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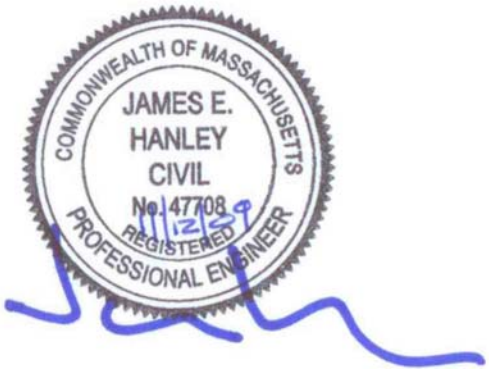
DRAINAGE REPORT

CRYSTAL SPRINGS GOLF COURSE

940 North Broadway (Tax Lot 575-2-8)
Haverhill, Massachusetts 01832



OWNER / APPLICANT:
Michael J. Maroney, Trustee
Premiere Realty Trust
423 East Broadway
Haverhill, MA

SUBMITTED TO:
City of Haverhill
4 Summer Street
Haverhill, MA 01527

ISSUED:
June 10, 2009
Revision #1: October 14, 2009
Revision #2: November 12, 2009

CDCI FILE #: 08-0703

DRAINAGE REPORT

TAB 1

DRAINAGE REPORT

Residential Cluster Subdivision and Club House Improvements
Crystal Springs Golf Course – Haverhill, MA

REVISION #2

Revision #2 has been prepared to address a second review letter prepared by Horsley Witten, the Conservation Commission's consulting engineer, dated October 26, 2009 as well as comments received in the Conservation Commission Meeting Notes from October 29, 2009. A copy of each response letter is provided in Tab 6 of this report.

REVISION #1

Revision #1 has been prepared to address a review letter prepared by Horsley Witten, the Conservation Commission's consulting engineer, dated September 9th, 2009. A copy of the response letter, as well as all additional information submitted with the response letter, is provided in Tab 6 of this report.

PROJECT DESCRIPTION

The applicant proposes to develop portions of the existing Crystal Springs Golf Course located at 940 North Broadway in Haverhill, Massachusetts into 50-single family residential homes. The project consists of the construction of a 2,400-FT +/- roadway (Front Nine Drive) supporting 34-single family residential lots, a separate 590-FT +/- roadway (Back Nine Drive) supporting 16-single family residential lots, a 10,000-SF +/- clubhouse, a 2,000-SF +/- maintenance building as well as associated infrastructure including parking areas, driveways, sidewalks, landscaping, drainage facilities and utilities. The proposed development has been designed beyond the limits of play to allow for a minimal disruption to the existing golf course. The majority of the development will be located beyond the limits of the 100-FT wetland buffer. Drainage will be collected at various points throughout the site, and after treatment, will outlet to one of several on-site wetland areas.

SITE DESCRIPTION

The project site fronts along Lake Street and North Broadway and supports an existing 18-hole golf course, club house and maintenance facility on 136-Acres +/-. Crystal Lake, a public drinking water supply, borders the site to the west. Existing residential uses border the site to the north, Lake Street borders the site to the south and North Broadway borders the site to the east. A ridge line runs north to south, along the 8th hole and continues toward Lake Street. The site drains from the north at elevation 212 +/- to the south at elevation 160 +/-, with slopes ranging from approximately 1% to 15%. Cover types include impervious surface (pavement and roof areas), grass and dense woods. There are also a series of wetlands scattered throughout the site.

According to the Natural Resource Conservation Service Soil Survey for Essex County, Massachusetts – Northern Part, the majority of the site consists of Ridgebury, Montauk and Woodbridge soils. These soils range from fine sandy loam to extremely stony material, with a relatively high water tables (2-FT to 4-FT) and belong to the hydrologic soils group (HSG) "C". HSG "C" soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine texture. These soils have a low rate of water transmission (0.05-0.15 in/hr). A small pocket of approximately 5.5-Acres of Whitman soil exists in a wooded wetland area located to the west of the 1st fairway. Whitman soils belong to the HSG "D". These soils have a high runoff potential with very low infiltration rates when thoroughly wetted and consist chiefly of clay with a high swelling potential and a permanently high water table. These soils typically have a claypan or clay layer at or near the surface and shallow soils over nearly impervious material. These soils have a very low rate of water transmission (0-0.05 in/hr). Test pits were conducted in May and June of 2009 to determine soil texture and estimated seasonal high groundwater elevations. Test pit logs are provided in the Supplemental Information portion of this report and are generally consistent with the NRCS mapping.

The Flood Insurance Rate Map for the City of Haverhill (Community Panel 250085-0002B, February 16, 1983) describes the project site as located in a Zone X. A Zone X is classified as an area outside of the 500-year floodplain. None of the developed portion of the site is located within the 100-year flood zone.

SURFACE DRAINAGE

Crystal Lake, a public drinking water supply, borders the site to the west. All improvements are designed beyond the limits of the contributing watershed to Crystal Lake, therefore, no impact to the quantity or quality of the discharge from the property to the lake are anticipated. It should also be noted that all of the proposed on-site improvements are located beyond the limits of the Zone A, a 400-FT lateral distance from the upper limits of the bank of a Class A surface water source.

Drainage from the developed portion of the site discharges to 1 of 3 Design Points located along the perimeter of the property. The following Design Point summary is provided:

Design Point #1 (DP-1)
DP-1 is an existing culvert located along North Broadway across from Parsonage Hill Road. This existing culvert drains approximately 12-Acres along the North Broadway frontage and discharges to the closed drainage system on Parsonage Hill Road.

Design Point #2 (DP-2)
DP-2 is an existing 12" RCP located across from 609 Lake Street, adjacent to the existing irrigation pond. This culvert receives flow, after detention from the existing irrigation pond, from approximately 60-Acres of the golf course. In addition, an off-site area of approximately 8-Acres also drains to this culvert. This culvert discharges to an existing swale located to the east of Lake Street, and eventually to a large surface water body located approximately 1,200-FT downstream.

Through discussions with the City, as well as abutters, it was brought to our attention that this culvert may be undersized to accommodate the existing flow and that the roadway overtops during relatively minor rainfall events. An analysis of this culvert was performed and the findings are provided in the *Lake Street Culvert Improvements* portion of this narrative.

Design Point #3 (DP-3)
DP-3 is an existing swale located further south of DP-2 west of Lake Street. This swale drains approximately 40-acres of the golf course and discharges to the existing wetland down gradient of Crystal Lake, and eventually combines with discharge from the DP-2.

Pre-Development Conditions
The Pre-Development Conditions drainage analysis is comprised of five (5) separate watershed areas as illustrated on Sheet 1 of 3 entitled Existing Watershed Plan provided in the Supplemental Information Portion of this report..

Existing Watershed Area #1 (EWA-1) drains to DP-1 and is approximately 12.0-Acres in area, has a weighted curve number of 76 and a time of concentration of 20.8-Minutes. Three separate watershed areas drain to DP-2. EWA-2A is located entirely on-site and is approximately 59.9-Acres in area, has a weighted curve number of 76 and a time of concentration of 19.1-Minutes. EWA-2B is located to the east of Lake Street and is approximately 6.8-Acres in area, has a weighted curve number of 78 and a time of concentration of 22.7-Minutes. EWA-2B drains through an existing 12" RCP located on Lake

Street approximately 1,050-FT west of North Broadway. The flow generated by this watershed eventually drains to the existing irrigation pond. EWA-2C is a portion of Lake Street and an adjacent wetland / roadway swale and is approximately 1.3-Acres in area, has a weighted curve number of 80 and a time of concentration of 12.6-Minutes. EWA-2C combines with the flow EWA-2A and EWA-2B, after detention from the existing irrigation pond, and discharges to DP-2. EWA-3 drains to DP-3 and is located entirely on-site. EWA-3 is approximately 40.6-Acres in area, has a weighted curve number of 75 and a time of concentration of 26.1-Minutes.

Post-Development Conditions

The proposed improvements include the construction of approximately 3,000-FT of roadway, 50-single family residential lots, a 10,000-SF +/- clubhouse, a 2,000-SF +/- maintenance building as well as associated infrastructure including parking areas, driveways, sidewalks, landscaping, drainage facilities and utilities. Approximately 19-Acres of area are anticipated to be disturbed during construction. Of which, approximately 6.1-Acres of area will change from pervious (woods/grass) to impervious. Impervious area will include roadways, parking lots, sidewalks, roof tops and patios. To determine the impact of the proposed improvements, it has been assumed that each of the 50, 7,500-SF +/- lots will contribute 3,000-SF of impervious area. We believe that this estimate is conservative based upon the proposed anticipated building footprint area and relatively small lot sizes.

The Post-Development Conditions drainage analysis is comprised of nine (9) separate watershed areas as illustrated on Sheet 2 entitled Proposed Watershed Plan provided in the Supplemental Information Portion of this report. PWA-1 corresponds with EWA-1 and has been modified to account for the proposed improvements along the entrances to both Front Nine Drive and Back Nine Drive. PWA-1 is approximately 11.9-Acres in area, has a weighted curve number of 76 and a time of concentration of 20.8-Minutes.

EWA-2A is subdivided into three (3) separate watershed areas to isolate the impact of a portion of Front Nine Drive, the club house and associated parking area and a portion of Back Nine Drive. PWA-2A corresponds with EWA-2A and is located entirely on-site. PWA-2A is approximately 53.0-Acres in area, has a weighted curve number of 75 and a time of concentration of 19.1-Minutes. PWA-2D is the watershed that drains to Proposed Wet Swale #1 and is comprised of a portion of Front Nine Drive as well as the club house and associated parking area. PWA-2D is approximately 2.8-Acres in area, has a weighted curve number of 87 and a time of concentration of 12.1-Minutes. PWA-2E is the watershed that drains to Infiltration Pond #1 and is comprised of a portion of Back Nine Drive. PWA-2E is approximately 2.5-Acres in area, has a weighted curve number of 86 and a time of concentration of 6.0-Minutes. PWA-2B and PWA-2C correspond with the existing conditions.

EWA-3 is subdivided into three (3) separate watershed areas to isolate the impact of a portion of Front Nine Drive and the proposed parking lot area west of the proposed clubhouse. PWA-3C corresponds with EWA-3 and is located entirely on-site. PWA-3C is approximately 23-Acres in area, has a weighted curve number of 76 and a time of concentration of 16.5-Minutes. PWA-3A is the watershed that drains to Proposed Wet Pond #1 and is comprised of a portion of Front Nine Drive. PWA-3A is approximately 6.6-Acres in area, has a weighted curve number of 79 and a time of concentration of 21.7-Minutes. PWA-3B is the watershed that drains a portion of Front Nine Drive and the proposed parking area located to the west of the proposed club house. PWA-3B is approximately 13-Acres in area, has a weighted curve number of 80 and a time of concentration of 22.2-Minutes. Reaches have been included in the post-development model to account for the time for both PWA-3A and PWA-3B to travel through the site and contribute to Design Point 3, consistent with the pre-development analysis.

Peak Discharge Comparison

As illustrated below, the impact of the proposed improvements has been mitigated through the use of best management practices including wet ponds, wet swales and infiltration basins at each of the design points for up to and including the 100-year, 24-hour storm event.

Table 1.1: Peak Discharge Comparison – Design Point #1					
	2-YR	10-YR	25-YR	50-YR	100-YR
	(3.1-IN)	(4.5-IN)	(5.4-IN)	(5.9-IN)	(6.5-IN)
Pre-Development	10.0-CFS	20.4-CFS	27.6-CFS	31.7-CFS	36.7-CFS
Post-Development	9.9-CFS	20.2-CFS	27.3-CFS	31.4-CFS	36.4-CFS
Difference:	-0.1 CFS	-0.2-CFS	-0.3-CFS	-0.3-CFS	-0.3-CFS
% Difference	-1.0%	-1.0%	-1.1%	-0.9%	-0.8%

Table 1.2: Peak Discharge Comparison – Design Point #2					
	2-YR	10-YR	25-YR	50-YR	100-YR
	(3.1-IN)	(4.5-IN)	(5.4-IN)	(5.9-IN)	(6.5-IN)
Pre-Development	13.3-CFS	23.4-CFS	99.5-CFS	138.1-CFS	180.3-CFS
Post-Development	12.5-CFS	21.1-CFS	83.6-CFS	122.4-CFS	166.6-CFS
Difference:	-0.8-CFS	-2.3-CFS	-15.9-CFS	-15.7-CFS	-13.7-CFS
% Difference	-6.0 %	-9.8 %	-16.0 %	-11.4 %	-7.6 %

Table 1.3: Peak Discharge Comparison – Design Point #3					
	2-YR	10-YR	25-YR	50-YR	100-YR
	(3.1-IN)	(4.5-IN)	(5.4-IN)	(5.9-IN)	(6.5-IN)
Pre-Development	29.0-CFS	60.5-CFS	82.6-CFS	95.2-CFS	110.7-CFS
Post-Development	23.5-CFS	55.4-CFS	77.7-CFS	90.0-CFS	104.9-CFS
Difference:	-5.5-CFS	-5.1-CFS	-4.9-CFS	-5.2-CFS	-5.8-CFS
% Difference	-19.0 %	-8.4 %	-5.9 %	- 5.5 %	- 5.2 %

LAKE STREET CULVERT IMPROVEMENTS

As previously stated, it was brought to our attention that the existing culvert located along Lake Street (See Design Point 2) that drains the existing irrigation ponds on the golf course may be undersized, and that the roadway may overtop under relatively minor rainfall events. An existing conditions survey of the area determined that the culvert is a 12" reinforced concrete pipe, approximately 35-FT in length with a slope of approximately 2%. The upstream invert is at elevation 156 and the centerline of the roadway directly up gradient of the culvert is at elevation 159.8. In addition, there is approximately 1,260-CF of storage along the roadway shoulder, down gradient of the irrigation ponds. As indicated on the Existing Watershed Plan, this culvert receives flow from approximately 68-Acres of area.

Our pre-development analysis indicates that the culvert surcharges, and the roadway overtops, prior to the 2-year, 24-hour storm event by approximately. The 2-year storm produces a stage of along the roadway of 159.9. The site design was performed to re-direct a small portion of area adjacent to the proposed clubhouse toward Design Point #3. This effort results in a reduction of approximately 3.2-Acres or 5% of watershed area contributing to the undersized culvert. In addition, a combined 41,600-CF of storage are provided within Wet Swale-1 (adjacent to the proposed club house parking area) and Infiltration Pond-1 (south of Back Nine Drive) to further reduce the anticipated peak discharge at the existing culvert. With these improvements, the culvert still surcharges prior to the 2-year, 24-hour storm event.

The applicant proposes to remove the existing 12" RCP and replace it with a 24" HDPE pipe. This improvement will allow for the 2-year (3.1-IN) 24-hour storm events to pass before the roadway is barely overtopped during the 10-year storm event. This improvement to the drainage system will not result in an increase in peak discharge downstream of the culvert for up to and including the 100-year, 24-hour storm event as summarized in Table 1.2.

METHODOLOGY

Drainage calculations were performed using the computer program Hydroflow Hydrographs Extension for AutoCAD Civil 3D 2009 by Autodesk, Inc. based upon Technical Release 20 (TR-20), developed by the NRCD, formerly the Soils Conservation Service. Drainage calculations were prepared for the 2-YR, 10-YR, 25-YR, 50-YR and 100-YR Type III 24-hour storm events. Rainfall data corresponds with the 24-hour, Type III storm events developed by the National Weather Service and published in Technical Paper 40. Curve numbers were generated using the information provided in Technical Release 55 (TR-55) and the SCS Soils Survey. Pipe design is based upon peak discharge developed by the Rational Method and pipe capacities determined by Manning's Formula.

This office is in the process of preparing a narrative to address the projects compliance with the City of Haverhill Regulations and the Massachusetts Department of Environmental Protection Stormwater Management Policy. This narrative, as well as the DEP's Stormwater Management Checklist and all additional supporting documentation, will be included with the Notice of Intent to be filed with the Haverhill Conservation Commission.

TAB 2

REF: MASSGIS USGS COLOR ORTHO IMAGERY (2008) – APRIL 2008

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Plaistow, NH 03865-2856 Fax: (603) 382-1818

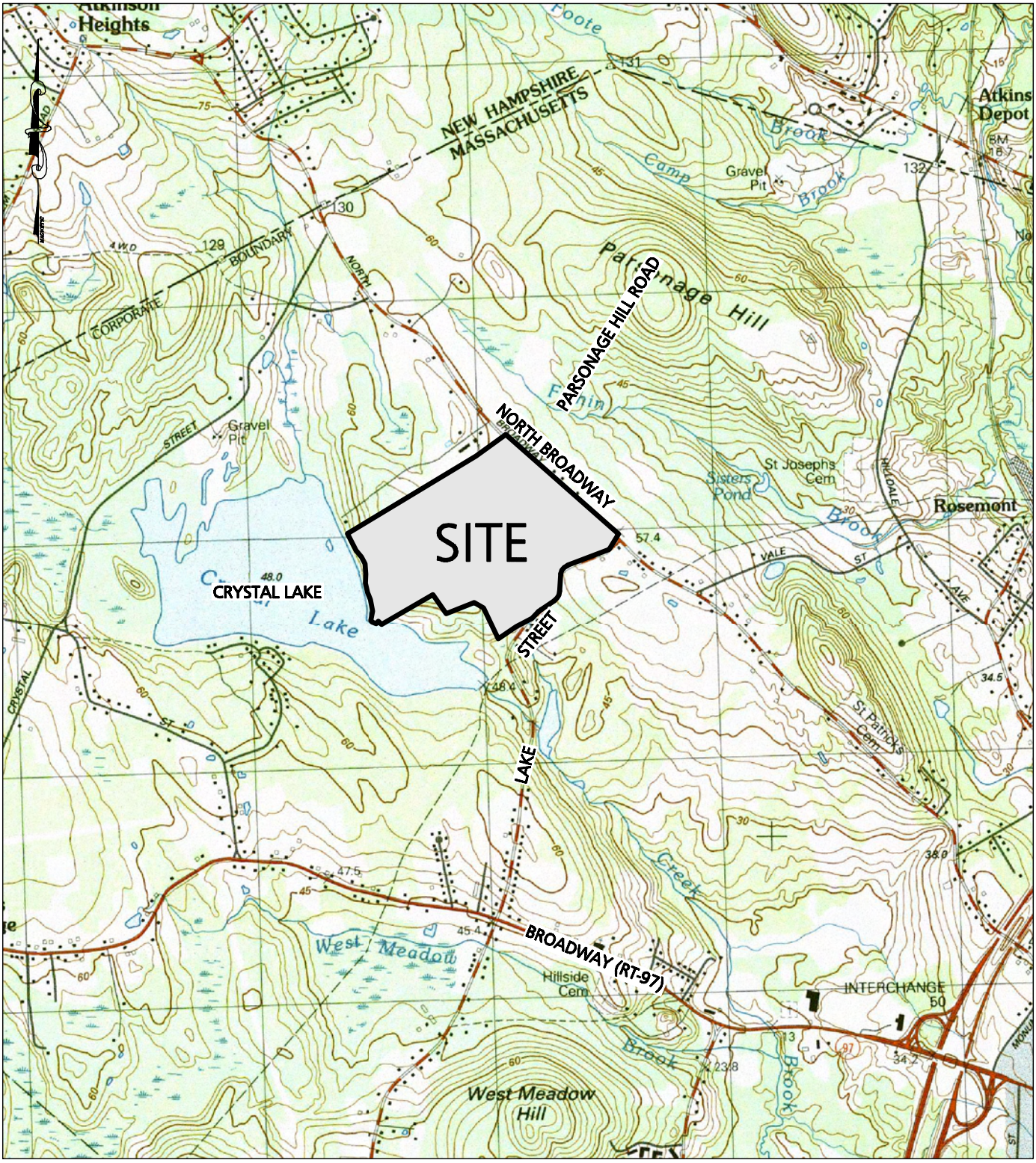
PROJECT:
CRYSTAL SPRINGS GOLF COURSE
(LOT 572-2-8)
940 NORTH BROADWAY
HAVERHILL, MA 01867

APPLICANT:
MARONEY CONSTRUCTION
423 EAST BROADWAY
HAVERHILL, MA 01830

DRAWN BY: JAMES E. HANLEY, PE
CHECKED BY: JAMES E. HANLEY, PE

FIGURE 1:
ORTHOPHOTO

DATE: APRIL 30, 2009
SCALE: 1"=2,000'
CDCI FILE #: 08-0703



REF: MASSGIS USGS TOPOGRAPHIC QUADRANGLE IMAGES

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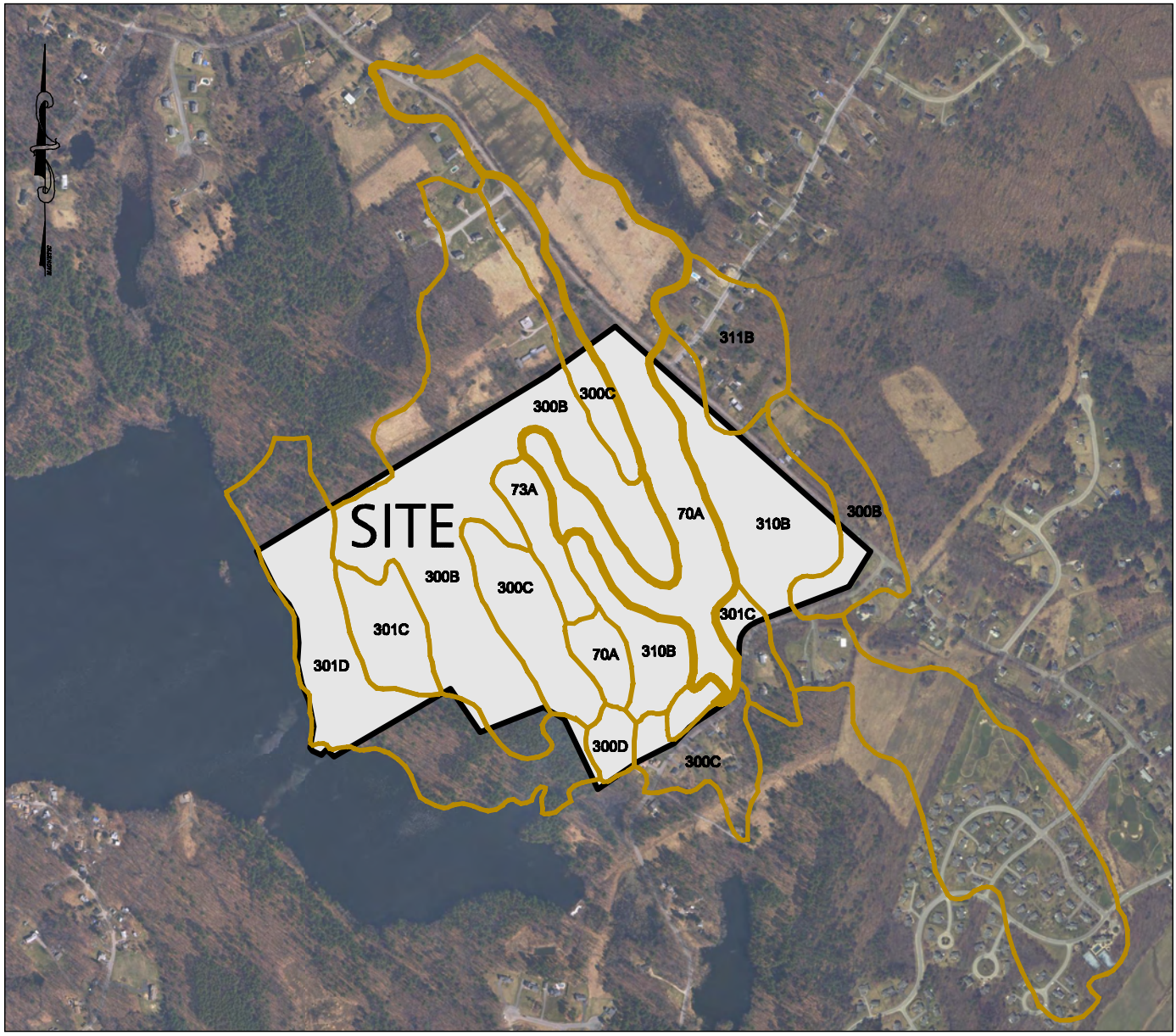
CHECKED BY: JAMES E. HANLEY, PE

FIGURE 2:

USGS MAP

DATE: APRIL 30, 2009
SCALE: 1"=2,000'
CDCI FILE #: 08-0703



REF: MASSGIS NATURAL RESOURCE CONSERVATION SERVICE SOILS INFORMATION – MAY 18, 2007

SOIL SUMMARY:

SOIL	DESCRIPTION	HSG
70A	RIDGEBURY FINE SANDY LOAM, 0 TO 3 PERCENT SLOPES	C
73A	WHITMAN LOAM, 0 TO 3 PERCENT SLOPES, EXTREMELY STONY	C
300B	MONTAUK FINE SANDY LOAM, 3 TO 8 PERCENT SLOPES	C
300C	MONTAUK FINE SANDY LOAM, 8 TO 15 PERCENT SLOPES	C
300D	MONTAUK FINE SANDY LOAM, 15 TO 25 PERCENT SLOPES	C
301C	MONTAUK FINE SANDY LOAM, 8 TO 15 PERCENT SLOPES, VERY STONY	C
301D	MONTAUK FINE SANDY LOAM, 15 TO 25 PERCENT SLOPES, VERY STONY	C
311B	WOODBRIDGE FINE SANDY LOAM, 0 TO 8 PERCENT SLOPES, VERY STONY	C
310B	WOODBRIDGE FINE SANDY LOAM, 3 TO 8 PERCENT SLOPES	C

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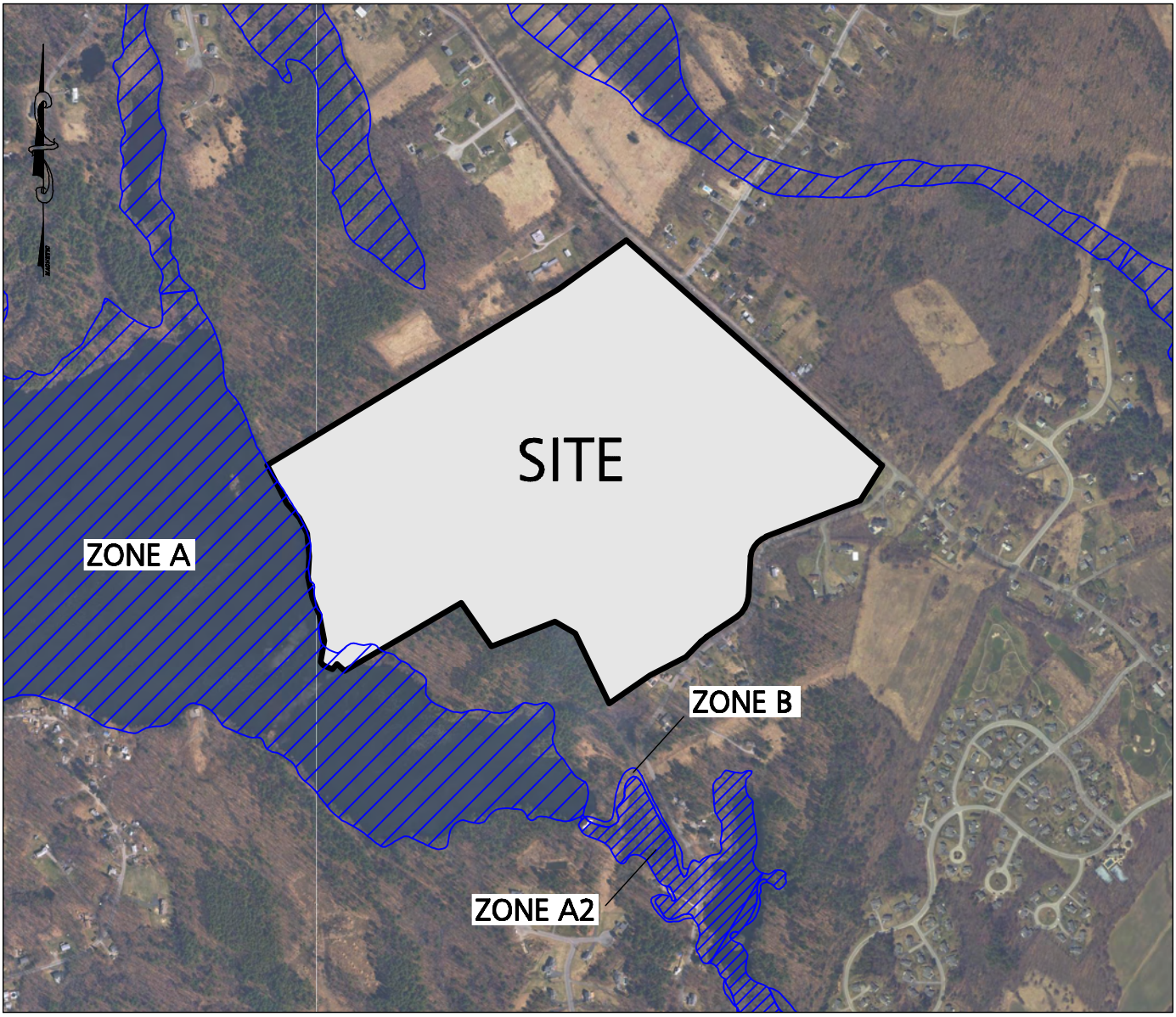
FIGURE 3:
SOILS MAP

DATE: APRIL 30, 2009
SCALE: 1"=1,000'
CDCI FILE #: 08-0703



REF: MASSGIS FLOOD INSURANCE RATE MAP (FIRM) Q3 FLOOD DATA
COMMUNITY PANEL NUMBER 250085 0002 B (REVISED FEBRUARY 16, 1983).

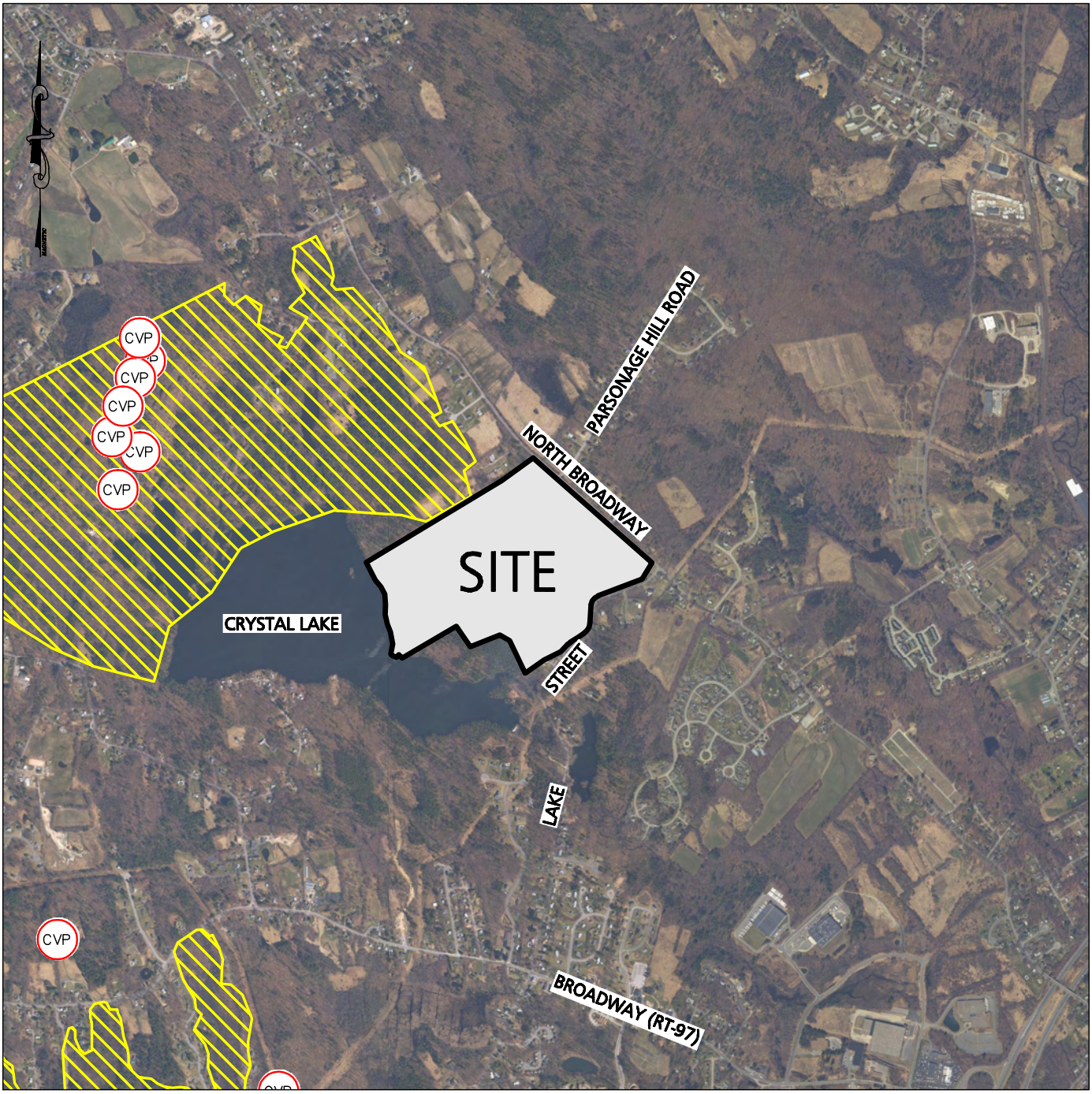
NOTES:

ZONE A: AREA OF 100–YEAR FLOOD; BASE FLOOD ELEVATIONS AND FLOOD HAZARD FACTORS NOT DETERMINED.

ZONE A2: AREA OF 100–YEAR FLOOD; BASE FLOOD ELEVATIONS AND FLOOD HAZARD FACTORS DETERMINED.

ZONE B: AREAS BETWEEN LIMITS OF THE 100–YEAR FLOOD AND 500–YEAR FLOOD; OR CERTAIN AREAS SUBJECT TO 100–YEAR FLOODING WITH AVERAGE DEPTHS LESS THAN ONE (1) FOOT OR WHERE THE CONTRIBUTING DRAINAGE AREA IS LESS THAN ONE SQUARE MILE; OR AREAS PROTECTED BY LEVEES FROM THE BASE FLOOD.

PREPARED BY:	PROJECT:	APPLICANT:	FIGURE 4:
CIVIL DESIGN Consultants, Inc. 37 Plaistow Road, Unit 7 - #235 Tel: (603) 275-5369 Plaistow, NH 03865-2856 Fax: (603) 382-1818	CRYSTAL SPRINGS GOLF COURSE (LOT 572-2-8) 940 NORTH BROADWAY HAVERHILL, MA 01867	MARONEY CONSTRUCTION 423 EAST BROADWAY HAVERHILL, MA 01830	FIRM
		DRAWN BY: JAMES E. HANLEY, PE	DATE: APRIL 30, 2009
		CHECKED BY: JAMES E. HANLEY, PE	SCALE: 1"=1,000'
			CDCI FILE #: 08-0703



CVP — CERTIFIED VERNOL POOL (TYP)

NHESP 2008 PRORITY HABITATE OF RARE SPECIES AND ESTIMATED HABITAT OF RARE WILD LIFE.

REF: MASSGIS PRIORITY AND ESTIMATED HABITAT – MA ENDANGERED SPECIES ACT
MASSGIS CERTIFIED VERNOL POOLS – MA ENDANGERED SPECIES ACT

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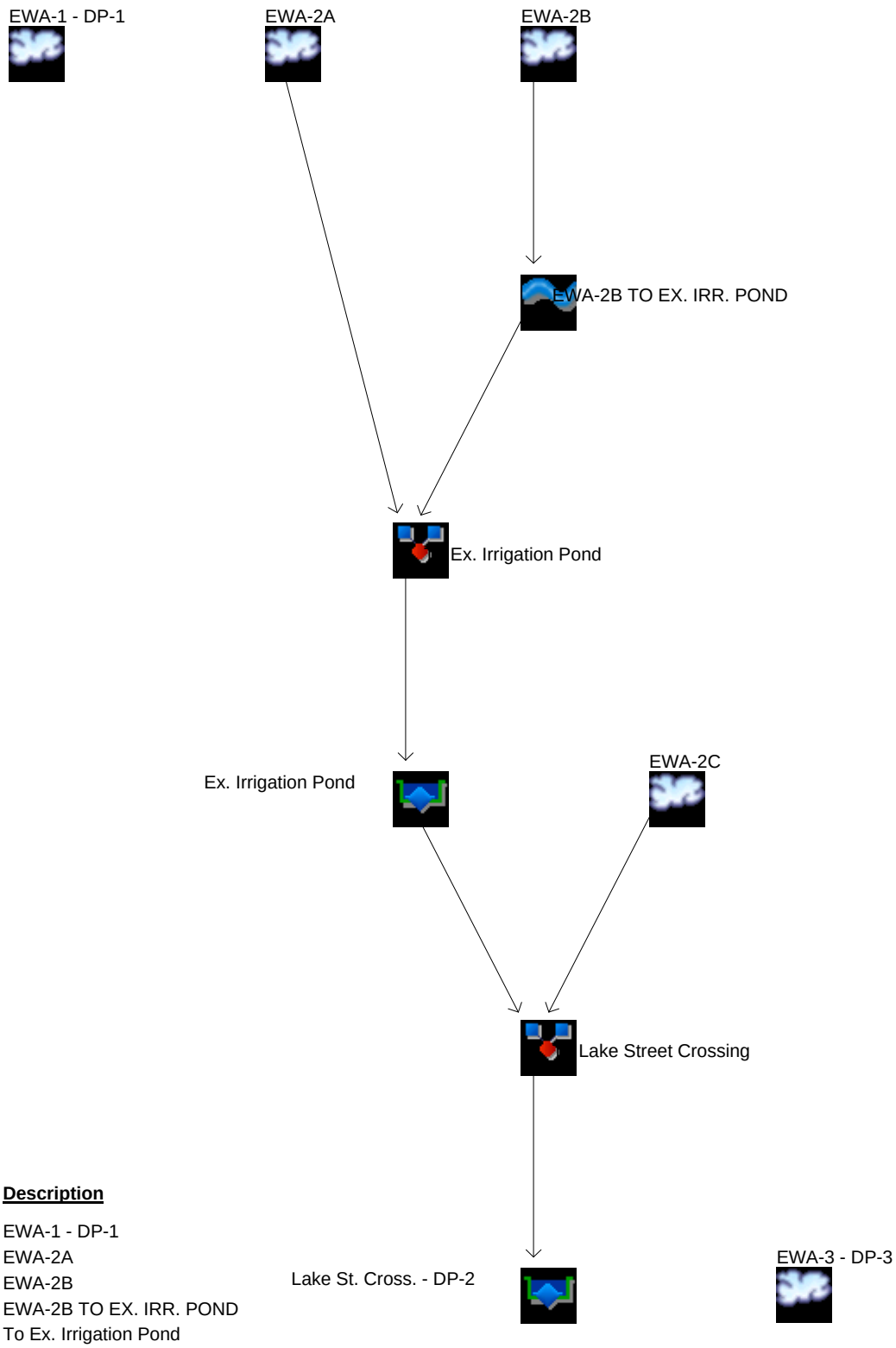
FIGURE 5:
NATURAL HERITAGE MAP

DATE: APRIL 30, 2009
SCALE: 1"=2,000'
CDCI FILE #: 08-0703

TAB 3

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066



Legend

Hyd.	Origin	Description
1	SCS Runoff	EWA-1 - DP-1
3	SCS Runoff	EWA-2A
4	SCS Runoff	EWA-2B
5	Reach	EWA-2B TO EX. IRR. POND
6	Combine	To Ex. Irrigation Pond
7	Reservoir	Ex. Irrigation Pond
8	SCS Runoff	EWA-2C
9	Combine	To Lake Street Crossing
10	Reservoir	Lake St. Cross. - DP-2
12	SCS Runoff	EWA-3 - DP-3

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	------	-------	9.974	-------	-------	20.35	27.57	31.68	36.69	EWA-1 - DP-1
3	SCS Runoff	------	-------	51.16	-------	-------	104.36	141.32	162.37	187.95	EWA-2A
4	SCS Runoff	------	-------	6.117	-------	-------	11.98	15.99	18.27	21.03	EWA-2B
5	Reach	4	-------	6.072	-------	-------	11.90	15.90	18.17	20.91	EWA-2B TO EX. IRR. POND
6	Combine	3, 5	-------	56.89	-------	-------	115.54	156.39	179.65	207.92	To Ex. Irrigation Pond
7	Reservoir	6	-------	13.03	-------	-------	22.99	98.12	136.24	177.71	Ex. Irrigation Pond
8	SCS Runoff	------	-------	1.614	-------	-------	3.042	4.005	4.546	5.200	EWA-2C
9	Combine	7, 8	-------	13.29	-------	-------	23.43	99.62	138.26	180.37	To Lake Street Crossing
10	Reservoir	9	-------	13.29	-------	-------	23.43	99.54	138.14	180.33	Lake St. Cross. - DP-2
12	SCS Runoff	------	-------	29.02	-------	-------	60.54	82.62	95.24	110.69	EWA-3 - DP-3

