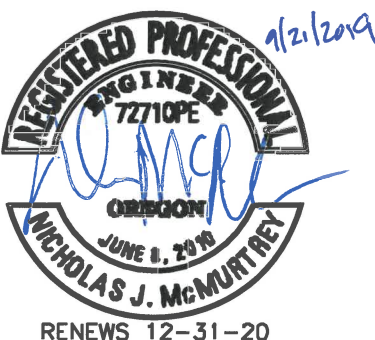


**Stormwater Management Plan
Veritas School Site Development
26500 NE Bell Road, Newberg, Oregon 97132**

Date:	September 21, 2019	 <p>REGISTERED PROFESSIONAL ENGINEER 72710PE OREGON JUNE 1, 2020 NICHOLAS J. McMURTREY RENEWS 12-31-20</p>
City of Newberg Case File #:	DR219-0002	
Project Type:	Site Development	
Project Location:	Yamhill County	
Latitude/Longitude:	45° 19' 49.08" N (45.3303), 122° 58' 00.56" W (-122.9668)	
Prepared By:	Nicholas J McMurtrey, P.E.	
Design Manual:	City of Newberg Public Works Design and Construction Standards (2015)	

PROJECT INTRODUCTION

Construction of Phase 1 of the Veritas School development has already occurred and consists of six modular buildings with a total of 14 classrooms, a science/art lab, a music room, a library and an office. These buildings are accessed via NE Bell Road (see Figure 1) by an asphalt driveway and served by a parking lot with approximately 90 stalls. The current student body includes approximately 220, with over 40 staff, both full- and part-time.

Site development activity prior to Phase 1 includes grading and gravel placement in 2010 (see Appendix A – C000 Cover Sheet), with all Phase 1 building construction completed between 2017 and 2018.

Phase 2 development includes a covered play area planned for construction in 2019. Phase 3 development includes a modular classroom and storage buildings in the southeast corner of the site, with an undefined construction schedule.

This Stormwater Management Plan considers prior site development during Phase 1 as ‘new development’, so that pre-development land conditions are documented circa 2006. Stormwater management facilities described herein reflect the City of Newberg Public Works Design and Construction Standards (2015) for all three phases of development summarized above. Future amendments to the City’s design standards may require updates to these findings if future development phases remain in the planning stage.

A summary of findings is provided in the Conclusion subsection below, including remedial action necessary for the site’s prior development to achieve compliance with City standards.

Figure 1: Vicinity Map



Climate:

Oregon Climate Zone 2 (Valley): Cool, wet winters, warm dry summers and mild temperatures throughout the year. Annual average total precipitation: 35 – 40 inches (Oregon DEQ – Erosion and Sediment Control Manual, 2005).

Soil Permeability:

Project soils along the project alignment consist of silty clay loams, which have relatively low potential for infiltration of stormwater runoff. Soils generally consist of the following NRCS soil types from north to south, as mapped in Appendix B:

- No. 2211B, Cove silty clay loam, hydrologic soil group D
- No. 2706C, Hazelair silty clay loam, hydrologic soil group D

Best Management Practices (BMPs):

Water quality treatment will occur via an existing vegetated swale constructed during Phase 1 development.

Water quantity considerations were excluded from prior development. As a result, additional site improvements are necessary to realize compliance with Section 4.7 of the City of Newberg (the City) Public Works Design and Construction Standards (D&CS).

POLLUTANTS OF CONCERN:

During and after construction, the types of pollutants associated with the project that pose a potential risk for release into the surrounding environment are: metals (zinc, copper, lead, etc.); oil, grease and other petroleum products; sediment; temperature; and polycyclic Aromatic Hydrocarbons (PAHs). For the purposes of this report, post-construction drainage contaminated by dissolved metals is due mainly to the operation of automobiles over the roadways. The main contributors of metal pollution are car brake pads and oil deposits leaking from vehicles.

Oil and grease are common contaminants resulting from the use of construction equipment and automobiles. The oil used to lubricate these machines leaks from moving parts over time. Petroleum spills are also a potential hazard during construction from the refueling of equipment on the construction site.

Sediments are a common source of contamination within runoff leaving a project site. Once native soils are exposed during grading activities, storm runoff can suspend loose soil particles and carry them downstream.

Temperature impacts to the surrounding environment occur mainly from impervious pavement areas, which contribute to the “heat island effect”. These surfaces collect and retain the sun’s energy more readily than natural vegetation and soil, so that during rainfall, heat is transferred into the resulting runoff. If the runoff is not infiltrated into the ground, or passed through vegetation, it retains a larger portion of this heat which is passed down the conveyance system into larger streams and rivers. In Oregon, temperature of drainage is primarily a function of shading (or lack thereof) over impervious surfaces, because of the hot, dry summer months.

Polycyclic aromatic hydrocarbons (PAHs) are generated from vehicular traffic as by-products of the fuel combustion process. These pollutants may remain airborne, or settle and adhere to sediments on the roadway where drainage can transport them into local receiving waters.

STATUS OF RECEIVING WATERS:

Rivers, Streams and Lakes:

The project is divided into two watersheds with separate receiving waters, as shown in **Table 1** below and illustrated on maps in Appendix B.

Table 1: Project Waterway Information

Waterway	Site Description	Location
Hess Creek	East Basin (E1)	±3,000 feet southeast
Chehalem Creek	West Basin (E2)	±5,000 feet southwest

Approximately 20% of the site’s northeastern corner drains easterly to an unnamed tributary of Hess Creek, while the larger remainder drains westerly to an unnamed tributary of Chehalem Creek.

Wetlands

While the site is omitted from publicly available State and local wetland inventories, the State’s 2018 GIS mapping tool shows USDA NRCS soil mapping on-site for predominately hydric soils. Further analysis of wetland potential is outside the scope of this report, and future development activity is shown to remain within the bounds of prior ground disturbance activity.

TMDLs and 303(d) listings:

Hess Creek is not listed under any water quality categories according to Oregon’s 2012 Integrated Report developed by Oregon DEQ; however, Chehalem Creek is listed as shown in **Table 2** below.

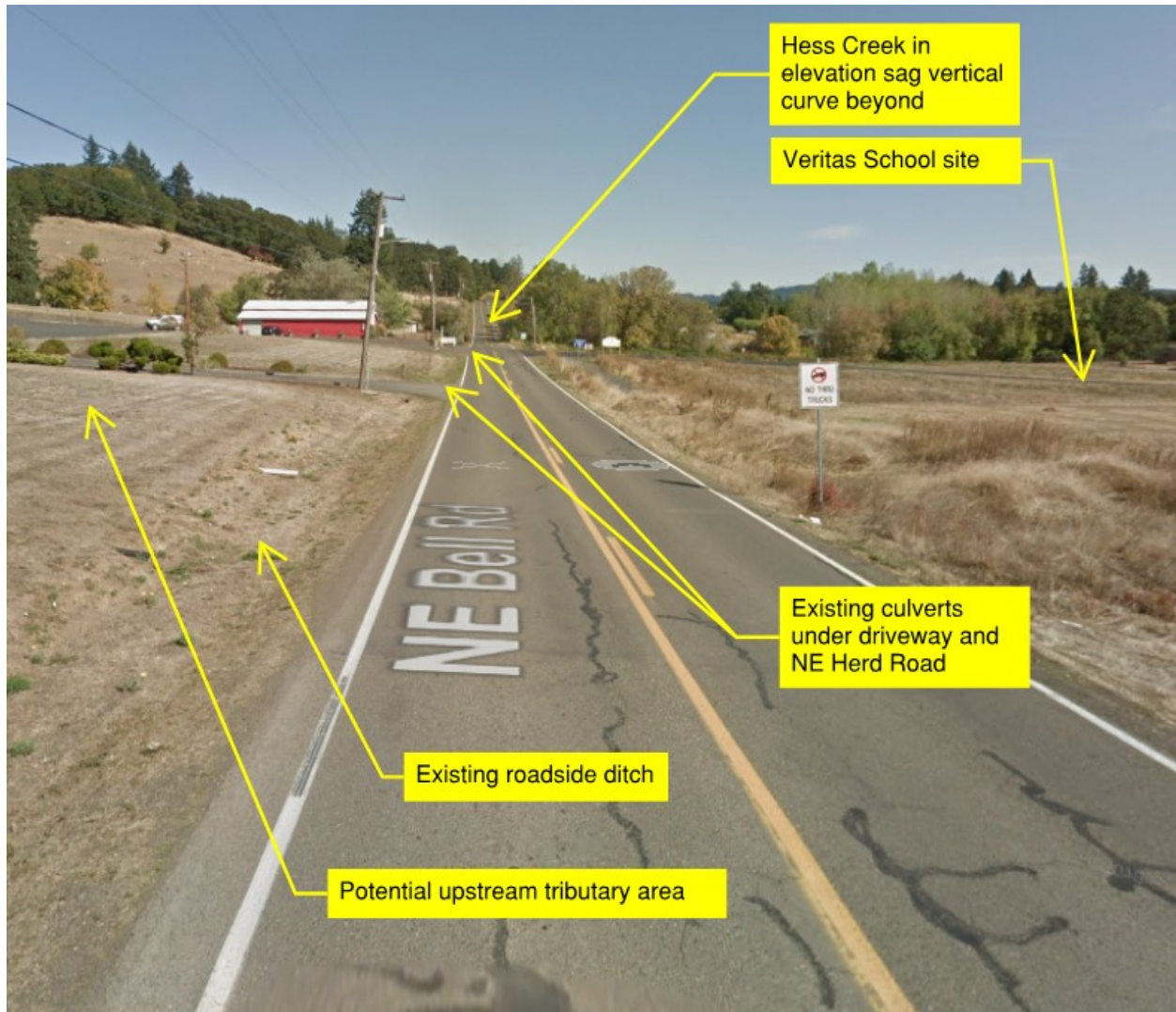
Table 2: Project Site 303(d) Listing Status of Receiving Water and 2-year Peak Flow

Project Site	Receiving Water	TMDL Pollutant
East Basin (E1)	Hess Creek	n/a
West Basin (E2)	Chehalem Creek	Dissolved oxygen; Temperature

UPSTREAM TRIBUTARY AREA:

Potential for upstream tributary area to discharge overland flow into the project area was assessed using visual observation and the USGS maps shown in Appendix B. An elevated hillside to the north of Bell Road has the potential to contribute overland flow into the school property, however a series of roadside ditches and culverts on the north side of Bell Road intercepts this flow and conveys it east towards Hess Creek (see Figure 2). These conveyances are assumed to intercept upstream flow before contributing to the Veritas site, and are therefore excluded from further analysis.

Figure 2: Upstream Tributary Area



CONTRIBUTING IMPERVIOUS AREA:

The project's contributing impervious area (CIA) are summarized in **Table 3** below. The CIA is limited to asphalt, concrete and roof areas within the site area shown in Appendix C.

Table 3: Contributing Impervious Area and Stormwater Treatment BMP by Sub-basin

Sub-basin ¹	Stormwater Quality BMP	Stormwater Quantity BMP	Pre-Project Impervious Area (acres)	Post-Project Impervious Area (acres)	Additional Impervious Area (acres)	Receiving Water
E1/P1	n/a	n/a	0.00	0.00	0.00	Hess Creek
E2/P2	Existing vegetated swale	Detention basin	0.00	1.67	1.67	Chehalem Creek
E2/P3	Existing vegetated swale	n/a	0.00	1.53 ²	1.53 ²	Chehalem Creek
E2/P4	n/a	n/a	0.00	0.00	0.00	Chehalem Creek

Totals = 0.00 3.20 3.20

STORMWATER MANAGEMENT PLAN NARRATIVE:

Treatment of stormwater from the CIA will be accomplished using Low Impact Development (LID) techniques including above ground detention and an existing vegetated swale.

The northeast corner of the site (Sub-basin E1/P1) remains undeveloped and is therefore excluded from stormwater management and further analysis. Future development plans for this basin include replacing the existing agricultural grasses with a soccer field, with similar stormwater runoff characteristics and no new impervious surfaces.

The primary development area consists of the following sub-basins:

- Sub-basin E2/P2 includes Phase 1 driveway and parking lot areas that will drain to a new detention basin. This detention area will function as an above ground stilling basin, providing qualitative opportunity for infiltration and evapotranspiration. Discharges from the new detention basin are directed to an existing vegetated swale for water quality treatment.

¹ Subbasin naming convention ‘E’ indicates a pre-development (or ‘existing’) project basin, while ‘P’ indicates a post-development (or ‘proposed’) project basin.

² Impervious area tabulations include future Phase 2 and Phase 3 improvements.

- Sub-basin E2/P3 includes Phase 1, Phase 2 and Phase 3 building roofs and walkways draining to lynch style catch basins. These inlets are conveyed to a below grade pipe system that outfalls to a new detention basin. Discharges from the new detention basin are directed to an existing vegetated swale for water quality treatment.
- Sub-basin E2/P4 includes the western half of the site that remains undeveloped. Future development plans for this basin include replacing the existing agricultural grasses with a baseball field and/or amphitheater, with similar stormwater runoff characteristics and no new impervious surfaces.

WATER QUALITY AND FLOW-CONTROL DESIGN STORMS:

The City’s D&CS Sections 4.5.1 and 4.8.5 flow determination requirements, including storm recurrence intervals and 24-hour rainfall depths. **Table 4** shows the design storm rainfall amounts, with supporting calculations contained in Appendix D. **Tables 5 and 6** summarizes the runoff results for the sub-basins and overall CIA.

Table 4: Design Storm Rainfall Data

Recurrence Interval	Precipitation (inches/24-hours)³
Water Quality (WQ)	1.00
50% of 2-year (50%)	1.25
2-year	2.50
5-year	3.00
10-year	3.50
25-year	4.00

Table 5: Pre-Developed Basin Peak Flow Summary (cfs)

Design Storm Event	Pervious Land Use	Sub-basin E2	Chehalem Creek Outfall
50%	Agricultural CN=80	0.15	0.15
2-Year		2.03	2.03
5-Year		3.16	3.16
10-Year		4.39	4.39
25-Year		5.70	5.70

³ Rainfall depths reported from City D&CS, Table 4.2.

Table 6: Post-Developed Basin Peak Flow Summary (cfs)

Design Storm Event	Pervious Land Use	Sub-basin P2	Sub-basin P3	Sub-basin P4	Chehalem Creek Outfall⁴
50%	Play Field CN=80	0.29	0.38	0.08	0.15
2-Year		1.38	0.93	1.10	1.28
5-Year		1.90	1.15	1.69	2.28
10-Year		2.44	1.36	2.34	3.51
25-Year		2.99	1.58	3.01	5.33

Table 7 summarizes the physical properties of the new detention basin necessary to provide the flow control performances summarized in Table 6.

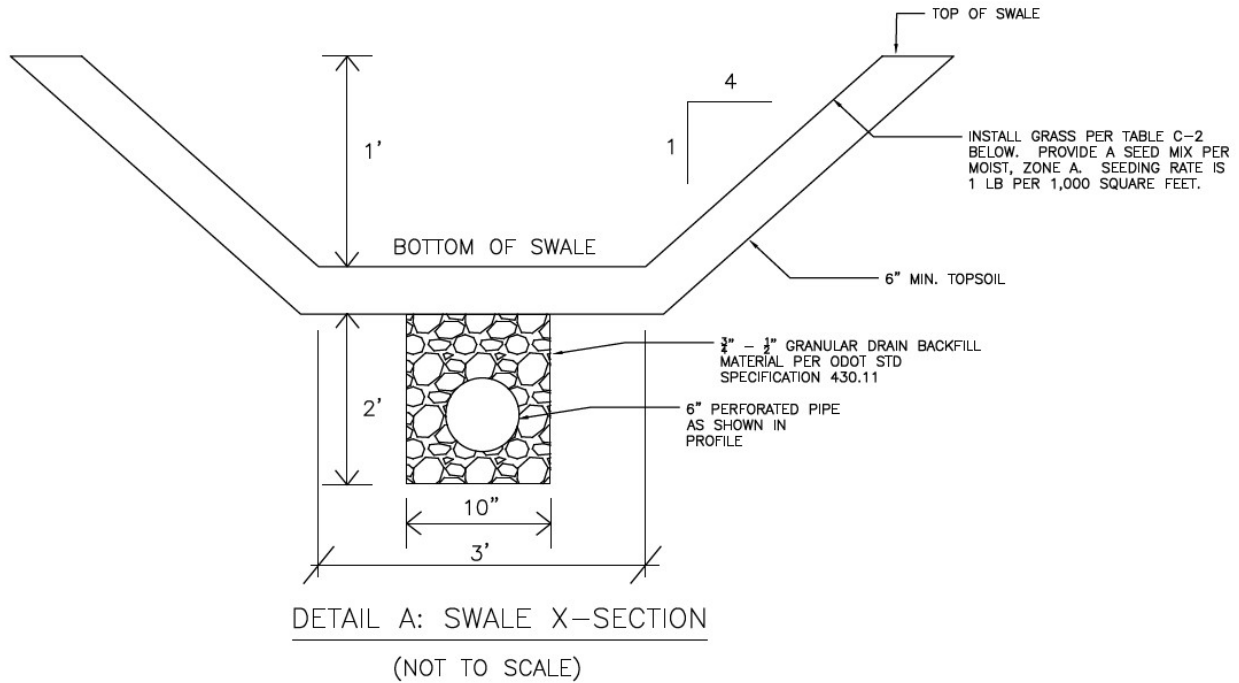
Detention Basin Property	Detention Basin Value
Base elevation	322.50 feet
Base area	11,460 sq.ft.
Basin side slopes	4 horizontal:1 vertical
Ditch inlet orifice diameter	2.9 inches
Ditch inlet orifice invert elevation	322.50 feet
Ditch inlet outlet diameter	12 inches
Ditch inlet rim elevation	323.17 feet
High flow bypass elevation	323.90 feet
High flow bypass width	5 feet
25-Year storm ponded water depth	17.4 inches
Top of embankment elevation	325.00 feet

TREATMENT CAPACITY, DIMENSIONS & DETAILS:

The water quality vegetated swale used to treat the CIA for this project is shown from prior construction drawings in **Figure 2** below.

⁴ Outfall includes detention effects of a new detention basin.

Figure 2: Vegetated Swale



A summary of the vegetated swales performance is provided in **Table 8** below.

Table 8: BMP Water Quality Flow Rates and Volumes

Drainage Segment	WQDS peak (cfs)	Runoff Velocity (ft/s)		Slope	Length (ft)	Width (ft)	WQDS Residence Time (min)
		WQDS	25-Year				
Vegetated Swale	0.11	0.10	1.02	2.0%	100	3	16.7

WQDS – water quality design storm
 cfs – cubic feet per second
 cf – cubic feet

min – minutes
 ft – feet
 s – seconds

BMP EFFECTIVENESS:

Table 3 of the Stormwater Treatment Program – ODOT BMP Selection Tool indicates the key treatment mechanisms for a water quality vegetated swale are sorption and filtration. Associated treatment mechanisms for a water quality vegetated swale are hydraulic attenuation, density separation, uptake/storage, and microbial transformation. The water quality vegetated swale will have a high capability to remove suspended solids and particulate metals; and a moderate capability to remove nutrients, oil and grease, polycyclic aromatic hydrocarbons, and dissolved metals.

Prior construction drawings indicate the vegetated swale omits the 12-inches of topsoil and concrete level spreaders as specified by City Standard Drawing No. 460, however the facility does exceed the minimum residence time of 9 minutes by nearly 185%. As a result, these omissions are not anticipated to compromise the swales overall water quality performance.

OPERATION SUMMARY:

Basin Flow Routing:

Flow routes for each project improvement are summarized below. Since the increase in runoff from each improvement reported at the property outfall in **Table 6** comprises a negligible impact to the existing discharge flows presented in **Table 5**, the downstream conveyance capability of each receiving water is unaffected by the proposed project.

- Sub-basin P2 – This basin consists of pavement runoff from the access driveway and parking lot serving the project area. A ditch collects runoff along the east side of the driveway and drains south towards the parking lot where a new culvert is required to transfer drainage to a new detention basin (see Appendix C). This runoff will be managed to mimic pre-development conditions by a new detention basin before eventually reaches Chehalem Creek.
- Sub-basin P3 – This basin contains the building area and courtyard of the school site, which drains to existing catch basins serving a centralized underground piped conveyance system. This runoff will be managed to mimic pre-development conditions by a new detention basin before eventually reaches Chehalem Creek.
- Sub-basin P4 – This basin consists of vegetated landscaped areas, and is anticipated to remain landscaped into the future, potentially serving as a baseball field or amphitheater. Drainage bypasses the new detention basin and vegetated swale serving sub-basins P2 and P3, and eventually reaches Chehalem Creek.

High Flow Operation:

During high flow events, the vegetated swale will function like conventional open channel drainage conveyances and transport runoff downstream as noted in the flow routes section above. There is ample adjacent open area to convey flows should the swales' capacity become limited by debris.

A high flow bypass channel is required in the detention basin embankment (see **Table 7**) to facilitate controlled overtopping. Since the velocity through the opening in the embankment as relatively low (around 0.5 feet per second) during the 25-year storm, establish grass vegetation is anticipated as sufficient to control erosion through the bypass. Erosion control measures are likely necessary prior to plant establishment to provide slope stability following construction.

Downstream Analysis:

The downstream system was assessed for approximately 1/4 mile south of the property. Once drainage leaves the vegetated swale, it flows southwesterly via an 18-inch diameter pipe where it continues via open channel conveyance towards Highway 219 (see **Figure 4**).

Figure 4: Swale Discharge Channel



From there, drainage follows a roadside ditch paralleling Highway 219 (see Figure 5), before turning southbound the traversing an open area (see Figure 6). Due to dense brush, the nature of the flow path leaving the Highway 219 should be unknown, however assumed to retain an open channel configuration in route to Chehalem Creek.

Figure 5: Highway 219 Open Channel Conveyance



Figure 6: Conveyance Route to Chehalem Creek



MAINTENANCE PLAN:

Responsible Party:

School staff are responsible to provide oversight during project construction and ensure that the water quality and stormwater management elements of the project are properly constructed in accordance with City requirements. After construction, School maintenance staff are responsible to review the stormwater facilities at intervals that facilitate continued functionality.

Routine Maintenance Actions and Schedule:

Specific maintenance recommendations are as follows:

- General maintenance of vegetated areas, including the new detention basin, see Table 1 in Appendix E.
- Maintenance of vegetated swales, see Table 1 and Table 3 in Appendix E.

- Complete annual inspection and maintenance of each facility as defined in the Operations, Maintenance, Contingency & Repair Plan in Appendix E.

Contingency and repair plan:

In the event of hazardous material spills, crashes, or uprooted or fallen trees, inspect stormwater facilities for contamination or damage. Repair or reconstruct these facilities to conform to original design intent. Handle and dispose of contaminated materials using only approved methods, equipment, and sites.

CONCLUSION:

Stormwater treatment on this project will achieve pollutant removal to the maximum extent practicable by treating runoff from 100% of the CIA with vegetated swales. Flow control is realized through a new detention basin, so that pre-development runoff characteristics are mimicked in the post-development condition.

Remedial activity is necessary to bring Phase 1 development into compliance with City drainage standards. Those remedial improvements are anticipated to accompany Phase 2 development and are described in Appendix C – Retrofit Strategy.

APPENDIX LIST

APPENDIX A: DEVELOPMENT PLANS

- C000 Cover Sheet
- C401 Power Plan
- C420 Storm Plan
- C421 Storm Profiles

APPENDIX B: MAPS

- NRCS Soil Survey
- USGS Receiving Waters

APPENDIX C: BASINS AND RETROFIT STRATEGY

- Pre-Development Basin Map
- Post-Development Basin Map
- Retrofit Strategy

APPENDIX D: STORMWATER CALCULATIONS

APPENDIX E: OPERATIONS, MAINTENANCE, CONTINGENCY & REPAIR PLAN

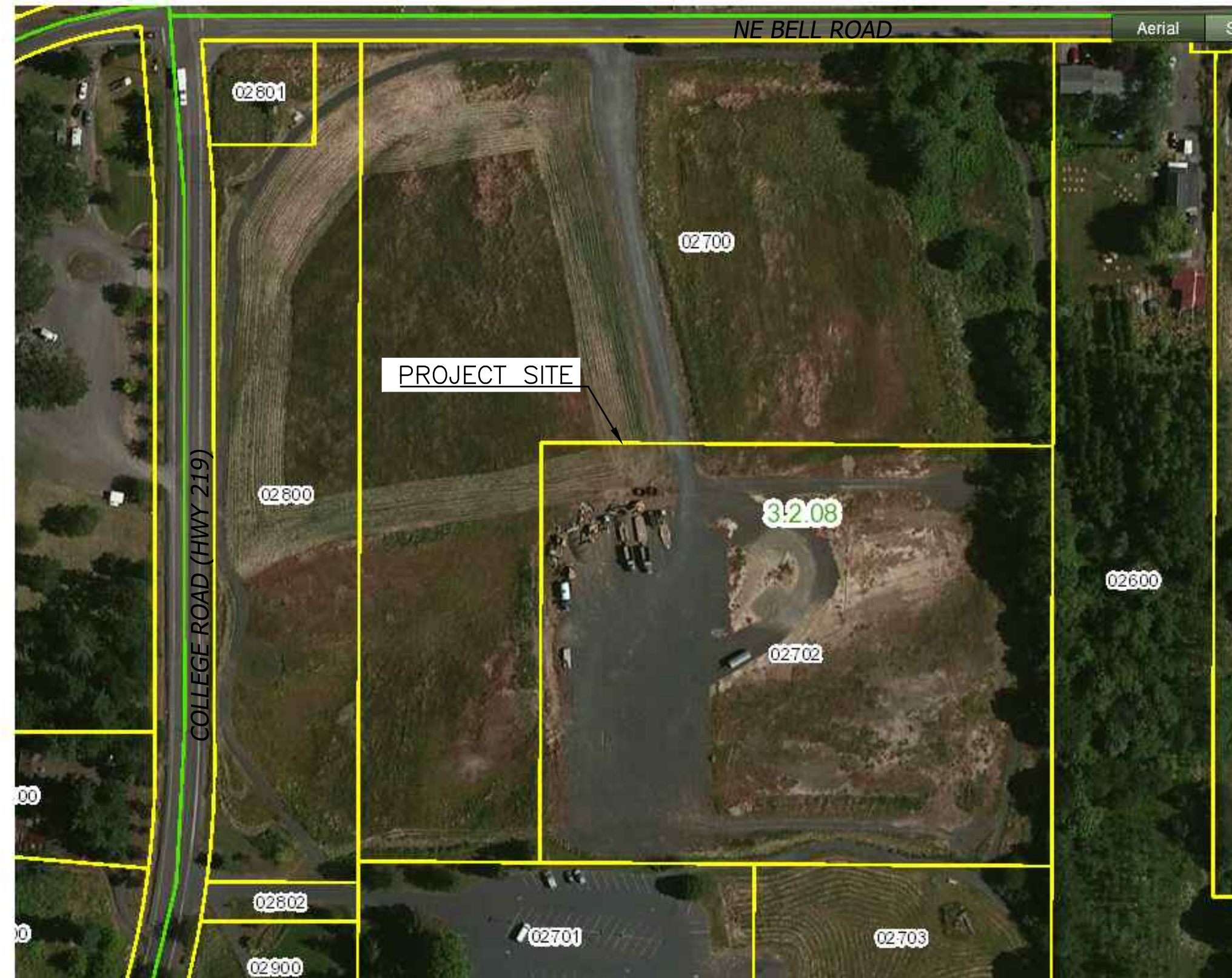
APPENDIX A
DEVELOPMENT PLANS

VERITAS SCHOOL SITE DEVELOPMENT

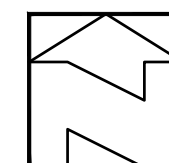
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NEWBERG, OREGON 97132



VICINITY MAP
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SITE MAP
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SHEET INDEX

Sheet Number	Sheet Title
C000	COVER SHEET
C001	CONSTRUCTION NOTES
C200	SITE PLAN
C300	GRADING & PAVING PLAN
C400	COMPOSITE UTILITY PLAN
C401	POWER PLAN
C420	STORM PLAN
C421	STORM PROFILES
C720	DETAILS
C721	DETAILS
C722	DETAILS

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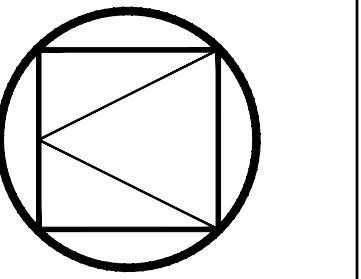
CLAIR COMPANY
595 NW 2ND ST. #3
CORVALLIS, OR 97330
541-758-1302

VERITAS SCHOOL SITE DEVELOPMENT
NEWBERG, OREGON
COVER SHEET
26500 NE BELL ROAD NEWBERG, OR 97132



RENEWAL: 6/30/2018

MSS INC
ENGINEERING CONSULTANTS
AND PLANNERS
215 NW 4th STREET
CORVALLIS, OR 97330
(541) 753-1320 FAX: (541) 753-5956



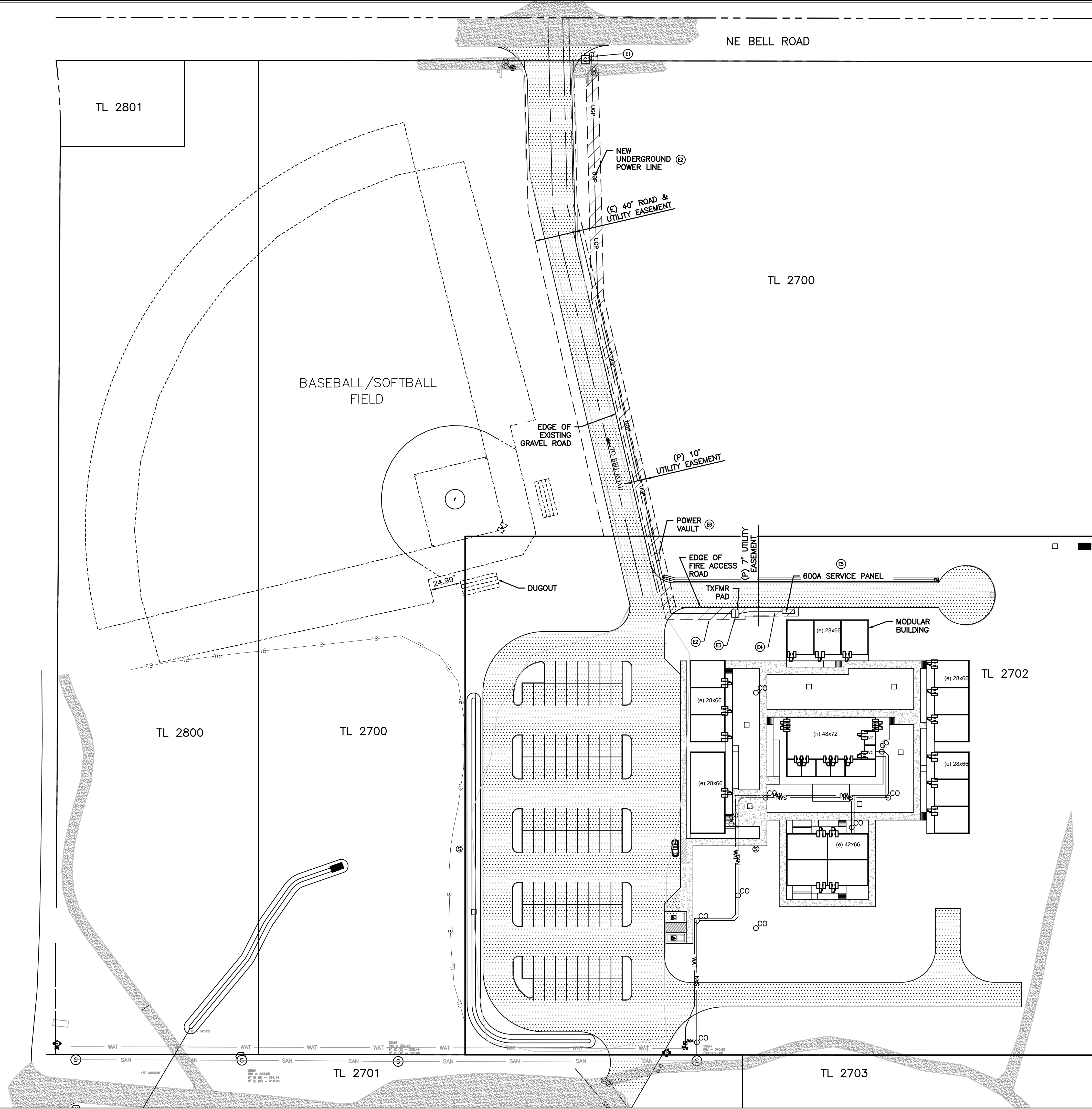
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C000
1 OF 11 SHEETS

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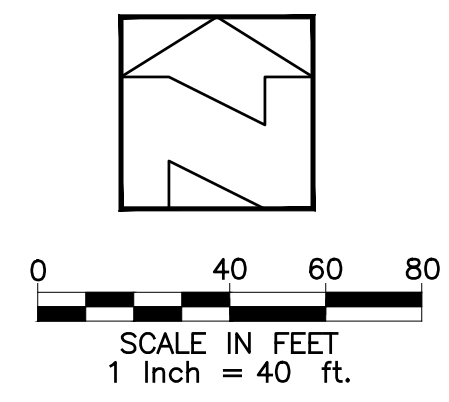
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ELECTRICAL NOTES

- ALL ELECTRICAL NOTES AND CONDUIT LOCATIONS ARE FOR COORDINATION PURPOSES ONLY. VERIFY ALL WIRING CONNECTIONS, SIZES AND REQUIREMENTS WITH THE ELECTRICAL PLANS PRIOR TO CONSTRUCTION. IN THE EVENT OF ANY CONFLICT THE REQUIREMENTS NOTED ON THE ELECTRICAL PLANS SHALL APPLY.
 - ADHERE TO PGE DTL 6/C721 FOR BACKFILL, MATERIAL AND CLEARANCES.
- E1 NEW DROP ON EXISTING POWER POLE ALONG BELL ROAD. CONTRACTOR TO COORDINATE. SEE SHEET C401.
- E2 PROVIDE TRENCHING, BACKFILL & CONDUIT FOR PRIMARY UNDERGROUND FEED PER UTILITY'S REQUIREMENTS. PROVIDE PULL STRING.
- E3 PROVIDE & INSTALL TRANSFORMER VAULT PER UTILITY REQUIREMENTS. INSTALL BOLLARDS PER DTL 1/C721 AS SHOWN. PROVIDE ADEQUATE CLEARANCES FOR TRANSFORMER PER PGE DTL 7/C721. TRANSFORMER SHALL BE 5' (MIN) FROM DRIVING SURFACES OR HAVE FIXED & REMOVABLE BOLLARDS INSTALLED PER PGE REQ'S.
- E4 PROVIDE & INSTALL TRENCHING, BACKFILL & CONDUIT FOR SECONDARY UNDERGROUND FEED PER UTILITY'S REQUIREMENTS. PROVIDE PULL STRING.
- E5 600A SERVICE PANEL PER ELECTRICAL PLANS
- E6 PROVIDE & INSTALL SECTIONALIZING POWER VAULT PER UTILITY REQUIREMENTS.



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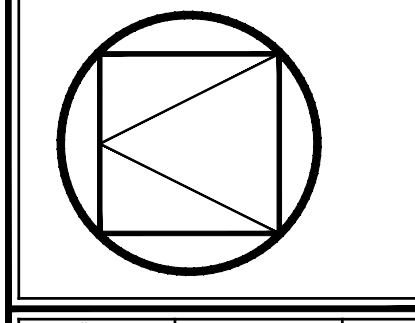
VERITAS SCHOOL SITE DEVELOPMENT
NEWBERG, OREGON

POWER PLAN

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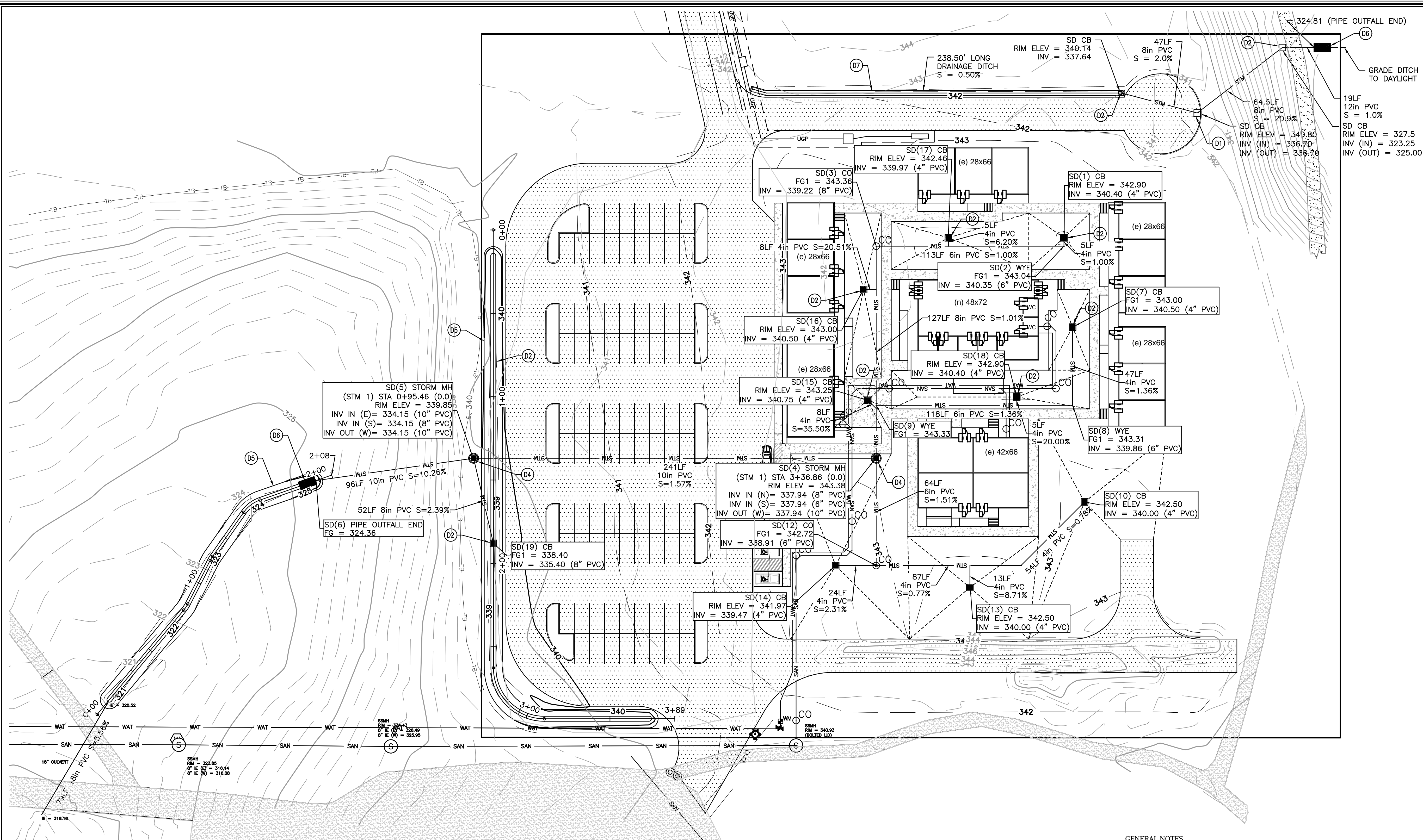
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C401
 # 6 OF 11 SHEETS

BUILDING PERMIT SET

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**VERITAS SCHOOL SITE DEVELOPMENT
 NEWBERG, OREGON
 STORM PLAN**

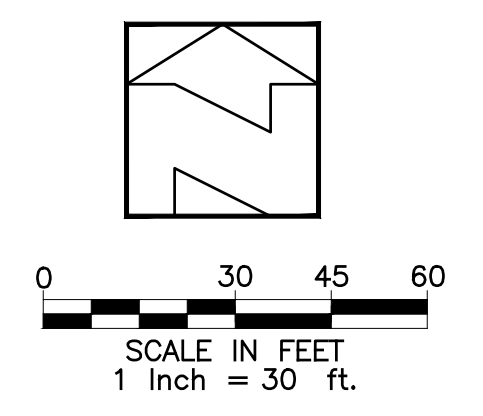
REGISTERED PROFESSIONAL ENGINEER
 PETER J. SEABERS
 RENEWAL: 6/30/2018

