Salem ASR Expansion Facility
Salem, OR

Final Stormwater Report

Date:	September 18, 2020
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AKS Job Number:	7563

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1.0 Project Overview and Description

1.1. Size and Location of Project Site

The total project site subject to this stormwater report is ±1.17 acres located at the existing City of Salem Water Facility adjacent to Woodmansee Park near 4550 Sunnyside Rd SE Salem, Marion County, Oregon, Tax Lot 200 and 300 of Marion County Assessor's Map 8 3W 10DB.

1.2. Property Scope and Proposed Improvements

The property is zoned RS (Single Family Residential). The proposed development involves demolishing the existing facility building, entrance driveway from Sunnyside Rd, and constructing a new water distribution facility building, parking lot, landscaped areas, stormwater facility, utilities, and other associated infrastructure.

1.3. Watershed Description

Current site runoff flows toward the north and northeast to Pringle Creek which flows across the western portion of the subject property from southwest to northeast. Pringle Creek ultimately drains to Willamette Slough in downtown Salem.

Runoff from the proposed development will be conveyed to a Green Stormwater Infrastructure (GSI) facility before being released at the allowable release rates.

1.4. Existing Site Conditions

The site currently contains an existing City of Salem Water Facility and is relatively flat, with on-site grades averaging 5-7% percent. The site slopes from a high point of ±381.5 feet in the southwest corner to a low point of ±367.50 feet at the northwest corner of the site.

1.5. Existing Trees and Native Vegetation Impact/Preservation

The interior of the site is relatively clear of vegetation, although the site contains approximately 37 trees. These existing trees will be removed as part of the proposed development and replaced as part of the City-approved landscaping plan.

1.6. Green Stormwater Infrastructure to the Maximum Extent Feasible (GSI/MEF)

This project is classified as a large project because it contains over 10,000 square feet of impervious area. As specified in Section 4.3 of the 2016 City of Salem *Public Works Design Standards*, large projects are required to use GSI to the Maximum Extent Feasible (GSI/MEF) to meet flow control and water quality treatment performance standards.

A proposed detention facility will be used to meet the GSI/MEF criteria for the proposed site. This project is treating over 80 percent of the new or replaced impervious surface and therefore meets the GSI/MEF requirement by using the discretionary approach outlined in section 4E.7 of the *Public Works Design Standards*.

See the attached figures for more information on the proposed facility.

1.7. Regulatory Permits Required

Building and site work permits through the City of Salem will be required for the project.

1.8. Emergency Overflow Escape Route

The stormwater system has been designed to convey stormwater runoff from storms with intensities higher than the 10-year design storm through an overflow in the flow control ditch inlet that discharges directly to Pringle Creek. Emergency overland overflow is available should the stormwater system be overwhelmed.

2.0 Methodology

2.1. Soils and Geologic Features

The pre-developed site contains Jory Silty Clay Loam, McAlpin Silty Clay Loam, Nekia Silty Clay Loam (2-7% and 12-20% slopes), and Salkum Silty Clay Loams, belonging to Hydrologic Soil Groups C and B, per the Natural Resources Conservation Service (NRCS) Soil Resource Web Survey (Appendix A).

2.2. Hazardous Materials

AKS is not aware of any existing hazardous material contamination onsite.

3.0 Analysis

3.1. Computational Methods and Software Used

The Santa Barbara Urban Hydrograph (SBUH) method was used to analyze stormwater runoff from the site. This method uses the NRCS Type 1A 24-hour design storm for the region. HydroCAD 10.0-22 computer software aided in the analysis.

3.2. Design Assumptions

The design of the stormwater system was analyzed for runoff generated by the water quality design storm event, one-half of the 2-year 24-hour design storm event, the 10-year 24-hour design storm event, the 25-year 24-hour design storm event, and the 100-year 24-hour design storm event.

The following 24-hour rainfall intensities were used for the design storm for the recurrence interval:

Table 3-1: Rainfall Intensities

Recurrence Interval (Years)	Total Precipitation Depth (Inches)
½ of 2-Year	1.10
Water Quality	1.38
10-Year	3.20
25-Year	3.60
100-Year	4.40

The following table outlines the Hydrologic Soil Group rating for the soil type:

Table 3-2: Hydrologic Soil Group Ratings

NRCS Map Unit Identification	NRCS Soil Classification (Percentage of Site)	Hydrologic Soil Group Rating
JoB	Jory Silty Clay Loam (35%)	C
MaA	McAlpin Silty Clay Loam (28%)	C
NeB	Nekia Silty Clay Loam, 2-7% Slopes (9%)	C
NeD	Nekia Silty Clay Loam, 12-20% Slopes (4%)	C
SlB	Salkum Silty Clay Loam (24)	B

The following CNs were used for this analysis:

- Pre-Developed – City of Salem Pre-Development CN=72 per *Public Works Design Standards*
- Post-Developed – CN=98 was used for all impervious surfaces; CN=74 for pervious surfaces

A time-of-concentration (Tc) of 23.8 minutes was used for pre-developed hydrograph routing based on a sheet flow length of 280 feet and an average slope across the site of 7%.

The minimum Tc of 6 minutes, per Technical Release 55 (TR-55), was used as a direct entry in the stormwater system model for post-developed hydrograph routing.

3.3. Hydrology Calculations

Tables 3-3, 3-4, and 3-5 below summarize areas tributary to each facility and the calculated elevations within each facility for post-developed peak flow rates of the half the 2-year, water quality, 10-year, 25-year, and 100-year design storm events. Supporting HydroCAD calculations are provided in Appendix B.

3.4. Conveyance Capacity Calculations

The proposed drainage conveyance system has been designed to convey the peak flows for the 10-year 24-hour storm event for a local storm drain with a drainage area less than 50 acres, per section 4.8 of the *Public Works Design Standards.*

3.5. Treatment Sizing

Water quality calculations are provided in Appendix C and summarized in Table 3-4 below, which shows that the water quality design storm event peak elevation is below the water quality overflow elevation for the facility, the peak flows will be fully retained by the facility.

Table 3-3: Impervious Area Conveyed to Facility

Subbasin ID	Source (roof, road, other)	Contributing Area (square feet)	Facility Ownership (private/public)	Facility Type	Facility Size (square feet)
POST	Parking, Road, Roof	±32,150 – Impervious 5,000 – Pervious	Private	Filtration Rain Garden	±5,000 Filtration Rain Garden

Table 3-4: Water Quality Event Summary

Facility ID	Facility Bottom Elevation (feet)	Facility Peak Elevation (Water Quality Event) (feet)	Overflow Elevation (feet)
2S (Filtration Rain Garden)	373.00	373.74	373.85

3.6. Flow Control Sizing

Post-developed peak flow HydroCAD calculations are shown in Appendix C and are summarized below. The onsite facility was modeled as two separate nodes although this will be constructed as one continuous facility.

The onsite facility is designed to fully filtrate the water-quality and half of the 2-year design storms conveying larger design storms through an overflow structure. The flow control structure contains a 0.3" orfice sized to satisfy the peak flow control requirements for post- to pre-developed half of the 2-year design storm event and a 1.2-inch orifice sized to satisfy the peak flow control requirements for post- to pre-developed 10-year design storm event. A 10-inch pipe is used to convey flows from the water quality overflow structure to the flow control structure. The 25-year and 100-year design storms are conveyed through a 10-inch orifice in the flow control structure. Refer to the attached figures for the post-developed stormwater facility layout and Appendix B for HydroCAD calculations.

Table 3-5 shows the peak elevation summary for the stormwater facilities during the water quality, half of the 2-year, 10-year, 25-year, and 100-year design storm events.

Table 3-5: Detention and Peak Elevation Summary

Facility ID	Orifice Diameter & Elevation	Overflow (feet)	Peak Elevation, ½ the 2-year Event (feet)	Peak Elevation, 10-year Event (feet)	Peak Elevation, 25-year Event (feet)	Peak Elevation, 100 Year Event (feet)
2S (Water Quality)	10” Orifice Elevation: 373.85	373.85	373.52	374.00	374.03	374.07
3S (Drain Rock Storage)	0.3” Orifice Elevation: 368.00	371.10	370.10	371.27	371.28	371.27
4S (Flow Control Above Water Quality)	1.2” Orifice Elevation: 370.00	375.10	NA	374.70	374.88	375.15

3.7. Pre- Vs. Post-Developed Condition Results

All stormwater from replaced and newly created impervious area will be routed into the proposed onsite facility.

The following table summarizes the calculated runoff for pre- and post-developed peak flow rates for half the 2-year, 10-year, 25-year, and 100-year design storm events. Supporting HydroCAD calculations are provided in Appendix B.

Table 3-6: Pre- Vs. Post-Developed Flow Rates

Peak Flow Rate (cubic feet per second)							
Half of the 2-Year Storm		10-Year Storm		25-Year Storm		100-Year Storm	
Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
0.00	0.00*	0.09	0.08	0.13	0.09	0.23	0.18

*Half of the 2-year design storm is fully filtrated under post-developed conditions