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

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	9.974	1	736	47,628	------	------	------	EWA-1 - DP-1
3	SCS Runoff	51.16	1	735	235,477	------	------	------	EWA-2A
4	SCS Runoff	6.117	1	737	29,370	------	------	------	EWA-2B
5	Reach	6.072	1	739	29,369	4	------	------	EWA-2B TO EX. IRR. POND
6	Combine	56.89	1	735	264,845	3, 5	------	------	To Ex. Irrigation Pond
7	Reservoir	13.03	1	773	259,942	6	164.27	102,230	Ex. Irrigation Pond
8	SCS Runoff	1.614	1	729	6,157	------	------	------	EWA-2C
9	Combine	13.29	1	772	266,099	7, 8	------	------	To Lake Street Crossing
10	Reservoir	13.29	1	772	266,095	9	159.86	1,295	Lake St. Cross. - DP-2
12	SCS Runoff	29.02	1	740	152,507	------	------	------	EWA-3 - DP-3

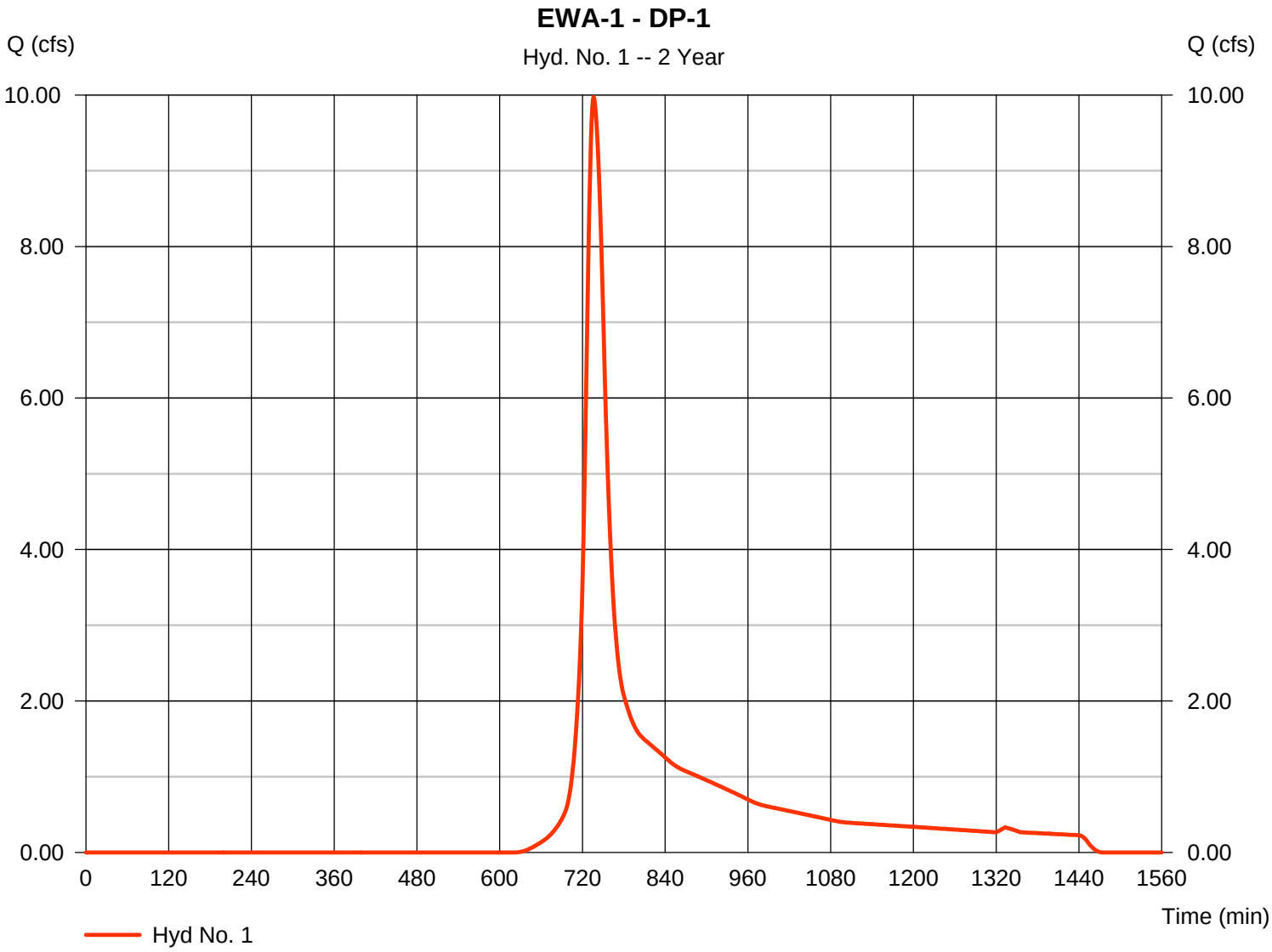
Hydrograph Report

Hyd. No. 1

EWA-1 - DP-1

Hydrograph type	=	SCS Runoff	Peak discharge	=	9.974 cfs
Storm frequency	=	2 yrs	Time to peak	=	736 min
Time interval	=	1 min	Hyd. volume	=	47,628 cuft
Drainage area	=	12.000 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	20.80 min
Total precip.	=	3.10 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.400 x 98) + (5.900 x 72) + (4.700 x 74)] / 12.000



TR55 Tc Worksheet

Hyd. No. 1

EWA-1 - DP-1

Description	A	B	C	Totals
Sheet Flow				
Manning's n-value	= 0.240	0.011	0.011	
Flow length (ft)	= 100.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 3.10	0.00	0.00	
Land slope (%)	= 6.80	0.00	0.00	
Travel Time (min)	**= 8.89**	**+ 0.00**	**+ 0.00**	**= 8.89**
Shallow Concentrated Flow				
Flow length (ft)	= 817.00	0.00	0.00	
Watercourse slope (%)	= 0.50	0.00	0.00	
Surface description	= Unpaved	Unpaved	Paved	
Average velocity (ft/s)	= 1.14	0.00	0.00	
Travel Time (min)	**= 11.94**	**+ 0.00**	**+ 0.00**	**= 11.94**
Channel Flow				
X sectional flow area (sqft)	= 0.00	0.00	0.00	
Wetted perimeter (ft)	= 0.00	0.00	0.00	
Channel slope (%)	= 0.00	0.00	0.00	
Manning's n-value	= 0.000	0.015	0.015	
Velocity (ft/s)	= 0.00	0.00	0.00	
Flow length (ft)	= 0.0	0.0	0.0	
Travel Time (min)	**= 0.00**	**+ 0.00**	**+ 0.00**	**= 0.00**

Total Travel Time, Tc ..... 20.80 min

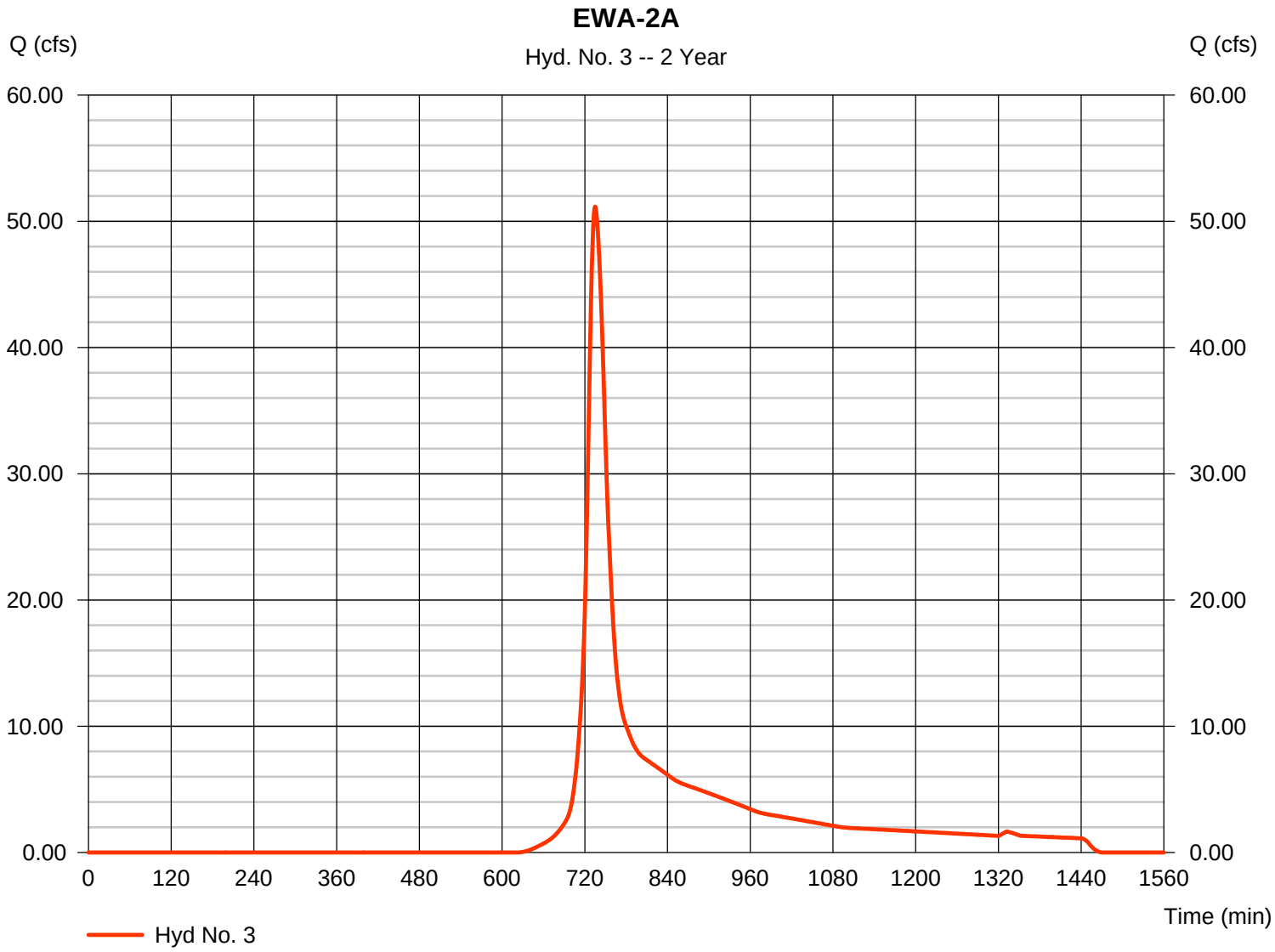
Hydrograph Report

Hyd. No. 3

EWA-2A

Hydrograph type	=	SCS Runoff	Peak discharge	=	51.16 cfs
Storm frequency	=	2 yrs	Time to peak	=	735 min
Time interval	=	1 min	Hyd. volume	=	235,477 cuft
Drainage area	=	59.900 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	19.10 min
Total precip.	=	3.10 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(4.300 x 98) + (6.200 x 72) + (49.400 x 74)] / 59.900



TR55 Tc Worksheet

Hyd. No. 3

EWA-2A

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.240		0.011		0.011		
Flow length (ft)	=	100.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.10		0.00		0.00		
Land slope (%)	=	3.30		0.00		0.00		
Travel Time (min)	**=**	**11.87**	**+**	**0.00**	**+**	**0.00**	**=**	**11.87**
Shallow Concentrated Flow								
Flow length (ft)	=	400.00		0.00		0.00		
Watercourse slope (%)	=	6.00		0.00		0.00		
Surface description	=	Unpaved		Paved		Paved		
Average velocity (ft/s)	=	3.95		0.00		0.00		
Travel Time (min)	**=**	**1.69**	**+**	**0.00**	**+**	**0.00**	**=**	**1.69**
Channel Flow								
X sectional flow area (sqft)	=	21.00		0.79		21.00		
Wetted perimeter (ft)	=	12.30		3.14		12.30		
Channel slope (%)	=	0.30		1.10		3.20		
Manning's n-value	=	0.026		0.013		0.026		
Velocity (ft/s)	=	4.49		4.77		14.67		
Flow length (ft)	=	862.0		553.0		375.0		
Travel Time (min)	**=**	**3.20**	**+**	**1.93**	**+**	**0.43**	**=**	**5.56**

Total Travel Time, Tc ..... 19.10 min

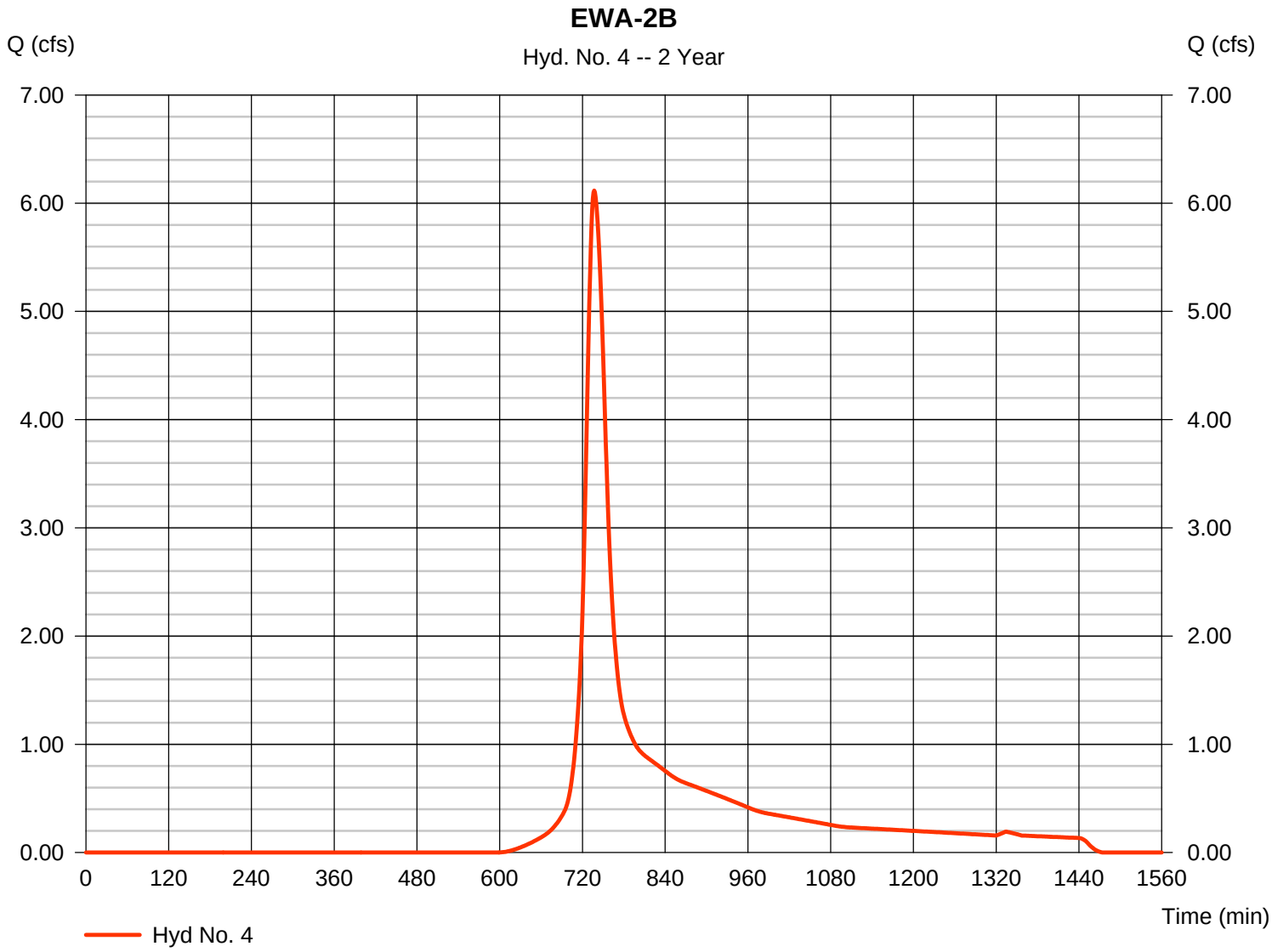
Hydrograph Report

Hyd. No. 4

EWA-2B

Hydrograph type	=	SCS Runoff	Peak discharge	=	6.117 cfs
Storm frequency	=	2 yrs	Time to peak	=	737 min
Time interval	=	1 min	Hyd. volume	=	29,370 cuft
Drainage area	=	6.800 ac	Curve number	=	78*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	22.70 min
Total precip.	=	3.10 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.300 x 98) + (2.700 x 72) + (2.800 x 74)] / 6.800



TR55 Tc Worksheet

Hyd. No. 4

EWA-2B

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.240		0.011		0.011		
Flow length (ft)	=	100.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.10		0.00		0.00		
Land slope (%)	=	1.00		0.00		0.00		
Travel Time (min)	**=**	**19.13**	**+**	**0.00**	**+**	**0.00**	**=**	**19.13**
Shallow Concentrated Flow								
Flow length (ft)	=	186.00		0.00		0.00		
Watercourse slope (%)	=	0.50		0.00		0.00		
Surface description	=	Unpaved		Unpaved		Unpaved		
Average velocity (ft/s)	=	1.14		0.00		0.00		
Travel Time (min)	**=**	**2.72**	**+**	**0.00**	**+**	**0.00**	**=**	**2.72**
Channel Flow								
X sectional flow area (sqft)	=	21.30		0.00		0.00		
Wetted perimeter (ft)	=	12.30		0.00		0.00		
Channel slope (%)	=	2.50		0.00		0.00		
Manning's n-value	=	0.026		0.240		0.015		
Velocity (ft/s)	=	13.09		0.00		0.00		
Flow length (ft)	=	670.0		0.0		0.0		
Travel Time (min)	**=**	**0.85**	**+**	**0.00**	**+**	**0.00**	**=**	**0.85**

Total Travel Time, Tc ..... 22.70 min

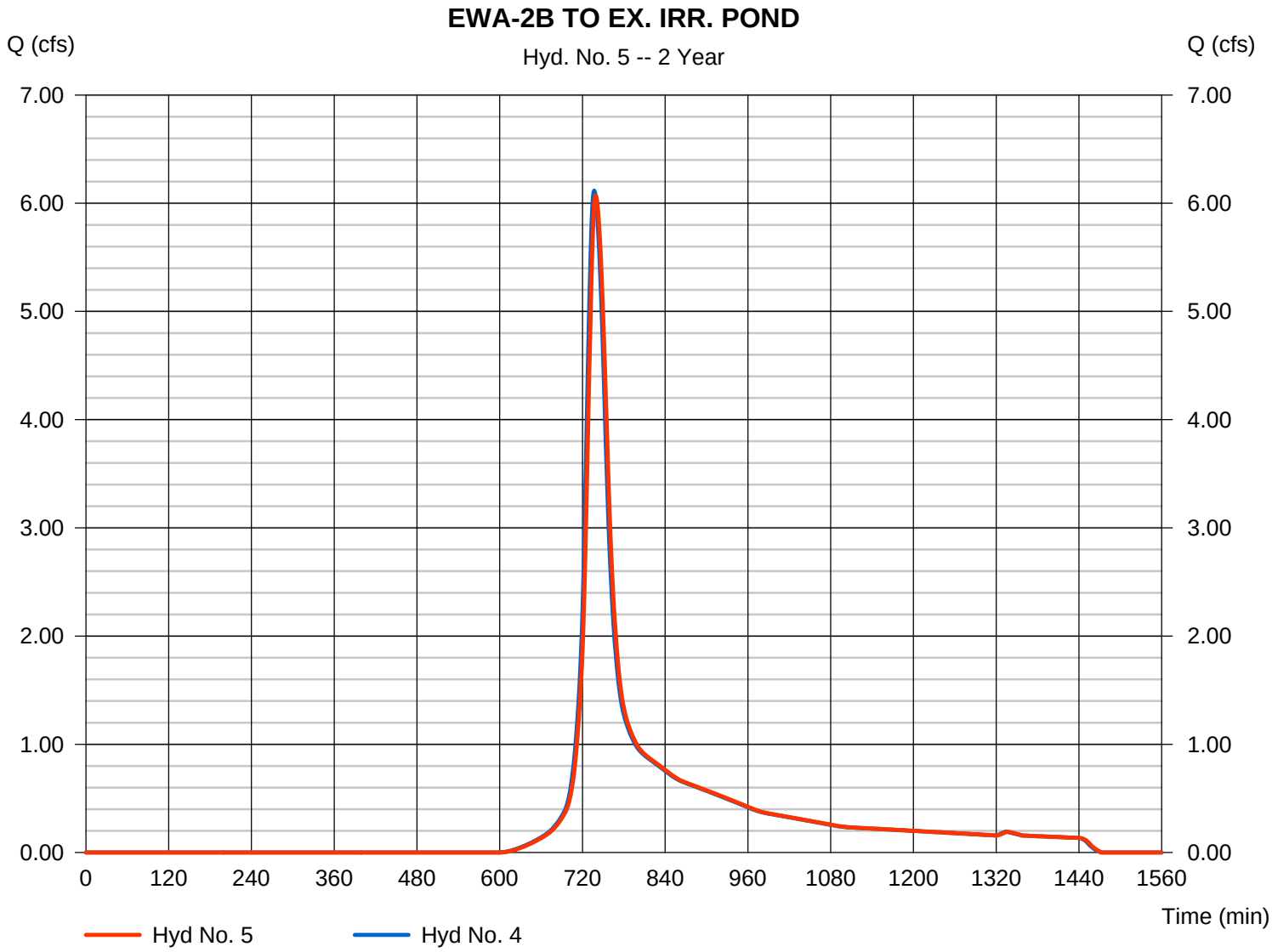
Hydrograph Report

Hyd. No. 5

EWA-2B TO EX. IRR. POND

Hydrograph type	=	Reach	Peak discharge	=	6.072 cfs
Storm frequency	=	2 yrs	Time to peak	=	739 min
Time interval	=	1 min	Hyd. volume	=	29,369 cuft
Inflow hyd. No.	=	4 - EWA-2B	Section type	=	Trapezoidal
Reach length	=	300.0 ft	Channel slope	=	3.0 %
Manning's n	=	0.040	Bottom width	=	5.0 ft
Side slope	=	3.0:1	Max. depth	=	1.0 ft
Rating curve x	=	2.205	Rating curve m	=	1.190
Ave. velocity	=	0.00 ft/s	Routing coeff.	=	0.4718

Modified Att-Kin routing method used.

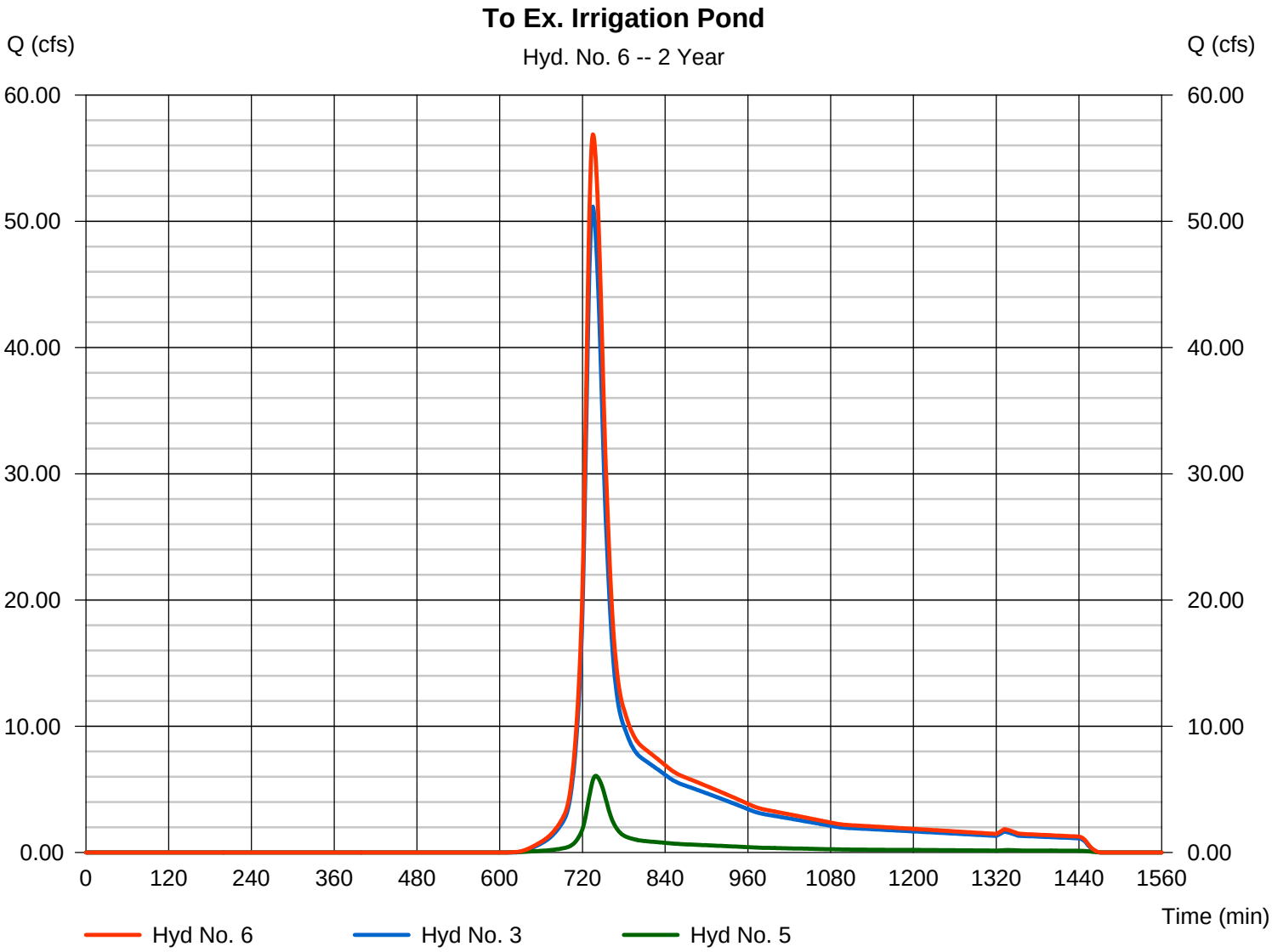


Hydrograph Report

Hyd. No. 6

To Ex. Irrigation Pond

Hydrograph type	=	Combine	Peak discharge	=	56.89 cfs
Storm frequency	=	2 yrs	Time to peak	=	735 min
Time interval	=	1 min	Hyd. volume	=	264,845 cuft
Inflow hyds.	=	3, 5	Contrib. drain. area	=	59.900 ac



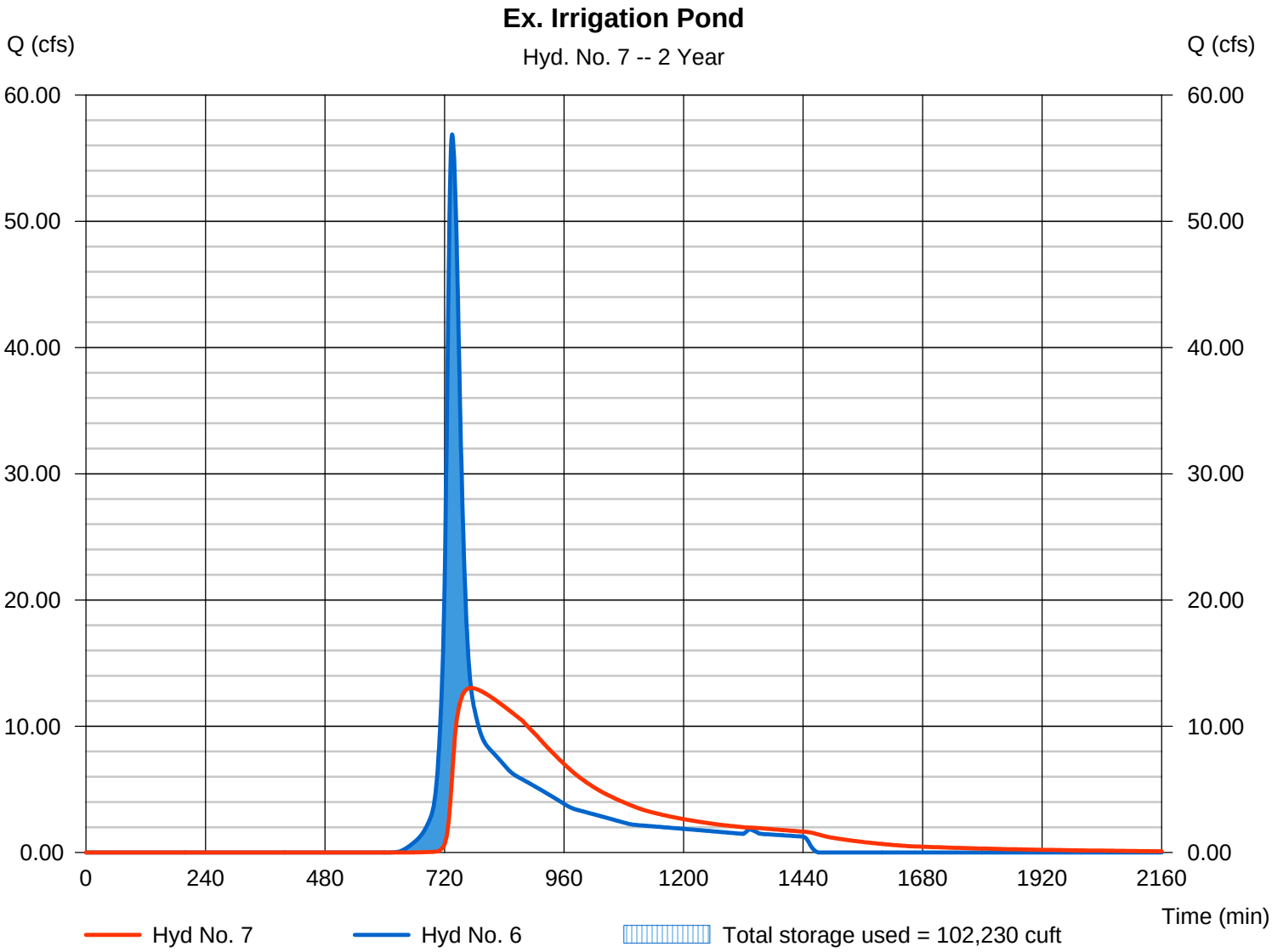
Hydrograph Report

Hyd. No. 7

Ex. Irrigation Pond

Hydrograph type	=	Reservoir	Peak discharge	=	13.03 cfs
Storm frequency	=	2 yrs	Time to peak	=	773 min
Time interval	=	1 min	Hyd. volume	=	259,942 cuft
Inflow hyd. No.	=	6 - To Ex. Irrigation Pond	Max. Elevation	=	164.27 ft
Reservoir name	=	Ex. Irrigation Pond	Max. Storage	=	102,230 cuft

Storage Indication method used.



Pond No. 1 - Ex. Irrigation Pond

Pond Data

Contours - User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 163.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	163.00	72,905	0	0
1.00	164.00	82,201	77,553	77,553
2.00	165.00	98,503	90,352	167,905
2.20	165.20	108,804	20,731	188,636
3.00	166.00	120,265	91,628	280,263

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	0.00	0.00	0.00
Span (in)	= 12.00	0.00	0.00	0.00
No. Barrels	= 4	0	0	0
Invert El. (ft)	= 163.03	0.00	0.00	0.00
Length (ft)	= 21.50	0.00	0.00	0.00
Slope (%)	= 9.10	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)	= 275.00	0.00	0.00	0.00
Crest El. (ft)	= 165.50	0.00	0.00	0.00
Weir Coeff.	= 2.60	3.33	3.33	3.33
Weir Type	= Broad	---	---	---
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).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	163.00	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.10	7,755	163.10	0.09 ic	---	---	---	0.00	---	---	---	---	---	0.087
0.20	15,511	163.20	0.50 ic	---	---	---	0.00	---	---	---	---	---	0.499
0.30	23,266	163.30	1.21 ic	---	---	---	0.00	---	---	---	---	---	1.212
0.40	31,021	163.40	2.19 ic	---	---	---	0.00	---	---	---	---	---	2.191
0.50	38,777	163.50	3.39 ic	---	---	---	0.00	---	---	---	---	---	3.388
0.60	46,532	163.60	4.76 ic	---	---	---	0.00	---	---	---	---	---	4.760
0.70	54,287	163.70	6.24 ic	---	---	---	0.00	---	---	---	---	---	6.237
0.80	62,042	163.80	7.76 ic	---	---	---	0.00	---	---	---	---	---	7.761
0.90	69,798	163.90	9.22 ic	---	---	---	0.00	---	---	---	---	---	9.218
1.00	77,553	164.00	10.44 ic	---	---	---	0.00	---	---	---	---	---	10.44
1.10	86,588	164.10	11.42 ic	---	---	---	0.00	---	---	---	---	---	11.42
1.20	95,623	164.20	12.38 ic	---	---	---	0.00	---	---	---	---	---	12.38
1.30	104,659	164.30	13.27 ic	---	---	---	0.00	---	---	---	---	---	13.27
1.40	113,694	164.40	14.11 ic	---	---	---	0.00	---	---	---	---	---	14.11
1.50	122,729	164.50	14.90 ic	---	---	---	0.00	---	---	---	---	---	14.90
1.60	131,764	164.60	15.65 ic	---	---	---	0.00	---	---	---	---	---	15.65
1.70	140,799	164.70	16.36 ic	---	---	---	0.00	---	---	---	---	---	16.36
1.80	149,835	164.80	17.05 ic	---	---	---	0.00	---	---	---	---	---	17.05
1.90	158,870	164.90	17.70 ic	---	---	---	0.00	---	---	---	---	---	17.70
2.00	167,905	165.00	18.34 ic	---	---	---	0.00	---	---	---	---	---	18.34
2.02	169,978	165.02	18.46 ic	---	---	---	0.00	---	---	---	---	---	18.46
2.04	172,051	165.04	18.59 ic	---	---	---	0.00	---	---	---	---	---	18.59
2.06	174,124	165.06	18.71 ic	---	---	---	0.00	---	---	---	---	---	18.71
2.08	176,197	165.08	18.83 ic	---	---	---	0.00	---	---	---	---	---	18.83
2.10	178,270	165.10	18.95 ic	---	---	---	0.00	---	---	---	---	---	18.95
2.12	180,343	165.12	19.07 ic	---	---	---	0.00	---	---	---	---	---	19.07
2.14	182,416	165.14	19.19 ic	---	---	---	0.00	---	---	---	---	---	19.19
2.16	184,490	165.16	19.31 ic	---	---	---	0.00	---	---	---	---	---	19.31
2.18	186,563	165.18	19.43 ic	---	---	---	0.00	---	---	---	---	---	19.43
2.20	188,636	165.20	19.55 ic	---	---	---	0.00	---	---	---	---	---	19.55
2.28	197,799	165.28	20.01 ic	---	---	---	0.00	---	---	---	---	---	20.01
2.36	206,961	165.36	20.46 ic	---	---	---	0.00	---	---	---	---	---	20.46
2.44	216,124	165.44	20.90 ic	---	---	---	0.00	---	---	---	---	---	20.90
2.52	225,287	165.52	21.34 ic	---	---	---	2.02	---	---	---	---	---	23.36
2.60	234,450	165.60	21.76 ic	---	---	---	22.61	---	---	---	---	---	44.37
2.68	243,612	165.68	22.18 ic	---	---	---	54.61	---	---	---	---	---	76.78
2.76	252,775	165.76	22.59 ic	---	---	---	94.80	---	---	---	---	---	117.38
2.84	261,938	165.84	22.99 ic	---	---	---	141.76	---	---	---	---	---	164.75
2.92	271,101	165.92	23.38 ic	---	---	---	194.63	---	---	---	---	---	218.01

Continues on next page...

