Frog Pond Cottage Park Place
Wilsonville, Oregon

Preliminary Stormwater Report

Date: November 2023

Client: Sullivan Homes, LLC
5832 Firestone Court
San Jose, CA 95138

Engineering Contact: Cody Street, EI
(503) 563-6151

Prepared By: Nathaniel Ahrend, PE

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12965 SW Herman Road
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AKS Job Number: 6175

AKS ENGINEERING & FORESTRY
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City of Wilsonville
Exhibit B3 DB23-0004

Contents

Appendices

Preliminary Stormwater Report
FROG POND COTTAGE PARK PLACE
WILSONVILLE, OREGON

1.0 Purpose of Report
The purpose of this report is to analyze the effect development of Frog Pond Cottage Park Place will have on the downstream stormwater conveyance system, document the criteria the proposed stormwater system was designed to meet, identify the sources of information on which the analysis was based, detail the design methodology, and document the results of the analysis.

2.0 Project Location/Description
The development is located on Tax Lot 1200 & 1300 of Clackamas County Assessor's Map 3 1W 12D. The project site is located on the south side of SW Frog Pond Lane in Wilsonville, Oregon. The site area is ±5.00 acres. The site area generally slopes towards the northwest and southwest corners. Currently, the south basin collects most of the existing stormwater runoff from this site, which drains to the southwest corner of the site. The north basin of the site drains northwest to the existing ditch along SW Frog Pond Lane. Stormwater runoff from this development will be collected and routed to new low impact development (LID) stormwater facilities throughout the site to meet city standards for water quality and flow control. Stormwater runoff from both basins of the site will be routed through a series of underground pipes and eventually discharge into Boeckman Creek. The site will be developed in two phases, with Phase 1 generally encompassing the north basin, and Phase 2 generally encompassing the south basin.

3.0 Regulatory Design Criteria
3.1. Water Quality Requirements
Per City of Wilsonville 2015 Stormwater & Surface Water Design & Construction Standards, water quality facilities shall be designed to capture and treat 80 percent of the average annual runoff volume to the maximum extent practicable (MEP) with the goal of removing 70 percent of total suspended soils (TSS). The BMP Sizing Tool addresses these water quality requirements to size stormwater management facilities meeting best management practices (BMPs).

3.2. Flow Control Requirements
Per the 2015 City of Wilsonville *Stormwater & Surface Water Design & Construction Standards*, the duration of peak flow rates from post-development conditions shall be less than or equal to the duration of peak flow rates from pre-developed conditions for all peak flows between 42 percent of the 2-year design storm peak flow rate and the 10-year design storm peak flow rate. The BMP Sizing Tool incorporates these flow control requirements to size stormwater management facilities.

4.0 Design Methodology
The BMP Sizing Tool was used to design and size LID stormwater facilities to meet city standards. The Santa Barbara Urban Hydrograph (SBUH) method will be used to design the stormwater conveyance system. The SBUH method uses the Soil Conservation Service (SCS) Type 1A 24-hour storm. HydroCAD computer software will aid in the analysis.

5.0 Design Parameters

5.1. Design Storms

5.1.1. On-Site Inlet and Conduit Sizing

Stormwater inlets for the site will be placed at locations that will adequately capture stormwater runoff from the roadways. The on-site stormwater conduit pipes will be sized with Manning's equation, based on peak flows for the 25-year, 3.9-inch storm event.

5.1.2. Upstream Basin

Existing stormwater runoff from a small upstream area near the northeast corner of the site drains towards the north basin of the site. The site will be graded to direct this runoff north to a ditch inlet installed upstream of the site along the south side of SW Frog Pond Lane.

Existing stormwater runoff from a small upstream area near the southeast corner of the site may drain towards the south basin of the site. The site will be graded to direct this runoff south towards an area drain installed by the future Frog Pond Primary School Project on the north side of SW Brisband Street.

5.2. Pre-Developed Site Topography and Land Use

5.2.1. Site Topography

The existing stormwater runoff drains to the northwest and southwest corners of the site. The vegetative cover of the site consists of grass, trees, and brush.

5.2.2. Land Use

Tax Lots 1200 & 1300 currently have a single-family home and several outbuildings on site. All existing structures will be removed as a part of this development.

5.3. Soil Type

The soils present on the site are classified as Aloha silt loam (hydrologic soil group C/D), and Woodburn silt loam (hydrologic soil group C) by the Natural Resources Conservation Service (NRCS) Soil Survey for Clackamas County. Information on these soil types is provided in Appendix H.

5.4. Post-Developed Site Topography and Land Use

5.4.1. Site Topography

The post-developed site topography will be altered from the pre-developed site topography to allow for the construction of public streets, attached single-family homes, stormwater facilities, and other associated infrastructure.

5.4.2. Land Use

The post-developed land use will consist of 22 attached single-family homes, 12 detached single-family homes, public streets, alleys, open space, and stormwater facilities.

5.4.3. Post-Developed Input Parameters

The City of Wilsonville 2015 Stormwater & Surface Water Design & Construction Standards assesses each dwelling with 2,750 square feet of impervious area. This area is not practical for the smaller lot sizes in this development; therefore, the assumed impervious area for each lot is based on an anticipated home product with a roof area of approximately 1,540 square feet, plus 360 square feet for an assumed 20-foot-wide by 18-foot-long driveway per lot. A total impervious area of 1,900 square feet was used for each lot.

5.5. Infiltration Rate
Per the infiltration testing and report prepared by GeoPacific Engineering, Inc. dated July 5, 2022, falling-head infiltration testing on the project site demonstrated an infiltration rate of 0.0 inches per hour.

6.0 Calculation Methodology

6.1. Proposed Stormwater Conduit Sizing and Inlet Spacing
The on-site stormwater conduit pipes will be sized using Manning's equation for the 25-year, 3.9 inch storm event. Stormwater inlets will be placed at locations to adequately capture stormwater runoff from the streets and alleys.

6.2. Proposed Stormwater Quality Control Facility Design
The new vegetated swales, planters and the stormwater pond will provide water quality management for stormwater runoff from impervious areas within the new street right-of-way, driveways, alleys, and roof areas. Lots 11 and 12 will utilize individual on-lot planters to provide water quality management for stormwater runoff from the lot's roof area. All LID stormwater facilities were sized with BMP Sizing Tool to accommodate flows generated by developed areas of the subject property in compliance with city water quality requirements (described in Section 3.1)

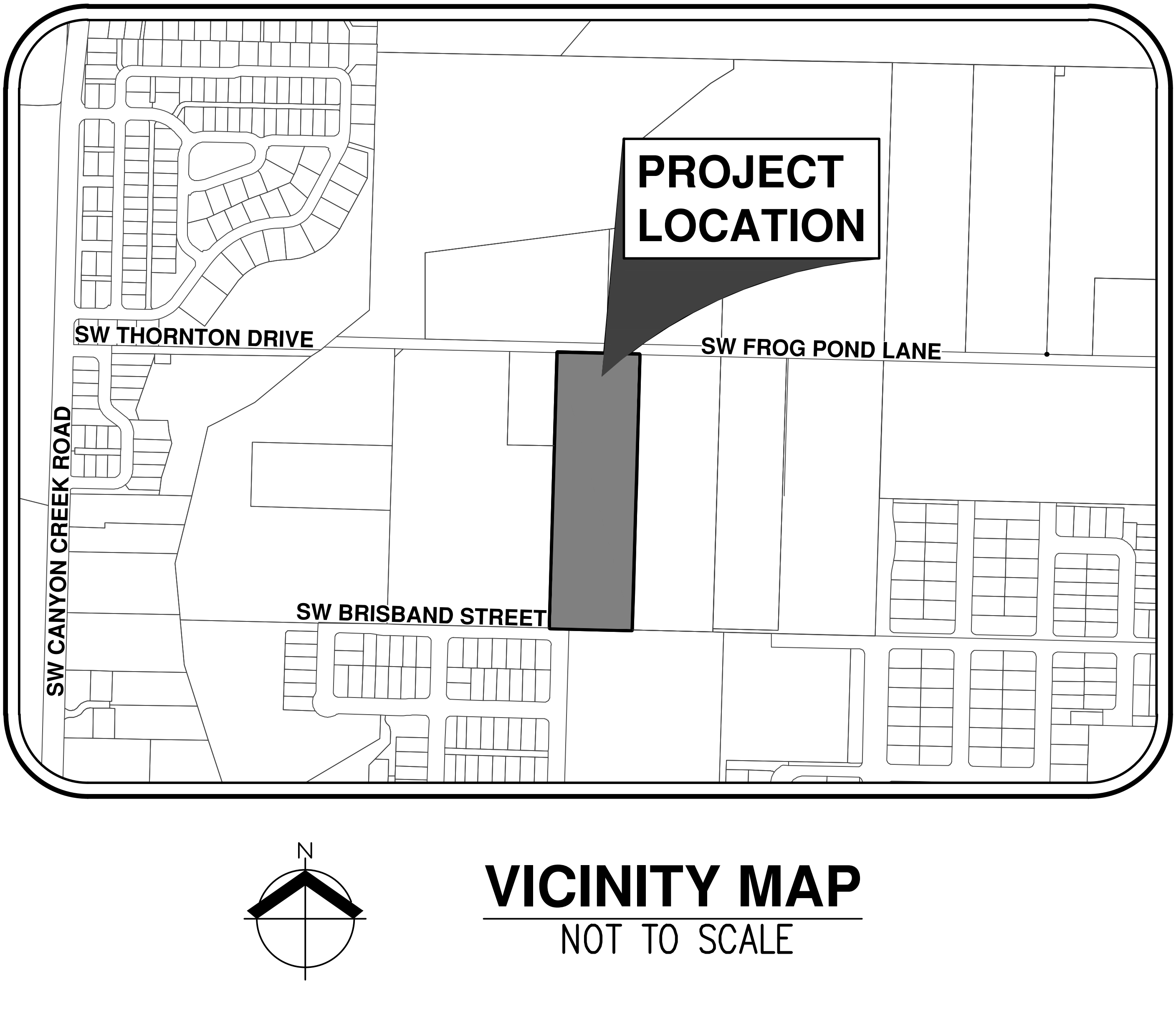
6.3. Proposed Stormwater Quantity Facility Design
The new vegetated swales, planters and stormwater pond will provide flow control management for stormwater runoff from impervious areas within the new street right-of-way and roof areas. Lots 11 and 12 will utilize individual on-lot planters to provide flow control management for stormwater runoff from the lot's roof area. All LID stormwater facilities were sized with the BMP Sizing Tool to accommodate flows generated by developed areas of the subject property in compliance with city flow control requirements (described in Section 3.2).

6.4. Emergency Overflow Calculations
The emergency overflow weir was sized to convey the 100-year storm event. Calculations are included in Appendix F. If the stormwater facility's outlet structures become plugged and cannot convey runoff from the site, the overflow stormwater from the stormwater facility will back up out of the catch basin along SW Brisband Street and flow down SW Brisband Street towards Boeckman Creek. If this catch basin becomes plugged, overflow will sheet flow out of the pond and across the overflow riprap pad and the curb ramp at the corner of SW Brisband Street and SW Sherman Drive, and down SW Brisband Street towards Boeckman Creek.

6.5. Downstream Analysis
Phase 1 will connect to the storm drain system proposed with the nearby Frog Pond Overlook development, and stormwater discharged at this location will travel west through Frog Pond Overlook and the nearby Frog Pond Terrace development and ultimately outfall into Boeckman Creek. Per the City of Wilsonville Stormwater Standards, the conveyance system of these developments will be sized to accommodate upstream runoff from the post-developed 25-year storm event, which includes the north basin of this site. Coordination and verification of downstream capacity will occur with final design.

Phase 2 will connect to an existing storm drain manhole constructed with Morgan Farm Ph. 2 in the intersection of SW Brisband Street & SW Sherman Drive, and the storm drain system proposed with the adjacent Frog Pond Primary School project. Stormwater discharged from the site at this location continues through Morgan Farm Ph. 2 and discharges into Boeckman Creek. Per the Morgan Farm Ph. 2 downstream analysis included in Appendix G, the existing system within Morgan Farm Ph. 2 has capacity to convey upstream runoff from the post-developed 25-year storm event (which includes the south basin of this site) while maintaining a minimum of ±1.23 feet of freeboard within the conveyance system.

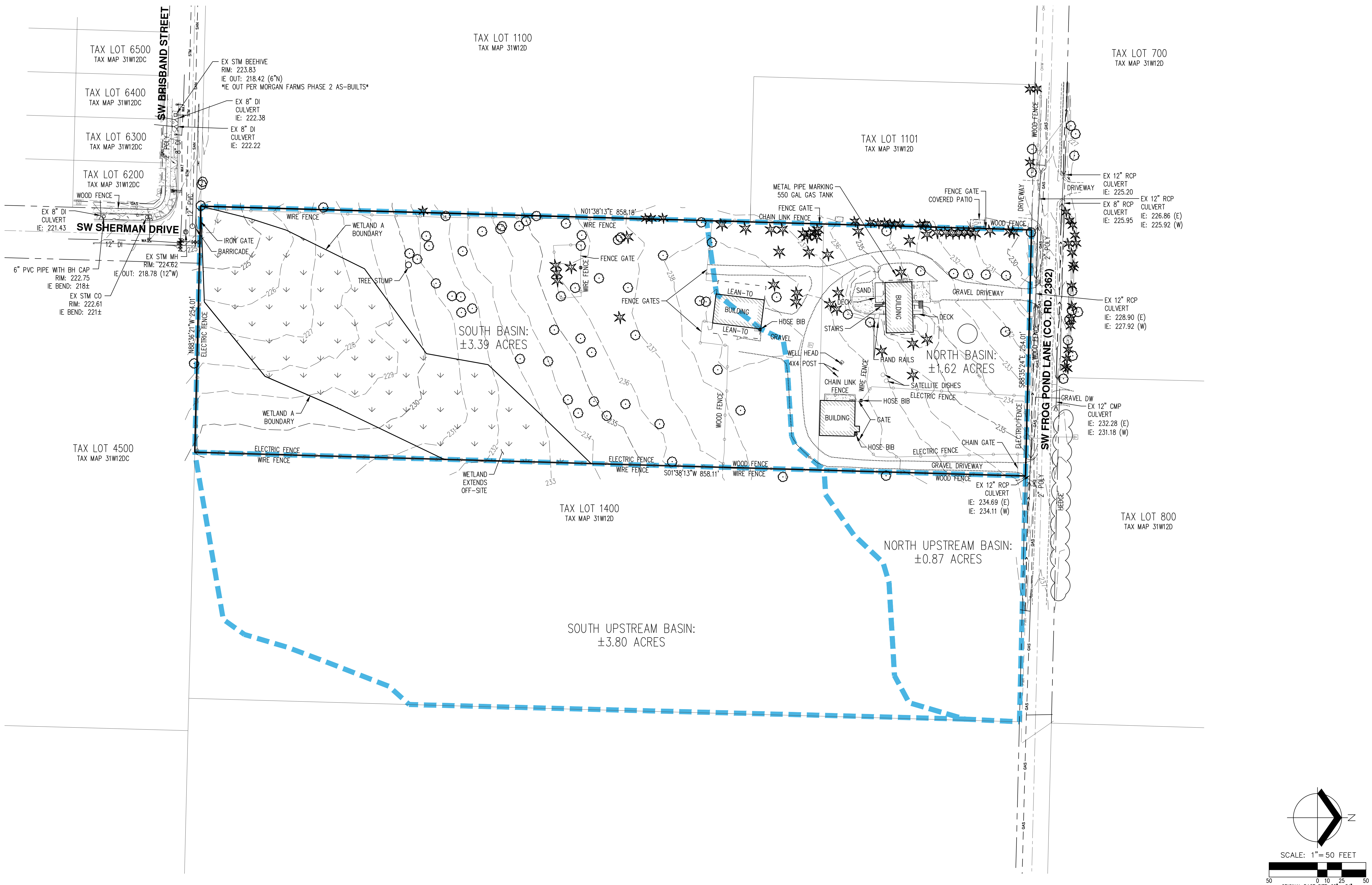
Appendix A: Vicinity Map



VICINITY MAP

NOT TO SCALE

Appendix B: Pre-Developed Catchment Map and Detail



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PRE-DEVELOPED MAP
FROG POND COTTAGE PARK PLACE
SULLIVAN HOMES, LLC.
WILSONVILLE, OREGON

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JOB NUMBER:	6175
DATE:	MAY 2023
DESIGNED BY:	NRA
DRAWN BY:	JJA
CHECKED BY:	CMS

AKS DRAWING FILE: 6175 PRE-DEVELOPED MAP.DWG | LAYOUT: PRE-DEV MAP

Appendix C: Post-Developed Catchment Map and Detail

NOTE:

STORM MAINS SHOWN ON TAX LOT 4500 AND WITHIN FROG POND LANE ADJACENT TO THE SITE ARE SCHEMATIC IN NATURE AND ASSUMED TO BE INSTALLED WITH THE NEARBY FROG POND OVERLOOK SUBDIVISION AND ADJACENT NEW WILSONVILLE PRIMARY SCHOOL PRIOR TO OR CONCURRENT WITH THIS SUBDIVISION.

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POST-DEVELOPED MAP
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Appendix D: BMP Sizing Tool Report

WES BMP Sizing Software Version 1.6.0.2, May 2018

WES BMP Sizing Report

Project Information

Project Name	FROG POND COTTAGE PARK PLACE
Project Type	Subdivision
Location	
Stormwater Management Area	2535
Project Applicant	AKS ENGINEERING & FORESTRY
Jurisdiction	OutofDistrict

Drainage Management Area

Name	Area (sq-ft)	Pre-Project Cover	Post-Project Cover	DMA Soil Type	BMP
BASIN 7 ROOFS	18,480	Grass	Roofs	D	BASIN 7, 10 & 13 POND
BASIN 7 IMPERVIOUS	10,923	Grass	ConventionalConcrete	D	BASIN 7, 10 & 13 POND
BASIN 7 PERVIOUS	14,880	Grass	LandscapeDsoil	D	BASIN 7, 10 & 13 POND
BASIN 11 IMPERVIOUS	5,700	Grass	ConventionalConcrete	D	BASIN 11 SWALE
BASIN 11 PERVIOUS	1,200	Grass	LandscapeDsoil	D	BASIN 11 SWALE
BASIN 14 ROOFS	6,160	Grass	Roofs	D	BASIN 14 SWALE
BASIN 14 IMPERVIOUS	2,564	Grass	ConventionalConcrete	D	BASIN 14 SWALE
BASIN 14 PERVIOUS	4,906	Grass	LandscapeDsoil	D	BASIN 14 SWALE
BASIN 1 IMPERVIOUS	1,075	Grass	ConventionalConcrete	C	BASIN 1 SWALE
BASIN 1 ROOF	3,080	Grass	Roofs	C	BASIN 1 SWALE
BASIN 1 PERVIOUS	4,185	Grass	LandscapeCsoil	C	BASIN 1 SWALE
BASIN 5 ROOF	1,540	Grass	Roofs	C	BASIN 5 PLANTER
BASIN 12 IMPERVIOUS	5,700	Grass	ConventionalConcrete	D	BASIN 12 SWALE

BASIN 12 PERVIOUS	1,200	Grass	LandscapeDsoil	D	BASIN 12 SWALE
BASIN 3 IMPERVIOUS	2,820	Grass	ConventionalConcrete	C	BASIN 3 SWALE
BASIN 2 IMPERVIOUS	2,078	Grass	ConventionalConcrete	C	BASIN 2 SWALE
BASIN 13 PERVIOUS	263	Grass	LandscapeDsoil	D	BASIN 7, 10 & 13 POND
BASIN 13 IMPERVIOUS	1,420	Grass	ConventionalConcrete	D	BASIN 7, 10 & 13 POND
BASIN 4 IMPERVIOUS	10,628	Grass	ConventionalConcrete	C	BASIN 4 SWALE
BASIN 3 PERVIOUS	8,630	Grass	LandscapeCsoil	C	BASIN 3 SWALE
BASIN 3 ROOF	1,540	Grass	LandscapeCsoil	C	BASIN 3 SWALE
BASIN 4 PERVIOUS	12,780	Grass	LandscapeCsoil	C	BASIN 4 SWALE
BASIN 4 ROOFS	10,780	Grass	Roofs	C	BASIN 4 SWALE
BASIN 8 IMPERVIOUS	4,940	Grass	ConventionalConcrete	D	BASIN 8 SWALE
BASIN 8 PERVIOUS	1,865	Grass	LandscapeDsoil	D	BASIN 8 SWALE
BASIN 8 ROOFS	3,080	Grass	Roofs	D	BASIN 8 SWALE
BASIN 9 IMPERVIOUS	4,040	Grass	ConventionalConcrete	D	BASIN 9 SWALE
BASIN 9 PERVIOUS	1,480	Grass	LandscapeDsoil	D	BASIN 9 SWALE
BASIN 6 ROOF	1,540	Grass	Roofs	C	BASIN 6 PLANTER
BASIN 10 IMPERVIOUS	7,740	Grass	ConventionalConcrete	D	BASIN 7, 10 & 13 POND
BASIN 10 PERVIOUS	6,560	Grass	LandscapeDsoil	D	BASIN 7, 10 & 13 POND
BASIN 10 ROOFS	6,160	Grass	Roofs	D	BASIN 7, 10 & 13 POND

LID Facility Sizing Details

LID ID	Design Criteria	BMP Type	Facility Soil Type	Minimum Area (sq-ft)	Planned Areas (sq-ft)	Orifice Diameter (in)
BASIN 5 PLANTER	FlowControlAndTreatment	Stormwater Planter - Filtration	Lined	107.8	110.0	0.4

BASIN 6 PLANTER	FlowControlAndTreatment	Stormwater Planter - Filtration	Lined	107.8	110.0	0.4
BASIN 1 SWALE	FlowControlAndTreatment	Vegetated Swale - Filtration	Lined	437.3	440.0	0.9
BASIN 2 SWALE	FlowControlAndTreatment	Vegetated Swale - Filtration	Lined	145.5	146.0	0.4
BASIN 11 SWALE	FlowControlAndTreatment	Vegetated Swale - Filtration	Lined	261.6	270.0	0.9
BASIN 14 SWALE	FlowControlAndTreatment	Vegetated Swale - Filtration	Lined	486.3	1,030.0	1.3
BASIN 12 SWALE	FlowControlAndTreatment	Vegetated Swale - Filtration	Lined	261.6	270.0	0.9
BASIN 3 SWALE	FlowControlAndTreatment	Vegetated Swale - Filtration	Lined	553.4	555.0	1.1
BASIN 4 SWALE	FlowControlAndTreatment	Vegetated Swale - Filtration	Lined	1,945.9	1,950.0	1.8
BASIN 8 SWALE	FlowControlAndTreatment	Vegetated Swale - Filtration	Lined	373.0	380.0	1.1
BASIN 9 SWALE	FlowControlAndTreatment	Vegetated Swale - Filtration	Lined	203.0	210.0	0.8

Pond Sizing Details

Pond ID	Design Criteria(1)	Facility Soil Type	Max Depth (ft)(2)	Top Area (sq-ft)	Side Slope (1:H)	Facility Vol. (cu-ft)(3)	Water Storage Vol. (cu-ft)(4)	Adequate Size?
BASIN 7, 10 & 13 POND	FCWQT	Lined	4.25	2,313.0	3	5,537.9	3,693.3	Yes

1. FCWQT = Flow control and water quality treatment, WQT = Water quality treatment only
2. Depth is measured from the bottom of the facility and includes the three feet of media (drain rock, separation layer and growing media).
3. Maximum volume of the facility. Includes the volume occupied by the media at the bottom of the facility.
4. Maximum water storage volume of the facility. Includes water storage in the three feet of soil media assuming a 40 percent porosity.

Simple Pond Geometry Configuration

Pond ID: BASIN 7, 10 & 13 POND
Design: FlowControlAndTreatment

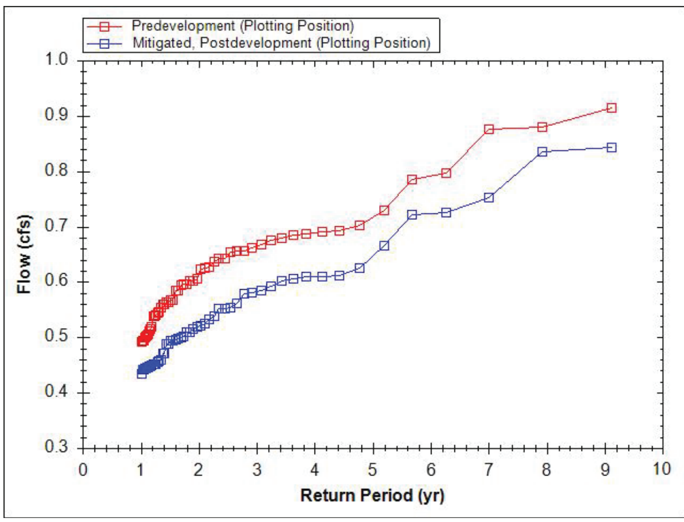
Shape Curve

Depth (ft)	Area (sq ft)
4.3	2,313.0

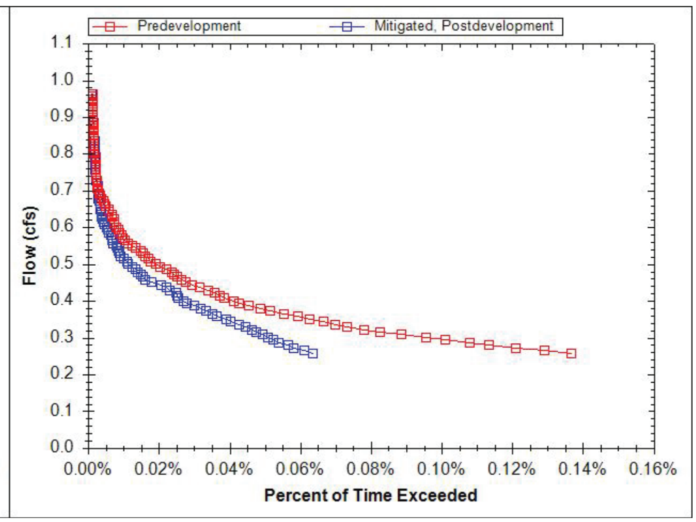
Outlet Structure Details

Lower Orifice Invert (ft)	0.0
Lower Orifice Dia (in)	2.2
Upper Orifice Invert(ft)	2.8
Upper Orifice Dia (in)	4.8
Overflow Weir Invert(ft)	3.3
Overflow Weir Length (ft)	6.3

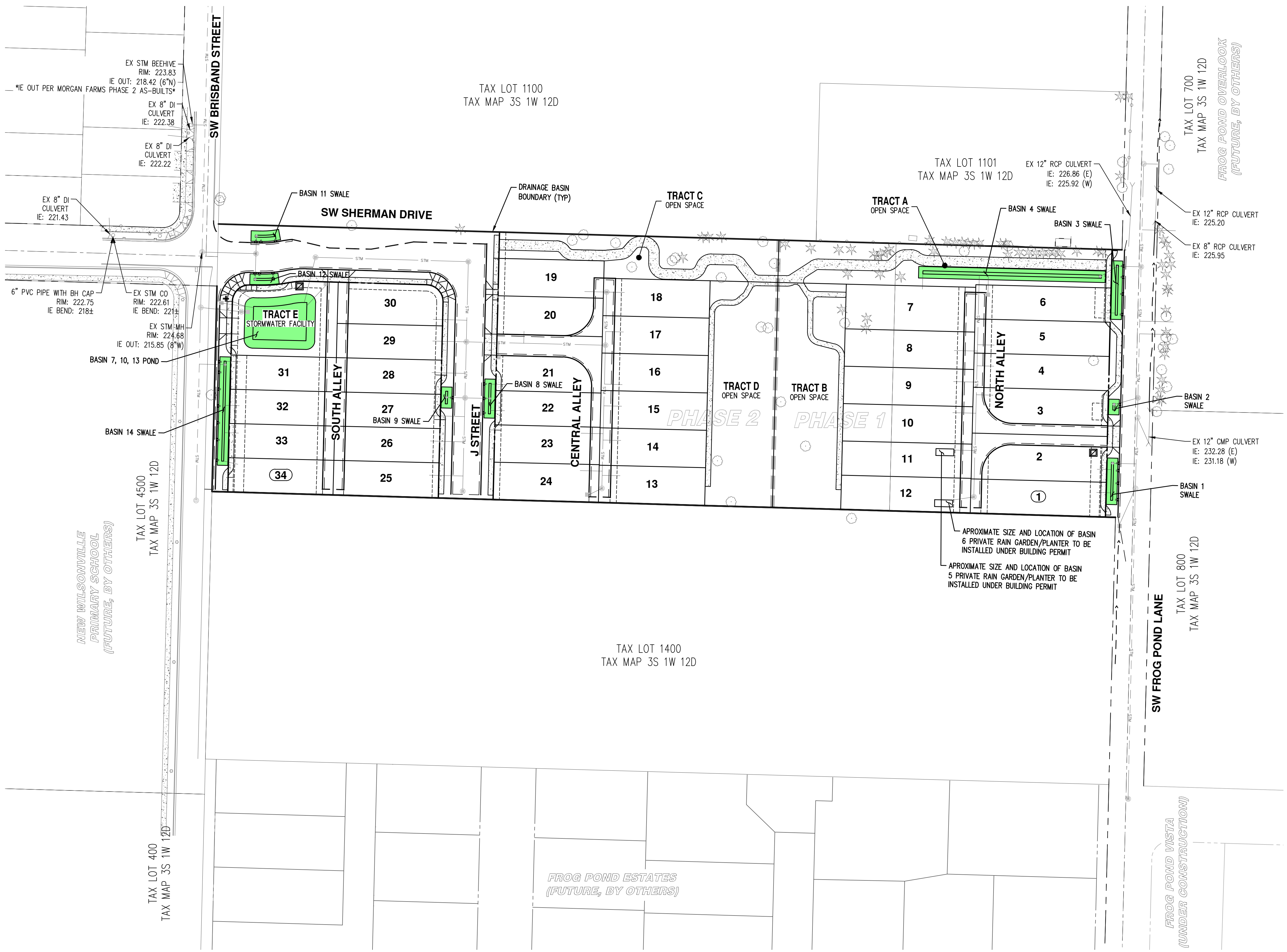
Flow Frequency Chart



Flow Duration Chart



Appendix E: Stormwater Facilities Location Map



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STORMWATER FACILITIES LOCATION MAP
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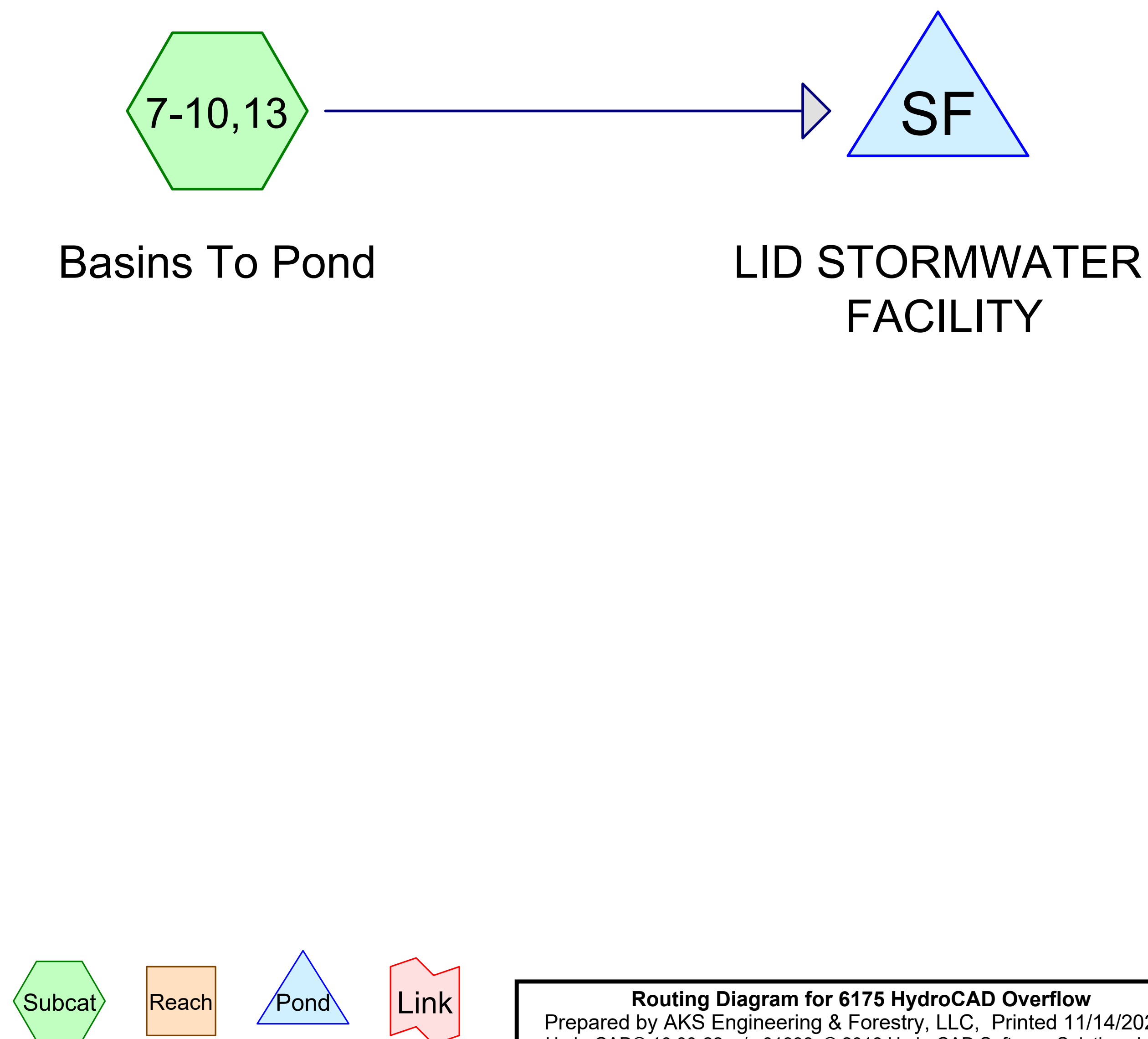
Appendix F: Emergency Overflow Calculations