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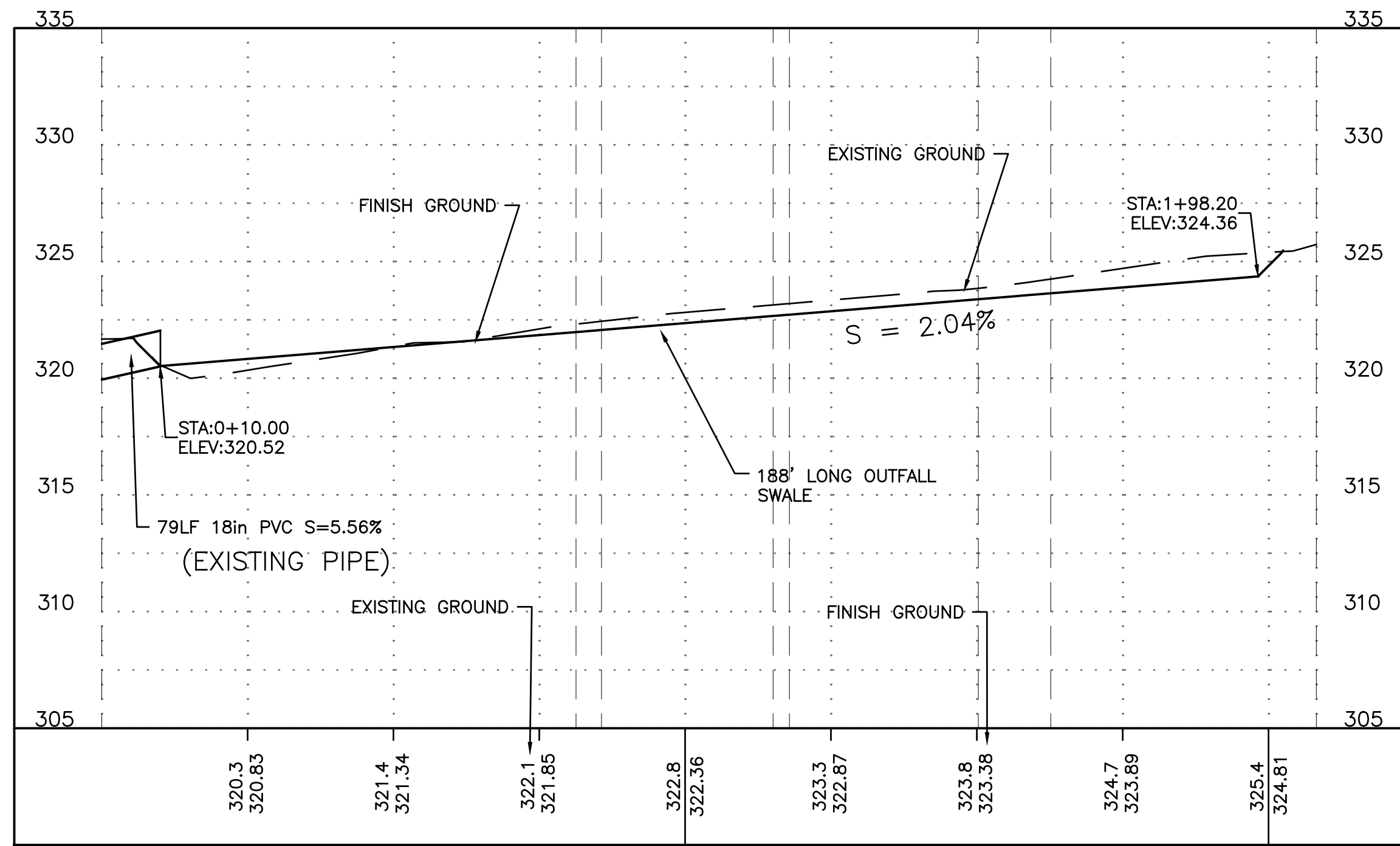
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	CENTERLINE
	EASEMENT LINES
	BUILDING
	CURB
	SIDWALK
	FENCE
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	SANITARY SEWER
	STORM DRAIN LINE
	OVERHEAD POWER
	UNDERGROUND POWER
	RETAINING WALL
	PROPOSED PAVING
	PROPERTY CORNER
	CONTROL POINT
	STORM MANHOLE
	STORM CATCHBASIN
	STORM/SEWER CLEANOUT
	FLOW DIRECTION ARROW
	STORM CULVERT END
	SEWER MANHOLE
	WATER METER
	CONCRETE PAVING
	ASPHALT PAVING
	GRAVEL SURFACE
	EXISTING MAJOR CONTOURS
	EXISTING MINOR CONTOURS
	MAJOR CONTOURS
	MINOR CONTOURS
	WATER VALVE
	WATER METER
	POWER/UTILITY POLE
	STREET LIGHT
	STREET SIGN
	GAS VALVE
	GAS METER
	TEL/COMM PED/RISER

- GENERAL NOTES**
- PROVIDE TRENCH BACKFILL PER CITY OF NEWBERG STD. DRAWING 201A.
 - PROVIDE PIPE BEDDING PER CIT OF NEWBERG STD. DRAWING 201B.
 - ALL PLUMBING SHALL BE INSTALLED IN ACCORDANCE WITH IPC REQUIREMENTS. PROVIDE ADDITIONAL CLEANOUTS (NOT SHOWN) ON SEWER & STORM LINES AT 100' MAX SPACING OR FOR EVERY 135' OF PIPE BENDS.
 - CONNECT BUILDING RAIN DRAINS TO COLLECTOR LINES AS REQUIRED. NOT SHOWN.
- STORM NOTES**
- D1 CONSTRUCT TRAPPED LYNCH STYLE BASIN WITH CONCRETE COLLAR PER DETAIL ON C720.
 - D2 CONSTRUCT TRAPPED LYNCH STYLE BASIN WITHOUT CONCRETE COLLAR PER DETAIL ON C720.
 - D3 CONSTRUCT CLEANOUTS PER CITY OF NEWBERG STD. DRAWING 210
 - D4 CONSTRUCT STANDARD STORMWATER MANHOLE PER CITY OF NEWBERG STD. DRAWING 204.
 - D5 CONSTRUCT DRAINAGE SWALE. SEE DETAIL "A" SHEET C421 FOR PROFILE AND X-SECTION DETAIL. INSTALL MINIMUM 6 INCH TOPSOIL BEDDING. SEED SWALE PER TABLE C-2.
 - D6 CONSTRUCT 10' LONG x 5' WIDE x 2.3' DEEP RIPRAP PAD PER CITY OF NEWBERG STD DRAWING 422. USE CLASS 50 RIPRAP.
 - D7 CONSTRUCT DRAINAGE DITCH. SEE DETAIL "B" SHEET C421 FOR X-SECTION DETAIL. LINE DRAINAGE DITCH WITH 6 INCHES OF 3 INCH CRUSHED AGGREGATE

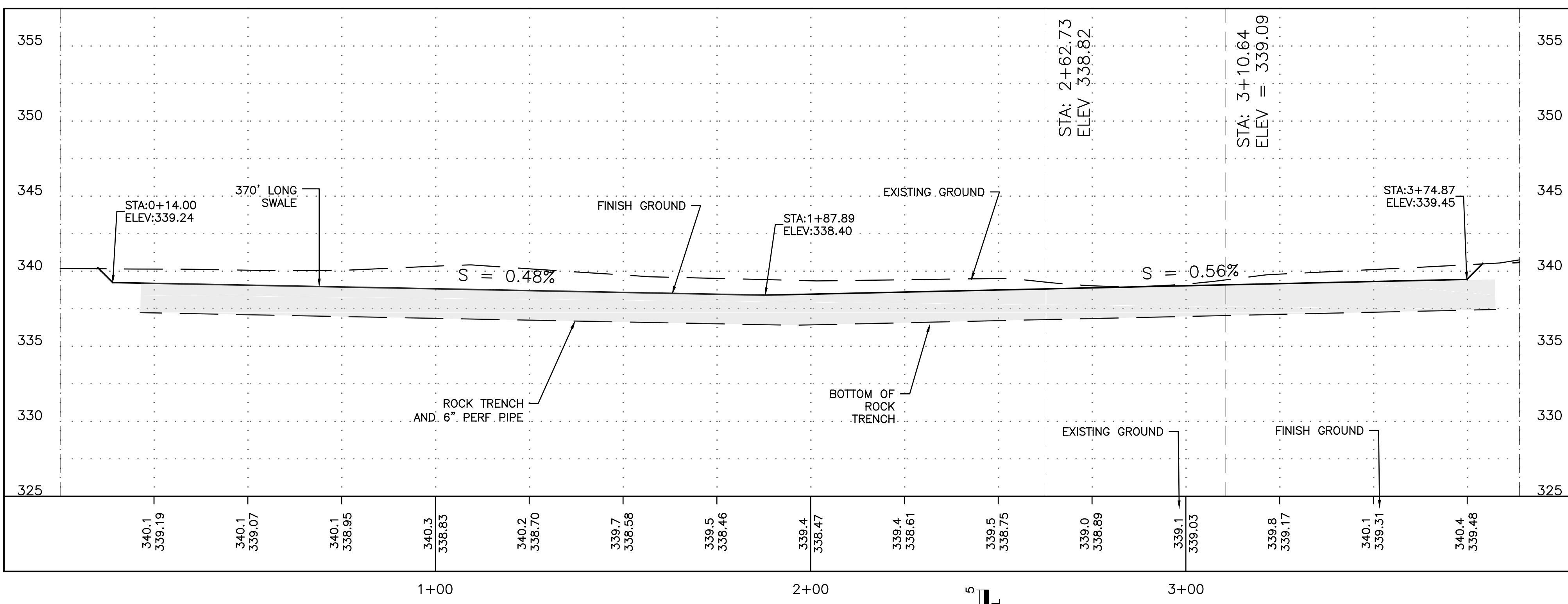
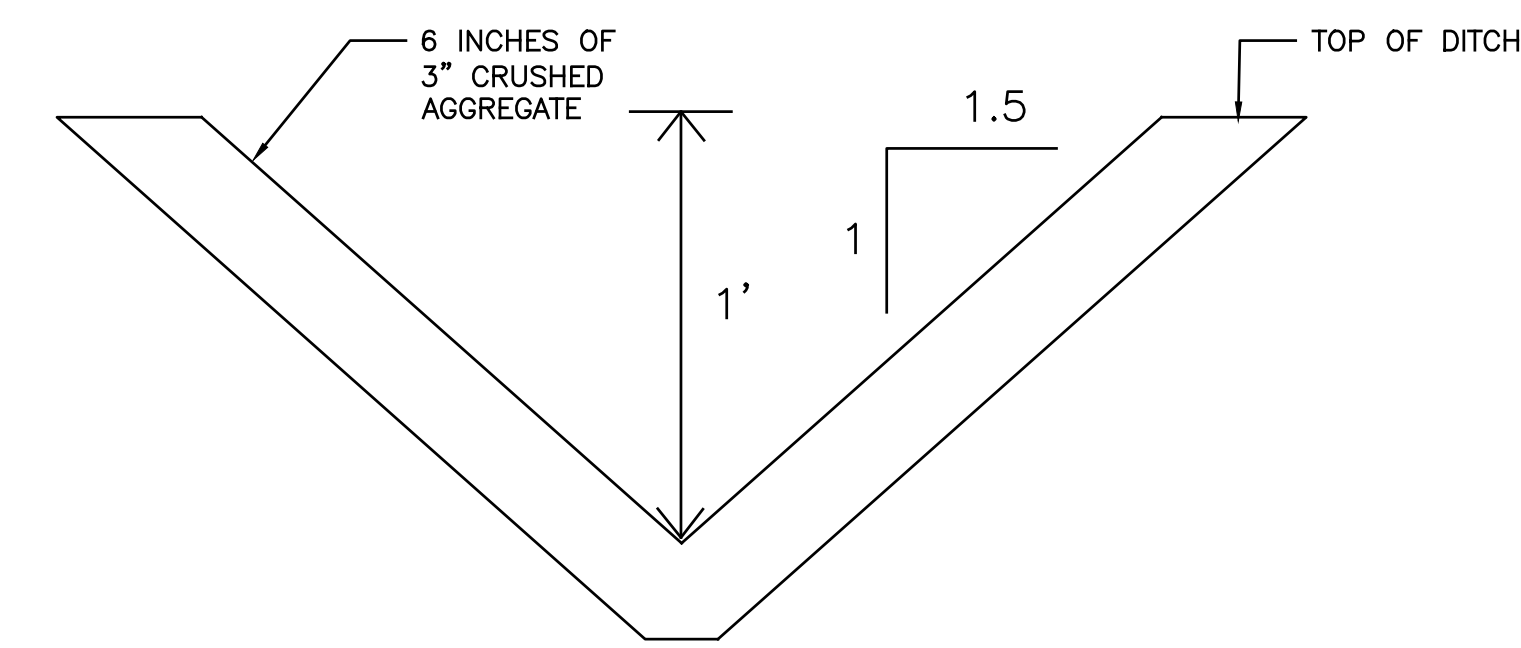
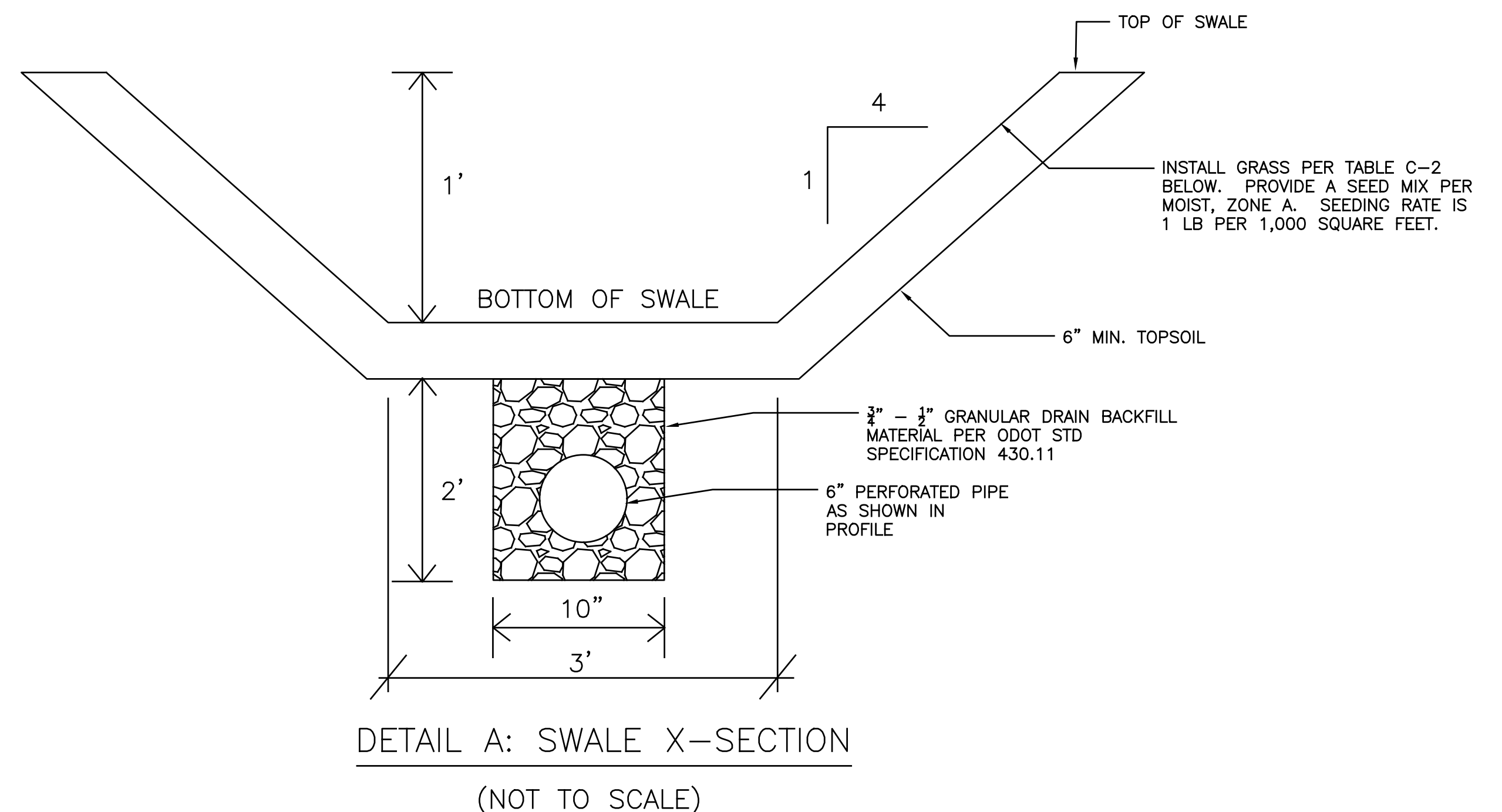
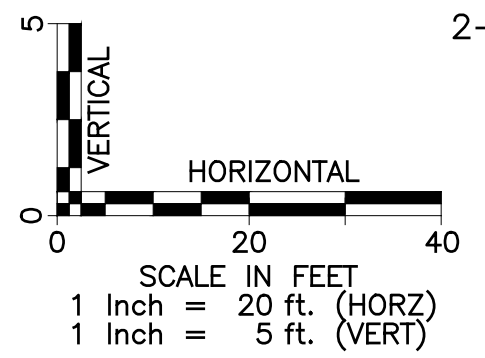


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BUILDING PERMIT SET



outfall swale
 STA 0+00 TO STA 2+08.20
 VERT SCALE FACTOR: 4.0



parking lot swale_longitudinal
 STA 0+00 TO STA 3+88.87
 VERT SCALE FACTOR: 4.0

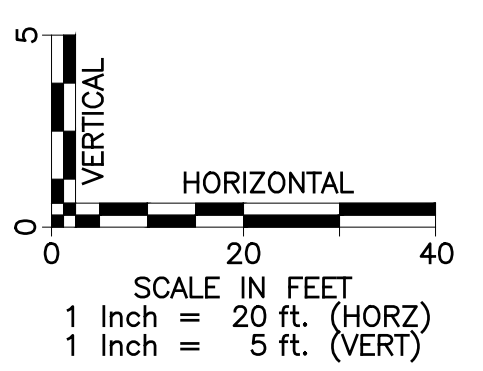


TABLE C-2: Seed Mixture Specifications

Saturated, Zone S			
Saturated Zone: Mix 1	Botanical Name	Common Name	% by Weight
	Carex obnupta	Slough Sedge	27.00%
	Carex microptera	Smallwing Sedge	25.00%
	Carex stipata	Awlfruit Sedge	29.50%
	Eleocharis palustris	Common Spikerush	15.00%
	Scirpus microcarpus	Panicled Bulrush	3.00%
	Juncus tenuis	Poverty Rush	0.50%
Moist, Zone A			
Moist Zone: Mix 1	Botanical Name	Common Name	% by Weight
	Elymus glaucus	Blue Wildrye	46.00%
	Festuca rubra rubra	Native Red Fescue	38.00%
	Deschampsia cespitosa	Tufted Hairgrass	12.00%
	Glyceria occidentalis	Western Mannagrass	2.00%
	Beckmania syzigachne	American Sloughgrass	2.00%
Moist Zone: Mix 2	Botanical Name	Common Name	% by Weight
	Elymus glaucus	Blue Wildrye	50.00%
	Festuca rubra rubra	Native Red Fescue	15.00%
	Hordeum brachyantherum	Meadow Barley	10.00%
	Glyceria occidentalis	Western Mannagrass	10.00%
	Beckmania syzigachne	American Sloughgrass	10.00%
	Deschampsia cespitosa	Tufted Hairgrass	5.00%
Moist Zone: Mix 3	Botanical Name	Common Name	% by Weight
	Hordeum brachyantherum	Meadow Barley	35.00%
	Glyceria occidentalis	Western Mannagrass	20.00%
	Festuca rubra rubra	Native Red Fescue	20.00%
	Alopecurus geniculatus	Water Foxtail	13.00%
	Eleocharis palustris	Common Spikerush	5.00%
	Beckmania syzigachne	American Sloughgrass	4.00%
	Deschampsia cespitosa	Tufted Hairgrass	2.50%
	Agrostis exarata	Spike Bentgrass	0.50%
Dry, Zone B and Upland Landscaping Areas			
Dry Zone: Mix 1	Botanical Name	Common Name	% by Weight
	Hordeum brachyantherum	Meadow Barley	40.00%
	Bromus carinatus	California Brome	35.00%
	Festuca rubra rubra	Native Red Fescue	20.00%
	Deschampsia cespitosa	Tufted Hairgrass	3.00%
	Agrostis exarata	Spike Bentgrass	2.00%

CLAIR COMPANY
 595 NW 2ND ST. #3
 CORVALLIS, OR 97330
 541-758-1302

VERITAS SCHOOL SITE DEVELOPMENT
 NEWBERG, OREGON
 STORM PROFILES
 26500 NE BELL ROAD NEWBERG, OR 97132



MSS INC
 ENGINEERING CONSULTANTS
 AND PLANNERS
 215 NW 4th STREET
 CORVALLIS, OR 97330
 (541) 753-1320 FAX: (541) 753-5956

JOB # 17001 FILE STORM DRAW AS
 SCALE AS SHOWN DATE 06.12.17

C421
 # 8 OF 11 SHEETS

6/13/2017 9:37:44 AM X:\17001\CIVIL\STORM.DWG SAVED ON 6/13/2017

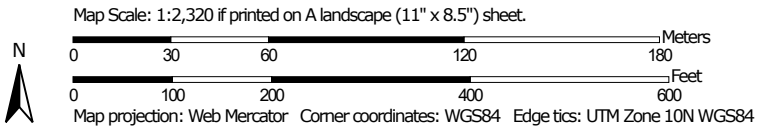
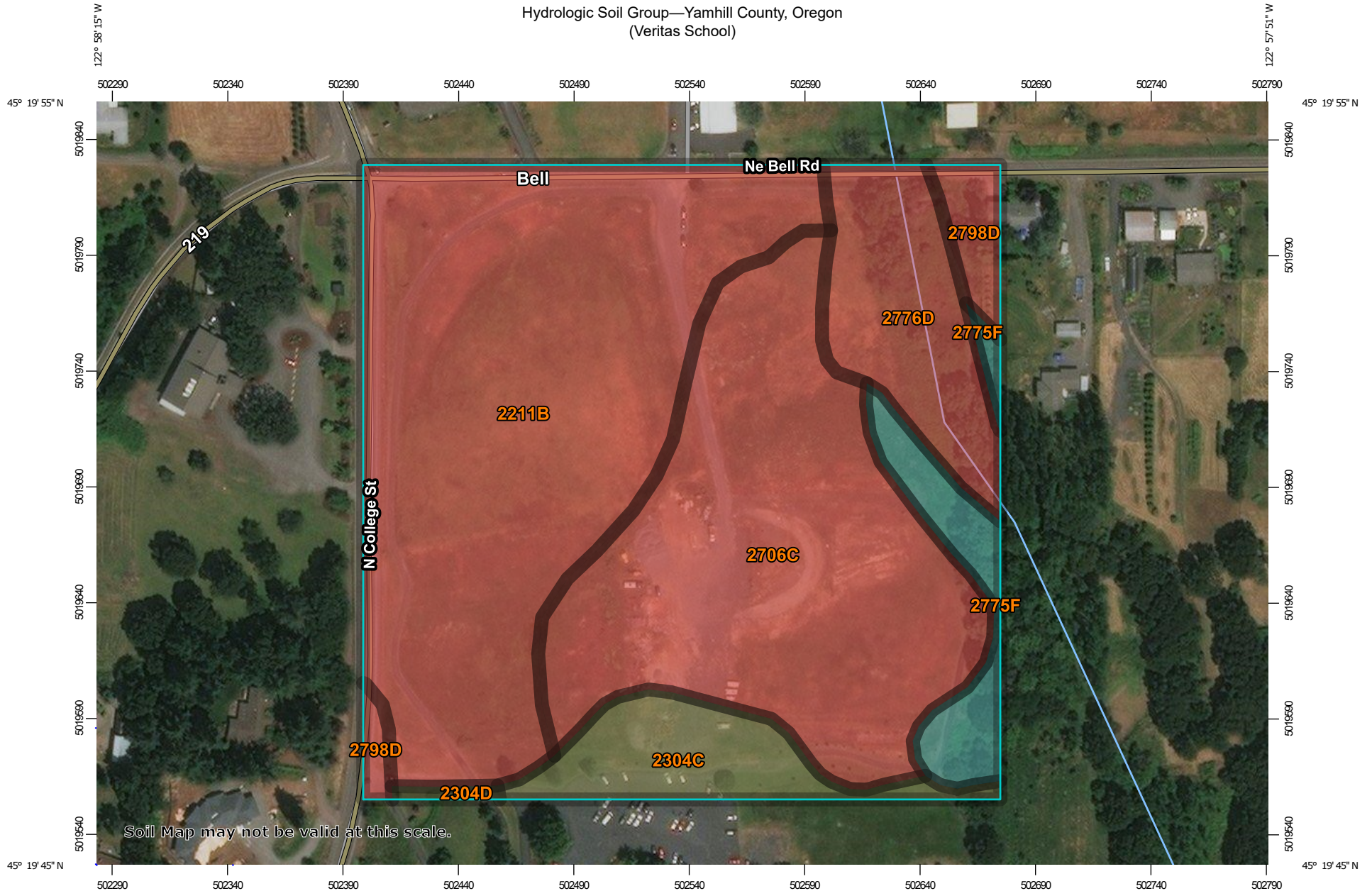
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BUILDING PERMIT SET

APPENDIX B

MAPS

Hydrologic Soil Group—Yamhill County, Oregon
(Veritas School)



MAP LEGEND

Area of Interest (AOI)









 Area of Interest (AOI)

Soils

Soil Rating Polygons





 A
 A/D
 B
 B/D
 C
 C/D
 D
 Not rated or not available

Soil Rating Lines


 A
 A/D
 B
 B/D
 C
 C/D
 D
 Not rated or not available

Soil Rating Points






 A
 A/D
 B
 B/D

 C
 C/D
 D
 Not rated or not available


Water Features

 Streams and Canals

Transportation

 Rails
 Interstate Highways
 US Routes
 Major Roads
 Local Roads

Background

 Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Yamhill County, Oregon
 Survey Area Data: Version 6, Sep 18, 2018

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

Date(s) aerial images were photographed: Aug 19, 2015—Sep 13, 2016

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.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
2211B	Cove silty clay loam, 3 to 8 percent slopes	D	8.1	43.2%
2304C	Carlton silt loam, 2 to 12 percent slopes	C/D	1.2	6.7%
2304D	Carlton silt loam, 12 to 20 percent slopes	C/D	0.1	0.3%
2706C	Hazelair silty clay loam, 2 to 12 percent slopes	D	6.2	32.9%
2775F	Saum-Ritner complex, 30 to 75 percent slopes	C	0.9	4.9%
2776D	Panther-Witham complex, hummocky, 2 to 25 percent slopes	D	1.7	9.3%
2798D	Witham silty clay loam, hummocky, 2 to 25 percent slopes	D	0.5	2.6%
Totals for Area of Interest			18.8	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

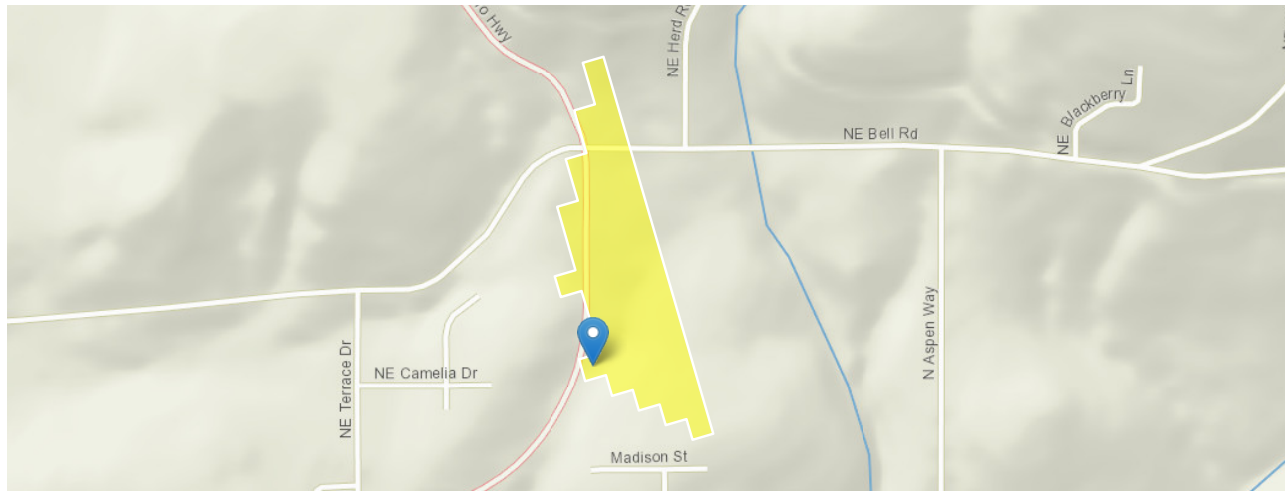
Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Chehalem Creek: StreamStats Report

Region ID:
 Workspace ID:
 Clicked Point (Latitude, Longitude):
 Time:

OR
 OR20190908123723925000
 45.32934, -122.96914
 2019-09-08 05:37:39 -0700



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.0195	square miles
I24H2Y	Maximum 24-hour precipitation that occurs on average once in 2 years - Equivalent to precipitation intensity index	1.99	inches
SOILPERM	Average Soil Permeability	0.53	inches per hour
JANMAXT2K	Mean Maximum January Temperature from 2K resolution PRISM 1961-1990 data	45.1	degrees F
WATCAPORC	Available water capacity from STATSGO data using methods from SIR 2005-5116	0.15	inches
ORREG2	Oregon Region Number	10001	dimensionless
BSLOPD	Mean basin slope measured in degrees	3.16	degrees
JANMINT2K	Mean Minimum January Temperature from 2K resolution PRISM PRISM 1961-1990 data	32.7	degrees F
ELEV	Mean Basin Elevation	341	feet

Peak-Flow Statistics Parameters^[Reg 2B Western Interior LT 3000 ft Cooper]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.0195	square miles	0.37	7270
BSLOPD	Mean Basin Slope degrees	3.16	degrees	5.62	28.3
I24H2Y	24 Hour 2 Year Precipitation	1.99	inches	1.53	4.48
ELEV	Mean Basin Elevation	341	feet		
ORREG2	Oregon Region Number	10001	dimensionless		

Peak-Flow Statistics Disclaimers^[Reg 2B Western Interior LT 3000 ft Cooper]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report^[Reg 2B Western Interior LT 3000 ft Cooper]

Statistic	Value	Unit
2 Year Peak Flood	0.811	ft ³ /s
5 Year Peak Flood	1.18	ft ³ /s
10 Year Peak Flood	1.44	ft ³ /s
25 Year Peak Flood	1.77	ft ³ /s
50 Year Peak Flood	2.02	ft ³ /s
100 Year Peak Flood	2.27	ft ³ /s
500 Year Peak Flood	2.86	ft ³ /s

Peak-Flow Statistics Citations

Cooper, R.M.,2005, Estimation of Peak Discharges for Rural, Unregulated Streams in Western Oregon: U.S. Geological Survey Scientific Investigations Report 2005-5116, 76 p. (<http://pubs.usgs.gov/sir/2005/5116/pdf/sir2005-5116.pdf>)

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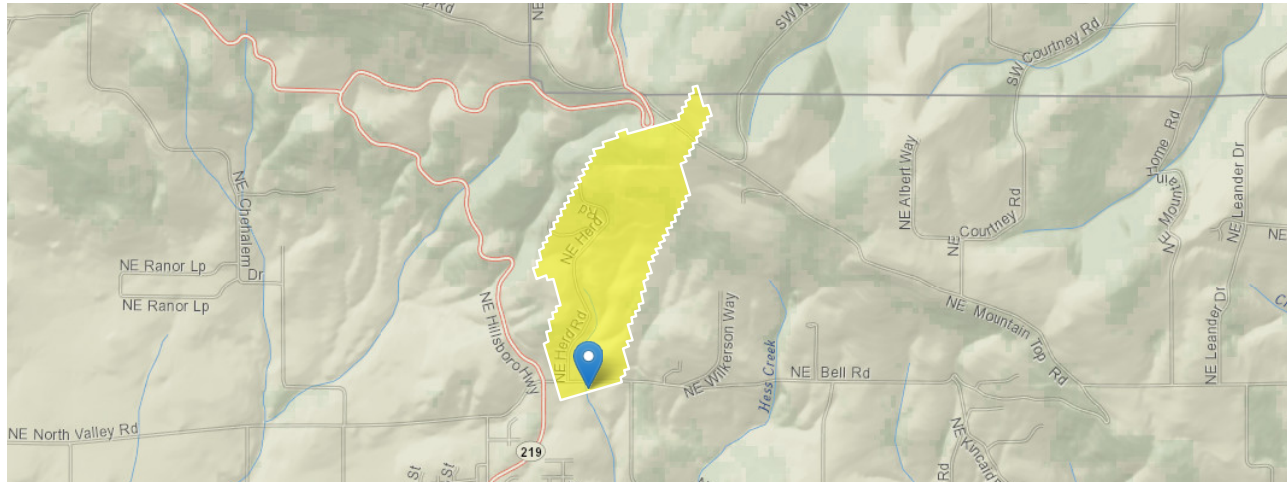
USGS Product Names Disclaimer: Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Application Version: 4.3.8

Hess Creek Tributary: StreamStats Report

Region ID:
 Workspace ID:
 Clicked Point (Latitude, Longitude):
 Time:

OR
 OR20190908123357715000
 45.33149, -122.96663
 2019-09-08 05:34:13 -0700



Basin Characteristics			
Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.31	square miles
I24H2Y	Maximum 24-hour precipitation that occurs on average once in 2 years - Equivalent to precipitation intensity index	2.09	inches
SOILPERM	Average Soil Permeability	0.86	inches per hour
JANMAXT2K	Mean Maximum January Temperature from 2K resolution PRISM 1961-1990 data	45	degrees F
WATCAPORC	Available water capacity from STATSGO data using methods from SIR 2005-5116	0.18	inches
ORREG2	Oregon Region Number	10001	dimensionless
BSLOPD	Mean basin slope measured in degrees	9.54	degrees
JANMINT2K	Mean Minimum January Temperature from 2K resolution PRISM PRISM 1961-1990 data	32.6	degrees F
ELEV	Mean Basin Elevation	719	feet

Peak-Flow Statistics Parameters <small>[Reg 2B Western Interior LT 3000 ft Cooper]</small>					
Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.31	square miles	0.37	7270
BSLOPD	Mean Basin Slope degrees	9.54	degrees	5.62	28.3
I24H2Y	24 Hour 2 Year Precipitation	2.09	inches	1.53	4.48
ELEV	Mean Basin Elevation	719	feet		
ORREG2	Oregon Region Number	10001	dimensionless		

Peak-Flow Statistics Disclaimers[Reg 2B Western Interior LT 3000 ft Cooper]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report[Reg 2B Western Interior LT 3000 ft Cooper]

Statistic	Value	Unit
-----------	-------	------

Statistic	Value	Unit
2 Year Peak Flood	17.1	ft ³ /s
5 Year Peak Flood	25.2	ft ³ /s
10 Year Peak Flood	30.7	ft ³ /s
25 Year Peak Flood	37.6	ft ³ /s
50 Year Peak Flood	42.8	ft ³ /s
100 Year Peak Flood	47.9	ft ³ /s
500 Year Peak Flood	59.8	ft ³ /s

Peak-Flow Statistics Citations

Cooper, R.M.,2005, Estimation of Peak Discharges for Rural, Unregulated Streams in Western Oregon: U.S. Geological Survey Scientific Investigations Report 2005-5116, 76 p. (<http://pubs.usgs.gov/sir/2005/5116/pdf/sir2005-5116.pdf>)

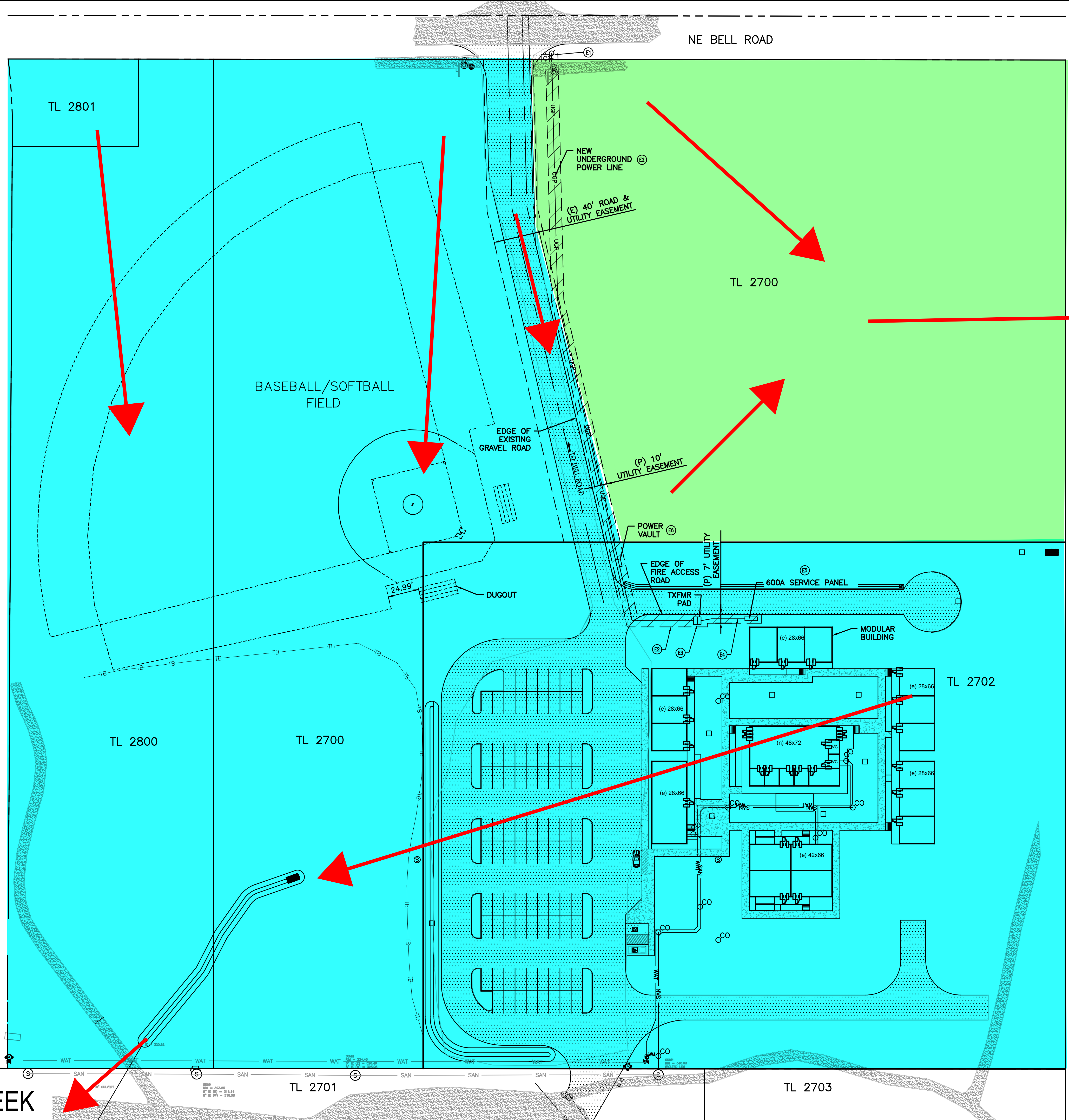
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Application Version: 4.3.8

APPENDIX C
BASINS AND RETROFIT STRATEGY

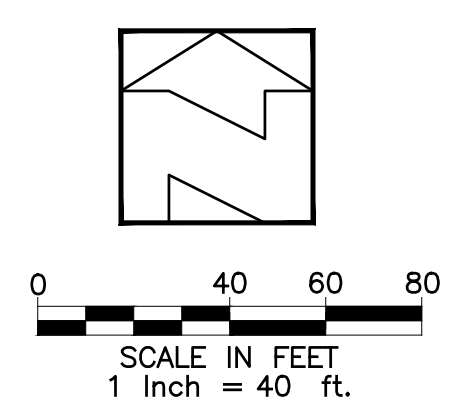


TO CHEHALEM CREEK

TO HESS CREEK

EAST BASIN (OR E1)

WEST BASIN (OR E2)



VERITAS SCHOOL SITE DEVELOPMENT
NEWBERG, OREGON

PRE-DEVELOPMENT BASIN MAP

26500 NE BELL ROAD NEWBERG, OR 97132

DATE	
BY	
REVISIONS	

INSTALL NEW 12" CULVERT TO DRAIN WEST

EXCAVATE NEW DETENTION BASIN WITH FLAT BOTTOM AREA OF 11,460 SF AND ELEVATION OF 322.50. IMPOUND DRAINAGE WITH EMBANKMENT AT TOP ELEVATION OF 325.00, AND HIGH FLOW BYPASS OF 5' WIDTH AT ELEVATION 323.90 FEET.

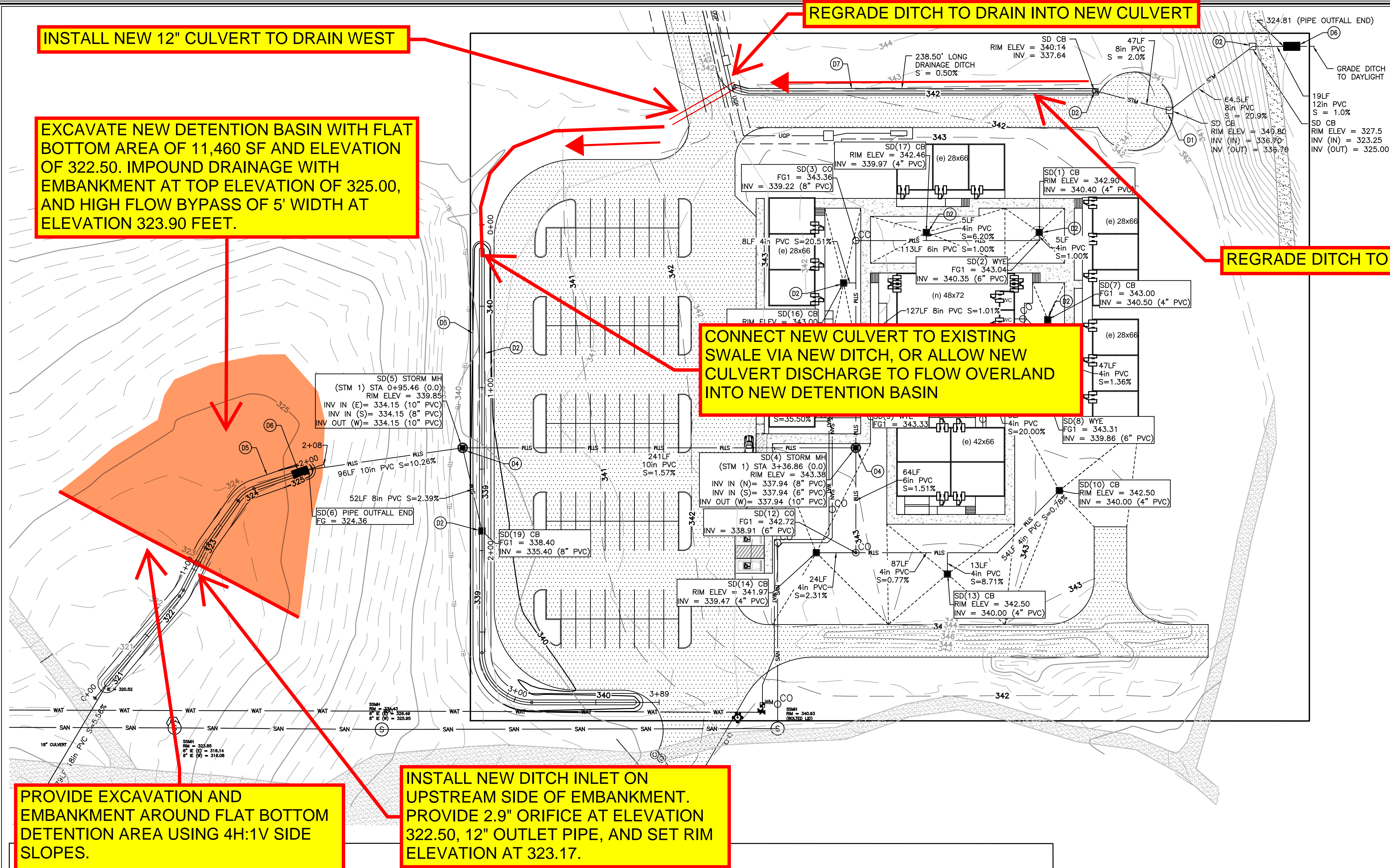
REGRADE DITCH TO DRAIN INTO NEW CULVERT

REGRADE DITCH TO DRAIN WEST

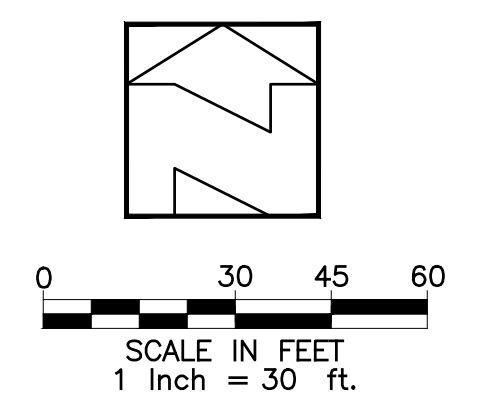
CONNECT NEW CULVERT TO EXISTING SWALE VIA NEW DITCH, OR ALLOW NEW CULVERT DISCHARGE TO FLOW OVERLAND INTO NEW DETENTION BASIN

PROVIDE EXCAVATION AND EMBANKMENT AROUND FLAT BOTTOM DETENTION AREA USING 4H:1V SIDE SLOPES.