Ex. Irrigation Pond

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
3.00	280,263	166.00	23.77 ic	---	---	---	252.79	---	---	---	---	---	276.56

...End

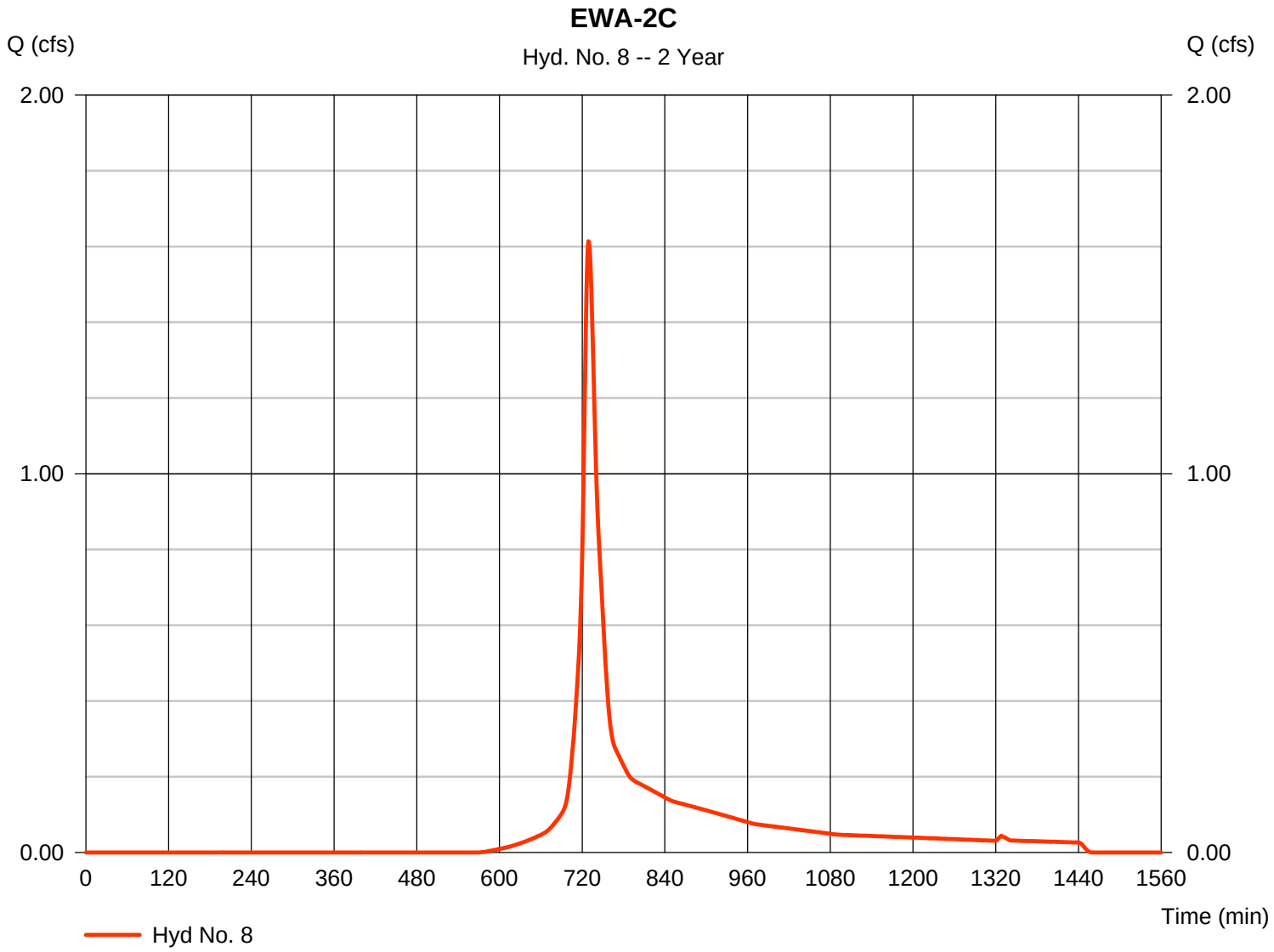
Hydrograph Report

Hyd. No. 8

EWA-2C

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.614 cfs
Storm frequency	=	2 yrs	Time to peak	=	729 min
Time interval	=	1 min	Hyd. volume	=	6,157 cuft
Drainage area	=	1.300 ac	Curve number	=	80*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	12.60 min
Total precip.	=	3.10 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.400 x 98) + (0.900 x 72)] / 1.300



TR55 Tc Worksheet

Hyd. No. 8

EWA-2C

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.011		0.011		0.011		
Flow length (ft)	=	100.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.10		0.00		0.00		
Land slope (%)	=	0.40		0.00		0.00		
Travel Time (min)	**=**	**2.34**	**+**	**0.00**	**+**	**0.00**	**=**	**2.34**
Shallow Concentrated Flow								
Flow length (ft)	=	1542.00		0.00		0.00		
Watercourse slope (%)	=	2.40		0.00		0.00		
Surface description	=	Unpaved		Paved		Paved		
Average velocity (ft/s)	=	2.50		0.00		0.00		
Travel Time (min)	**=**	**10.28**	**+**	**0.00**	**+**	**0.00**	**=**	**10.28**
Channel Flow								
X sectional flow area (sqft)	=	0.00		0.00		0.00		
Wetted perimeter (ft)	=	0.00		0.00		0.00		
Channel slope (%)	=	0.00		0.00		0.00		
Manning's n-value	=	0.026		0.015		0.015		
Velocity (ft/s)	=	0.00		0.00		0.00		
Flow length (ft)	=	0.0		0.0		0.0		
Travel Time (min)	**=**	**0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

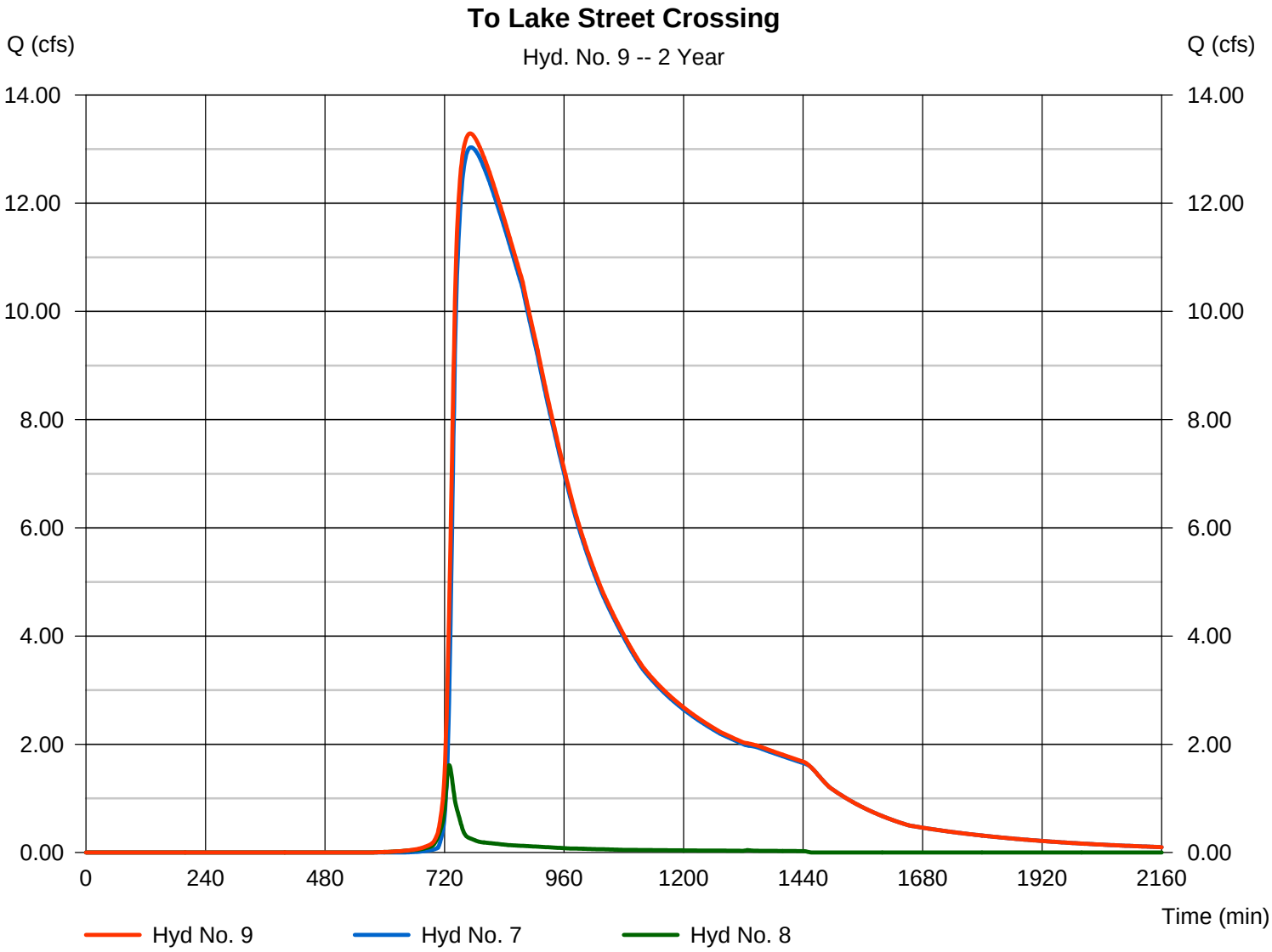
Total Travel Time, Tc ..... 12.60 min

Hydrograph Report

Hyd. No. 9

To Lake Street Crossing

Hydrograph type	= Combine	Peak discharge	= 13.29 cfs
Storm frequency	= 2 yrs	Time to peak	= 772 min
Time interval	= 1 min	Hyd. volume	= 266,099 cuft
Inflow hyds.	= 7, 8	Contrib. drain. area	= 1.300 ac



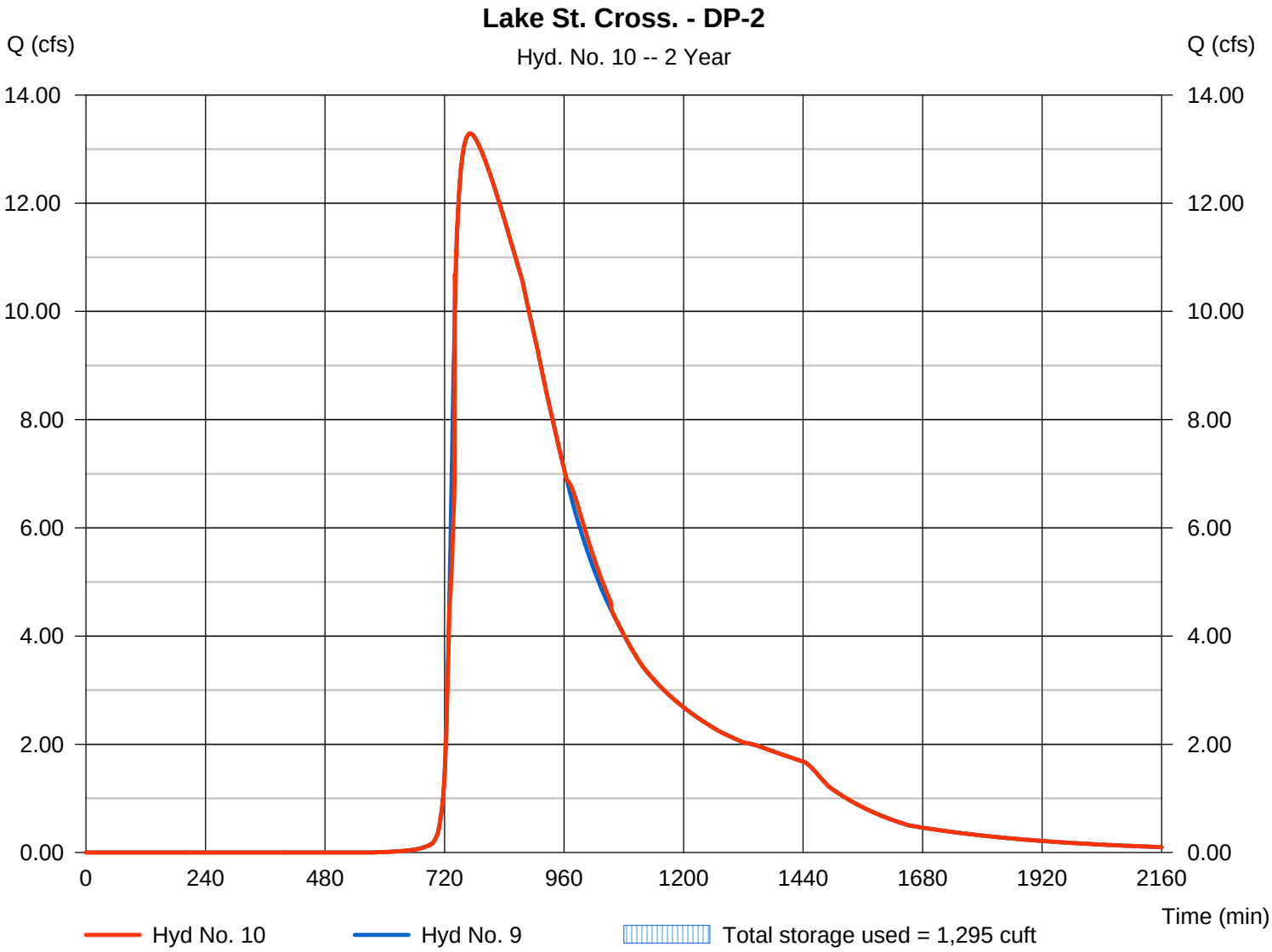
Hydrograph Report

Hyd. No. 10

Lake St. Cross. - DP-2

Hydrograph type	=	Reservoir	Peak discharge	=	13.29 cfs
Storm frequency	=	2 yrs	Time to peak	=	772 min
Time interval	=	1 min	Hyd. volume	=	266,095 cuft
Inflow hyd. No.	=	9 - To Lake Street Crossing	Max. Elevation	=	159.86 ft
Reservoir name	=	Lake Street Crossing	Max. Storage	=	1,295 cuft

Storage Indication method used.



Pond No. 2 - Lake Street Crossing

Pond Data

Contours - User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 156.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	156.00	00	0	0
2.00	158.00	126	126	126
4.00	160.00	1,135	1,261	1,387
5.00	161.00	5,000	3,068	4,455

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	0.00	0.00	0.00
Span (in)	= 12.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 156.00	0.00	0.00	0.00
Length (ft)	= 34.60	0.00	0.00	0.00
Slope (%)	= 2.10	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)	= 100.00	0.00	0.00	0.00
Crest El. (ft)	= 159.80	0.00	0.00	0.00
Weir Coeff.	= 2.60	3.33	3.33	3.33
Weir Type	= Broad	---	---	---
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).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	156.00	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.20	13	156.20	0.17 ic	---	---	---	0.00	---	---	---	---	---	0.171
0.40	25	156.40	0.63 ic	---	---	---	0.00	---	---	---	---	---	0.632
0.60	38	156.60	1.30 ic	---	---	---	0.00	---	---	---	---	---	1.299
0.80	50	156.80	2.05 ic	---	---	---	0.00	---	---	---	---	---	2.052
1.00	63	157.00	2.67 ic	---	---	---	0.00	---	---	---	---	---	2.674
1.20	76	157.20	3.16 ic	---	---	---	0.00	---	---	---	---	---	3.164
1.40	88	157.40	3.59 ic	---	---	---	0.00	---	---	---	---	---	3.587
1.60	101	157.60	3.97 ic	---	---	---	0.00	---	---	---	---	---	3.966
1.80	113	157.80	4.31 ic	---	---	---	0.00	---	---	---	---	---	4.311
2.00	126	158.00	4.63 ic	---	---	---	0.00	---	---	---	---	---	4.631
2.20	252	158.20	4.93 ic	---	---	---	0.00	---	---	---	---	---	4.930
2.40	378	158.40	5.21 ic	---	---	---	0.00	---	---	---	---	---	5.212
2.60	504	158.60	5.48 ic	---	---	---	0.00	---	---	---	---	---	5.479
2.80	630	158.80	5.73 ic	---	---	---	0.00	---	---	---	---	---	5.734
3.00	757	159.00	5.98 ic	---	---	---	0.00	---	---	---	---	---	5.979
3.20	883	159.20	6.21 ic	---	---	---	0.00	---	---	---	---	---	6.213
3.40	1,009	159.40	6.44 ic	---	---	---	0.00	---	---	---	---	---	6.439
3.60	1,135	159.60	6.66 ic	---	---	---	0.00	---	---	---	---	---	6.657
3.80	1,261	159.80	6.87 ic	---	---	---	0.00	---	---	---	---	---	6.869
4.00	1,387	160.00	7.07 ic	---	---	---	23.25	---	---	---	---	---	30.33
4.10	1,694	160.10	7.17 ic	---	---	---	42.72	---	---	---	---	---	49.90
4.20	2,001	160.20	7.27 ic	---	---	---	65.78	---	---	---	---	---	73.05
4.30	2,307	160.30	7.37 ic	---	---	---	91.93	---	---	---	---	---	99.30
4.40	2,614	160.40	7.47 ic	---	---	---	120.84	---	---	---	---	---	128.31
4.50	2,921	160.50	7.56 ic	---	---	---	152.28	---	---	---	---	---	159.84
4.60	3,228	160.60	7.66 ic	---	---	---	186.05	---	---	---	---	---	193.71
4.70	3,534	160.70	7.75 ic	---	---	---	222.01	---	---	---	---	---	229.76
4.80	3,841	160.80	7.84 ic	---	---	---	260.02	---	---	---	---	---	267.86
4.90	4,148	160.90	7.93 ic	---	---	---	299.98	---	---	---	---	---	307.91
5.00	4,455	161.00	8.02 ic	---	---	---	341.78	---	---	---	---	---	349.80

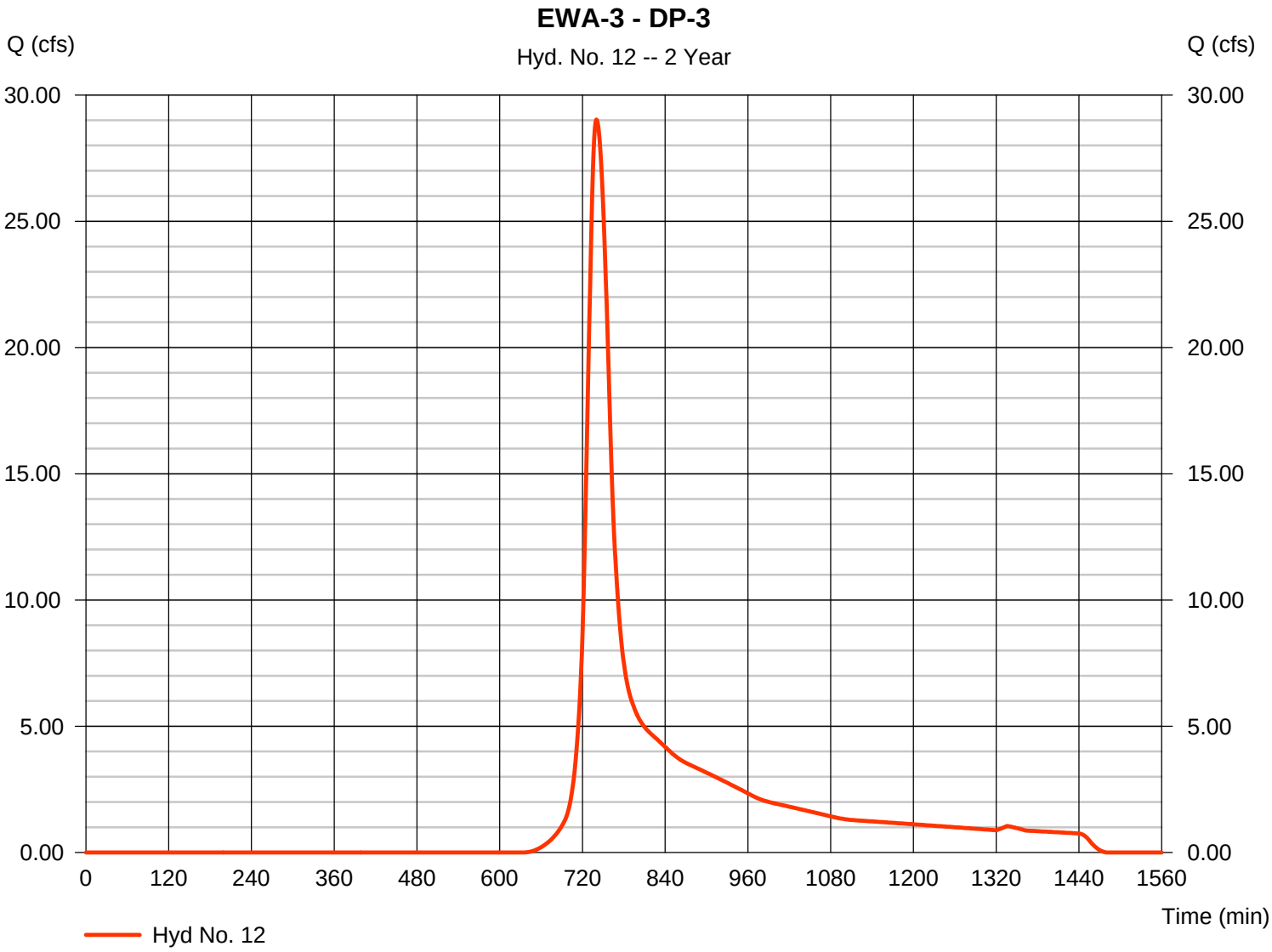
Hydrograph Report

Hyd. No. 12

EWA-3 - DP-3

Hydrograph type	=	SCS Runoff	Peak discharge	=	29.02 cfs
Storm frequency	=	2 yrs	Time to peak	=	740 min
Time interval	=	1 min	Hyd. volume	=	152,507 cuft
Drainage area	=	40.600 ac	Curve number	=	75*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	26.10 min
Total precip.	=	3.10 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.300 x 98) + (5.500 x 72) + (4.000 x 79) + (28.700 x 74) + (1.100 x 80)] / 40.600



TR55 Tc Worksheet

Hyd. No. 12

EWA-3 - DP-3

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.240		0.011		0.011		
Flow length (ft)	=	100.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.10		0.00		0.00		
Land slope (%)	=	1.30		0.00		0.00		
Travel Time (min)	**=**	**17.23**	**+**	**0.00**	**+**	**0.00**	**=**	**17.23**
Shallow Concentrated Flow								
Flow length (ft)	=	143.00		248.00		678.00		
Watercourse slope (%)	=	2.60		7.40		2.50		
Surface description	=	Unpaved		Unpaved		Unpaved		
Average velocity (ft/s)	=	2.60		4.39		2.55		
Travel Time (min)	**=**	**0.92**	**+**	**0.94**	**+**	**4.43**	**=**	**6.29**
Channel Flow								
X sectional flow area (sqft)	=	21.00		0.00		0.00		
Wetted perimeter (ft)	=	12.30		0.00		0.00		
Channel slope (%)	=	2.20		0.00		0.00		
Manning's n-value	=	0.026		0.015		0.015		
Velocity (ft/s)	=	12.16		0.00		0.00		
Flow length (ft)	=	1876.0		0.0		0.0		
Travel Time (min)	**=**	**2.57**	**+**	**0.00**	**+**	**0.00**	**=**	**2.57**

Total Travel Time, Tc ..... 26.10 min

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

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	20.35	1	735	93,666	------	------	------	EWA-1 - DP-1
3	SCS Runoff	104.36	1	734	463,098	------	------	------	EWA-2A
4	SCS Runoff	11.98	1	736	56,091	------	------	------	EWA-2B
5	Reach	11.90	1	738	56,090	4	------	------	EWA-2B TO EX. IRR. POND
6	Combine	115.54	1	734	519,188	3, 5	------	------	To Ex. Irrigation Pond
7	Reservoir	22.99	1	774	514,078	6	165.51	223,917	Ex. Irrigation Pond
8	SCS Runoff	3.042	1	729	11,435	------	------	------	EWA-2C
9	Combine	23.43	1	774	525,512	7, 8	------	------	To Lake Street Crossing
10	Reservoir	23.43	1	774	525,507	9	159.94	1,350	Lake St. Cross. - DP-2
12	SCS Runoff	60.54	1	739	304,543	------	------	------	EWA-3 - DP-3

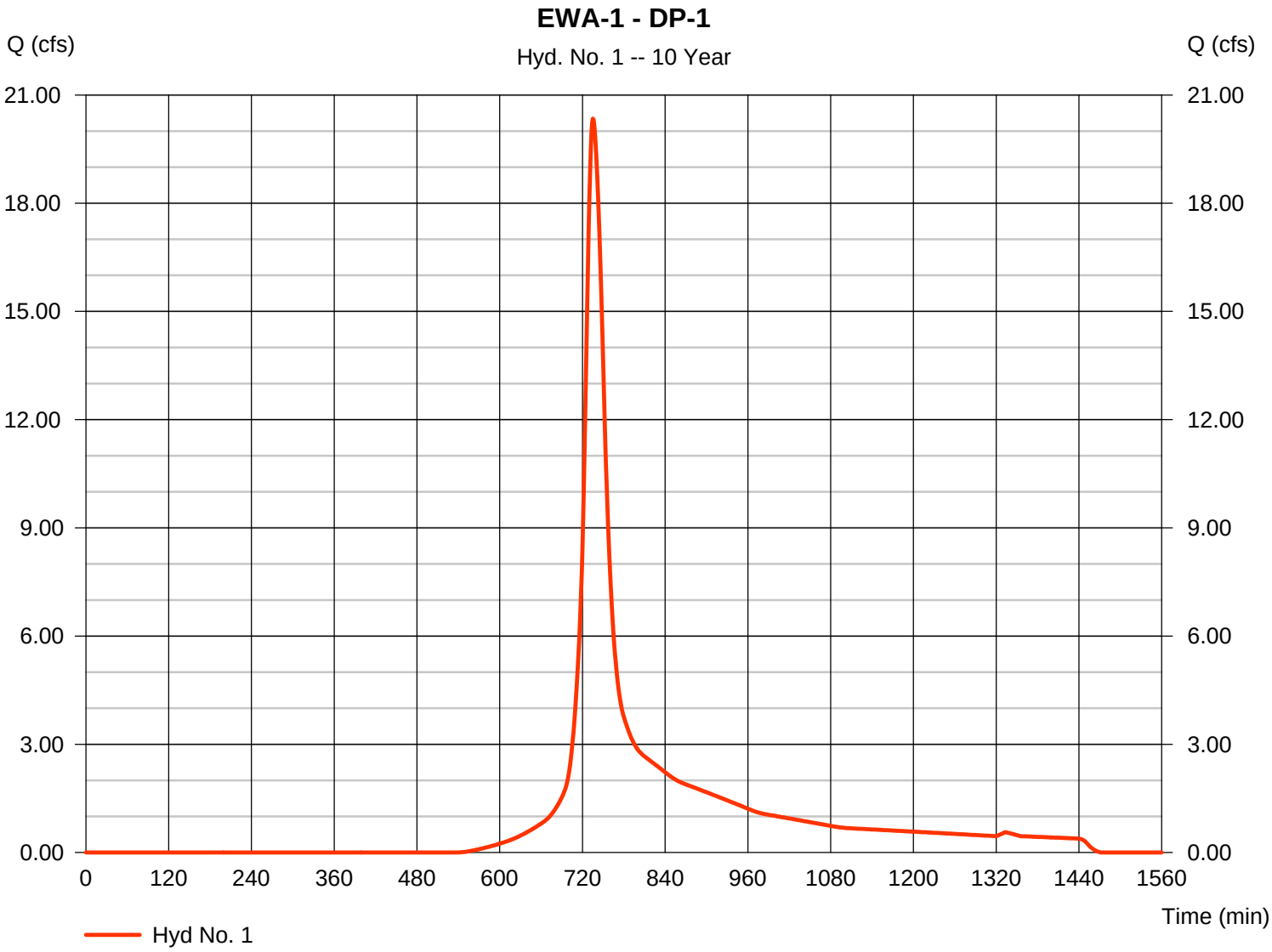
Hydrograph Report

Hyd. No. 1

EWA-1 - DP-1

Hydrograph type	=	SCS Runoff	Peak discharge	=	20.35 cfs
Storm frequency	=	10 yrs	Time to peak	=	735 min
Time interval	=	1 min	Hyd. volume	=	93,666 cuft
Drainage area	=	12.000 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	20.80 min
Total precip.	=	4.50 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.400 x 98) + (5.900 x 72) + (4.700 x 74)] / 12.000



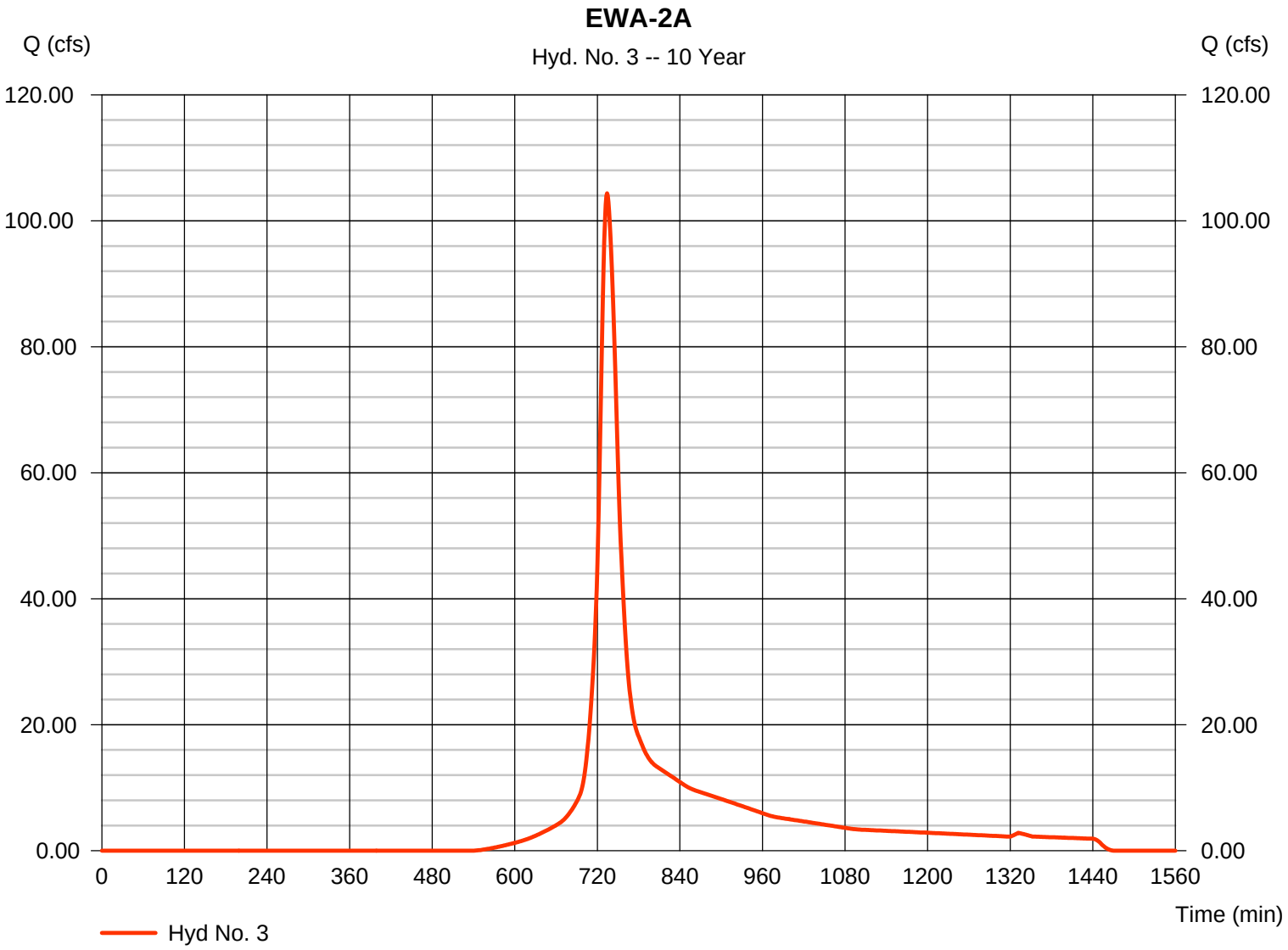
Hydrograph Report

Hyd. No. 3

EWA-2A

Hydrograph type	=	SCS Runoff	Peak discharge	=	104.36 cfs
Storm frequency	=	10 yrs	Time to peak	=	734 min
Time interval	=	1 min	Hyd. volume	=	463,098 cuft
Drainage area	=	59.900 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	19.10 min
Total precip.	=	4.50 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(4.300 x 98) + (6.200 x 72) + (49.400 x 74)] / 59.900



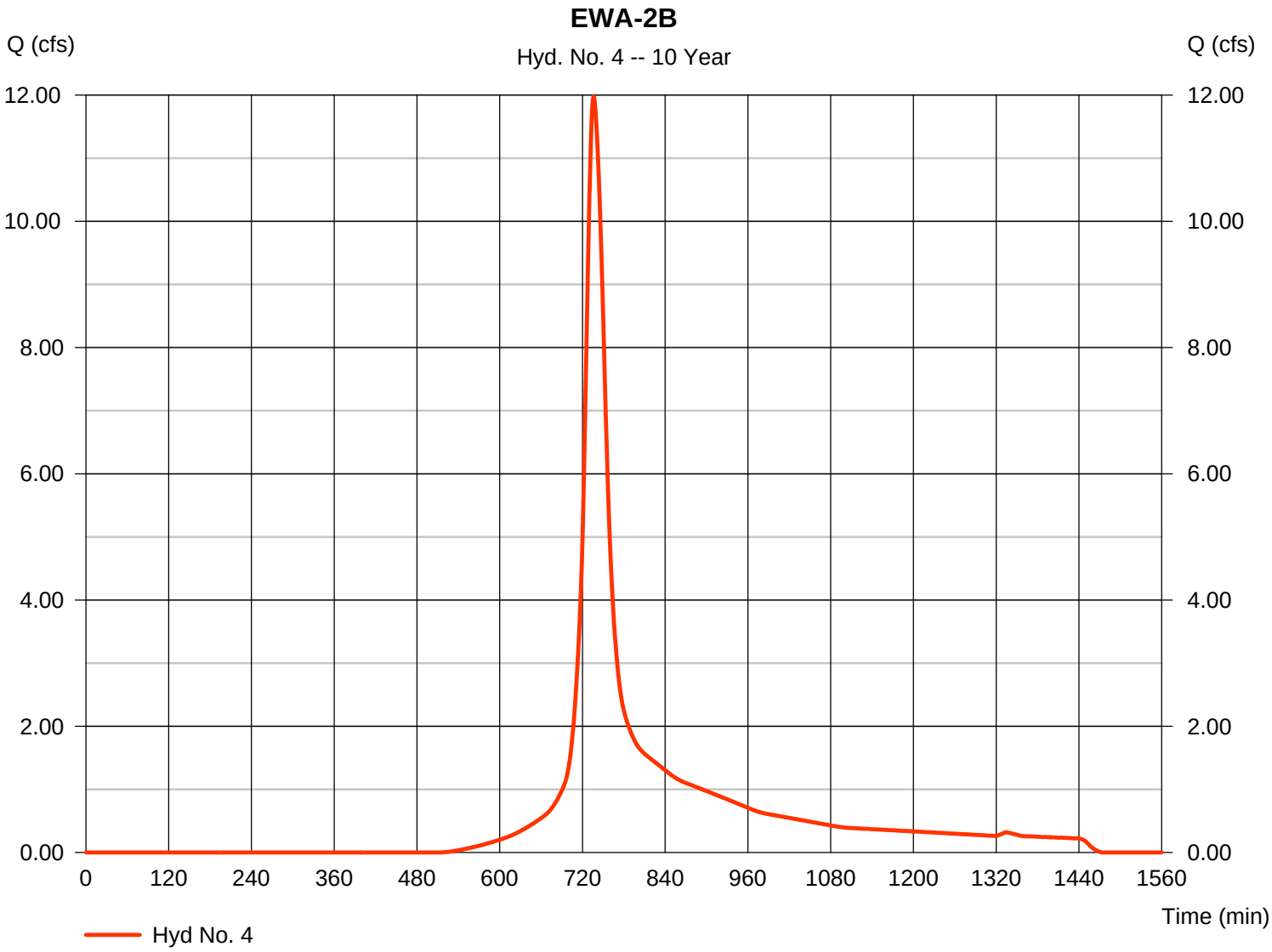
Hydrograph Report

Hyd. No. 4

EWA-2B

Hydrograph type	=	SCS Runoff	Peak discharge	=	11.98 cfs
Storm frequency	=	10 yrs	Time to peak	=	736 min
Time interval	=	1 min	Hyd. volume	=	56,091 cuft
Drainage area	=	6.800 ac	Curve number	=	78*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	22.70 min
Total precip.	=	4.50 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.300 x 98) + (2.700 x 72) + (2.800 x 74)] / 6.800



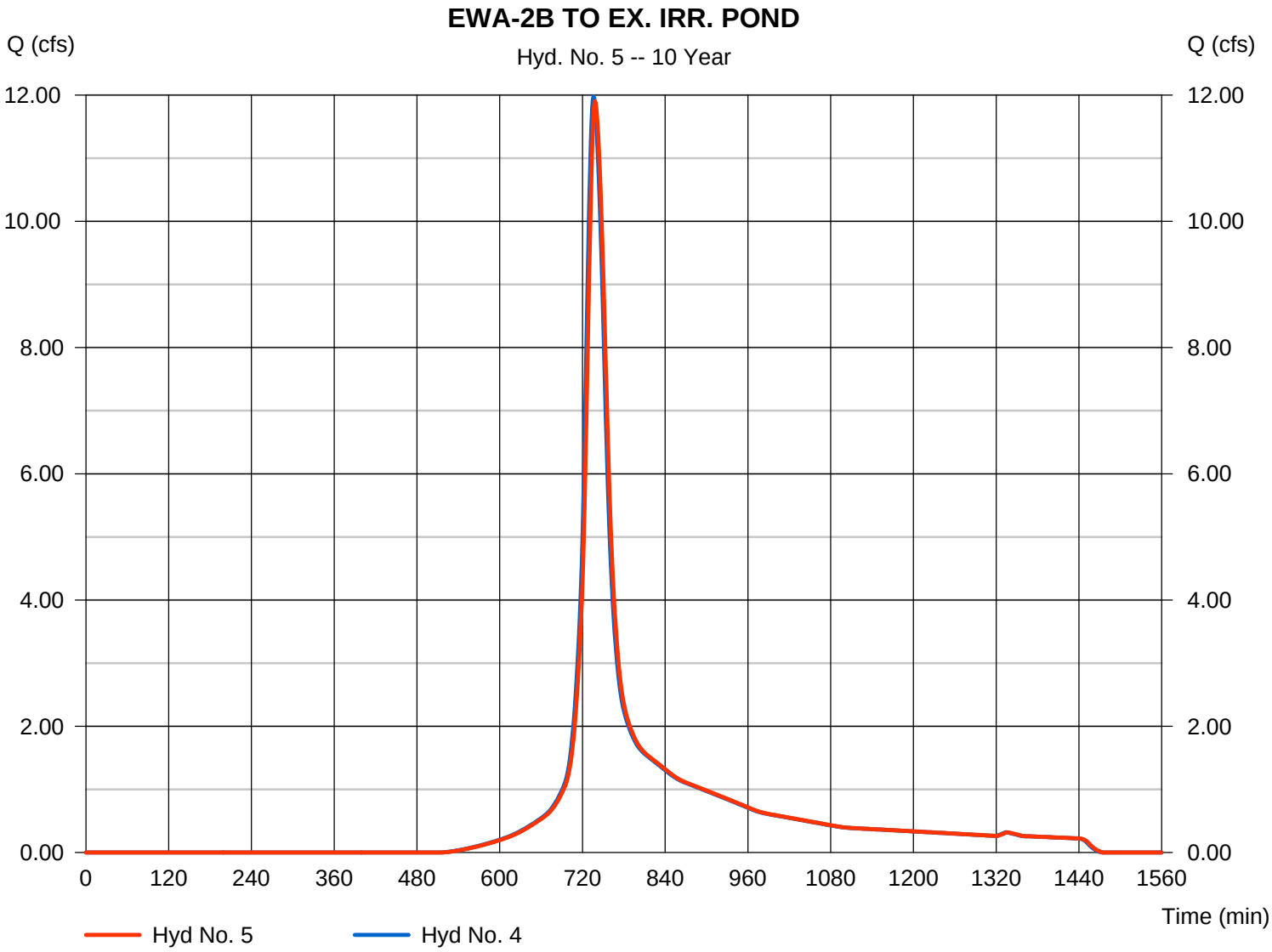
Hydrograph Report

Hyd. No. 5

EWA-2B TO EX. IRR. POND

Hydrograph type	=	Reach	Peak discharge	=	11.90 cfs
Storm frequency	=	10 yrs	Time to peak	=	738 min
Time interval	=	1 min	Hyd. volume	=	56,090 cuft
Inflow hyd. No.	=	4 - EWA-2B	Section type	=	Trapezoidal
Reach length	=	300.0 ft	Channel slope	=	3.0 %
Manning's n	=	0.040	Bottom width	=	5.0 ft
Side slope	=	3.0:1	Max. depth	=	1.0 ft
Rating curve x	=	2.205	Rating curve m	=	1.190
Ave. velocity	=	0.00 ft/s	Routing coeff.	=	0.5116

Modified Att-Kin routing method used.

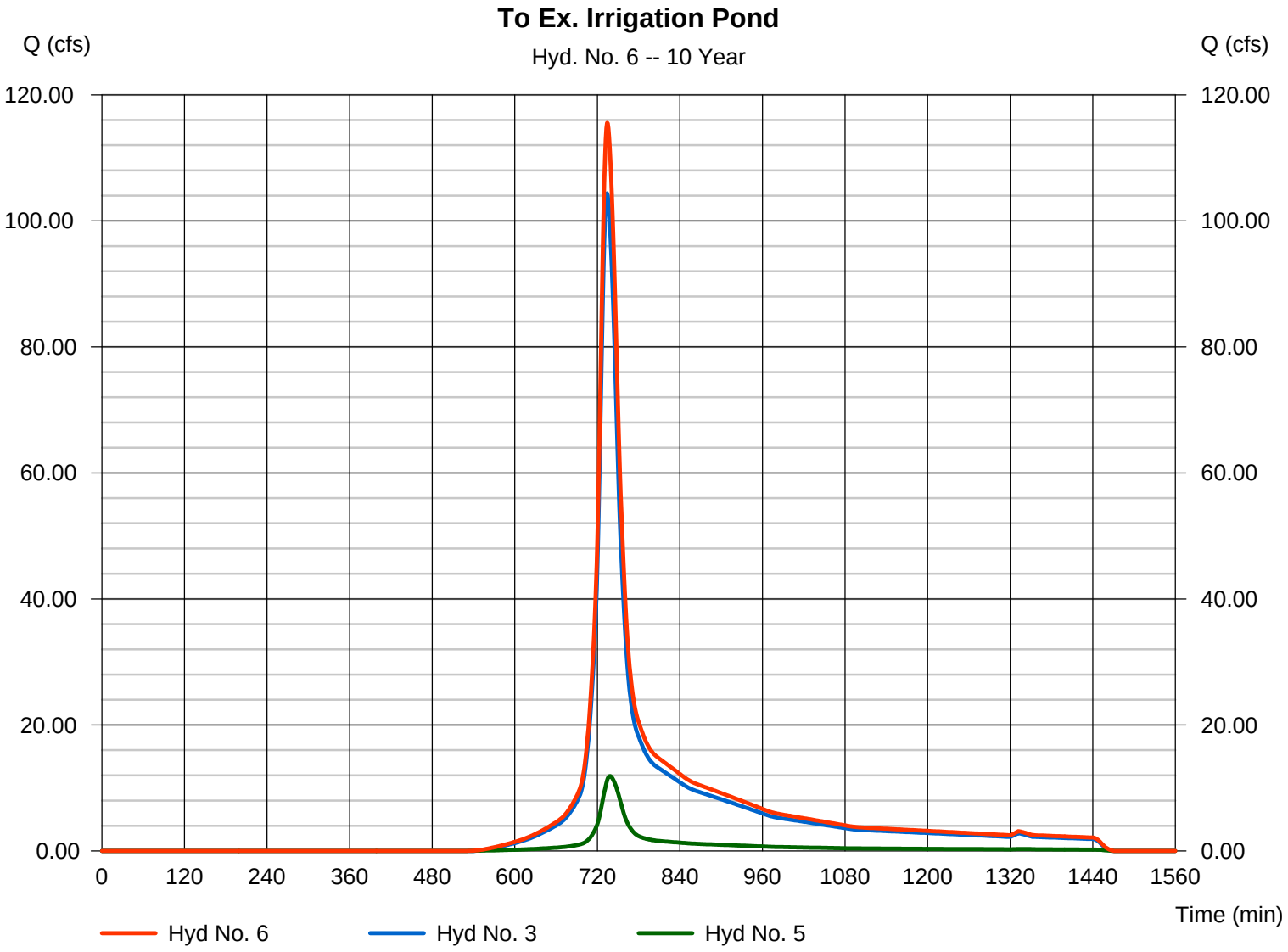


Hydrograph Report

Hyd. No. 6

To Ex. Irrigation Pond

Hydrograph type	=	Combine	Peak discharge	=	115.54 cfs
Storm frequency	=	10 yrs	Time to peak	=	734 min
Time interval	=	1 min	Hyd. volume	=	519,188 cuft
Inflow hyds.	=	3, 5	Contrib. drain. area	=	59.900 ac



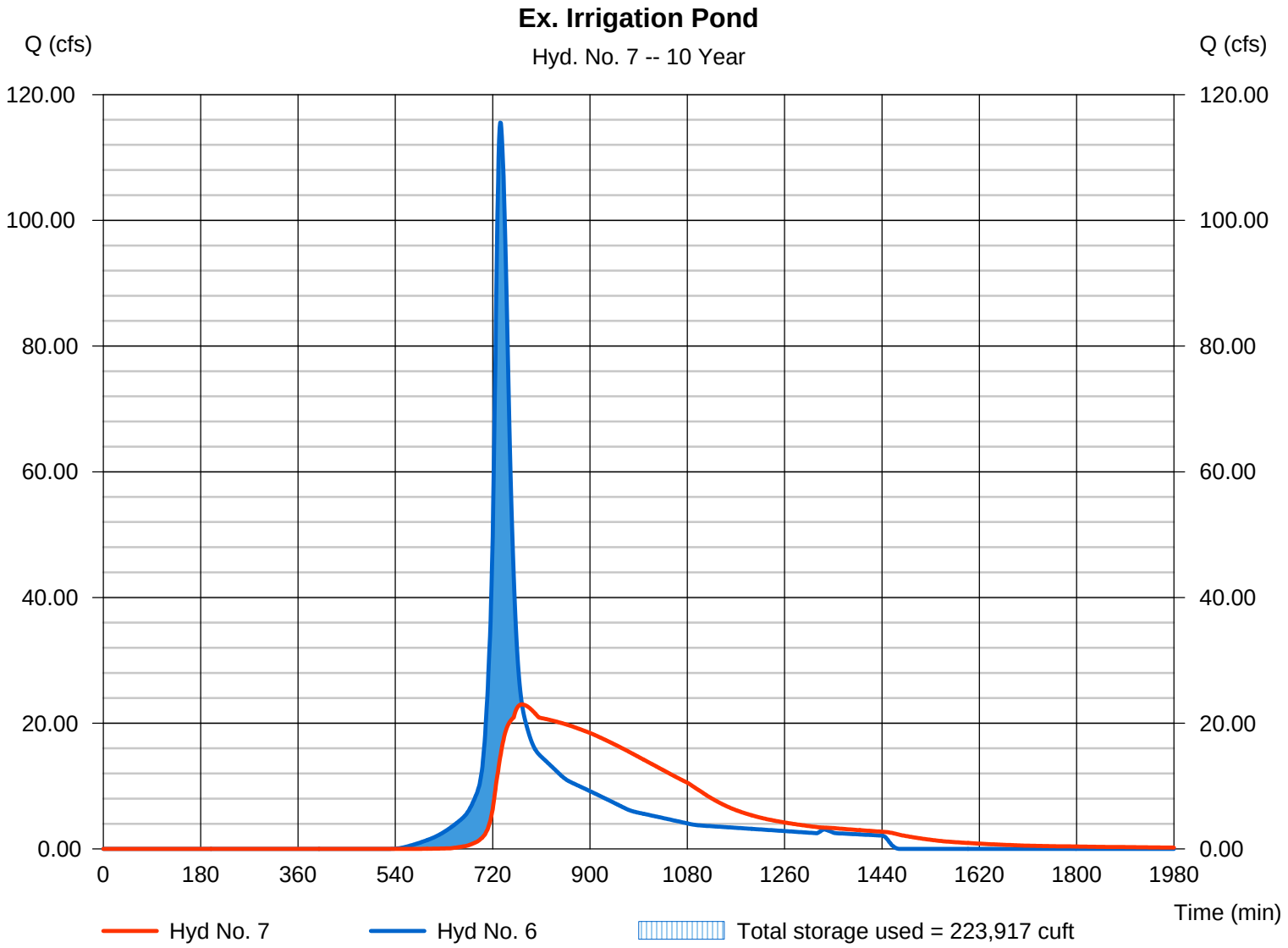
Hydrograph Report

Hyd. No. 7

Ex. Irrigation Pond

Hydrograph type	=	Reservoir	Peak discharge	=	22.99 cfs
Storm frequency	=	10 yrs	Time to peak	=	774 min
Time interval	=	1 min	Hyd. volume	=	514,078 cuft
Inflow hyd. No.	=	6 - To Ex. Irrigation Pond	Max. Elevation	=	165.51 ft
Reservoir name	=	Ex. Irrigation Pond	Max. Storage	=	223,917 cuft

Storage Indication method used.