Routing Diagram for 6175 HydroCAD Overflow
Prepared by AKS Engineering & Forestry, LLC, Printed 11/14/2023

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
29,063	98	Impervious (7-10,13)
25,048	80	Pervious (7-10,13)
27,720	98	Roofs (7-10,13)
81,831	**92**	**TOTAL AREA**

Summary for Subcatchment 7-10,13: Basins To Pond

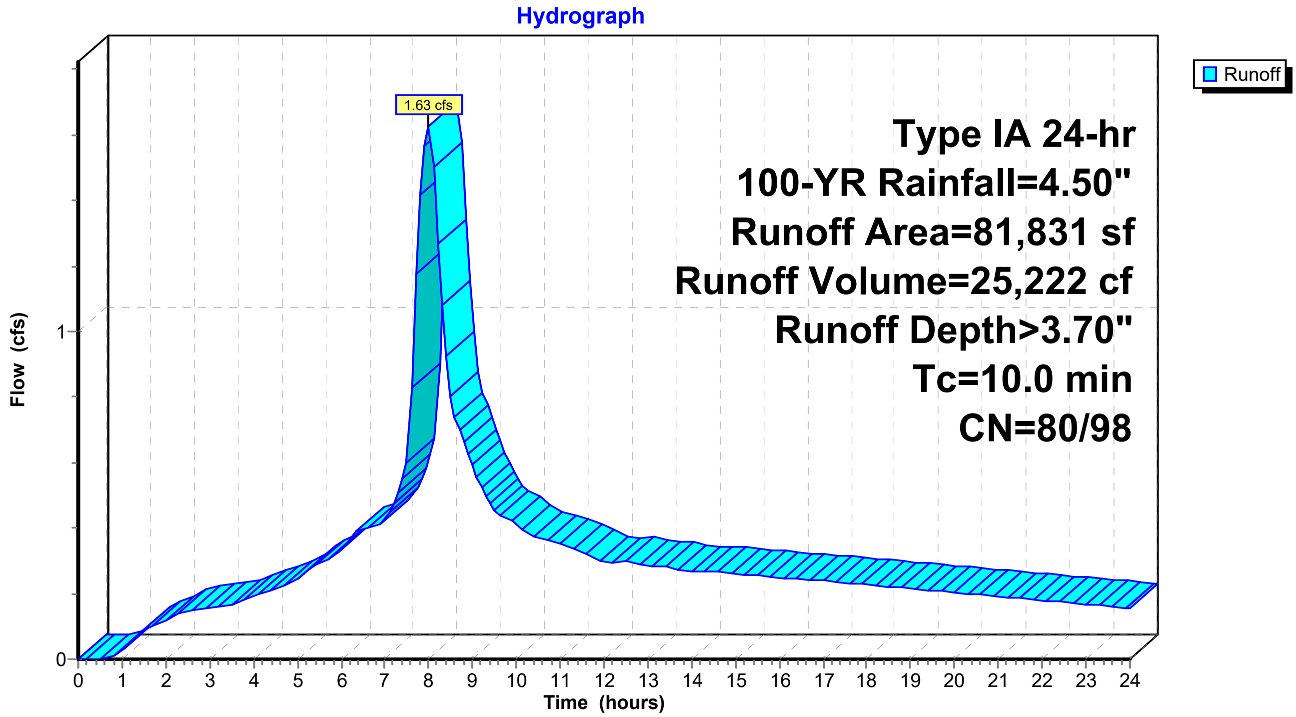
Runoff = 1.63 cfs @ 7.98 hrs, Volume= 25,222 cf, Depth> 3.70"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type IA 24-hr 100-YR Rainfall=4.50"

	Area (sf)	CN	Description
*	29,063	98	Impervious
*	25,048	80	Pervious
*	27,720	98	Roofs
	81,831	92	Weighted Average
	25,048		30.61% Pervious Area
	56,783		69.39% Impervious Area

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

Subcatchment 7-10,13: Basins To Pond



Summary for Pond SF: LID STORMWATER FACILITY

Inflow Area = 81,831 sf, 69.39% Impervious, Inflow Depth > 3.70" for 100-YR event
Inflow = 1.63 cfs @ 7.98 hrs, Volume= 25,222 cf
Outflow = 0.93 cfs @ 8.43 hrs, Volume= 16,325 cf, Atten= 43%, Lag= 26.9 min
Primary = 0.93 cfs @ 8.43 hrs, Volume= 16,325 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 225.61' @ 8.43 hrs Surf.Area= 3,291 sf Storage= 9,176 cf

Plug-Flow detention time= 384.5 min calculated for 16,258 cf (64% of inflow)
Center-of-Mass det. time= 176.0 min (864.0 - 688.0)

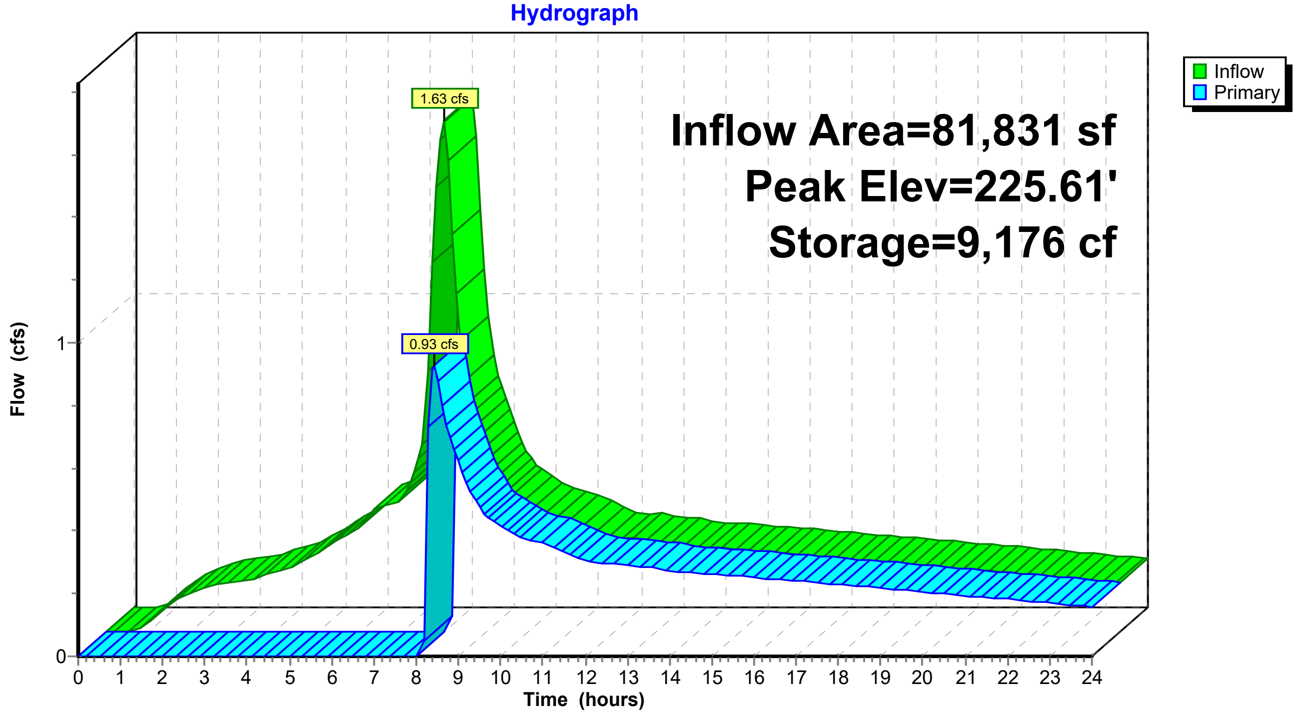
Volume	Invert	Avail.Storage	Storage Description
#1	219.75'	10,453 cf	**Custom Stage Data (Pyramidal)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
219.75	1,683	0.0	0	0	1,683
222.70	1,683	40.0	1,986	1,986	2,167
222.75	1,683	100.0	84	2,070	2,175
224.00	2,361	100.0	2,516	4,586	2,889
225.00	2,967	100.0	2,658	7,244	3,529
225.50	3,291	100.0	1,564	8,808	3,872
226.00	3,291	100.0	1,646	10,453	3,987

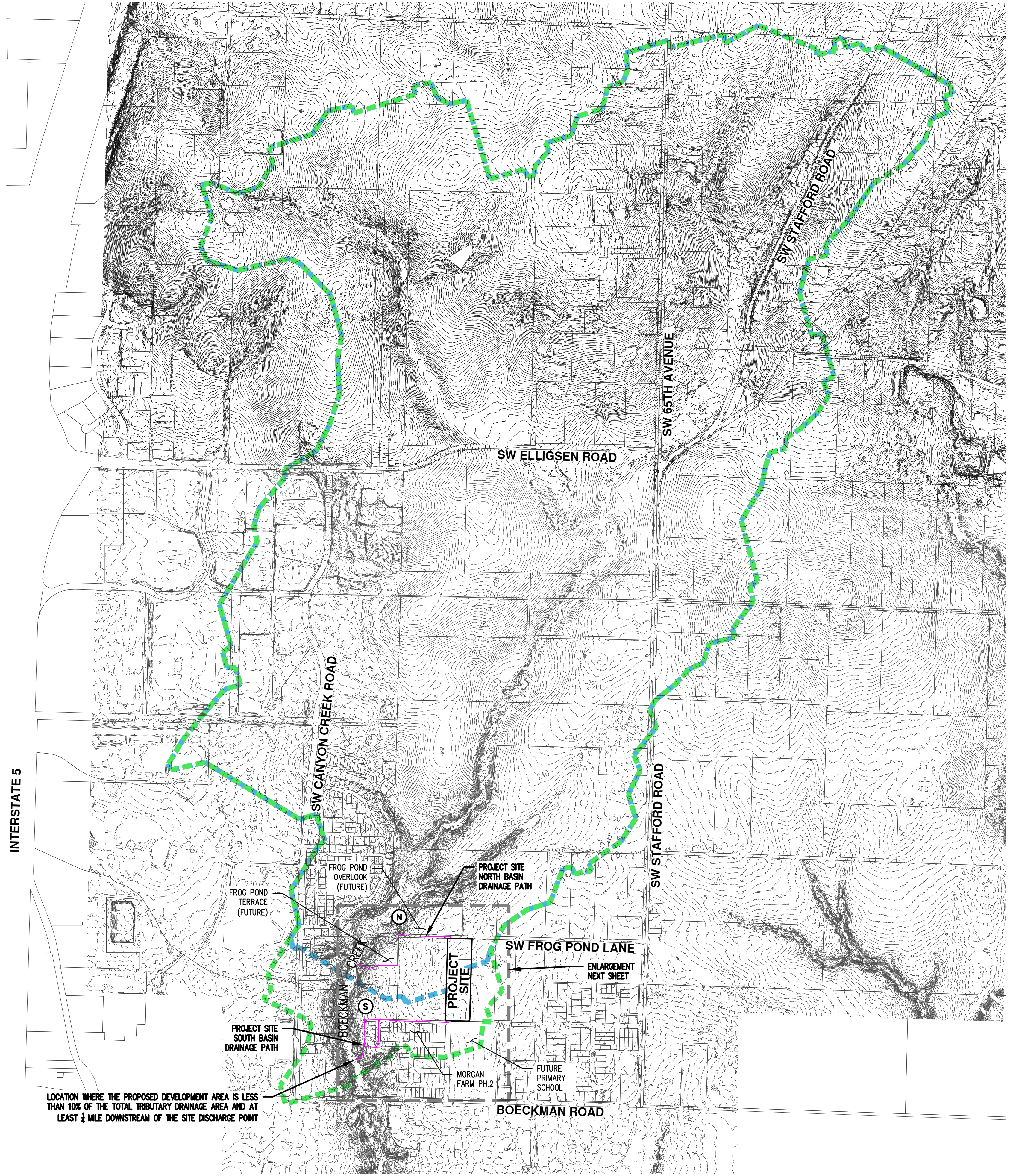
Device	Routing	Invert	Outlet Devices
#1	Primary	225.50'	**10.0' long x 8.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74

Primary OutFlow Max=0.88 cfs @ 8.43 hrs HW=225.61' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.88 cfs @ 0.80 fps)

Pond SF: LID STORMWATER FACILITY



Appendix G: Downstream Analysis



BASIN LEGEND

N	NORTH
S	SOUTH

N

SCALE: 1"= 600 FEET

600 0 100 300 600

ORIGINAL PAGE SIZE: 22" X 34"

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DOWNSTREAM BASIN MAP
FROG POND COTTAGE PARK PLACE
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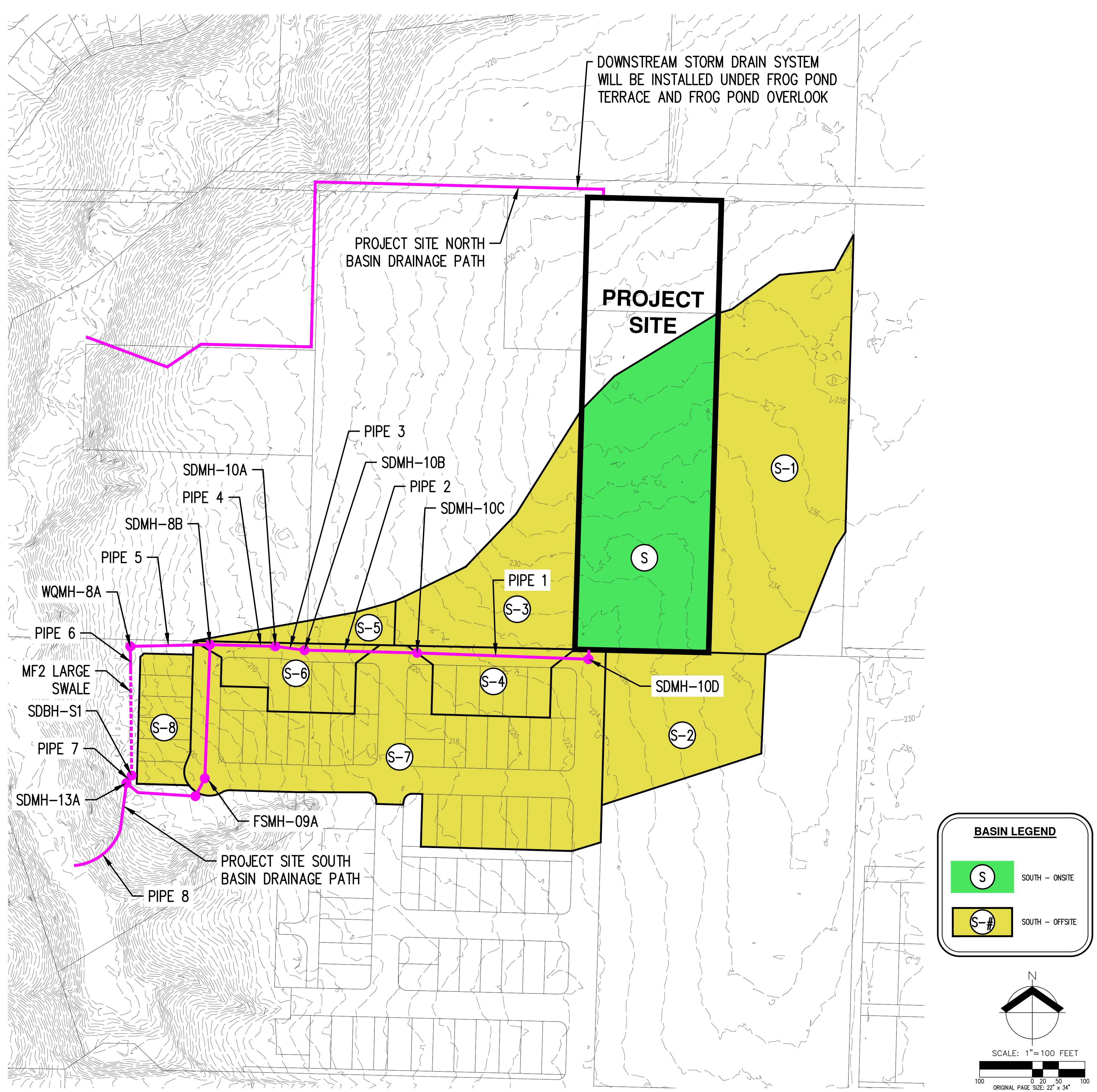

DOWNSTREAM BASIN MAP ENLARGEMENT
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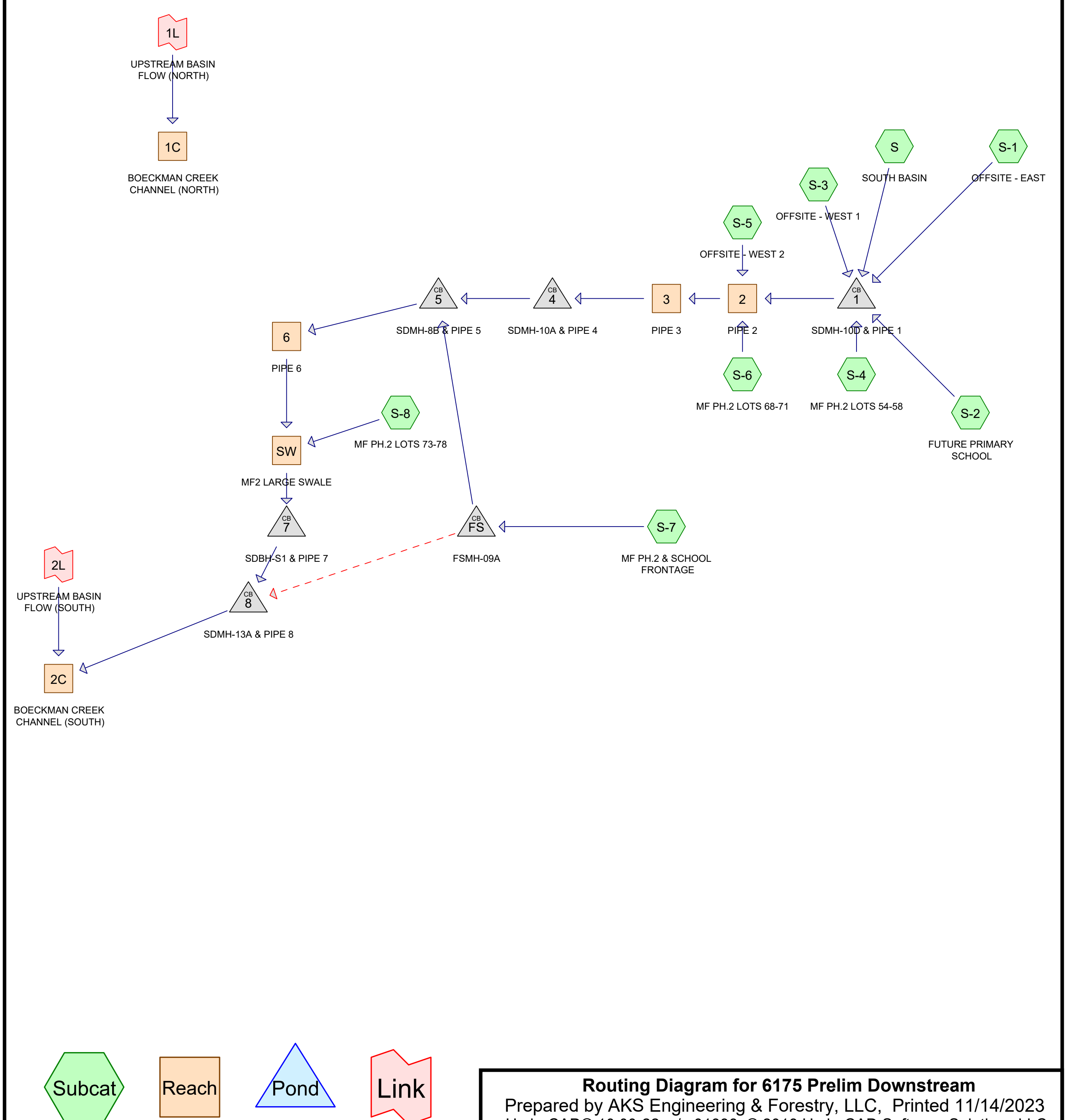


Routing Diagram for 6175 Prelim Downstream
Prepared by AKS Engineering & Forestry, LLC, Printed 11/14/2023
HydroCAD® 10.00-22 s/n 01338 © 2018 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
64,362	74	>75% Grass cover, Good, HSG C (S-6, S-7, S-8)
68,555	80	>75% Grass cover, Good, HSG D (S, S-2, S-4)
43,027	98	BASIN 5-11 IMPERVIOUS (S)
33,880	98	BASIN 5-11 ROOFS (S)
102,950	98	IMPERVIOUS (S-2, S-4, S-6, S-7)
91,513	74	Pasture/grassland/range, Good, HSG C (S-3, S-5)
167,500	80	Pasture/grassland/range, Good, HSG D (S-1)
115,509	98	ROOFS (S-4, S-6, S-7, S-8)
32,918	79	Woods/grass comb., Good, HSG D (S)
720,214	**86**	**TOTAL AREA**

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	2	215.09	206.41	213.8	0.0406	0.013	12.0	0.0	0.0
2	3	206.20	203.59	55.9	0.0467	0.013	12.0	0.0	0.0
3	6	194.42	191.90	28.7	0.0878	0.013	15.0	0.0	0.0
4	1	218.89	215.29	327.4	0.0110	0.013	12.0	0.0	0.0
5	4	203.39	200.94	124.2	0.0197	0.013	12.0	0.0	0.0
6	5	196.70	194.97	140.3	0.0123	0.013	15.0	0.0	0.0
7	7	188.48	187.89	17.6	0.0335	0.013	12.0	0.0	0.0
8	8	187.69	185.99	50.0	0.0340	0.013	12.0	0.0	0.0
9	FS	200.29	196.90	250.2	0.0135	0.013	15.0	0.0	0.0
10	FS	200.12	199.85	47.2	0.0057	0.013	12.0	0.0	0.0

Time span=0.00-24.00 hrs, dt=0.10 hrs, 241 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentS: SOUTH BASIN Runoff Area=142,170 sf 54.10% Impervious Runoff Depth>2.84"
Tc=5.0 min CN=79/98 Runoff=2.28 cfs 33,664 cf

SubcatchmentS-1: OFFSITE - EAST Runoff Area=167,500 sf 0.00% Impervious Runoff Depth>1.90"
Flow Length=815' Tc=55.1 min CN=80/0 Runoff=0.92 cfs 26,526 cf

SubcatchmentS-2: FUTURE PRIMARY Runoff Area=39,074 sf 26.53% Impervious Runoff Depth>2.41"
Tc=5.0 min CN=80/98 Runoff=0.52 cfs 7,837 cf

SubcatchmentS-3: OFFSITE - WEST 1 Runoff Area=76,554 sf 0.00% Impervious Runoff Depth>1.50"
Flow Length=550' Slope=0.0270 '/' Tc=29.3 min CN=74/0 Runoff=0.37 cfs 9,546 cf

SubcatchmentS-4: MF PH.2 LOTS 54-58 Runoff Area=30,788 sf 75.63% Impervious Runoff Depth>3.24"
Tc=5.0 min CN=80/98 Runoff=0.57 cfs 8,322 cf

SubcatchmentS-5: OFFSITE - WEST 2 Runoff Area=14,959 sf 0.00% Impervious Runoff Depth>1.51"
Flow Length=200' Slope=0.0350 '/' Tc=16.7 min CN=74/0 Runoff=0.09 cfs 1,880 cf

SubcatchmentS-6: MF PH.2 LOTS 68-71 Runoff Area=30,682 sf 76.24% Impervious Runoff Depth>3.15"
Tc=5.0 min CN=74/98 Runoff=0.54 cfs 8,056 cf

SubcatchmentS-7: MF PH.2 & SCHOOL Runoff Area=194,137 sf 74.64% Impervious Runoff Depth>3.12"
Tc=5.0 min CN=74/98 Runoff=3.39 cfs 50,418 cf

SubcatchmentS-8: MF PH.2 LOTS 73-78 Runoff Area=24,350 sf 67.80% Impervious Runoff Depth>2.97"
Tc=5.0 min CN=74/98 Runoff=0.40 cfs 6,027 cf

Reach 1C: BOECKMAN CREEK Avg. Flow Depth=0.65' Max Vel=2.48 fps Inflow=111.00 cfs 9,630,360 cf
n=0.040 L=541.0' S=0.0080 '/' Capacity=40,939.08 cfs Outflow=112.22 cfs 9,561,761 cf

Reach 2: PIPE 2 Avg. Flow Depth=0.62' Max Vel=9.92 fps Inflow=5.12 cfs 95,830 cf
12.0" Round Pipe n=0.013 L=213.8' S=0.0406 '/' Capacity=7.18 cfs Outflow=5.10 cfs 95,787 cf

Reach 2C: BOECKMAN CREEK Avg. Flow Depth=0.69' Max Vel=2.59 fps Inflow=125.79 cfs 10,302,944 cf
n=0.040 L=541.0' S=0.0080 '/' Capacity=40,939.08 cfs Outflow=125.63 cfs 10,231,859 cf

Reach 3: PIPE 3 Avg. Flow Depth=0.59' Max Vel=10.48 fps Inflow=5.10 cfs 95,787 cf
12.0" Round Pipe n=0.013 L=55.9' S=0.0467 '/' Capacity=7.70 cfs Outflow=5.10 cfs 95,776 cf

Reach 6: PIPE 6 Avg. Flow Depth=0.56' Max Vel=14.83 fps Inflow=7.90 cfs 123,087 cf
15.0" Round Pipe n=0.013 L=28.7' S=0.0878 '/' Capacity=19.14 cfs Outflow=7.90 cfs 123,082 cf

Reach SW: MF2 LARGE SWALE Avg. Flow Depth=0.70' Max Vel=2.89 fps Inflow=8.30 cfs 129,109 cf
n=0.030 L=217.0' S=0.0100 '/' Capacity=54.57 cfs Outflow=8.19 cfs 128,916 cf

Pond 1: SDMH-10D & PIPE 1 Peak Elev=222.28' Inflow=4.49 cfs 85,894 cf
12.0" Round Culvert n=0.013 L=327.4' S=0.0110 '/' Outflow=4.49 cfs 85,894 cf

Pond 4: SDMH-10A & PIPE 4 Peak Elev=205.71' Inflow=5.10 cfs 95,776 cf
12.0" Round Culvert n=0.013 L=124.2' S=0.0197 '/' Outflow=5.10 cfs 95,776 cf

Pond 5: SDMH-8B & PIPE 5 Peak Elev=199.28' Inflow=7.90 cfs 123,087 cf
15.0" Round Culvert n=0.013 L=140.3' S=0.0123 '/' Outflow=7.90 cfs 123,087 cf

Pond 7: SDBH-S1 & PIPE 7 Peak Elev=193.67' Inflow=8.19 cfs 128,916 cf
12.0" Round Culvert n=0.013 L=17.6' S=0.0335 '/' Outflow=8.19 cfs 128,916 cf

Pond 8: SDMH-13A & PIPE 8 Peak Elev=193.59' Inflow=8.79 cfs 152,024 cf
12.0" Round Culvert n=0.013 L=50.0' S=0.0340 '/' Outflow=8.79 cfs 152,024 cf

Pond FS: FSMH-09A Peak Elev=201.14' Inflow=3.39 cfs 50,418 cf
Primary=2.79 cfs 27,310 cf Secondary=0.60 cfs 23,108 cf Outflow=3.39 cfs 50,418 cf

Link 1L: UPSTREAM BASIN FLOW (NORTH) Manual Hydrograph Inflow=111.00 cfs 9,630,360 cf
Primary=111.00 cfs 9,630,360 cf

Link 2L: UPSTREAM BASIN FLOW (SOUTH) Manual Hydrograph Inflow=117.00 cfs 10,150,920 cf
Primary=117.00 cfs 10,150,920 cf

Total Runoff Area = 720,214 sf Runoff Volume = 152,275 cf Average Runoff Depth = 2.54"
58.99% Pervious = 424,848 sf 41.01% Impervious = 295,366 sf

