NC1 Ash Disposal Area

Run-on and Run-off Control System Plan

Omaha Public Power District

Nebraska City Station

Nebraska City, Nebraska

July 1, 2016

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OPPD NC1 Ash Disposal Area
Run-On and Run-Off Control System Plan

Table of Contents

Appendices

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OPPD NC1 Ash Disposal Area
Run-On and Run-Off Control System Plan

Professional Engineer Certification

"I hereby certify that this Run-on and Run-off Control System Plan for the CCR landfill known as the NC1 Ash Disposal Area at the Nebraska City Generating Station, owned and operated by the Omaha Public Power District, meets the requirements of the Coal Combustion Residual Rule 40 CFR 257.81. I am a duly licensed Professional Engineer under the laws of the State of Nebraska."

Print Name: Garrett M. Williams

Signature:

Date: July 1, 2016

License #: E-15124

My license renewal date is December 31, 2016.

I. Introduction

A. Purpose

On April 17, 2015 the U.S. Environmental Protection Agency (EPA) published the final rule for the regulation and management of coal combustion residuals (CCR) under the Resource Conservation and Recovery Act (RCRA). Section 40 CFR 257.81 requires that an owner or operator of a CCR landfill must prepare an initial run-on and run-off control system plan. The plan must document how the control systems have been designed and constructed to meet the applicable requirements of the CCR rule, supported by appropriate engineering calculations. In accordance with the CCR rule 40 CFR 257.81, the intent of stormwater management is to design, construct, operate, and maintain:

- 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; and
- 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. Run-off from the active portion of the CCR unit must be handled in accordance with the surface water requirements under 40 CFR 257.3-3.

B. Facility Background

OPPD has a two-unit (Unit 1 and Unit 2) fossil fuel-fired generating plant at the Nebraska City Station (Station) located 5.5 miles southeast of Nebraska City, Nebraska, along the west shore of the Missouri River. This Station has two (2) existing CCR landfills that are permitted under the current Nebraska Department of Environmental Quality (NDEQ) Title 132 regulations for fossil fuel combustion ash disposal area; the NC1 Ash Disposal Area and NC2 Ash Disposal Area. This initial run-on and run-off control system plan is for the NC1 Ash Disposal Area (NDEQ Permit No. NE0054712, Facility ID 58343). The NC1 Ash Disposal Area is an unlined CCR landfill of approximately 52 acres that has historically received CCR for disposal.

The NDEQ Title 132 permit for the NC1 Ash Disposal Area includes a description, calculations and figures of the run-on and run-off control system features. The stormwater and contact water management plan and calculations from the permit are included in Appendix A to this plan. The figures are included in Appendix B.

II. Run-On Control System

The run-on control system for the NC1 Ash Disposal Area consists of perimeter roads, ditches and grading sloped away from the disposal area to prevent and minimize stormwater run-on. As shown on the drawings in Appendix B, the NC1 Ash Disposal Area is bounded by roadways along the north and east sides, and ground surface slopes away from the disposal area along the west and south sides. Perimeter ditches intercept the minimal run-on from the roadway embankments. Stormwater around the NC1 Ash Disposal Area will flow east or south along the channels and roadway and into the fields. Capacity flow calculations of the perimeter ditches are included in Appendix A.

III. Run-Off Control System

The run-off control system for the NC1 Ash Disposal Area will consist of separation of clean stormwater from contact water with the CCR. Clean stormwater runoff from the intermediate and final cover side-slopes will be conveyed to constructed let-down structures and the perimeter ditches for discharge. Contact water generated from the 25-year, 24-hour storm (and lesser storms) will be collected, controlled and conveyed to the Plant Runoff Pond for management in accordance with existing surface water requirements.

Filling and grading activities will occur within Phases 2 and 3 developments of the NC1 Ash Disposal Area to direct the runoff from the active area away from the edges of the perimeter temporary berms, and grade the CCR for run-off flow to collect within a temporary holding pond for subsequent controlled discharge as shown in the figures (Appendix B). Contact water will be gravity drained and/or pumped from the temporary holding pond to the Plant Runoff Pond after a rain event. Stormwater in the Plant Runoff Pond will either evaporate or be pumped to the process water ponds for discharge through an existing National Pollutant Discharge Elimination System (NPDES) permitted outfall under the NPDES permit (Permit No. NE0111635) or any revised NPDES permit for the Station. No storm water run-off from the NC1 Ash Disposal Area will be allowed to discharge directly off the Station property.

OPPD will install a transducer at the bottom of the temporary holding pond or mount transducer in the pump sump to notify OPPD control room operators when a minimum of six inches of water is in the pond. A low point/sump pit will be created near the portable pump staging area for the pump hose suction to facilitate pumping operations. During a 25-year/24-hour storm event, pumping operations should begin before the water depth in the temporary holding pond exceeds 1.5 feet. With a pump size of 6000 gallons per minute (gpm), the pond will be pumped down within a 24-hour period of initiating pumping. For smaller rain events, OPPD may utilize a smaller pump to remove the contact water. OPPD will regularly pump contact water from the pond to maintain capacity for storm events.

During final development of Phase 3, filling and grading activities are anticipated to occur from west to east as CCR is placed to final grades. Final cover is also anticipated to be constructed from west to east with clean stormwater run-off kept separate from contact water as much as possible. Contact water will be directed towards the temporary holding pond near the southeast corner of the NC1 Ash Disposal Area. During final closure, the exposed CCR area will continue to diminish as final cover is constructed which will reduce the amount of contact water to manage. As part of the last area to receive final cover, the temporary holding pond will be filled with CCR to final grades and final cover constructed.

Calculations, figures and management of stormwater run-off from the active portion of the NC1 Ash Disposal Area is further described in Appendices A and B of this plan.

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Appendix A
Stormwater Run-Off Management and Calculations

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Calculation Cover Sheet

Client:	Omaha Public Power District – Nebraska City Plat		
Project:	**NC1 Ash Disposal Area**		
Project No:	134-265015-004	Rev:	-
Calculation No:	1	Page:	1 of 91
Title:	NC1 Storm Water and Contact Water Management Plan		
Purpose:	CCR Run\ Runoff Control Plan and Calculations		

Originator:	Brent Erickson	Date:	12/7/2015
Checked by:	Lori Calub	Date:	Click to enter date.
QC Review by:	Garrett Williams	Date:	Click to enter date.

Supersedes Calculation No:	1 for NC1 Stormwater Channel Capacity Calculation 2/5/2015
Superseded by Calculation No:	N/A

Table of Contents

List of Tables

List of Appendix

Purpose

The purpose of this memorandum is to summarize the Storm Water and Contact water management plan for the permit renewal of the OPPD Nebraska City NC1 ash disposal unit. This memo and attached calculations, documentation and figures are indented to constitute the basis of the "Run-on/Run-off Control Plan" as required by the Nebraska DEQ for landfill permitting and the federal CCR for coal ash landfill disposal. For the purposes of this memorandum the following terms are defined as follows:

Storm water : Precipitation or snow melt that falls on and runs off from the closed, or intermediately closed, areas of the landfill disposal unit. Storm water may be directed to the Nebraska City Plant storm water control and conveyance locations consistent with the facility NPDES permit.

Contact water: Precipitation or snow met that falls on the landfill disposal unit and comes in direct contact with the ash waste. Contact water needs to be collected and conveyed to the Plant runoff pond located east of the NC1 disposal area.

Design Storm: Storm Water and Contact Water rates and volumes are to be controlled and conveyed for the 25-year 24-hour storm. This memorandum utilized the NOAA Atlas 14 rainfall depths for all hydrologic and hydraulic calculations. The following table summarizes the NOAA Atlas 14 rainfall depths for the Plant.

Table 1 NOAA Atlas 14 Rainfall Depths

Recurrence Interval	24 Hour Rainfall Depth (in)
2-year	3.24
5-year	4.07
10-year	4.84
25-year	**6.02**
50-year	7.03
100-year	8.11

Run-off\Run-on Plan General Description

NC1 landfill will be operated to limit the mixing of Contact Water and Storm Water runoff. Storm Water will be directed to surface water body discharge points consist with the Plant NDPES permit. Contact Water will be collected on the ash waste disposal deck in temporary sumps and pumped to the Plant run-off pond located east of the NC1 landfill.

The side-slopes of the NC1 disposal are planned to be constructed with 3 horizontal to 1 vertical grade. As these slopes are constructed the outside edges will be covered with tarps or 1-foot of clay soil material to limit the area of exposed ash. Approximately annually, OPPD will complete closure projects on the intermediately completed side slopes to construct the final closure section as described in the landfill permit. Runoff from the intermediate and final closure side-slopes can be managed as Storm Water as the runoff will not come in contact with ash waste.

Storm water from the side-slopes will be conveyed to constructed let-down structures to the bottom of the slope where a perimeter ditch will direct the water to a discharge point. The NC1 disposal unit historic storm water discharge point is located in the south east corner. Storm water will be generated from two sub-basin areas. Area 1 will generally consist of the storm water runoff from the north side-slope that is captured by the northern perimeter ditch and directed to an existing 30-inch concrete culvert. Area 2 will generally consist of the storm water runoff from the west, south and east side-slopes that are collected in a perimeter drainage ditch. Area 1 is directed into the Area 2 perimeter ditch via an existing 30-inch

culvert. Storm water collected in the perimeter ditches eventually overflows to the south into OPPD controlled lands. One the south side of the NC1 landfill unit, there is any abandoned access road that is placed through the perimeter ditch with a 24-inch culvert to provide connection for the ditch. This access road and culvert will be removed and replaced with a typical ditch section.

Contact Water generated from the 25-year 24-hour storm (and lesser storms) will need to be collected and conveyed to the Plant runoff pond in a manner that does not allow an illicit discharge of the Contact Water to a surface water body. In general storm water can be directed and discharged to surface water bodies. Any storm water that is mixed with contact water is to be considered contact water and directed to the Plant runoff pond. Contact Water generated from events in excess of 25-year 24-hour storm should be controlled to greatest extent possible to mitigate an illicit discharge to a surface water body, however controlling all rain events is likely not possible or required by State or Federal regulations.

Contact Water is planned to be managed by operating the ash waste deck to direct runoff away from the side-slopes to a series of temporary sumps located in the disposal area. Contact Water ill be collected in the sump and pumped via a closed pipe to the Plant surface runoff pond located east of the NC1 landfill unit. By using operational controls consisting of top of slope perimeter berms, temporary tarps and waste deck grading Contact Water will be separated and directed away from the side-slopes such that it is not mixed with Storm Water runoff.

Hydrologic & Hydraulic Calculations

Existing Hydraulic Structure Capacities

In the existing condition runoff from the NC1 disposal area is configured to drain runoff to a single point in the southeast corner of the permitted disposal area. Currently Storm Water and Contact Water are mixed and at the south east point of collection there is a small concrete structure and manual pumping system to the Plant run-on pond. The major existing hydraulic structures are listed as follows:

- North Perimeter Ditch
- North 30-inch Diameter Culvert
- East Perimeter Ditch
- West Perimeter Ditch
- South Perimeter Ditch

For the purposes of this analysis the existing runoff patterns were divided into two drainage areas; North area (Area 1) and the West/South/East area (Area 2). In general the Area 1 is the potion of the NC1 permitted area that is collected by the existing north perimeter ditch and then conveyed to the existing 30-inch culvert. The 30-inch culvert discharges to the east perimeter ditch that eventual flow to the southeast point of collection for pumping. Area 2 is the portion of the NC1 permitted area that is collected by the perimeter ditch on the west, south and east side of the landfill. These ditches all flow to the south east point of collection. The following tables summarize the capacities of the existing hydraulic structures.

Table 2 Existing Hydraulic Structure Capacity and Overflow Elevation

Structure	Capacity (cfs)	Approximate Overflow Elev.
North Perimeter Ditch	830 cfs	919’
30-inch Culvert	36 cfs	919’
West Perimeter Ditch	300 cfs	917’
East Perimeter Ditch	300 cfs	917’
South Perimeter Ditch	300 cfs	917’

The existing hydraulic structures will be utilized in the proposed Storm Water management to convey clean runoff from the closed portions of the NC1 landfill to the Plant’s existing storm water conveyance system. All Storm Water runoff will be discharged onto OPPD owned lands.

Storm Water and Contact Water Generation by Phase

The following sections summarize the Storm Water and Contract Water generation and hydraulic structure sizing for the Phase 1, Phase 2, Phase 3 and final conditions of the NC1 landfilling operations. Area 1 is the closed portion of the NC1 landfill that is directed to the north perimeter ditch. Area 2 is the closed portion of NC1 landfill that is directed o the west, south and east perimeter ditches. Both Area 1 and Area 2 are considered Strom Water runoff.

Table 3 Area of Close versus Exposed Ash by Operational Phase

Operational Phase	Area 1 (Acre)	Area 2 (Acres)	Exposed Ash Area (Acre)	Total Area (Acre)
Phase 1 (Existing)	5.2	10.0	36.9	52.1
Phase 2	7.4	15.9	28.8	52.1
Phase 3	8.0	17.3	26.8	52.1
Final Closed	17.7	34.4	0	52.1

For the hydrologic analysis a curve runoff number (CN) of 85 was used for exposed ash area and 70 for closed and vegetated landfill slopes. Detailed hydrologic and hydraulic calculations are included as appendix attachments to this memorandum.

Phase 1 Contact Water Generation & Controls

Contact Water will be managed after the Phase 1 closure (side-slopes closed to approximately elevation 940’) by the use of operational controls to direct precipitation that contact exposed waste to a temporary control sump, This temporary control sump will be sized to manage the Contact Water runoff from the 25-year 24-hour storm by collecting the precipitation in a sump constructed in the ash waste and eventual pumping to the Plant run-off pond. The following table summarizes the Contact Water generation, sump sizing and approximate pump rating required to mange the 25-year 24 hour storm.

Table 4 Phase 1 Contact Water Controls Summary

Maximum Area of Ash Waste	36.9 Acres
25-year 24- Hour Peak Flow	168 CFS
25-year 24-Hour Volume of Runoff	589,000 cubic feet
Temporary Control Pump	6,000 GPM (13.4 cfs)
Temporary Sump Sizing (L x W x D)	320’ x 320’ x 4’ (380,000 CF)
Temporary Sump Side Slopes	3H to 1V
Max Water Depth	3.7 feet
Time to Drain	28 hours +/-

As an alternative to using a pump to convey the Contact Water to the Plant run-off pond, the elevation of difference between the NC1 disposal area, a minimum of elevation 936-feet, and the Plant run-off pond, elevation 917-feet, could be utilized with a 15-inch pipe to function as a discharge orifice.

For additional details please refer to the calculations included in Appendix C Phase 1 Contact Water and Storm Water Calculations.

Phase 1 Storm Water Generation & Controls

At the start of the Phase 1 ash landfilling operations, NC1 landfill unit will have closed side-slopes with vegetation generating storm water runoff. The following table summarizes the runoff generation from the northern sub-basin (Area 1), the west\south\east sub-basin (Area 2) and the discharge from the perimeter ditch into the southern field for the 25-year 24-hour storm.

Discharge to the adjacent southern field will be via a 15-foot wide ditch weir constructed with an invert elevation of 916.0 feet. This ditch weir will be graded to daylight and provide a path for the discharge to transition from concentrated channel flow to a sheet flow condition across the field. The peak discharge is provided to allow OPPD to plan future use in the southern field. Note, the modeling for this Phase indicates no discharge, however it is likely in real world conditions there will be a minimum about of storm water leaving the ditch discharge, likely less than 1 cubic foot per second and outside of the precision of the modeling.

Table 5 Phase 1 Storm water Summary – 25-year 24-hour Storm

Sub-Basin	Area (acres)	Qpeak (cfs)	Ditch Max Elev. (ft)
Area 1	5.2	15.5	915.5
Area 2	10.0	18.7	916.8
To South Field (Discharge)	15.2	0*	916.0

For additional details please refer to the calculations included in Appendix C Phase 1 Contact Water and Storm Water Calculations

Phase 2 Contact Water Generation & Controls

Contact Water will be managed after the Phase 2 closure (side-slopes closed to approximately elevation 960') by the use of operational controls to direct precipitation that contact exposed waste to a temporary control sump, This temporary control sump will be sized to manage the Contact Water runoff from the 25-year 24-hour storm by collecting the precipitation in a sump constructed in the ash waste and eventual pumping to the Plant run-off pond. The following table summarizes the Contact Water generation, sump sizing and approximate pump rating required to mange the 25-year 24 hour storm.

Table 6 Phase 2 Contact Water Controls Summary

Maximum Area of Ash Waste	28.8 Acres
25-year 24- Hour Peak Flow	131 CFS
25-year 24-Hour Volume of Runoff	460,000 cubic feet
Temporary Control Pump	6,000 GPM (13.4 cfs)
Temporary Sump Sizing (L x W x D)	320' x 320' x 3.5' (380,000 CF)
Temporary Sump Side Slopes	3H to 1V
Max Water Depth	2.8 feet
Time to Drain	30 hours +/-

As an alternative to using a pump to convey the Contact Water to the Plant run-off pond a properly sized pipe orifice could be used. The pipe orifice would function based on the elevation difference between the top of the NC1 disposal area and the Plant runoff pond.

For additional details please refer to the calculations included in Appendix D Phase 2 Contact Water and Storm Water Calculations.

Phase 2 Storm Water Generation & Controls

At the start of the Phase 2 ash landfilling operations, NC1 landfill unit will have closed side-slopes with vegetation generating storm water runoff. The following table summarizes the runoff generation from the northern sub-basin (Area 1), the west\south\east sub-basin (Area 2) and the discharge from the perimeter ditch into the southern field for the 25-year 24-hour storm.

Discharge to the adjacent southern field will be via a 15-foot wide ditch weir constructed with an invert elevation of 916.0 feet. This ditch weir will be graded to daylight and provide a path for the discharge to transition from concentrated channel flow to a sheet flow condition across the field. The peak discharge is provided to allow OPPD to plan future use in the southern field.

Table 7 Phase 2 Storm water Summary – 25-year 24-hour Storm

Sub-Basin	Area (acres)	Qpeak (cfs)	Ditch Max Elev. (ft)
Area 1	7.4	22.1	916.0
Area 2	15.9	29.7	916.8
To South Field (Discharge)	23.3	2.7	916.1

For additional details please refer to the calculations included in Appendix D Phase 2 Contact Water and Storm Water Calculations.

Phase 3 Contact Water Generation & Controls

Contact Water will be managed after the Phase 2 closure (side-slopes closed to approximately elevation 965') by the use of operational controls to direct precipitation that contact exposed waste to a temporary control sump, This temporary control sump will be sized to manage the Contact Water runoff from the 25-year 24-hour storm by collecting the precipitation in a sump constructed in the ash waste and eventual pumping to the Plant run-off pond. The following table summarizes the Contact Water generation, sump sizing and approximate pump rating required to mange the 25-year 24 hour storm.

Table 8 Phase 3 Contact Water Controls Summary

Maximum Area of Ash Waste	26.8 Acres
25-year 24- Hour Peak Flow	122 CFS
25-year 24-Hour Volume of Runoff	427,000 cubic feet
Temporary Control Pump	6,000 GPM (13.4 cfs)
Temporary Sump Sizing (L x W x D)	320' x 320' x 3.5' (380,000 CF)
Temporary Sump Side Slopes	3H to 1V
Max Water Depth	2.5 feet
Time to Drain	28 hours +/-

As an alternative to using a pump to convey the Contact Water to the Plant run-off pond a properly sized pipe orifice could be used. The pipe orifice would function based on the elevation difference between the top of the NC1 disposal area and the Plant runoff pond.

For additional details please refer to the calculations included in Appendix E Phase 3 Contact Water and Storm Water Calculations.

Phase 3 Storm Water Generation & Controls

At the start of the Phase 3 ash landfilling operations, NC1 landfill unit will have closed side-slopes with vegetation generating storm water runoff. The following table summarizes the runoff generation from the

northern sub-basin (Area 1), the west\south\east sub-basin (Area 2) and the discharge from the perimeter ditch into the southern field for the 25-year 24-hour storm.

Discharge to the adjacent southern field will be via a 15-foot wide ditch weir constructed with an invert elevation of 916.0 feet. This ditch weir will be graded to daylight and provide a path for the discharge to transition from concentrated channel flow to a sheet flow condition across the field. The peak discharge is provided to allow OPPD to plan future use in the southern field.

Table 9 Phase 3 Storm water Summary – 25-year 24-hour Storm

Sub-Basin	Area (acres)	Qpeak (cfs)	Ditch Max Elev. (ft)
Area 1	8.0	23.9	916.0
Area 2	17.3	32.3	916.8
To South Field (Discharge)	25.3	3.5	916.2

For additional details please refer to the calculations included in Appendix E Phase 3 Contact Water and Storm Water Calculations.

Final Closure Storm Water Generation & Controls

In the final condition the entire NC1 landfill unit has been closed and vegetation has been established. This condition will result in the greatest discharge to the southern OPPD owned fields. The following table summarizes the runoff generation from the northern sub-basin (Area 1), the west\south\east sub-basin (Area 2) and the discharge from the perimeter ditch into the southern field for the 25-year 24-hour storm.

Discharge to the adjacent southern field will be via a 15-foot wide ditch weir constructed with an invert elevation of 916.0 feet. This ditch weir will be graded to daylight and provide a path for the discharge to transition from concentrated channel flow to a sheet flow condition across the field. The peak discharge is provided to allow OPPD to plan future use in the southern field.

Table 10 Final Closure Storm water Summary – 25-year 24-hour Storm

Sub-Basin	Area (acres)	Qpeak (cfs)	Ditch Max Elev. (ft)
Area 1	17.7	53.3	917.0
Area 2	34.4	64.3	916.8
To South Field (Discharge)	52.1	34.1	916.8

For additional details please refer to the calculations included in Appendix F Final Closure Storm Water Calculations.

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Appendix A NOAA Atlas 14 Data

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(402) 399-1000

NOAA Atlas 14, Volume 8, Version 2
Location name: Nebraska City, Nebraska, US*
Latitude: 40.6189°, Longitude: -95.7858°
Elevation: 930 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	0.405 (0.324–0.517)	0.476 (0.381–0.608)	0.595 (0.475–0.761)	0.697 (0.553–0.893)	0.841 (0.647–1.10)	0.955 (0.717–1.25)	1.07 (0.779–1.43)	1.19 (0.832–1.61)	1.36 (0.911–1.85)	1.49 (0.971–2.04)
10-min	0.593 (0.475–0.757)	0.697 (0.558–0.890)	0.872 (0.696–1.12)	1.02 (0.810–1.31)	1.23 (0.947–1.61)	1.40 (1.05–1.84)	1.57 (1.14–2.09)	1.75 (1.22–2.35)	1.99 (1.33–2.71)	2.18 (1.42–2.99)
15-min	0.723 (0.579–0.923)	0.850 (0.681–1.09)	1.06 (0.848–1.36)	1.25 (0.988–1.60)	1.50 (1.16–1.96)	1.71 (1.28–2.24)	1.91 (1.39–2.54)	2.13 (1.49–2.87)	2.43 (1.63–3.31)	2.65 (1.73–3.64)
30-min	1.02 (0.820–1.31)	1.21 (0.968–1.55)	1.52 (1.21–1.94)	1.78 (1.42–2.29)	2.16 (1.66–2.82)	2.45 (1.84–3.22)	2.75 (2.00–3.66)	3.06 (2.14–4.12)	3.49 (2.34–4.75)	3.81 (2.49–5.23)
60-min	1.33 (1.06–1.69)	1.57 (1.25–2.00)	1.98 (1.58–2.53)	2.34 (1.85–2.99)	2.86 (2.21–3.75)	3.29 (2.47–4.33)	3.73 (2.72–4.98)	4.20 (2.94–5.67)	4.86 (3.26–6.64)	5.38 (3.51–7.38)
2-hr	1.63 (1.32–2.05)	1.92 (1.55–2.42)	2.43 (1.96–3.07)	2.89 (2.31–3.65)	3.56 (2.78–4.64)	4.12 (3.14–5.38)	4.71 (3.47–6.23)	5.34 (3.77–7.16)	6.23 (4.23–8.46)	6.94 (4.58–9.45)
3-hr	1.81 (1.47–2.26)	2.13 (1.73–2.66)	2.70 (2.19–3.38)	3.22 (2.60–4.04)	4.01 (3.16–5.20)	4.67 (3.58–6.08)	5.38 (3.99–7.09)	6.15 (4.37–8.21)	7.24 (4.95–9.81)	8.13 (5.39–11.0)
6-hr	2.12 (1.74–2.61)	2.48 (2.04–3.07)	3.16 (2.59–3.91)	3.78 (3.08–4.70)	4.75 (3.79–6.11)	5.57 (4.32–7.19)	6.46 (4.84–8.44)	7.43 (5.34–9.85)	8.83 (6.10–11.9)	9.97 (6.67–13.4)
12-hr	2.43 (2.02–2.96)	2.85 (2.37–3.48)	3.62 (3.00–4.43)	4.34 (3.57–5.31)	5.43 (4.38–6.91)	6.36 (4.99–8.12)	7.37 (5.58–9.53)	8.47 (6.15–11.1)	10.0 (7.01–13.4)	11.3 (7.66–15.1)
24-hr	2.78 (2.34–3.35)	3.24 (2.72–3.90)	4.07 (3.41–4.91)	4.84 (4.03–5.86)	6.02 (4.90–7.57)	7.03 (5.56–8.86)	8.11 (6.20–10.4)	9.29 (6.81–12.1)	11.0 (7.73–14.5)	12.4 (8.43–16.3)
2-day	3.21 (2.72–3.81)	3.69 (3.13–4.38)	4.57 (3.87–5.44)	5.39 (4.53–6.43)	6.63 (5.45–8.22)	7.69 (6.15–9.58)	8.83 (6.82–11.2)	10.1 (7.46–13.0)	11.9 (8.44–15.5)	13.3 (9.18–17.5)
3-day	3.48 (2.98–4.10)	4.03 (3.44–4.75)	5.00 (4.25–5.90)	5.88 (4.97–6.96)	7.19 (5.94–8.83)	8.30 (6.67–10.2)	9.47 (7.35–11.9)	10.7 (7.99–13.7)	12.5 (8.96–16.3)	14.0 (9.69–18.2)
4-day	3.72 (3.20–4.36)	4.31 (3.70–5.06)	5.35 (4.57–6.28)	6.27 (5.33–7.38)	7.63 (6.32–9.30)	8.76 (7.07–10.7)	9.96 (7.75–12.4)	11.2 (8.39–14.3)	13.0 (9.35–16.9)	14.5 (10.1–18.8)
7-day	4.40 (3.81–5.09)	5.02 (4.35–5.83)	6.12 (5.28–7.11)	7.10 (6.09–8.27)	8.54 (7.12–10.3)	9.72 (7.90–11.8)	11.0 (8.61–13.5)	12.3 (9.26–15.5)	14.2 (10.2–18.2)	15.7 (11.0–20.2)
10-day	5.01 (4.36–5.76)	5.69 (4.95–6.55)	6.87 (5.96–7.92)	7.91 (6.82–9.15)	9.45 (7.92–11.3)	10.7 (8.75–12.9)	12.0 (9.50–14.8)	13.5 (10.2–16.8)	15.4 (11.2–19.7)	17.0 (12.0–21.9)
20-day	6.74 (5.94–7.65)	7.69 (6.77–8.72)	9.28 (8.14–10.6)	10.7 (9.29–12.2)	12.6 (10.7–14.8)	14.2 (11.7–16.8)	15.8 (12.6–19.1)	17.5 (13.3–21.6)	19.8 (14.5–25.0)	21.6 (15.4–27.6)
30-day	8.19 (7.26–9.21)	9.36 (8.29–10.5)	11.3 (9.98–12.7)	12.9 (11.4–14.6)	15.2 (12.9–17.7)	17.0 (14.1–20.0)	18.8 (15.0–22.5)	20.6 (15.8–25.3)	23.1 (17.0–29.0)	25.0 (17.9–31.8)
45-day	10.0 (8.95–11.2)	11.4 (10.2–12.8)	13.8 (12.2–15.4)	15.7 (13.8–17.6)	18.2 (15.5–20.9)	20.2 (16.8–23.5)	22.1 (17.8–26.3)	24.1 (18.5–29.3)	26.7 (19.7–33.1)	28.6 (20.6–36.0)
60-day	11.6 (10.4–12.9)	13.2 (11.8–14.6)	15.8 (14.1–17.5)	17.8 (15.8–19.9)	20.6 (17.6–23.4)	22.6 (18.9–26.1)	24.6 (19.9–29.0)	26.6 (20.5–32.1)	29.1 (21.6–35.9)	30.9 (22.4–38.9)

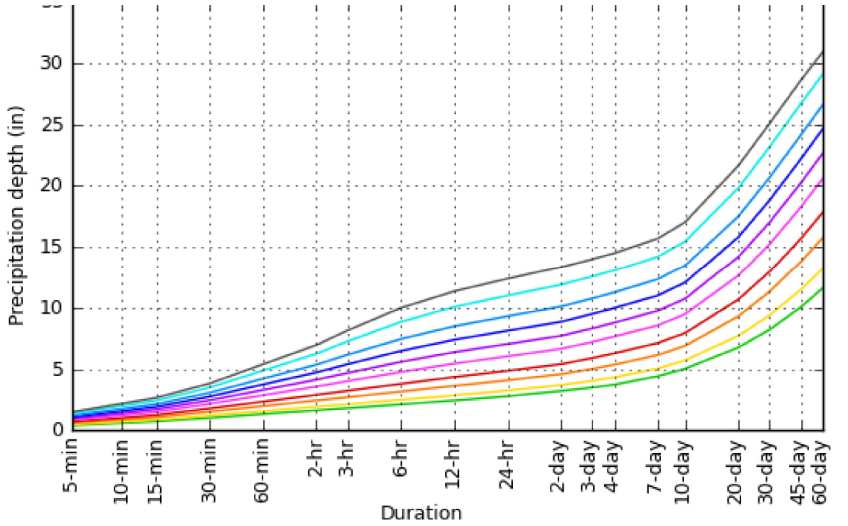
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

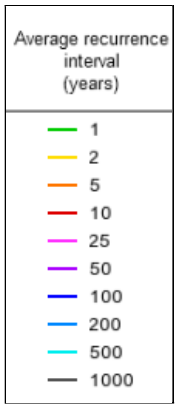
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper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

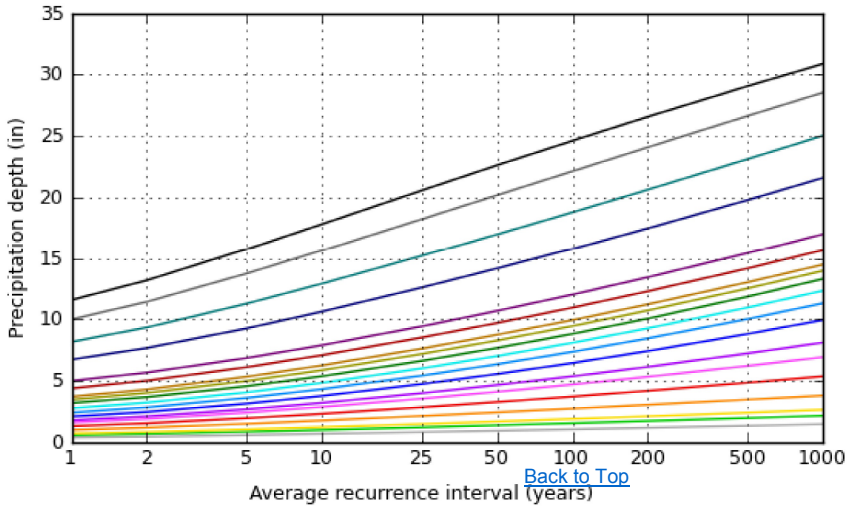
Please refer to NOAA Atlas 14 document for more information.

