HOURS: N/A		NE = Not Encountered; NMR = No Measurement Recorded	

NOTE: Stratification lines between soil types represent the approximate boundary; gradual transition between in-situ soil layers should be expected.

PROJECT NAME: GWA - Alternative BPS Site 2	GREAT WATER ALLIANCE	**BORING LOG**	Intertek	psi	**BORING No BPSRN-B-09**
PROJECT No: 00521741					PAGE No: 1 of 1
CONSULTANT: Greeley-Hansen	CONSULTANT PROJECT No:	DATE STARTED: 4/23/20			HORIZONTAL DATUM / VERTICAL DATUM
DRILLING CONTRACTOR: PSI	DRILLING CONTRACTOR PROJECT No:	DATE COMPLETED: 4/23/20			LATITUDE
CREW CHIEF: V. Jones	DRILLING RIG: Marooka #395	BORING OFFSET:			LONGITUDE
FIELD LOG BY: D. Buchman	DRILLING METHOD / HOLE SIZE:	ROADWAY NAME:			NORTHING
LOG QC BY	HAMMER TYPE / EFFICIENCY:	STATION / OFFSET:			EASTING
COUNTY	TOWNSHIP / RANGE / SECTION:	1/4 SECTION / 1/4 SECTION:			SURFACE ELEVATION

Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q_t (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
						Topsoil (10"± Thick), Dark Brown Silty Clay, Very Moist	OL							28	
1 SS	6	3 19 8	27			0.8 Brown Sand With Gravel, Moist to Wet								5	
2 SS	6	9 8 9	17											3	
3 SS	8	31 15 16	31											6	
4 SS	10	33 43 22	65	10			SP							3	
5 SS	14	19 11 9	20			17								9	
						Gray Sandy Silt With Gravel, Wet									
6 SS	8	3 3 8	11	20		22	ML							9	
						Brown Silty Sand, Wet									
7 SS	8	13 11 13	24			27	SM							18	
						Brown Sand and Gravel, Wet									
8 SS	10	12 21 21	42	30		30	SW							7	
						End of Boring at 30.0 ft.									

WATER & CAVE-IN OBSERVATION DATA

▽	WATER ENCOUNTERED DURING DRILLING: 12ft.		CAVE DEPTH AT COMPLETION: 12ft.	WET ☐ DRY ☐
▼	WATER LEVEL AT COMPLETION: NE		CAVE DEPTH AFTER 0 HOURS: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AFTER 0 HOURS: N/A		NE = Not Encountered; NMR = No Measurement Recorded	

NOTE: Stratification lines between soil types represent the approximate boundary; gradual transition between in-situ soil layers should be expected.

PROJECT NAME				PROJECT No				CONSULTANT				DRILLING CONTRACTOR				CREW CHIEF				FIELD LOG BY				LOG QC BY				COUNTY			
GWA - Alternative BPS Site 2				00521741				Greeley-Hansen				PSI				V. Jones				N. Canning											

BORING LOG

BORING No BPSRN-B-10

CONSULTANT PROJECT No	DRILLING CONTRACTOR PROJECT No	DRILLING METHOD / HOLE SIZE	HAMMER TYPE	EFFICIENCY	TOWNSHIP	RANGE	SECTION	1/4 SECTION	1/4 SECTION

DATE STARTED	DATE COMPLETED	DRILLING RIG	BORING OFFSET	ROADWAY NAME	STATION	OFFSET
4/27/20	4/27/20	Marooka #395				

PAGE No	HORIZONTAL DATUM	VERTICAL DATUM	LATITUDE	LONGITUDE	NORTHING	EASTING	SURFACE ELEVATION
1 of 1							

Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q_t (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
						Topsoil (10"± Thick), Dark Brown Silty Clay, Very Moist	OL							30	
1 SS	7	3 4 4	8			0.8				3.5				23	
2 SS	10	4 3 3	6			Brown Lean Clay, Moist	CL			2.0					
3 SS	9	17 18 19	37			5.5								5	
4 SS	11	13 12 9	21	10		Brown Sand and Gravel, Moist	SP							7	
5 SS	13	9 10 12	22			12								8	
6 SS	12	12 26 35	61	20		Brown Silty Sand With Gravel, Moist	SM							14	
7 SS	15	16 23 30	53			22								11	
8 SS	12	21 41 50	91	30		Brown Silt, Moist	ML							13	
9 SS	13	16 29 33	62			32								8	
10 SS	16	20 28 37	65	40		Brownish Gray Coarse Sand and Gravel, Wet	SP							7	
						40									
						End of Boring at 40.0 ft.									

WATER & CAVE-IN OBSERVATION DATA

▽	WATER ENCOUNTERED DURING DRILLING: 33.5ft.	▩	CAVE DEPTH AT COMPLETION: 22ft.	WET ☐ DRY ☐
▼	WATER LEVEL AT COMPLETION: NE	■	CAVE DEPTH AFTER 0 HOURS: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AFTER 0 HOURS: N/A		NE = Not Encountered; NMR = No Measurement Recorded	

NOTE: Stratification lines between soil types represent the approximate boundary; gradual transition between in-situ soil layers should be expected.

PROJECT NAME: GWA - Alternative BPS Site 2	GREAT WATER ALLIANCE	**BORING LOG**	Intertek psi	**BORING No BPSRN-B-11**
PROJECT No: 00521741				PAGE No: 1 of 2
CONSULTANT: Greeley-Hansen	CONSULTANT PROJECT No:	DATE STARTED: 5/01/20		HORIZONTAL DATUM / VERTICAL DATUM
DRILLING CONTRACTOR: PSI	DRILLING CONTRACTOR PROJECT No:	DATE COMPLETED: 5/01/20		LATITUDE
CREW CHIEF: V. Jones	DRILLING RIG: Marooka #395	BORING OFFSET:		LONGITUDE
FIELD LOG BY: N. Canning	DRILLING METHOD / HOLE SIZE:	ROADWAY NAME:		NORTHING
LOG QC BY:	HAMMER TYPE / EFFICIENCY:	STATION / OFFSET:		EASTING
COUNTY:	TOWNSHIP / RANGE / SECTION:	1/4 SECTION / 1/4 SECTION:		SURFACE ELEVATION

Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q_t (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
						Topsoil (3"± Thick), Dark Brown Silty With Root Matter and Gravel, Very Moist	OL							21	
1 SS	9	8 10 11	21			0.3 Brown Silty Sand With Gravel, Moist								10	
2 SS	10	8 13 15	28											5	
3 SS	14	7 41 50	91											10	
4 SS	13	18 34 47	81	10			SM							4	
5 SS	15	18 27 40	67							3.5				5	
6 SS	12	29 38 50	88	20		22								6	
7 SS	14	22 28 32	60			Brown Sandy Silt and Gravel, Very Moist to Wet ▽								7	
8 SS	6	50		30			ML							10	
9 SS	6	50												9	
10 SS	5	50/5"	R	40		42									
11 SS	5	50/5"	R			Brown Silty Sand, Wet	SM							15	
12 SS	5	50/5"	R	50		47 Gray Sandy Silt With Gravel, Wet	ML			4.5+	6.6			7	
13	1	50/1"	R												

WATER & CAVE-IN OBSERVATION DATA

▽	WATER ENCOUNTERED DURING DRILLING: 27ft.		CAVE DEPTH AT COMPLETION: NE	WET ☐ DRY ☐
▼	WATER LEVEL AT COMPLETION: NE		CAVE DEPTH AFTER 0 HOURS: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AFTER 0 HOURS: N/A		NE = Not Encountered; NMR = No Measurement Recorded	

NOTE: Stratification lines between soil types represent the approximate boundary; gradual transition between in-situ soil layers should be expected.

PROJECT NAME: GWA - Alternative BPS Site 2	GREAT WATER ALLIANCE	**BORING LOG** Intertek psi		**BORING No BPSRN-B-11**
PROJECT No: 00521741				PAGE No: 2 of 2
CONSULTANT: Greeley-Hansen	CONSULTANT PROJECT No	DATE STARTED: 5/01/20	HORIZONTAL DATUM	VERTICAL DATUM
DRILLING CONTRACTOR: PSI	DRILLING CONTRACTOR PROJECT No	DATE COMPLETED: 5/01/20	LATITUDE	
CREW CHIEF: V. Jones	DRILLING RIG: Marooka #395	BORING OFFSET	LONGITUDE	
FIELD LOG BY: N. Canning	DRILLING METHOD / HOLE SIZE	ROADWAY NAME	NORTHING	
LOG QC BY	HAMMER TYPE / EFFICIENCY	STATION / OFFSET	EASTING	
COUNTY	TOWNSHIP / RANGE / SECTION / 1/4 SECTION / 1/4 SECTION		SURFACE ELEVATION	

Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q_t (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
SS						Gray Sandy Silt With Gravel, Wet	ML			4.5+				8	
						57									
14 SS	4	50/4"	R	60		Brownish Gray Sand and Gravel, Wet	SP							11	
15 SS	2	50/2"	R			67.5									
						End of Boring at 67.5' Due to Auger Refusal on Possible Cobbles, Boulders, or Bedrock End of Boring at 67.5 ft.									

WATER & CAVE-IN OBSERVATION DATA

▽	WATER ENCOUNTERED DURING DRILLING: 27ft.		CAVE DEPTH AT COMPLETION: NE	WET ☐ DRY ☐
▼	WATER LEVEL AT COMPLETION: NE		CAVE DEPTH AFTER 0 HOURS: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AFTER 0 HOURS: N/A		NE = Not Encountered; NMR = No Measurement Recorded	

NOTE: Stratification lines between soil types represent the approximate boundary; gradual transition between in-situ soil layers should be expected.

PROJECT NAME: GWA - Alternative BPS Site 2	GREAT WATER ALLIANCE	**BORING LOG**	Intertek	psi	**BORING No BPSRN-B-12**
PROJECT No: 00521741					PAGE No: 1 of 2
CONSULTANT: Greeley-Hansen	CONSULTANT PROJECT No:	DATE STARTED: 4/29/20			HORIZONTAL DATUM / VERTICAL DATUM
DRILLING CONTRACTOR: PSI	DRILLING CONTRACTOR PROJECT No:	DATE COMPLETED: 4/29/20			LATITUDE
CREW CHIEF: V. Jones	DRILLING RIG: Marooka #395	BORING OFFSET:			LONGITUDE
FIELD LOG BY: N. Canning	DRILLING METHOD / HOLE SIZE:	ROADWAY NAME:			NORTHING
LOG QC BY	HAMMER TYPE / EFFICIENCY:	STATION / OFFSET:			EASTING
COUNTY	TOWNSHIP / RANGE / SECTION:	1/4 SECTION / 1/4 SECTION:			SURFACE ELEVATION

Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q_u (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
						Topsoil (9"± Thick), Dark Brown Silty Clay, Very Moist 0.8	OL							26	
1 SS	15	3 3 3	6			Brown Lean Clay, Very Moist	CL			2	2.14			23	
2 SS	15	4 3 4	7			5.5				2.5				19	
3 SS	9	4 5 9	14			Brown Sandy Silt With Gravel, Very Moist 8	ML							11	
4 SS	10	10 14 14	28	10		Brown Medium Sand With Gravel, Moist	SP							4	
5 SS	13	18 35 34	69			17								3	
6 SS	14	13 18 19	37	20		Brown Silty Sand With Gravel, Moist	SM							13	
7 SS	6	50				27								7	
8 SS	10	20 18 19	37	30		▽ Brown Medium Sand, Wet	SP							19	
9 SS	12	17 20 20	40			Gray Medium Sand, Wet 37	SP							19	
10 SS	15	16 20 25	45	40		Gray Silt, Wet 42	ML			3.0				22	
11 SS	13	23 23 39	62			Brown Lean Clay, Trace Gravel, Moist	CL			4.5	5.77			13	
12 SS	18	17 20 34	54	50						3.5	6.18			13	
13	15		59												

WATER & CAVE-IN OBSERVATION DATA

▽	WATER ENCOUNTERED DURING DRILLING: 28.5ft.	CAVE DEPTH AT COMPLETION: NE	WET ☐ DRY ☐
▼	WATER LEVEL AT COMPLETION: NE	CAVE DEPTH AFTER 0 HOURS: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AFTER 0 HOURS: N/A	NE = Not Encountered; NMR = No Measurement Recorded	

NOTE: Stratification lines between soil types represent the approximate boundary; gradual transition between in-situ soil layers should be expected.

PROJECT NAME: GWA - Alternative BPS Site 2	GREAT WATER ALLIANCE	**BORING LOG**	Intertek	psi	**BORING No BPSRN-B-12**
PROJECT No: 00521741					PAGE No: 2 of 2
CONSULTANT: Greeley-Hansen	CONSULTANT PROJECT No	DATE STARTED: 4/29/20			HORIZONTAL DATUM / VERTICAL DATUM
DRILLING CONTRACTOR: PSI	DRILLING CONTRACTOR PROJECT No	DATE COMPLETED: 4/29/20			LATITUDE
CREW CHIEF: V. Jones	DRILLING RIG: Marooka #395	BORING OFFSET			LONGITUDE
FIELD LOG BY: N. Canning	DRILLING METHOD / HOLE SIZE	ROADWAY NAME			NORTHING
LOG QC BY	HAMMER TYPE / EFFICIENCY	STATION / OFFSET			EASTING
COUNTY	TOWNSHIP / RANGE / SECTION / 1/4 SECTION / 1/4 SECTION				SURFACE ELEVATION

Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft) / Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q_t (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
SS		19 23 36			Brown Lean Clay, Trace Gravel, Moist					3.46			13	
14 SS	5	50/5"	R	60					4.5	5.56			12	
15 SS	6	50								9.89			11	
16 SS	5	50/5"	R	70		CL				4.95			10	
17 SS	5	50/5"	R						4.5+	7.63			12	
18 SS	4	50/4"	R	80					4.5+	10.31			11	
					82									
19 SS	5	29 39 49	88		Brown Clayey Sand With Gravel, Very Moist	SC							12	
					87									
20 SS	4	50/4"	R	90	Brown Lean Clay, Moist								11	
21 SS	3	50/3"	R			CL			4.5	8.24			10	
22 SS	1	50/1"	R	100					4.5+	10.31			11	
					100									

End of Boring at 100.0 ft.

WATER & CAVE-IN OBSERVATION DATA

▽	WATER ENCOUNTERED DURING DRILLING: 28.5ft.		CAVE DEPTH AT COMPLETION: NE	WET ☐ DRY ☐
▼	WATER LEVEL AT COMPLETION: NE		CAVE DEPTH AFTER 0 HOURS: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AFTER 0 HOURS: N/A		NE = Not Encountered; NMR = No Measurement Recorded	

NOTE: Stratification lines between soil types represent the approximate boundary; gradual transition between in-situ soil layers should be expected.

PROJECT NAME: GWA - Alternative BPS Site 2	GREAT WATER ALLIANCE	**BORING LOG**	Intertek	psi	**BORING No BPSRN-B-13**
PROJECT No: 00521741					PAGE No: 1 of 2
CONSULTANT: Greeley-Hansen	CONSULTANT PROJECT No:	DATE STARTED: 4/17/20			HORIZONTAL DATUM / VERTICAL DATUM
DRILLING CONTRACTOR: PSI	DRILLING CONTRACTOR PROJECT No:	DATE COMPLETED: 4/17/20			LATITUDE
CREW CHIEF: V. Jones	DRILLING RIG: Marooka #395	BORING OFFSET:			LONGITUDE
FIELD LOG BY: R. Sayles	DRILLING METHOD / HOLE SIZE:	ROADWAY NAME:			NORTHING
LOG QC BY:	HAMMER TYPE: / EFFICIENCY:	STATION: / OFFSET:			EASTING
COUNTY:	TOWNSHIP: / RANGE: / SECTION:	1/4 SECTION: / 1/4 SECTION:			SURFACE ELEVATION

Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q_t (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
						Topsoil (11"± Thick), Dark Brown Silty Clay, Very Moist	OL							32	
1 SS	7	3 3 4	7			0.9				3.0				23	
2 SS	10	3 3 3	6			Brown Lean Clay, Very Moist	CL							20	
3 SS	6	5 11 10	21			5.5								12	
4 SS	11	6 10 12	22	10		Brown Silt, Trace Gravel, Moist	ML							11	
						12									
5 SS	7	6 6 7	13			Brown Sand and Gravel, Wet								3	
6 SS	7	6 8 8	16	20			SW							7	
7 SS	8	14 13 14	27			27								12	
8 SS	9	10 16 30	46	30		Brown Sandy Lean Clay With Gravel, Very Moist	CL							10	
9 SS	10	6 15 6	21			37								7	
10 SS	5	8 16 19	35	40		Brown Silt Sand With Gravel, Very Moist	SM							13	
						42									
11 SS	6	50				Brown Lean Clay, Trace Gravel, Moist				4.0				9	
12 SS	14	9 12 26	38	50			CL			4.0	3.13			12	
13	18		39												

WATER & CAVE-IN OBSERVATION DATA

▽	WATER ENCOUNTERED DURING DRILLING: 12ft.		CAVE DEPTH AT COMPLETION: 75ft.	WET ☐ DRY ☐
▼	WATER LEVEL AT COMPLETION: NE		CAVE DEPTH AFTER 0 HOURS: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AFTER 0 HOURS: N/A		NE = Not Encountered; NMR = No Measurement Recorded	

NOTE: Stratification lines between soil types represent the approximate boundary; gradual transition between in-situ soil layers should be expected.

PROJECT NAME: GWA - Alternative BPS Site 2	GREAT WATER ALLIANCE	**BORING LOG**	Intertek	psi	**BORING No BPSRN-B-13**
PROJECT No: 00521741					PAGE No: 2 of 2
CONSULTANT: Greeley-Hansen	CONSULTANT PROJECT No:	DATE STARTED: 4/17/20			HORIZONTAL DATUM / VERTICAL DATUM
DRILLING CONTRACTOR: PSI	DRILLING CONTRACTOR PROJECT No:	DATE COMPLETED: 4/17/20			LATITUDE
CREW CHIEF: V. Jones	DRILLING RIG: Marooka #395	BORING OFFSET:			LONGITUDE
FIELD LOG BY: R. Sayles	DRILLING METHOD / HOLE SIZE:	ROADWAY NAME:			NORTHING
LOG QC BY	HAMMER TYPE / EFFICIENCY:	STATION / OFFSET:			EASTING
COUNTY	TOWNSHIP / RANGE / SECTION:	1/4 SECTION / 1/4 SECTION:			SURFACE ELEVATION

Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q_t (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
SS		11 14 25				Brown Lean Clay, Trace Gravel, Moist				3.5	3.71			14	
14 SS	16	19 32 48	80	60						3.5	4.74			14	
15 SS	18	22 38 47	85							3.5	4.33			13	
16 SS	6	50		70						4.5	7.01			10	
17 SS	4	50/4"	R											16	
18 SS	5	50/5"	R	80			CL			3.5	3.87			2	
19 SS	2	50/2"	R											17	
20 SS	1	50/1"	R	90						3.0				15	
21 SS	3	50/3"	R							3.5	3.63			15	
22 SS	1	50/1"	R	100		100				4.5				12	

End of Boring at 100.0 ft.

WATER & CAVE-IN OBSERVATION DATA

▽	WATER ENCOUNTERED DURING DRILLING: 12ft.	▨	CAVE DEPTH AT COMPLETION: 75ft.	WET ☐ DRY ☐
▼	WATER LEVEL AT COMPLETION: NE	■	CAVE DEPTH AFTER 0 HOURS: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AFTER 0 HOURS: N/A		NE = Not Encountered; NMR = No Measurement Recorded	

NOTE: Stratification lines between soil types represent the approximate boundary; gradual transition between in-situ soil layers should be expected.

PROJECT NAME: GWA - Alternative BPS Site 2	GREAT WATER ALLIANCE	**BORING LOG**	Intertek	psi	**BORING No BPSRN-B-14**
PROJECT No: 00521741					PAGE No: 1 of 2
CONSULTANT: Greeley-Hansen	CONSULTANT PROJECT No:	DATE STARTED: 4/28/20			HORIZONTAL DATUM / VERTICAL DATUM
DRILLING CONTRACTOR: PSI	DRILLING CONTRACTOR PROJECT No:	DATE COMPLETED: 4/28/20			LATITUDE
CREW CHIEF: V. Jones	DRILLING RIG: Marooka #395	BORING OFFSET:			LONGITUDE
FIELD LOG BY: N. Canning	DRILLING METHOD / HOLE SIZE:	ROADWAY NAME:			NORTHING
LOG QC BY	HAMMER TYPE / EFFICIENCY:	STATION / OFFSET:			EASTING
COUNTY	TOWNSHIP / RANGE / SECTION:	1/4 SECTION / 1/4 SECTION:			SURFACE ELEVATION

Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q_t (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
						Topsoil (10"± Thick), Dark Brown Silty Clay, Very Moist	OL							33	
1 SS	9	3 5 7	12			0.8 Brown Sand and Gravel, Moist	SP							6	
2 SS	8	5 8 17	25			5.5 Brown Sandy Silt With Gravel, Moist								5	
3 SS	12	9 5 8	13							1.75				11	
4 SS	11	4 9 9	18	10			ML			2.5				14	
						12 Brown Silty Sand With Gravel, Very Moist									
5 SS	7	22 23 24	47				SM							9	
6 SS	12	3 4 6	10	20		▽ 22								9	
						Brown Medium Sand, Wet (Possible Perched Water)									
7 SS	0	6 6 7	13				SP								
8 SS	10	12 17 19	36	30		32 Gray Coarse Sand and Gravel, Wet (Possible Perched Water)								15	
9 SS	9	18 23 26	49			37 Brown Medium Sand, Very Moist	SW							10	
10 SS	11	14 16 18	34	40			SP							18	
11 SS	5	50/5"	R			47 Brown Lean Clay, Trace Gravel, Moist to Very Moist								12	
12 SS	14	21 30 31	61	50			CL			3.75	4.12			12	
13	16		65												

WATER & CAVE-IN OBSERVATION DATA

▽	WATER ENCOUNTERED DURING DRILLING: 22ft.		CAVE DEPTH AT COMPLETION: NE	WET ☐ DRY ☐
▼	WATER LEVEL AT COMPLETION: NE		CAVE DEPTH AFTER 0 HOURS: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AFTER 0 HOURS: N/A		NE = Not Encountered; NMR = No Measurement Recorded	

NOTE: Stratification lines between soil types represent the approximate boundary; gradual transition between in-situ soil layers should be expected.

PROJECT NAME: GWA - Alternative BPS Site 2	GREAT WATER ALLIANCE	**BORING LOG** Intertek PSI		**BORING No BPSRN-B-14**
PROJECT No: 00521741				PAGE No: 2 of 2
CONSULTANT: Greeley-Hansen	CONSULTANT PROJECT No	DATE STARTED: 4/28/20		HORIZONTAL DATUM / VERTICAL DATUM
DRILLING CONTRACTOR: PSI	DRILLING CONTRACTOR PROJECT No	DATE COMPLETED: 4/28/20		LATITUDE
CREW CHIEF: V. Jones	DRILLING RIG: Marooka #395	BORING OFFSET		LONGITUDE
FIELD LOG BY: N. Canning	DRILLING METHOD / HOLE SIZE	ROADWAY NAME		NORTHING
LOG QC BY	HAMMER TYPE / EFFICIENCY	STATION / OFFSET		EASTING
COUNTY	TOWNSHIP / RANGE / SECTION	1/4 SECTION / 1/4 SECTION		SURFACE ELEVATION

Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q_t (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
SS		22 31 34				Brown Lean Clay, Trace Gravel, Moist to Very Moist				3.75	7.42			11	
14 SS	18	21 30 41	71	60						4.75	6.18			11	
15 SS	18	26 33 39	72							4.25	3.30			10	
16 SS	13	19 39 50	89	70						4.5+	9.48			10	
17 SS	5	50/5"	R				CL			3.5	4.95			12	
18 SS	5	50/5"	R	80						3.75				15	
19 SS	6	50								4.0	4.95			15	
20 SS	4	50/4"	R	90						4.5	3.71			24	
21 SS	5	50/5"	R											16	
22 SS	1	50/1"	R	100		100				4.0	4.12			15	

End of Boring at 100.0 ft.

WATER & CAVE-IN OBSERVATION DATA

▽	WATER ENCOUNTERED DURING DRILLING: 22ft.		CAVE DEPTH AT COMPLETION: NE	WET ☐ DRY ☐
▼	WATER LEVEL AT COMPLETION: NE		CAVE DEPTH AFTER 0 HOURS: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AFTER 0 HOURS: N/A		NE = Not Encountered; NMR = No Measurement Recorded	

NOTE: Stratification lines between soil types represent the approximate boundary; gradual transition between in-situ soil layers should be expected.

PROJECT NAME: GWA - Alternative BPS Site 2	GREAT WATER ALLIANCE	**BORING LOG**	Intertek psi	**BORING No BPSRN-B-15**
PROJECT No: 00521741				PAGE No: 1 of 2
CONSULTANT: Greeley-Hansen	CONSULTANT PROJECT No	DATE STARTED: 4/15/20		HORIZONTAL DATUM / VERTICAL DATUM
DRILLING CONTRACTOR: PSI	DRILLING CONTRACTOR PROJECT No	DATE COMPLETED: 4/15/20		LATITUDE
CREW CHIEF: V. Jones	DRILLING RIG: Marooka #395	BORING OFFSET		LONGITUDE
FIELD LOG BY: N. Canning	DRILLING METHOD / HOLE SIZE	ROADWAY NAME		NORTHING
LOG QC BY	HAMMER TYPE / EFFICIENCY	STATION / OFFSET		EASTING
COUNTY	TOWNSHIP / RANGE / SECTION / 1/4 SECTION / 1/4 SECTION			SURFACE ELEVATION

Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q_t (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
						Topsoil (14"± Thick), Dark Brown Silt, Very Moist	OL							30	
						1.1									
1 SS	8	3 3 3	6			Brown Lean Clay, Very Moist	CL			2.0				22	
2 SS	13	3 3 5	8			5.5				3.5				23	
3 SS	6	4 11 15/0"	R			Brown Medium to Coarse Sand and Gravel, Moist to Wet (Possible Perched Water)								5	
4 SS	4	14 17 14	31	10		▽								5	
5 SS	8	14 14 10	24				SW							8	
6 SS	3	9 7 8/0"	R	20											
7 SS	7	7 5 4	9			27								17	
8 SS	10	13 12 14/0"	R	30		Brown Silty Fine Sand, Wet (Possible Perched Water)	SM							20	
9 SS	10	16 19 18/0"	R			37								22	
10 SS	6	6 9 6/0"	R	40		Brownish Gray Sandy Clay With Gravel, Very Moist to Moist								15	
11 SS	13	4 6 5/0"	R				CL			1.25				11	
12 SS	8	6 5 5/0"	R	50						1.0				10	
13	12		R												

WATER & CAVE-IN OBSERVATION DATA

▽	WATER ENCOUNTERED DURING DRILLING: 12ft.		CAVE DEPTH AT COMPLETION: NE	WET ☐ DRY ☐
▼	WATER LEVEL AT COMPLETION: NE		CAVE DEPTH AFTER 0 HOURS: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AFTER 0 HOURS: N/A		NE = Not Encountered; NMR = No Measurement Recorded	

NOTE: Stratification lines between soil types represent the approximate boundary; gradual transition between in-situ soil layers should be expected.

PROJECT NAME: GWA - Alternative BPS Site 2	GREAT WATER ALLIANCE	**BORING LOG** Intertek psi		**BORING No BPSRN-B-15**
PROJECT No: 00521741				PAGE No: 2 of 2
CONSULTANT: Greeley-Hansen	CONSULTANT PROJECT No:	DATE STARTED: 4/15/20	HORIZONTAL DATUM	VERTICAL DATUM
DRILLING CONTRACTOR: PSI	DRILLING CONTRACTOR PROJECT No:	DATE COMPLETED: 4/15/20	LATITUDE:	
CREW CHIEF: V. Jones	DRILLING RIG: Marooka #395	BORING OFFSET:	LONGITUDE:	
FIELD LOG BY: N. Canning	DRILLING METHOD / HOLE SIZE:	ROADWAY NAME:	NORTHING:	
LOG QC BY:	HAMMER TYPE: / EFFICIENCY:	STATION: / OFFSET:	EASTING:	
COUNTY:	TOWNSHIP: / RANGE: / SECTION: / 1/4 SECTION: / 1/4 SECTION:		SURFACE ELEVATION:	

Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q_t (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
SS		9 15 18/0"				Brownish Gray Sandy Clay With Gravel, Very Moist to Moist	CL			3.0				10	
						57									
14 SS	18	15 20 37/0"	R	60		Brown Lean Clay, Trace Gravel, Moist				4.0				14	
15 SS	13	14 24 35	59							4.5				16	
16 SS	18	18 22 20	42	70						4.5				4	
17 SS	16	20 26 22	48							4.5				13	
18 SS	14	24 30 28	58	80			CL			4.5				13	
19 SS	2	50/2"	R							4.5				13	
20 SS	3	50/3"	R	90						4.5				15	
21 SS	4	50/4"	R							4.5				14	
22 SS	1	50/1"	R	100		100				4.5					

End of Boring at 100.0 ft.

WATER & CAVE-IN OBSERVATION DATA

▽	WATER ENCOUNTERED DURING DRILLING: 12ft.		CAVE DEPTH AT COMPLETION: NE	WET ☐ DRY ☐
▼	WATER LEVEL AT COMPLETION: NE		CAVE DEPTH AFTER 0 HOURS: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AFTER 0 HOURS: N/A		NE = Not Encountered; NMR = No Measurement Recorded	

NOTE: Stratification lines between soil types represent the approximate boundary; gradual transition between in-situ soil layers should be expected.

PROJECT NAME: GWA - Alternative BPS Site 2	GREAT WATER ALLIANCE	**BORING LOG**	Intertek	psi	**BORING No BPSRN-B-16**
PROJECT No: 00521741					PAGE No: 1 of 2
CONSULTANT: Greeley-Hansen	CONSULTANT PROJECT No:	DATE STARTED: 4/16/20			HORIZONTAL DATUM / VERTICAL DATUM
DRILLING CONTRACTOR: PSI	DRILLING CONTRACTOR PROJECT No:	DATE COMPLETED: 4/16/20			LATITUDE
CREW CHIEF: V. Jones	DRILLING RIG: Marooka #395	BORING OFFSET:			LONGITUDE
FIELD LOG BY: A. Salinas	DRILLING METHOD / HOLE SIZE:	ROADWAY NAME:			NORTHING
LOG QC BY	HAMMER TYPE / EFFICIENCY:	STATION / OFFSET:			EASTING
COUNTY	TOWNSHIP / RANGE / SECTION:	1/4 SECTION / 1/4 SECTION:			SURFACE ELEVATION

Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q_t (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
						Topsoil (9"± Thick), Dark Brown Silty Clay, Very Moist	OL							29	
						0.8									
1 SS	9	3 3 3	6			Brown Lean Clay, Trace Gravel, Very Moist	CL			1.25				22	
						3									
2 SS	7	8 9 10	19			Brown Sand and Gravel, Moist								5	
3 SS	14	8 15 14	29											5	
4 SS	10	8 10 22	32	10										5	
							SP								
5 SS	12	22 10 7	17											3	
6 SS	3	14 6 9	15	20											
						▽ 22									
						Brown Medium Sand, Wet (Possible Perched Water)									
7 SS	16	7 9 10	19											19	
8 SS	14	11 11 13	24	30										17	
							SP								
9 SS	12	8 10 13	23											20	
10 SS	15	11 10 15	25	40										15	
						42									
						Brown Lean Clay, Trace Gravel, Moist									
11 SS	10	7 9 14	23							3.0				7	
12 SS	13	21 17 19	36	50			CL			3.5				13	
13	14		45												

WATER & CAVE-IN OBSERVATION DATA

▽	WATER ENCOUNTERED DURING DRILLING: 22ft.		CAVE DEPTH AT COMPLETION: NE	WET ☐ DRY ☐
▼	WATER LEVEL AT COMPLETION: NE		CAVE DEPTH AFTER 0 HOURS: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AFTER 0 HOURS: N/A		NE = Not Encountered; NMR = No Measurement Recorded	

NOTE: Stratification lines between soil types represent the approximate boundary; gradual transition between in-situ soil layers should be expected.

PROJECT NAME			PROJECT No		BORING No
GWA - Alternative BPS Site 2	GREAT WATER ALLIANCE	**BORING LOG** Intertek PSI	00521741		BPSRN-B-16
					PAGE No: 2 of 2

CONSULTANT	CONSULTANT PROJECT No	DATE STARTED	HORIZONTAL DATUM	VERTICAL DATUM
Greeley-Hansen		4/16/20		
DRILLING CONTRACTOR	**DRILLING CONTRACTOR PROJECT No**	**DATE COMPLETED**	**LATITUDE**	
PSI		4/16/20		
CREW CHIEF	**DRILLING RIG**	**BORING OFFSET**	**LONGITUDE**	
V. Jones	Marooka #395			
FIELD LOG BY	**DRILLING METHOD / HOLE SIZE**	**ROADWAY NAME**	**NORTHING**	
A. Salinas				
LOG QC BY	**HAMMER TYPE / EFFICIENCY**	**STATION / OFFSET**	**EASTING**	
COUNTY	**TOWNSHIP / RANGE / SECTION / 1/4 SECTION / 1/4 SECTION**		**SURFACE ELEVATION**	

Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q_t (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
SS		15 23 22				Brown Lean Clay, Trace Gravel, Moist				4	4.12			12	
14 SS	18	18 20 27	47	60						4.5				12	
15 SS	10	28 41 49	90							4.5	6.18			12	
16 SS	12	36 44 50	94	70						4.5	6.18			11	
17 SS	9	30 36 50	86							4.5	4.95			12	
18 SS	11	50/5"	R	80			CL			4.5	6.39			12	
19 SS	7	29 39 50	89							4.0	3.71			13	
20 SS	4	50/4"	R	90						3.75	3.71			12	
21 SS	4	50/4"	R							4.5				12	
22 SS	5	50/5"	R	100		100				3					

End of Boring at 100.0 ft.

WATER & CAVE-IN OBSERVATION DATA

▽	WATER ENCOUNTERED DURING DRILLING: 22ft.		CAVE DEPTH AT COMPLETION: NE	WET ☐ DRY ☐
▼	WATER LEVEL AT COMPLETION: NE		CAVE DEPTH AFTER 0 HOURS: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AFTER 0 HOURS: N/A		NE = Not Encountered; NMR = No Measurement Recorded	

NOTE: Stratification lines between soil types represent the approximate boundary; gradual transition between in-situ soil layers should be expected.

PROJECT NAME: GWA - Alternative BPS Site 2	GREAT WATER ALLIANCE	**BORING LOG**	Intertek	psi	**BORING No BPSRN-B-19**
PROJECT No: 00521741					PAGE No: 1 of 2
CONSULTANT: Greeley-Hansen	CONSULTANT PROJECT No:	DATE STARTED: 5/26/20			HORIZONTAL DATUM / VERTICAL DATUM
DRILLING CONTRACTOR: PSI	DRILLING CONTRACTOR PROJECT No:	DATE COMPLETED: 5/26/20			LATITUDE
CREW CHIEF: P. Rotaru	DRILLING RIG: HD ATV #419	BORING OFFSET:			LONGITUDE
FIELD LOG BY: A. Salinas	DRILLING METHOD / HOLE SIZE:	ROADWAY NAME:			NORTHING
LOG QC BY	HAMMER TYPE / EFFICIENCY:	STATION / OFFSET:			EASTING
COUNTY	TOWNSHIP / RANGE / SECTION:	1/4 SECTION / 1/4 SECTION:			SURFACE ELEVATION

Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q_t (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
						Topsoil, Dark Brown Silty Clay, Very Moist (12"± Thick)	OL							35	
1 SS	9	5 4 4	8			0.99	CL							23	
2 SS	9	50				Brown Lean Clay, Very Moist 3	SP							4	
3 SS	14	10 8 10	18			Brown Medium Sand With Gravel, Damp 5.5								8	
4 SS	7	7 9 12	21	10		Brown Sandy Silt With Gravel, Moist	ML							8	
5 SS	12	15 18 25	43			17								6	
6 SS	16	20 22 23	45	20		▽ Brown Medium Sand, Wet	SP							19	
7 SS	14	27 25 35	60			27								21	
8 SS	13	25 29 23	52	30		Brown Silty Fine Sand, Wet 32	SM							20	
9 SS	14	19 29 47	76			Brown Lean Clay, Moist to Very Moist				2.5	2.23			12	
10 SS	15	11 21 25	46	40						3.5	6.60			12	
11 SS	18	11 21 27	48				CL			3.0	7.21			11	
12 SS	18	12 25 37	62	50							4.12			12	
13	14		54												

WATER & CAVE-IN OBSERVATION DATA

▽	WATER ENCOUNTERED DURING DRILLING: 18.5ft.		CAVE DEPTH AT COMPLETION: NE	WET ☐ DRY ☐
▼	WATER LEVEL AT COMPLETION: NE		CAVE DEPTH AFTER 0 HOURS: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AFTER 0 HOURS: N/A		NE = Not Encountered; NMR = No Measurement Recorded	

NOTE: Stratification lines between soil types represent the approximate boundary; gradual transition between in-situ soil layers should be expected.

PROJECT NAME: GWA - Alternative BPS Site 2	GREAT WATER ALLIANCE	**BORING LOG** Intertek psi	**BORING No BPSRN-B-19**
PROJECT No: 00521741			PAGE No: 2 of 2
CONSULTANT: Greeley-Hansen	CONSULTANT PROJECT No:	DATE STARTED: 5/26/20	HORIZONTAL DATUM / VERTICAL DATUM
DRILLING CONTRACTOR: PSI	DRILLING CONTRACTOR PROJECT No:	DATE COMPLETED: 5/26/20	LATITUDE
CREW CHIEF: P. Rotaru	DRILLING RIG: HD ATV #419	BORING OFFSET	LONGITUDE
FIELD LOG BY: A. Salinas	DRILLING METHOD / HOLE SIZE	ROADWAY NAME	NORTHING
LOG QC BY	HAMMER TYPE / EFFICIENCY	STATION / OFFSET	EASTING
COUNTY	TOWNSHIP / RANGE / SECTION / 1/4 SECTION / 1/4 SECTION		SURFACE ELEVATION

Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q_t (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
SS		15 18 36				Brown Lean Clay, Moist to Very Moist				3.0	3.71			13	
14 SS	18	13 15 29	44	60						4.0	5.77			12	
15 SS	16	18 29 37	66							3.5	3.22			15	
16 SS	18	20 23 34	57	70						2.25	3.22			15	
17 SS	18	14 19 46	65				CL			3.25	4.04			16	
18 SS	18	20 25 42	67	80						4.5	5.77			11	
19 SS	17	25 26 43	69							4.5	5.15			12	
20 SS	18	19 24 38	62	90						3.75	3.91			17	
						92									
						Gray Sandy Silt, Very Moist									
21 SS	18	22 23 39	62				ML							13	
22 SS	18	26 30 41	71	100		100								13	
						End of Boring at 100.0 ft.									