Summary for Subcatchment S: SOUTH BASIN

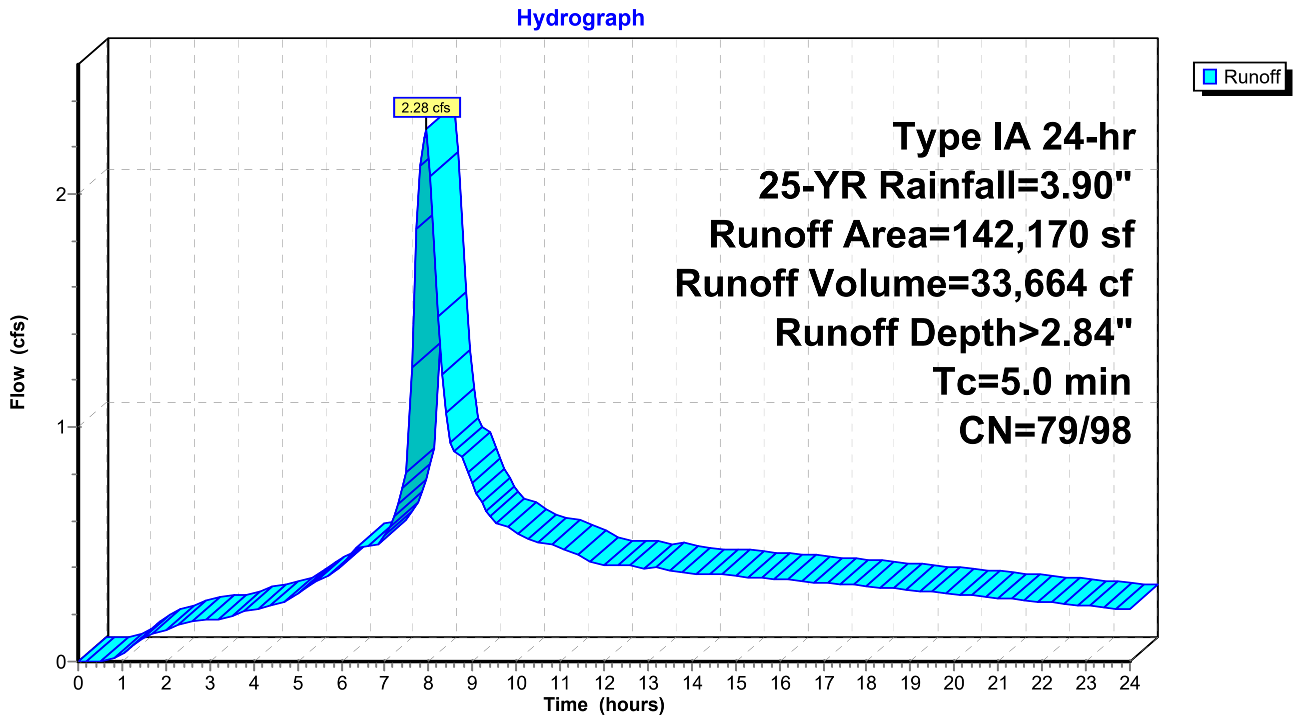
Runoff = 2.28 cfs @ 7.95 hrs, Volume= 33,664 cf, Depth> 2.84"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type IA 24-hr 25-YR Rainfall=3.90"

	Area (sf)	CN	Description
	32,345	80	>75% Grass cover, Good, HSG D
*	43,027	98	BASIN 5-11 IMPERVIOUS
*	33,880	98	BASIN 5-11 ROOFS
	32,918	79	Woods/grass comb., Good, HSG D
	142,170	90	Weighted Average
	65,263		45.90% Pervious Area
	76,907		54.10% Impervious Area

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

Subcatchment S: SOUTH BASIN



Summary for Subcatchment S-1: OFFSITE - EAST

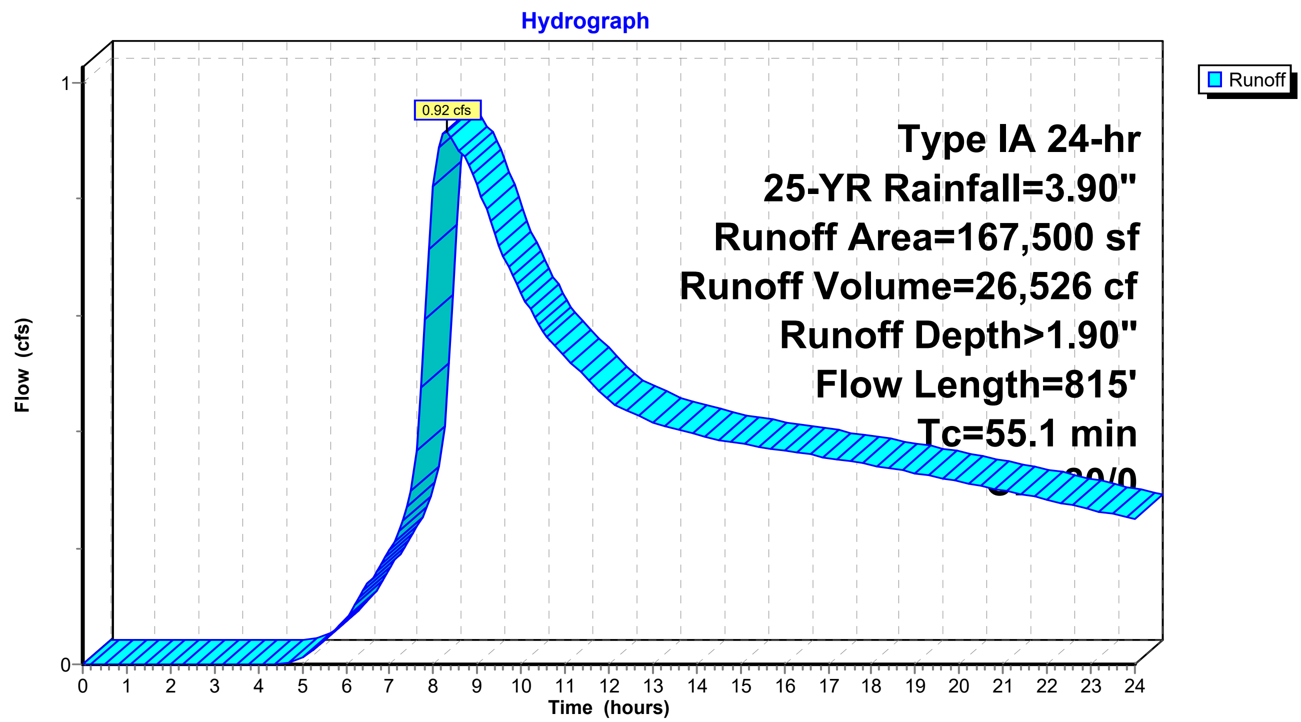
Runoff = 0.92 cfs @ 8.30 hrs, Volume= 26,526 cf, Depth> 1.90"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type IA 24-hr 25-YR Rainfall=3.90"

Area (sf)	CN	Description
167,500	80	Pasture/grassland/range, Good, HSG D
167,500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
42.8	300	0.0150	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.60"
12.3	515	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
55.1	815	Total			

Subcatchment S-1: OFFSITE - EAST



Summary for Subcatchment S-2: FUTURE PRIMARY SCHOOL

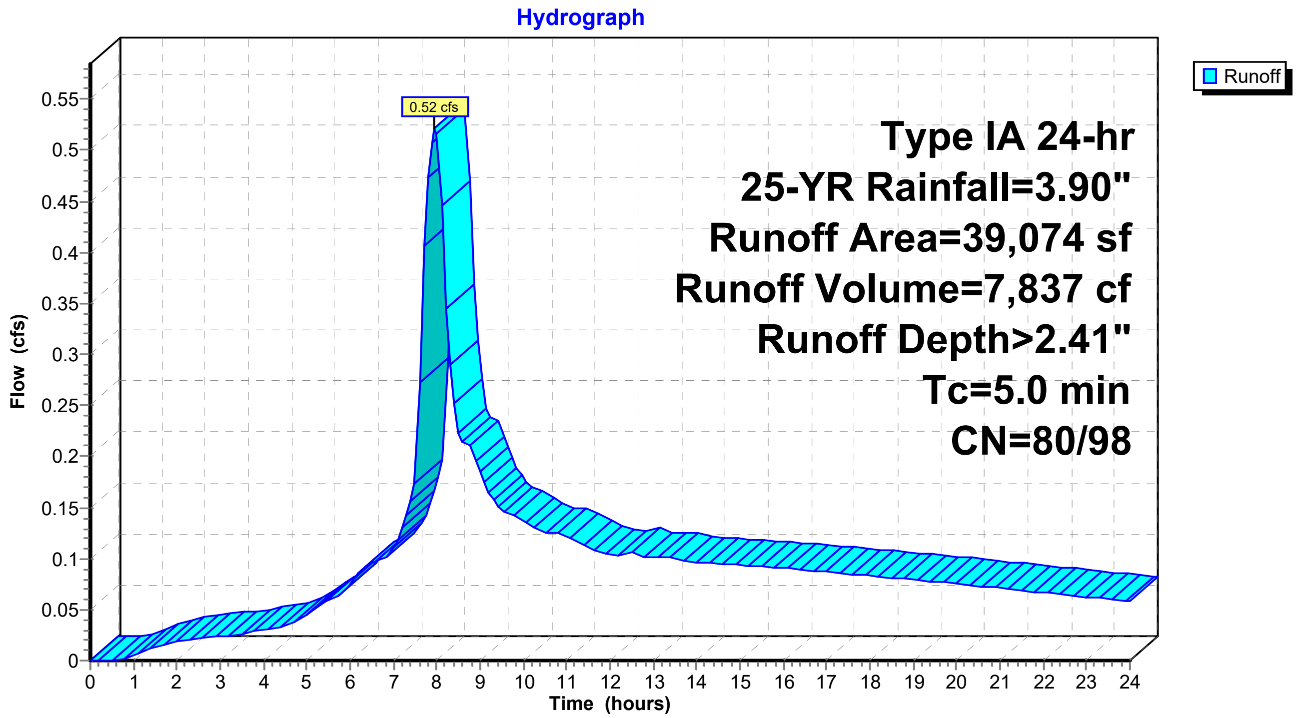
Runoff = 0.52 cfs @ 7.96 hrs, Volume= 7,837 cf, Depth> 2.41"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type IA 24-hr 25-YR Rainfall=3.90"

	Area (sf)	CN	Description
*	10,368	98	IMPERVIOUS
	28,706	80	>75% Grass cover, Good, HSG D
	39,074	85	Weighted Average
	28,706		73.47% Pervious Area
	10,368		26.53% Impervious Area

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

Subcatchment S-2: FUTURE PRIMARY SCHOOL



Summary for Subcatchment S-3: OFFSITE - WEST 1

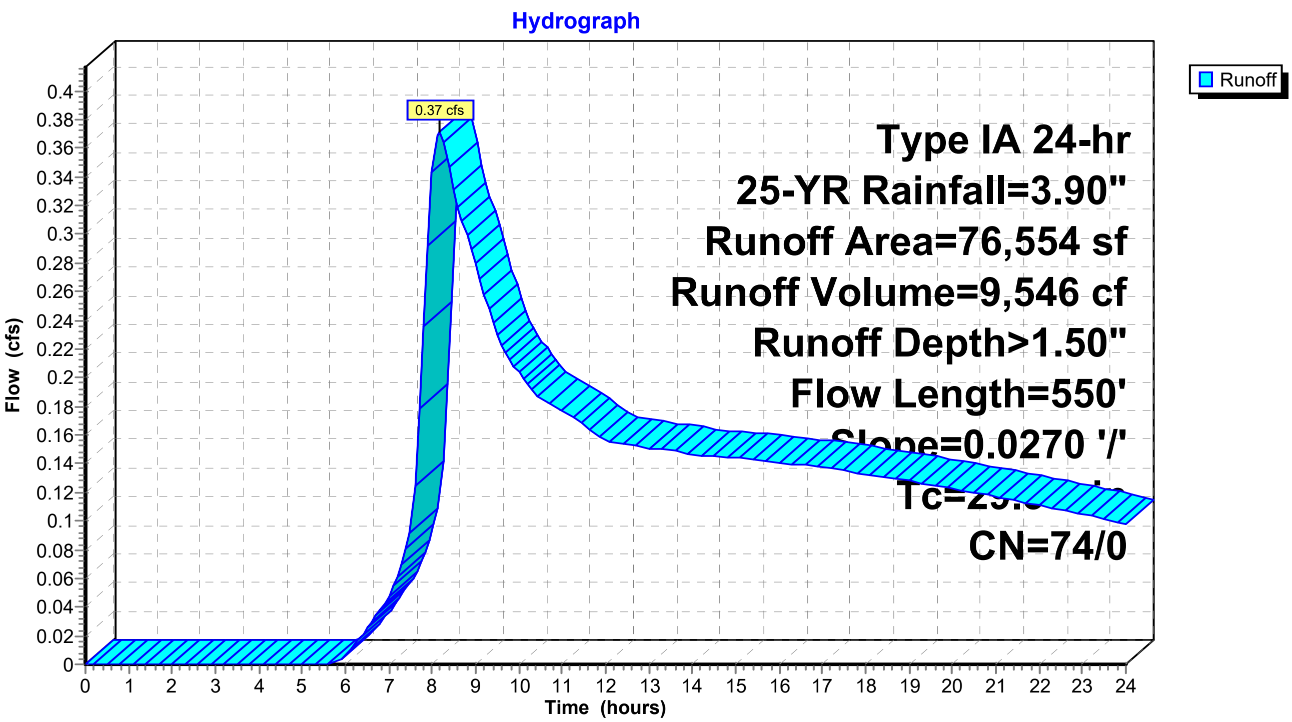
Runoff = 0.37 cfs @ 8.15 hrs, Volume= 9,546 cf, Depth> 1.50"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type IA 24-hr 25-YR Rainfall=3.90"

Area (sf)	CN	Description
76,554	74	Pasture/grassland/range, Good, HSG C
76,554		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.7	300	0.0270	0.19		**Sheet Flow,** Cultivated: Residue>20% n= 0.170 P2= 2.60"
3.6	250	0.0270	1.15		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
29.3	550	Total			

Subcatchment S-3: OFFSITE - WEST 1



Summary for Subcatchment S-4: MF PH.2 LOTS 54-58

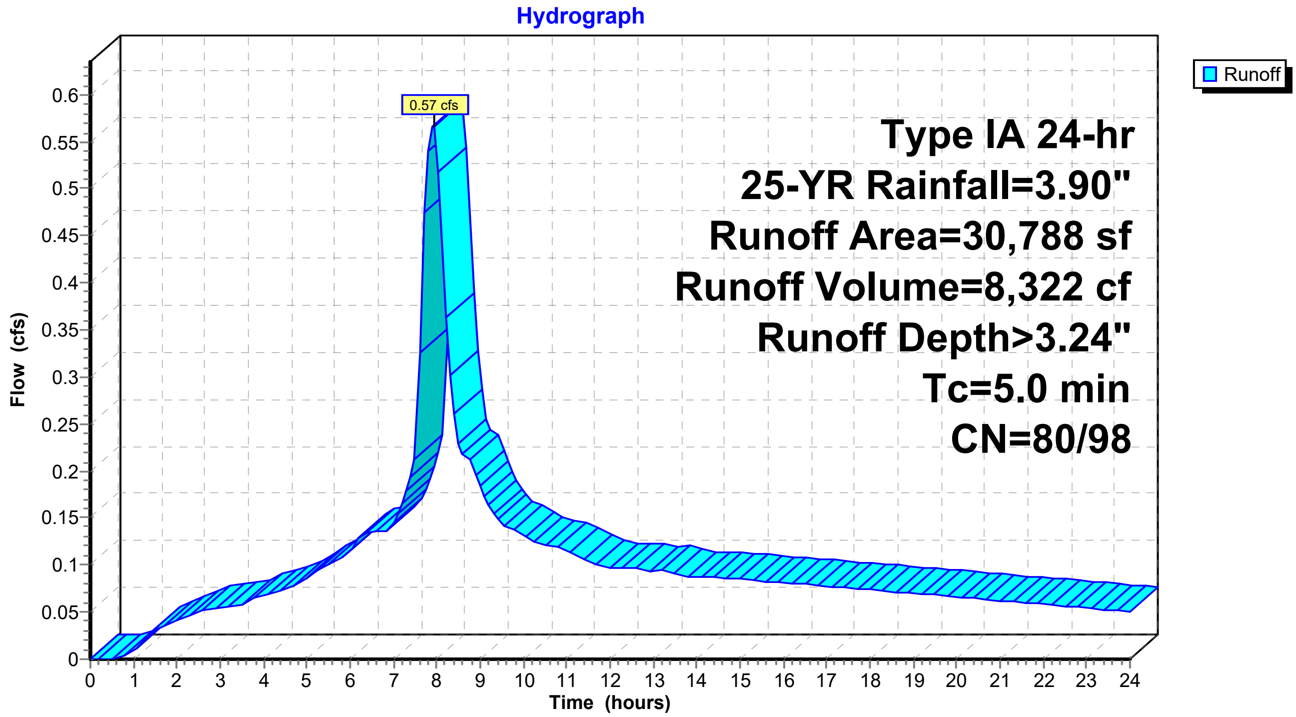
Runoff = 0.57 cfs @ 7.93 hrs, Volume= 8,322 cf, Depth> 3.24"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type IA 24-hr 25-YR Rainfall=3.90"

	Area (sf)	CN	Description
*	9,534	98	IMPERVIOUS
	7,504	80	>75% Grass cover, Good, HSG D
*	13,750	98	ROOFS
	30,788	94	Weighted Average
	7,504		24.37% Pervious Area
	23,284		75.63% Impervious Area

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

Subcatchment S-4: MF PH.2 LOTS 54-58



Summary for Subcatchment S-5: OFFSITE - WEST 2

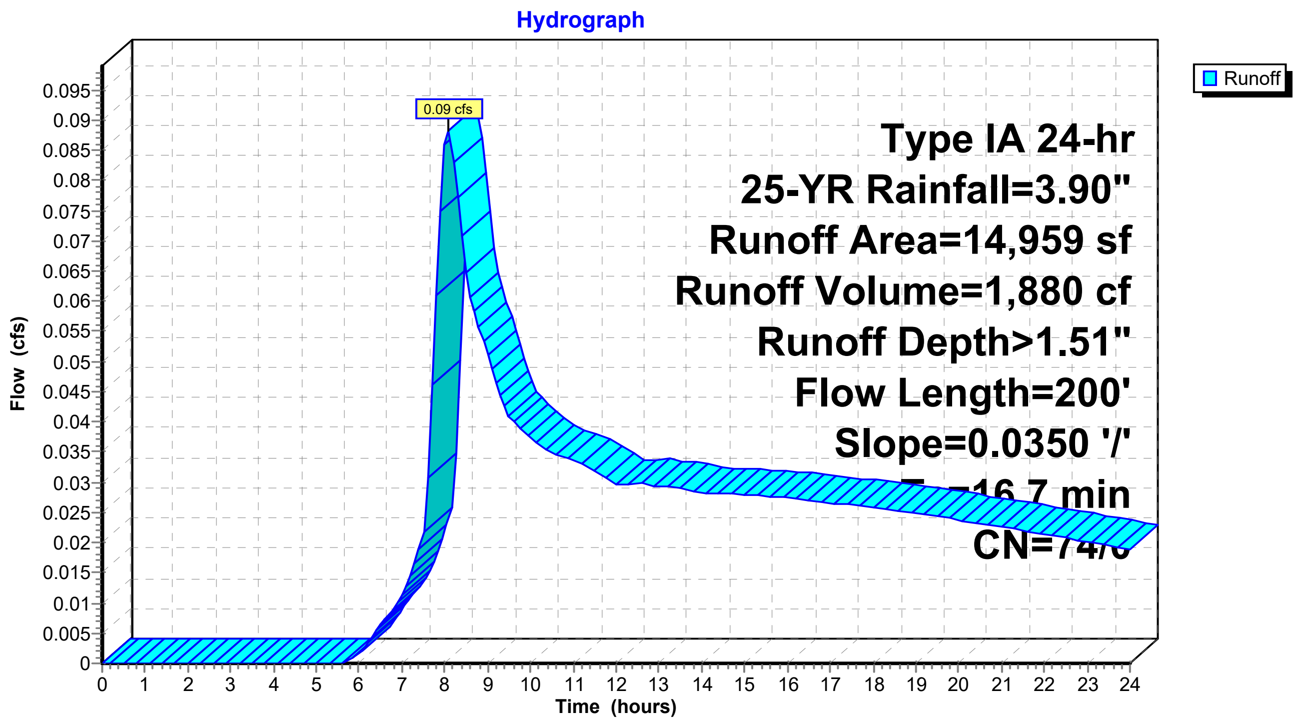
Runoff = 0.09 cfs @ 8.08 hrs, Volume= 1,880 cf, Depth> 1.51"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type IA 24-hr 25-YR Rainfall=3.90"

Area (sf)	CN	Description
14,959	74	Pasture/grassland/range, Good, HSG C
14,959		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.7	200	0.0350	0.20		**Sheet Flow,** Cultivated: Residue>20% n= 0.170 P2= 2.60"

Subcatchment S-5: OFFSITE - WEST 2



Summary for Subcatchment S-6: MF PH.2 LOTS 68-71

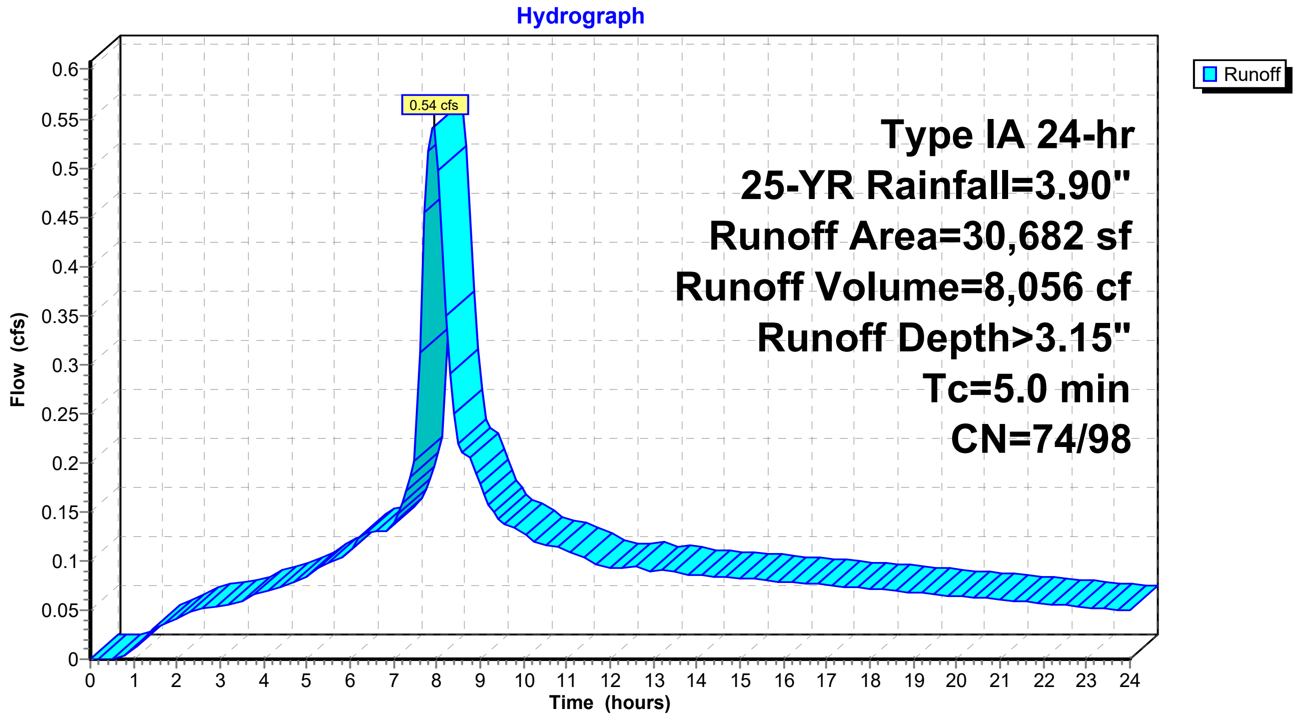
Runoff = 0.54 cfs @ 7.94 hrs, Volume= 8,056 cf, Depth> 3.15"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type IA 24-hr 25-YR Rainfall=3.90"

	Area (sf)	CN	Description
	7,289	74	>75% Grass cover, Good, HSG C
*	13,750	98	ROOFS
*	9,643	98	IMPERVIOUS
	30,682	92	Weighted Average
	7,289		23.76% Pervious Area
	23,393		76.24% Impervious Area

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

Subcatchment S-6: MF PH.2 LOTS 68-71



Summary for Subcatchment S-7: MF PH.2 & SCHOOL FRONTAGE

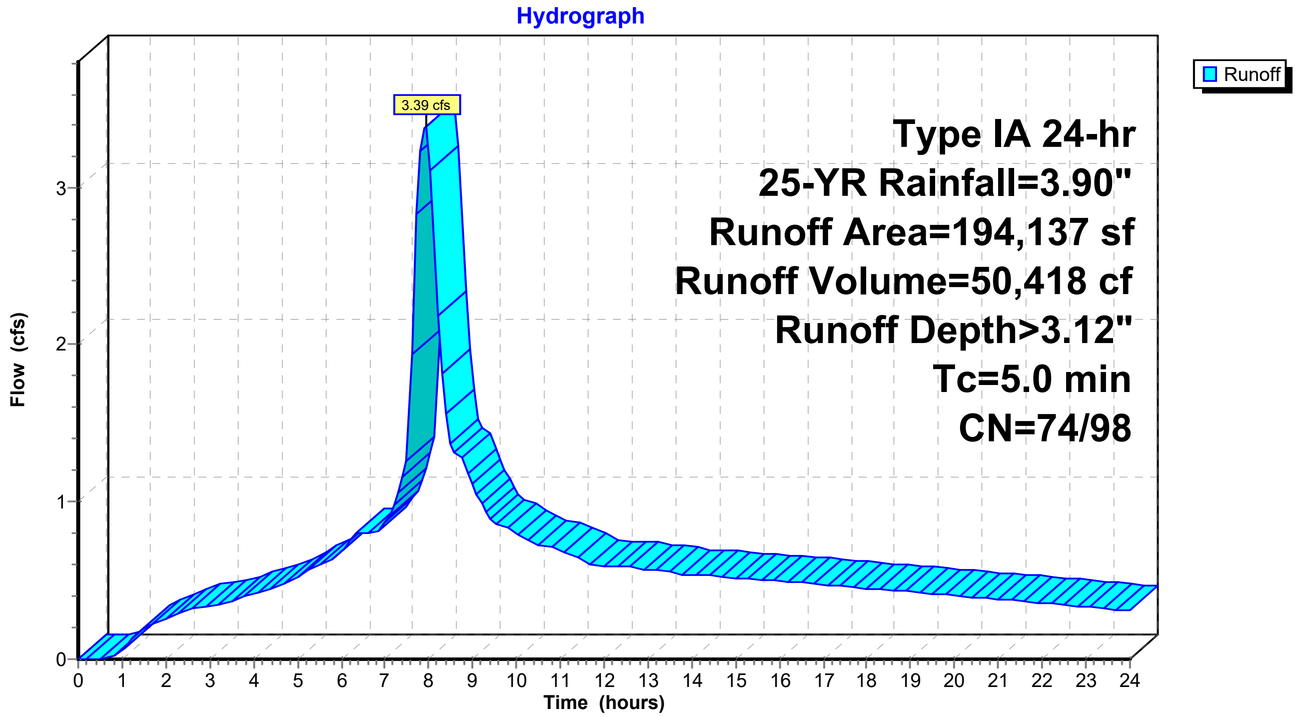
Runoff = 3.39 cfs @ 7.94 hrs, Volume= 50,418 cf, Depth> 3.12"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type IA 24-hr 25-YR Rainfall=3.90"

	Area (sf)	CN	Description
*	73,405	98	IMPERVIOUS
	49,232	74	>75% Grass cover, Good, HSG C
*	71,500	98	ROOFS
	194,137	92	Weighted Average
	49,232		25.36% Pervious Area
	144,905		74.64% Impervious Area

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

Subcatchment S-7: MF PH.2 & SCHOOL FRONTAGE



Summary for Subcatchment S-8: MF PH.2 LOTS 73-78

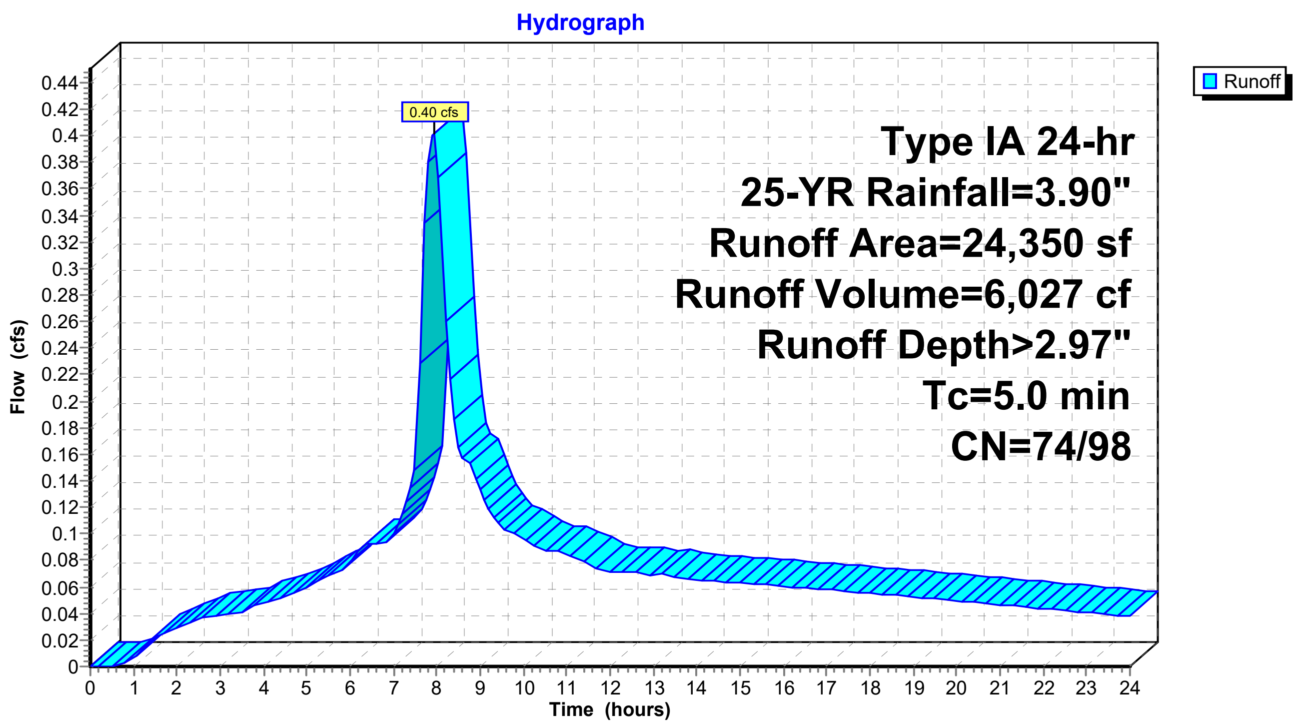
Runoff = 0.40 cfs @ 7.94 hrs, Volume= 6,027 cf, Depth> 2.97"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type IA 24-hr 25-YR Rainfall=3.90"