4.0 Conclusion

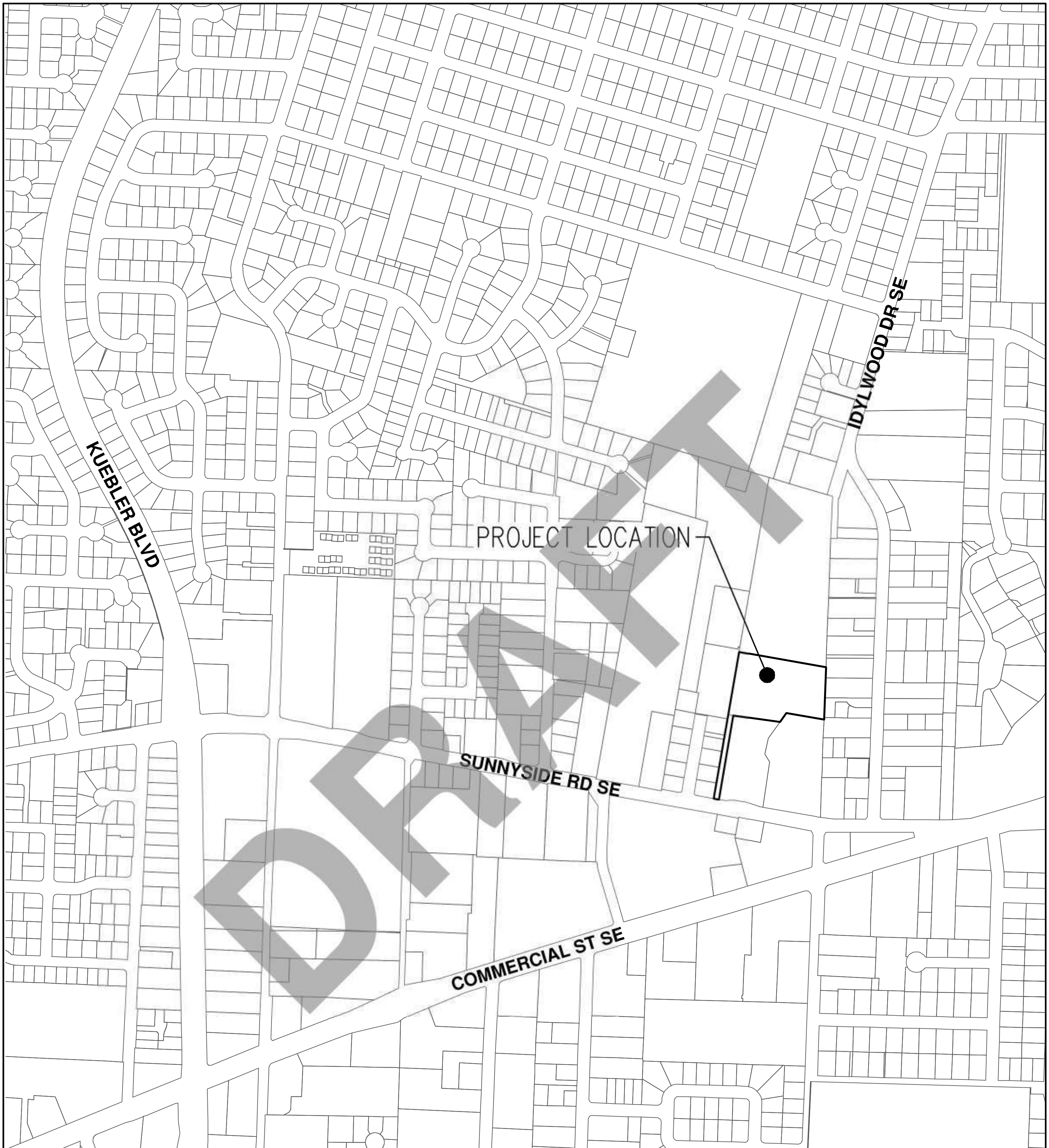
This stormwater report describes the engineering and design process used for the design of the stormwater facility for this project. The GSI facility has been designed in compliance with the City of

Salem's *Public Works Design Standards*. Supporting HydroCAD calculations are included in Appendix B. Facility Maintenace forms for the cfiltration rain garden are included in Appendix C.

Runoff from the new building, entry road, parking lot, and immediate surrounding areas will be conveyed to the proposed GSI facility discussed previously.

The proposed storm system has been designed to treat over 80 percent of the new or replaced impervious surface and therefore meets the GSI/MEF requirement by using the discretionary approach outlined in 4E.7 of the *Public Works Design Standards*. Detention has been provided in accordance with the *Public Works Design Standards* to detain the 10-year design storm event. Post-developed flows for the 10-year, 25-year, and 100-year design storms are less than peak flows from these design storms in pre-developed conditions.

Figure 1: Vicinity Map



DATE: 09/18/2020

SALEM ASR- VICINITY MAP

FIGURE
1

AKS ENGINEERING & FORESTRY, LLC
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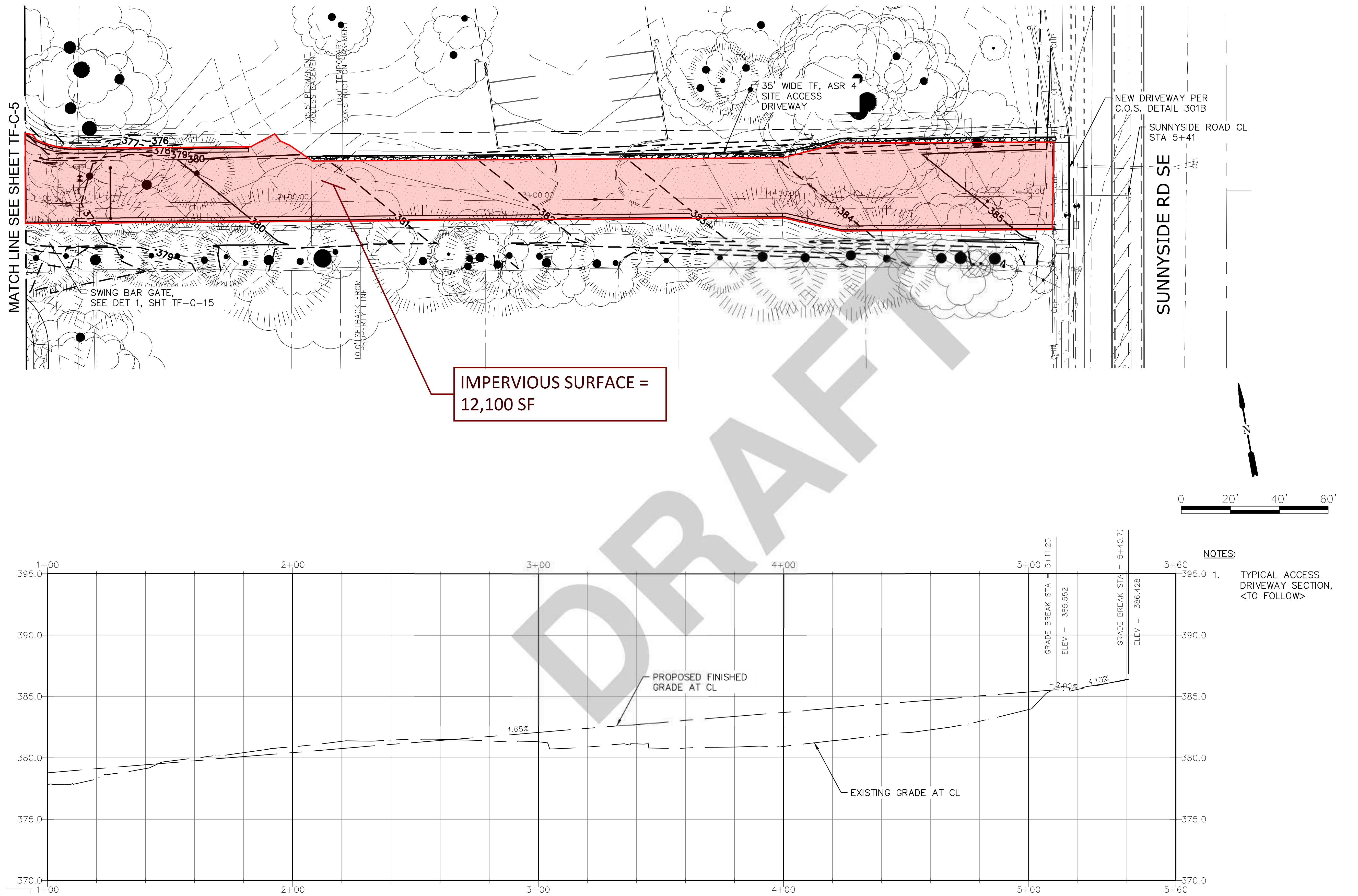
DRWN: JWB
CHKD: RCW
AKS JOB:
7563

DWG: 7563 20200917 BASIN MAP | FIG 1

Figure 2: Post-Developed Basin Map



NOTES:

1. TYPICAL ACCESS DRIVEWAY SECTION, <TO FOLLOW>

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ENGINEERING DIVISION

SALEM PUBLIC WORKS DEPARTMENT

SHEET PREPARED BY:

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90% SUBMITTAL

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9/2/2020

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JULY 2020

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NO.	DESCRIPTION	DATE	BY

PN:719000

HORIZ DATUM: NAD 83-SPCS
VERT DATUM: NGVD 1929 (47)
HORIZ SCALE: AS SHOWN
VERT SCALE:
DESIGN: KGC
DRAWN: BAW
CHECKED:
APPROVED:

