Run-on and Run-off Control System Plan

Comanche Station - Active CCR Landfill

Public Service Company of Colorado
Pueblo, Colorado

October 17, 2016

Rev. 1 – March 29, 2019

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Table of Abbreviations and Acronyms

Abbreviation	Definition
ADF	Ash Disposal Facility
amsl	above mean sea level
CCR	Coal Combustion Residuals
CDPHE	Colorado Department of Public Health and Environment
CFR	Code of Federal Regulations
CLOMR	Conditional Letter of Map Revision
D&O	Design and Operations
EDOP	Engineering Design and Operations Plan
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
NOAA	National Oceanic and Atmospheric Administration
PSCo	Public Service Company of Colorado
SCS	Soil Conservation Service
SFHA	Special Flood Hazard Area

1.0 General Information

On April 17, 2015, the U.S. Environmental Protection Agency published regulations under Subtitle D of the Resource Conservation and Recovery Act meant to control the safe disposal of coal combustion residuals (CCR) generated by coal-fired electric utilities. The rule defines a set of requirements for the disposal and handling of CCR within CCR units (defined as either landfills or surface impoundments). The requirements include preparation of a Run-on and Run-off Control System Plan for all existing and new CCR landfills, including lateral expansions.

This Run-on and Run-off Control System Plan (Plan) has been prepared for the CCR landfill at the Comanche Station. It has been prepared in accordance with the requirements of 40 Code of Federal Regulations [CFR] §257.81. The initial Run-on and Run-off Control System Plan was prepared by October 17, 2016. Revision 1 of this Plan was prepared to reflect construction of Cell 2 East, which will be operationally active over the next five years.

1.1 Facility Description

Comanche Station is a 1,450-megawatt coal-fired, steam turbine power plant owned and operated by Public Service Company of Colorado (PSCo), an Xcel Energy company. The Station is located at 2005 Lime Road, Pueblo, Colorado, approximately 3 miles south of Colorado Highway 50 in Pueblo County, Colorado.

The station's Ash Disposal Facility (ADF) is located on the southwest corner of the Comanche Station property (see **Figure 1**). The land surface elevations range from approximately 4,830 feet above mean sea level (amsl) in the southwest and northwest corners of the Site to approximately 4,800 feet amsl in the southeast corner of the Site.

The ADF is an active CCR disposal unit that began construction and operation in 1987 and has remained in continuous operation since that time. The ADF is operated under an Engineering Design and Operations Plan (EDOP) developed pursuant to Colorado Department of Public Health and Environment (CDPHE) Solid Waste Regulations.

The ADF is designed as an approximately 280-acre engineered ash monofill consisting of eight permitted disposal cells that will be constructed in phases as needed to contain ash and waste from power generating activities. The cells may be further subdivided to facilitate construction and operation. At full build-out, approximately 38.7 acres of the ADF will be used for surface water control structures, access roads, and borrow area. The wastes accepted at the ADF consist primarily of coal ash (fly ash and bottom ash), with smaller quantities of water treatment sludge, process water pond sediment, coal impurities, and excavation soils. Cell 1 is the current active cell, with operations transitioning to Cell 2 East which completed construction in 2018.

The most recent EDOP was prepared in 2018 (2018 EDOP) by Tetra Tech. The purpose of the 2018 EDOP was to update and replace the previously prepared 2015 EDOP, as well as the Design and Operations (D&O) Plan dated August 24, 2005 prepared by Wenck Associates (2005 D&O). This Run-on and Run-off Control System Plan incorporates information and permit drawings from the 2018 EDOP and 2005 D&O Plan and includes the most recent cell constructed (Cell 2 East).

Figure 1. Site Topography

1.2 Regulatory Requirements

Title 40 CFR §257.81 requires that an owner or operator of an existing or new CCR landfill or any lateral expansion of a CCR landfill design, construct, operate, and maintain:

1) A run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm;
2) A run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm; and
3) A run-off control system designed to handle run-off from the active portion of the CCR unit so that it does not cause a discharge of pollutants to waters of the United States that is in violation of the requirements of the National Pollutant Discharge Elimination System under Section 402 of the Clean Water Act.

2.0 Run-on and Run-off Controls for CCR Landfills

A hydrologic and hydraulic analysis was completed for the active portion of the CCR landfill unit in accordance with 40 CFR §257.81 and Part 1 of 6 CCR 1007-2. Per 40 CFR §257.53, the active portion means *"that part of the CCR unit that has received or is receiving CCR or non-CCR waste and that has not completed closure in accordance with §257.102."* Active portions may include areas that are at interim grades with soil cover, but which will receive additional ash in the future. Runoff from active portions that have soil cover is non-contact stormwater.

Cell 1 is the current active cell with operations transitioning into Cell 2 East which completed construction in 2018. Cell 2 East will provide additional capacity for approximately 5 years. The future Cell 2 West is anticipated to be constructed in 2024. Based on current landfilling projections, Cells 1 and 2 East were the only cells evaluated for the 5-year period.

The evaluation included preparation of a surface water run-off model using AutoCAD Hydraflow Hydrographs 2018 to determine whether existing run-on and run-off control systems meet the required criteria for controlling run-on and run-off from the 24-hour, 25-year storm event. The evaluation was completed using the best available information at the time and was based on projected landfill grades and existing topography.

2.1 Description of CCR Landfill and Drainage Area

The ADF sits on an upland between the St. Charles River and Salt Creek drainages. The facility is not within the floodplain of either drainage; however, an unnamed ponding area is present within the footprint of the ADF. This area collects precipitation from the upland area between the St. Charles River and Salt Creek. The ponding area is currently designated a Special Flood Hazard Area (SFHA) by the Federal Emergency Management Agency (FEMA). A SFHA is an area that will be inundated by a storm having a 1 percent chance of being equaled or exceeded in any given year. Based on the Conditional Letter of Map Revision (CLOMR) permit application submitted by PSCo Energy on May 23, 2006, the 100-year flood volume draining to the SFHA is 57.3 acre-feet. The storage capacity of the SFHA will be replaced by perimeter ponds when ADF construction intercepts and displaces the SFHA. The 2018 EDOP proposed a series of five ponds constructed concurrent with cell expansions for the purpose of (1) controlling run-on into the active disposal area from surrounding areas and (2) replacing the SFHA storage volume consistent with the requirements of the CLOMR.

The CLOMR permit application indicates that storm water Pond 1 as shown on 2005 D&O Sheet No. 12A is sized to contain the 57.3 acre-feet plus 25.1 acre-feet of run-off from the proposed final cover design. The SFHA is present in Cells 4, 5, 6, 7, and 8. As a result of ADF cell configuration and construction sequencing, Pond 1 will be installed during construction of Cells 4, 5, and 6 and prior to ADF construction intercepting the portions of the SFHA present in Cells 7 and 8. Cells 1, 2 and 3 are not at risk from flooding prior to construction of Pond 1 during Cell 4 construction.

The December 7, 2006, FEMA response (U.S. Department of Homeland Security, 2006) to the CLOMR application stated that the proposed ADF project meets the minimum floodplain management criteria of Part 65 of the National Flood Insurance Program. The FEMA response also stated that as a result of the project, the City of Pueblo Flood Insurance Rate Map (FIRM) will be revised to remove the existing unnamed ponding area and storm water Pond 1 will be shown as containing the SFHA. To make a final determination on revising the effective FIRM, FEMA requires certified as-builts upon completion of the ADF project for all proposed project elements as shown on 2005 D&O Sheet No. 12A – Pond Boundaries that was submitted with the CLOMR request.

2.2 Description of Run-on Control System

Active Cell 1 is approximately 80 feet above grade and is located in the southeast corner of the permitted ADF, and is approximately 28.8 acres. It includes a containment berm constructed around the cell. According to the 2018 EDOP, the containment berm has a minimum interior height of 4 feet above the liner protective cover, and a minimum exterior height of 2 feet above adjacent ground surface. The purpose of the berm is to provide containment for waste and leachate during the operational life of the cell and to prevent surface water from entering the cell. Containment berms will limit the potential for surface water to run into the active disposal area when it is below surrounding grade. Once the active area is above surrounding grade, the cell geometry will also prevent run-on. A perimeter access road to the east and south of Cell 1 acts as another deterrent that prevents surface water to run into the active disposal area. Cell 2 is split between Cell 2 East and future Cell 2 West. Cell 2 East is approximately 15.2 acres. The run-on control measures for Cell 2 East, includes a containment berm along its perimeter similar to Cell 1 that directs run-on away from entering the cell. Additionally the natural surrounding topography adjacent to Cell 2 East does not direct run-on towards the cell.

2.3 Description of Run-off Control System

A containment berm constructed around the top deck of the active area provides containment of ash contact water within the cell and leachate collection system. An existing storm water retention pond is located immediately north of Cell 1 and receives all non-contact surface water run-off from Cell 1 and a majority of that from Cell 2 East. Run-off from the east and south outside side slopes of Cell 1, as well as south side slope of Cell 2 East, is conveyed using a diversion berm or through a perimeter channel into tiered ponds and ultimately a 36-inch corrugated metal pipe into the existing storm water retention pond. Runoff from the northern slope of Cell 1 and the northern slope of Cell 2 East will pass through sediment controls (i.e. silt fence or equivalent) and drain into the open field to the north. Run-off from the west side slope of Cell 2 East will pass through a series of sediment controls and then directed to the north following the natural grade of the surrounding topography and discharged into a low lying area. Channels at the toe of slope for both the south and east sides are shown as part of this plan and are intended to convey the design storm event to the appropriate storm water control/ponds. There is no outfall for the existing storm water retention pond; collected surface water run-off is absorbed into the underlying materials or evaporated. The overall area of the existing storm water pond is approximately 1.35 acres.

2.4 Surface Water Run-off Model

A surface water run-off model was prepared for Cells 1 and 2 East for the 5-year period of this Run-on and Run-off Control System Plan using HydroCAD Hydrographs, which utilizes procedures outlined in Soil Conservation Service (SCS) Technical Release 55 (TR-55) for computing curve numbers and times of concentration and SCS TR-20 for calculating and generating run-off hydrographs. The model is included as Appendix A, and a detailed discussion of the information inputted into the model is provided below.

2.4.1 Rainfall Data

Rainfall data were taken from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 Precipitation Frequency Data Server. Rainfall data inputted into the model included the 25-year, 24-hour Type II storm event in the amount of 3.01 inches. The information from the NOAA Precipitation Frequency Data Server is included as Appendix B.

2.4.2 Run-off Curve Number

The run-off curve number is determined according to a hydrologic soil group and ground cover for a delineated drainage basin. The active portions of the landfill (existing Cells 1 and Cell 2 East) were delineated into the appropriate drainage basin, which sequentially drains to an existing storm water pond centrally located in the permitted ADF (refer to **Figure 1**). A composite run-off curve number of 90 was used for the ADF, including disposal materials and final cover system.

2.4.3 Time of Concentration

The time of concentration is defined as the time required for run-off to travel from the most hydrologically distant point of a sub-catchment to the point of collection. It is determined by summing the travel time for consecutive flow segments along the sub-catchment's hydraulic path. The path for the time of concentration used to compute surface water run-off from the active landfill area was conservatively estimated as 5 minutes.

2.4.4 Conveyance Channels

Channels or diversion berms will be placed on the south and west side of the Cell 2 East to convey drainage to the appropriate storm water control pond. A channel or natural grade will collect drainage from Sub-basin 2 and discharge through a series of wattles to a low lying are to the north. The west channel has been sized for the 25-year, 24-hour storm and is required, at a minimum, to be a trapezoidal channel with 3:1 side slopes, 8 feet wide at bottom, and 2 feet deep. This minimum sizing assumes a clean, straight, vegetated channel with slope of 0.5 percent. A typical diversion berm along the south side of Cell 2 East with a depth of 12 inches will direct storm water into Pond 3-1.

2.4.5 Storm Water Ponds

Four storm water ponds are designed to overflow into the existing storm water pond. Ponds 3-1, 3-2, 3-3, and 4 are located at the perimeter of Cells 1 and 2. The ponds are intended to contain and control the drainage area associated with each sub-basin. Drainage that overtops each respective pond is routed to the next pond until it eventually reaches the existing storm water pond. According to the 2018 EDOP, the size constraints for Pond 3-3 and Pond 4 and the existing grade resulted in the need to continue utilizing the existing storm water pond. The existing storm water pond was modeled as a detention basin with exfiltration as its only outlet. The 25-year, 24-hour storm, modelled with each pond dry, indicates that the system will contain, convey, and control the anticipated run-off volume.

2.5 Evaluation of Run-off Controls

To comply with 40 CFR §257.81, the existing storm water pond, and ponds 3-1, 3-2, 3-3, and 4 must be of sufficient size to collect and control run-off resulting from the 25-year, 24-hour storm event. The model was therefore run using this storm water event to evaluate whether the ponds were of sufficient size to meet the requirements.

Based on the model results, the areas of the ponds, as a system, are of sufficient size and volume to prevent surface water run-off from discharging outside the active landfill area during the 25-year, 24-hour storm event. The model estimated a peak run-off volume of 94.53 cubic feet per second during the 25-year storm event for the largest sub-basin within the model (Sub-basin 4). During the 25-year storm, the high water level was estimated to be 4,796.80 feet, which is 1.10 feet below the lowest berm elevation (4,797.90 feet).