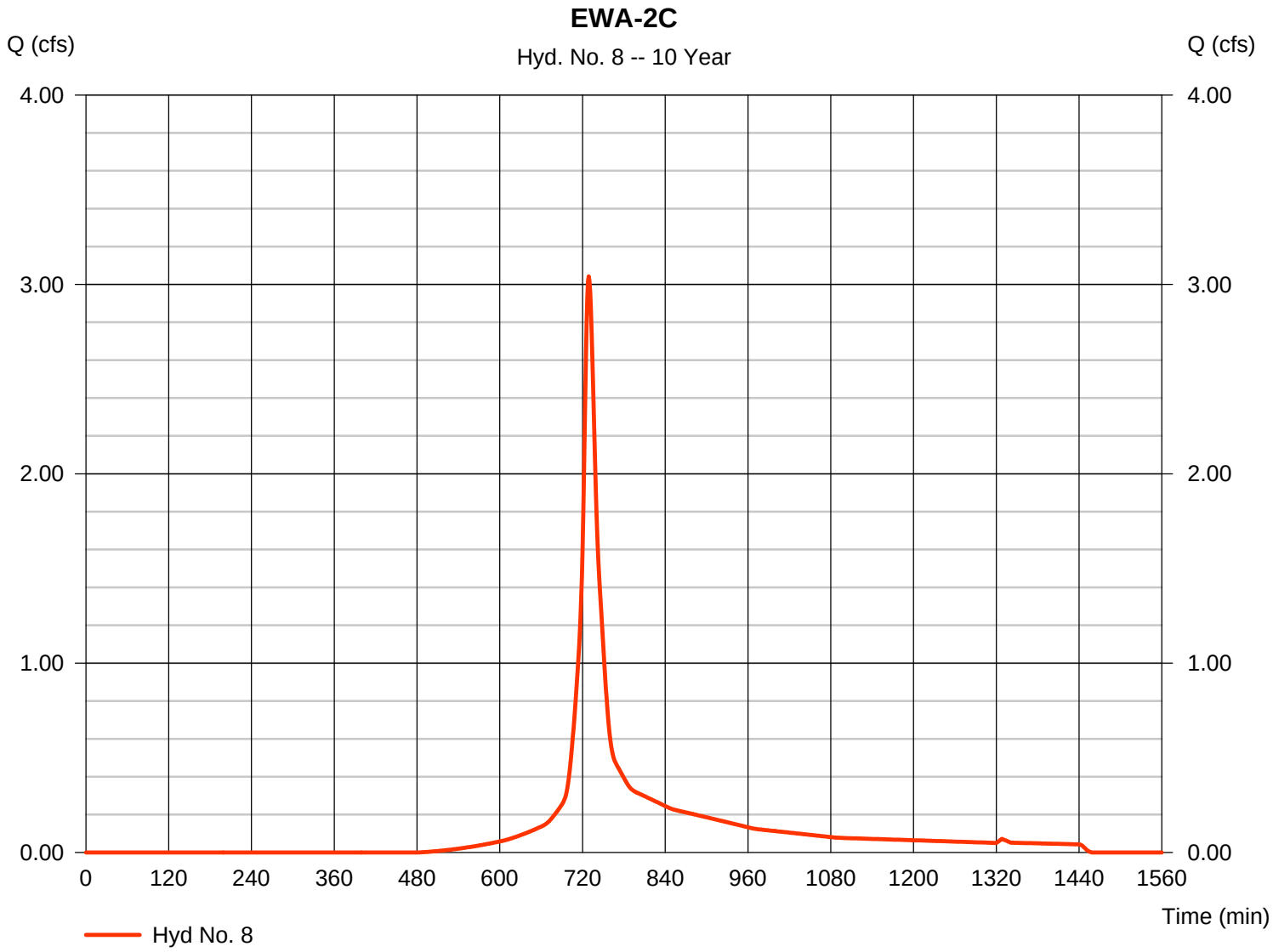
Hydrograph Report

Hyd. No. 8

EWA-2C

Hydrograph type	=	SCS Runoff	Peak discharge	=	3.042 cfs
Storm frequency	=	10 yrs	Time to peak	=	729 min
Time interval	=	1 min	Hyd. volume	=	11,435 cuft
Drainage area	=	1.300 ac	Curve number	=	80*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	12.60 min
Total precip.	=	4.50 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.400 x 98) + (0.900 x 72)] / 1.300

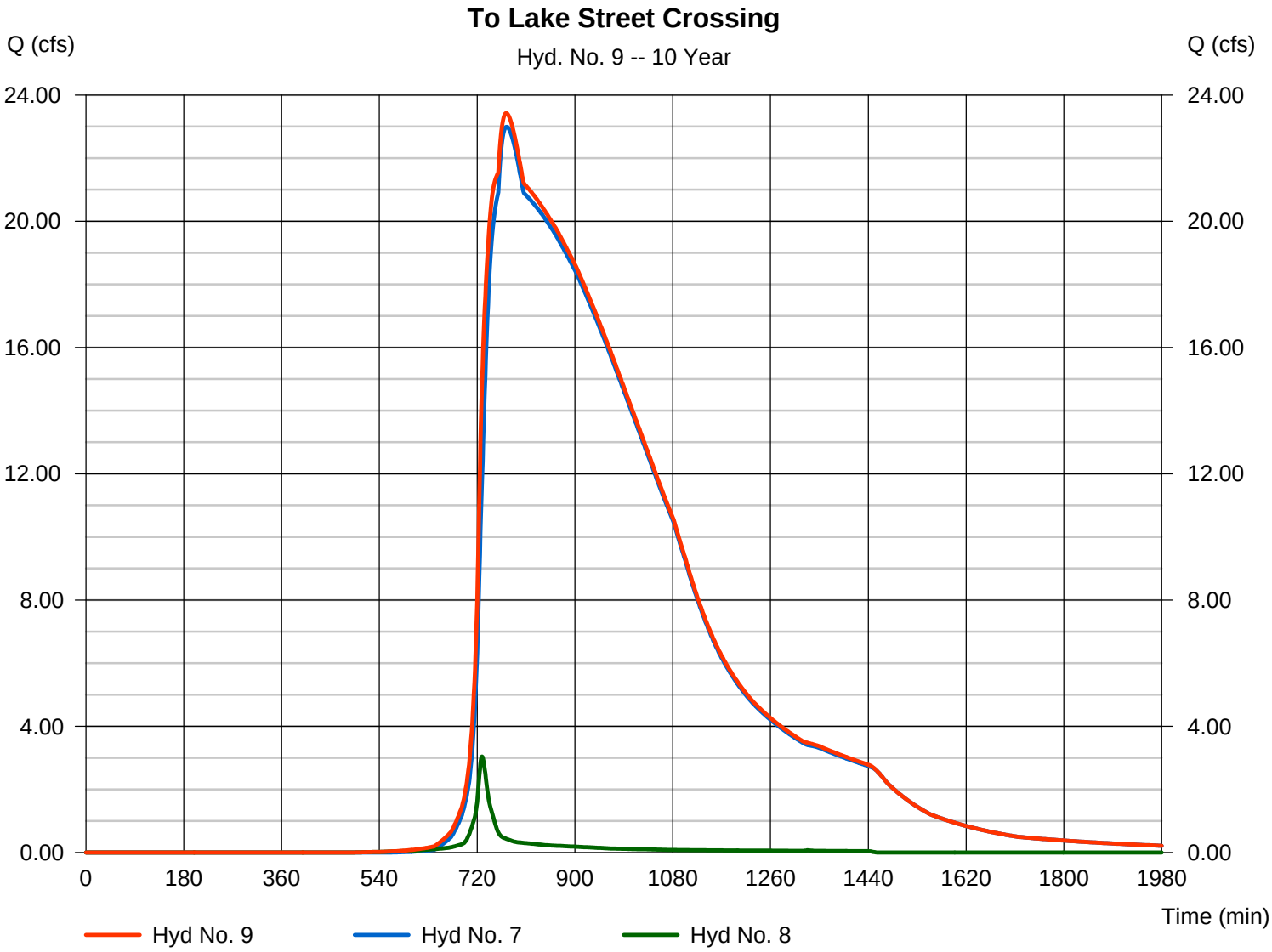


Hydrograph Report

Hyd. No. 9

To Lake Street Crossing

Hydrograph type	= Combine	Peak discharge	= 23.43 cfs
Storm frequency	= 10 yrs	Time to peak	= 774 min
Time interval	= 1 min	Hyd. volume	= 525,512 cuft
Inflow hyds.	= 7, 8	Contrib. drain. area	= 1.300 ac



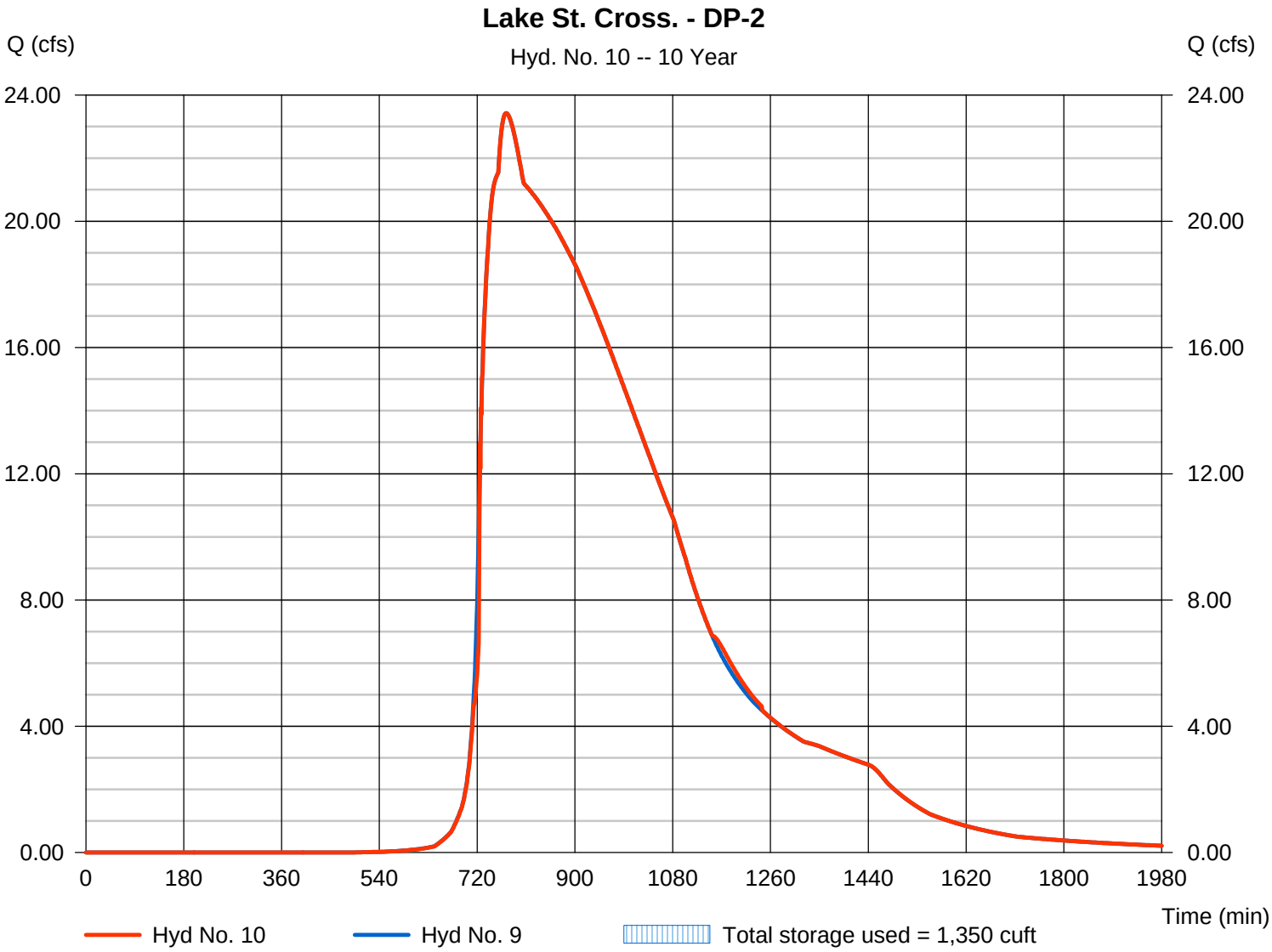
Hydrograph Report

Hyd. No. 10

Lake St. Cross. - DP-2

Hydrograph type	=	Reservoir	Peak discharge	=	23.43 cfs
Storm frequency	=	10 yrs	Time to peak	=	774 min
Time interval	=	1 min	Hyd. volume	=	525,507 cuft
Inflow hyd. No.	=	9 - To Lake Street Crossing	Max. Elevation	=	159.94 ft
Reservoir name	=	Lake Street Crossing	Max. Storage	=	1,350 cuft

Storage Indication method used.



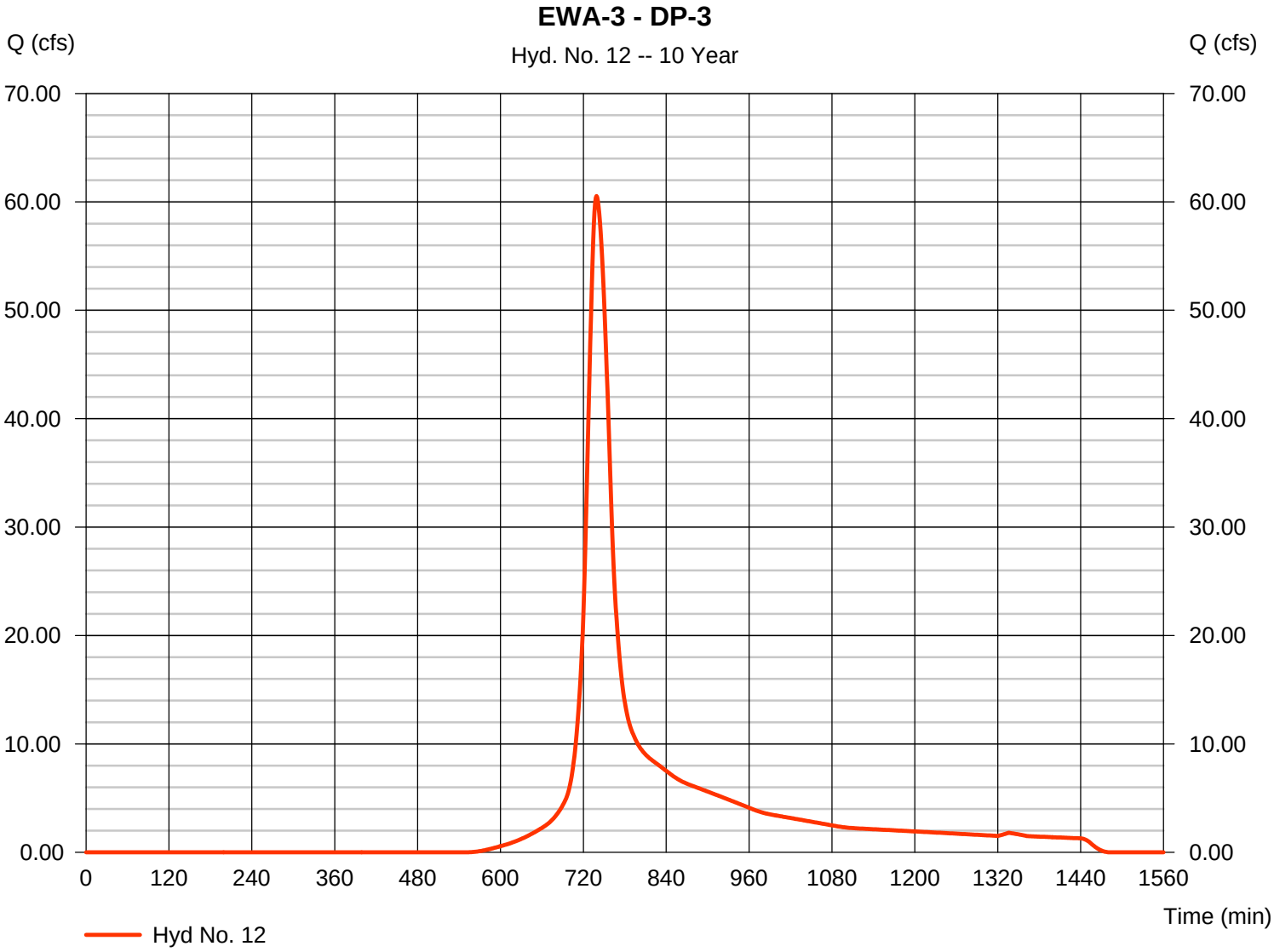
Hydrograph Report

Hyd. No. 12

EWA-3 - DP-3

Hydrograph type	=	SCS Runoff	Peak discharge	=	60.54 cfs
Storm frequency	=	10 yrs	Time to peak	=	739 min
Time interval	=	1 min	Hyd. volume	=	304,543 cuft
Drainage area	=	40.600 ac	Curve number	=	75*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	26.10 min
Total precip.	=	4.50 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.300 x 98) + (5.500 x 72) + (4.000 x 79) + (28.700 x 74) + (1.100 x 80)] / 40.600



Hydrograph Summary Report

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	27.57	1	735	126,160	------	------	------	EWA-1 - DP-1
3	SCS Runoff	141.32	1	734	623,750	------	------	------	EWA-2A
4	SCS Runoff	15.99	1	736	74,722	------	------	------	EWA-2B
5	Reach	15.90	1	738	74,721	4	------	------	EWA-2B TO EX. IRR. POND
6	Combine	156.39	1	734	698,472	3, 5	------	------	To Ex. Irrigation Pond
7	Reservoir	98.12	1	749	693,279	6	165.72	248,429	Ex. Irrigation Pond
8	SCS Runoff	4.005	1	729	15,072	------	------	------	EWA-2C
9	Combine	99.62	1	749	708,350	7, 8	------	------	To Lake Street Crossing
10	Reservoir	99.54	1	749	708,346	9	160.30	2,310	Lake St. Cross. - DP-2
12	SCS Runoff	82.62	1	739	412,527	------	------	------	EWA-3 - DP-3

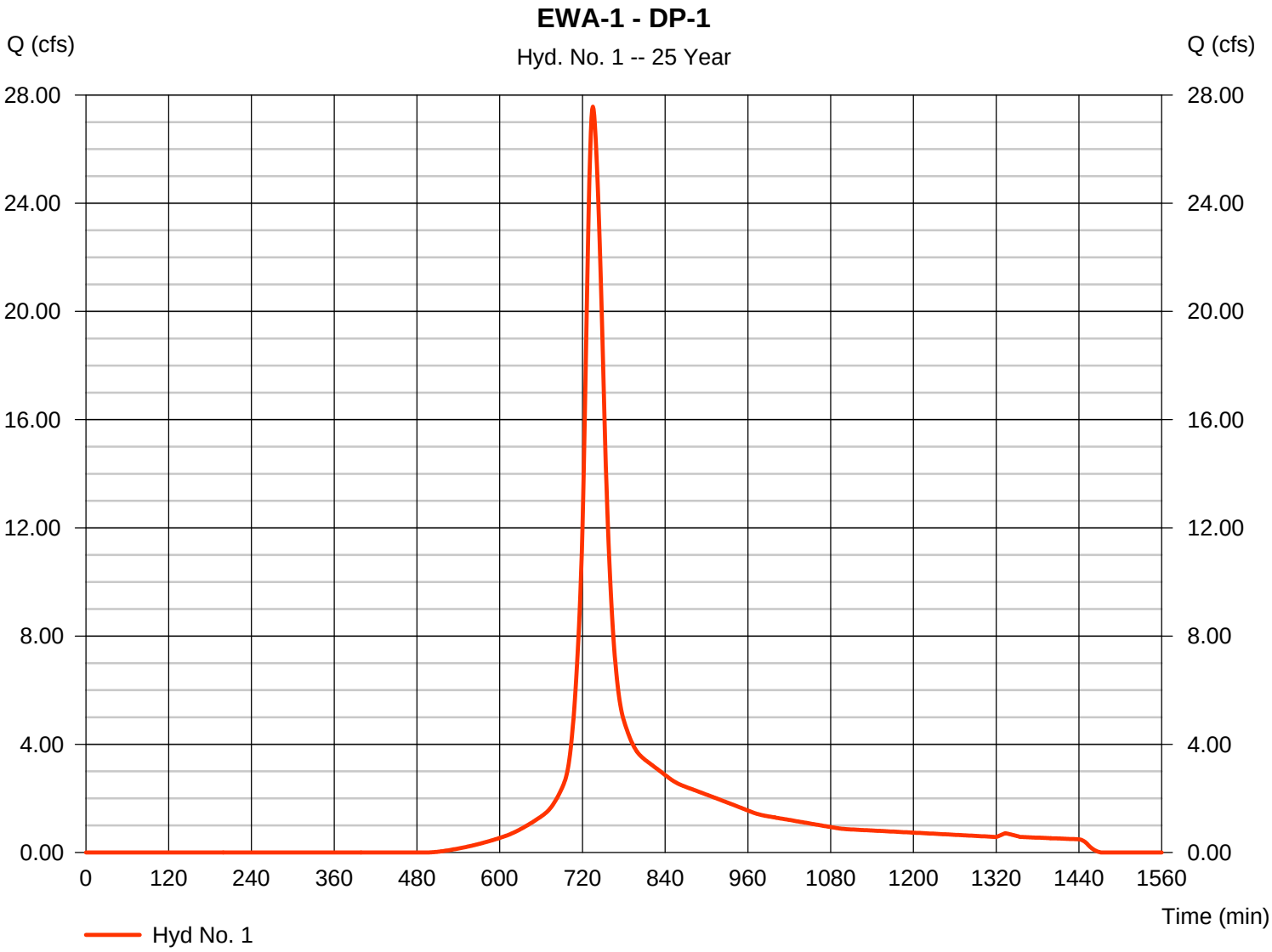
Hydrograph Report

Hyd. No. 1

EWA-1 - DP-1

Hydrograph type	=	SCS Runoff	Peak discharge	=	27.57 cfs
Storm frequency	=	25 yrs	Time to peak	=	735 min
Time interval	=	1 min	Hyd. volume	=	126,160 cuft
Drainage area	=	12.000 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	20.80 min
Total precip.	=	5.40 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.400 x 98) + (5.900 x 72) + (4.700 x 74)] / 12.000



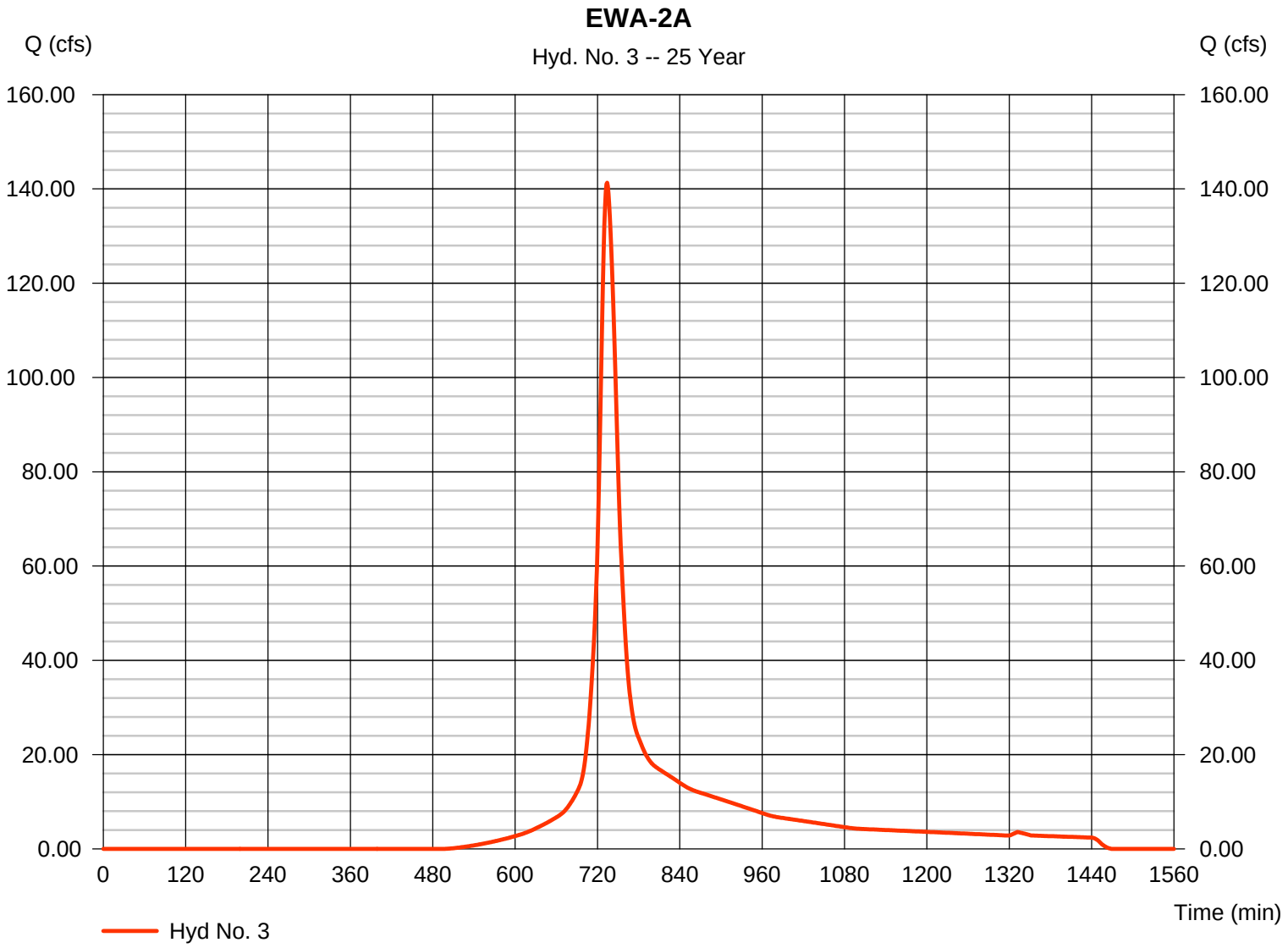
Hydrograph Report

Hyd. No. 3

EWA-2A

Hydrograph type	=	SCS Runoff	Peak discharge	=	141.32 cfs
Storm frequency	=	25 yrs	Time to peak	=	734 min
Time interval	=	1 min	Hyd. volume	=	623,750 cuft
Drainage area	=	59.900 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	19.10 min
Total precip.	=	5.40 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(4.300 x 98) + (6.200 x 72) + (49.400 x 74)] / 59.900



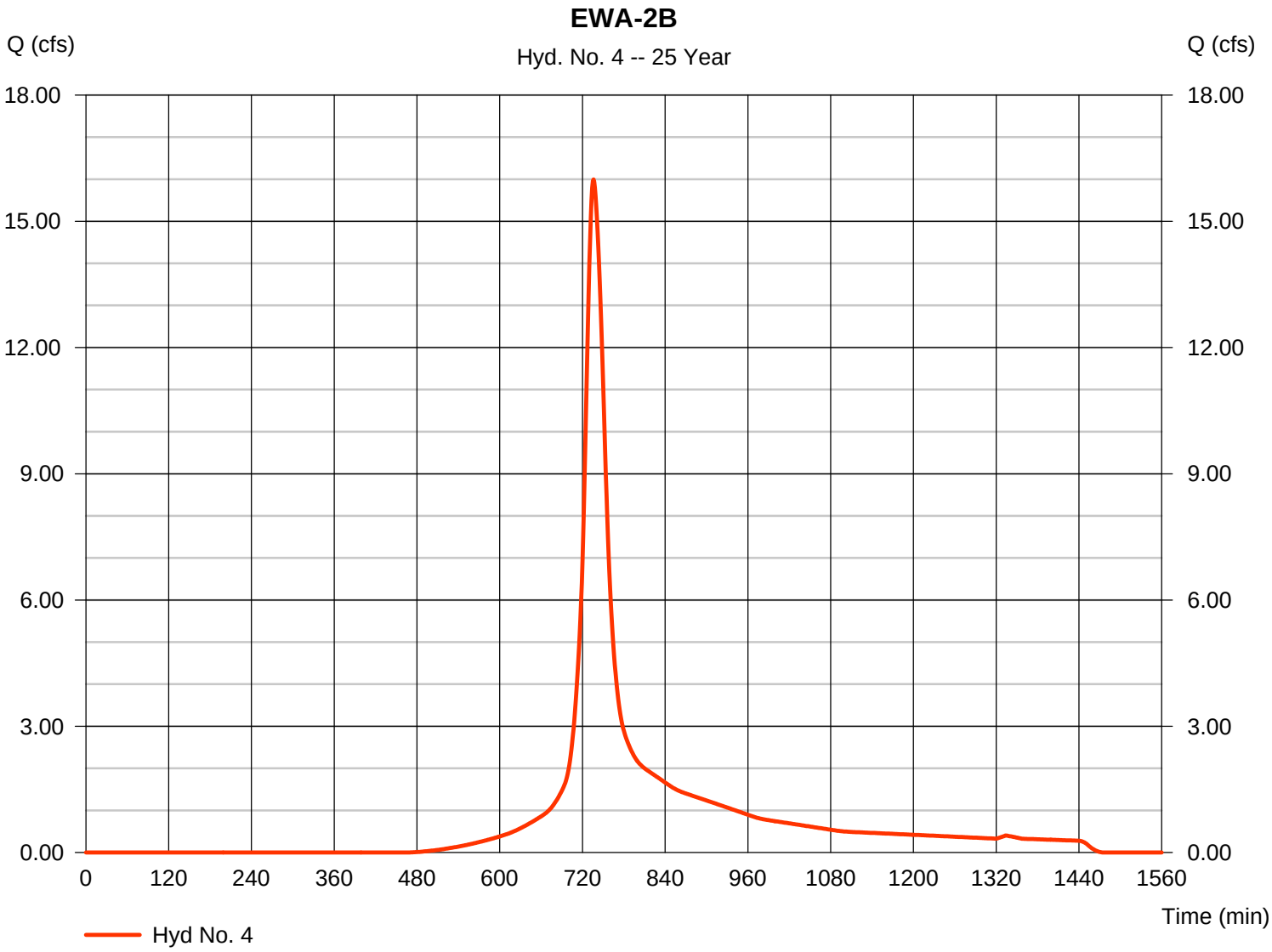
Hydrograph Report

Hyd. No. 4

EWA-2B

Hydrograph type	=	SCS Runoff	Peak discharge	=	15.99 cfs
Storm frequency	=	25 yrs	Time to peak	=	736 min
Time interval	=	1 min	Hyd. volume	=	74,722 cuft
Drainage area	=	6.800 ac	Curve number	=	78*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	22.70 min
Total precip.	=	5.40 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.300 x 98) + (2.700 x 72) + (2.800 x 74)] / 6.800



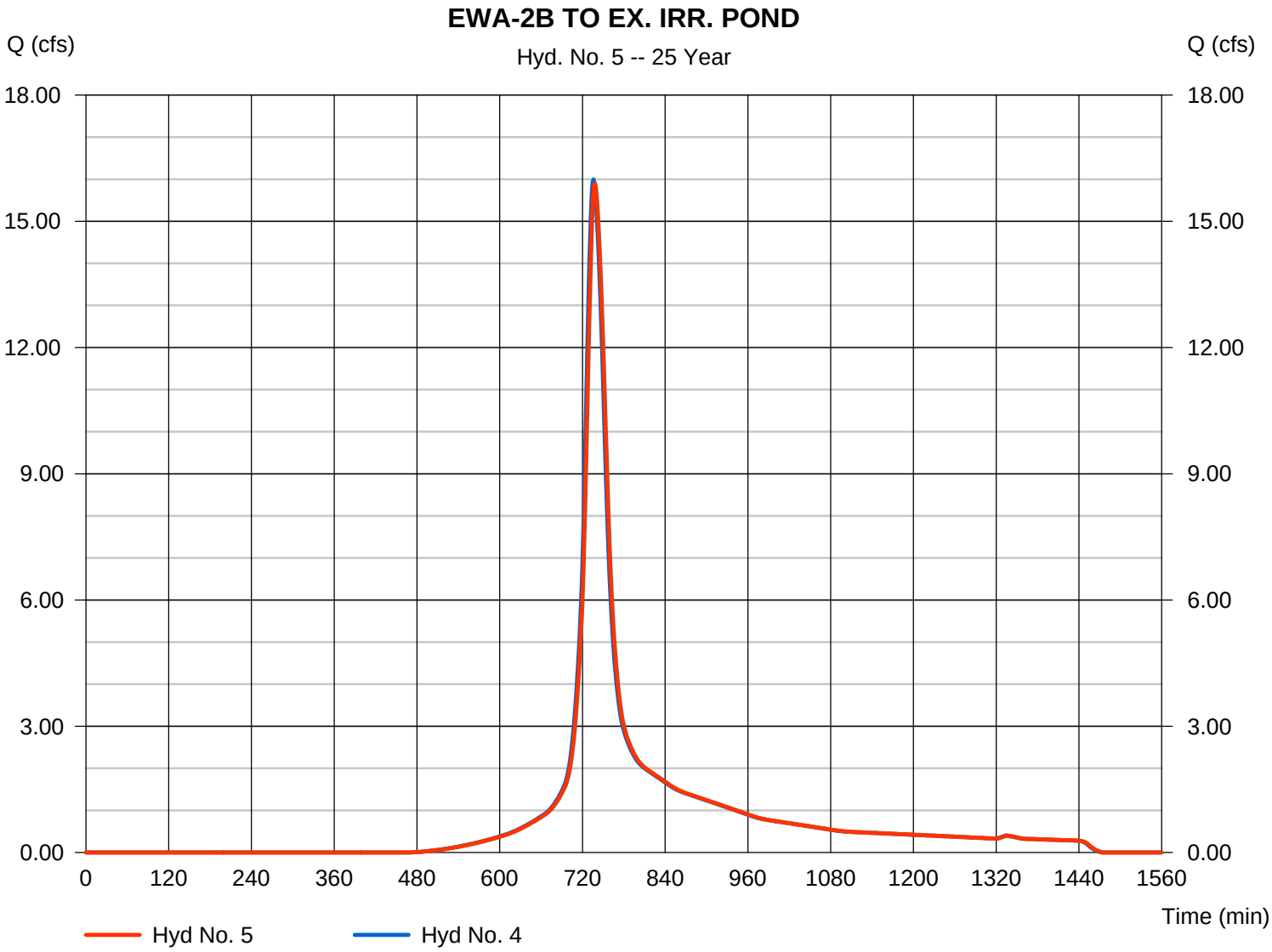
Hydrograph Report

Hyd. No. 5

EWA-2B TO EX. IRR. POND

Hydrograph type	=	Reach	Peak discharge	=	15.90 cfs
Storm frequency	=	25 yrs	Time to peak	=	738 min
Time interval	=	1 min	Hyd. volume	=	74,721 cuft
Inflow hyd. No.	=	4 - EWA-2B	Section type	=	Trapezoidal
Reach length	=	300.0 ft	Channel slope	=	3.0 %
Manning's n	=	0.040	Bottom width	=	5.0 ft
Side slope	=	3.0:1	Max. depth	=	1.0 ft
Rating curve x	=	2.205	Rating curve m	=	1.190
Ave. velocity	=	0.00 ft/s	Routing coeff.	=	0.5293

Modified Att-Kin routing method used.