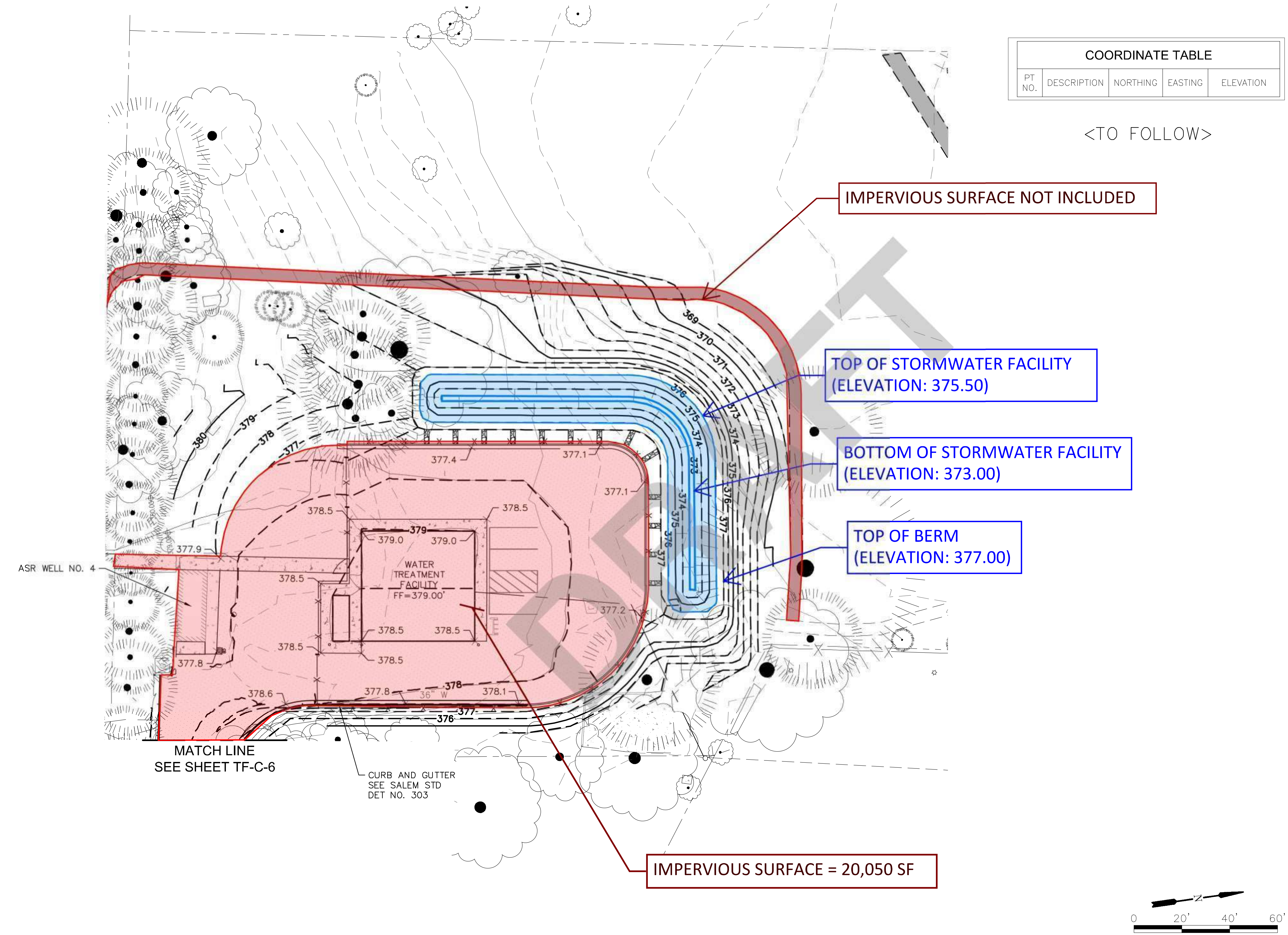
SHEET TITLE

SCHEDULE A
TREATMENT FACILITY
SITE ACCESS
DRIVEWAY
PROFILE & DETAILS

TF-C-6

SHEET ---- OF

G:\PDX_Projects\19\2629 - Salem Improvements To ASR\CAD\Sheets\SCHED A - TF And Onsite Piping\19-2629-OR-TF-C-6.dwg TF-C-6 6/23/2020 2:04 PM LEA.CONNORS 23.0s (LMS Tech)



COORDINATE TABLE

PT NO.	DESCRIPTION	NORTHING	EASTING	ELEVATION

<TO FOLLOW>

CITY OF Salem AT YOUR SERVICE
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REVISIONS

NO.	DESCRIPTION	DATE	BY

PN:719000

HORIZ DATUM: NAD 83-SPCS
VERT DATUM: NGVD 1929 (47)
HORIZ SCALE: AS SHOWN
VERT SCALE:
DESIGN: LRC
DRAWN: CAD
CHECKED:
APPROVED:

SHEET TITLE

SCHEDULE A TREATMENT FACILTY SITE GRADING PLAN

TF-C-8

SHEET ---- OF

Appendix A: NRCS Soil Resource Web Survey Results

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

Marion County Area, Oregon

May 13, 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.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

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.

Soil Map

Map Scale: 1:3,040 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 45, 90, 180, 270

Feet: 0, 100, 200, 400, 600

N

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

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Marion County Area, Oregon
Survey Area Data: Version 16, Sep 10, 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, 2018—Aug 31, 2018

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
JoB	Jory silty clay loam, 2 to 7 percent slopes	10.7	35.3%
MaA	McAlpin silty clay loam, 0 to 3 percent slopes	8.4	27.5%
NeB	Nekia silty clay loam, 2 to 7 percent slopes	2.8	9.2%
NeD	Nekia silty clay loam, 12 to 20 percent slopes	1.2	4.1%
SlB	Salkum silty clay loam, basin, 0 to 6 percent slopes	7.3	24.0%
Totals for Area of Interest		**30.4**	**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.

Marion County Area, Oregon

JoB—Jory silty clay loam, 2 to 7 percent slopes

Map Unit Setting

National map unit symbol: 24px
Elevation: 300 to 1,000 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 190 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Jory

Setting

Landform: Hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from tuff and basalt

Typical profile

H1 - 0 to 15 inches: silty clay loam
H2 - 15 to 63 inches: clay

Properties and qualities

Slope: 2 to 7 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 (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 10.2 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Forage suitability group: Well drained < 15% Slopes (G002XY002OR)
Hydric soil rating: No

MaA—McAlpin silty clay loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 24qd
Elevation: 250 to 1,000 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 190 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Mcalpin and similar soils: 95 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mcalpin

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium

Typical profile

H1 - 0 to 23 inches: silty clay loam
H2 - 23 to 65 inches: silty clay

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 24 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 10.5 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Forage suitability group: Moderately Well Drained < 15% Slopes (G002XY004OR)
Hydric soil rating: No

Minor Components

Waldo

Percent of map unit: 2 percent
Landform: Flood plains
Landform position (three-dimensional): Tread

Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

NeB—Nekia silty clay loam, 2 to 7 percent slopes

Map Unit Setting

National map unit symbol: 24qt
Elevation: 300 to 1,000 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 190 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Nekia and similar soils: 85 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nekia

Setting

Landform: Hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from tuffs and basalt

Typical profile

H1 - 0 to 9 inches: silty clay loam
H2 - 9 to 36 inches: clay
H3 - 36 to 40 inches: unweathered bedrock

Properties and qualities

Slope: 2 to 7 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.2 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Forage suitability group: Well drained < 15% Slopes (G002XY002OR)
Hydric soil rating: No

Minor Components

Aquults

Percent of map unit: 2 percent
Landform: Hills
Hydric soil rating: Yes

NeD—Nekia silty clay loam, 12 to 20 percent slopes

Map Unit Setting

National map unit symbol: 24qw
Elevation: 300 to 1,000 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 190 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Nekia

Setting

Landform: Hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from tuffs and basalt

Typical profile

H1 - 0 to 9 inches: silty clay loam
H2 - 9 to 36 inches: clay
H3 - 36 to 40 inches: unweathered bedrock

Properties and qualities

Slope: 12 to 20 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.2 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e

Hydrologic Soil Group: C
Forage suitability group: Well Drained > 15% Slopes (G002XY001OR)
Hydric soil rating: No

SIB—Salkum silty clay loam, basin, 0 to 6 percent slopes

Map Unit Setting

National map unit symbol: 24r9
Elevation: 250 to 1,000 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 190 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Salkum and similar soils: 90 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Salkum

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Weathered gravelly alluvium

Typical profile

H1 - 0 to 20 inches: silty clay loam
H2 - 20 to 40 inches: silty clay
H3 - 40 to 65 inches: silty clay loam

Properties and qualities

Slope: 0 to 6 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 (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 10.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Forage suitability group: Well drained < 15% Slopes (G002XY002OR)
Hydric soil rating: No

Minor Components

Waldo

Percent of map unit: 3 percent
Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

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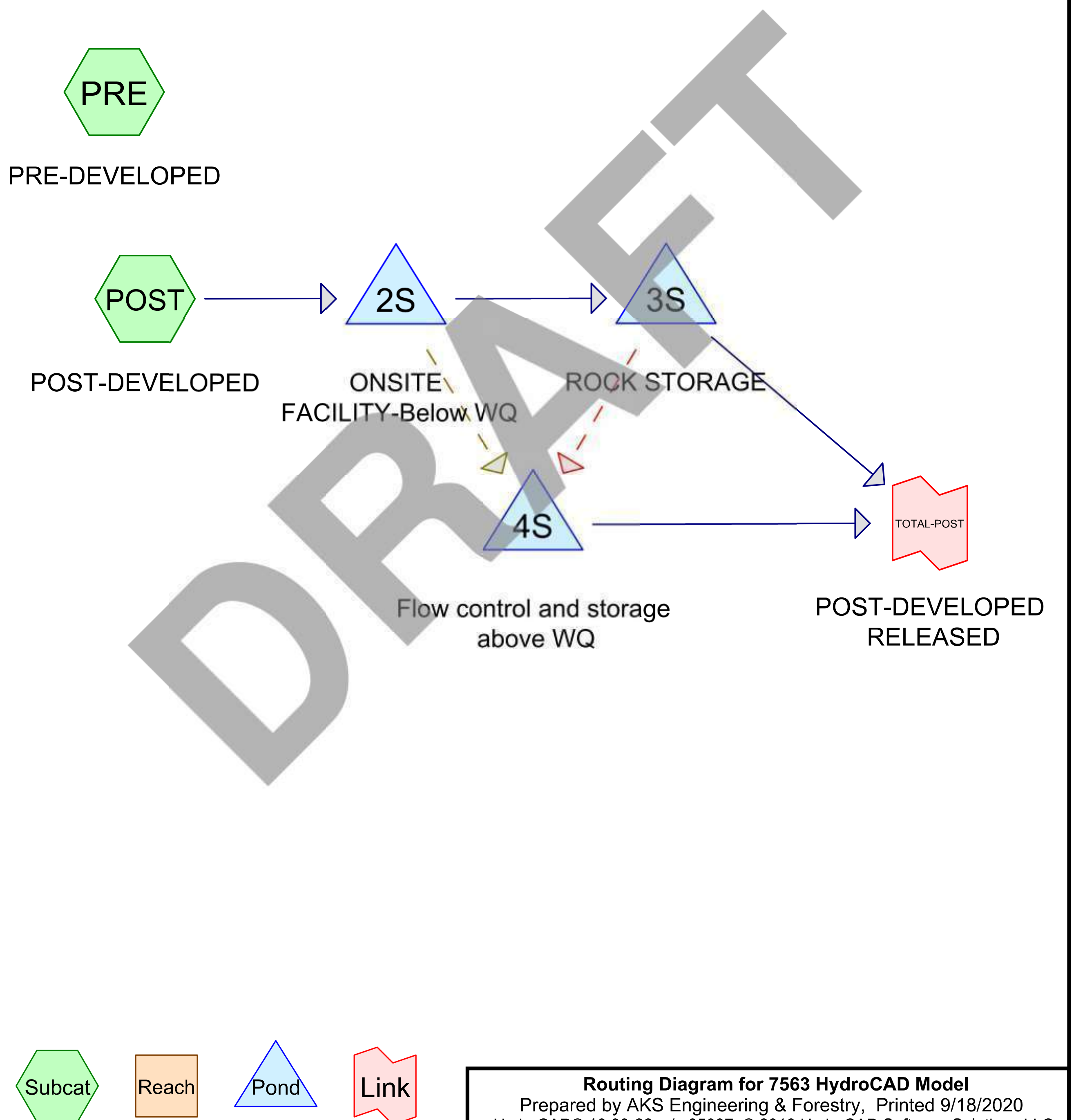
Appendix B: HydroCAD Analysis



Routing Diagram for 7563 HydroCAD Model
Prepared by AKS Engineering & Forestry, Printed 9/18/2020
HydroCAD® 10.00-22 s/n 05097 © 2018 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.278	98	Entry Road (POST)
0.460	98	Paved parking, HSG C (POST)
0.115	74	Stormwater Facility Landscaping (POST)
0.853	**95**	**TOTAL AREA**

Summary for Subcatchment POST: POST-DEVELOPED

Runoff = 0.14 cfs @ 7.98 hrs, Volume= 0.046 af, Depth= 0.65"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type IA 24-hr Half 2-Year Rainfall=1.10"