WATER & CAVE-IN OBSERVATION DATA

▽	WATER ENCOUNTERED DURING DRILLING: 18.5ft.		CAVE DEPTH AT COMPLETION: NE	WET ☐ DRY ☐
▼	WATER LEVEL AT COMPLETION: NE		CAVE DEPTH AFTER 0 HOURS: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AFTER 0 HOURS: N/A		NE = Not Encountered; NMR = No Measurement Recorded	

NOTE: Stratification lines between soil types represent the approximate boundary; gradual transition between in-situ soil layers should be expected.

PROJECT NAME: GWA - Alternative BPS Site 2	GREAT WATER ALLIANCE	**BORING LOG**	Intertek	psi	**BORING No WTRN-B-01**
PROJECT No: 00521741					PAGE No: 1 of 2
CONSULTANT: Greeley-Hansen	CONSULTANT PROJECT No:	DATE STARTED: 5/06/20			HORIZONTAL DATUM / VERTICAL DATUM
DRILLING CONTRACTOR: PSI	DRILLING CONTRACTOR PROJECT No:	DATE COMPLETED: 5/06/20			LATITUDE
CREW CHIEF: T. Ebert	DRILLING RIG: ASV ATV #420	BORING OFFSET:			LONGITUDE
FIELD LOG BY: D. Turley	DRILLING METHOD / HOLE SIZE:	ROADWAY NAME:			NORTHING
LOG QC BY	HAMMER TYPE / EFFICIENCY:	STATION / OFFSET:			EASTING
COUNTY	TOWNSHIP / RANGE / SECTION:	1/4 SECTION / 1/4 SECTION:			SURFACE ELEVATION

Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q_t (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
						Topsoil, Dark Brown Silty Clay, Very Moist (12"± Thick) 0.99	OL							17	
1 SS	18	4 4 4	8			Brown Lean Clay, Very Moist 5.5	CL			2.0	2.14			22	
2 SS	6	10 13 14	27			Brown Medium Sand With Gravel, Damp				1.5				24	
3 SS	14	16 21 21	42											5	
4 SS	5	50/5"	R	10		▽ 12	SP								
5 SS	12	18 20 34	54			Brown Coarse Sand and Gravel, Wet 17	SP							12	
6 SS	14	17 25 28	53	20		Brown Lean Clay, Trace Gravel, Moist to Very Moist				3.5	4.12			13	
7 SS	16	20 24 34	58							4.0				12	
8 SS	14	10 15 24	39	30						2.25	2.06			13	
9 SS	12	11 15 24	39				CL			3.0	2.72			12	
10 SS	14	10 15 23	38	40						0.5	2.31			16	
11 SS	14	12 18 27	45							4.25	4.53			12	
12 SS	16	10 15 24	39	50						3.5	3.54			13	
13	14		52												

WATER & CAVE-IN OBSERVATION DATA

▽	WATER ENCOUNTERED DURING DRILLING: 12ft.		CAVE DEPTH AT COMPLETION: NE	WET ☐ DRY ☐
▼	WATER LEVEL AT COMPLETION: NE		CAVE DEPTH AFTER 0 HOURS: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AFTER 0 HOURS: N/A		NE = Not Encountered; NMR = No Measurement Recorded	

NOTE: Stratification lines between soil types represent the approximate boundary; gradual transition between in-situ soil layers should be expected.

PROJECT NAME: GWA - Alternative BPS Site 2	GREAT WATER ALLIANCE	**BORING LOG** Intertek psi	**BORING No WTRN-B-01**
PROJECT No: 00521741			PAGE No: 2 of 2
CONSULTANT: Greeley-Hansen	CONSULTANT PROJECT No:	DATE STARTED: 5/06/20	HORIZONTAL DATUM / VERTICAL DATUM
DRILLING CONTRACTOR: PSI	DRILLING CONTRACTOR PROJECT No:	DATE COMPLETED: 5/06/20	LATITUDE
CREW CHIEF: T. Ebert	DRILLING RIG: ASV ATV #420	BORING OFFSET:	LONGITUDE
FIELD LOG BY: D. Turley	DRILLING METHOD / HOLE SIZE:	ROADWAY NAME:	NORTHING
LOG QC BY:	HAMMER TYPE: / EFFICIENCY:	STATION: / OFFSET:	EASTING
COUNTY:	TOWNSHIP: / RANGE: / SECTION: / 1/4 SECTION: / 1/4 SECTION:		SURFACE ELEVATION

Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q_t (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
SS		12 20 32				Brown Lean Clay, Trace Gravel, Moist to Very Moist				3.75	4.53			12	
14 SS	10	28 28 41	69	60						1.0				17	
15 SS	12	12 14 28	42							2.0	2.06			14	
16 SS	14	11 18 28	46	70						4.5+	4.74			12	
17 SS	12	12 30 30	60				CL			4.25	4.33			12	
18 SS	12	14 25 28	53	80						4.25	4.12			12	
19 SS	12	13 28 29	57							4.5	4.95			12	
20 SS	12	15 28 34	62	90						4.5+				7	
21 SS	10	18 30 38	68							4.0	3.13			12	
22 SS	12	21 29 40	69	100		100 End of Boring at 100.0 ft.				4.5+	7.42			12	

WATER & CAVE-IN OBSERVATION DATA

▽	WATER ENCOUNTERED DURING DRILLING: 12ft.		CAVE DEPTH AT COMPLETION: NE	WET ☐ DRY ☐
▼	WATER LEVEL AT COMPLETION: NE		CAVE DEPTH AFTER 0 HOURS: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AFTER 0 HOURS: N/A		NE = Not Encountered; NMR = No Measurement Recorded	

NOTE: Stratification lines between soil types represent the approximate boundary; gradual transition between in-situ soil layers should be expected.

PROJECT NAME: GWA - Alternative BPS Site 2	GREAT WATER ALLIANCE	**BORING LOG**	Intertek	psi	**BORING No WTRN-B-02**
PROJECT No: 00521741					PAGE No: 1 of 2
CONSULTANT: Greeley-Hansen	CONSULTANT PROJECT No:		DATE STARTED: 5/11/20		HORIZONTAL DATUM / VERTICAL DATUM
DRILLING CONTRACTOR: PSI	DRILLING CONTRACTOR PROJECT No:		DATE COMPLETED: 5/11/20		LATITUDE
CREW CHIEF: D. Turley	DRILLING RIG: ASV ATV #420		BORING OFFSET:		LONGITUDE
FIELD LOG BY: A. Salinas	DRILLING METHOD / HOLE SIZE:		ROADWAY NAME:		NORTHING
LOG QC BY:	HAMMER TYPE:	EFFICIENCY:	STATION:	OFFSET:	EASTING
COUNTY:	TOWNSHIP:	RANGE:	SECTION:	1/4 SECTION: 1/4 SECTION:	SURFACE ELEVATION

Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q_t (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
						Topsoil, Dark Brown Silt, Very Moist (10"± Thick)	OL								
1 SS	5	4 4 4	8			0.8 Brown Lean Clay, Moist	CL			2.75				33 20	
2 SS	10	4 8 8	16			3 Brown Medium to Coarse Sand With Gravel, Moist to Wet								10	
3 SS	12	21 21 22	43			▽								4	
4 SS	16	25 8 11	19	10			SP							11	
5 SS	14	15 11 13	24											12	
6 SS	12	14 11 30	41	20		22								14	
7 SS	13	8 16 21	37			Brown Lean Clay, Trace Gravel, Moist to Very Moist				4.5+				11	
8 SS	12	8 11 18	29	30						4.0				14	
9 SS	16	10 14 24	38							4.5	4.95			11	
10 SS	16	8 9 20	29	40			CL			3.5	4.33			13	
11 SS	18	12 18 32	50							2.5	3.30			13	
12 SS	14	8 11 21	32	50						4.5+	5.50			12	
13	10		35												

WATER & CAVE-IN OBSERVATION DATA

▽	WATER ENCOUNTERED DURING DRILLING: 8.5ft.		CAVE DEPTH AT COMPLETION: NE	WET ☐ DRY ☐
▼	WATER LEVEL AT COMPLETION: NE		CAVE DEPTH AFTER 0 HOURS: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AFTER 0 HOURS: N/A		NE = Not Encountered; NMR = No Measurement Recorded	

NOTE: Stratification lines between soil types represent the approximate boundary; gradual transition between in-situ soil layers should be expected.

PROJECT NAME				PROJECT No		PAGE No
GWA - Alternative BPS Site 2	GREAT WATER ALLIANCE	**BORING LOG**	Intertek psi	00521741	**BORING No WTRN-B-02**	2 of 2

CONSULTANT	CONSULTANT PROJECT No	DATE STARTED	HORIZONTAL DATUM	VERTICAL DATUM
Greeley-Hansen		5/11/20		
DRILLING CONTRACTOR	**DRILLING CONTRACTOR PROJECT No**	**DATE COMPLETED**	**LATITUDE**	
PSI		5/11/20		
CREW CHIEF	**DRILLING RIG**	**BORING OFFSET**	**LONGITUDE**	
D. Turley	ASV ATV #420			
FIELD LOG BY	**DRILLING METHOD / HOLE SIZE**	**ROADWAY NAME**	**NORTHING**	
A. Salinas				
LOG QC BY	**HAMMER TYPE / EFFICIENCY**	**STATION / OFFSET**	**EASTING**	
COUNTY	**TOWNSHIP / RANGE / SECTION / 1/4 SECTION / 1/4 SECTION**		**SURFACE ELEVATION**	

Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q_t (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
SS		12 18 17				Brown Lean Clay, Trace Gravel, Moist to Very Moist				4.5+	7.83			11	
14 SS	16	11 15 21	36	60						4.0	5.35			12	
15 SS	12	9 15 18	33							3.5	4.12			13	
16 SS	14	10 12 16	28	70						1.5	1.24			13	
17 SS	13	13 21 21	42				CL			2.5	3.71			14	
18 SS	16	18 16 20	36	80						4.5+	6.18			12	
19 SS	12	21 16 18	34							4.5	4.53			12	
20 SS	18	20 24 36	60	90						4.5				9	
						92									
						Gray Sandy Silt With Gravel, Very Moist									
21 SS	9	50					ML							9	
22 SS	3	50/3"	R	100		100								10	

End of Boring at 100.0 ft.

WATER & CAVE-IN OBSERVATION DATA

▽	WATER ENCOUNTERED DURING DRILLING: 8.5ft.		CAVE DEPTH AT COMPLETION: NE	WET ☐ DRY ☐
▼	WATER LEVEL AT COMPLETION: NE		CAVE DEPTH AFTER 0 HOURS: N/A	WET ☐ DRY ☐
▼	WATER LEVEL AFTER 0 HOURS: N/A		NE = Not Encountered; NMR = No Measurement Recorded	

NOTE: Stratification lines between soil types represent the approximate boundary; gradual transition between in-situ soil layers should be expected.

Professional Service Industries, Inc.
821 Corporate Court, Suite 100
Waukesha, WI 53189
Telephone: (262) 521-2125
Fax: (262) 521-2471

LOG OF STRM-B-1

PSI Job No.: 00521741-test pits alt bps site 2
Project: GWA Alternative BPS Site 2
Location: E Broadway
Waukesha, WI

Excavation Method:Excavator
Sampling Method:
DCP Type:
Boring Location:

WATER LEVELS
While Digging 10 feet
Delay N/A

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	Dynamic Cone (DCP) Blows per 1¾-inch	Moisture, %	DYNAMIC CONE PENETRATION TEST DATA Blows per 1¾-inch ◎ 0 15 30 / Moisture ✕ PL ◪ LL ✚ 0 25 50 / STRENGTH, tsf ▲ Qu ✳ Qp 0 2.0 4.0	Additional Remarks
	0					Topsoil, Dark Brown Silty Clay, Very Moist (18"± Thick)					
	1			1	18					✳	
	2			2	18	Light Brown Clay (C), Moist					
	3					Brown Gravelly Sand (S) with Cobbles, Moist to Wet					
	4										
	5										
	6										
	7			3	108						
	8										
	9										
	10										
	11										
	12					End of Pit at 12'					

Completion Depth: 12.0 ft
Date Boring Started: 5/26/20
Date Boring Completed: 5/26/20
Logged By:
Excavation Contractor: R&W

Sample Types:
Shelby Tube
Dynamic Cone (DCP)
Grab Sample

Latitude: °
Longitude: °
Excavation Equipment:
Remarks:

The stratification lines represent approximate boundaries. The transition may be gradual.

Professional Service Industries, Inc.
821 Corporate Court, Suite 100
Waukesha, WI 53189
Telephone: (262) 521-2125
Fax: (262) 521-2471

LOG OF STRM-B-2

PSI Job No.: 00521741-test pits alt bps site 2
Project: GWA Alternative BPS Site 2
Location: E Broadway
Waukesha, WI

Excavation Method:Excavator
Sampling Method:
DCP Type:
Boring Location:

WATER LEVELS
While Digging: Not Obsvd
Delay: N/A

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	Dynamic Cone (DCP) Blows per 1¾-inch	Moisture, %	DYNAMIC CONE PENETRATION TEST DATA Blows per 1¾-inch ◎ 0 15 30 / Moisture PL LL 0 25 50 / STRENGTH, tsf Qu Qp 0 2.0 4.0	Additional Remarks
	0					Topsoil, Dark Brown Silty Clay, Very Moist (16"± Thick)					
	1			1	16					✳	
	2					Light Brown Clay (C), Moist					
	3			2	44						
	4										
	5					Brown Very Gravelly Sand (vgS) with Cobbles, Moist					
	6										
	7										
	8										
	9			3	84						
	10										
	11										
	12					End of Pit at 12'					

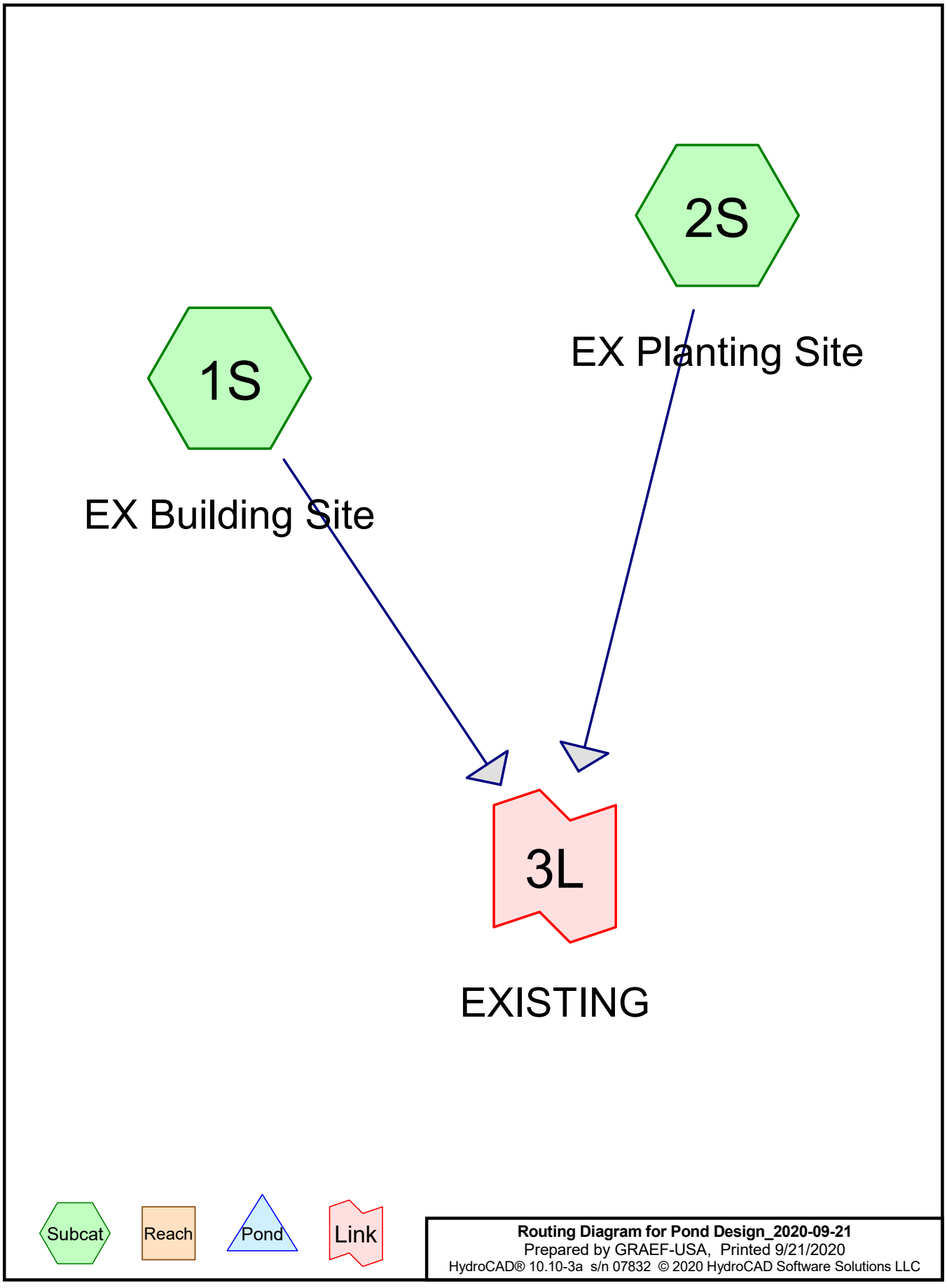
Completion Depth: 12.0 ft
Date Boring Started: 5/26/20
Date Boring Completed: 5/26/20
Logged By:
Excavation Contractor: R&W

Sample Types:
Shelby Tube
Dynamic Cone (DCP)
Grab Sample

Latitude: °
Longitude: °
Excavation Equipment:
Remarks:

The stratification lines represent approximate boundaries. The transition may be gradual.

Appendix C – Existing Conditions HydroCAD Modeling



Routing Diagram for Pond Design_2020-09-21
Prepared by GRAEF-USA, Printed 9/21/2020

Summary for Subcatchment 1S: EX Building Site

Existing conditions - disturbed area
Deteriorated Asphalt assumed Gravel

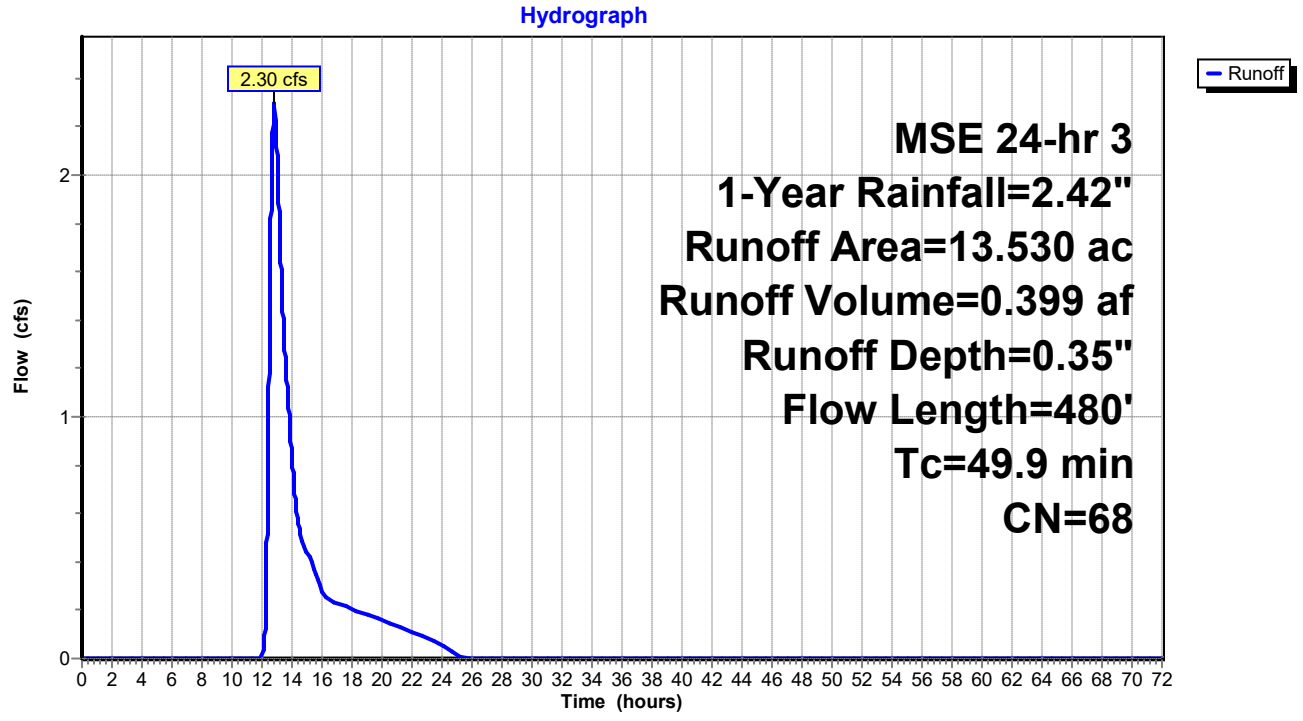
Runoff = 2.30 cfs @ 12.81 hrs, Volume= 0.399 af, Depth= 0.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 1-Year Rainfall=2.42"

	Area (ac)	CN	Description
*	0.710	96	Gravel surface, HSG A
	5.128	77	Woods, Good, HSG D
	2.564	70	Woods, Good, HSG C
	5.128	55	Woods, Good, HSG B
	13.530	68	Weighted Average
	13.530		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
45.9	300	0.0330	0.11		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.72"
4.0	180	0.0222	0.74		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
49.9	480	Total			

Subcatchment 1S: EX Building Site



Summary for Subcatchment 2S: EX Planting Site

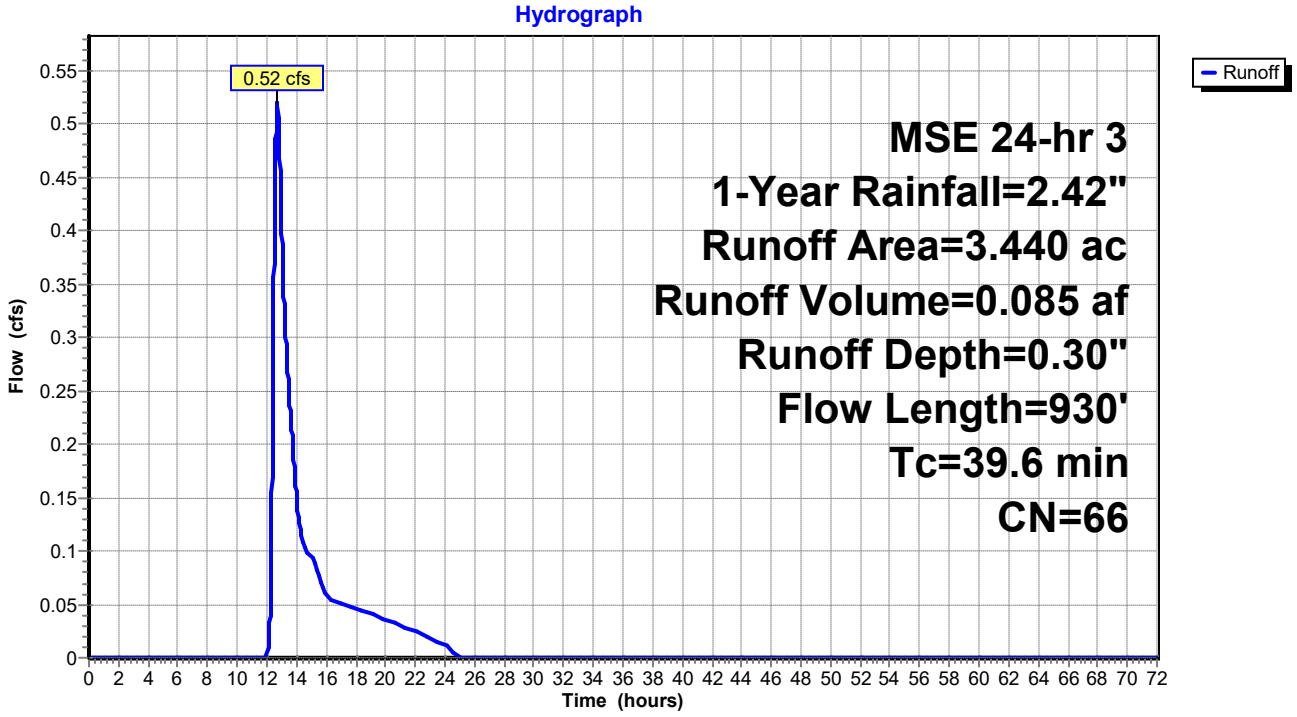
Runoff = 0.52 cfs @ 12.71 hrs, Volume= 0.085 af, Depth= 0.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 1-Year Rainfall=2.42"

	Area (ac)	CN	Description
*	1.720	77	Soil D Woodland
*	1.720	55	Soil B Woodland
	3.440	66	Weighted Average
	3.440		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
30.3	300	0.0933	0.17		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.72"
1.4	150	0.1200	1.73		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.9	300	0.0330	1.27		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
4.0	180	0.0222	0.74		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
39.6	930	Total			

Subcatchment 2S: EX Planting Site

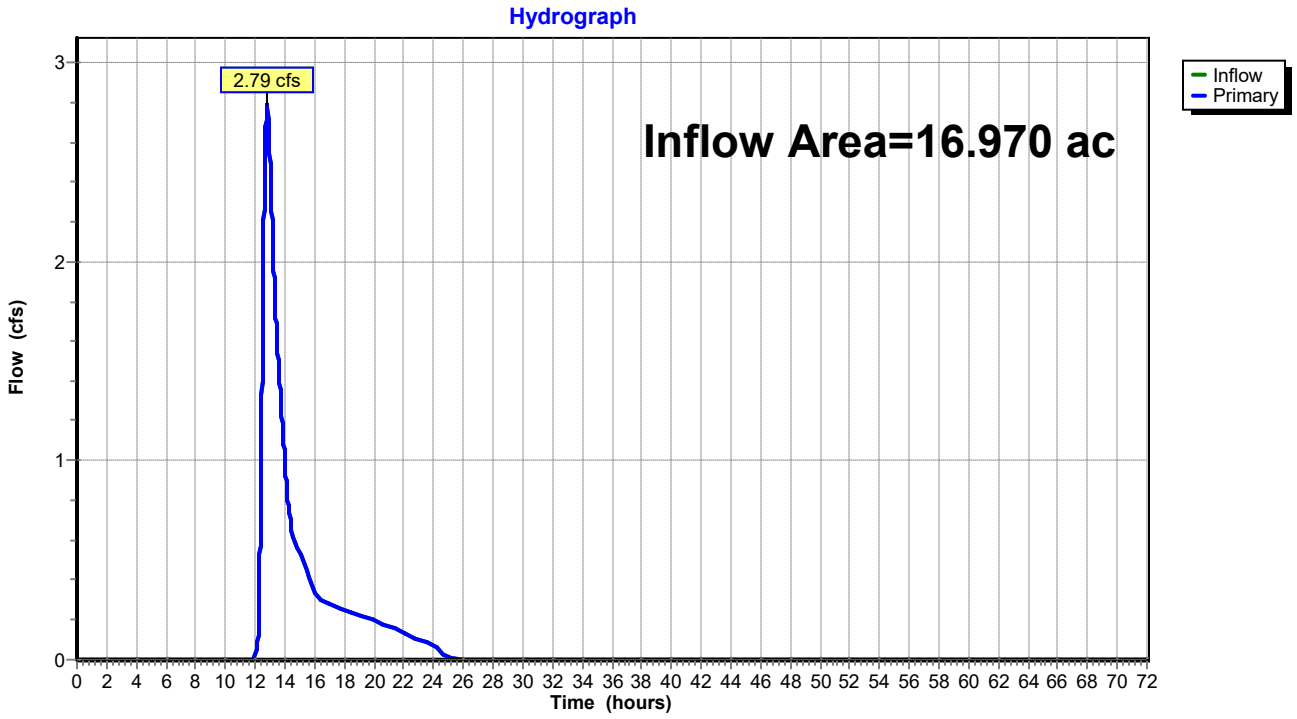


Summary for Link 3L: EXISTING

Inflow Area = 16.970 ac, 0.00% Impervious, Inflow Depth = 0.34" for 1-Year event
Inflow = 2.79 cfs @ 12.81 hrs, Volume= 0.483 af
Primary = 2.79 cfs @ 12.81 hrs, Volume= 0.483 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 3L: EXISTING



Summary for Subcatchment 1S: EX Building Site

Existing conditions - disturbed area
Deteriorated Asphalt assumed Gravel

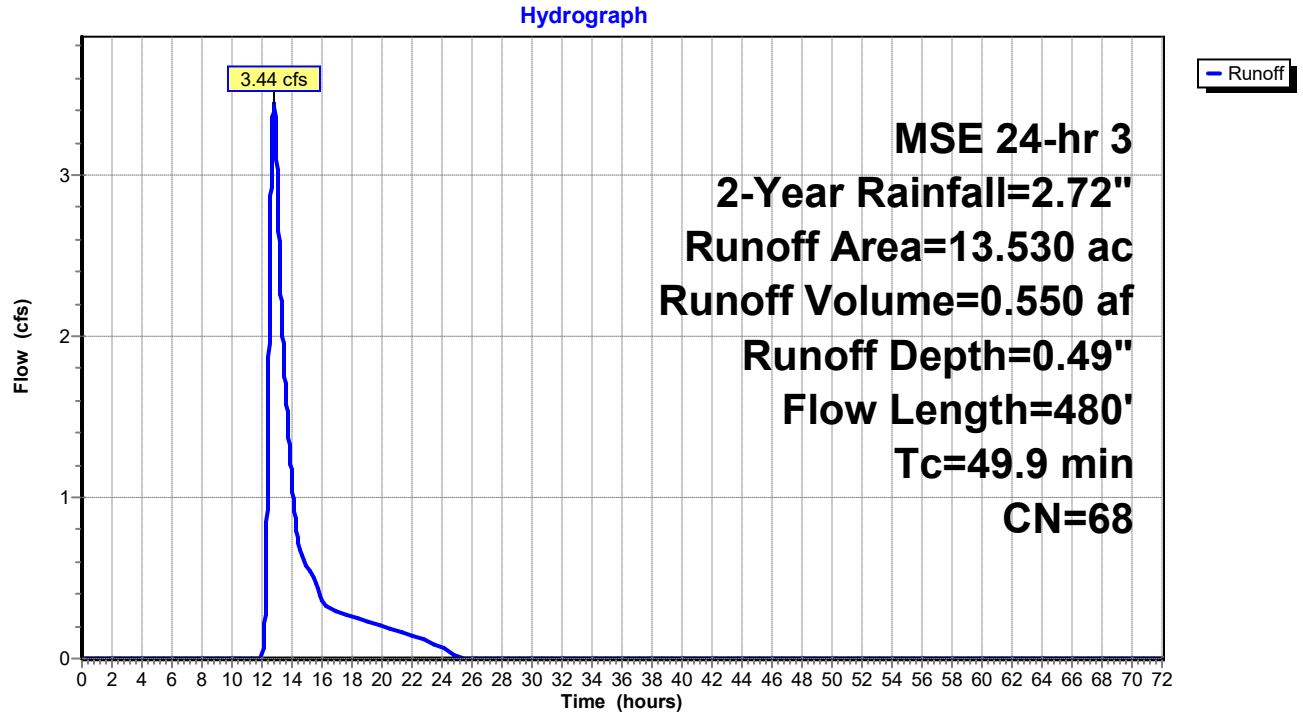
Runoff = 3.44 cfs @ 12.81 hrs, Volume= 0.550 af, Depth= 0.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.72"

	Area (ac)	CN	Description
*	0.710	96	Gravel surface, HSG A
	5.128	77	Woods, Good, HSG D
	2.564	70	Woods, Good, HSG C
	5.128	55	Woods, Good, HSG B
	13.530	68	Weighted Average
	13.530		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
45.9	300	0.0330	0.11		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.72"
4.0	180	0.0222	0.74		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
49.9	480	Total			

Subcatchment 1S: EX Building Site



Summary for Subcatchment 2S: EX Planting Site

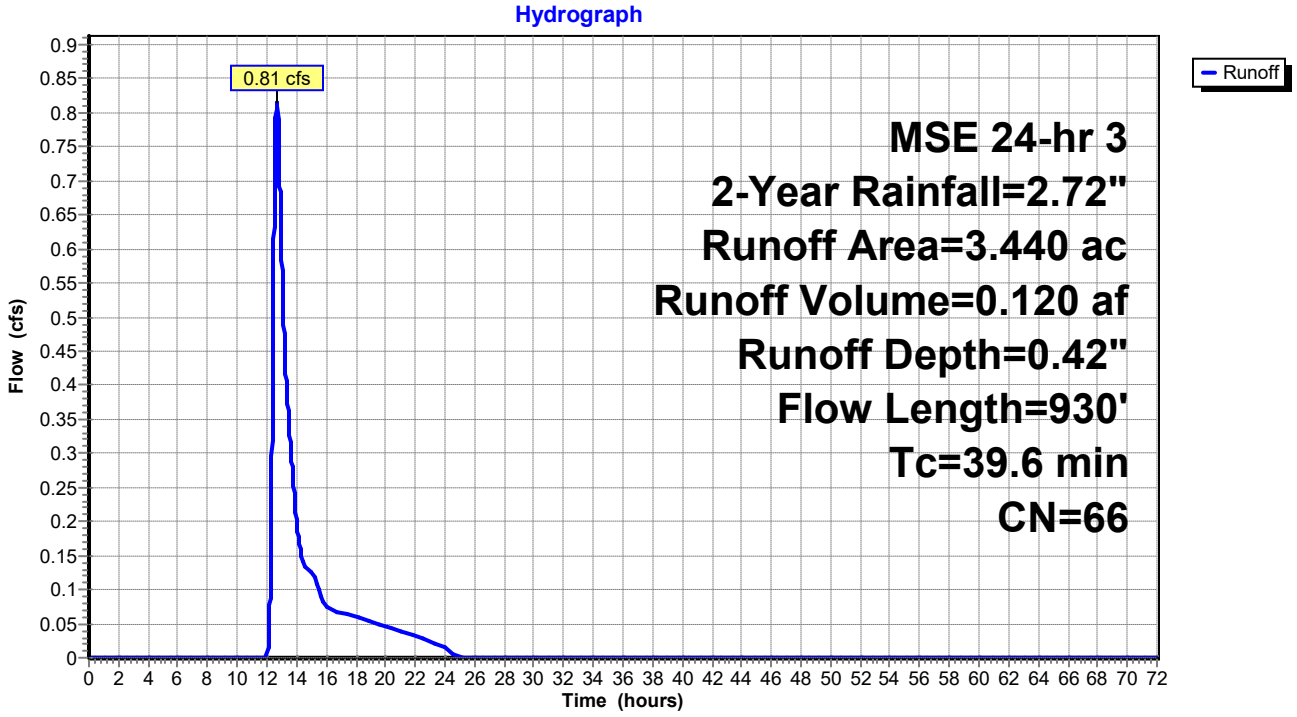
Runoff = 0.81 cfs @ 12.67 hrs, Volume= 0.120 af, Depth= 0.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.72"

	Area (ac)	CN	Description
*	1.720	77	Soil D Woodland
*	1.720	55	Soil B Woodland
	3.440	66	Weighted Average
	3.440		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
30.3	300	0.0933	0.17		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.72"
1.4	150	0.1200	1.73		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.9	300	0.0330	1.27		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
4.0	180	0.0222	0.74		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
39.6	930	Total			

Subcatchment 2S: EX Planting Site

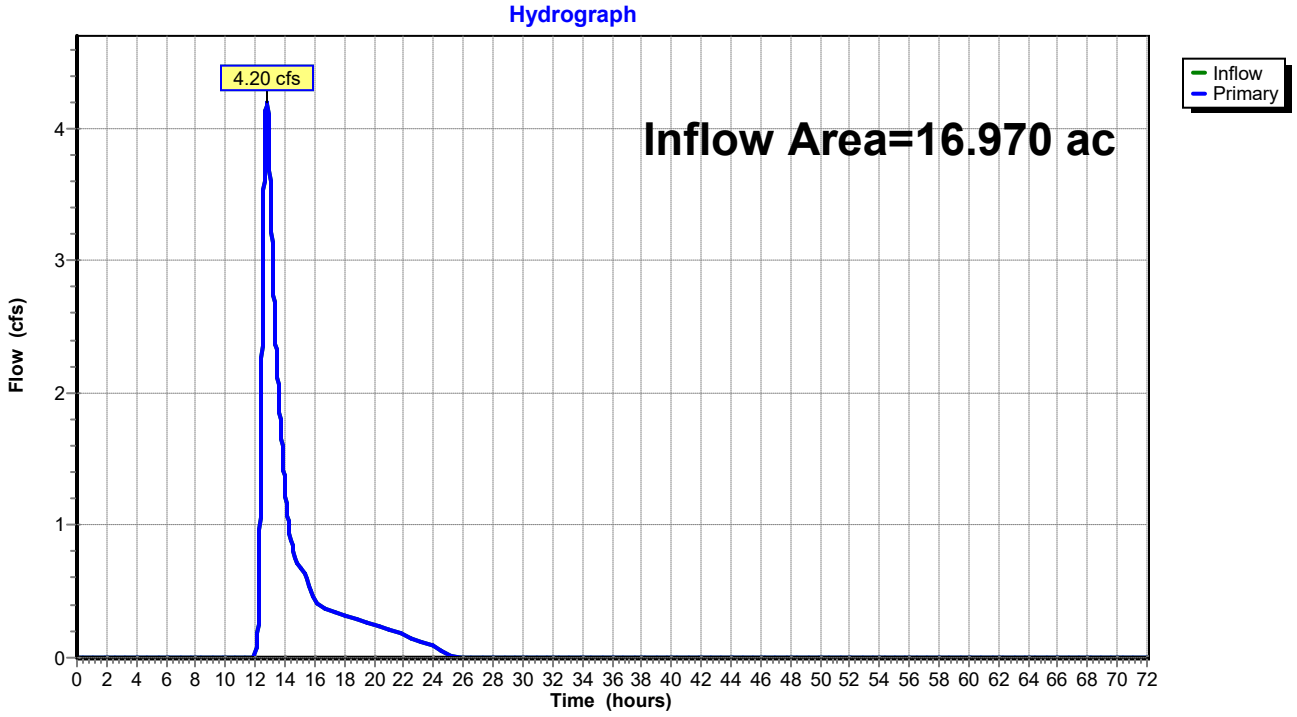


Summary for Link 3L: EXISTING

Inflow Area = 16.970 ac, 0.00% Impervious, Inflow Depth = 0.47" for 2-Year event
Inflow = 4.20 cfs @ 12.80 hrs, Volume= 0.670 af
Primary = 4.20 cfs @ 12.80 hrs, Volume= 0.670 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 3L: EXISTING