INSTALL NEW DITCH INLET ON UPSTREAM SIDE OF EMBANKMENT. PROVIDE 2.9" ORIFICE AT ELEVATION 322.50, 12" OUTLET PIPE, AND SET RIM ELEVATION AT 323.17.



	PROPERTY BOUNDARY		PROPERTY CORNER		CONCRETE PAVING		WATER VALVE
	ADJACENT PROPERTY LINES		CONTROL POINT		ASPHALT PAVING		WATER METER
	CENTERLINE		STORM MANHOLE		GRAVEL SURFACE		POWER/UTILITY POLE
	EASEMENT LINES		STORM CATCHBASIN		EXISTING MAJOR CONTOURS		STREET LIGHT
	BUILDING		STORM/SEWER CLEANOUT		EXISTING MINOR CONTOURS		STREET SIGN
	CURB		FLOW DIRECTION ARROW		MAJOR CONTOURS		GAS VALVE
	SIDWALK		STORM CULVERT END		MINOR CONTOURS		GAS METER
	FENCE		SEWER MANHOLE				TEL/COMM PED/RISER
	WATERLINE		WATER METER				
	SANITARY SEWER						
	STORM DRAIN LINE						
	OVERHEAD POWER						
	UNDERGROUND POWER						
	RETAINING WALL						
	PROPOSED PAVING						



VERITAS SCHOOL SITE DEVELOPMENT
NEWBERG, OREGON

RETROFIT STRATEGY

26500 NE BELL ROAD NEWBERG, OR 97132

DATE	
BY	
REVISIONS	

APPENDIX D
STORMWATER CALCULATIONS

Project Description

File Name 20190920-Model.SPF

Project Options

Flow Units CFS
 Elevation Type Elevation
 Hydrology Method SCS TR-55
 Time of Concentration (TOC) Method SCS TR-55
 Link Routing Method Hydrodynamic
 Enable Overflow Ponding at Nodes YES
 Skip Steady State Analysis Time Periods YES

Analysis Options

Start Analysis On Sep 21, 2019 00:00:00
 End Analysis On Sep 23, 2019 00:00:00
 Start Reporting On Sep 21, 2019 00:00:00
 Antecedent Dry Days 0 days
 Runoff (Dry Weather) Time Step 0 01:00:00 days hh:mm:ss
 Runoff (Wet Weather) Time Step 0 00:05:00 days hh:mm:ss
 Reporting Time Step 0 00:05:00 days hh:mm:ss
 Routing Time Step 1 seconds

Number of Elements

Qty
 Rain Gages 1
 Subbasins..... 5
 Nodes..... 8
 Junctions 4
 Outfalls 3
 Flow Diversions 0
 Inlets 0
 Storage Nodes 1
 Links..... 7
 Channels 3
 Pipes 4
 Pumps 0
 Orifices 0
 Weirs 0
 Outlets 0
 Pollutants 0
 Land Uses 0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	Rain Gage-01	Time Series	TS-50%	Intensity	inches	Oregon	Yamhill	1	1.25	SCS Type IA 24-hr

Subbasin Summary

SN	Subbasin ID	Area	Total Runoff	Total Runoff Volume	Peak Runoff
		(ac)	(in)	(ac-in)	(cfs)
1	E1/P1	2.97	0.17	0.51	0.04
2	E2_E3_E4	12.74	0.17	2.20	0.15
3	P2	4.46	0.36	1.61	0.29
4	P3	1.72	0.86	1.48	0.38
5	P4	6.56	0.17	1.13	0.08

Node Summary

SN Element ID	Element Type	Invert Elevation	Ground/Rim (Max) Elevation	Initial Water Elevation	Surcharge Elevation	Ponded Area	Peak Inflow	Max HGL Elevation Attained	Max Surcharge Depth Attained	Min Freeboard Attained	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded	
		(ft)	(ft)	(ft)	(ft)	(ft²)	(cfs)	(ft)	(ft)	(ft)	(days hh:mm)	(ac-in)	(min)	
1	REV-Swale-End	Junction	320.52	330.00	320.52	330.00	12.00	0.15	321.09	0.00	8.91	0 00:00	0.00	0.00
2	REV-Swale-Start	Junction	322.50	330.00	322.50	330.00	12.00	0.15	322.59	0.00	7.41	0 00:00	0.00	0.00
3	SD(5)	Junction	334.15	339.85	334.15	340.00	12.00	0.38	334.31	0.00	5.54	0 00:00	0.00	0.00
4	SD(6)	Junction	324.36	330.00	324.36	330.00	12.00	0.66	324.40	0.00	5.60	0 00:00	0.00	0.00
5	Out-PRE-East	Outfall	325.00					0.04	325.00					
6	Out-PRE-West	Outfall	316.16					0.15	316.16					
7	Out-REV-POST-West	Outfall	316.16					0.15	316.25					
8	Det-Basin	Storage Node	322.50	326.00	322.50		12.00	0.66	323.17			0.00	0.00	

Link Summary

SN Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
1	Ditch-Inlet	Pipe Det-Basin	REV-Swale-Start	5.00	323.17	322.50	13.4000	12.000	0.0150	0.00	11.30	0.00	0.01	0.05	0.05	0.00	Calculated
2	Orifice	Pipe Det-Basin	REV-Swale-Start	5.00	322.50	322.50	0.0000	2.900	0.0130	0.15	0.01	13.43	4.54	0.17	0.69	0.00	> CAPACITY
3	REV-Swale-Discharge	Pipe REV-Swale-End	Out-REV-POST-West	68.56	321.00	316.16	7.0600	18.000	0.0150	0.15	24.19	0.01	3.78	0.09	0.06	0.00	Calculated
4	SD5_SD6	Pipe SD(5)	SD(6)	96.00	334.15	324.36	10.2000	10.000	0.0130	0.38	7.00	0.05	10.06	0.10	0.12	0.00	Calculated
5	HF_Bypass	Channel Det-Basin	REV-Swale-Start	5.00	323.90	322.50	28.0000	24.000	0.0320	0.00	263.60	0.00	0.00	0.05	0.02	0.00	
6	Link-22	Channel SD(6)	Det-Basin	5.00	324.36	322.50	37.2000	60.000	0.0320	0.66	995.36	0.00	1.63	0.34	0.07	0.00	
7	REV-Swale	Channel REV-Swale-Start	REV-Swale-End	100.00	322.50	320.52	1.9800	18.000	0.2400	0.15	31.07	0.00	0.11	0.33	0.22	0.00	

Subbasin Hydrology

Subbasin : E1/P1

Input Data

Area (ac) 2.97
 Weighted Curve Number 80.00
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pasture, grassland, or range, Good	2.97	D	80.00
Composite Area & Weighted CN	2.97		80.00

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8}) / ((P^{0.5}) * (S_f^{0.4})))$$

Where :

T_c = Time of Concentration (hr)
 n = Manning's roughness
 L_f = Flow Length (ft)
 P = 2 yr, 24 hr Rainfall (inches)
 S_f = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (S_f^{0.5}) (unpaved surface)
 V = 20.3282 * (S_f^{0.5}) (paved surface)
 V = 15.0 * (S_f^{0.5}) (grassed waterway surface)
 V = 10.0 * (S_f^{0.5}) (nearly bare & untilled surface)
 V = 9.0 * (S_f^{0.5}) (cultivated straight rows surface)
 V = 7.0 * (S_f^{0.5}) (short grass pasture surface)
 V = 5.0 * (S_f^{0.5}) (woodland surface)
 V = 2.5 * (S_f^{0.5}) (forest w/heavy litter surface)
 T_c = (L_f / V) / (3600 sec/hr)

Where:

T_c = Time of Concentration (hr)
 L_f = Flow Length (ft)
 V = Velocity (ft/sec)
 S_f = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^{2/3}) * (S_f^{0.5})) / n
 R = A_q / W_p
 T_c = (L_f / V) / (3600 sec/hr)

Where :

T_c = Time of Concentration (hr)
 L_f = Flow Length (ft)
 R = Hydraulic Radius (ft)
 A_q = Flow Area (ft²)
 W_p = Wetted Perimeter (ft)
 V = Velocity (ft/sec)
 S_f = Slope (ft/ft)
 n = Manning's roughness

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.24	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.5	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	16.14	0.00	0.00

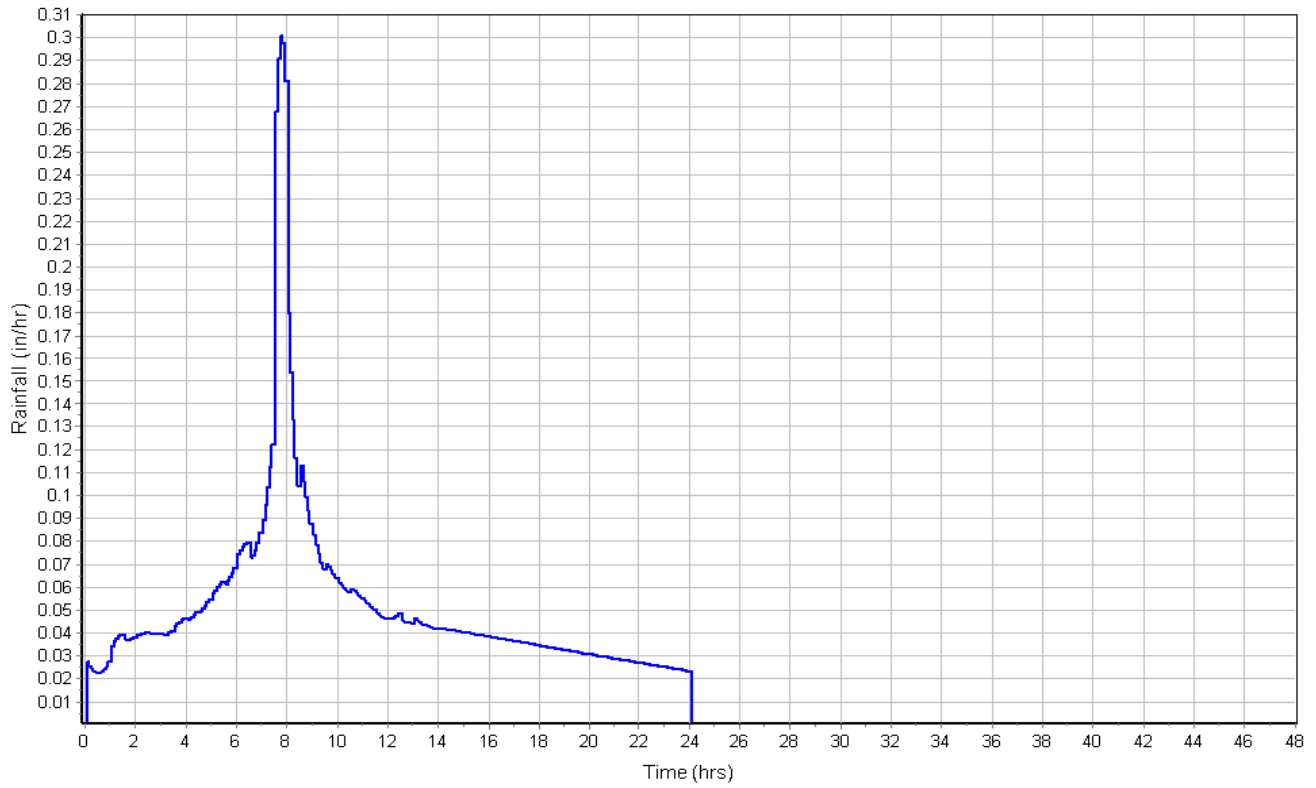
Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	200	0.00	0.00
Slope (%) :	2	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	2.28	0.00	0.00
Computed Flow Time (min) :	1.46	0.00	0.00
Total TOC (min)	17.61		

Subbasin Runoff Results

Total Rainfall (in)	1.25
Total Runoff (in)	0.17
Peak Runoff (cfs)	0.04
Weighted Curve Number	80.00
Time of Concentration (days hh:mm:ss)	0 00:17:37

Subbasin : E1/P1

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : E2_E3_E4

Input Data

Area (ac) 12.74
 Weighted Curve Number 80.00
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pasture, grassland, or range, Good	12.74	D	80.00
Composite Area & Weighted CN	12.74		80.00

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.24	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	3	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.5	0.00	0.00
Velocity (ft/sec) :	0.12	0.00	0.00
Computed Flow Time (min) :	13.73	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
	Flow Length (ft) :	500	0.00
Slope (%) :	3	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	2.79	0.00	0.00
Computed Flow Time (min) :	2.99	0.00	0.00

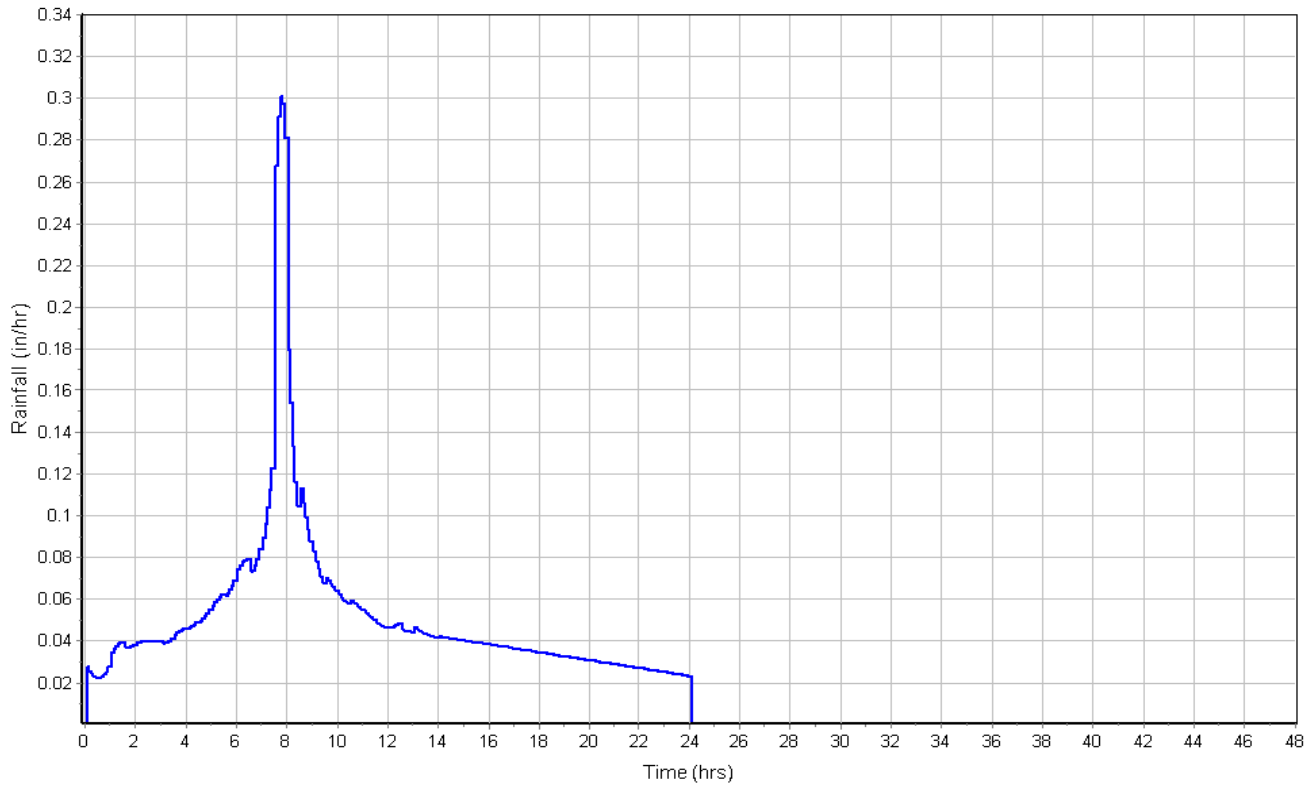
Channel Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.24	0.00
Flow Length (ft) :	300	0.00	0.00
Channel Slope (%) :	3	0.00	0.00
Cross Section Area (ft²) :	12	0.00	0.00
Wetted Perimeter (ft) :	12	0.00	0.00
Velocity (ft/sec) :	1.08	0.00	0.00
Computed Flow Time (min) :	4.65	0.00	0.00
Total TOC (min)	21.36		

Subbasin Runoff Results

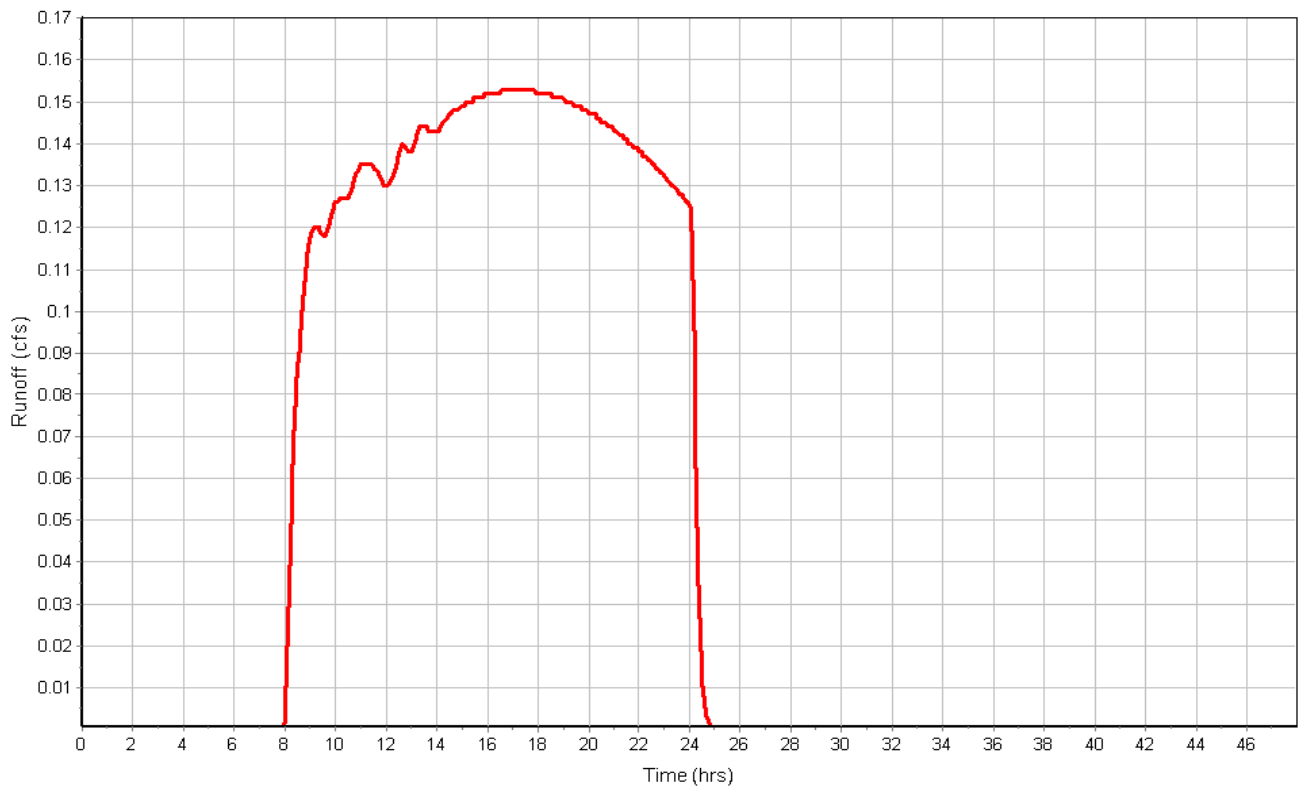
Total Rainfall (in) 1.25
 Total Runoff (in) 0.17
 Peak Runoff (cfs) 0.15
 Weighted Curve Number 80.00
 Time of Concentration (days hh:mm:ss) 0 00:21:22

Subbasin : E2_E3_E4

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : P2

Input Data

Area (ac) 4.46
 Weighted Curve Number 86.74
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	1.67	-	98.00
-	2.79	-	80.00
Composite Area & Weighted CN	4.46		86.74

Time of Concentration

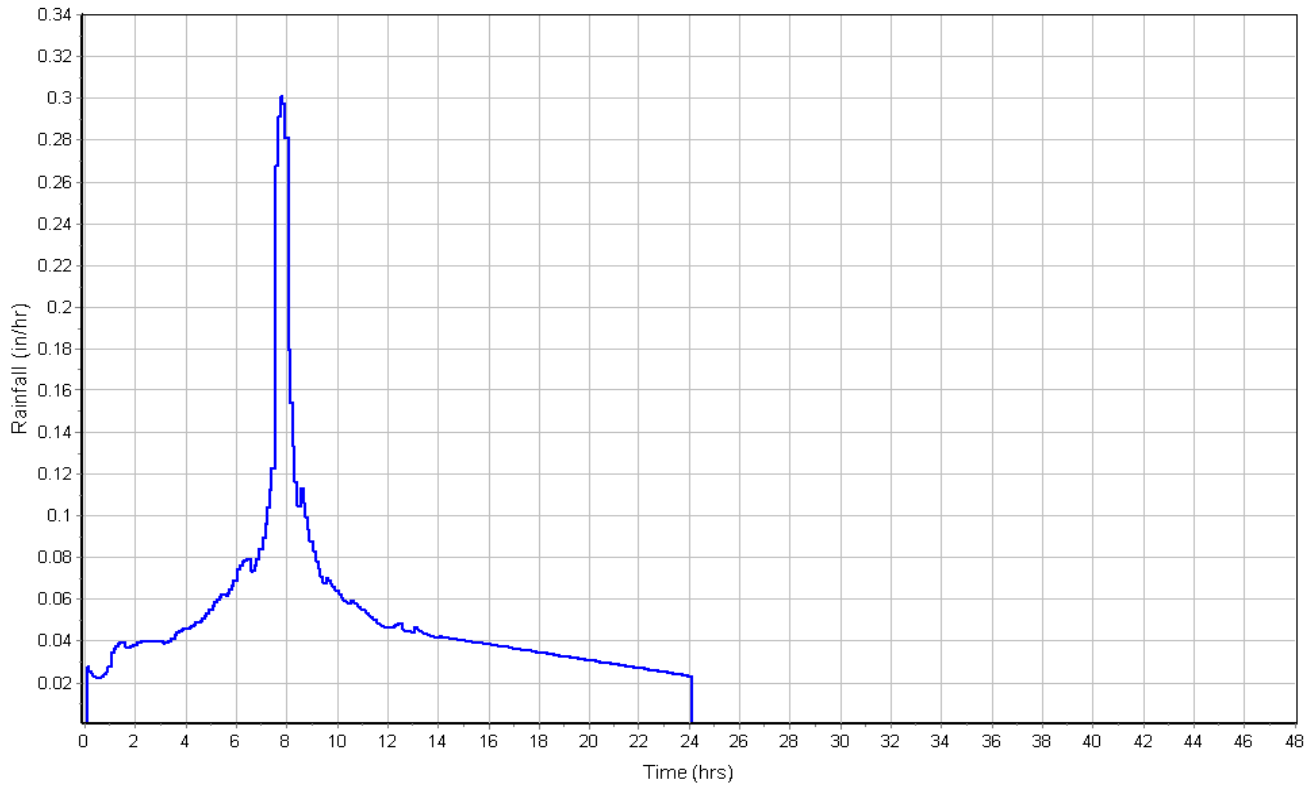
User-Defined TOC override (minutes): 5

Subbasin Runoff Results

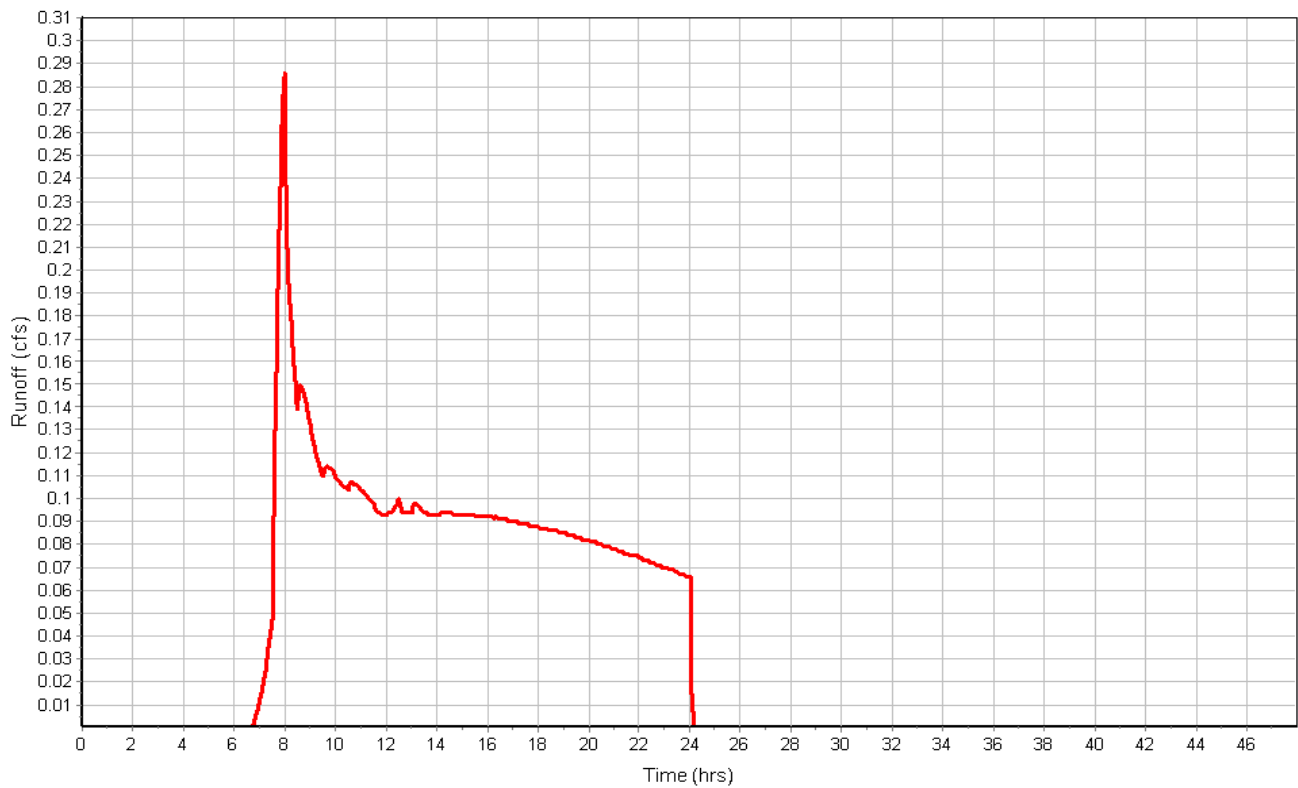
Total Rainfall (in) 1.25
 Total Runoff (in) 0.36
 Peak Runoff (cfs) 0.29
 Weighted Curve Number 86.74
 Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : P2

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : P3

Input Data

Area (ac) 1.72
 Weighted Curve Number 96.01
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	1.53	-	98.00
-	0.19	-	80.00
Composite Area & Weighted CN	1.72		96.01

Time of Concentration

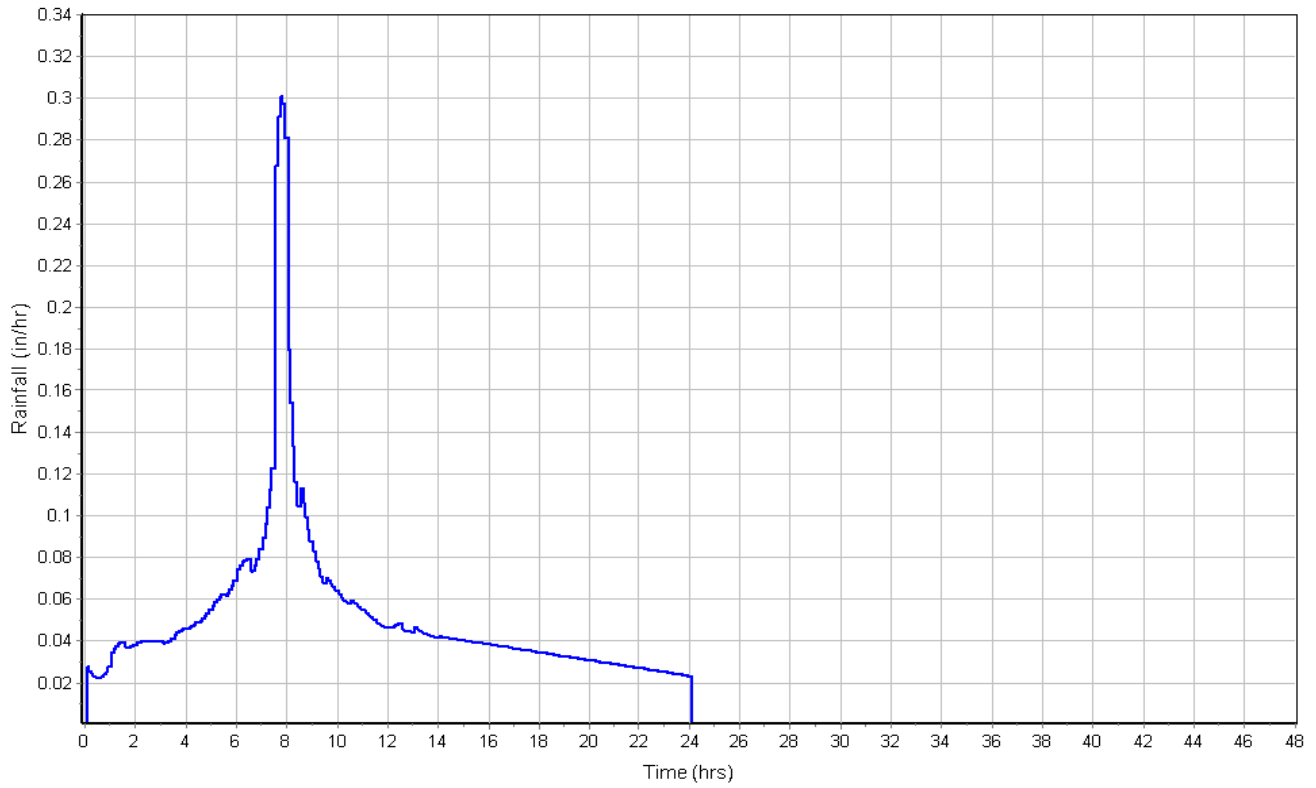
User-Defined TOC override (minutes): 5

Subbasin Runoff Results

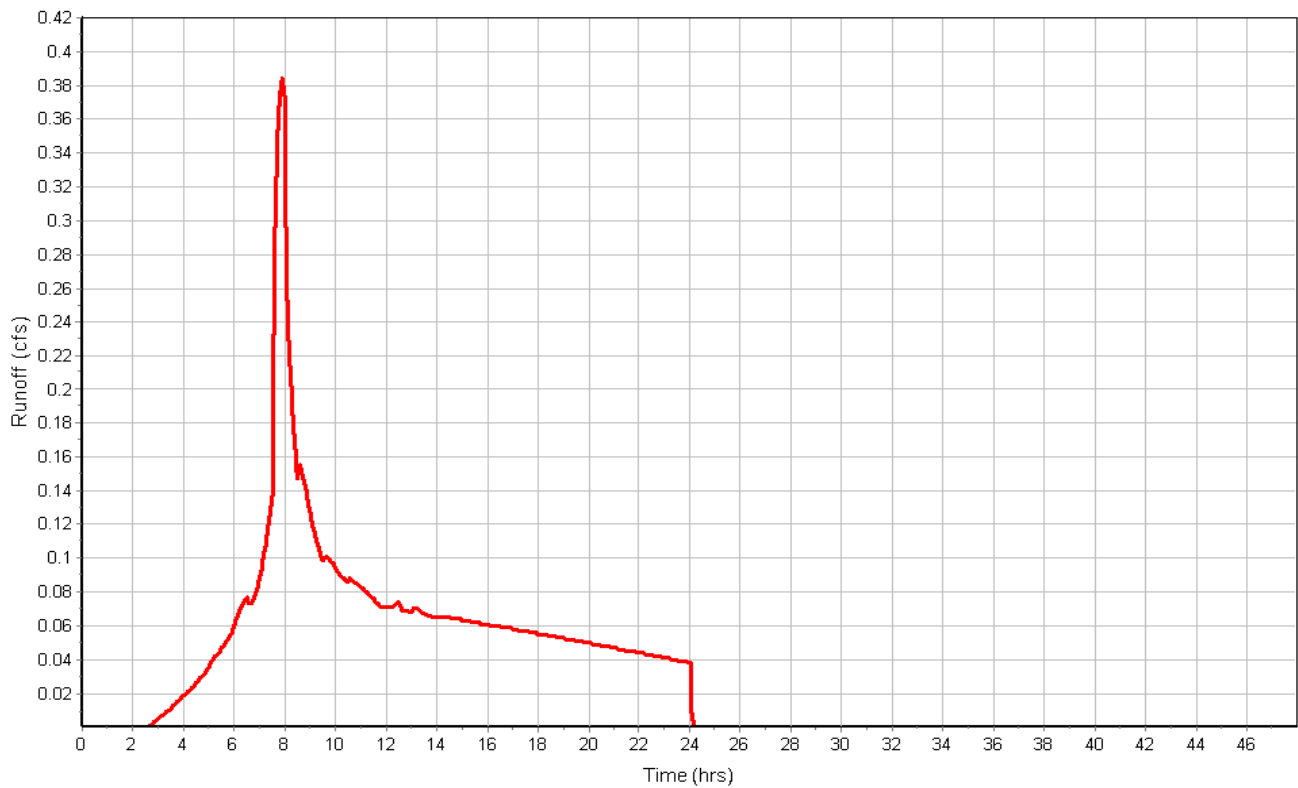
Total Rainfall (in) 1.25
 Total Runoff (in) 0.86
 Peak Runoff (cfs) 0.38
 Weighted Curve Number 96.01
 Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : P3

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : P4

Input Data

Area (ac) 6.56
 Weighted Curve Number 80.00
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	9.91	D	80.00
Composite Area & Weighted CN	9.91		80.00

Time of Concentration

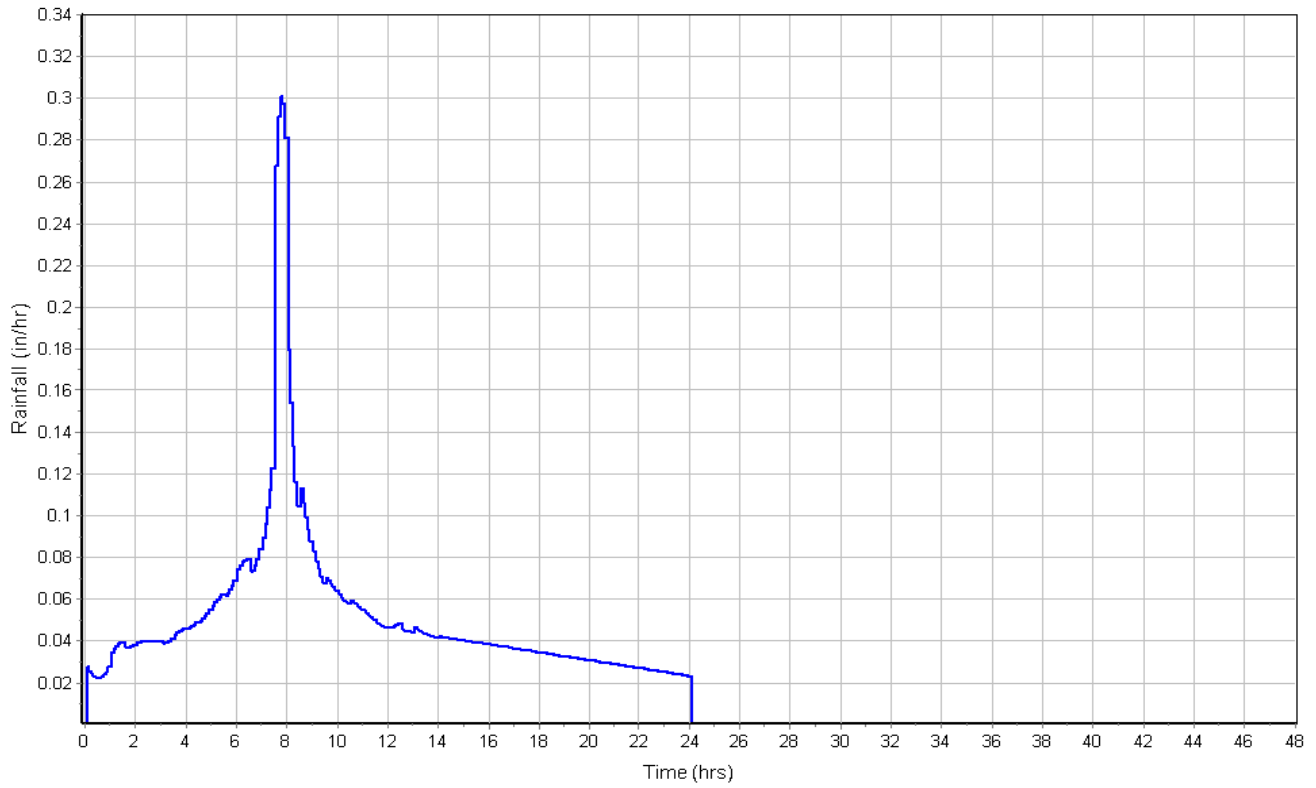
User-Defined TOC override (minutes): 16.71

Subbasin Runoff Results

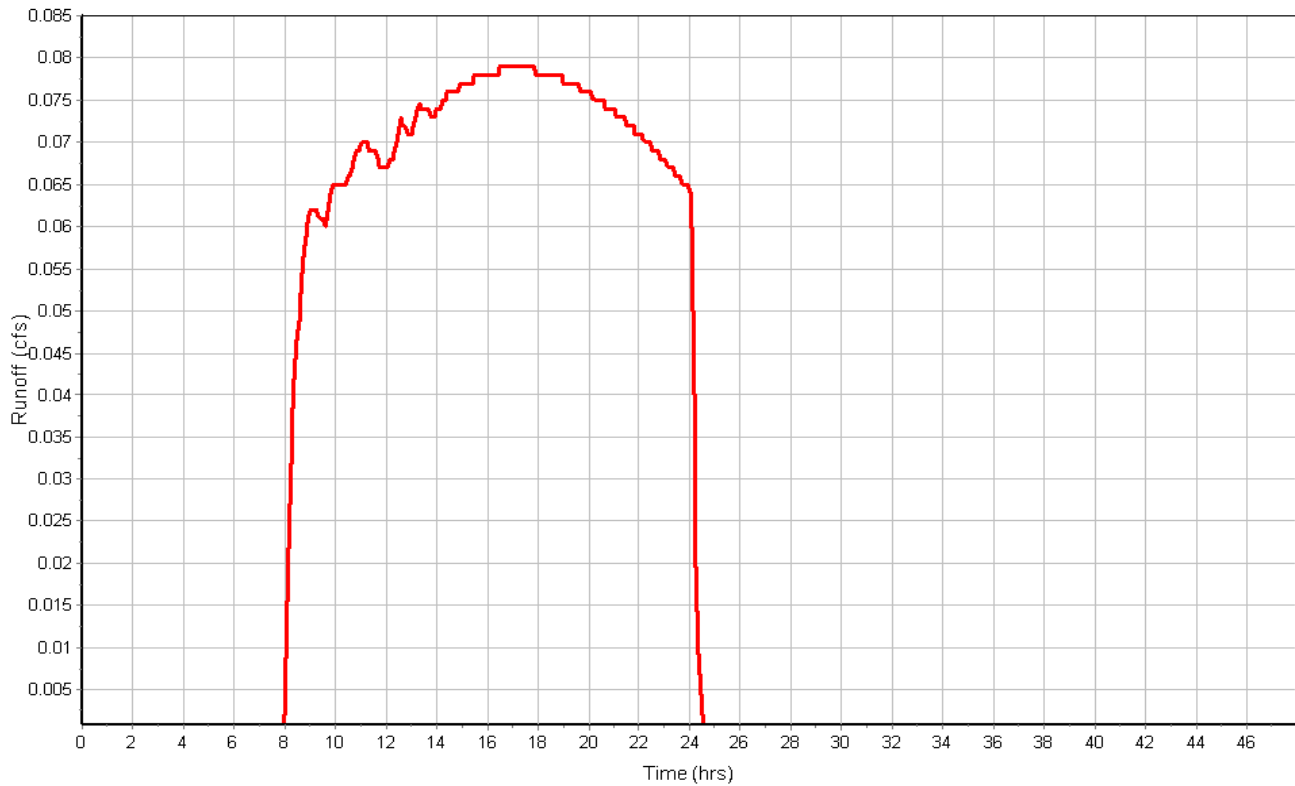
Total Rainfall (in) 1.25
 Total Runoff (in) 0.17
 Peak Runoff (cfs) 0.08
 Weighted Curve Number 80.00
 Time of Concentration (days hh:mm:ss) 0 00:16:43