	Area (sf)	CN	Description
	7,841	74	>75% Grass cover, Good, HSG C
*	16,509	98	ROOFS
	24,350	90	Weighted Average
	7,841		32.20% Pervious Area
	16,509		67.80% Impervious Area

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

Subcatchment S-8: MF PH.2 LOTS 73-78



Summary for Reach 1C: BOECKMAN CREEK CHANNEL (NORTH)

Inflow	=	111.00 cfs @	0.00 hrs, Volume=	9,630,360 cf	
Outflow	=	112.22 cfs @	0.30 hrs, Volume=	9,561,761 cf,	Atten= 0%, Lag= 18.0 min

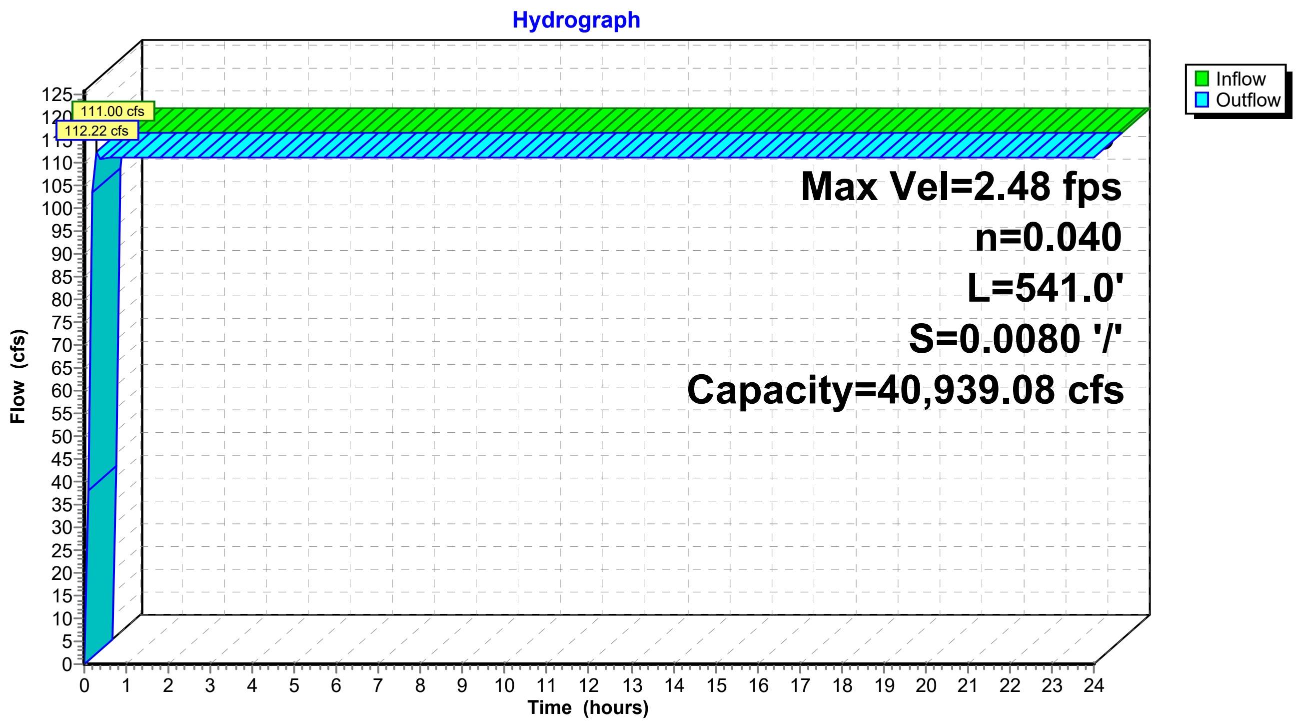
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Max. Velocity= 2.48 fps, Min. Travel Time= 3.6 min
Avg. Velocity = 2.46 fps, Avg. Travel Time= 3.7 min

Peak Storage= 24,701 cf @ 0.20 hrs
Average Depth at Peak Storage= 0.65'
Bank-Full Depth= 20.00' Flow Area= 2,140.0 sf, Capacity= 40,939.08 cfs

69.00' x 20.00' deep channel, n= 0.040 Mountain streams
Side Slope Z-value= 1.7 2.1 '/' Top Width= 145.00'
Length= 541.0' Slope= 0.0080 '/'
Inlet Invert= 138.50', Outlet Invert= 134.17'

‡

Reach 1C: BOECKMAN CREEK CHANNEL (NORTH)



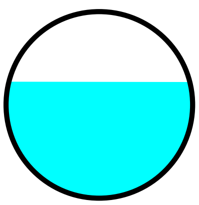
Summary for Reach 2: PIPE 2

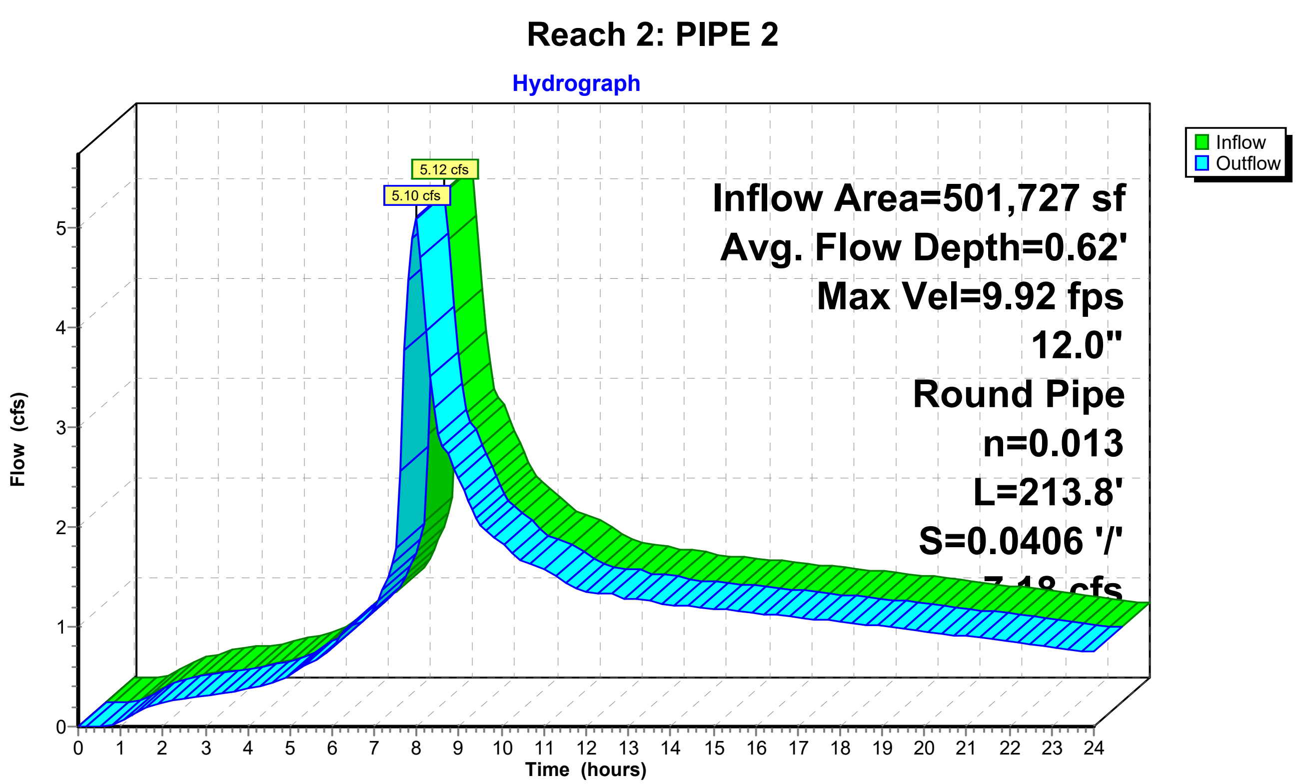
Inflow Area = 501,727 sf, 26.70% Impervious, Inflow Depth > 2.29" for 25-YR event
Inflow = 5.12 cfs @ 7.98 hrs, Volume= 95,830 cf
Outflow = 5.10 cfs @ 7.98 hrs, Volume= 95,787 cf, Atten= 0%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Max. Velocity= 9.92 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 6.32 fps, Avg. Travel Time= 0.6 min

Peak Storage= 110 cf @ 7.98 hrs
Average Depth at Peak Storage= 0.62'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 7.18 cfs

12.0" Round Pipe
n= 0.013 PVC, smooth interior
Length= 213.8' Slope= 0.0406 '/'
Inlet Invert= 215.09', Outlet Invert= 206.41'





Summary for Reach 2C: BOECKMAN CREEK CHANNEL (SOUTH)

Inflow Area = 720,214 sf, 41.01% Impervious, Inflow Depth >171.66" for 25-YR event
Inflow = 125.79 cfs @ 7.99 hrs, Volume= 10,302,944 cf
Outflow = 125.63 cfs @ 8.08 hrs, Volume= 10,231,859 cf, Atten= 0%, Lag= 5.2 min

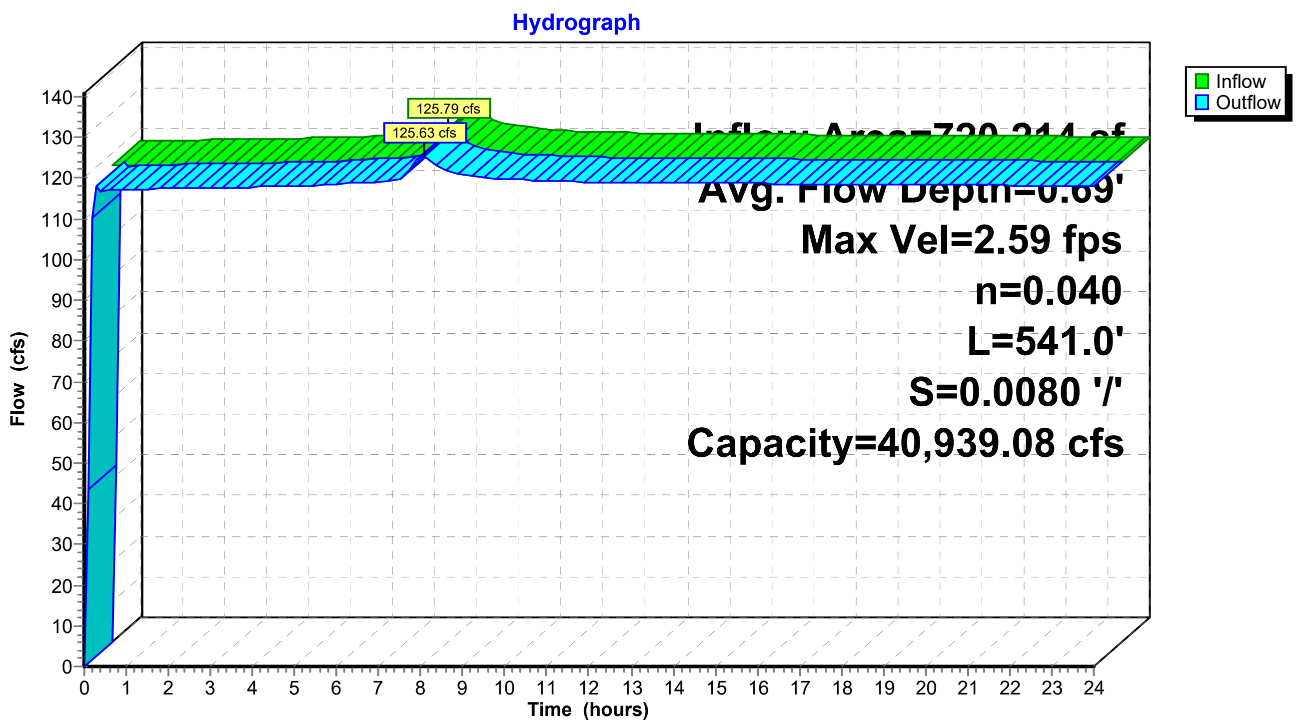
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Max. Velocity= 2.59 fps, Min. Travel Time= 3.5 min
Avg. Velocity = 2.53 fps, Avg. Travel Time= 3.6 min

Peak Storage= 26,294 cf @ 8.02 hrs
Average Depth at Peak Storage= 0.69'
Bank-Full Depth= 20.00' Flow Area= 2,140.0 sf, Capacity= 40,939.08 cfs

69.00' x 20.00' deep channel, n= 0.040 Mountain streams
Side Slope Z-value= 1.7 2.1 '/' Top Width= 145.00'
Length= 541.0' Slope= 0.0080 '/'
Inlet Invert= 138.50', Outlet Invert= 134.17'

‡

Reach 2C: BOECKMAN CREEK CHANNEL (SOUTH)



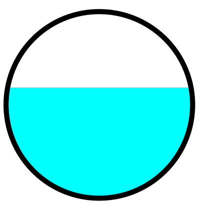
Summary for Reach 3: PIPE 3

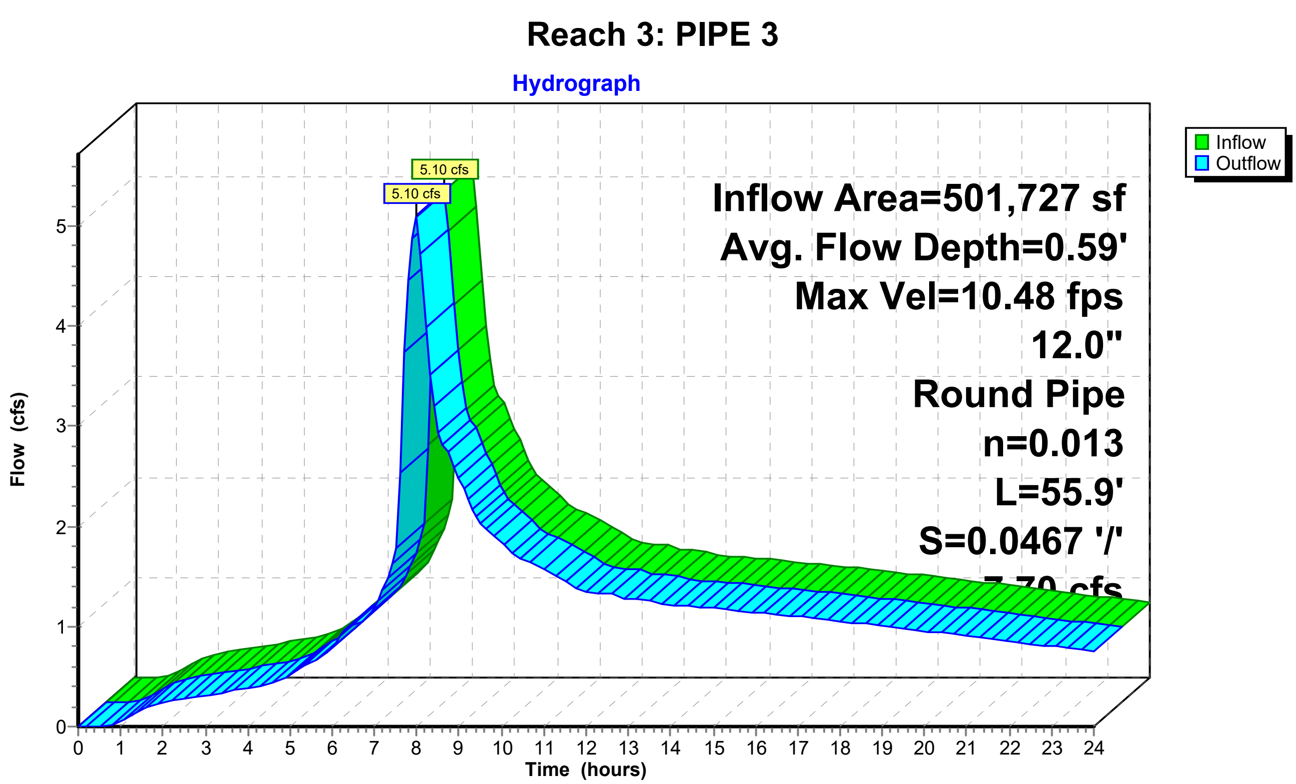
Inflow Area = 501,727 sf, 26.70% Impervious, Inflow Depth > 2.29" for 25-YR event
Inflow = 5.10 cfs @ 7.98 hrs, Volume= 95,787 cf
Outflow = 5.10 cfs @ 7.99 hrs, Volume= 95,776 cf, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Max. Velocity= 10.48 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 6.65 fps, Avg. Travel Time= 0.1 min

Peak Storage= 27 cf @ 7.99 hrs
Average Depth at Peak Storage= 0.59'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 7.70 cfs

12.0" Round Pipe
n= 0.013 PVC, smooth interior
Length= 55.9' Slope= 0.0467 '/'
Inlet Invert= 206.20', Outlet Invert= 203.59'





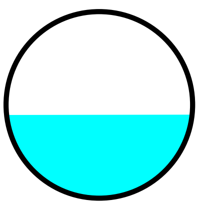
Summary for Reach 6: PIPE 6

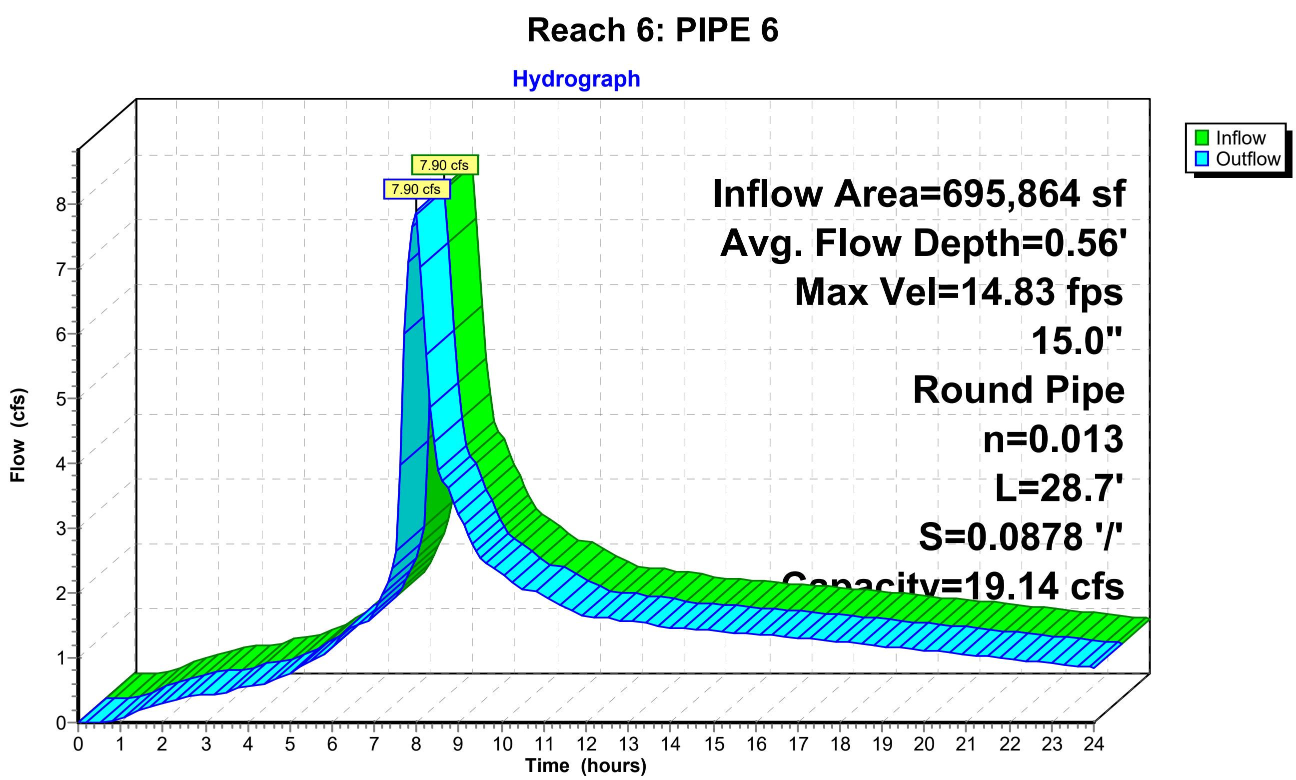
Inflow Area = 695,864 sf, 40.07% Impervious, Inflow Depth > 2.12" for 25-YR event
Inflow = 7.90 cfs @ 7.97 hrs, Volume= 123,087 cf
Outflow = 7.90 cfs @ 7.97 hrs, Volume= 123,082 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Max. Velocity= 14.83 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 8.69 fps, Avg. Travel Time= 0.1 min

Peak Storage= 15 cf @ 7.97 hrs
Average Depth at Peak Storage= 0.56'
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 19.14 cfs

15.0" Round Pipe
n= 0.013
Length= 28.7' Slope= 0.0878 '/'
Inlet Invert= 194.42', Outlet Invert= 191.90'





Summary for Reach SW: MF2 LARGE SWALE

Inflow Area = 720,214 sf, 41.01% Impervious, Inflow Depth > 2.15" for 25-YR event
Inflow = 8.30 cfs @ 7.97 hrs, Volume= 129,109 cf
Outflow = 8.19 cfs @ 7.99 hrs, Volume= 128,916 cf, Atten= 1%, Lag= 1.4 min

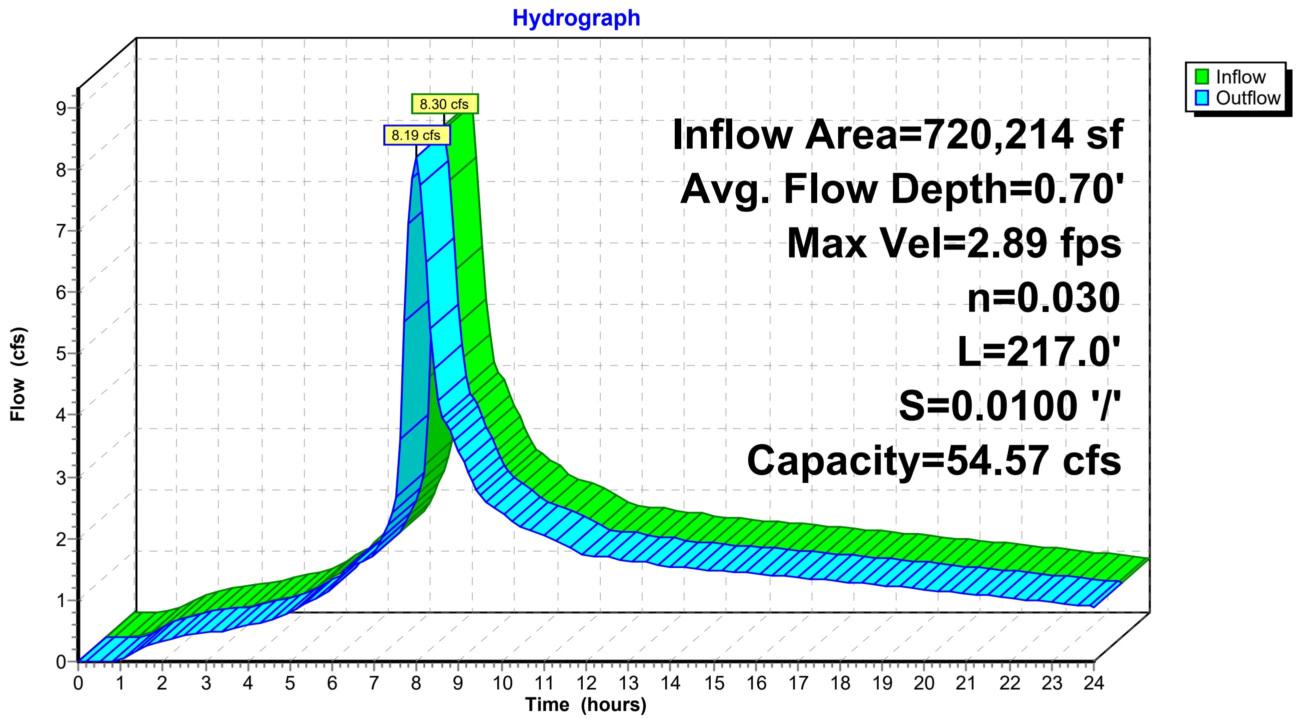
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Max. Velocity= 2.89 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 1.69 fps, Avg. Travel Time= 2.1 min

Peak Storage= 621 cf @ 7.98 hrs
Average Depth at Peak Storage= 0.70'
Bank-Full Depth= 1.66' Flow Area= 11.6 sf, Capacity= 54.57 cfs

2.00' x 1.66' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 11.96'
Length= 217.0' Slope= 0.0100 '/'
Inlet Invert= 190.65', Outlet Invert= 188.48'

‡

Reach SW: MF2 LARGE SWALE



Summary for Pond 1: SDMH-10D & PIPE 1

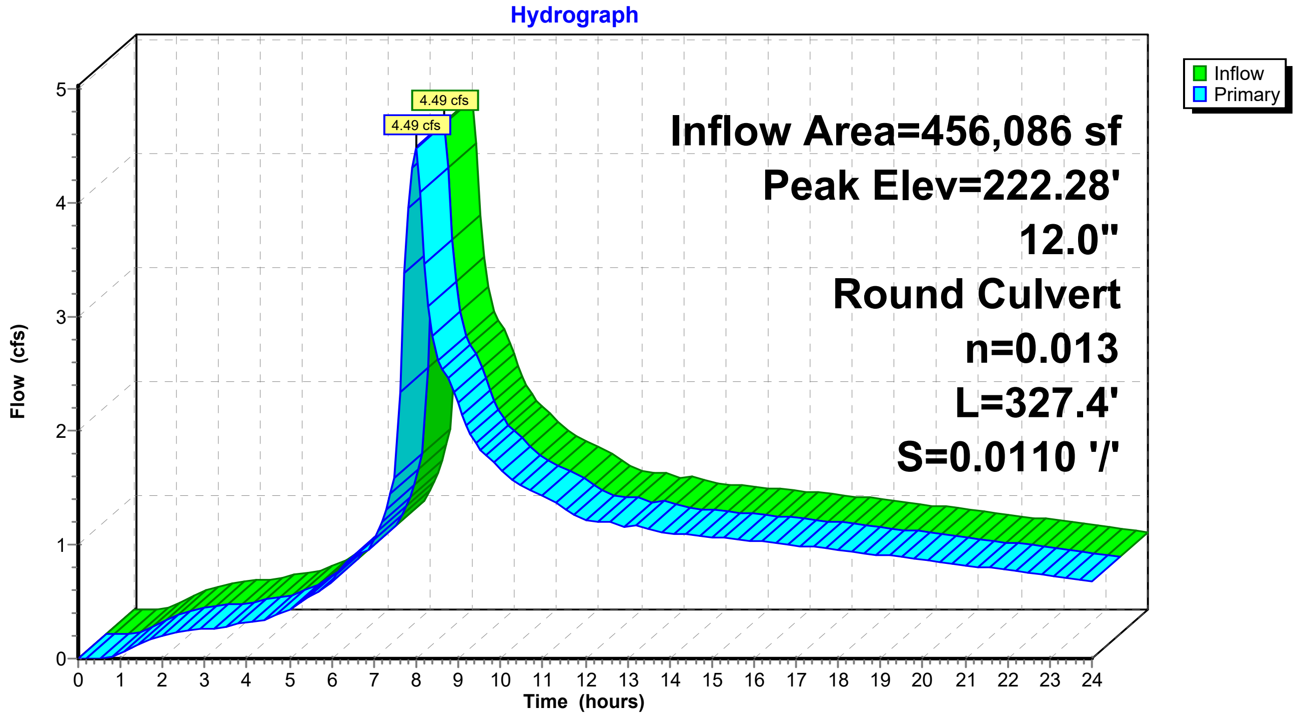
Inflow Area = 456,086 sf, 24.24% Impervious, Inflow Depth > 2.26" for 25-YR event
Inflow = 4.49 cfs @ 7.98 hrs, Volume= 85,894 cf
Outflow = 4.49 cfs @ 7.98 hrs, Volume= 85,894 cf, Atten= 0%, Lag= 0.0 min
Primary = 4.49 cfs @ 7.98 hrs, Volume= 85,894 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Peak Elev= 222.28' @ 7.98 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	218.89'	**12.0" Round Culvert** L= 327.4' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 218.89' / 215.29' S= 0.0110 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=4.45 cfs @ 7.98 hrs HW=222.16' (Free Discharge)
1=Culvert (Barrel Controls 4.45 cfs @ 5.67 fps)

Pond 1: SDMH-10D & PIPE 1



Summary for Pond 4: SDMH-10A & PIPE 4

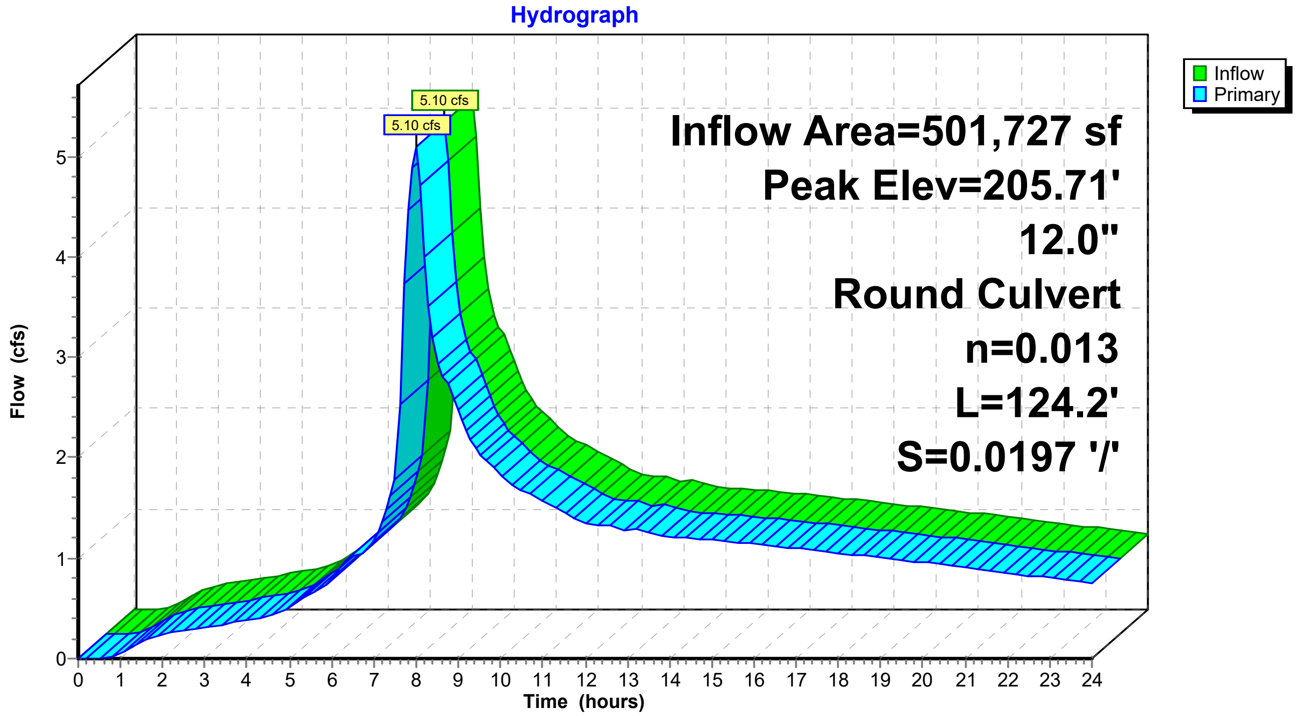
Inflow Area = 501,727 sf, 26.70% Impervious, Inflow Depth > 2.29" for 25-YR event
Inflow = 5.10 cfs @ 7.99 hrs, Volume= 95,776 cf
Outflow = 5.10 cfs @ 7.99 hrs, Volume= 95,776 cf, Atten= 0%, Lag= 0.0 min
Primary = 5.10 cfs @ 7.99 hrs, Volume= 95,776 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Peak Elev= 205.71' @ 7.99 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	203.39'	**12.0" Round Culvert** L= 124.2' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 203.39' / 200.94' S= 0.0197 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=5.06 cfs @ 7.99 hrs HW=205.68' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 5.06 cfs @ 6.45 fps)