2.6 Improvements to Existing Run-off Controls

Based on the available information and the model results, the existing run-on and run-off controls in place for the Cells 1 and 2 East of the Comanche CCR landfill unit meet the requirements of 40 CFR §257.81. There are no improvements proposed for the existing designed run-on and run-off control systems for the active portion of the CCR landfill.

3.0 Certification §257.81(c)(5)

In accordance with 40 CFR §257.81(c)(5), the owner or operator of the CCR unit must obtain a written certification from a qualified professional engineer that the initial and any amendment of the run-on and run-off control system plan meets the requirements of this section.

I, Douglas T. DeCesare, being a registered Professional Engineer, in accordance with the Colorado State Board of Licensure for Architects, Professional Engineers, and Professional Land Surveyors, do hereby certify to the best of my knowledge, information, and belief, that the information contained in this Run-On and Run-Off Control System Plan, dated March 29, 2019, was conducted in accordance with the requirements of 40 CFR §257.281(c)(5), is true and correct, and was prepared in accordance with recognized and generally accepted good engineering practices.

SIGNATURE: COLORADO LICENSED PROFESSIONAL ENGINEER DOUGLAS TRISTAN DECESARE 0051341 Douglas Tristan DeCesare 3/29/19

Colorado PE 0051341

DATE: March 29, 2019

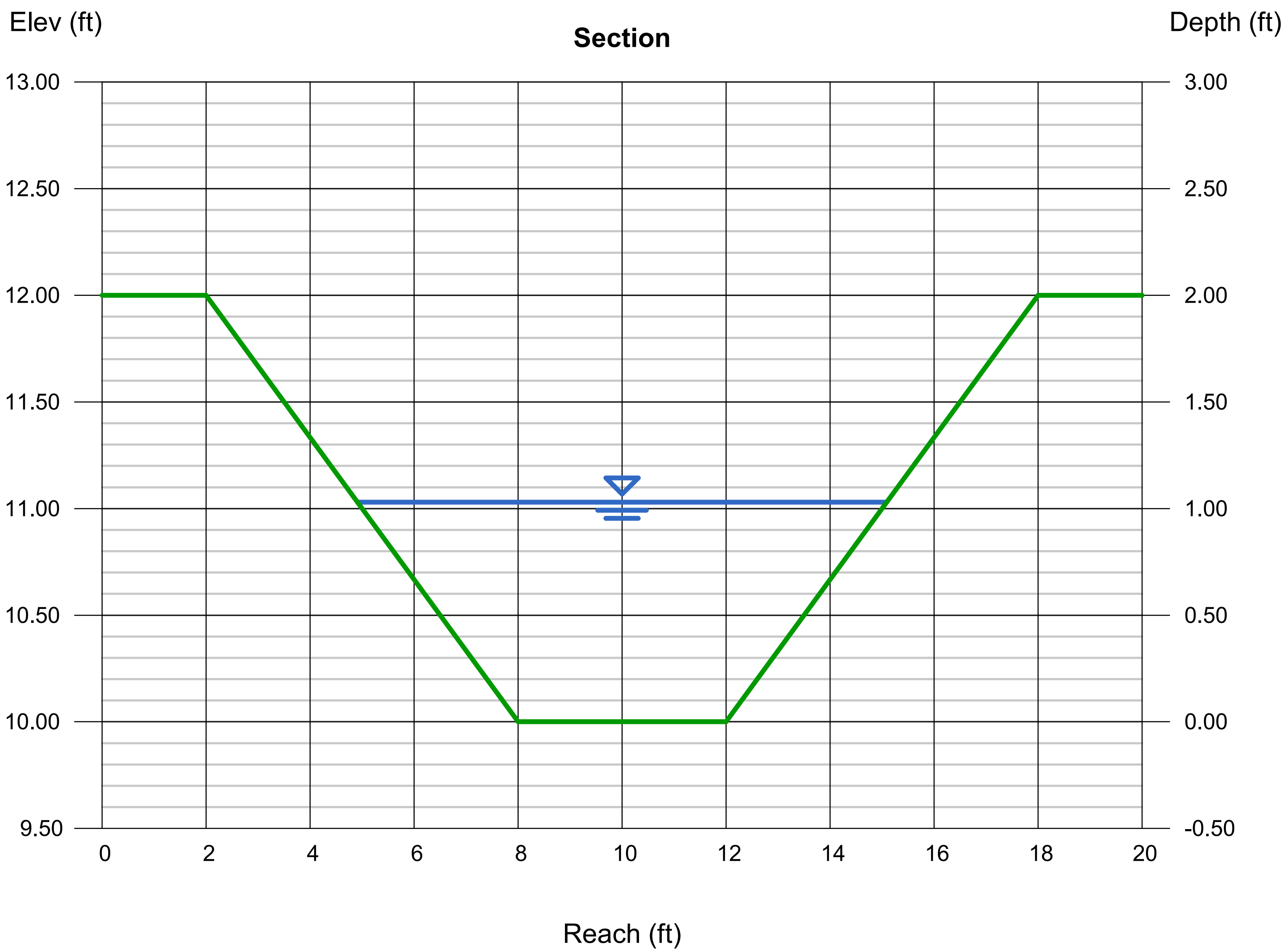
APPENDIX A - SURFACE WATER RUNOFF MODEL

Channel Report

West Perimeter Channel 25yr-24hr Storm

Trapezoidal	
Bottom Width (ft)	= 4.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 10.00
Slope (%)	= 0.50
N-Value	= 0.012
Calculations	
Compute by:	Known Q
Known Q (cfs)	= 49.81

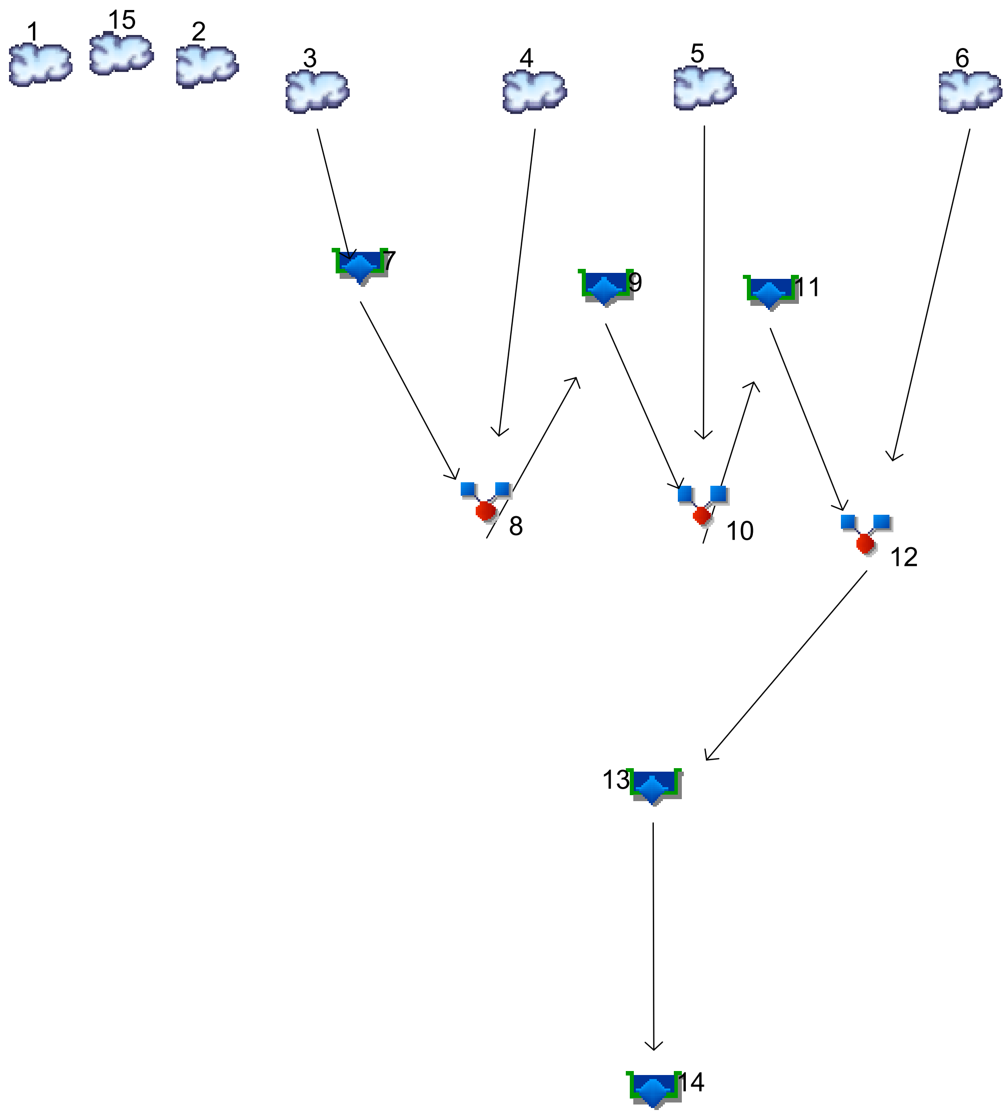
Highlighted	
Depth (ft)	= 1.03
Q (cfs)	= 49.81
Area (sqft)	= 7.30
Velocity (ft/s)	= 6.82
Wetted Perim (ft)	= 10.51
Crit Depth, Yc (ft)	= 1.25
Top Width (ft)	= 10.18
EGL (ft)	= 1.75



	Pond 3.1	Pond 3.2	Pond 3.3	Pond 4	Ex Basin
Outlet Elevation (MSL)	4815.90	4807.90	4799.90	4799.80	4797.90
Max Water Surface Elevation to Prevent Overtopping During 25 yr - 24 hr Event (MSL)	4814.40	4804.60	4798.20	4796.80	4796.80
Freeboard to be Maintained	1.50	3.30	1.70	3.00	1.10

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12



Legend

Hyd.	Origin	Description
1	SCS Runoff	Sub Basin #1a
2	SCS Runoff	Sub Basin #2
3	SCS Runoff	Sub Basin #3-1
4	SCS Runoff	Sub Basin #3-2
5	SCS Runoff	Sub Basin #3-3
6	SCS Runoff	Sub Basin #4
7	Reservoir	Pond 3-1
8	Combine	Pond 3-1 + Sub Basin 3-2
9	Reservoir	Pond 3-2
10	Combine	Pond 3-2 + Sub Basin 3-3
11	Reservoir	Pond 3-3
12	Combine	Pond 3-3 + Sub Basin 4
13	Reservoir	Pond 4
14	Reservoir	Existing Sed Basin
15	SCS Runoff	Sub Basin #1b

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)								Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	------	-------	-------	-------	-------	-------	20.54	-------	-------	Sub Basin #1a
2	SCS Runoff	------	-------	-------	-------	-------	-------	49.81	-------	-------	Sub Basin #2
3	SCS Runoff	------	-------	-------	-------	-------	-------	22.05	-------	-------	Sub Basin #3-1
4	SCS Runoff	------	-------	-------	-------	-------	-------	6.890	-------	-------	Sub Basin #3-2
5	SCS Runoff	------	-------	-------	-------	-------	-------	5.250	-------	-------	Sub Basin #3-3
6	SCS Runoff	------	-------	-------	-------	-------	-------	94.53	-------	-------	Sub Basin #4
7	Reservoir	3	-------	-------	-------	-------	-------	0.245	-------	-------	Pond 3-1
8	Combine	4, 7	-------	-------	-------	-------	-------	6.890	-------	-------	Pond 3-1 + Sub Basin 3-2
9	Reservoir	8	-------	-------	-------	-------	-------	0.322	-------	-------	Pond 3-2
10	Combine	5, 9	-------	-------	-------	-------	-------	5.250	-------	-------	Pond 3-2 + Sub Basin 3-3
11	Reservoir	10	-------	-------	-------	-------	-------	0.382	-------	-------	Pond 3-3
12	Combine	6, 11	-------	-------	-------	-------	-------	94.53	-------	-------	Pond 3-3 + Sub Basin 4
13	Reservoir	12	-------	-------	-------	-------	-------	2.329	-------	-------	Pond 4
14	Reservoir	13	-------	-------	-------	-------	-------	0.774	-------	-------	Existing Sed Basin
15	SCS Runoff	------	-------	-------	-------	-------	-------	8.695	-------	-------	Sub Basin #1b

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	20.54	2	716	42,465	------	------	------	Sub Basin #1a
2	SCS Runoff	49.81	2	716	102,973	------	------	------	Sub Basin #2
3	SCS Runoff	22.05	2	716	45,585	------	------	------	Sub Basin #3-1
4	SCS Runoff	6.890	2	716	14,245	------	------	------	Sub Basin #3-2
5	SCS Runoff	5.250	2	716	10,854	------	------	------	Sub Basin #3-3
6	SCS Runoff	94.53	2	716	195,433	------	------	------	Sub Basin #4
7	Reservoir	0.245	2	1178	7,085	3	4815.86	109,110	Pond 3-1
8	Combine	6.890	2	716	21,331	4, 7	------	------	Pond 3-1 + Sub Basin 3-2
9	Reservoir	0.322	2	1172	9,477	8	4807.88	13,168	Pond 3-2
10	Combine	5.250	2	716	20,331	5, 9	------	------	Pond 3-2 + Sub Basin 3-3
11	Reservoir	0.382	2	1172	14,118	10	4799.89	7,348	Pond 3-3
12	Combine	94.53	2	716	209,551	6, 11	------	------	Pond 3-3 + Sub Basin 4
13	Reservoir	2.329	2	904	74,204	12	4800.00	225,069	Pond 4
14	Reservoir	0.774	2	1488	21,595	13	4797.99	186,017	Existing Sed Basin
15	SCS Runoff	8.695	2	716	17,976	------	------	------	Sub Basin #1b