Subbasin : P4

Rainfall Intensity Graph



Runoff Hydrograph



Storage Nodes

Storage Node : Det-Basin

Input Data

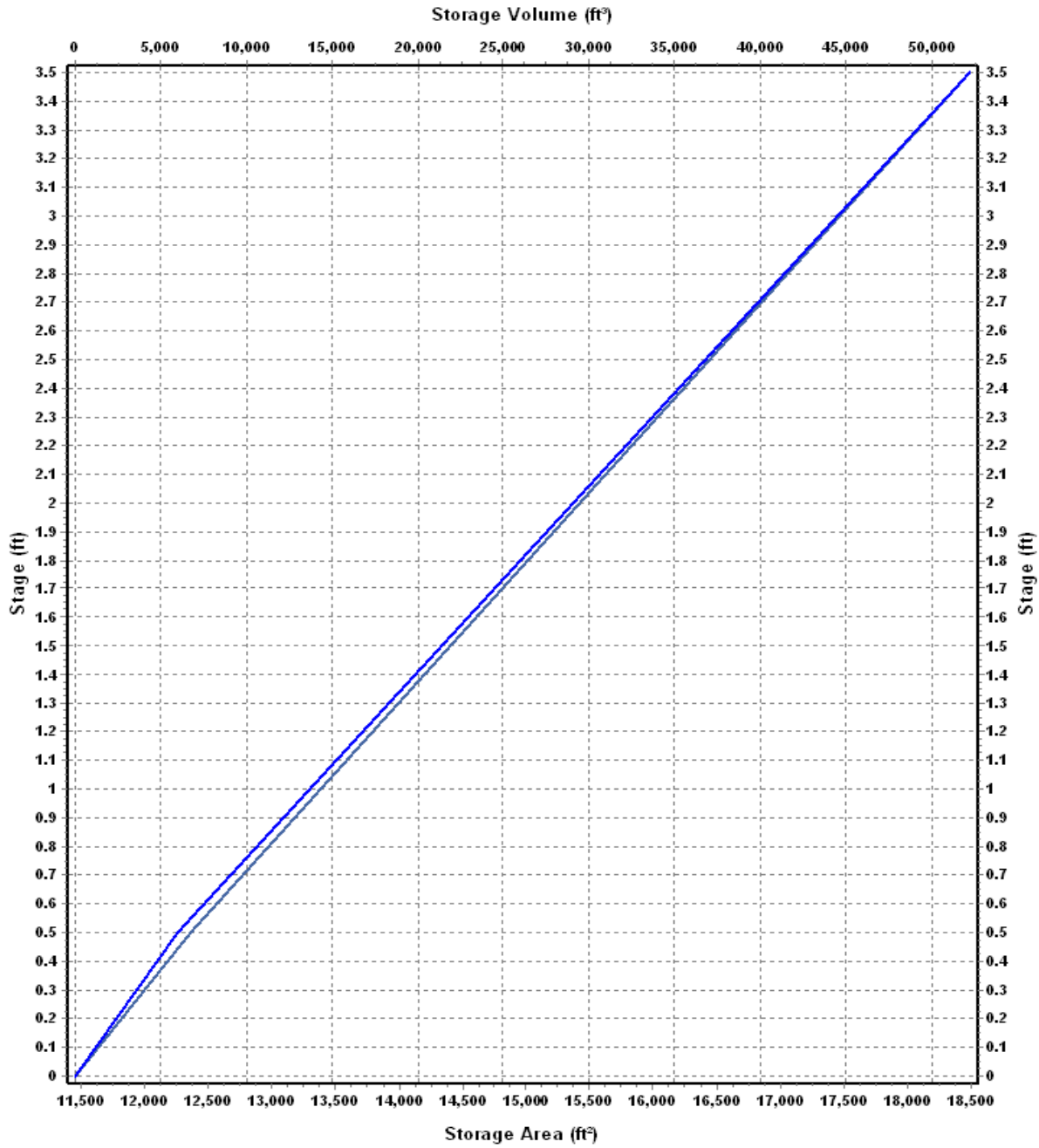
Invert Elevation (ft) 322.50
 Max (Rim) Elevation (ft) 326.00
 Max (Rim) Offset (ft) 3.50
 Initial Water Elevation (ft) 322.50
 Initial Water Depth (ft) 0.00
 Ponded Area (ft²) 12.00
 Evaporation Loss 0.00

Storage Area Volume Curves

Storage Curve : Detention_Basin

Stage (ft)	Storage Area (ft ²)	Storage Volume (ft ³)
0	11460	0.000
0.5	12362	5955.50
3.5	18484	52224.50

Storage Area Volume Curves



— Storage Area — Storage Volume

Storage Node : Det-Basin (continued)**Output Summary Results**

Peak Inflow (cfs)	0.66
Peak Lateral Inflow (cfs)	0.08
Peak Outflow (cfs)	0.15
Peak Exfiltration Flow Rate (cfm)	0.00
Max HGL Elevation Attained (ft)	323.17
Max HGL Depth Attained (ft)	0.67
Average HGL Elevation Attained (ft)	322.88
Average HGL Depth Attained (ft)	0.38
Time of Max HGL Occurrence (days hh:mm)	1 00:06
Total Exfiltration Volume (1000-ft ³)	0.000
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00

Project Description

File Name 20190920-Model.SPF

Project Options

Flow Units CFS
 Elevation Type Elevation
 Hydrology Method SCS TR-55
 Time of Concentration (TOC) Method SCS TR-55
 Link Routing Method Hydrodynamic
 Enable Overflow Ponding at Nodes YES
 Skip Steady State Analysis Time Periods YES

Analysis Options

Start Analysis On Sep 21, 2019 00:00:00
 End Analysis On Sep 23, 2019 00:00:00
 Start Reporting On Sep 21, 2019 00:00:00
 Antecedent Dry Days 0 days
 Runoff (Dry Weather) Time Step 0 01:00:00 days hh:mm:ss
 Runoff (Wet Weather) Time Step 0 00:05:00 days hh:mm:ss
 Reporting Time Step 0 00:05:00 days hh:mm:ss
 Routing Time Step 1 seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins.....	5
Nodes.....	8
<i>Junctions</i>	4
<i>Outfalls</i>	3
<i>Flow Diversions</i>	0
<i>Inlets</i>	0
<i>Storage Nodes</i>	1
Links.....	7
<i>Channels</i>	3
<i>Pipes</i>	4
<i>Pumps</i>	0
<i>Orifices</i>	0
<i>Weirs</i>	0
<i>Outlets</i>	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	Rain Gage-01	Time Series	TS-002	Intensity	inches	Oregon	Yamhill	2	2.50	SCS Type IA 24-hr

Subbasin Summary

SN	Subbasin ID	Area	Total Runoff	Total Runoff Volume	Peak Runoff
		(ac)	(in)	(ac-in)	(cfs)
1	E1/P1	2.97	0.89	2.64	0.49
2	E2_E3_E4	12.74	0.89	11.33	2.05
3	P2	4.46	1.29	5.77	1.38
4	P3	1.72	2.06	3.55	0.93
5	P4	6.56	0.89	5.83	1.10

Node Summary

SN Element ID	Element Type	Invert Elevation	Ground/Rim (Max) Elevation	Initial Water Elevation	Surcharge Elevation	Ponded Area	Peak Inflow	Max HGL Elevation Attained	Max Surcharge Depth Attained	Min Freeboard Attained	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded	
		(ft)	(ft)	(ft)	(ft)	(ft²)	(cfs)	(ft)	(ft)	(ft)	(days hh:mm)	(ac-in)	(min)	
1	REV-Swale-End	Junction	320.52	330.00	320.52	330.00	12.00	1.28	321.25	0.00	8.75	0 00:00	0.00	0.00
2	REV-Swale-Start	Junction	322.50	330.00	322.50	330.00	12.00	1.28	322.81	0.00	7.19	0 00:00	0.00	0.00
3	SD(5)	Junction	334.15	339.85	334.15	340.00	12.00	0.93	334.40	0.00	5.45	0 00:00	0.00	0.00
4	SD(6)	Junction	324.36	330.00	324.36	330.00	12.00	2.31	324.45	0.00	5.55	0 00:00	0.00	0.00
5	Out-PRE-East	Outfall	325.00				0.49	325.00						
6	Out-PRE-West	Outfall	316.16				2.03	316.16						
7	Out-REV-POST-West	Outfall	316.16				1.28	316.39						
8	Det-Basin	Storage Node	322.50	326.00	322.50		12.00	3.32	323.46			0.00	0.00	

Link Summary

SN Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged (min)
1	Ditch-Inlet	Pipe Det-Basin	REV-Swale-Start	5.00	323.17	322.50	13.4000	12.000	0.0150	1.07	11.30	0.09	5.46	0.30	0.30	0.00
2	Orifice	Pipe Det-Basin	REV-Swale-Start	5.00	322.50	322.50	0.0000	2.900	0.0130	0.21	0.01	18.26	4.72	0.24	1.00	259.00
3	REV-Swale-Discharge	Pipe REV-Swale-End	Out-REV-POST-West	68.56	321.00	316.16	7.0600	18.000	0.0150	1.28	24.19	0.05	7.01	0.24	0.16	0.00
4	SD5_SD6	Pipe SD(5)	SD(6)	96.00	334.15	324.36	10.2000	10.000	0.0130	0.93	7.00	0.13	11.89	0.17	0.20	0.00
5	HF_Bypass	Channel Det-Basin	REV-Swale-Start	5.00	323.90	322.50	28.0000	24.000	0.0320	0.00	263.60	0.00	0.00	0.15	0.08	0.00
6	Link-22	Channel SD(6)	Det-Basin	5.00	324.36	322.50	37.2000	60.000	0.0320	2.31	995.36	0.00	1.50	0.50	0.10	0.00
7	REV-Swale	Channel REV-Swale-Start	REV-Swale-End	100.00	322.50	320.52	1.9800	18.000	0.2400	1.28	31.07	0.04	0.49	0.52	0.34	0.00

Reported
Condition

Calculated
SURCHARGED
Calculated
Calculated

Subbasin Hydrology

Subbasin : E1/P1

Input Data

Area (ac) 2.97
 Weighted Curve Number 80.00
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pasture, grassland, or range, Good	2.97	D	80.00
Composite Area & Weighted CN	2.97		80.00

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8}) / ((P^{0.5}) * (S_f^{0.4})))$$

Where :

T_c = Time of Concentration (hr)
 n = Manning's roughness
 L_f = Flow Length (ft)
 P = 2 yr, 24 hr Rainfall (inches)
 S_f = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (S_f^{0.5}) (unpaved surface)
 V = 20.3282 * (S_f^{0.5}) (paved surface)
 V = 15.0 * (S_f^{0.5}) (grassed waterway surface)
 V = 10.0 * (S_f^{0.5}) (nearly bare & untilled surface)
 V = 9.0 * (S_f^{0.5}) (cultivated straight rows surface)
 V = 7.0 * (S_f^{0.5}) (short grass pasture surface)
 V = 5.0 * (S_f^{0.5}) (woodland surface)
 V = 2.5 * (S_f^{0.5}) (forest w/heavy litter surface)
 T_c = (L_f / V) / (3600 sec/hr)

Where:

T_c = Time of Concentration (hr)
 L_f = Flow Length (ft)
 V = Velocity (ft/sec)
 S_f = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^{2/3}) * (S_f^{0.5})) / n
 R = A_q / W_p
 T_c = (L_f / V) / (3600 sec/hr)

Where :

T_c = Time of Concentration (hr)
 L_f = Flow Length (ft)
 R = Hydraulic Radius (ft)
 A_q = Flow Area (ft²)
 W_p = Wetted Perimeter (ft)
 V = Velocity (ft/sec)
 S_f = Slope (ft/ft)
 n = Manning's roughness

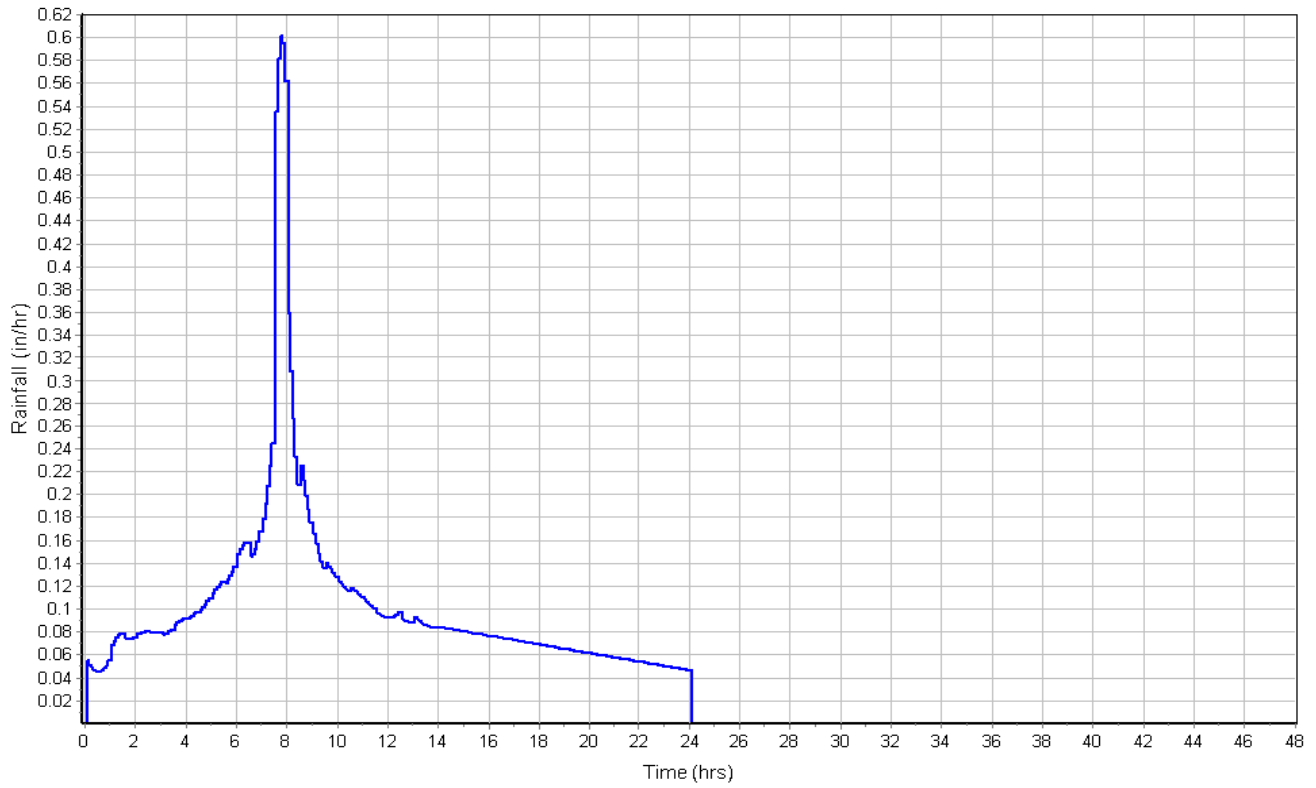
	Subarea	Subarea	Subarea
	A	B	C
Sheet Flow Computations			
Manning's Roughness :	0.24	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.5	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	16.14	0.00	0.00
Shallow Concentrated Flow Computations			
	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	200	0.00	0.00
Slope (%) :	2	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	2.28	0.00	0.00
Computed Flow Time (min) :	1.46	0.00	0.00
Total TOC (min)	17.61		

Subbasin Runoff Results

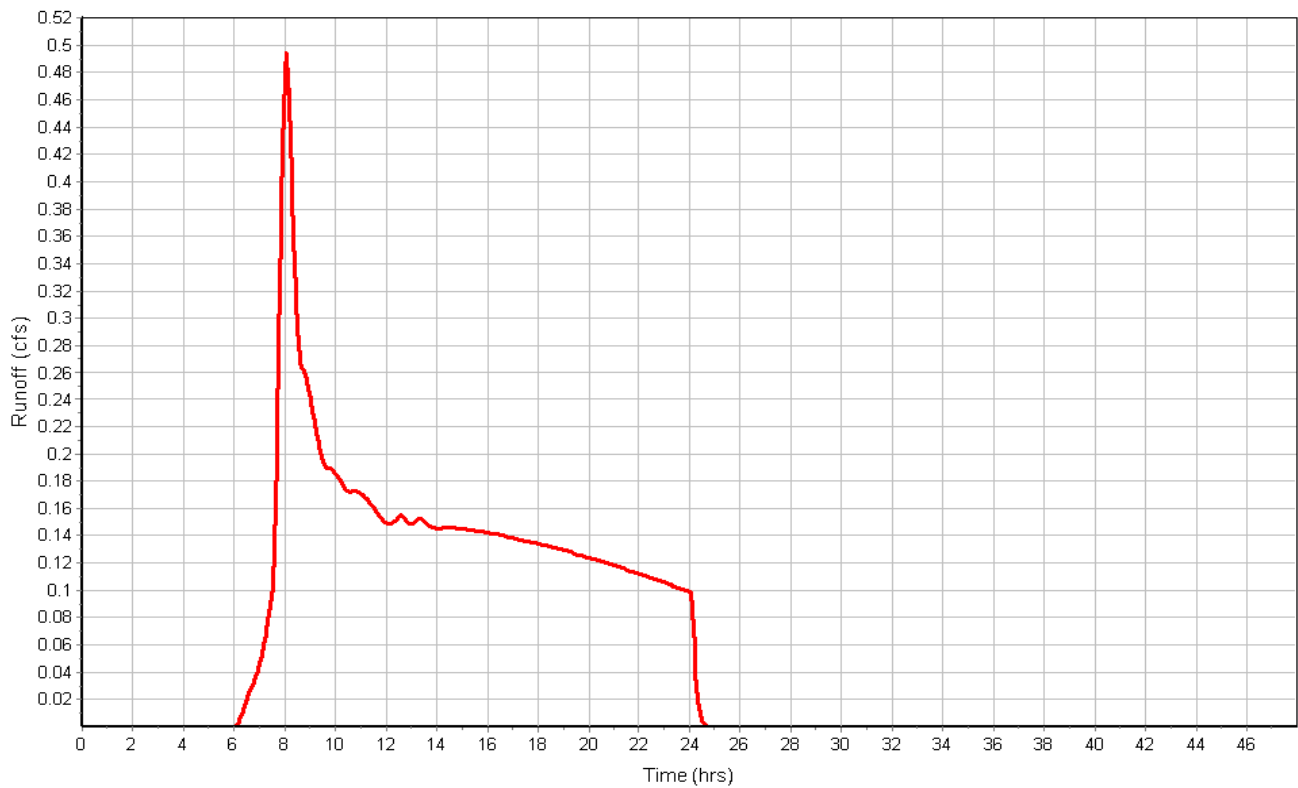
Total Rainfall (in)	2.50
Total Runoff (in)	0.89
Peak Runoff (cfs)	0.49
Weighted Curve Number	80.00
Time of Concentration (days hh:mm:ss)	0 00:17:37

Subbasin : E1/P1

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : E2_E3_E4

Input Data

Area (ac) 12.74
 Weighted Curve Number 80.00
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pasture, grassland, or range, Good	12.74	D	80.00
Composite Area & Weighted CN	12.74		80.00

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.24	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	3	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.5	0.00	0.00
Velocity (ft/sec) :	0.12	0.00	0.00
Computed Flow Time (min) :	13.73	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
	Flow Length (ft) :	500	0.00
Slope (%) :	3	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	2.79	0.00	0.00
Computed Flow Time (min) :	2.99	0.00	0.00

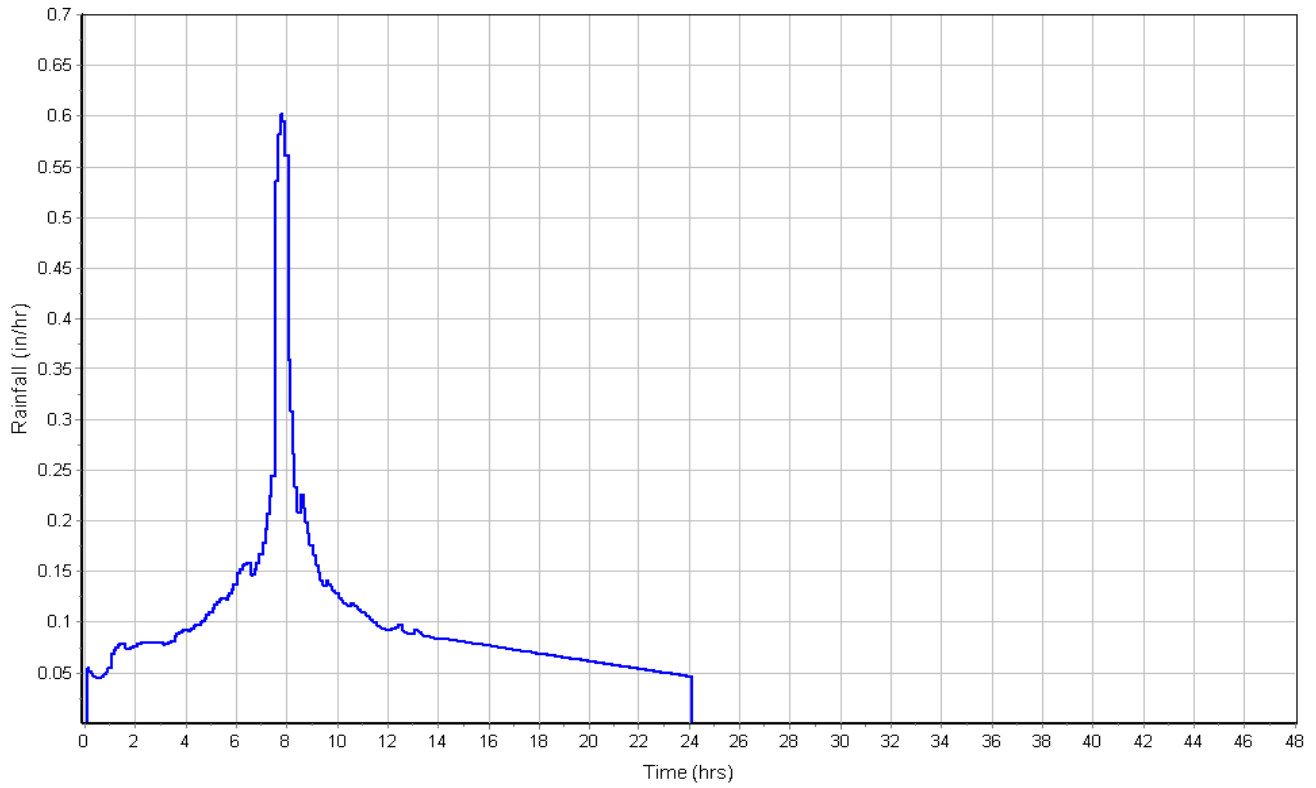
Channel Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.24	0.00
Flow Length (ft) :	300	0.00	0.00
Channel Slope (%) :	3	0.00	0.00
Cross Section Area (ft²) :	12	0.00	0.00
Wetted Perimeter (ft) :	12	0.00	0.00
Velocity (ft/sec) :	1.08	0.00	0.00
Computed Flow Time (min) :	4.65	0.00	0.00
Total TOC (min)	21.36		

Subbasin Runoff Results

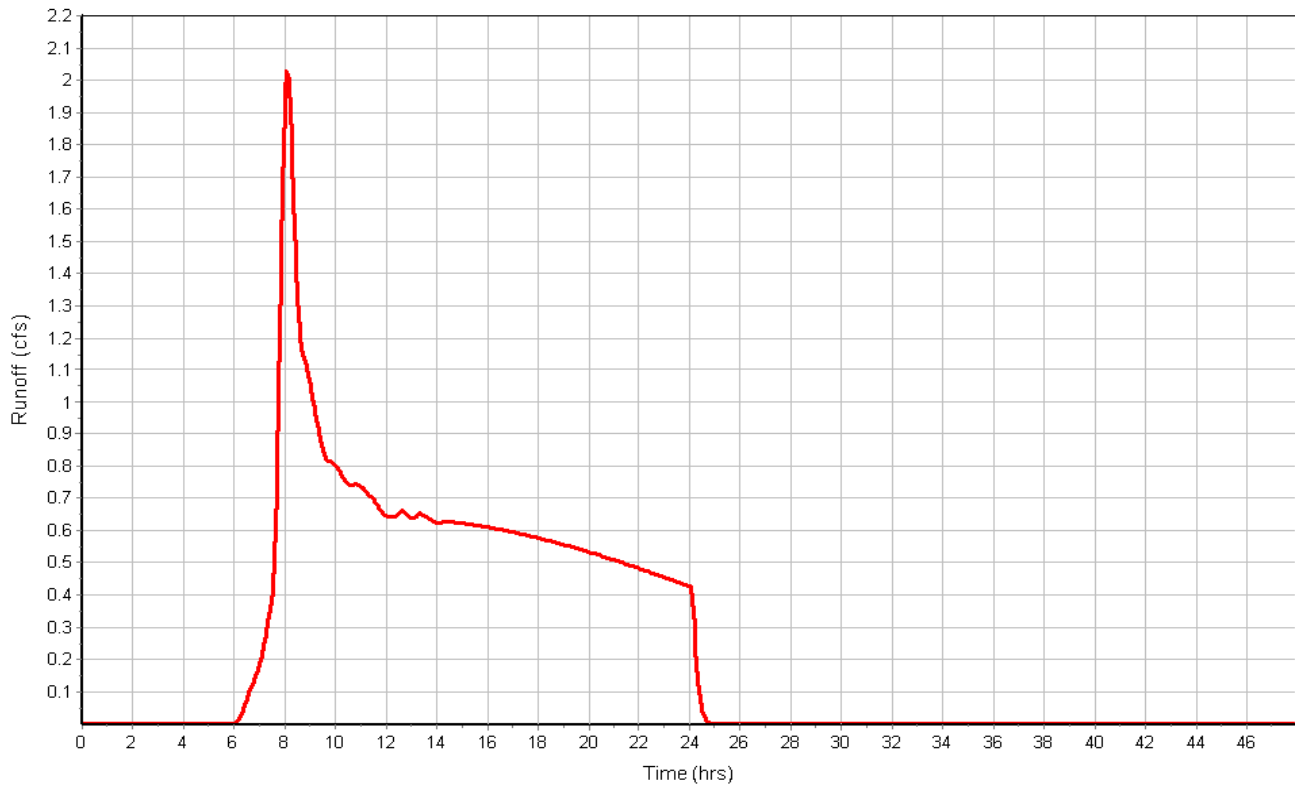
Total Rainfall (in) 2.50
 Total Runoff (in) 0.89
 Peak Runoff (cfs) 2.05
 Weighted Curve Number 80.00
 Time of Concentration (days hh:mm:ss) 0 00:21:22

Subbasin : E2_E3_E4

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : P2

Input Data

Area (ac) 4.46
 Weighted Curve Number 86.74
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	1.67	-	98.00
-	2.79	-	80.00
Composite Area & Weighted CN	4.46		86.74

Time of Concentration

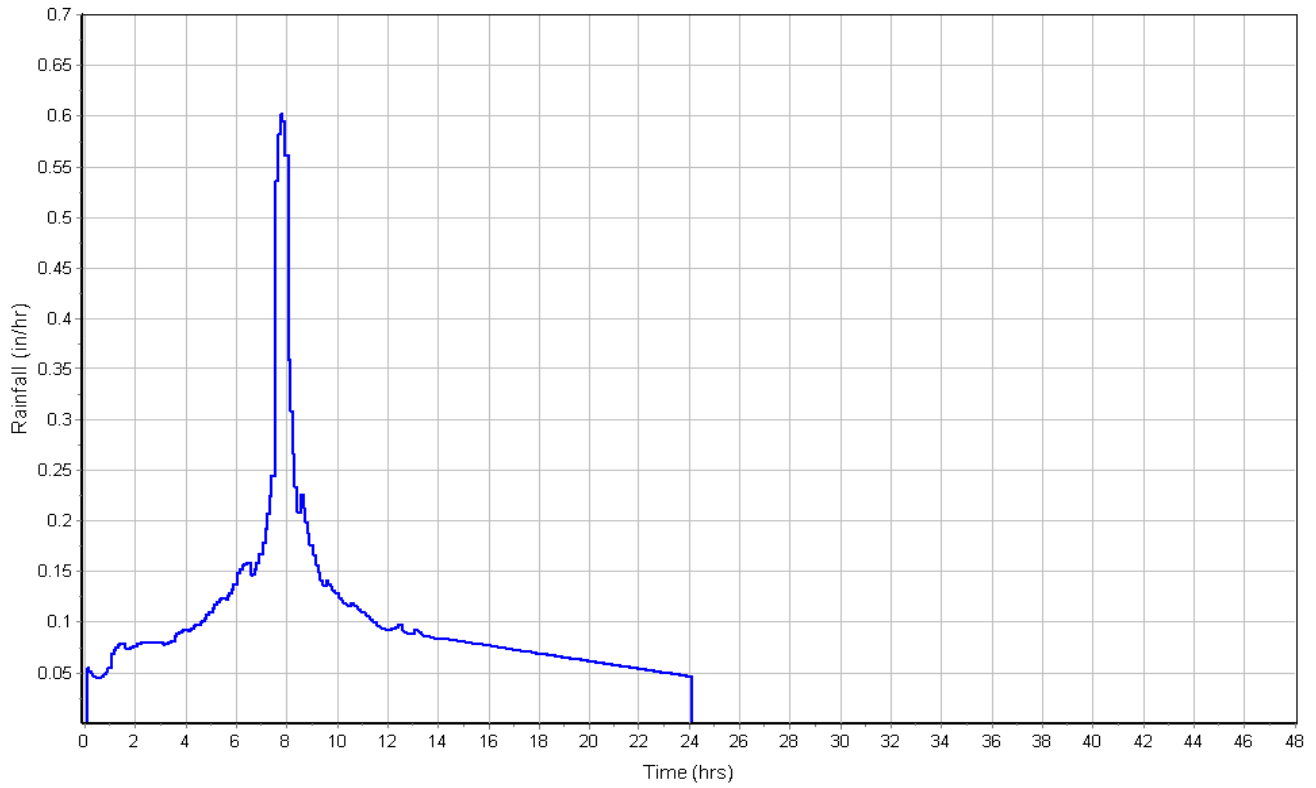
User-Defined TOC override (minutes): 5

Subbasin Runoff Results

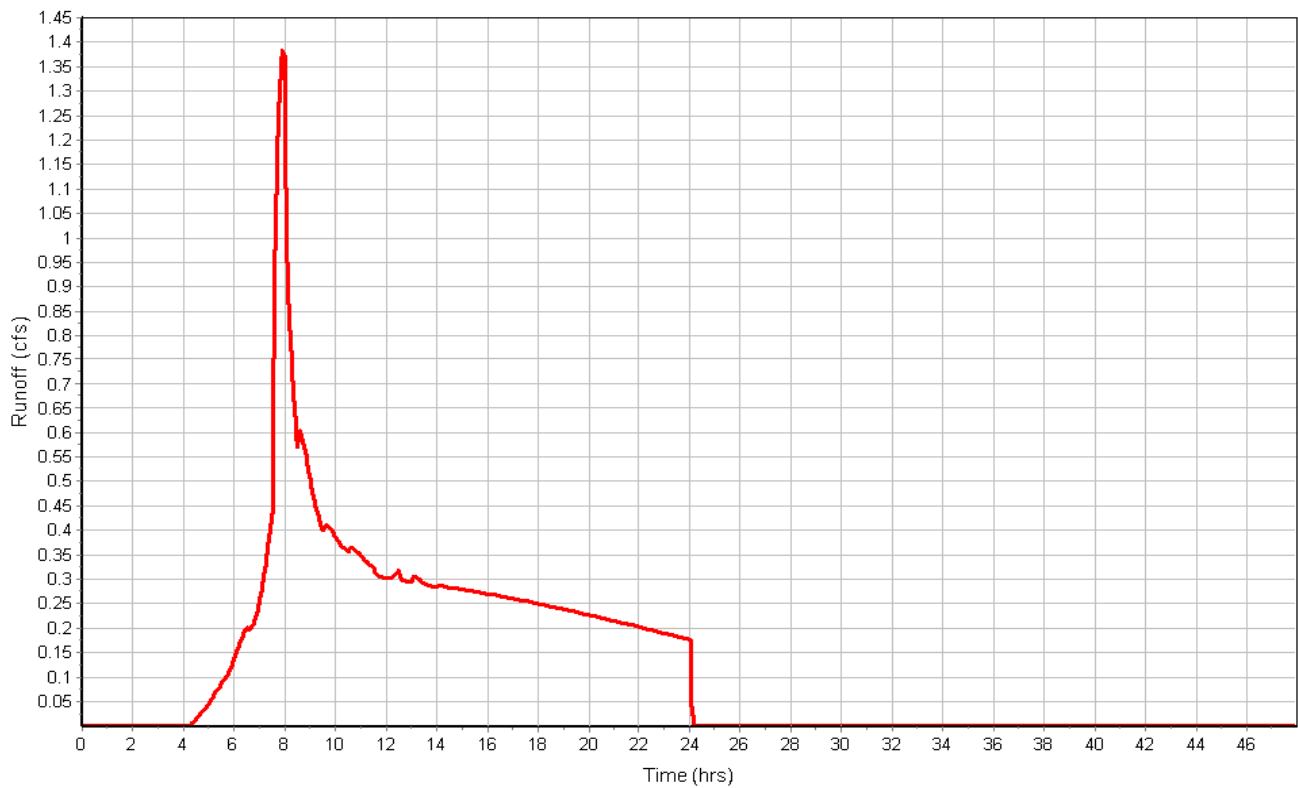
Total Rainfall (in) 2.50
 Total Runoff (in) 1.29
 Peak Runoff (cfs) 1.38
 Weighted Curve Number 86.74
 Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : P2

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : P3

Input Data

Area (ac) 1.72
 Weighted Curve Number 96.01
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	1.53	-	98.00
-	0.19	-	80.00
Composite Area & Weighted CN	1.72		96.01

Time of Concentration

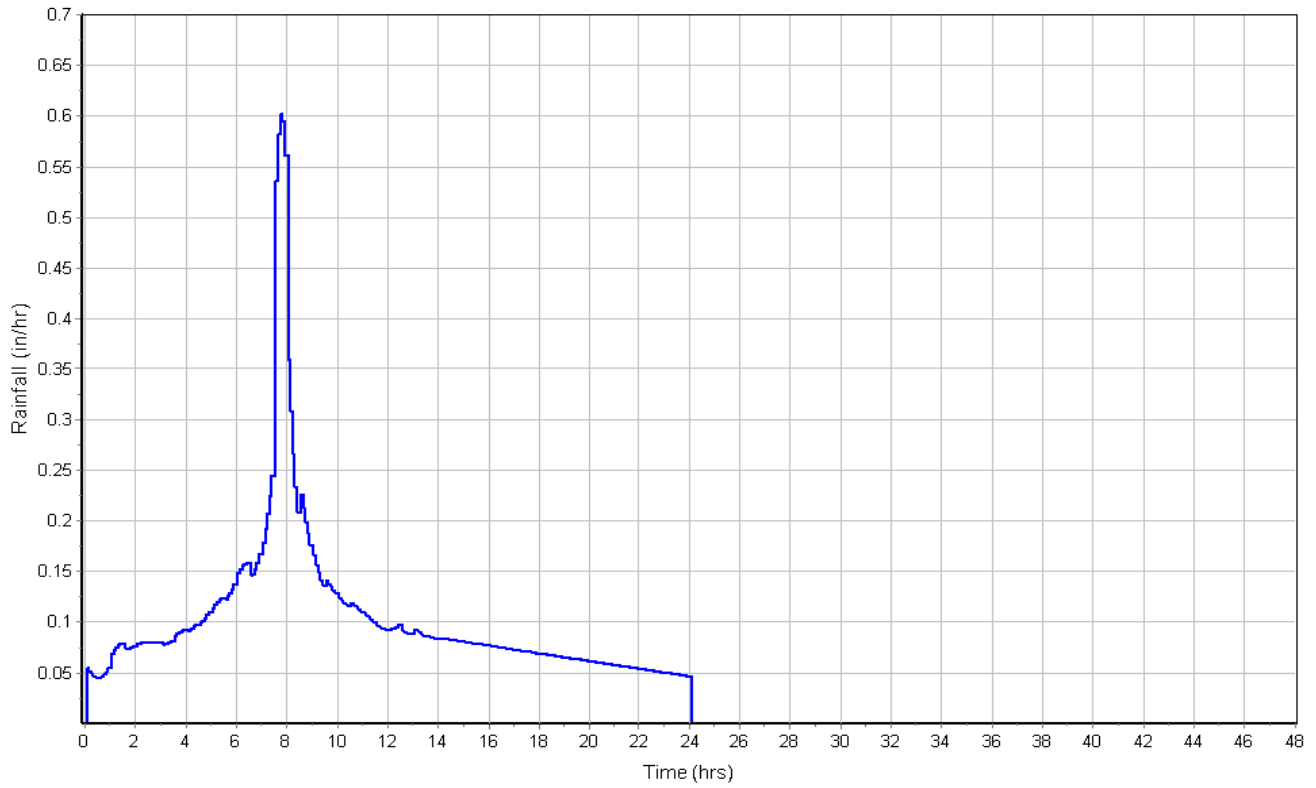
User-Defined TOC override (minutes): 5

Subbasin Runoff Results

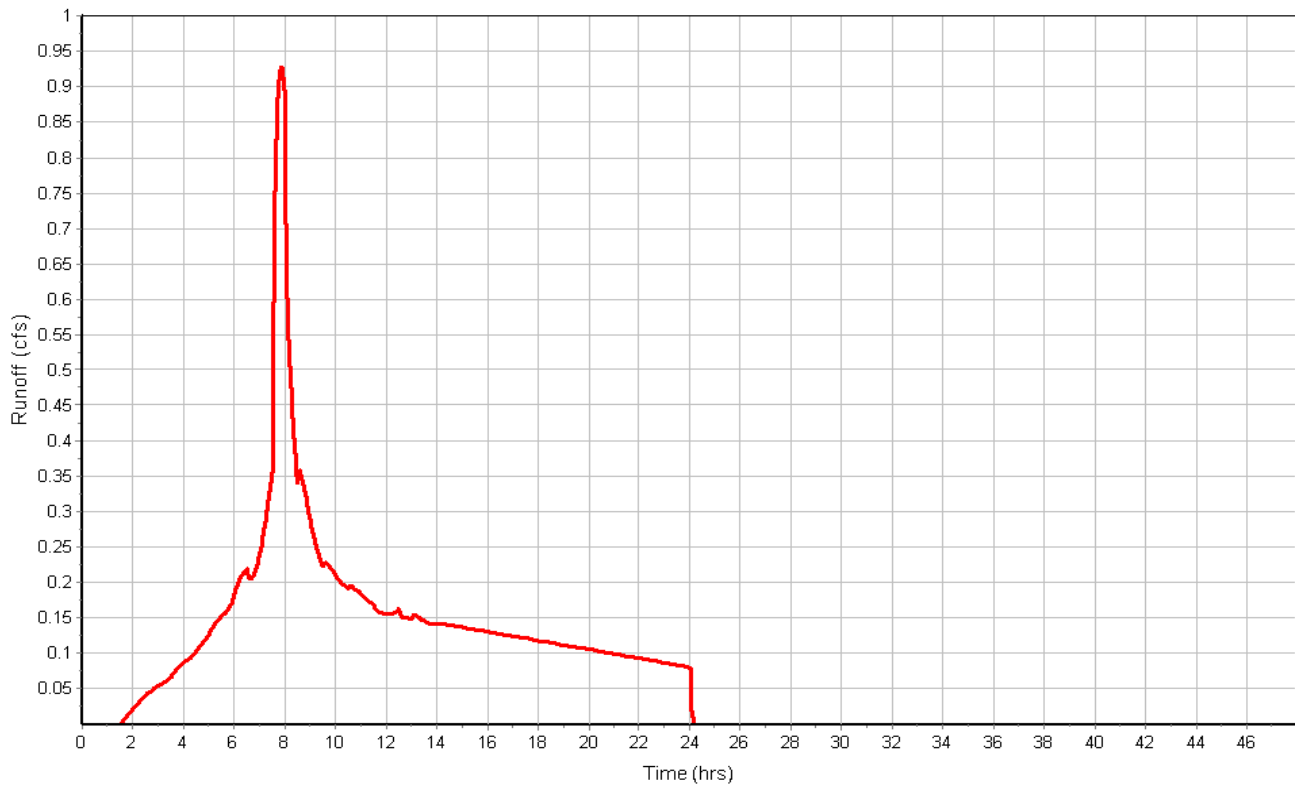
Total Rainfall (in) 2.50
 Total Runoff (in) 2.06
 Peak Runoff (cfs) 0.93
 Weighted Curve Number 96.01
 Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : P3

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : P4

Input Data

Area (ac) 6.56
 Weighted Curve Number 80.00
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	9.91	D	80.00
Composite Area & Weighted CN	9.91		80.00