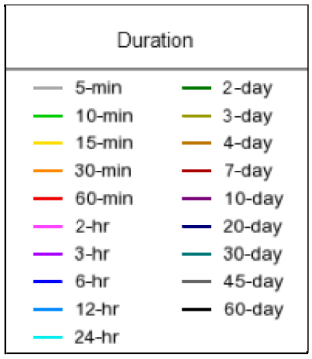
Back to Top

PF graphical









Back to Top

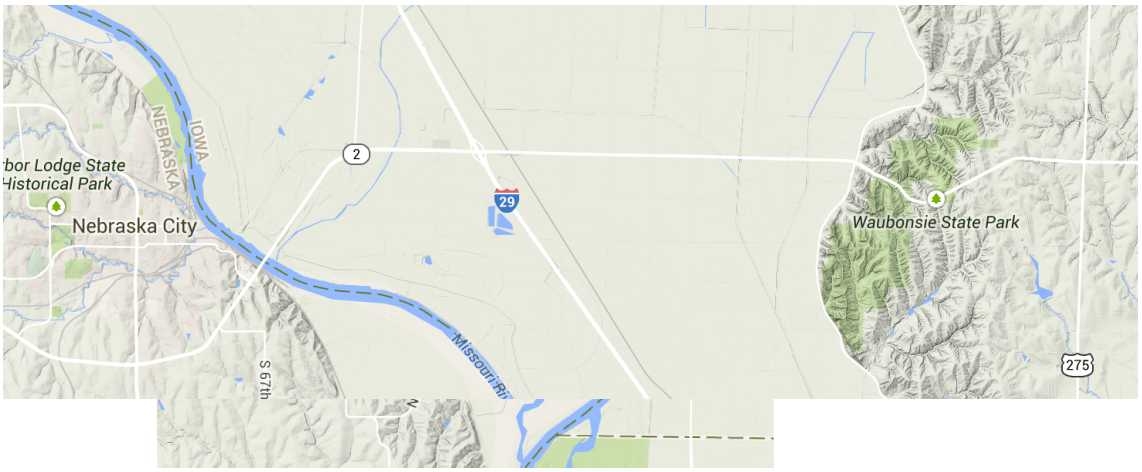
Maps & aerials

NOAA Atlas 14, Volume 8, Version 2

Created (GMT): Thu Feb 5 15:32:08 2015

Small scale terrain

Large scale terrain



Large scale map

Large scale aerial

Back to Top

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Appendix B Existing Hydraulic Structure Capacity Calculations

1. North Perimeter Ditch
2. 30-inch Culvert
3. West\South\East Perimeter Ditch

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Channel Report

OPPD NC1 North Ditch Capacity

Trapezoidal

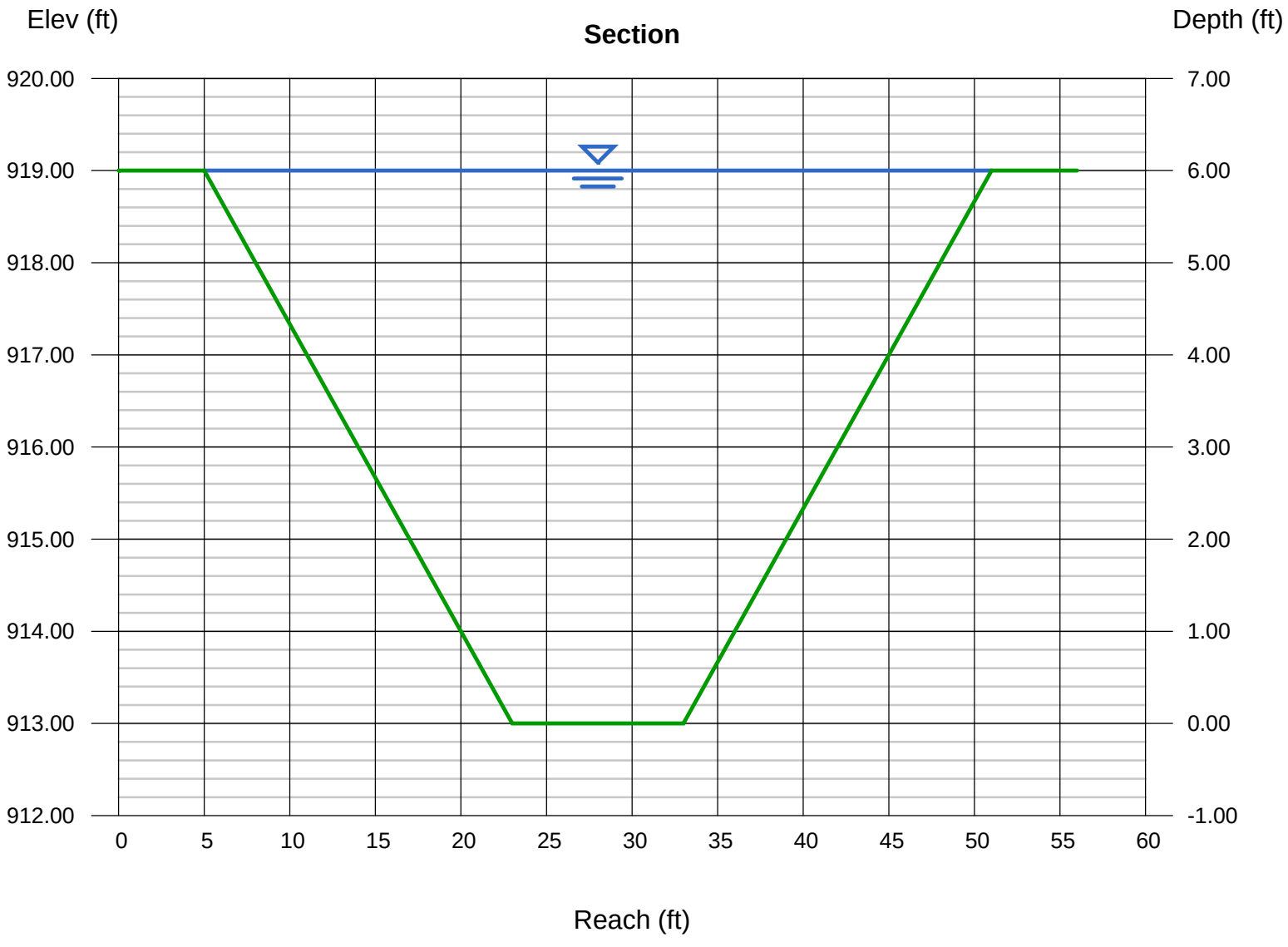
Bottom Width (ft)	= 10.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 6.00
Invert Elev (ft)	= 913.00
Slope (%)	= 0.10
N-Value	= 0.022

Calculations

Compute by:	Q vs Depth
No. Increments	= 10

Highlighted

Depth (ft)	= 6.00
Q (cfs)	= 828.16
Area (sqft)	= 168.00
Velocity (ft/s)	= 4.93
Wetted Perim (ft)	= 47.95
Crit Depth, Yc (ft)	= 4.07
Top Width (ft)	= 46.00
EGL (ft)	= 6.38



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, Dec 7 2015

North 30-Inch Culvert

Invert Elev Dn (ft)	=	913.34
Pipe Length (ft)	=	300.00
Slope (%)	=	0.20
Invert Elev Up (ft)	=	913.95
Rise (in)	=	30.0
Shape	=	Circular
Span (in)	=	30.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end projecting (C)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

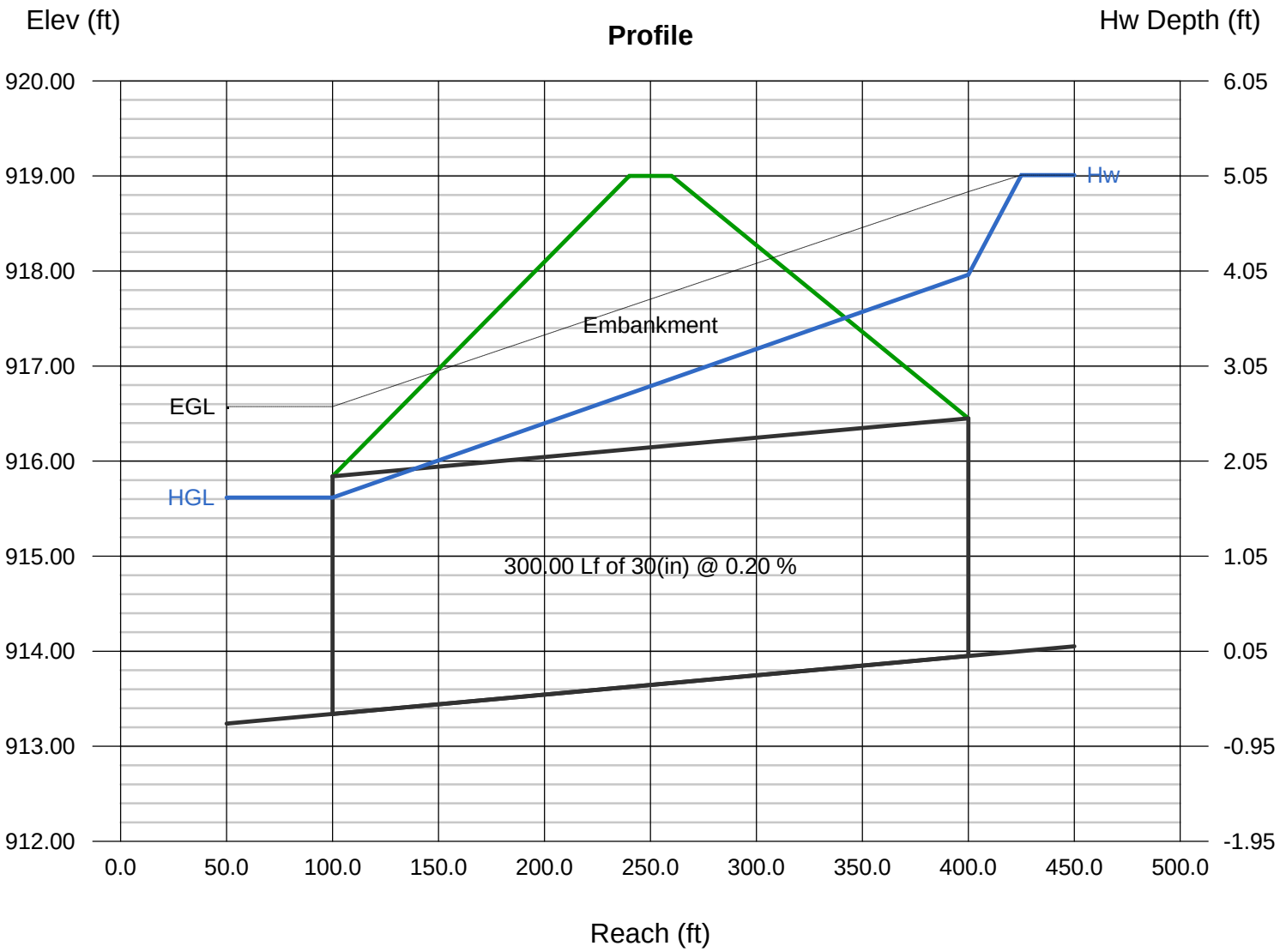
Top Elevation (ft)	=	919.00
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	30.00
Qmax (cfs)	=	39.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	36.80
Qpipe (cfs)	=	36.80
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	7.84
Veloc Up (ft/s)	=	7.50
HGL Dn (ft)	=	915.62
HGL Up (ft)	=	917.96
Hw Elev (ft)	=	919.01
Hw/D (ft)	=	2.02
Flow Regime	=	Outlet Control



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Dec 9 2015

OPPD NC1 East/West/South Ditch Capacity

Trapezoidal

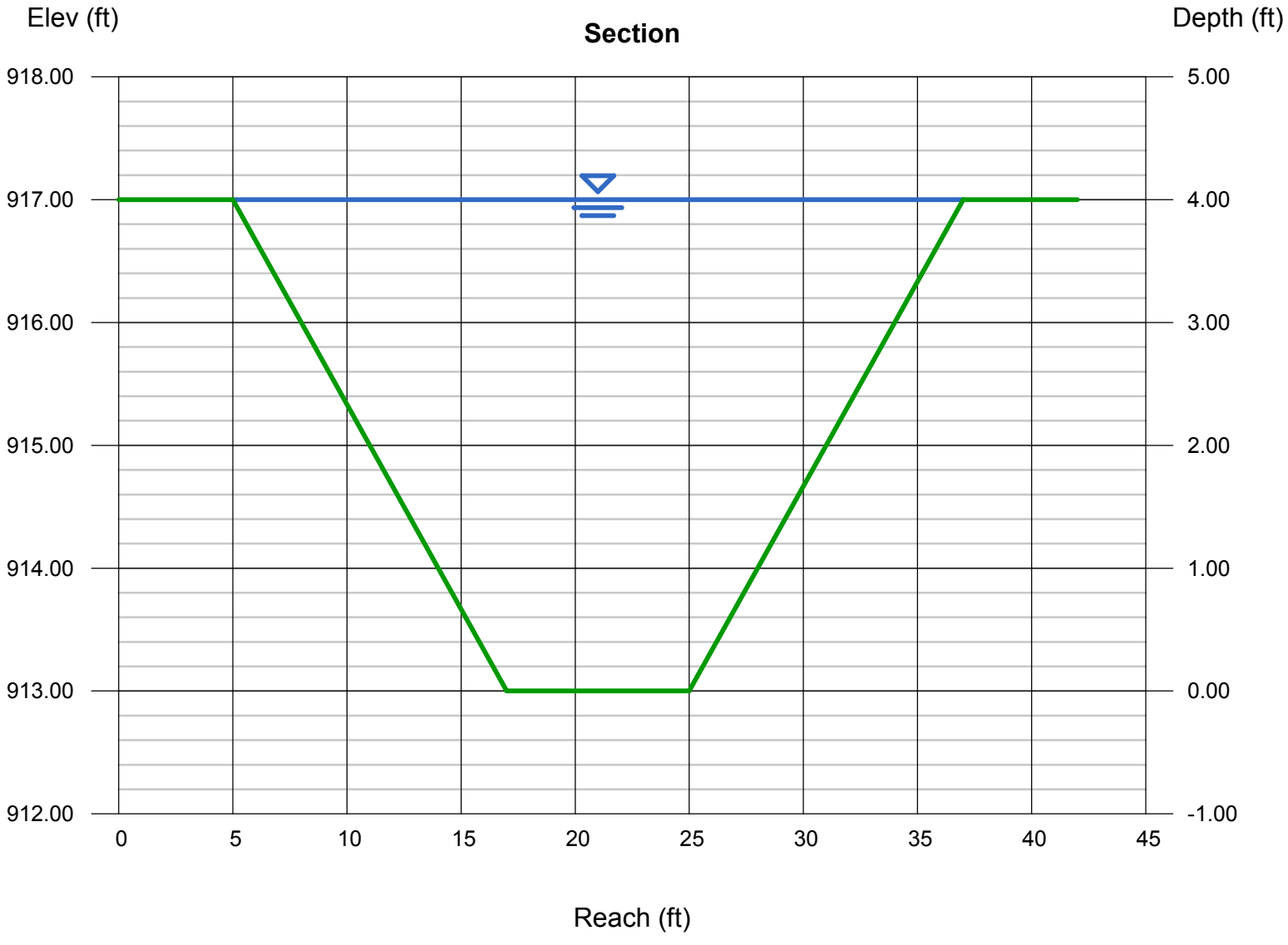
Bottom Width (ft)	= 8.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 4.00
Invert Elev (ft)	= 913.00
Slope (%)	= 0.10
N-Value	= 0.022

Calculations

Compute by:	Q vs Depth
No. Increments	= 10

Highlighted

Depth (ft)	= 4.00
Q (cfs)	= 306.61
Area (sqft)	= 80.00
Velocity (ft/s)	= 3.83
Wetted Perim (ft)	= 33.30
Crit Depth, Yc (ft)	= 2.60
Top Width (ft)	= 32.00
EGL (ft)	= 4.23



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Appendix C Phase 1 Contact Water and Storm Water Calculations

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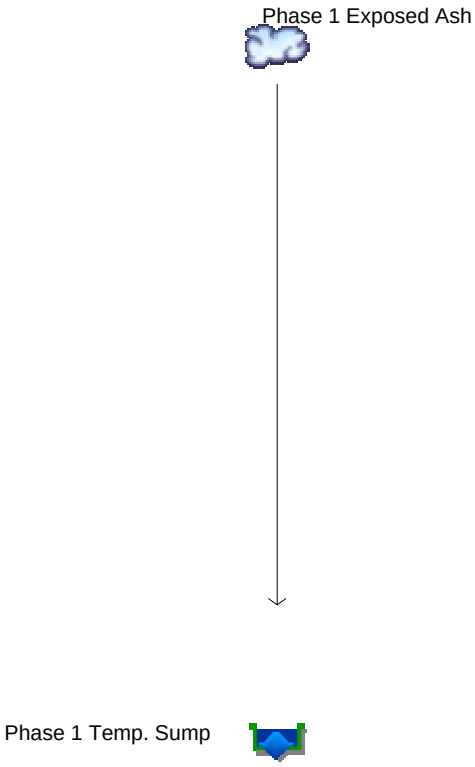
Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	SCS Runoff	Phase 1 Exposed Ash
2	Reservoir	Phase 1 Temp. Sump

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	------	-------	-------	-------	-------	-------	168.37	-------	-------	Phase 1 Exposed Ash
2	Reservoir	1	-------	-------	-------	-------	-------	13.40	-------	-------	Phase 1 Temp. Sump

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

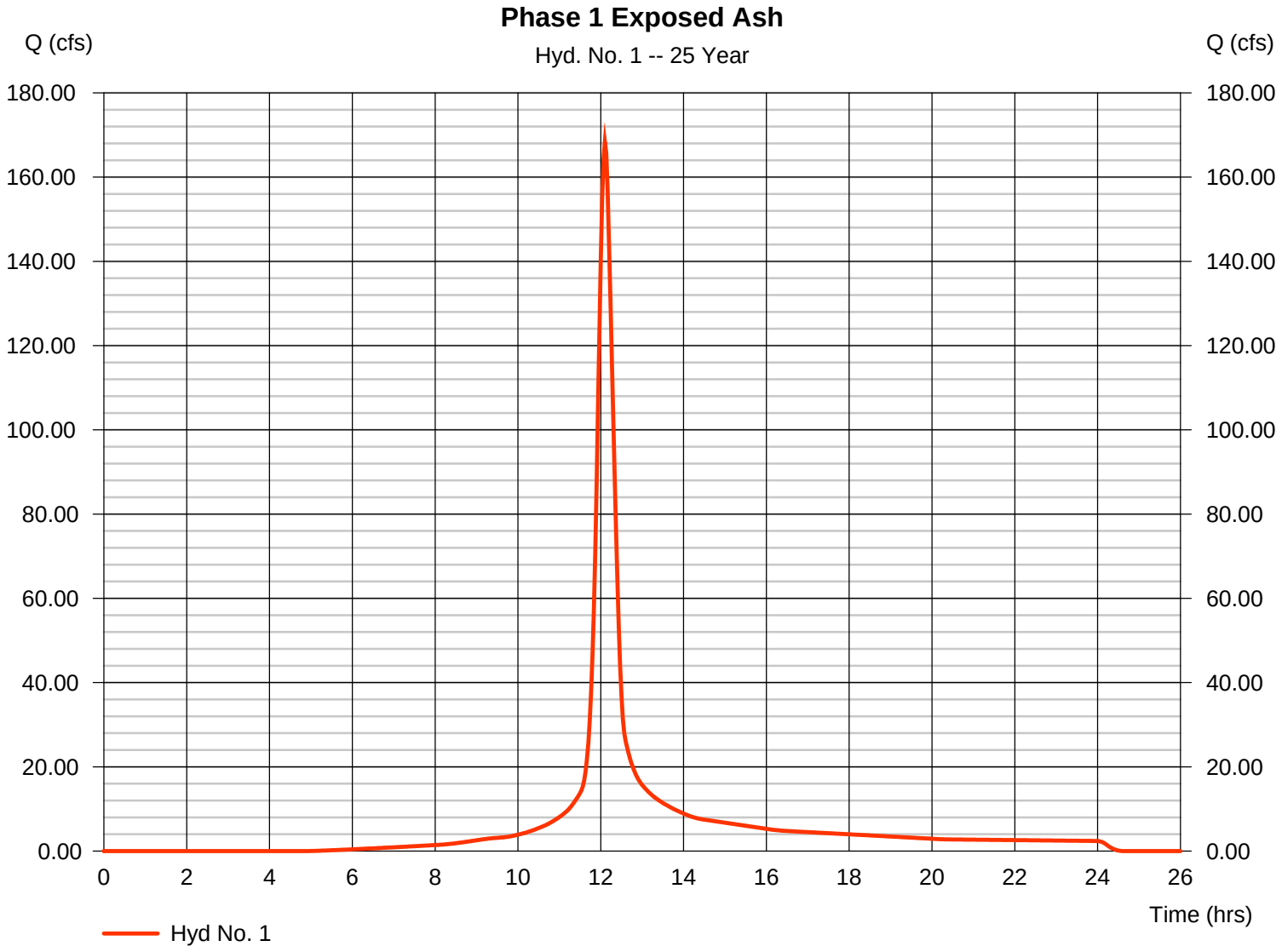
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	168.37	2	726	589,174	------	------	------	Phase 1 Exposed Ash
2	Reservoir	13.40	2	714	517,938	1	939.64	343,353	Phase 1 Temp. Sump

Hydrograph Report

Hyd. No. 1

Phase 1 Exposed Ash

Hydrograph type	= SCS Runoff	Peak discharge	= 168.37 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 589,174 cuft
Drainage area	= 36.900 ac	Curve number	= 85
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 20.40 min
Total precip.	= 6.02 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



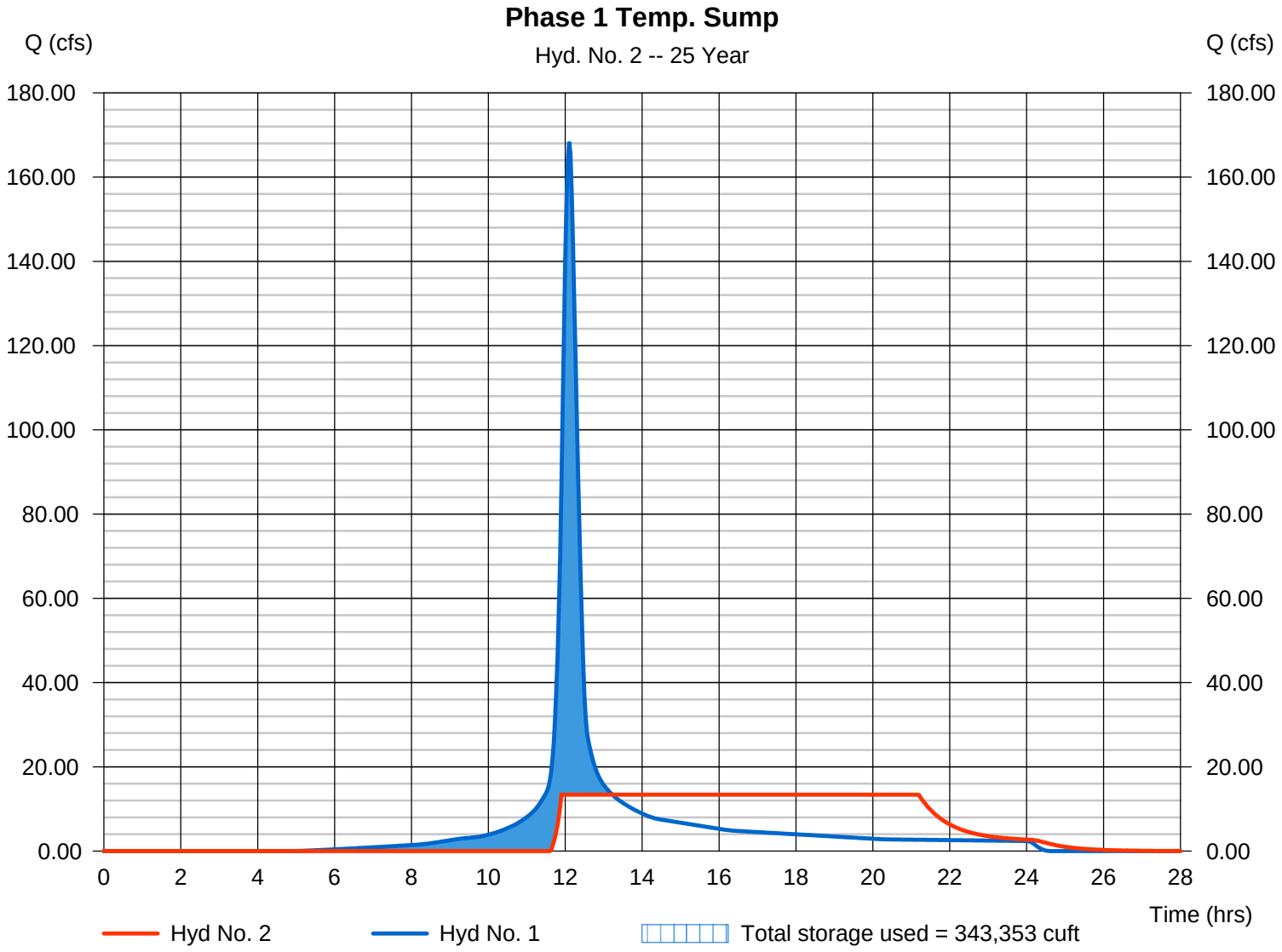
Hydrograph Report

Hyd. No. 2

Phase 1 Temp. Sump

Hydrograph type	=	Reservoir	Peak discharge	=	13.40 cfs
Storm frequency	=	25 yrs	Time to peak	=	11.90 hrs
Time interval	=	2 min	Hyd. volume	=	517,938 cuft
Inflow hyd. No.	=	1 - Phase 1 Exposed Ash	Max. Elevation	=	939.64 ft
Reservoir name	=	Phase 1 Temp. Sump	Max. Storage	=	343,353 cuft

Storage Indication method used.