Pond 4: SDMH-10A & PIPE 4



Summary for Pond 5: SDMH-8B & PIPE 5

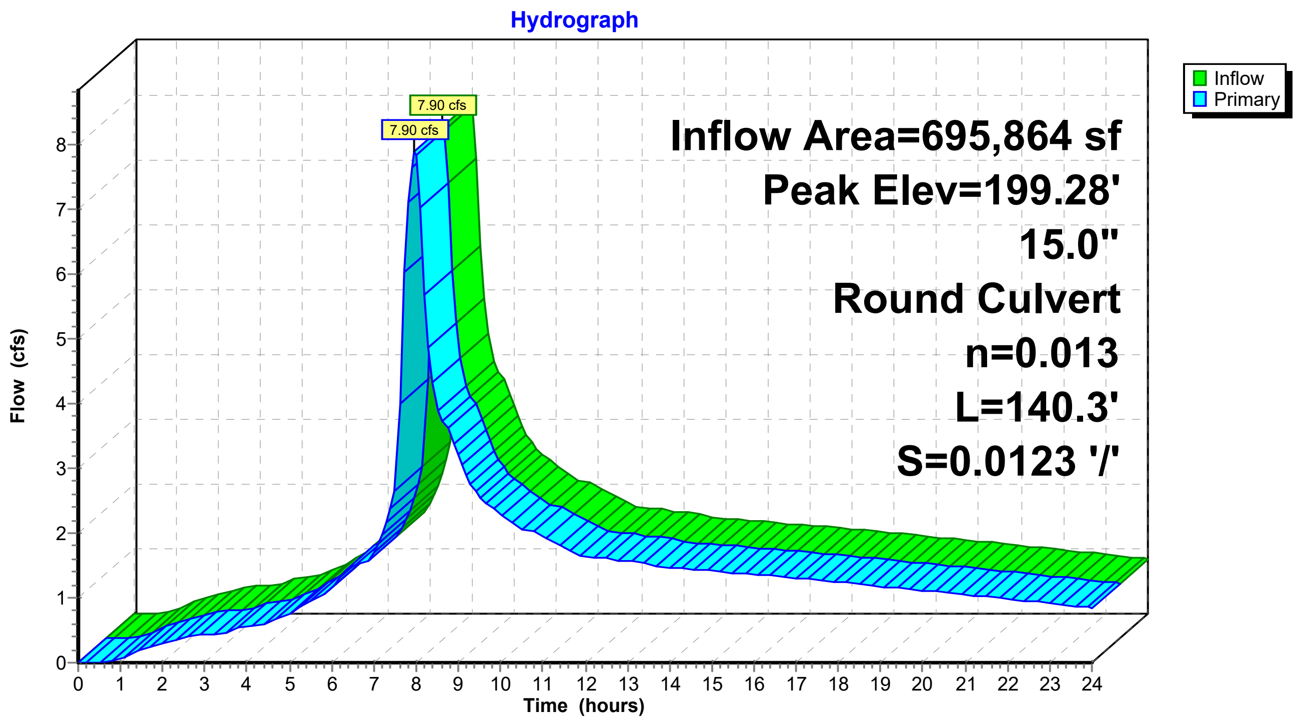
Inflow Area = 695,864 sf, 40.07% Impervious, Inflow Depth > 2.12" for 25-YR event
Inflow = 7.90 cfs @ 7.97 hrs, Volume= 123,087 cf
Outflow = 7.90 cfs @ 7.97 hrs, Volume= 123,087 cf, Atten= 0%, Lag= 0.0 min
Primary = 7.90 cfs @ 7.97 hrs, Volume= 123,087 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Peak Elev= 199.28' @ 7.97 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	196.70'	**15.0" Round Culvert** L= 140.3' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 196.70' / 194.97' S= 0.0123 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf

Primary OutFlow Max=7.79 cfs @ 7.97 hrs HW=199.21' (Free Discharge)
└─**1=Culvert** (Barrel Controls 7.79 cfs @ 6.35 fps)

Pond 5: SDMH-8B & PIPE 5



Summary for Pond 7: SDBH-S1 & PIPE 7

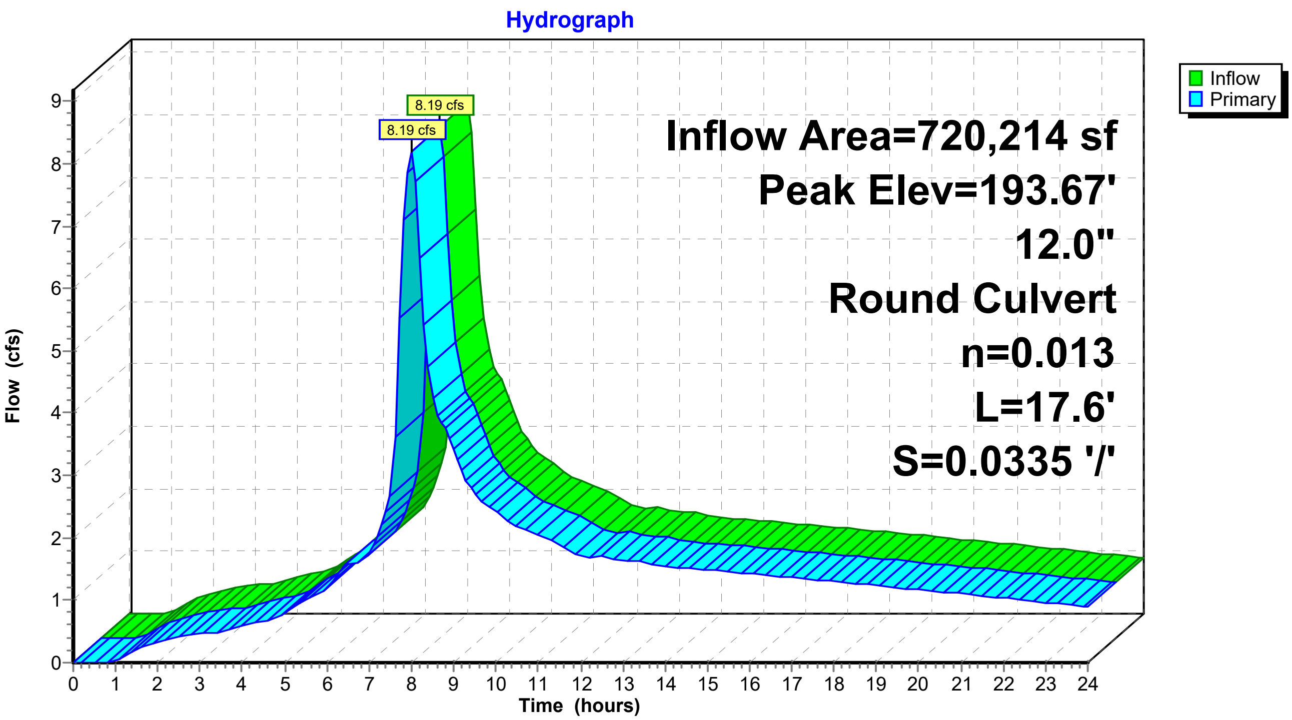
Inflow Area =	720,214 sf,	41.01% Impervious,	Inflow Depth > 2.15"	for 25-YR event
Inflow =	8.19 cfs @	7.99 hrs, Volume=	128,916 cf	
Outflow =	8.19 cfs @	7.99 hrs, Volume=	128,916 cf,	Atten= 0%, Lag= 0.0 min
Primary =	8.19 cfs @	7.99 hrs, Volume=	128,916 cf	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Peak Elev= 193.67' @ 7.99 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	188.48'	**12.0" Round Culvert** L= 17.6' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 188.48' / 187.89' S= 0.0335 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=8.17 cfs @ 7.99 hrs HW=193.64' (Free Discharge)
↑**1=Culvert** (Inlet Controls 8.17 cfs @ 10.40 fps)

Pond 7: SDBH-S1 & PIPE 7



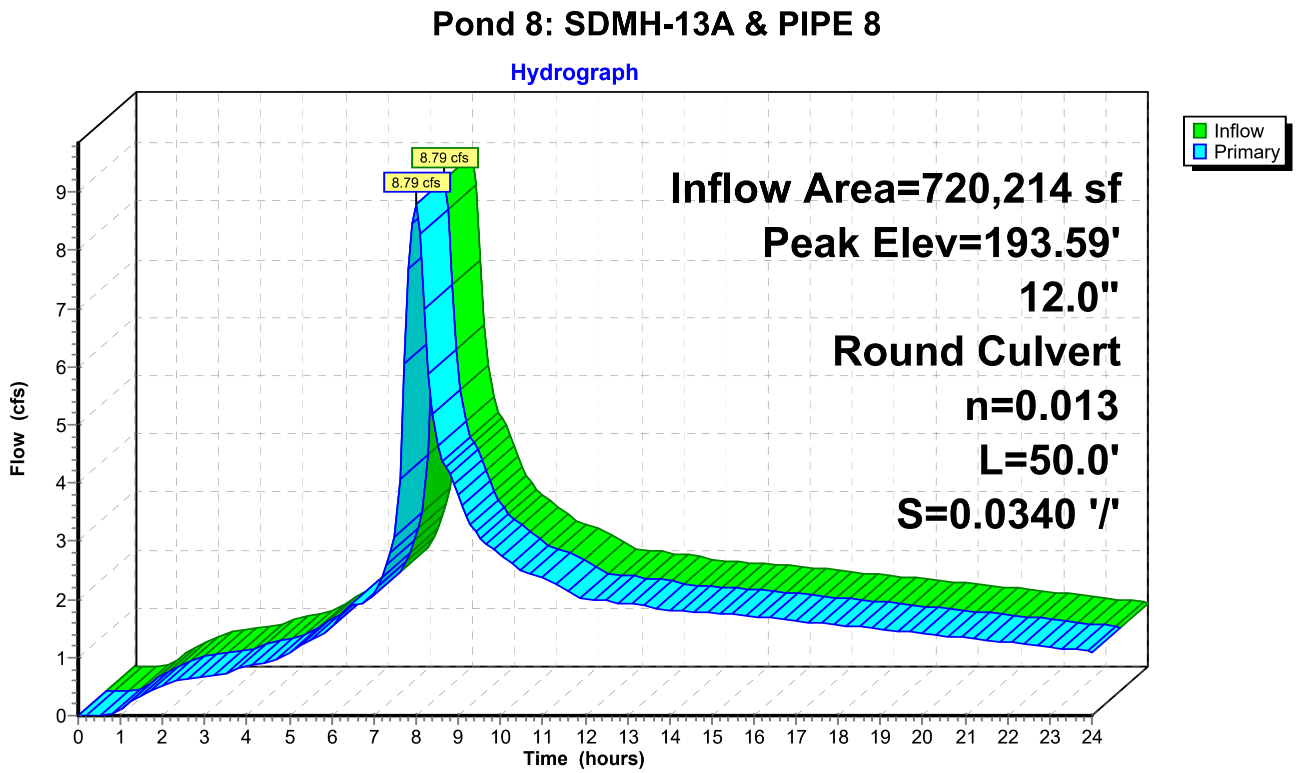
Summary for Pond 8: SDMH-13A & PIPE 8

Inflow Area = 720,214 sf, 41.01% Impervious, Inflow Depth > 2.53" for 25-YR event
Inflow = 8.79 cfs @ 7.99 hrs, Volume= 152,024 cf
Outflow = 8.79 cfs @ 7.99 hrs, Volume= 152,024 cf, Atten= 0%, Lag= 0.0 min
Primary = 8.79 cfs @ 7.99 hrs, Volume= 152,024 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Peak Elev= 193.59' @ 7.99 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	187.69'	**12.0" Round Culvert** L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 187.69' / 185.99' S= 0.0340 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=8.75 cfs @ 7.99 hrs HW=193.54' (Free Discharge)
└─**1=Culvert** (Inlet Controls 8.75 cfs @ 11.14 fps)



Summary for Pond FS: FSMH-09A

Inflow Area = 194,137 sf, 74.64% Impervious, Inflow Depth > 3.12" for 25-YR event
Inflow = 3.39 cfs @ 7.94 hrs, Volume= 50,418 cf
Outflow = 3.39 cfs @ 7.94 hrs, Volume= 50,418 cf, Atten= 0%, Lag= 0.0 min
Primary = 2.79 cfs @ 7.94 hrs, Volume= 27,310 cf
Secondary = 0.60 cfs @ 7.93 hrs, Volume= 23,108 cf

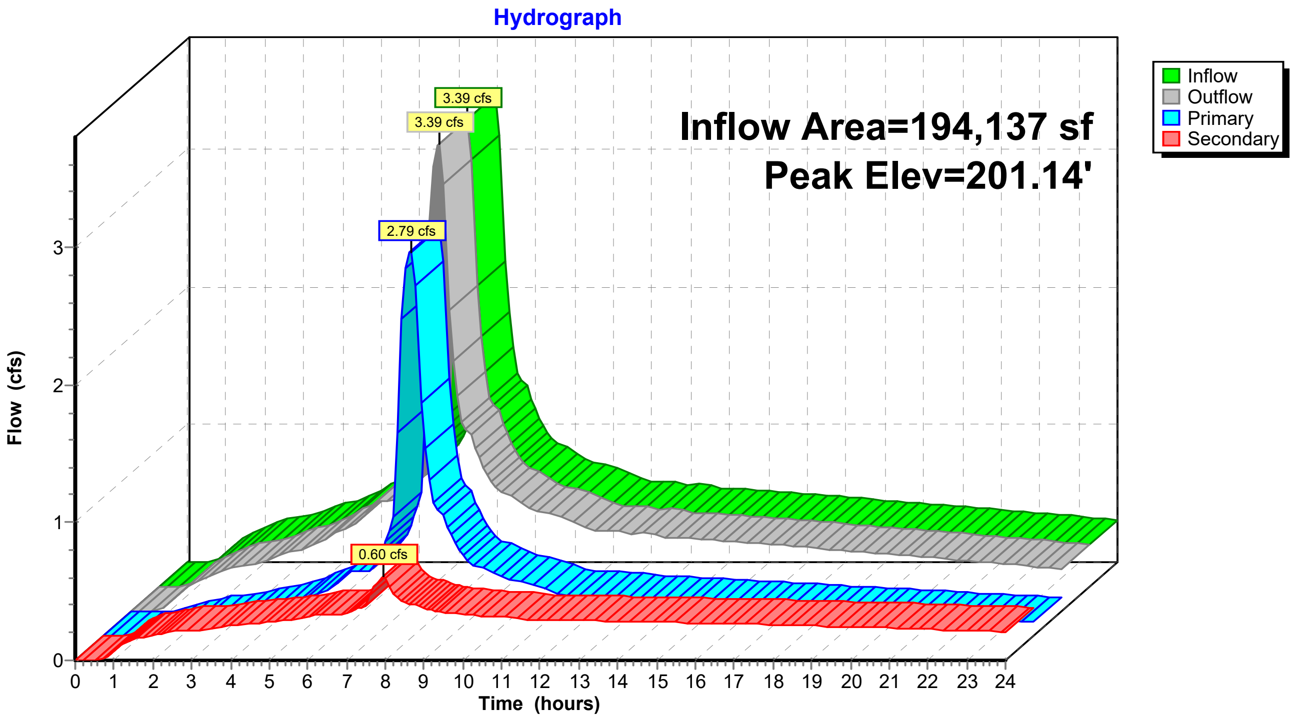
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Peak Elev= 201.14' @ 7.94 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	200.29'	**15.0" Round Culvert** L= 250.2' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 200.29' / 196.90' S= 0.0135 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Secondary	200.12'	**12.0" Round Culvert** L= 47.2' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 200.12' / 199.85' S= 0.0057 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#3	Device 2	200.12'	**4.9" Vert. Orifice/Grate** C= 0.600
#4	Device 2	201.12'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=2.77 cfs @ 7.94 hrs HW=201.14' (Free Discharge)
└─**1=Culvert** (Inlet Controls 2.77 cfs @ 3.13 fps)

Secondary OutFlow Max=0.60 cfs @ 7.93 hrs HW=201.14' (Free Discharge)
└─**2=Culvert** (Passes 0.60 cfs of 2.29 cfs potential flow)
  ├─**3=Orifice/Grate** (Orifice Controls 0.57 cfs @ 4.34 fps)
  └─**4=Sharp-Crested Rectangular Weir** (Weir Controls 0.03 cfs @ 0.42 fps)

Pond FS: FSMH-09A



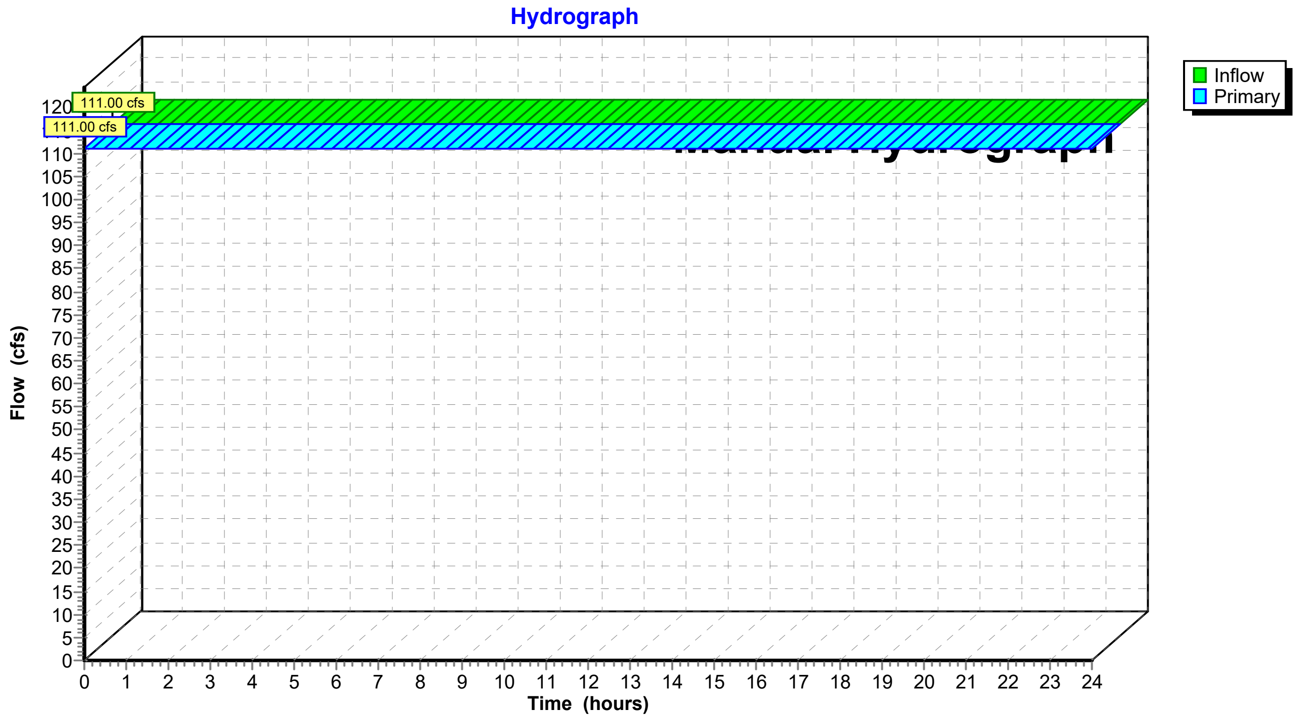
Summary for Link 1L: UPSTREAM BASIN FLOW (NORTH)

Inflow	=	111.00 cfs @	0.00 hrs, Volume=	9,630,360 cf
Primary	=	111.00 cfs @	0.00 hrs, Volume=	9,630,360 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Constant Inflow= 111.00 cfs

Link 1L: UPSTREAM BASIN FLOW (NORTH)



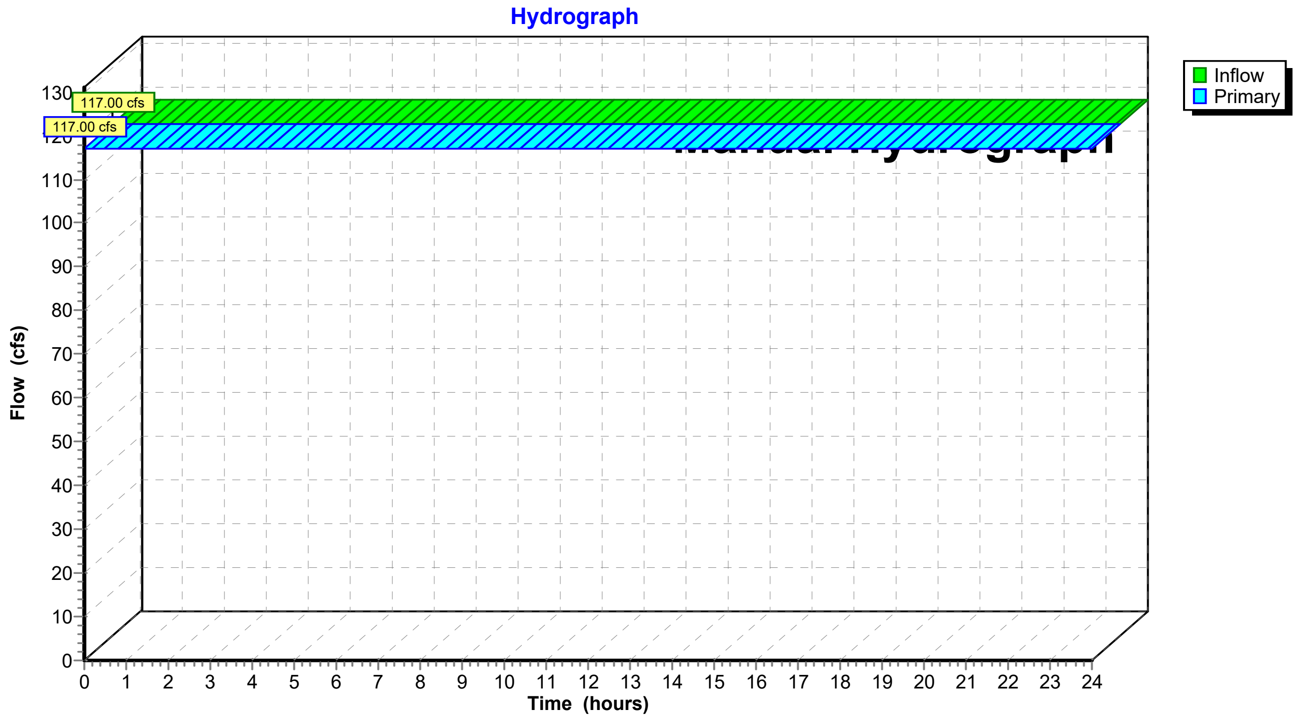
Summary for Link 2L: UPSTREAM BASIN FLOW (SOUTH)

Inflow	=	117.00 cfs @	0.00 hrs, Volume=	10,150,920 cf
Primary	=	117.00 cfs @	0.00 hrs, Volume=	10,150,920 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Constant Inflow= 117.00 cfs

Link 2L: UPSTREAM BASIN FLOW (SOUTH)



Appendix H: Information from NRCS Soil Survey of Clackamas County, Oregon

United States Department of Agriculture

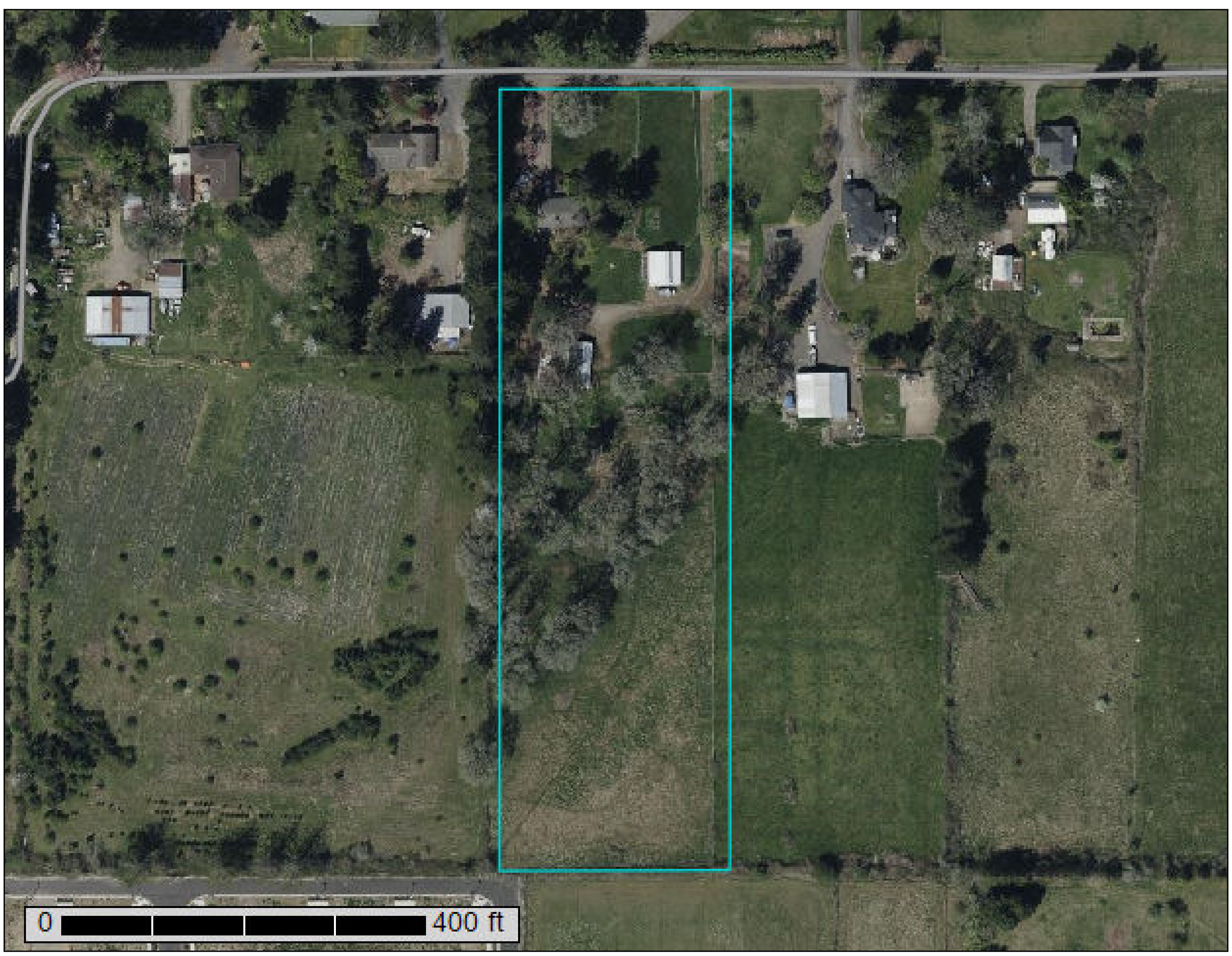
NRCS

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

Clackamas County Area, Oregon



June 22, 2022

Preface

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

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

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

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

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

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

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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.

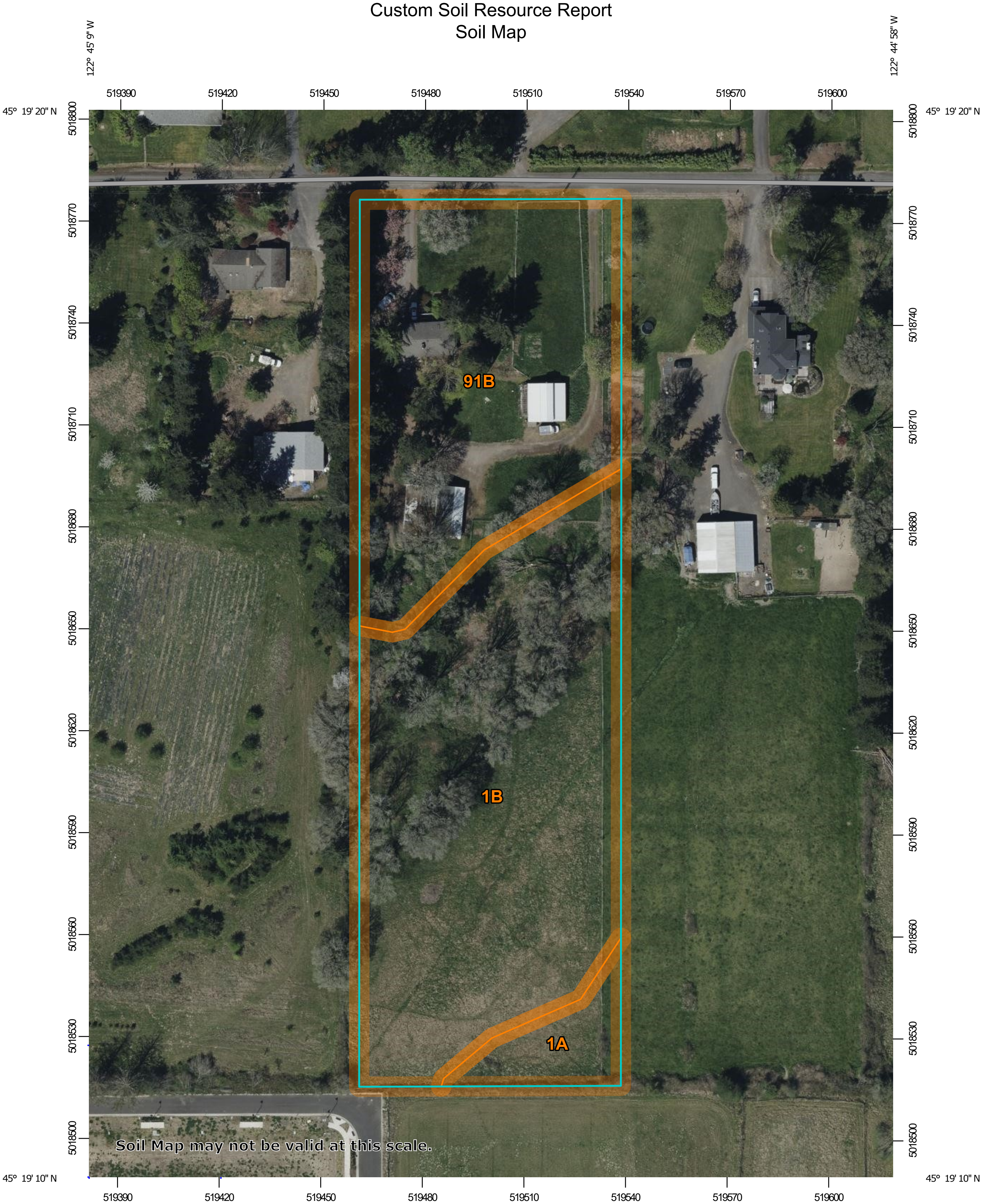
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree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

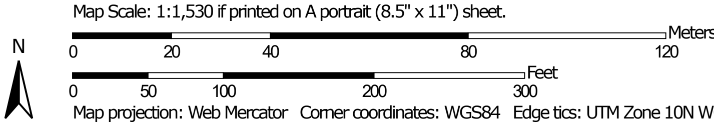
Soil Map

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: 1:1,530 if printed on A portrait (8.5" x 11") sheet.