Time of Concentration

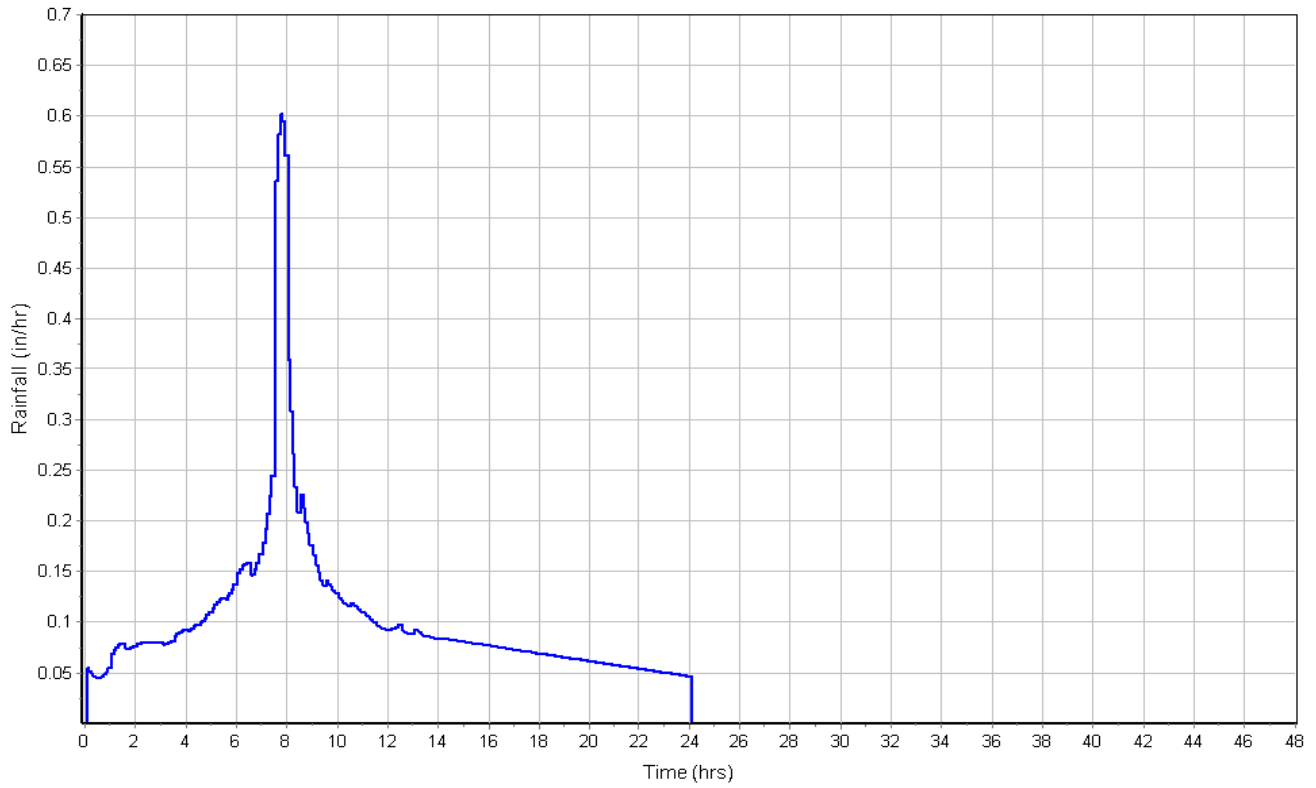
User-Defined TOC override (minutes): 16.71

Subbasin Runoff Results

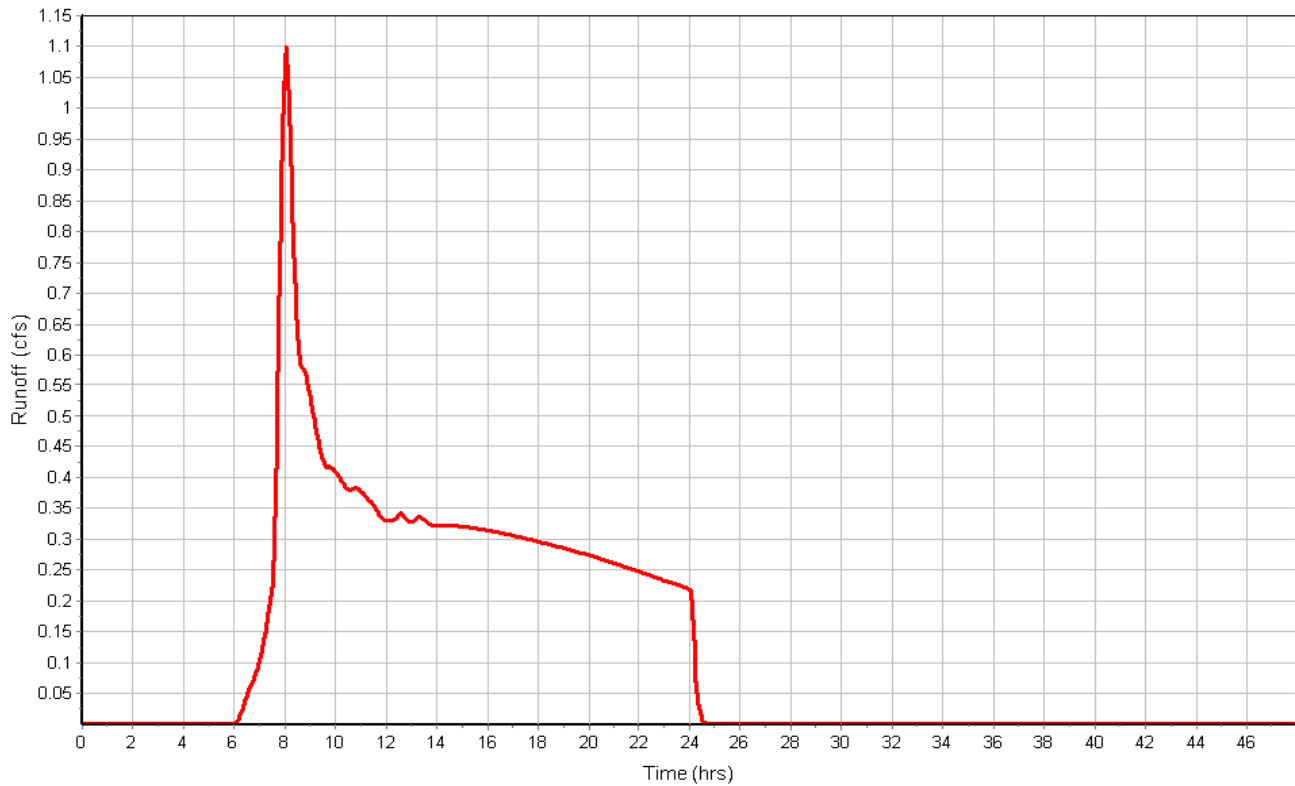
Total Rainfall (in) 2.50
 Total Runoff (in) 0.89
 Peak Runoff (cfs) 1.10
 Weighted Curve Number 80.00
 Time of Concentration (days hh:mm:ss) 0 00:16:43

Subbasin : P4

Rainfall Intensity Graph



Runoff Hydrograph



Storage Nodes

Storage Node : Det-Basin

Input Data

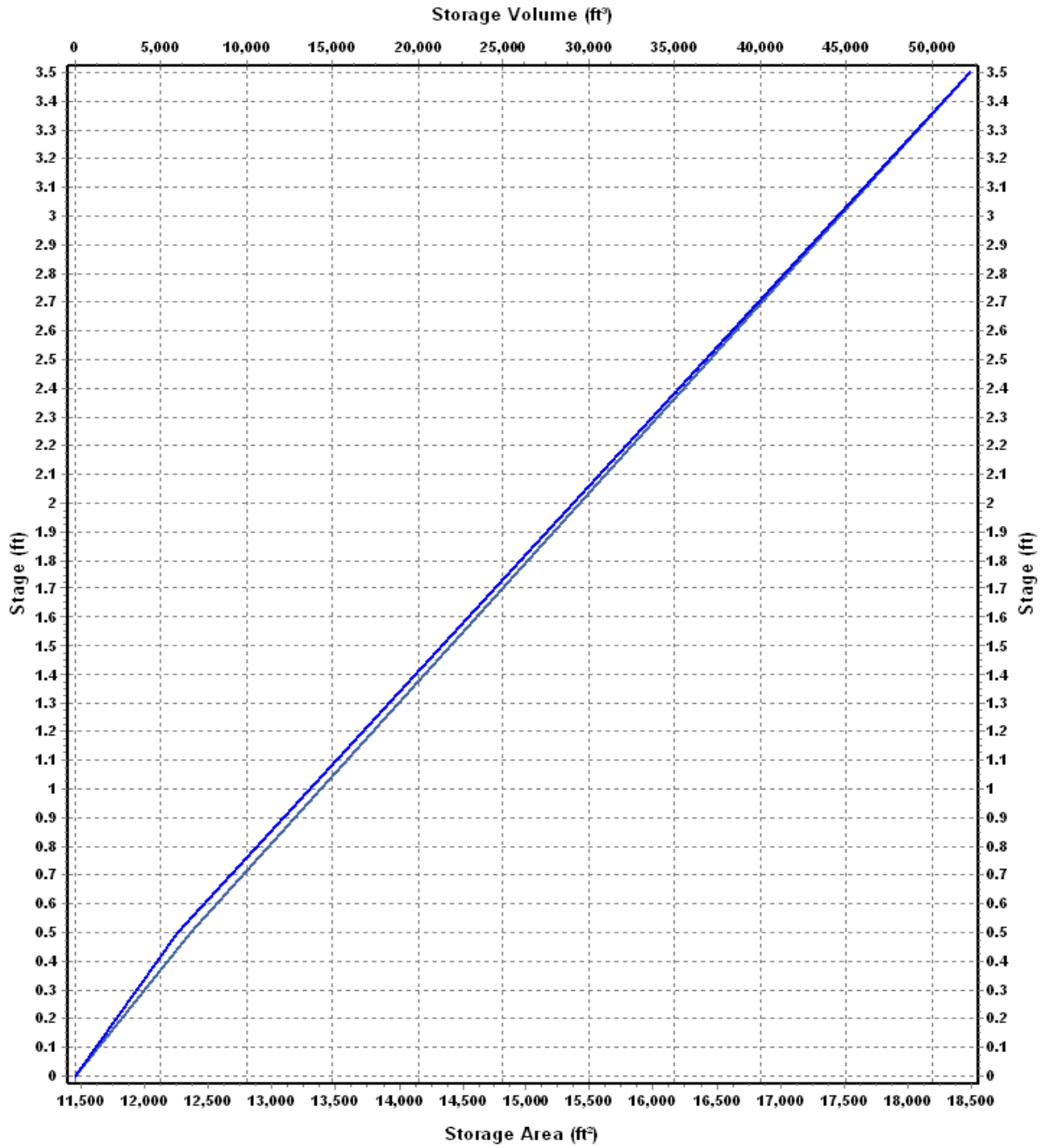
Invert Elevation (ft) 322.50
 Max (Rim) Elevation (ft) 326.00
 Max (Rim) Offset (ft) 3.50
 Initial Water Elevation (ft) 322.50
 Initial Water Depth (ft) 0.00
 Ponded Area (ft²) 12.00
 Evaporation Loss 0.00

Storage Area Volume Curves

Storage Curve : Detention_Basin

Stage (ft)	Storage Area (ft ²)	Storage Volume (ft ³)
0	11460	0.000
0.5	12362	5955.50
3.5	18484	52224.50

Storage Area Volume Curves



— Storage Area — Storage Volume

Storage Node : Det-Basin (continued)**Output Summary Results**

Peak Inflow (cfs)	3.32
Peak Lateral Inflow (cfs)	1.10
Peak Outflow (cfs)	1.28
Peak Exfiltration Flow Rate (cfm)	0.00
Max HGL Elevation Attained (ft)	323.46
Max HGL Depth Attained (ft)	0.96
Average HGL Elevation Attained (ft)	323.06
Average HGL Depth Attained (ft)	0.56
Time of Max HGL Occurrence (days hh:mm)	0 09:08
Total Exfiltration Volume (1000-ft ³)	0.000
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00

Project Description

File Name 20190920-Model.SPF

Project Options

Flow Units CFS
 Elevation Type Elevation
 Hydrology Method SCS TR-55
 Time of Concentration (TOC) Method SCS TR-55
 Link Routing Method Hydrodynamic
 Enable Overflow Ponding at Nodes YES
 Skip Steady State Analysis Time Periods YES

Analysis Options

Start Analysis On Sep 21, 2019 00:00:00
 End Analysis On Sep 23, 2019 00:00:00
 Start Reporting On Sep 21, 2019 00:00:00
 Antecedent Dry Days 0 days
 Runoff (Dry Weather) Time Step 0 01:00:00 days hh:mm:ss
 Runoff (Wet Weather) Time Step 0 00:05:00 days hh:mm:ss
 Reporting Time Step 0 00:05:00 days hh:mm:ss
 Routing Time Step 1 seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins.....	5
Nodes.....	8
<i>Junctions</i>	4
<i>Outfalls</i>	3
<i>Flow Diversions</i>	0
<i>Inlets</i>	0
<i>Storage Nodes</i>	1
Links.....	7
<i>Channels</i>	3
<i>Pipes</i>	4
<i>Pumps</i>	0
<i>Orifices</i>	0
<i>Weirs</i>	0
<i>Outlets</i>	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	Rain Gage-01	Time Series	TS-005	Intensity	inches	Oregon	Yamhill	5	3.00	SCS Type IA 24-hr

Subbasin Summary

SN	Subbasin ID	Area	Total Runoff	Total Runoff Volume	Peak Runoff
		(ac)	(in)	(ac-in)	(cfs)
1	E1/P1	2.97	1.25	3.71	0.76
2	E2_E3_E4	12.74	1.25	15.93	3.17
3	P2	4.46	1.72	7.67	1.90
4	P3	1.72	2.55	4.39	1.15
5	P4	6.56	1.25	8.20	1.70

Node Summary

SN Element ID	Element Type	Invert Elevation	Ground/Rim (Max) Elevation	Initial Water Elevation	Surcharge Elevation	Ponded Area	Peak Inflow	Max HGL Elevation Attained	Max Surcharge Depth Attained	Min Freeboard Attained	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded	
		(ft)	(ft)	(ft)	(ft)	(ft²)	(cfs)	(ft)	(ft)	(ft)	(days hh:mm)	(ac-in)	(min)	
1	REV-Swale-End	Junction	320.52	330.00	320.52	330.00	12.00	2.29	321.33	0.00	8.67	0 00:00	0.00	0.00
2	REV-Swale-Start	Junction	322.50	330.00	322.50	330.00	12.00	2.29	322.92	0.00	7.08	0 00:00	0.00	0.00
3	SD(5)	Junction	334.15	339.85	334.15	340.00	12.00	1.15	334.43	0.00	5.42	0 00:00	0.00	0.00
4	SD(6)	Junction	324.36	330.00	324.36	330.00	12.00	3.05	324.46	0.00	5.54	0 00:00	0.00	0.00
5	Out-PRE-East	Outfall	325.00					0.76	325.00					
6	Out-PRE-West	Outfall	316.16					3.16	316.16					
7	Out-REV-POST-West	Outfall	316.16					2.29	316.47					
8	Det-Basin	Storage Node	322.50	326.00	322.50		12.00	4.62	323.63			0.00	0.00	

Link Summary

SN Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged (min)
1	Ditch-Inlet	Pipe Det-Basin	REV-Swale-Start	5.00	323.17	322.50	13.4000	12.000	0.0150	2.07	11.30	0.18	6.28	0.44	0.44	0.00
2	Orifice	Pipe Det-Basin	REV-Swale-Start	5.00	322.50	322.50	0.0000	2.900	0.0130	0.22	0.01	19.02	4.73	0.24	1.00	684.00
3	REV-Swale-Discharge	Pipe REV-Swale-End	Out-REV-POST-West	68.56	321.00	316.16	7.0600	18.000	0.0150	2.29	24.19	0.09	8.20	0.32	0.21	0.00
4	SD5_SD6	Pipe SD(5)	SD(6)	96.00	334.15	324.36	10.2000	10.000	0.0130	1.15	7.00	0.16	12.33	0.19	0.23	0.00
5	HF_Bypass	Channel Det-Basin	REV-Swale-Start	5.00	323.90	322.50	28.0000	24.000	0.0320	0.00	263.60	0.00	0.00	0.21	0.10	0.00
6	Link-22	Channel SD(6)	Det-Basin	5.00	324.36	322.50	37.2000	60.000	0.0320	3.05	995.36	0.00	1.38	0.59	0.12	0.00
7	REV-Swale	Channel REV-Swale-Start	REV-Swale-End	100.00	322.50	320.52	1.9800	18.000	0.2400	2.29	31.07	0.07	0.68	0.62	0.41	0.00

Reported
Condition

Calculated
SURCHARGED
Calculated
Calculated

Subbasin Hydrology

Subbasin : E1/P1

Input Data

Area (ac) 2.97
 Weighted Curve Number 80.00
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pasture, grassland, or range, Good	2.97	D	80.00
Composite Area & Weighted CN	2.97		80.00

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8}) / ((P^{0.5}) * (S_f^{0.4})))$$

Where :

T_c = Time of Concentration (hr)
 n = Manning's roughness
 L_f = Flow Length (ft)
 P = 2 yr, 24 hr Rainfall (inches)
 S_f = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (S_f^{0.5}) (unpaved surface)
 V = 20.3282 * (S_f^{0.5}) (paved surface)
 V = 15.0 * (S_f^{0.5}) (grassed waterway surface)
 V = 10.0 * (S_f^{0.5}) (nearly bare & untilled surface)
 V = 9.0 * (S_f^{0.5}) (cultivated straight rows surface)
 V = 7.0 * (S_f^{0.5}) (short grass pasture surface)
 V = 5.0 * (S_f^{0.5}) (woodland surface)
 V = 2.5 * (S_f^{0.5}) (forest w/heavy litter surface)
 T_c = (L_f / V) / (3600 sec/hr)

Where:

T_c = Time of Concentration (hr)
 L_f = Flow Length (ft)
 V = Velocity (ft/sec)
 S_f = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^{2/3}) * (S_f^{0.5})) / n
 R = A_q / W_p
 T_c = (L_f / V) / (3600 sec/hr)

Where :

T_c = Time of Concentration (hr)
 L_f = Flow Length (ft)
 R = Hydraulic Radius (ft)
 A_q = Flow Area (ft²)
 W_p = Wetted Perimeter (ft)
 V = Velocity (ft/sec)
 S_f = Slope (ft/ft)
 n = Manning's roughness

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.24	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.5	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	16.14	0.00	0.00

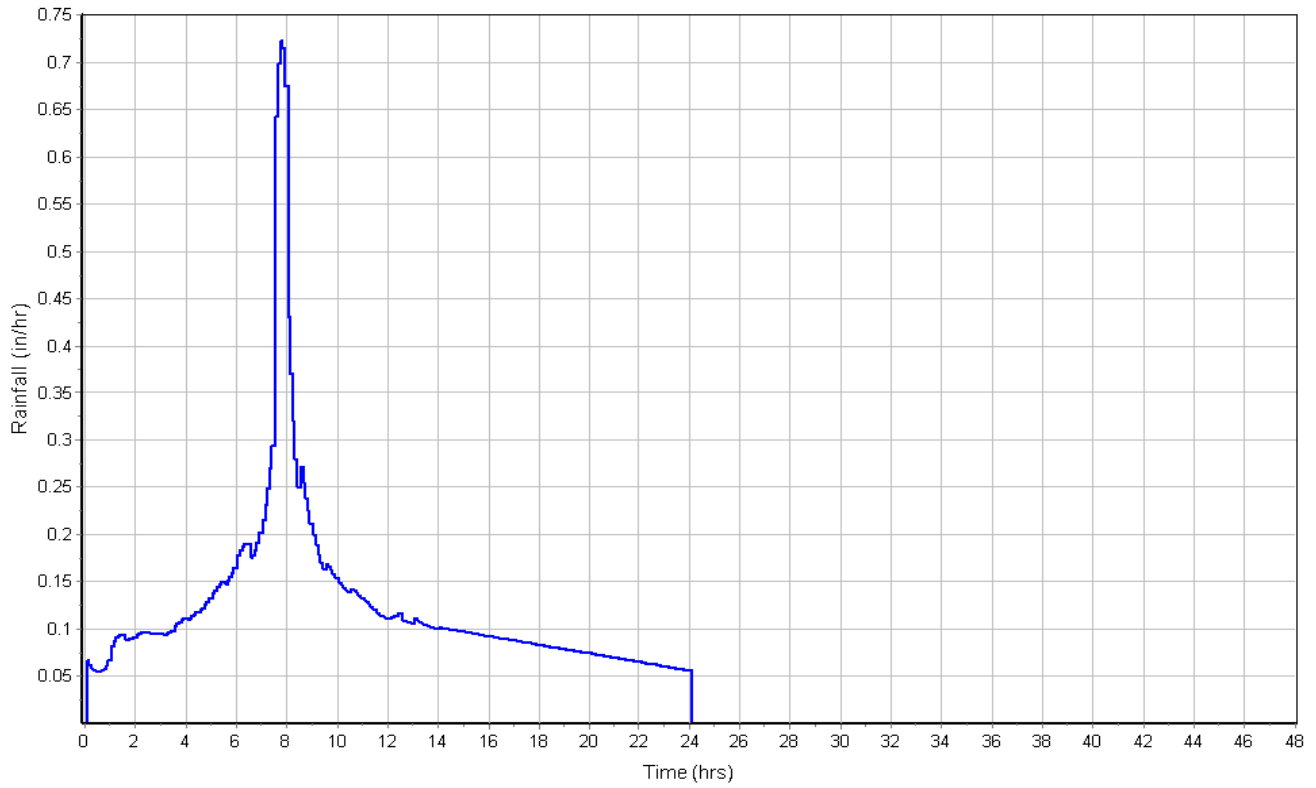
Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	200	0.00	0.00
Slope (%) :	2	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	2.28	0.00	0.00
Computed Flow Time (min) :	1.46	0.00	0.00
Total TOC (min)	17.61		

Subbasin Runoff Results

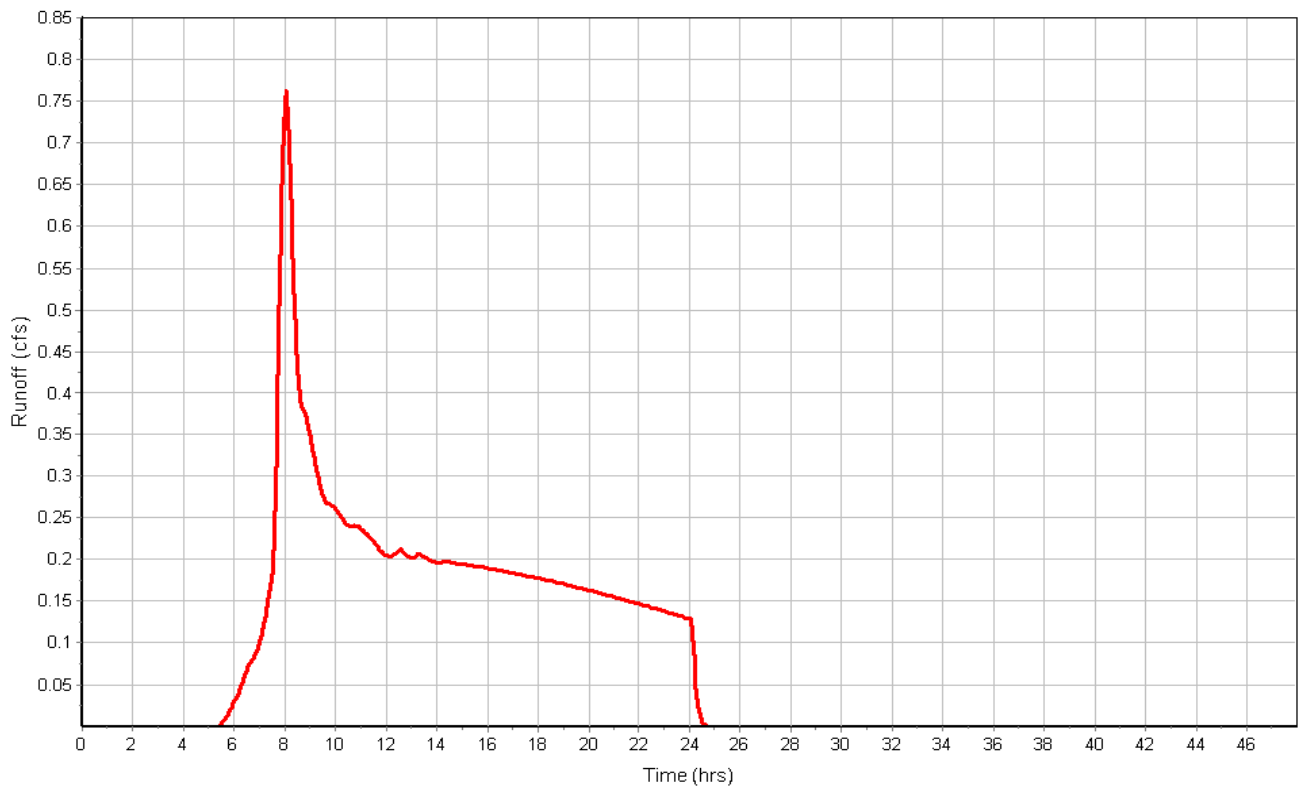
Total Rainfall (in)	3.00
Total Runoff (in)	1.25
Peak Runoff (cfs)	0.76
Weighted Curve Number	80.00
Time of Concentration (days hh:mm:ss)	0 00:17:37

Subbasin : E1/P1

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : E2_E3_E4

Input Data

Area (ac) 12.74
 Weighted Curve Number 80.00
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pasture, grassland, or range, Good	12.74	D	80.00
Composite Area & Weighted CN	12.74		80.00

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.24	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	3	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.5	0.00	0.00
Velocity (ft/sec) :	0.12	0.00	0.00
Computed Flow Time (min) :	13.73	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
	Flow Length (ft) :	500	0.00
Slope (%) :	3	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	2.79	0.00	0.00
Computed Flow Time (min) :	2.99	0.00	0.00

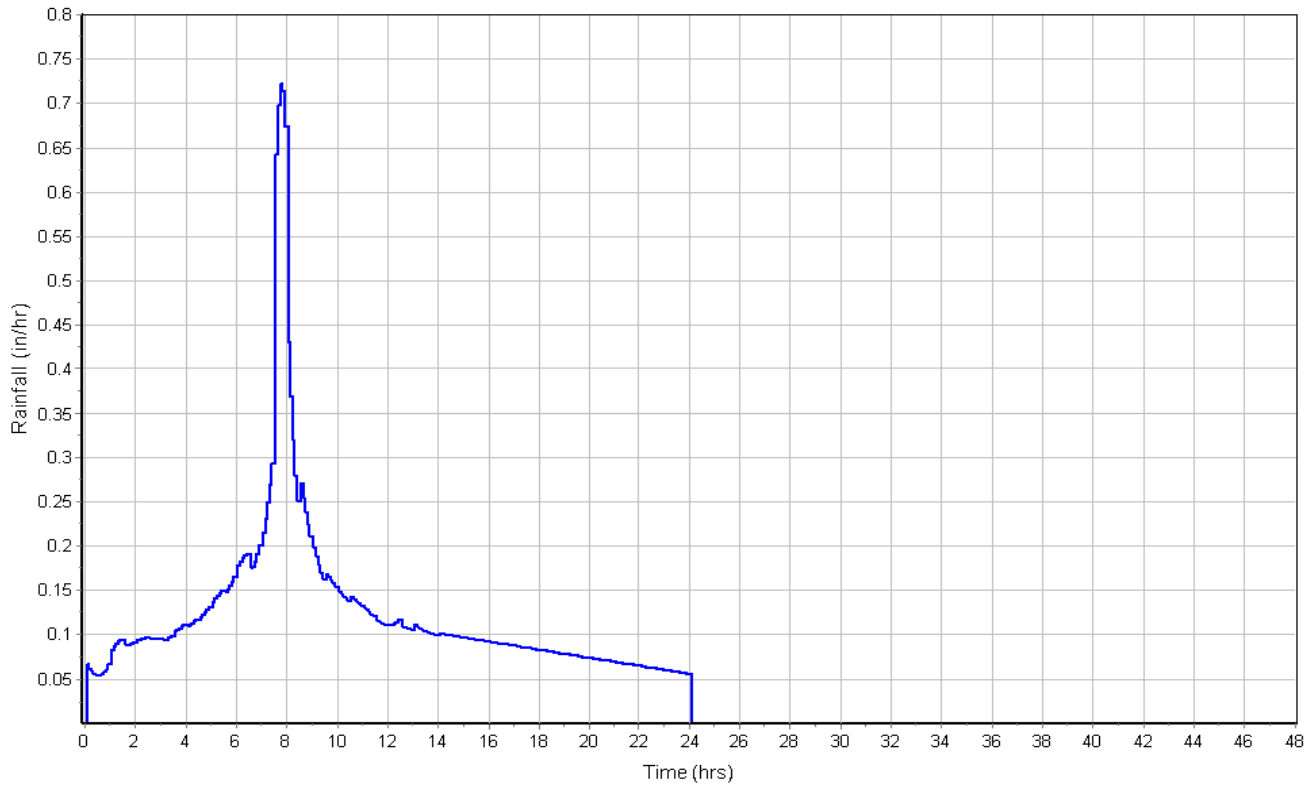
Channel Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.24	0.00
Flow Length (ft) :	300	0.00	0.00
Channel Slope (%) :	3	0.00	0.00
Cross Section Area (ft²) :	12	0.00	0.00
Wetted Perimeter (ft) :	12	0.00	0.00
Velocity (ft/sec) :	1.08	0.00	0.00
Computed Flow Time (min) :	4.65	0.00	0.00
Total TOC (min)	21.36		

Subbasin Runoff Results

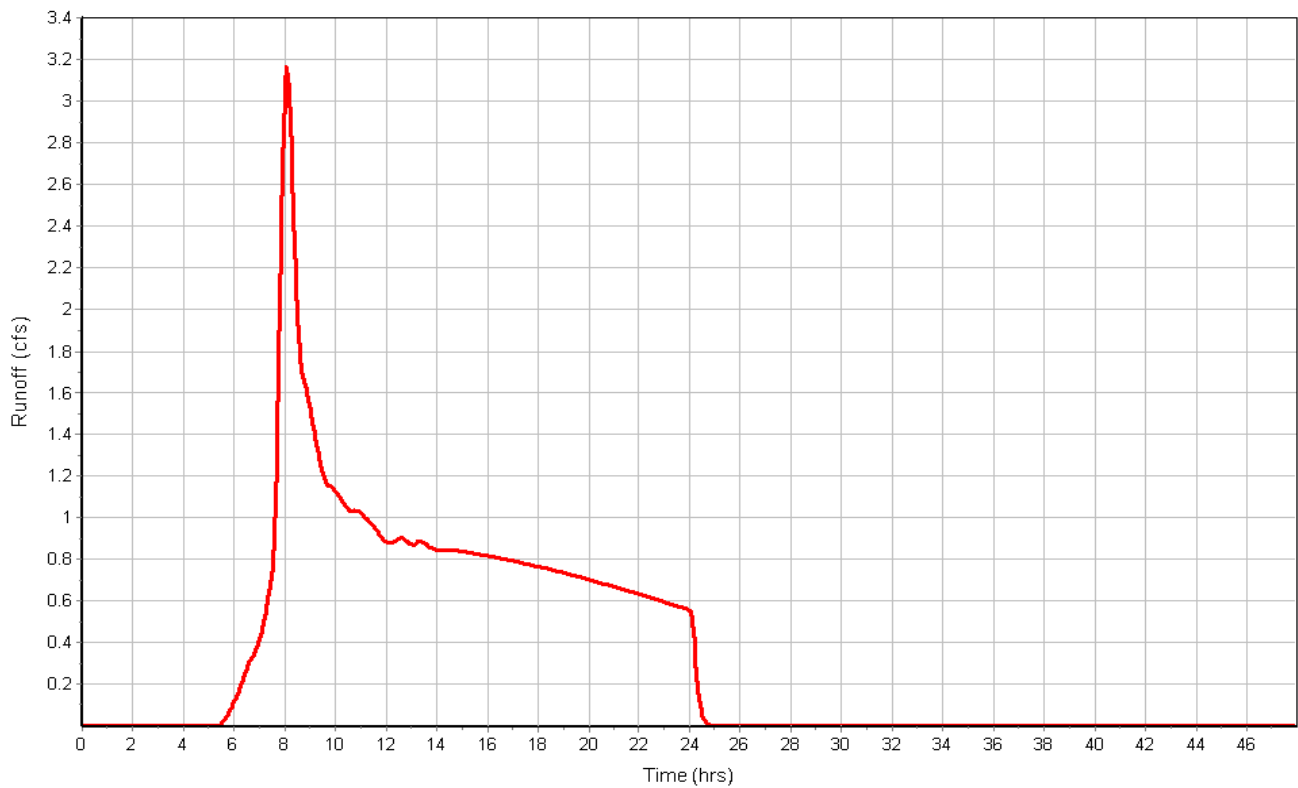
Total Rainfall (in) 3.00
 Total Runoff (in) 1.25
 Peak Runoff (cfs) 3.17
 Weighted Curve Number 80.00
 Time of Concentration (days hh:mm:ss) 0 00:21:22

Subbasin : E2_E3_E4

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : P2

Input Data

Area (ac) 4.46
 Weighted Curve Number 86.74
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	1.67	-	98.00
-	2.79	-	80.00
Composite Area & Weighted CN	4.46		86.74

Time of Concentration

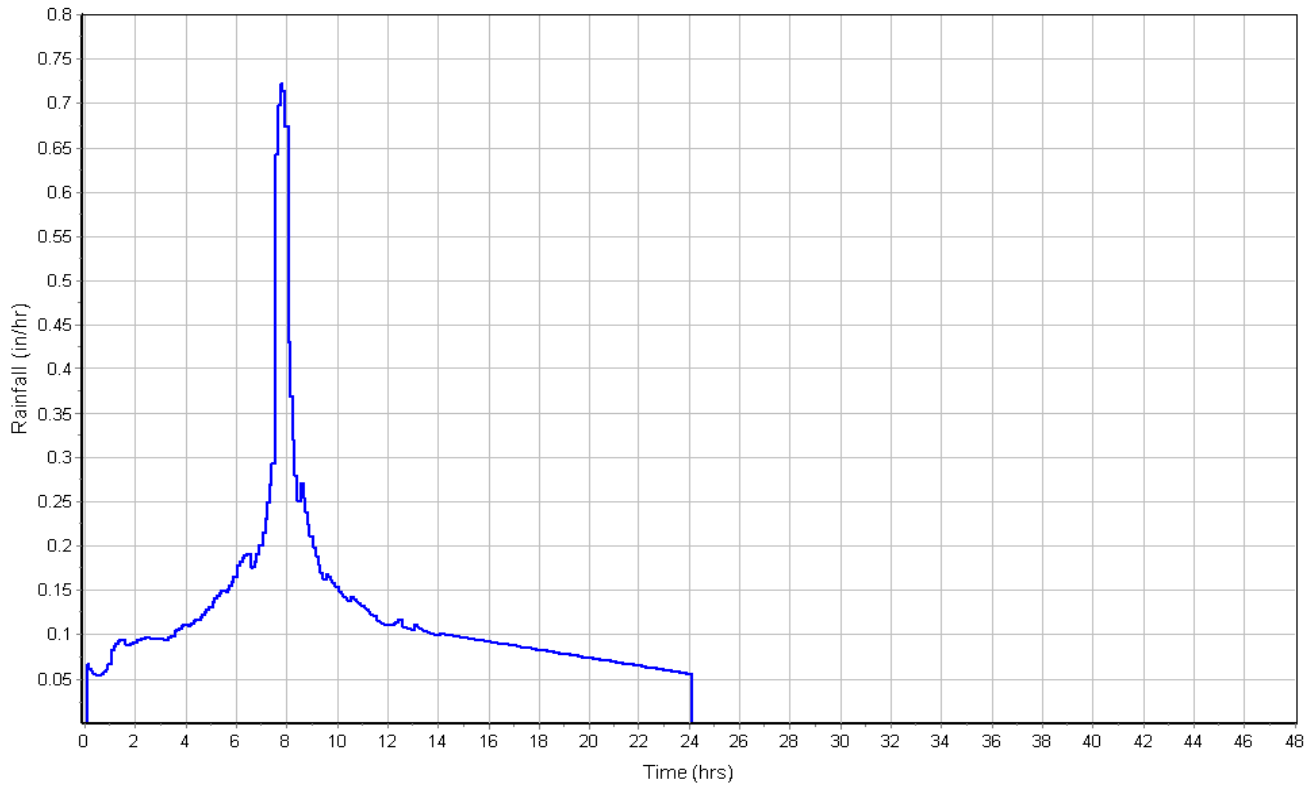
User-Defined TOC override (minutes): 5

Subbasin Runoff Results

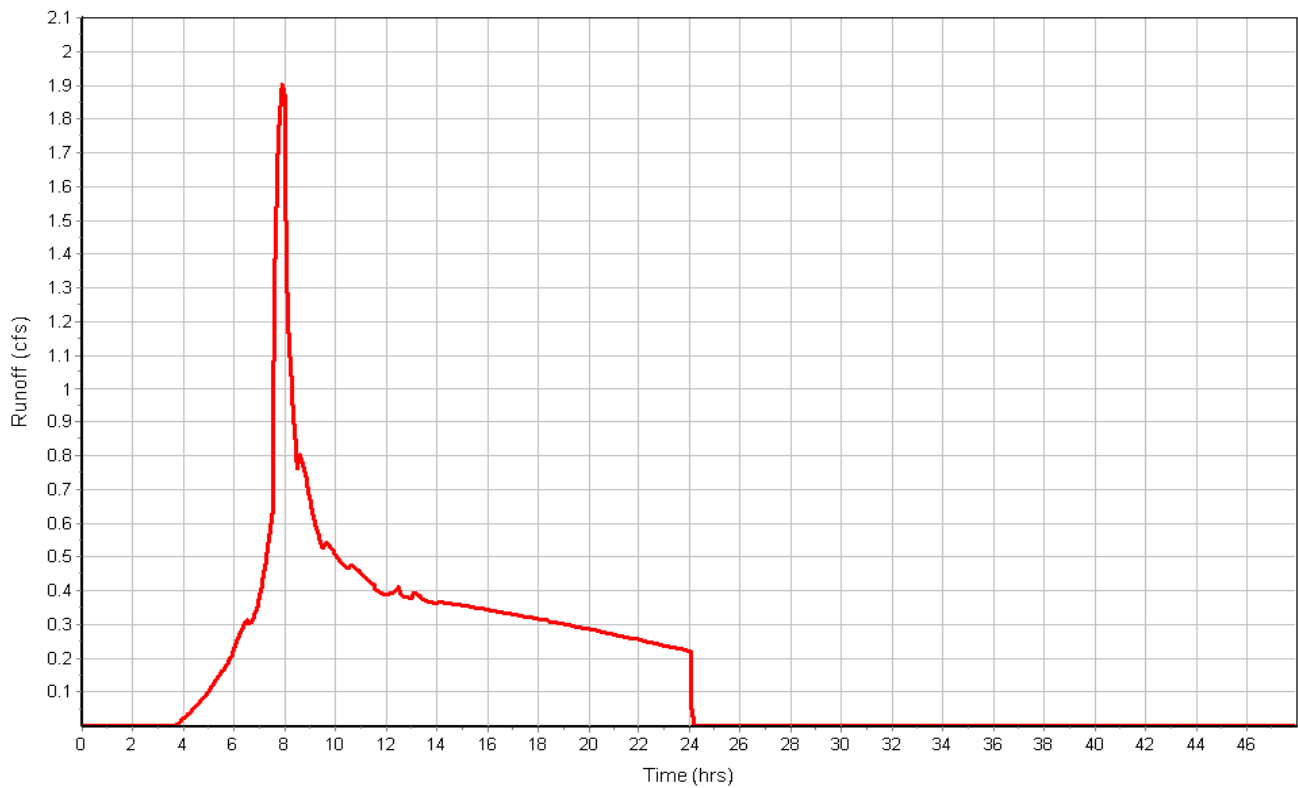
Total Rainfall (in) 3.00
 Total Runoff (in) 1.72
 Peak Runoff (cfs) 1.90
 Weighted Curve Number 86.74
 Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : P2

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : P3

Input Data

Area (ac) 1.72
 Weighted Curve Number 96.01
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	1.53	-	98.00
-	0.19	-	80.00
Composite Area & Weighted CN	1.72		96.01