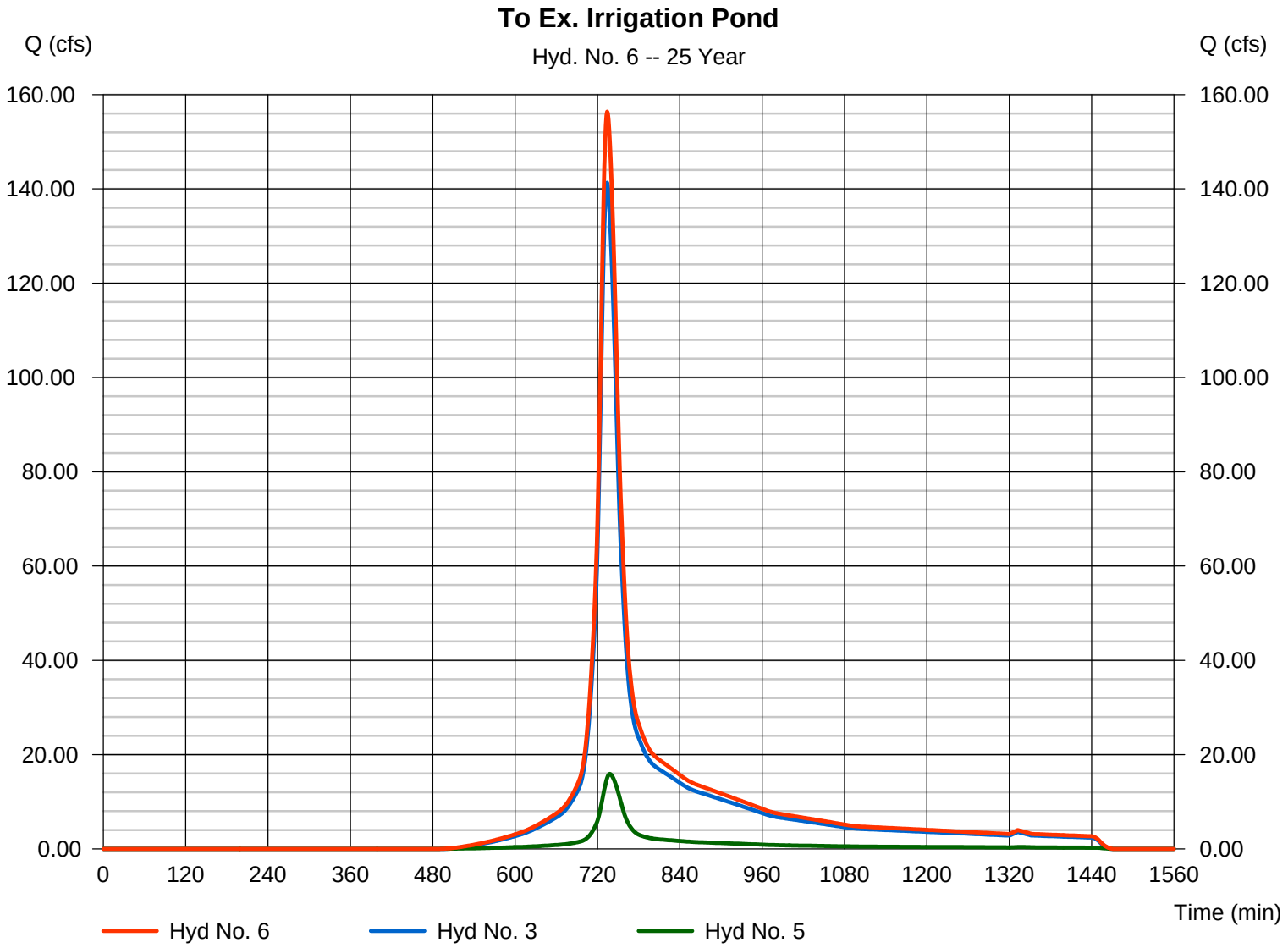


Hydrograph Report

Hyd. No. 6

To Ex. Irrigation Pond

Hydrograph type	= Combine	Peak discharge	= 156.39 cfs
Storm frequency	= 25 yrs	Time to peak	= 734 min
Time interval	= 1 min	Hyd. volume	= 698,472 cuft
Inflow hyds.	= 3, 5	Contrib. drain. area	= 59.900 ac



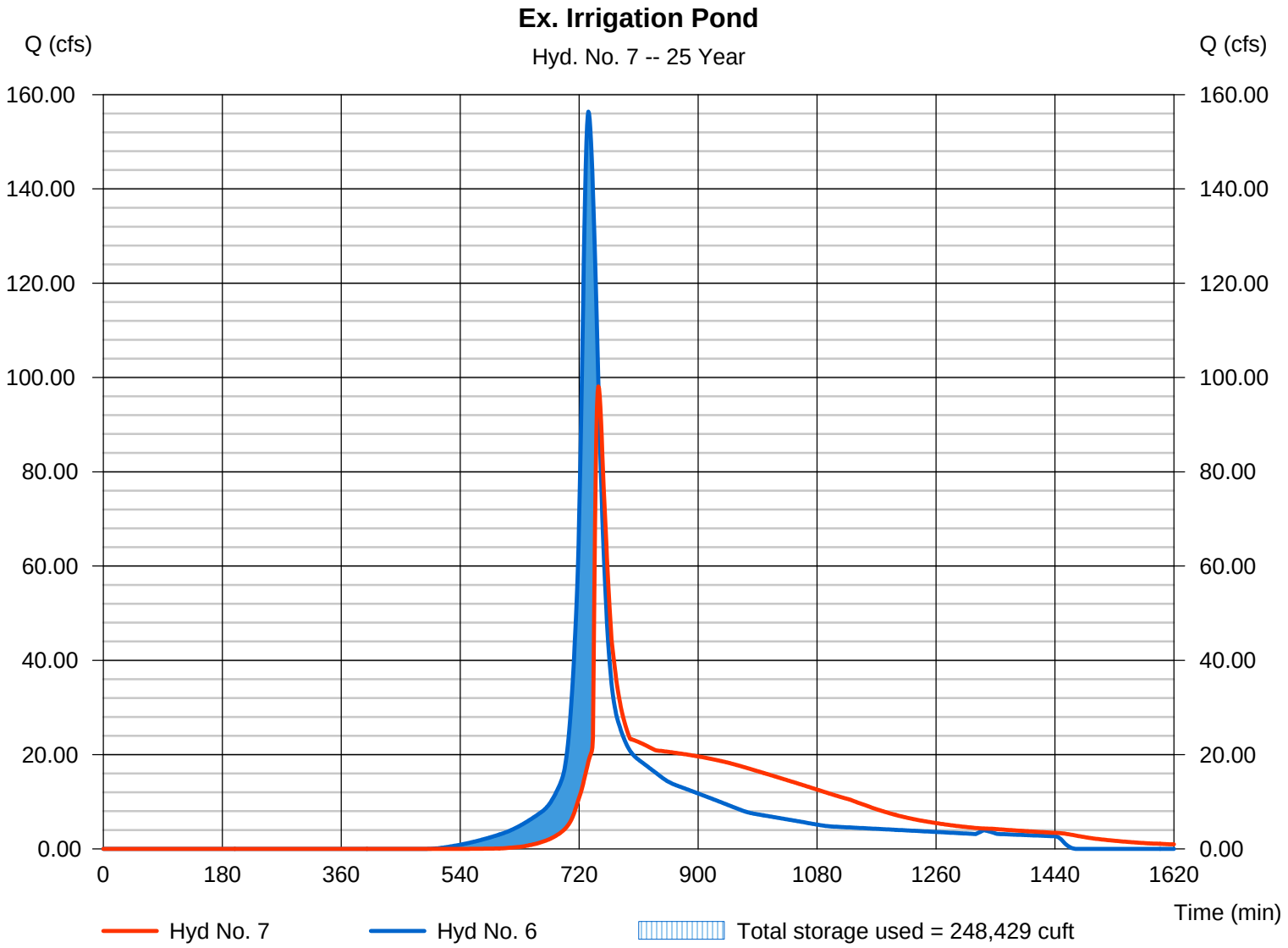
Hydrograph Report

Hyd. No. 7

Ex. Irrigation Pond

Hydrograph type	=	Reservoir	Peak discharge	=	98.12 cfs
Storm frequency	=	25 yrs	Time to peak	=	749 min
Time interval	=	1 min	Hyd. volume	=	693,279 cuft
Inflow hyd. No.	=	6 - To Ex. Irrigation Pond	Max. Elevation	=	165.72 ft
Reservoir name	=	Ex. Irrigation Pond	Max. Storage	=	248,429 cuft

Storage Indication method used.



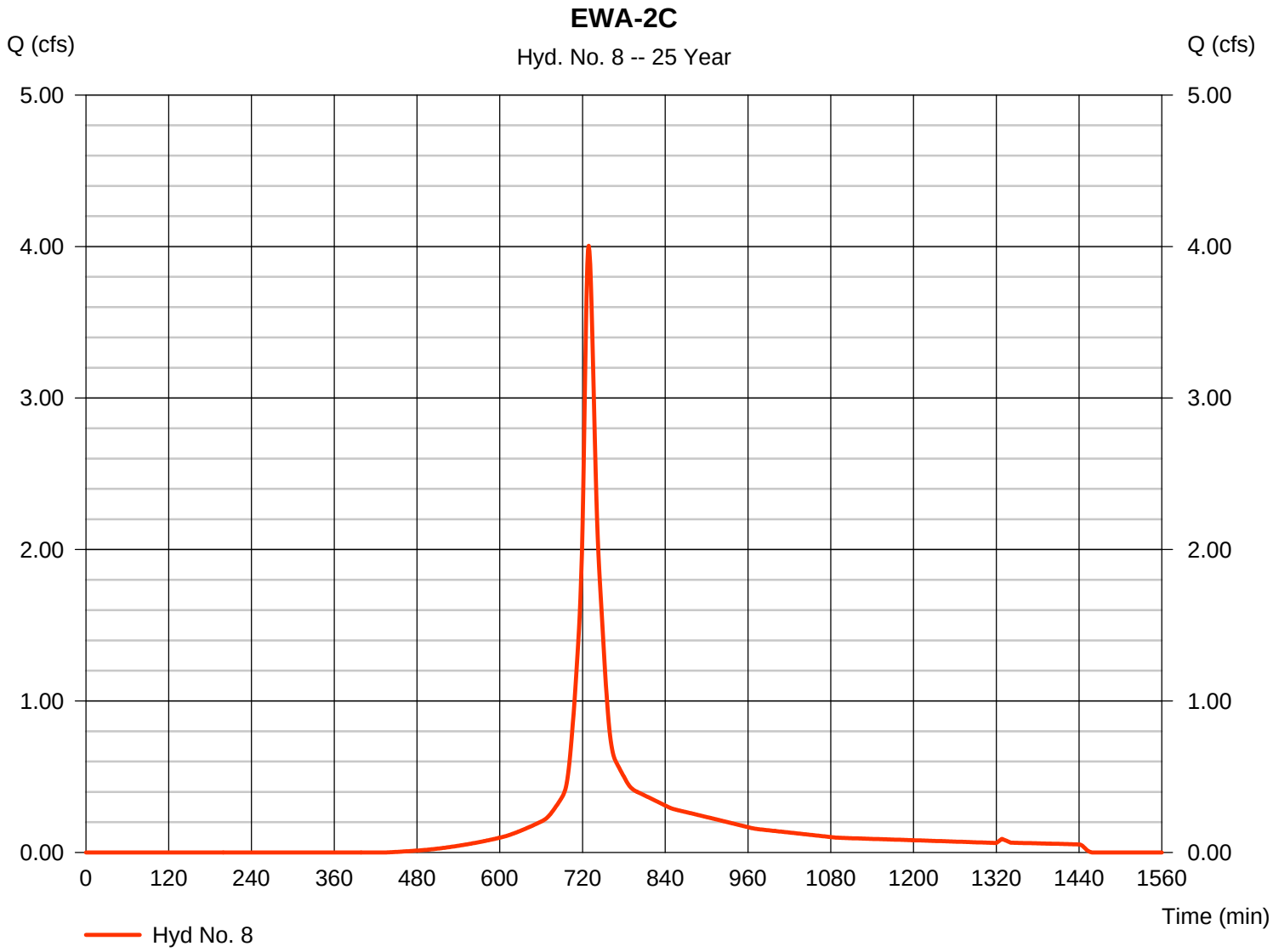
Hydrograph Report

Hyd. No. 8

EWA-2C

Hydrograph type	=	SCS Runoff	Peak discharge	=	4.005 cfs
Storm frequency	=	25 yrs	Time to peak	=	729 min
Time interval	=	1 min	Hyd. volume	=	15,072 cuft
Drainage area	=	1.300 ac	Curve number	=	80*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	12.60 min
Total precip.	=	5.40 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.400 x 98) + (0.900 x 72)] / 1.300

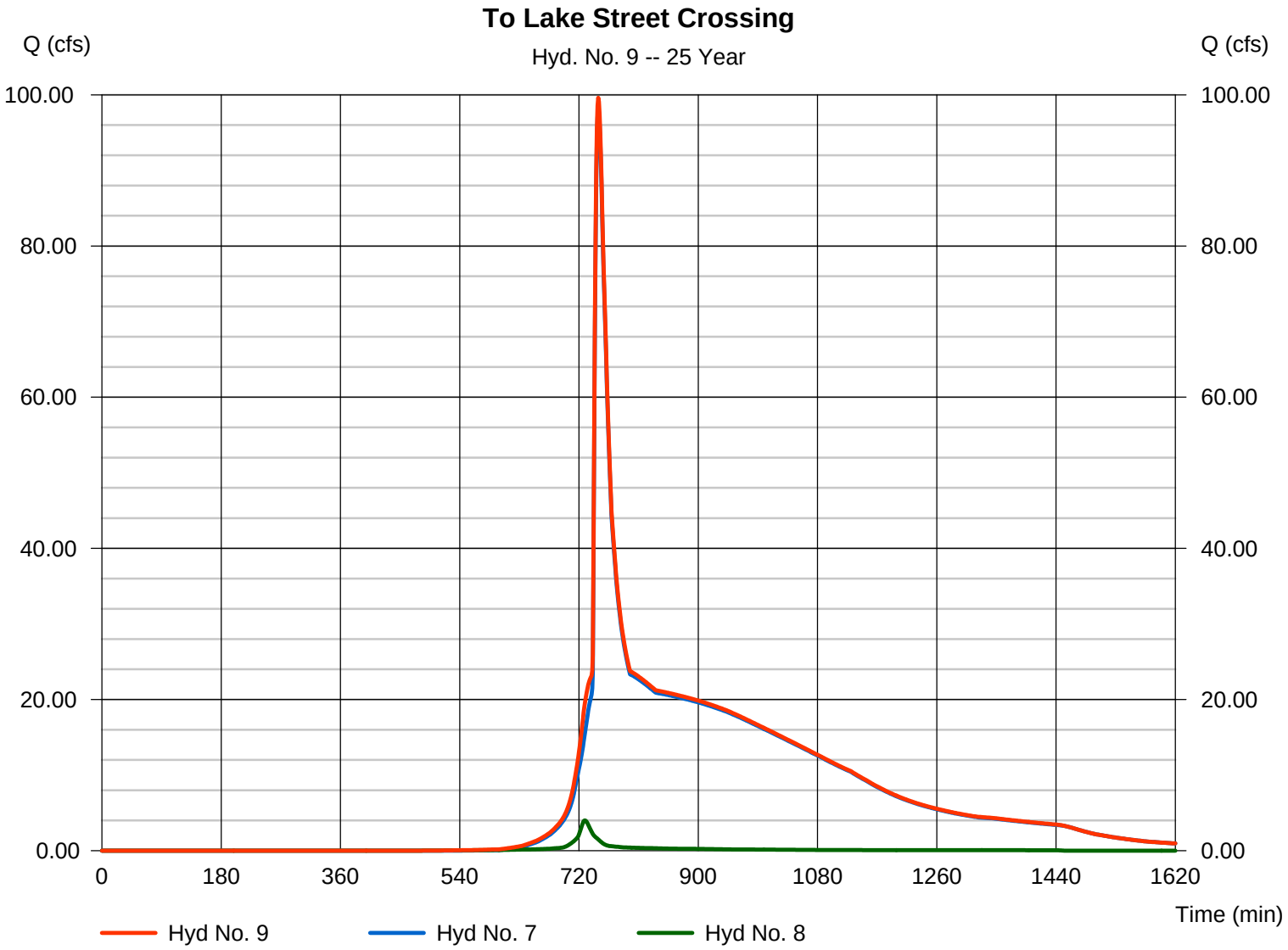


Hydrograph Report

Hyd. No. 9

To Lake Street Crossing

Hydrograph type	= Combine	Peak discharge	= 99.62 cfs
Storm frequency	= 25 yrs	Time to peak	= 749 min
Time interval	= 1 min	Hyd. volume	= 708,350 cuft
Inflow hyds.	= 7, 8	Contrib. drain. area	= 1.300 ac



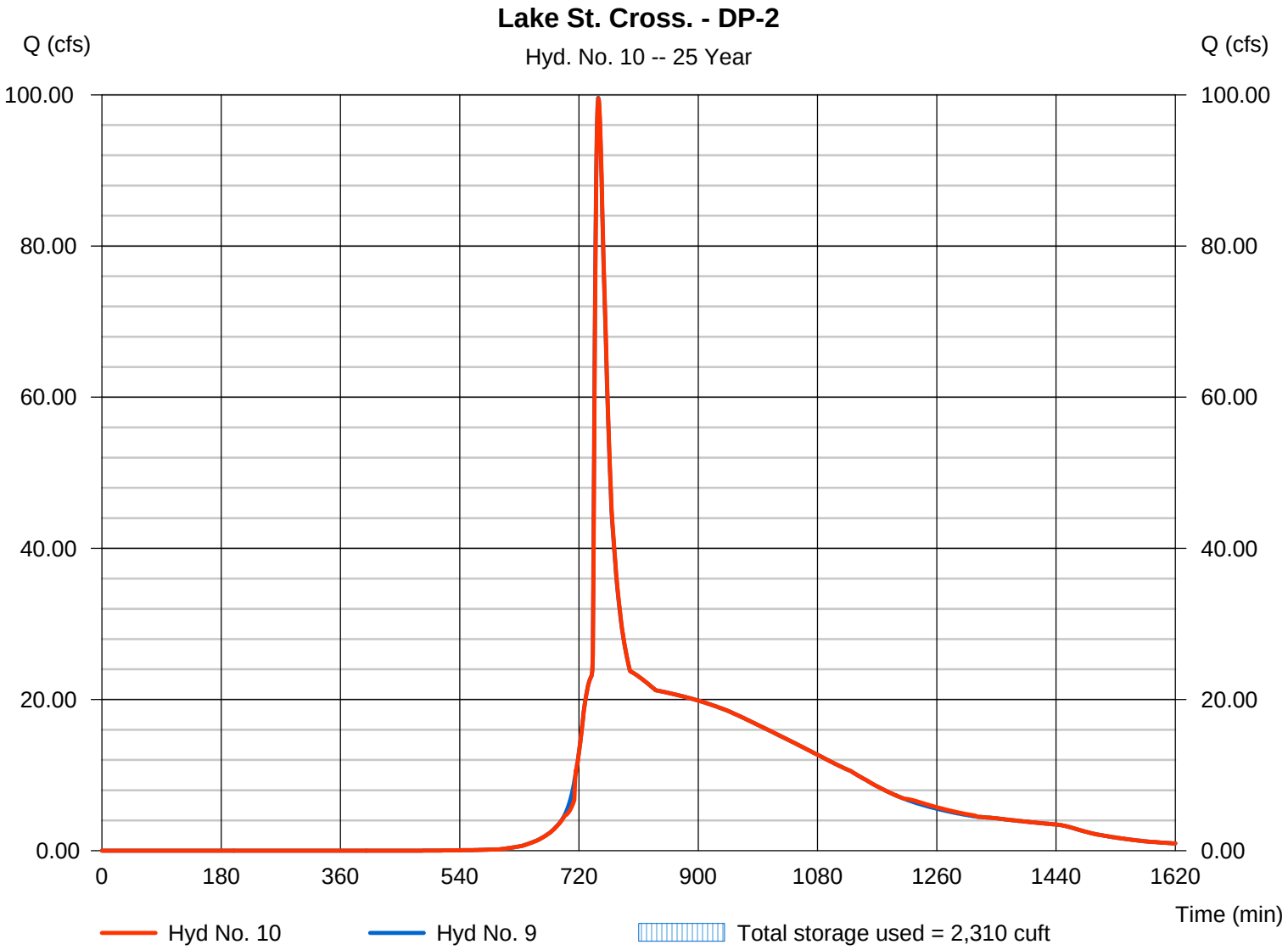
Hydrograph Report

Hyd. No. 10

Lake St. Cross. - DP-2

Hydrograph type	=	Reservoir	Peak discharge	=	99.54 cfs
Storm frequency	=	25 yrs	Time to peak	=	749 min
Time interval	=	1 min	Hyd. volume	=	708,346 cuft
Inflow hyd. No.	=	9 - To Lake Street Crossing	Max. Elevation	=	160.30 ft
Reservoir name	=	Lake Street Crossing	Max. Storage	=	2,310 cuft

Storage Indication method used.



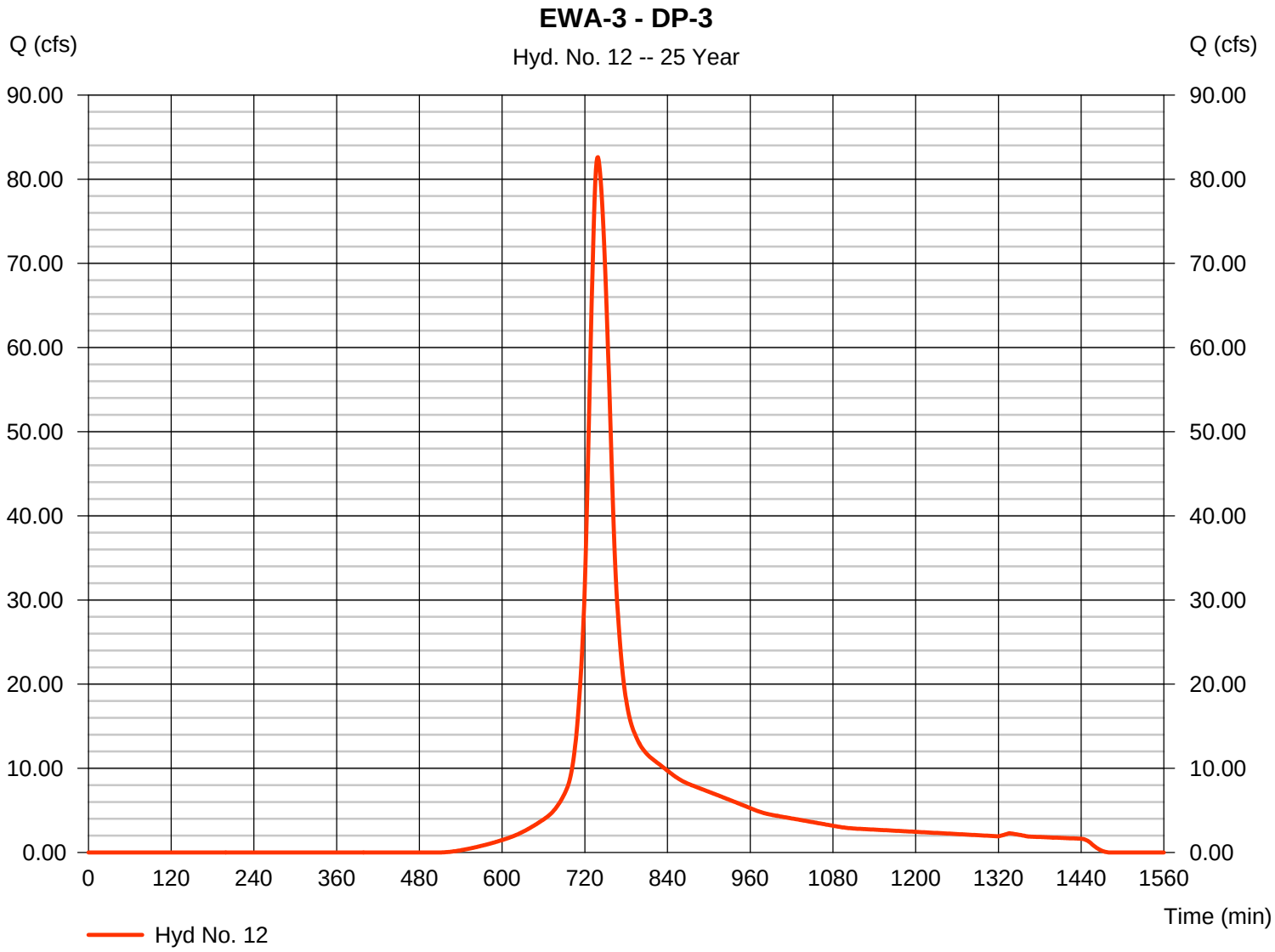
Hydrograph Report

Hyd. No. 12

EWA-3 - DP-3

Hydrograph type	=	SCS Runoff	Peak discharge	=	82.62 cfs
Storm frequency	=	25 yrs	Time to peak	=	739 min
Time interval	=	1 min	Hyd. volume	=	412,527 cuft
Drainage area	=	40.600 ac	Curve number	=	75*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	26.10 min
Total precip.	=	5.40 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.300 x 98) + (5.500 x 72) + (4.000 x 79) + (28.700 x 74) + (1.100 x 80)] / 40.600



Hydrograph Summary Report

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	31.68	1	735	144,866	------	------	------	EWA-1 - DP-1
3	SCS Runoff	162.37	1	734	716,238	------	------	------	EWA-2A
4	SCS Runoff	18.27	1	736	85,396	------	------	------	EWA-2B
5	Reach	18.17	1	738	85,395	4	------	------	EWA-2B TO EX. IRR. POND
6	Combine	179.65	1	734	801,633	3, 5	------	------	To Ex. Irrigation Pond
7	Reservoir	136.24	1	745	796,401	6	165.79	256,423	Ex. Irrigation Pond
8	SCS Runoff	4.546	1	729	17,146	------	------	------	EWA-2C
9	Combine	138.26	1	745	813,547	7, 8	------	------	To Lake Street Crossing
10	Reservoir	138.14	1	745	813,544	9	160.43	2,710	Lake St. Cross. - DP-2
12	SCS Runoff	95.24	1	738	474,850	------	------	------	EWA-3 - DP-3

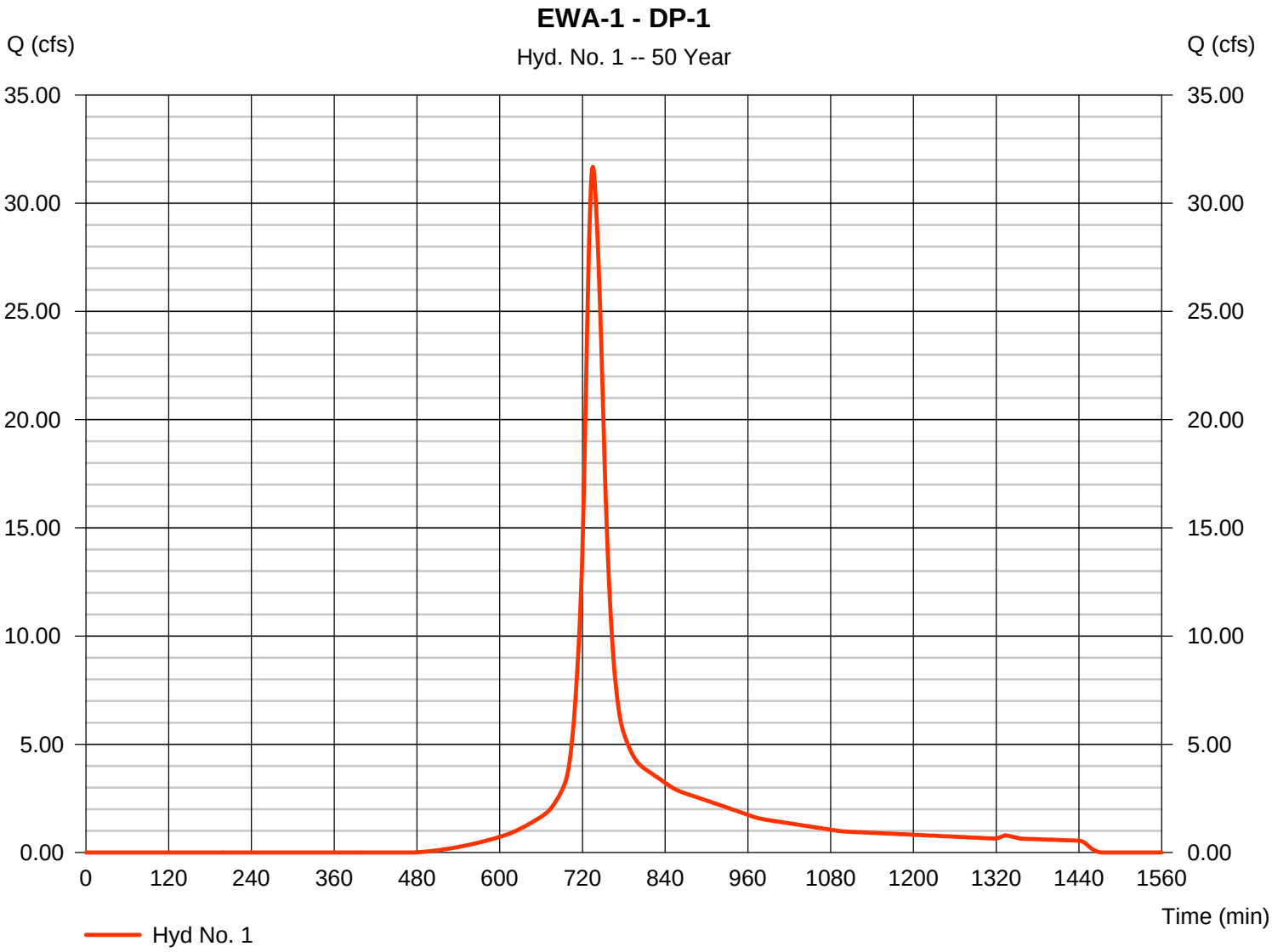
Hydrograph Report

Hyd. No. 1

EWA-1 - DP-1

Hydrograph type	=	SCS Runoff	Peak discharge	=	31.68 cfs
Storm frequency	=	50 yrs	Time to peak	=	735 min
Time interval	=	1 min	Hyd. volume	=	144,866 cuft
Drainage area	=	12.000 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	20.80 min
Total precip.	=	5.90 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.400 x 98) + (5.900 x 72) + (4.700 x 74)] / 12.000



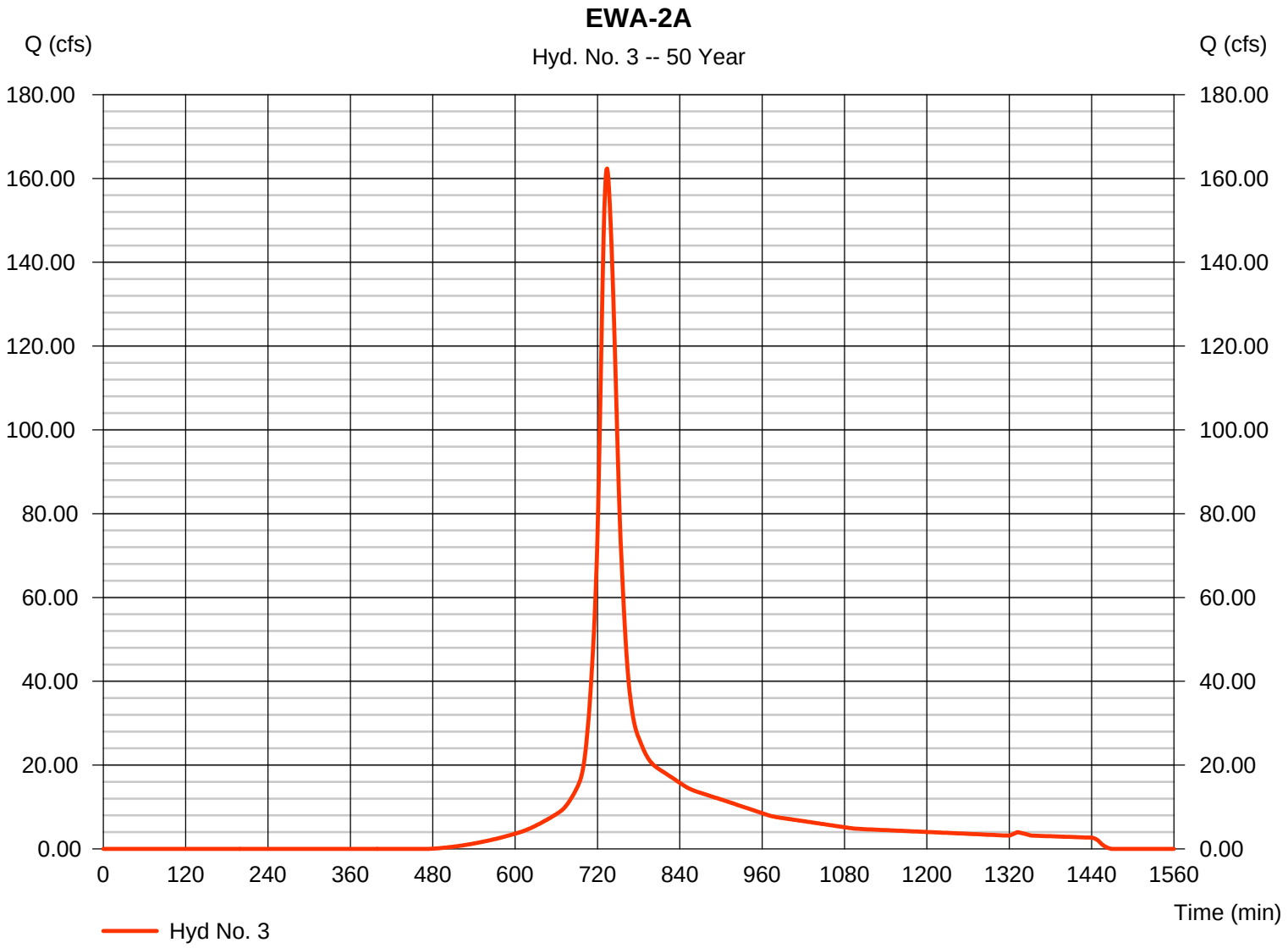
Hydrograph Report

Hyd. No. 3

EWA-2A

Hydrograph type	=	SCS Runoff	Peak discharge	=	162.37 cfs
Storm frequency	=	50 yrs	Time to peak	=	734 min
Time interval	=	1 min	Hyd. volume	=	716,238 cuft
Drainage area	=	59.900 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	19.10 min
Total precip.	=	5.90 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(4.300 x 98) + (6.200 x 72) + (49.400 x 74)] / 59.900



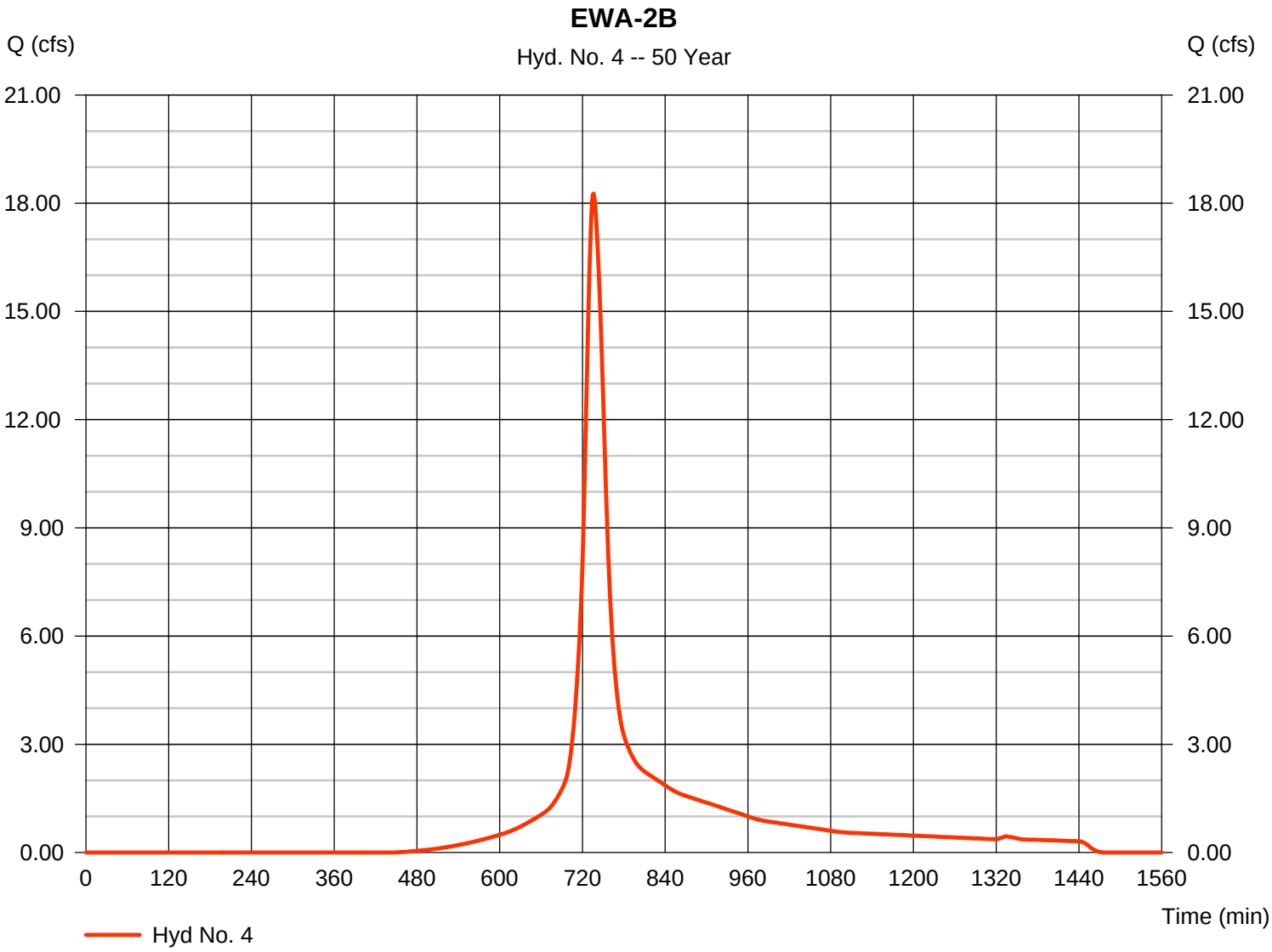
Hydrograph Report

Hyd. No. 4

EWA-2B

Hydrograph type	=	SCS Runoff	Peak discharge	=	18.27 cfs
Storm frequency	=	50 yrs	Time to peak	=	736 min
Time interval	=	1 min	Hyd. volume	=	85,396 cuft
Drainage area	=	6.800 ac	Curve number	=	78*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	22.70 min
Total precip.	=	5.90 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.300 x 98) + (2.700 x 72) + (2.800 x 74)] / 6.800



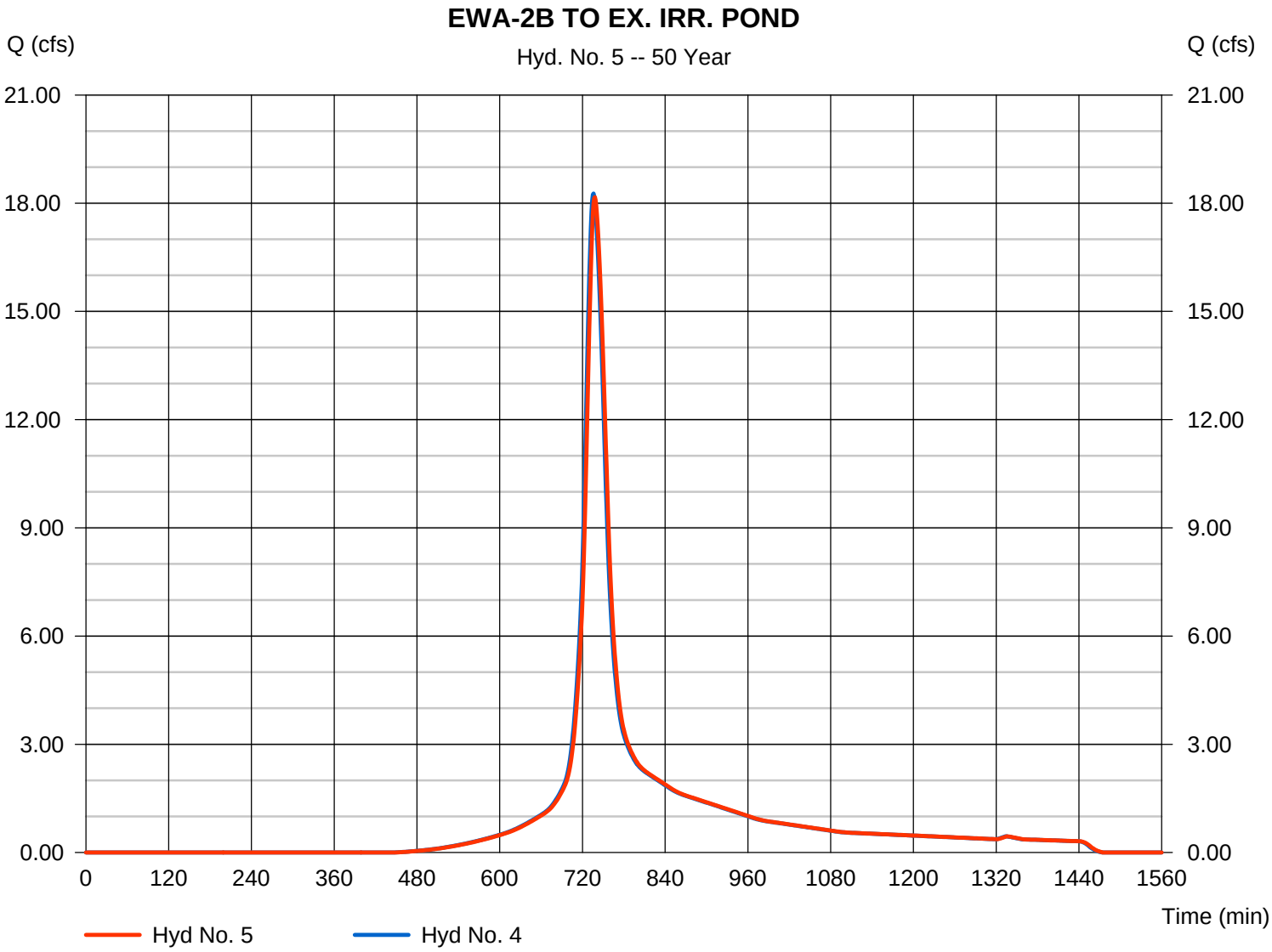
Hydrograph Report

Hyd. No. 5

EWA-2B TO EX. IRR. POND

Hydrograph type	=	Reach	Peak discharge	=	18.17 cfs
Storm frequency	=	50 yrs	Time to peak	=	738 min
Time interval	=	1 min	Hyd. volume	=	85,395 cuft
Inflow hyd. No.	=	4 - EWA-2B	Section type	=	Trapezoidal
Reach length	=	300.0 ft	Channel slope	=	3.0 %
Manning's n	=	0.040	Bottom width	=	5.0 ft
Side slope	=	3.0:1	Max. depth	=	1.0 ft
Rating curve x	=	2.205	Rating curve m	=	1.190
Ave. velocity	=	0.00 ft/s	Routing coeff.	=	0.5376

Modified Att-Kin routing method used.