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: Clackamas County Area, Oregon
Survey Area Data: Version 18, Oct 27, 2021

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

Date(s) aerial images were photographed: Apr 16, 2021—Apr 18, 2021

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1A	Aloha silt loam, 0 to 3 percent slopes	0.3	5.2%
1B	Aloha silt loam, 3 to 6 percent slopes	2.7	54.7%
91B	Woodburn silt loam, 3 to 8 percent slopes	2.0	40.0%
Totals for Area of Interest		**5.0**	**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.

Clackamas County Area, Oregon

1A—Aloha silt loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 223l
Elevation: 150 to 400 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Prime farmland if drained

Map Unit Composition

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

Description of Aloha

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Stratified glaciolacustrine deposits

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 51 inches: silt loam
H3 - 51 to 80 inches: silt loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly 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 18 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 11.9 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C/D
Ecological site: R002XC007OR - Valley Swale Group
Forage suitability group: Somewhat Poorly Drained (G002XY005OR)
Other vegetative classification: Somewhat Poorly Drained (G002XY005OR)
Hydric soil rating: No

Minor Components

Huberly

Percent of map unit: 3 percent
Landform: Swales on terraces

Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Dayton

Percent of map unit: 2 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

1B—Aloha silt loam, 3 to 6 percent slopes

Map Unit Setting

National map unit symbol: 223m
Elevation: 150 to 400 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Prime farmland if drained

Map Unit Composition

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

Description of Aloha

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Stratified glaciolacustrine deposits

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 51 inches: silt loam
H3 - 51 to 80 inches: silt loam

Properties and qualities

Slope: 3 to 6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly 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 18 to 24 inches

Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 11.9 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C/D
Ecological site: R002XC007OR - Valley Swale Group
Forage suitability group: Somewhat Poorly Drained (G002XY005OR)
Other vegetative classification: Somewhat Poorly Drained (G002XY005OR)
Hydric soil rating: No

Minor Components

Huberly

Percent of map unit: 3 percent
Landform: Swales on terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Dayton

Percent of map unit: 2 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

91B—Woodburn silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 227z
Elevation: 150 to 400 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Woodburn and similar soils: 90 percent
Minor components: 4 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Woodburn

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Stratified glaciolacustrine deposits

Typical profile

H1 - 0 to 16 inches: silt loam
H2 - 16 to 38 inches: silty clay loam
H3 - 38 to 60 inches: silt loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 25 to 32 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Ecological site: R002XC008OR - Valley Terrace Group
Forage suitability group: Moderately Well Drained < 15% Slopes (G002XY004OR)
Other vegetative classification: Moderately Well Drained < 15% Slopes (G002XY004OR)
Hydric soil rating: No

Minor Components

Huberly

Percent of map unit: 2 percent
Landform: Swales on terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Dayton

Percent of map unit: 1 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Aquolls

Percent of map unit: 1 percent

Landform: Flood plains
Hydric soil rating: Yes

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Appendix I: Relevant Information from City of Wilsonville Stormwater and Surface Water Standards

City of
WILSONVILLE
in OREGON

2015

STORMWATER & SURFACE WATER DESIGN & CONSTRUCTION STANDARDS

SECTION 3 - PUBLIC WORKS STANDARDS

Community Development Department
29799 SW Town Center Loop E
Wilsonville, OR 97070

Revised December 2015

allowable maximum density to use in the upstream basin analysis for ultimate development potential and conveyance system sizing.

301.1.12 Extension of Public Storm Sewer Systems

a. The extension or upsizing of the public stormwater systems in excess of 12 inches in diameter (or equivalent flows) or as shown in the Wilsonville Stormwater Master Plan to serve the ultimate development density of the contributing area shall be done by the property owner or permit applicant and may be subject to applicable System Development Charge (SDC) credits.

b. The City reserves the right to perform the work or cause it to be performed and bill the owner for the cost of the work or to pursue special assessment proceedings.

c. The public storm sewer system shall extend to the most distant parcel boundary and be designed at a size and grade to facilitate future extension to serve development of the entire contributing area.

d. Where public infrastructure improvements paid for by the property owner or permit applicant directly benefit adjacent properties, the property owner or permit applicant may pursue establishment of a reimbursement district per Section 3.116 of the City Code.

e. The City’s authorized representative may require a storm pipeline that serves or may serve more than one property to be a public system.

301.1.13 Conveyance System Hydraulic Standards

a. The conveyance system shall be designed to convey and contain at least the peak runoff for the 25-year design storm.

b. Structures for proposed pipe systems must be demonstrated to provide a minimum of 1 foot of freeboard between the hydraulic grade line and the top of the structure or finish grade above pipe for the 25-year post-development peak rate of runoff.

c. Design surcharge in new pipe systems shall not be allowed if it will cause flooding in a habitable structure, including below-floor crawl spaces.

d. The 25-year design shall be supplemented with an overland conveyance component demonstrating how a 100-year event will be accommodated. The overland component shall not be allowed to flow through or inundate an existing building.

e. Flows in streets during the 25-year event shall not run deeper than 4 inches against the curb or extend more than 2 feet into the travel lane.

f. Open channel systems shall be designed for minimum 1-foot freeboard from bank full, provided that no structures are impacted by the design water surface elevation.

301.1.14 Storm Systems and Fish Passage

For pipe systems that convey flows from a stream or through sensitive areas, a local representative of ODFW or other applicable state or federal agency shall be contacted to

Protecting undisturbed, uncompacted areas from construction activities provides more rainfall interception, evapo-transpiration and runoff rate attenuation than clearing and replanting, even with soil amendments. On the Preliminary Site Plan, identify areas that will not be cleared during construction.

(c) Minimize Soil Compaction

Avoid any construction activity that could cause soil compaction in areas designated for stormwater management facilities to preserve filtration and infiltration characteristics of the soil. Also avoid soil compaction in natural resource areas, and mitigation and/or re-vegetation areas. Delineate these areas on the Preliminary Site Plan and protect them during construction with orange construction fencing.

(d) Minimize Imperviousness

Complete and attach the Impervious Area Threshold Determination Form. The form allows for impervious area reduction credits for use of porous pavement, green roofs, tree preservation and tree planting (tree credits apply to non-single family developments only). Identify proposed impervious area reduction methods, and show them on the Preliminary Site Plan.

4. **Proposed Stormwater Management Strategy**

Given suitable site and soil conditions, the City requires that development shall incorporate LID facilities to infiltrate stormwater runoff to the Maximum Extent Practicable (MEP) to recharge groundwater and mimic pre-development hydrologic conditions. LID facilities will be designed and sized according to the soil classification and/or infiltration testing rate. Onsite soil characteristics may require a geotechnical report to address soil conditions, infiltration rates and groundwater to incorporate an infiltration strategy into the stormwater management plan to the MEP.

For the *Site Assessment and Planning Checklist*, the applicant must identify and select a proposed stormwater management strategy from the choices below.

(a) LID facilities to the MEP – Check this option if LID facilities will be utilized to the MEP to address the water quality and flow control requirements of the site. LID facilities must be sized according to the design requirements in Section 301.4.00, “Stormwater Management Facility Selection and Design” utilizing either the BMP Sizing Tool or the Engineered Method. MEP is defined as installing LID facilities with a surface area of at least 10% of the total new or redeveloped impervious area. Approved stormwater management facilities that qualify as LID facilities are defined in Section 301.4.00.

(b) Onsite retention of the 10-year design storm – Where possible, retain and infiltrate all stormwater runoff up to and including the 10-year storm onsite using LID facilities. Infiltration of the full 10-year design storm is assumed to satisfy both water quality and flow control requirements of Section 301.4.00, “Stormwater Management Facility Selection and Design”.

(c) Limiting conditions for LID facilities - The following limiting conditions restrict the practicality of using onsite infiltration and may require the use of lined, non-infiltrating stormwater management facilities or underground facilities to meet stormwater management requirements. When sites have limiting conditions, a report is required to document one of the following:

(1) Stormwater management facilities will be located on fill.

(2) Site areas with steep slopes (≥20%) and/or slope stability concerns (geotechnical engineering or geologist report and City approval required for infiltration facilities on moderate slopes of 10-20%).

(3) Sites in areas of seasonal high groundwater table (for site planning submittal, sites with jurisdictional wetlands or FEMA floodplains may be required to perform a seasonal high groundwater table assessment and determine that the seasonal groundwater table is below the proposed bottom elevation of stormwater infiltration facilities).

(4) Sites with contaminated soils (sites that have contaminated soils conditions must be evaluated by the Oregon Department of Environmental Quality (ODEQ) and/or the Environmental Protection Agency to determine if areas on the property are suitable for infiltration without the risk of mobilizing contaminants in the soil or groundwater. Documentation showing contamination assessment and determination must be submitted to the City at the time of application).

(5) There is a conflict with required source controls for high-risk sites (a geotechnical report is not required to document this limiting condition, but approval from the City is required to install lined and/or underground facilities in place of LID facilities).

5. **Facility Selection/Sizing**

After selecting a stormwater management strategy, applicants shall indicate which stormwater management facilities are proposed for the site based on the results of the site assessment and planning process. The BMP Sizing Tool shall be used to calculate the size of the facilities and the BMP Sizing Tool report shall be included as part of the application. All proposed impervious area reduction methods and proposed stormwater management facilities shall be shown on the Preliminary Site Plan.

301.3.00 SUBMITTAL REQUIREMENTS

The Developer's engineer shall submit sufficient supporting information as outlined below to justify the proposed stormwater management design meets all the provisions within these standards and the land use conditions of approval. It is the design engineer's responsibility to ensure that engineering plans are sufficiently clear and concise to construct the project in proper sequence, using specified methods and materials, with sufficient dimensions to fulfill the intent of these design standards. A Storm Drainage Report as outlined in Section 301.3.02, "Storm Drainage Report", is required to be prepared and submitted with the design plans.

301.4.01 Impervious Area Used in Design

a. Stormwater management facilities are required when proposed development establishes or increases the impervious surface area by more than 5,000 square feet. Development includes new development, redevelopment, and/or partial redevelopment.

b. For single-family and duplex residential subdivisions, stormwater management facilities shall be sized for all impervious areas created by the subdivision, including all residences on individual lots at the current rate of 2,750 square feet of impervious surface area per dwelling unit.

c. For all developments other than single-family and duplex dwellings, including row houses and condominiums, the sizing of stormwater management facilities shall be based on the impervious area to be created by the development, including structures and all roads and impervious areas. Impervious surfaces shall be based on building permits, construction plans, or other appropriate methods of measurement deemed reliable by the City's authorized representative.

d. The City encourages design initiatives that reduce the effective impervious area. For developments other than single-family and duplex dwellings, a smaller stormwater management facility may be possible.

301.4.02 Criteria for Requiring a Stormwater Management Facility

A stormwater management facility shall be constructed on site unless, in the judgment of the City's authorized representative, any of the following conditions exist:

a. The site location, size, gradient, topography, soils, or presence of an SROZ make it impractical or ineffective to construct an on-site facility.

b. The subbasin has a more effective, existing regional site designed to incorporate the development or which has the capacity to treat the site stormwater.

c. The development is for construction of one- or two-family (duplex) dwellings on existing lots of record which will establish or create less than 5,000 square feet of impervious surface.

301.4.03 Facility Selection

LID facilities such as planters, swales, rain gardens, ponds, and other vegetated facilities are the preferred strategy to meet the stormwater management requirements for water quality treatment and flow control. Impervious area reduction techniques, such as preservation of existing trees, retaining vegetation and open space, clustering buildings, disconnecting residential downspouts, and constructing pervious pavement and green roofs, may be used as techniques to help mitigate stormwater runoff and reduce the size of the required stormwater management facilities.

a. The following types of stormwater management facilities can be used to meet these standards:

    1. Impervious Area Reduction Methods:

c. Alternate Facilities - Applicants may propose stormwater management facilities that are not listed in **Table 3.10**. Such a proposal will require the applicant to submit a request for a modification to these standards. Alternate facilities must be sized using the Engineered Method as described in this section. An example of an alternate facility would be for the use of a drywell, infiltration trench, or other underground injection control (UIC) facility on private property. To propose a UIC on private property, the applicant would need to prepare appropriate registration information to ODEQ and submit a modification request to the City.

301.4.04 Design Criteria

Stormwater management facility design is based on meeting the City's design criteria to address LID requirements, water quality treatment standards, and flow control requirements.

a. **LID to the MEP:** The goal is to prioritize the use of LID facilities to the MEP to mimic the natural stormwater runoff conditions of the pre-developed site and recharge the groundwater. The City's strategy to meet this goal is to incorporate LID principles in site planning and facility design.

   Either one of the following two options may be used to meet the LID requirement:

   1. LID facilities to the MEP – Utilize LID facilities to the MEP to address the water quality and flow control requirements of the site. LID facilities shall be sized according to the design requirements of this section, utilizing either the BMP Sizing Tool or the Engineered Method. When site constraints limit the surface area available for stormwater management facilities, MEP is defined as installing LID facilities with a surface area of at least 10% of the total new plus replaced impervious area.

   2. Onsite Retention – Retain and fully infiltrate the 10-year design storm on site using LID facilities. This is equivalent to retaining and infiltrating runoff from new impervious surface for the 3.4-inch storm over 24 hours. The facility shall fully infiltrate within 72 hours following the beginning of the storm event. Infiltration of the full 10-year design storm is assumed to satisfy both water quality and flow control requirements.

b. **Limited Infiltration:** For sites with conditions that limit the use of infiltration (fill, steep slopes, high groundwater table, well-head protection areas, and/or contaminated soils), utilizing LID facilities may not be practicable and the applicant may use lined, non-infiltrating or underground stormwater management facilities. In such cases, the applicant shall submit documentation of limiting conditions from a geotechnical engineer or engineering geologist registered in the State of Oregon, or documentation from ODEQ.

c. **Water Quality Requirement:** Water quality facilities shall be designed to capture and treat 80% of the average annual runoff volume to the MEP with the goal of 70% total suspended soils (TSS) removal. In this context, MEP means less effective treatment may not be substituted when it is practicable to provide more effective treatment. The treatment volume equates to a design storm of 1.0 inch over 24 hours.

The BMP Sizing Tool addresses these water quality requirements to size stormwater management facilities.

Hydrodynamic separators, when used as a sole method of stormwater treatment, do not meet the MEP requirement for stormwater treatment effectiveness with regard to these stormwater standards.

d. **Flow Control Requirement:** The duration of peak flow rates from post-development conditions shall be less than or equal to the duration of peak flow rates from pre-development conditions for all peak flows between 42% of the 2-year storm peak flow rate[1] up to the 10-year peak flow rate. A hydrologic/hydraulic analytical model capable of performing a continuous simulation of flows from local long-term rainfall data shall be used to determine the peak flow rates, recurrence intervals and durations. The BMP Sizing Tool incorporates these flow control requirements to size stormwater management facilities.

301.4.05 Design Methods

This section explains the two methods accepted by the City for designing stormwater management facilities: the BMP Sizing Tool Method and the Engineered Method. To use a different method for sizing a treatment facility type not covered in these standards, applicants shall obtain approval from the City's authorized representative prior to submitting permit applications for review.

a. BMP Sizing Tool Method:

1. A BMP Sizing Tool application is available from the City to assist with the sizing of stormwater management facilities that meet the requirements of these standards. The following facilities can be sized using the tool:

   (a) Rain Garden – Infiltration and Filtration

   (b) Stormwater Planter – Infiltration and Filtration

   (c) Vegetated Swale - Infiltration and Filtration

   (d) Infiltrator

   (e) Detention Pond

2. The detention pond option will allow credit for the utilization of upstream LID facilities.

3. The report generated by the BMP Sizing Tool shall be included with permit application submittals. The BMP Sizing Tool can be used during the initial site

[1] The lower threshold of 42% of the 2-year peak flow rate for flow-duration matching is based on a 2008 study by the Oregon Department of Transportation (ODOT) titled, "Water Quantity (Flow Control) Design Storm Performance Standard." ODOT's study found that bed movement in sand-bedded streams occurs at approximately two-thirds of the bank full flow, which is assumed to be roughly equivalent to the 1.2 year discharge. ODOT's flow frequency analysis established that two thirds of the 1.2-year discharge is approximately equivalent to 42 percent of the 2-year discharge.

Table 2-2a Runoff curve numbers for urban areas [1/]

Cover description		Curve numbers for hydrologic soil group			
Cover type and hydrologic condition	Average percent impervious area [2/]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3/]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4/]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5/]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

1 Average runoff condition, and $I_a = 0.2S$.

2 The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

3 CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

4 Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

5 Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Table 2-2b Runoff curve numbers for cultivated agricultural lands [1/]

Cover description			Curve numbers for hydrologic soil group			
Cover type	Treatment [2/]	Hydrologic condition [3/]	A	B	C	D
Fallow	Bare soil	—	77	86	91	94
	Crop residue cover (CR)	Poor	76	85	90	93
		Good	74	83	88	90
Row crops	Straight row (SR)	Poor	72	81	88	91
		Good	67	78	85	89
	SR + CR	Poor	71	80	87	90
		Good	64	75	82	85
	Contoured (C)	Poor	70	79	84	88
		Good	65	75	82	86
	C + CR	Poor	69	78	83	87
		Good	64	74	81	85
	Contoured & terraced (C&T)	Poor	66	74	80	82
		Good	62	71	78	81
	C&T+ CR	Poor	65	73	79	81
		Good	61	70	77	80
Small grain	SR	Poor	65	76	84	88
		Good	63	75	83	87
	SR + CR	Poor	64	75	83	86
		Good	60	72	80	84
	C	Poor	63	74	82	85
		Good	61	73	81	84
	C + CR	Poor	62	73	81	84
		Good	60	72	80	83
	C&T	Poor	61	72	79	82
		Good	59	70	78	81
	C&T+ CR	Poor	60	71	78	81
		Good	58	69	77	80
Close-seeded or broadcast legumes or rotation meadow	SR	Poor	66	77	85	89
		Good	58	72	81	85
	C	Poor	64	75	83	85
		Good	55	69	78	83
	C&T	Poor	63	73	80	83
		Good	51	67	76	80

1 Average runoff condition, and I_a=0.2S
2 Crop residue cover applies only if residue is on at least 5% of the surface throughout the year.
3 Hydraulic condition is based on combination factors that affect infiltration and runoff, including (a) density and canopy of vegetative areas, (b) amount of year-round cover, (c) amount of grass or close-seeded legumes, (d) percent of residue cover on the land surface (good ≥ 20%), and (e) degree of surface roughness.

Poor: Factors impair infiltration and tend to increase runoff.

Good: Factors encourage average and better than average infiltration and tend to decrease runoff.

Table 2-2c Runoff curve numbers for other agricultural lands [1/]

Cover description: Cover type	Hydrologic condition	Curve numbers for hydrologic soil group: A	B	C	D
Pasture, grassland, or range—continuous forage for grazing. [2/]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element. [3/]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30 [4/]	48	65	73
Woods—grass combination (orchard or tree farm). [5/]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods. [6/]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30 [4/]	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

1 Average runoff condition, and $I_a = 0.2S$.
2 *Poor:* <50%) ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: > 75% ground cover and lightly or only occasionally grazed.
3 *Poor:* <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.
4 Actual curve number is less than 30; use CN = 30 for runoff computations.
5 CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.
6 *Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

Table 2-2d Runoff curve numbers for arid and semiarid rangelands [1/]

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition [2/]	A [3/]	B	C	D
Herbaceous—mixture of grass, weeds, and low-growing brush, with brush the minor element.	Poor		80	87	93
	Fair		71	81	89
	Good		62	74	85
Oak-aspen—mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush.	Poor		66	74	79
	Fair		48	57	63
	Good		30	41	48
Pinyon-juniper—pinyon, juniper, or both; grass understory.	Poor		75	85	89
	Fair		58	73	80
	Good		41	61	71
Sagebrush with grass understory.	Poor		67	80	85
	Fair		51	63	70
	Good		35	47	55
Desert shrub—major plants include saltbush, greasewood, creosotebush, blackbrush, bursage, palo verde, mesquite, and cactus.	Poor	63	77	85	88
	Fair	55	72	81	86
	Good	49	68	79	84

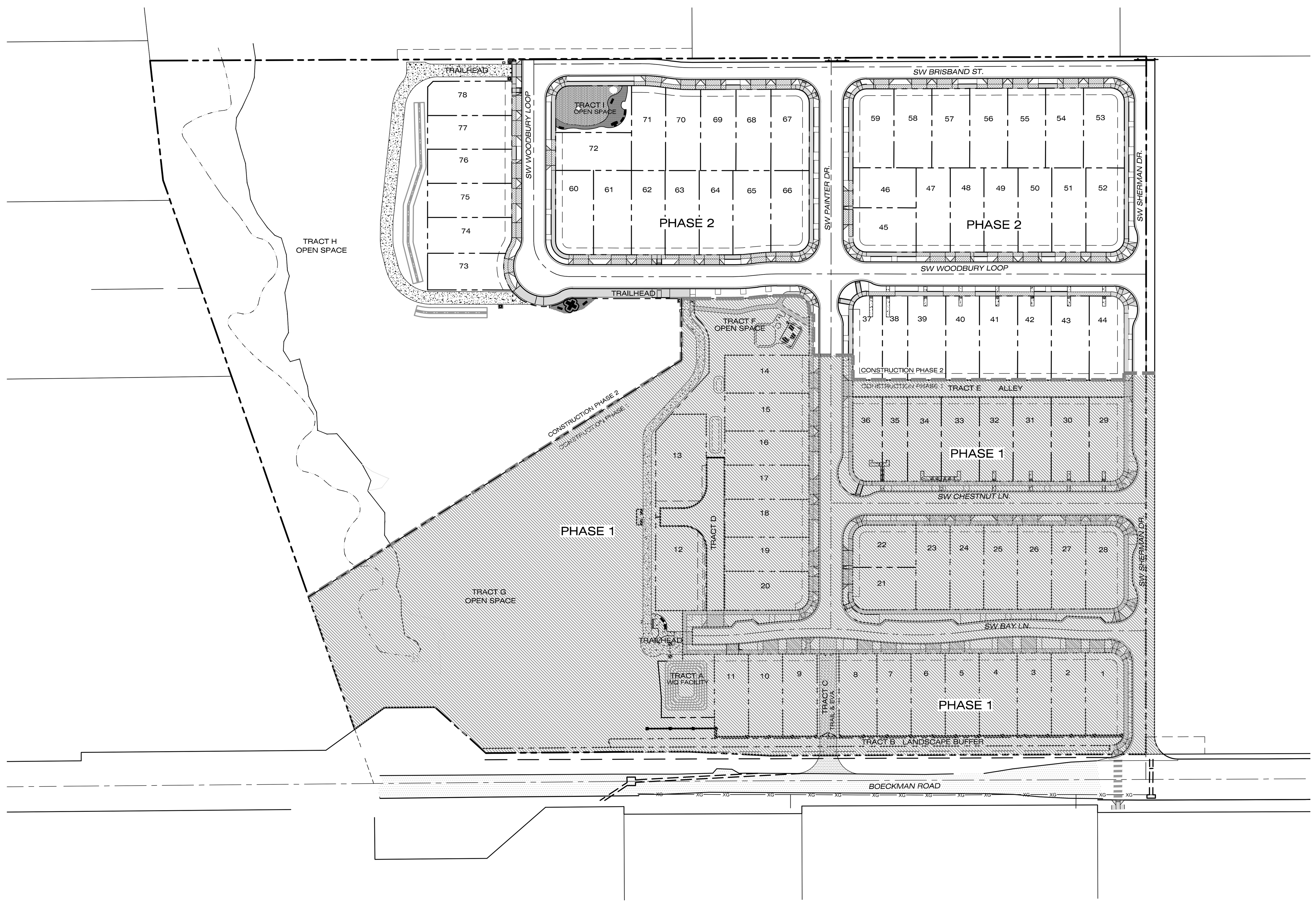
1 Average runoff condition, and I_a, = 0.2S. For range in humid regions, use table 2-2c.
2 Poor: <30% ground cover (litter, grass, and brush overstory).
Fair: 30 to 70% ground cover.
Good: > 70% ground cover.
3 Curve numbers for group A have been developed only for desert shrub.

Appendix J: Additional Downstream Analysis Reference Documents

MORGAN FARM (PHASE 2)

PHASE 2 OF A PLANNED DEVELOPMENT FOR A 78-LOT SUBDIVISION - LOTS 37-78
TAX LOTS 2400, 2600 & 2700, TAX MAP T3S, R1W, SEC. 12D

VICINITY MAP
N.T.S.



SHEET INDEX

PROJECT CONTACTS

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CONTACT: C. MIRTH WALKER

VERTICAL DATUM

CITY OF WILSONVILLE CONTROL SURVEY PS25218
STATION #5806 - A 3 1/4" BRASS DISC IN MONUMENT BOX - THE SECTION CORNER COMMON TO SECTIONS 11, 12, 13 & 14, T3S R1E, IN THE CENTER OF BOECKMAN RD, EAST OF BOONES FERRY RD.

ELEVATION = 213.19'
DATUM: NAVD 88, US FEET

SITE INFORMATION

SITE ADDRESS:	7331 & 7447 SW BOECKMAN RD.
1/4 SECTION MAP:	T3S R1W SEC 12D
TAX LOTS:	2400, 2600 & 2700
SITE SIZE:	20.13 ACRES

LOCATES (48 HOURS NOTICE REQUIRED)

ONE CALL SYSTEM 1-800-332-2344
(GENERAL TELEPHONE, NORTHWEST NATURAL GAS, PORTLAND GENERAL ELECTRIC)

REPAIR EMERGENCIES

NORTHWEST NATURAL GAS	- 800-882-3377
QWEST	- 503-242-6064
PORTLAND GENERAL ELECTRIC	- 503-464-7777
COMCAST	- 888-824-8264
CITY OF WILSONVILLE	- 866-252-3614
VERIZON	- 503-526-2220

ATTENTION: OREGON LAW REQUIRES YOU TO FOLLOW RULES ADOPTED BY THE OREGON UTILITY NOTIFICATION CENTER. THOSE RULES ARE SET FORTH IN OAR 952-001-0010 THROUGH OAR 952-001-0090. YOU MAY OBTAIN COPIES OF THE RULES BY CALLING THE OREGON UTILITY NOTIFICATION CENTER AT 503-232-1987.

CALL BEFORE YOU DIG 1-800-332-2344

GRAPHIC SCALE
100 0 50 100 200
(IN FEET)
1 inch = 100 ft.

THIS DESIGN COMPLIES WITH ORS 92.044 (7) IN THAT NO UTILITY INFRASTRUCTURE IS DESIGNED TO BE WITHIN ONE (1) FOOT OF A SURVEY MONUMENT LOCATION SHOWN ON A SUBDIVISION OR PARTITION PLAT. NO DESIGN EXCEPTIONS NOR FINAL FIELD LOCATION CHANGES SHALL BE PERMITTED IF THAT CHANGE WOULD CAUSE ANY UTILITY INFRASTRUCTURE TO BE PLACED WITHIN THE PROHIBITED AREA.

N

WILSONVILLE APP. NO. DB18-0018 - DB18-0021

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COVER SHEET

MORGAN FARM PHASE 2
CITY OF WILSONVILLE, OREGON

Designed by	TCC	Date	12/2018
Drawn by	TCC	Date	12/2018
Reviewed by	BEF	Date	12/2018
Project No.	321-002	REF.	
Horiz. Scale:	N/A		
Vert. Scale:	N/A		

3381_C0-0COVR.dwg

No.	Date	Revision	By

RECORD DRAWINGS
DATE 12/18/2019 THESE RECORD DRAWINGS HAVE BEEN PREPARED BASED ON FIELD OBSERVATION AND SURVEYED INFORMATION.