Pond Report

Pond No. 1 - Phase 1 Temp. Sump

Pond Data

Trapezoid -Bottom L x W = 296.0 x 296.0 ft, Side slope = 3.00:1, Bottom elev. = 936.00 ft, Depth = 4.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	936.00	87,616	0	0
0.40	936.40	89,043	35,331	35,331
0.80	936.80	90,481	35,904	71,236
1.20	937.20	91,930	36,482	107,717
1.60	937.60	93,391	37,064	144,781
2.00	938.00	94,864	37,651	182,432
2.40	938.40	96,348	38,242	220,674
2.80	938.80	97,844	38,838	259,512
3.20	939.20	99,351	39,439	298,951
3.60	939.60	100,870	40,044	338,994
4.00	940.00	102,400	40,654	379,648

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

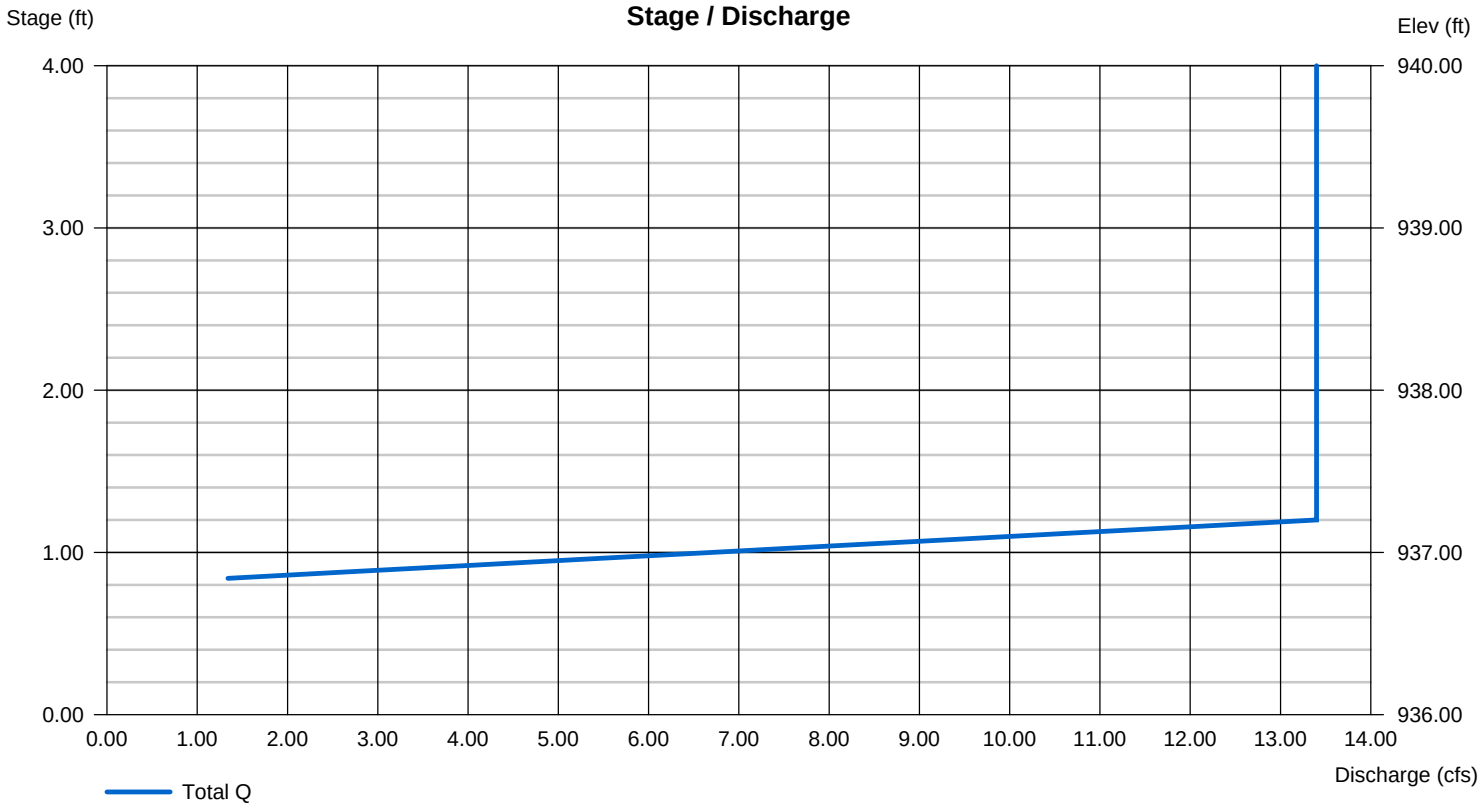
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.00	0.00	0.00	0.00
Crest El. (ft)	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= ---	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Contour)

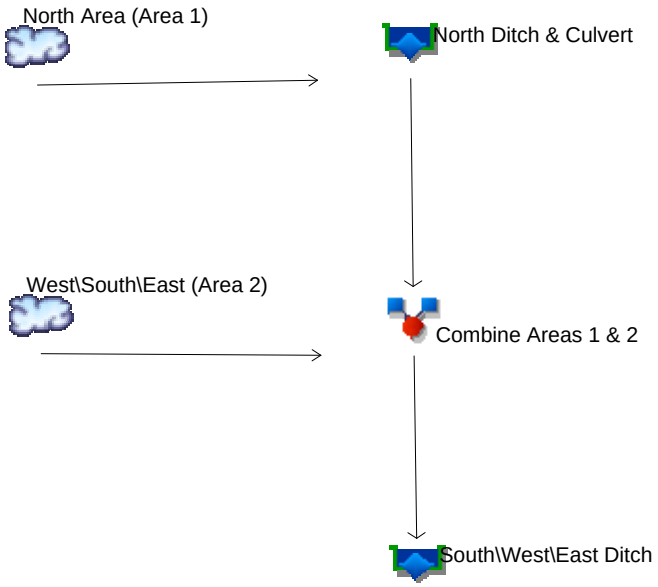
TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



Watershed Model Schematic

Phase 1 Storm Water



Legend

Hyd.	Origin	Description
1	SCS Runoff	North Area (Area 1)
2	Reservoir	North Ditch & Culvert
3	SCS Runoff	West\South\East (Area 2)
4	Combine	Combine Areas 1 & 2
5	Reservoir	South\West\East Ditch

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	------	-------	-------	-------	-------	-------	15.54	-------	-------	North Area (Area 1)
2	Reservoir	1	-------	-------	-------	-------	-------	11.88	-------	-------	North Ditch & Culvert
3	SCS Runoff	------	-------	-------	-------	-------	-------	18.69	-------	-------	West\South\East (Area 2)
4	Combine	2, 3	-------	-------	-------	-------	-------	30.07	-------	-------	Combine Areas 1 & 2
5	Reservoir	4	-------	-------	-------	-------	-------	0.000	-------	-------	South\West\East Ditch

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

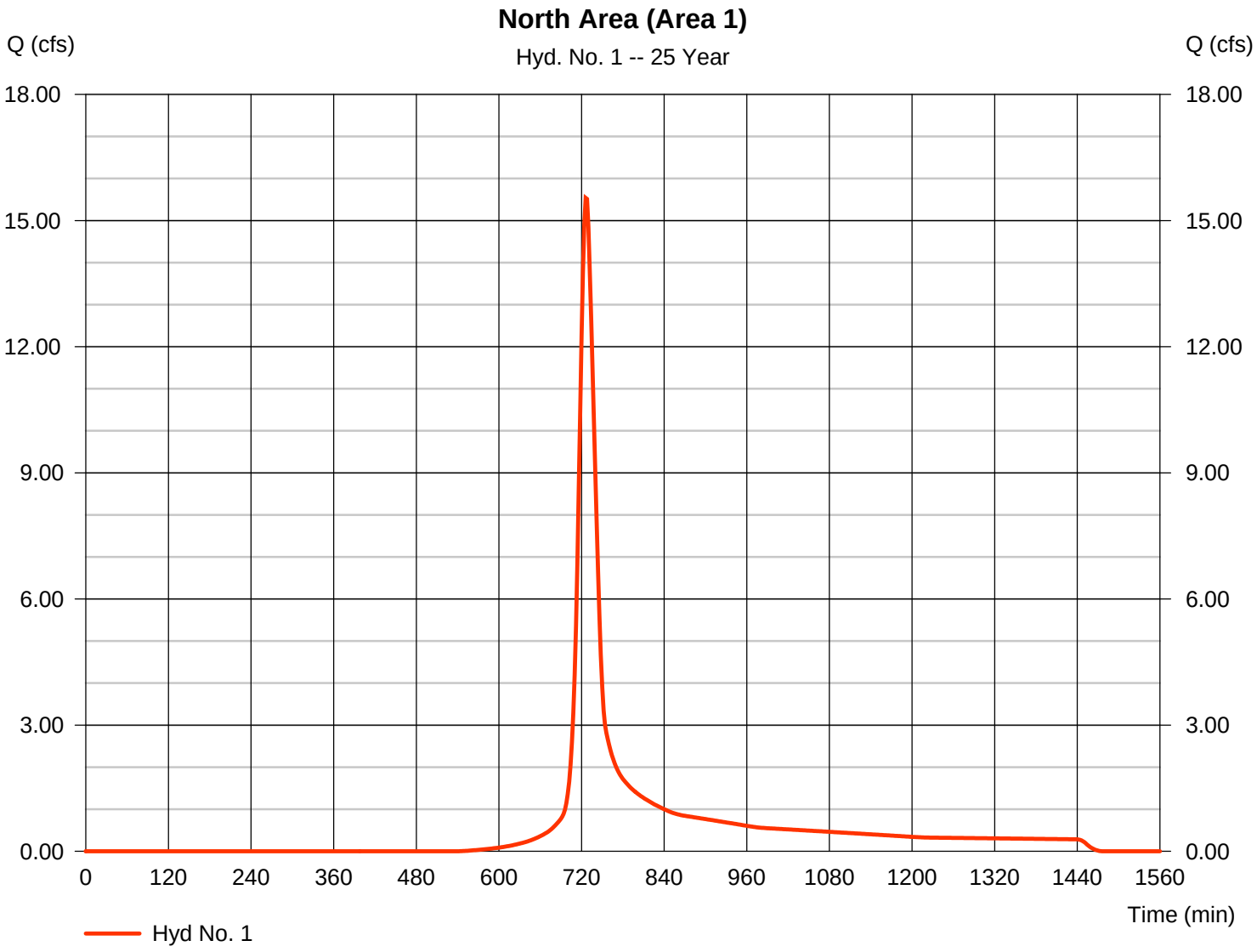
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	15.54	2	726	54,201	------	------	------	North Area (Area 1)
2	Reservoir	11.88	2	736	54,201	1	915.54	4,976	North Ditch & Culvert
3	SCS Runoff	18.69	2	742	101,491	------	------	------	West\South\East (Area 2)
4	Combine	30.07	2	740	155,691	2, 3	------	------	Combine Areas 1 & 2
5	Reservoir	0.000	2	n/a	0	4	915.99	155,692	South\West\East Ditch

Hydrograph Report

Hyd. No. 1

North Area (Area 1)

Hydrograph type	=	SCS Runoff	Peak discharge	=	15.54 cfs
Storm frequency	=	25 yrs	Time to peak	=	726 min
Time interval	=	2 min	Hyd. volume	=	54,201 cuft
Drainage area	=	5.200 ac	Curve number	=	70
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	23.30 min
Total precip.	=	6.02 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



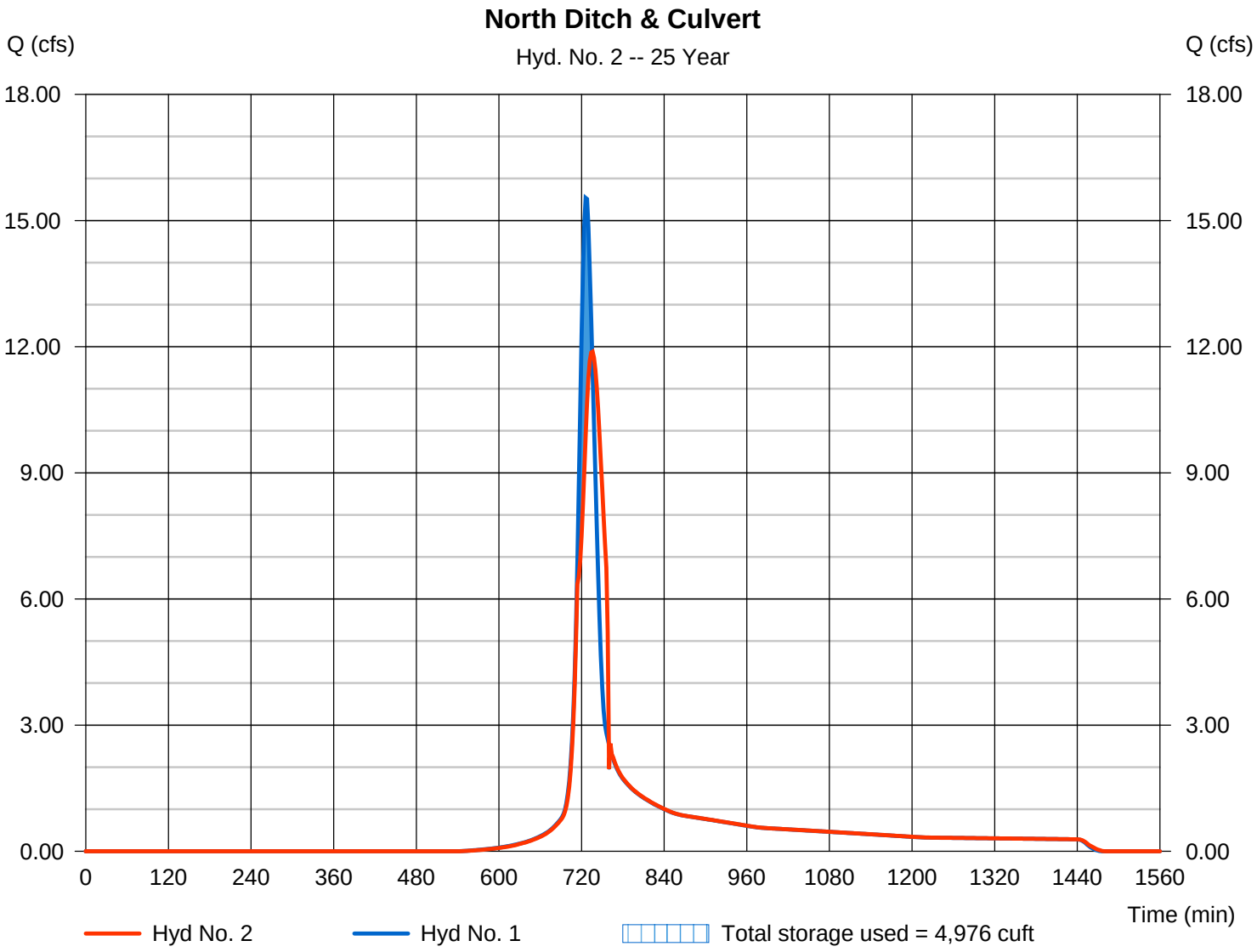
Hydrograph Report

Hyd. No. 2

North Ditch & Culvert

Hydrograph type	=	Reservoir	Peak discharge	=	11.88 cfs
Storm frequency	=	25 yrs	Time to peak	=	736 min
Time interval	=	2 min	Hyd. volume	=	54,201 cuft
Inflow hyd. No.	=	1 - North Area (Area 1)	Max. Elevation	=	915.54 ft
Reservoir name	=	North Ditch	Max. Storage	=	4,976 cuft

Storage Indication method used.



Pond Report

Pond No. 1 - North Ditch

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 913.95 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	913.95	00	0	0
0.05	914.00	100	2	2
1.05	915.00	570	303	305
2.05	916.00	22,013	8,708	9,012
3.05	917.00	42,365	31,636	40,648
4.05	918.00	59,387	50,632	91,280
5.05	919.00	76,300	67,660	158,940

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 30.00	0.00	0.00	0.00
Span (in)	= 30.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 913.95	0.00	0.00	0.00
Length (ft)	= 323.00	0.00	0.00	0.00
Slope (%)	= 0.25	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

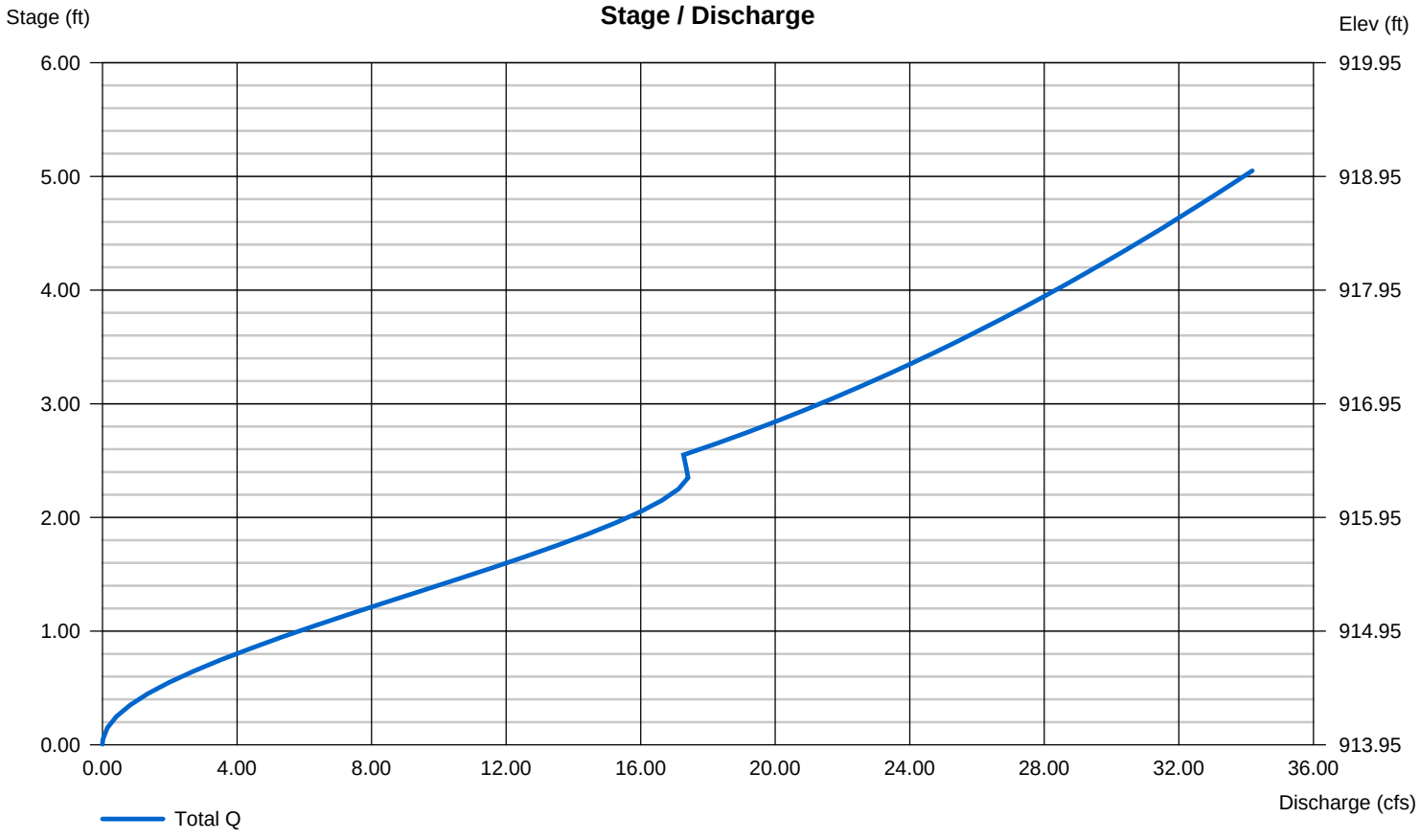
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.00	0.00	0.00	0.00
Crest El. (ft)	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= ---	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

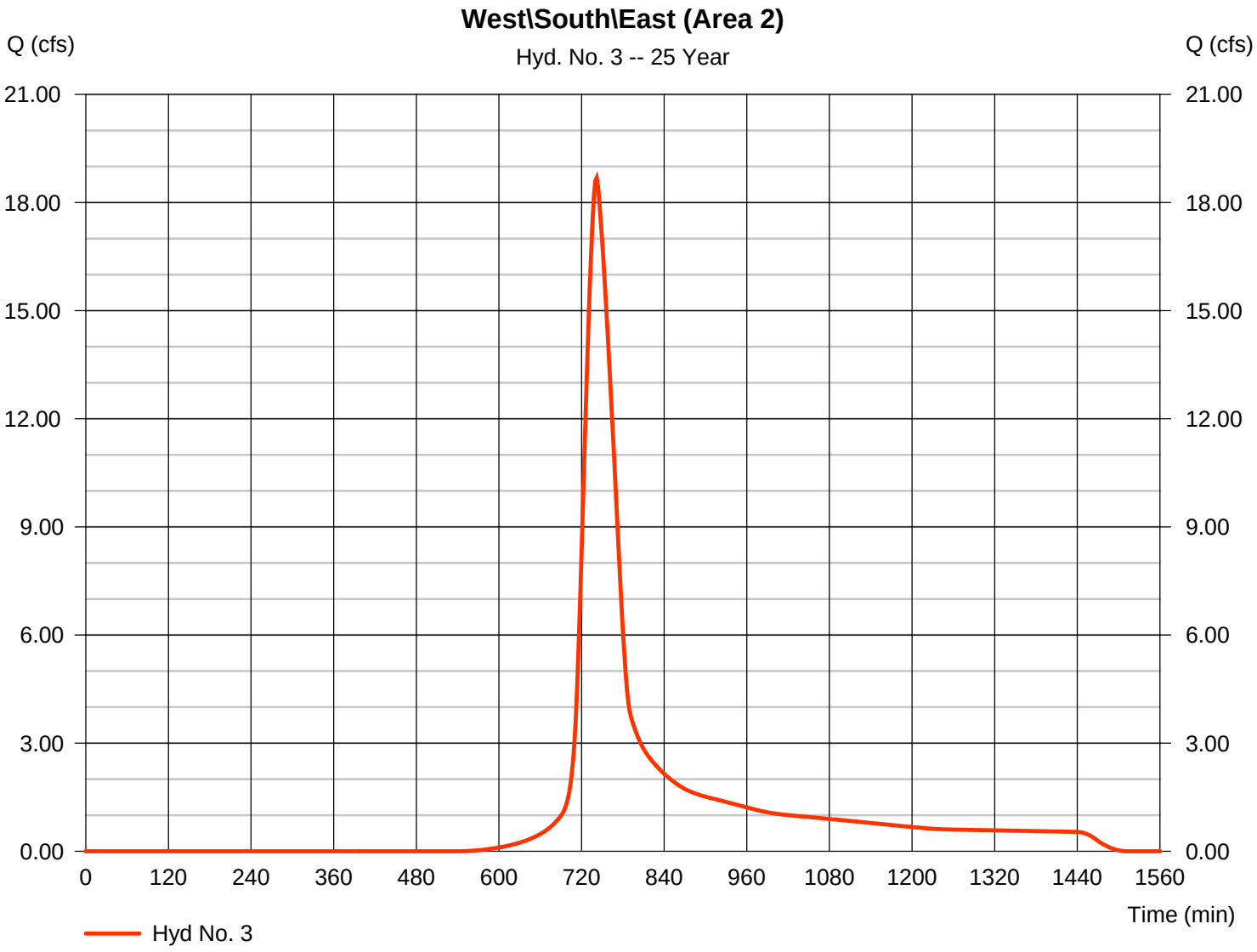


Hydrograph Report

Hyd. No. 3

West\South\East (Area 2)

Hydrograph type	=	SCS Runoff	Peak discharge	=	18.69 cfs
Storm frequency	=	25 yrs	Time to peak	=	742 min
Time interval	=	2 min	Hyd. volume	=	101,491 cuft
Drainage area	=	10.000 ac	Curve number	=	70
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	46.40 min
Total precip.	=	6.02 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

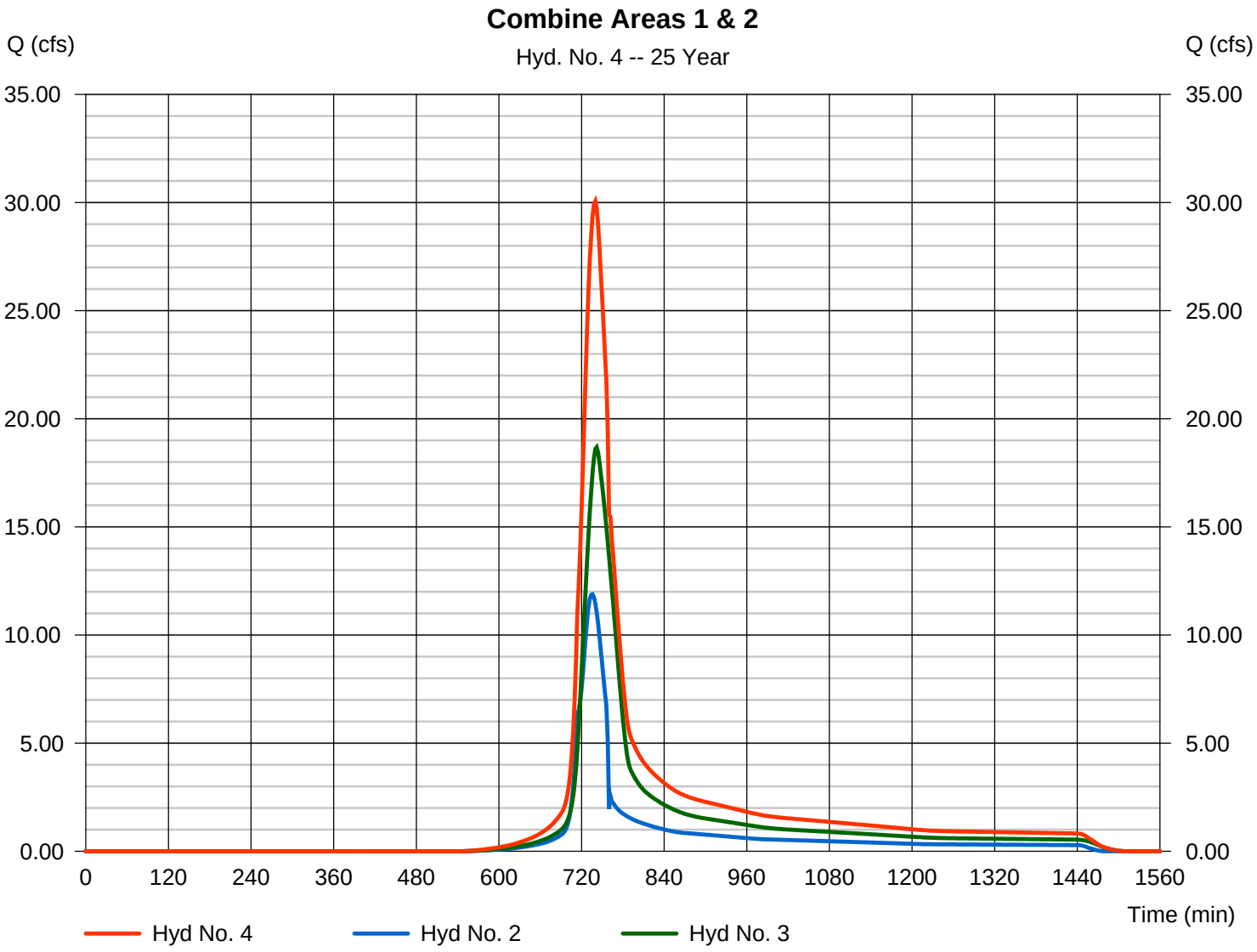


Hydrograph Report

Hyd. No. 4

Combine Areas 1 & 2

Hydrograph type	=	Combine	Peak discharge	=	30.07 cfs
Storm frequency	=	25 yrs	Time to peak	=	740 min
Time interval	=	2 min	Hyd. volume	=	155,691 cuft
Inflow hyds.	=	2, 3	Contrib. drain. area	=	10.000 ac



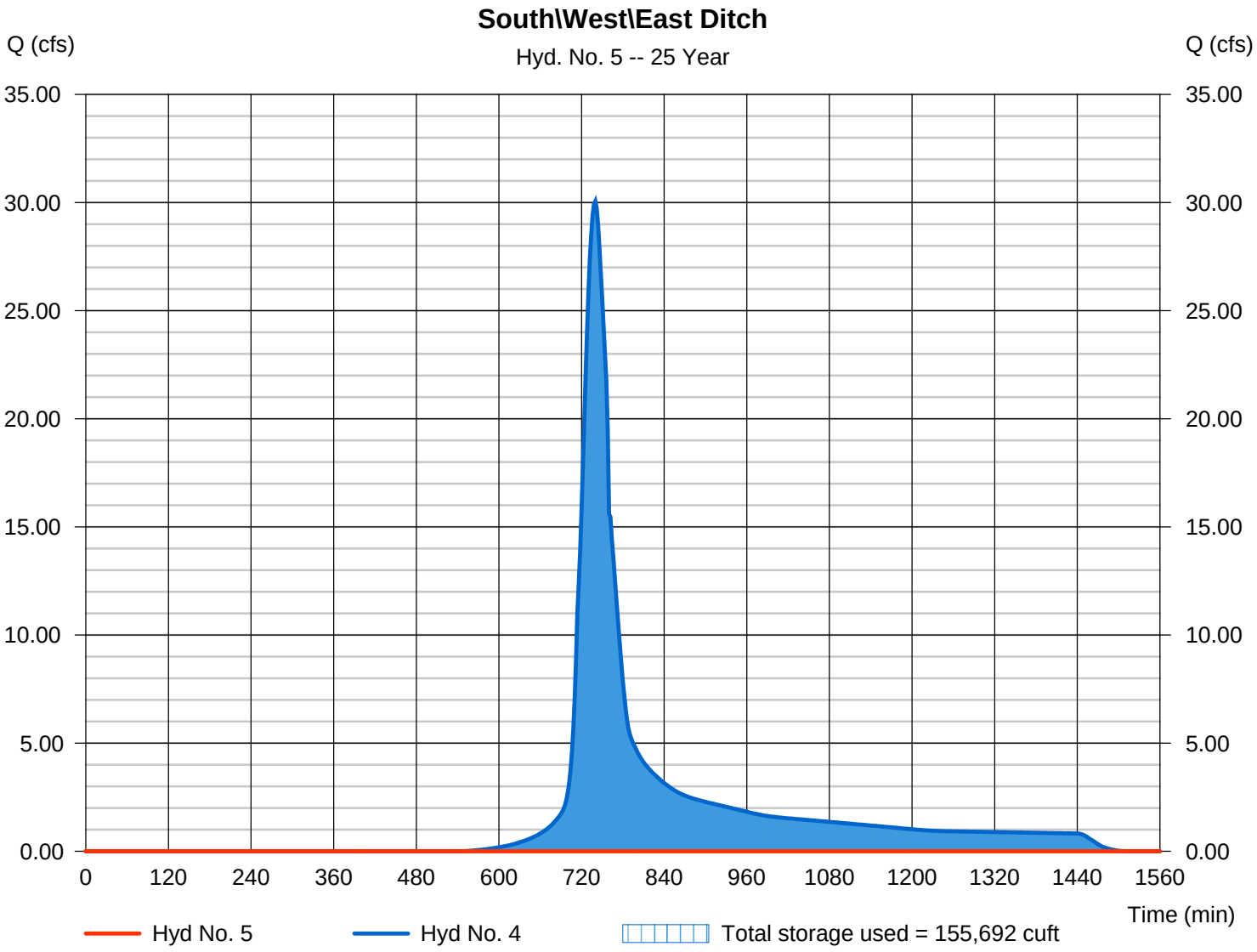
Hydrograph Report

Hyd. No. 5

South\West\East Ditch

Hydrograph type	=	Reservoir	Peak discharge	=	0.000 cfs
Storm frequency	=	25 yrs	Time to peak	=	n/a
Time interval	=	2 min	Hyd. volume	=	0 cuft
Inflow hyd. No.	=	4 - Combine Areas 1 & 2	Max. Elevation	=	915.99 ft
Reservoir name	=	West\South\East Ditch	Max. Storage	=	155,692 cuft

Storage Indication method used.