	Area (sf)	CN	Description
	20,050	98	Paved parking, HSG C
*	5,000	74	Stormwater Facility Landscaping
*	12,100	98	Entry Road
	37,150	95	Weighted Average
	5,000	74	13.46% Pervious Area
	32,150	98	86.54% Impervious Area

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

Summary for Pond 2S: ONSITE FACILITY-Below WQ

Inflow Area = 0.853 ac, 86.54% Impervious, Inflow Depth = 0.65" for Half 2-Year event
Inflow = 0.14 cfs @ 7.98 hrs, Volume= 0.046 af
Outflow = 0.04 cfs @ 9.38 hrs, Volume= 0.046 af, Atten= 70%, Lag= 84.0 min
Primary = 0.04 cfs @ 9.38 hrs, Volume= 0.046 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 373.52' @ 9.38 hrs Surf.Area= 888 sf Storage= 318 cf

Plug-Flow detention time= 81.5 min calculated for 0.046 af (100% of inflow)
Center-of-Mass det. time= 81.4 min (856.3 - 774.9)

Volume	Invert	Avail.Storage	Storage Description
#1	373.00'	870 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
373.00	340	0	0
374.00	1,400	870	870

Device	Routing	Invert	Outlet Devices
#1	Primary	373.00'	**2.000 in/hr Exfiltration Through Growing Medium over Surface area**
#2	Secondary	373.85'	**10.0" Horiz. Overflow above WQ** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.04 cfs @ 9.38 hrs HW=373.52' (Free Discharge)
↑—**1=Exfiltration Through Growing Medium** (Exfiltration Controls 0.04 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=373.00' (Free Discharge)
↑—**2=Overflow above WQ** (Controls 0.00 cfs)

Summary for Subcatchment POST: POST-DEVELOPED

Runoff = 0.19 cfs @ 7.97 hrs, Volume= 0.064 af, Depth= 0.90"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type IA 24-hr WQ Rainfall=1.38"

	Area (sf)	CN	Description
	20,050	98	Paved parking, HSG C
*	5,000	74	Stormwater Facility Landscaping
*	12,100	98	Entry Road
	37,150	95	Weighted Average
	5,000	74	13.46% Pervious Area
	32,150	98	86.54% Impervious Area

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

Summary for Pond 2S: ONSITE FACILITY-Below WQ

Inflow Area = 0.853 ac, 86.54% Impervious, Inflow Depth = 0.90" for WQ event
Inflow = 0.19 cfs @ 7.97 hrs, Volume= 0.064 af
Outflow = 0.05 cfs @ 9.85 hrs, Volume= 0.064 af, Atten= 73%, Lag= 112.9 min
Primary = 0.05 cfs @ 9.85 hrs, Volume= 0.064 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 373.74' @ 9.85 hrs Surf.Area= 1,122 sf Storage= 539 cf

Plug-Flow detention time= 121.4 min calculated for 0.064 af (100% of inflow)
Center-of-Mass det. time= 121.4 min (877.8 - 756.4)

Volume	Invert	Avail.Storage	Storage Description
#1	373.00'	870 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
373.00	340	0	0
374.00	1,400	870	870

Device	Routing	Invert	Outlet Devices
#1	Primary	373.00'	**2.000 in/hr Exfiltration Through Growing Medium over Surface area**
#2	Secondary	373.85'	**10.0" Horiz. Overflow above WQ** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.05 cfs @ 9.85 hrs HW=373.74' (Free Discharge)
└─**1=Exfiltration Through Growing Medium** (Exfiltration Controls 0.05 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=373.00' (Free Discharge)
└─**2=Overflow above WQ** (Controls 0.00 cfs)

Summary for Subcatchment POST: POST-DEVELOPED

Runoff = 0.58 cfs @ 7.93 hrs, Volume= 0.188 af, Depth= 2.64"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-Year Rainfall=3.20"

	Area (sf)	CN	Description
	20,050	98	Paved parking, HSG C
*	5,000	74	Stormwater Facility Landscaping
*	12,100	98	Entry Road
	37,150	95	Weighted Average
	5,000	74	13.46% Pervious Area
	32,150	98	86.54% Impervious Area

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

Summary for Pond 2S: ONSITE FACILITY-Below WQ

Inflow Area = 0.853 ac, 86.54% Impervious, Inflow Depth = 2.64" for 10-Year event
Inflow = 0.58 cfs @ 7.93 hrs, Volume= 0.188 af
Outflow = 0.58 cfs @ 8.00 hrs, Volume= 0.188 af, Atten= 0%, Lag= 3.8 min
Primary = 0.06 cfs @ 7.98 hrs, Volume= 0.112 af
Secondary = 0.52 cfs @ 8.00 hrs, Volume= 0.076 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 374.00' @ 8.00 hrs Surf.Area= 1,400 sf Storage= 870 cf

Plug-Flow detention time= 106.4 min calculated for 0.188 af (100% of inflow)
Center-of-Mass det. time= 106.6 min (810.0 - 703.4)

Volume	Invert	Avail.Storage	Storage Description
#1	373.00'	870 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
373.00	340	0	0
374.00	1,400	870	870

Device	Routing	Invert	Outlet Devices
#1	Primary	373.00'	**2.000 in/hr Exfiltration Through Growing Medium over Surface area**
#2	Secondary	373.85'	**10.0" Horiz. Overflow above WQ** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.06 cfs @ 7.98 hrs HW=374.00' (Free Discharge)
└─**1=Exfiltration Through Growing Medium** (Exfiltration Controls 0.06 cfs)

Secondary OutFlow Max=0.52 cfs @ 8.00 hrs HW=374.00' (Free Discharge)
└─**2=Overflow above WQ** (Weir Controls 0.52 cfs @ 1.28 fps)

Summary for Pond 3S: ROCK STORAGE

Inflow Area = 0.853 ac, 86.54% Impervious, Inflow Depth = 1.58" for 10-Year event
Inflow = 0.06 cfs @ 7.98 hrs, Volume= 0.112 af
Outflow = 0.06 cfs @ 17.85 hrs, Volume= 0.058 af, Atten= 3%, Lag= 592.2 min
Primary = 0.00 cfs @ 17.85 hrs, Volume= 0.013 af
Secondary = 0.06 cfs @ 17.85 hrs, Volume= 0.045 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 371.27' @ 17.85 hrs Surf.Area= 1,800 sf Storage= 2,700 cf

Plug-Flow detention time= 838.9 min calculated for 0.058 af (52% of inflow)
Center-of-Mass det. time= 497.8 min (1,434.9 - 937.1)

Volume	Invert	Avail.Storage	Storage Description
#1	367.50'	2,700 cf	**Rock Storage (Prismatic)** Listed below (Recalc) 6,750 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
367.50	1,800	0	0
371.25	1,800	6,750	6,750

Device	Routing	Invert	Outlet Devices
#1	Primary	368.00'	**0.3" Vert. Orifice/Grate** C= 0.600
#2	Secondary	371.10'	**3.5" Vert. Overflow** C= 0.600

Primary OutFlow Max=0.00 cfs @ 17.85 hrs HW=371.27' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.00 cfs @ 8.69 fps)

Secondary OutFlow Max=0.06 cfs @ 17.85 hrs HW=371.27' (Free Discharge)
└─**2=Overflow** (Orifice Controls 0.06 cfs @ 1.42 fps)

Summary for Pond 4S: Flow control and storage above WQ

Inflow = 0.52 cfs @ 8.00 hrs, Volume= 0.121 af
Outflow = 0.08 cfs @ 9.94 hrs, Volume= 0.121 af, Atten= 84%, Lag= 116.9 min
Primary = 0.08 cfs @ 9.94 hrs, Volume= 0.121 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 374.70' @ 9.94 hrs Surf.Area= 2,238 sf Storage= 1,271 cf

Plug-Flow detention time= 103.6 min calculated for 0.121 af (100% of inflow)
Center-of-Mass det. time= 103.5 min (998.5 - 894.9)

Volume	Invert	Avail.Storage	Storage Description
#1	374.00'	9,600 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
374.00	1,400	0	0
376.00	3,800	5,200	5,200
377.00	5,000	4,400	9,600

Device	Routing	Invert	Outlet Devices
#1	Primary	367.75'	**10.0" Round Outlet** L= 5.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 367.75' / 367.50' S= 0.0500 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.55 sf
#2	Device 1	370.00'	**1.2" Horiz. 10 yr orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	375.10'	**10.0" Horiz. Overflow** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.08 cfs @ 9.94 hrs HW=374.70' (Free Discharge)
└─**1=Outlet** (Passes 0.08 cfs of 6.71 cfs potential flow)
  ├─**2=10 yr orifice** (Orifice Controls 0.08 cfs @ 10.44 fps)
  └─**3=Overflow** (Controls 0.00 cfs)

Summary for Subcatchment POST: POST-DEVELOPED

Runoff = 0.66 cfs @ 7.93 hrs, Volume= 0.216 af, Depth= 3.04"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-Year Rainfall=3.60"

	Area (sf)	CN	Description
	20,050	98	Paved parking, HSG C
*	5,000	74	Stormwater Facility Landscaping
*	12,100	98	Entry Road
	37,150	95	Weighted Average
	5,000	74	13.46% Pervious Area
	32,150	98	86.54% Impervious Area

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

Summary for Pond 2S: ONSITE FACILITY-Below WQ

Inflow Area = 0.853 ac, 86.54% Impervious, Inflow Depth = 3.04" for 25-Year event
Inflow = 0.66 cfs @ 7.93 hrs, Volume= 0.216 af
Outflow = 0.73 cfs @ 7.95 hrs, Volume= 0.216 af, Atten= 0%, Lag= 1.2 min
Primary = 0.06 cfs @ 7.80 hrs, Volume= 0.115 af
Secondary = 0.67 cfs @ 7.95 hrs, Volume= 0.101 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 374.03' @ 7.95 hrs Surf.Area= 1,400 sf Storage= 870 cf

Plug-Flow detention time= 96.3 min calculated for 0.216 af (100% of inflow)
Center-of-Mass det. time= 96.3 min (794.0 - 697.7)

Volume	Invert	Avail.Storage	Storage Description
#1	373.00'	870 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
373.00	340	0	0
374.00	1,400	870	870

Device	Routing	Invert	Outlet Devices
#1	Primary	373.00'	**2.000 in/hr Exfiltration Through Growing Medium over Surface area**
#2	Secondary	373.85'	**10.0" Horiz. Overflow above WQ** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.06 cfs @ 7.80 hrs HW=374.00' (Free Discharge)
└—**1=Exfiltration Through Growing Medium** (Exfiltration Controls 0.06 cfs)