Summary for Subcatchment 1S: EX Building Site

Existing conditions - disturbed area
Deteriorated Asphalt assumed Gravel

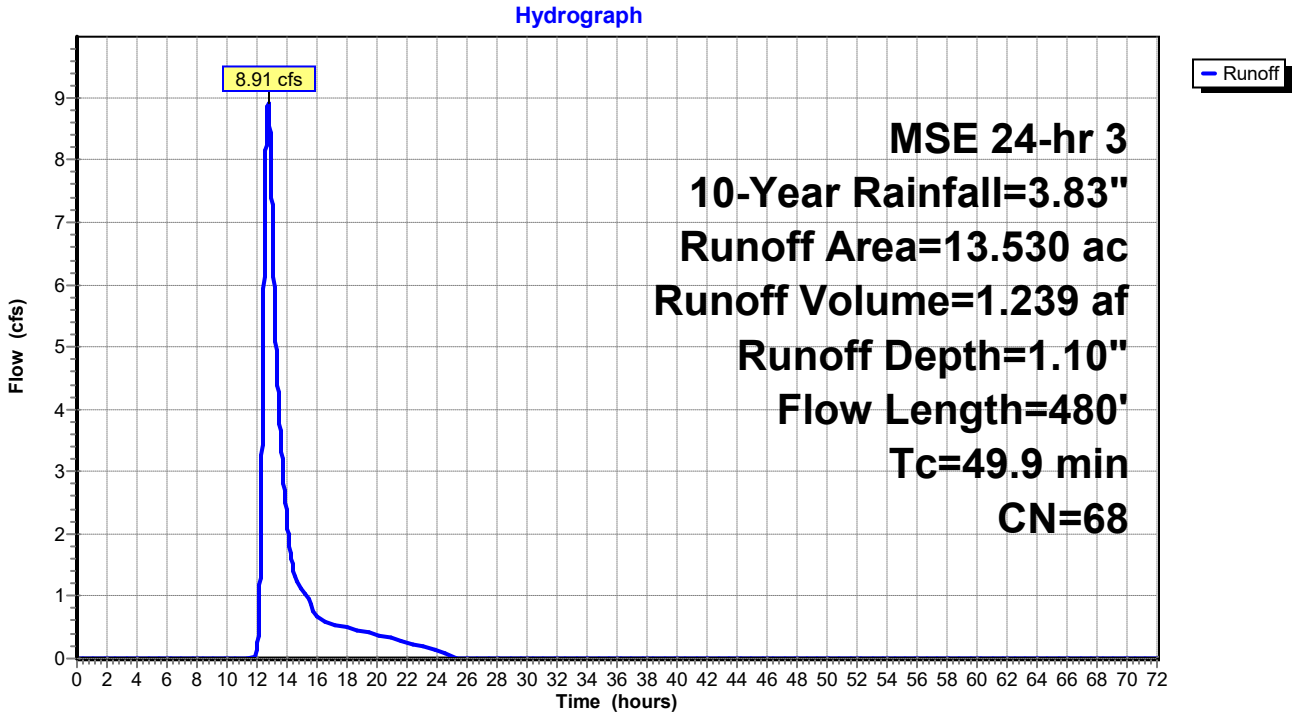
Runoff = 8.91 cfs @ 12.75 hrs, Volume= 1.239 af, Depth= 1.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=3.83"

	Area (ac)	CN	Description
*	0.710	96	Gravel surface, HSG A
	5.128	77	Woods, Good, HSG D
	2.564	70	Woods, Good, HSG C
	5.128	55	Woods, Good, HSG B
	13.530	68	Weighted Average
	13.530		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
45.9	300	0.0330	0.11		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.72"
4.0	180	0.0222	0.74		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
49.9	480	Total			

Subcatchment 1S: EX Building Site



Summary for Subcatchment 2S: EX Planting Site

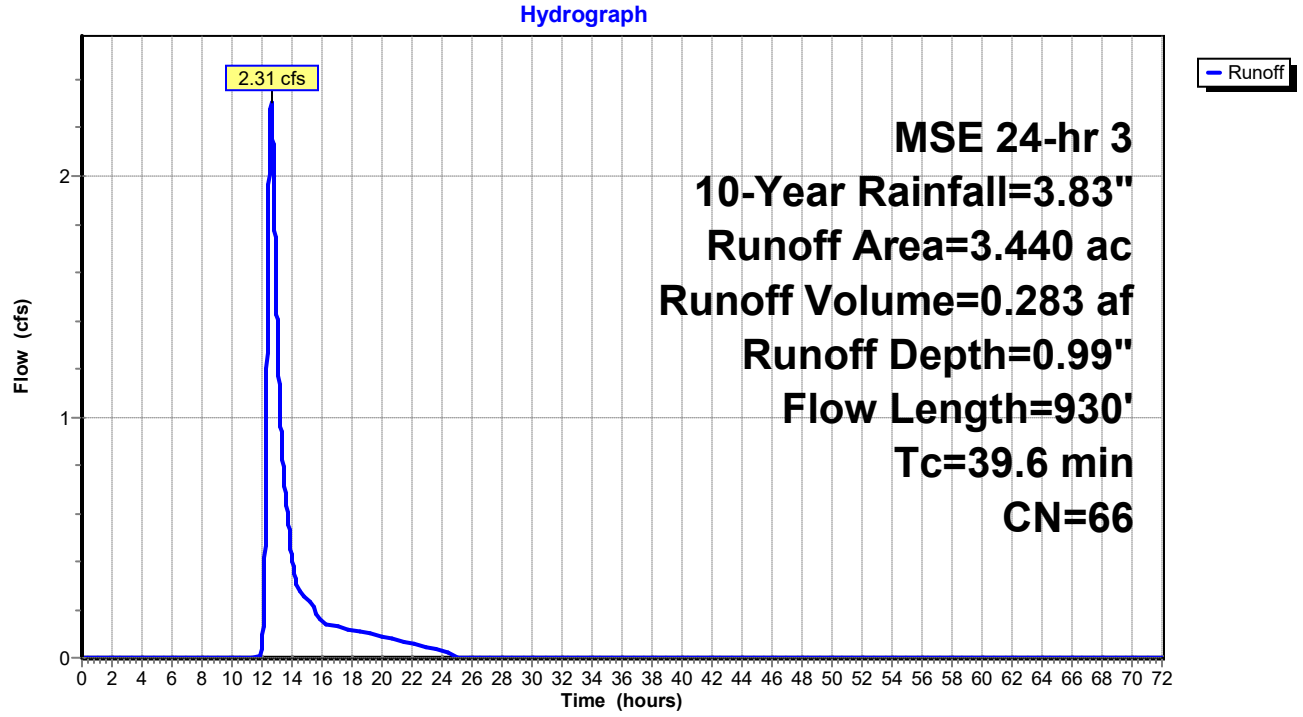
Runoff = 2.31 cfs @ 12.63 hrs, Volume= 0.283 af, Depth= 0.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=3.83"

	Area (ac)	CN	Description
*	1.720	77	Soil D Woodland
*	1.720	55	Soil B Woodland
	3.440	66	Weighted Average
	3.440		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
30.3	300	0.0933	0.17		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.72"
1.4	150	0.1200	1.73		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.9	300	0.0330	1.27		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
4.0	180	0.0222	0.74		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
39.6	930	Total			

Subcatchment 2S: EX Planting Site

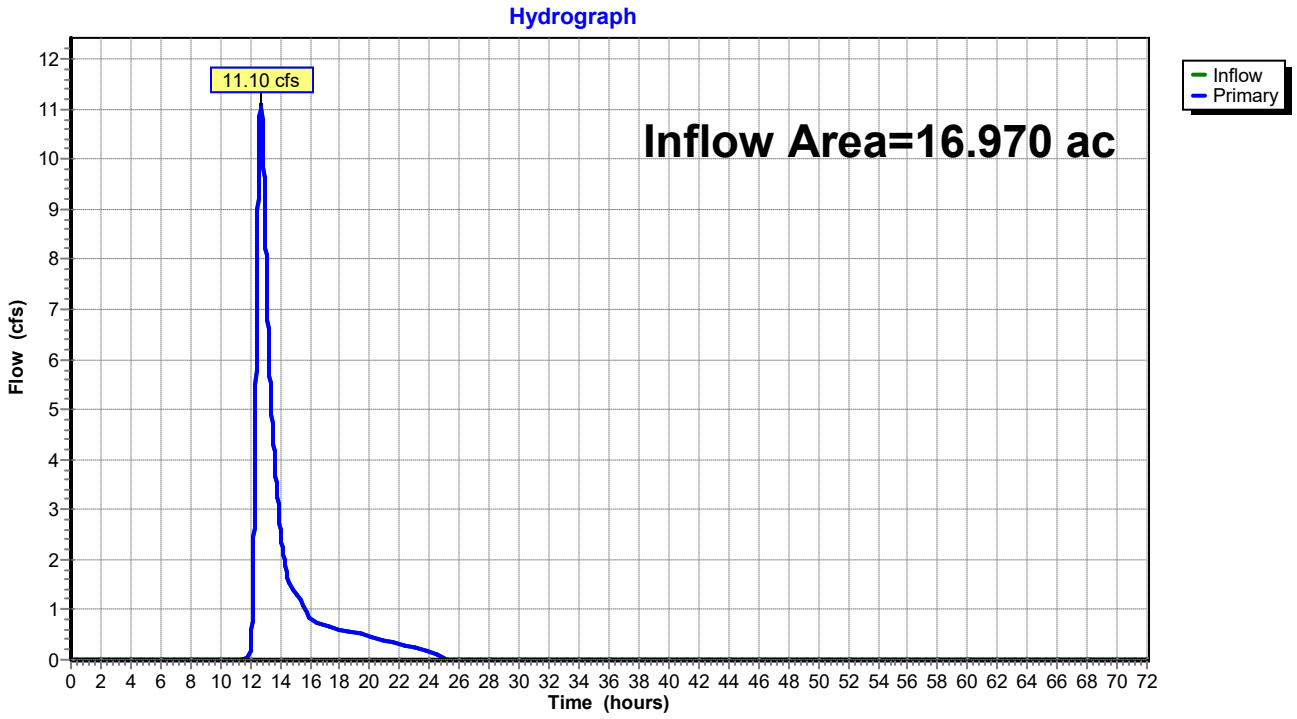


Summary for Link 3L: EXISTING

Inflow Area = 16.970 ac, 0.00% Impervious, Inflow Depth = 1.08" for 10-Year event
Inflow = 11.10 cfs @ 12.70 hrs, Volume= 1.522 af
Primary = 11.10 cfs @ 12.70 hrs, Volume= 1.522 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 3L: EXISTING



Summary for Subcatchment 1S: EX Building Site

Existing conditions - disturbed area
Deteriorated Asphalt assumed Gravel

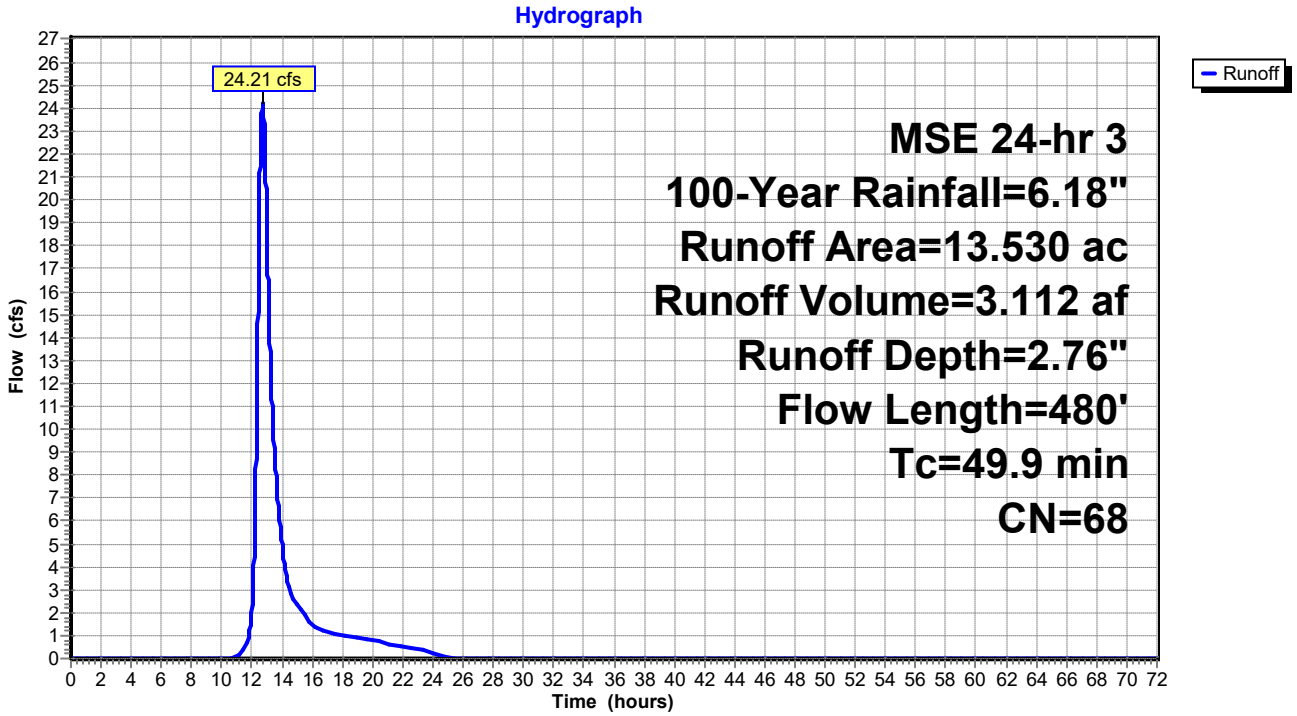
Runoff = 24.21 cfs @ 12.70 hrs, Volume= 3.112 af, Depth= 2.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=6.18"

	Area (ac)	CN	Description
*	0.710	96	Gravel surface, HSG A
	5.128	77	Woods, Good, HSG D
	2.564	70	Woods, Good, HSG C
	5.128	55	Woods, Good, HSG B
	13.530	68	Weighted Average
	13.530		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
45.9	300	0.0330	0.11		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.72"
4.0	180	0.0222	0.74		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
49.9	480	Total			

Subcatchment 1S: EX Building Site



Summary for Subcatchment 2S: EX Planting Site

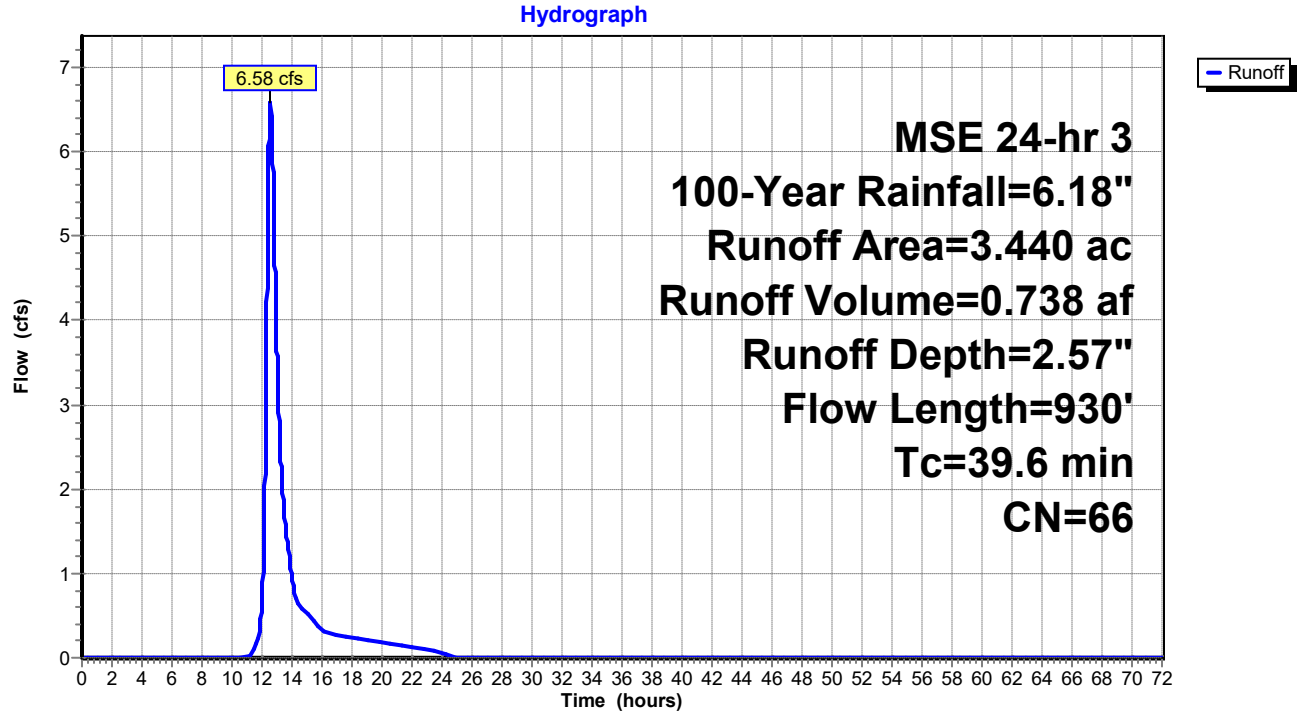
Runoff = 6.58 cfs @ 12.58 hrs, Volume= 0.738 af, Depth= 2.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=6.18"

	Area (ac)	CN	Description
*	1.720	77	Soil D Woodland
*	1.720	55	Soil B Woodland
	3.440	66	Weighted Average
	3.440		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
30.3	300	0.0933	0.17		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.72"
1.4	150	0.1200	1.73		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.9	300	0.0330	1.27		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
4.0	180	0.0222	0.74		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
39.6	930	Total			

Subcatchment 2S: EX Planting Site

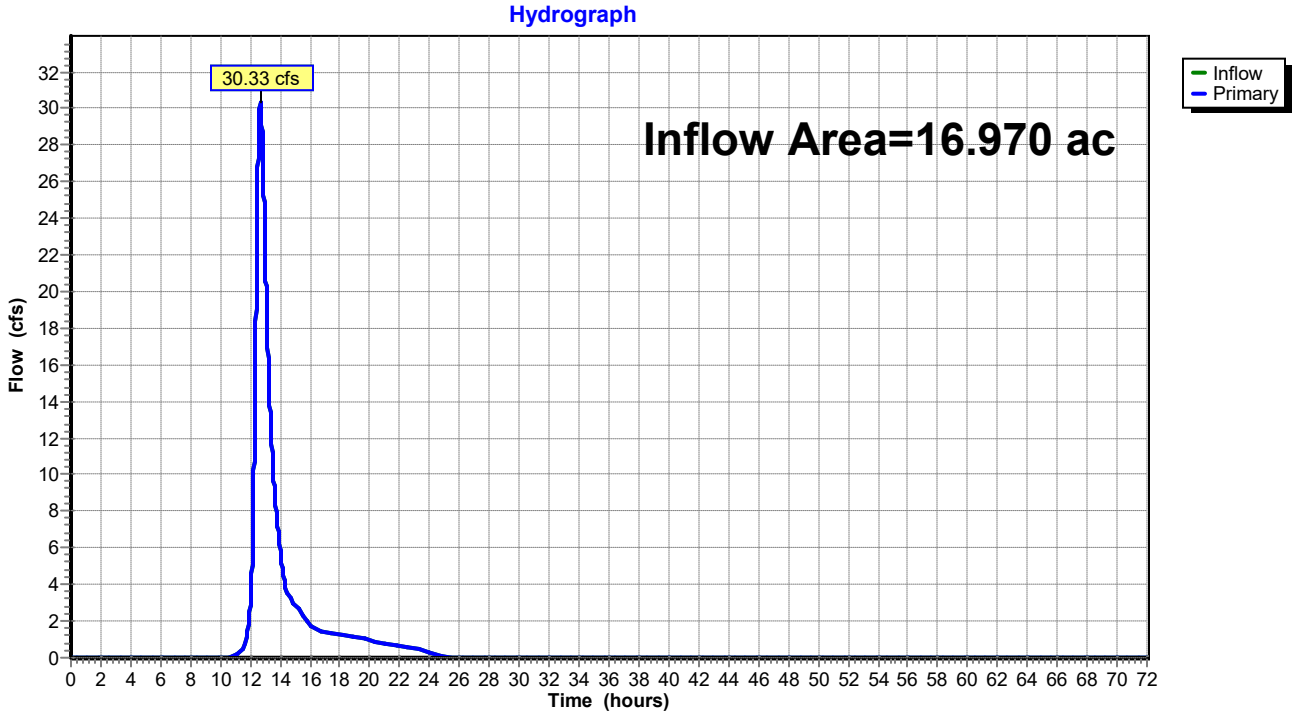


Summary for Link 3L: EXISTING

Inflow Area = 16.970 ac, 0.00% Impervious, Inflow Depth = 2.72" for 100-Year event
Inflow = 30.33 cfs @ 12.69 hrs, Volume= 3.850 af
Primary = 30.33 cfs @ 12.69 hrs, Volume= 3.850 af, Atten= 0%, Lag= 0.0 min

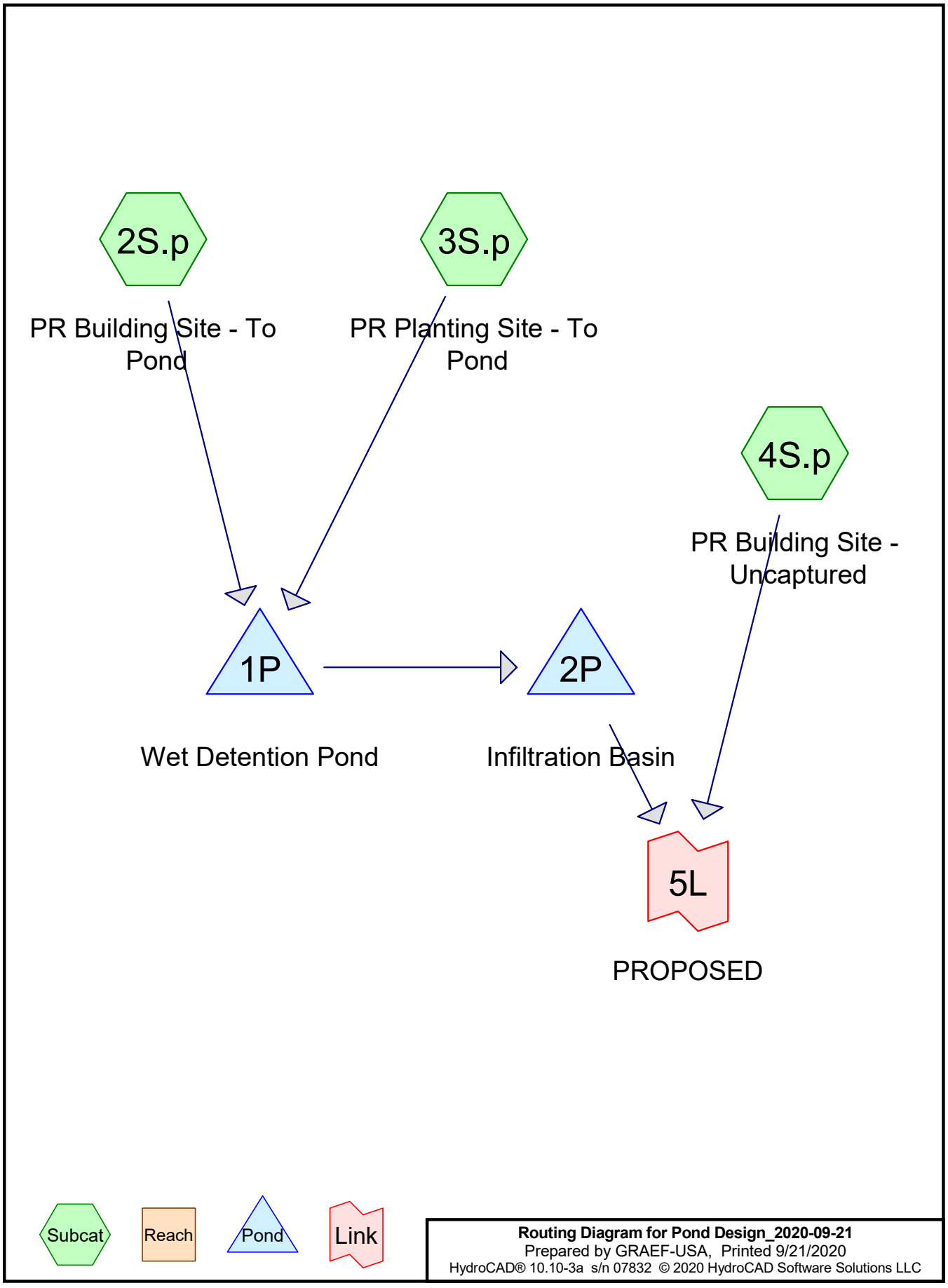
Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 3L: EXISTING



Appendix D – Proposed Conditions

HydroCAD Modeling



Routing Diagram for Pond Design_2020-09-21
Prepared by GRAEF-USA, Printed 9/21/2020

Summary for Subcatchment 2S.p: PR Building Site - To Pond

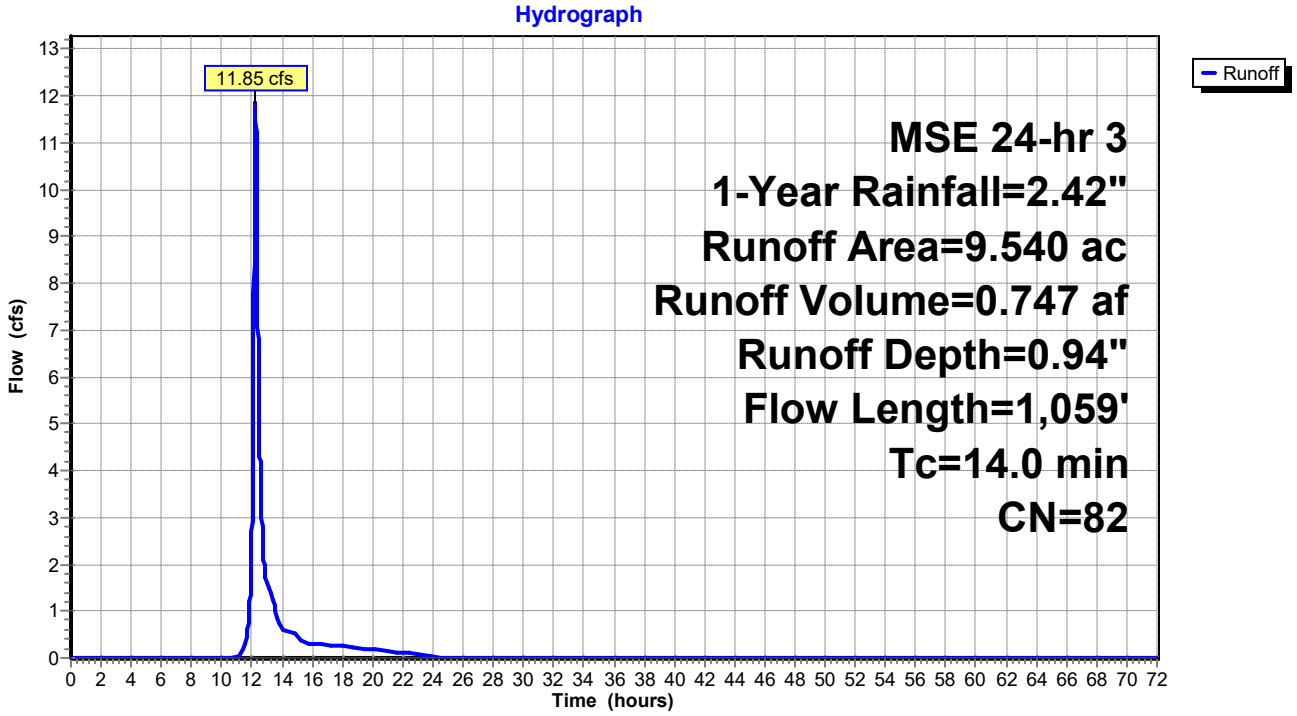
Runoff = 11.85 cfs @ 12.23 hrs, Volume= 0.747 af, Depth= 0.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 1-Year Rainfall=2.42"

	Area (ac)	CN	Description
*	1.660	98	Roofs
*	1.660	98	Paved parking
	2.236	80	>75% Grass cover, Good, HSG D
	1.118	74	>75% Grass cover, Good, HSG C
	2.236	61	>75% Grass cover, Good, HSG B
*	0.630	98	Water Surface, 0% imp
	9.540	82	Weighted Average
	6.220		65.20% Pervious Area
	3.320		34.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0	150	0.0333	0.21		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.72"
1.4	325	0.0654	3.84		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.3	264	0.0400	15.46	27.31	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.010 Concrete pipe, straight & clean
0.3	320	0.0300	16.21	50.94	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.010 Concrete pipe, straight & clean
14.0	1,059	Total			

Subcatchment 2S.p: PR Building Site - To Pond



Summary for Subcatchment 3S.p: PR Planting Site - To Pond

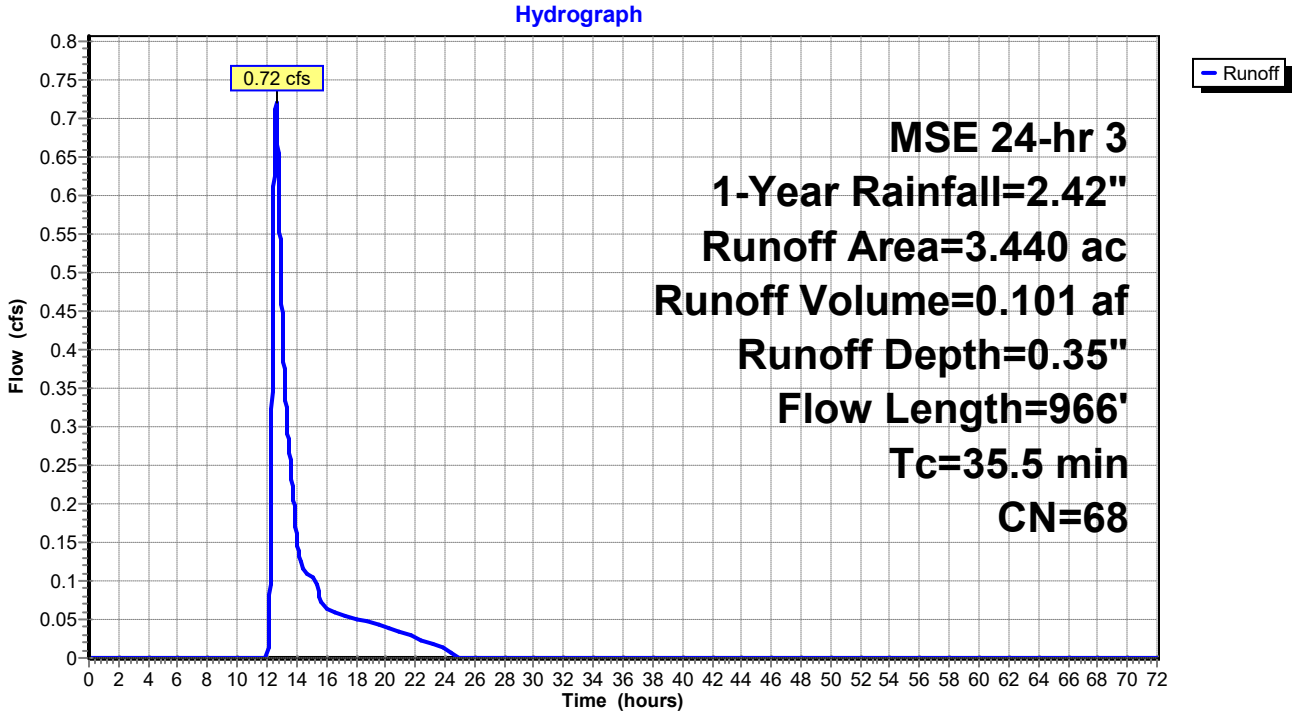
Runoff = 0.72 cfs @ 12.62 hrs, Volume= 0.101 af, Depth= 0.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 1-Year Rainfall=2.42"

Area (ac)	CN	Description
1.720	78	Meadow, non-grazed, HSG D
1.720	58	Meadow, non-grazed, HSG B
3.440	68	Weighted Average
3.440		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
30.3	300	0.0933	0.17		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.72"
1.4	150	0.1200	1.73		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.2	126	0.0400	13.69	16.80	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.010 Concrete pipe, straight & clean
1.8	150	0.0400	1.37	1.68	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.100
1.2	150	0.0400	2.17	10.66	**Pipe Channel,** 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.100
0.6	90	0.0400	2.45	17.34	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.100
35.5	966	Total			

Subcatchment 3S.p: PR Planting Site - To Pond



Summary for Subcatchment 4S.p: PR Building Site - Uncaptured

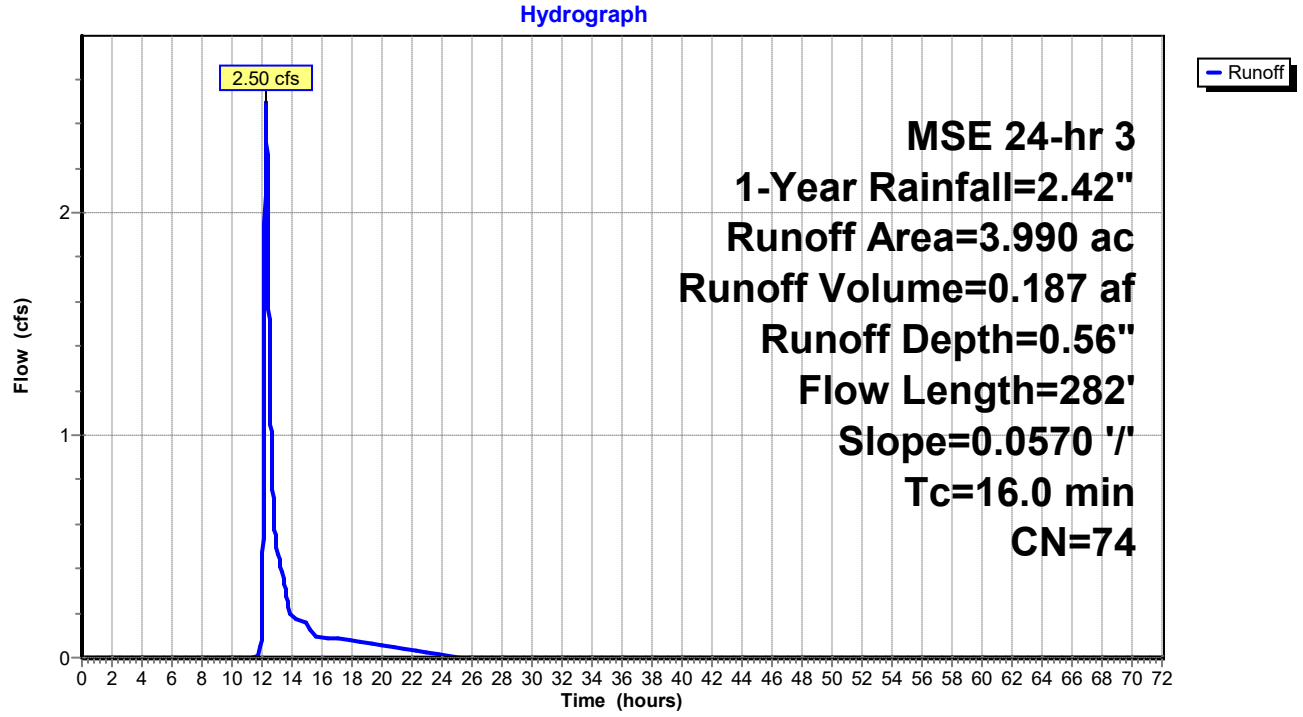
Runoff = 2.50 cfs @ 12.28 hrs, Volume= 0.187 af, Depth= 0.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 1-Year Rainfall=2.42"

	Area (ac)	CN	Description
*	0.200	98	Paved parking
	1.896	80	>75% Grass cover, Good, HSG D
	1.263	61	>75% Grass cover, Good, HSG B
	0.631	74	>75% Grass cover, Good, HSG C
	3.990	74	Weighted Average
	3.790		94.99% Pervious Area
	0.200		5.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.0	282	0.0570	0.29		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.72"

Subcatchment 4S.p: PR Building Site - Uncaptured



Summary for Pond 1P: Wet Detention Pond

Inflow Area = 12.980 ac, 25.58% Impervious, Inflow Depth = 0.78" for 1-Year event
Inflow = 11.97 cfs @ 12.23 hrs, Volume= 0.848 af
Outflow = 1.40 cfs @ 12.85 hrs, Volume= 0.801 af, Atten= 88%, Lag= 36.9 min
Primary = 1.40 cfs @ 12.85 hrs, Volume= 0.801 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3
Starting Elev= 874.00' Surf.Area= 29,464 sf Storage= 127,044 cf
Peak Elev= 874.71' @ 15.10 hrs Surf.Area= 30,844 sf Storage= 148,507 cf (21,463 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= 491.9 min (1,327.2 - 835.4)