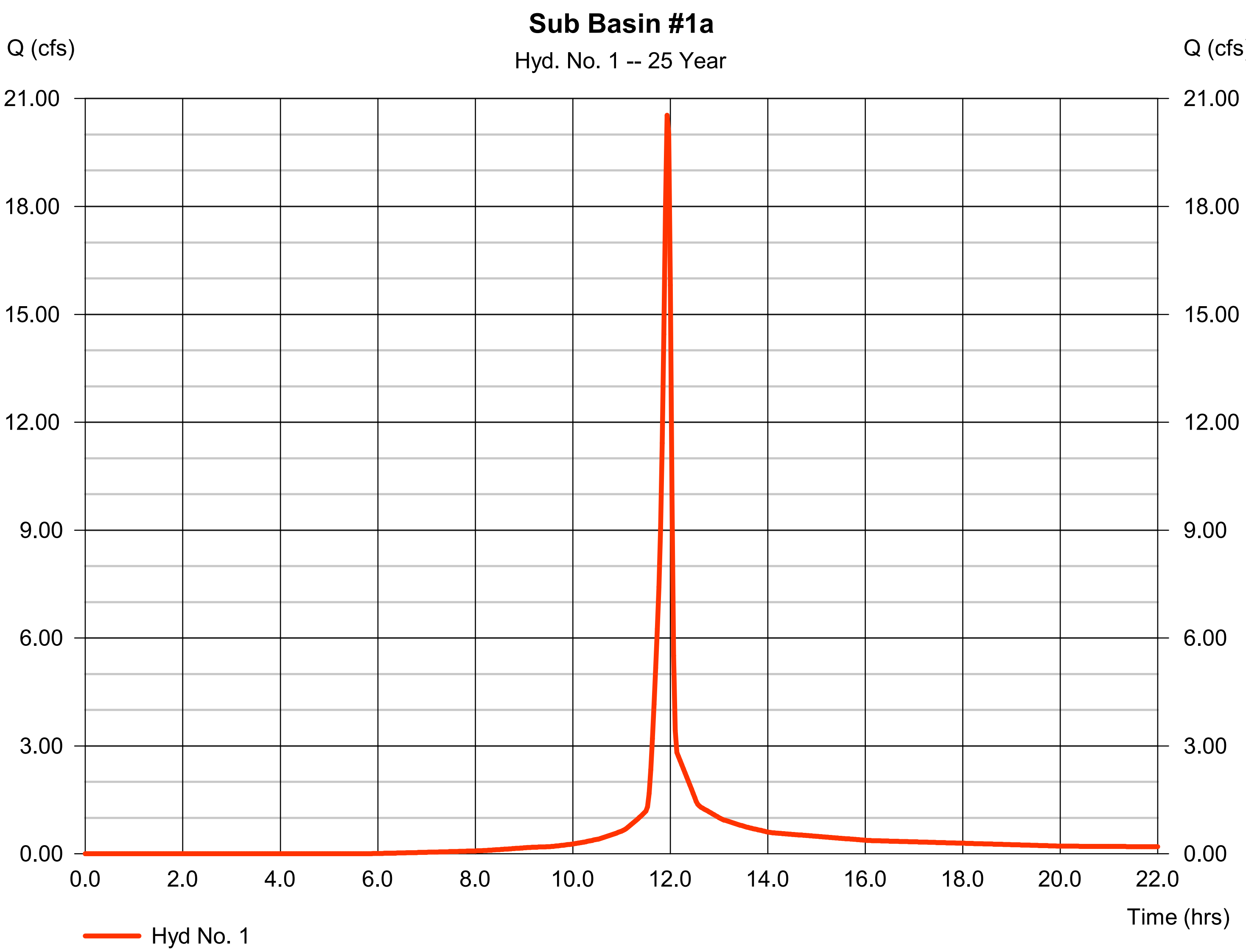
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12 Monday, 12 / 31 / 2018

Hyd. No. 1

Sub Basin #1a

Hydrograph type	= SCS Runoff	Peak discharge	= 20.54 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 42,465 cuft
Drainage area	= 6.260 ac	Curve number	= 90
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.01 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

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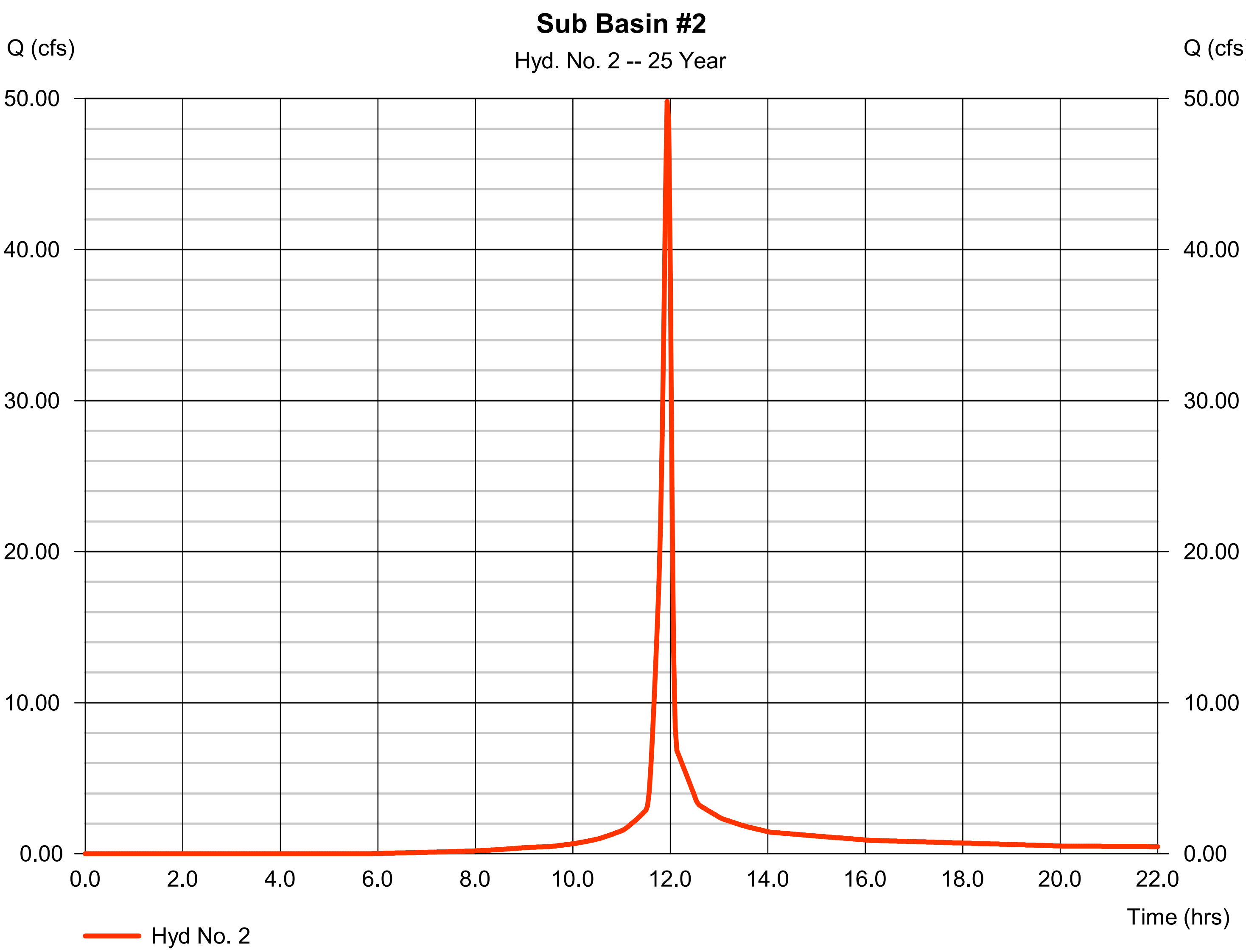
Hyd. No. 2

Sub Basin #2

Hydrograph type	= SCS Runoff	Peak discharge	= 49.81 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 102,973 cuft
Drainage area	= 15.180 ac	Curve number	= 90
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.01 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

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Hyd. No. 3

Sub Basin #3-1

Hydrograph type	= SCS Runoff	Peak discharge	= 22.05 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 45,585 cuft
Drainage area	= 6.720 ac	Curve number	= 90
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
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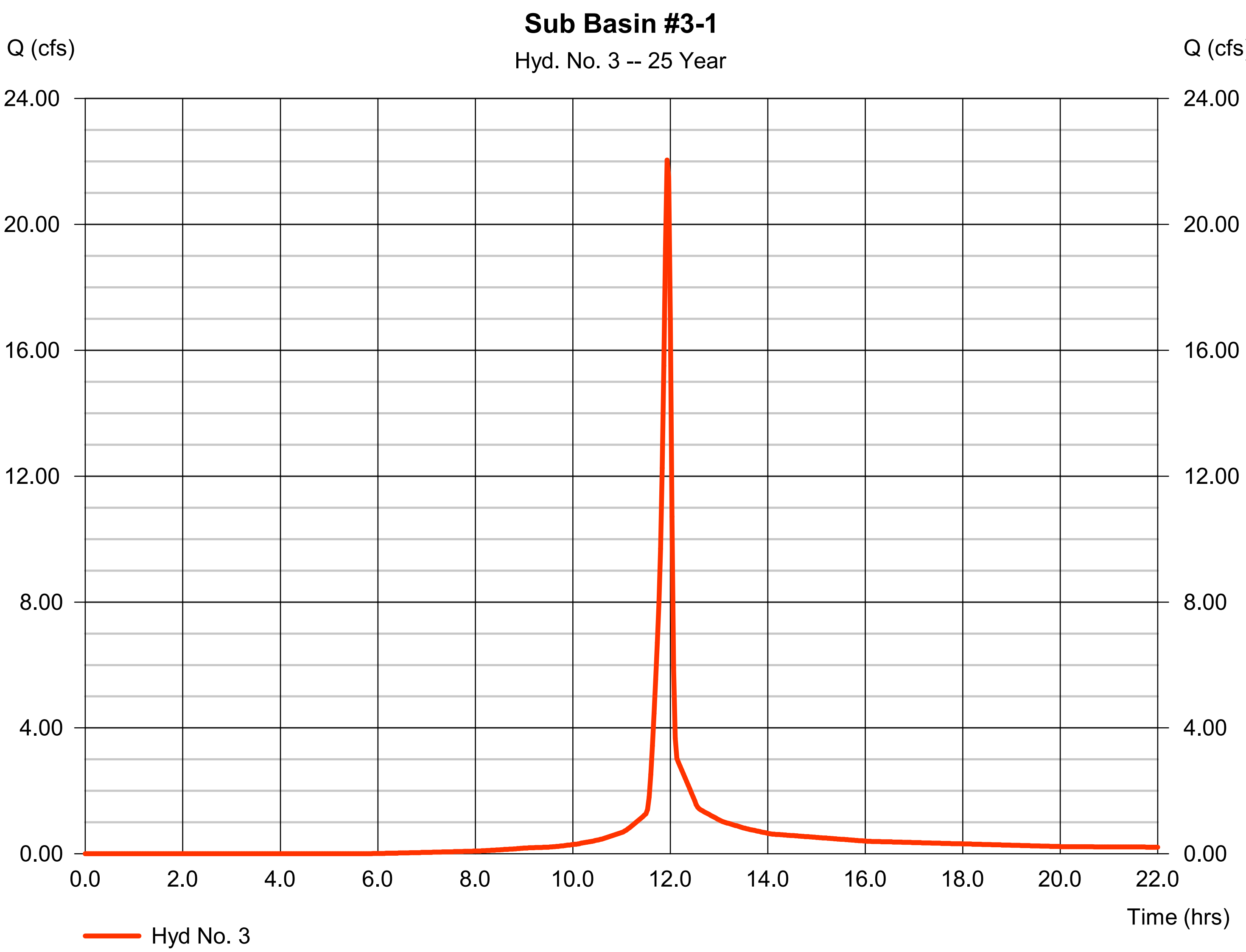
Total precip.	= 3.01 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