Time of Concentration

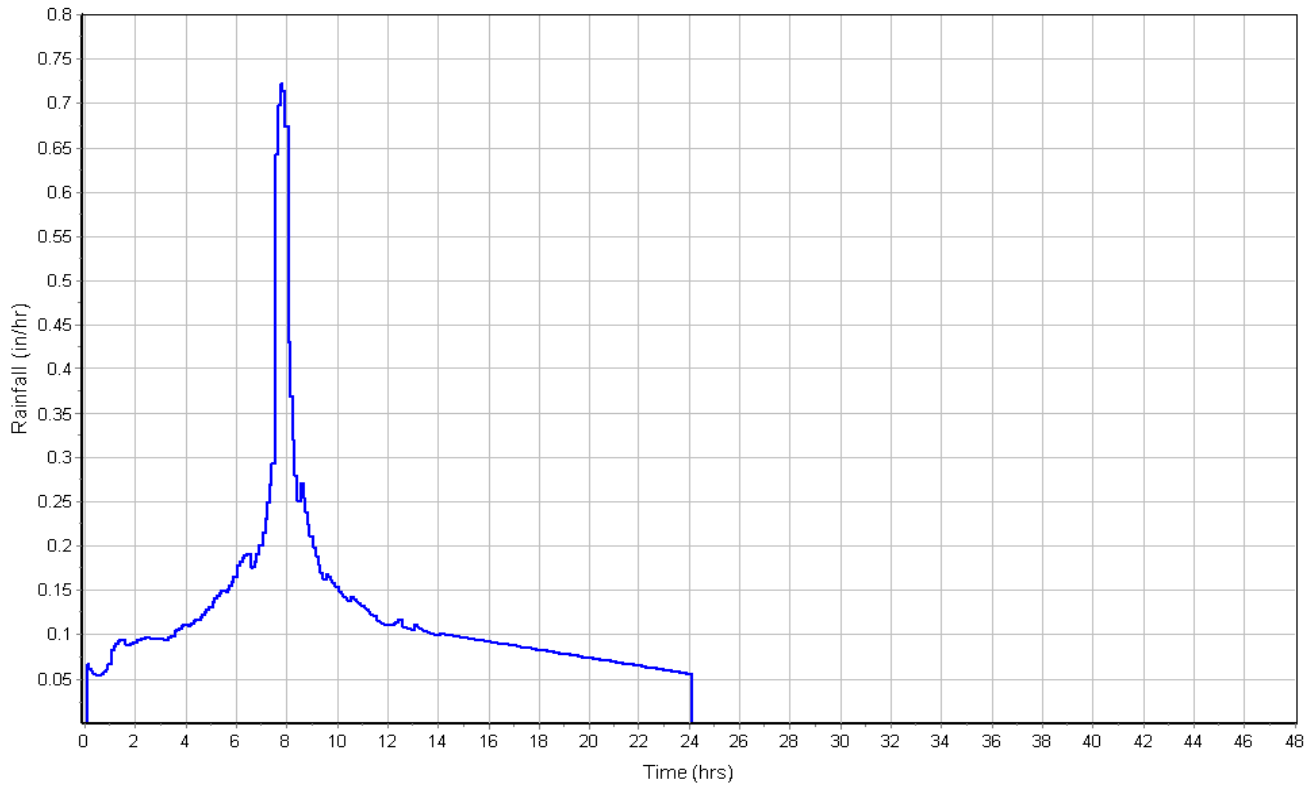
User-Defined TOC override (minutes): 5

Subbasin Runoff Results

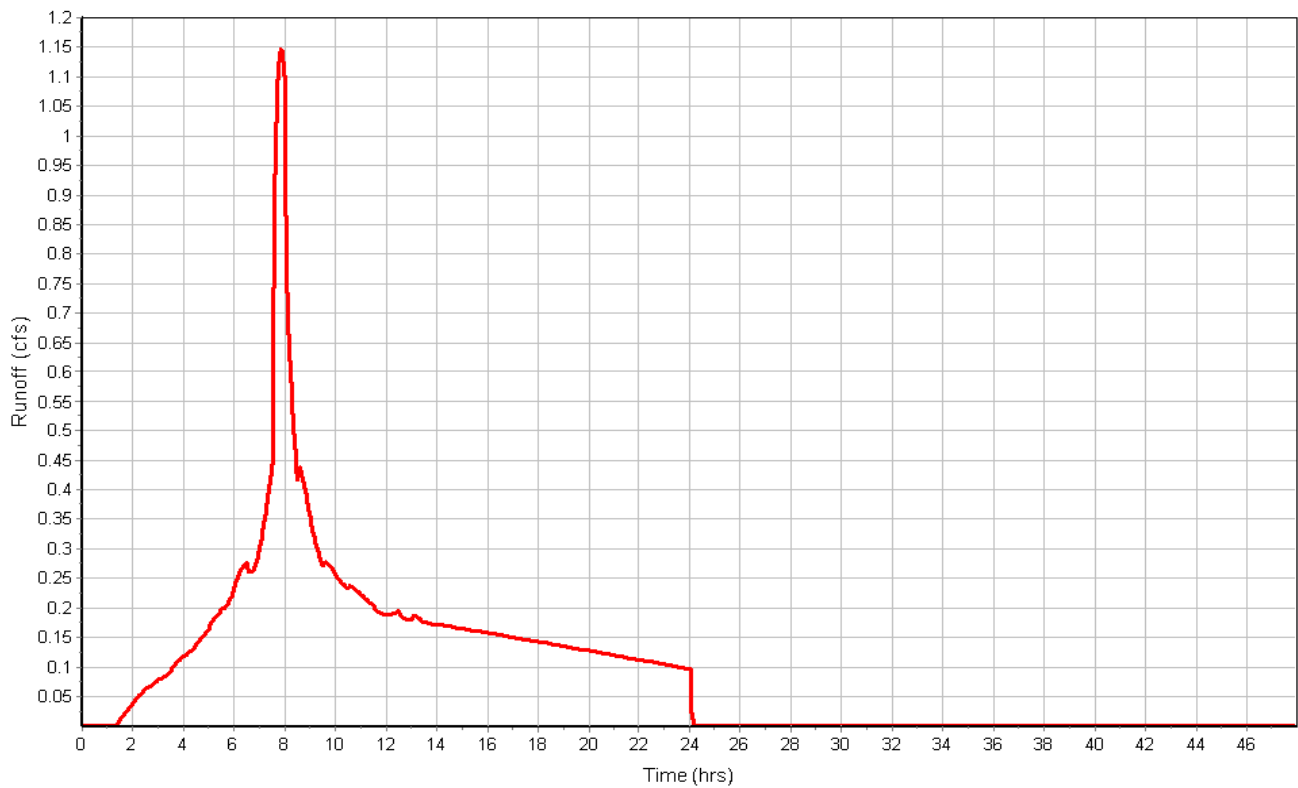
Total Rainfall (in) 3.00
 Total Runoff (in) 2.55
 Peak Runoff (cfs) 1.15
 Weighted Curve Number 96.01
 Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : P3

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : P4

Input Data

Area (ac) 6.56
 Weighted Curve Number 80.00
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	9.91	D	80.00
Composite Area & Weighted CN	9.91		80.00

Time of Concentration

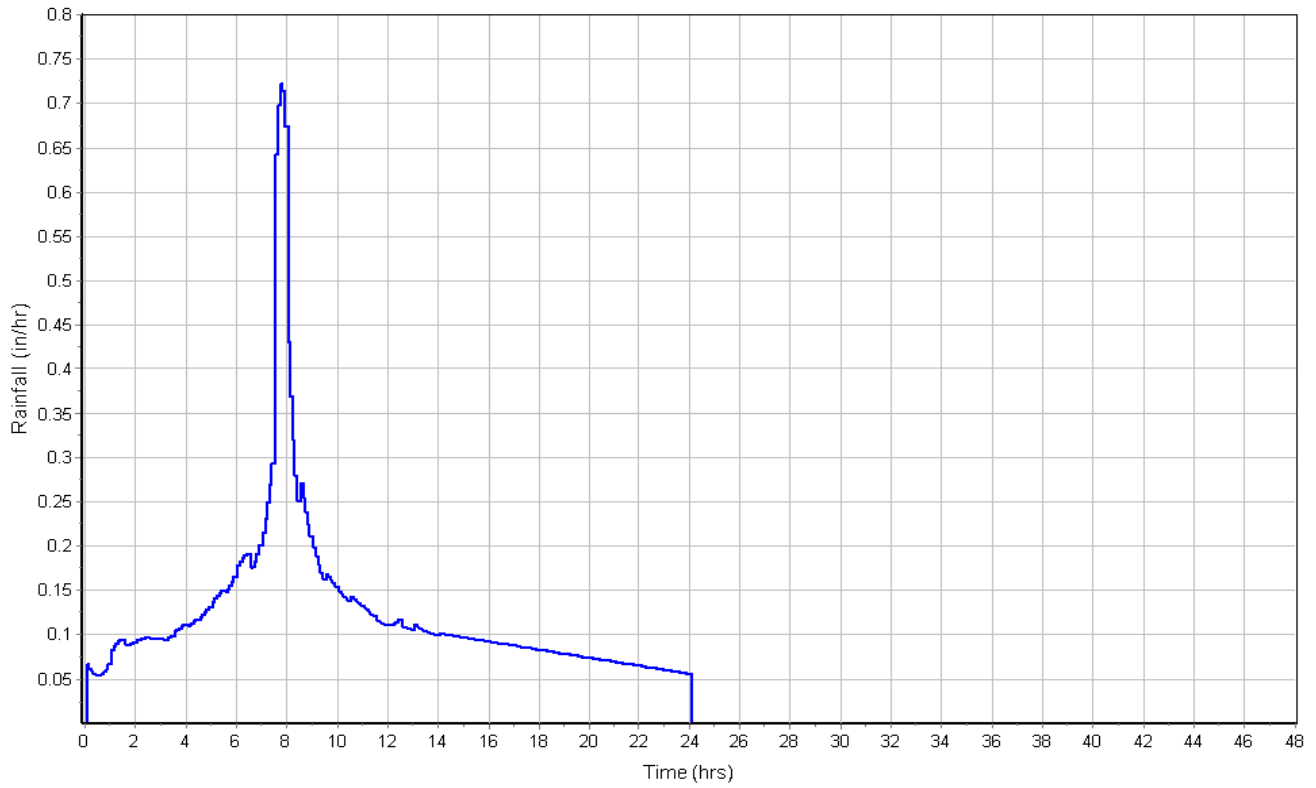
User-Defined TOC override (minutes): 16.71

Subbasin Runoff Results

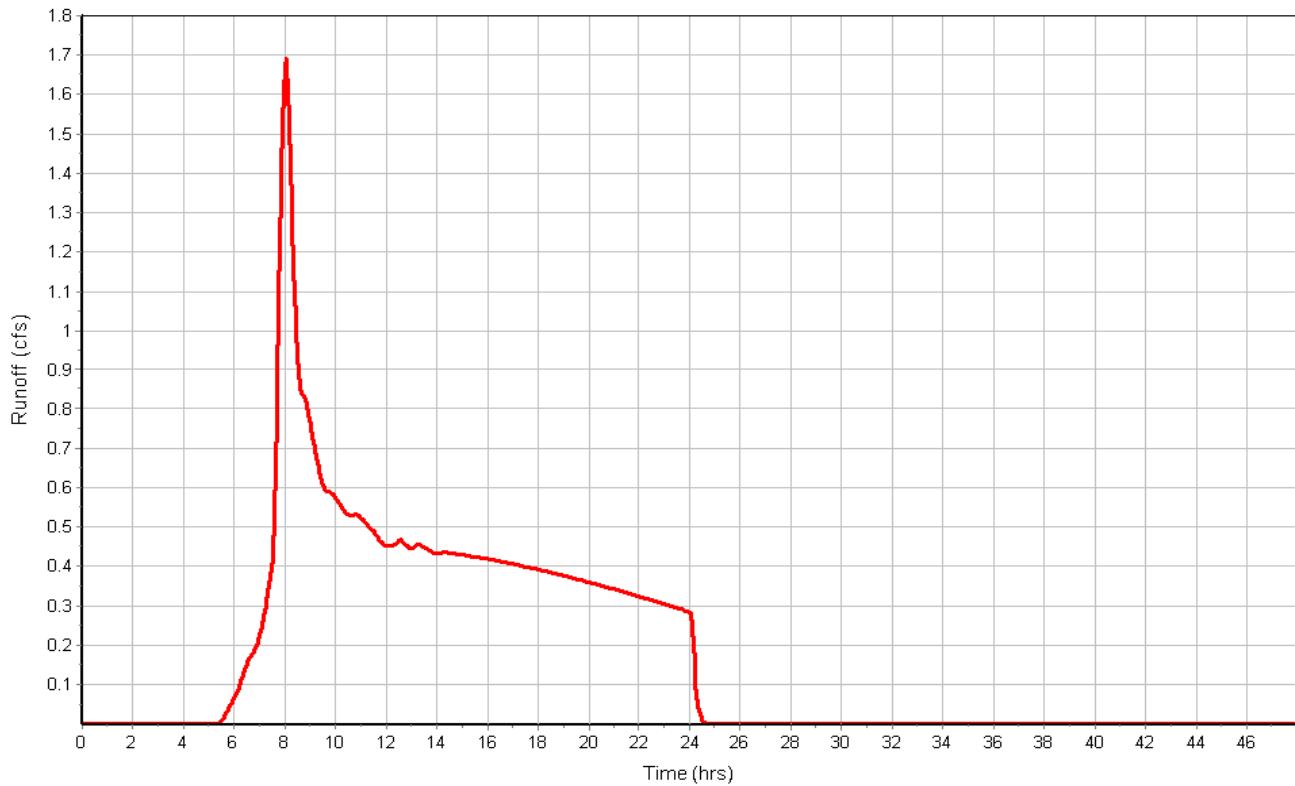
Total Rainfall (in) 3.00
 Total Runoff (in) 1.25
 Peak Runoff (cfs) 1.70
 Weighted Curve Number 80.00
 Time of Concentration (days hh:mm:ss) 0 00:16:43

Subbasin : P4

Rainfall Intensity Graph



Runoff Hydrograph



Storage Nodes

Storage Node : Det-Basin

Input Data

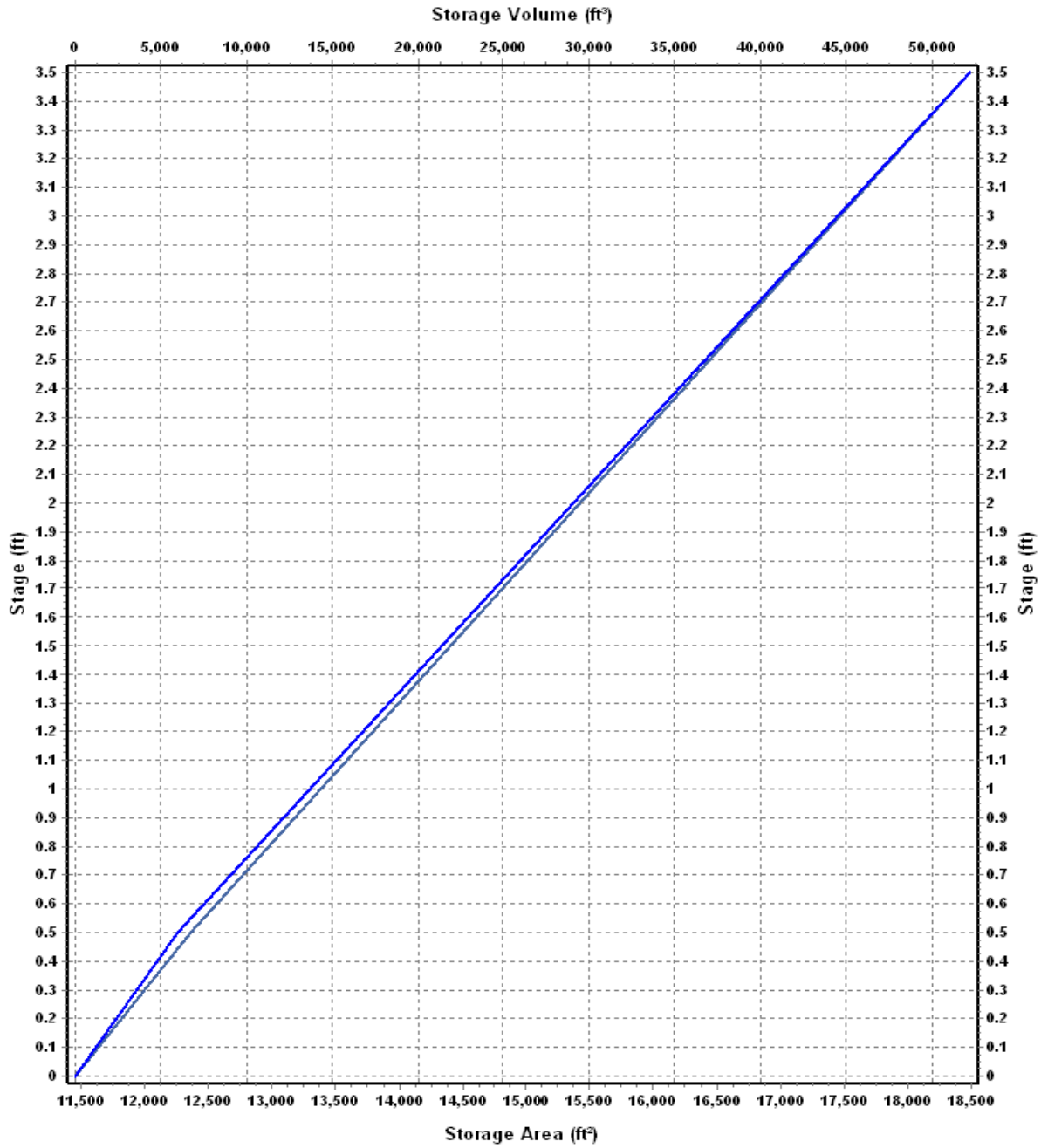
Invert Elevation (ft) 322.50
 Max (Rim) Elevation (ft) 326.00
 Max (Rim) Offset (ft) 3.50
 Initial Water Elevation (ft) 322.50
 Initial Water Depth (ft) 0.00
 Ponded Area (ft²) 12.00
 Evaporation Loss 0.00

Storage Area Volume Curves

Storage Curve : Detention_Basin

Stage (ft)	Storage Area (ft ²)	Storage Volume (ft ³)
0	11460	0.000
0.5	12362	5955.50
3.5	18484	52224.50

Storage Area Volume Curves



— Storage Area — Storage Volume

Storage Node : Det-Basin (continued)

Output Summary Results

Peak Inflow (cfs)	4.62
Peak Lateral Inflow (cfs)	1.69
Peak Outflow (cfs)	2.29
Peak Exfiltration Flow Rate (cfm)	0.00
Max HGL Elevation Attained (ft)	323.63
Max HGL Depth Attained (ft)	1.13
Average HGL Elevation Attained (ft)	323.10
Average HGL Depth Attained (ft)	0.6
Time of Max HGL Occurrence (days hh:mm)	0 08:31
Total Exfiltration Volume (1000-ft³)	0.000
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00

Project Description

File Name 20190920-Model.SPF

Project Options

Flow Units CFS
 Elevation Type Elevation
 Hydrology Method SCS TR-55
 Time of Concentration (TOC) Method SCS TR-55
 Link Routing Method Hydrodynamic
 Enable Overflow Ponding at Nodes YES
 Skip Steady State Analysis Time Periods YES

Analysis Options

Start Analysis On Sep 21, 2019 00:00:00
 End Analysis On Sep 23, 2019 00:00:00
 Start Reporting On Sep 21, 2019 00:00:00
 Antecedent Dry Days 0 days
 Runoff (Dry Weather) Time Step 0 01:00:00 days hh:mm:ss
 Runoff (Wet Weather) Time Step 0 00:05:00 days hh:mm:ss
 Reporting Time Step 0 00:05:00 days hh:mm:ss
 Routing Time Step 1 seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins.....	5
Nodes.....	8
<i>Junctions</i>	4
<i>Outfalls</i>	3
<i>Flow Diversions</i>	0
<i>Inlets</i>	0
<i>Storage Nodes</i>	1
Links.....	7
<i>Channels</i>	3
<i>Pipes</i>	4
<i>Pumps</i>	0
<i>Orifices</i>	0
<i>Weirs</i>	0
<i>Outlets</i>	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	Rain Gage-01	Time Series	TS-010	Intensity	inches	Oregon	Yamhill	10	3.50	SCS Type IA 24-hr

Subbasin Summary

SN	Subbasin ID	Area	Total Runoff	Total Runoff Volume	Peak Runoff
		(ac)	(in)	(ac-in)	(cfs)
1	E1/P1	2.97	1.64	4.86	1.06
2	E2_E3_E4	12.74	1.64	20.84	4.40
3	P2	4.46	2.16	9.63	2.44
4	P3	1.72	3.05	5.24	1.36
5	P4	6.56	1.64	10.73	2.35

Node Summary

SN Element ID	Element Type	Invert Elevation	Ground/Rim (Max) Elevation	Initial Water Elevation	Surcharge Elevation	Ponded Area	Peak Inflow	Max HGL Elevation Attained	Max Surcharge Depth Attained	Min Freeboard Attained	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded	
		(ft)	(ft)	(ft)	(ft)	(ft²)	(cfs)	(ft)	(ft)	(ft)	(days hh:mm)	(ac-in)	(min)	
1	REV-Swale-End	Junction	320.52	330.00	320.52	330.00	12.00	3.51	321.42	0.00	8.58	0 00:00	0.00	0.00
2	REV-Swale-Start	Junction	322.50	330.00	322.50	330.00	12.00	3.52	323.02	0.00	6.98	0 00:00	0.00	0.00
3	SD(5)	Junction	334.15	339.85	334.15	340.00	12.00	1.36	334.45	0.00	5.40	0 00:00	0.00	0.00
4	SD(6)	Junction	324.36	330.00	324.36	330.00	12.00	3.80	324.48	0.00	5.52	0 00:00	0.00	0.00
5	Out-PRE-East	Outfall	325.00					1.05	325.00					
6	Out-PRE-West	Outfall	316.16					4.39	316.16					
7	Out-REV-POST-West	Outfall	316.16					3.51	316.55					
8	Det-Basin	Storage Node	322.50	326.00	322.50		12.00	5.99	323.81			0.00	0.00	

Link Summary

SN Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged (min)
1	Ditch-Inlet	Pipe Det-Basin	REV-Swale-Start	5.00	323.17	322.50	13.4000	12.000	0.0150	3.29	11.30	0.29	6.94	0.58	0.58	0.00
2	Orifice	Pipe Det-Basin	REV-Swale-Start	5.00	322.50	322.50	0.0000	2.900	0.0130	0.23	0.01	20.08	5.00	0.24	1.00	914.00
3	REV-Swale-Discharge	Pipe REV-Swale-End	Out-REV-POST-West	68.56	321.00	316.16	7.0600	18.000	0.0150	3.51	24.19	0.15	9.16	0.40	0.27	0.00
4	SD5_SD6	Pipe SD(5)	SD(6)	96.00	334.15	324.36	10.2000	10.000	0.0130	1.36	7.00	0.19	12.70	0.21	0.25	0.00
5	HF_Bypass	Channel Det-Basin	REV-Swale-Start	5.00	323.90	322.50	28.0000	24.000	0.0320	0.00	263.60	0.00	0.00	0.26	0.13	0.00
6	Link-22	Channel SD(6)	Det-Basin	5.00	324.36	322.50	37.2000	60.000	0.0320	3.80	995.36	0.00	1.33	0.69	0.14	0.00
7	REV-Swale	Channel REV-Swale-Start	REV-Swale-End	100.00	322.50	320.52	1.9800	18.000	0.2400	3.51	31.07	0.11	0.85	0.71	0.47	0.00

Reported
Condition

Calculated
SURCHARGED
Calculated
Calculated

Subbasin Hydrology

Subbasin : E1/P1

Input Data

Area (ac) 2.97
 Weighted Curve Number 80.00
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pasture, grassland, or range, Good	2.97	D	80.00
Composite Area & Weighted CN	2.97		80.00

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8}) / ((P^{0.5}) * (S_f^{0.4})))$$

Where :

T_c = Time of Concentration (hr)
 n = Manning's roughness
 L_f = Flow Length (ft)
 P = 2 yr, 24 hr Rainfall (inches)
 S_f = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (S_f^{0.5}) (unpaved surface)
 V = 20.3282 * (S_f^{0.5}) (paved surface)
 V = 15.0 * (S_f^{0.5}) (grassed waterway surface)
 V = 10.0 * (S_f^{0.5}) (nearly bare & untilled surface)
 V = 9.0 * (S_f^{0.5}) (cultivated straight rows surface)
 V = 7.0 * (S_f^{0.5}) (short grass pasture surface)
 V = 5.0 * (S_f^{0.5}) (woodland surface)
 V = 2.5 * (S_f^{0.5}) (forest w/heavy litter surface)
 T_c = (L_f / V) / (3600 sec/hr)

Where:

T_c = Time of Concentration (hr)
 L_f = Flow Length (ft)
 V = Velocity (ft/sec)
 S_f = Slope (ft/ft)

Channel Flow Equation :

$$V = (1.49 * (R^{2/3}) * (S_f^{0.5})) / n$$

R = A_q / W_p
 T_c = (L_f / V) / (3600 sec/hr)

Where :

T_c = Time of Concentration (hr)
 L_f = Flow Length (ft)
 R = Hydraulic Radius (ft)
 A_q = Flow Area (ft²)
 W_p = Wetted Perimeter (ft)
 V = Velocity (ft/sec)
 S_f = Slope (ft/ft)
 n = Manning's roughness

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.24	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.5	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	16.14	0.00	0.00

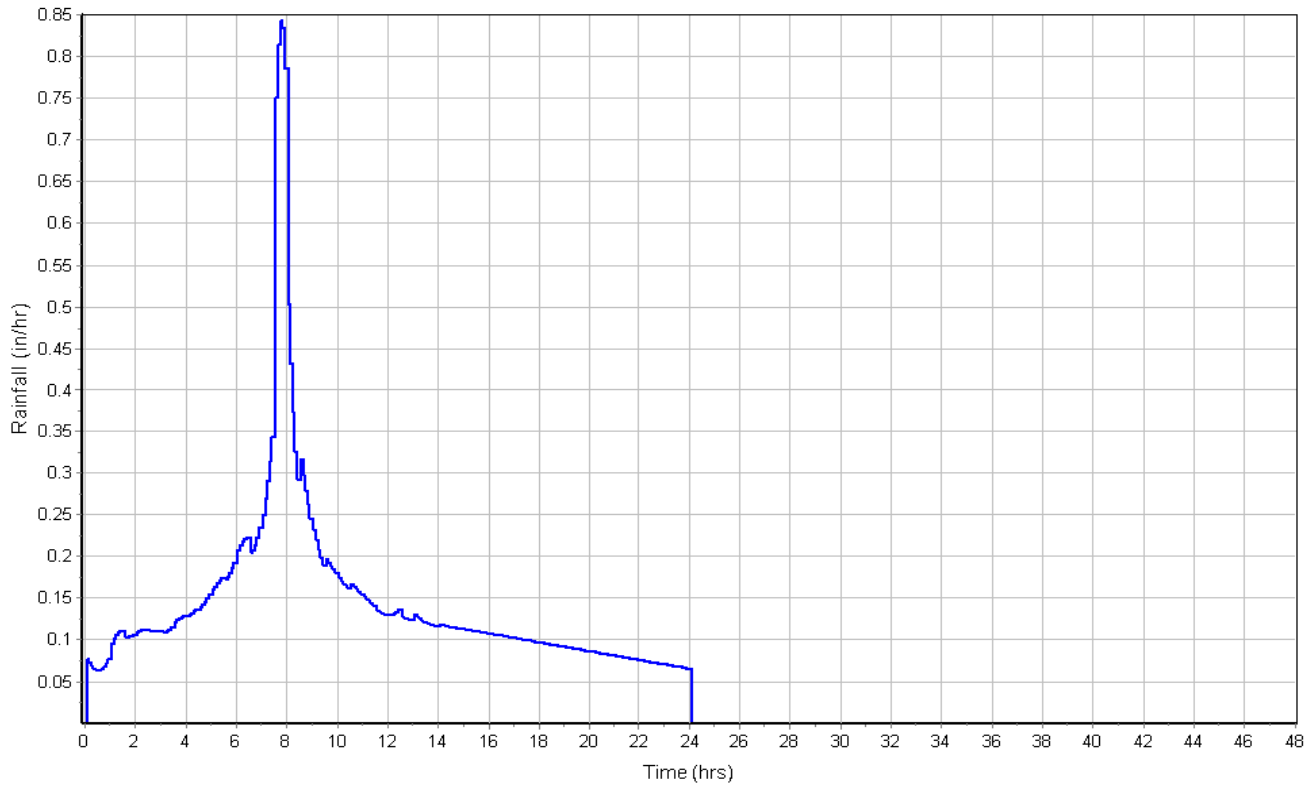
Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	200	0.00	0.00
Slope (%) :	2	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	2.28	0.00	0.00
Computed Flow Time (min) :	1.46	0.00	0.00
Total TOC (min)	17.61		

Subbasin Runoff Results

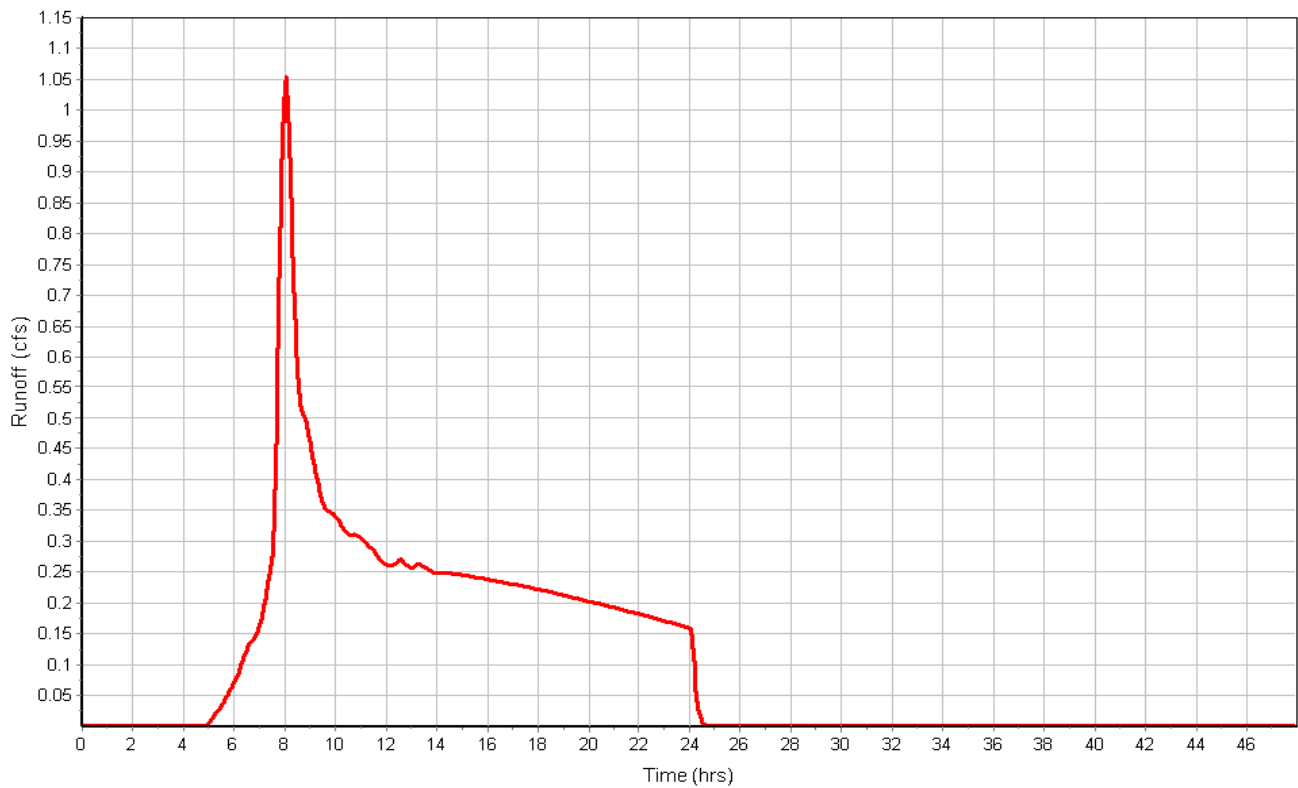
Total Rainfall (in)	3.50
Total Runoff (in)	1.64
Peak Runoff (cfs)	1.06
Weighted Curve Number	80.00
Time of Concentration (days hh:mm:ss)	0 00:17:37

Subbasin : E1/P1

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : E2_E3_E4

Input Data

Area (ac) 12.74
 Weighted Curve Number 80.00
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pasture, grassland, or range, Good	12.74	D	80.00
Composite Area & Weighted CN	12.74		80.00

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.24	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	3	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.5	0.00	0.00
Velocity (ft/sec) :	0.12	0.00	0.00
Computed Flow Time (min) :	13.73	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
	Flow Length (ft) :	500	0.00
Slope (%) :	3	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	2.79	0.00	0.00
Computed Flow Time (min) :	2.99	0.00	0.00

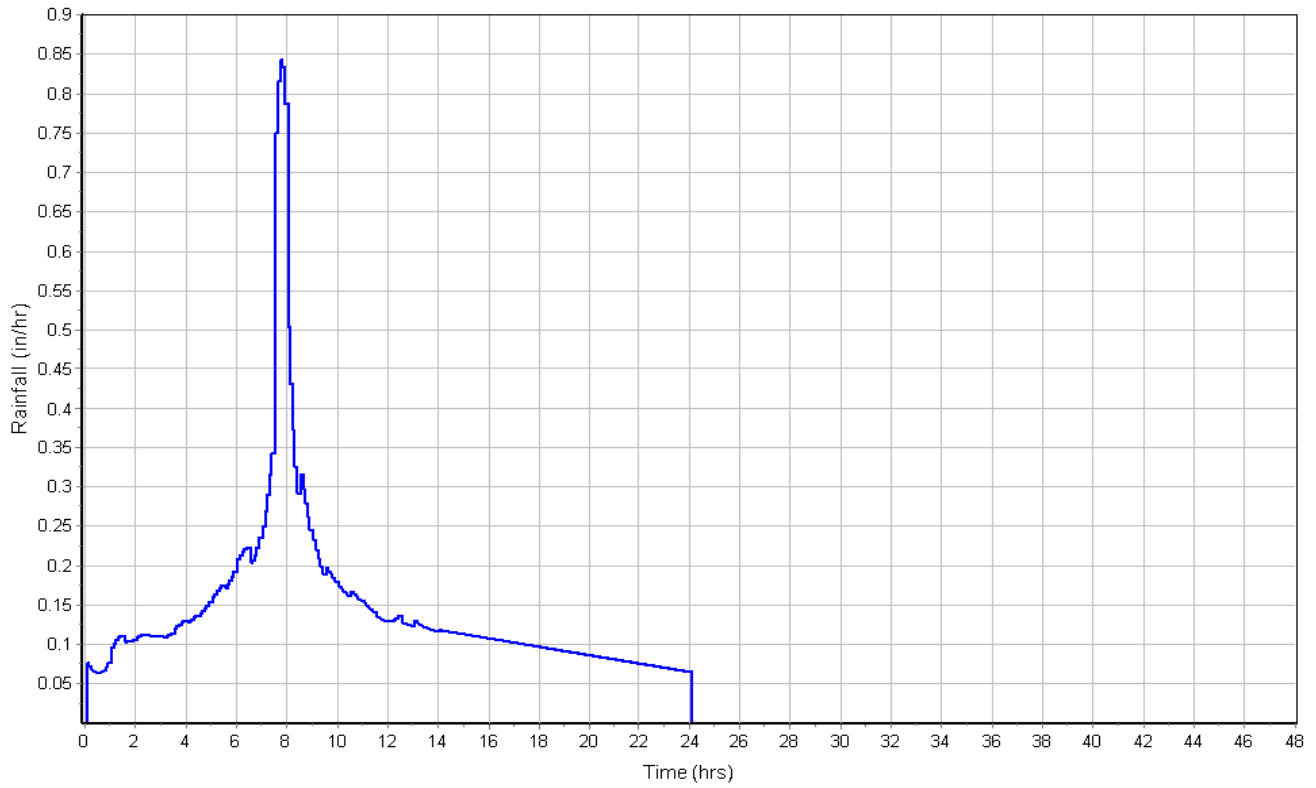
Channel Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.24	0.00
Flow Length (ft) :	300	0.00	0.00
Channel Slope (%) :	3	0.00	0.00
Cross Section Area (ft²) :	12	0.00	0.00
Wetted Perimeter (ft) :	12	0.00	0.00
Velocity (ft/sec) :	1.08	0.00	0.00
Computed Flow Time (min) :	4.65	0.00	0.00
Total TOC (min)	21.36		

Subbasin Runoff Results

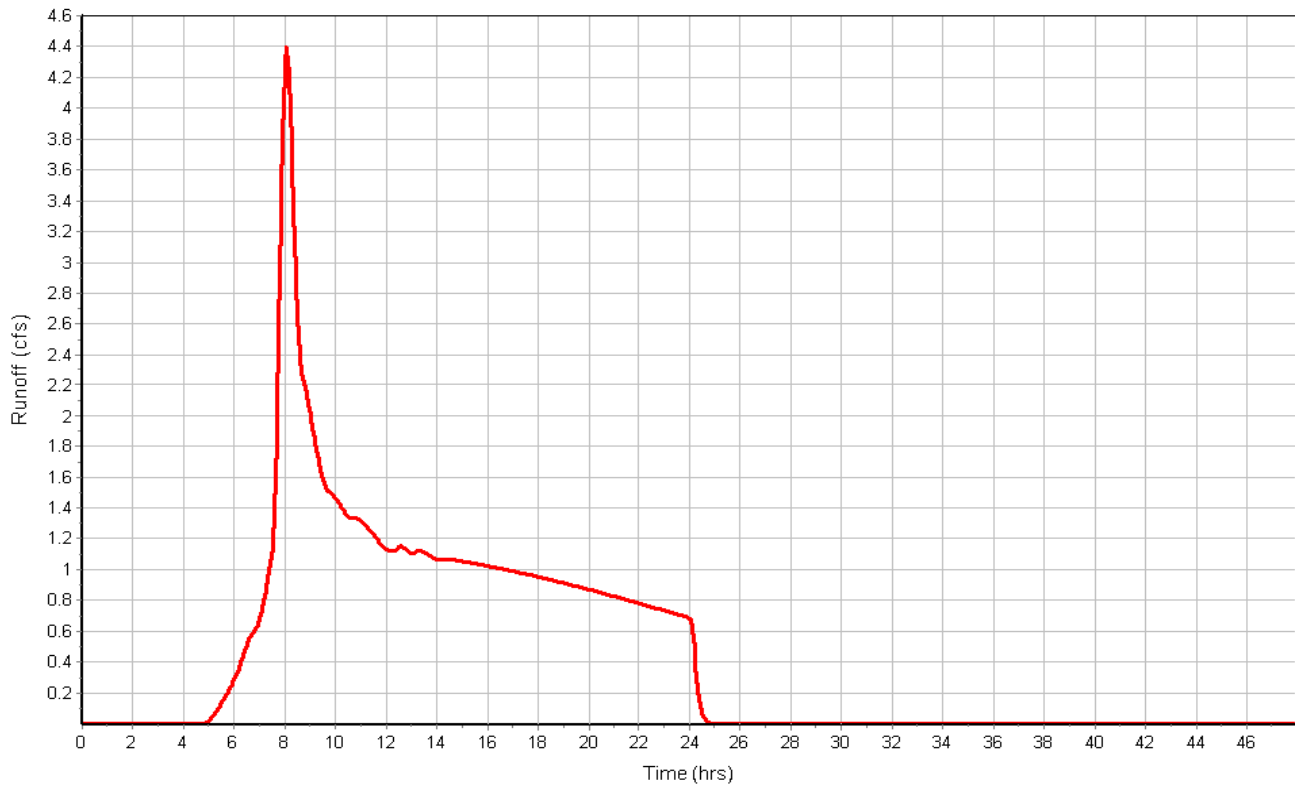
Total Rainfall (in) 3.50
 Total Runoff (in) 1.64
 Peak Runoff (cfs) 4.40
 Weighted Curve Number 80.00
 Time of Concentration (days hh:mm:ss) 0 00:21:22

Subbasin : E2_E3_E4

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : P2

Input Data

Area (ac) 4.46
 Weighted Curve Number 86.74
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	1.67	-	98.00
-	2.79	-	80.00
Composite Area & Weighted CN	4.46		86.74

Time of Concentration

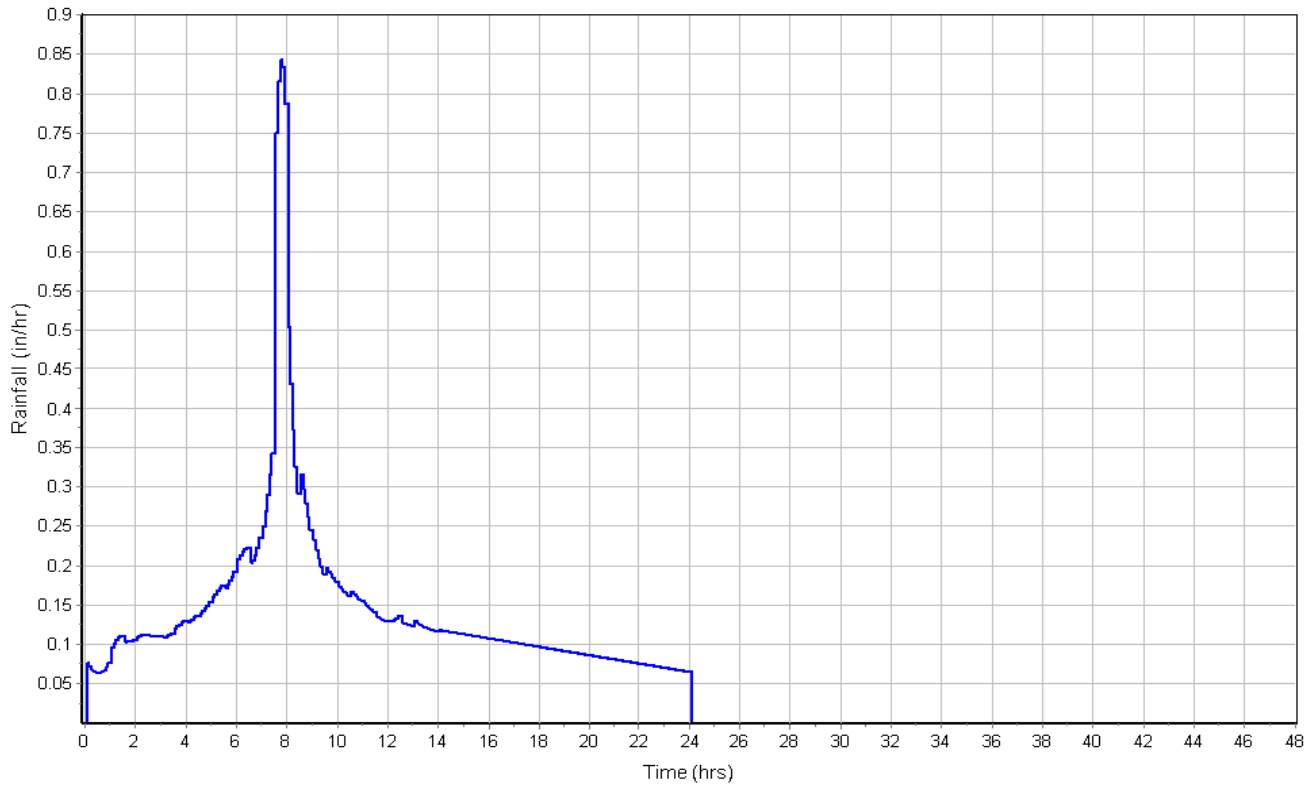
User-Defined TOC override (minutes): 5

Subbasin Runoff Results

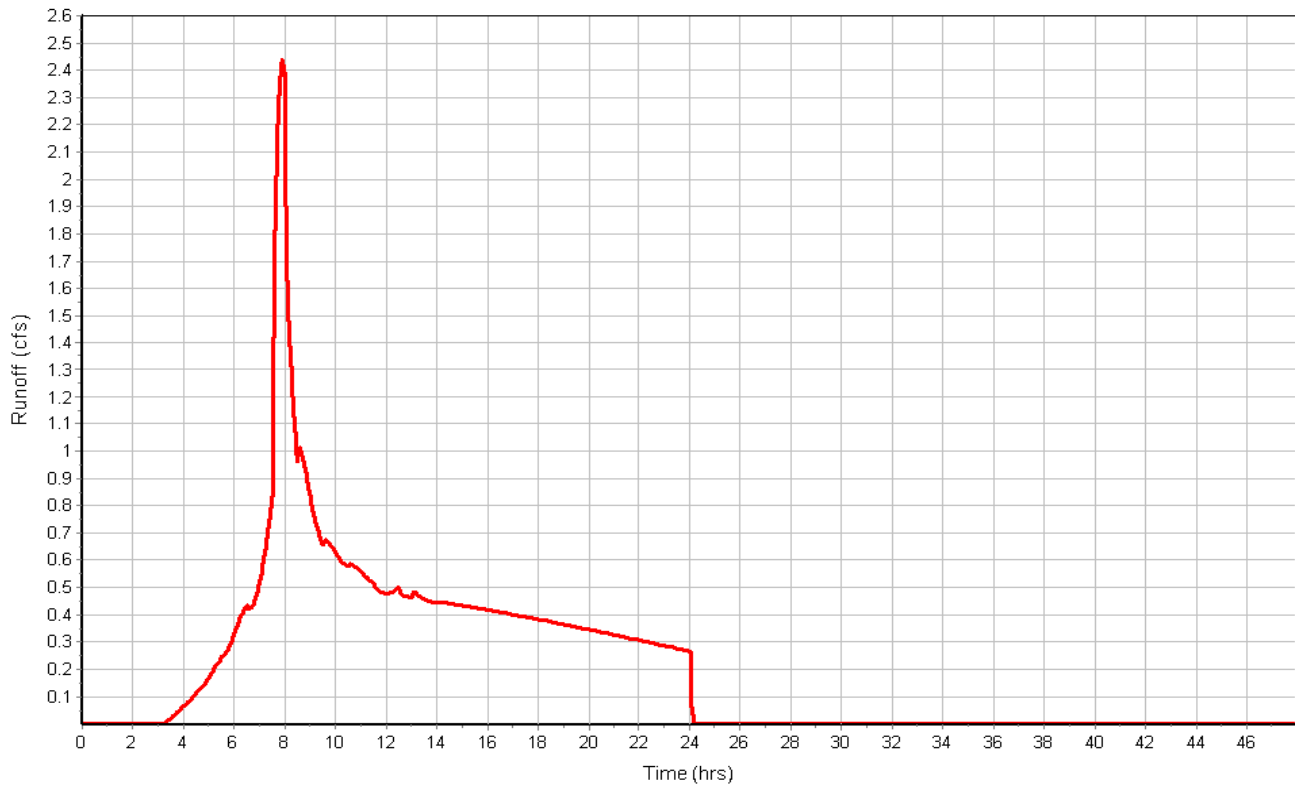
Total Rainfall (in) 3.50
 Total Runoff (in) 2.16
 Peak Runoff (cfs) 2.44
 Weighted Curve Number 86.74
 Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : P2