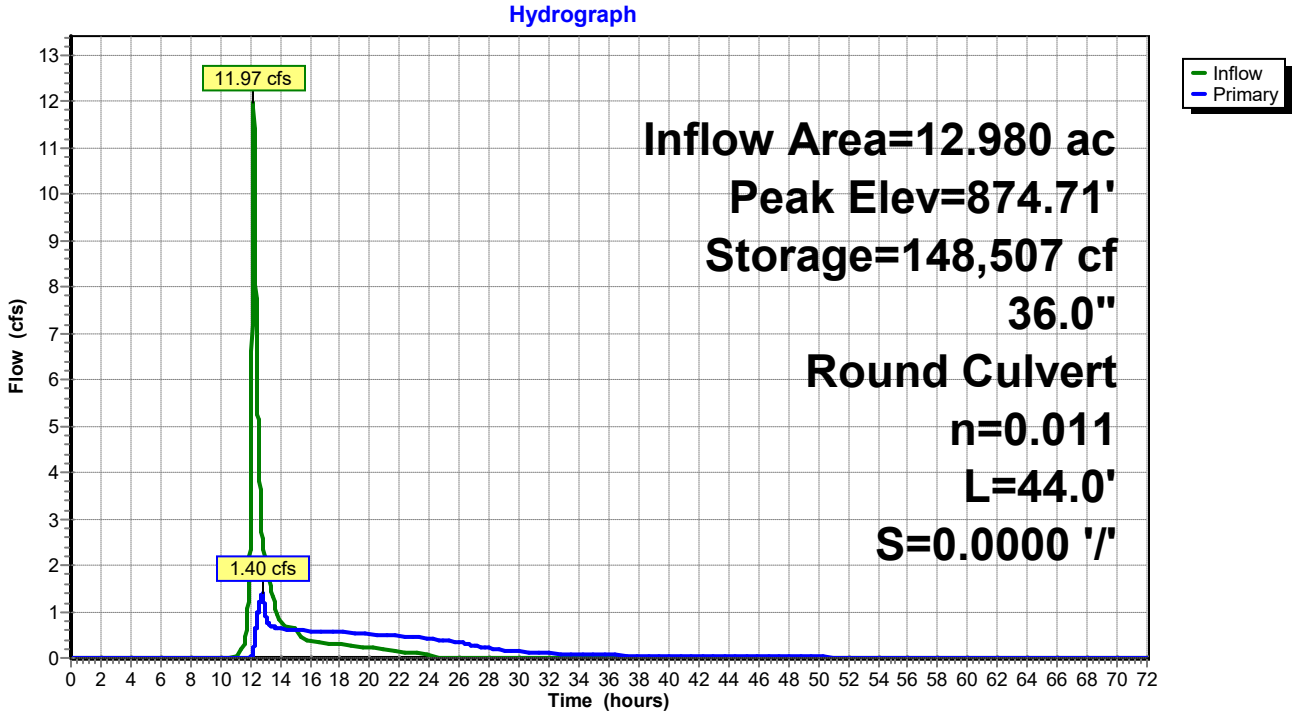
Volume	Invert	Avail.Storage	Storage Description
#1	868.00'	357,260 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
868.00	15,446	0	0	15,446
869.00	16,921	16,178	16,178	16,988
870.00	18,453	17,681	33,859	18,591
871.00	20,041	19,242	53,101	20,254
872.00	21,685	20,858	73,959	21,975
873.00	27,575	24,571	98,530	27,892
874.00	29,464	28,514	127,044	29,873
875.00	31,411	30,432	157,476	31,916
876.00	33,413	32,407	189,883	34,017
877.00	35,472	34,437	224,320	36,179
878.00	37,588	36,525	260,845	38,401
879.00	50,492	43,882	304,727	51,326
880.00	54,601	52,533	357,260	55,514

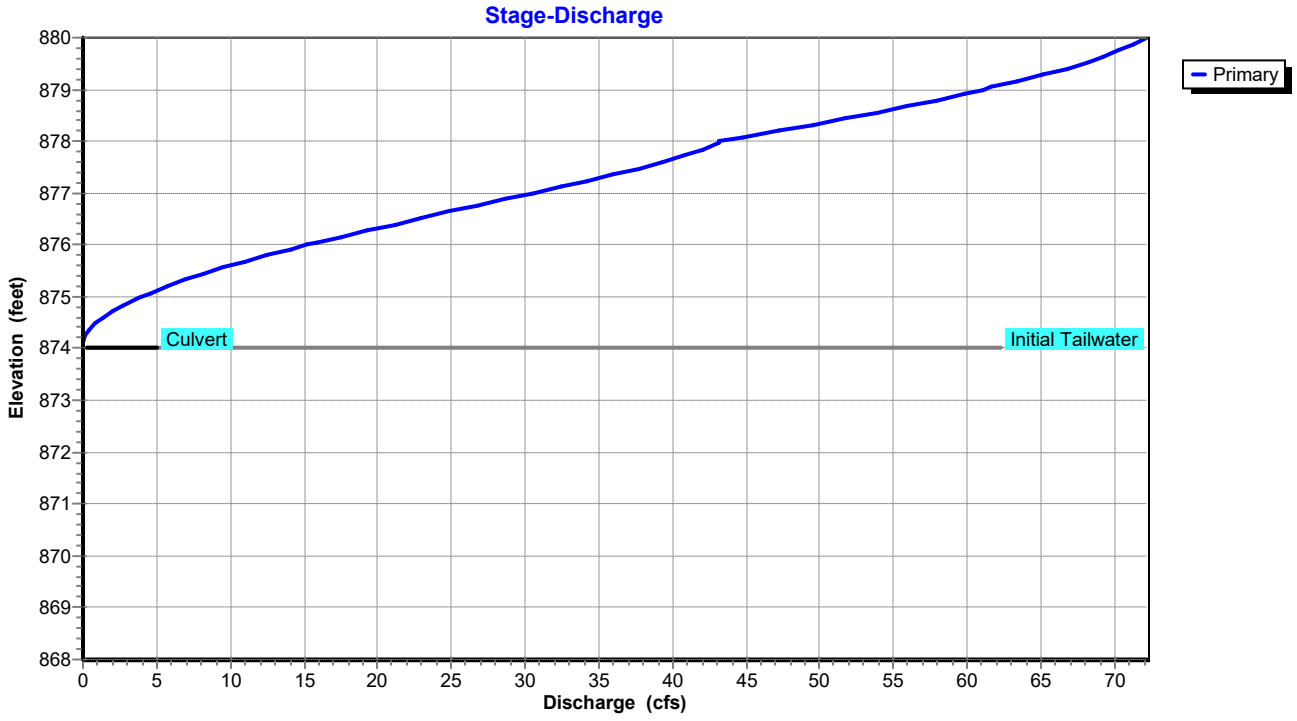
Device	Routing	Invert	Outlet Devices
#1	Primary	874.00'	**36.0" Round Culvert** L= 44.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 874.00' / 874.00' S= 0.0000 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 7.07 sf

Primary OutFlow Max=1.40 cfs @ 12.85 hrs HW=874.61' TW=874.45' (Dynamic Tailwater)
↑**1=Culvert** (Barrel Controls 1.40 cfs @ 2.05 fps)

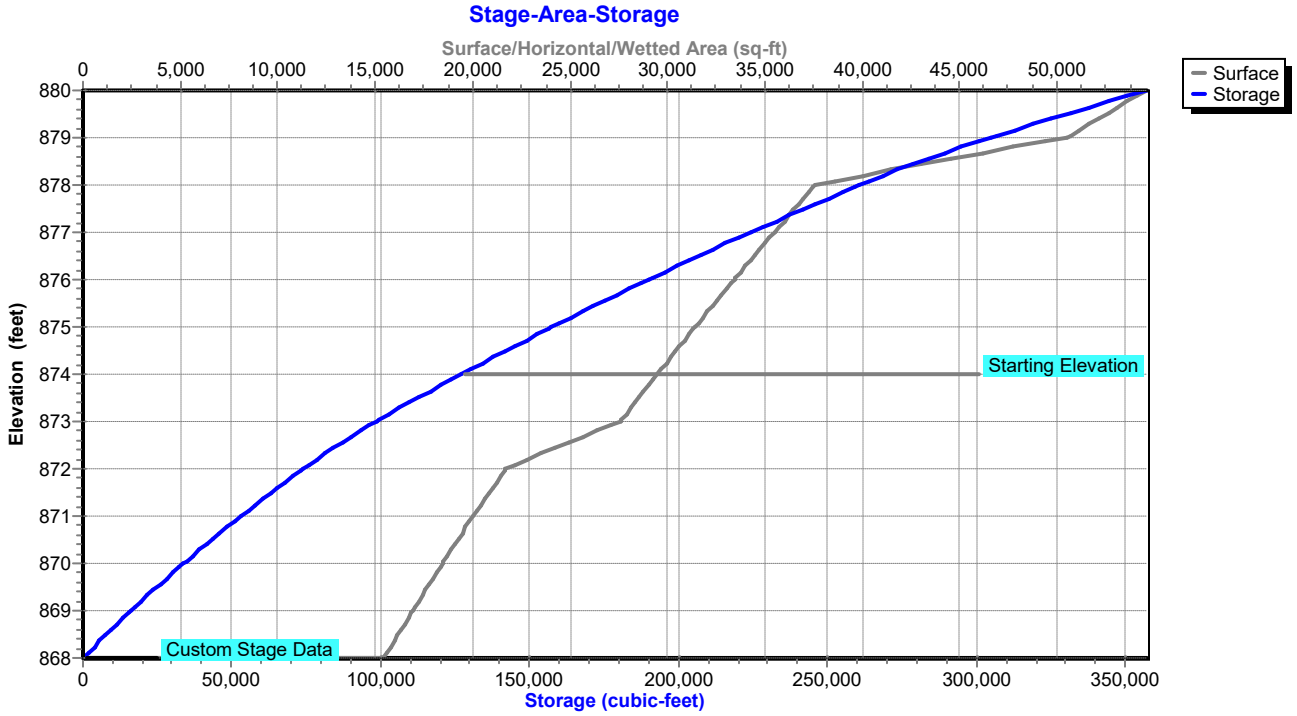
Pond 1P: Wet Detention Pond



Pond 1P: Wet Detention Pond



Pond 1P: Wet Detention Pond



Summary for Pond 2P: Infiltration Basin

Inflow Area = 12.980 ac, 25.58% Impervious, Inflow Depth > 0.74" for 1-Year event
Inflow = 1.40 cfs @ 12.85 hrs, Volume= 0.801 af
Outflow = 0.61 cfs @ 15.13 hrs, Volume= 0.801 af, Atten= 56%, Lag= 137.0 min
Discarded = 0.31 cfs @ 15.13 hrs, Volume= 0.513 af
Primary = 0.31 cfs @ 15.13 hrs, Volume= 0.288 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 874.69' @ 15.13 hrs Surf.Area= 3,238 sf Storage= 2,140 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 39.7 min (1,366.9 - 1,327.2)

Volume	Invert	Avail.Storage	Storage Description
#1	874.00'	15,470 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
874.00	2,927	0	0
875.00	3,375	3,151	3,151
876.00	3,849	3,612	6,763
877.00	4,347	4,098	10,861
878.00	4,871	4,609	15,470

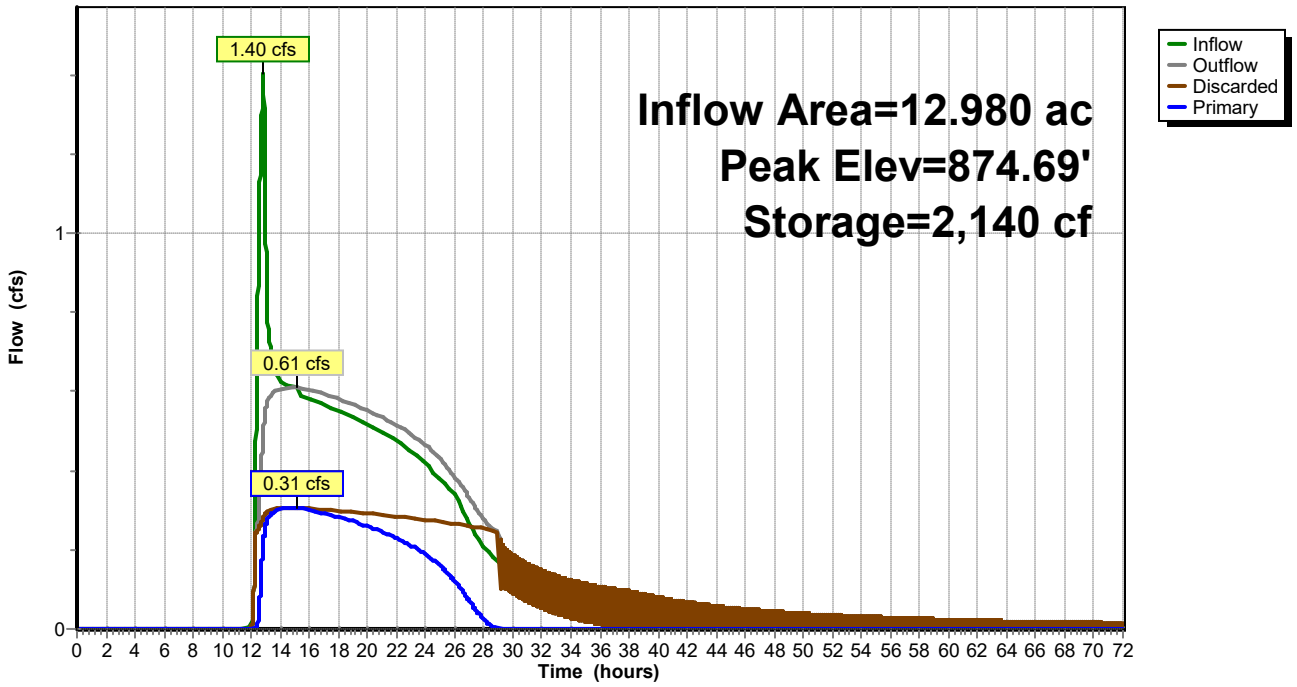
Device	Routing	Invert	Outlet Devices
#1	Discarded	874.00'	**3.600 in/hr Infiltration over Surface area** Conductivity to Groundwater Elevation = 869.00'
#2	Primary	874.00'	**24.0" Round Culvert** L= 23.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 874.00' / 873.95' S= 0.0022 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 3.14 sf
#3	Device 2	874.00'	**4.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#4	Device 2	876.00'	**4.0' long x 4.00' rise Sharp-Crested Weir** Cv= 2.62 (C= 3.28)

Discarded OutFlow Max=0.31 cfs @ 15.13 hrs HW=874.69' (Free Discharge)
└**1=Infiltration** (Controls 0.31 cfs)

Primary OutFlow Max=0.31 cfs @ 15.13 hrs HW=874.69' TW=0.00' (Dynamic Tailwater)
└**2=Culvert** (Passes 0.31 cfs of 1.76 cfs potential flow)
  ├**3=Orifice** (Orifice Controls 0.31 cfs @ 3.50 fps)
  └**4=Sharp-Crested Weir** (Controls 0.00 cfs)

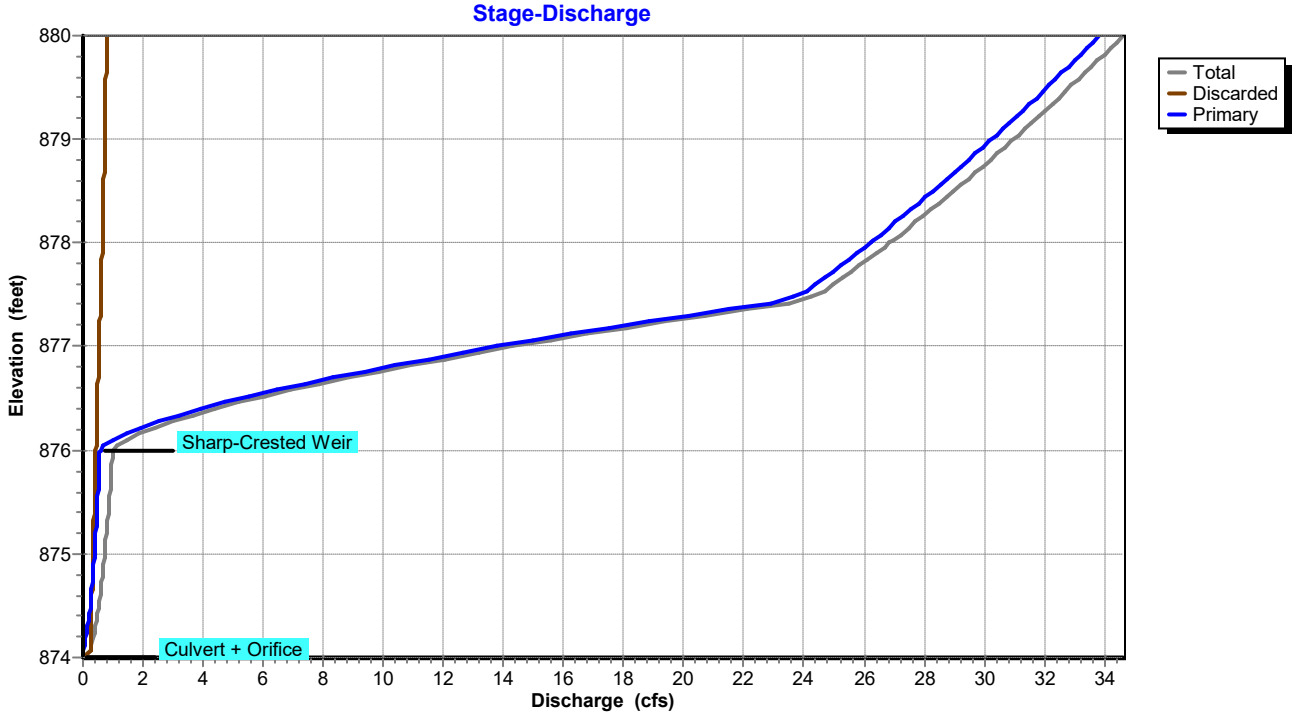
Pond 2P: Infiltration Basin

Hydrograph

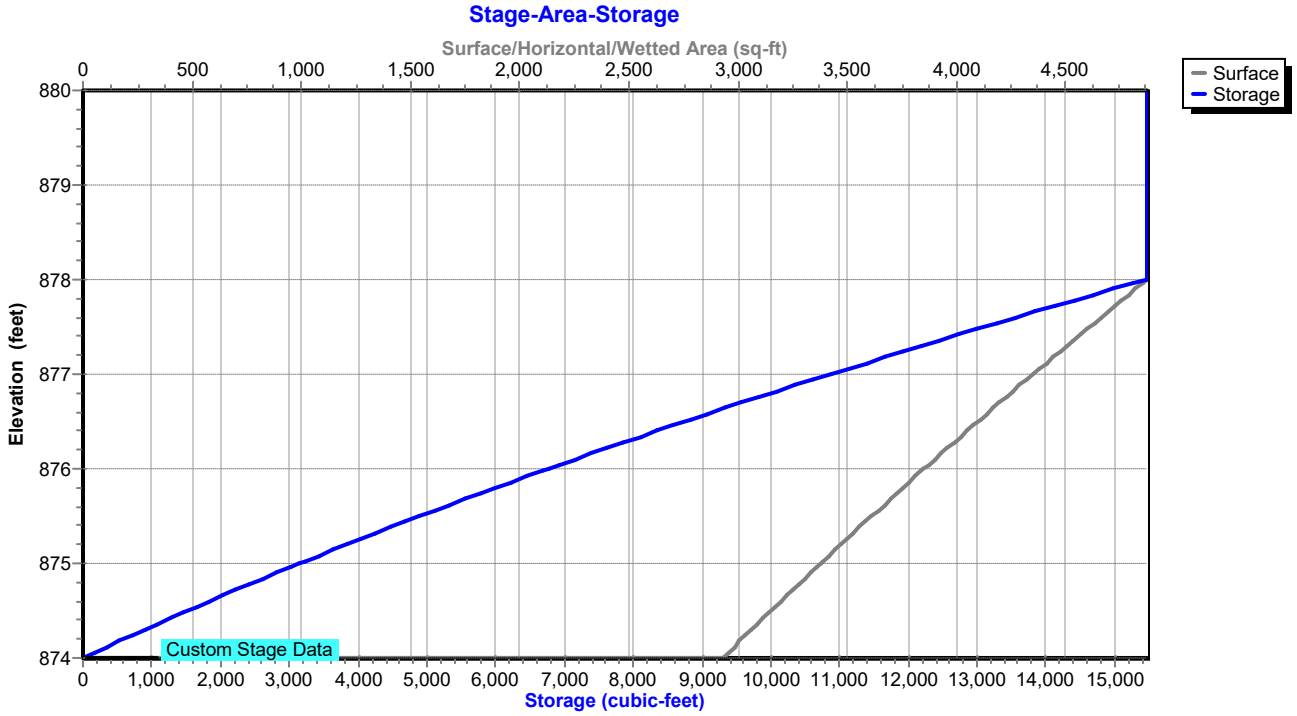


Pond 2P: Infiltration Basin

Stage-Discharge



Pond 2P: Infiltration Basin

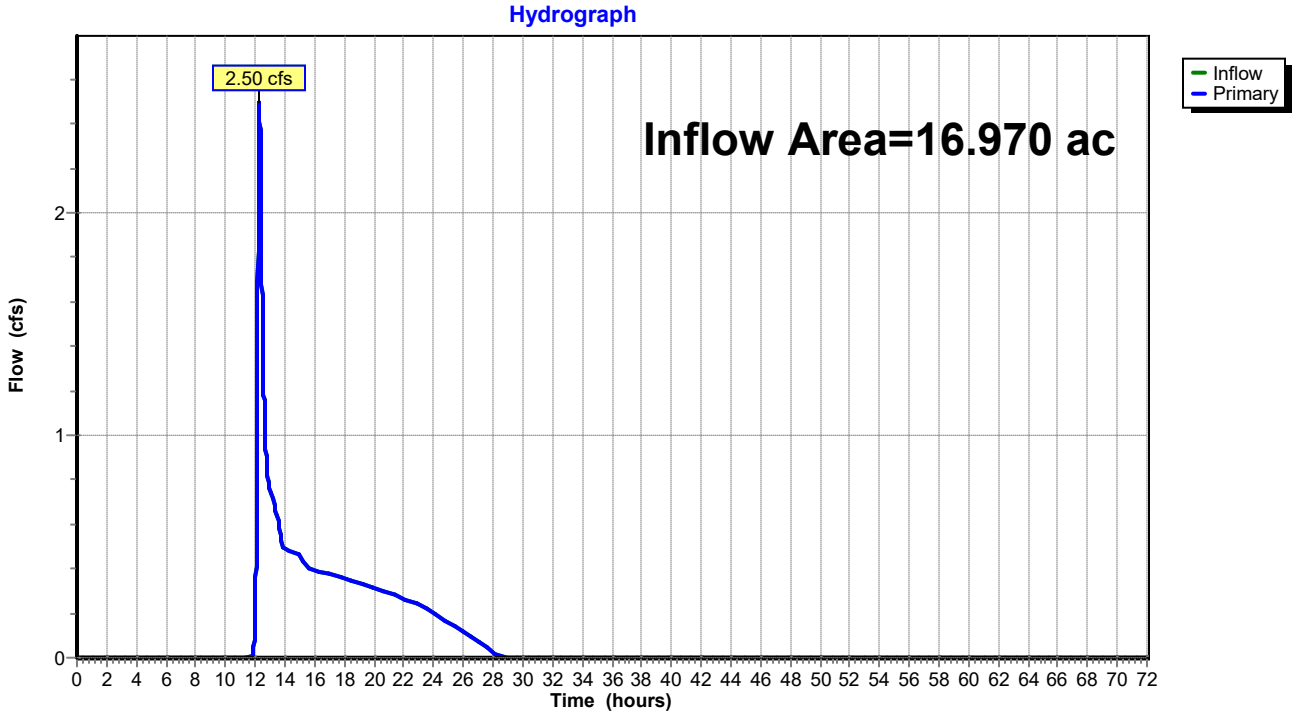


Summary for Link 5L: PROPOSED

Inflow Area = 16.970 ac, 20.74% Impervious, Inflow Depth = 0.34" for 1-Year event
Inflow = 2.50 cfs @ 12.28 hrs, Volume= 0.476 af
Primary = 2.50 cfs @ 12.28 hrs, Volume= 0.476 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 5L: PROPOSED



Summary for Subcatchment 2S.p: PR Building Site - To Pond

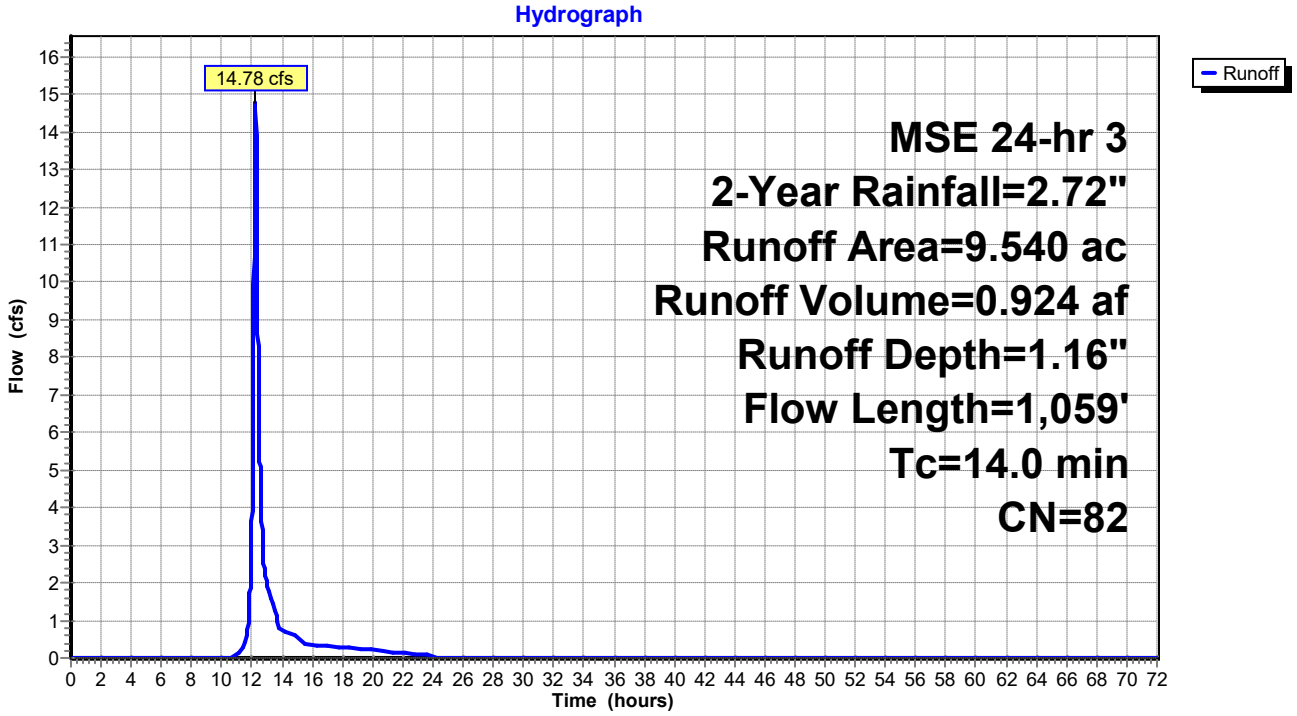
Runoff = 14.78 cfs @ 12.23 hrs, Volume= 0.924 af, Depth= 1.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.72"

	Area (ac)	CN	Description
*	1.660	98	Roofs
*	1.660	98	Paved parking
	2.236	80	>75% Grass cover, Good, HSG D
	1.118	74	>75% Grass cover, Good, HSG C
	2.236	61	>75% Grass cover, Good, HSG B
*	0.630	98	Water Surface, 0% imp
	9.540	82	Weighted Average
	6.220		65.20% Pervious Area
	3.320		34.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0	150	0.0333	0.21		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.72"
1.4	325	0.0654	3.84		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.3	264	0.0400	15.46	27.31	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.010 Concrete pipe, straight & clean
0.3	320	0.0300	16.21	50.94	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.010 Concrete pipe, straight & clean
14.0	1,059	Total			

Subcatchment 2S.p: PR Building Site - To Pond



Summary for Subcatchment 3S.p: PR Planting Site - To Pond

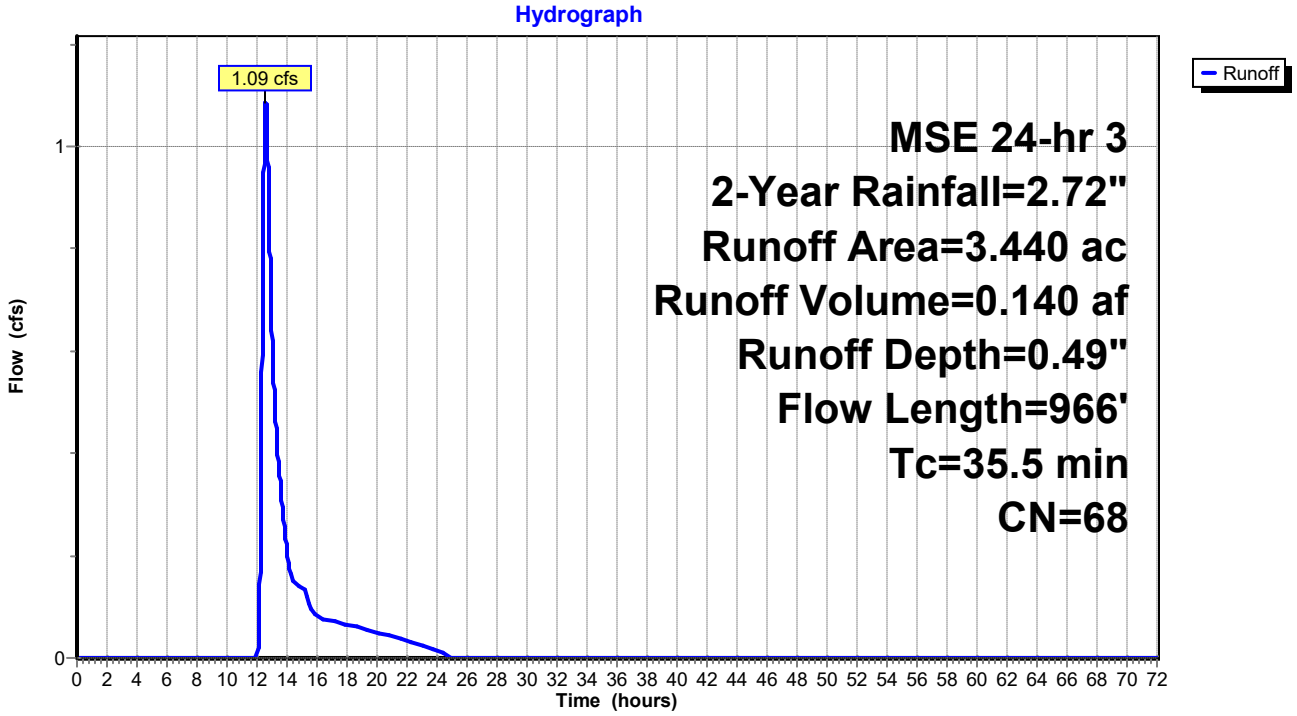
Runoff = 1.09 cfs @ 12.59 hrs, Volume= 0.140 af, Depth= 0.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.72"

Area (ac)	CN	Description
1.720	78	Meadow, non-grazed, HSG D
1.720	58	Meadow, non-grazed, HSG B
3.440	68	Weighted Average
3.440		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
30.3	300	0.0933	0.17		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.72"
1.4	150	0.1200	1.73		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.2	126	0.0400	13.69	16.80	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.010 Concrete pipe, straight & clean
1.8	150	0.0400	1.37	1.68	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.100
1.2	150	0.0400	2.17	10.66	**Pipe Channel,** 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.100
0.6	90	0.0400	2.45	17.34	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.100
35.5	966	Total			

Subcatchment 3S.p: PR Planting Site - To Pond



Summary for Subcatchment 4S.p: PR Building Site - Uncaptured

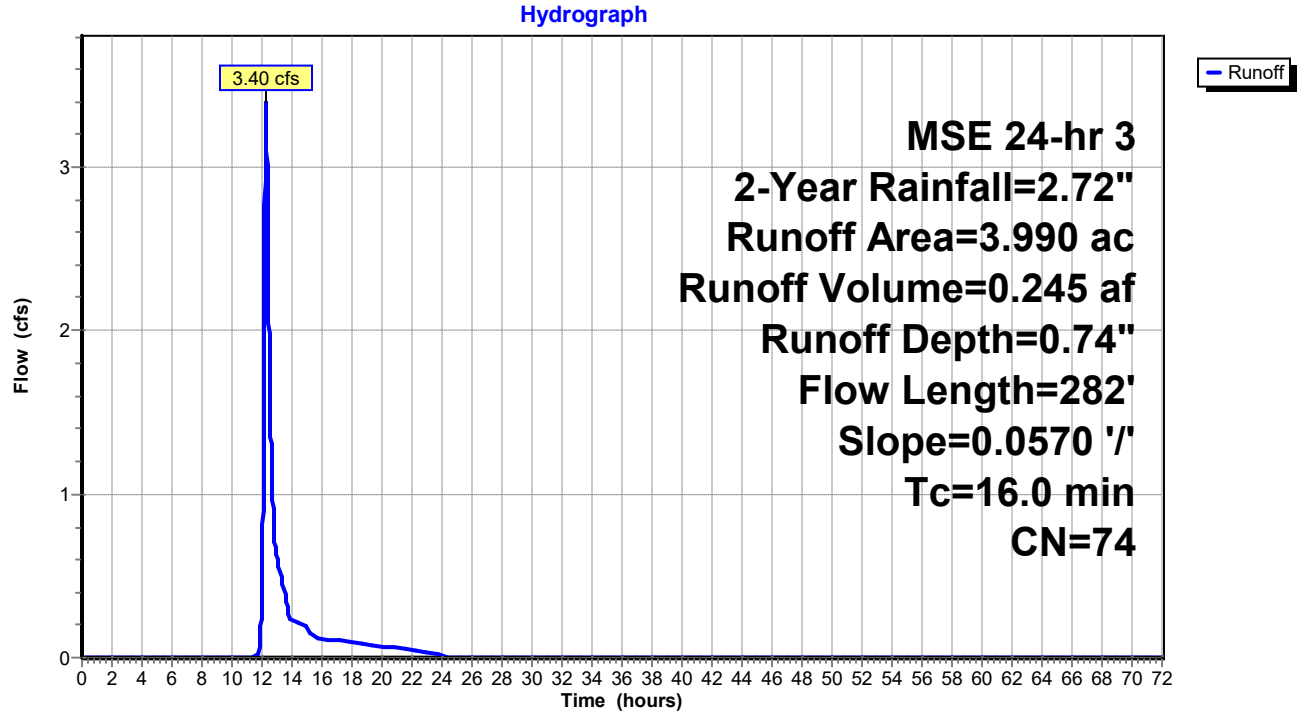
Runoff = 3.40 cfs @ 12.27 hrs, Volume= 0.245 af, Depth= 0.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.72"

	Area (ac)	CN	Description
*	0.200	98	Paved parking
	1.896	80	>75% Grass cover, Good, HSG D
	1.263	61	>75% Grass cover, Good, HSG B
	0.631	74	>75% Grass cover, Good, HSG C
	3.990	74	Weighted Average
	3.790		94.99% Pervious Area
	0.200		5.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.0	282	0.0570	0.29		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.72"

Subcatchment 4S.p: PR Building Site - Uncaptured



Summary for Pond 1P: Wet Detention Pond

Inflow Area = 12.980 ac, 25.58% Impervious, Inflow Depth = 0.98" for 2-Year event
Inflow = 15.01 cfs @ 12.23 hrs, Volume= 1.064 af
Outflow = 2.04 cfs @ 12.68 hrs, Volume= 1.015 af, Atten= 86%, Lag= 26.9 min
Primary = 2.04 cfs @ 12.68 hrs, Volume= 1.015 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3
Starting Elev= 874.00' Surf.Area= 29,464 sf Storage= 127,044 cf
Peak Elev= 874.91' @ 15.15 hrs Surf.Area= 31,243 sf Storage= 154,812 cf (27,768 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= 532.1 min (1,362.9 - 830.9)

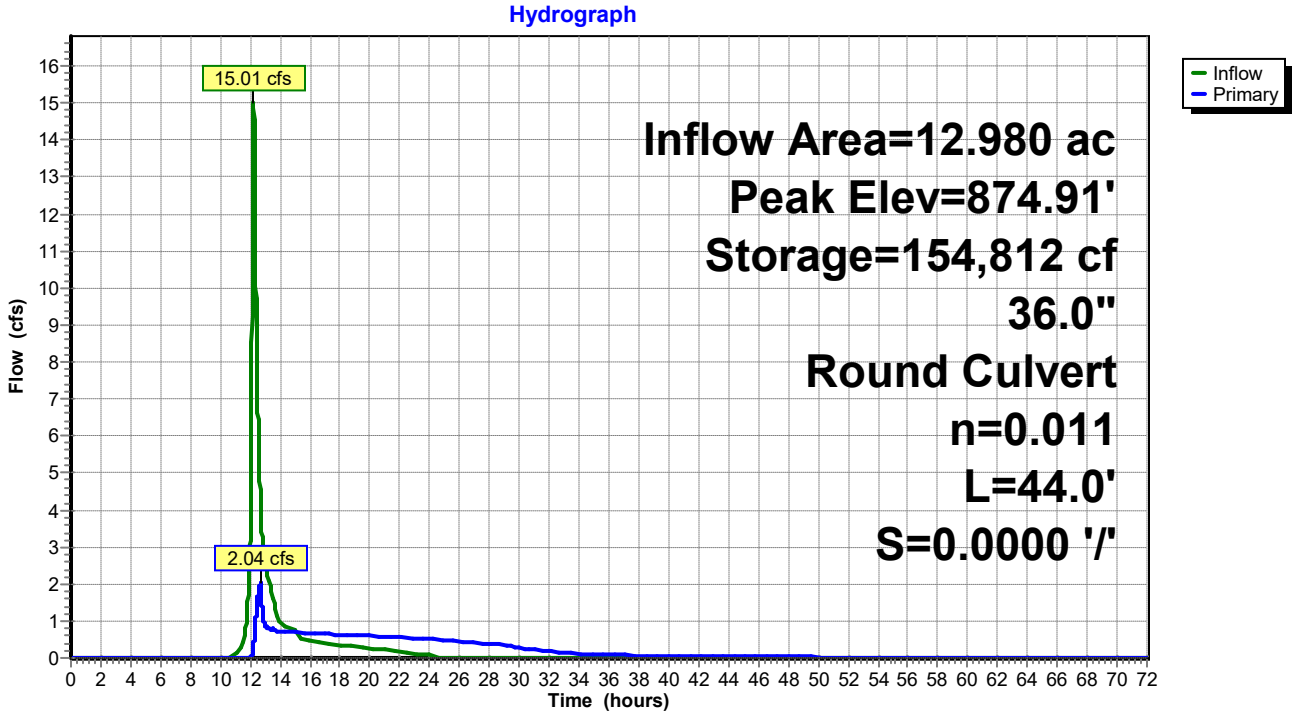
Volume	Invert	Avail.Storage	Storage Description
#1	868.00'	357,260 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
868.00	15,446	0	0	15,446
869.00	16,921	16,178	16,178	16,988
870.00	18,453	17,681	33,859	18,591
871.00	20,041	19,242	53,101	20,254
872.00	21,685	20,858	73,959	21,975
873.00	27,575	24,571	98,530	27,892
874.00	29,464	28,514	127,044	29,873
875.00	31,411	30,432	157,476	31,916
876.00	33,413	32,407	189,883	34,017
877.00	35,472	34,437	224,320	36,179
878.00	37,588	36,525	260,845	38,401
879.00	50,492	43,882	304,727	51,326
880.00	54,601	52,533	357,260	55,514