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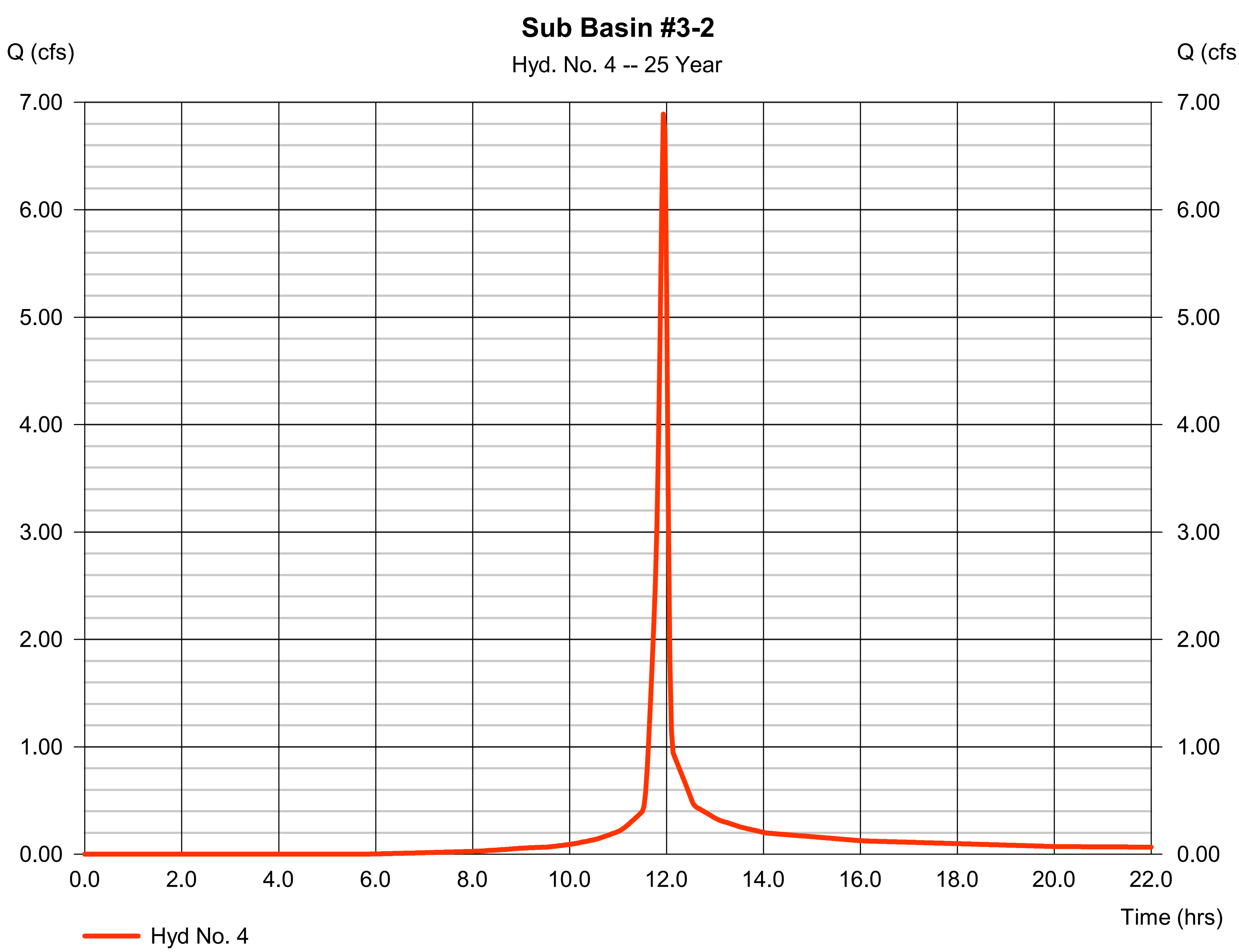
Hyd. No. 4

Sub Basin #3-2

Hydrograph type	= SCS Runoff	Peak discharge	= 6.890 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 14,245 cuft
Drainage area	= 2.100 ac	Curve number	= 90
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.01 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

Hyd. No. 5

Sub Basin #3-3

Hydrograph type	= SCS Runoff	Peak discharge	= 5.250 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 10,854 cuft
Drainage area	= 1.600 ac	Curve number	= 90
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
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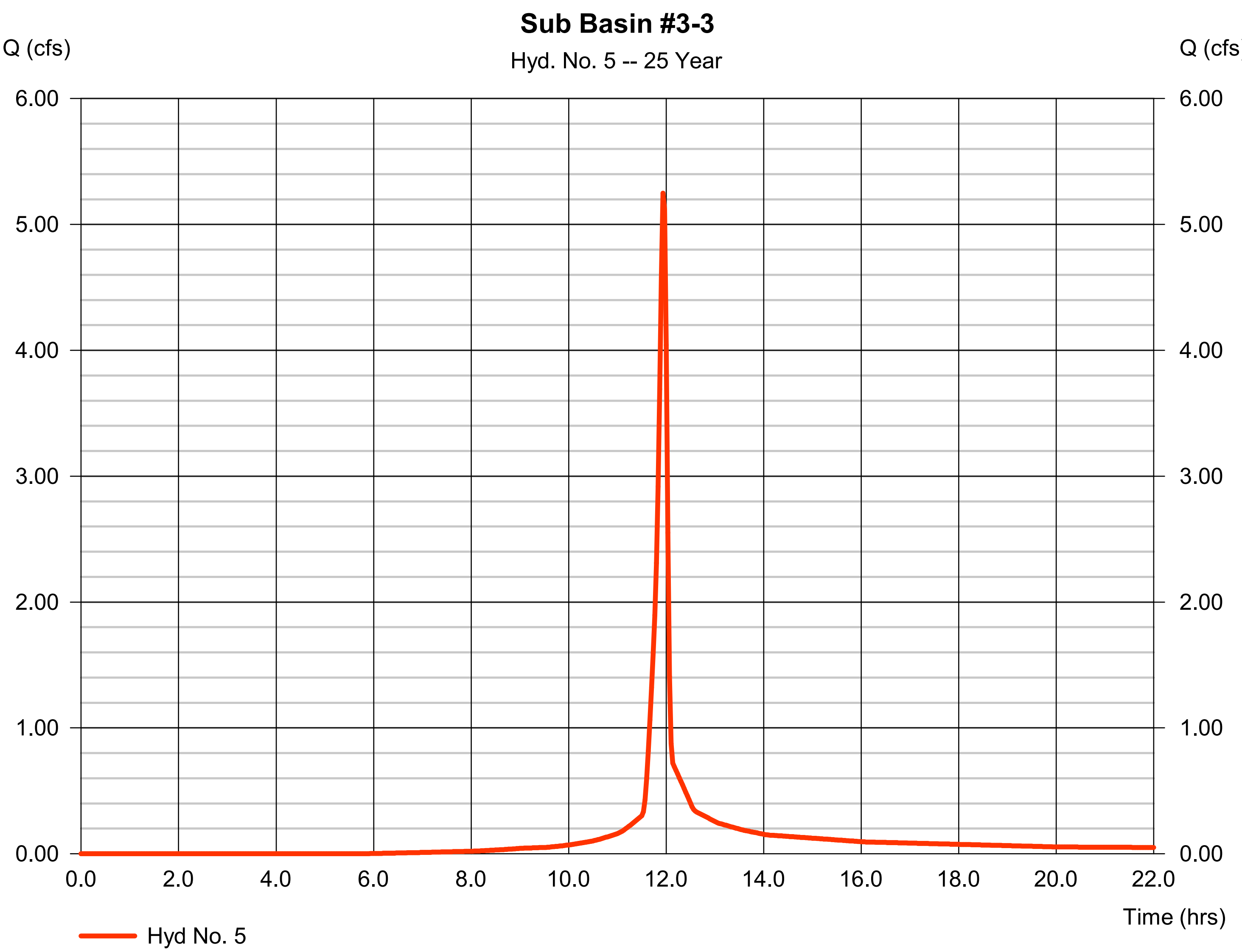
Total precip.	= 3.01 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



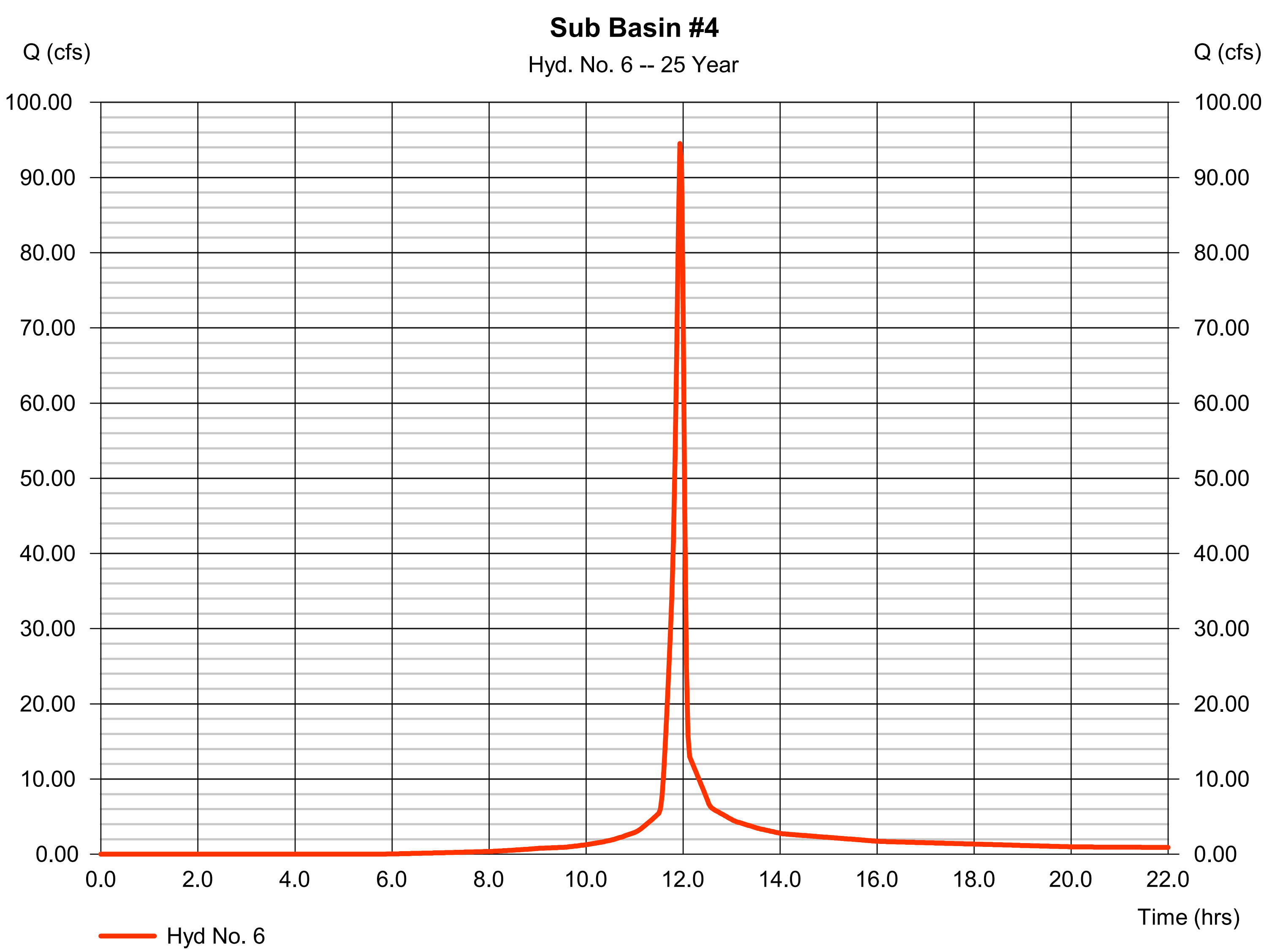
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12 Monday, 12 / 31 / 2018

Hyd. No. 6

Sub Basin #4

Hydrograph type	= SCS Runoff	Peak discharge	= 94.53 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 195,433 cuft
Drainage area	= 28.810 ac	Curve number	= 90
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.01 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

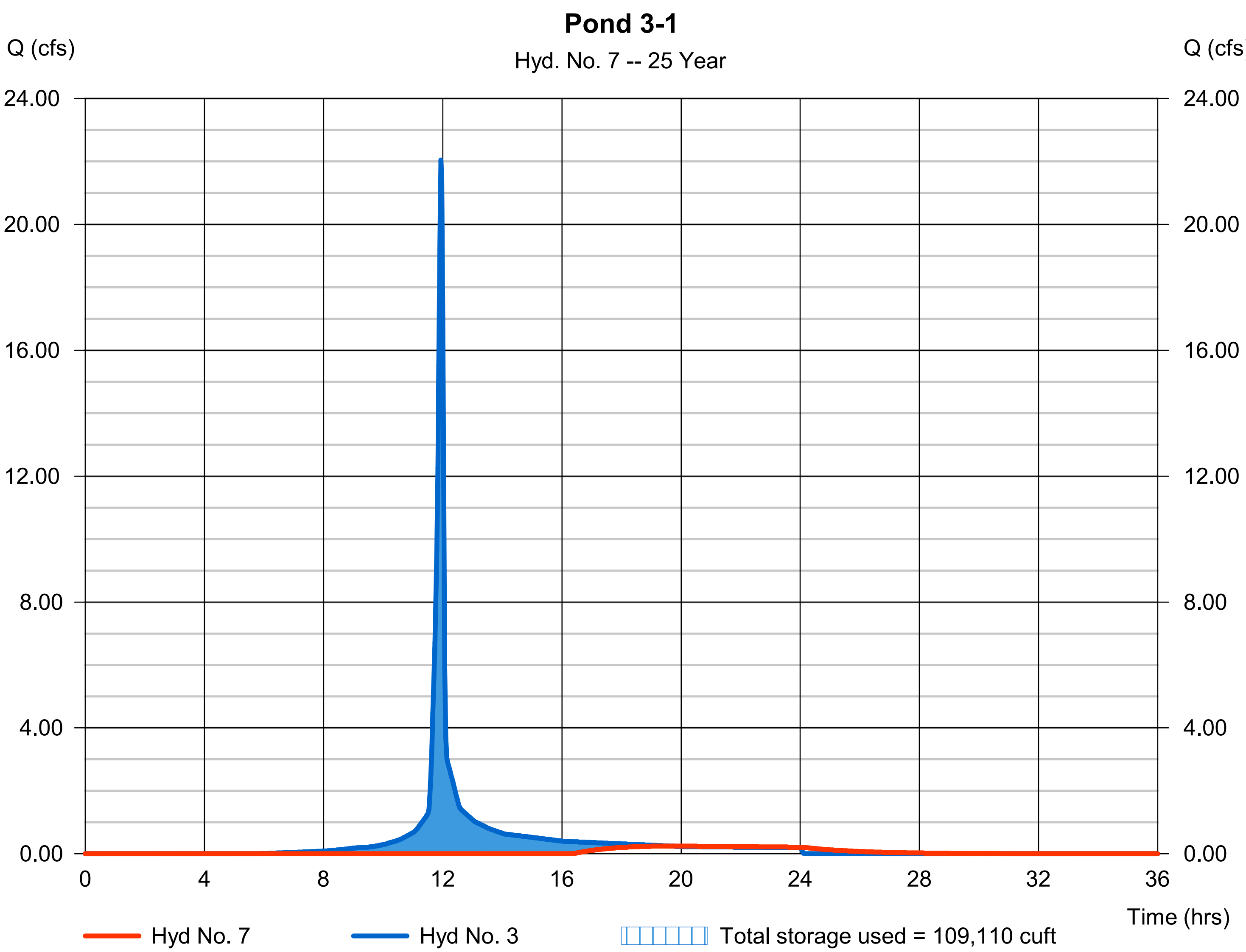
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12 — Monday, 12 / 31 / 2018