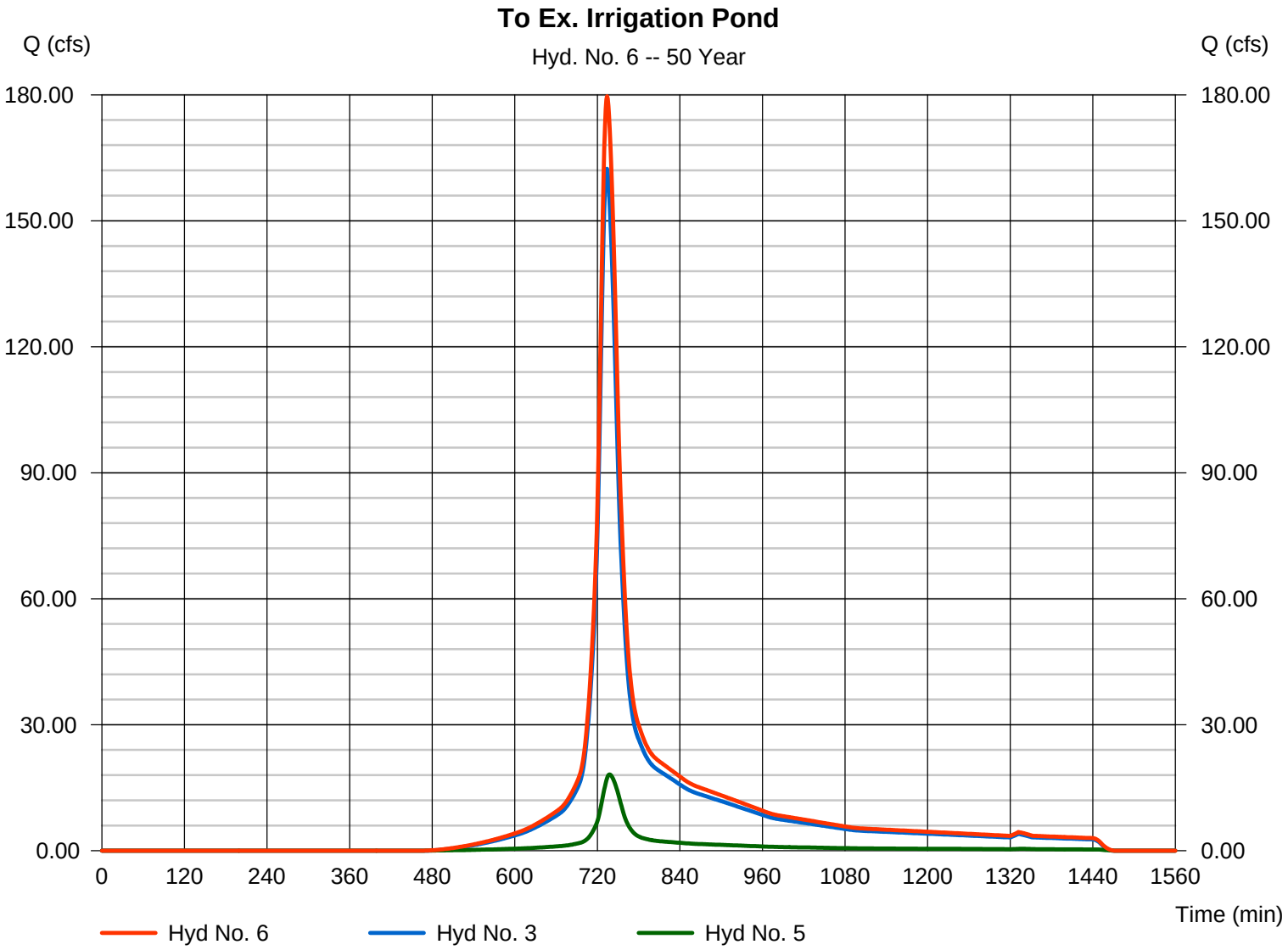


Hydrograph Report

Hyd. No. 6

To Ex. Irrigation Pond

Hydrograph type	=	Combine	Peak discharge	=	179.65 cfs
Storm frequency	=	50 yrs	Time to peak	=	734 min
Time interval	=	1 min	Hyd. volume	=	801,633 cuft
Inflow hyds.	=	3, 5	Contrib. drain. area	=	59.900 ac



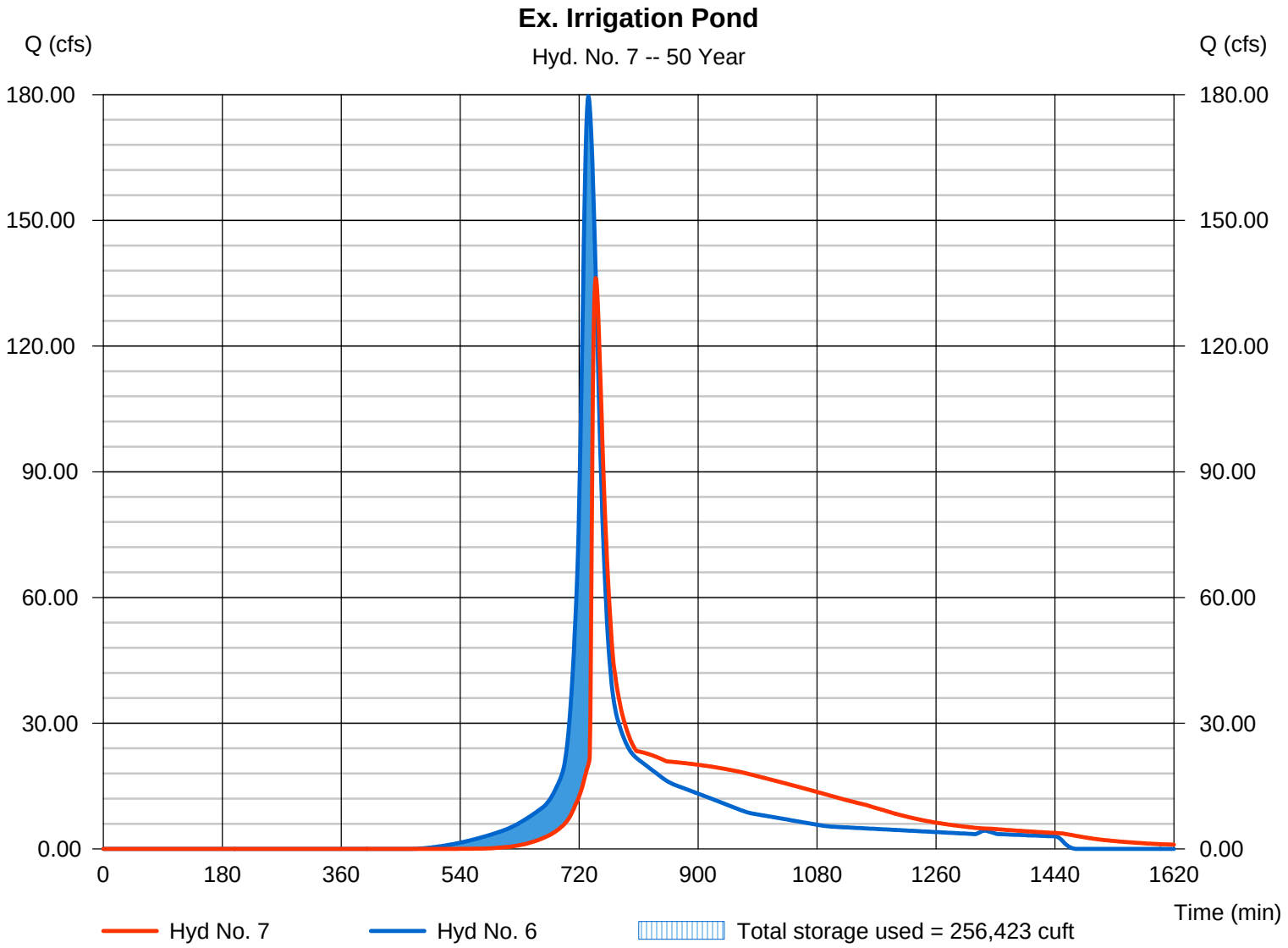
Hydrograph Report

Hyd. No. 7

Ex. Irrigation Pond

Hydrograph type	=	Reservoir	Peak discharge	=	136.24 cfs
Storm frequency	=	50 yrs	Time to peak	=	745 min
Time interval	=	1 min	Hyd. volume	=	796,401 cuft
Inflow hyd. No.	=	6 - To Ex. Irrigation Pond	Max. Elevation	=	165.79 ft
Reservoir name	=	Ex. Irrigation Pond	Max. Storage	=	256,423 cuft

Storage Indication method used.



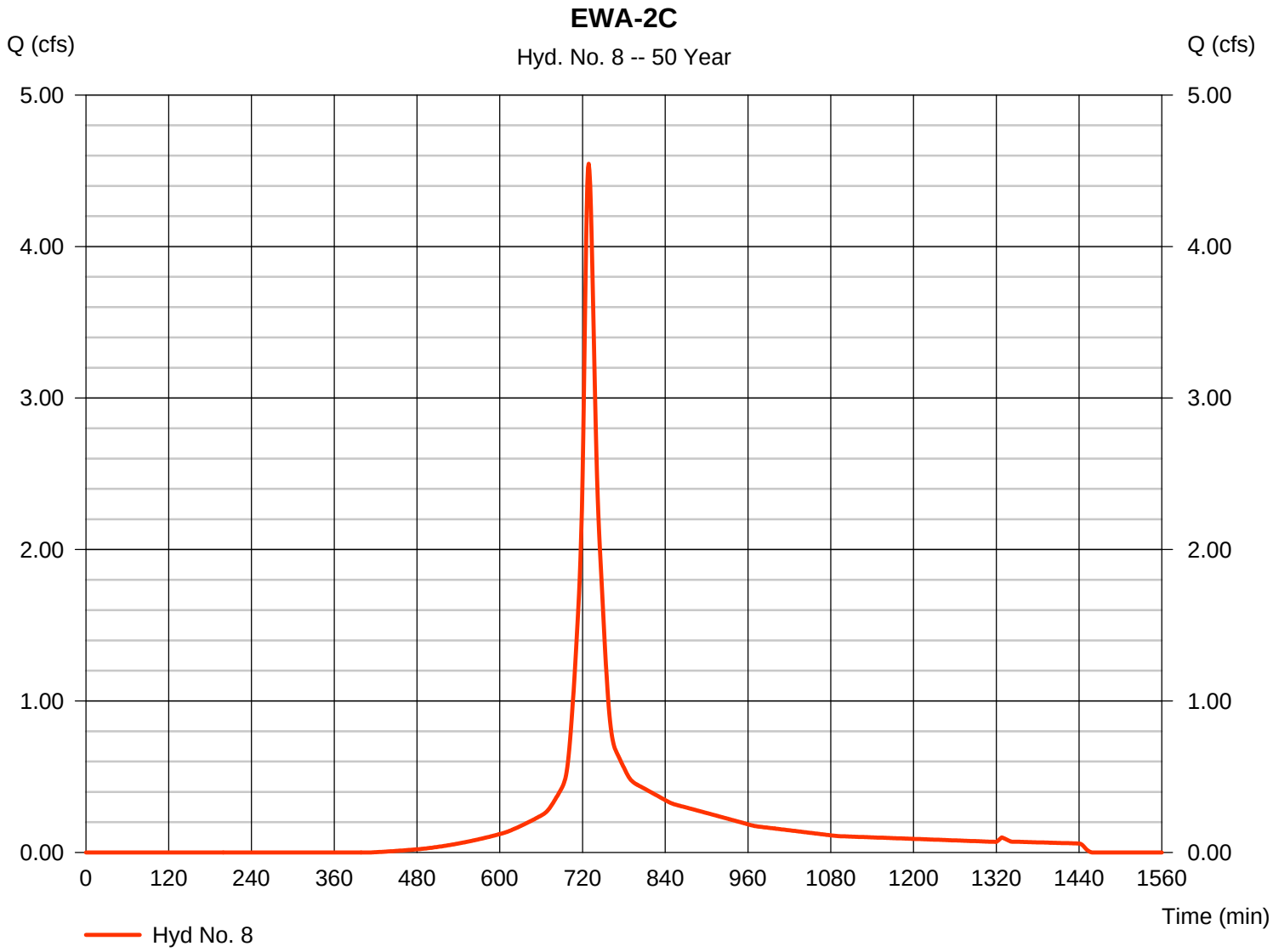
Hydrograph Report

Hyd. No. 8

EWA-2C

Hydrograph type	=	SCS Runoff	Peak discharge	=	4.546 cfs
Storm frequency	=	50 yrs	Time to peak	=	729 min
Time interval	=	1 min	Hyd. volume	=	17,146 cuft
Drainage area	=	1.300 ac	Curve number	=	80*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	12.60 min
Total precip.	=	5.90 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.400 x 98) + (0.900 x 72)] / 1.300

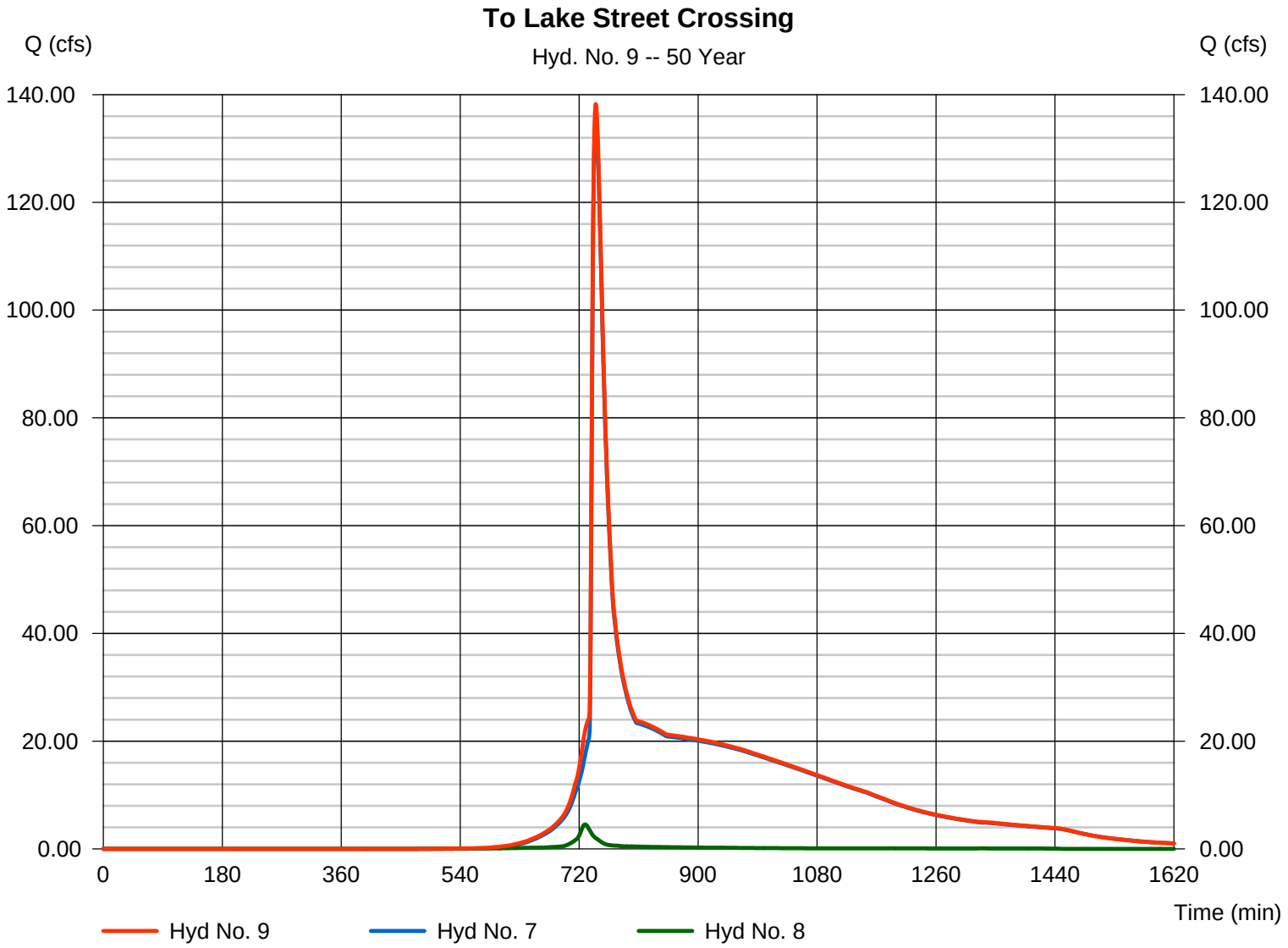


Hydrograph Report

Hyd. No. 9

To Lake Street Crossing

Hydrograph type	= Combine	Peak discharge	= 138.26 cfs
Storm frequency	= 50 yrs	Time to peak	= 745 min
Time interval	= 1 min	Hyd. volume	= 813,547 cuft
Inflow hyds.	= 7, 8	Contrib. drain. area	= 1.300 ac



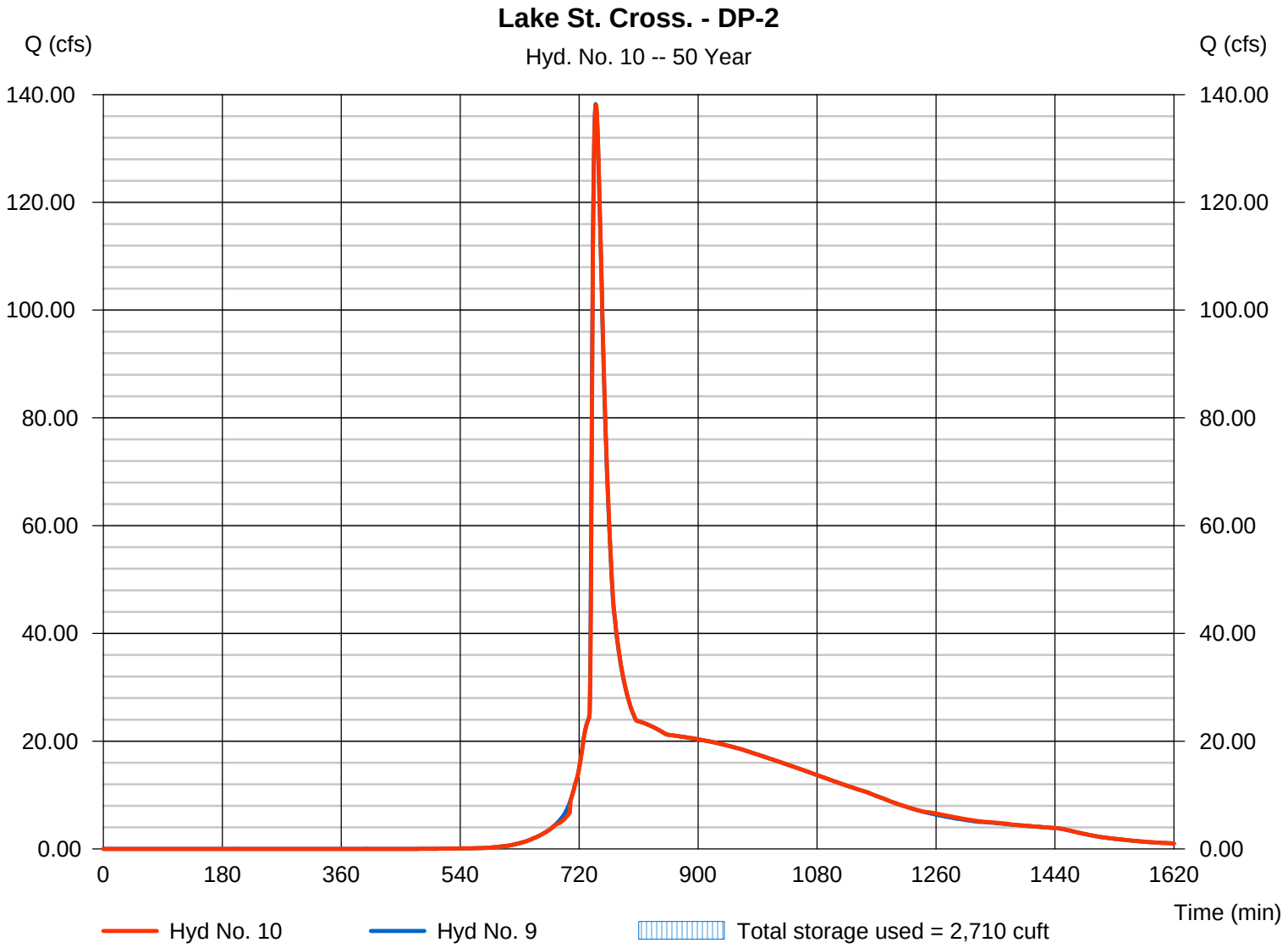
Hydrograph Report

Hyd. No. 10

Lake St. Cross. - DP-2

Hydrograph type	=	Reservoir	Peak discharge	=	138.14 cfs
Storm frequency	=	50 yrs	Time to peak	=	745 min
Time interval	=	1 min	Hyd. volume	=	813,544 cuft
Inflow hyd. No.	=	9 - To Lake Street Crossing	Max. Elevation	=	160.43 ft
Reservoir name	=	Lake Street Crossing	Max. Storage	=	2,710 cuft

Storage Indication method used.



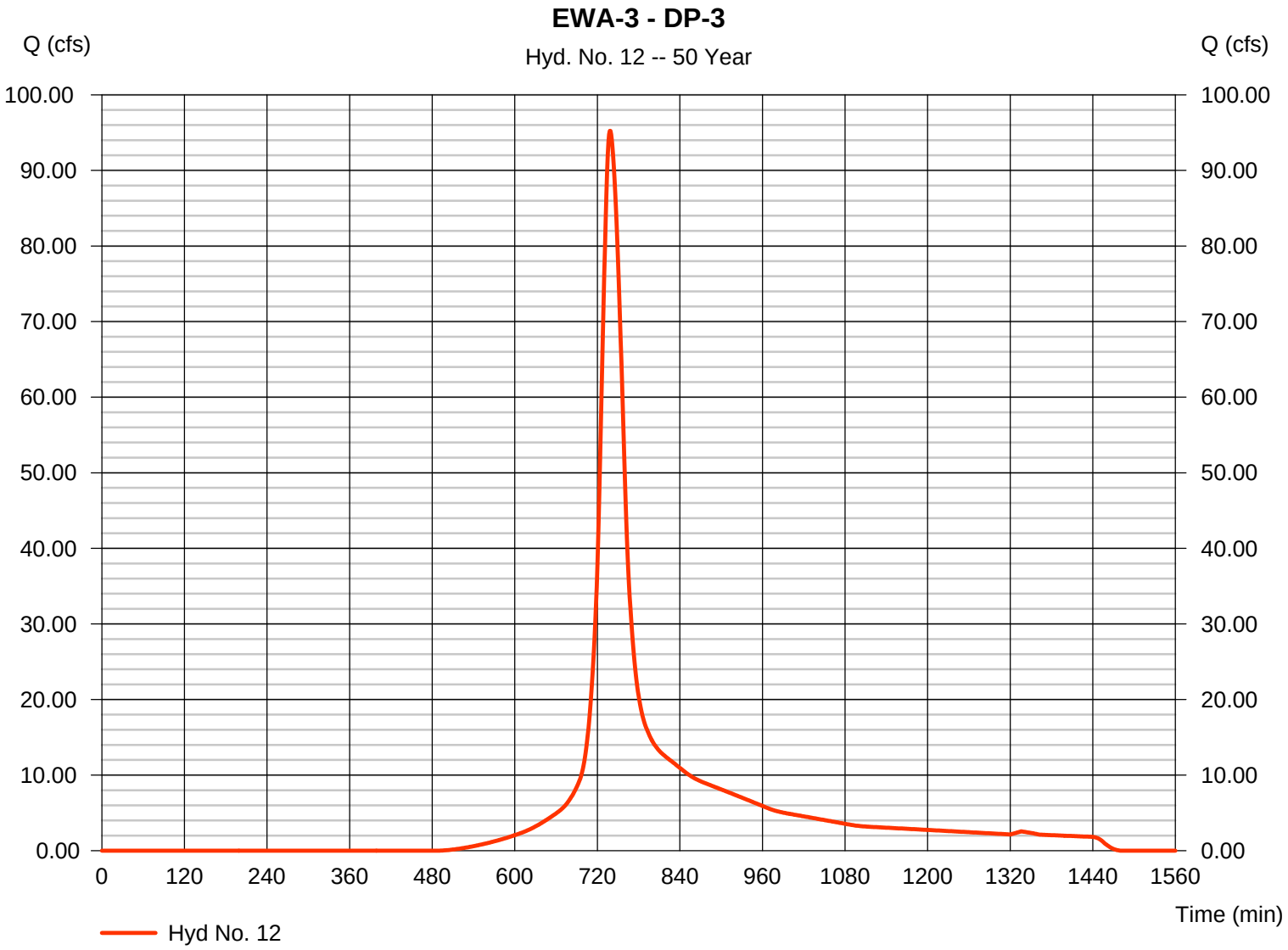
Hydrograph Report

Hyd. No. 12

EWA-3 - DP-3

Hydrograph type	=	SCS Runoff	Peak discharge	=	95.24 cfs
Storm frequency	=	50 yrs	Time to peak	=	738 min
Time interval	=	1 min	Hyd. volume	=	474,850 cuft
Drainage area	=	40.600 ac	Curve number	=	75*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	26.10 min
Total precip.	=	5.90 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.300 x 98) + (5.500 x 72) + (4.000 x 79) + (28.700 x 74) + (1.100 x 80)] / 40.600



Hydrograph Summary Report

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	36.69	1	735	167,794	------	------	------	EWA-1 - DP-1
3	SCS Runoff	187.95	1	734	829,593	------	------	------	EWA-2A
4	SCS Runoff	21.03	1	736	98,439	------	------	------	EWA-2B
5	Reach	20.91	1	738	98,438	4	------	------	EWA-2B TO EX. IRR. POND
6	Combine	207.92	1	734	928,031	3, 5	------	------	To Ex. Irrigation Pond
7	Reservoir	177.71	1	742	922,763	6	165.86	264,168	Ex. Irrigation Pond
8	SCS Runoff	5.200	1	729	19,674	------	------	------	EWA-2C
9	Combine	180.37	1	742	942,437	7, 8	------	------	To Lake Street Crossing
10	Reservoir	180.33	1	742	942,430	9	160.56	3,106	Lake St. Cross. - DP-2
12	SCS Runoff	110.69	1	738	551,359	------	------	------	EWA-3 - DP-3

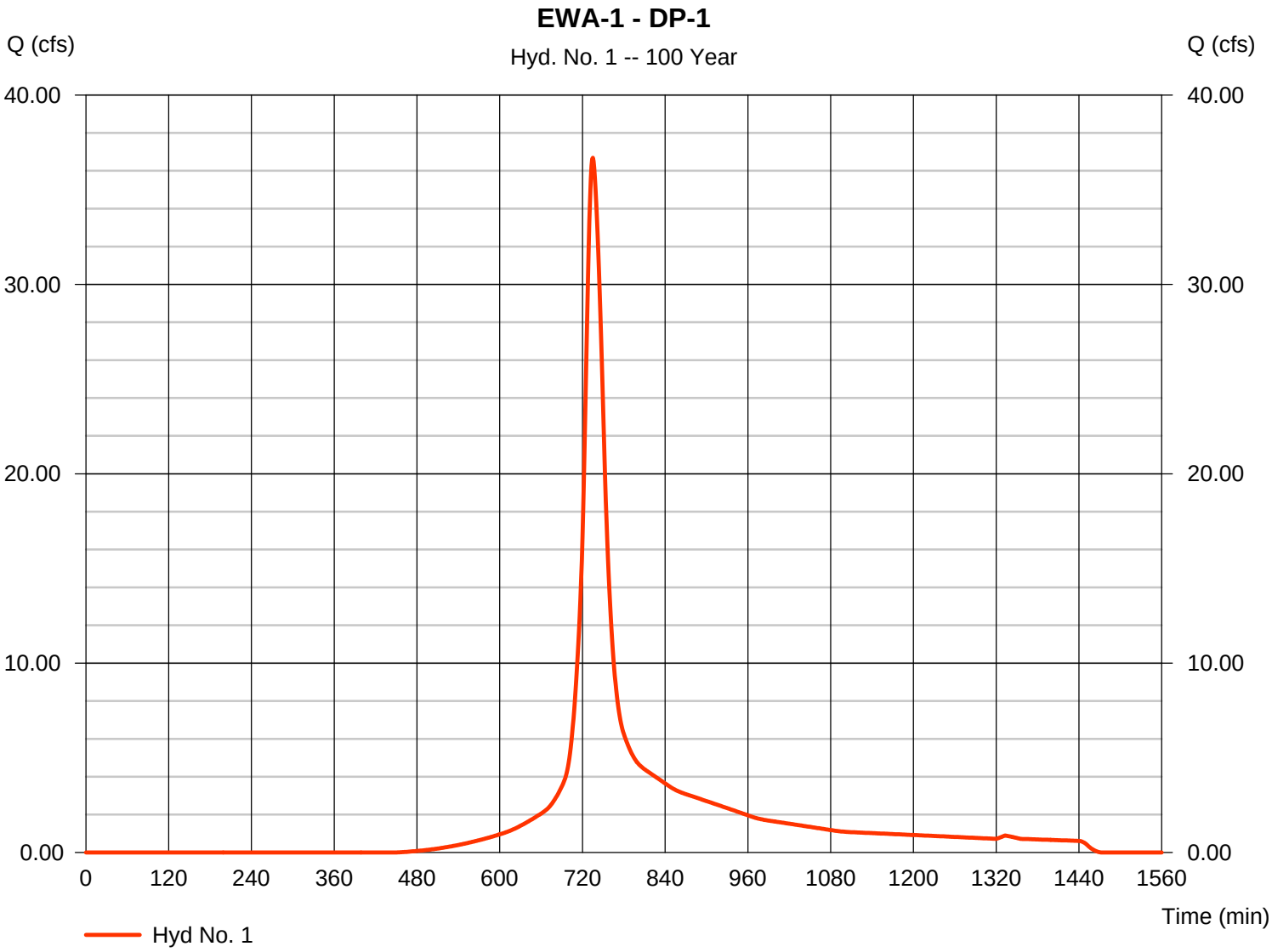
Hydrograph Report

Hyd. No. 1

EWA-1 - DP-1

Hydrograph type	=	SCS Runoff	Peak discharge	=	36.69 cfs
Storm frequency	=	100 yrs	Time to peak	=	735 min
Time interval	=	1 min	Hyd. volume	=	167,794 cuft
Drainage area	=	12.000 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	20.80 min
Total precip.	=	6.50 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.400 x 98) + (5.900 x 72) + (4.700 x 74)] / 12.000



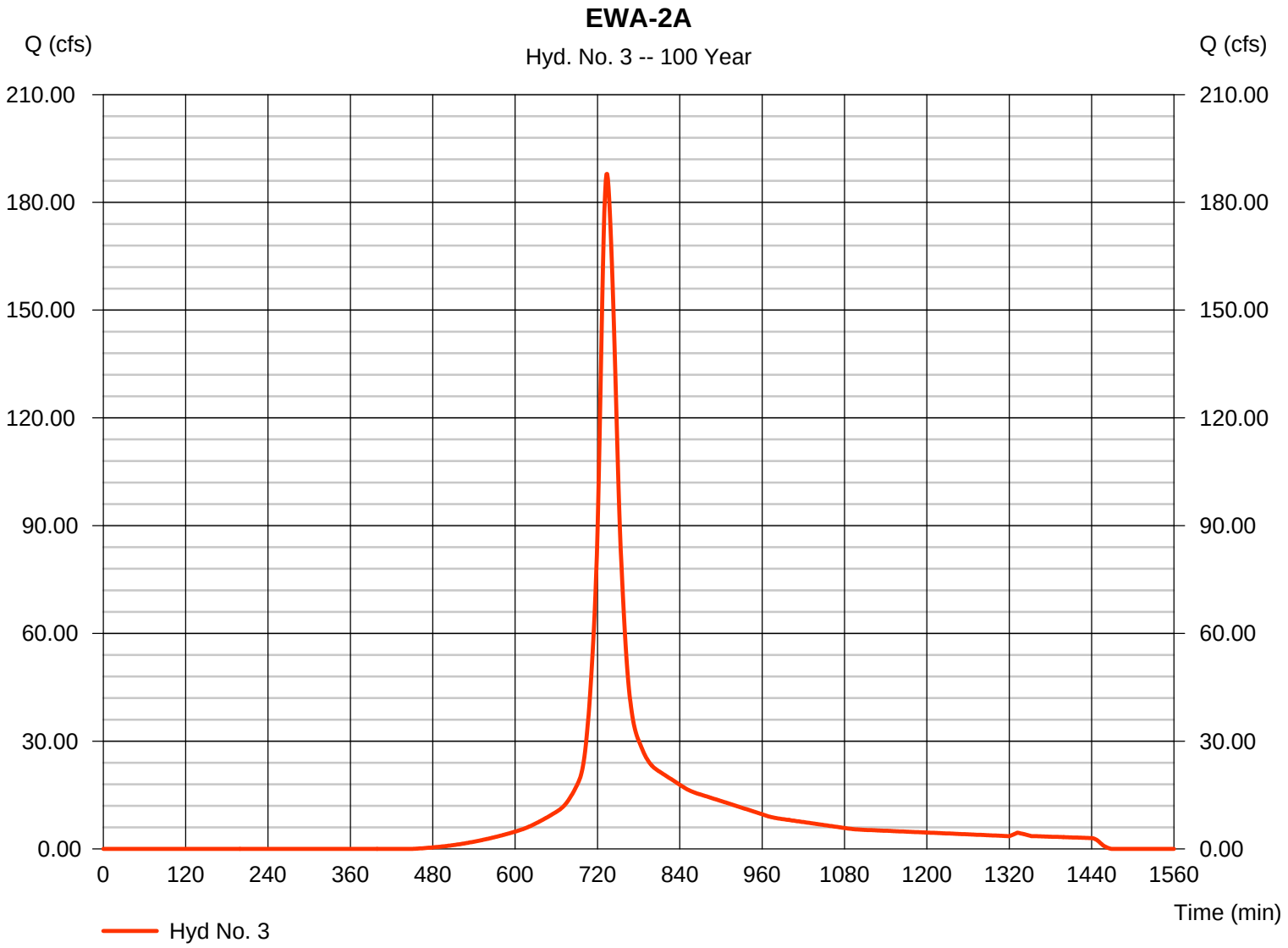
Hydrograph Report

Hyd. No. 3

EWA-2A

Hydrograph type	=	SCS Runoff	Peak discharge	=	187.95 cfs
Storm frequency	=	100 yrs	Time to peak	=	734 min
Time interval	=	1 min	Hyd. volume	=	829,593 cuft
Drainage area	=	59.900 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	19.10 min
Total precip.	=	6.50 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(4.300 x 98) + (6.200 x 72) + (49.400 x 74)] / 59.900



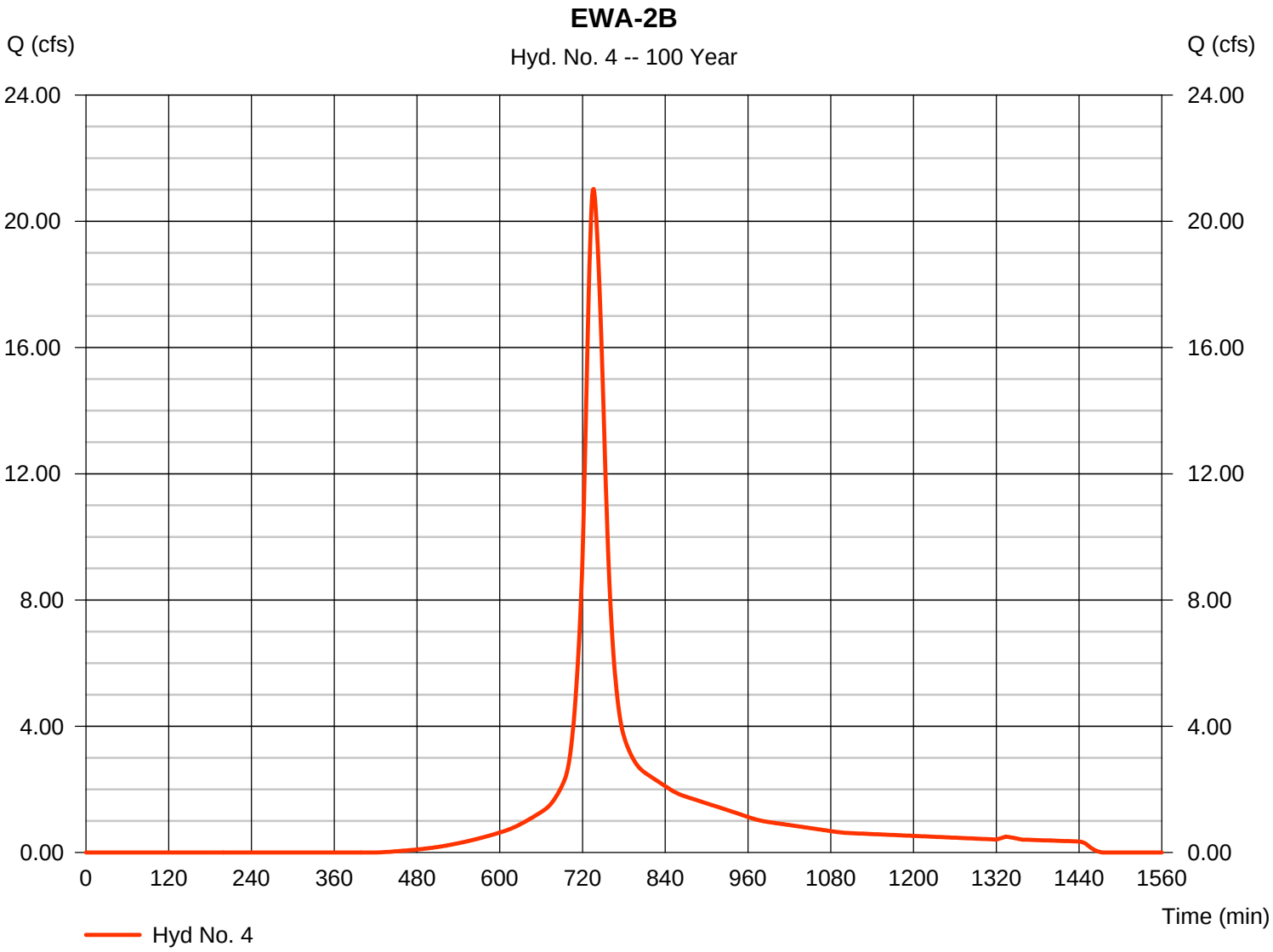
Hydrograph Report

Hyd. No. 4

EWA-2B

Hydrograph type	=	SCS Runoff	Peak discharge	=	21.03 cfs
Storm frequency	=	100 yrs	Time to peak	=	736 min
Time interval	=	1 min	Hyd. volume	=	98,439 cuft
Drainage area	=	6.800 ac	Curve number	=	78*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	22.70 min
Total precip.	=	6.50 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.300 x 98) + (2.700 x 72) + (2.800 x 74)] / 6.800



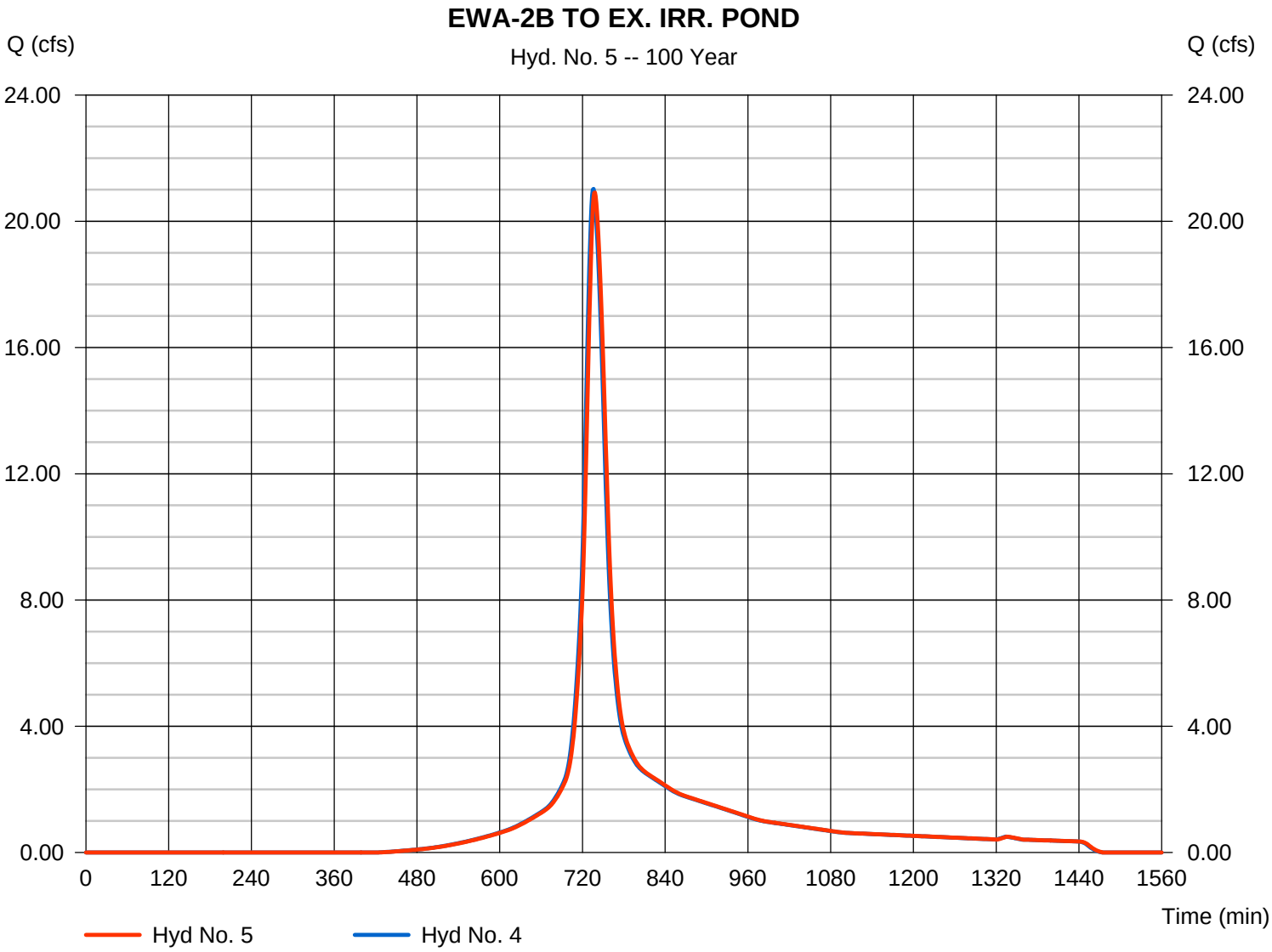
Hydrograph Report

Hyd. No. 5

EWA-2B TO EX. IRR. POND

Hydrograph type	=	Reach	Peak discharge	=	20.91 cfs
Storm frequency	=	100 yrs	Time to peak	=	738 min
Time interval	=	1 min	Hyd. volume	=	98,438 cuft
Inflow hyd. No.	=	4 - EWA-2B	Section type	=	Trapezoidal
Reach length	=	300.0 ft	Channel slope	=	3.0 %
Manning's n	=	0.040	Bottom width	=	5.0 ft
Side slope	=	3.0:1	Max. depth	=	1.0 ft
Rating curve x	=	2.205	Rating curve m	=	1.190
Ave. velocity	=	0.00 ft/s	Routing coeff.	=	0.5465

Modified Att-Kin routing method used.