Project MORGAN FARM PH.2
No. 321-002
Type AS-BUILTS
Sheet C0.0

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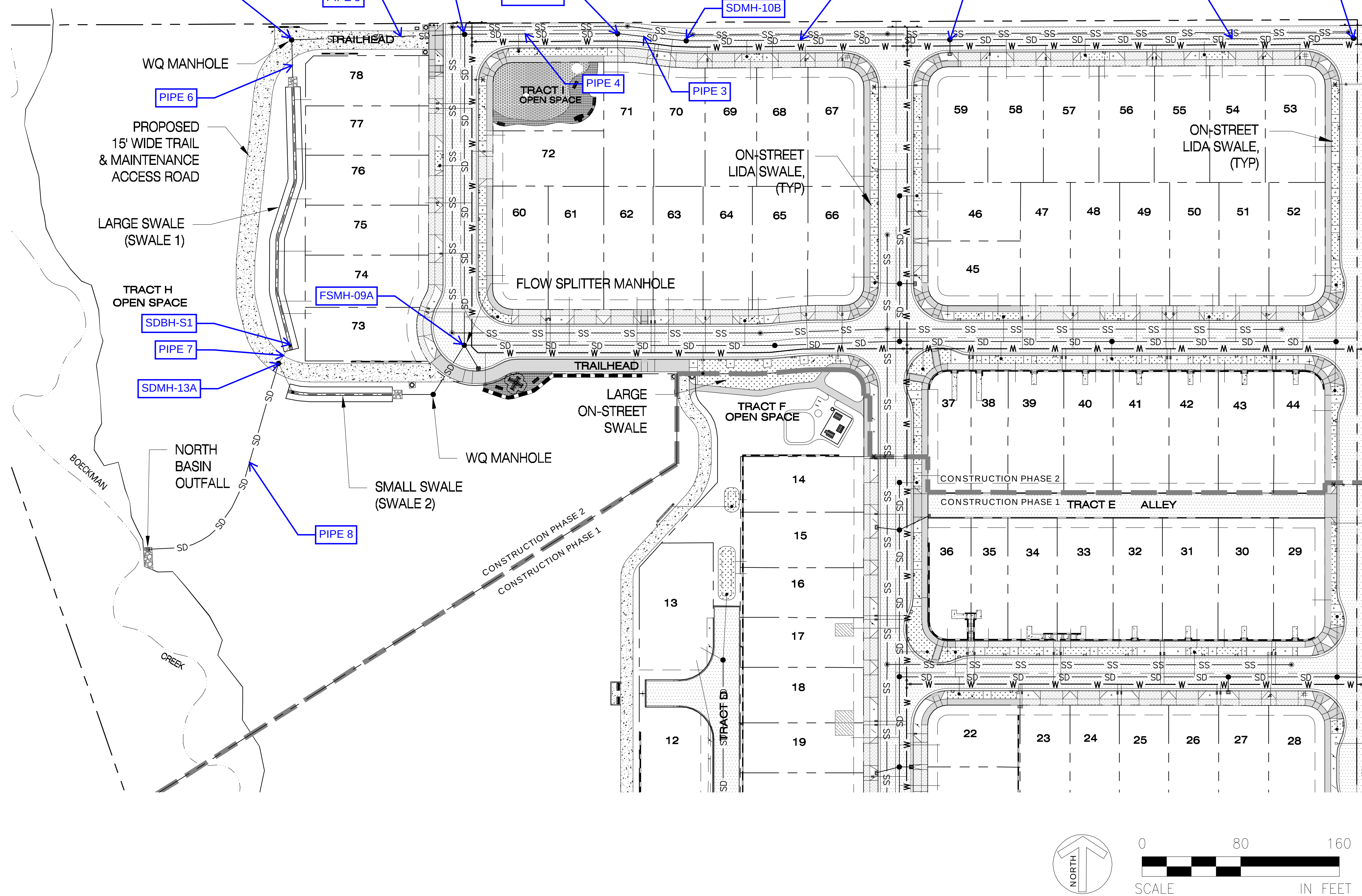
COMPOSITE UTILITY PLAN

MORGAN FARM - PHASE 2



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PORTLAND, OREGON 97223
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f 844.715.4743
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PIONEER DESIGN GROUP, INC.

Designed by	TCC	Date	01/18
Drawn by	TCC	Date	01/18
Reviewed by	BEF	Date	01/18
Project No.	321-002	REF.	
Horiz. Scale: 1"=80'			
Vert. Scale:			

Project MORGAN FARMS

No. 321-002

Type ENGINEERING

Sheet 1 of 1

CONSTRUCTION NOTES

1. INSTALL 4' HIGH ORNAMENTAL FENCE WITH 12' WIDE ACCESS GATE. SEE LANDSCAPE PLANS FOR FENCING DETAILS.
2. VEGETATED SWALES TO BE COMPLETELY LINED WITH 30 MIL PLASTIC LINER OR APPROVED EQUAL PER CITY DETAIL ST-6045.

BEEHIVE INLET STRUCTURE DATA

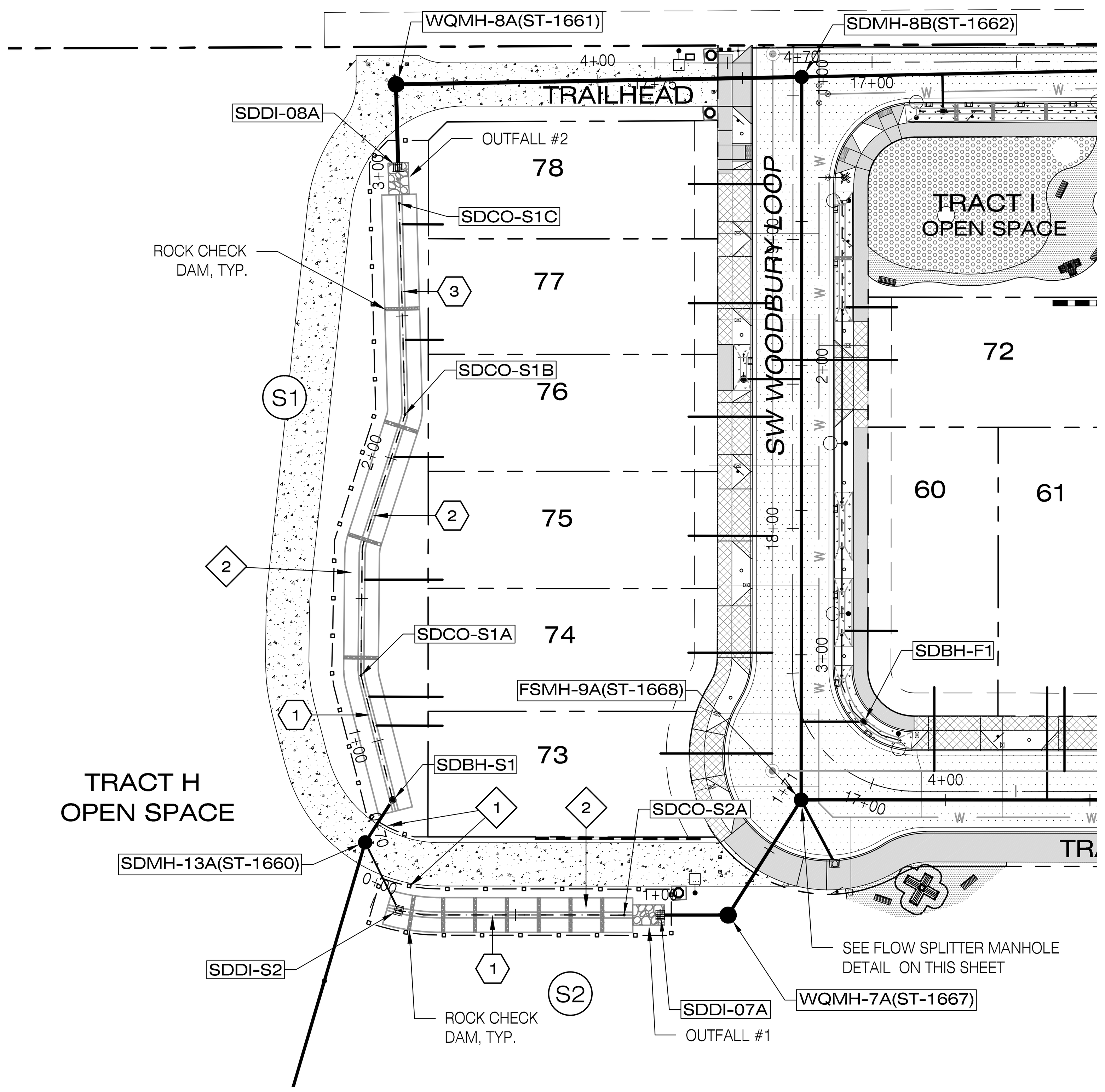
TAG	TYPE	STATION	RIM ELEV	IE IN	IE OUT	SLOPE	PIPE
SDBH-S1	Beehive Inlet	0+78.89 0.00' RT SDLN-08	193.85	189.35	188.48	0.0337	17.50 LF 12" PVC D-3034
SDDI-S2	Ditch Inlet	0+09.50 0.00' RT SDLN-07	195.33	191.14	190.98	0.1091	26.21 LF 6" PVC D-3034

VEGETATED SWALE 1

SWALE SIZE (SF)	2604 SF
1	44.5 LF - 6" ABS SCH.40 PERF PIPE
2	92.6 LF - 6" ABS SCH.40 PERF PIPE
3	73.1 LF - 6" ABS SCH.40 PERF PIPE

VEGETATED SWALE 2

SWALE SIZE (SF)	1020 SF
1	78.0 LF - 6" ABS SCH.40 PERF PIPE



SDLN-07 / SDLN-08 / SWALES 1 & 2 - PLAN
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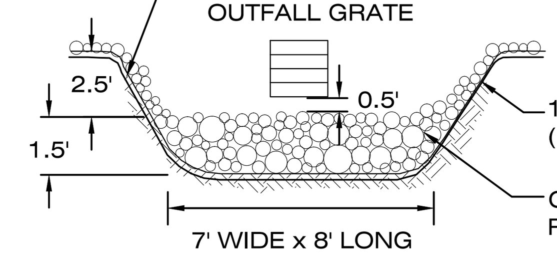
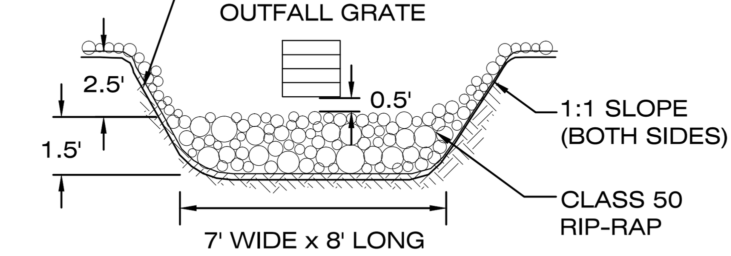


OUTFALL #1 PROTECTION
N.T.S.



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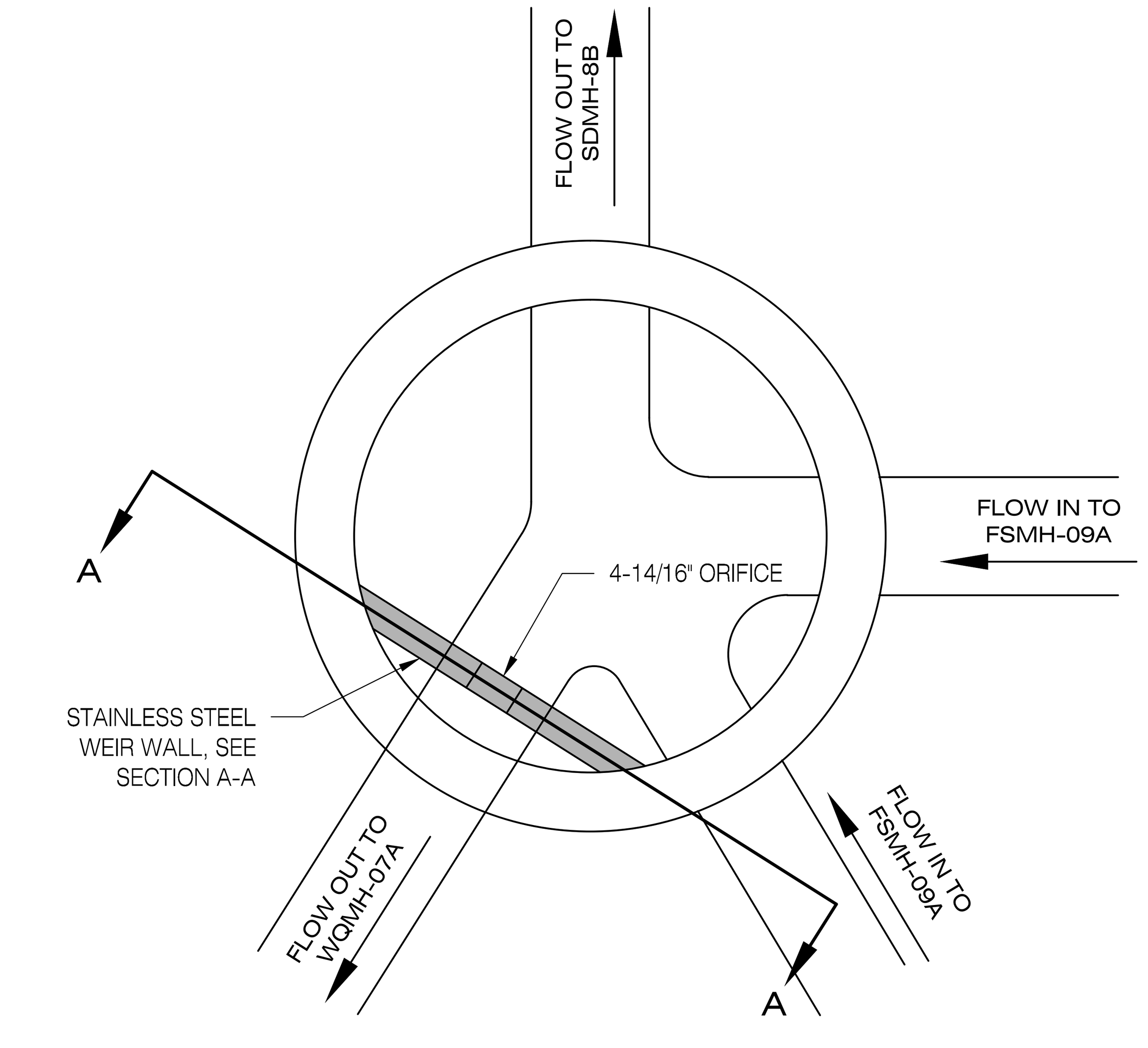
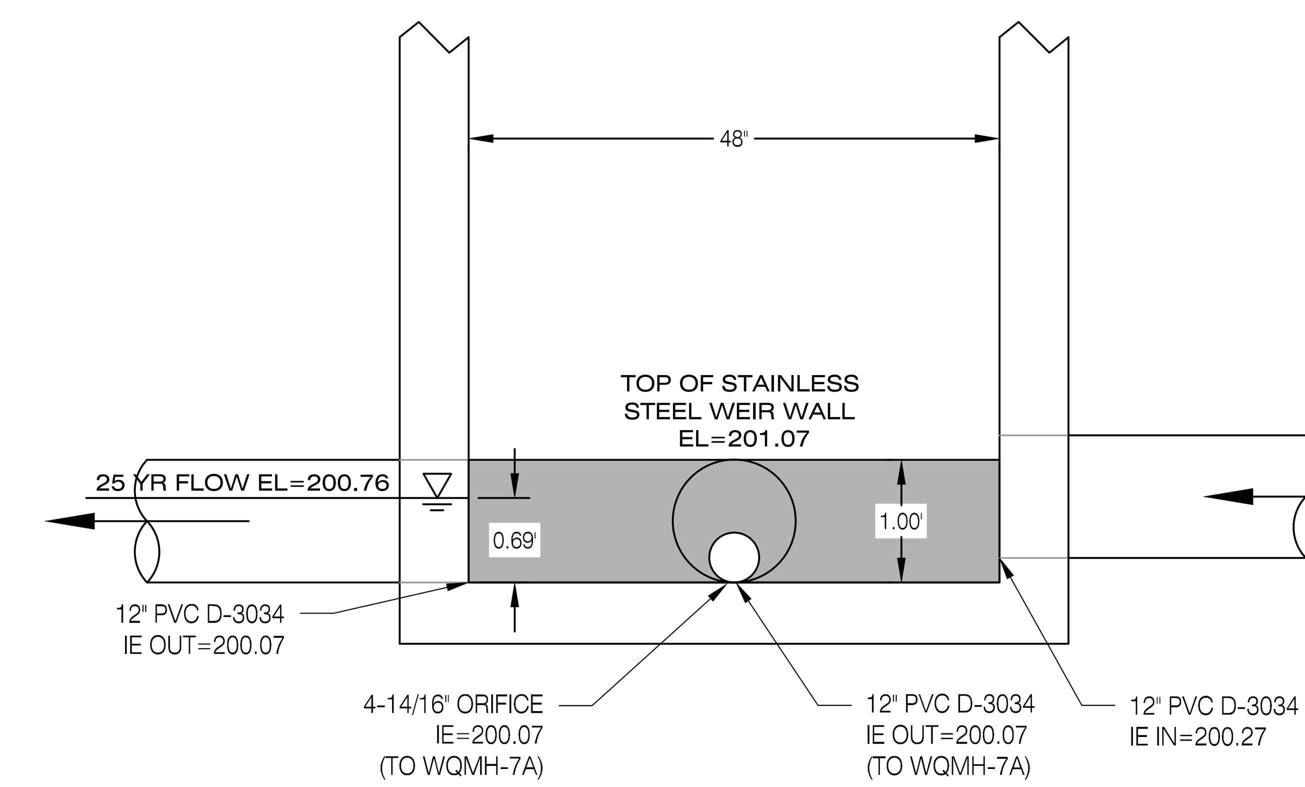
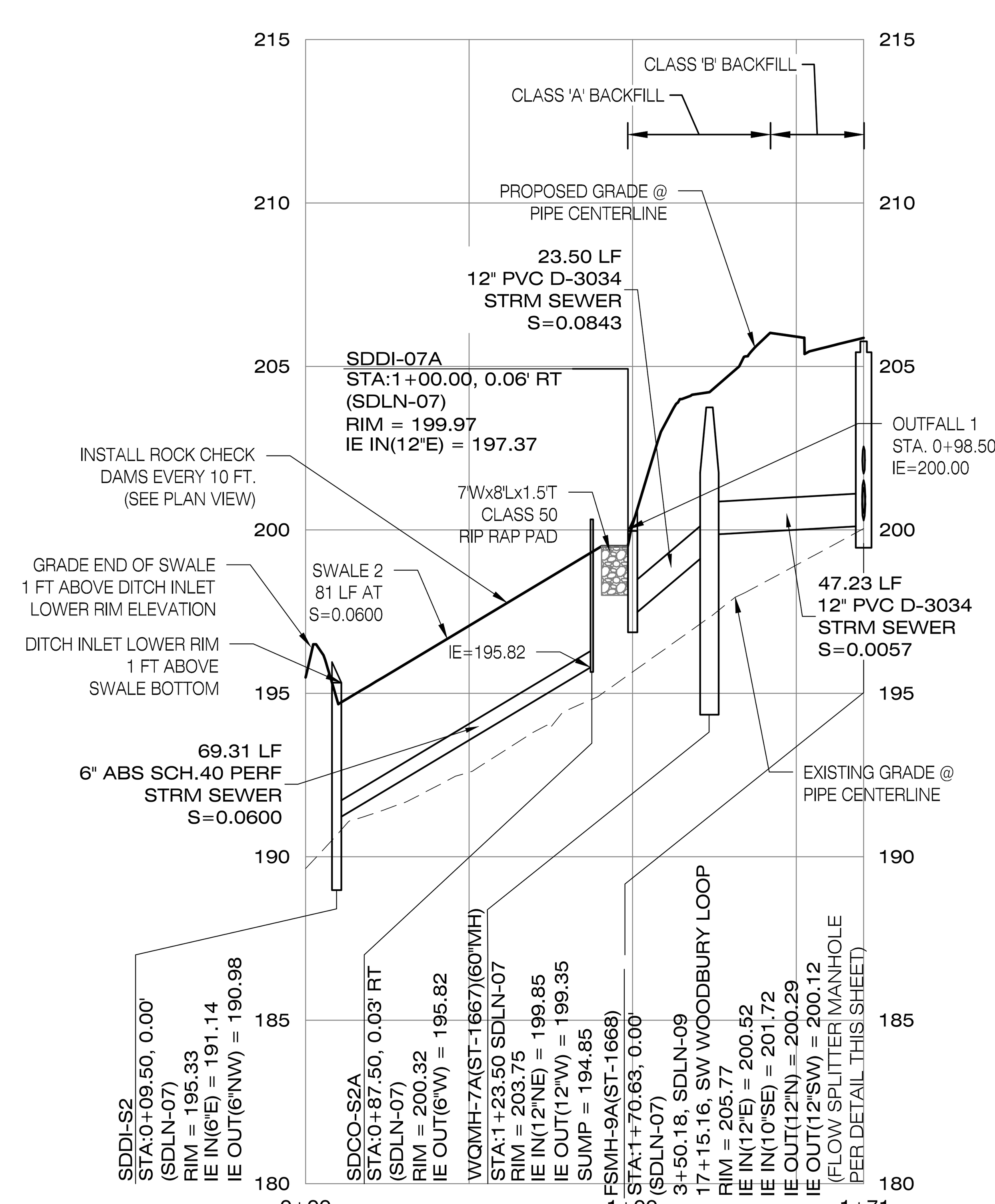


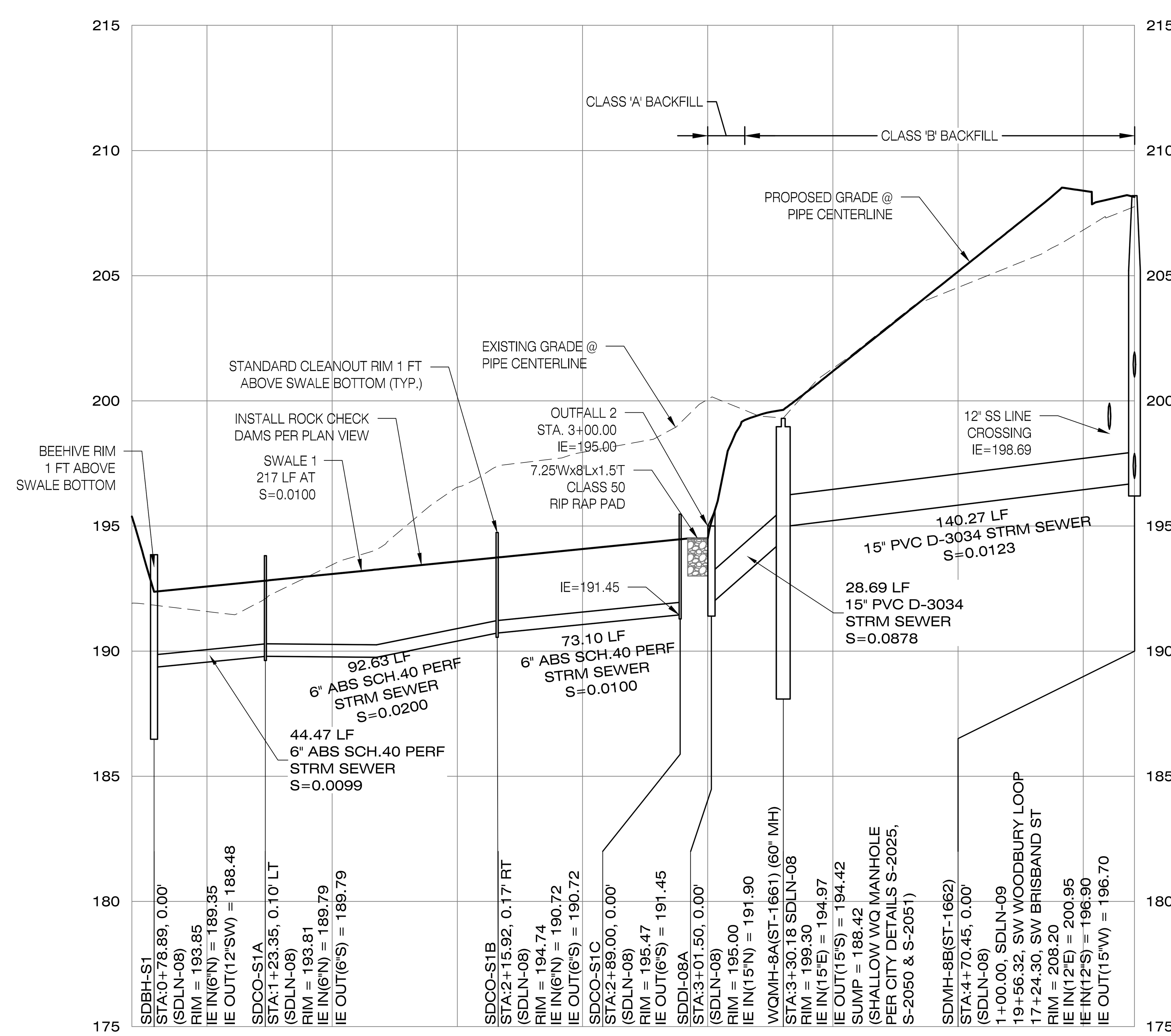
FLOW SPLITTER MANHOLE 9A - PLAN (48" DIA.)
NTS



FLOW SPLITTER MANHOLE 9A - SECTION A-A
NTS



SDLN-07 / SWALE 2 - PROFILE
SCALE: 1"=40' (H), 1"=4' (V)



SDLN-08 / SWALE 1 - PROFILE
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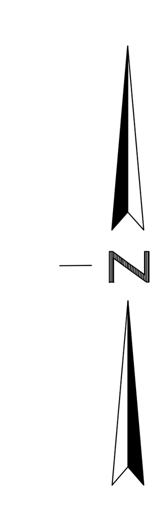

GRAPHIC SCALE
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(IN FEET)
1 inch = 20 ft.

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SDLN-07, SDLN-08, SWALES 1 & 2 - PLAN AND PROFILE

MORGAN FARM PHASE 2
CITY OF WILSONVILLE, OREGON

Designed by	TCC	Date	12/2018
Drawn by	TCC	Date	12/2018
Reviewed by	BEF	Date	12/2018
Project No.	321-002	REF.	
Horiz. Scale:	N/A		
Vert. Scale:	N/A		

3381_C4-7WQPF.dwg

No.	Date	Revision	By

RECORD DRAWINGS
DATE 12/18/2019 THESE RECORD DRAWINGS HAVE BEEN PREPARED BASED ON FIELD OBSERVATION AND SURVEYED INFORMATION.

Project: MORGAN FARM PH.2
No.: 321-002
Type: AS-BUILTS
Sheet: C4.7

WILSONVILLE APP. NO. DB18-0018 - DB18-0021

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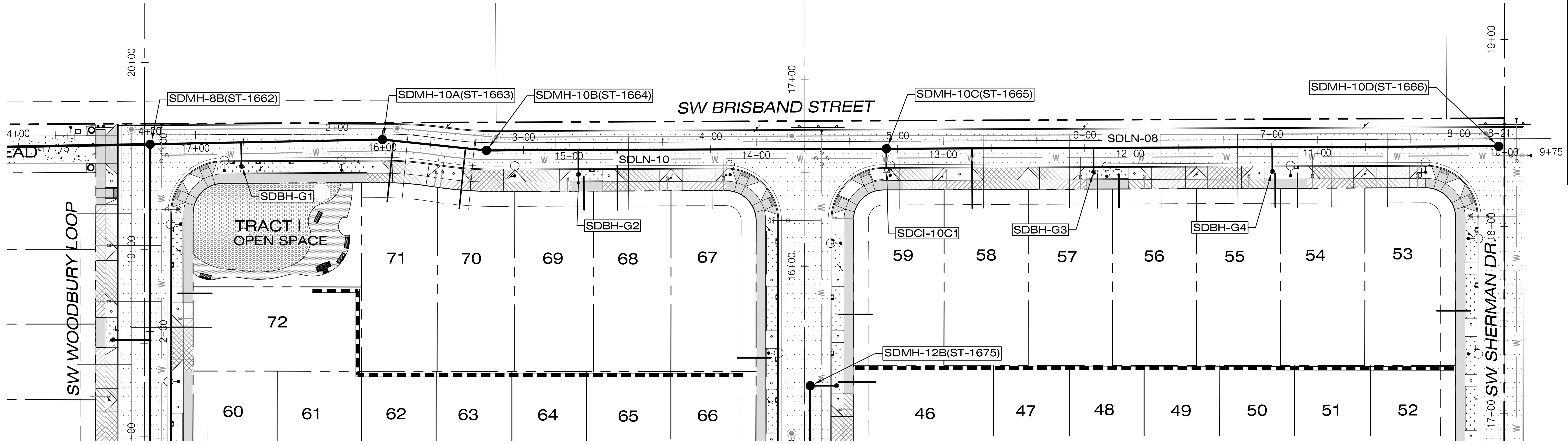

SW BRISBAND STREET / SDLN-10 (PUBLIC) PLAN

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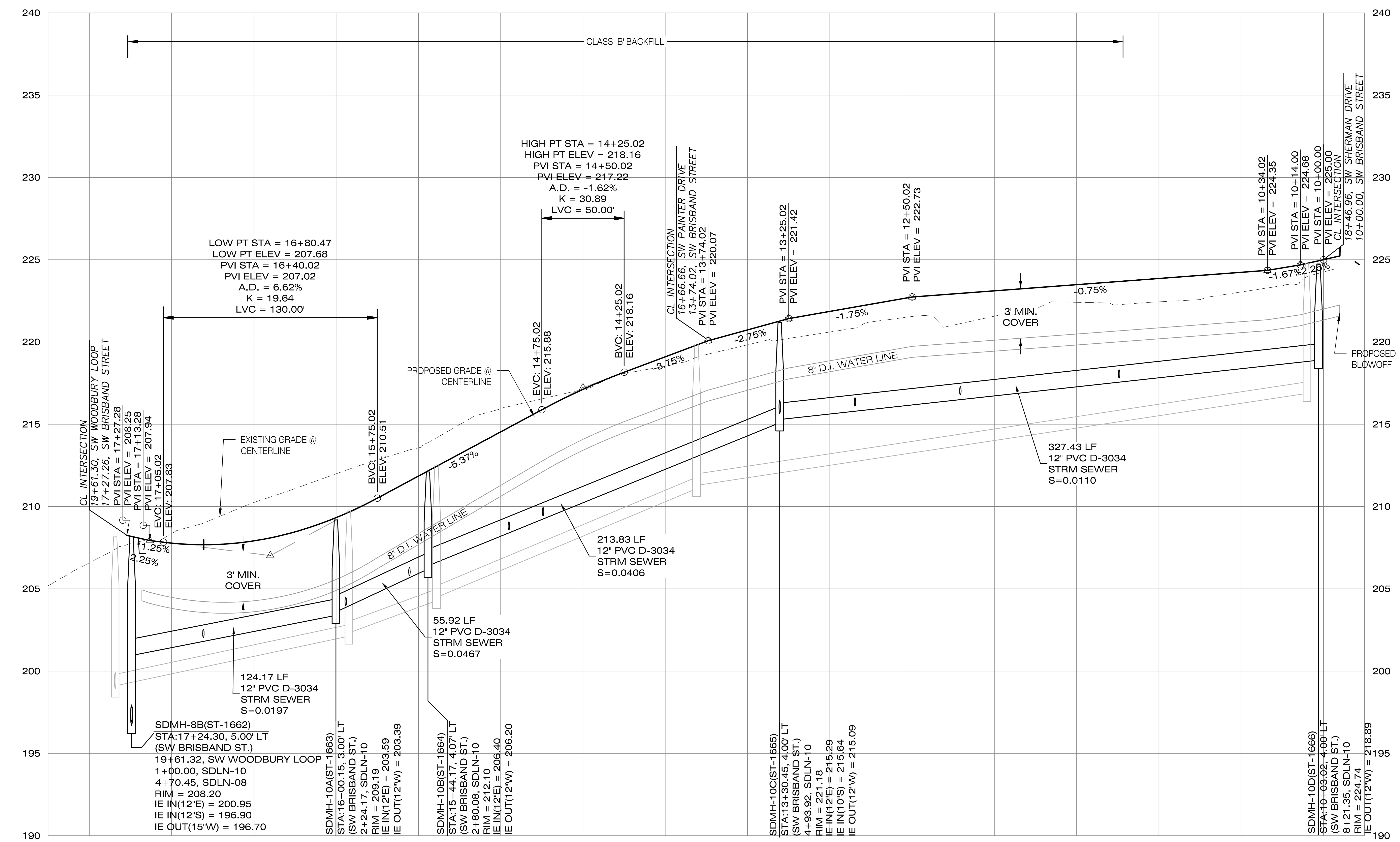

SW BRISBAND STREET / SDLN-10 (PUBLIC) PROFILE

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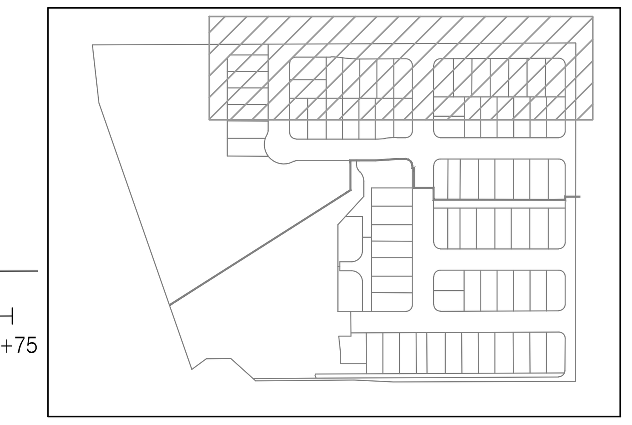

KEY MAP

NTS

LEGEND

- PROPOSED SIDEWALK WITH FACILITY PERMIT
- PROPOSED SIDEWALK (BY HOMEBUILDER)
- PROPOSED CONCRETE CURB AND GUTTER
- PROPOSED STORM LINE & MANHOLE
- PROPOSED SANITARY LINE & MANHOLE
- PROPOSED WATERLINE & VALVE
- PROPOSED PAVEMENT

STORM LATERAL DATA

	LOT NO.	D.S. M.H.	DIST. FROM D.S. M.H.	LENGTH	INV. EL. @ MAINLINE	INV. EL. @ PLUG	SLOPE	DEPTH @ PLUG
1)	54	LIDA	--	18.0'	222.37	222.55	0.0100	0.9'
1)	55	LIDA	--	18.0'	222.50	222.68	0.0100	0.9'
1)	56	LIDA	--	18.0'	221.94	222.12	0.0100	0.9'
1)	57	LIDA	--	18.0'	221.57	221.75	0.0100	0.9'
	58	10C	45.80'	32.0'	216.04	217.43	0.0434	5.0'
	68	10B	69.94'	32.0'	209.49	211.36	0.0584	5.0'
1)	69	LIDA	--	18.0'	213.75	213.93	0.0100	1.0'
	70	10A	44.71'	32.5'	205.93	207.08	0.0354	5.0'
	71	10A	6.00'	32.6'	204.12	205.07	0.0292	5.0'

1) STORM LATERAL TO BE 6" DUCTILE IRON PIPE.