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : P3

Input Data

Area (ac) 1.72
 Weighted Curve Number 96.01
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	1.53	-	98.00
-	0.19	-	80.00
Composite Area & Weighted CN	1.72		96.01

Time of Concentration

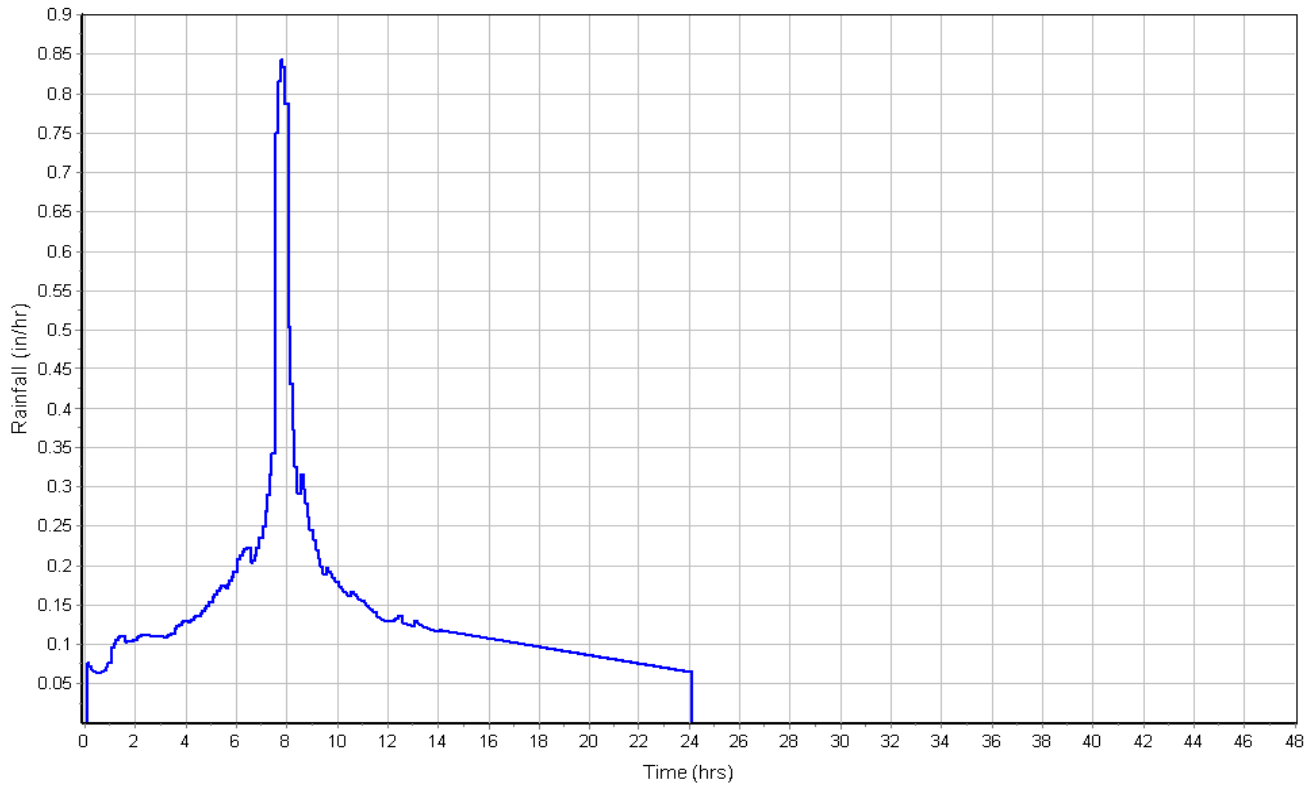
User-Defined TOC override (minutes): 5

Subbasin Runoff Results

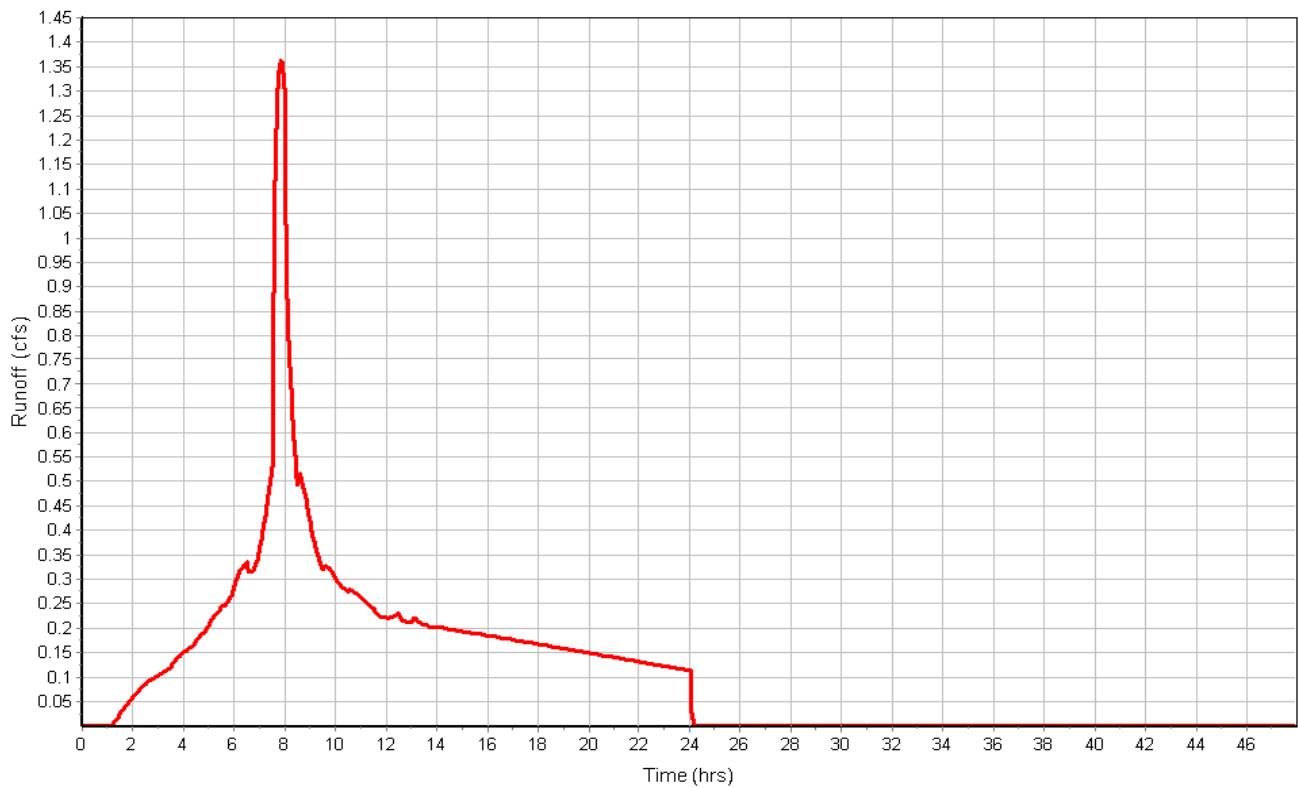
Total Rainfall (in) 3.50
 Total Runoff (in) 3.05
 Peak Runoff (cfs) 1.36
 Weighted Curve Number 96.01
 Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : P3

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : P4

Input Data

Area (ac) 6.56
 Weighted Curve Number 80.00
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	9.91	D	80.00
Composite Area & Weighted CN	9.91		80.00

Time of Concentration

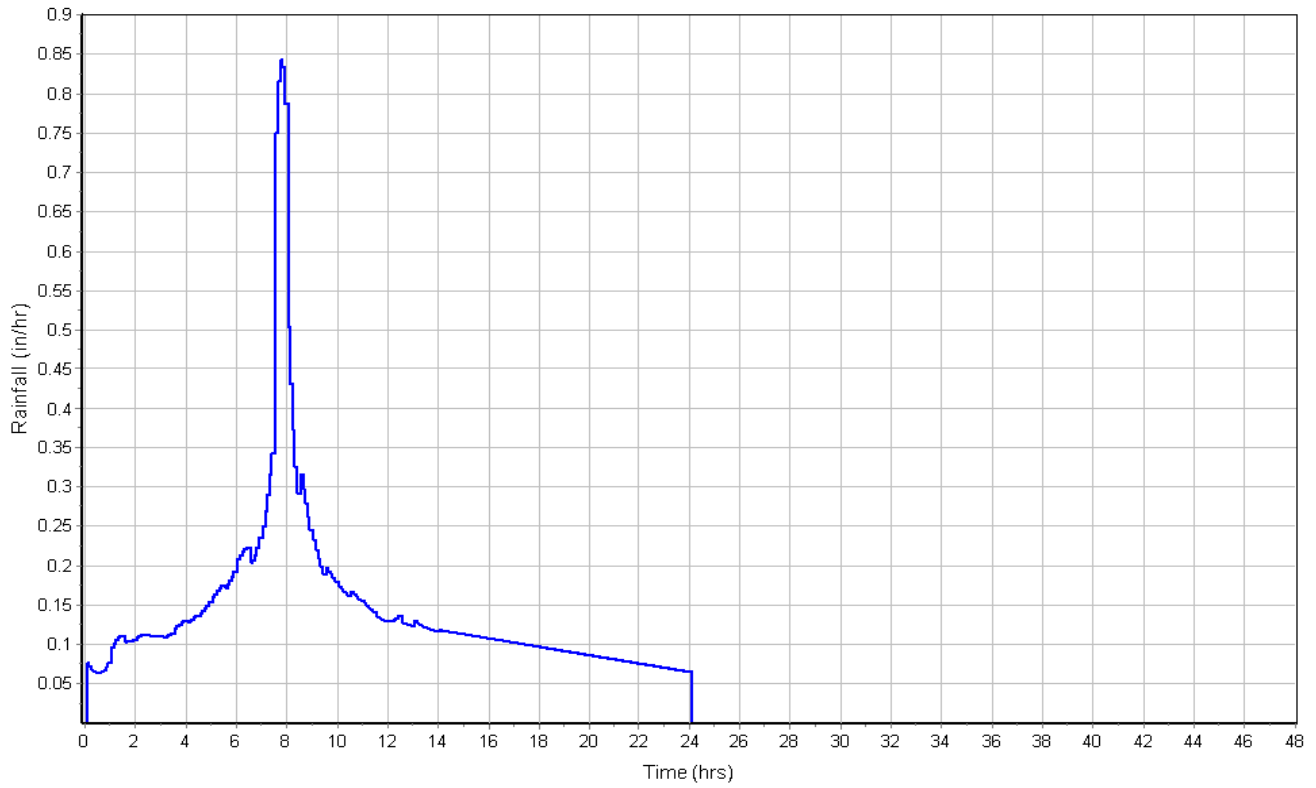
User-Defined TOC override (minutes): 16.71

Subbasin Runoff Results

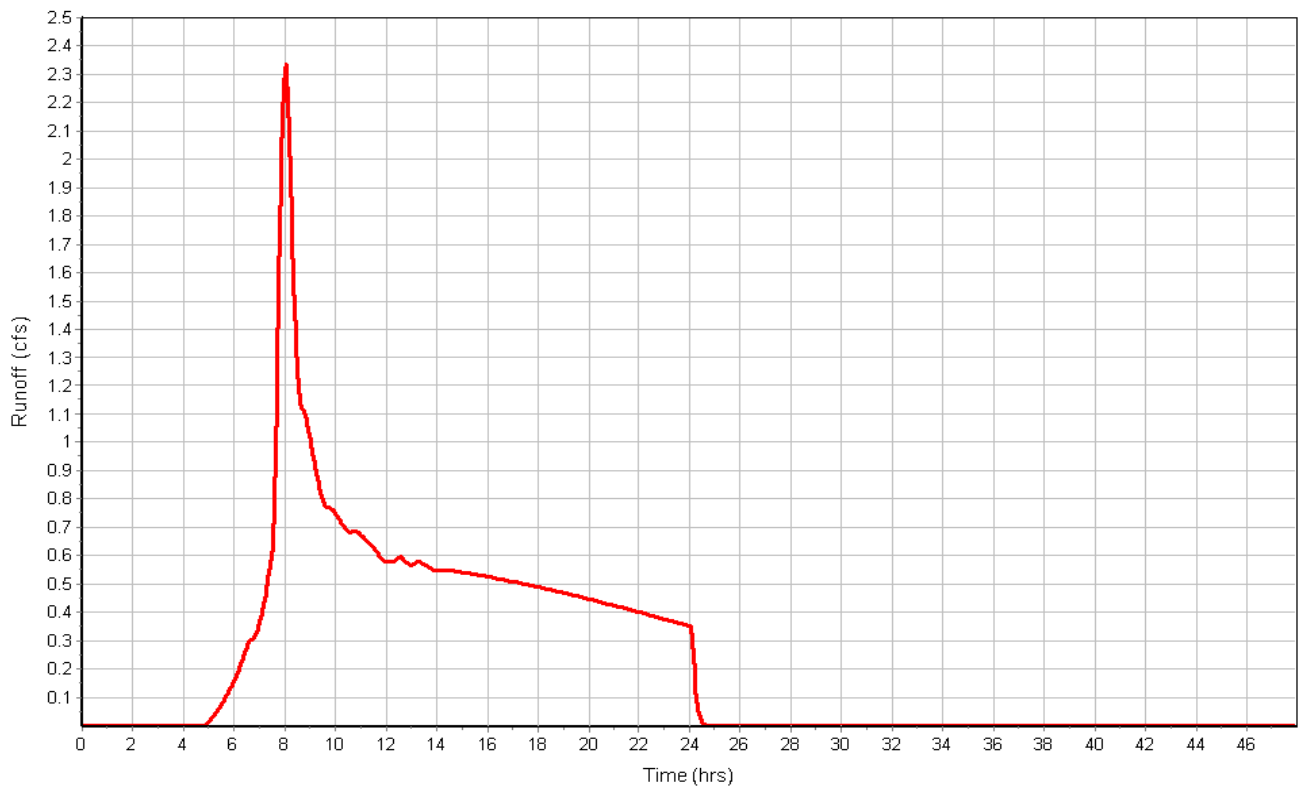
Total Rainfall (in) 3.50
 Total Runoff (in) 1.64
 Peak Runoff (cfs) 2.35
 Weighted Curve Number 80.00
 Time of Concentration (days hh:mm:ss) 0 00:16:43

Subbasin : P4

Rainfall Intensity Graph



Runoff Hydrograph



Storage Nodes

Storage Node : Det-Basin

Input Data

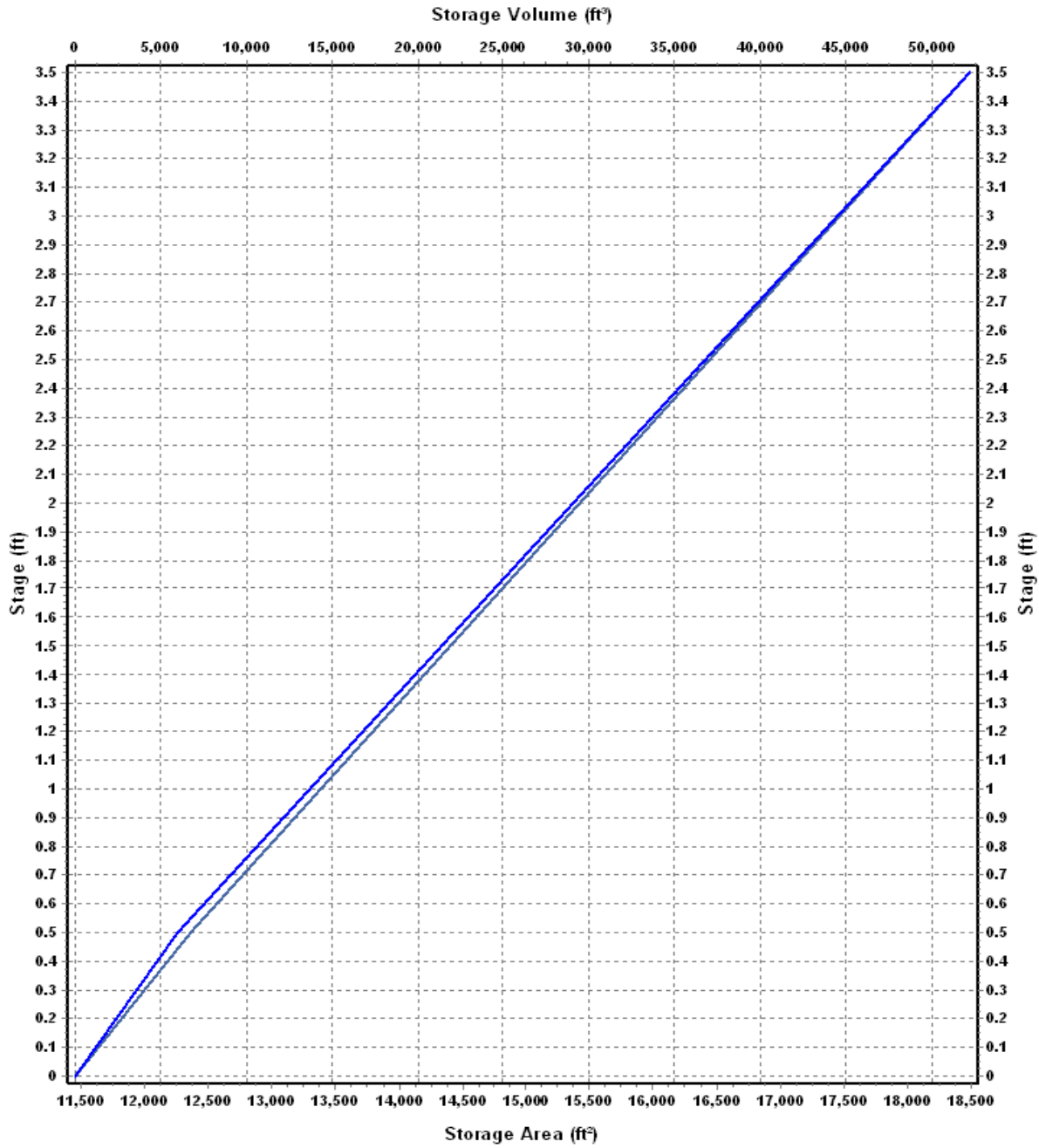
Invert Elevation (ft) 322.50
 Max (Rim) Elevation (ft) 326.00
 Max (Rim) Offset (ft) 3.50
 Initial Water Elevation (ft) 322.50
 Initial Water Depth (ft) 0.00
 Ponded Area (ft²) 12.00
 Evaporation Loss 0.00

Storage Area Volume Curves

Storage Curve : Detention_Basin

Stage (ft)	Storage Area (ft ²)	Storage Volume (ft ³)
0	11460	0.000
0.5	12362	5955.50
3.5	18484	52224.50

Storage Area Volume Curves



— Storage Area — Storage Volume

Storage Node : Det-Basin (continued)**Output Summary Results**

Peak Inflow (cfs)	5.99
Peak Lateral Inflow (cfs)	2.34
Peak Outflow (cfs)	3.52
Peak Exfiltration Flow Rate (cfm)	0.00
Max HGL Elevation Attained (ft)	323.81
Max HGL Depth Attained (ft)	1.31
Average HGL Elevation Attained (ft)	323.13
Average HGL Depth Attained (ft)	0.63
Time of Max HGL Occurrence (days hh:mm)	0 08:23
Total Exfiltration Volume (1000-ft ³)	0.000
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00

Project Description

File Name 20190920-Model.SPF

Project Options

Flow Units CFS
 Elevation Type Elevation
 Hydrology Method SCS TR-55
 Time of Concentration (TOC) Method SCS TR-55
 Link Routing Method Hydrodynamic
 Enable Overflow Ponding at Nodes YES
 Skip Steady State Analysis Time Periods YES

Analysis Options

Start Analysis On Sep 21, 2019 00:00:00
 End Analysis On Sep 23, 2019 00:00:00
 Start Reporting On Sep 21, 2019 00:00:00
 Antecedent Dry Days 0 days
 Runoff (Dry Weather) Time Step 0 01:00:00 days hh:mm:ss
 Runoff (Wet Weather) Time Step 0 00:05:00 days hh:mm:ss
 Reporting Time Step 0 00:05:00 days hh:mm:ss
 Routing Time Step 1 seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins.....	5
Nodes.....	8
<i>Junctions</i>	4
<i>Outfalls</i>	3
<i>Flow Diversions</i>	0
<i>Inlets</i>	0
<i>Storage Nodes</i>	1
Links.....	7
<i>Channels</i>	3
<i>Pipes</i>	4
<i>Pumps</i>	0
<i>Orifices</i>	0
<i>Weirs</i>	0
<i>Outlets</i>	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	Rain Gage-01	Time Series	TS-025	Intensity	inches	Oregon	Yamhill	25	4.00	SCS Type IA 24-hr

Subbasin Summary

SN	Subbasin ID	Area	Total Runoff	Total Runoff Volume	Peak Runoff
		(ac)	(in)	(ac-in)	(cfs)
1	E1/P1	2.97	2.04	6.06	1.37
2	E2_E3_E4	12.74	2.04	26.02	5.70
3	P2	4.46	2.61	11.65	2.99
4	P3	1.72	3.54	6.09	1.58
5	P4	6.56	2.04	13.40	3.04

Node Summary

SN Element ID	Element Type	Invert Elevation	Ground/Rim (Max) Elevation	Initial Water Elevation	Surcharge Elevation	Ponded Area	Peak Inflow	Max HGL Elevation Attained	Max Surcharge Depth Attained	Min Freeboard Attained	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded	
		(ft)	(ft)	(ft)	(ft)	(ft²)	(cfs)	(ft)	(ft)	(ft)	(days hh:mm)	(ac-in)	(min)	
1	REV-Swale-End	Junction	320.52	330.00	320.52	330.00	12.00	5.35	321.54	0.00	8.46	0 00:00	0.00	0.00
2	REV-Swale-Start	Junction	322.50	330.00	322.50	330.00	12.00	5.35	323.14	0.00	6.86	0 00:00	0.00	0.00
3	SD(5)	Junction	334.15	339.85	334.15	340.00	12.00	1.58	334.48	0.00	5.37	0 00:00	0.00	0.00
4	SD(6)	Junction	324.36	330.00	324.36	330.00	12.00	4.56	324.49	0.00	5.51	0 00:00	0.00	0.00
5	Out-PRE-East	Outfall	325.00					1.36	325.00					
6	Out-PRE-West	Outfall	316.16					5.70	316.16					
7	Out-REV-POST-West	Outfall	316.16					5.35	316.64					
8	Det-Basin	Storage Node	322.50	326.00	322.50		12.00	7.41	323.95			0.00	0.00	

Link Summary

SN Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged (min)
1	Ditch-Inlet	Pipe Det-Basin	REV-Swale-Start	5.00	323.17	322.50	13.4000	12.000	0.0150	4.19	11.30	0.37	7.23	0.71	0.71	0.00
2	Orifice	Pipe Det-Basin	REV-Swale-Start	5.00	322.50	322.50	0.0000	2.900	0.0130	0.24	0.01	20.74	5.16	0.24	1.00	1010.00
3	REV-Swale-Discharge	Pipe REV-Swale-End	Out-REV-POST-West	68.56	321.00	316.16	7.0600	18.000	0.0150	5.35	24.19	0.22	10.15	0.51	0.34	0.00
4	SD5_SD6	Pipe SD(5)	SD(6)	96.00	334.15	324.36	10.2000	10.000	0.0130	1.58	7.00	0.23	13.02	0.23	0.27	0.00
5	HF_Bypass	Channel Det-Basin	REV-Swale-Start	5.00	323.90	322.50	28.0000	24.000	0.0320	0.93	263.60	0.00	0.53	0.35	0.17	0.00
6	Link-22	Channel SD(6)	Det-Basin	5.00	324.36	322.50	37.2000	60.000	0.0320	4.56	995.36	0.00	1.40	0.77	0.16	0.00
7	REV-Swale	Channel REV-Swale-Start	REV-Swale-End	100.00	322.50	320.52	1.9800	18.000	0.2400	5.35	31.07	0.17	1.02	0.83	0.55	0.00

Reported
Condition

Calculated
SURCHARGED
Calculated
Calculated

Subbasin Hydrology

Subbasin : E1/P1

Input Data

Area (ac) 2.97
 Weighted Curve Number 80.00
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pasture, grassland, or range, Good	2.97	D	80.00
Composite Area & Weighted CN	2.97		80.00

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8})) / ((P^{0.5}) * (S_f^{0.4}))$$

Where :

T_c = Time of Concentration (hr)
 n = Manning's roughness
 L_f = Flow Length (ft)
 P = 2 yr, 24 hr Rainfall (inches)
 S_f = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (S_f^{0.5}) (unpaved surface)
 V = 20.3282 * (S_f^{0.5}) (paved surface)
 V = 15.0 * (S_f^{0.5}) (grassed waterway surface)
 V = 10.0 * (S_f^{0.5}) (nearly bare & untilled surface)
 V = 9.0 * (S_f^{0.5}) (cultivated straight rows surface)
 V = 7.0 * (S_f^{0.5}) (short grass pasture surface)
 V = 5.0 * (S_f^{0.5}) (woodland surface)
 V = 2.5 * (S_f^{0.5}) (forest w/heavy litter surface)
 T_c = (L_f / V) / (3600 sec/hr)

Where:

T_c = Time of Concentration (hr)
 L_f = Flow Length (ft)
 V = Velocity (ft/sec)
 S_f = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^{2/3}) * (S_f^{0.5})) / n
 R = A_q / W_p
 T_c = (L_f / V) / (3600 sec/hr)

Where :

T_c = Time of Concentration (hr)
 L_f = Flow Length (ft)
 R = Hydraulic Radius (ft)
 A_q = Flow Area (ft²)
 W_p = Wetted Perimeter (ft)
 V = Velocity (ft/sec)
 S_f = Slope (ft/ft)
 n = Manning's roughness

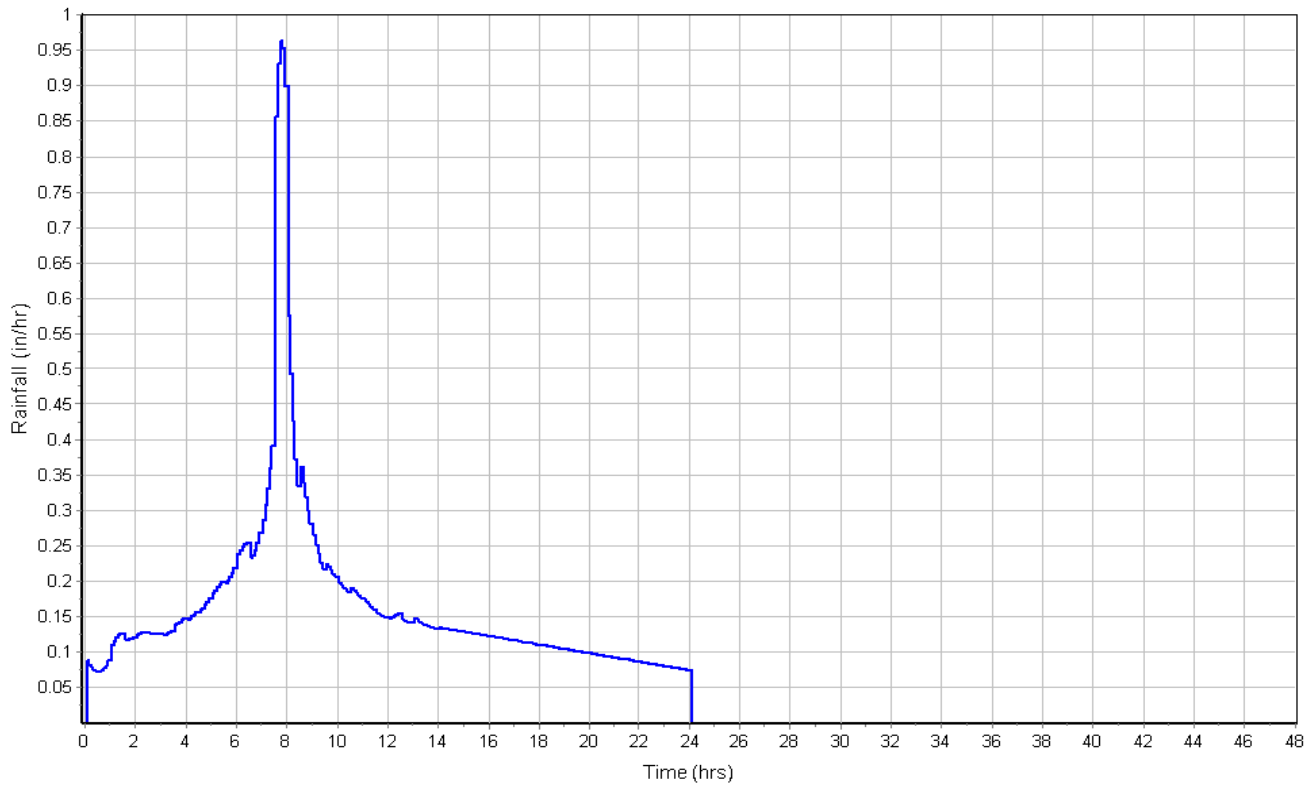
	Subarea	Subarea	Subarea
	A	B	C
Sheet Flow Computations			
Manning's Roughness :	0.24	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.5	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	16.14	0.00	0.00
Shallow Concentrated Flow Computations			
	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	200	0.00	0.00
Slope (%) :	2	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	2.28	0.00	0.00
Computed Flow Time (min) :	1.46	0.00	0.00
Total TOC (min)	17.61		

Subbasin Runoff Results

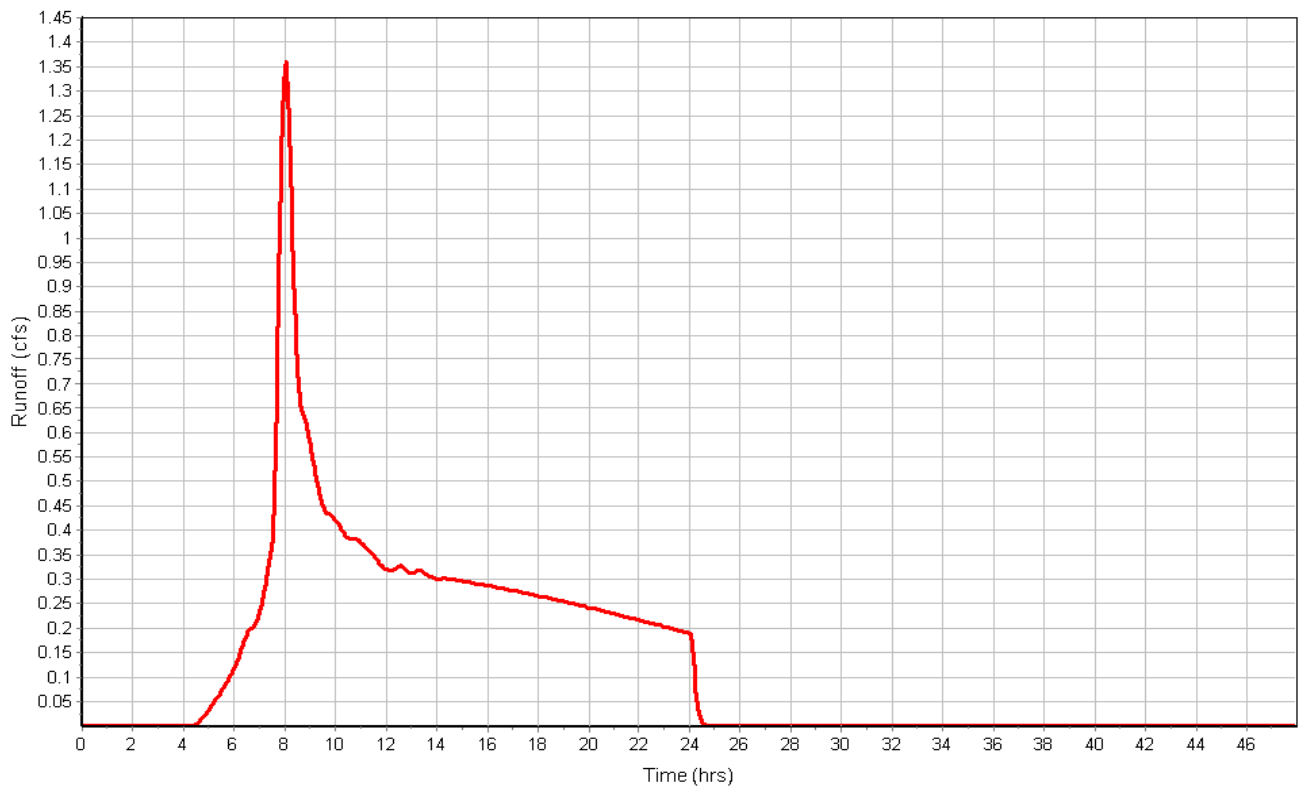
Total Rainfall (in)	4.00
Total Runoff (in)	2.04
Peak Runoff (cfs)	1.37
Weighted Curve Number	80.00
Time of Concentration (days hh:mm:ss)	0 00:17:37

Subbasin : E1/P1

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : E2_E3_E4

Input Data

Area (ac) 12.74
 Weighted Curve Number 80.00
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pasture, grassland, or range, Good	12.74	D	80.00
Composite Area & Weighted CN	12.74		80.00

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.24	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	3	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.5	0.00	0.00
Velocity (ft/sec) :	0.12	0.00	0.00
Computed Flow Time (min) :	13.73	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
	Flow Length (ft) :	500	0.00
Slope (%) :	3	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	2.79	0.00	0.00
Computed Flow Time (min) :	2.99	0.00	0.00

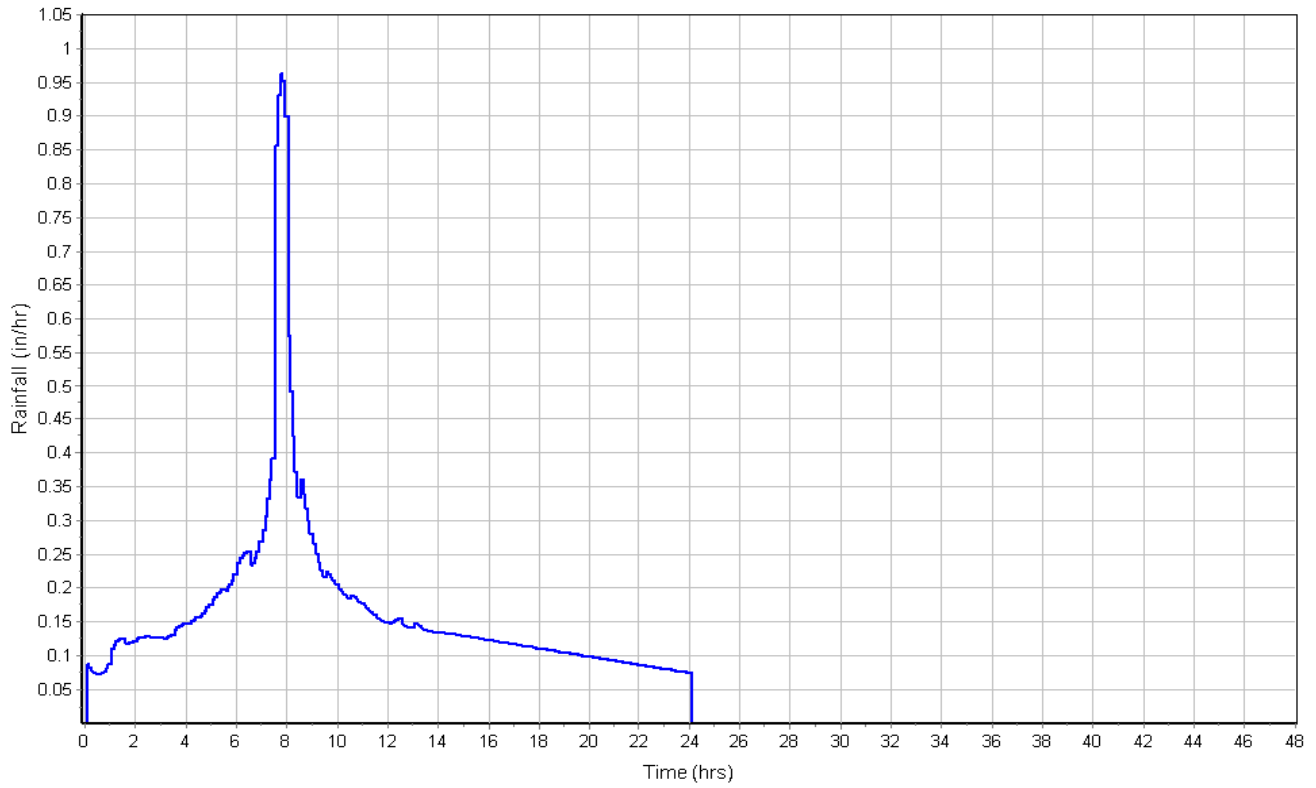
Channel Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.24	0.00
Flow Length (ft) :	300	0.00	0.00
Channel Slope (%) :	3	0.00	0.00
Cross Section Area (ft²) :	12	0.00	0.00
Wetted Perimeter (ft) :	12	0.00	0.00
Velocity (ft/sec) :	1.08	0.00	0.00
Computed Flow Time (min) :	4.65	0.00	0.00
Total TOC (min)	21.36		

Subbasin Runoff Results

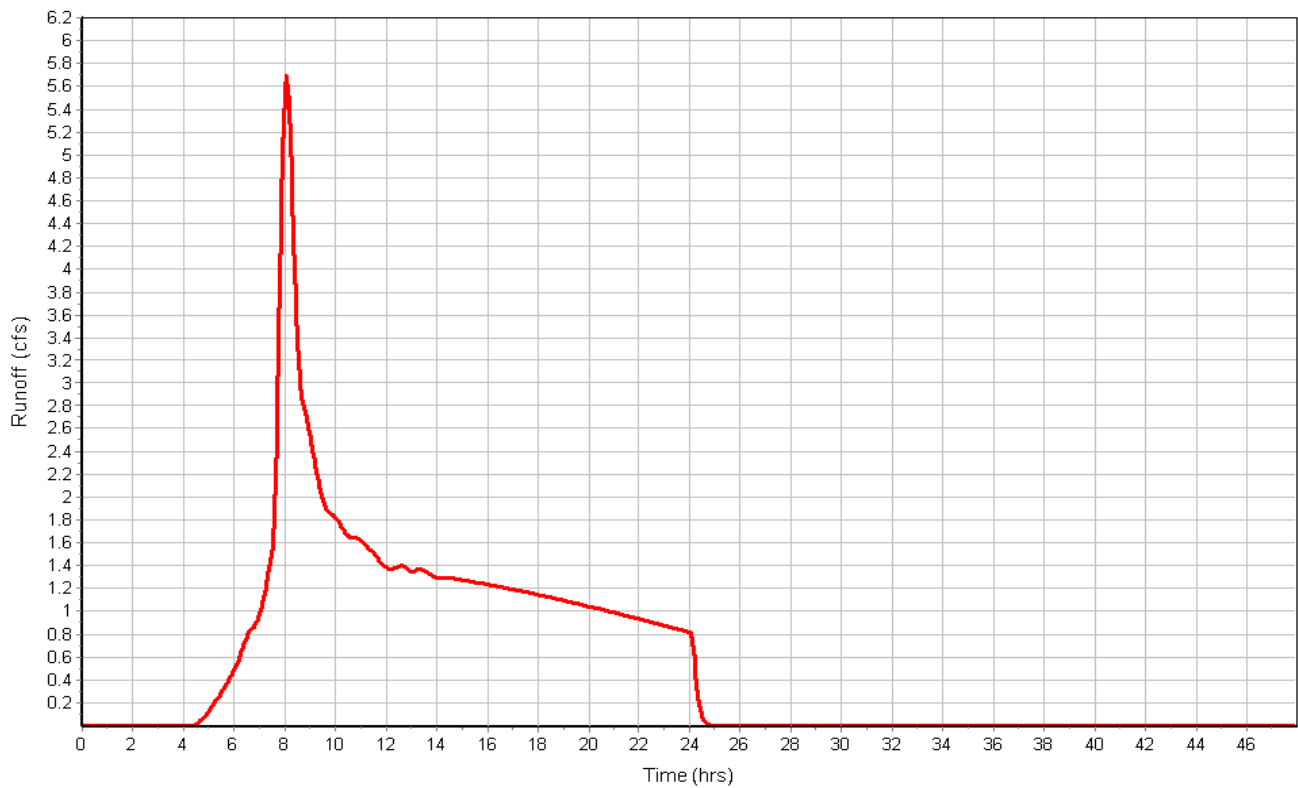
Total Rainfall (in) 4.00
 Total Runoff (in) 2.04
 Peak Runoff (cfs) 5.70
 Weighted Curve Number 80.00
 Time of Concentration (days hh:mm:ss) 0 00:21:22