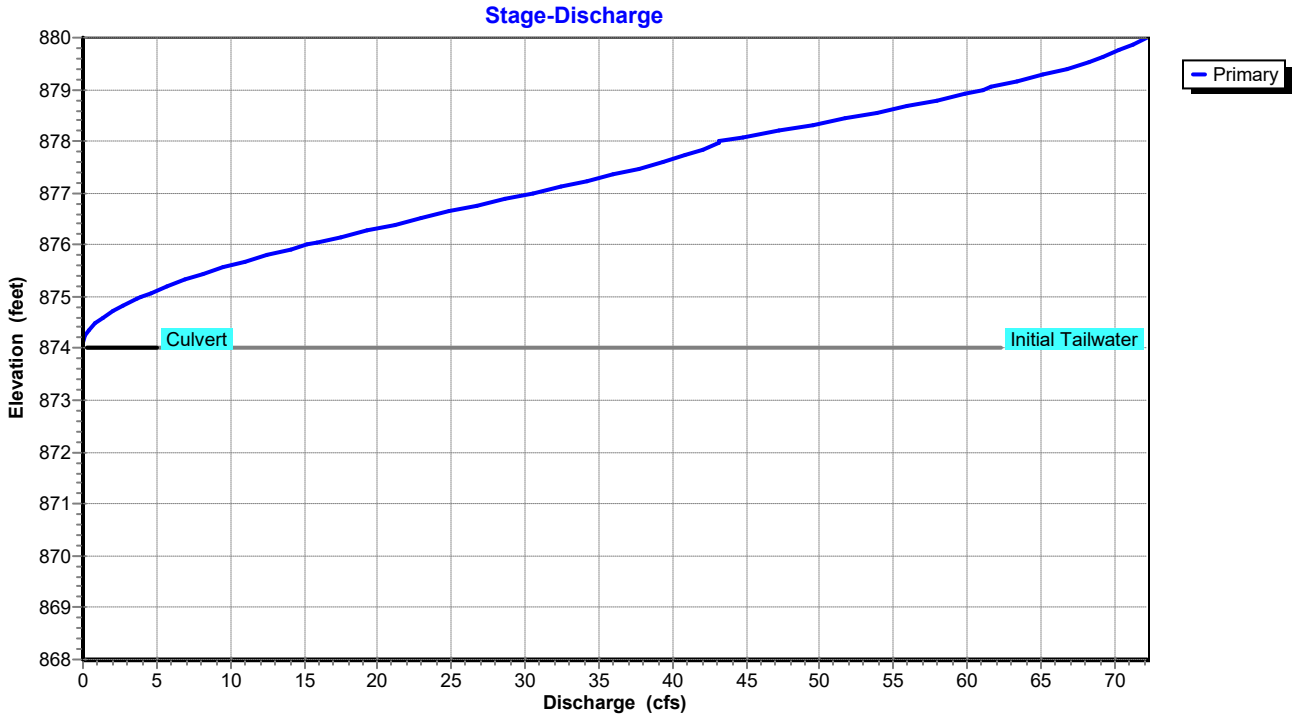
Device	Routing	Invert	Outlet Devices
#1	Primary	874.00'	**36.0" Round Culvert** L= 44.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 874.00' / 874.00' S= 0.0000 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 7.07 sf

Primary OutFlow Max=2.03 cfs @ 12.68 hrs HW=874.73' TW=874.54' (Dynamic Tailwater)
↑**1=Culvert** (Barrel Controls 2.03 cfs @ 2.32 fps)

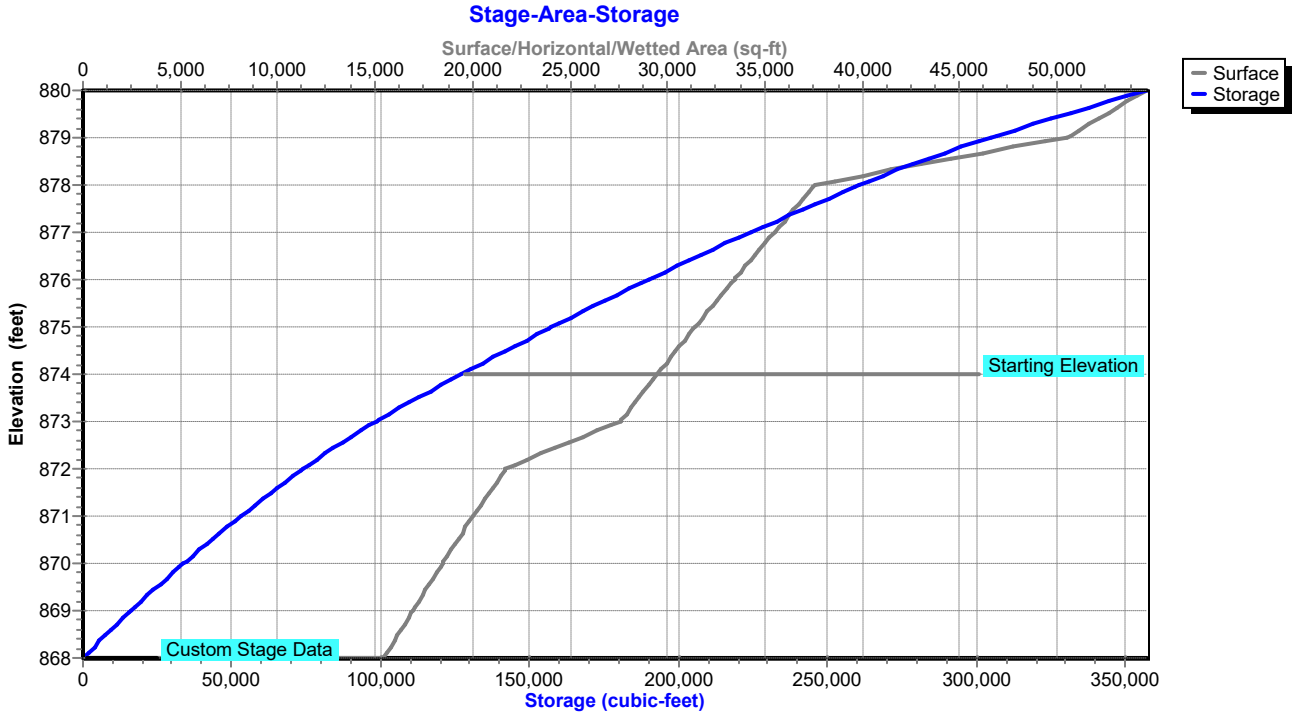
Pond 1P: Wet Detention Pond



Pond 1P: Wet Detention Pond



Pond 1P: Wet Detention Pond



Summary for Pond 2P: Infiltration Basin

Inflow Area = 12.980 ac, 25.58% Impervious, Inflow Depth > 0.94" for 2-Year event
Inflow = 2.04 cfs @ 12.68 hrs, Volume= 1.015 af
Outflow = 0.69 cfs @ 15.17 hrs, Volume= 1.015 af, Atten= 66%, Lag= 149.7 min
Discarded = 0.32 cfs @ 15.17 hrs, Volume= 0.605 af
Primary = 0.36 cfs @ 15.17 hrs, Volume= 0.410 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 874.91' @ 15.17 hrs Surf.Area= 3,332 sf Storage= 2,832 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 48.1 min (1,411.0 - 1,362.9)

Volume	Invert	Avail.Storage	Storage Description
#1	874.00'	15,470 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
874.00	2,927	0	0
875.00	3,375	3,151	3,151
876.00	3,849	3,612	6,763
877.00	4,347	4,098	10,861
878.00	4,871	4,609	15,470

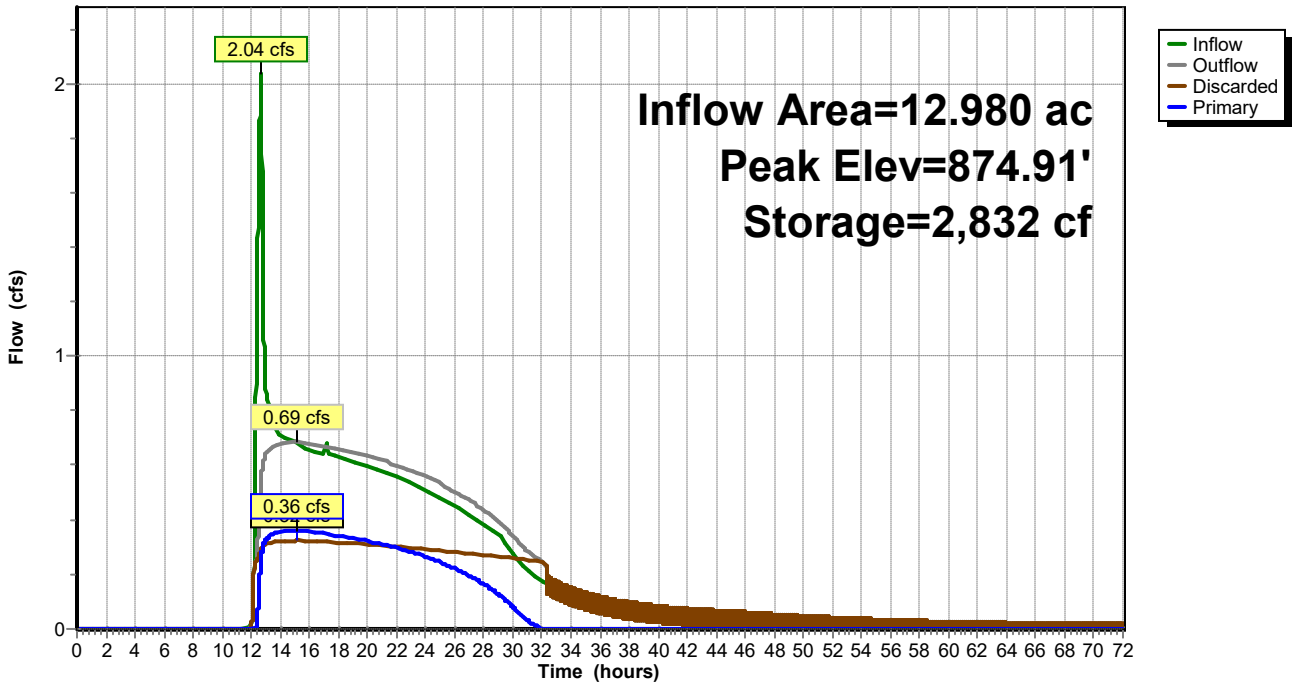
Device	Routing	Invert	Outlet Devices
#1	Discarded	874.00'	**3.600 in/hr Infiltration over Surface area** Conductivity to Groundwater Elevation = 869.00'
#2	Primary	874.00'	**24.0" Round Culvert** L= 23.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 874.00' / 873.95' S= 0.0022 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 3.14 sf
#3	Device 2	874.00'	**4.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#4	Device 2	876.00'	**4.0' long x 4.00' rise Sharp-Crested Weir** Cv= 2.62 (C= 3.28)

Discarded OutFlow Max=0.32 cfs @ 15.17 hrs HW=874.91' (Free Discharge)
└**1=Infiltration** (Controls 0.32 cfs)

Primary OutFlow Max=0.36 cfs @ 15.17 hrs HW=874.91' TW=0.00' (Dynamic Tailwater)
└**2=Culvert** (Passes 0.36 cfs of 2.91 cfs potential flow)
  ├**3=Orifice** (Orifice Controls 0.36 cfs @ 4.14 fps)
  └**4=Sharp-Crested Weir** (Controls 0.00 cfs)

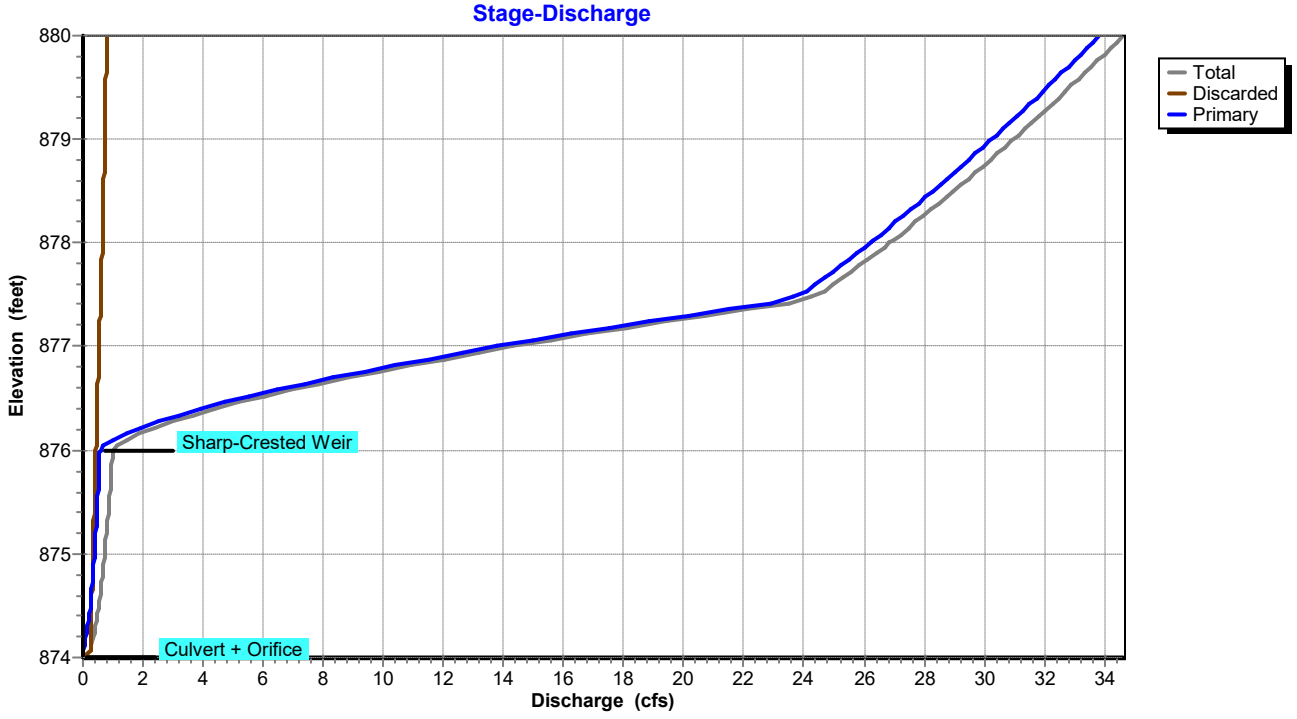
Pond 2P: Infiltration Basin

Hydrograph

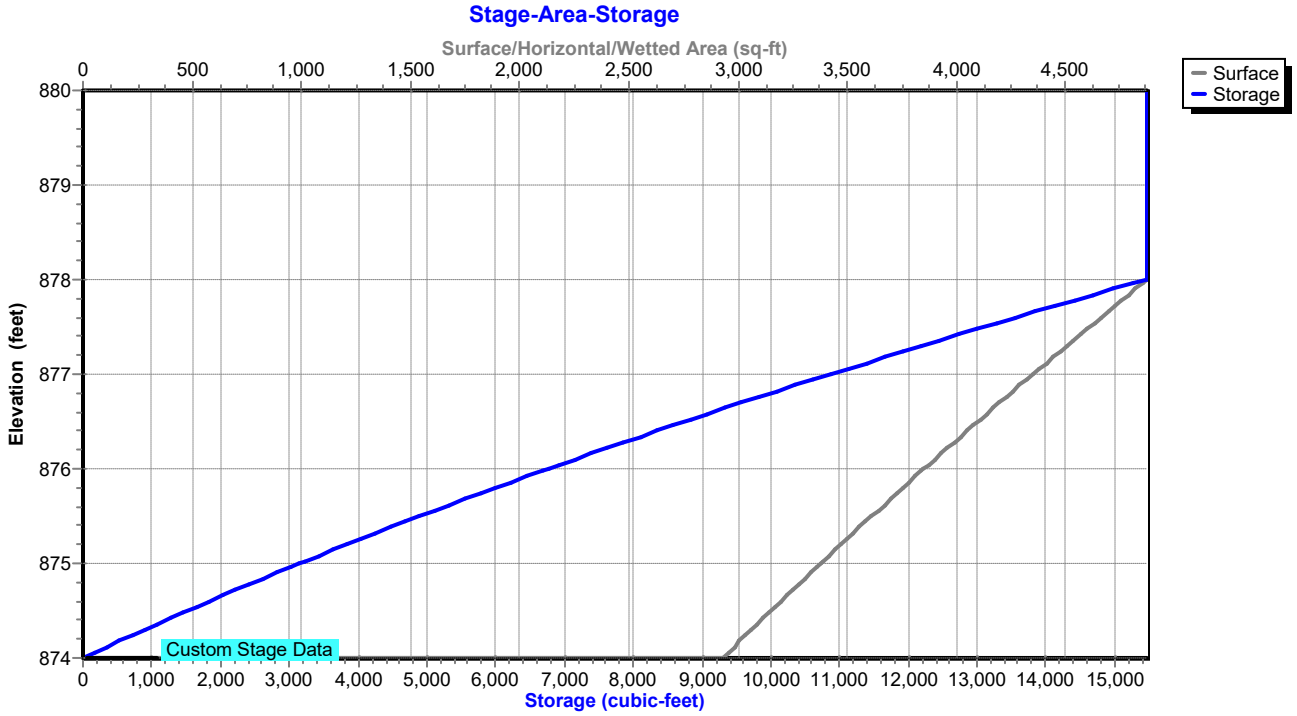


Pond 2P: Infiltration Basin

Stage-Discharge



Pond 2P: Infiltration Basin

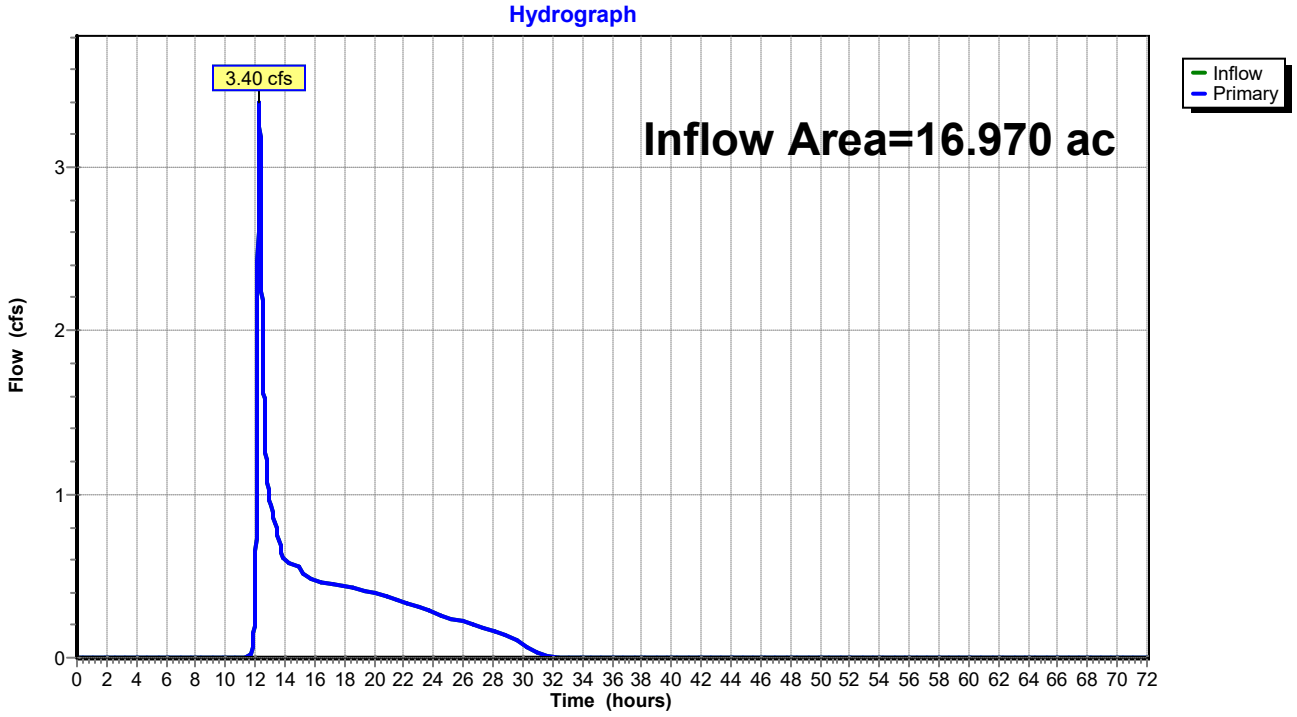


Summary for Link 5L: PROPOSED

Inflow Area = 16.970 ac, 20.74% Impervious, Inflow Depth = 0.46" for 2-Year event
Inflow = 3.40 cfs @ 12.27 hrs, Volume= 0.655 af
Primary = 3.40 cfs @ 12.27 hrs, Volume= 0.655 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 5L: PROPOSED



Summary for Subcatchment 2S.p: PR Building Site - To Pond

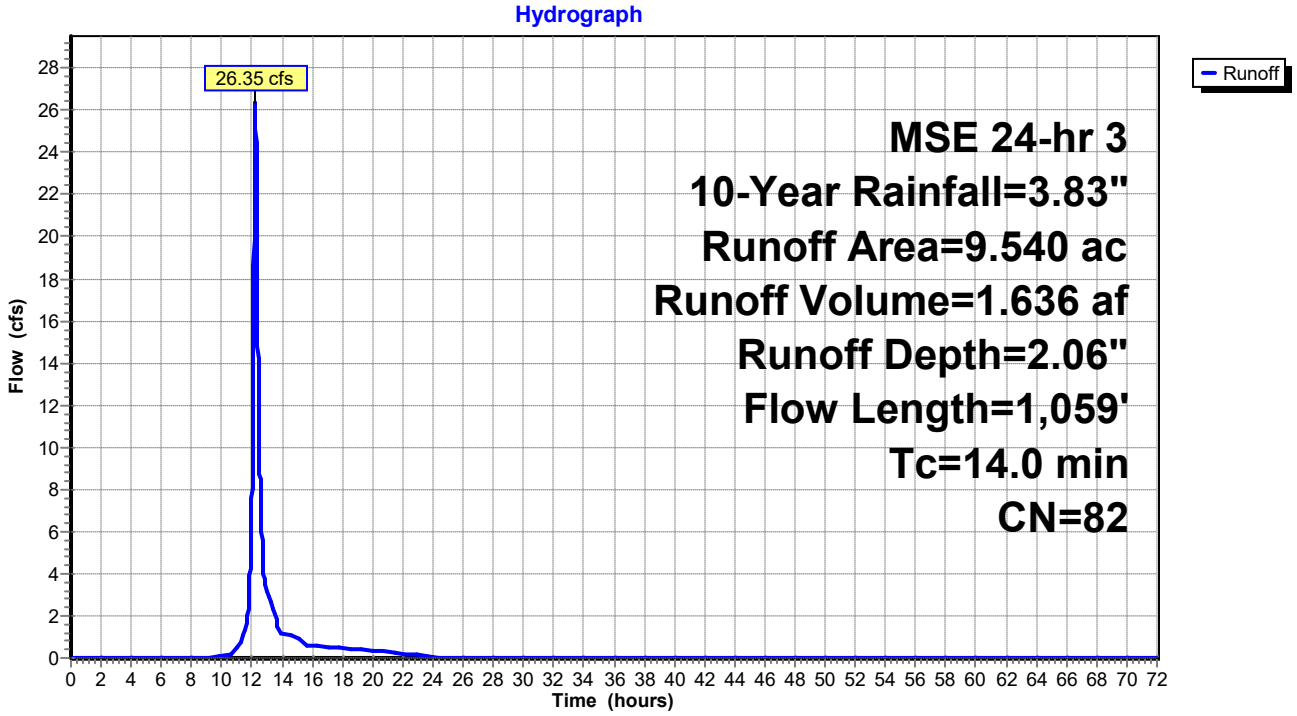
Runoff = 26.35 cfs @ 12.22 hrs, Volume= 1.636 af, Depth= 2.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=3.83"

	Area (ac)	CN	Description
*	1.660	98	Roofs
*	1.660	98	Paved parking
	2.236	80	>75% Grass cover, Good, HSG D
	1.118	74	>75% Grass cover, Good, HSG C
	2.236	61	>75% Grass cover, Good, HSG B
*	0.630	98	Water Surface, 0% imp
	9.540	82	Weighted Average
	6.220		65.20% Pervious Area
	3.320		34.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0	150	0.0333	0.21		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.72"
1.4	325	0.0654	3.84		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.3	264	0.0400	15.46	27.31	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.010 Concrete pipe, straight & clean
0.3	320	0.0300	16.21	50.94	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.010 Concrete pipe, straight & clean
14.0	1,059	Total			

Subcatchment 2S.p: PR Building Site - To Pond



Summary for Subcatchment 3S.p: PR Planting Site - To Pond

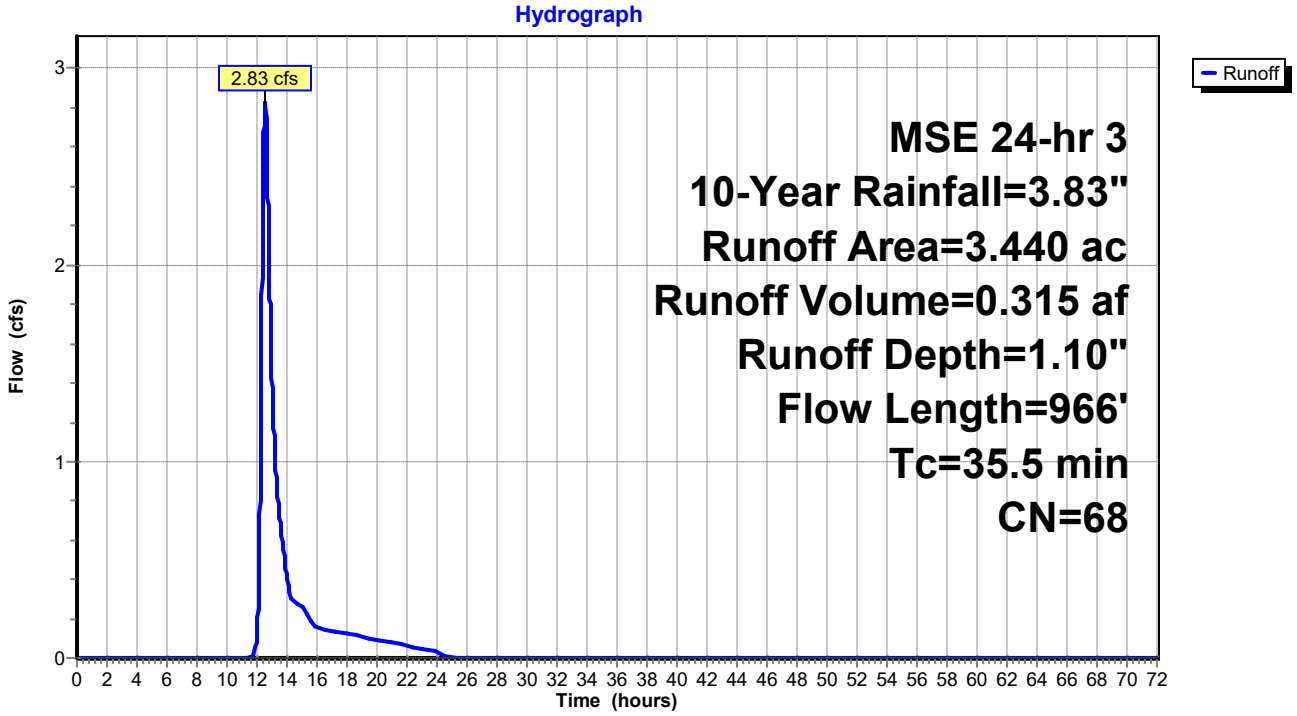
Runoff = 2.83 cfs @ 12.54 hrs, Volume= 0.315 af, Depth= 1.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=3.83"

Area (ac)	CN	Description
1.720	78	Meadow, non-grazed, HSG D
1.720	58	Meadow, non-grazed, HSG B
3.440	68	Weighted Average
3.440		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
30.3	300	0.0933	0.17		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.72"
1.4	150	0.1200	1.73		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.2	126	0.0400	13.69	16.80	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.010 Concrete pipe, straight & clean
1.8	150	0.0400	1.37	1.68	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.100
1.2	150	0.0400	2.17	10.66	**Pipe Channel,** 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.100
0.6	90	0.0400	2.45	17.34	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.100
35.5	966	Total			

Subcatchment 3S.p: PR Planting Site - To Pond



Summary for Subcatchment 4S.p: PR Building Site - Uncaptured

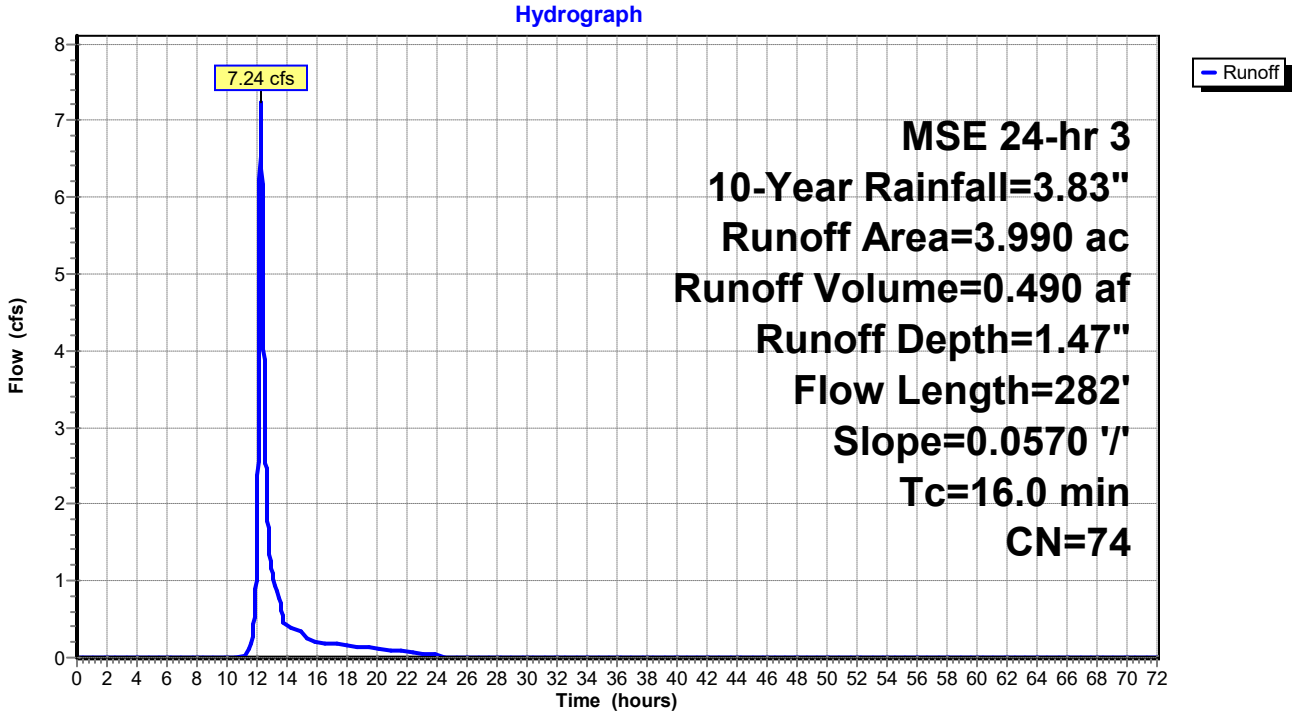
Runoff = 7.24 cfs @ 12.25 hrs, Volume= 0.490 af, Depth= 1.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=3.83"

	Area (ac)	CN	Description
*	0.200	98	Paved parking
	1.896	80	>75% Grass cover, Good, HSG D
	1.263	61	>75% Grass cover, Good, HSG B
	0.631	74	>75% Grass cover, Good, HSG C
	3.990	74	Weighted Average
	3.790		94.99% Pervious Area
	0.200		5.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.0	282	0.0570	0.29		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.72"

Subcatchment 4S.p: PR Building Site - Uncaptured



Summary for Pond 1P: Wet Detention Pond

Inflow Area = 12.980 ac, 25.58% Impervious, Inflow Depth = 1.80" for 10-Year event
Inflow = 27.32 cfs @ 12.23 hrs, Volume= 1.951 af
Outflow = 4.91 cfs @ 12.42 hrs, Volume= 1.893 af, Atten= 82%, Lag= 11.8 min
Primary = 4.91 cfs @ 12.42 hrs, Volume= 1.893 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3
Starting Elev= 874.00' Surf.Area= 29,464 sf Storage= 127,044 cf
Peak Elev= 875.76' @ 15.27 hrs Surf.Area= 32,923 sf Storage= 181,865 cf (54,821 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= 707.6 min (1,526.9 - 819.3)

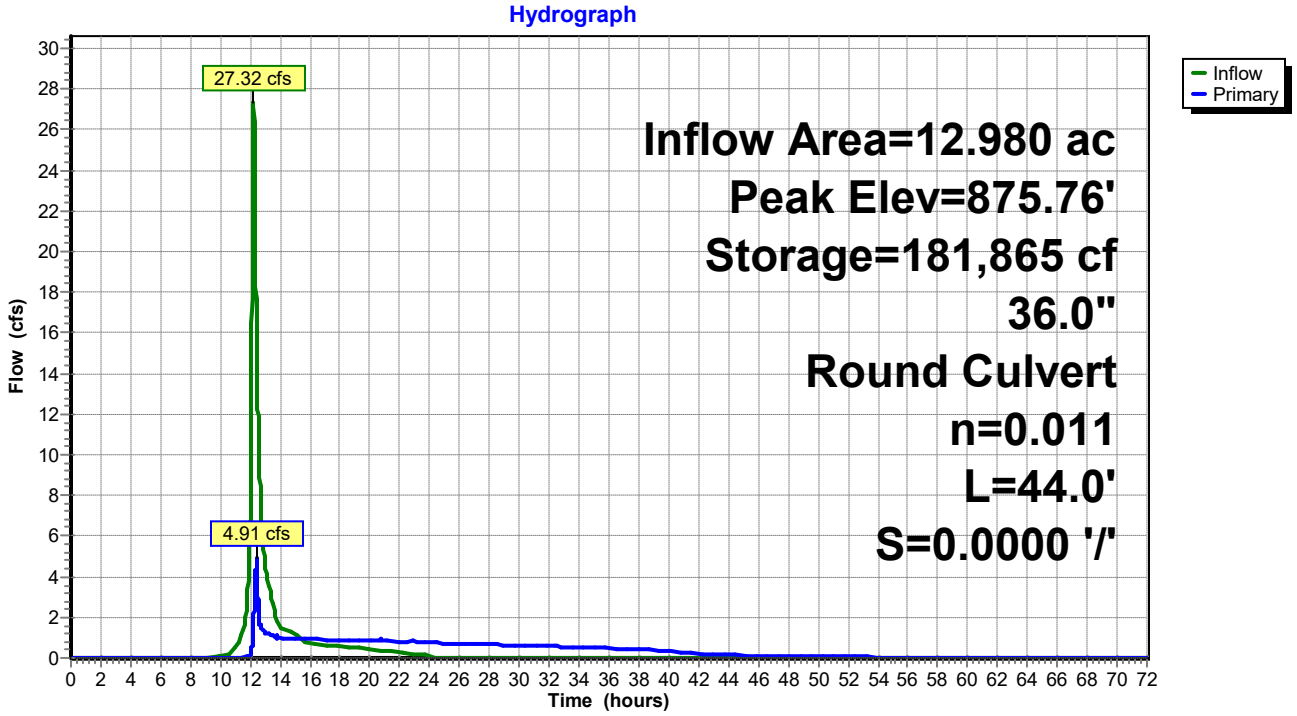
Volume	Invert	Avail.Storage	Storage Description
#1	868.00'	357,260 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
868.00	15,446	0	0	15,446
869.00	16,921	16,178	16,178	16,988
870.00	18,453	17,681	33,859	18,591
871.00	20,041	19,242	53,101	20,254
872.00	21,685	20,858	73,959	21,975
873.00	27,575	24,571	98,530	27,892
874.00	29,464	28,514	127,044	29,873
875.00	31,411	30,432	157,476	31,916
876.00	33,413	32,407	189,883	34,017
877.00	35,472	34,437	224,320	36,179
878.00	37,588	36,525	260,845	38,401
879.00	50,492	43,882	304,727	51,326
880.00	54,601	52,533	357,260	55,514

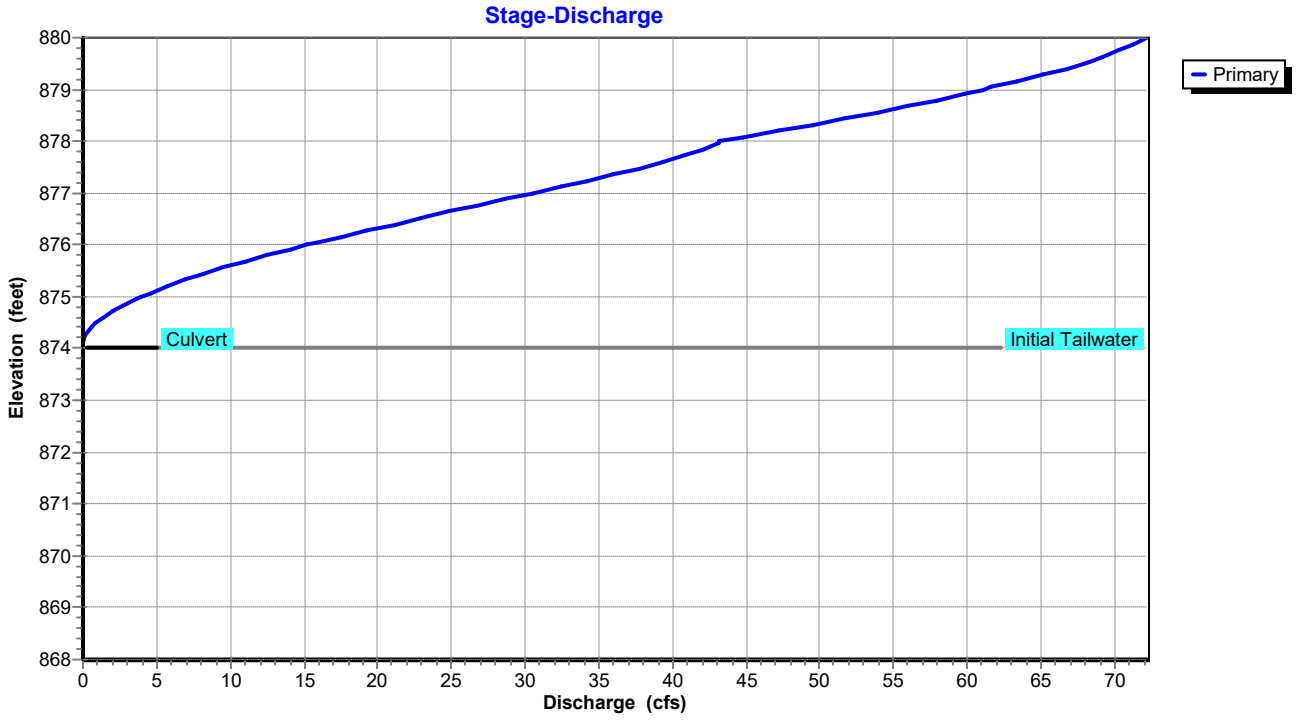
Device	Routing	Invert	Outlet Devices
#1	Primary	874.00'	**36.0" Round Culvert** L= 44.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 874.00' / 874.00' S= 0.0000 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 7.07 sf