Secondary OutFlow Max=0.67 cfs @ 7.95 hrs HW=374.03' (Free Discharge)
└—**2=Overflow above WQ** (Weir Controls 0.67 cfs @ 1.40 fps)

Summary for Pond 3S: ROCK STORAGE

Inflow Area = 0.853 ac, 86.54% Impervious, Inflow Depth = 1.62" for 25-Year event
Inflow = 0.06 cfs @ 7.80 hrs, Volume= 0.115 af
Outflow = 0.07 cfs @ 17.40 hrs, Volume= 0.061 af, Atten= 0%, Lag= 576.0 min
Primary = 0.00 cfs @ 17.40 hrs, Volume= 0.013 af
Secondary = 0.06 cfs @ 17.40 hrs, Volume= 0.048 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 371.28' @ 17.40 hrs Surf.Area= 1,800 sf Storage= 2,700 cf

Plug-Flow detention time= 830.4 min calculated for 0.061 af (53% of inflow)
Center-of-Mass det. time= 491.5 min (1,420.7 - 929.2)

Volume	Invert	Avail.Storage	Storage Description
#1	367.50'	2,700 cf	**Rock Storage (Prismatic)** Listed below (Recalc) 6,750 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
367.50	1,800	0	0
371.25	1,800	6,750	6,750

Device	Routing	Invert	Outlet Devices
#1	Primary	368.00'	**0.3" Vert. Orifice/Grate** C= 0.600
#2	Secondary	371.10'	**3.5" Vert. Overflow** C= 0.600

Primary OutFlow Max=0.00 cfs @ 17.40 hrs HW=371.28' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.00 cfs @ 8.70 fps)

Secondary OutFlow Max=0.06 cfs @ 17.40 hrs HW=371.28' (Free Discharge)
└─**2=Overflow** (Orifice Controls 0.06 cfs @ 1.44 fps)

Summary for Pond 4S: Flow control and storage above WQ

Inflow = 0.67 cfs @ 7.95 hrs, Volume= 0.149 af
Outflow = 0.08 cfs @ 10.47 hrs, Volume= 0.149 af, Atten= 87%, Lag= 151.3 min
Primary = 0.08 cfs @ 10.47 hrs, Volume= 0.149 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 374.88' @ 10.47 hrs Surf.Area= 2,460 sf Storage= 1,705 cf

Plug-Flow detention time= 196.7 min calculated for 0.149 af (100% of inflow)
Center-of-Mass det. time= 196.6 min (1,062.3 - 865.7)

Volume	Invert	Avail.Storage	Storage Description
#1	374.00'	9,600 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
374.00	1,400	0	0
376.00	3,800	5,200	5,200
377.00	5,000	4,400	9,600

Device	Routing	Invert	Outlet Devices
#1	Primary	367.75'	**10.0" Round Outlet** L= 5.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 367.75' / 367.50' S= 0.0500 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.55 sf
#2	Device 1	370.00'	**1.2" Horiz. 10 yr orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	375.10'	**10.0" Horiz. Overflow** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.08 cfs @ 10.47 hrs HW=374.88' (Free Discharge)
└**1=Outlet** (Passes 0.08 cfs of 6.81 cfs potential flow)
  ├**2=10 yr orifice** (Orifice Controls 0.08 cfs @ 10.64 fps)
  └**3=Overflow** (Controls 0.00 cfs)

Summary for Subcatchment POST: POST-DEVELOPED

Runoff = 0.83 cfs @ 7.92 hrs, Volume= 0.272 af, Depth= 3.83"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-Year Rainfall=4.40"

	Area (sf)	CN	Description
	20,050	98	Paved parking, HSG C
*	5,000	74	Stormwater Facility Landscaping
*	12,100	98	Entry Road
	37,150	95	Weighted Average
	5,000	74	13.46% Pervious Area
	32,150	98	86.54% Impervious Area

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

Summary for Pond 2S: ONSITE FACILITY-Below WQ

Inflow Area = 0.853 ac, 86.54% Impervious, Inflow Depth = 3.83" for 100-Year event
Inflow = 0.83 cfs @ 7.92 hrs, Volume= 0.272 af
Outflow = 0.93 cfs @ 7.95 hrs, Volume= 0.272 af, Atten= 0%, Lag= 1.5 min
Primary = 0.06 cfs @ 7.70 hrs, Volume= 0.119 af
Secondary = 0.87 cfs @ 7.95 hrs, Volume= 0.153 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 374.07' @ 7.95 hrs Surf.Area= 1,400 sf Storage= 870 cf

Plug-Flow detention time= 80.5 min calculated for 0.272 af (100% of inflow)
Center-of-Mass det. time= 80.8 min (769.7 - 688.9)

Volume	Invert	Avail.Storage	Storage Description
#1	373.00'	870 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
373.00	340	0	0
374.00	1,400	870	870

Device	Routing	Invert	Outlet Devices
#1	Primary	373.00'	**2.000 in/hr Exfiltration Through Growing Medium over Surface area**
#2	Secondary	373.85'	**10.0" Horiz. Overflow above WQ** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.06 cfs @ 7.70 hrs HW=374.01' (Free Discharge)
↑—**1=Exfiltration Through Growing Medium** (Exfiltration Controls 0.06 cfs)

Secondary OutFlow Max=0.86 cfs @ 7.95 hrs HW=374.07' (Free Discharge)
↑—**2=Overflow above WQ** (Weir Controls 0.86 cfs @ 1.52 fps)

Summary for Pond 3S: ROCK STORAGE

Inflow Area = 0.853 ac, 86.54% Impervious, Inflow Depth = 1.67" for 100-Year event
Inflow = 0.06 cfs @ 7.70 hrs, Volume= 0.119 af
Outflow = 0.06 cfs @ 16.65 hrs, Volume= 0.065 af, Atten= 6%, Lag= 537.0 min
Primary = 0.00 cfs @ 16.65 hrs, Volume= 0.014 af
Secondary = 0.06 cfs @ 16.65 hrs, Volume= 0.051 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 371.27' @ 16.65 hrs Surf.Area= 1,800 sf Storage= 2,700 cf

Plug-Flow detention time= 817.0 min calculated for 0.065 af (55% of inflow)
Center-of-Mass det. time= 483.0 min (1,396.8 - 913.8)

Volume	Invert	Avail.Storage	Storage Description
#1	367.50'	2,700 cf	**Rock Storage (Prismatic)** Listed below (Recalc) 6,750 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
367.50	1,800	0	0
371.25	1,800	6,750	6,750

Device	Routing	Invert	Outlet Devices
#1	Primary	368.00'	**0.3" Vert. Orifice/Grate** C= 0.600
#2	Secondary	371.10'	**3.5" Vert. Overflow** C= 0.600

Primary OutFlow Max=0.00 cfs @ 16.65 hrs HW=371.27' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.00 cfs @ 8.69 fps)

Secondary OutFlow Max=0.06 cfs @ 16.65 hrs HW=371.27' (Free Discharge)
└─**2=Overflow** (Orifice Controls 0.06 cfs @ 1.40 fps)

Summary for Pond 4S: Flow control and storage above WQ

Inflow = 0.87 cfs @ 7.95 hrs, Volume= 0.204 af
Outflow = 0.17 cfs @ 9.34 hrs, Volume= 0.204 af, Atten= 80%, Lag= 83.5 min
Primary = 0.17 cfs @ 9.34 hrs, Volume= 0.204 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 375.15' @ 9.34 hrs Surf.Area= 2,775 sf Storage= 2,393 cf

Plug-Flow detention time= 323.9 min calculated for 0.204 af (100% of inflow)
Center-of-Mass det. time= 323.8 min (1,148.9 - 825.1)

Volume	Invert	Avail.Storage	Storage Description
#1	374.00'	9,600 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
374.00	1,400	0	0
376.00	3,800	5,200	5,200
377.00	5,000	4,400	9,600

Device	Routing	Invert	Outlet Devices
#1	Primary	367.75'	**10.0" Round Outlet** L= 5.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 367.75' / 367.50' S= 0.0500 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.55 sf
#2	Device 1	370.00'	**1.2" Horiz. 10 yr orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	375.10'	**10.0" Horiz. Overflow** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.17 cfs @ 9.34 hrs HW=375.15' (Free Discharge)
└─**1=Outlet** (Passes 0.17 cfs of 6.94 cfs potential flow)
  ├─**2=10 yr orifice** (Orifice Controls 0.09 cfs @ 10.92 fps)
  └─**3=Overflow** (Weir Controls 0.08 cfs @ 0.70 fps)

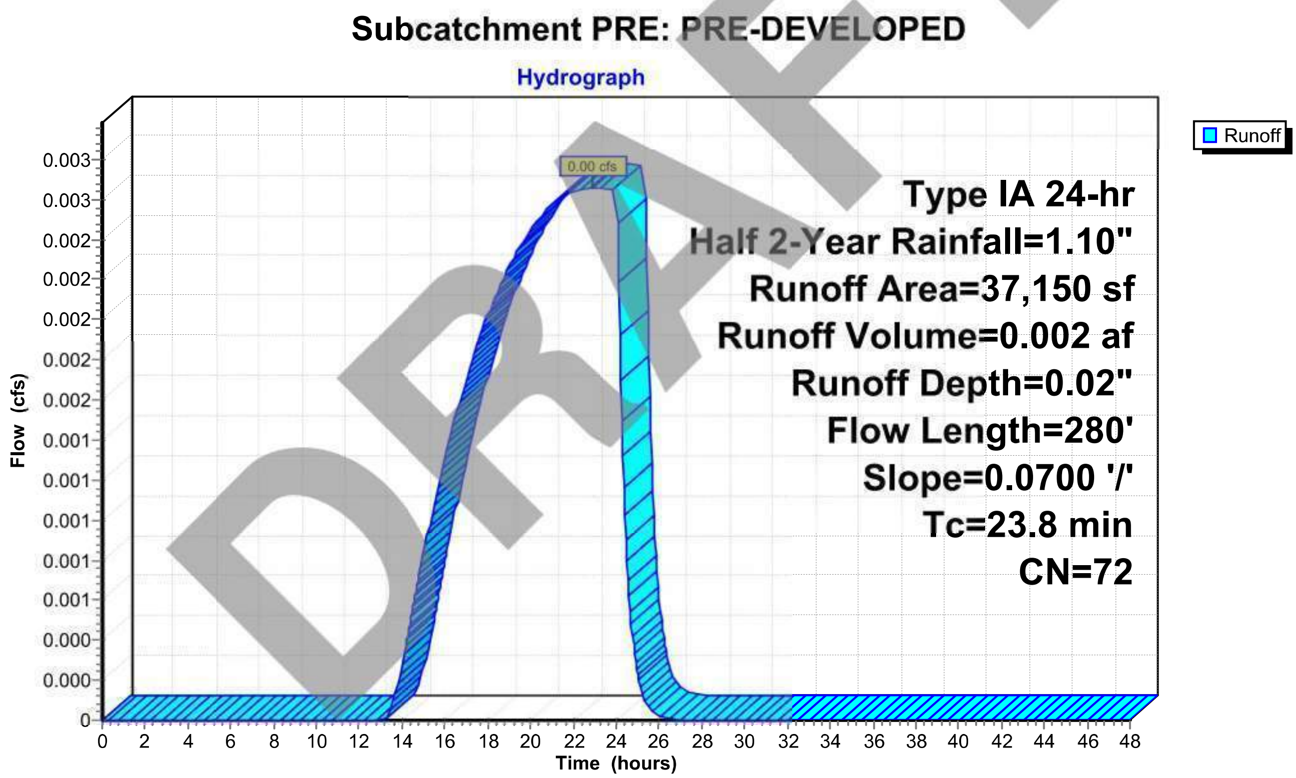
Summary for Subcatchment PRE: PRE-DEVELOPED