Hyd. No. 7

Pond 3-1

Hydrograph type	= Reservoir	Peak discharge	= 0.245 cfs
Storm frequency	= 25 yrs	Time to peak	= 19.63 hrs
Time interval	= 2 min	Hyd. volume	= 7,085 cuft
Inflow hyd. No.	= 3 - Sub Basin #3-1	Max. Elevation	= 4815.86 ft
Reservoir name	= Pond 3-1	Max. Storage	= 109,110 cuft

Storage Indication method used. Wet pond routing start elevation = 4814.40 ft.



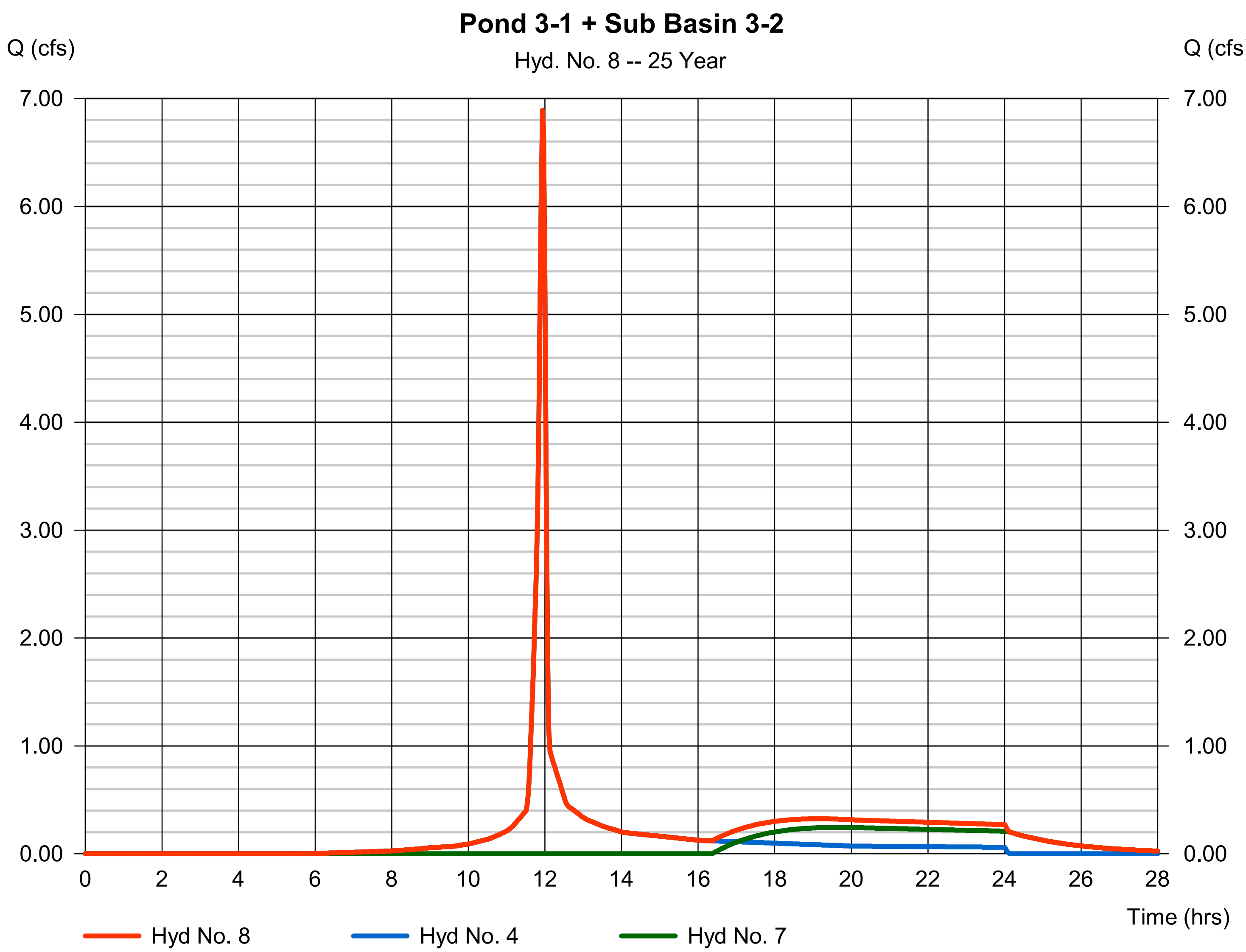
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12 Monday, 12 / 31 / 2018

Hyd. No. 8

Pond 3-1 + Sub Basin 3-2

Hydrograph type	= Combine	Peak discharge	= 6.890 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 21,331 cuft
Inflow hyds.	= 4, 7	Contrib. drain. area	= 2.100 ac



Hydrograph Report

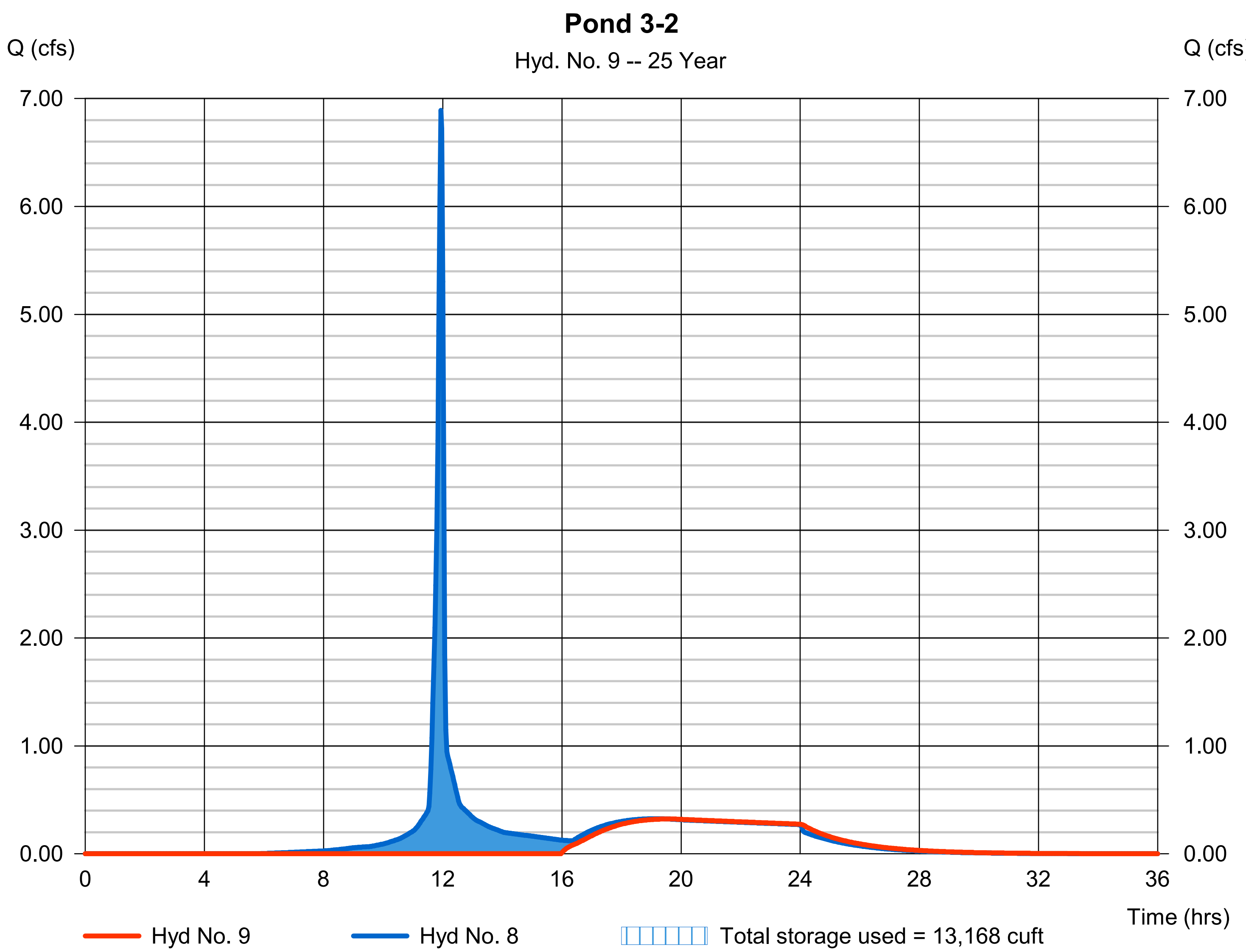
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12 Monday, 12 / 31 / 2018

Hyd. No. 9

Pond 3-2

Hydrograph type	= Reservoir	Peak discharge	= 0.322 cfs
Storm frequency	= 25 yrs	Time to peak	= 19.53 hrs
Time interval	= 2 min	Hyd. volume	= 9,477 cuft
Inflow hyd. No.	= 8 - Pond 3-1 + Sub Basin 3-2	Max. Elevation	= 4807.88 ft
Reservoir name	= Pond 3-2	Max. Storage	= 13,168 cuft

Storage Indication method used. Wet pond routing start elevation = 4804.60 ft.



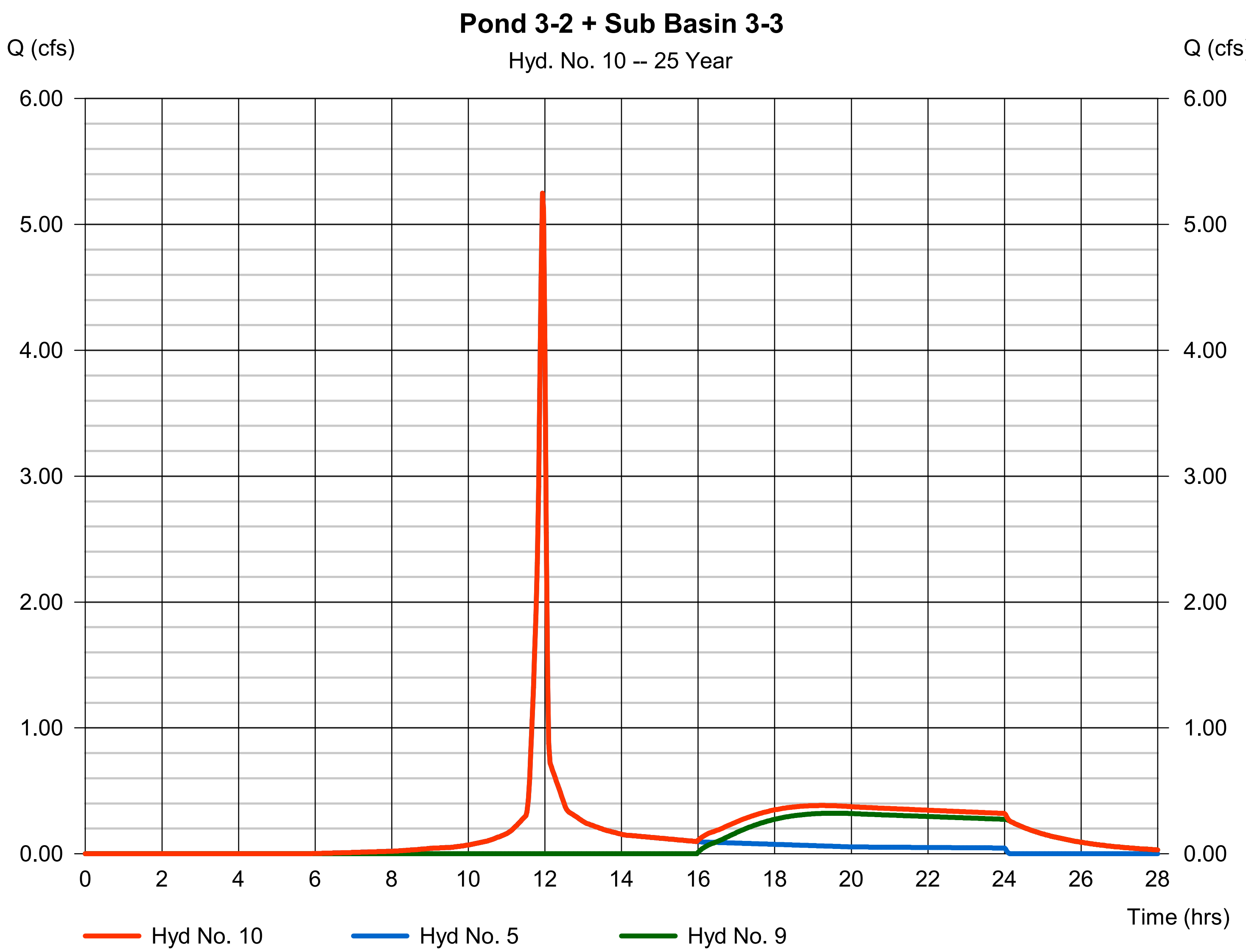
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12 Monday, 12 / 31 / 2018