Pond Report

Pond No. 2 - West\South\East Ditch

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 912.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	912.50	00	0	0
0.50	913.00	8,464	1,411	1,411
1.50	914.00	38,541	21,687	23,097
2.50	915.00	66,415	51,845	74,942
3.50	916.00	97,433	81,422	156,364
4.50	917.00	118,297	107,686	264,050

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

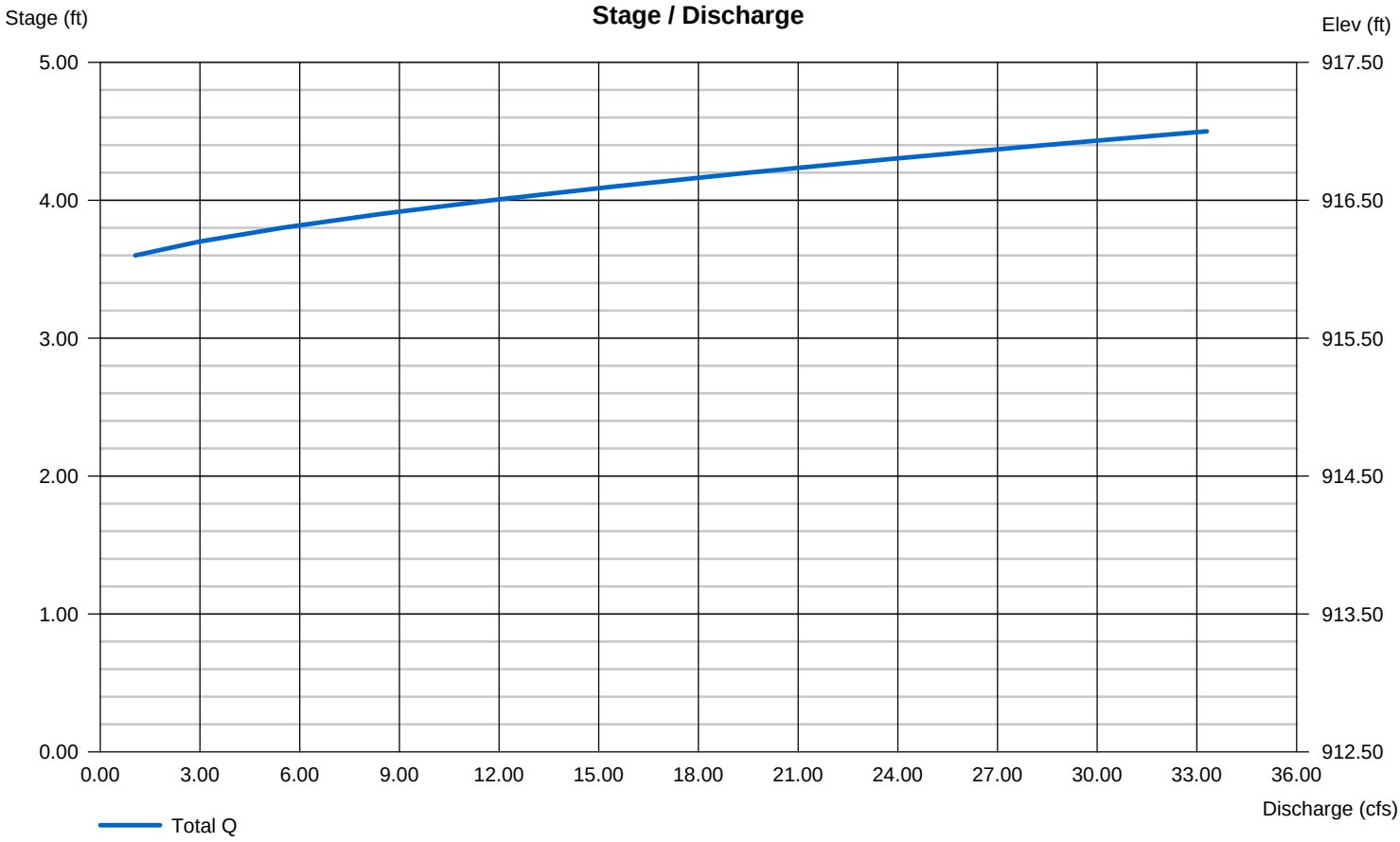
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 10.00	0.00	0.00	0.00
Crest El. (ft)	= 916.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



Appendix D Phase 2 Contact Water and Storm Water Calculations

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Watershed Model Schematic

Legend

Hyd.	Origin	Description
1	SCS Runoff	Phase 2 Exposed Ash
2	Reservoir	Phase 2 Temp. Sump

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	------	-------	-------	-------	-------	-------	131.41	-------	-------	Phase 2 Exposed Ash
2	Reservoir	1	-------	-------	-------	-------	-------	13.40	-------	-------	Phase 2 Temp. Sump

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

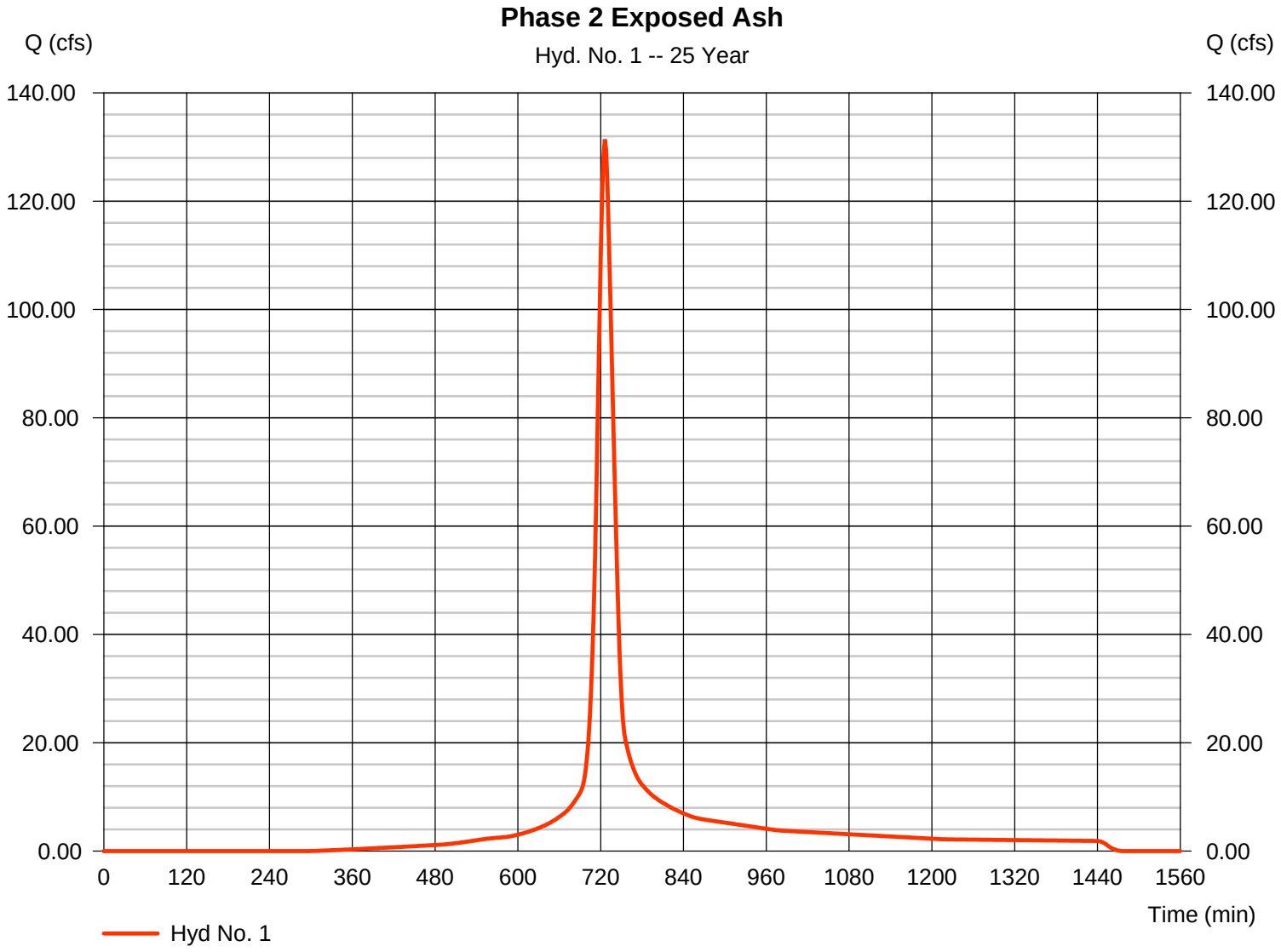
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	131.41	2	726	459,843	------	------	------	Phase 2 Exposed Ash
2	Reservoir	13.40	2	718	396,377	1	959.23	257,912	Phase 2 Temp. Sump

Hydrograph Report

Hyd. No. 1

Phase 2 Exposed Ash

Hydrograph type	=	SCS Runoff	Peak discharge	=	131.41 cfs
Storm frequency	=	25 yrs	Time to peak	=	726 min
Time interval	=	2 min	Hyd. volume	=	459,843 cuft
Drainage area	=	28.800 ac	Curve number	=	85
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	20.40 min
Total precip.	=	6.02 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



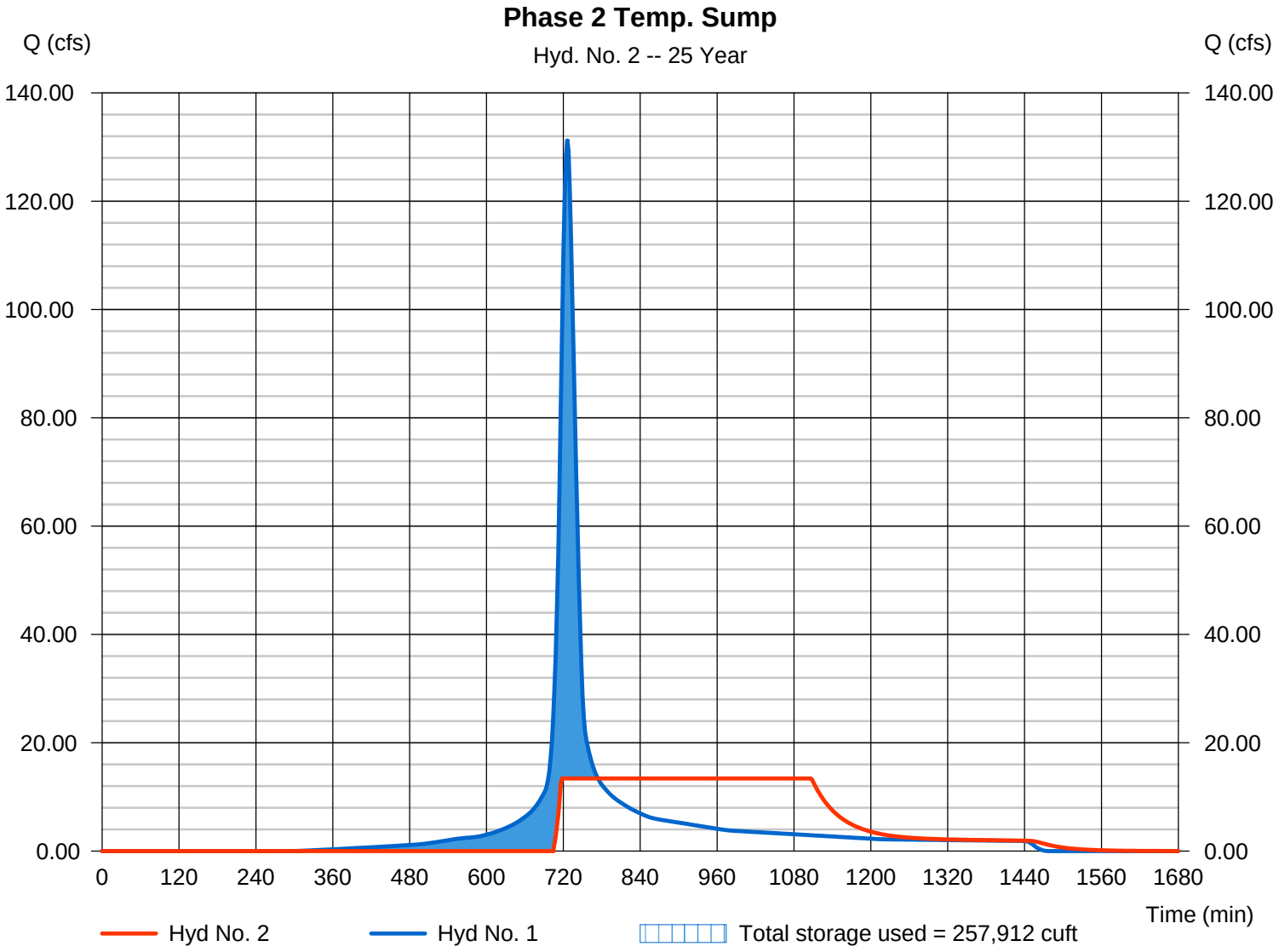
Hydrograph Report

Hyd. No. 2

Phase 2 Temp. Sump

Hydrograph type	=	Reservoir	Peak discharge	=	13.40 cfs
Storm frequency	=	25 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	396,377 cuft
Inflow hyd. No.	=	1 - Phase 2 Exposed Ash	Max. Elevation	=	959.23 ft
Reservoir name	=	Phase 2 Temp. Sump	Max. Storage	=	257,912 cuft

Storage Indication method used.



Pond Report

Pond No. 1 - Phase 2 Temp. Sump

Pond Data

Trapezoid -Bottom L x W = 299.0 x 299.0 ft, Side slope = 3.00:1, Bottom elev. = 956.50 ft, Depth = 3.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	956.50	89,401	0	0
0.35	956.85	90,661	31,511	31,511
0.70	957.20	91,930	31,953	63,464
1.05	957.55	93,208	32,399	95,863
1.40	957.90	94,495	32,848	128,711
1.75	958.25	95,790	33,300	162,010
2.10	958.60	97,095	33,755	195,765
2.45	958.95	98,408	34,213	229,977
2.80	959.30	99,730	34,674	264,651
3.15	959.65	101,060	35,138	299,789
3.50	960.00	102,400	35,605	335,395

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

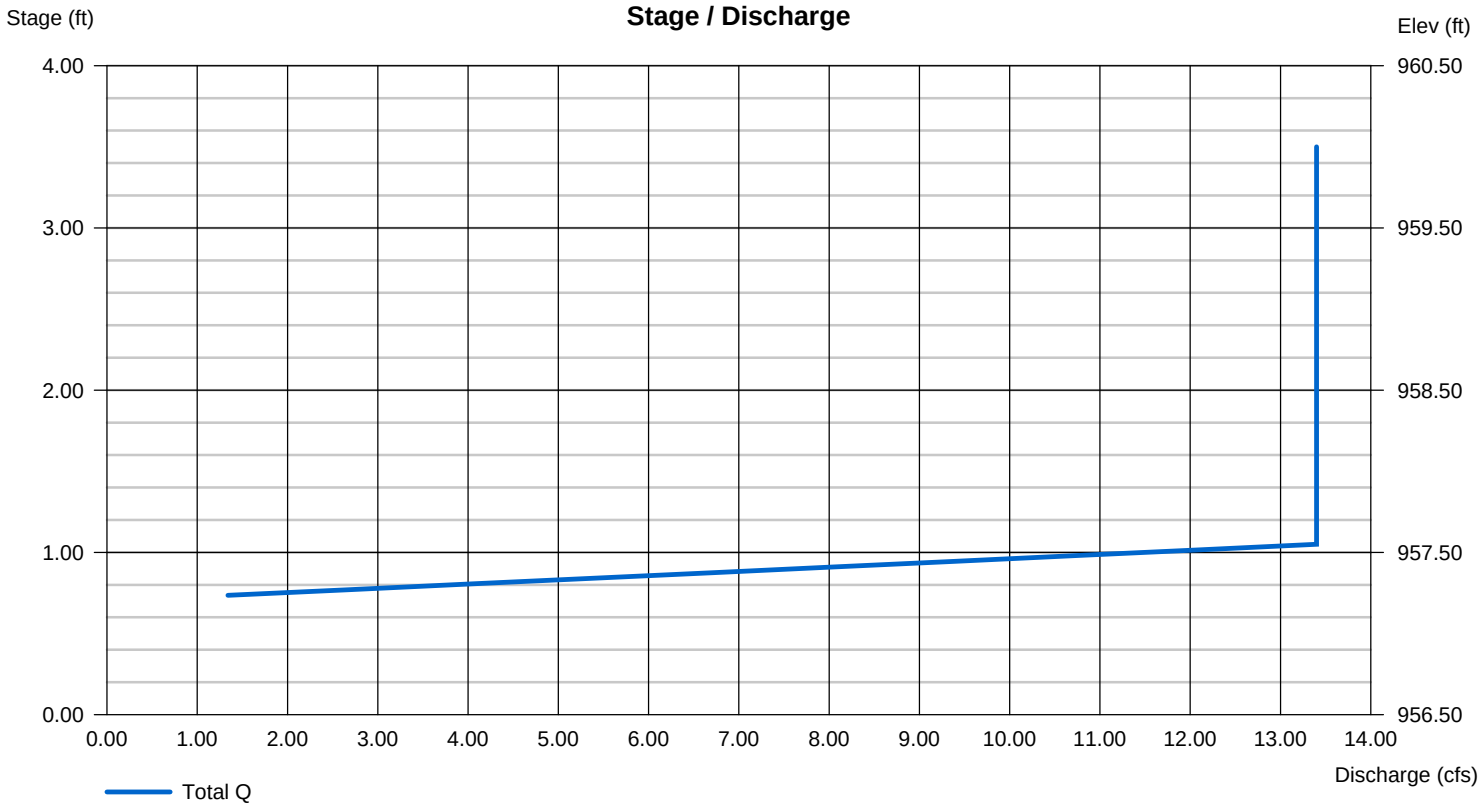
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.00	0.00	0.00	0.00
Crest El. (ft)	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= ---	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Contour)

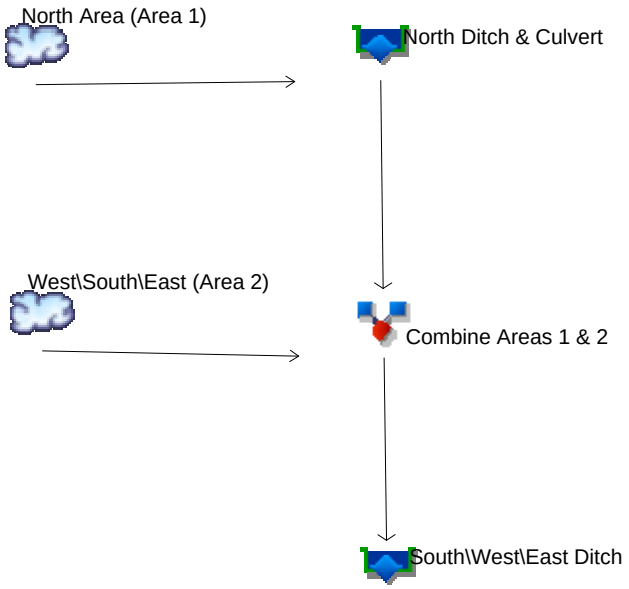
TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



Watershed Model Schematic

Phase 2 Storm Water



Legend

Hyd.	Origin	Description
1	SCS Runoff	North Area (Area 1)
2	Reservoir	North Ditch & Culvert
3	SCS Runoff	West\South\East (Area 2)
4	Combine	Combine Areas 1 & 2
5	Reservoir	South\West\East Ditch

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	------	-------	-------	-------	-------	-------	22.11	-------	-------	North Area (Area 1)
2	Reservoir	1	-------	-------	-------	-------	-------	15.98	-------	-------	North Ditch & Culvert
3	SCS Runoff	------	-------	-------	-------	-------	-------	29.71	-------	-------	West\South\East (Area 2)
4	Combine	2, 3	-------	-------	-------	-------	-------	45.28	-------	-------	Combine Areas 1 & 2
5	Reservoir	4	-------	-------	-------	-------	-------	2.727	-------	-------	South\West\East Ditch

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

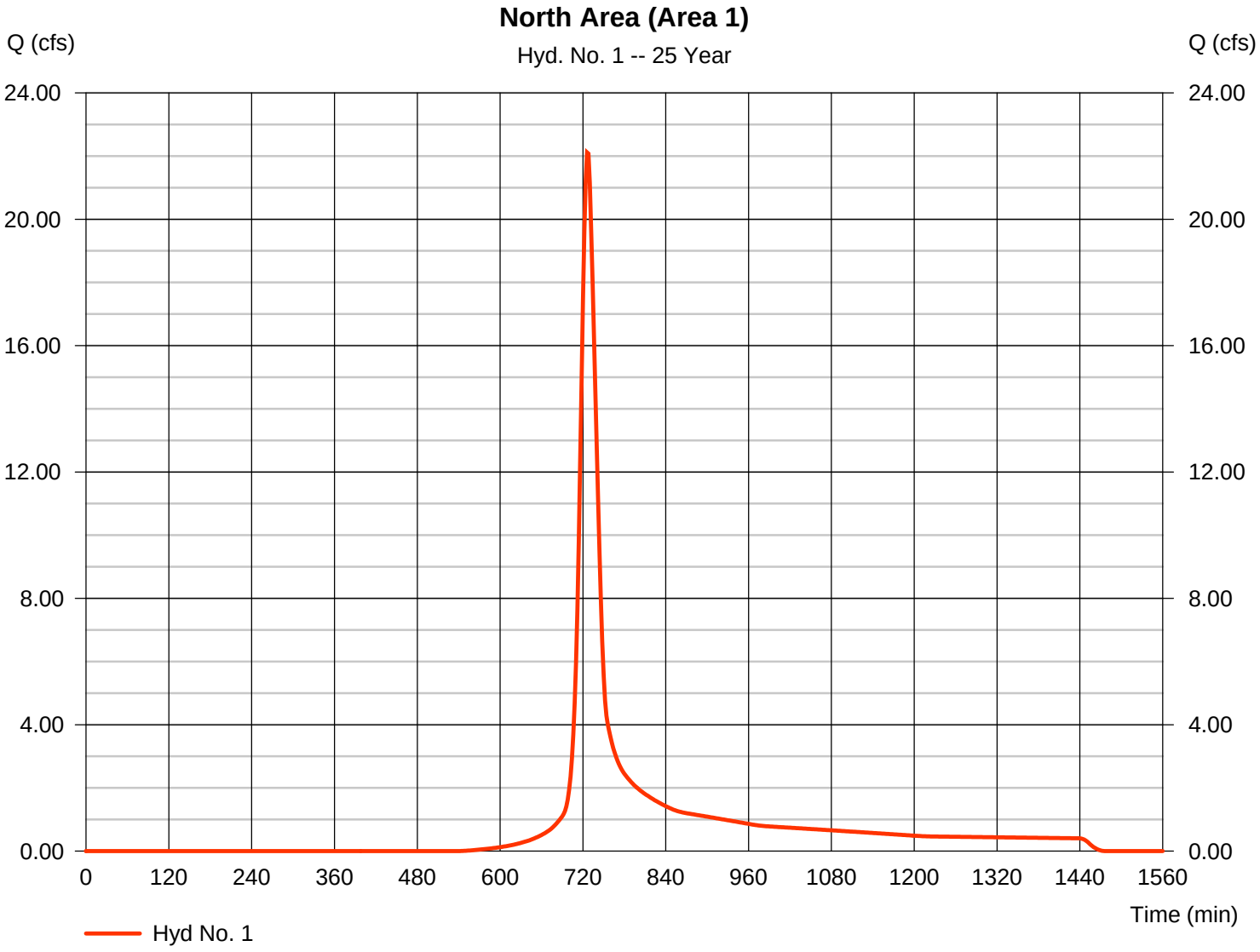
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	22.11	2	726	77,133	------	------	------	North Area (Area 1)
2	Reservoir	15.98	2	736	77,132	1	916.00	9,000	North Ditch & Culvert
3	SCS Runoff	29.71	2	742	161,370	------	------	------	West\South\East (Area 2)
4	Combine	45.28	2	740	238,502	2, 3	------	------	Combine Areas 1 & 2
5	Reservoir	2.727	2	966	82,131	4	916.14	172,115	South\West\East Ditch

Hydrograph Report

Hyd. No. 1

North Area (Area 1)

Hydrograph type	=	SCS Runoff	Peak discharge	=	22.11 cfs
Storm frequency	=	25 yrs	Time to peak	=	726 min
Time interval	=	2 min	Hyd. volume	=	77,133 cuft
Drainage area	=	7.400 ac	Curve number	=	70
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	23.30 min
Total precip.	=	6.02 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



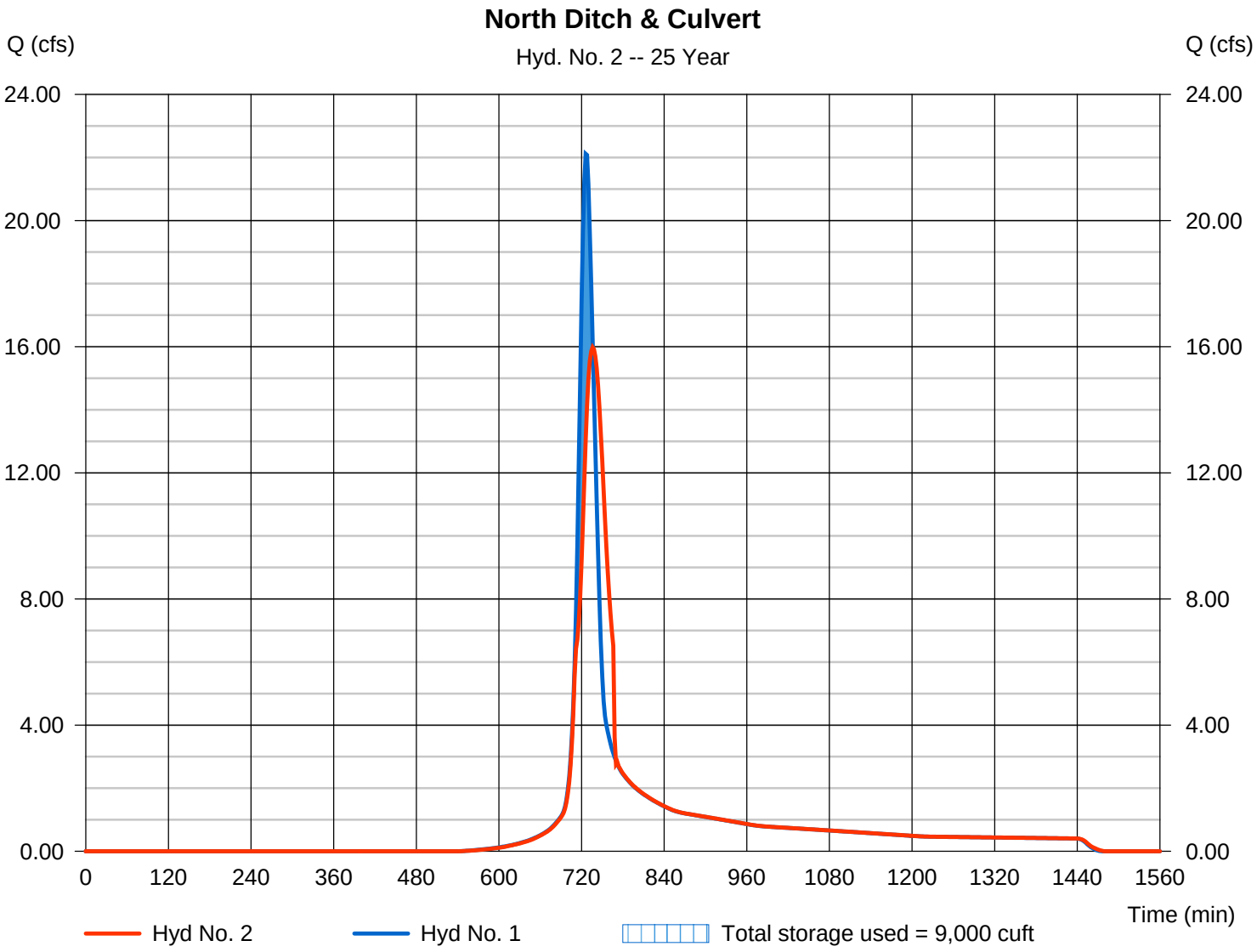
Hydrograph Report

Hyd. No. 2

North Ditch & Culvert

Hydrograph type	=	Reservoir	Peak discharge	=	15.98 cfs
Storm frequency	=	25 yrs	Time to peak	=	736 min
Time interval	=	2 min	Hyd. volume	=	77,132 cuft
Inflow hyd. No.	=	1 - North Area (Area 1)	Max. Elevation	=	916.00 ft
Reservoir name	=	North Ditch	Max. Storage	=	9,000 cuft

Storage Indication method used.