PUBLIC CATCH BASIN DATA

TAG	TYPE	STATION	TC ELEV	IE IN	IE OUT	SLOPE	PIPE
SDCI-10C1	CG-30	13+30.47 14.00' LT BRISBAND	221.30	--	216.40	0.0668	11.38 LF 10" PVC C900

BEEHIVE LATERAL DATA

BEEHIVE NO.	D.S. M.H.	DIST. FROM D.S. M.H.	LENGTH	INV. EL. @ MAINLINE	INV. EL. @ BEEHIVE	SLOPE
G1	8B	43.63'	12.8'	202.06	202.23	0.0133
G2	10B	49.13'	13.0'	208.64	210.38	0.1338
G3	10C	109.80'	13.0'	216.75	217.35	0.0462
G4	10C	206.30'	13.0'	217.80	218.42	0.0474

CONSTRUCTION NOTES

ALL 6" STORM LATERALS THAT OUTFALL INTO STREET SIDE SWALES WILL BE DUCTILE IRON PIPE INSTALLED UNDER THE SIDEWALK AT S=0.0100 TO MAXIMIZE COVER AT THE END OF THE PIPE. SEE STORM LATERAL TO SWALE DETAIL ON SHEET C4.2.

STORM SEWER NOTES

UNLESS OTHERWISE NOTED, ALL LATERALS ARE TO BE 6" PVC (ASTM D3034) WITH A MINIMUM SLOPE OF 0.0100. LATERAL CONNECTIONS TO MAIN SEWER LINE TO BE MADE WITH MANUFACTURED TEES.

ALL 2"x 4" STORM SERVICE CONNECTION MARKERS TO BE COLOR CODED WHITE. CONTRACTOR TO NOTE LENGTH OF BOARD USED ON EACH MARKER.

BACKFILL NOTE: PIPES UNDER PAVED SURFACES REQUIRE GRANULAR BACKFILL. FOR PIPES OUTSIDE PAVEMENT, NATIVE BACKFILL IS PERMITTED, UNLESS OTHERWISE NOTED.

THE CONTRACTOR SHALL FIELD VERIFY THE SIZE, LOCATION & DEPTH OF EXISTING UTILITIES PRIOR TO CONSTRUCTION.

GRAPHIC SCALE

(IN FEET)
1 inch = 40 ft.

PIONEER DESIGN GROUP
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SW BRISBAND STREET - SDLN-10 PLAN AND PROFILE

MORGAN FARM PHASE 2
CITY OF WILSONVILLE, OREGON

Designed by TCC Date 12/2018
Drawn by TCC Date 12/2018
Reviewed by BEF Date 12/2018
Project No. 321-002 REF.
Horiz. Scale: 1" = 40'
Vert. Scale: 1" = 4'
3381_C5-4STRT.dwg

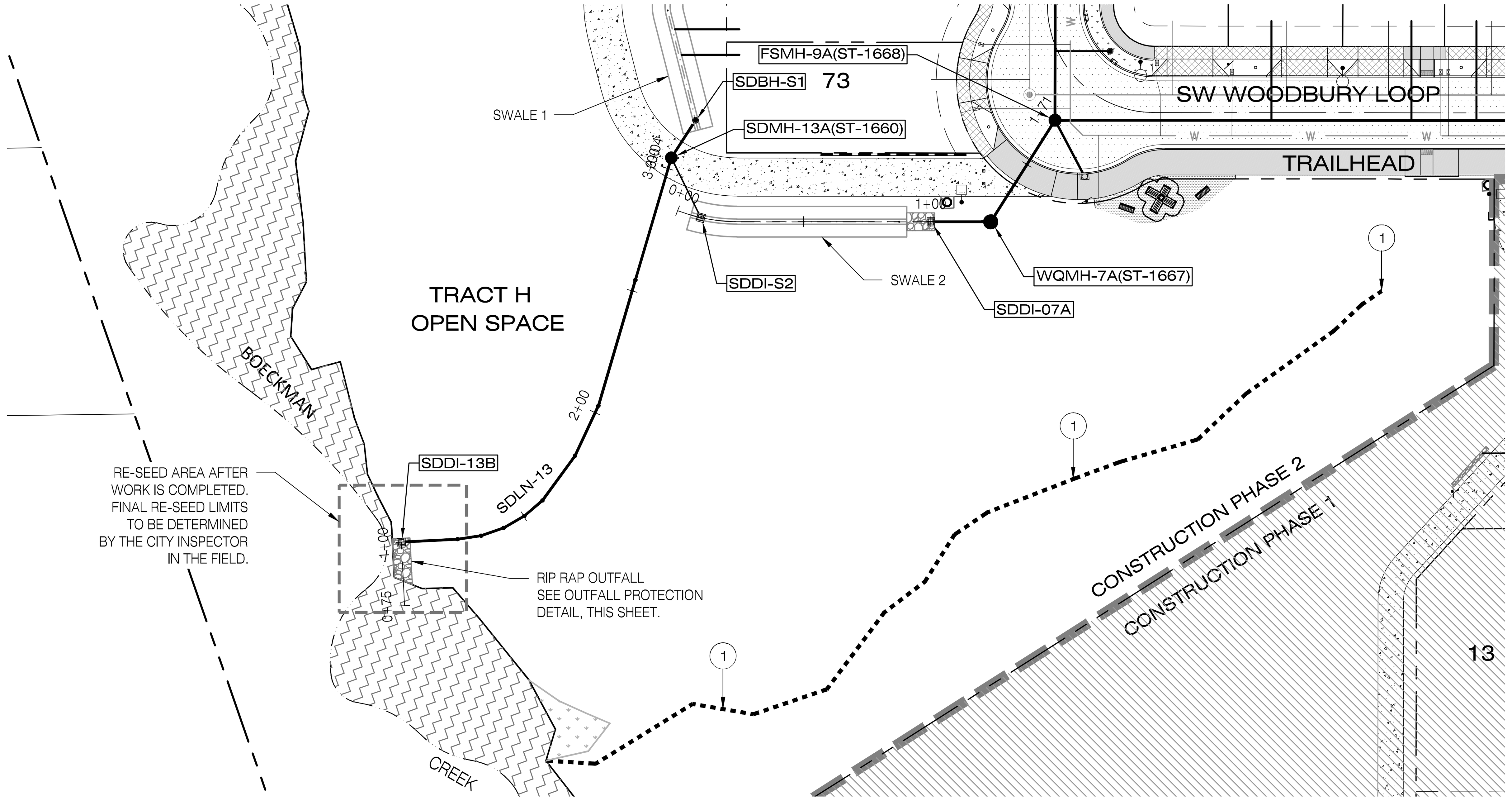
RECORD DRAWINGS
DATE 12/18/2019 THESE RECORD DRAWINGS HAVE BEEN PREPARED BASED ON FIELD OBSERVATION AND SURVEYED INFORMATION.

No.	Date	Revision	By

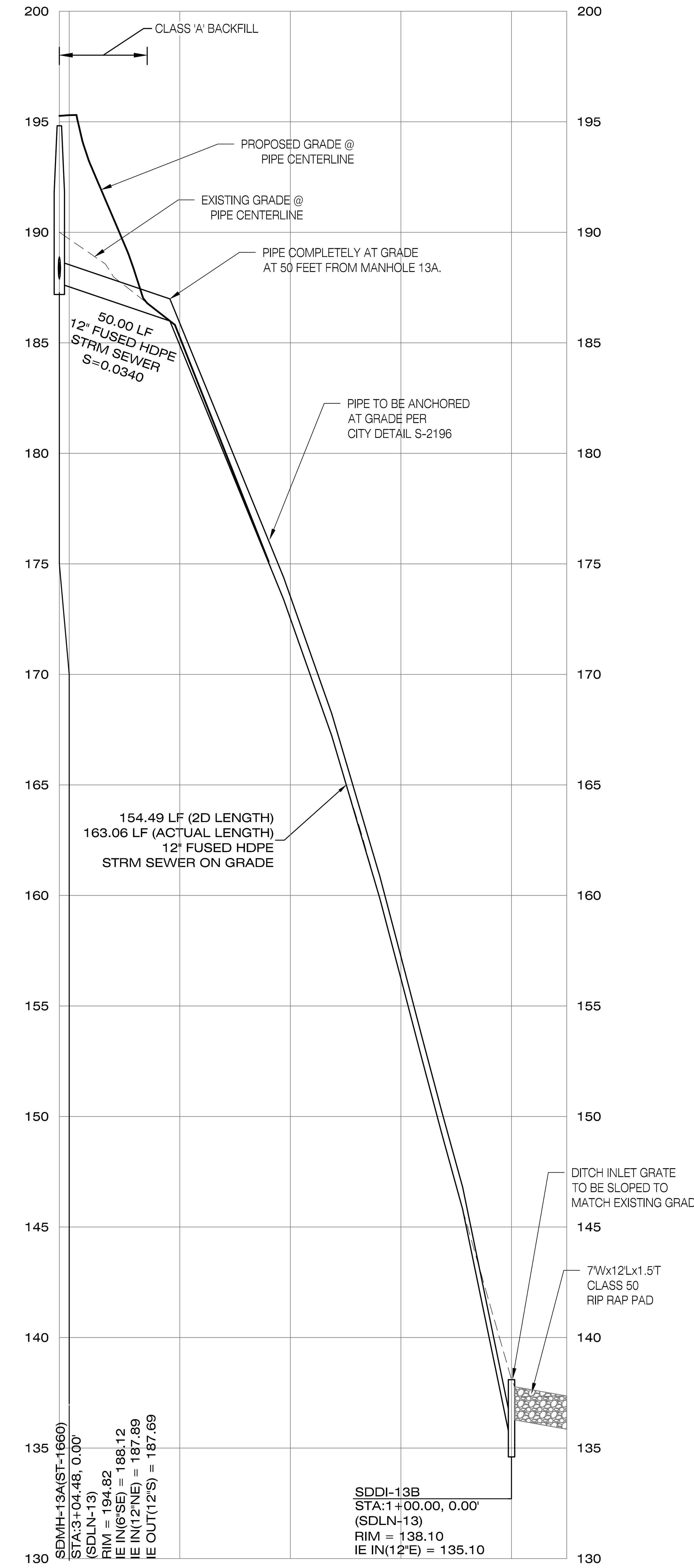
Project MORGAN FARM PH.2
No. 321-002
Type AS-BUILTS
Sheet C5.4

WILSONVILLE APP. NO. DB18-0018 - DB18-0021

B:\Land Projects 2004\338-001\dwg\engineering\Phase 2\3381_C5-4STRT.dwg 12/18/2019 12:50:01 PM



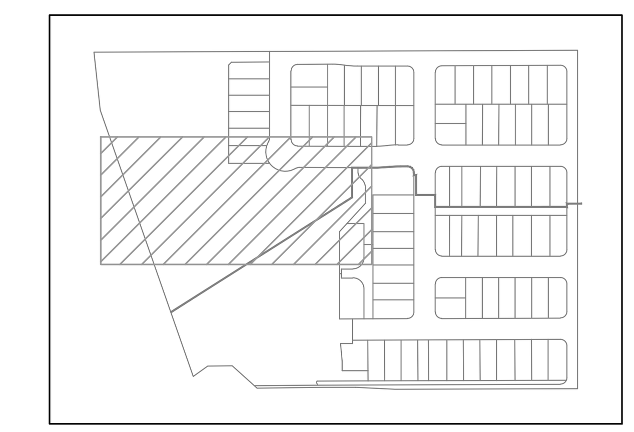
SDLN-13 (PUBLIC) PLAN
SCALE: 1"=40' (H)



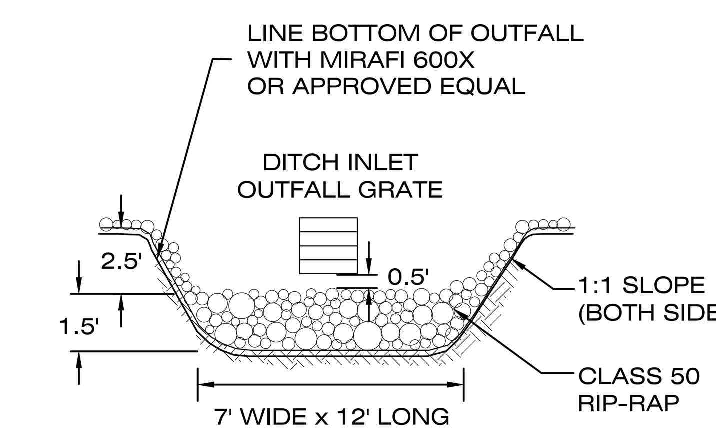
SDLN-13 (PUBLIC) PROFILE
SCALE: 1"=40' (H), 1"=4' (V)

LEGEND

PROPOSED SIDEWALK WITH FACILITY PERMIT	
PROPOSED SIDEWALK (BY HOMEBUILDER)	
PROPOSED CONCRETE CURB AND GUTTER	
PROPOSED STORM LINE & MANHOLE	
PROPOSED SANITARY LINE & MANHOLE	
PROPOSED WATERLINE & VALVE	
PROPOSED PAVEMENT	



KEY MAP
NTS



DITCH INLET
OUTFALL PROTECTION
N.T.S.

STORM SEWER NOTES

UNLESS OTHERWISE NOTED, ALL LATERALS ARE TO BE 6" PVC (ASTM D3034) WITH A MINIMUM SLOPE OF 0.0100. LATERAL CONNECTIONS TO MAIN SEWER LINE TO BE MADE WITH MANUFACTURED TEES.

ALL 2"x 4" STORM SERVICE CONNECTION MARKERS TO BE COLOR CODED WHITE. CONTRACTOR TO NOTE LENGTH OF BOARD USED ON EACH MARKER.

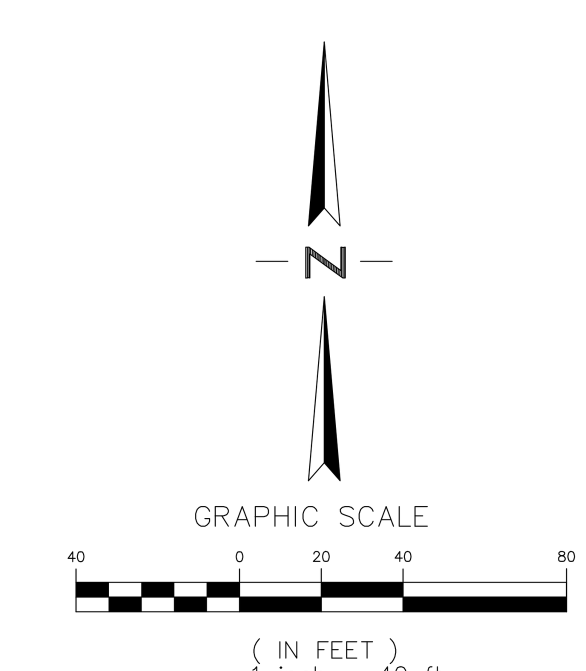
BACKFILL NOTE: PIPES UNDER PAVED SURFACES REQUIRE GRANULAR BACKFILL. FOR PIPES OUTSIDE PAVEMENT, NATIVE BACKFILL IS PERMITTED, UNLESS OTHERWISE NOTED.

THE CONTRACTOR SHALL FIELD VERIFY THE SIZE, LOCATION & DEPTH OF EXISTING UTILITIES PRIOR TO CONSTRUCTION.

CONSTRUCTION NOTES

(1) STREAM STABILIZATION USING BEAVER DAM ANALOGS TO BE COMPLETED ALONG THE EXISTING DRAINAGEWAY. REFER TO APPROVED REPORT AND DESIGN PLANS FROM WOLFE WATER RESOURCES INC. DATED JULY 2018. THIS WORK WILL BE COMPLETED BY OTHERS AND IS NOTED FOR REFERENCE ONLY.

CONTRACTOR TO VERIFY FINAL LOCATION OF FUSED HDPE PIPE IN THE FIELD PRIOR TO INSTALLATION. SHOULD THE LOCATION OF PIPE NEED TO CHANGE, CONTACT THE ENGINEER IMMEDIATELY .



PIONEER DESIGN GROUP
CIVIL ENGINEERING • LAND USE PLANNING • LAND SURVEYING • LANDSCAPE ARCHITECTURE
9020 SW WASHINGTON SQUARE RD., SUITE 170 PORTLAND, OREGON 97223
p 503.643.8286 www.pd-grp.com

SDLN-13 PLAN AND PROFILE

MORGAN FARM PHASE 2
CITY OF WILSONVILLE, OREGON

Designed by	TCC	Date	12/2018
Drawn by	TCC	Date	12/2018
Reviewed by	BEF	Date	12/2018
Project No.	321-002	REF.	
Horiz. Scale:	1" = 40'		
Vert. Scale:	1" = 4'		

3381_C5-5STRM.dwg

No.	Date	Revision	By

RECORD DRAWINGS
DATE 12/18/2019 THESE RECORD DRAWINGS HAVE BEEN PREPARED BASED ON FIELD OBSERVATION AND SURVEYED INFORMATION.

Project
MORGAN FARM PH.2
No.
321-002
Type
AS-BUILTS
Sheet
C5.5

WILSONVILLE APP. NO. DB18-0018 - DB18-0021

PIONEER DESIGN GROUP, INC.
CIVIL LAND USE PLANNING SURVEY
P 503.643.8286 F 844.715.4743 www.pd-grp.com
9020 SW Washington Square Rd Suite 170
Portland, Oregon 97223

Final Storm Drainage Report

Morgan Farm – Phase 2

City of Wilsonville, Oregon

Date: January 16, 2019

Prepared By: T.C. Campbell, P.E.
Reviewed By: Brent E. Fitch, P.E.

PDG Job No. 321-002

Applicant: Pahlisch Homes, Inc.
15333 SW Sequoia Pkwy.
Suite 190
Portland, OR 97224
(503) 317-6500

Engineer: Pioneer Design Group, Inc.
9020 SW Washington Sq. Dr.
Suite 170
Portland, OR 97223
(503) 643-8286

Map Scale: 1:2,170 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 30, 60, 120, 180

Feet: 0, 100, 200, 400, 600

N

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

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Clackamas County Area, Oregon (OR610)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
1A	Aloha silt loam, 0 to 3 percent slopes	C/D	0.7	5.4%
1B	Aloha silt loam, 3 to 6 percent slopes	C/D	10.4	74.2%
91C	Woodburn silt loam, 8 to 15 percent slopes	C	2.7	19.0%
92F	Xerochrepts and Haploxerolls, very steep	B	0.2	1.4%
Totals for Area of Interest			**13.9**	**100.0%**

RUNOFF CURVE NUMBERS (TR55)

Table 2-2a: Runoff curve numbers for urban areas [1]

Cover description		CN for hydrologic soil group				
Cover type and hydrologic condition	Average percent impervious area[2]	A	B	C	D	
Fully developed urban areas (vegetation established)						
Open space (lawns, parks, golf courses, cemeteries, etc.) [3]:						
Poor condition (grass cover <50%)		68	79	86	89	
Fair condition (grass cover 50% to 75%)		49	69	79	84	
Good condition (grass cover >75%)		39	61	74	80	POST
Impervious areas:						
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98	PRE/POST
Streets and roads:						
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98	
Paved; open ditches (including right-of-way)		83	89	92	93	
Gravel (including right-of-way)		76	85	89	91	
Dirt (including right-of-way)		72	82	87	89	
Western desert urban areas:						
Natural desert landscaping (pervious areas only) [4]		63	77	85	88	
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96	
Urban districts:						
Commercial and business	85	89	92	94	95	
Industrial	72	81	88	91	93	
Residential districts by average lot size:						
1/8 acre or less (town houses)	65	77	85	90	92	
1/4 acre	38	61	75	83	87	
1/3 acre	30	57	72	81	86	
1/2 acre	25	54	70	80	85	
1 acre	20	51	68	79	84	
2 acres	12	46	65	77	82	
Developing urban areas						
Newly graded areas (pervious areas only, no vegetation) [5]	77	86	91	94		
Idle lands (CNs are determined using cover types similar to those in table 2-2c)						

1: Average runoff condition, and $I_a = 0.2S$.

2: The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas hava a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

3: CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

4: Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

5: Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

3J CONSULTING

CIVIL ENGINEERING | WATER RESOURCES | COMMUNITY PLANNING

PRELIMINARY DRAINAGE REPORT

NEW WILSONVILLE PRIMARY SCHOOL
7151 BOECKMAN ROAD
WILSONVILLE, OREGON

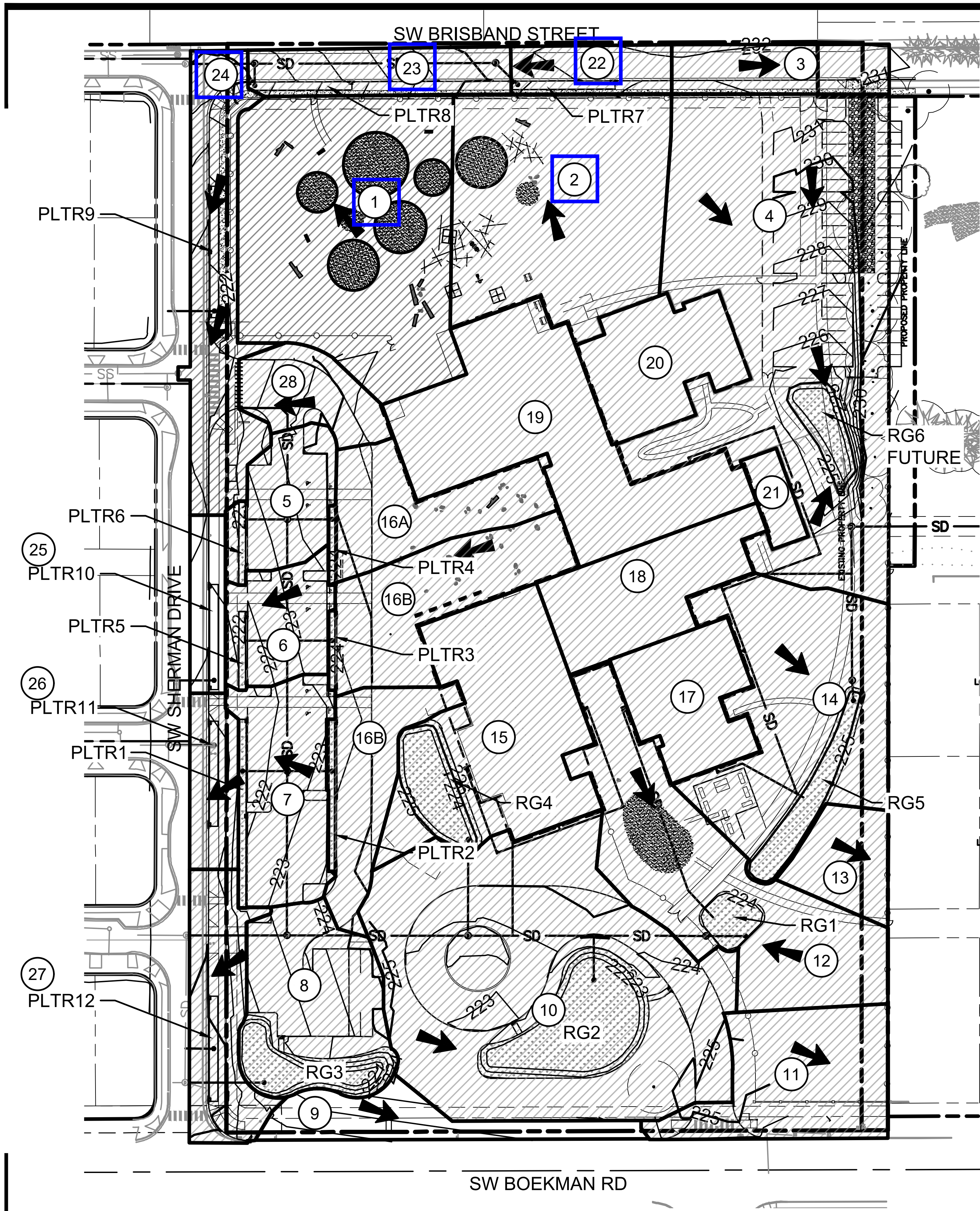
Planning DB No. TBD

November 2, 2022

Applicant:

West Linn-Wilsonville School District
22210 SW Stafford Road
Tualatin, Oregon 97062
503-673-7000

Prepared By:
3J Consulting, Inc.
9600 SW Nimbus Avenue, Suite 100
Beaverton, Oregon 97008
Project No: 21680
Kathleen Freeman, PE
Water Resources Project Manager



LEGEND

- PROPERTY LINE
- EXTG. RIGHT OF WAY
- STORM STRUCTURES
- MAJOR DESIGN CONTOUR
- MINOR DESIGN CONTOUR
- DRAINAGE BASIN
- DIRECTION OF FLOW

EAST / WEST BASIN TOTALS

EAST	155,885 SF - 3.59 ACRES
WEST	277,571 SF - 6.37 ACRES

NOTE:
SEE PROPOSED DRAINAGE BASIN TABLE
TABLE ABOVE DOES NOT INCLUDE 7,921 SF OF REPAVING ON SHERMAN DRIVE FOR HALF STREET IMPROVEMENTS

SCALE: 1" = 100'

0 100 200 FT

NOV 2022

NEW WILSONVILLE PRIMARY SCHOOL

WEST LINN / WILSONVILLE SCHOOL DISTRICT

PROPOSED DRAINAGE BASIN PLAN

3J CONSULTING
CIVIL ENGINEERING . WATER RESOURCES . COMMUNITY PLANNING

DRAINAGE BASIN TABLE

Included in downstream analysis per drainage flow arrows on basin map

#	IMP AREA (SF)	PERV AREA (SF)	[1]DIRECTION OF DRAINAGE	FACILITY ID	MIN LID SIZE (FT)	ORIFICE SIZE (IN)
1	0	33,544	MF PH1	OFFSITE	N/A	N/A
2	0	27,467	MF PH2	OFFSITE	N/A	N/A
3	5,855	374	EAST	OFFSITE	N/A	N/A
4	11,720	40,771	SM CULVERT	RG6 FUTURE	1,986	2.51
5	5,493	1,856	MF PH1	PLTR6	204	0.96
6	5,323	1,592	MF PH1	PLTR5	194	0.93
7	9,428	2,447	MF PH1	PLTR1	334	1.22
8	8,338	5,983	MF PH1	RG3	501	1.21
9	0	6,876	MF PH1	OFFSITE	N/A	N/A
10	17,937	31,413	MF PH1	RG2	1597	2.24
11	759	12,609	EAST	OFFSITE	N/A	N/A
12	3,464	20,578	MF PH1	RG1	576	1.45
13	0	5,222	EAST	OFFSITE	N/A	N/A
14	22,325	1,745	SM CULVERT	RG5	2746	2.66
15	16,032	6,105	MF PH1	RG4	812	1.50
16A	2,675	7,393	MF PH1	PLTR4	236	1.12
16B	2,749	9,853	MF PH1	PLTR3	290	1.26
16C	7,205	1,755	MF PH1	PLTR2	253	1.06
17	8,633	0	SM CULVERT	RG5	SEE BASIN 14	
18	10,815	0	SM CULVERT	RG5	SEE BASIN 14	
19	23,645	0	SM CULVERT	RG5	SEE BASIN 14	
20	9,398	0	SM CULVERT	RG6 FUTURE	SEE BASIN 4	
21	2,014	0	SM CULVERT	RG5	SEE BASIN 14	
22	4,016	489	MF PH2	PLTR7	131	0.75
23	6,352	750	MF PH2	PLTR8	206	0.94
24	9,127	5,375	MF PH1	PLTR9	289	1.18
25	2,639	1,015	MF PH1	PLTR10	64	0.55
26	2,685	2,119	MF PH1	PLTR11	89	0.67
27	5,017	4,384	MF PH1	PLTR12	176	0.95
28	3,795	2,192	MF PH1	NOT TREATED	N/A	N/A
TOTAL	207,469	233,907				

Included with MF PH2 for downstream analysis per pipe routing diagram

[1]MF PH1 = MORGAN FARM SUBDIVISION PHASE 1
MF PH1 = MORGAN FARM SUBDIVISION PHASE 2
SM CULVERT = STAFFORD MEADOWS CULVERT
BASINS 24–27 INCLUDE HALF STREET IMPROVEMENTS TO SHERMAN

NEW WILSONVILLE PRIMARY SCHOOL
WEST LINN / WILSONVILLE SCHOOL DISTRICT
PROPOSED DRAINAGE BASIN TABLE
3J CONSULTING
CIVIL ENGINEERING . WATER RESOURCES . COMMUNITY PLANNING
NOV 2022

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