Runoff = 0.00 cfs @ 22.92 hrs, Volume= 0.002 af, Depth= 0.02"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type IA 24-hr Half 2-Year Rainfall=1.10"

	Area (sf)	CN	Description
*	37,150	72	City of Slaem Pre-Devlopment; HSG C
	37,150	72	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.8	280	0.0700	0.20		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.20"

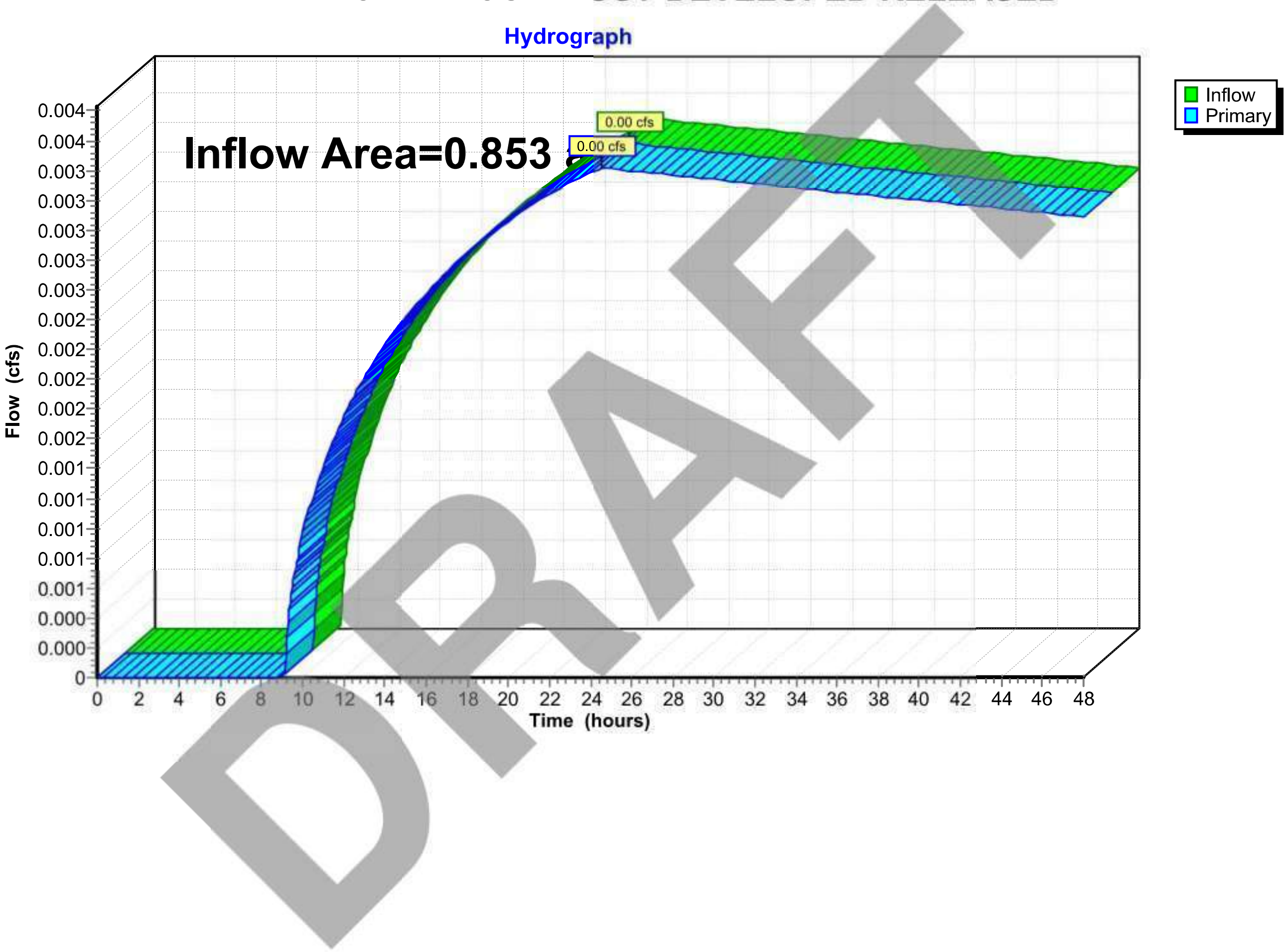


Summary for Link TOTAL-POST: POST-DEVELOPED RELEASED

Inflow Area = 0.853 ac, 86.54% Impervious, Inflow Depth > 0.13" for Half 2-Year event
Inflow = 0.00 cfs @ 24.56 hrs, Volume= 0.009 af
Primary = 0.00 cfs @ 24.56 hrs, Volume= 0.009 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Link TOTAL-POST: POST-DEVELOPED RELEASED



Summary for Subcatchment PRE: PRE-DEVELOPED

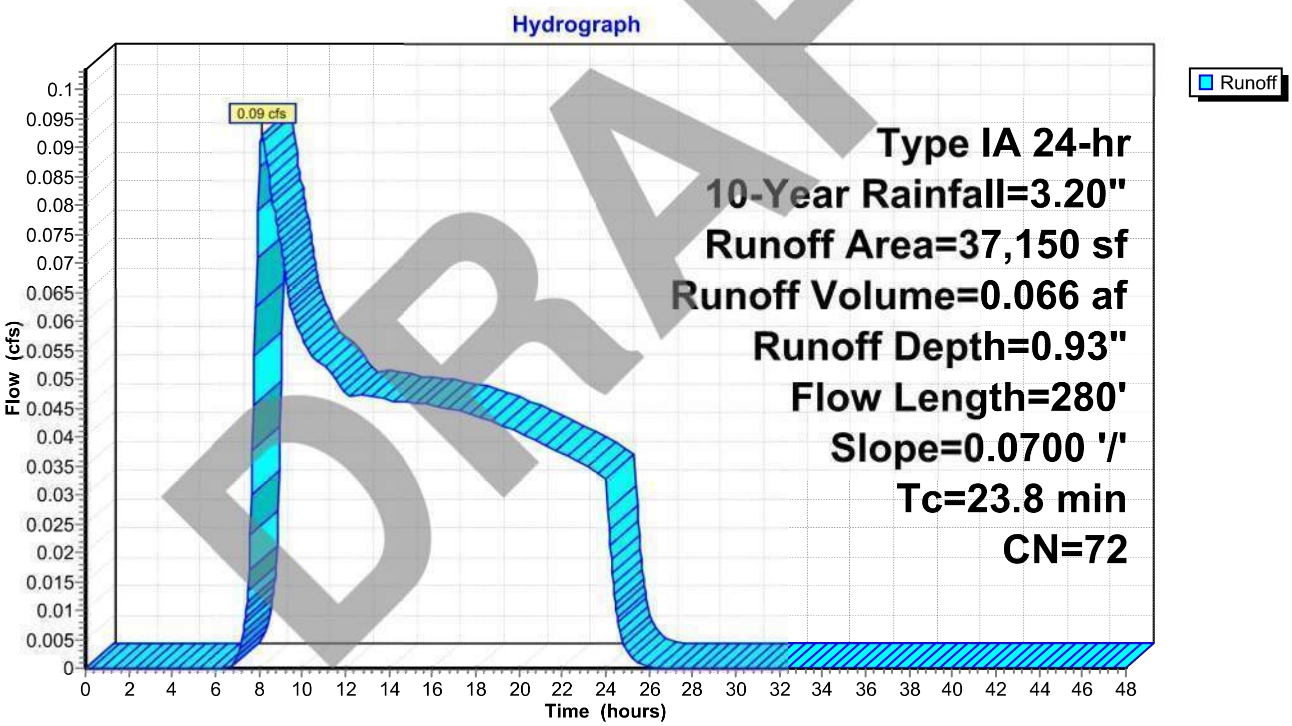
Runoff = 0.09 cfs @ 8.15 hrs, Volume= 0.066 af, Depth= 0.93"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-Year Rainfall=3.20"

	Area (sf)	CN	Description
*	37,150	72	City of Slaem Pre-Devlopment; HSG C
	37,150	72	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.8	280	0.0700	0.20		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.20"