Primary OutFlow Max=4.93 cfs @ 12.42 hrs HW=875.11' TW=874.83' (Dynamic Tailwater)
↑**1=Culvert** (Barrel Controls 4.93 cfs @ 3.06 fps)

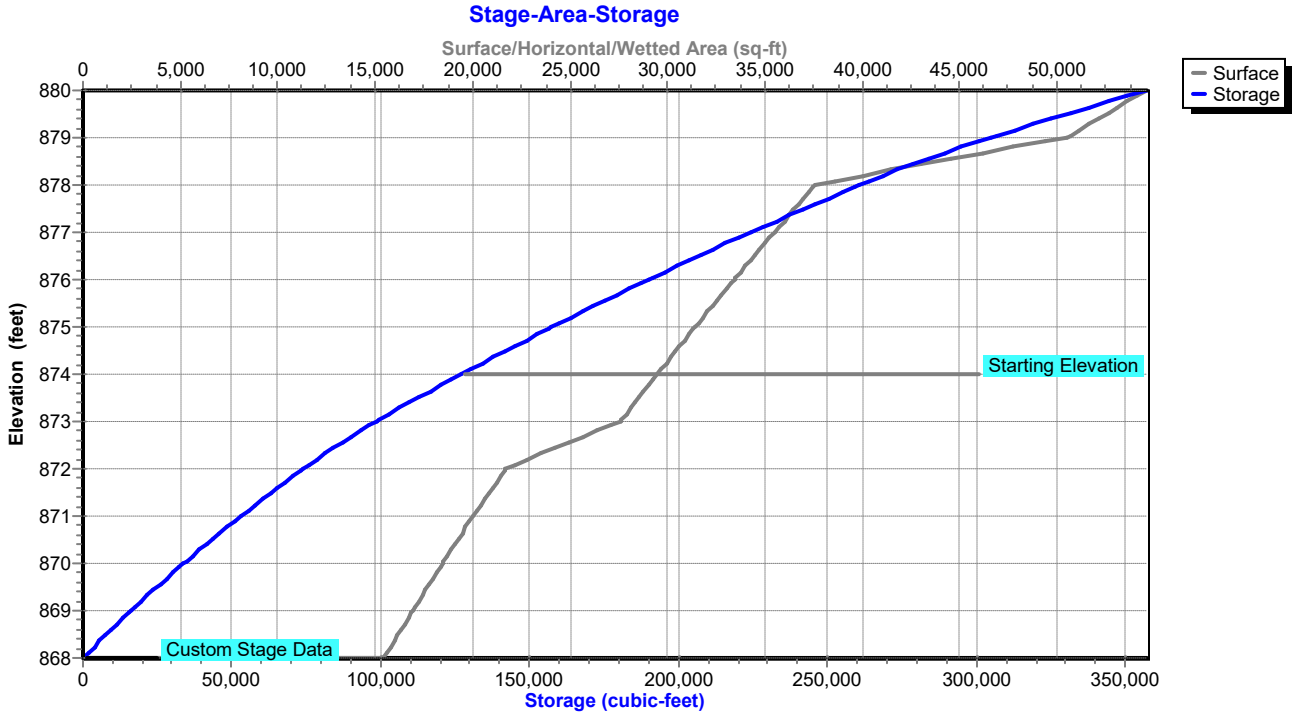
Pond 1P: Wet Detention Pond



Pond 1P: Wet Detention Pond



Pond 1P: Wet Detention Pond



Summary for Pond 2P: Infiltration Basin

Inflow Area = 12.980 ac, 25.58% Impervious, Inflow Depth > 1.75" for 10-Year event
Inflow = 4.91 cfs @ 12.42 hrs, Volume= 1.893 af
Outflow = 0.94 cfs @ 15.27 hrs, Volume= 1.893 af, Atten= 81%, Lag= 171.0 min
Discarded = 0.41 cfs @ 15.27 hrs, Volume= 0.975 af
Primary = 0.53 cfs @ 15.27 hrs, Volume= 0.918 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 875.76' @ 15.27 hrs Surf.Area= 3,733 sf Storage= 5,836 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 74.3 min (1,601.2 - 1,526.9)

Volume	Invert	Avail.Storage	Storage Description
#1	874.00'	15,470 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
874.00	2,927	0	0
875.00	3,375	3,151	3,151
876.00	3,849	3,612	6,763
877.00	4,347	4,098	10,861
878.00	4,871	4,609	15,470

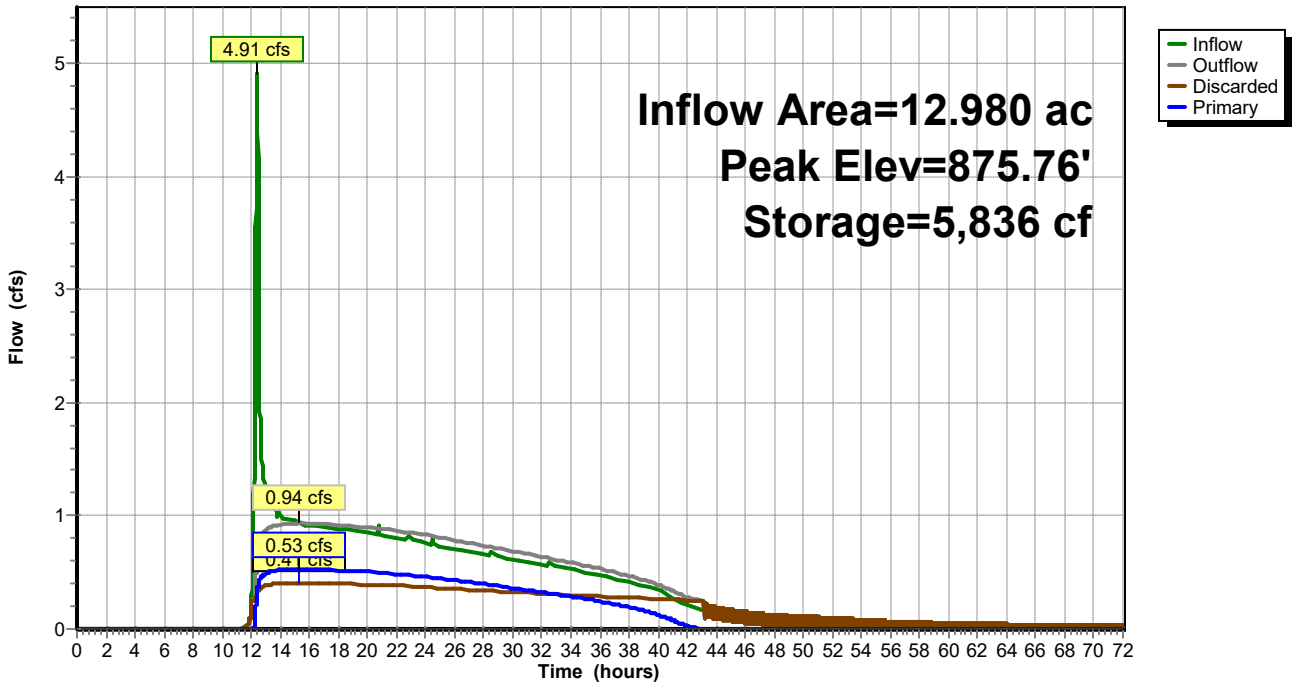
Device	Routing	Invert	Outlet Devices
#1	Discarded	874.00'	**3.600 in/hr Infiltration over Surface area** Conductivity to Groundwater Elevation = 869.00'
#2	Primary	874.00'	**24.0" Round Culvert** L= 23.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 874.00' / 873.95' S= 0.0022 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 3.14 sf
#3	Device 2	874.00'	**4.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#4	Device 2	876.00'	**4.0' long x 4.00' rise Sharp-Crested Weir** Cv= 2.62 (C= 3.28)

Discarded OutFlow Max=0.41 cfs @ 15.27 hrs HW=875.76' (Free Discharge)
└**1=Infiltration** (Controls 0.41 cfs)

Primary OutFlow Max=0.53 cfs @ 15.27 hrs HW=875.76' TW=0.00' (Dynamic Tailwater)
└**2=Culvert** (Passes 0.53 cfs of 9.44 cfs potential flow)
  ├**3=Orifice** (Orifice Controls 0.53 cfs @ 6.07 fps)
  └**4=Sharp-Crested Weir** (Controls 0.00 cfs)

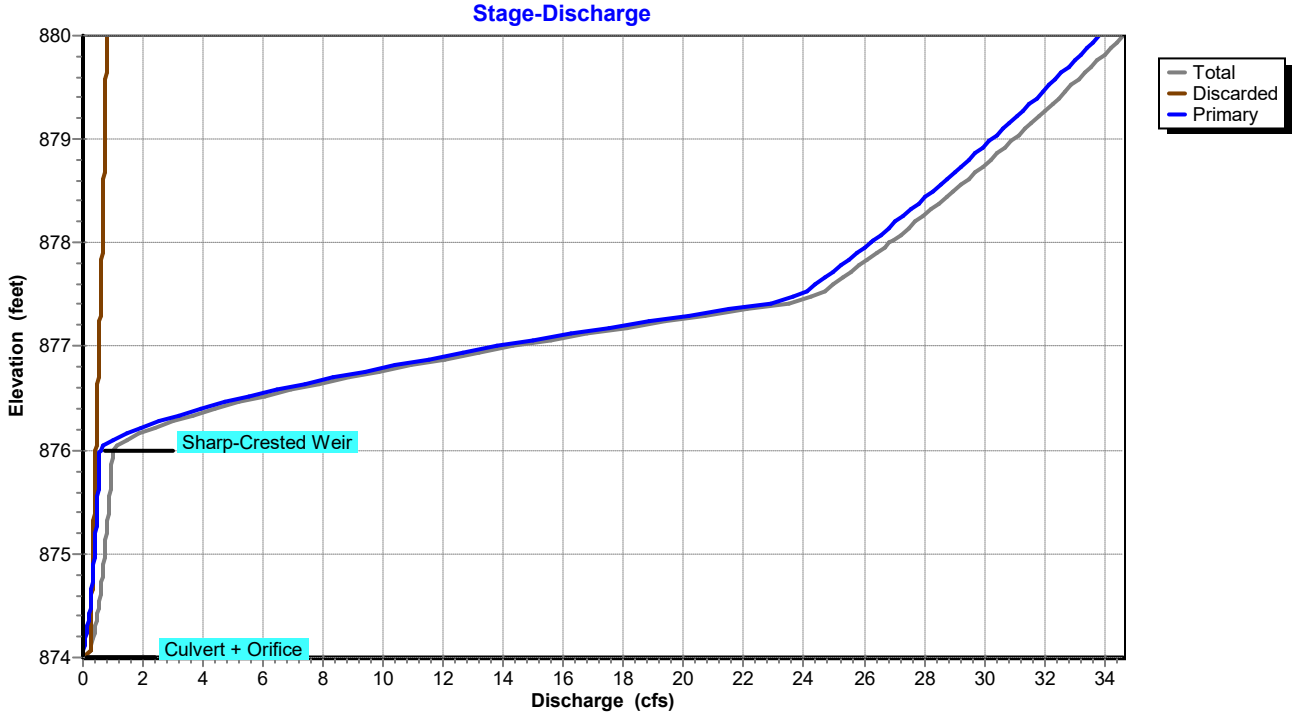
Pond 2P: Infiltration Basin

Hydrograph

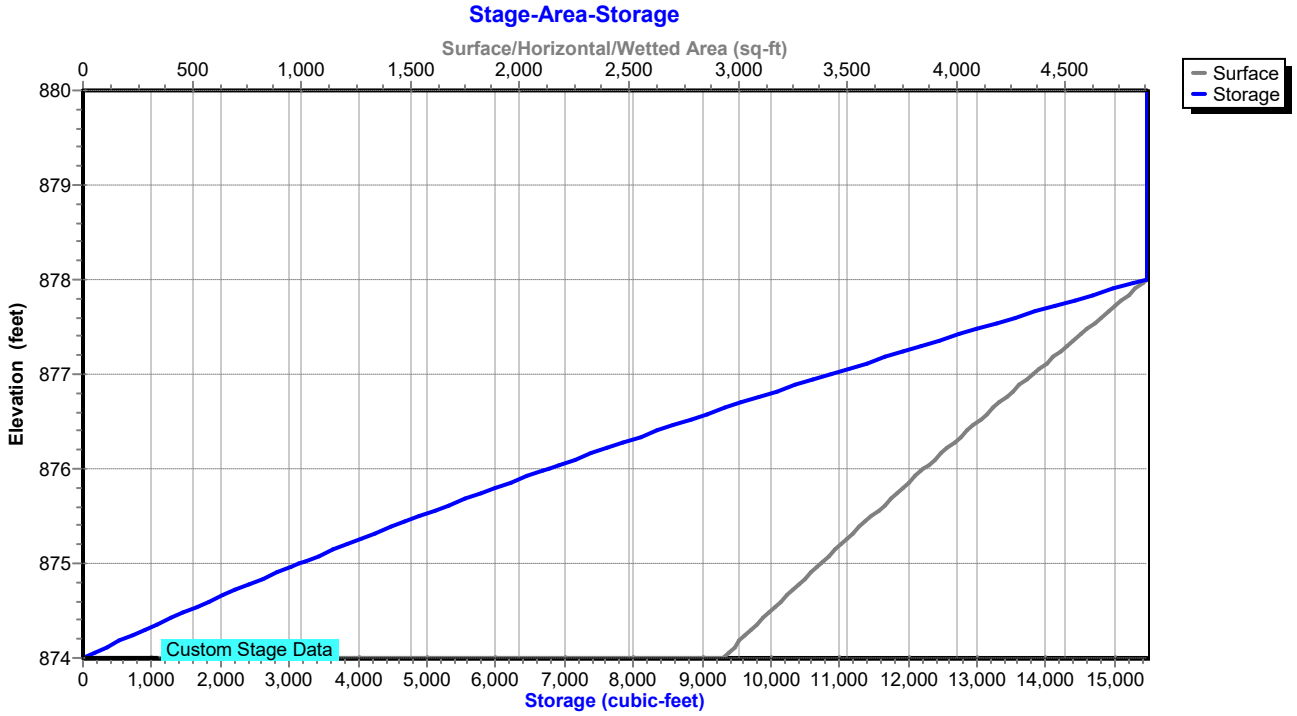


Pond 2P: Infiltration Basin

Stage-Discharge



Pond 2P: Infiltration Basin

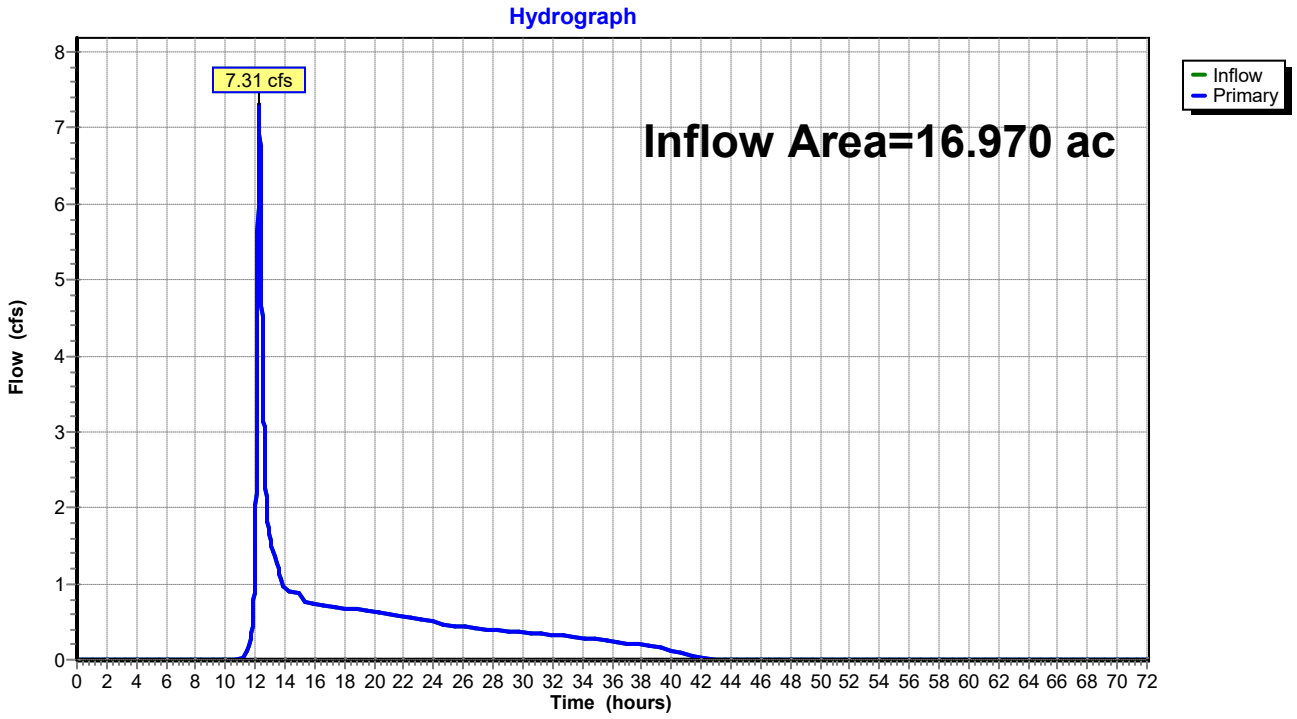


Summary for Link 5L: PROPOSED

Inflow Area = 16.970 ac, 20.74% Impervious, Inflow Depth = 1.00" for 10-Year event
Inflow = 7.31 cfs @ 12.26 hrs, Volume= 1.408 af
Primary = 7.31 cfs @ 12.26 hrs, Volume= 1.408 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 5L: PROPOSED



Summary for Subcatchment 2S.p: PR Building Site - To Pond

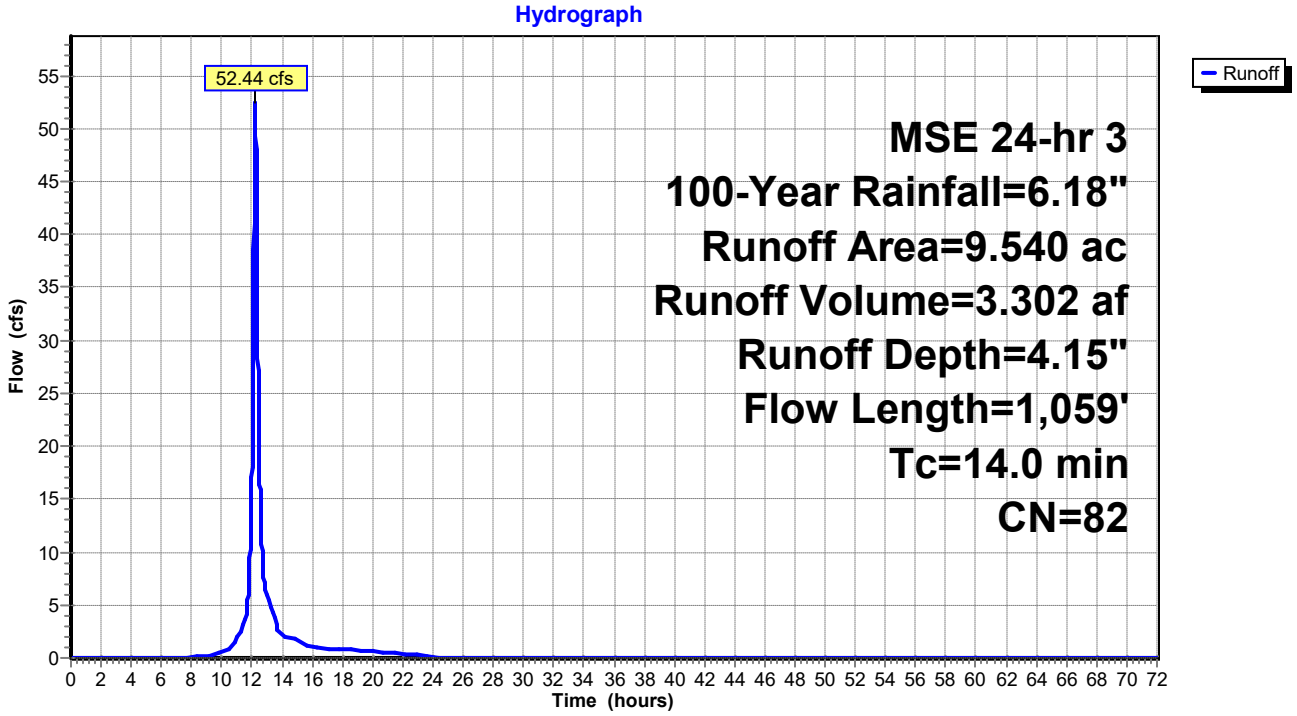
Runoff = 52.44 cfs @ 12.22 hrs, Volume= 3.302 af, Depth= 4.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=6.18"

	Area (ac)	CN	Description
*	1.660	98	Roofs
*	1.660	98	Paved parking
	2.236	80	>75% Grass cover, Good, HSG D
	1.118	74	>75% Grass cover, Good, HSG C
	2.236	61	>75% Grass cover, Good, HSG B
*	0.630	98	Water Surface, 0% imp
	9.540	82	Weighted Average
	6.220		65.20% Pervious Area
	3.320		34.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0	150	0.0333	0.21		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.72"
1.4	325	0.0654	3.84		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.3	264	0.0400	15.46	27.31	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.010 Concrete pipe, straight & clean
0.3	320	0.0300	16.21	50.94	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.010 Concrete pipe, straight & clean
14.0	1,059	Total			

Subcatchment 2S.p: PR Building Site - To Pond



Summary for Subcatchment 3S.p: PR Planting Site - To Pond

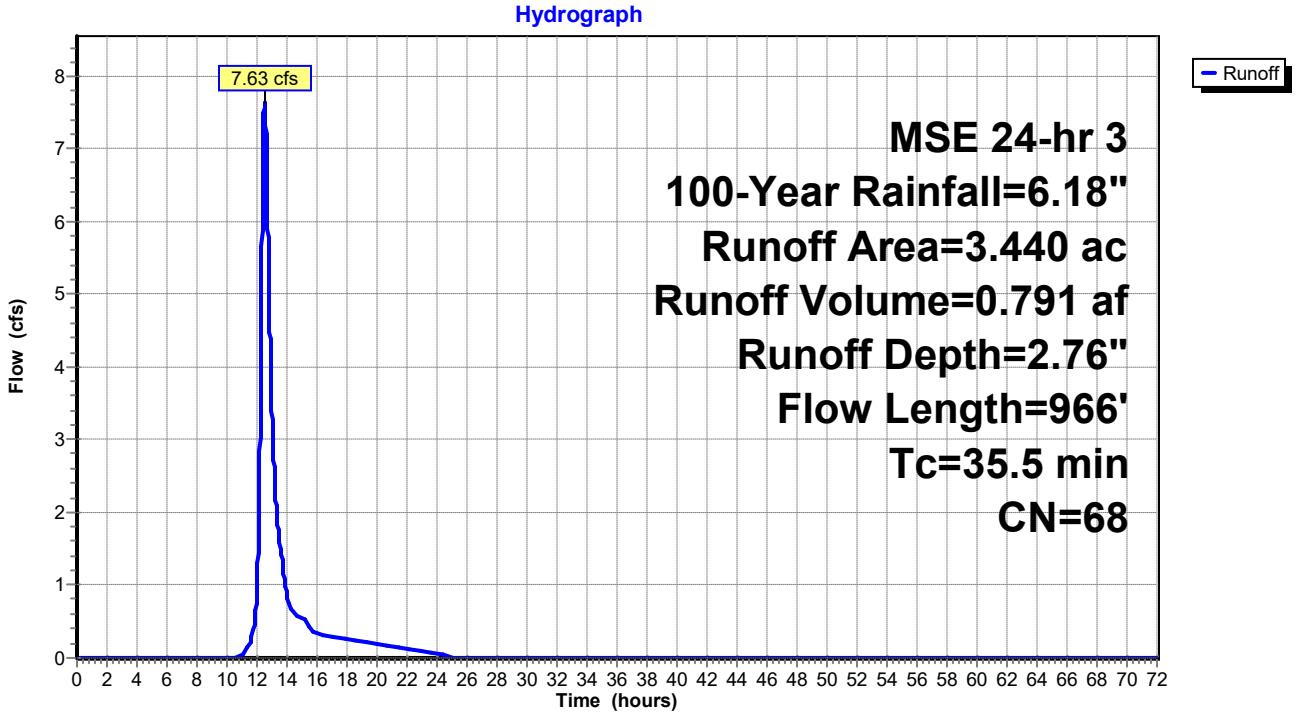
Runoff = 7.63 cfs @ 12.51 hrs, Volume= 0.791 af, Depth= 2.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=6.18"

Area (ac)	CN	Description
1.720	78	Meadow, non-grazed, HSG D
1.720	58	Meadow, non-grazed, HSG B
3.440	68	Weighted Average
3.440		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
30.3	300	0.0933	0.17		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.72"
1.4	150	0.1200	1.73		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.2	126	0.0400	13.69	16.80	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.010 Concrete pipe, straight & clean
1.8	150	0.0400	1.37	1.68	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.100
1.2	150	0.0400	2.17	10.66	**Pipe Channel,** 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.100
0.6	90	0.0400	2.45	17.34	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.100
35.5	966	Total			

Subcatchment 3S.p: PR Planting Site - To Pond



Summary for Subcatchment 4S.p: PR Building Site - Uncaptured

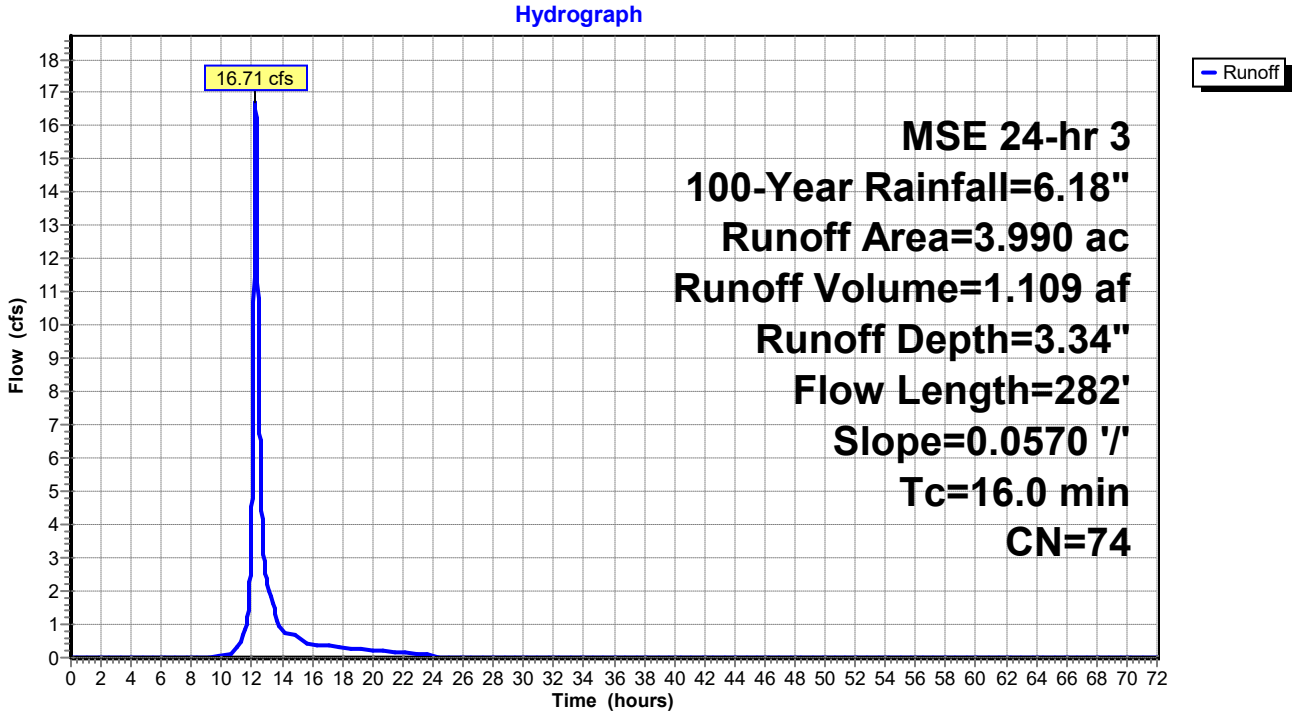
Runoff = 16.71 cfs @ 12.25 hrs, Volume= 1.109 af, Depth= 3.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=6.18"

	Area (ac)	CN	Description
*	0.200	98	Paved parking
	1.896	80	>75% Grass cover, Good, HSG D
	1.263	61	>75% Grass cover, Good, HSG B
	0.631	74	>75% Grass cover, Good, HSG C
	3.990	74	Weighted Average
	3.790		94.99% Pervious Area
	0.200		5.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.0	282	0.0570	0.29		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.72"

Subcatchment 4S.p: PR Building Site - Uncaptured



Summary for Pond 1P: Wet Detention Pond

Inflow Area = 12.980 ac, 25.58% Impervious, Inflow Depth = 3.78" for 100-Year event
Inflow = 55.82 cfs @ 12.22 hrs, Volume= 4.093 af
Outflow = 9.85 cfs @ 12.88 hrs, Volume= 4.028 af, Atten= 82%, Lag= 39.4 min
Primary = 9.85 cfs @ 12.88 hrs, Volume= 4.028 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3
Starting Elev= 874.00' Surf.Area= 29,464 sf Storage= 127,044 cf
Peak Elev= 876.84' @ 12.95 hrs Surf.Area= 35,145 sf Storage= 218,779 cf (91,735 cf above start)

Plug-Flow detention time= 1,527.4 min calculated for 1.111 af (27% of inflow)
Center-of-Mass det. time= 497.2 min (1,302.7 - 805.5)

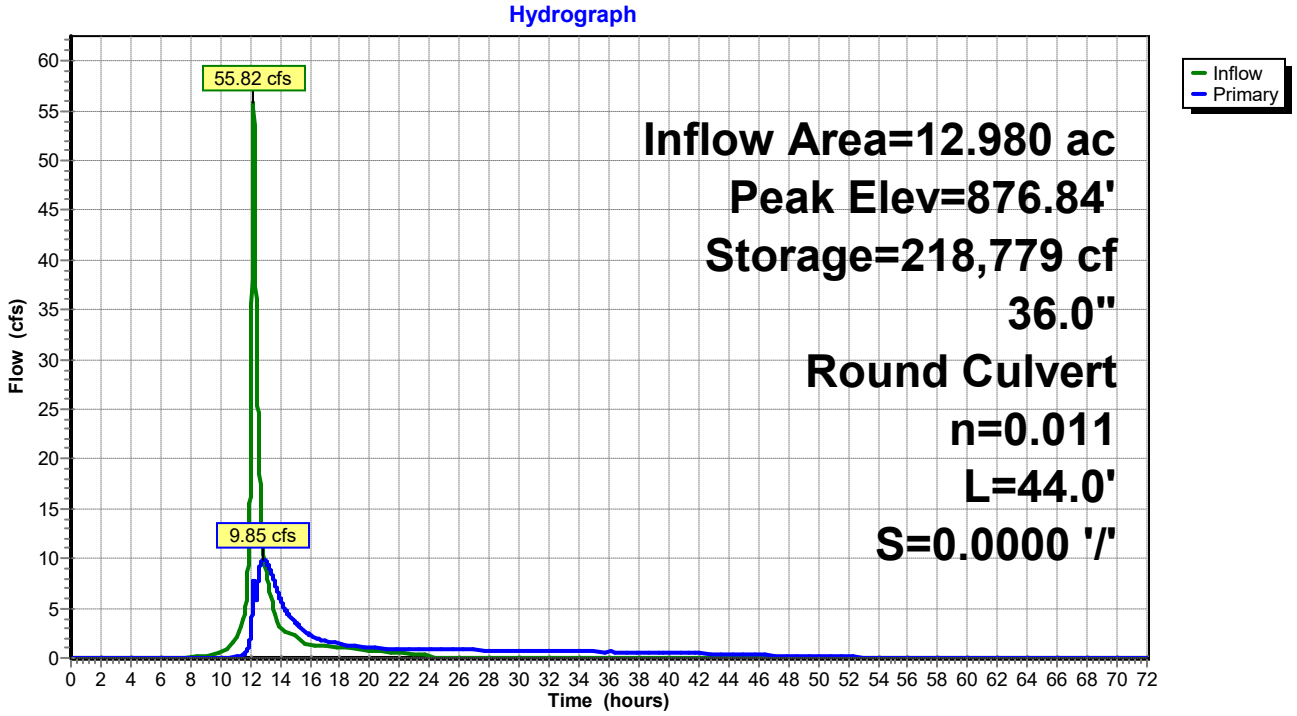
Volume	Invert	Avail.Storage	Storage Description
#1	868.00'	357,260 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
868.00	15,446	0	0	15,446
869.00	16,921	16,178	16,178	16,988
870.00	18,453	17,681	33,859	18,591
871.00	20,041	19,242	53,101	20,254
872.00	21,685	20,858	73,959	21,975
873.00	27,575	24,571	98,530	27,892
874.00	29,464	28,514	127,044	29,873
875.00	31,411	30,432	157,476	31,916
876.00	33,413	32,407	189,883	34,017
877.00	35,472	34,437	224,320	36,179
878.00	37,588	36,525	260,845	38,401
879.00	50,492	43,882	304,727	51,326
880.00	54,601	52,533	357,260	55,514

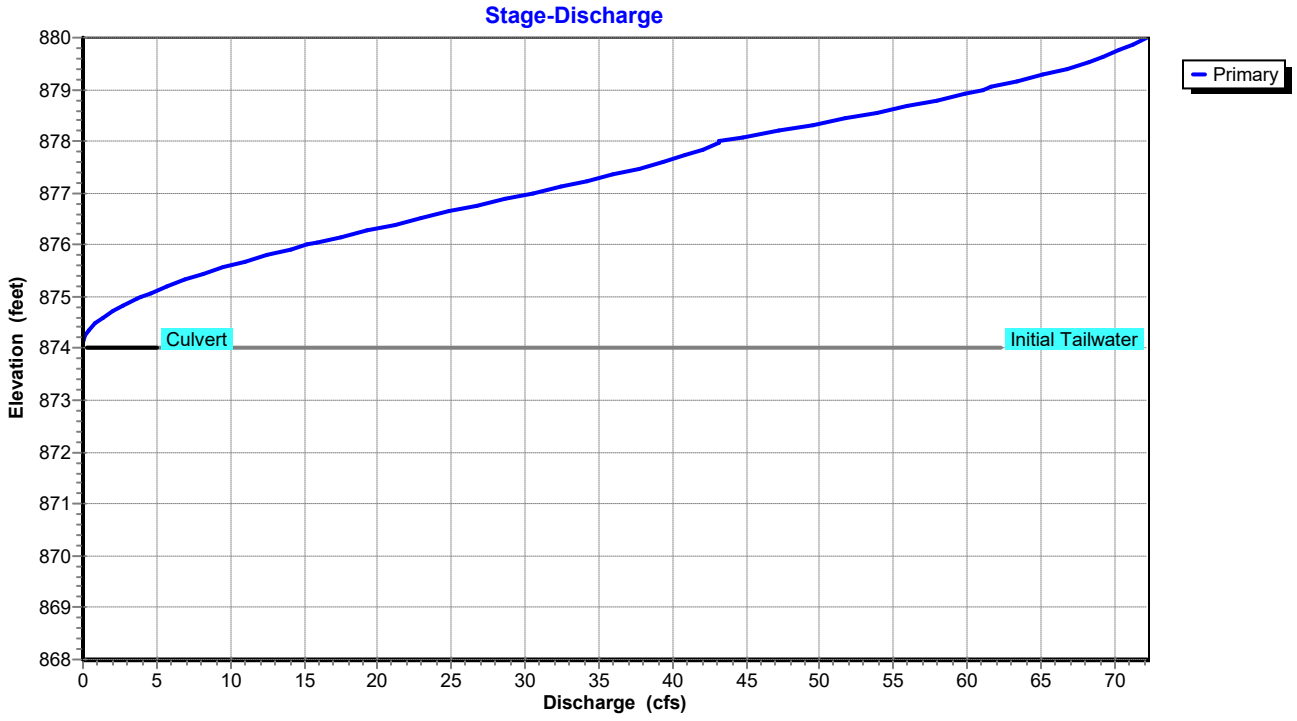
Device	Routing	Invert	Outlet Devices
#1	Primary	874.00'	**36.0" Round Culvert** L= 44.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 874.00' / 874.00' S= 0.0000 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 7.07 sf

Primary OutFlow Max=9.85 cfs @ 12.88 hrs HW=876.84' TW=876.75' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 9.85 cfs @ 1.83 fps)