Pond Report

Pond No. 1 - North Ditch

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 913.95 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	913.95	00	0	0
0.05	914.00	100	2	2
1.05	915.00	570	303	305
2.05	916.00	22,013	8,708	9,012
3.05	917.00	42,365	31,636	40,648
4.05	918.00	59,387	50,632	91,280
5.05	919.00	76,300	67,660	158,940

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 30.00	0.00	0.00	0.00
Span (in)	= 30.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 913.95	0.00	0.00	0.00
Length (ft)	= 323.00	0.00	0.00	0.00
Slope (%)	= 0.25	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

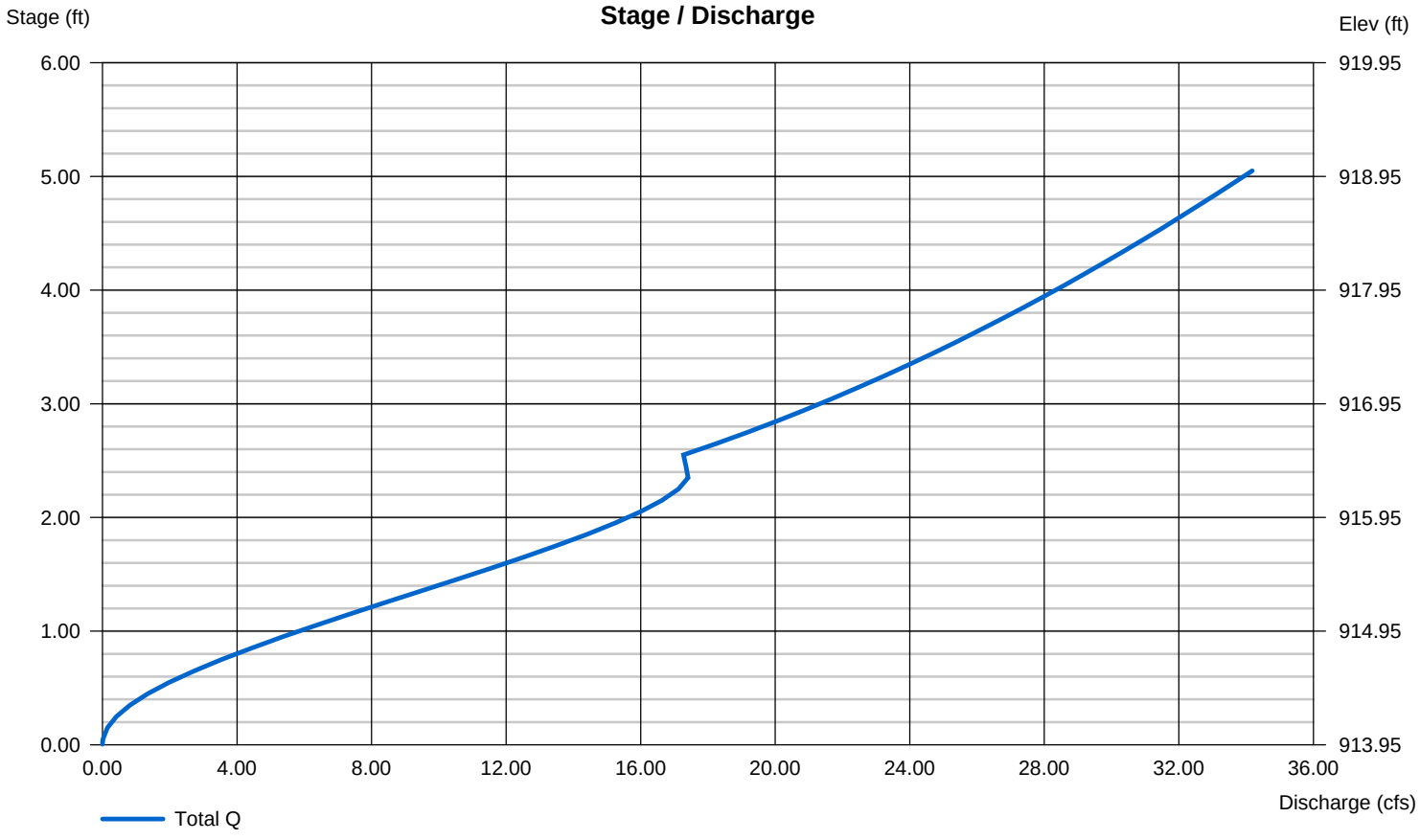
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.00	0.00	0.00	0.00
Crest El. (ft)	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= ---	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

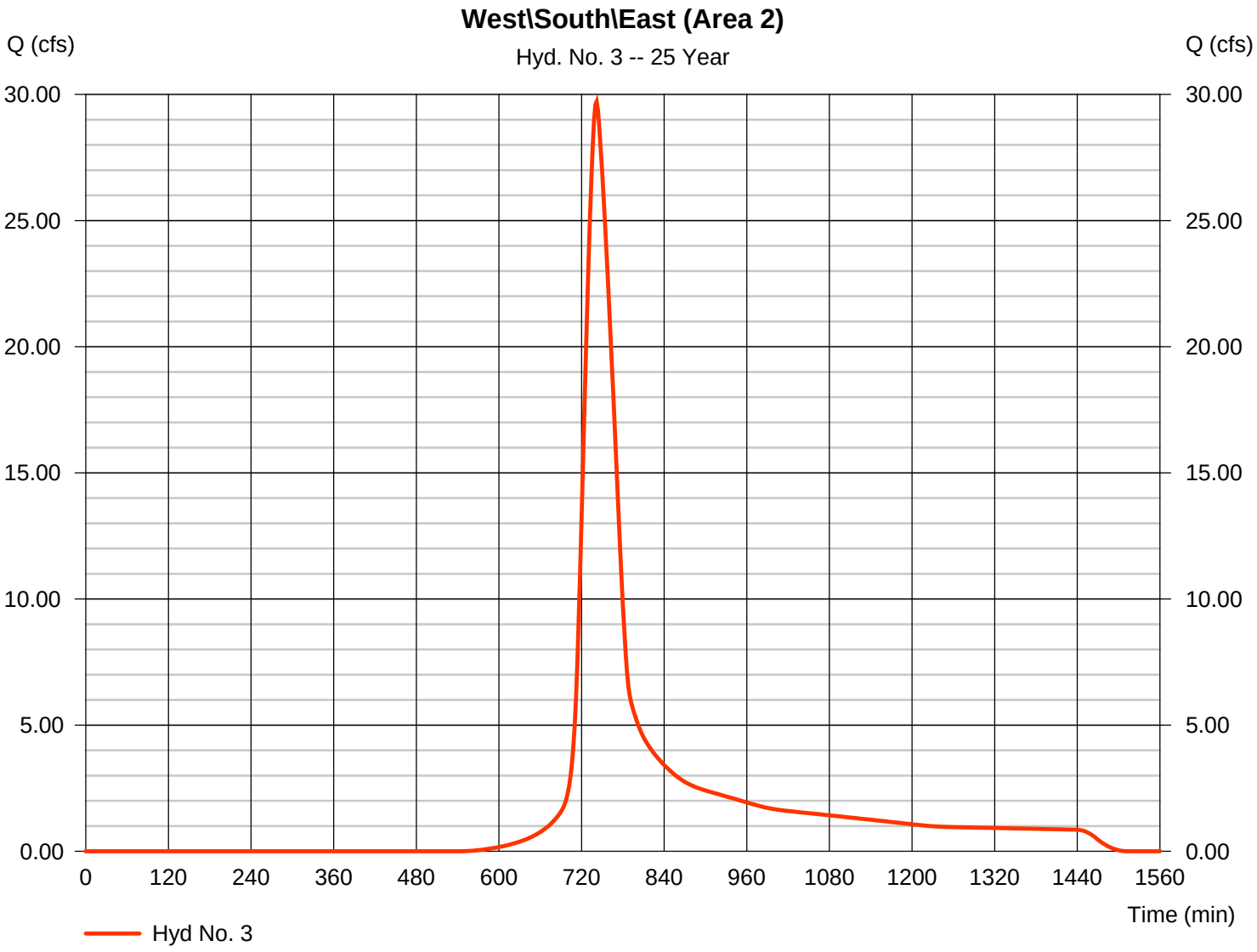


Hydrograph Report

Hyd. No. 3

West\South\East (Area 2)

Hydrograph type	=	SCS Runoff	Peak discharge	=	29.71 cfs
Storm frequency	=	25 yrs	Time to peak	=	742 min
Time interval	=	2 min	Hyd. volume	=	161,370 cuft
Drainage area	=	15.900 ac	Curve number	=	70
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	46.40 min
Total precip.	=	6.02 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

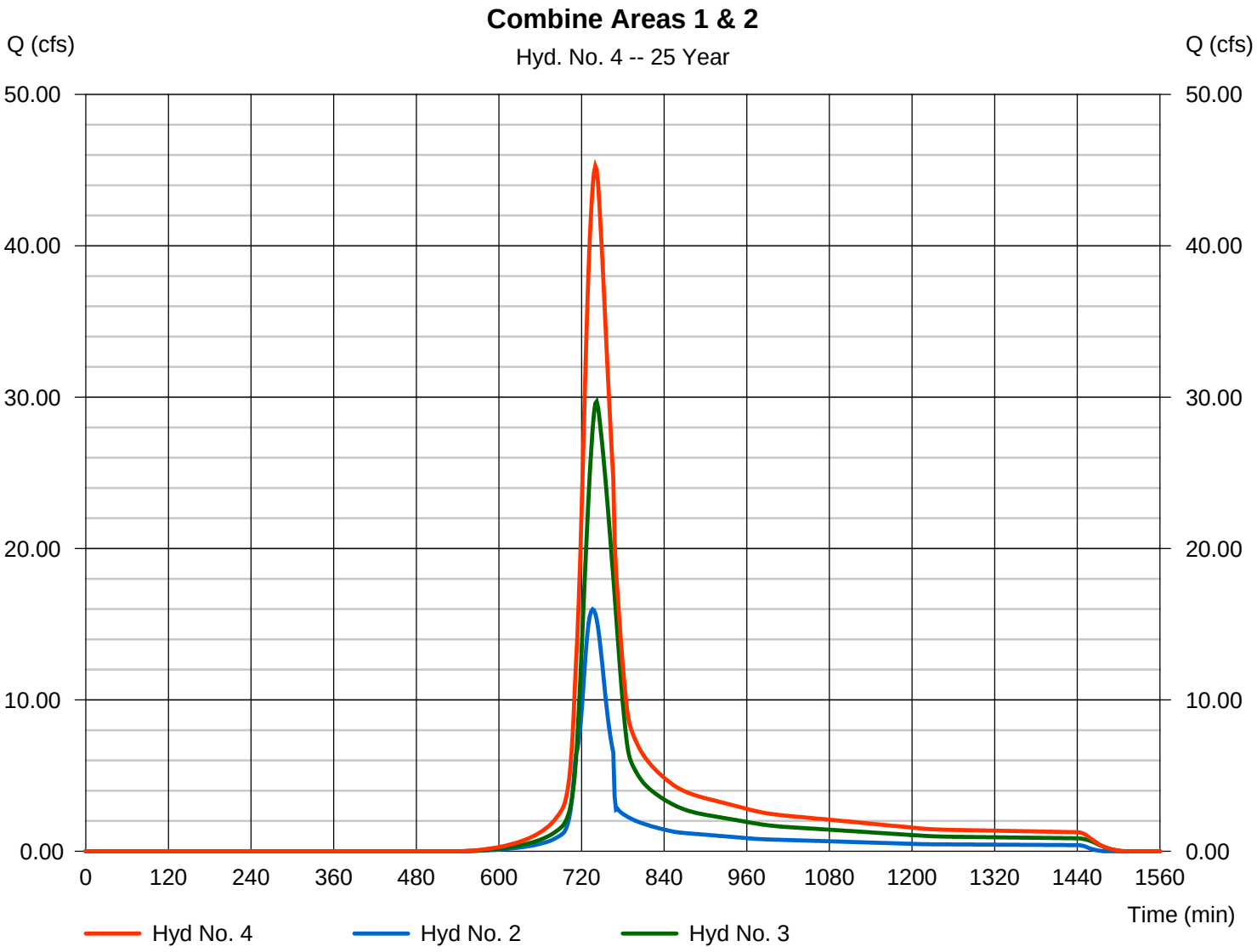


Hydrograph Report

Hyd. No. 4

Combine Areas 1 & 2

Hydrograph type	= Combine	Peak discharge	= 45.28 cfs
Storm frequency	= 25 yrs	Time to peak	= 740 min
Time interval	= 2 min	Hyd. volume	= 238,502 cuft
Inflow hyds.	= 2, 3	Contrib. drain. area	= 15.900 ac



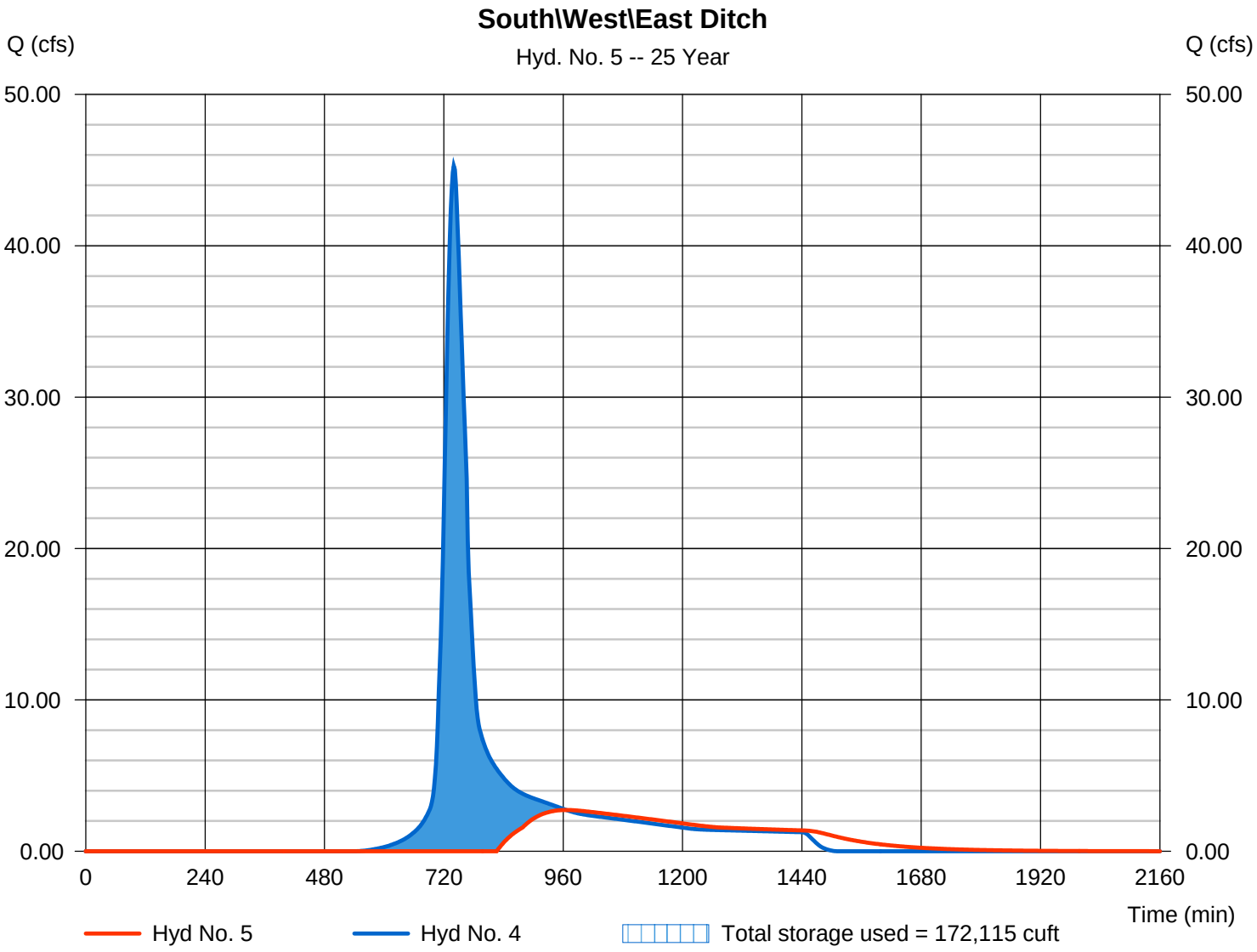
Hydrograph Report

Hyd. No. 5

South\West\East Ditch

Hydrograph type	=	Reservoir	Peak discharge	=	2.727 cfs
Storm frequency	=	25 yrs	Time to peak	=	966 min
Time interval	=	2 min	Hyd. volume	=	82,131 cuft
Inflow hyd. No.	=	4 - Combine Areas 1 & 2	Max. Elevation	=	916.14 ft
Reservoir name	=	West\South\East Ditch	Max. Storage	=	172,115 cuft

Storage Indication method used.



Pond Report

Pond No. 2 - West\South\East Ditch

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 912.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	912.50	00	0	0
0.50	913.00	8,464	1,411	1,411
1.50	914.00	38,541	21,687	23,097
2.50	915.00	66,415	51,845	74,942
3.50	916.00	97,433	81,422	156,364
4.50	917.00	128,731	112,708	269,072

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

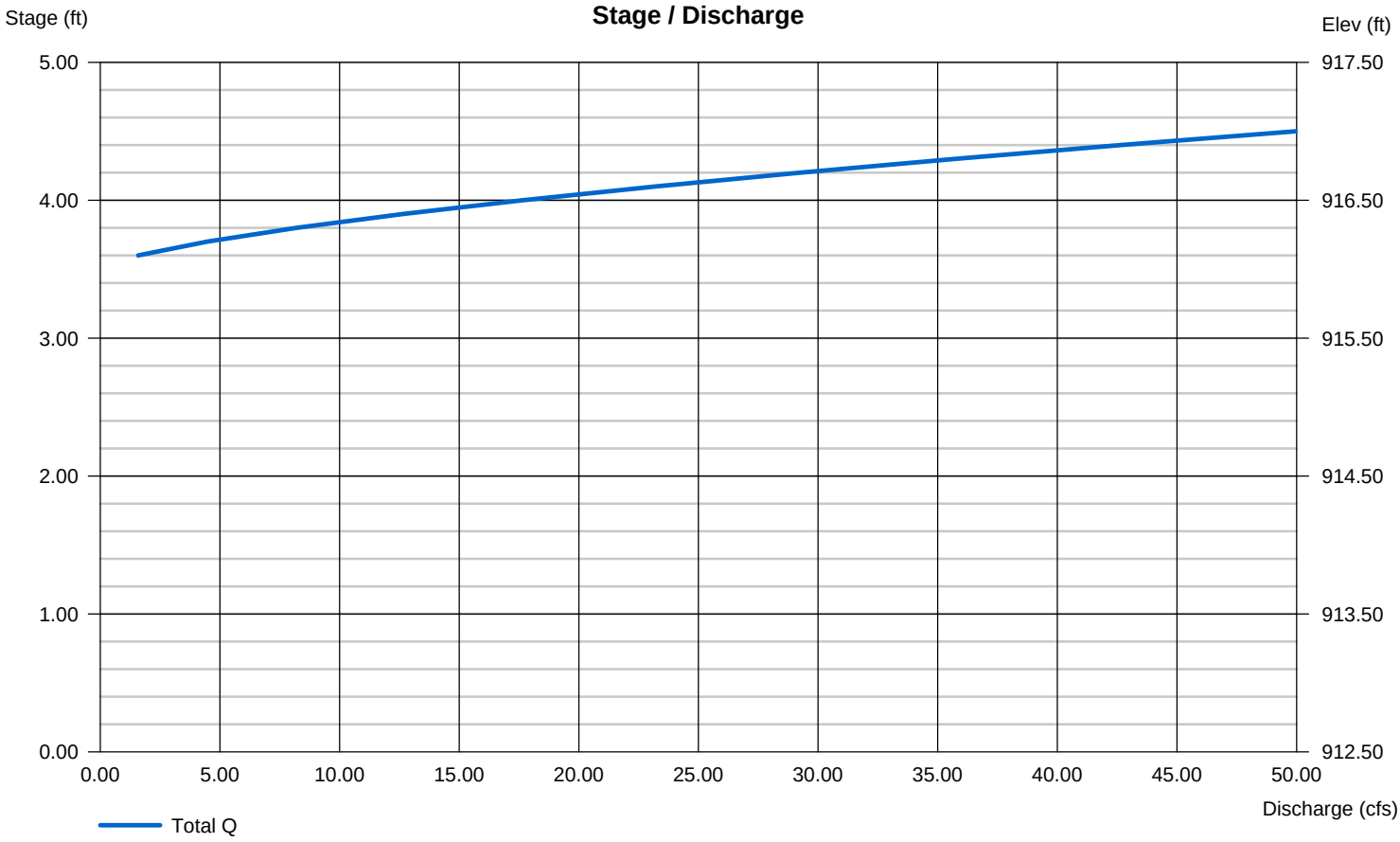
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 15.00	0.00	0.00	0.00
Crest El. (ft)	= 916.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



Appendix E Phase 3 Contact Water and Storm Water Calculations

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Watershed Model Schematic

Legend

Hyd.	Origin	Description
1	SCS Runoff	Phase 3 Exposed Ash
2	Reservoir	Phase 3 Temp. Sump

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	------	-------	-------	-------	-------	-------	122.29	-------	-------	Phase 3 Exposed Ash
2	Reservoir	1	-------	-------	-------	-------	-------	13.40	-------	-------	Phase 3 Temp. Sump

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

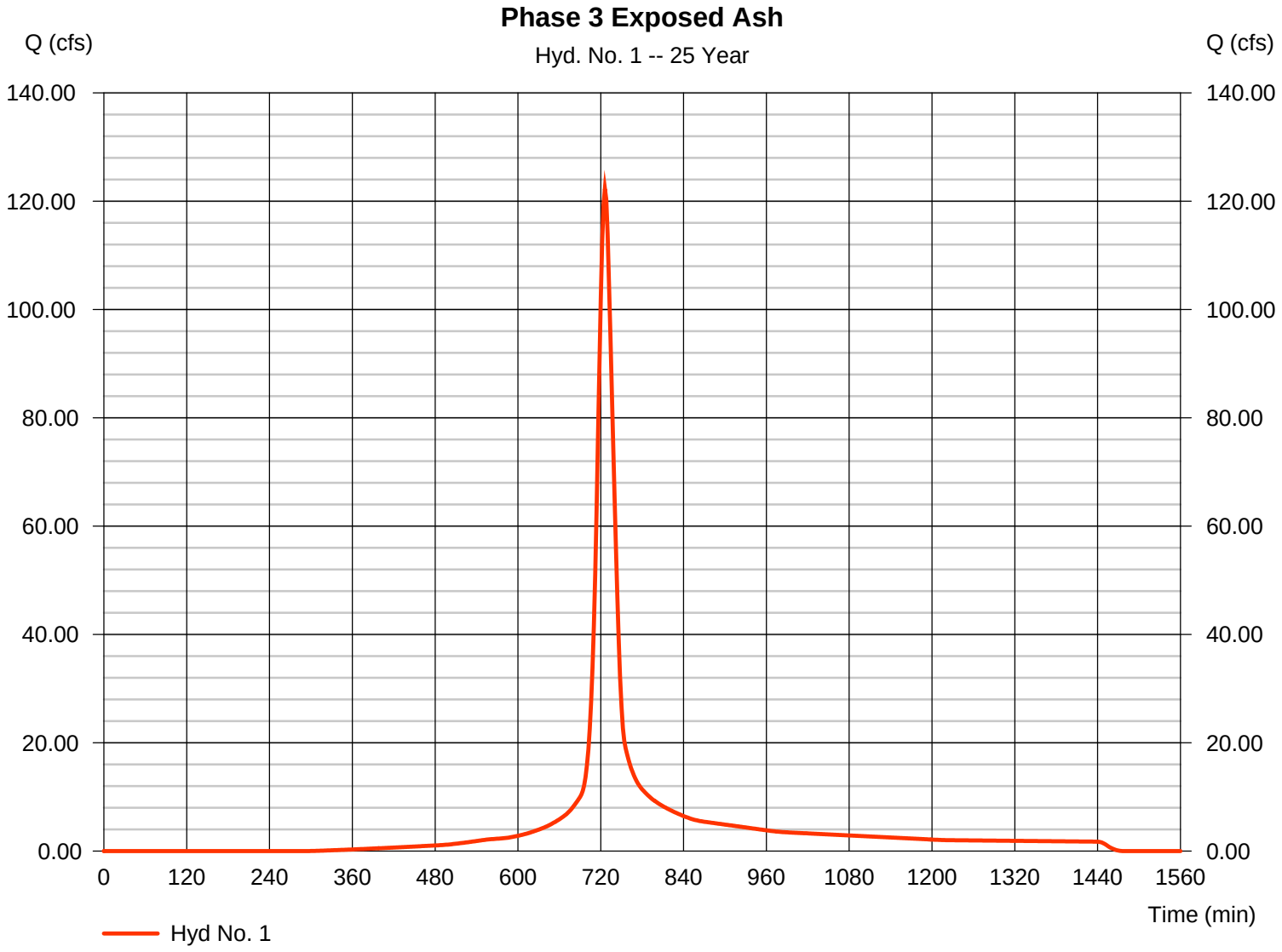
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	122.29	2	726	427,909	------	------	------	Phase 3 Exposed Ash
2	Reservoir	13.40	2	718	364,443	1	964.03	238,003	Phase 3 Temp. Sump

Hydrograph Report

Hyd. No. 1

Phase 3 Exposed Ash

Hydrograph type	= SCS Runoff	Peak discharge	= 122.29 cfs
Storm frequency	= 25 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 427,909 cuft
Drainage area	= 26.800 ac	Curve number	= 85
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 20.40 min
Total precip.	= 6.02 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



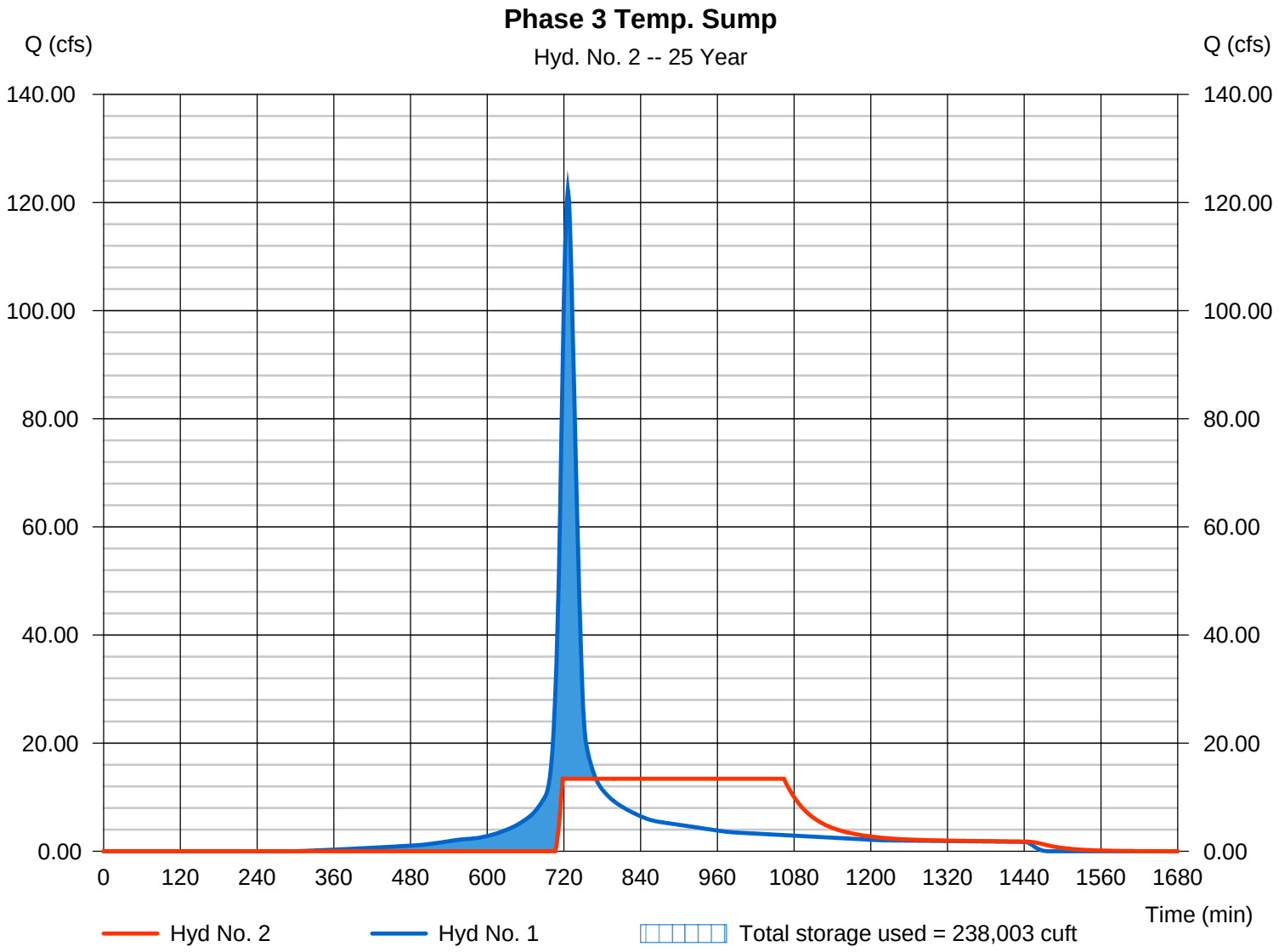
Hydrograph Report

Hyd. No. 2

Phase 3 Temp. Sump

Hydrograph type	=	Reservoir	Peak discharge	=	13.40 cfs
Storm frequency	=	25 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	364,443 cuft
Inflow hyd. No.	=	1 - Phase 3 Exposed Ash	Max. Elevation	=	964.03 ft
Reservoir name	=	Phase 3 Temp. Sump	Max. Storage	=	238,003 cuft

Storage Indication method used.