Subcatchment PRE: PRE-DEVELOPED

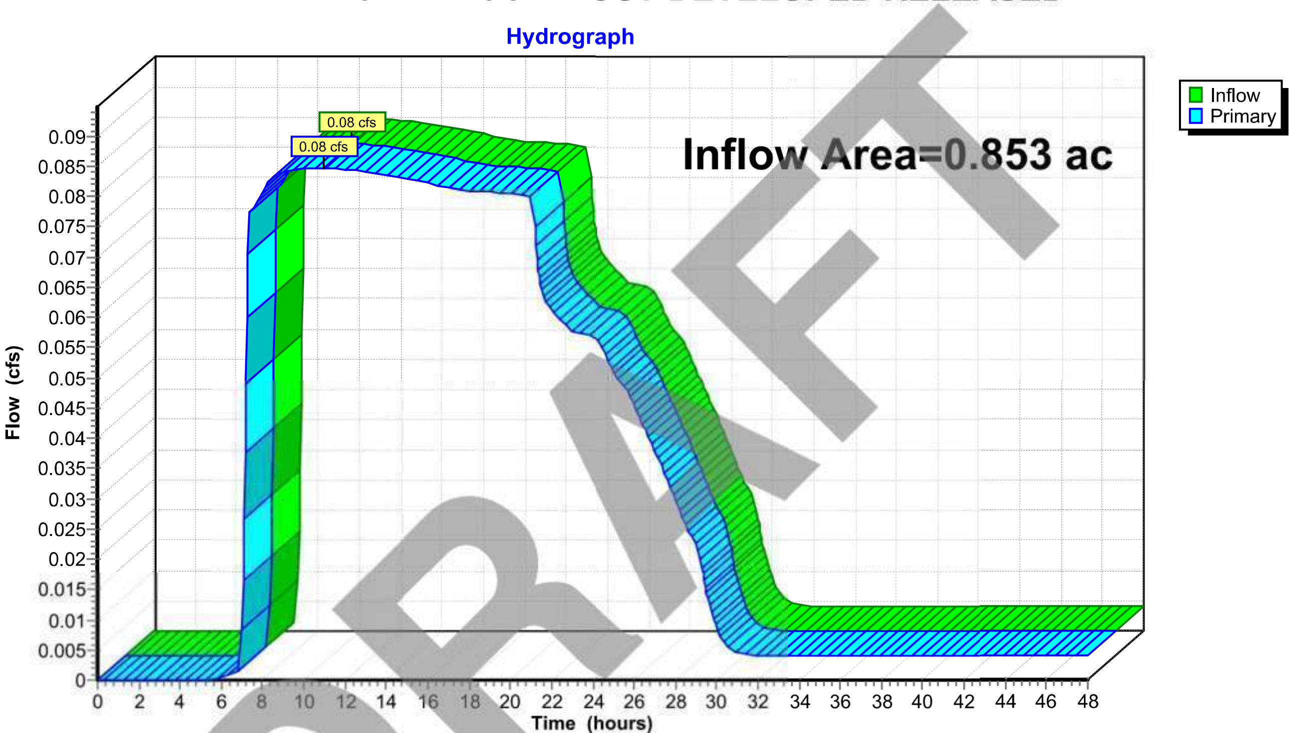


Summary for Link TOTAL-POST: POST-DEVELOPED RELEASED

Inflow Area = 0.853 ac, 86.54% Impervious, Inflow Depth > 1.89" for 10-Year event
Inflow = 0.08 cfs @ 10.91 hrs, Volume= 0.134 af
Primary = 0.08 cfs @ 10.91 hrs, Volume= 0.134 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Link TOTAL-POST: POST-DEVELOPED RELEASED



Summary for Subcatchment PRE: PRE-DEVELOPED

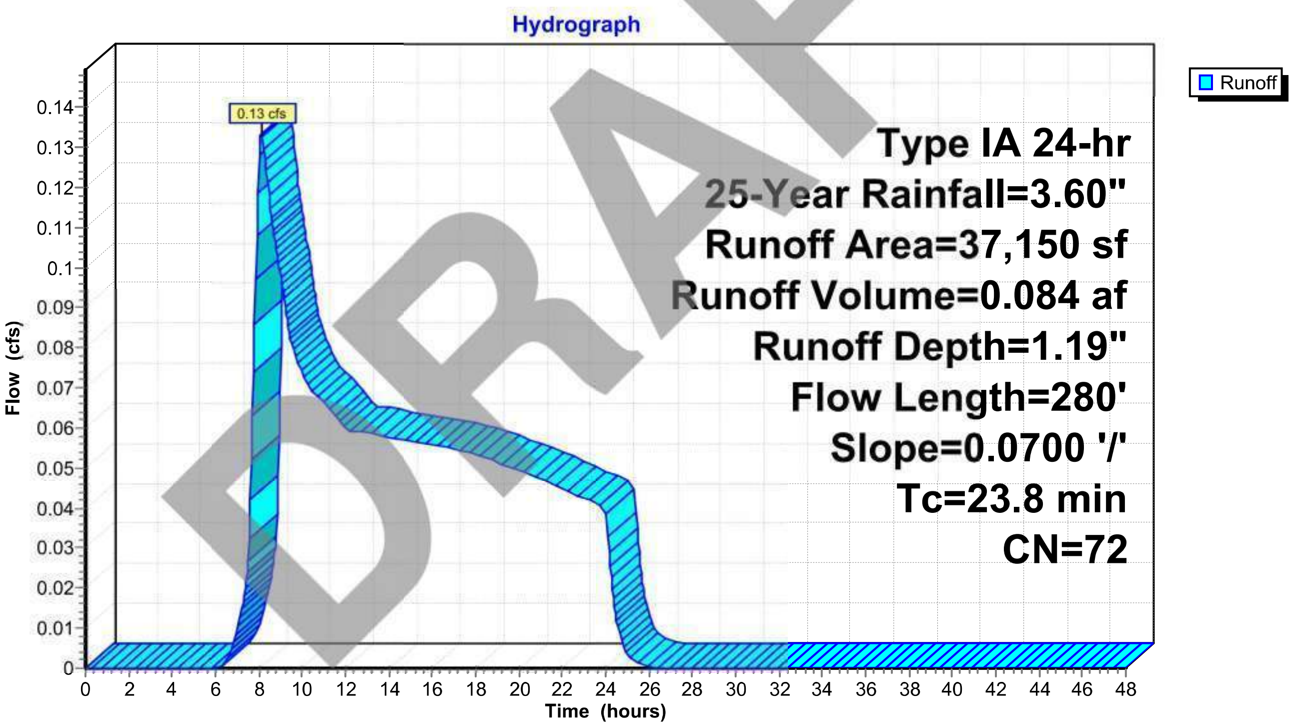
Runoff = 0.13 cfs @ 8.09 hrs, Volume= 0.084 af, Depth= 1.19"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-Year Rainfall=3.60"

	Area (sf)	CN	Description
*	37,150	72	City of Slaem Pre-Devlopment; HSG C
	37,150	72	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.8	280	0.0700	0.20		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.20"

Subcatchment PRE: PRE-DEVELOPED

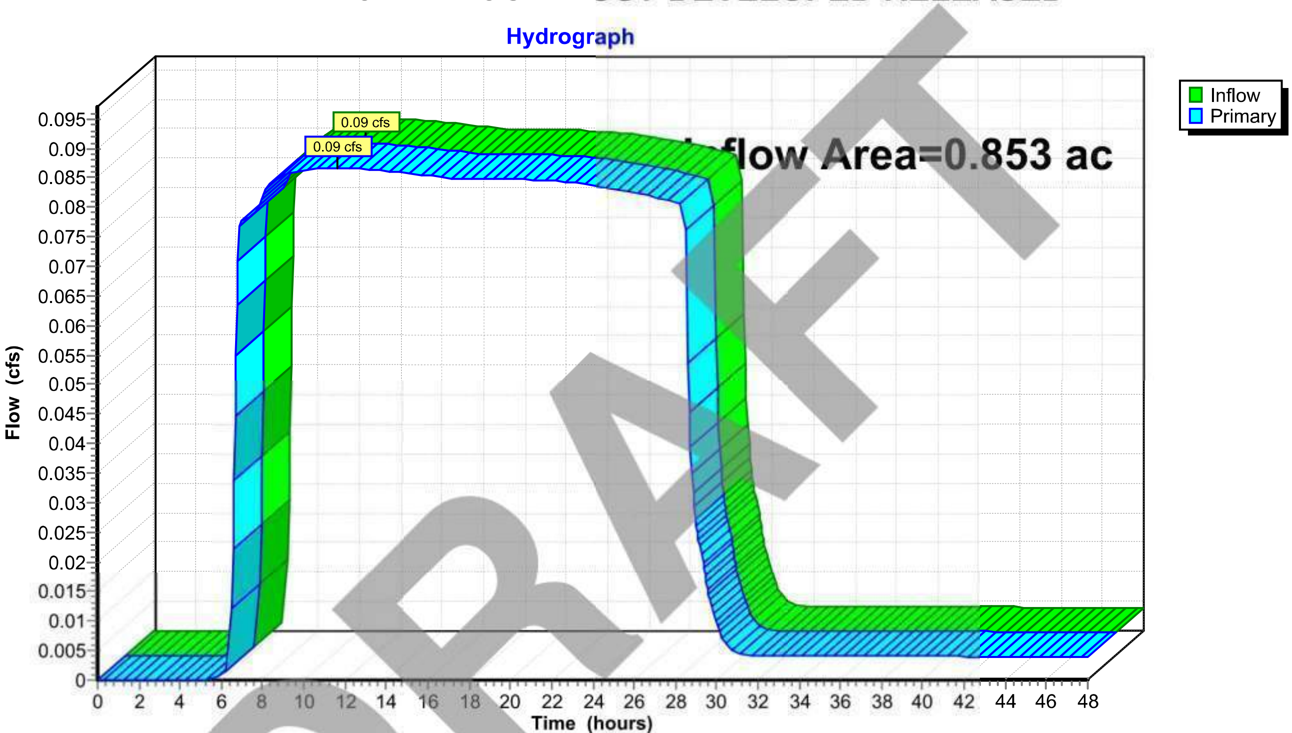


Summary for Link TOTAL-POST: POST-DEVELOPED RELEASED

Inflow Area = 0.853 ac, 86.54% Impervious, Inflow Depth > 2.28" for 25-Year event
Inflow = 0.09 cfs @ 11.59 hrs, Volume= 0.162 af
Primary = 0.09 cfs @ 11.59 hrs, Volume= 0.162 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Link TOTAL-POST: POST-DEVELOPED RELEASED