Hyd. No. 10

Pond 3-2 + Sub Basin 3-3

Hydrograph type	= Combine	Peak discharge	= 5.250 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 20,331 cuft
Inflow hyds.	= 5, 9	Contrib. drain. area	= 1.600 ac



Hydrograph Report

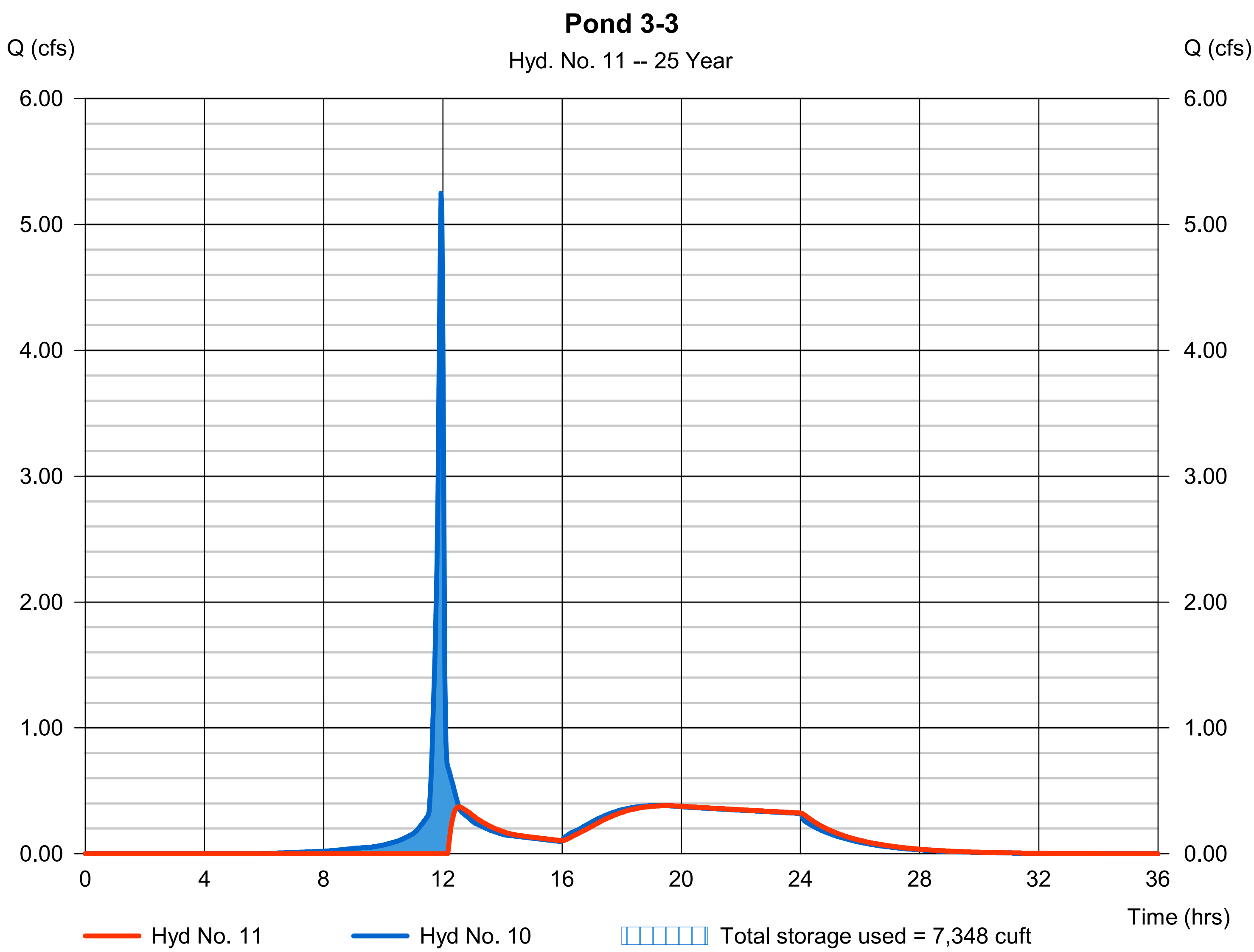
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12 Monday, 12 / 31 / 2018

Hyd. No. 11

Pond 3-3

Hydrograph type	= Reservoir	Peak discharge	= 0.382 cfs
Storm frequency	= 25 yrs	Time to peak	= 19.53 hrs
Time interval	= 2 min	Hyd. volume	= 14,118 cuft
Inflow hyd. No.	= 10 - Pond 3-2 + Sub Basin 3-3	Max. Elevation	= 4799.89 ft
Reservoir name	= Pond 3-3	Max. Storage	= 7,348 cuft

Storage Indication method used. Wet pond routing start elevation = 4798.20 ft.



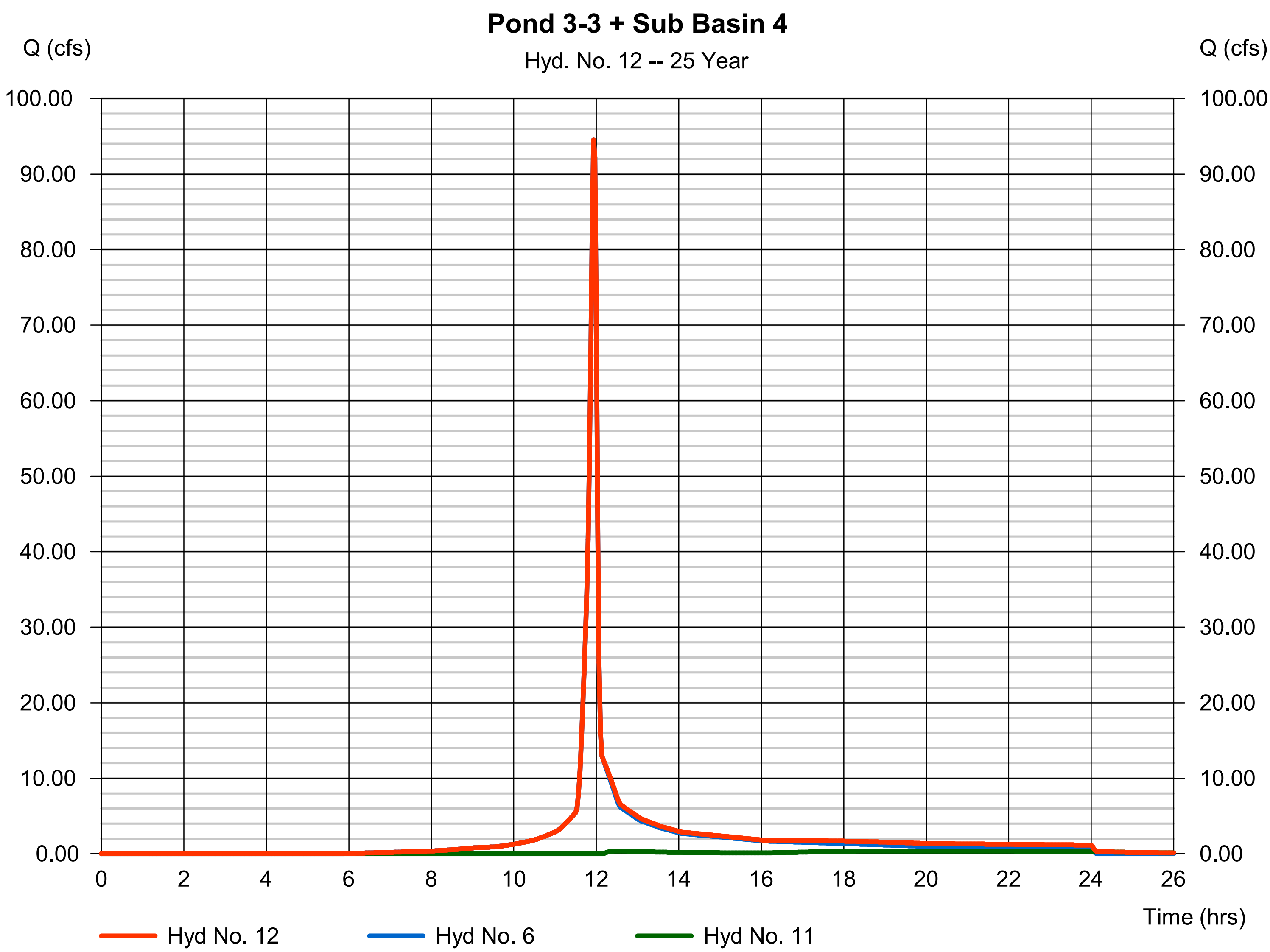
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12 Monday, 12 / 31 / 2018

Hyd. No. 12

Pond 3-3 + Sub Basin 4

Hydrograph type	= Combine	Peak discharge	= 94.53 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 209,551 cuft
Inflow hyds.	= 6, 11	Contrib. drain. area	= 28.810 ac



Hydrograph Report

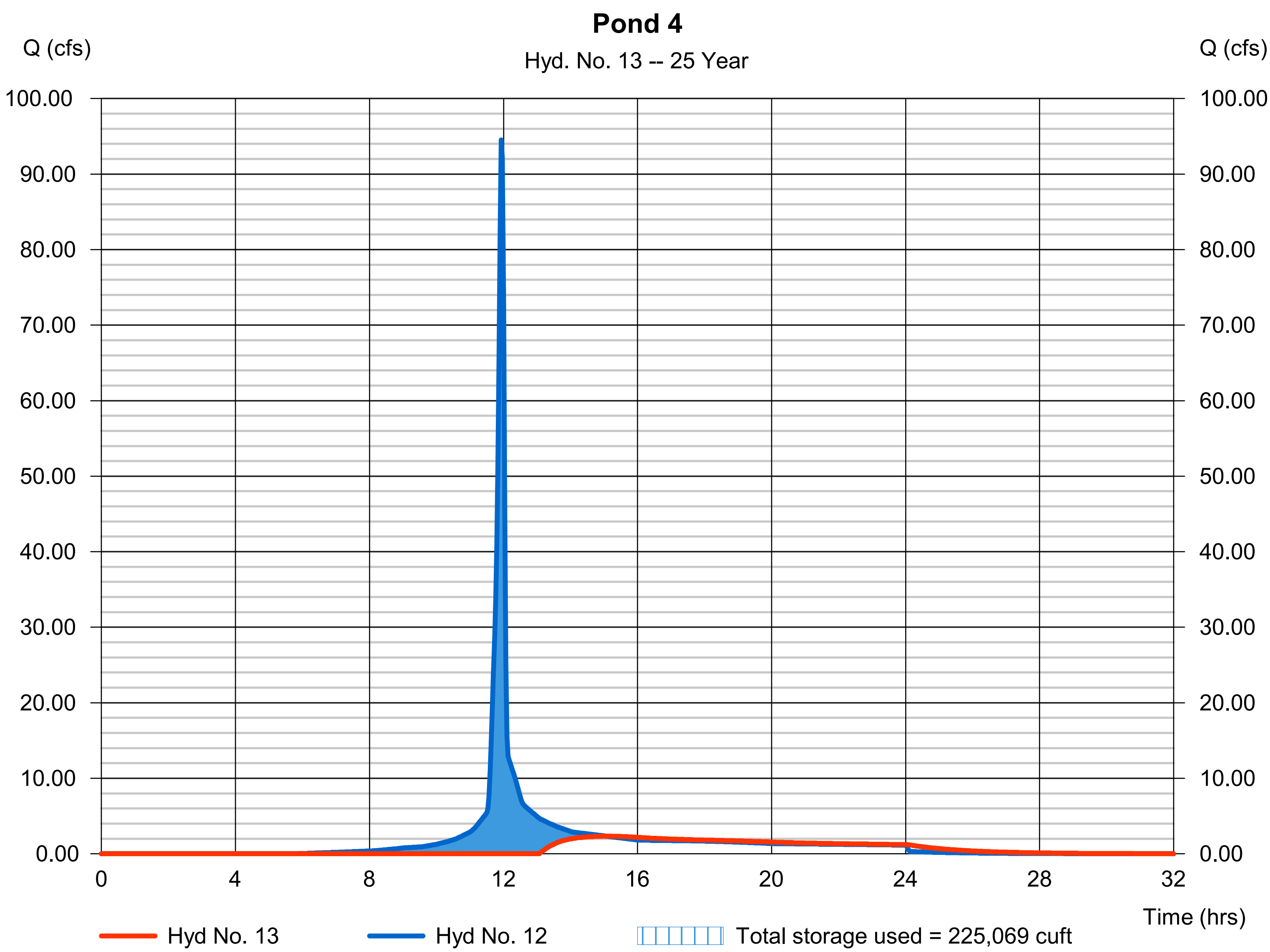
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12 Monday, 12 / 31 / 2018

Hyd. No. 13

Pond 4

Hydrograph type	= Reservoir	Peak discharge	= 2.329 cfs
Storm frequency	= 25 yrs	Time to peak	= 15.07 hrs
Time interval	= 2 min	Hyd. volume	= 74,204 cuft
Inflow hyd. No.	= 12 - Pond 3-3 + Sub Basin 4	Max. Elevation	= 4800.00 ft
Reservoir name	= Pond 4	Max. Storage	= 225,069 cuft

Storage Indication method used. Wet pond routing start elevation = 4796.80 ft.