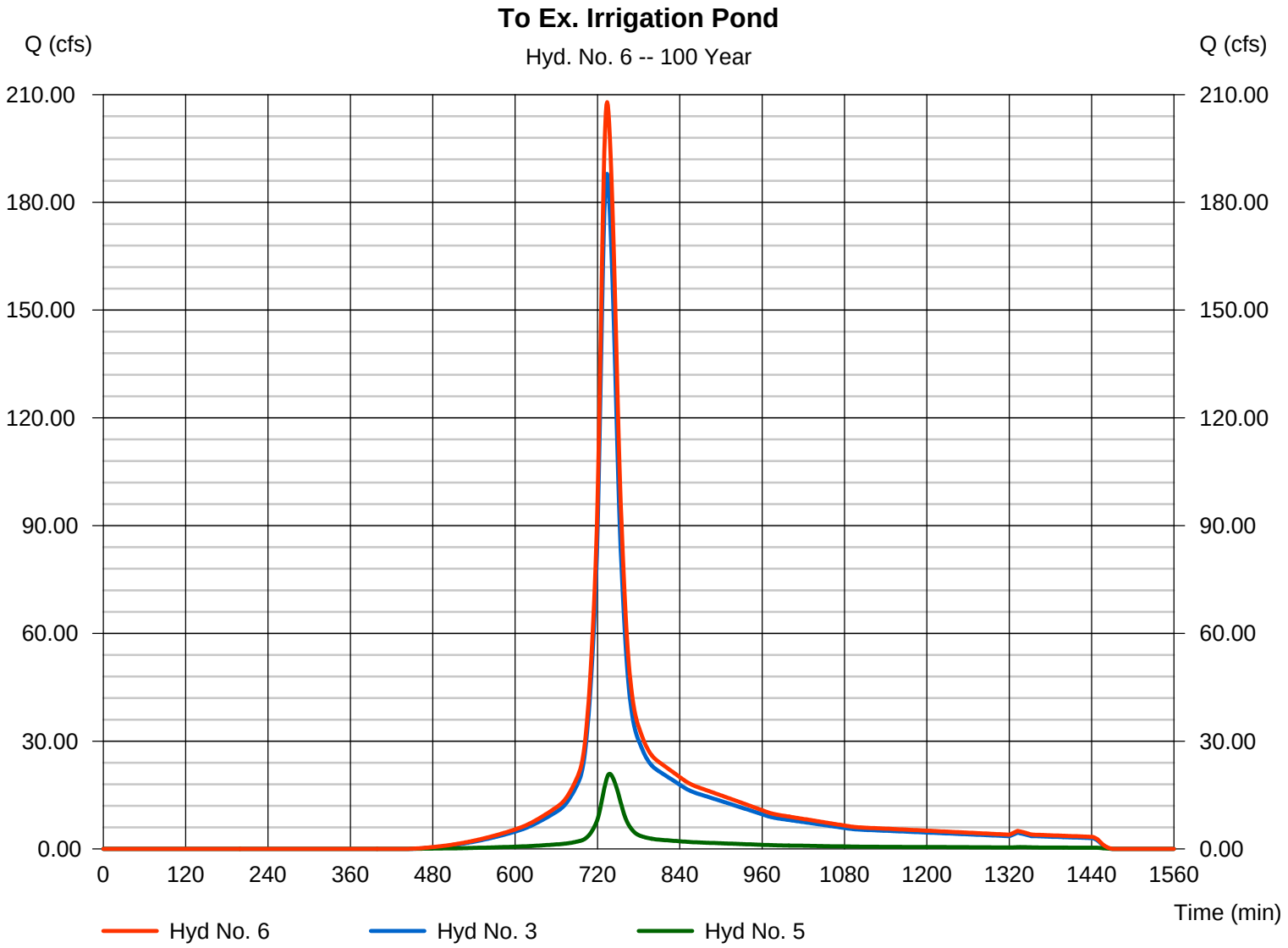


Hydrograph Report

Hyd. No. 6

To Ex. Irrigation Pond

Hydrograph type	= Combine	Peak discharge	= 207.92 cfs
Storm frequency	= 100 yrs	Time to peak	= 734 min
Time interval	= 1 min	Hyd. volume	= 928,031 cuft
Inflow hyds.	= 3, 5	Contrib. drain. area	= 59.900 ac



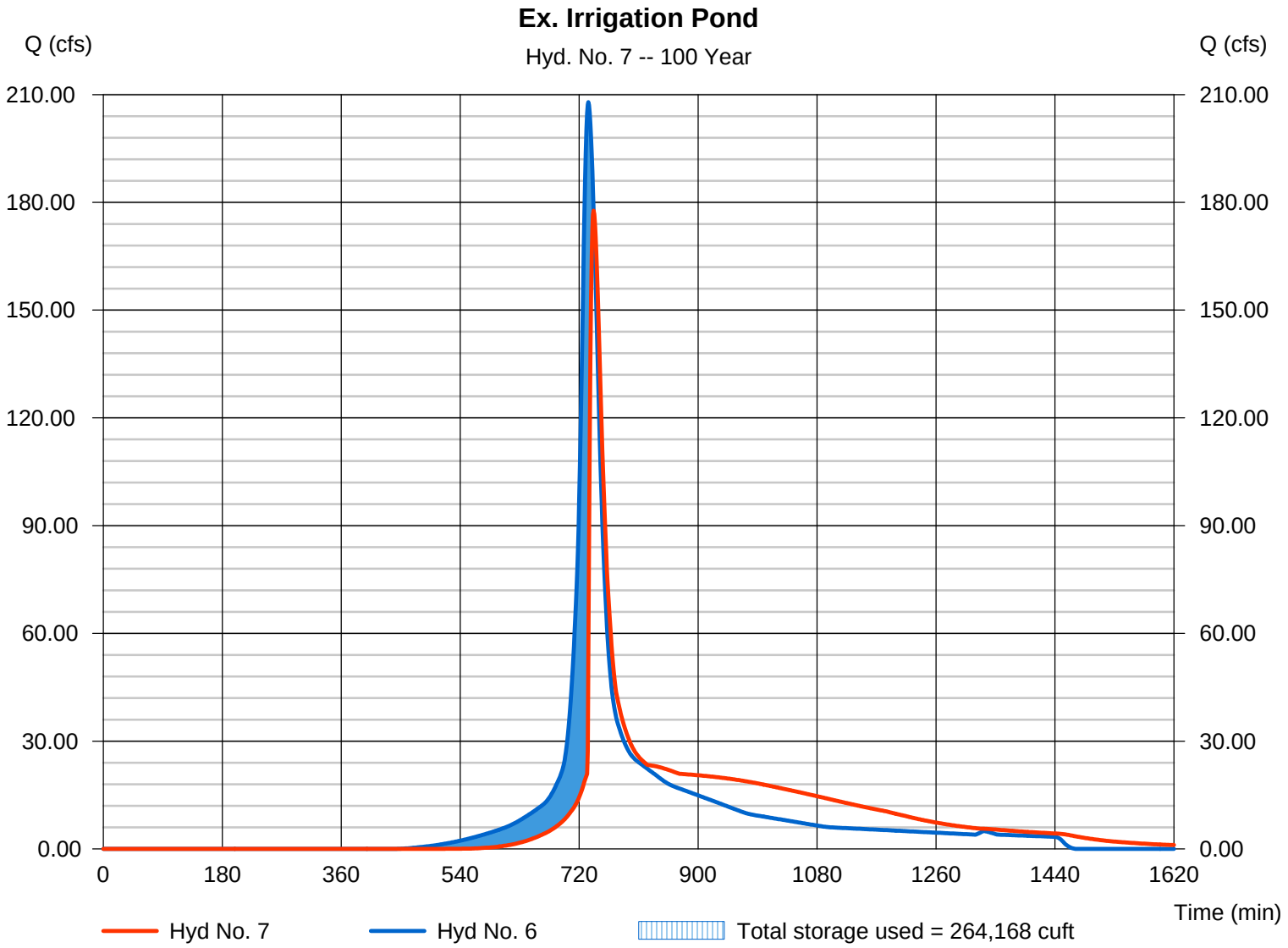
Hydrograph Report

Hyd. No. 7

Ex. Irrigation Pond

Hydrograph type	=	Reservoir	Peak discharge	=	177.71 cfs
Storm frequency	=	100 yrs	Time to peak	=	742 min
Time interval	=	1 min	Hyd. volume	=	922,763 cuft
Inflow hyd. No.	=	6 - To Ex. Irrigation Pond	Max. Elevation	=	165.86 ft
Reservoir name	=	Ex. Irrigation Pond	Max. Storage	=	264,168 cuft

Storage Indication method used.



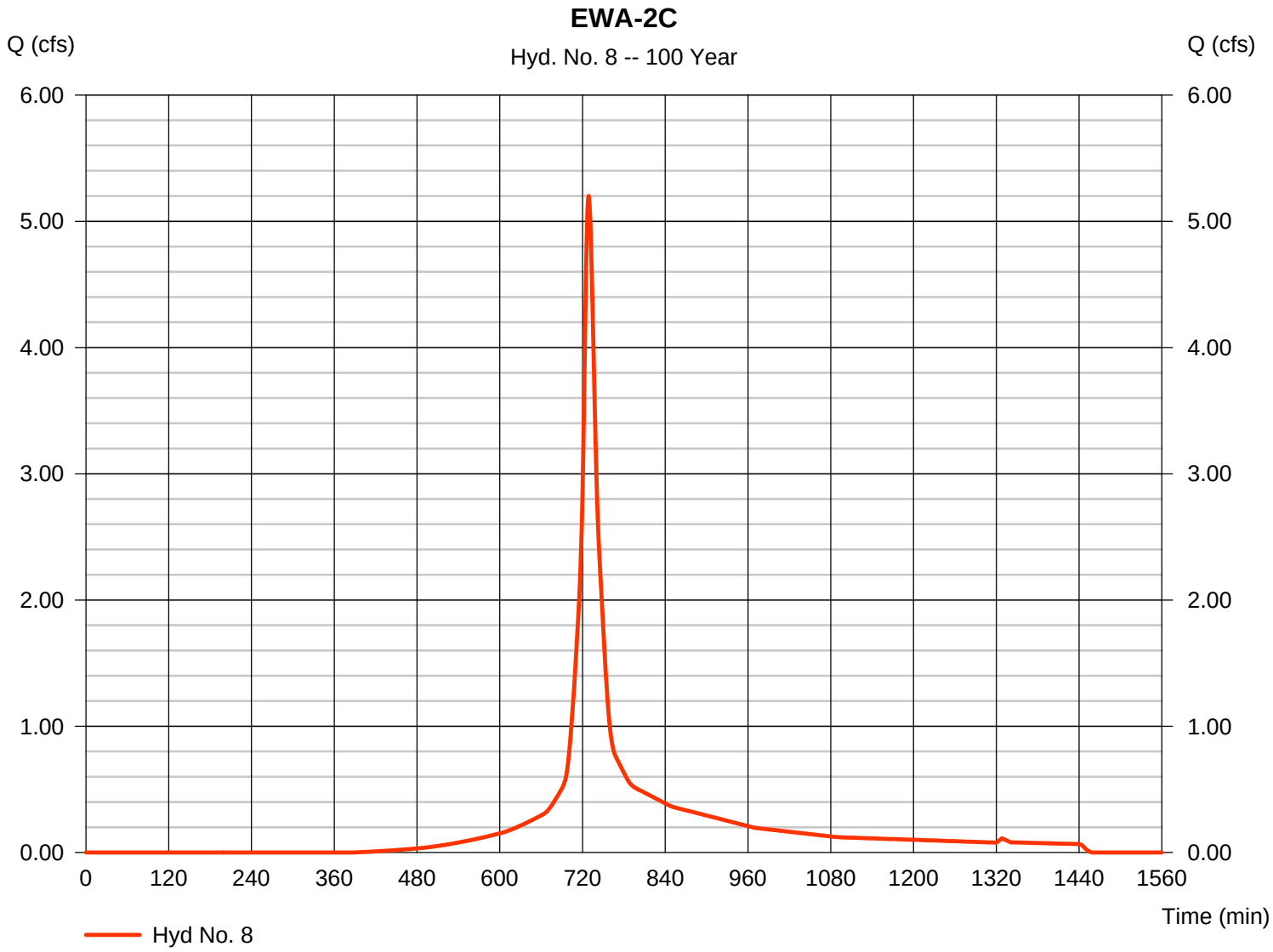
Hydrograph Report

Hyd. No. 8

EWA-2C

Hydrograph type	=	SCS Runoff	Peak discharge	=	5.200 cfs
Storm frequency	=	100 yrs	Time to peak	=	729 min
Time interval	=	1 min	Hyd. volume	=	19,674 cuft
Drainage area	=	1.300 ac	Curve number	=	80*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	12.60 min
Total precip.	=	6.50 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.400 x 98) + (0.900 x 72)] / 1.300

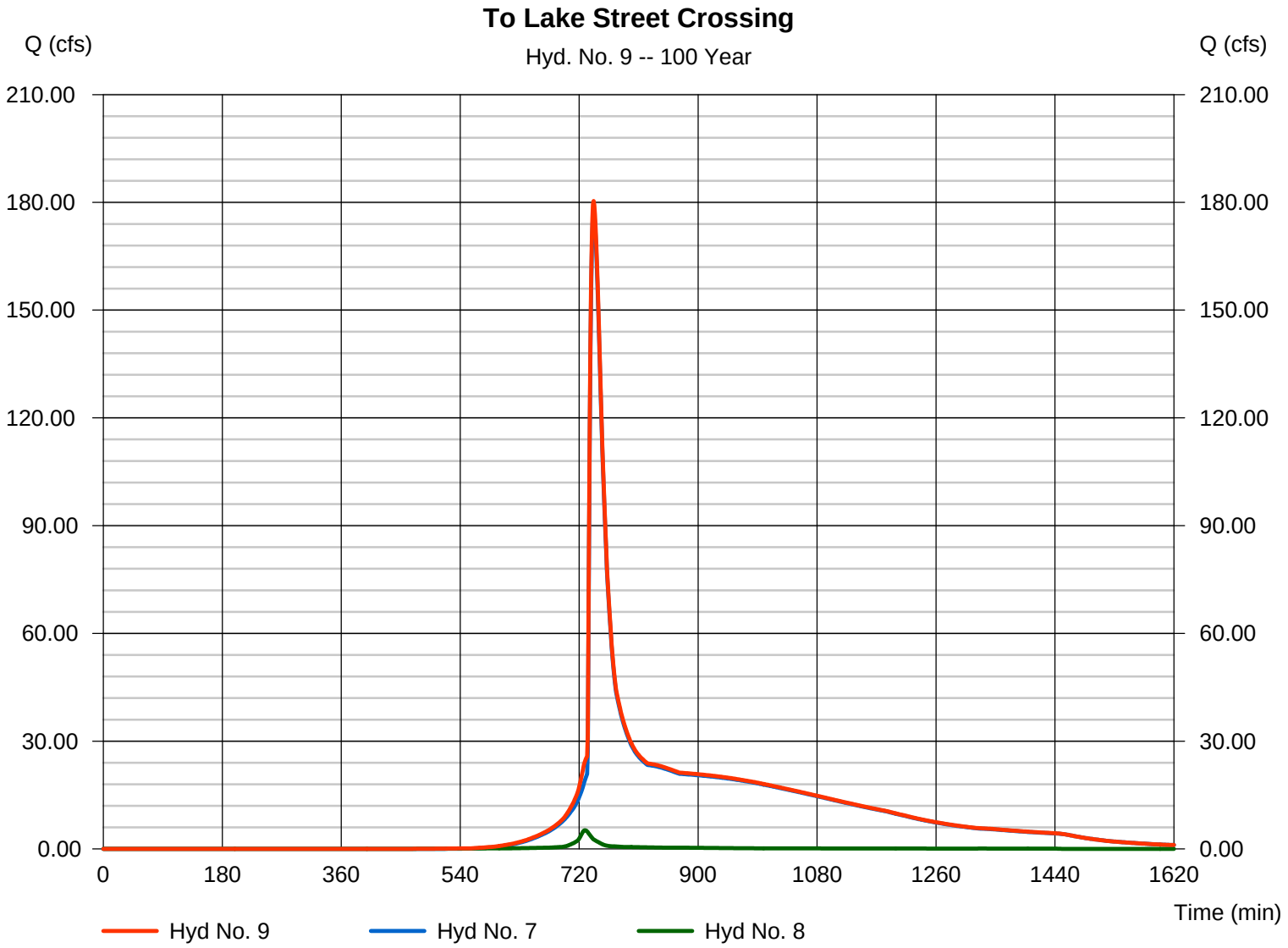


Hydrograph Report

Hyd. No. 9

To Lake Street Crossing

Hydrograph type	= Combine	Peak discharge	= 180.37 cfs
Storm frequency	= 100 yrs	Time to peak	= 742 min
Time interval	= 1 min	Hyd. volume	= 942,437 cuft
Inflow hyds.	= 7, 8	Contrib. drain. area	= 1.300 ac



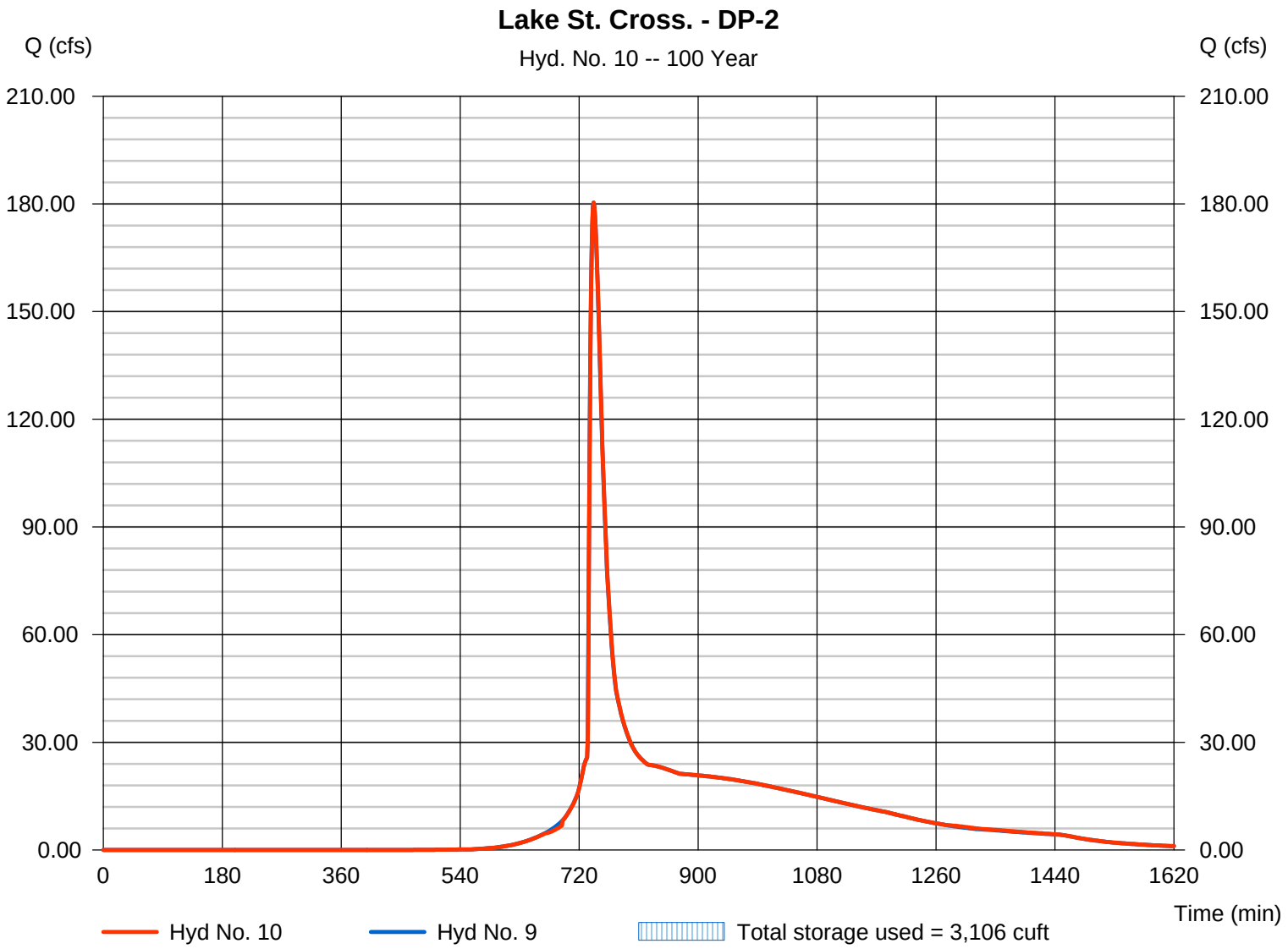
Hydrograph Report

Hyd. No. 10

Lake St. Cross. - DP-2

Hydrograph type	=	Reservoir	Peak discharge	=	180.33 cfs
Storm frequency	=	100 yrs	Time to peak	=	742 min
Time interval	=	1 min	Hyd. volume	=	942,430 cuft
Inflow hyd. No.	=	9 - To Lake Street Crossing	Max. Elevation	=	160.56 ft
Reservoir name	=	Lake Street Crossing	Max. Storage	=	3,106 cuft

Storage Indication method used.



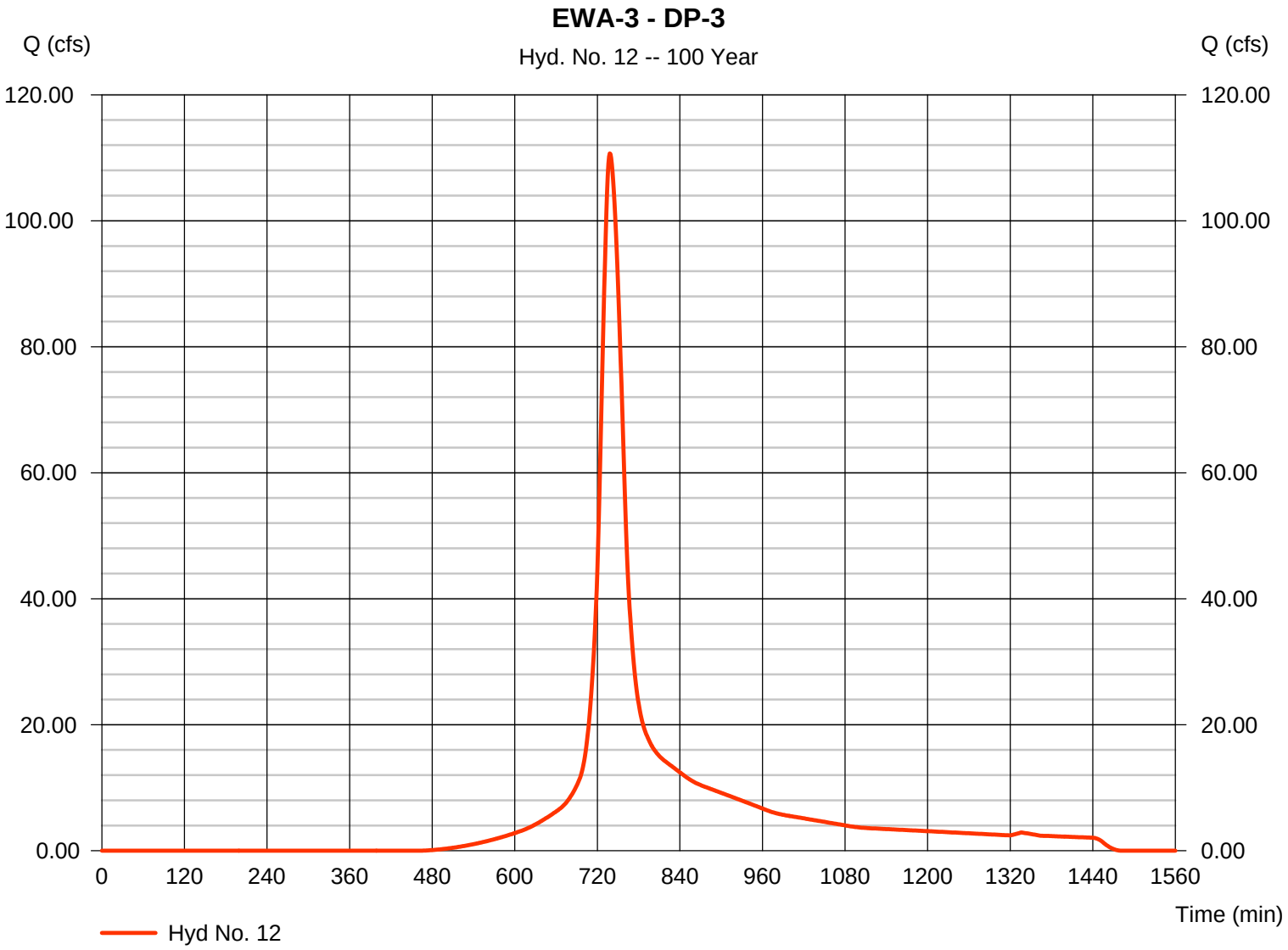
Hydrograph Report

Hyd. No. 12

EWA-3 - DP-3

Hydrograph type	=	SCS Runoff	Peak discharge	=	110.69 cfs
Storm frequency	=	100 yrs	Time to peak	=	738 min
Time interval	=	1 min	Hyd. volume	=	551,359 cuft
Drainage area	=	40.600 ac	Curve number	=	75*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	26.10 min
Total precip.	=	6.50 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

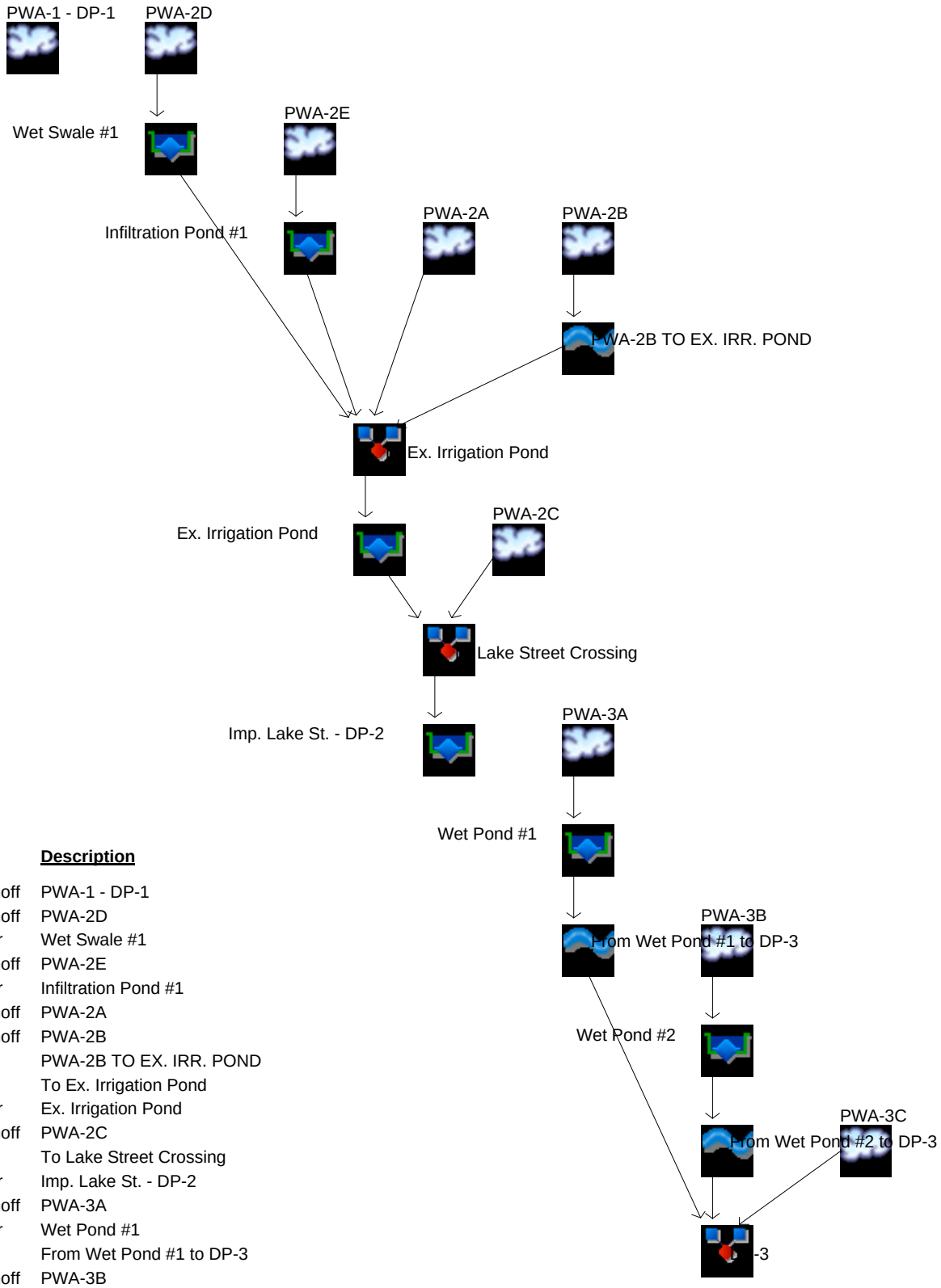
* Composite (Area/CN) = [(1.300 x 98) + (5.500 x 72) + (4.000 x 79) + (28.700 x 74) + (1.100 x 80)] / 40.600



TAB 4

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066



Legend

Hyd.	Origin	Description
1	SCS Runoff	PWA-1 - DP-1
3	SCS Runoff	PWA-2D
4	Reservoir	Wet Swale #1
5	SCS Runoff	PWA-2E
6	Reservoir	Infiltration Pond #1
7	SCS Runoff	PWA-2A
8	SCS Runoff	PWA-2B
9	Reach	PWA-2B TO EX. IRR. POND
10	Combine	To Ex. Irrigation Pond
11	Reservoir	Ex. Irrigation Pond
12	SCS Runoff	PWA-2C
13	Combine	To Lake Street Crossing
14	Reservoir	Imp. Lake St. - DP-2
16	SCS Runoff	PWA-3A
17	Reservoir	Wet Pond #1
18	Reach	From Wet Pond #1 to DP-3
19	SCS Runoff	PWA-3B
20	Reservoir	Wet Pond #2
21	Reach	From Wet Pond #2 to DP-3
22	SCS Runoff	PWA-3C
23	Combine	DP-3

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	------	-------	9.891	-------	-------	20.18	27.34	31.42	36.38	PWA-1 - DP-1
3	SCS Runoff	------	-------	4.859	-------	-------	8.145	10.27	11.45	12.86	PWA-2D
4	Reservoir	3	-------	3.725	-------	-------	6.895	9.025	10.19	11.61	Wet Swale #1
5	SCS Runoff	------	-------	5.309	-------	-------	9.009	11.43	12.77	14.38	PWA-2E
6	Reservoir	5	-------	0.638	-------	-------	2.282	3.727	4.614	5.736	Infiltration Pond #1
7	SCS Runoff	------	-------	42.27	-------	-------	88.13	120.27	138.62	160.96	PWA-2A
8	SCS Runoff	------	-------	6.117	-------	-------	11.98	15.99	18.27	21.03	PWA-2B
9	Reach	8	-------	6.072	-------	-------	11.90	15.90	18.17	20.91	PWA-2B TO EX. IRR. POND
10	Combine	4, 6, 7, 9	-------	52.14	-------	-------	108.19	147.79	170.49	198.10	To Ex. Irrigation Pond
11	Reservoir	10	-------	12.23	-------	-------	20.65	82.35	120.59	162.21	Ex. Irrigation Pond
12	SCS Runoff	------	-------	1.614	-------	-------	3.042	4.005	4.546	5.200	PWA-2C
13	Combine	11, 12	-------	12.47	-------	-------	21.06	83.60	122.44	164.74	To Lake Street Crossing
14	Reservoir	13	-------	12.47	-------	-------	21.05	83.64	122.43	164.63	Imp. Lake St. - DP-2
16	SCS Runoff	------	-------	6.536	-------	-------	12.56	16.66	18.97	21.77	PWA-3A
17	Reservoir	16	-------	4.865	-------	-------	10.41	14.33	16.57	19.36	Wet Pond #1
18	Reach	17	-------	4.583	-------	-------	10.03	13.85	16.03	18.69	From Wet Pond #1 to DP-3
19	SCS Runoff	------	-------	13.06	-------	-------	24.64	32.45	36.85	42.17	PWA-3B
20	Reservoir	19	-------	7.308	-------	-------	17.42	22.78	25.41	27.84	Wet Pond #2
21	Reach	20	-------	6.822	-------	-------	16.77	22.17	24.84	27.39	From Wet Pond #2 to DP-3
22	SCS Runoff	------	-------	21.23	-------	-------	43.31	58.60	67.37	78.02	PWA-3C
23	Combine	18, 21, 22	-------	23.46	-------	-------	55.35	77.71	90.04	104.87	DP-3

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

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	9.891	1	736	47,231	------	------	------	PWA-1 - DP-1
3	SCS Runoff	4.859	1	729	18,277	------	------	------	PWA-2D
4	Reservoir	3.725	1	736	18,239	3	192.93	3,986	Wet Swale #1
5	SCS Runoff	5.309	1	725	16,363	------	------	------	PWA-2E
6	Reservoir	0.638	1	767	14,189	5	184.11	8,396	Infiltration Pond #1
7	SCS Runoff	42.27	1	735	196,424	------	------	------	PWA-2A
8	SCS Runoff	6.117	1	737	29,370	------	------	------	PWA-2B
9	Reach	6.072	1	739	29,369	8	------	------	PWA-2B TO EX. IRR. POND
10	Combine	52.14	1	736	258,221	4, 6, 7, 9	------	------	To Ex. Irrigation Pond
11	Reservoir	12.23	1	776	252,094	10	164.18	94,165	Ex. Irrigation Pond
12	SCS Runoff	1.614	1	729	6,157	------	------	------	PWA-2C
13	Combine	12.47	1	774	258,251	11, 12	------	------	To Lake Street Crossing
14	Reservoir	12.47	1	774	258,241	13	157.69	308	Imp. Lake St. - DP-2
16	SCS Runoff	6.536	1	736	30,528	------	------	------	PWA-3A
17	Reservoir	4.865	1	749	30,367	16	195.94	7,135	Wet Pond #1
18	Reach	4.583	1	755	30,090	17	------	------	From Wet Pond #1 to DP-3
19	SCS Runoff	13.06	1	737	61,991	------	------	------	PWA-3B
20	Reservoir	7.308	1	755	61,138	19	203.62	19,444	Wet Pond #2
21	Reach	6.822	1	763	61,131	20	------	------	From Wet Pond #2 to DP-3
22	SCS Runoff	21.23	1	732	91,547	------	------	------	PWA-3C
23	Combine	23.46	1	735	182,768	18, 21, 22	------	------	DP-3

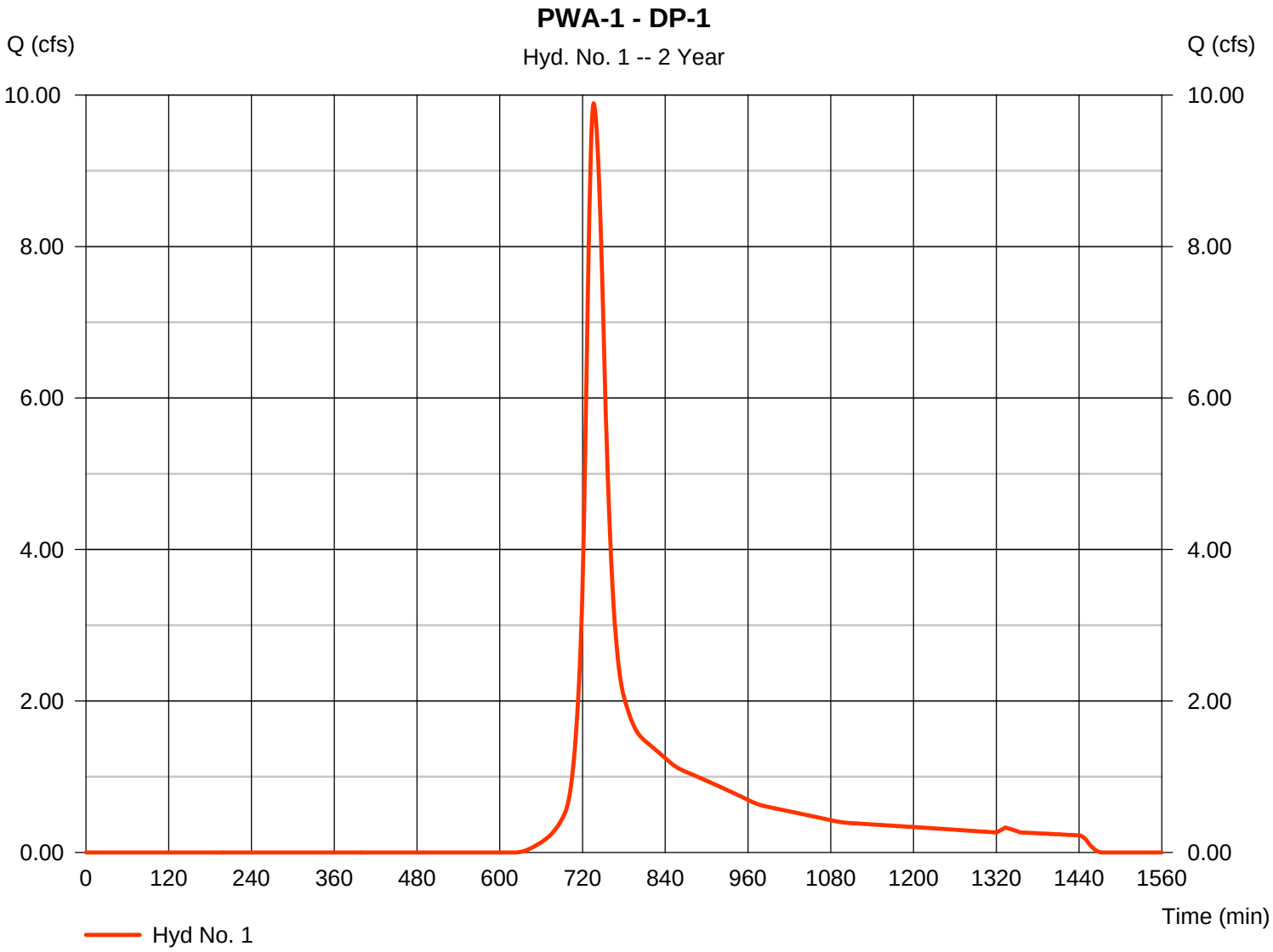
Hydrograph Report

Hyd. No. 1

PWA-1 - DP-1

Hydrograph type	=	SCS Runoff	Peak discharge	=	9.891 cfs
Storm frequency	=	2 yrs	Time to peak	=	736 min
Time interval	=	1 min	Hyd. volume	=	47,231 cuft
Drainage area	=	11.900 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	20.80 min
Total precip.	=	3.10 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.500 x 98) + (5.700 x 72) + (4.700 x 74)] / 11.900



TR55 Tc Worksheet

Hyd. No. 1

PWA-1 - DP-1

Description	A	B	C	Totals
Sheet Flow				
Manning's n-value	= 0.240	0.011	0.011	
Flow length (ft)	= 100.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 3.10	0.00	0.00	
Land slope (%)	= 6.80	0.00	0.00	
Travel Time (min)	**= 8.89**	**+ 0.00**	**+ 0.00**	**= 8.89**
Shallow Concentrated Flow				
Flow length (ft)	= 817.00	0.00	0.00	
Watercourse slope (%)	= 0.50	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	= 1.14	0.00	0.00	
Travel Time (min)	**= 11.94**	**+ 0.00**	**+ 0.00**	**= 11.94**
Channel Flow				
X sectional flow area (sqft)	= 0.00	0.00	0.00	
Wetted perimeter (ft)	= 0.00	0.00	0.00	
Channel slope (%)	= 0.00	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	= 0.00	0.00	0.00	
Flow length (ft)	= 0.0	0.0	0.0	
Travel Time (min)	**= 0.00**	**+ 0.00**	**+ 0.00**	**= 0.00**