Pond Report

Pond No. 1 - Phase 3 Temp. Sump

Pond Data

Trapezoid -Bottom L x W = 299.0 x 299.0 ft, Side slope = 3.00:1, Bottom elev. = 961.50 ft, Depth = 3.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	961.50	89,401	0	0
0.35	961.85	90,661	31,511	31,511
0.70	962.20	91,930	31,953	63,464
1.05	962.55	93,208	32,399	95,863
1.40	962.90	94,495	32,848	128,711
1.75	963.25	95,790	33,300	162,010
2.10	963.60	97,095	33,755	195,765
2.45	963.95	98,408	34,213	229,977
2.80	964.30	99,730	34,674	264,651
3.15	964.65	101,060	35,138	299,789
3.50	965.00	102,400	35,605	335,395

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

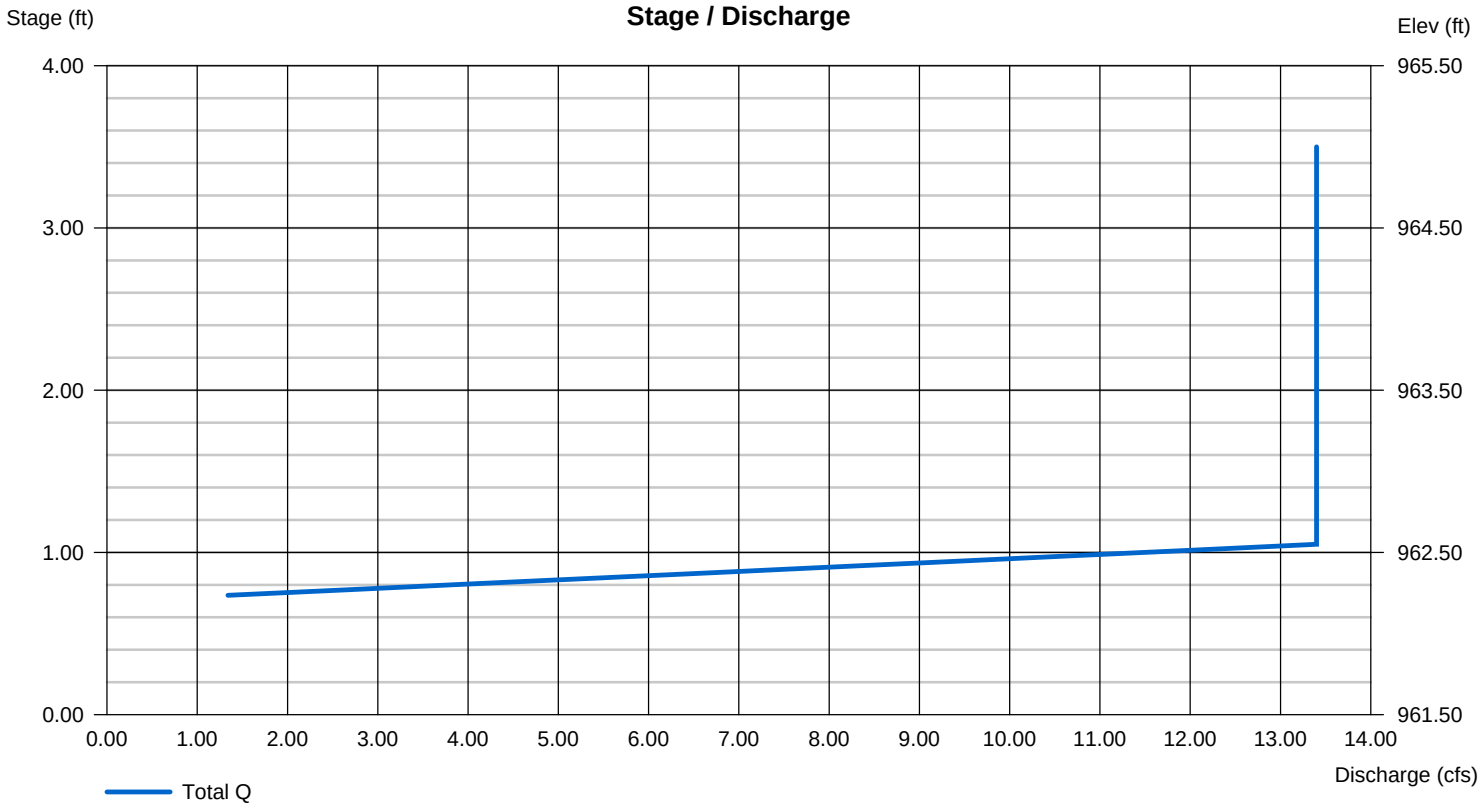
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.00	0.00	0.00	0.00
Crest El. (ft)	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= ---	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Contour)

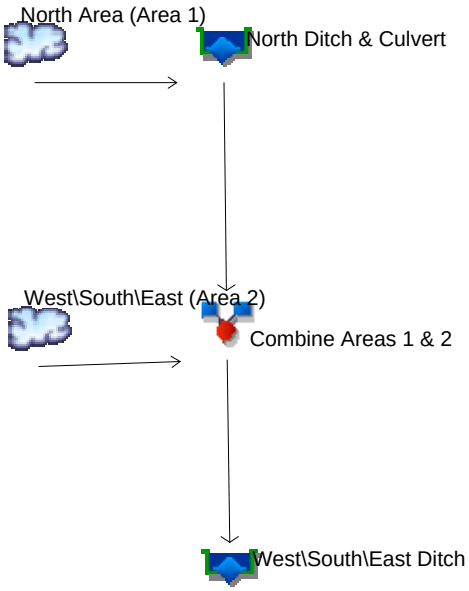
TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



Watershed Model Schematic

Phase 3 Storm Water



Legend

Hyd.	Origin	Description
1	SCS Runoff	North Area (Area 1)
2	Reservoir	North Ditch & Culvert
3	SCS Runoff	West\South\East (Area 2)
4	Combine	Combine Areas 1 & 2
5	Reservoir	West\South\East Ditch

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	------	-------	-------	-------	-------	-------	23.91	-------	-------	North Area (Area 1)
2	Reservoir	1	-------	-------	-------	-------	-------	16.27	-------	-------	North Ditch & Culvert
3	SCS Runoff	------	-------	-------	-------	-------	-------	32.33	-------	-------	West\South\East (Area 2)
4	Combine	2, 3	-------	-------	-------	-------	-------	48.48	-------	-------	Combine Areas 1 & 2
5	Reservoir	4	-------	-------	-------	-------	-------	3.573	-------	-------	West\South\East Ditch

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

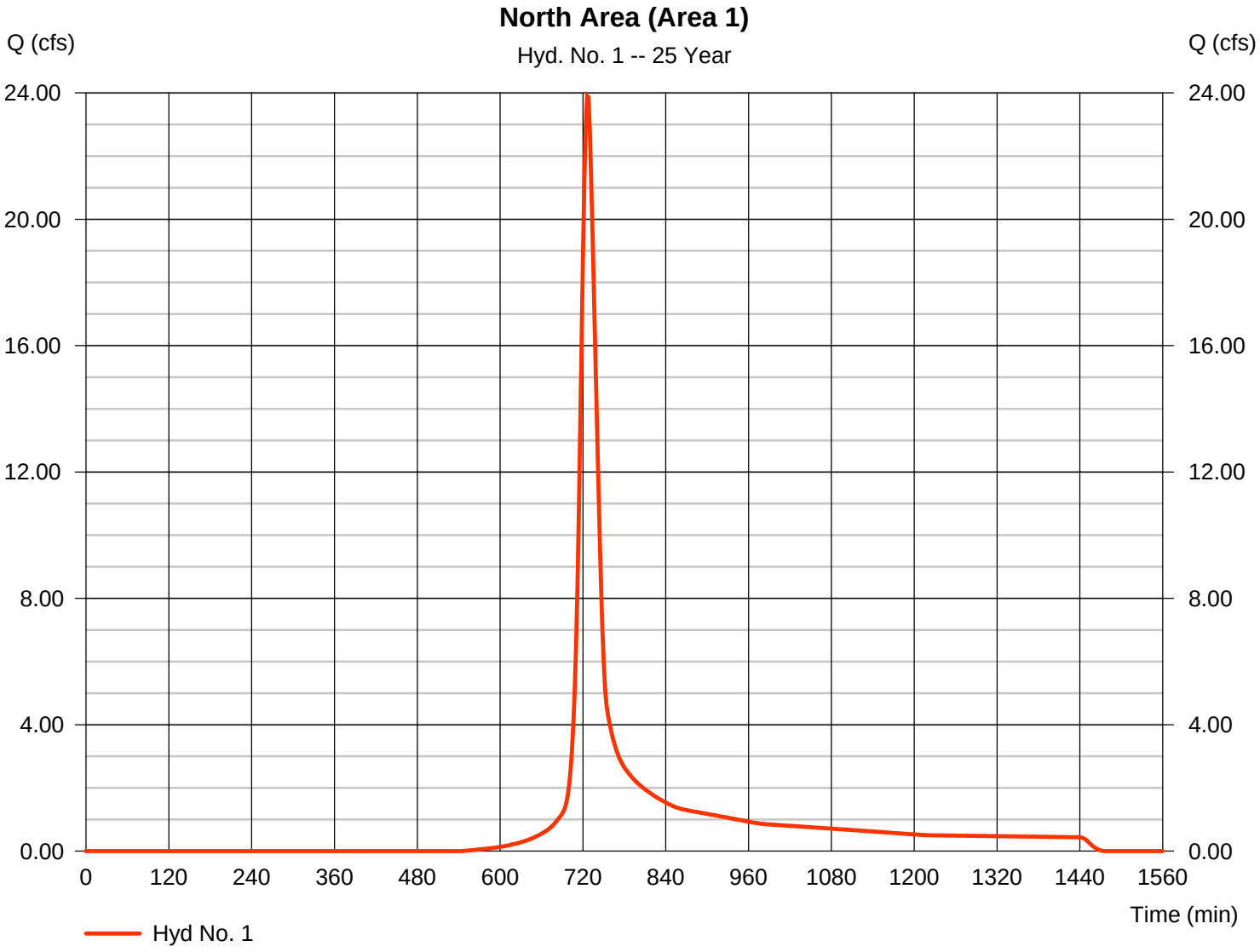
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	23.91	2	726	83,387	------	------	------	North Area (Area 1)
2	Reservoir	16.27	2	738	83,386	1	916.04	10,386	North Ditch & Culvert
3	SCS Runoff	32.33	2	742	175,579	------	------	------	West\South\East (Area 2)
4	Combine	48.48	2	742	258,965	2, 3	------	------	Combine Areas 1 & 2
5	Reservoir	3.573	2	918	102,594	4	916.17	175,419	West\South\East Ditch

Hydrograph Report

Hyd. No. 1

North Area (Area 1)

Hydrograph type	=	SCS Runoff	Peak discharge	=	23.91 cfs
Storm frequency	=	25 yrs	Time to peak	=	726 min
Time interval	=	2 min	Hyd. volume	=	83,387 cuft
Drainage area	=	8.000 ac	Curve number	=	70
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	23.30 min
Total precip.	=	6.02 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



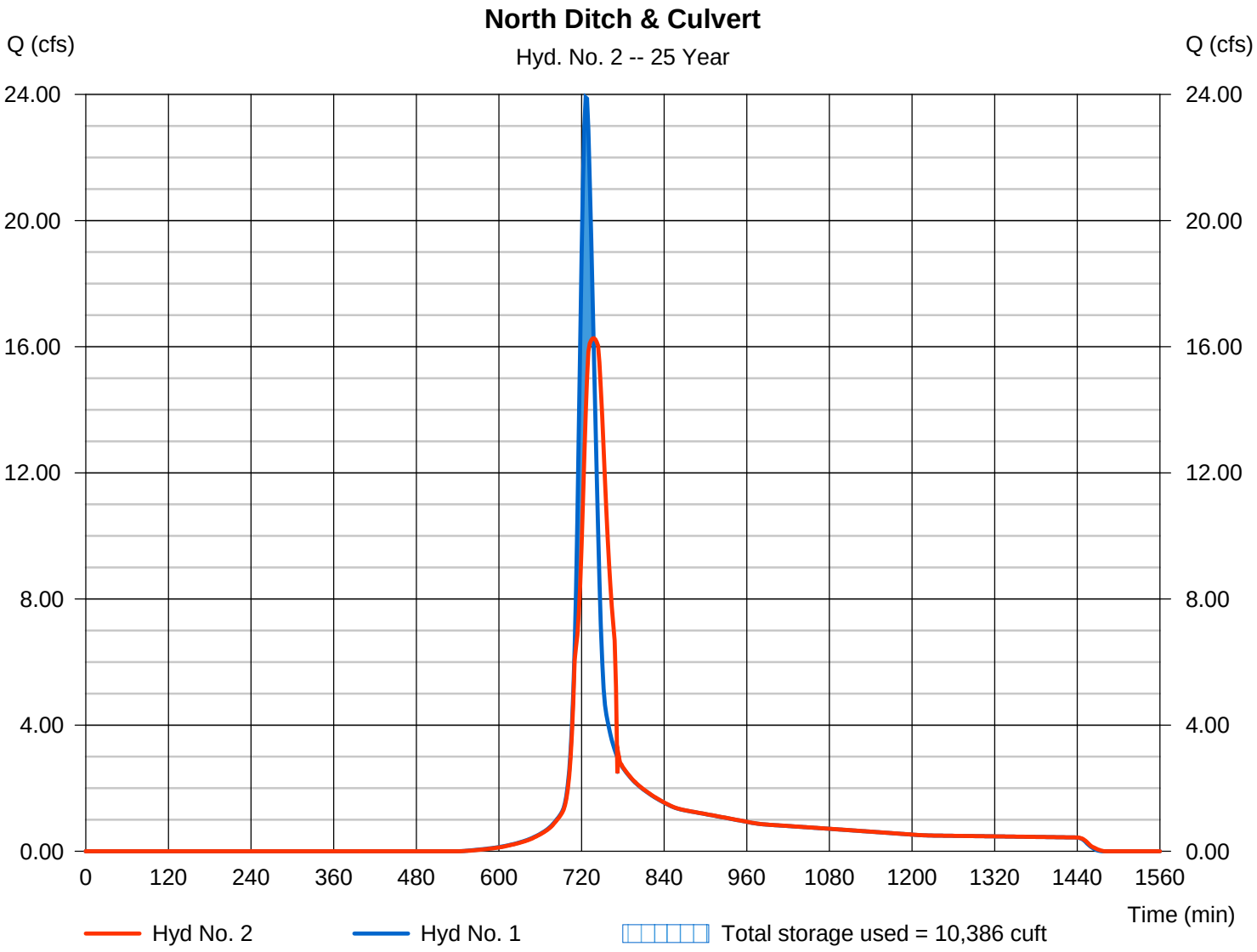
Hydrograph Report

Hyd. No. 2

North Ditch & Culvert

Hydrograph type	=	Reservoir	Peak discharge	=	16.27 cfs
Storm frequency	=	25 yrs	Time to peak	=	738 min
Time interval	=	2 min	Hyd. volume	=	83,386 cuft
Inflow hyd. No.	=	1 - North Area (Area 1)	Max. Elevation	=	916.04 ft
Reservoir name	=	North Ditch	Max. Storage	=	10,386 cuft

Storage Indication method used.



Pond Report

Pond No. 1 - North Ditch

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 913.95 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	913.95	00	0	0
0.05	914.00	100	2	2
1.05	915.00	570	303	305
2.05	916.00	22,013	8,708	9,012
3.05	917.00	42,365	31,636	40,648
4.05	918.00	59,387	50,632	91,280
5.05	919.00	76,300	67,660	158,940

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 30.00	0.00	0.00	0.00
Span (in)	= 30.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 913.95	0.00	0.00	0.00
Length (ft)	= 323.00	0.00	0.00	0.00
Slope (%)	= 0.25	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

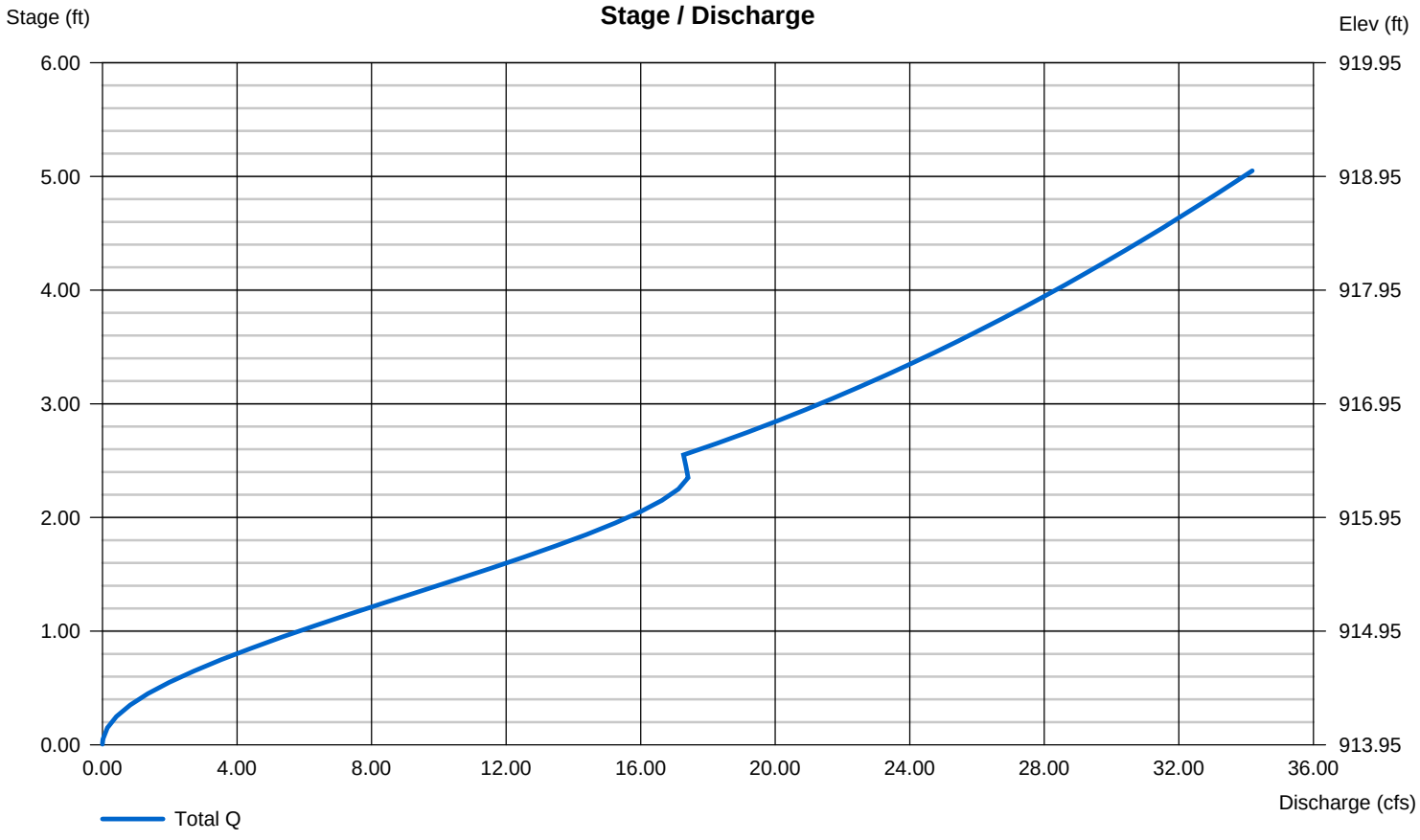
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.00	0.00	0.00	0.00
Crest El. (ft)	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= ---	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

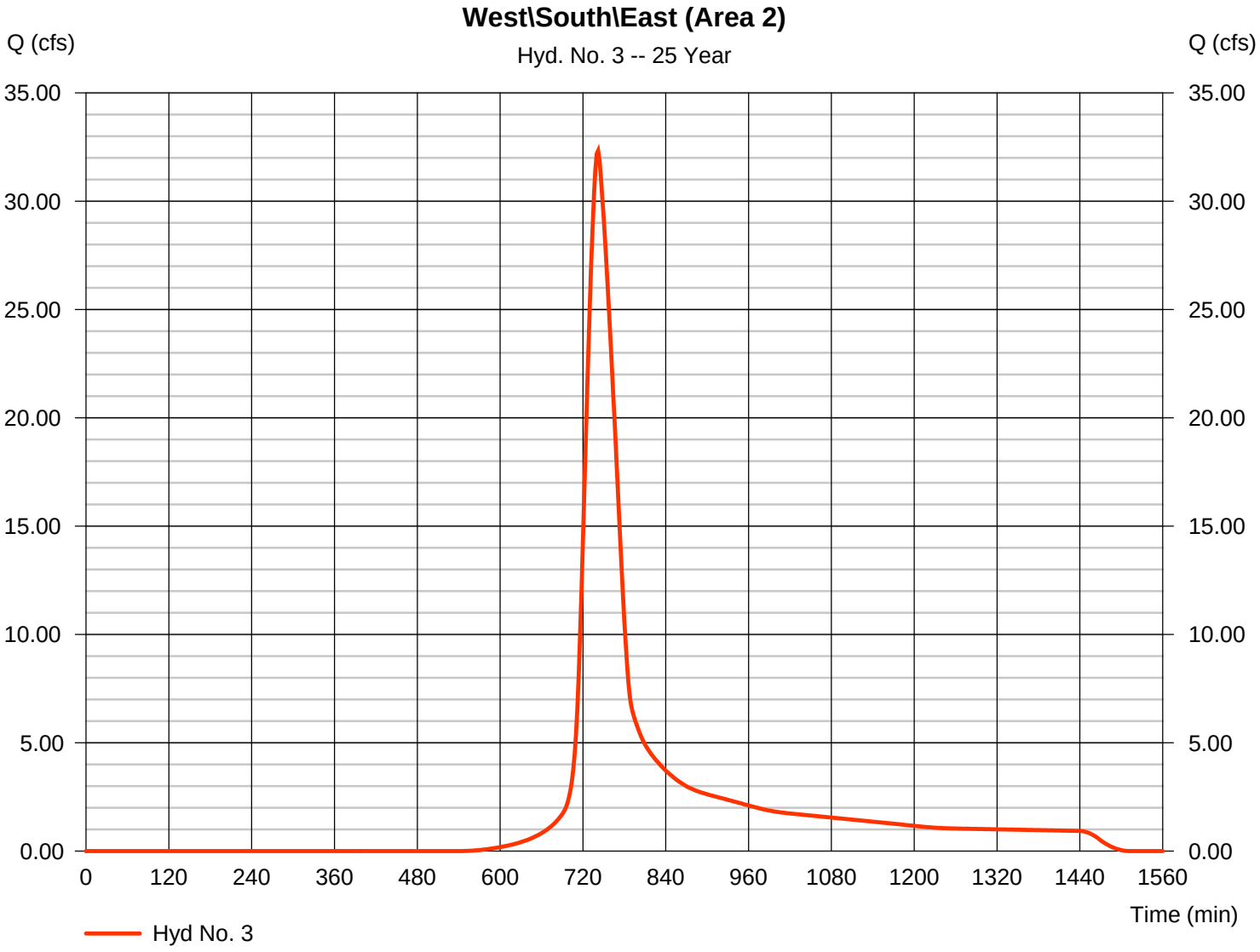


Hydrograph Report

Hyd. No. 3

West\South\East (Area 2)

Hydrograph type	=	SCS Runoff	Peak discharge	=	32.33 cfs
Storm frequency	=	25 yrs	Time to peak	=	742 min
Time interval	=	2 min	Hyd. volume	=	175,579 cuft
Drainage area	=	17.300 ac	Curve number	=	70
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	46.40 min
Total precip.	=	6.02 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

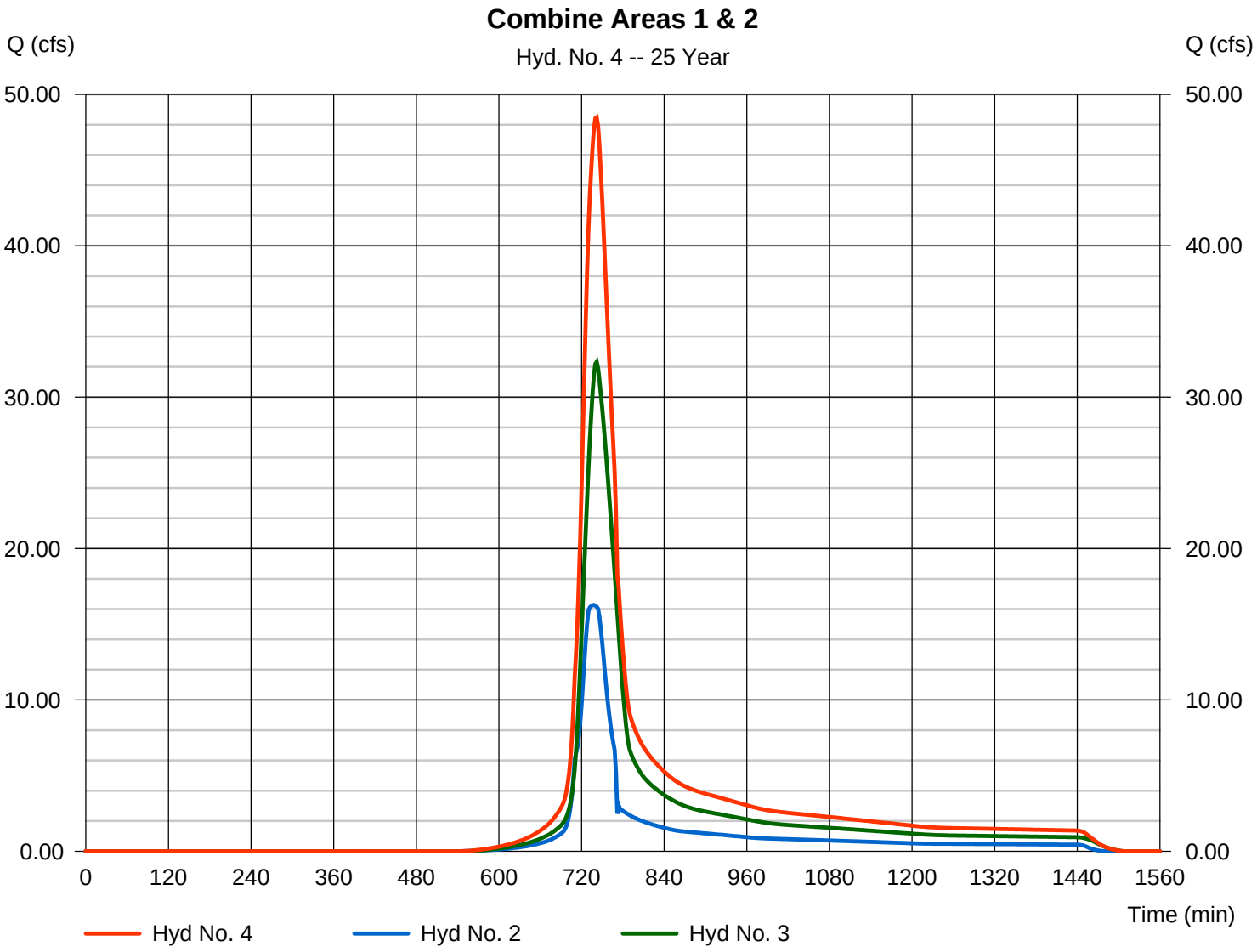


Hydrograph Report

Hyd. No. 4

Combine Areas 1 & 2

Hydrograph type	= Combine	Peak discharge	= 48.48 cfs
Storm frequency	= 25 yrs	Time to peak	= 742 min
Time interval	= 2 min	Hyd. volume	= 258,965 cuft
Inflow hyds.	= 2, 3	Contrib. drain. area	= 17.300 ac



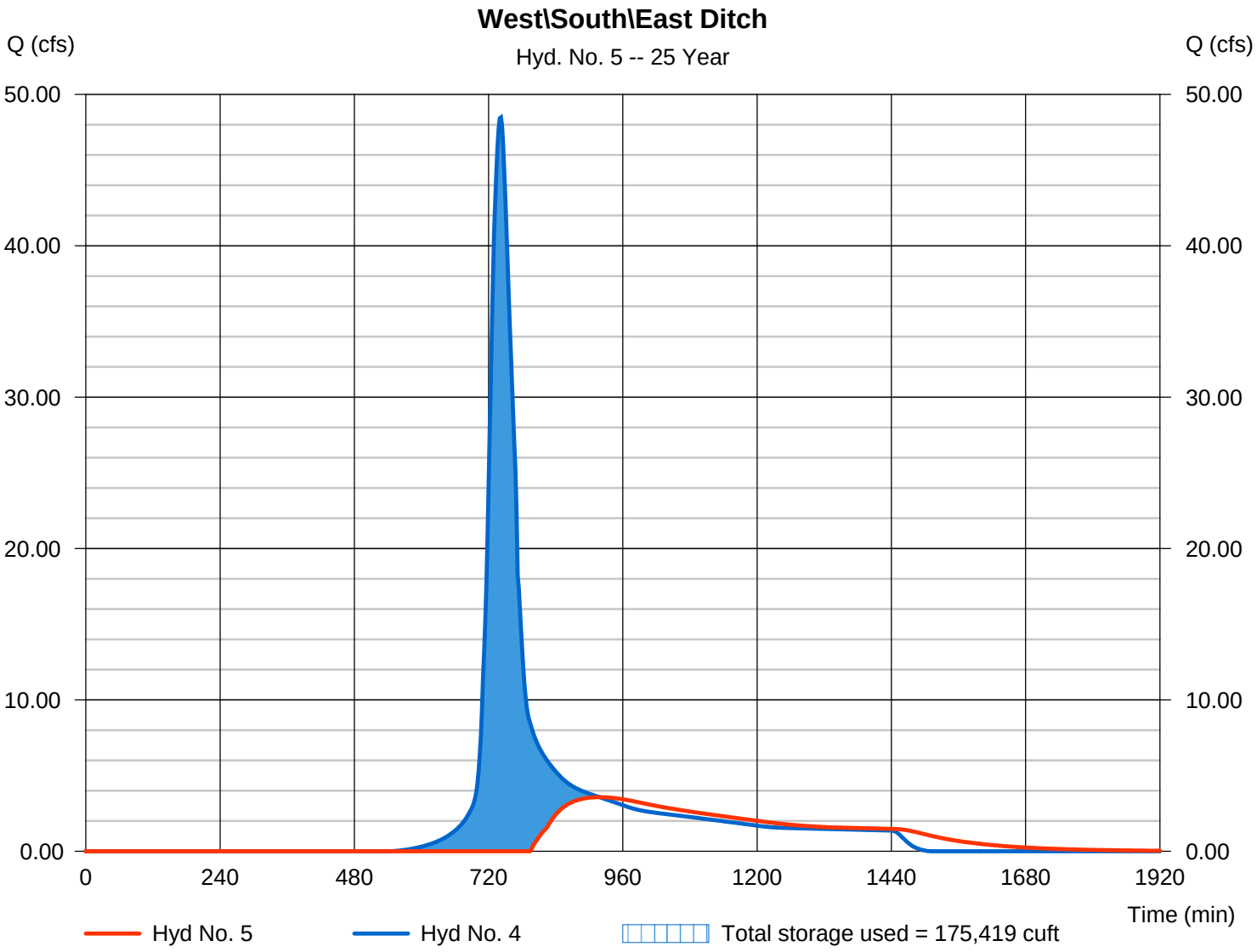
Hydrograph Report

Hyd. No. 5

West\South\East Ditch

Hydrograph type	=	Reservoir	Peak discharge	=	3.573 cfs
Storm frequency	=	25 yrs	Time to peak	=	918 min
Time interval	=	2 min	Hyd. volume	=	102,594 cuft
Inflow hyd. No.	=	4 - Combine Areas 1 & 2	Max. Elevation	=	916.17 ft
Reservoir name	=	West\South\East Ditch	Max. Storage	=	175,419 cuft

Storage Indication method used.