Hydrograph Report

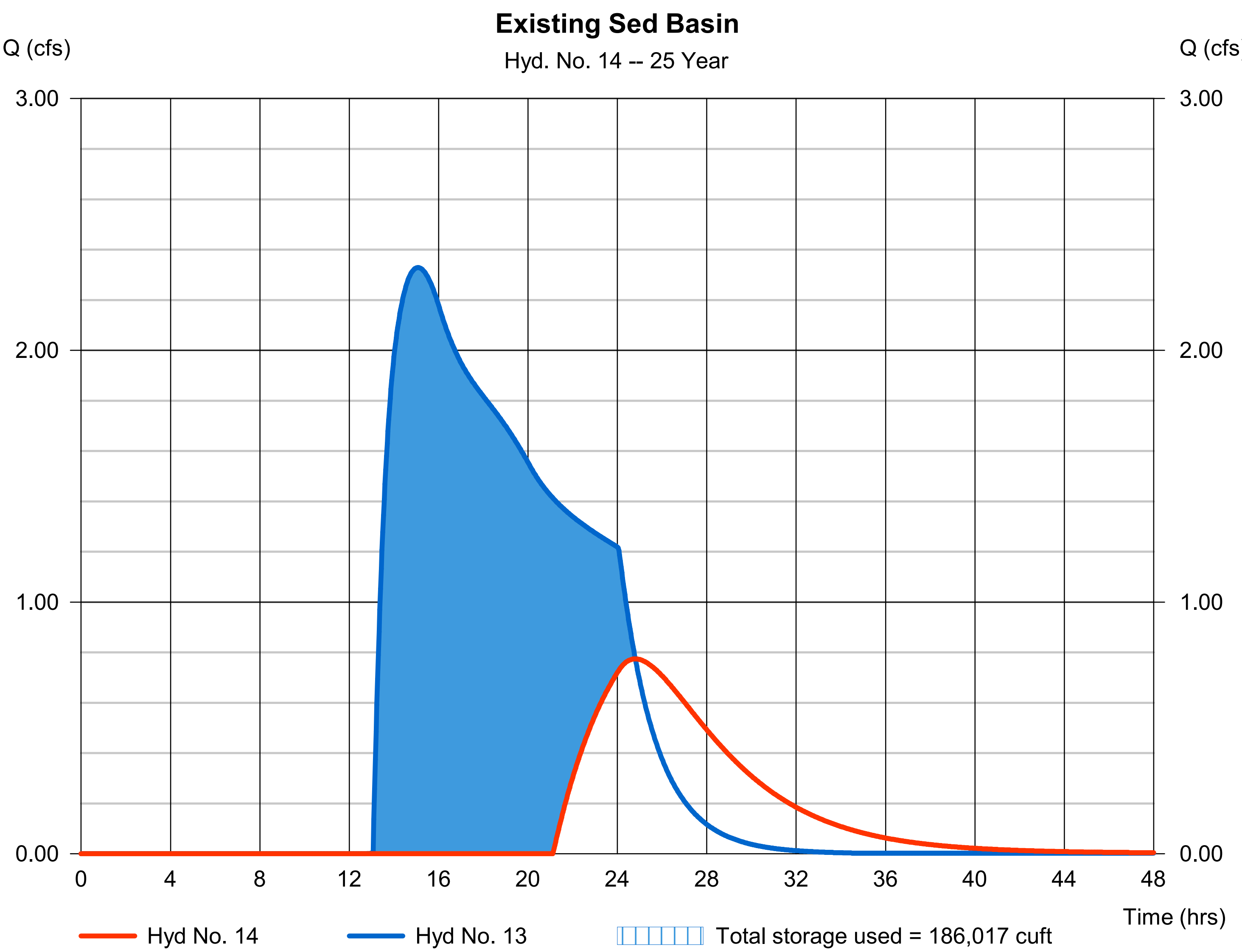
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12 — Monday, 12 / 31 / 2018

Hyd. No. 14

Existing Sed Basin

Hydrograph type	= Reservoir	Peak discharge	= 0.774 cfs
Storm frequency	= 25 yrs	Time to peak	= 24.80 hrs
Time interval	= 2 min	Hyd. volume	= 21,595 cuft
Inflow hyd. No.	= 13 - Pond 4	Max. Elevation	= 4797.99 ft
Reservoir name	= Ex. Sed Basin	Max. Storage	= 186,017 cuft

Storage Indication method used. Wet pond routing start elevation = 4796.80 ft.



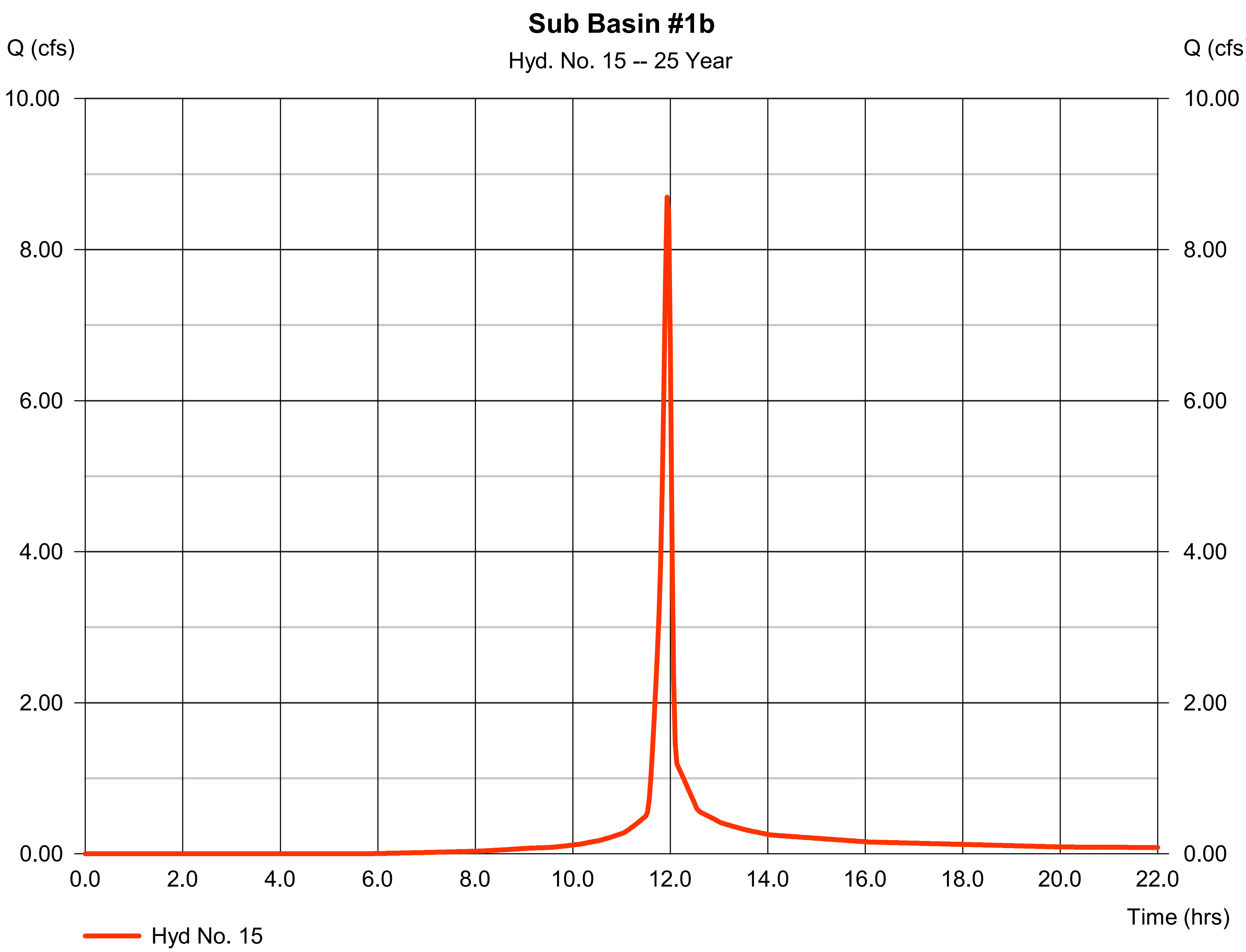
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12 Monday, 12 / 31 / 2018

Hyd. No. 15

Sub Basin #1b

Hydrograph type	= SCS Runoff	Peak discharge	= 8.695 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 17,976 cuft
Drainage area	= 2.650 ac	Curve number	= 90
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.01 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



APPENDIX B - NOAA AVERAGE RAINFALL DATA

NOAA Atlas 14, Volume 8, Version 2
Location name: Pueblo, Colorado, US*
Latitude: 38.2067°, Longitude: -104.5800°
Elevation: 4811 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	**2**	**5**	**10**	**25**	**50**	**100**	**200**	**500**	**1000**
5-min	**0.220** (0.176-0.279)	**0.266** (0.212-0.337)	**0.350** (0.279-0.445)	**0.429** (0.339-0.548)	**0.551** (0.424-0.741)	**0.655** (0.489-0.887)	**0.767** (0.551-1.06)	**0.891** (0.610-1.26)	**1.07** (0.700-1.55)	**1.21** (0.768-1.77)
10-min	**0.322** (0.257-0.408)	**0.389** (0.311-0.494)	**0.513** (0.408-0.652)	**0.628** (0.496-0.802)	**0.806** (0.621-1.08)	**0.958** (0.716-1.30)	**1.12** (0.807-1.56)	**1.30** (0.894-1.85)	**1.56** (1.02-2.27)	**1.78** (1.13-2.59)
15-min	**0.392** (0.314-0.498)	**0.475** (0.379-0.602)	**0.625** (0.497-0.795)	**0.766** (0.605-0.979)	**0.983** (0.758-1.32)	**1.17** (0.873-1.58)	**1.37** (0.984-1.90)	**1.59** (1.09-2.25)	**1.91** (1.25-2.77)	**2.17** (1.37-3.16)
30-min	**0.616** (0.493-0.781)	**0.737** (0.589-0.936)	**0.961** (0.764-1.22)	**1.17** (0.925-1.49)	**1.49** (1.15-2.01)	**1.77** (1.32-2.40)	**2.07** (1.49-2.87)	**2.40** (1.65-3.41)	**2.88** (1.89-4.18)	**3.27** (2.07-4.76)
60-min	**0.784** (0.627-0.994)	**0.934** (0.745-1.19)	**1.21** (0.961-1.54)	**1.47** (1.16-1.87)	**1.87** (1.44-2.51)	**2.21** (1.65-2.99)	**2.58** (1.85-3.57)	**2.99** (2.05-4.24)	**3.58** (2.35-5.19)	**4.06** (2.57-5.92)
2-hr	**0.952** (0.767-1.20)	**1.13** (0.909-1.42)	**1.46** (1.17-1.84)	**1.76** (1.41-2.23)	**2.24** (1.74-2.98)	**2.65** (2.00-3.55)	**3.09** (2.24-4.24)	**3.58** (2.47-5.03)	**4.28** (2.83-6.15)	**4.85** (3.10-7.01)
3-hr	**1.01** (0.814-1.26)	**1.19** (0.962-1.49)	**1.53** (1.23-1.92)	**1.85** (1.48-2.33)	**2.34** (1.83-3.10)	**2.76** (2.09-3.69)	**3.22** (2.34-4.39)	**3.72** (2.59-5.20)	**4.45** (2.96-6.36)	**5.04** (3.24-7.24)
6-hr	**1.11** (0.903-1.37)	**1.30** (1.06-1.61)	**1.65** (1.34-2.05)	**1.98** (1.60-2.48)	**2.50** (1.97-3.28)	**2.94** (2.24-3.88)	**3.42** (2.51-4.62)	**3.94** (2.77-5.46)	**4.70** (3.16-6.66)	**5.32** (3.46-7.58)
12-hr	**1.25** (1.02-1.53)	**1.45** (1.19-1.78)	**1.82** (1.49-2.24)	**2.17** (1.76-2.68)	**2.71** (2.15-3.52)	**3.17** (2.44-4.15)	**3.67** (2.73-4.92)	**4.23** (3.00-5.79)	**5.02** (3.41-7.05)	**5.67** (3.73-8.00)
24-hr	**1.40** (1.16-1.70)	**1.63** (1.35-1.98)	**2.04** (1.68-2.49)	**2.42** (1.99-2.97)	**3.01** (2.40-3.86)	**3.50** (2.72-4.54)	**4.04** (3.02-5.35)	**4.62** (3.31-6.27)	**5.46** (3.74-7.58)	**6.13** (4.07-8.57)
2-day	**1.56** (1.30-1.88)	**1.84** (1.53-2.21)	**2.33** (1.93-2.81)	**2.76** (2.28-3.35)	**3.42** (2.75-4.33)	**3.96** (3.10-5.07)	**4.54** (3.42-5.94)	**5.16** (3.72-6.92)	**6.04** (4.18-8.29)	**6.74** (4.52-9.34)
3-day	**1.68** (1.41-2.01)	**1.98** (1.66-2.38)	**2.51** (2.10-3.02)	**2.99** (2.48-3.60)	**3.69** (2.98-4.64)	**4.27** (3.35-5.43)	**4.88** (3.70-6.35)	**5.54** (4.02-7.39)	**6.47** (4.50-8.84)	**7.21** (4.87-9.94)
4-day	**1.79** (1.51-2.14)	**2.10** (1.77-2.51)	**2.66** (2.22-3.18)	**3.15** (2.62-3.79)	**3.88** (3.14-4.87)	**4.49** (3.54-5.68)	**5.13** (3.90-6.64)	**5.82** (4.24-7.72)	**6.78** (4.74-9.23)	**7.56** (5.13-10.4)
7-day	**2.07** (1.75-2.45)	**2.40** (2.03-2.85)	**2.99** (2.52-3.55)	**3.51** (2.94-4.19)	**4.29** (3.50-5.34)	**4.94** (3.92-6.20)	**5.62** (4.31-7.22)	**6.36** (4.67-8.37)	**7.39** (5.21-9.97)	**8.21** (5.62-11.2)
10-day	**2.29** (1.95-2.70)	**2.66** (2.26-3.14)	**3.30** (2.80-3.91)	**3.87** (3.26-4.59)	**4.70** (3.85-5.80)	**5.38** (4.29-6.71)	**6.09** (4.69-7.77)	**6.85** (5.05-8.96)	**7.91** (5.61-10.6)	**8.75** (6.03-11.9)
20-day	**2.90** (2.48-3.38)	**3.42** (2.93-4.00)	**4.28** (3.66-5.02)	**5.01** (4.25-5.89)	**6.01** (4.93-7.29)	**6.80** (5.45-8.34)	**7.59** (5.88-9.53)	**8.40** (6.24-10.8)	**9.48** (6.77-12.5)	**10.3** (7.17-13.8)
30-day	**3.42** (2.95-3.97)	**4.05** (3.49-4.71)	**5.06** (4.34-5.89)	**5.89** (5.02-6.88)	**7.00** (5.75-8.40)	**7.85** (6.31-9.54)	**8.68** (6.74-10.8)	**9.51** (7.09-12.1)	**10.6** (7.59-13.9)	**11.4** (7.97-15.2)
45-day	**4.14** (3.59-4.78)	**4.85** (4.19-5.60)	**5.96** (5.14-6.91)	**6.86** (5.88-7.98)	**8.05** (6.64-9.57)	**8.93** (7.21-10.8)	**9.78** (7.64-12.1)	**10.6** (7.95-13.4)	**11.7** (8.41-15.2)	**12.4** (8.75-16.5)
60-day	**4.80** (4.17-5.51)	**5.52** (4.80-6.35)	**6.67** (5.77-7.69)	**7.58** (6.53-8.78)	**8.79** (7.27-10.4)	**9.67** (7.84-11.6)	**10.5** (8.24-12.9)	**11.3** (8.52-14.3)	**12.3** (8.94-16.0)	**13.1** (9.25-17.3)