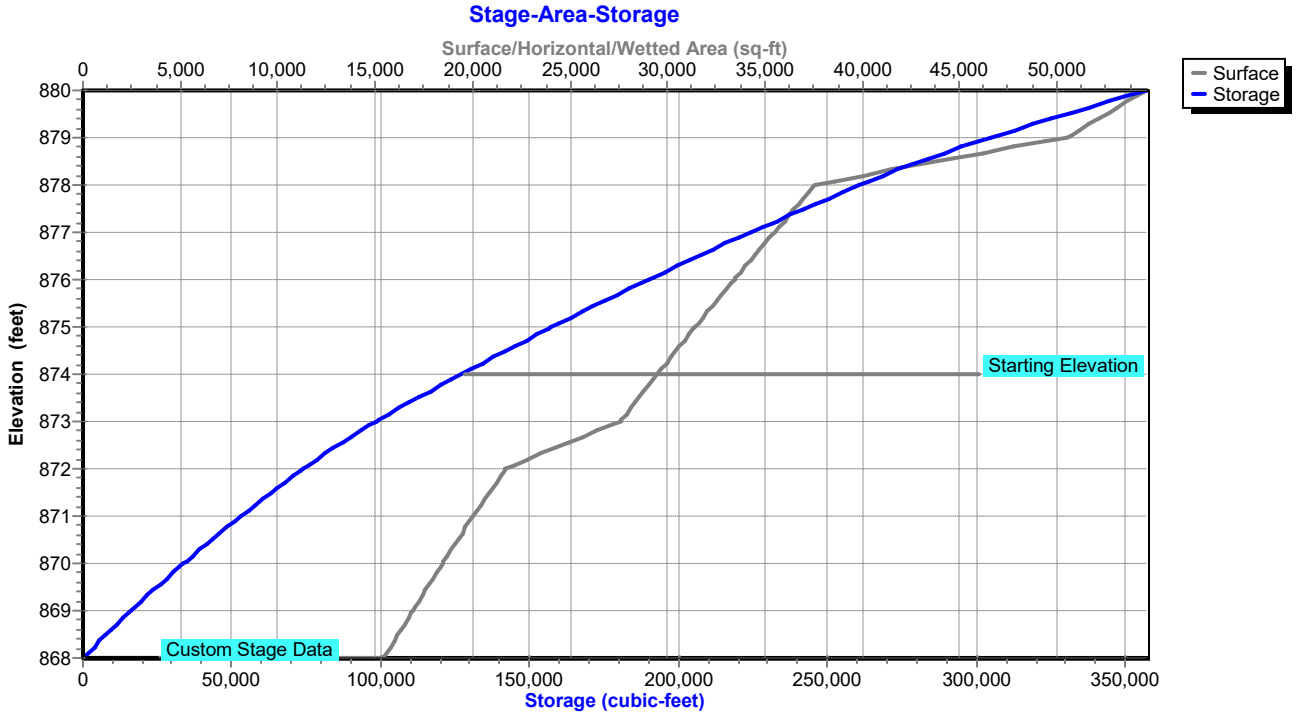
Pond 1P: Wet Detention Pond



Pond 1P: Wet Detention Pond



Pond 1P: Wet Detention Pond



Summary for Pond 2P: Infiltration Basin

Inflow Area = 12.980 ac, 25.58% Impervious, Inflow Depth > 3.72" for 100-Year event
Inflow = 9.85 cfs @ 12.88 hrs, Volume= 4.028 af
Outflow = 9.80 cfs @ 12.96 hrs, Volume= 4.028 af, Atten= 1%, Lag= 5.0 min
Discarded = 0.51 cfs @ 12.96 hrs, Volume= 1.217 af
Primary = 9.29 cfs @ 12.96 hrs, Volume= 2.811 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 876.76' @ 12.96 hrs Surf.Area= 4,226 sf Storage= 9,815 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 53.7 min (1,356.5 - 1,302.7)

Volume	Invert	Avail.Storage	Storage Description
#1	874.00'	15,470 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

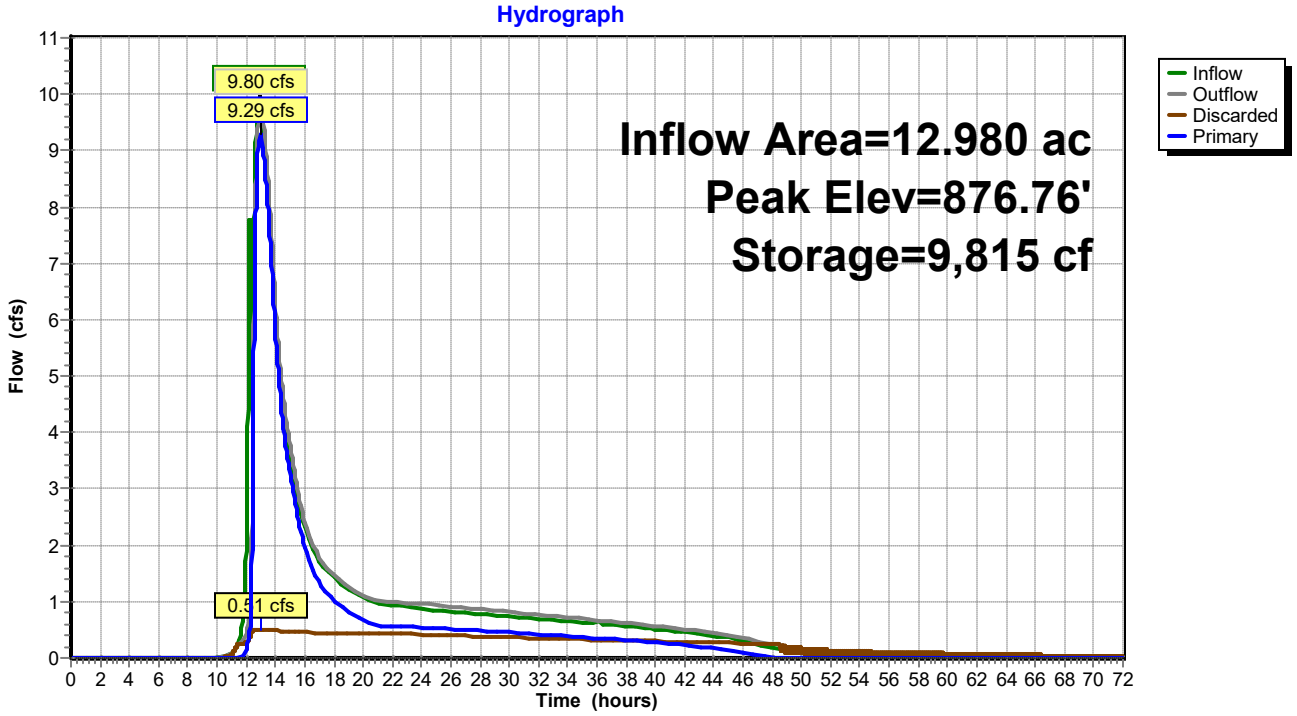
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
874.00	2,927	0	0
875.00	3,375	3,151	3,151
876.00	3,849	3,612	6,763
877.00	4,347	4,098	10,861
878.00	4,871	4,609	15,470

Device	Routing	Invert	Outlet Devices
#1	Discarded	874.00'	**3.600 in/hr Infiltration over Surface area** Conductivity to Groundwater Elevation = 869.00'
#2	Primary	874.00'	**24.0" Round Culvert** L= 23.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 874.00' / 873.95' S= 0.0022 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 3.14 sf
#3	Device 2	874.00'	**4.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#4	Device 2	876.00'	**4.0' long x 4.00' rise Sharp-Crested Weir** Cv= 2.62 (C= 3.28)

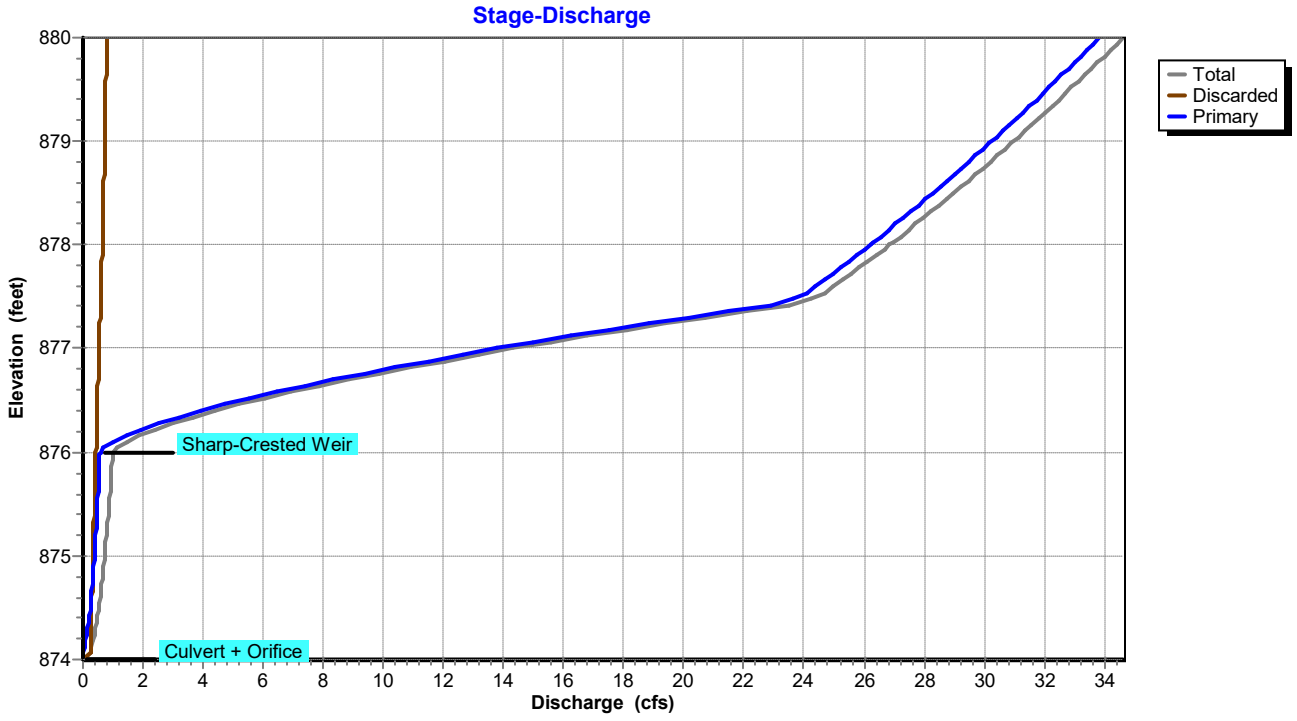
Discarded OutFlow Max=0.51 cfs @ 12.96 hrs HW=876.76' (Free Discharge)
└**1=Infiltration** (Controls 0.51 cfs)

Primary OutFlow Max=9.29 cfs @ 12.96 hrs HW=876.76' TW=0.00' (Dynamic Tailwater)
└**2=Culvert** (Passes 9.29 cfs of 17.14 cfs potential flow)
  ├**3=Orifice** (Orifice Controls 0.68 cfs @ 7.75 fps)
  └**4=Sharp-Crested Weir** (Weir Controls 8.61 cfs @ 2.85 fps)

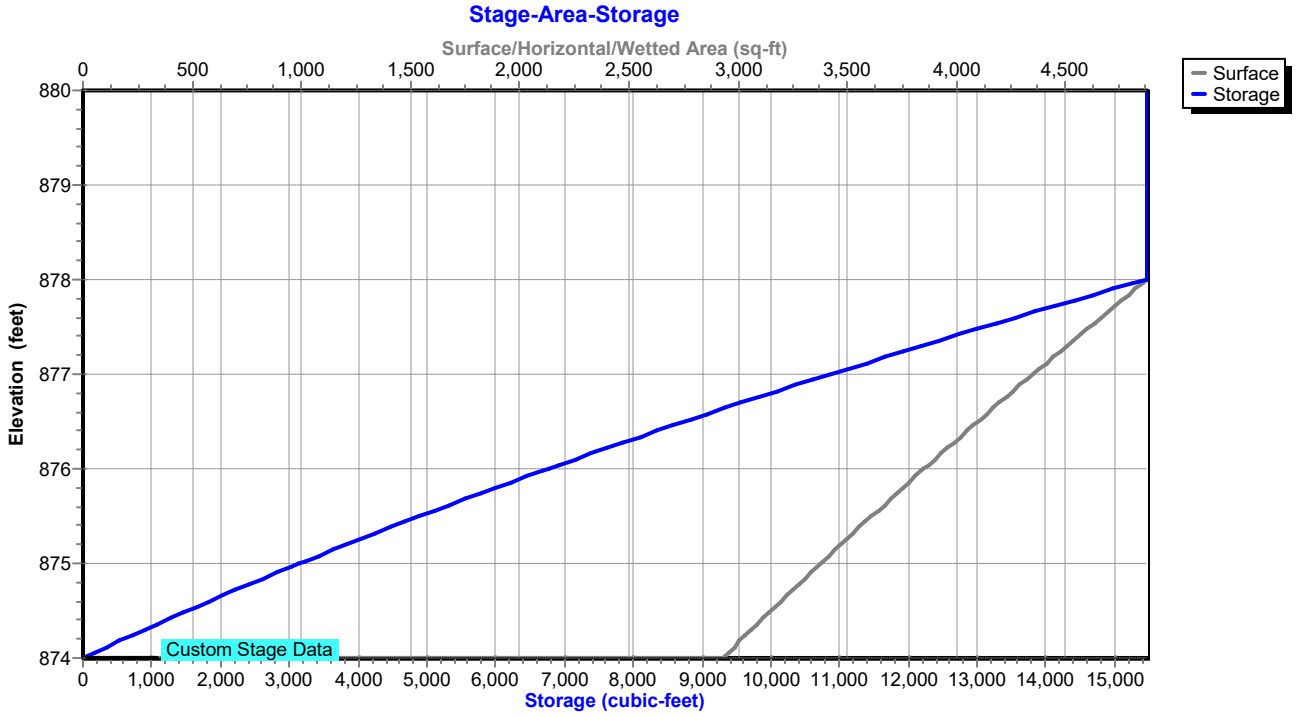
Pond 2P: Infiltration Basin



Pond 2P: Infiltration Basin



Pond 2P: Infiltration Basin

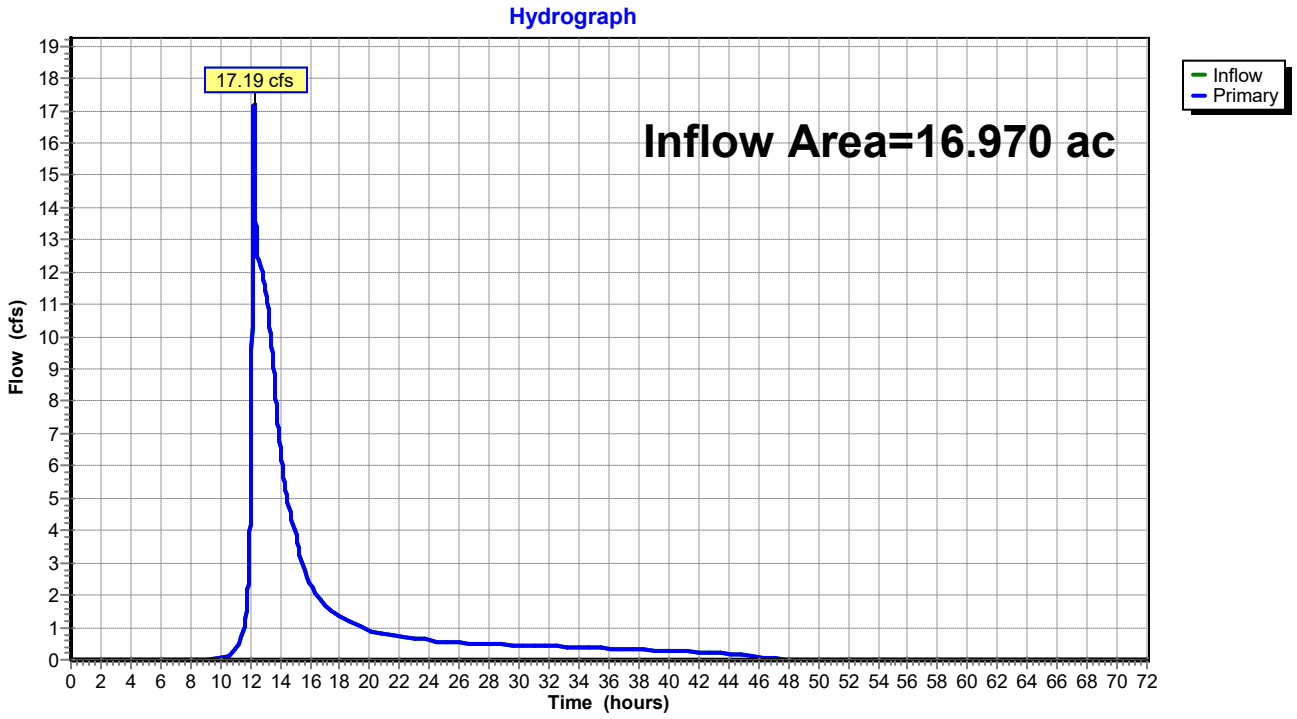


Summary for Link 5L: PROPOSED

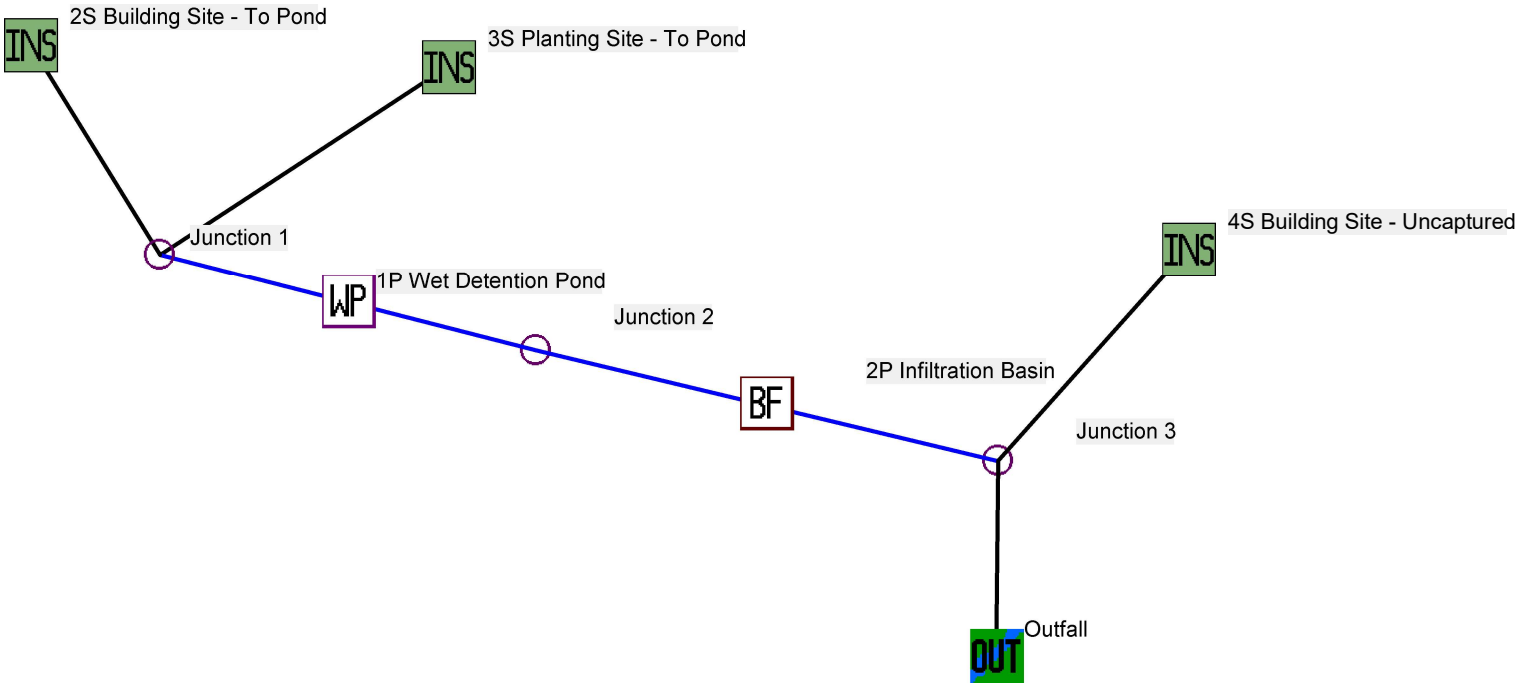
Inflow Area = 16.970 ac, 20.74% Impervious, Inflow Depth = 2.77" for 100-Year event
Inflow = 17.19 cfs @ 12.25 hrs, Volume= 3.921 af
Primary = 17.19 cfs @ 12.25 hrs, Volume= 3.921 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 5L: PROPOSED



Appendix E – WinSLAMM Modeling


INS
2S Building Site - To Pond
INS
3S Planting Site - To Pond
Junction 1
WP
1P Wet Detention Pond
Junction 2
BF
2P Infiltration Basin
INS
4S Building Site - Uncaptured
Junction 3
OUT
Outfall

Data file name: C:\Users\1987\Documents_PROJECTS\20200998.02 Great Water Alliance Waukesha\WinSLAMM\2020-0998.02 GWA Waukesha 2020-09-21.mdb
WinSLAMM Version 10.4.1
Rain file name: C:\WinSLAMM Files\Rain Files\WisReg - Milwaukee WI 1969.RAN
Particulate Solids Concentration file name: C:\WinSLAMM Files\v10.1 WI_AVG01.pscx
Runoff Coefficient file name: C:\WinSLAMM Files\WI_SL06 Dec06.rsvx
Residential Street Delivery file name: C:\WinSLAMM Files\WI_Res and Other Urban Dec06.std
Institutional Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Commercial Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Industrial Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Other Urban Street Delivery file name: C:\WinSLAMM Files\WI_Res and Other Urban Dec06.std
Freeway Street Delivery file name: C:\WinSLAMM Files\Freeway Dec06.std
Apply Street Delivery Files to Adjust the After Event Load Street Dirt Mass Balance: False
Pollutant Relative Concentration file name: C:\WinSLAMM Files\WI_GEO03.ppdx
Source Area PSD and Peak to Average Flow Ratio File: C:\WinSLAMM Files\NURP Source Area PSD Files.csv
Cost Data file name:
Seed for random number generator: -42
Study period starting date: 01/05/69 Study period ending date: 12/31/69
Start of Winter Season: 12/06 End of Winter Season: 03/28
Date: 09-22-2020 Time: 19:59:39
Site information: Great Water Alliance - Booster Pump Station
Waukesha, WI

LU# 1 - Institutional: 2S Building Site - To Pond Total area (ac): 9.540
1 - Roofs 1: 1.660 ac. Pitched Connected PSD File: C:\WinSLAMM Files\NURP.cpz
13 - Paved Parking 1: 1.660 ac. Connected PSD File: C:\WinSLAMM Files\NURP.cpz
45 - Large Landscaped Areas 1: 2.236 ac. Normal Clayey Low Density PSD File: C:\WinSLAMM Files\NURP.cpz
46 - Large Landscaped Areas 2: 1.118 ac. Normal Silty PSD File: C:\WinSLAMM Files\NURP.cpz
47 - Large Landscaped Areas 3: 2.236 ac. Normal Sandy PSD File: C:\WinSLAMM Files\NURP.cpz
70 - Water Body Areas: 0.630 ac. PSD File:

LU# 2 - Institutional: 4S Building Site - Uncaptured Total area (ac): 3.990
13 - Paved Parking 1: 0.200 ac. Connected PSD File: C:\WinSLAMM Files\NURP.cpz
45 - Large Landscaped Areas 1: 1.896 ac. Normal Sandy PSD File: C:\WinSLAMM Files\NURP.cpz
46 - Large Landscaped Areas 2: 0.631 ac. Normal Silty PSD File: C:\WinSLAMM Files\NURP.cpz
47 - Large Landscaped Areas 3: 1.263 ac. Normal Clayey Low Density PSD File: C:\WinSLAMM Files\NURP.cpz

LU# 3 - Institutional: 3S Planting Site - To Pond Total area (ac): 3.440
57 - Undeveloped Areas 1: 1.720 ac. Normal Sandy PSD File: C:\WinSLAMM Files\NURP.cpz
58 - Undeveloped Areas 2: 1.720 ac. Normal Clayey Low Density PSD File: C:\WinSLAMM Files\NURP.cpz

Control Practice 1: Wet Detention Pond CP# 1 (DS) - 1P Wet Detention Pond
Particle Size Distribution file name: Not needed - calculated by program
Initial stage elevation (ft): 6
Peak to Average Flow Ratio: 3.8
Maximum flow allowed into pond (cfs): No maximum value entered
Outlet Characteristics:
Outlet type: Orifice 1
1. Orifice diameter (ft): 3
2. Number of orifices: 1
3. Invert elevation above datum (ft): 6
Outlet type: Broad Crested Weir
1. Weir crest length (ft): 10
2. Weir crest width (ft): 10
3. Height from datum to bottom of weir opening: 10
Pond stage and surface area

Entry Number	Stage (ft)	Pond Area (acres)	Natural Seepage (in/hr)	Other Outflow (cfs)
0	0.00	0.0000	0.00	0.00
1	0.01	0.3550	0.00	0.00
2	1.00	0.3880	0.00	0.00
3	2.00	0.4240	0.00	0.00
4	3.00	0.4600	0.00	0.00
5	4.00	0.4980	0.00	0.00
6	5.00	0.6330	0.00	0.00
7	6.00	0.6760	0.00	0.00
8	7.00	0.7210	0.00	0.00
9	8.00	0.7670	0.00	0.00
10	9.00	0.8140	0.00	0.00
11	10.00	0.8630	0.00	0.00
12	11.00	1.1590	0.00	0.00
13	12.00	1.2530	0.00	0.00

Control Practice 2: Biofilter CP# 1 (DS) - 2P Infiltration Basin

1. Top area (square feet) = 4871
2. Bottom aea (square feet) = 2927
3. Depth (ft): 4
4. Biofilter width (ft) - for Cost Purposes Only: 10
5. Infiltration rate (in/hr) = 3.6
6. Random infiltration rate generation? No
7. Infiltration rate fraction (side): 1
8. Infiltration rate fraction (bottom): 1
9. Depth of biofilter that is rock filled (ft) 0
10. Porosity of rock filled volume = 0
11. Engineered soil infiltration rate: 0
12. Engineered soil depth (ft) = 0
13. Engineered soil porosity = 0
14. Percent solids reduction due to flow through engineered soil = 0
15. Biofilter peak to average flow ratio = 3.8
16. Number of biofiltration control devices = 1
17. Particle size distribution file: Not needed - calculated by program
18. Initial water surface elevation (ft): 0

Soil Data Soil Type Fraction in Eng. Soil

Biofilter Outlet/Discharge Characteristics:

Outlet type: Sharp Crested Weir

1. Weir length (ft): 4
2. Invert elevation above datum (ft): 2

Outlet type: Broad Crested Weir

1. Weir crest length (ft): 10
2. Weir crest width (ft): 10
3. Height of datum to bottom of weir opening: 3.99

Outlet type: Surface Discharge Pipe

1. Surface discharge pipe outlet diameter (ft): 0.33
2. Pipe invert elevation above datum (ft): 0
3. Number of surface pipe outlets: 1

SLAMM for Windows Version 10.4.1

Data file name: C:\Users\1987\Documents_PROJECTS\20200998.02 Great Water Alliance Waukesha\WinSLAMM\2020-0998.02 GWA Waukesha 2020-09-21.mdb
WinSLAMM Version 10.4.1
Rain file name: C:\WinSLAMM Files\Rain Files\WisReg - Milwaukee WI 1969.RAN
Particulate Solids Concentration file name: C:\WinSLAMM Files\v10.1 WI_AVG01.pscx
Runoff Coefficient file name: C:\WinSLAMM Files\WI_SL06 Dec06.rsvx
Pollutant Relative Concentration file name: C:\WinSLAMM Files\WI_GEO03.ppdx
Residential Street Delivery file name: C:\WinSLAMM Files\WI_Res and Other Urban Dec06.std
Institutional Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Commercial Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Industrial Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Other Urban Street Delivery file name: C:\WinSLAMM Files\WI_Res and Other Urban Dec06.std
Freeway Street Delivery file name: C:\WinSLAMM Files\Freeway Dec06.std
Apply Street Delivery Files to Adjust the After Event Load Street Dirt Mass Balance: False
Source Area PSD and Peak to Average Flow Ratio File: C:\WinSLAMM Files\NURP Source Area PSD Files.csv
Cost Data file name:
Seed for random number generator: -42
Study period starting date: 01/05/69 Study period ending date: 12/31/69
Start of Winter Season: 12/06 End of Winter Season: 03/28
Model Run Start Date: 01/05/69 Model Run End Date: 12/31/69
Date of run: 09-22-2020 Time of run: 19:59:01
Total Area Modeled (acres): 16.970
Years in Model Run: 0.99

	Runoff Volume (cu ft)	Percent Runoff Volume Reduction	Particulate Solids Conc. (mg/L)	Particulate Solids Yield (lbs)	Percent Particulate Solids Reduction
Total of all Land Uses without Controls:	424790	-	78.12	2072	-
Outfall Total with Controls:	174782	58.85%	47.09	513.8	75.20%
Annualized Total After Outfall Controls:	177209			520.9	

Pollutant	Conc. No Controls	Conc. With Controls	Conc. Units	Pollutant Yield No Controls	Pollutant Yield With Controls	Pol. Yield Units	Percent Reduction
Particulate Solids	78.12	47.09	mg/L	2072	513.8	lbs	75.20 %
Total Phosphorus	0.3283	0.2848	mg/L	8.707	3.108	lbs	64.30 %

Appendix F – WWU and Waukesha Long Term Maintenance Agreement

Storm Water Management Practice Maintenance Agreement

Document Number

Waukesha Water Utility, as "Owner" of the property described below, in accordance with Chapter 32 City of Waukesha Storm Water Management and Erosion Control, agrees to install and maintain storm water management practice(s) on the subject property in accordance with approved plans and Storm Water Management Plan conditions. The owner further agrees to the terms stated in this document to ensure that the storm water management practice(s) continues serving the intended functions in perpetuity. This Agreement includes the following exhibits:

Exhibit A: Legal Description of the real estate for which this Agreement applies ("Property").
Exhibit B: Location Map(s) – shows an accurate location of each storm water management practice affected by this Agreement.
Exhibit C: Maintenance Plan – prescribes those activities that must be carried out to maintain compliance with this Agreement.

Note: After construction verification has been accepted by the City of Waukesha, for all planned storm water management practices, an addendum(s) to this agreement shall be recorded by the Owner showing design and construction details. The addendum(s) may contain several additional exhibits, including certification by City of Waukesha of Storm Water and Erosion Control Permit termination, as described below.

Name and Return Address

City of Waukesha
130 Delafield Street
Waukesha, WI 53188

Parcel Identification Number(s) – _____

Through this Agreement, the Owner hereby subjects the Property to the following covenants, conditions and restrictions:

1. The Owner shall be responsible for the routine and extraordinary maintenance and repair of the storm water management practice(s) and drainage easements identified in Exhibit B until Storm Water and Erosion Control Permit termination by the City of Waukesha in accordance with Chapter 32 of the City Code of Ordinances.
2. After Storm Water and Erosion Control Permit termination under 1., the current Owner(s) shall be solely responsible for maintenance and repair of the storm water management practices and drainage easements in accordance with the maintenance plan contained in Exhibit C.
3. The Owner(s) shall, at their own cost, complete inspections of the storm water management practices at the time intervals listed in Exhibit C, and conduct the inspections by a qualified professional, file the reports with the City of Waukesha after each inspection and complete any maintenance or repair work recommended in the report. The Owner(s) shall be liable for the failure to undertake any maintenance or repairs. After the work is completed by the Contractor, the qualified professional shall verify that the work was properly completed and submit the follow-up report to the City within 30 days.
4. In addition, and independent of the requirements under paragraph 3 above, the City of Waukesha, or its designee, is authorized to access the property as necessary to conduct inspections of the storm water management practices or drainage easements to ascertain compliance with the intent of this Agreement and the activities prescribed in Exhibit C. The City of Waukesha may require work to be done which differs from the report described in paragraph 3 above, if the City of Waukesha reasonably concludes that such work is necessary and consistent with the intent of this agreement. Upon notification by the City of Waukesha of required maintenance or repairs, the Owner(s) shall complete the specified maintenance or repairs within a reasonable time frame determined by the City of Waukesha.
5. If the Owner(s) do not complete an inspection under 3. above or required maintenance or repairs under 4. above within the specified time period, the City of Waukesha is authorized, but not required, to perform the specified inspections, maintenance or repairs. In the case of an emergency situation, as determined by the City of Waukesha, no notice shall be required prior to the City of Waukesha performing emergency maintenance or repairs. The City of Waukesha may levy the costs and expenses of such inspections, maintenance or repair related actions as a special charge against the Property and collected as such in accordance with the procedures under s. 66.0627 Wis. Stats. or subch. VII of ch. 66 Wis. Stats.

6. This Agreement shall run with the Property and be binding upon all heirs, successors and assigns. After the Owner records the addendum noted above, the City of Waukesha shall have the sole authority to modify this agreement upon a 30-day notice to the current Owner(s).

Dated this ___ day of _____, 2021.

Owner:

_____
(Owners Signature)

_____
(Owners Typed Name)

Acknowledgements

State of Wisconsin:
County of Waukesha

Personally came before me this ____ day of _____, 2021, the above named _____ to me known to be the person who executed the foregoing instrument and acknowledged the same.

_____.
(Name)
Notary Public, Waukesha County, WI
My commission expires:_____.

This document was drafted by:
Graef-USA, Inc.
275 W Wisconsin Avenue, Suite 300
Milwaukee, Wisconsin 53203
(414) 259-1500

For Certification Stamp

City of Waukesha Common Council Approval

Dated this ___ day of _____, 202_.

_____

Shawn N. Reilly, Mayor

_____

Gina Kozlik, City Clerk

Acknowledgements

State of Wisconsin:
County of Waukesha

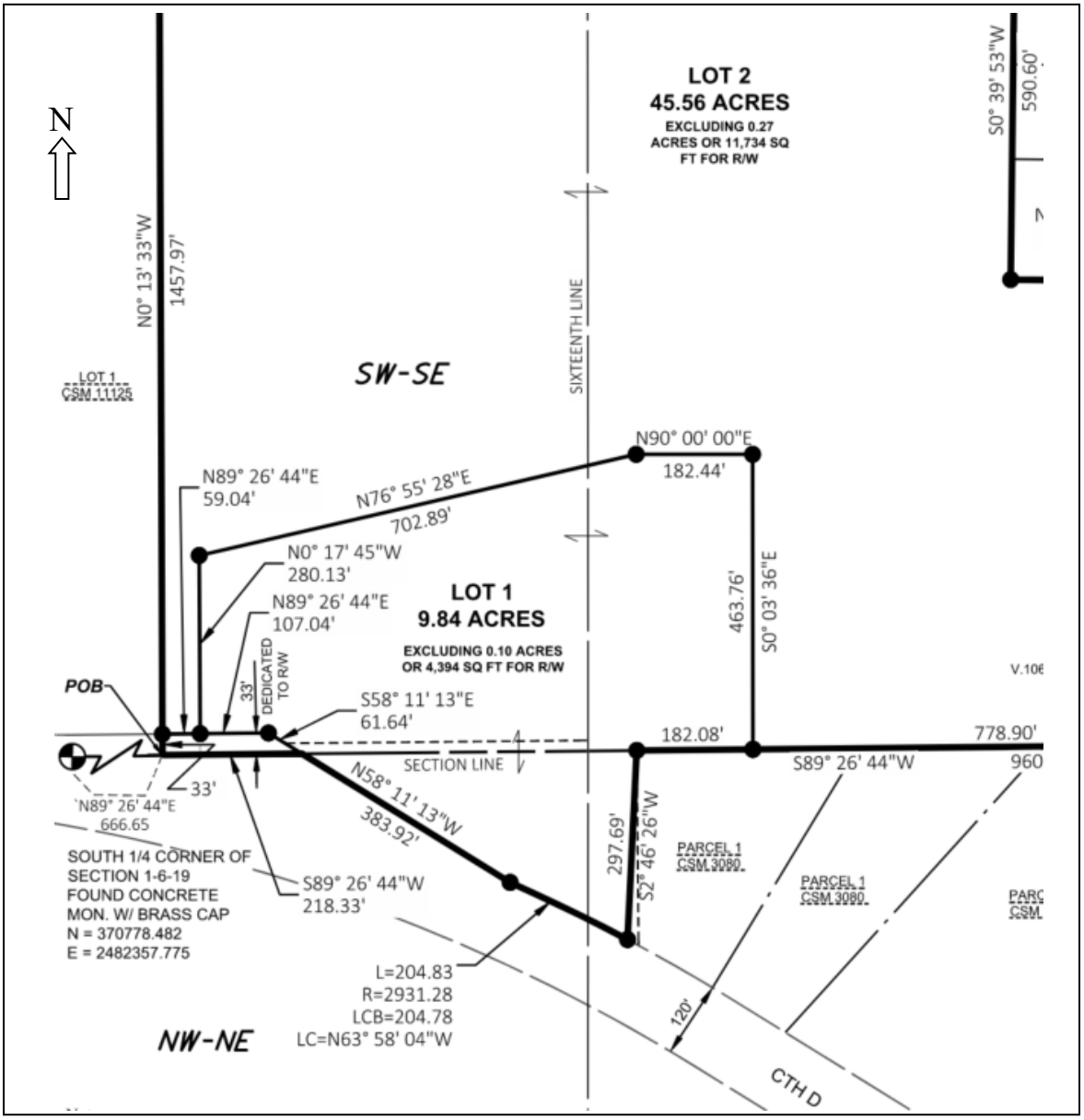
Personally came before me this ____ day of _____, 2021, the above named _____ to me known to be the person who executed the foregoing instrument and acknowledged the same.

_____.
(Name)
Notary Public, Waukesha County, WI
My commission expires:_____.

Exhibit A – Legal Description

The following description and reduced copy map identify the land parcel(s) affected by this Agreement. For a larger scale view of the referenced document, contact the Waukesha County Register of Deeds office.

Site Name: **GWA Booster Pumping Station and Water Tower** Acres**: 17.0**
Date of Recording: _____
Map Produced By: **Benjamin Larson, N17 W24222 Riverwood Dr, Suite 310, Waukesha WI 53188**
Legal Description: **Lot 1 of CSM _____, located in the southwest 1/4 of the southeast 1/4, and the southeast 1/4 of the southeast 1/4 of section 1, the northwest 1/4 of the northeast 1/4 and the northeast 1/4 of the northeast 1/4 of section 12 township 6 north, range 19 east, in the City of Waukesha, Waukesha County, Wisconsin.**



Site notes: See Exhibit C for specific maintenance requirements for storm water management practices within this area.

Exhibit B - Location Map
Storm Water Management Practices Covered by this Agreement

The storm water management practices covered by this Agreement are depicted in the reduced copy of a portion of the construction plans, as shown below. The practices include one wet detention basin, one infiltration basin, one overflow relief dry basin and all associated pipes, earthen berms, rock chutes and other components of these practices.