Pond Report

Pond No. 2 - West\South\East Ditch

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 912.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	912.50	00	0	0
0.50	913.00	8,464	1,411	1,411
1.50	914.00	38,541	21,687	23,097
2.50	915.00	66,415	51,845	74,942
3.50	916.00	97,433	81,422	156,364
4.50	917.00	128,731	112,708	269,072

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

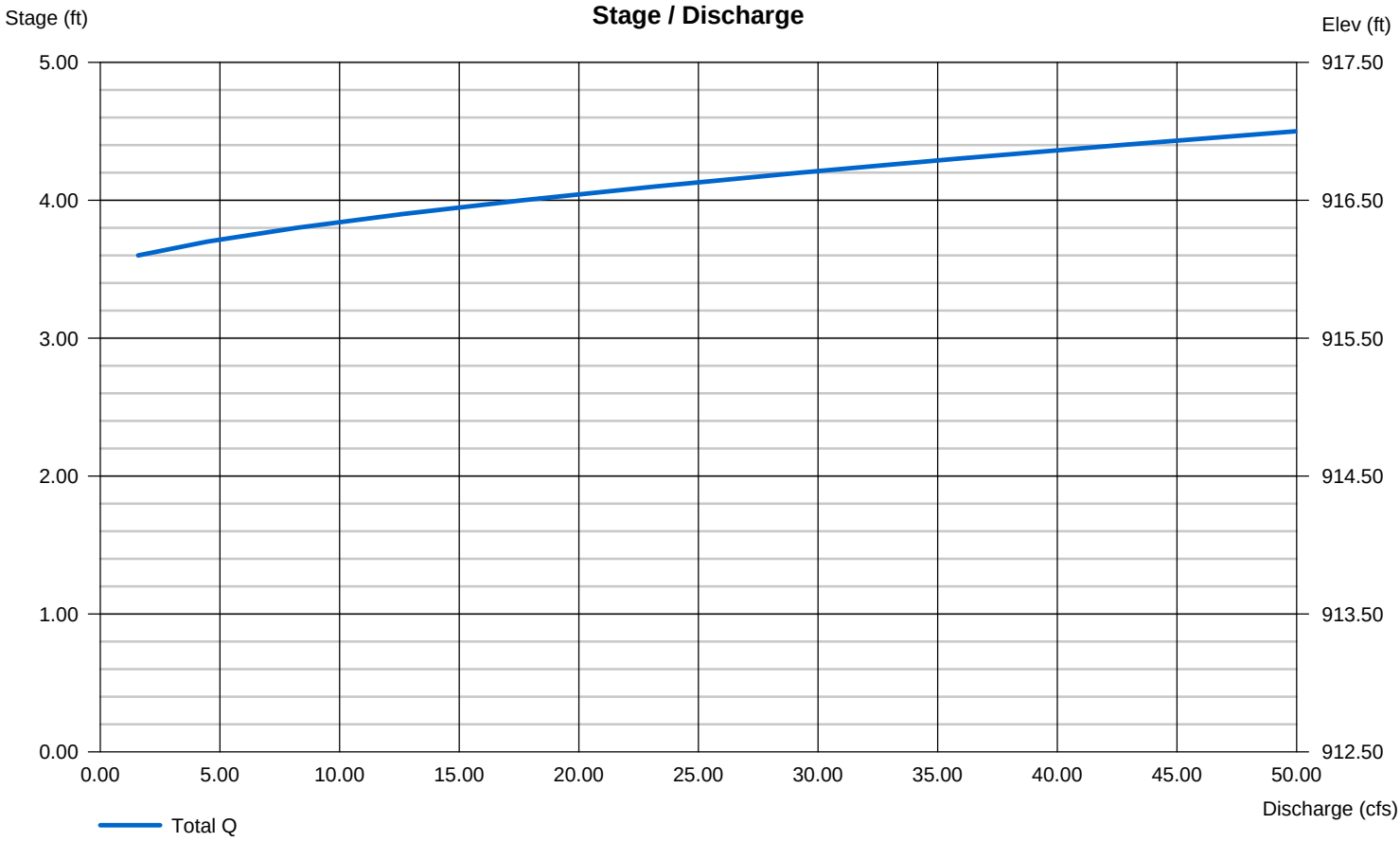
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 15.00	0.00	0.00	0.00
Crest El. (ft)	= 916.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



Appendix F Final Closure Storm Water Calculations

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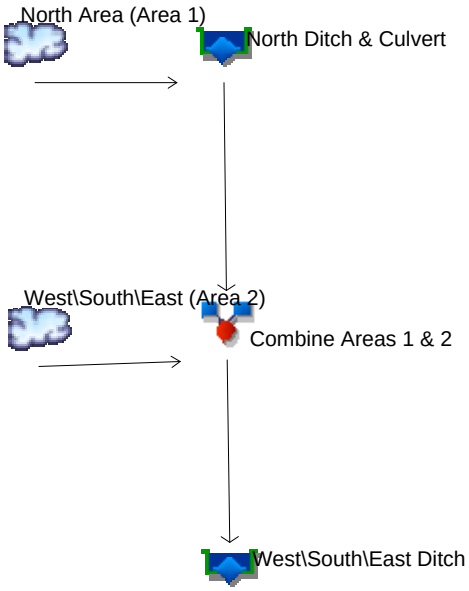
Watershed Model Schematic

Final Closure Storm Water



Legend

Hyd.	Origin	Description
1	SCS Runoff	North Area (Area 1)
2	Reservoir	North Ditch & Culvert
3	SCS Runoff	West\South\East (Area 2)
4	Combine	Combine Areas 1 & 2
5	Reservoir	West\South\East Ditch

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	------	-------	-------	-------	-------	-------	52.89	-------	-------	North Area (Area 1)
2	Reservoir	1	-------	-------	-------	-------	-------	22.13	-------	-------	North Ditch & Culvert
3	SCS Runoff	------	-------	-------	-------	-------	-------	64.28	-------	-------	West\South\East (Area 2)
4	Combine	2, 3	-------	-------	-------	-------	-------	86.37	-------	-------	Combine Areas 1 & 2
5	Reservoir	4	-------	-------	-------	-------	-------	34.08	-------	-------	West\South\East Ditch

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

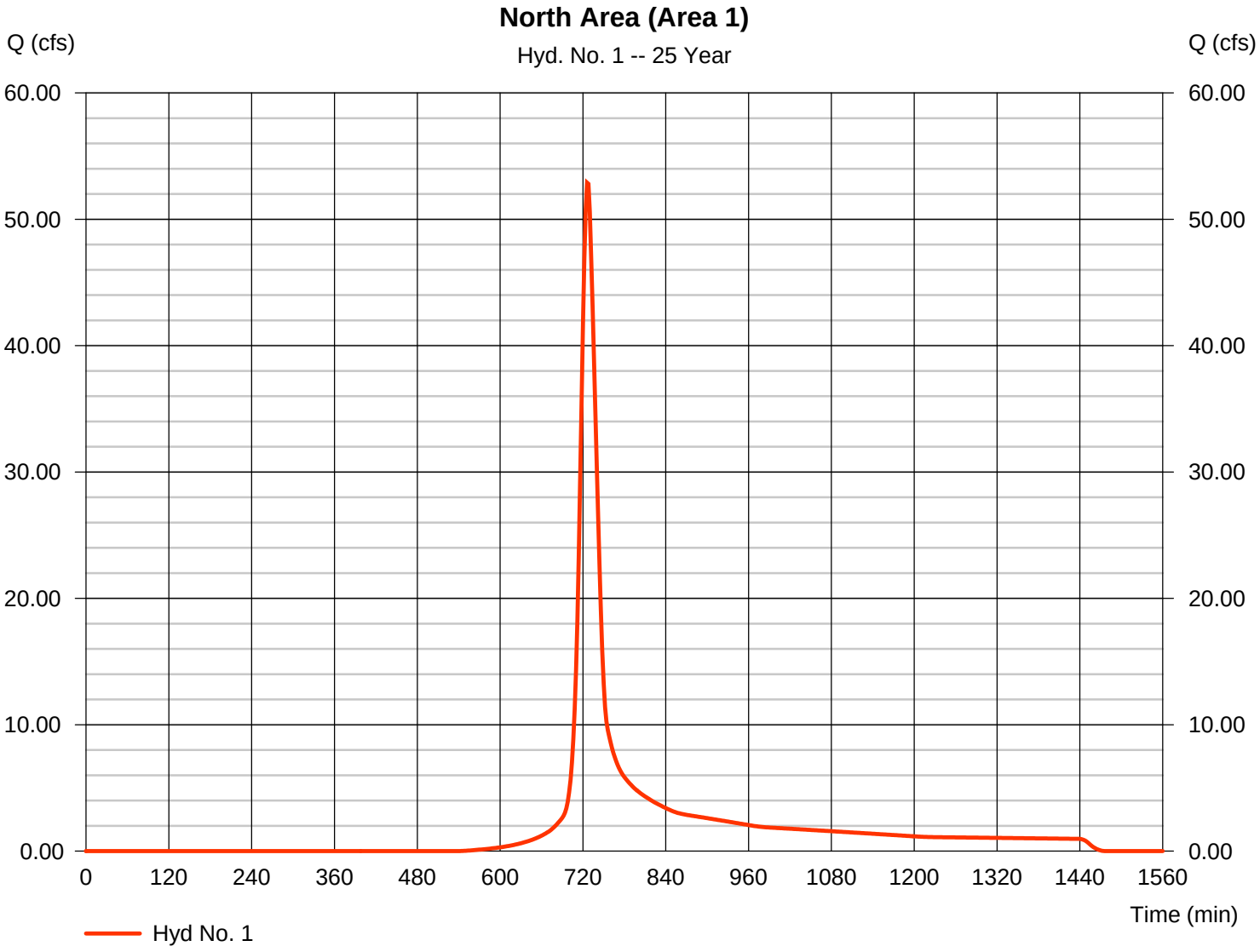
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	52.89	2	726	184,494	------	------	------	North Area (Area 1)
2	Reservoir	22.13	2	744	184,493	1	917.05	43,218	North Ditch & Culvert
3	SCS Runoff	64.28	2	742	349,127	------	------	------	West\South\East (Area 2)
4	Combine	86.37	2	742	533,620	2, 3	------	------	Combine Areas 1 & 2
5	Reservoir	34.08	2	784	377,249	4	916.77	243,657	West\South\East Ditch

Hydrograph Report

Hyd. No. 1

North Area (Area 1)

Hydrograph type	=	SCS Runoff	Peak discharge	=	52.89 cfs
Storm frequency	=	25 yrs	Time to peak	=	726 min
Time interval	=	2 min	Hyd. volume	=	184,494 cuft
Drainage area	=	17.700 ac	Curve number	=	70
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	23.30 min
Total precip.	=	6.02 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



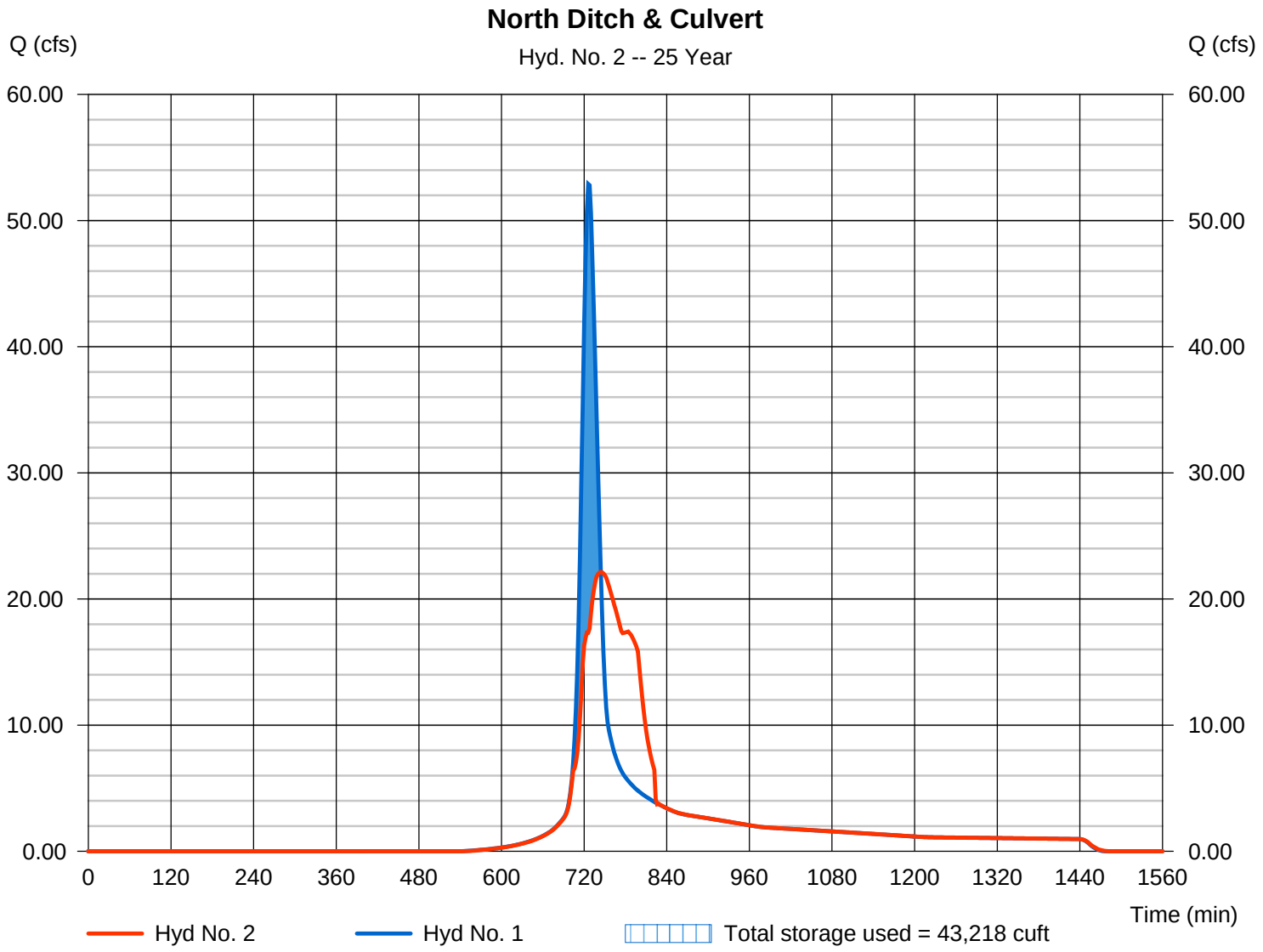
Hydrograph Report

Hyd. No. 2

North Ditch & Culvert

Hydrograph type	=	Reservoir	Peak discharge	=	22.13 cfs
Storm frequency	=	25 yrs	Time to peak	=	744 min
Time interval	=	2 min	Hyd. volume	=	184,493 cuft
Inflow hyd. No.	=	1 - North Area (Area 1)	Max. Elevation	=	917.05 ft
Reservoir name	=	North Ditch	Max. Storage	=	43,218 cuft

Storage Indication method used.



Pond Report

Pond No. 1 - North Ditch

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 913.95 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	913.95	00	0	0
0.05	914.00	100	2	2
1.05	915.00	570	303	305
2.05	916.00	22,013	8,708	9,012
3.05	917.00	42,365	31,636	40,648
4.05	918.00	59,387	50,632	91,280
5.05	919.00	76,300	67,660	158,940

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 30.00	0.00	0.00	0.00
Span (in)	= 30.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 913.95	0.00	0.00	0.00
Length (ft)	= 323.00	0.00	0.00	0.00
Slope (%)	= 0.25	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

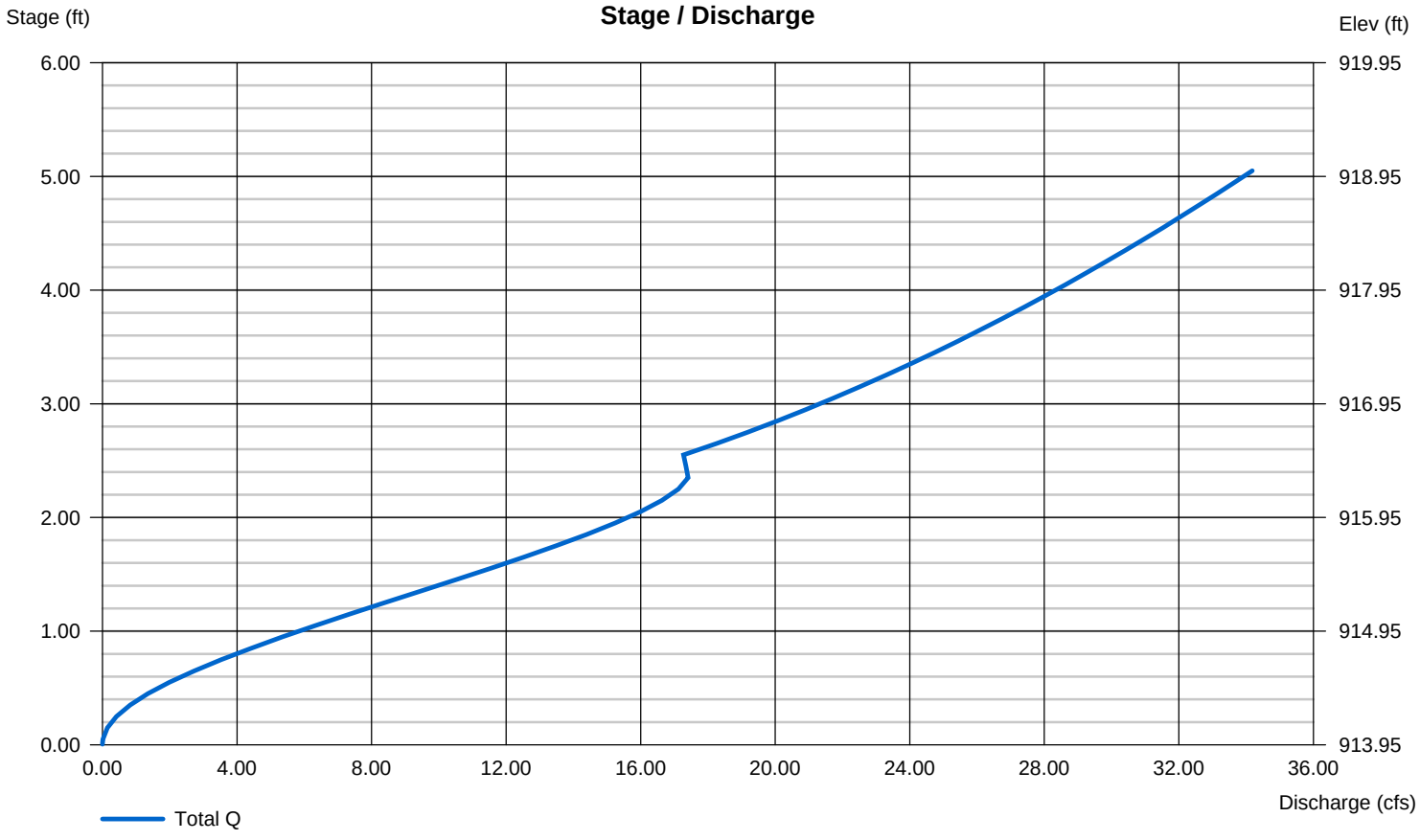
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.00	0.00	0.00	0.00
Crest El. (ft)	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= ---	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

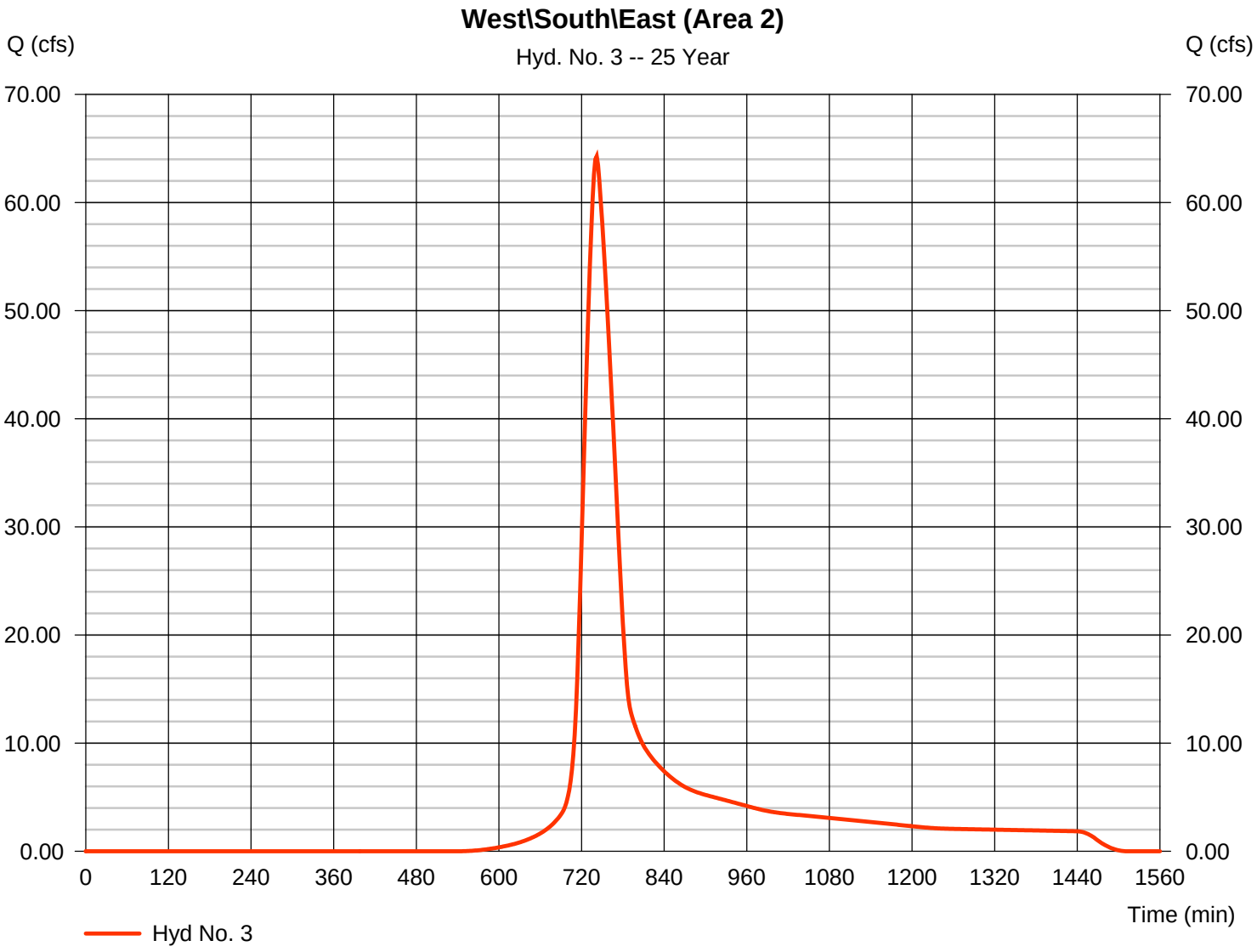


Hydrograph Report

Hyd. No. 3

West\South\East (Area 2)

Hydrograph type	=	SCS Runoff	Peak discharge	=	64.28 cfs
Storm frequency	=	25 yrs	Time to peak	=	742 min
Time interval	=	2 min	Hyd. volume	=	349,127 cuft
Drainage area	=	34.400 ac	Curve number	=	70
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	46.40 min
Total precip.	=	6.02 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

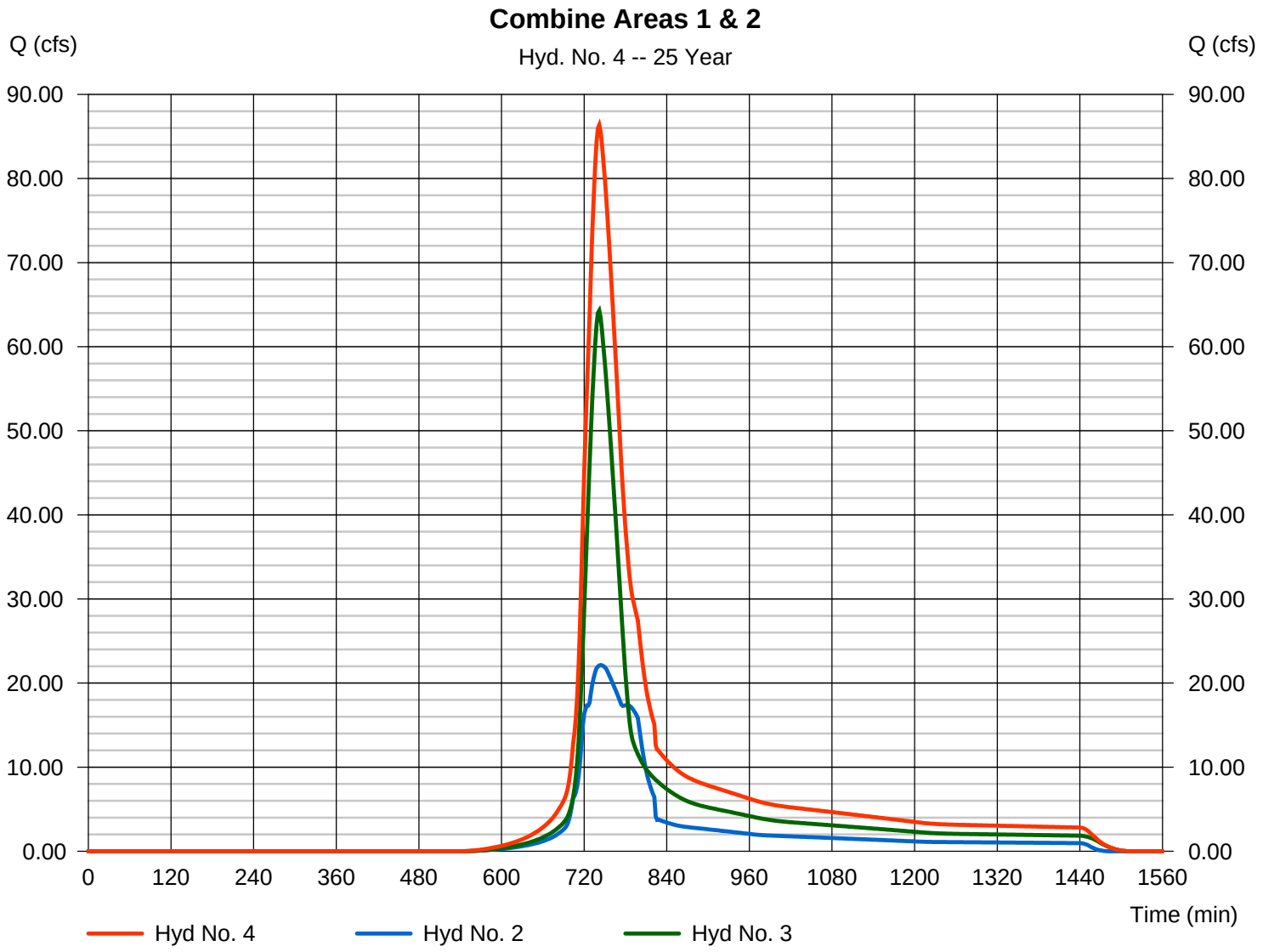


Hydrograph Report

Hyd. No. 4

Combine Areas 1 & 2

Hydrograph type	=	Combine	Peak discharge	=	86.37 cfs
Storm frequency	=	25 yrs	Time to peak	=	742 min
Time interval	=	2 min	Hyd. volume	=	533,620 cuft
Inflow hyds.	=	2, 3	Contrib. drain. area	=	34.400 ac



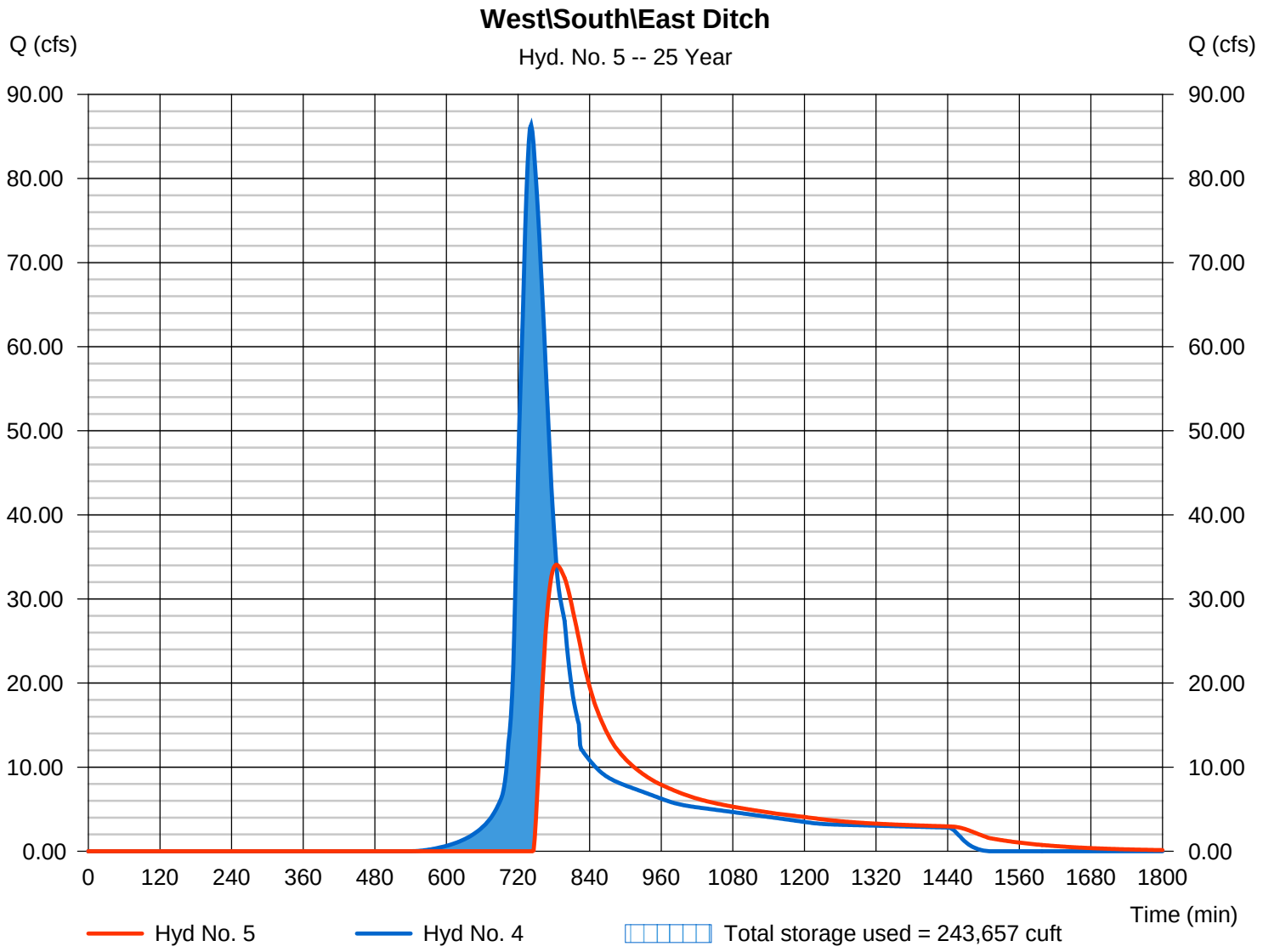
Hydrograph Report

Hyd. No. 5

West\South\East Ditch

Hydrograph type	=	Reservoir	Peak discharge	=	34.08 cfs
Storm frequency	=	25 yrs	Time to peak	=	784 min
Time interval	=	2 min	Hyd. volume	=	377,249 cuft
Inflow hyd. No.	=	4 - Combine Areas 1 & 2	Max. Elevation	=	916.77 ft
Reservoir name	=	West\South\East Ditch	Max. Storage	=	243,657 cuft

Storage Indication method used.