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

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

Please refer to NOAA Atlas 14 document for more information.

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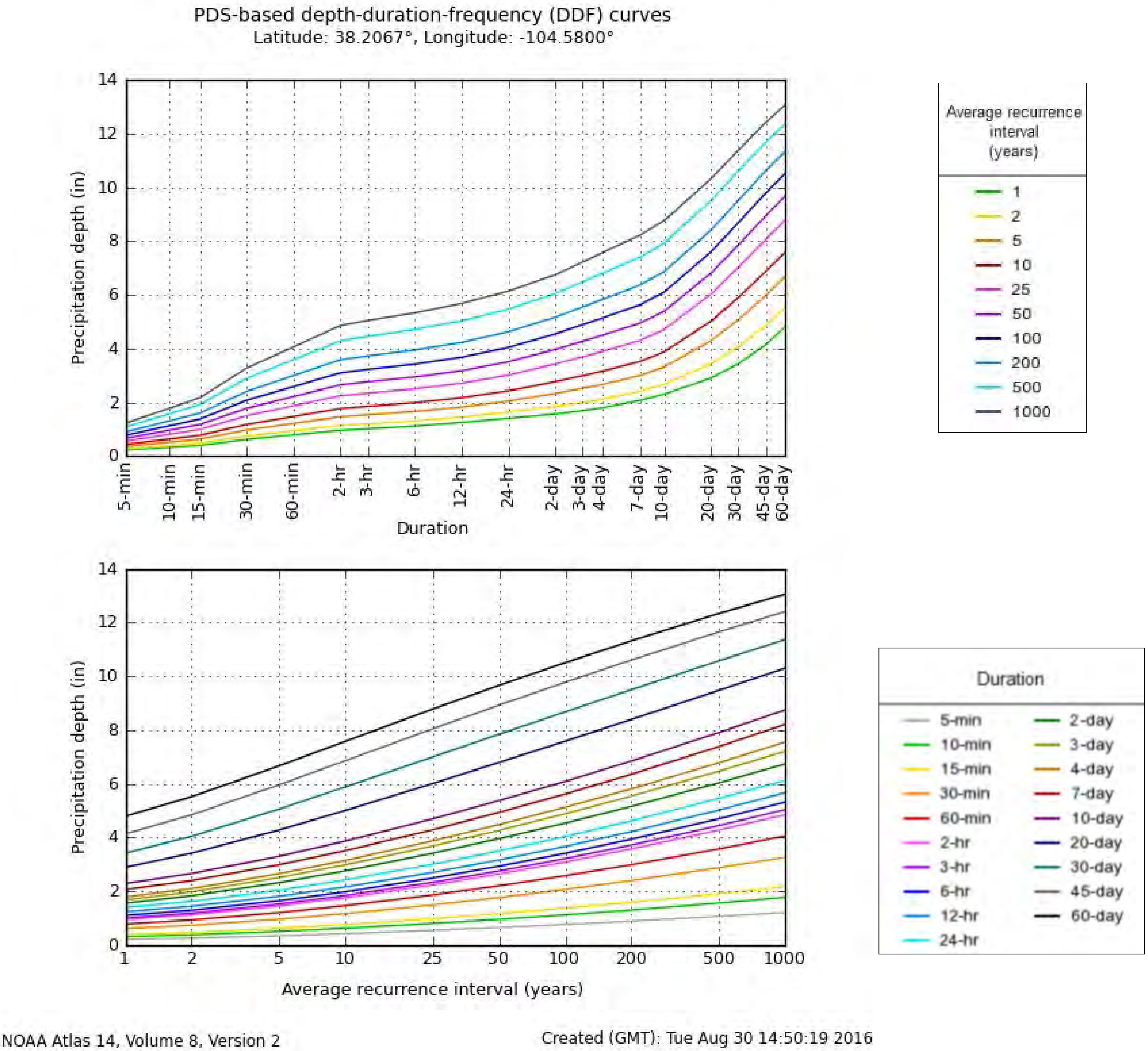
PF graphical



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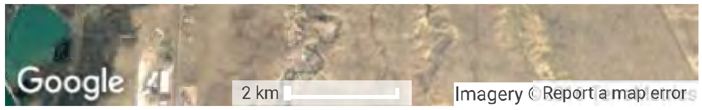
Maps & aerials

Small scale terrain

Large scale terrain

Large scale map

Large scale aerial



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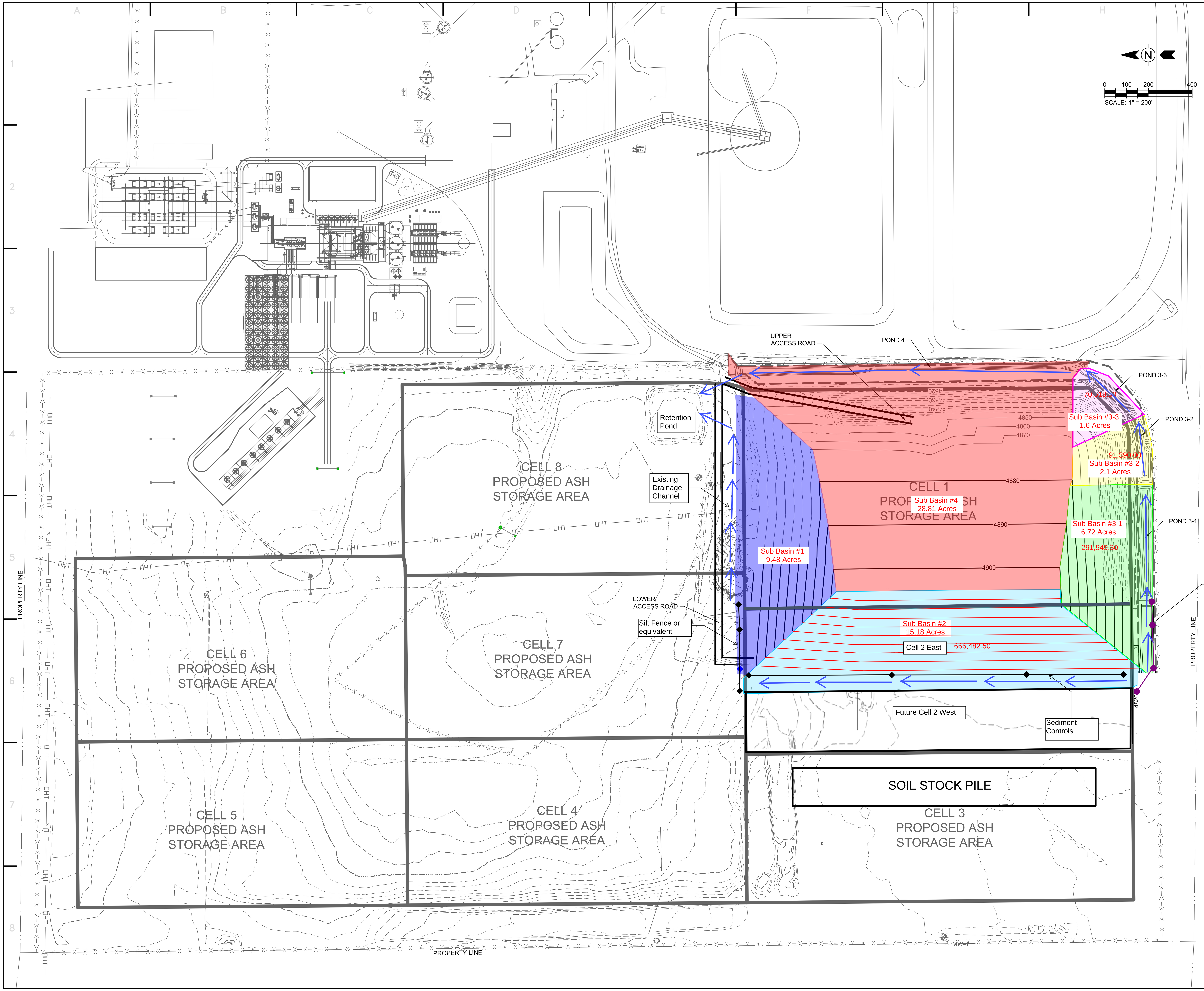
US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

APPENDIX C – DRAINAGE AREAS AND RUN-OFF CONTROLS



SCALE: 1" = 200'

REFERENCE DRAWINGS

DWG NO.	MANUFACTURER	DRAWING TITLE
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SURVEY NOTES:

1. SURVEY CONDUCTED AUGUST, 2013, BY:
   EDWARD-JAMES SURVEYING, INC.
   4732 EAGLERIDGE CIRCLE
   PUEBLO, CO 81008
   (719) 545-6240
2. PROJECT BENCHMARK: COMANCHE STATION CONTROL POINT 6, ELEVATION 4801.52' (NAVD88).

LEGEND

- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- EXISTING RAILROAD
- EXISTING FENCE
- EXISTING ROAD
- EXISTING STRUCTURE
- CELL BOUNDARY
- MW-1 MONITORING WELL
- PROPOSED ACCESS ROAD
- X DETAIL NUMBER
- XX SHEET NUMBER WHERE DETAIL IS LOCATED

CELL VOLUMES

CELL	VOLUME (CY)
1	1,512,800
2	3,316,500

Legend:
Flow Direction
Diversion Berm
Sediment Controls (e.g. Silt Fence, waddles, etc.)

COLORADO REGISTERED PROFESSIONAL ENGINEER DAVID JAMES BOHMANN 37684

NO	REVISION	ZONE	DATE	BY	CHK	ENG

TETRA TECH

COMANCHE - COMMON
ASH LANDFILL
DESIGN & OPERATIONS PLAN
CELL 2 OPERATION GRADES

Xcel Energy®
PUBLIC SERVICE COMPANY OF COLORADO

DWN: SEF	DATE: 8-14-14	CHK: JMS	DATE: 8-14-14	PROJ. NO: 0000000
ENG: JMS	DATE: 8-14-14	CHK: DHB	DATE: 8-14-14	SCALE:
PM: JRE	DATE: 8-14-14			
APVD:	DATE:			

D17803-EPDOL00002 SH.6 SHEET 6/14 REV 0

MF NO 0000