Summary for Subcatchment PRE: PRE-DEVELOPED

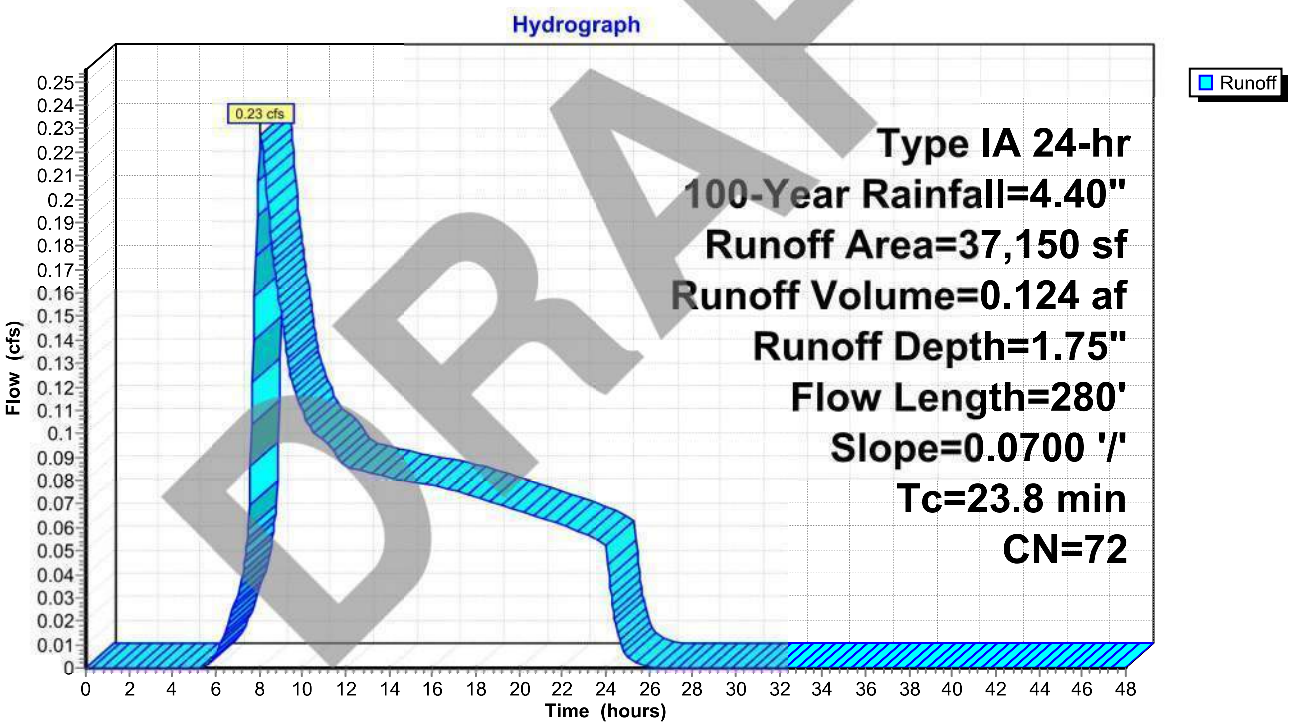
Runoff = 0.23 cfs @ 8.07 hrs, Volume= 0.124 af, Depth= 1.75"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-Year Rainfall=4.40"

	Area (sf)	CN	Description
*	37,150	72	City of Slaem Pre-Devlopment; HSG C
	37,150	72	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.8	280	0.0700	0.20		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.20"

Subcatchment PRE: PRE-DEVELOPED

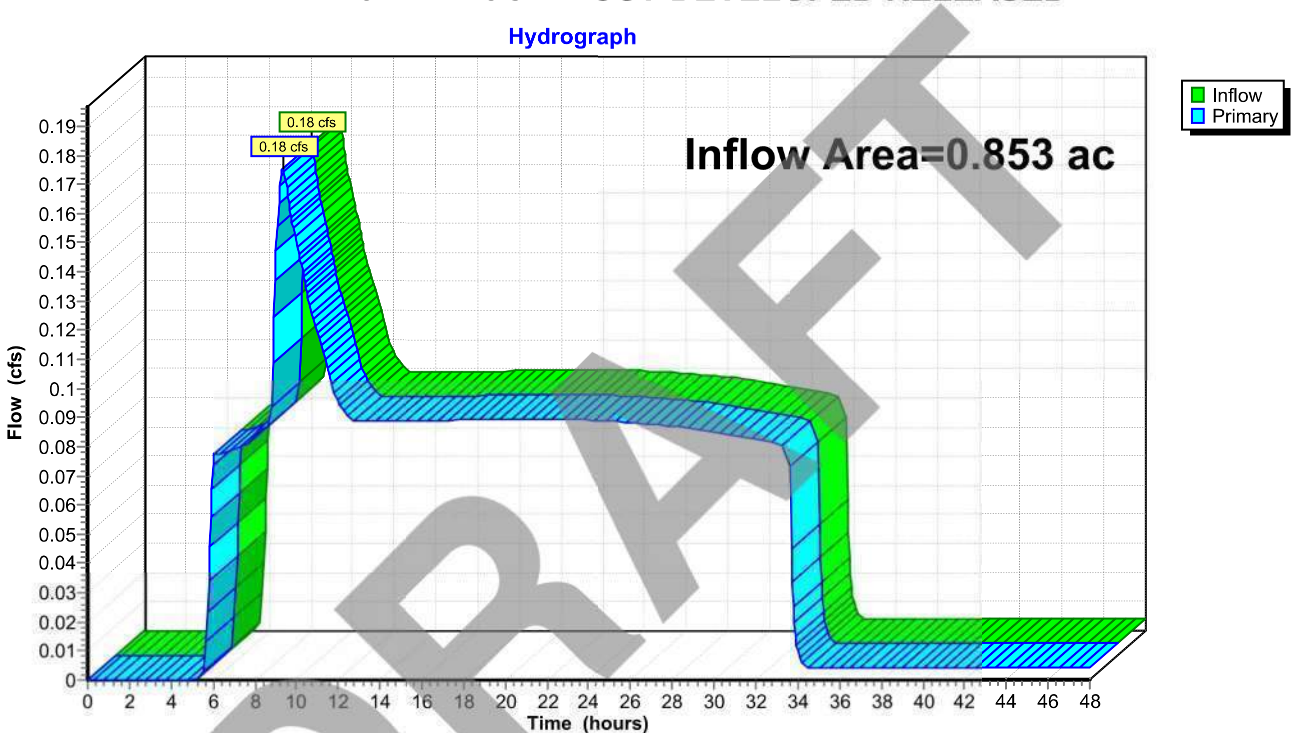


Summary for Link TOTAL-POST: POST-DEVELOPED RELEASED

Inflow Area = 0.853 ac, 86.54% Impervious, Inflow Depth > 3.07" for 100-Year event
Inflow = 0.18 cfs @ 9.34 hrs, Volume= 0.218 af
Primary = 0.18 cfs @ 9.34 hrs, Volume= 0.218 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Link TOTAL-POST: POST-DEVELOPED RELEASED



Appendix C: Facility Maintenance Form

Appendix B to 109-011 – Facility Maintenance Forms

2. Rain Garden

A rain garden is a **vegetated infiltration basin** or depression created by excavation, berms, or small dams to provide for short-term ponding of surface water until it percolates into the soil. The basin should infiltrate stormwater within 24 hours.

Inspections

All facility components and vegetation shall be inspected for proper operations and structural stability. *These inspections shall occur, at a minimum, quarterly for the first two years from the date of installation, and two times per year thereafter.* It is recommended that a visual inspection be made within 48 hours after each major storm event to ensure proper function. The facility owner must keep a log, recording all inspection dates, observations, and maintenance activities. The following items shall be inspected and maintained as stated:

Date: ____/____/_________ Inspector's Name: ________________________________

Basin inlet shall ensure unrestricted stormwater flow to the vegetated basin.

- □ Sources of erosion shall be identified and controlled when native soil is exposed or erosion channels are present.
- □ Inlet shall be kept clear at all times.
- □ Rock splash pads shall be replenished to prevent erosion.

Inspection Comments: ________________________________

____

Embankment, dikes, berms, and side slopes retain water in the infiltration basin.

- □ Structural deficiencies shall be corrected upon discovery.
- □ Slopes shall be stabilized using appropriate erosion control measures when soil is exposed/flow channels are forming.
- □ Sources of erosion damage shall be identified and controlled.

Inspection Comments: ________________________________

____

Overflow or emergency spillway conveys flow exceeding reservoir capacity to an approved stormwater receiving system.

- □ Overflow shall be kept clear at all times.
- □ Sources of erosion damage shall be identified and controlled when soil is exposed.
- □ Rocks or other armament shall be replaced when only one layer of rock exists.

Inspection Comments: ________________________________

____

Amended soils shall allow stormwater to percolate uniformly through the infiltration basin. If water remains 36 hours after a storm, sources of possible clogging shall be identified and corrected.

- □ Basin shall be raked and, if necessary, soil shall be excavated and cleaned or replaced.

Inspection Comments: ________________________________

____

Appendix B to 109-011 – Facility Maintenance Forms

2. Rain Garden (continued)

Sediment/Basin debris management shall prevent loss of infiltration basin volume caused by sedimentation.

- □ Sediment exceeding 3 inches in depth, or so thick as to damage or kill vegetation, shall be removed.
- □ Sediment accumulation shall be hand-removed with minimum damage to vegetation using proper erosion control measures.

Inspection Comments: ____________________

____

Debris and litter shall be removed to ensure stormwater infiltration and to prevent clogging of overflow drains and interference with plant growth.

- □ Restricted sources of sediment and debris, such as discarded lawn clippings, shall be identified and prevented.

Inspection Comments: ____________________

____

Vegetation shall be healthy and dense enough to provide filtering while protecting underlying soils from erosion. Proper horticultural practices shall be employed to ensure that plants are vigorous and healthy.

- □ Mulch shall be replenished as needed, but not inhibiting water flow.
- □ Vegetation, large shrubs, or trees that interfere with rain garden operation shall be pruned.
- □ Fallen leaves and debris from deciduous plant foliage shall be raked and removed.
- □ Nuisance or prohibited vegetation from the City of Salem Non-Native Invasive Plant list shall be removed when discovered. Invasive vegetation shall be removed immediately upon discovery.
- □ Dead vegetation shall be removed upon discovery.
- □ Vegetation shall be replaced as soon as possible to maintain cover density and control erosion where soils are exposed.

Inspection Comments: ____________________

____

Spill prevention measures shall be exercised when handling substances that contaminate stormwater.

- □ Releases of pollutants shall be corrected as soon as identified.

Inspection Comments: ____________________

Training and/or written guidance information for operating and maintaining vegetated infiltration basins shall be provided to all property owners and tenants. This Facility Maintenance Form can be used to meet this requirement.

Inspection Comments: ____________________

Access to the infiltration basin shall be safe and efficient. Egress and ingress routes shall be maintained to design standards. Roadways shall be maintained to accommodate size and weight of vehicles, if applicable.

- □ Obstacles preventing maintenance personnel and/or equipment access to the infiltration basin shall be removed.
- □ Gravel or ground cover shall be added if erosion has occurred.

Inspection Comments: ____________________

____

Appendix B to 109-011 – Facility Maintenance Forms

2. Rain Garden (continued)

Nuisance insects and rodents shall not be harbored in the infiltration basin. Pest control measures shall be taken when nuisance insects/rodents are found to be present.

- ◻ Holes in the ground located in and around the infiltration basin shall be filled.

Inspection Comments: ____

____

If used at this site, the following will be applicable:

Fences shall be maintained to preserve their functionality and appearance.

- ◻ Collapsed fences shall be restored to an upright position.
- ◻ Jagged edges and damaged fences shall be repaired or replaced.

Inspection Comments: ____

____

Appendix D: Reduced-Size Grading & Drainage Plan