Site Name: **GWA Booster Pumping Station and Water Tower**
Storm water Practices: **Wet Detention Basin, Infiltration Basin, Overflow Relief Dry Basin**
Location of Practices: **South end of site (See Figure 1)**
Owners: **Waukesha Water Utility**

Figure 1
Plan View of Storm Water Practices

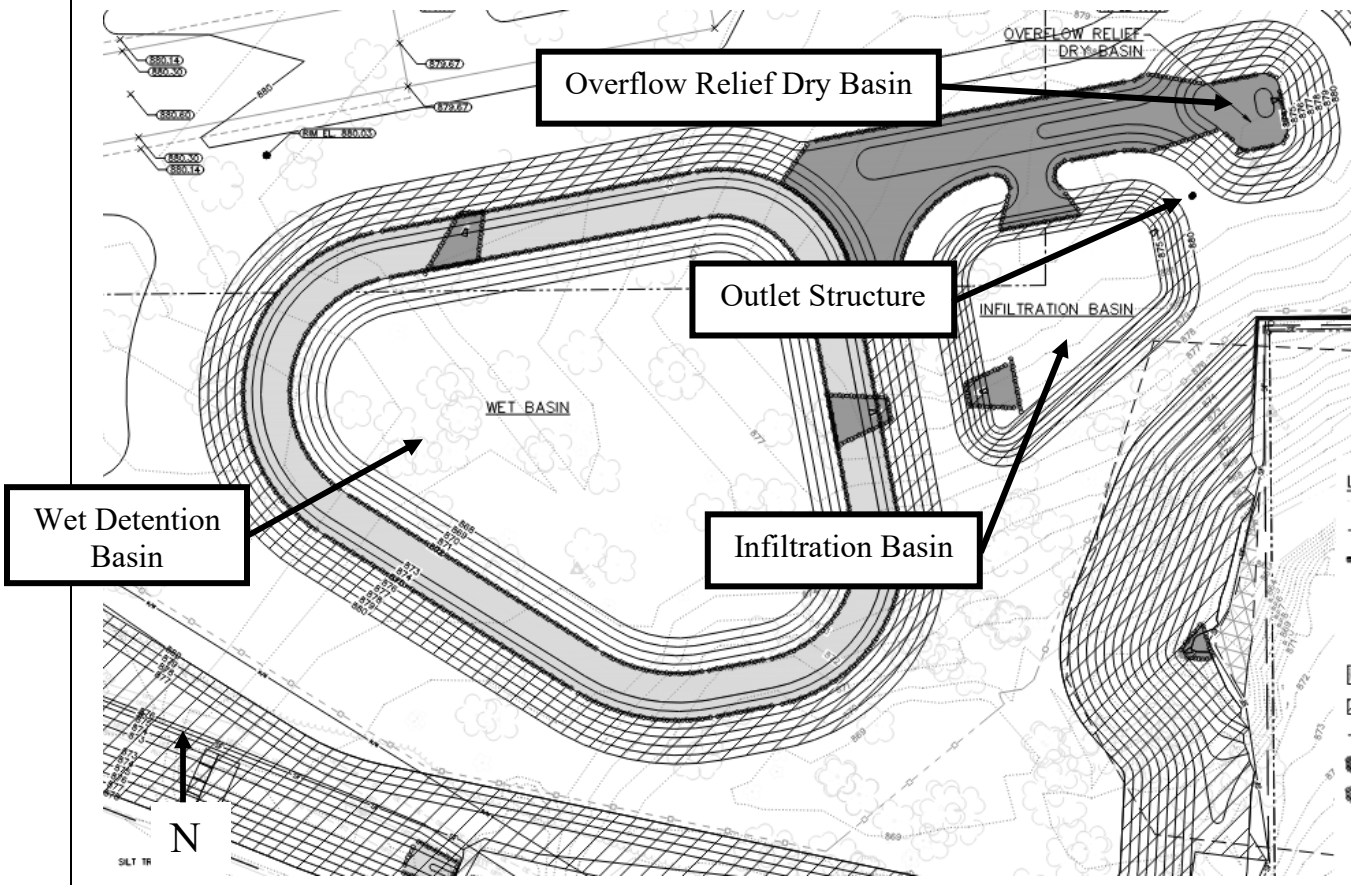


Exhibit C
Storm Water Practice Maintenance Plan

This exhibit explains the basic function of each of the storm water practices listed in Exhibit B and prescribes the minimum maintenance requirements to remain compliant with this Agreement. The maintenance activities listed below are aimed to ensure these practices continue serving their intended functions in perpetuity. The list of activities is not all inclusive, but rather indicates the minimum type of maintenance that can be expected for this particular site. Any failure of a storm water practice that is caused by a lack of maintenance will subject the Owner(s) to enforcement of the provisions listed on page 1 of this Agreement by the City of Waukesha.

System Description:

A wet detention basin and a dry infiltration basin will be constructed on-site to control stormwater by reducing the rate of runoff and enhancing the quality of runoff flowing from the site. The Wet Detention Basin is connected to the Infiltration Basin with a 36-inch diameter round culvert. The Infiltration Basin drains into an Overflow Basin and then to the wetland through the outlet. The outlet functions as a multi-stage outlet, with a 4-inch diameter low-flow orifice outlet, and a 24-inch diameter high-flow orifice.

The proposed development consists of approximately 17 acres of developed land, delineated into two sub-basins. The proposed development will disturb approximately 13.5 acres and will result in a net increase in impervious area of approximately 2.81 acres. The Wet Detention Basin is in the Sub-Pond 1 Area and collects flow from the site via storm sewer and overland flows. As runoff enters the pond, it is held back (detained) and slowly released through the control orifices. The Wet Detention Basin, along with the Infiltration Basin, will reduce the Total Suspended Solid (TSS) concentration in runoff by 75% (the TSS resulting composite goal) and will also dissipate chlorine from clear water discharges.

For the system to operate properly, the pond size, water level and outlet structures must be maintained as specified in this Agreement (see Figures 1, 2 and 3). "As-built" construction drawings of the basin, showing actual dimensions, elevations, outlet structures, etc. will be recorded as an addendum(s) to this agreement within 60 days after City of Waukesha accepts verification of construction from the project engineer.

Minimum Maintenance Requirements for the Wet Detention Basin:
To ensure the proper long-term function of the storm water management practices described above, the following activities must be completed:

1. All outlet pipes must be checked monthly to ensure there is no blockage from floating debris or ice, especially the washed stone in front of the 3-inch orifice and the trash rack on the riser in the main basin. Any blockage must be removed immediately. The washed stone must be replaced when it becomes clogged.
2. Inlets and outlets must be checked after heavy rains (minimum of annually) for signs of erosion. Any eroding areas must be repaired immediately to prevent premature sediment build-up in the downstream forebays or basin. Erosion matting is recommended for repairing grassed areas.
3. NO trees are to be planted or allowed to grow on the earthen berms. Tree root systems can reduce soil compaction and cause berm failure. The berms must be inspected annually, and any woody vegetation removed.
4. Invasive plant and animal species shall be managed in compliance with Wisconsin Administrative Code Chapter NR 40. This may require eradication of invasive species in some cases.
5. If the permanent pool falls below the safety shelf, a review shall be performed to determine whether the cause is liner leakage or an insufficient water budget. If the cause is leakage, the liner shall be repaired. Leakage due to muskrat burrows may require removal of the animals. If the permanent pool cannot be sustained at the design elevation, benching of the safety shelf may be necessary.
6. If floating algae or weed growth becomes a nuisance (decay odors, etc.), it must be removed from the basin or the forebay and deposited where it cannot drain back into the basin. Removal of the vegetation from the water reduces regrowth the following season (by harvesting the nutrients). Wetland vegetation must be maintained along the waters edge for safety and pollutant removal purposes.
7. When sediment in the infiltration basin and wet detention basin has accumulated to an elevation of three feet below the outlet elevation, it must be removed (see Exhibit D). All removed sediment must be placed in an appropriate upland disposal site and stabilized (grass cover) to prevent sediment from washing back

into the basin. The forebays will likely need sediment removal first. Failure to remove sediment from the forebays will cause resuspension of previously trapped sediments and increase downstream deposition.

8. No grading or filling of the basins or berm other than for sediment removal is allowed, unless otherwise approved by the City of Waukesha.
9. Periodic mowing of the grass swales will encourage vigorous grass cover and allow better inspections for erosion. Waiting until after August 1 will avoid disturbing nesting wildlife. Mowing around the basin or the forebays may attract nuisance populations of geese to the property and is not necessary or recommended.
10. Any other repair or maintenance needed to ensure the continued function of the storm water practices or as ordered by the City of Waukesha under the provisions listed on page 1 of this Agreement.
11. The titleholder(s) or their designee must document all inspections as specified above. Documentation shall include as a minimum: (a) Inspectors Name, Address and Telephone Number, (b) Date of Inspections, (c) Condition Report of the Storm Water Management Practice, (d) Corrective Actions to be Taken and Time Frame for Completion, (e) Follow-up Documentation after Completion of the Maintenance Activities. All documentation is to be delivered to the attention of the City Engineer at the City of Waukesha Engineering Department on January 10th and July 10th each year.

Minimum Maintenance Requirements for Infiltration Basin:

To ensure the proper function of storm water infiltration basin, the following list of maintenance activities are recommended:

1. A minimum of 70% soil cover made up of native grasses must be maintained on the basin bottom to ensure infiltration rates. Periodic burning or mowing is recommended to enhance establishment of the prairie grasses (which may take 2-3 years) and maintain the minimum native cover. To reduce competition from cool season grasses (bluegrass, fescues, quack, etc.) and other weeds:
    - For the first year, cut to a 6" height three times – once each in June, July and early August. To prevent damage to the native grasses, do not mow below a 6" height. Remove excessive accumulation of clippings to avoid smothering next year's seedlings.
    - After the first year, mowing may only be needed in early June each year to help control the spread of cool season plants. The mowing should also be raised to 10-12" to avoid damage to the warm season plants.
    - Burning may also be used to manage weeds in 2-5 years intervals. Late spring burns (mid-late May) provide maximum stimulus to warm season grasses and work well to control cool season grasses. Burn when the cool season grasses are growing, and the warm season plants are just barely starting to grow to get maximum control of cool season species.
    - Any major bare areas or areas taken over by nonnative species must be reseeded. To clear area of weeds and cool season grasses, treat with an herbicide that contains glysophosphate in accordance with manufacturer's instructions. Ensure a firm seedbed is prepared to a depth of 3 inches (a roller is recommended). Seeding should occur in early-mid June. Seed with Big Bluestem, Indian Grass, Little Blue Stem or Switchgrass (preferably an equal mix of all four types). A companion crop of oats is recommended. Seed must be placed at a depth of 1/4 – 1/2" and a minimum rate of 1/4 pound per 100 square feet. If broadcast seeding by hand, drag leaf rake over soil surface after seeding. Then roll it again and cover with a light layer of mulch and staked erosion control netting to hold it in place until germination. For other planting details, see NRCS standard 342 (Critical Area Planting).
2. Invasive plant and animal species shall be managed in compliance with Wisconsin Administrative Code Chapter NR 40. This may require eradication of invasive species in some cases.
3. The basin and all components (inlets, outlets, etc.) should be inspected after each heavy rain, but at a minimum of once per year. If the basin is not draining properly (within 72 hours), further inspection may be required by persons with expertise in storm water management and/or soils.
    - If soil testing shows that the soil surface has become crusted, sealed or compacted, some deep tillage should be performed. Deep tillage will cut through the underlying soils at a 2-3 foot depth, loosening the soil and improving infiltration rates, with minimal disturbance of the surface vegetation. Types of tillage equipment that can be used include a subsoiler or straight, narrow-shanked chisel plow.
    - If sedimentation is determined to be causing the failure, the accumulated sediment must be removed, and the area reseeded in accordance with the notes above.
    - If inspection of the monitoring well shows that groundwater is regularly near the surface, additional design features may need to be considered, such as subsurface drainage or conversion to a wetland treatment system.

- If the washed stone trench has become clogged, the stone – and possibly the soil immediately around the stone - must be replaced.

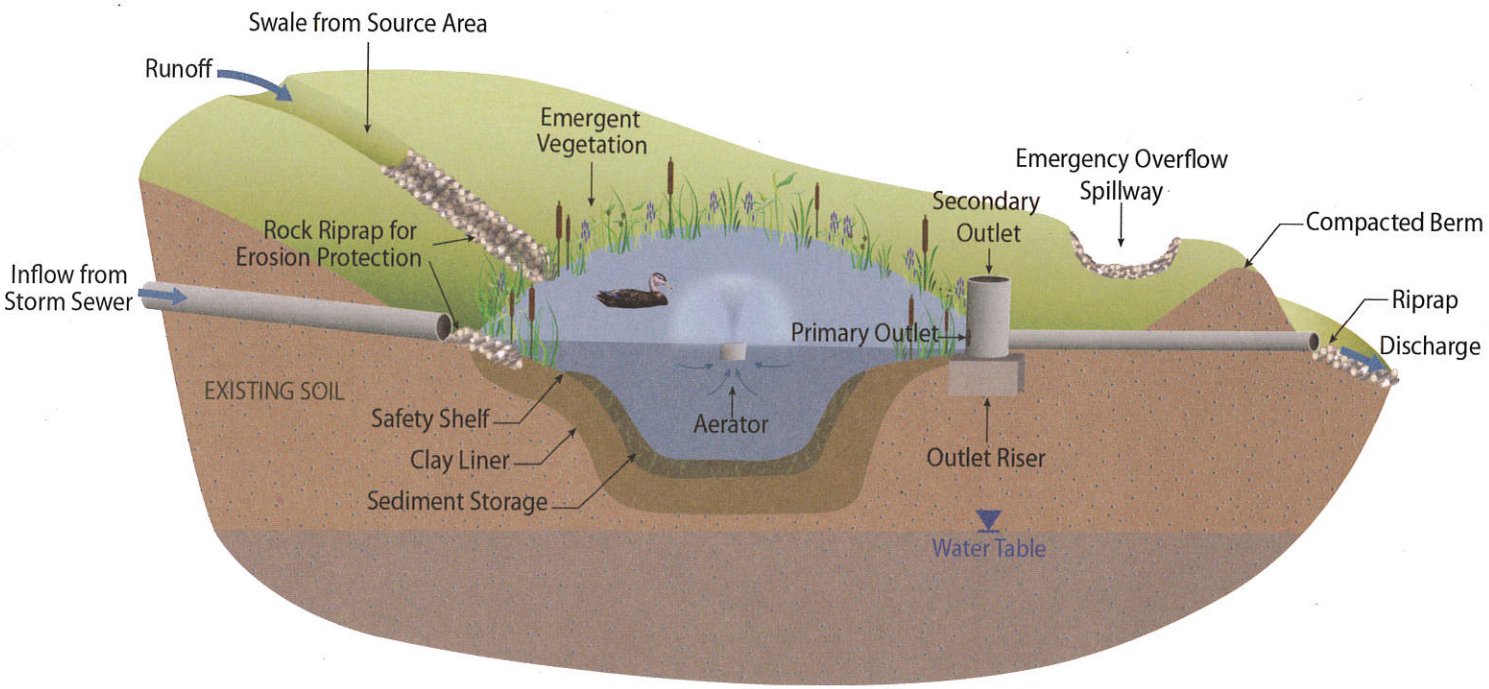
4. All outlet pipes, stone trenches and other flow control devices must be kept free of debris. Any blockage must be removed immediately.
5. Any eroding areas must be repaired immediately to prevent premature sediment build-up in the system. Erosion matting is recommended for repairing grassed areas.
6. Heavy equipment and vehicles must be kept off of the bottom and side slopes of infiltration basins to prevent soil compaction. Soil compaction will reduce infiltration rates and may cause failure of the basin, resulting in ponding and possible growth of wetland plants.
7. No trees are to be planted or allowed to grow on the earthen berms of the bottom of the basin. On the berms, tree root systems can reduce soil compaction and cause berm failure. On the basin bottom, trees may shade out the native grasses. The basin must be inspected annually, and any woody vegetation removed.
8. Grass swales leading to the basin shall be preserved to allow free flowing of surface runoff in accordance with approved grading plans. No buildings or other structures are allowed in these areas. No grading or filling is allowed that may interrupt flows in any way.
9. If floating algae or weed growth becomes a nuisance in the forebay (decay odors, etc.), it must be removed and deposited where it cannot drain back into the basin or forebay. Removal of the vegetation from the water reduces regrowth the following season (by harvesting the nutrients). Wetland vegetation must be maintained along the waters edge for safety and pollutant removal purposes.
10. When sediment in the forebay has accumulated to an elevation of three feet below the outlet elevation, it must be removed (refer to figure). All removed sediment must be placed in an appropriate upland disposal site and stabilized (grass cover) to prevent sediment from washing back into the basin. Failure to remove sediment from the forebays will cause resuspension of previously trapped sediments and increase deposition in the infiltration basin.
11. No grading or filling of the basin or berms other than for sediment removal is allowed.
12. Periodic mowing of the grass swales will encourage rigorous grass cover and allow better inspections for erosion. Waiting until after August 1 will avoid disturbing nesting wildlife. Mowing around forebay may attract nuisance populations of geese to the property and is not necessary or recommended.
13. Any other repair or maintenance needed to ensure the continued function of the infiltration basin as ordered by the City of Waukesha under the provisions listed on page 1 of this Agreement.
14. The titleholder(s) or their designee must document all inspections as specified above. Documentation shall include as a minimum: (a) Inspectors Name, Address and Telephone Number, (b) Date of Inspections, (c) Condition Report of the Storm Water Management Practice, (d) Corrective Actions to be Taken and Time Frame for Completion, (e) Follow-up Documentation after Completion of the Maintenance Activities. All documentation is to be delivered to the attention of the City Engineer at the City of Waukesha Engineering Department on January 10th and July 10th each year.

STORMWATER PONDS

Guidelines for Maintenance

A **stormwater pond** is a best management practice (BMP) that collects and holds storm runoff to remove pollutants carried by the water before they enter our rivers and lakes. Water reaches the stormwater pond through a combination of underground pipes, ditches and overland flow. Once the runoff enters the stormwater pond, sediment and other pollutants settle to the bottom. The water that entered as polluted runoff leaves the pond gradually, resulting in cleaner water draining into our lakes and streams and reduced flooding problems downstream.

Stormwater ponds are carefully designed to hold and treat runoff. Over time, the pond fills in with sediments and begins to lose its ability to remove pollutants. A smaller "forebay" may be present, which may fill up with sediment first. Maintenance is needed for the pond to continue to function the way it was designed, to protect our lakes and streams. Maintenance is also required by an agreement on file with the municipality.



NOT TO SCALE

Illustrations by Geosyntec Consultants, Inc.

ANNUAL MAINTENANCE FOR STORMWATER PONDS

DO-IT-YOURSELF

There are some maintenance jobs that can—and should—be regularly attended to by the owner of the stormwater pond. This includes:

- Remove vegetation/debris obstructions around the outlet pipes and trash rack. Outlets come in a variety of shapes and designs and may look different from the drawing on page 1.
- Check the sediment depth—most easily done through hole in ice when frozen. Many ponds will have a forebay where the runoff flows in, intended to trap the bulk of the sediment and which will fill up first.(See page 3.)
- Record water levels including depth along the safety shelf. This is best done by reading a depth gauge that is permanently mounted in the pond.
- Visually assess water quality and estimate percent weed/algae cover in early and late summer.
- Remove trash, litter and invasive plants. Cattails or reeds around the edge of the pond (safety shelf) help deter children and geese from entering the water and should be left uncut.
- Remove trees sprouting along the embankments. Left to grow, tree roots threaten the structural integrity of the embankments.
- Be sure to check the engineering design before doing any digging. Ponds often have a clay or synthetic lining that could be punctured or damaged resulting in a pond that no longer holds water.
- Inspect any fencing or signage for damage.
- Replace spent mosquito control devices.
- Invite bats to the area by installing bat houses to provide natural mosquito control.
- Aeration is sometimes added for algae control. While it helps with the aesthetics of a pond, it detracts from the sediment trapping abilities. Turn off aerators during rain or snow melt periods to allow settling of sediment.

ENLIST A PROFESSIONAL

Besides the maintenance that owners can do, a qualified inspector should be hired to annually inspect the pond and check for the following:

- The condition of the pipes, swales or structures where water flows into and out of the basin.
- Erosion of sideslopes, embankments, inlet/outlet, and emergency spillway, including the condition of rock riprap and underlying fabric.
- The condition of the pond liner (if present). Patch holes and remove burrowing animals, if necessary.
- The presence of invasive species. Develop a plan for their removal if necessary.
- The permanent pool elevation and sediment depth by surveying and referencing to a vertical benchmark (known elevation).
- Soft spots or settling that may have occurred in the embankment.

For a sample inspection report, visit the Waukesha County website at www.waukeshacounty.gov/cleanwater.

CHECKING SEDIMENT DEPTH

Simply use an ice auger to drill a hole and insert a measuring pole or rod into the hole to get the total depth. If distance from water surface to top of sediment is less than 3 feet, refer to a professional for advice on possible sediment removal. A reference to as-built surveys and design water levels is necessary. You may have less than 3 feet if water levels are low, so record water from the depth gauge levels at the same time. (See page 2.)

MANAGING THE WATERSHED: WHAT HOMEOWNERS CAN DO

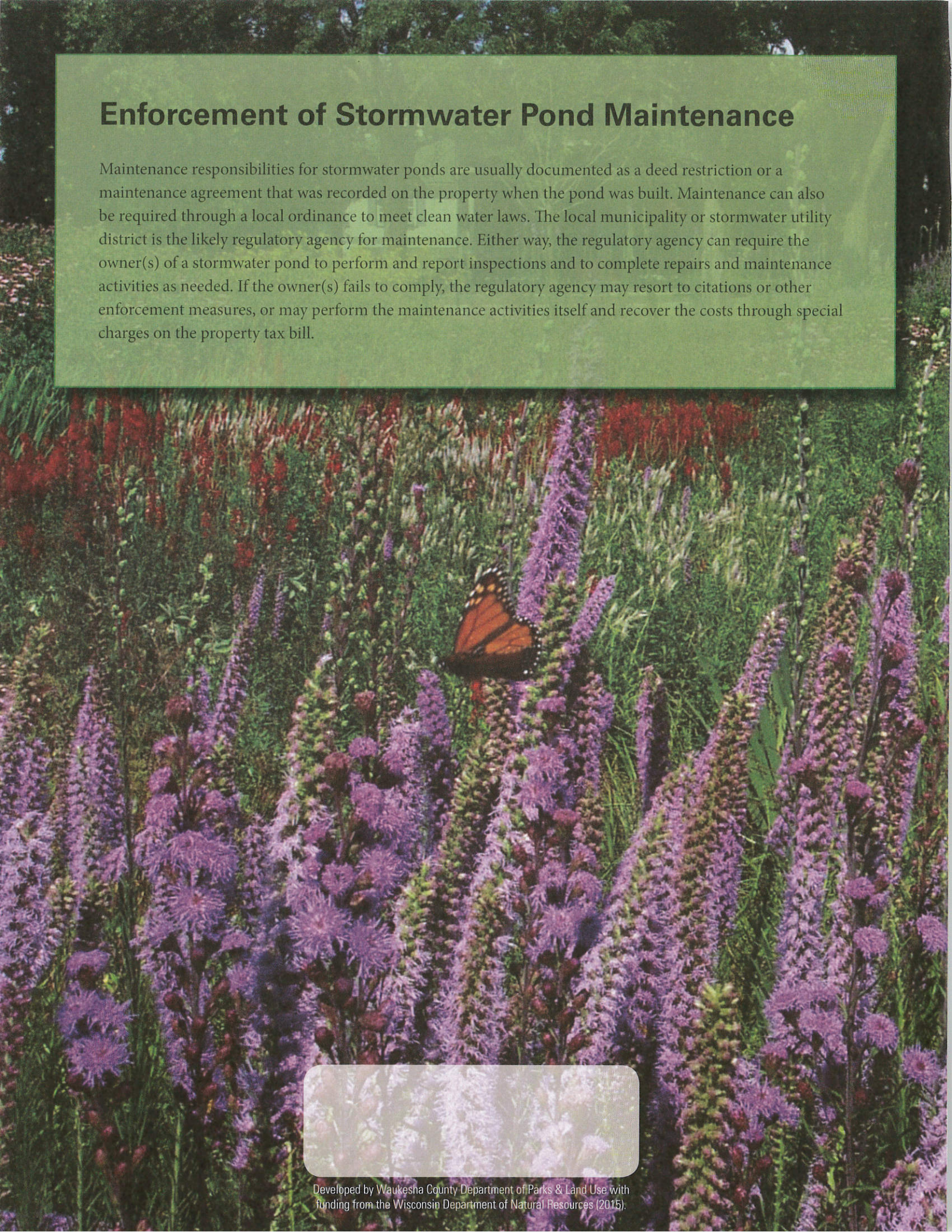
Many stormwater ponds are owned by a group of landowners and maintained through a homeowner association within a subdivision. In addition to maintaining the ponds, there are actions that each homeowner can take to manage the land that drains to the ponds. The following will help extend the life of the ponds and reduce water pollution at the same time:

- Regularly sweep litter and grass clippings off sidewalks, driveways, streets and parking lots.
- Test the soil in landscaped areas, and follow recommended application rates for fertilizers and pesticides.
- Pick up after pets. This also helps keep excess nutrients and bacteria out of the pond.
- Minimize salt application to impervious areas. Salt generally passes through the pond soils, damaging the plants and polluting the receiving surface and groundwater resources.
- Prevent sediment from leaving construction sites. The more sediment that enters the pond, the sooner it will require expensive soil restoration or replanting.

Ponds that fill up with sediment over time will have to be cleaned out, requiring expensive maintenance like dredging. Proper care and maintenance of your pond will extend its life.

Enforcement of Stormwater Pond Maintenance

Maintenance responsibilities for stormwater ponds are usually documented as a deed restriction or a maintenance agreement that was recorded on the property when the pond was built. Maintenance can also be required through a local ordinance to meet clean water laws. The local municipality or stormwater utility district is the likely regulatory agency for maintenance. Either way, the regulatory agency can require the owner(s) of a stormwater pond to perform and report inspections and to complete repairs and maintenance activities as needed. If the owner(s) fails to comply, the regulatory agency may resort to citations or other enforcement measures, or may perform the maintenance activities itself and recover the costs through special charges on the property tax bill.



Developed by Waukesha County Department of Parks & Land Use with funding from the Wisconsin Department of Natural Resources (2015).

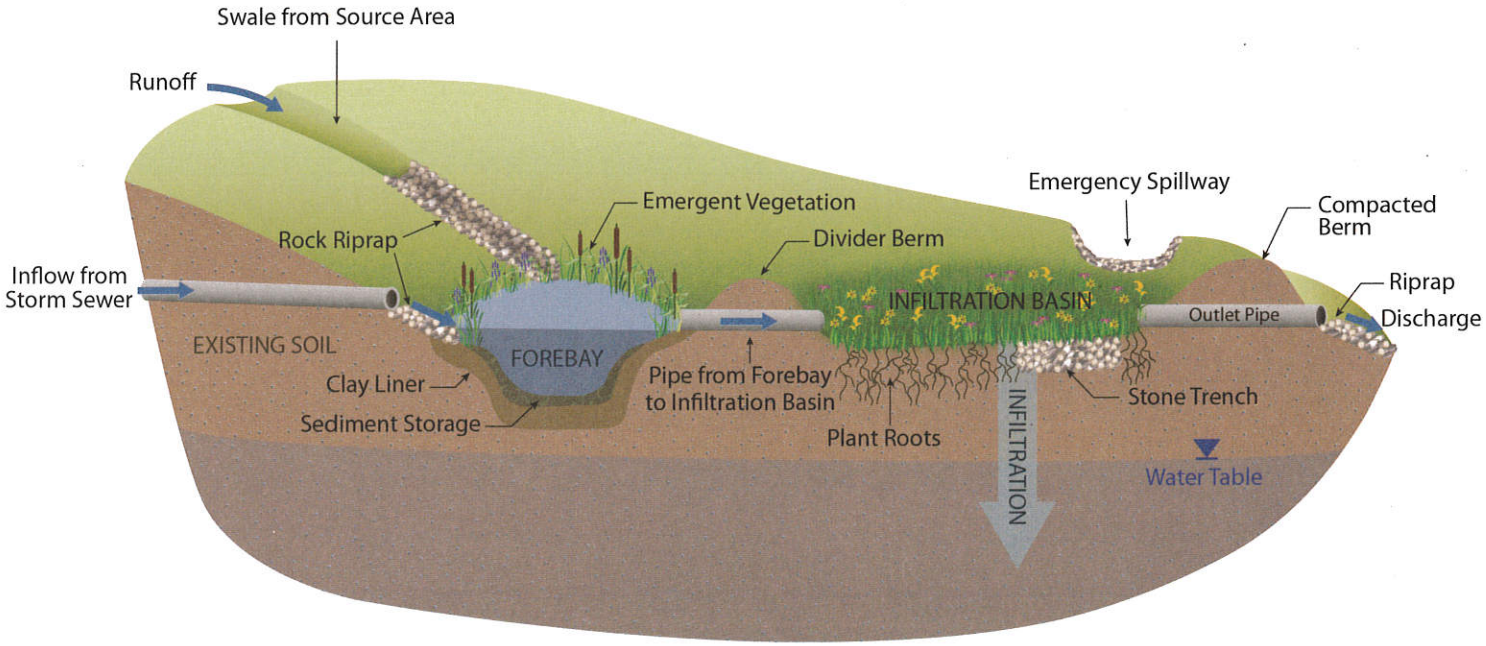
INFILTRATION BASINS

Guidelines for Maintenance

An **infiltration basin** is a storm water best management practice (BMP) designed to capture runoff and let it soak into the ground—a process called infiltration. The basin is carefully engineered to infiltrate runoff volumes from the specific land area, or watershed that drains to the basin. Runoff will enter the infiltration basin through a combination of underground pipes, ditches and overland flow. A small pond, or forebay, is usually constructed at the inflow area to trap sediment and attached pollutants before entering the infiltration basin. This can help prevent plugging the soils in the infiltration basin.

The bottom of the infiltration basin is flat, wide and planted with vegetation specifically designed to encourage infiltration (see page 2). There may be a stone-filled trench constructed within the basin bottom or near the perimeter to further enhance infiltration, especially during frozen ground periods. The basin will usually have an overflow pipe and an emergency spillway to handle runoff events that exceed the design capacity. The infiltration basin is generally designed not to pond runoff in the basin for more than a few days at a time.

An infiltration basin may act like a leaky pond, but they are very effective at protecting local lakes, rivers and downstream properties from water pollution and flooding caused by urban runoff. Infiltrating runoff also helps replenish the groundwater, the source of drinking water for 80% of Wisconsin residents. Groundwater also supports water levels in local lakes and base flows in streams, especially during periods of dry weather.



Note: Rain gardens are essentially small infiltration basins. They are designed to capture and infiltrate runoff from small watersheds such as a rooftop, driveway or small parking lot. Some roadside or backyard swales are also designed as small infiltration practices.

NOT TO SCALE

Illustrations by Geosyntec Consultants, Inc.

THE NATIVE LANDSCAPE

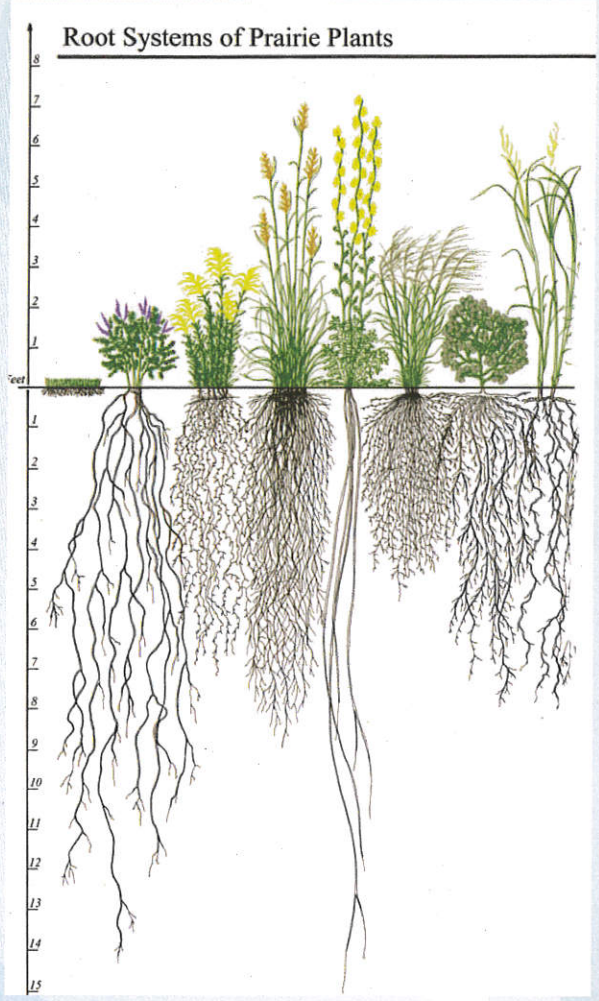


Image Source: Conservation Resource Institute

Before our landscape was developed, very little rainfall actually ran off the ground. Most of it soaked into the soil, where it was either used by plants or became part of the groundwater system. Native plants are used in infiltration basins to help replicate some of these conditions. Native plants have very deep root systems with as much as two-thirds of the plant being underground. This massive root system improves the soil, creating more pathways for infiltration, and making the basin more effective at soaking up runoff and filtering pollutants. By comparison, turf grass (pictured at far left in the illustration) only has a few inches of root mass. Other benefits of using native plants include:

- Creating habitat and food sources for birds, butterflies, bees and other wildlife.
- Absorbing more nutrients in runoff like phosphorous and nitrogen, which cause algae blooms and excessive weed growth in lakes and streams.
- Improving aesthetics of the infiltration basin, providing year round interest and color with a mix of wildflowers and grasses.
- Reducing maintenance needs (once established), such as mowing, watering (plants are drought resistant), or use of fertilizer or pesticide.

MANAGING THE WATERSHED: WHAT HOMEOWNERS CAN DO

Many infiltration basins are owned by a group of landowners and maintained through a homeowner association within a subdivision. In addition to maintaining the basin, there are actions that each homeowner can take to manage the land that drains to the basin. The following will help extend the life of the basin and reduce water pollution at the same time:

- Regularly sweep litter and grass clippings off sidewalks, driveways, streets and parking lots.
- Test the soil in landscaped areas, and follow recommended application rates for fertilizers and pesticides.
- Pick up after pets. This also helps keep excess nutrients and bacteria out of the basin.
- Minimize salt application to impervious areas. Salt generally passes through the basin soils, damaging the plants and polluting the receiving surface and groundwater resources.
- Prevent sediment from leaving construction sites. The more sediment that enters the basin, the sooner it will require expensive soil restoration or replanting.

MAINTENANCE FOR INFILTRATION BASINS

DO-IT-YOURSELF

There are some maintenance jobs that can—and should—be regularly attended to by the owner of the infiltration basin. This includes:

- Inspect and remove debris in the forebay, or near the inflow or outlet pipes, stone trench and spillway.
- Remove weeds by carefully spot-applying herbicide rather than by pulling. This is because pulling weeds disturbs the soil and provides an opening for invasive species to grow.
- Remove excessive dead plant material in the early spring.
- Replant with different species if an original plant dies out. The original plant may have been unsuitable for the soil type or degree of wetness.
- Water native plants during establishment only. Once established, watering won't be necessary.

ENLIST A PROFESSIONAL

Besides the maintenance that an owner can do, a qualified inspector should be hired annually to inspect and repair the following, as needed:

- The condition of the forebay, including the amount of sediment build-up or liner damage. Take soil cores if needed to evaluate liner. Patch holes and remove burrowing animals, if necessary.
- The condition of the pipes, swales or structures where water flows into and out of the basin.
- Erosion of side slopes, embankments, inlet/outlet, and emergency spillway, including the condition of rock riprap and underlying filter fabric.
- Detect the presence of invasive species. Develop a plan for their removal if necessary.
- Soft spots or settling that may have occurred in the embankment.
- Diagnose any reported prolonged ponding (more than three days). Evaluate the condition of the soils, taking core samples and testing infiltration rates, if needed.
- Burn every-other-year in April where feasible. Otherwise, mow in late spring or very early summer to a height of 4 to 6 inches. The purpose is to cut the weeds before they can go to seed, and do it before the native plants start to really shoot up. This cutting height generally requires a brush hog or similar device. A normal lawn mower will cut it too short.
- Remove any large trees growing in the embankment and re-compact the soil as needed.
- Develop plans to repair damaged structures, plantings or forebay liners, to remove sediment or enhance soil infiltration rates (aeration, tillage, etc.), if necessary.

For a sample inspection report, visit:
www.waukeshacounty.gov/cleanwater

Enforcement of Infiltration Basin Maintenance

Maintenance responsibilities for infiltration basins are usually documented as a deed restriction or a maintenance agreement that was recorded on the property when the basin was built. Maintenance can also be required through a local ordinance to meet clean water laws. The local municipality or storm water utility district is the likely regulatory agency for maintenance. Either way, the regulatory agency can require the owner(s) of an infiltration basin to perform and report inspections and to complete repairs and maintenance activities as needed. If the owner(s) fails to comply, the regulatory agency may resort to citations or other enforcement measures, or may perform the maintenance activities itself and recover the costs through special charges on the property tax bill.

Developed by Waukesha County Department of Parks & Land Use with funding from the Wisconsin Department of Natural Resources (2015).

Send Inspection Reports to:

City of Waukesha
ATTN: Velvet Weier
130 Delafield Street
Waukesha, WI 53188

BMP Inspection Report

(Rev 11/12/18)

OWNER/REPRESENTATIVE INFORMATION	
Name:	**Representative (Y/N)**
Address:	
Email:	
Phone:	

INSPECTOR INFORMATION
Name:
Company:
Contact:

BMP INFORMATION	
Location:	
BMP Type:	**Year of Installation:**
ID#/Tax Key:	**Record Drawing Available**

INSPECTION	
Date:	**Date of Last Precipitation:**
Weather:	**Amount of Precipitation (inches):**

ITEM	Okay	Modify	N/A	NOTES
1) Access - 3' wide Inspection	☐	☐	☐	
2) Access - 12' wide Equipment	☐	☐	☐	
3) Slopes - Fully vegetated, no bare soil/erosion	☐	☐	☐	
4) Trees - None present in basin or on slopes	☐	☐	☐	
5) Safety Shelf	☐	☐	☐	
6) Emergency Spillway	☐	☐	☐	
7) Inlet(s) - No obstruction/no erosion	☐	☐	☐	
8) Inlet(s) - Quantity inspected	_____			
9) Outlet(s) - No obstruction/no erosion	☐	☐	☐	
10) Outlet(s) - Quantity inspected	_____			
11) Control Structure - Functional and secure	☐	☐	☐	
12) All Rip Rap - Clear of debris and vegetation	☐	☐	☐	
13) Sedimentation - No major accumulation	☐	☐	☐	
14) Permanent Pool Level - Per plan/weir	☐	☐	☐	
15) Evidence of pollutant *(e.g. oily sheen, trash)*	☐	☐	☐	
16) Evidence of invasive species	☐	☐	☐	
17) Evidence of burrowing animals	☐	☐	☐	
18) * Permanent Pool Level - Elevation	_____			
19) * Depth from sediment to water surface	_____			

INSPECTION SUMMARY/ADDITIONAL NOTES

PHOTOS
Include at least 3 photos with descriptions
1) Overall BMP condition
2) Condition of Control Structure
3) Condition of Inlet, Outlet, Spillway(s)
Other: *Items requiring significant maintenance, hazards, questionable findings*

RESOLUTION OF MODIFICATIONS

ACTION # KEY: (**1**) Monitor Condition (**2**) Routine Maintenance (**3**) Urgent Modification Required

ITEM #	DESCRIPTION OF WORK REQUIRED	ACTION #

COMPANY SCHEDULED TO PERFORM REQUIRED MODIFICATIONS
Name:
Company:
Contact:

GREELEY AND HANSEN

741 N. Grand Ave., Suite 308
Waukesha, WI 53186