Pond Report

Pond No. 2 - West\South\East Ditch

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 912.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	912.50	00	0	0
0.50	913.00	8,464	1,411	1,411
1.50	914.00	38,541	21,687	23,097
2.50	915.00	66,415	51,845	74,942
3.50	916.00	97,433	81,422	156,364
4.50	917.00	128,731	112,708	269,072

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

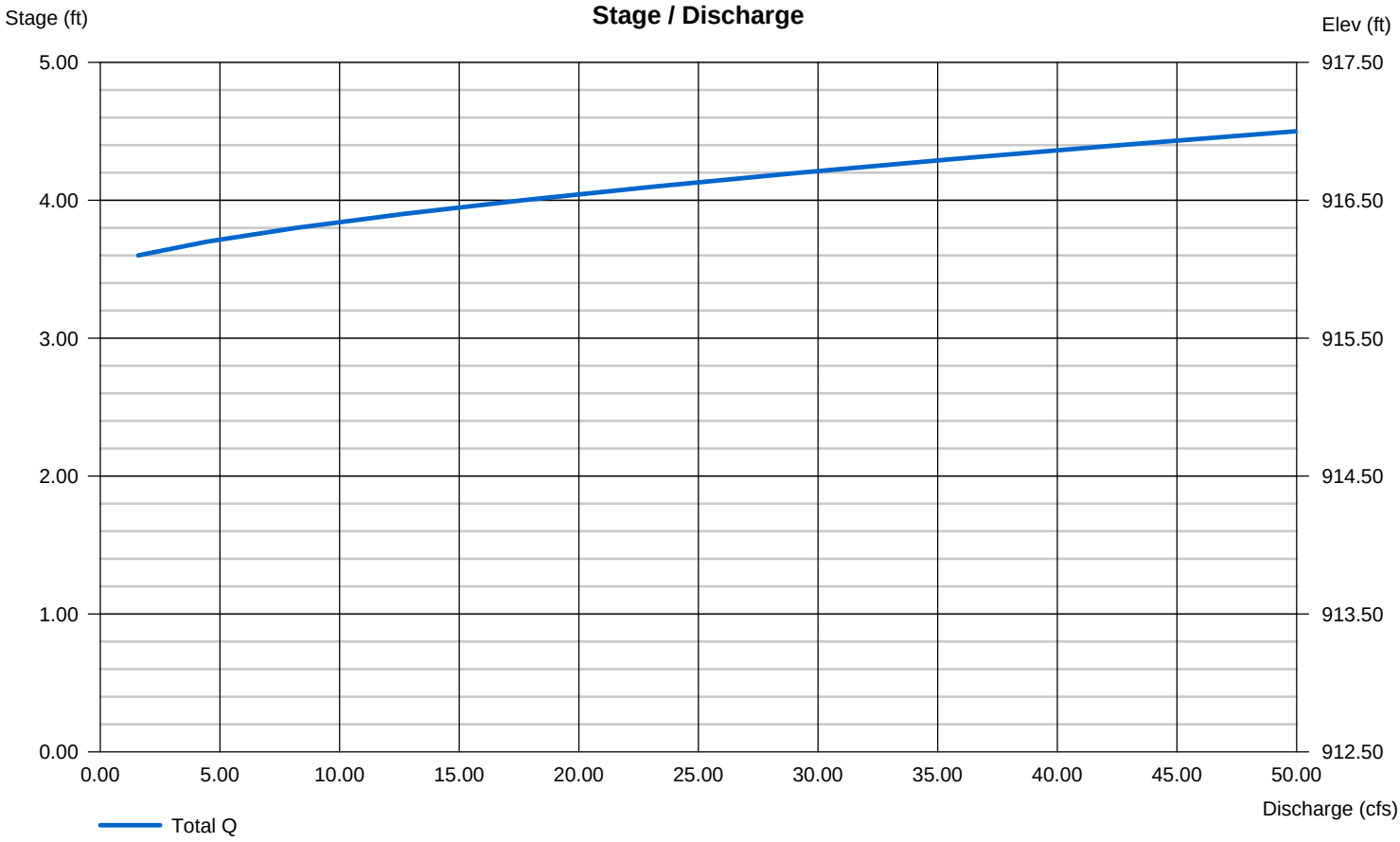
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 15.00	0.00	0.00	0.00
Crest El. (ft)	= 916.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



Appendix B
Figures

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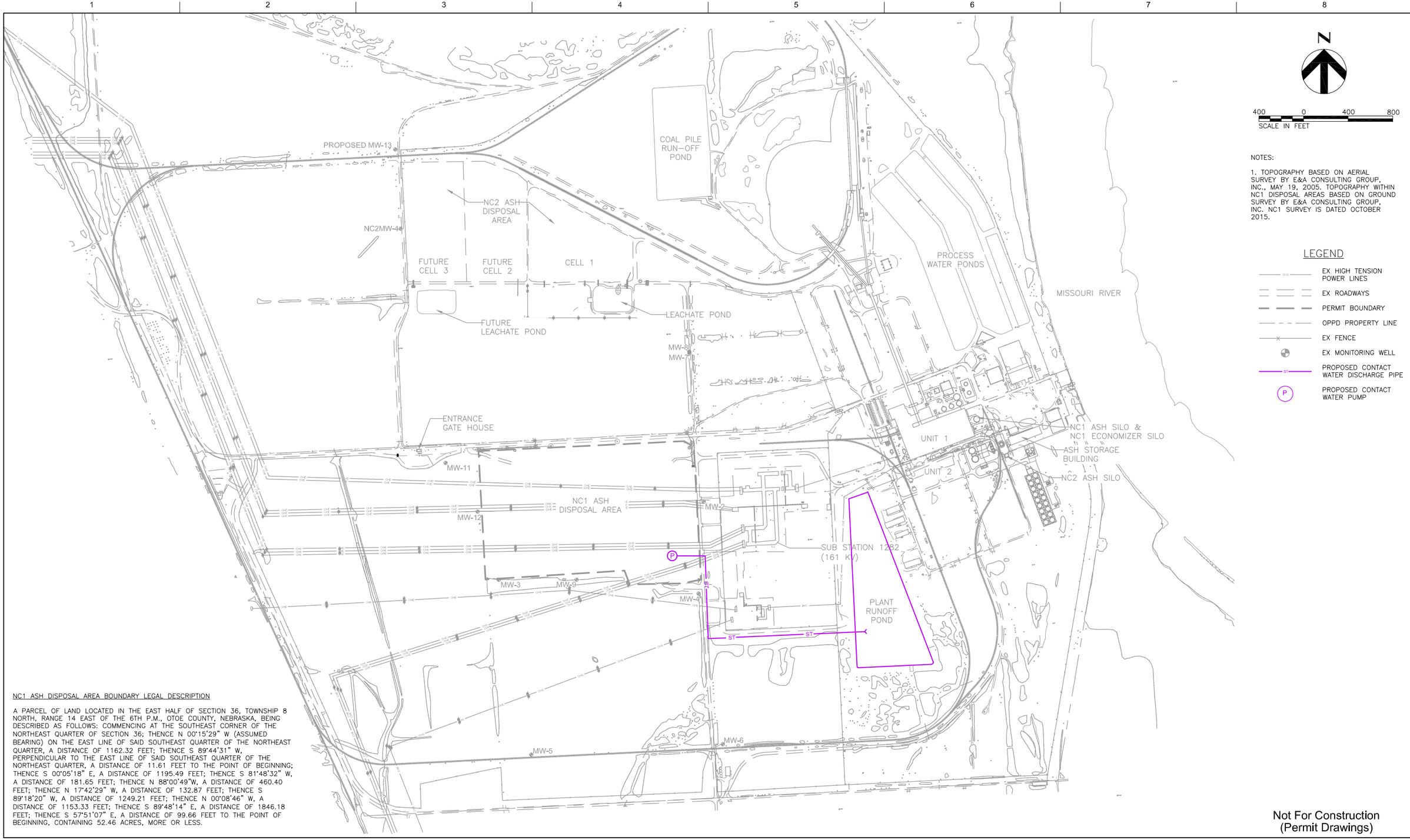

NOTES:

1. TOPOGRAPHY BASED ON AERIAL SURVEY BY E&A CONSULTING GROUP, INC., MAY 19, 2005. TOPOGRAPHY WITHIN NC1 DISPOSAL AREAS BASED ON GROUND SURVEY BY E&A CONSULTING GROUP, INC. NC1 SURVEY IS DATED OCTOBER 2015.

LEGEND

- EX HIGH TENSION POWER LINES
- EX ROADWAYS
- PERMIT BOUNDARY
- OPPD PROPERTY LINE
- EX FENCE
- EX MONITORING WELL
- PROPOSED CONTACT WATER DISCHARGE PIPE
- PROPOSED CONTACT WATER PUMP

NC1 ASH DISPOSAL AREA BOUNDARY LEGAL DESCRIPTION

A PARCEL OF LAND LOCATED IN THE EAST HALF OF SECTION 36, TOWNSHIP 8 NORTH, RANGE 14 EAST OF THE 6TH P.M., OTOE COUNTY, NEBRASKA, BEING DESCRIBED AS FOLLOWS: COMMENCING AT THE SOUTHEAST CORNER OF THE NORTHEAST QUARTER OF SECTION 36; THENCE N 00°15'29" W (ASSUMED BEARING) ON THE EAST LINE OF SAID SOUTHEAST QUARTER OF THE NORTHEAST QUARTER, A DISTANCE OF 1162.32 FEET; THENCE S 89°44'31" W, PERPENDICULAR TO THE EAST LINE OF SAID SOUTHEAST QUARTER OF THE NORTHEAST QUARTER, A DISTANCE OF 11.61 FEET TO THE POINT OF BEGINNING; THENCE S 00°05'18" E, A DISTANCE OF 1195.49 FEET; THENCE S 81°48'32" W, A DISTANCE OF 181.65 FEET; THENCE N 88°00'49"W, A DISTANCE OF 460.40 FEET; THENCE N 17°42'29" W, A DISTANCE OF 132.87 FEET; THENCE S 89°18'20" W, A DISTANCE OF 1249.21 FEET; THENCE N 00°08'46" W, A DISTANCE OF 1153.33 FEET; THENCE S 89°48'14" E, A DISTANCE OF 1846.18 FEET; THENCE S 57°51'07" E, A DISTANCE OF 99.66 FEET TO THE POINT OF BEGINNING, CONTAINING 52.46 ACRES, MORE OR LESS.

Not For Construction
(Permit Drawings)

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER L. CALUB, P.E.

PROJECT NUMBER 000000000257427

Omaha Public Power District

Nebraska City Station
NC1 Ash Disposal Area - Permit Drawings

RUN OFF RUN ON CONTROLS - AREA PLAN

0 1" 2"

FILENAME RO_CONT-AREA.DWG

SCALE 1" = 400'

SHEET **RC-AP**

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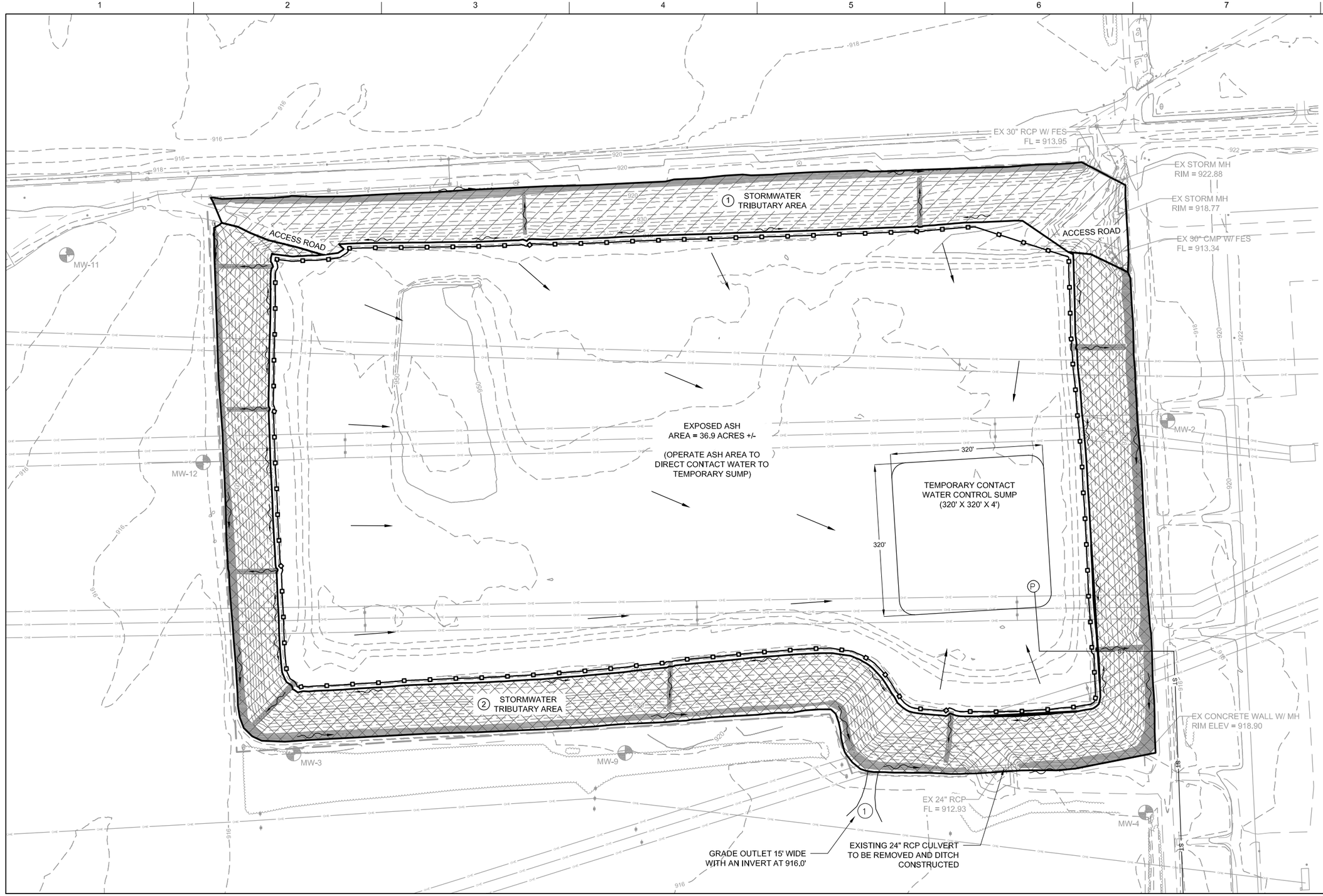

NOTES:

1. TOPOGRAPHY BASED ON AERIAL SURVEY BY E&A CONSULTING GROUP, INC., MAY 19, 2005. TOPOGRAPHY WITHIN NC1 DISPOSAL AREAS BASED ON GROUND SURVEY BY E&A CONSULTING GROUP, INC. NC1 SURVEY IS DATED OCTOBER 2015.

Not For Construction
(Permit Drawings)

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ISSUE	DATE	DESCRIPTION

PROJECT MANAGER L. CALUB, P.E.

PROJECT NUMBER 000000000257427

OPPD Omaha Public Power District

Nebraska City Station
NC1 Ash Disposal Area - Permit Drawings

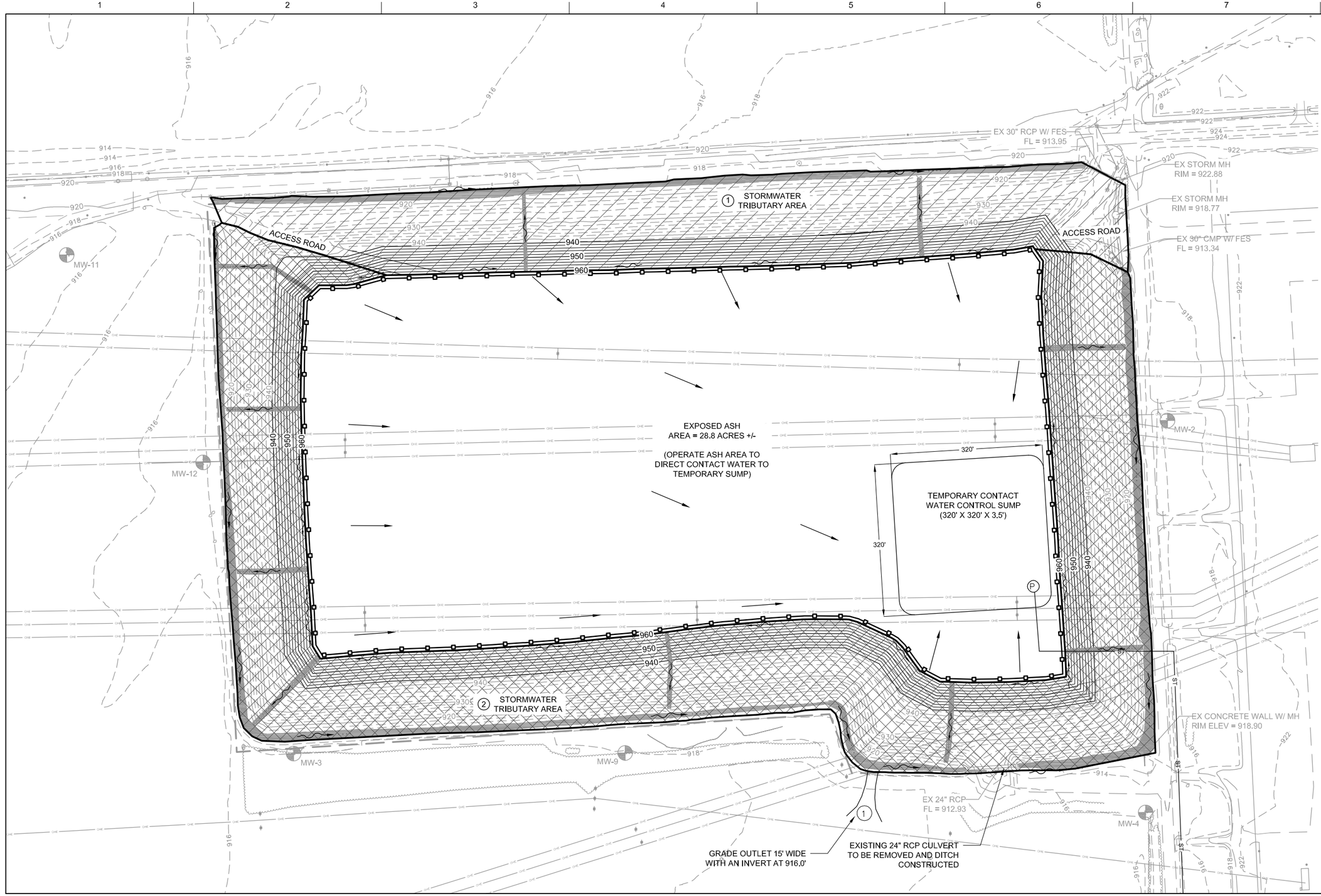
RUN OFF RUN ON CONTROLS - PHASE 1

0 1" 2"

FILENAME RO_CONT-PH_01.DWG

SCALE 1" = 100'

SHEET PH-01



NOTES:

1. TOPOGRAPHY BASED ON AERIAL SURVEY BY E&A CONSULTING GROUP, INC., MAY 19, 2005. TOPOGRAPHY WITHIN NC1 DISPOSAL AREAS BASED ON GROUND SURVEY BY E&A CONSULTING GROUP, INC. NC1 SURVEY IS DATED OCTOBER 2015.

2. PROPOSED CONTOURS ARE TO TOP OF ASH.

Not For Construction
(Permit Drawings)

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	L. CALUB, P.E.
PROJECT NUMBER	000000000257427

OPPD
Omaha Public Power District

Nebraska City Station
NC1 Ash Disposal Area - Permit Drawings

RUN OFF RUN ON CONTROLS - PHASE 2

0 1" 2"

FILENAME	RO_CONT-PH_02.DWG
SCALE	1" = 100'

SHEET
PH-02

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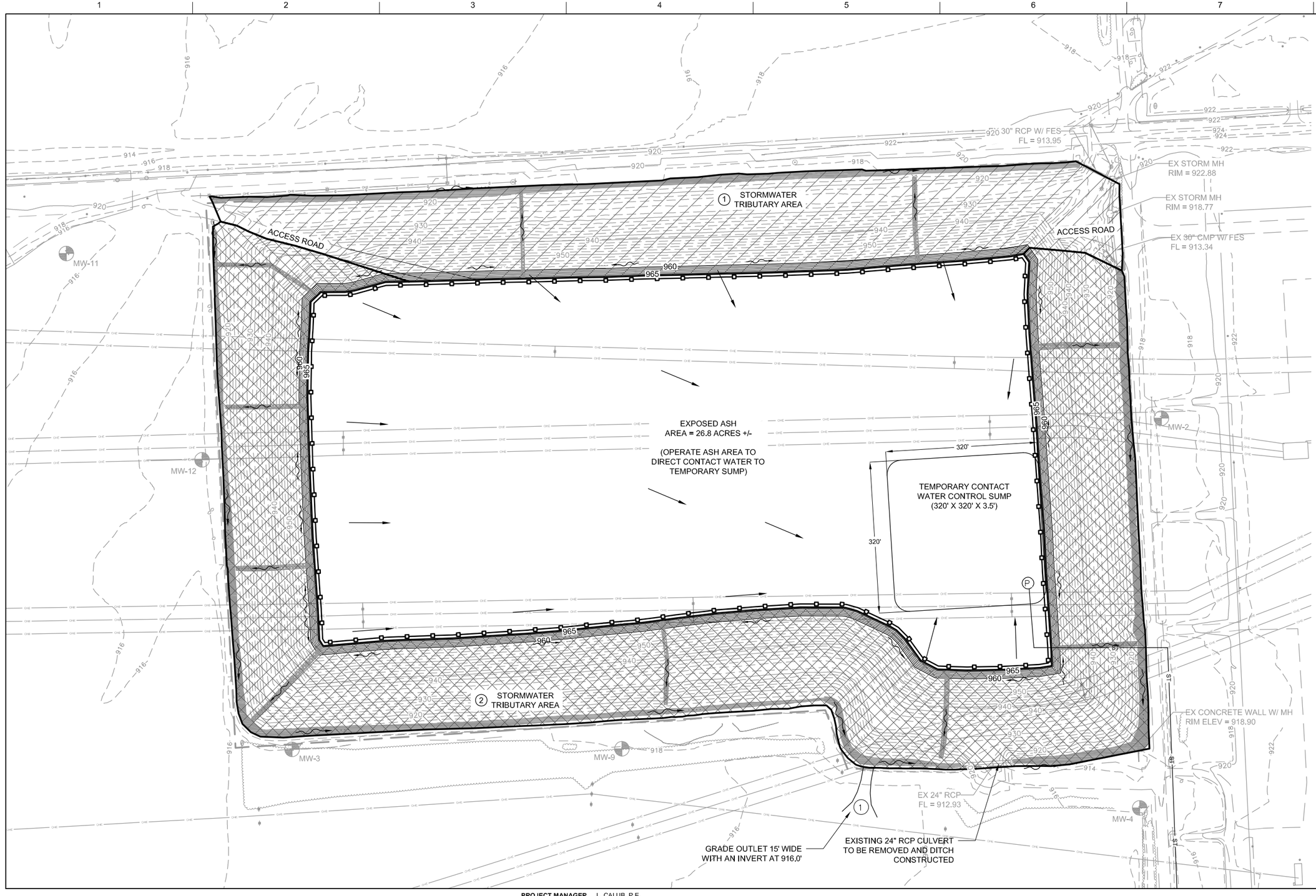

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ISSUE	DATE	DESCRIPTION

PROJECT MANAGER L. CALUB, P.E.

PROJECT NUMBER 000000000257427

Omaha Public Power District

Nebraska City Station
NC1 Ash Disposal Area - Permit Drawings

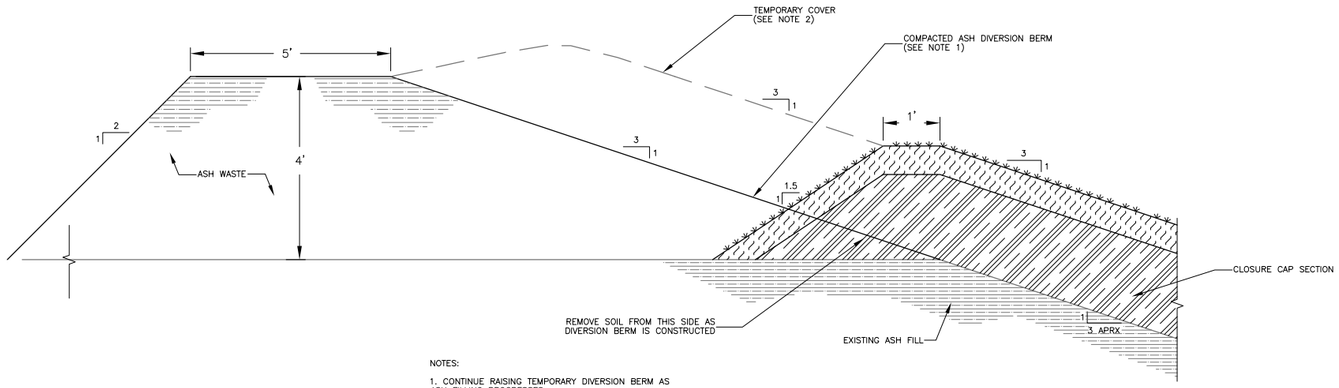
RUN OFF RUN ON CONTROLS - PHASE 3

0 1" 2"

FILENAME RO_CONT-PH_03.DWG

SCALE 1" = 100'

SHEET **PH-03**



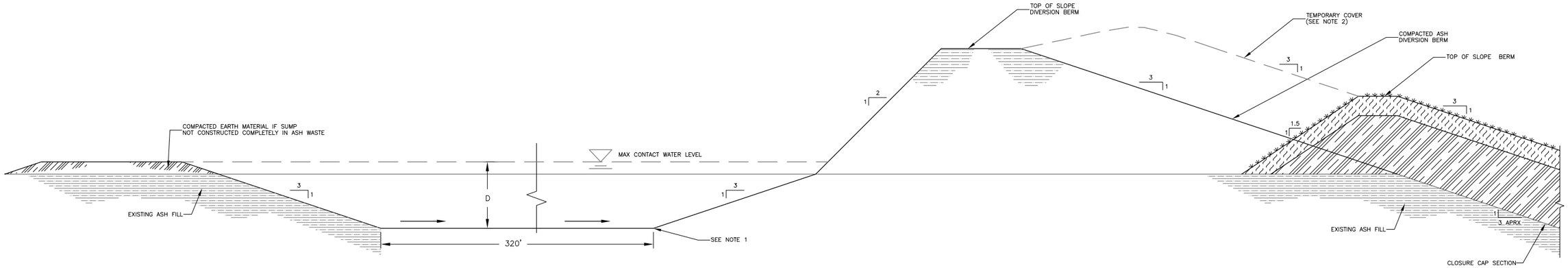
NOTES:

1. CONTINUE RAISING TEMPORARY DIVERSION BERM AS ASH FILLING PROGRESSES

2. COVER OUTSIDE OF SLOPE WITH TEMPORARY COVER (EARTHEN MATERIAL OR GEOMEMBRANES). IF GEOMEMBRANES UTILIZED, DRAINAGE DIRECTED TO EXISTING LETDOWN STRUCTURES.

TOP OF SLOPE DIVERSION BERM

NO SCALE



NOTES:

1. AS NEEDED, CREATE LOW POINT/PIT IN SUMP NEAR CONTACT WATER PUMP LOCATION TO FACILITATE PUMPING.

2. COVER OUTSIDE OF SLOPE WITH TEMPORARY COVER (EARTHEN MATERIAL OR GEOMEMBRANES). IF GEOMEMBRANES UTILIZED, DRAINAGE DIRECTED TO EXISTING LETDOWN STRUCTURES.

3. PHASE 1: D = 4.0 FEET
PHASE 2: D = 3.5 FEET
PHASE 3: D = 3.5 FEET

TEMPORARY CONTACT WATER SUMP

NO SCALE

Not For Construction
(Permit Drawings)

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	L. CALUB, P.E.
PROJECT NUMBER	000000000257427

Omaha Public Power District

Nebraska City Station
NC1 Ash Disposal Area - Permit Drawings

RUN OFF RUN ON CONTROLS - DETAILS

0 1" 2"

FILENAME RO_CONT-DETAILS.DWG

SCALE

SHEET **RC-DET**

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