Subbasin : E2_E3_E4

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : P2

Input Data

Area (ac) 4.46
 Weighted Curve Number 86.74
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	1.67	-	98.00
-	2.79	-	80.00
Composite Area & Weighted CN	4.46		86.74

Time of Concentration

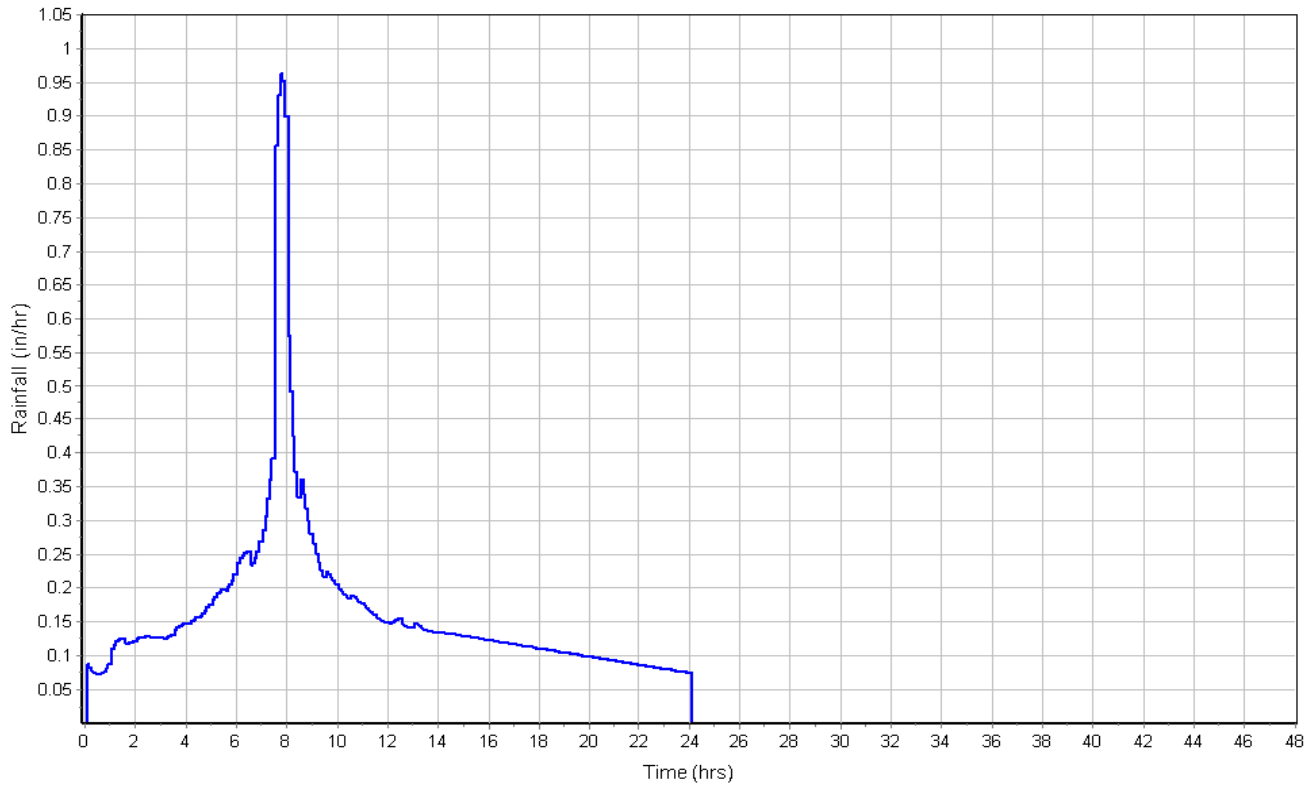
User-Defined TOC override (minutes): 5

Subbasin Runoff Results

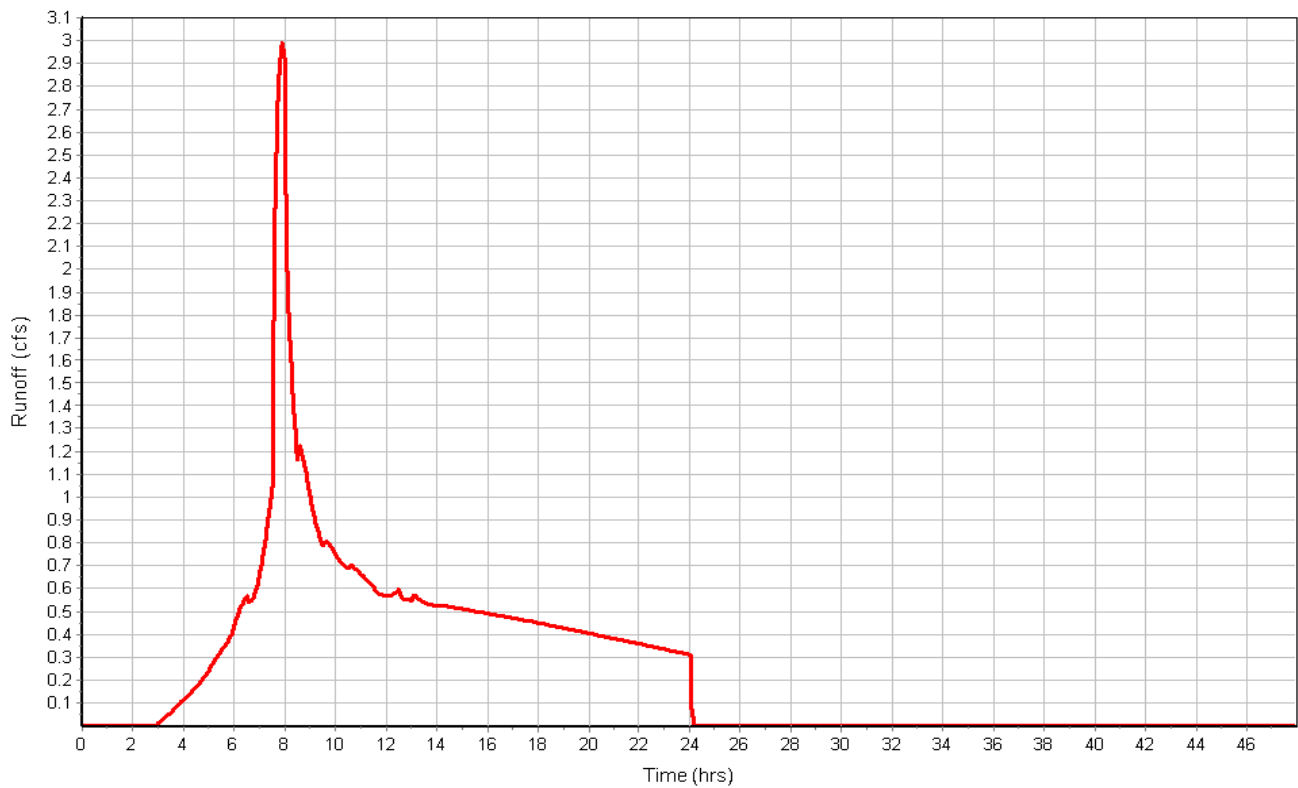
Total Rainfall (in) 4.00
 Total Runoff (in) 2.61
 Peak Runoff (cfs) 2.99
 Weighted Curve Number 86.74
 Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : P2

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : P3

Input Data

Area (ac) 1.72
 Weighted Curve Number 96.01
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	1.53	-	98.00
-	0.19	-	80.00
Composite Area & Weighted CN	1.72		96.01

Time of Concentration

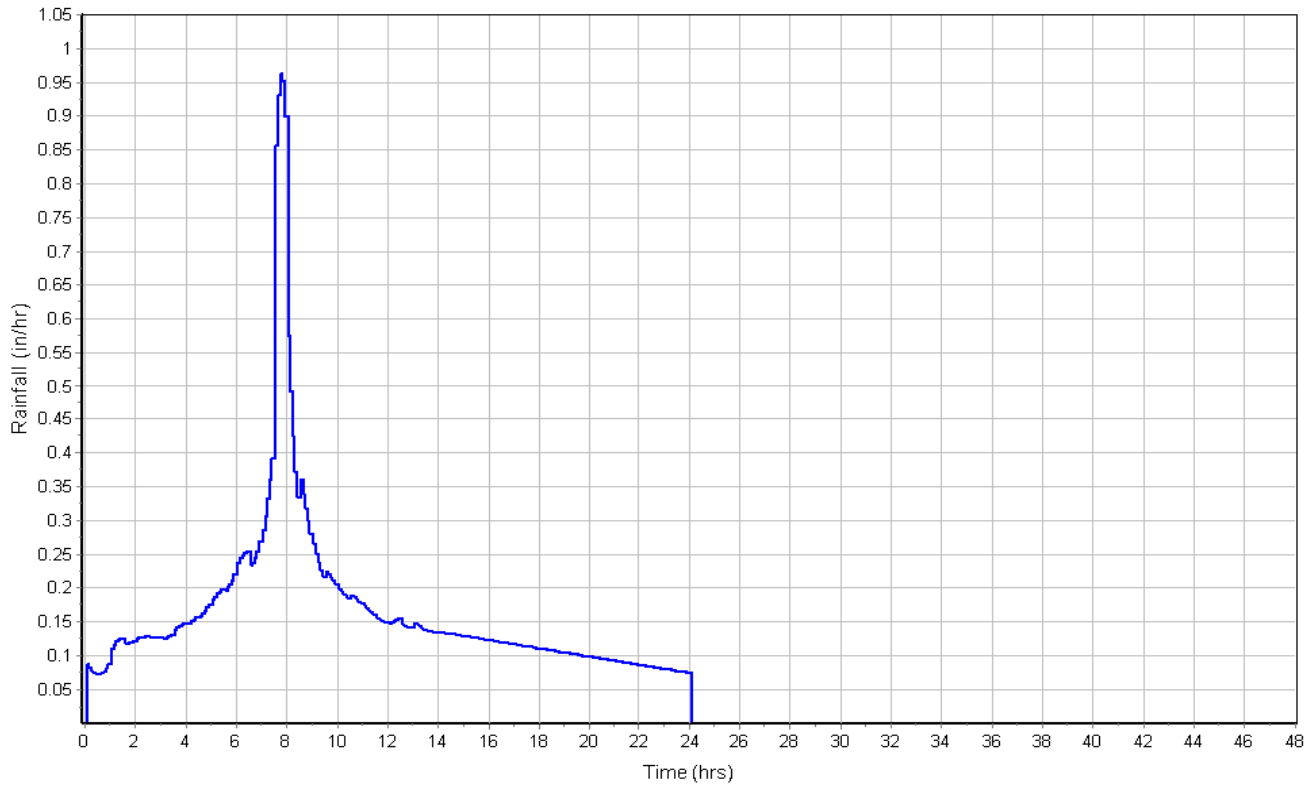
User-Defined TOC override (minutes): 5

Subbasin Runoff Results

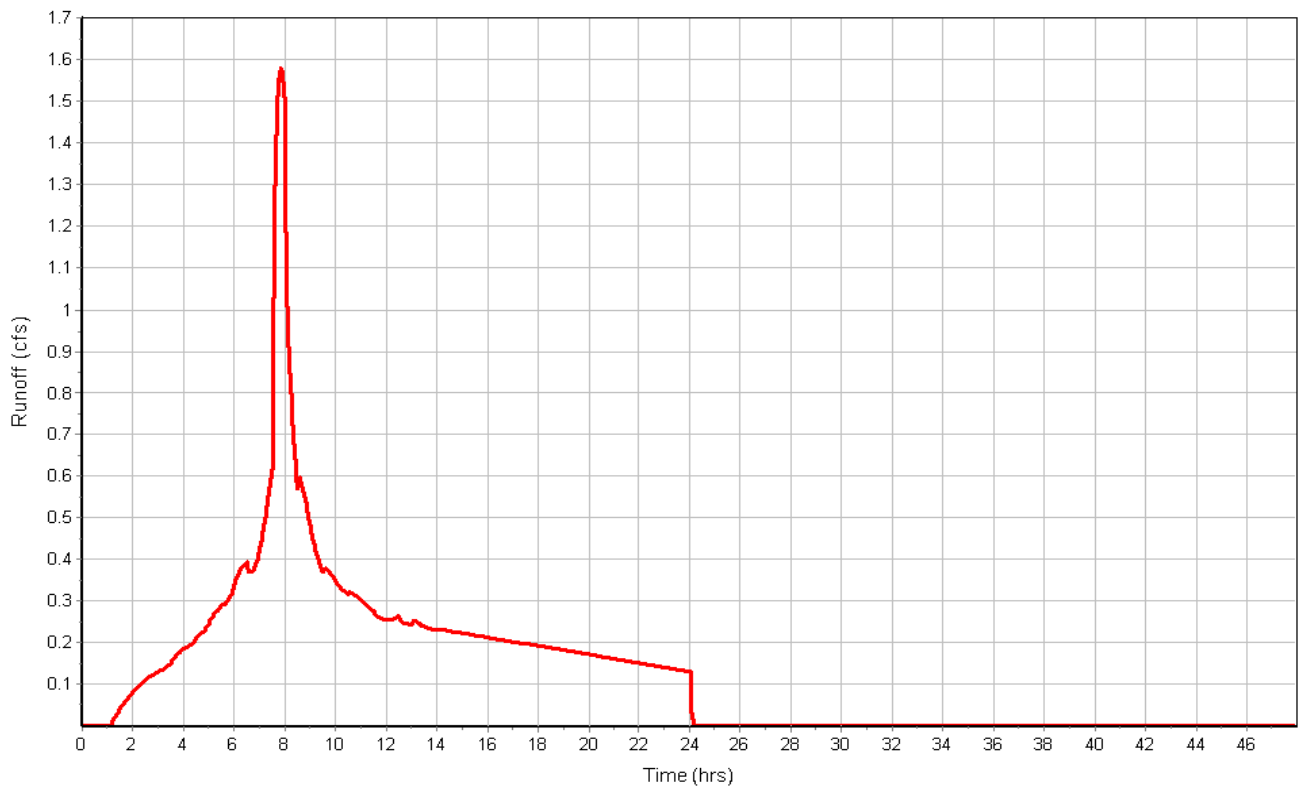
Total Rainfall (in) 4.00
 Total Runoff (in) 3.54
 Peak Runoff (cfs) 1.58
 Weighted Curve Number 96.01
 Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : P3

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : P4

Input Data

Area (ac) 6.56
 Weighted Curve Number 80.00
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	9.91	D	80.00
Composite Area & Weighted CN	9.91		80.00

Time of Concentration

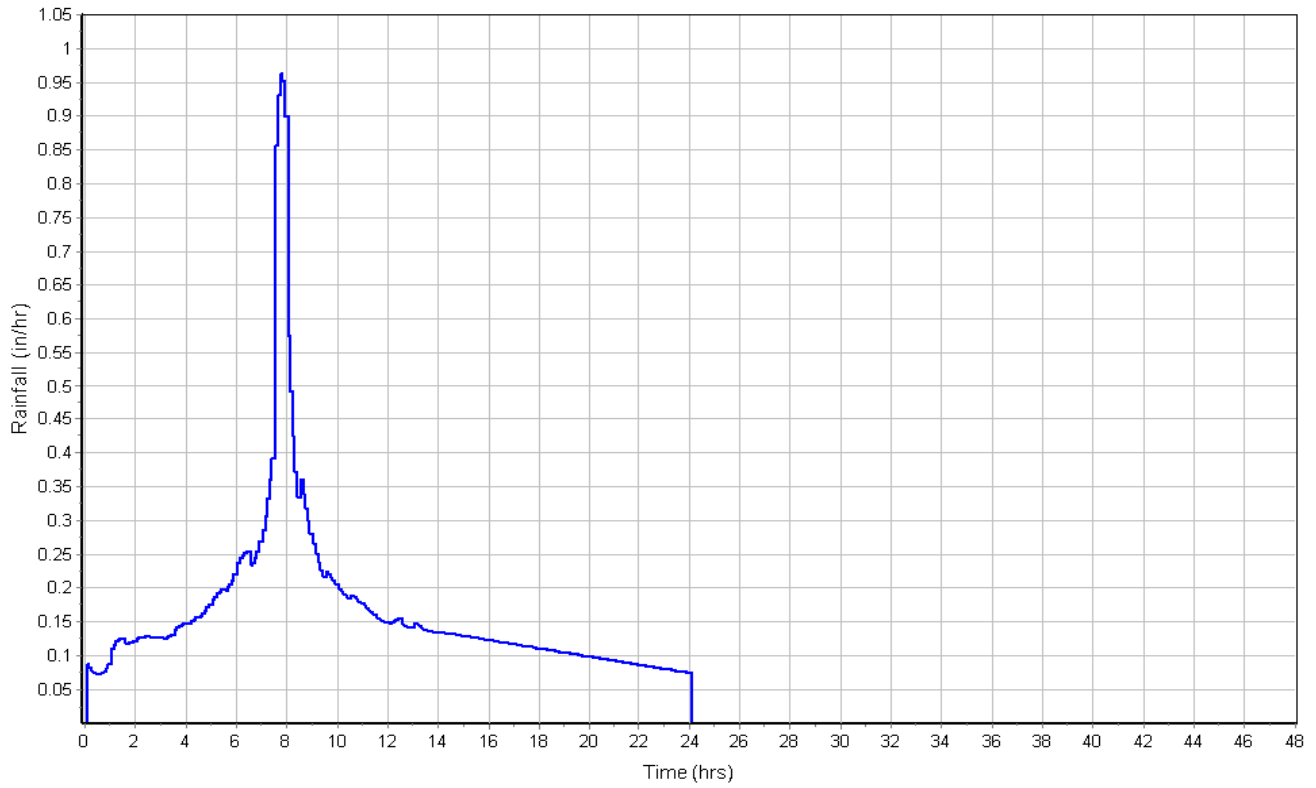
User-Defined TOC override (minutes): 16.71

Subbasin Runoff Results

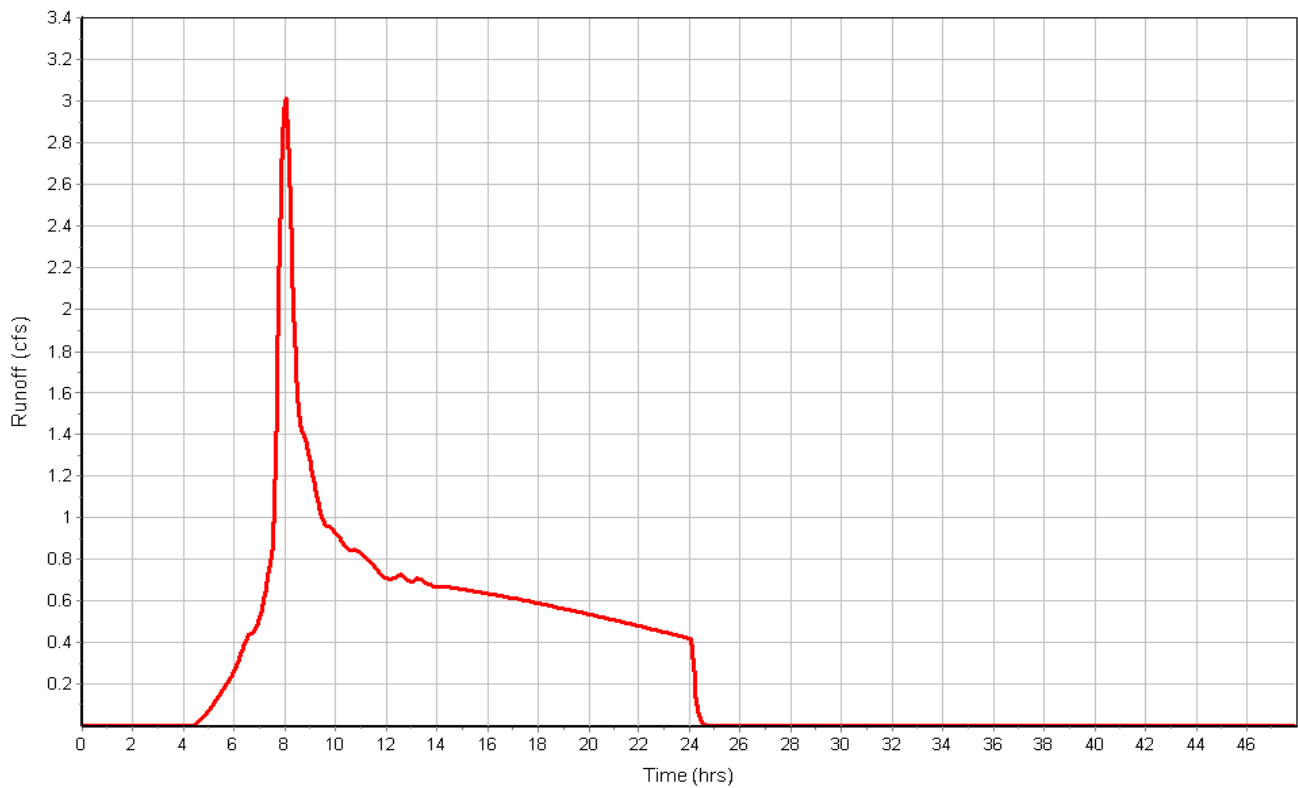
Total Rainfall (in) 4.00
 Total Runoff (in) 2.04
 Peak Runoff (cfs) 3.04
 Weighted Curve Number 80.00
 Time of Concentration (days hh:mm:ss) 0 00:16:43

Subbasin : P4

Rainfall Intensity Graph



Runoff Hydrograph



Storage Nodes

Storage Node : Det-Basin

Input Data

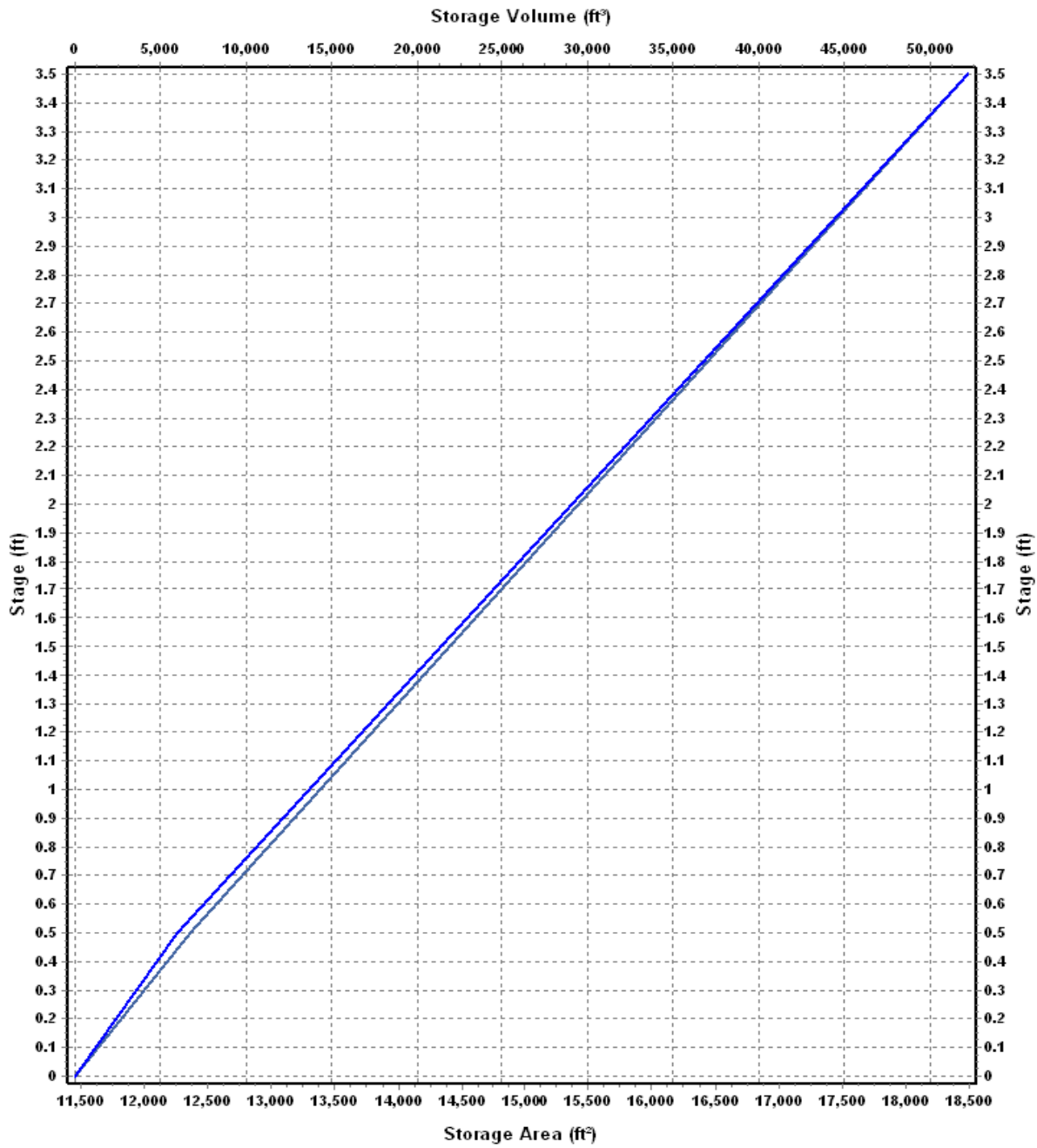
Invert Elevation (ft) 322.50
 Max (Rim) Elevation (ft) 326.00
 Max (Rim) Offset (ft) 3.50
 Initial Water Elevation (ft) 322.50
 Initial Water Depth (ft) 0.00
 Ponded Area (ft²) 12.00
 Evaporation Loss 0.00

Storage Area Volume Curves

Storage Curve : Detention_Basin

Stage (ft)	Storage Area (ft ²)	Storage Volume (ft ³)
0	11460	0.000
0.5	12362	5955.50
3.5	18484	52224.50

Storage Area Volume Curves



— Storage Area — Storage Volume

Storage Node : Det-Basin (continued)**Output Summary Results**

Peak Inflow (cfs)	7.41
Peak Lateral Inflow (cfs)	3.01
Peak Outflow (cfs)	5.35
Peak Exfiltration Flow Rate (cfm)	0.00
Max HGL Elevation Attained (ft)	323.95
Max HGL Depth Attained (ft)	1.45
Average HGL Elevation Attained (ft)	323.16
Average HGL Depth Attained (ft)	0.66
Time of Max HGL Occurrence (days hh:mm)	0 08:15
Total Exfiltration Volume (1000-ft ³)	0.000
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00

APPENDIX E

OPERATIONS, MAINTENANCE, CONTINGENCY & REPAIR PLAN

OPERATIONS, MAINTENANCE, CONTINGENCY & REPAIR PLAN

FOR THE

Veritas School Site Development

***City of Newberg, Yamhill County, Oregon
Case File # DR219-0002***

In order for the storm water treatment facilities to continue operating at acceptable levels, regular maintenance and inspection are required. This plan provides instructions for how to do this.

Prepared by: Nicholas McMurtrey, P.E.

September 2019

**Storm Water System
Operations, Maintenance, Contingency & Repair Plan**

O & M TABLE OF CONTENTS

- A. Responsibility
- B. Description
- C. Schedule
- D. Procedure
- E. Inspection & Maintenance Logs
- F. Sample O&M Logs
- G. O&M Log Sheet
- H. Appendix: Exhibits

Storm Water System Operations, Maintenance, Contingency & Repair Plan

A. RESPONSIBILITY

The stormwater management facilities are to be maintained by School staff. The preparer has worked with the owner's designated personnel to design a system that can be easily maintained by maintenance staff. A copy of this plan shall be provided to all applicable maintenance personnel.

B. DESCRIPTION

The stormwater system collects and conveys all runoff within the site and treats drainage from both landscaping and impervious surfaces. All runoff is will either infiltrate into the ground, or be collected by **catch basins, ditches and culverts** before discharging into stormwater quality and/or quantity facilities. Stormwater quantity, or **detention basins**, will eventually overflow towards the piped conveyance system via a catch basin.

These conveyance systems discharge to a **riprap outfall** upstream of **vegetated swale**. Stormwater in the vegetated swale either (1) infiltrates through the plants and soil for treatment, (2) flows through the swale for treatment in route to an outfall or downstream conveyance channel. Drainage originating from impervious surfaces throughout the project area will be treated by the vegetated swale. Any facility unable to absorb drainage during high flow events will discharge towards the historic discharge location for the project, and ultimately Chehalem Creek.

Definitions

- **Riprap outfalls** are rock lined depressions installed where pipes daylight to reduce scour at the discharge location.
- **Vegetated swales** are depressed landscaped channels used to collect, filter, infiltrate, and convey storm water runoff. Their primary purpose is to treat storm water runoff as it passes through the vegetation, and underlying topsoil. These facilities also provide detention for stormwater runoff and slowly release it over extended periods of time.
- **Catch basins** are inlet structures with a sump for sediment and debris storage and a turned down elbow on the outlet pipe. They collect surface storm water and convey it to the storm system.
- **Detention basins** are depressed landscaped areas used to collect, filter, infiltrate, and convey storm water runoff. Their primary purpose is to slow down and detain stormwater runoff as the basin fills. These facilities slowly release runoff over extended periods of time.

**Storm Water System
Operations, Maintenance, Contingency & Repair Plan**

**Table B1
Stormwater Facility Summary**

Facility Type	Size (sf)	Contributing Source	Impervious Area Managed (ac)	Discharge Point
Vegetated Swale	570 (base area)	Building roofs and central courtyard walkways	1.16	Flows discharge to SW corner of property, and eventually Chehalem Creek.
Detention Basin	7,100 (base area)	Parking lot; asphalt pavement and concrete sidewalk	1.67	Flows discharge to vegetated swale

C. SCHEDULE

The whole system shall be inspected and maintained quarterly and within 24 hours after each major storm event. For this O&M plan, a major storm event is defined as 1.0 inches of rain in 24 hours or more. All components of the storm system as described below must be inspected and maintained frequently or they will cease to function effectively. The facility owner must keep a log recording all inspection dates, observations, and maintenance activities. Receipts shall be saved when maintenance is performed and there is record of expense.

D. PROCEDURE

The following items shall be inspected and maintained as stated:

Riprap Outfalls

- Facilities shall be inspected for debris and sediment buildup, which shall be removed upon discovery. If necessary, sources of potential sediment and debris, such as discarded landscape clippings, shall be identified and prevented.
- Inspect outfalls and adjacent landscaping areas for areas of erosion, scouring, undercutting, and slumping. Fill eroded area with compacted soil and cover with mulch, riprap, seed, sod, or other erosion prevention materials.

Vegetated Swale and Detention Basin

- Fallen leaves and debris from deciduous plant foliage shall be raked and removed biannually.
- Nuisance and prohibited vegetation of all species shall be removed biannually. Invasive vegetation shall be removed and replaced.
- Dead vegetation shall be removed to maintain less than 10% of area coverage or when planter function is impaired. Vegetation shall be replaced to maintain cover density and control erosion where soils are exposed.
- The facilities shall fully drain within 24 hours after a storm event. If water continues to pond after that time, sources of possible clogging shall be identified and corrected. If necessary,

Storm Water System Operations, Maintenance, Contingency & Repair Plan

the topsoil layers shall be tilled and amended with compost; if this is not sufficient, they shall be removed and replaced with new freely draining growing medium.

- Inlets and outlets shall be inspected quarterly and after any large rain event.
- Any trash or debris that collects in the planters may inhibit function and shall be removed quarterly.
- Use of pesticides and/or herbicides is not recommended.

Catch Basins and Piped Storm System

- Quarterly inspection for clogging shall be performed.
- Shall be inspected for cracks or leaks during each inspection. Area drains, overflow structures and manholes shall be cleaned out at a minimum of once per year or more frequently if inspections deem it necessary. Cleanout shall be done in a manner to minimize the amount of sediment and trapped oil entering the outlet pipe. Any valves on outlet pipes shall be closed or plugged prior to cleanout.
- Water, oil, and sediment in sumps shall be removed, tested, and disposed of in accordance with federal and state regulations. Grit and sediment that has settled to the bottom of drainage structures shall be removed during each cleaning.
- Cleaning shall be done without use of detergents or surfactants. A pressure washer may be used if necessary.

Source Control measures prevent pollutants from mixing with storm water. Typical non-structural control measures include raking and removing leaves, street sweeping, vacuum sweeping, controlled application of pesticides and fertilizers, and other good house keeping practices.

- Source control measures shall be inspected and maintained (where applicable).

Spill Prevention measures shall be exercised when handling substances that can contaminate storm water. It is important to exercise caution when handling substances that can contaminate storm water. Activities that pose the chance of hazardous material spills shall not take place near collection facilities.

- Contact facility owner immediately if spill is observed.
- Releases of pollutants shall be corrected as soon as identified.

Insects & Rodents shall not be harbored in the any part of the storm system.

- Pest control measures shall be taken when insects/rodents are found to be present.
- If sprays are considered, then a mosquito larvicide, such as Bacillus thurendensis or Altoside formulations can be applied only if absolutely necessary and shall not be used where it will enter groundwater or come in contact with any standing water. Sprays shall be applied only by a licensed individual or contractor.
- Holes in the ground located in and around the storm system shall be filled.
- Outfalls draining into storm water planters shall be inspected and cleaned regularly to insure no rodent activity which would clog or decrease the efficiency of the storm system.

**Storm Water System
Operations, Maintenance, Contingency & Repair Plan**

Access to the storm system is required for efficient maintenance.

- Egress and ingress routes adjacent to stormwater facilities shall be opened for maintenance. Traffic control may be necessary to safely perform maintenance activities.

E. INSPECTION AND MAINTENANCE LOGS

Maintenance staff shall complete inspection and maintenance logs. The logs shall be produced for:

Proper Conveyance – All facilities shall drain within 24 hours. Date, time, weather, and site conditions when ponding occurs shall be recorded.

Pollution Prevention – All sites shall implement best management practices to prevent hazardous wastes, litter, or excessive oil and sediment from contaminating storm water. Contact Spill Prevention & Citizen Response at (503) 823-7180 for immediate assistance with responding to spills. Record date, time, weather, and site conditions if activities are found to contaminate storm water.

Vectors (mosquitoes and rodents) – Storm water facilities shall not harbor mosquito larvae or rats that pose a threat to public health or that undermine the facility structure. Monitor standing water for small wiggling sticks perpendicular to the water's surface. Note holes/burrows in and around facilities. Call Washington County Vector Control at (503) 846-8722 for recommendations and guidance with eradicating vectors. Record date, time, weather, and site conditions when vector activity is observed.

Maintenance – Record date, description, and contractor (if applicable) for all structural repairs, landscape maintenance, and facility cleanout activities.

**Storm Water System
Operations, Maintenance, Contingency & Repair Plan**

F. SAMPLE O&M LOG SHEET

SAMPLE

Date: 9/10/2019 Time: 13:30 Initials: NJM
 Weather and site conditions: Overcast
 Work performed by: Veritas School maintenance personnel
 Work performed: Replanted Vegetated Swale with sedges and rushes
 Details: *Work order on file and available by request

G. O&M LOG SHEET

Date: _____ Time: _____ Initials: _____
 Weather and site conditions: _____
 Work performed by: _____
 Work performed: _____
 Details: _____

Date: _____ Time: _____ Initials: _____
 Weather and site conditions: _____
 Work performed by: _____
 Work performed: _____
 Details: _____

**Storm Water System
Operations, Maintenance, Contingency & Repair Plan**

Date: _____ Time: _____ Initials: _____

Weather and site conditions: _____

Work performed

by: _____

Work performed:

Details: _____

Date: _____ Time: _____ Initials: _____

Weather and site conditions: _____

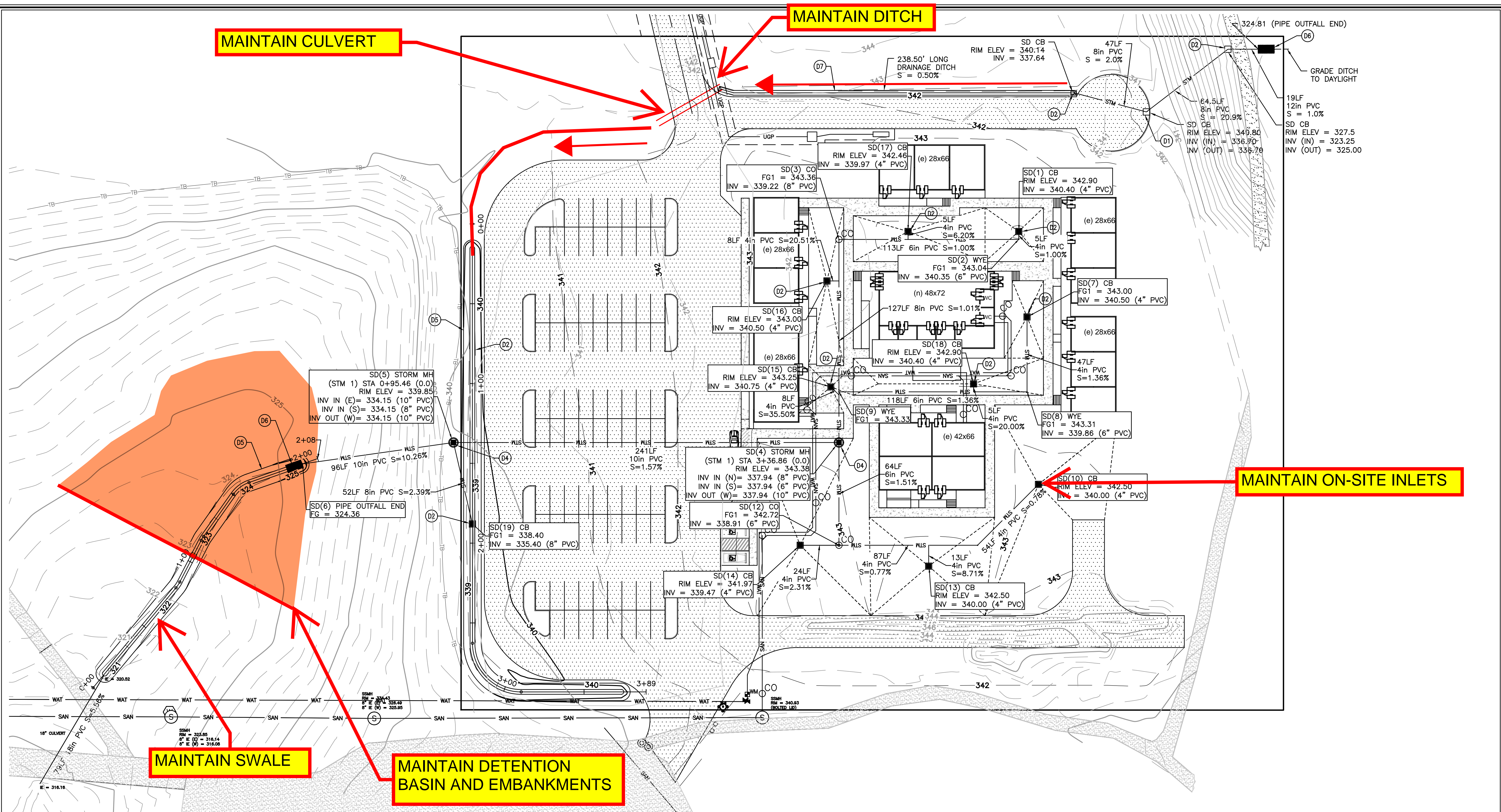
Work performed

by: _____

Work performed:

Details: _____

H. Appendix: Exhibits



DATE	
BY	
REVISIONS	

VERITAS SCHOOL SITE DEVELOPMENT
NEWBERG, OREGON

26500 NE BELL ROAD NEWBERG, OR 97132

MAINTENANCE EXHIBIT

LEGEND

	PROPERTY BOUNDARY		PROPERTY CORNER		CONCRETE PAVING		WATER VALVE
	ADJACENT PROPERTY LINES		CONTROL POINT		ASPHALT PAVING		WATER METER
	CENTERLINE		STORM MANHOLE		GRAVEL SURFACE		POWER/UTILITY POLE
	EASEMENT LINES		STORM CATCHBASIN		EXISTING MAJOR CONTOURS		STREET LIGHT
	BUILDING		STORM/SEWER CLEANOUT		EXISTING MINOR CONTOURS		STREET SIGN
	CURB		FLOW DIRECTION ARROW		MAJOR CONTOURS		GAS VALVE
	SIDWALK		STORM CULVERT END		MINOR CONTOURS		GAS METER
	FENCE		SEWER MANHOLE				TEL/COMM PED/RISER
	WATERLINE		WATER METER				
	SANITARY SEWER						
	STORM DRAIN LINE						
	OVERHEAD POWER						
	UNDERGROUND POWER						
	RETAINING WALL						
	PROPOSED PAVING						