Total Travel Time, Tc ..... 20.80 min

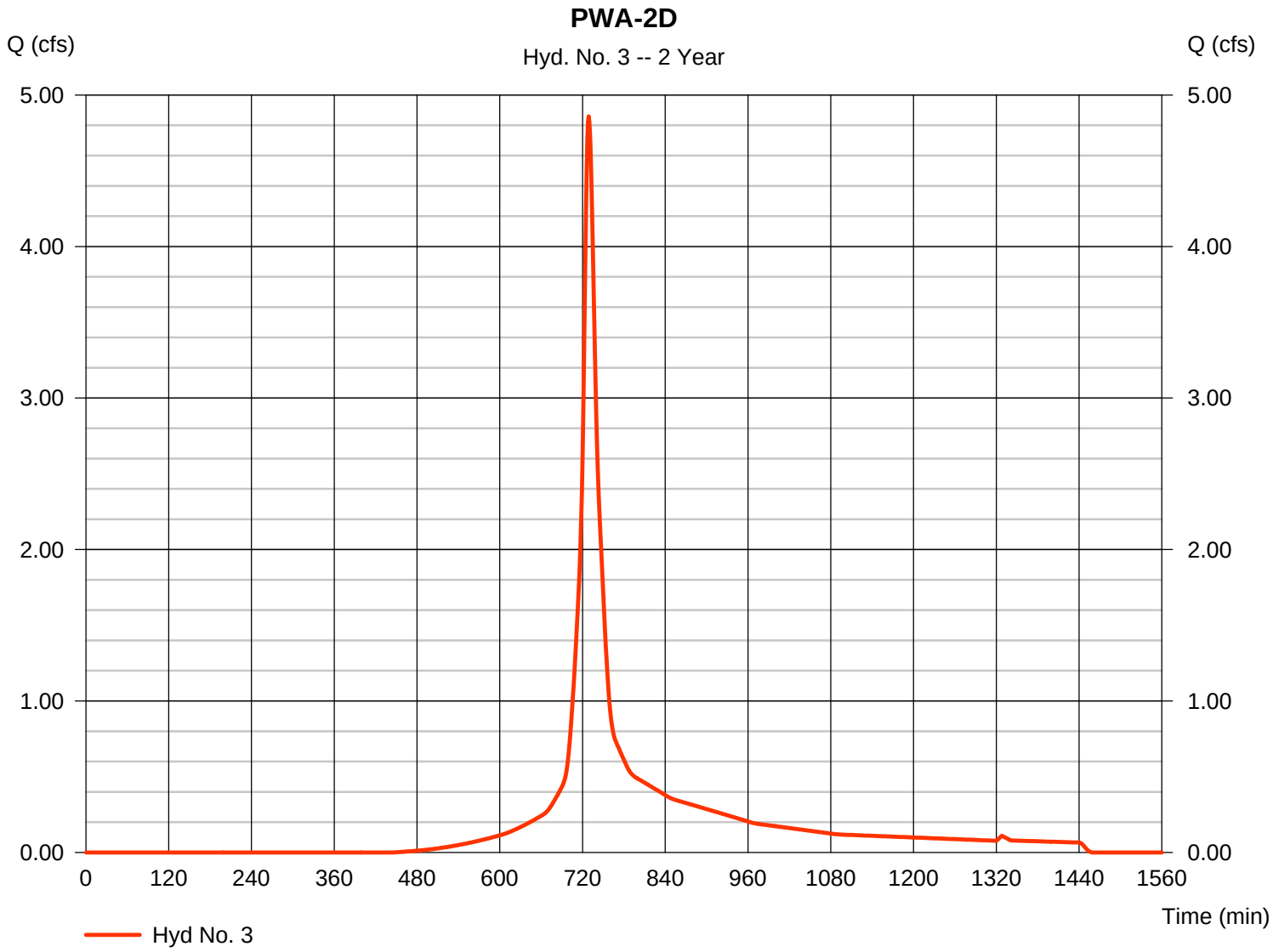
Hydrograph Report

Hyd. No. 3

PWA-2D

Hydrograph type	=	SCS Runoff	Peak discharge	=	4.859 cfs
Storm frequency	=	2 yrs	Time to peak	=	729 min
Time interval	=	1 min	Hyd. volume	=	18,277 cuft
Drainage area	=	2.800 ac	Curve number	=	87*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	12.10 min
Total precip.	=	3.10 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.500 x 98) + (1.300 x 74)] / 2.800



TR55 Tc Worksheet

Hyd. No. 3

PWA-2D

Description	A	B	C	Totals
Sheet Flow				
Manning's n-value	= 0.240	0.011	0.011	
Flow length (ft)	= 100.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 3.10	0.00	0.00	
Land slope (%)	= 4.00	0.00	0.00	
Travel Time (min)	**= 10.99**	**+ 0.00**	**+ 0.00**	**= 10.99**
Shallow Concentrated Flow				
Flow length (ft)	= 238.00	0.00	0.00	
Watercourse slope (%)	= 4.60	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	= 3.46	0.00	0.00	
Travel Time (min)	**= 1.15**	**+ 0.00**	**+ 0.00**	**= 1.15**
Channel Flow				
X sectional flow area (sqft)	= 0.00	0.00	0.00	
Wetted perimeter (ft)	= 0.00	0.00	0.00	
Channel slope (%)	= 0.00	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	= 0.00	0.00	0.00	
Flow length (ft)	= 0.0	0.0	0.0	
Travel Time (min)	**= 0.00**	**+ 0.00**	**+ 0.00**	**= 0.00**

Total Travel Time, Tc ..... 12.10 min

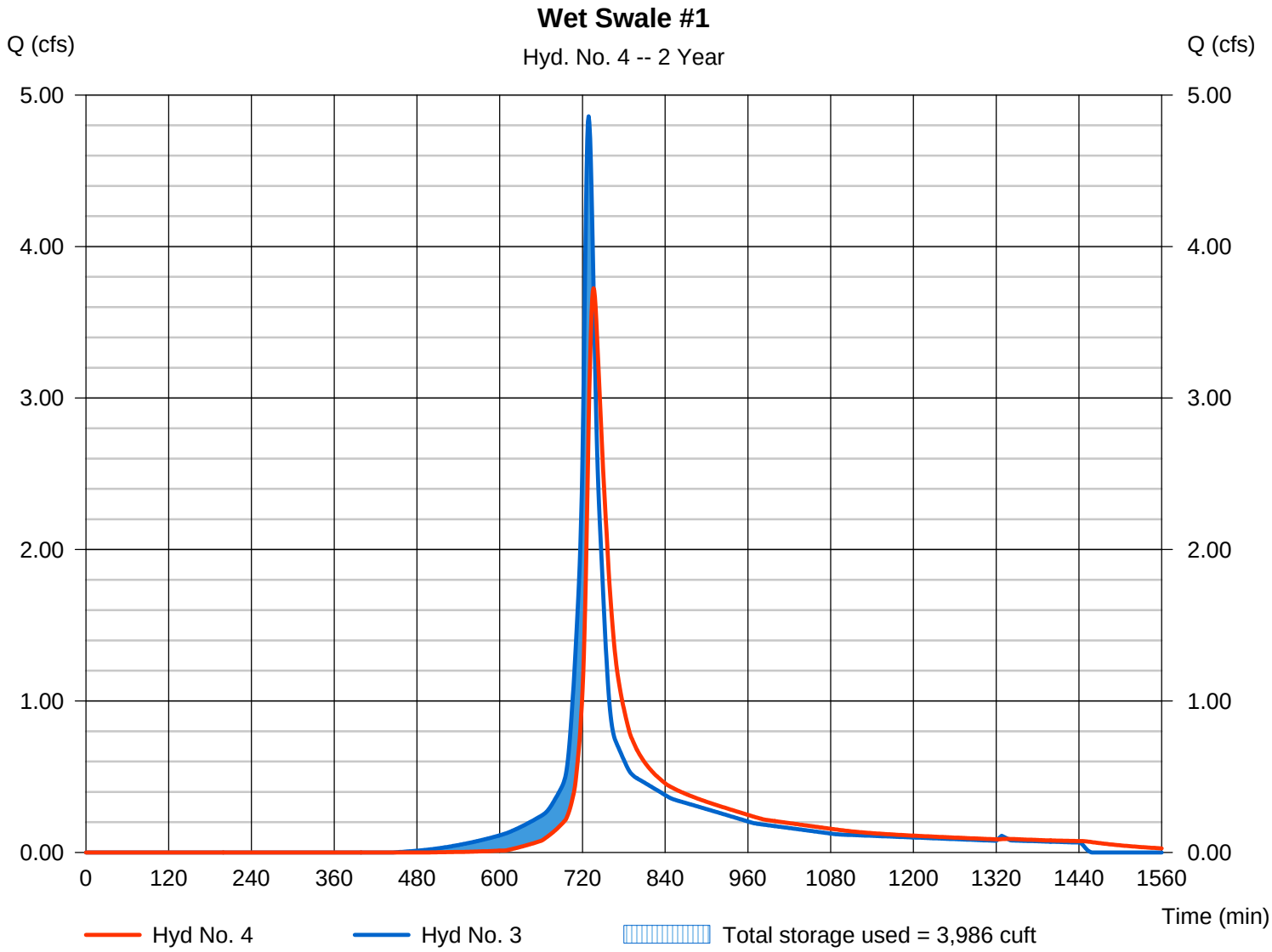
Hydrograph Report

Hyd. No. 4

Wet Swale #1

Hydrograph type	=	Reservoir	Peak discharge	=	3.725 cfs
Storm frequency	=	2 yrs	Time to peak	=	736 min
Time interval	=	1 min	Hyd. volume	=	18,239 cuft
Inflow hyd. No.	=	3 - PWA-2D	Max. Elevation	=	192.93 ft
Reservoir name	=	Wet Swale #1	Max. Storage	=	3,986 cuft

Storage Indication method used.



Pond No. 10 - Wet Swale #1

Pond Data

Contours - User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 192.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	192.00	3,603	0	0
1.00	193.00	4,935	4,269	4,269
2.00	194.00	8,106	6,521	10,790

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	0.00	0.00	0.00
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 190.00	0.00	0.00	0.00
Length (ft)	= 22.20	0.00	0.00	0.00
Slope (%)	= 1.00	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	5.00	0.00	0.00
Crest El. (ft)	= 192.00	193.00	0.00	0.00
Weir Coeff.	= 4.40	2.60	3.33	3.33
Weir Type	= 120degV	Broad	---	---
Multi-Stage	= Yes	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).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	192.00	0.00	---	---	---	---	0.00	---	---	---	---	0.000
0.10	427	192.10	8.92 oc	---	---	---	0.01	0.00	---	---	---	---	0.014
0.20	854	192.20	8.92 oc	---	---	---	0.08	0.00	---	---	---	---	0.079
0.30	1,281	192.30	8.92 oc	---	---	---	0.22	0.00	---	---	---	---	0.217
0.40	1,708	192.40	8.92 oc	---	---	---	0.45	0.00	---	---	---	---	0.445
0.50	2,135	192.50	8.92 oc	---	---	---	0.78	0.00	---	---	---	---	0.778
0.60	2,561	192.60	8.92 oc	---	---	---	1.23	0.00	---	---	---	---	1.227
0.70	2,988	192.70	8.92 oc	---	---	---	1.80	0.00	---	---	---	---	1.804
0.80	3,415	192.80	8.92 oc	---	---	---	2.52	0.00	---	---	---	---	2.519
0.90	3,842	192.90	8.92 oc	---	---	---	3.38	0.00	---	---	---	---	3.381
1.00	4,269	193.00	8.92 oc	---	---	---	4.40	0.00	---	---	---	---	4.399
1.10	4,921	193.10	8.92 oc	---	---	---	5.58	0.41	---	---	---	---	5.994
1.20	5,573	193.20	8.92 oc	---	---	---	6.94	1.16	---	---	---	---	8.102
1.30	6,225	193.30	8.92 oc	---	---	---	8.48	2.14	---	---	---	---	10.61
1.40	6,877	193.40	10.16 oc	---	---	---	10.16 s	3.29	---	---	---	---	13.45
1.50	7,529	193.50	11.93 oc	---	---	---	11.93 s	4.60	---	---	---	---	16.53
1.60	8,181	193.60	13.77 oc	---	---	---	13.77 s	6.04	---	---	---	---	19.81
1.70	8,833	193.70	15.64 oc	---	---	---	15.64 s	7.61	---	---	---	---	23.25
1.80	9,485	193.80	17.49 oc	---	---	---	17.48 s	9.30	---	---	---	---	26.79
1.90	10,137	193.90	19.28 oc	---	---	---	19.28 s	11.10	---	---	---	---	30.38
2.00	10,790	194.00	20.99 oc	---	---	---	20.99 s	13.00	---	---	---	---	33.99

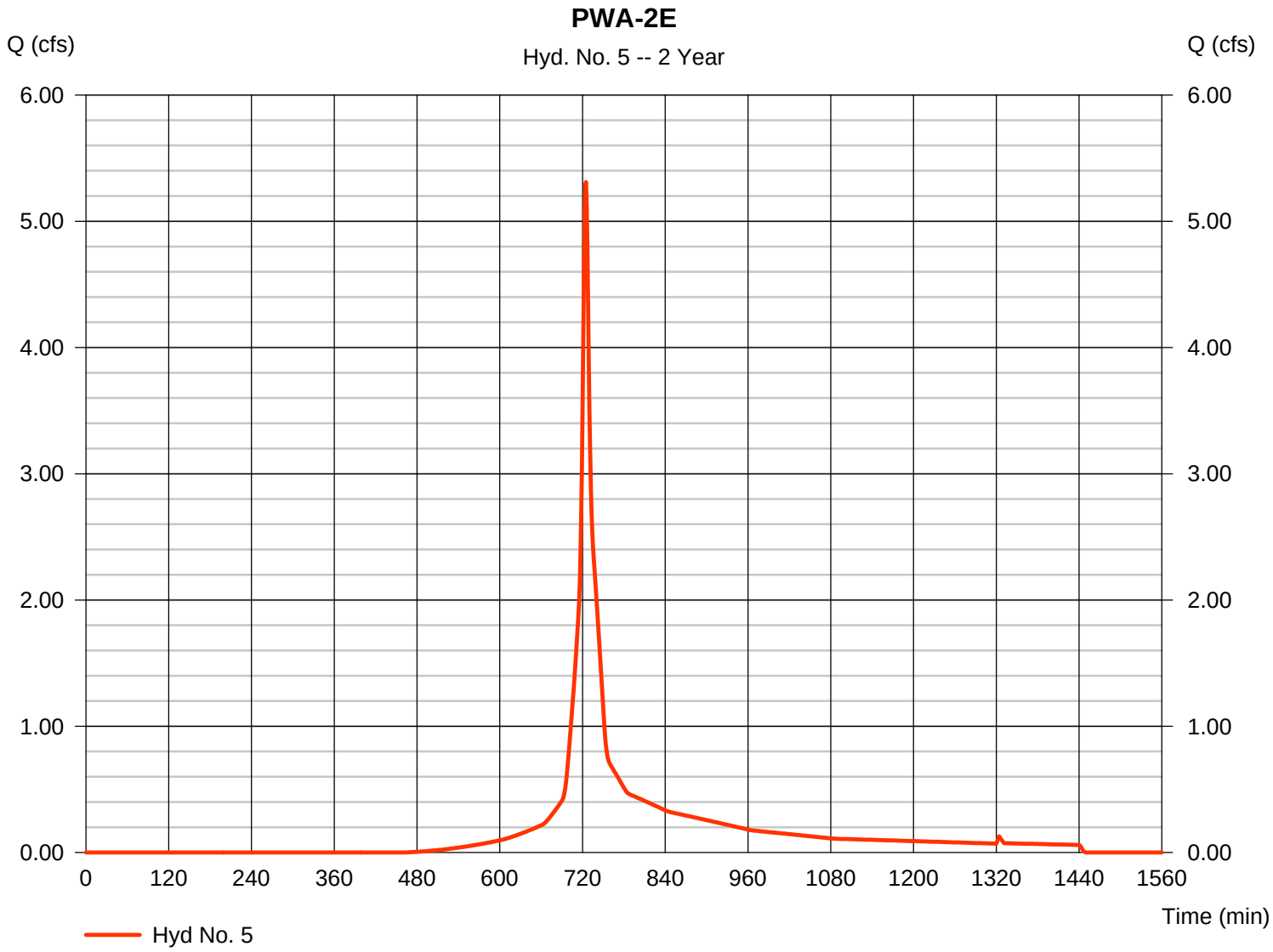
Hydrograph Report

Hyd. No. 5

PWA-2E

Hydrograph type	=	SCS Runoff	Peak discharge	=	5.309 cfs
Storm frequency	=	2 yrs	Time to peak	=	725 min
Time interval	=	1 min	Hyd. volume	=	16,363 cuft
Drainage area	=	2.500 ac	Curve number	=	86*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	USER	Time of conc. (Tc)	=	6.00 min
Total precip.	=	3.10 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.400 x 98) + (1.200 x 74)] / 2.500



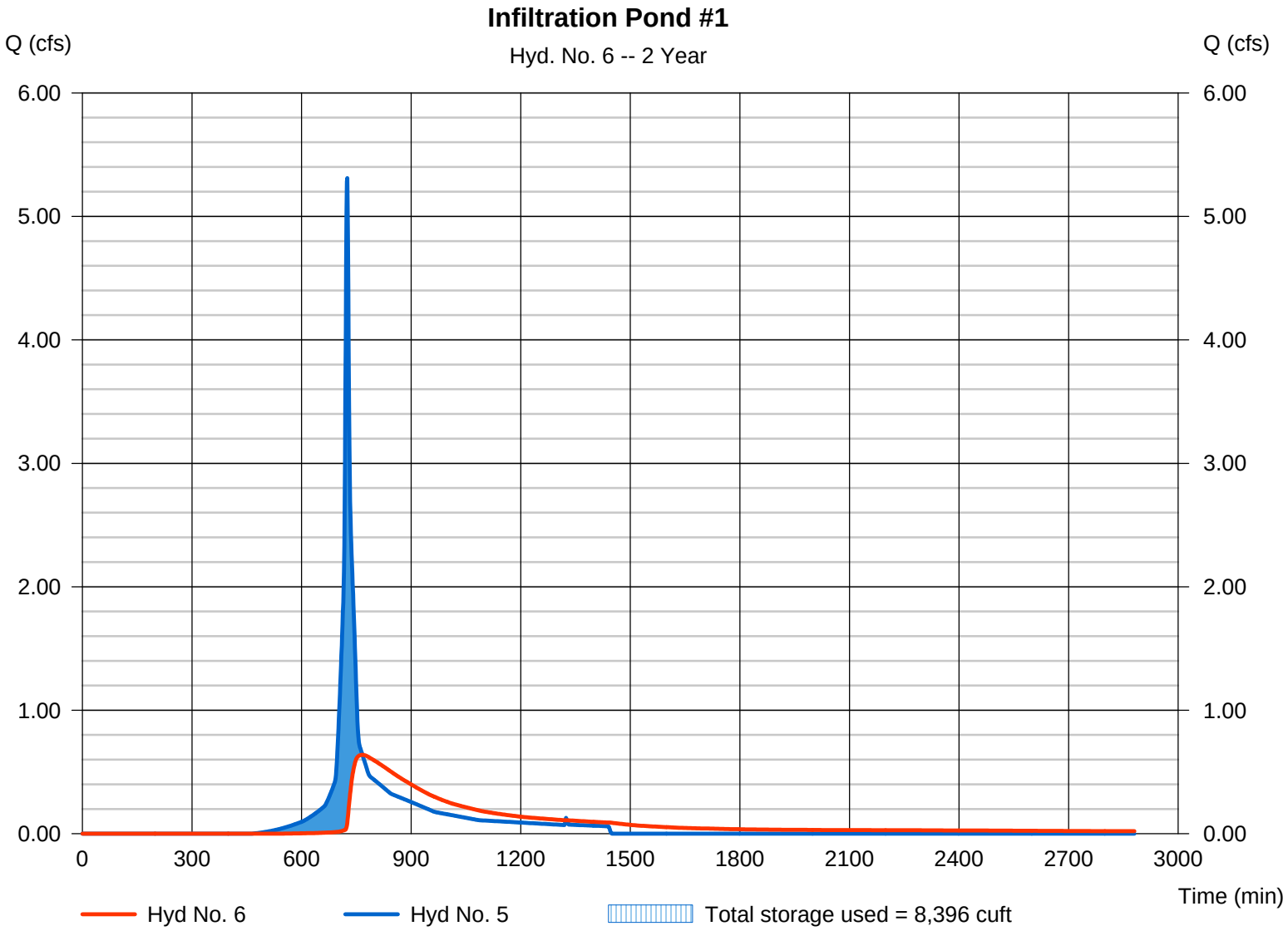
Hydrograph Report

Hyd. No. 6

Infiltration Pond #1

Hydrograph type	=	Reservoir	Peak discharge	=	0.638 cfs
Storm frequency	=	2 yrs	Time to peak	=	767 min
Time interval	=	1 min	Hyd. volume	=	14,189 cuft
Inflow hyd. No.	=	5 - PWA-2E	Max. Elevation	=	184.11 ft
Reservoir name	=	Infiltation Pond #1	Max. Storage	=	8,396 cuft

Storage Indication method used.



Pond Report

Pond No. 3 - Infiltation Pond #1

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 183.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	183.00	5,823	0	0
0.50	183.50	6,350	3,042	3,042
1.00	184.00	10,519	4,173	7,215
2.00	185.00	11,833	11,168	18,384
3.00	186.00	13,203	12,511	30,894

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	0.00	0.00	0.00
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 182.00	0.00	0.00	0.00
Length (ft)	= 22.00	0.00	0.00	0.00
Slope (%)	= 2.50	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	25.00	0.00	0.00
Crest El. (ft)	= 183.50	185.00	0.00	0.00
Weir Coeff.	= 2.13	2.60	3.33	3.33
Weir Type	= 80 degV	Broad	---	---
Multi-Stage	= Yes	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).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	183.00	0.00	---	---	---	---	0.00	---	---	---	---	0.000
0.05	304	183.05	5.35 ic	---	---	---	---	0.00	---	---	---	0.003	0.003
0.10	608	183.10	5.35 ic	---	---	---	---	0.00	---	---	---	0.006	0.006
0.15	913	183.15	5.35 ic	---	---	---	---	0.00	---	---	---	0.008	0.008
0.20	1,217	183.20	5.35 ic	---	---	---	---	0.00	---	---	---	0.011	0.011
0.25	1,521	183.25	5.35 ic	---	---	---	---	0.00	---	---	---	0.014	0.014
0.30	1,825	183.30	5.35 ic	---	---	---	---	0.00	---	---	---	0.017	0.017
0.35	2,129	183.35	5.35 ic	---	---	---	---	0.00	---	---	---	0.020	0.020
0.40	2,434	183.40	5.35 ic	---	---	---	---	0.00	---	---	---	0.022	0.022
0.45	2,738	183.45	5.35 ic	---	---	---	---	0.00	---	---	---	0.025	0.025
0.50	3,042	183.50	5.35 ic	---	---	---	---	0.00	---	---	---	0.028	0.028
0.55	3,459	183.55	5.35 ic	---	---	---	0.00	0.00	---	---	---	0.028	0.029
0.60	3,877	183.60	5.35 ic	---	---	---	0.01	0.00	---	---	---	0.028	0.035
0.65	4,294	183.65	5.35 ic	---	---	---	0.02	0.00	---	---	---	0.028	0.047
0.70	4,711	183.70	5.35 ic	---	---	---	0.04	0.00	---	---	---	0.028	0.066
0.75	5,129	183.75	5.35 ic	---	---	---	0.07	0.00	---	---	---	0.028	0.095
0.80	5,546	183.80	5.35 ic	---	---	---	0.11	0.00	---	---	---	0.028	0.133
0.85	5,963	183.85	5.35 ic	---	---	---	0.15	0.00	---	---	---	0.028	0.183
0.90	6,381	183.90	5.35 ic	---	---	---	0.22	0.00	---	---	---	0.028	0.244
0.95	6,798	183.95	5.35 ic	---	---	---	0.29	0.00	---	---	---	0.028	0.318
1.00	7,215	184.00	5.35 ic	---	---	---	0.38	0.00	---	---	---	0.028	0.405
1.10	8,332	184.10	5.35 ic	---	---	---	0.59	0.00	---	---	---	0.028	0.622
1.20	9,449	184.20	5.35 ic	---	---	---	0.87	0.00	---	---	---	0.028	0.902
1.30	10,566	184.30	5.35 ic	---	---	---	1.22	0.00	---	---	---	0.028	1.248
1.40	11,683	184.40	5.35 ic	---	---	---	1.64	0.00	---	---	---	0.028	1.666
1.50	12,799	184.50	5.35 ic	---	---	---	2.13	0.00	---	---	---	0.028	2.159
1.60	13,916	184.60	5.35 ic	---	---	---	2.70	0.00	---	---	---	0.028	2.733
1.70	15,033	184.70	5.35 ic	---	---	---	3.36	0.00	---	---	---	0.028	3.390
1.80	16,150	184.80	5.35 ic	---	---	---	4.11	0.00	---	---	---	0.028	4.135
1.90	17,267	184.90	5.35 ic	---	---	---	4.94	0.00	---	---	---	0.028	4.971
2.00	18,384	185.00	5.91 ic	---	---	---	5.87	0.00	---	---	---	0.028	5.901
2.10	19,635	185.10	7.00 ic	---	---	---	6.90	2.06	---	---	---	0.028	8.985
2.20	20,886	185.20	8.12 ic	---	---	---	8.03	5.81	---	---	---	0.028	13.87
2.30	22,137	185.30	9.26 ic	---	---	---	9.26	10.68	---	---	---	0.028	19.97
2.40	23,388	185.40	10.60 ic	---	---	---	10.60 s	16.44	---	---	---	0.028	27.08
2.50	24,639	185.50	11.98 ic	---	---	---	11.98 s	22.98	---	---	---	0.028	34.98
2.60	25,890	185.60	13.38 ic	---	---	---	13.37 s	30.21	---	---	---	0.028	43.61
2.70	27,141	185.70	14.55 oc	---	---	---	14.55 s	38.07	---	---	---	0.028	52.65
2.80	28,392	185.80	16.02 oc	---	---	---	16.02 s	46.51	---	---	---	0.028	62.56
2.90	29,643	185.90	17.43 ic	---	---	---	17.43 s	55.51	---	---	---	0.028	72.97

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Infiltation Pond #1

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
3.00	30,894	186.00	18.71 ic	---	---	---	18.71 s	65.00	---	---	---	0.028	83.74

...End

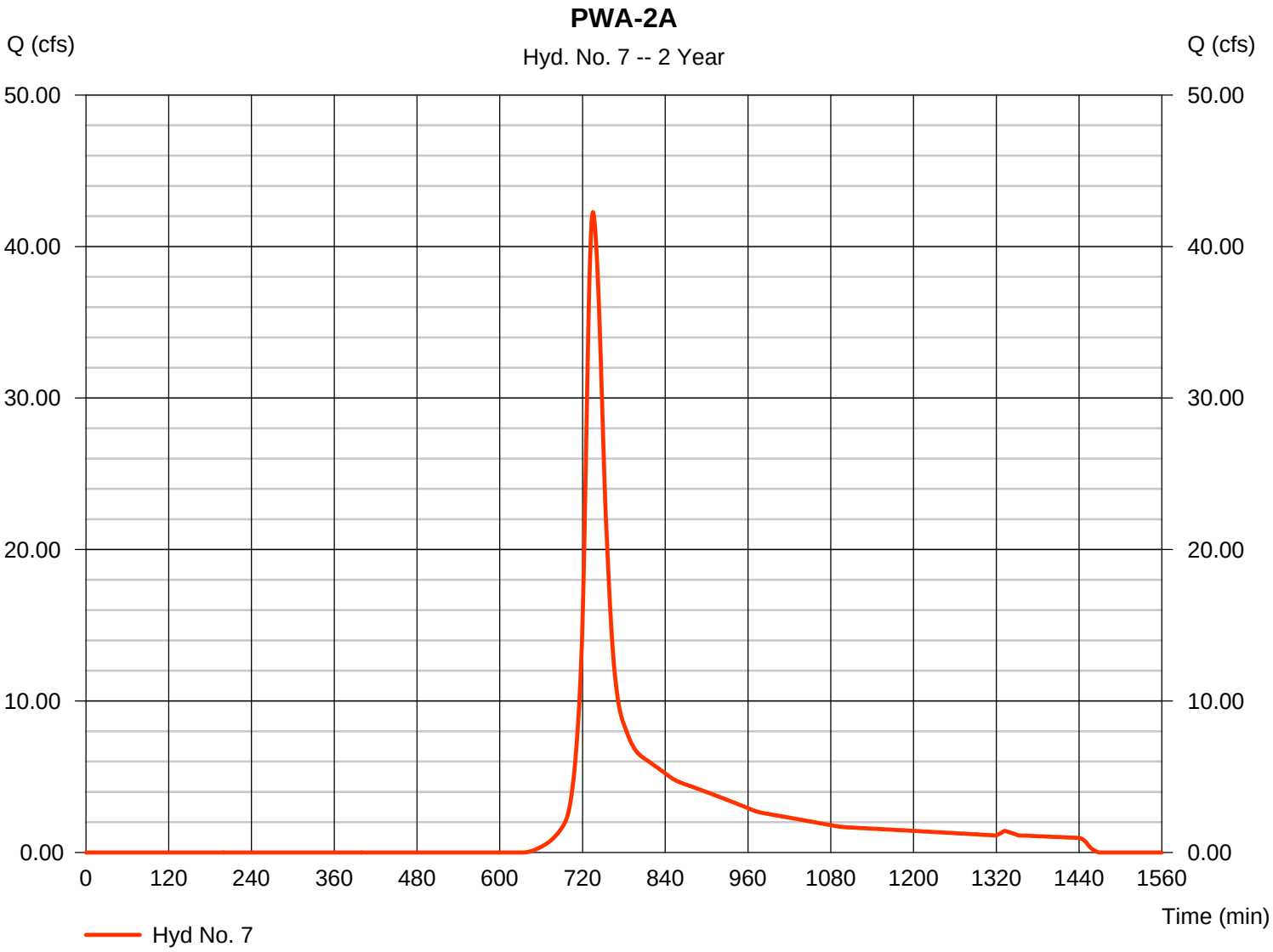
Hydrograph Report

Hyd. No. 7

PWA-2A

Hydrograph type	=	SCS Runoff	Peak discharge	=	42.27 cfs
Storm frequency	=	2 yrs	Time to peak	=	735 min
Time interval	=	1 min	Hyd. volume	=	196,424 cuft
Drainage area	=	52.700 ac	Curve number	=	75*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	19.10 min
Total precip.	=	3.10 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(2.700 x 98) + (5.400 x 72) + (44.600 x 74)] / 52.700



TR55 Tc Worksheet

Hyd. No. 7

PWA-2A

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.240		0.011		0.011		
Flow length (ft)	=	100.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.10		0.00		0.00		
Land slope (%)	=	3.30		0.00		0.00		
Travel Time (min)	**=**	**11.87**	**+**	**0.00**	**+**	**0.00**	**=**	**11.87**
Shallow Concentrated Flow								
Flow length (ft)	=	400.00		0.00		0.00		
Watercourse slope (%)	=	6.00		0.00		0.00		
Surface description	=	Unpaved		Paved		Paved		
Average velocity (ft/s)	=	3.95		0.00		0.00		
Travel Time (min)	**=**	**1.69**	**+**	**0.00**	**+**	**0.00**	**=**	**1.69**
Channel Flow								
X sectional flow area (sqft)	=	21.00		0.79		21.00		
Wetted perimeter (ft)	=	12.30		3.14		12.30		
Channel slope (%)	=	0.30		1.10		3.20		
Manning's n-value	=	0.026		0.013		0.026		
Velocity (ft/s)	=	4.49		4.77		14.67		
Flow length (ft)	=	862.0		553.0		375.0		
Travel Time (min)	**=**	**3.20**	**+**	**1.93**	**+**	**0.43**	**=**	**5.56**

Total Travel Time, Tc ..... 19.10 min

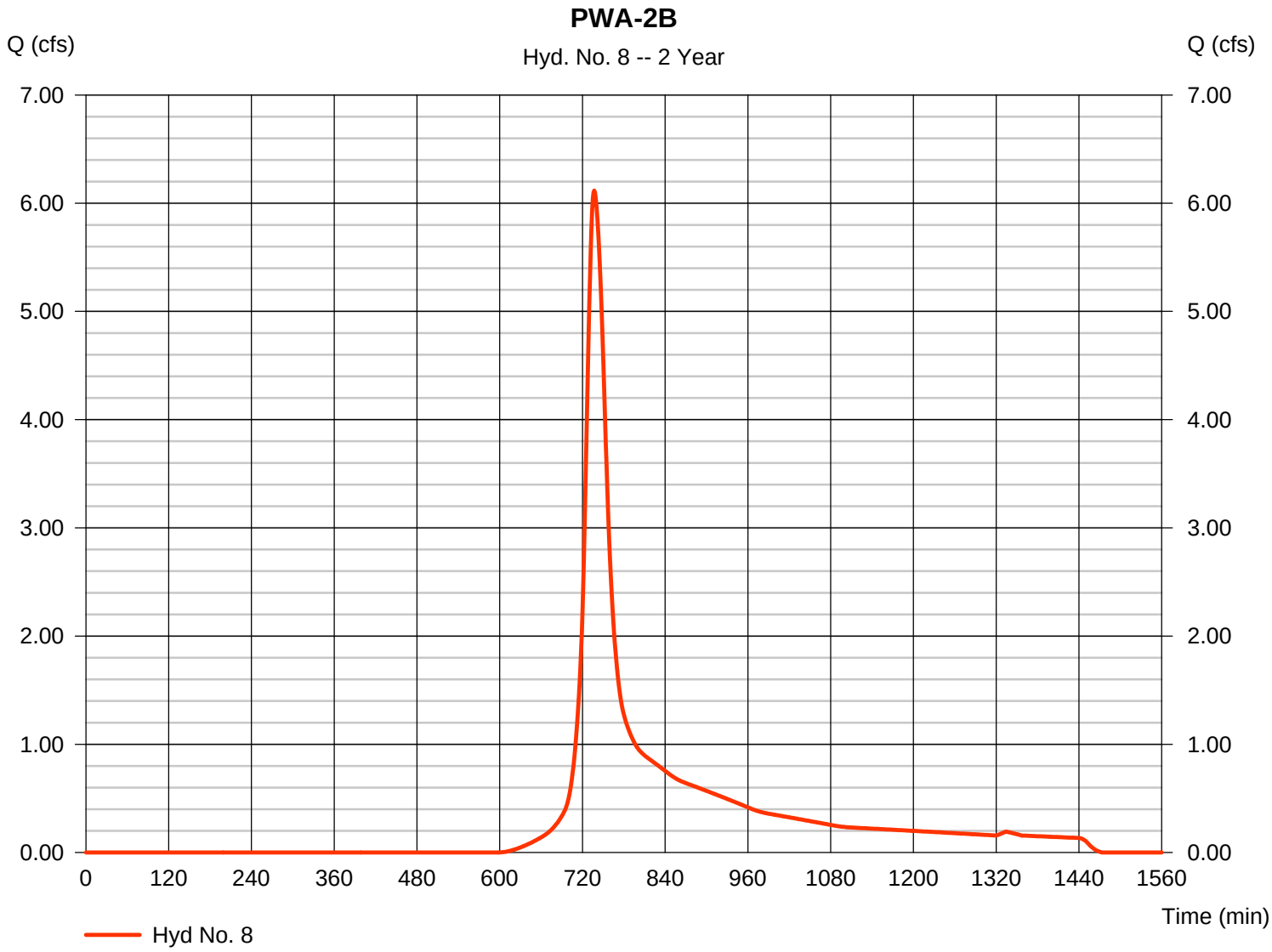
Hydrograph Report

Hyd. No. 8

PWA-2B

Hydrograph type	=	SCS Runoff	Peak discharge	=	6.117 cfs
Storm frequency	=	2 yrs	Time to peak	=	737 min
Time interval	=	1 min	Hyd. volume	=	29,370 cuft
Drainage area	=	6.800 ac	Curve number	=	78*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	22.70 min
Total precip.	=	3.10 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.300 x 98) + (2.700 x 72) + (2.800 x 74)] / 6.800



TR55 Tc Worksheet

Hyd. No. 8

PWA-2B

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.240		0.011		0.011		
Flow length (ft)	=	100.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.10		0.00		0.00		
Land slope (%)	=	1.00		0.00		0.00		
Travel Time (min)	**=**	**19.13**	**+**	**0.00**	**+**	**0.00**	**=**	**19.13**
Shallow Concentrated Flow								
Flow length (ft)	=	186.00		0.00		0.00		
Watercourse slope (%)	=	0.50		0.00		0.00		
Surface description	=	Unpaved		Paved		Paved		
Average velocity (ft/s)	=	1.14		0.00		0.00		
Travel Time (min)	**=**	**2.72**	**+**	**0.00**	**+**	**0.00**	**=**	**2.72**
Channel Flow								
X sectional flow area (sqft)	=	21.30		0.00		0.00		
Wetted perimeter (ft)	=	12.30		0.00		0.00		
Channel slope (%)	=	2.50		0.00		0.00		
Manning's n-value	=	0.026		0.015		0.015		
Velocity (ft/s)	=	13.09		0.00		0.00		
Flow length (ft)	=	670.0		0.0		0.0		
Travel Time (min)	**=**	**0.85**	**+**	**0.00**	**+**	**0.00**	**=**	**0.85**

Total Travel Time, Tc ..... 22.70 min

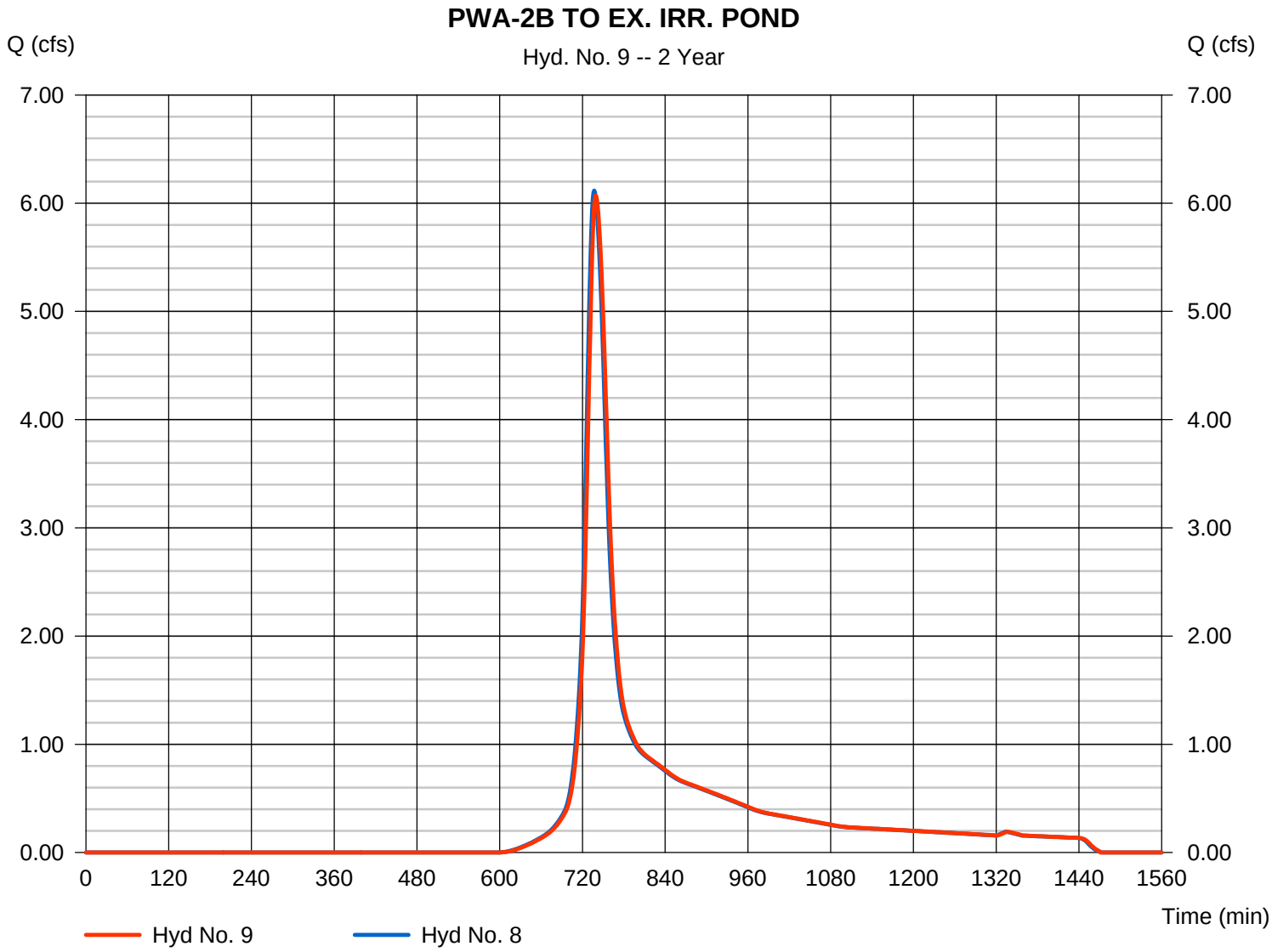
Hydrograph Report

Hyd. No. 9

PWA-2B TO EX. IRR. POND

Hydrograph type	=	Reach	Peak discharge	=	6.072 cfs
Storm frequency	=	2 yrs	Time to peak	=	739 min
Time interval	=	1 min	Hyd. volume	=	29,369 cuft
Inflow hyd. No.	=	8 - PWA-2B	Section type	=	Trapezoidal
Reach length	=	300.0 ft	Channel slope	=	3.0 %
Manning's n	=	0.040	Bottom width	=	5.0 ft
Side slope	=	3.0:1	Max. depth	=	1.0 ft
Rating curve x	=	2.205	Rating curve m	=	1.190
Ave. velocity	=	2.60 ft/s	Routing coeff.	=	0.4718

Modified Att-Kin routing method used.

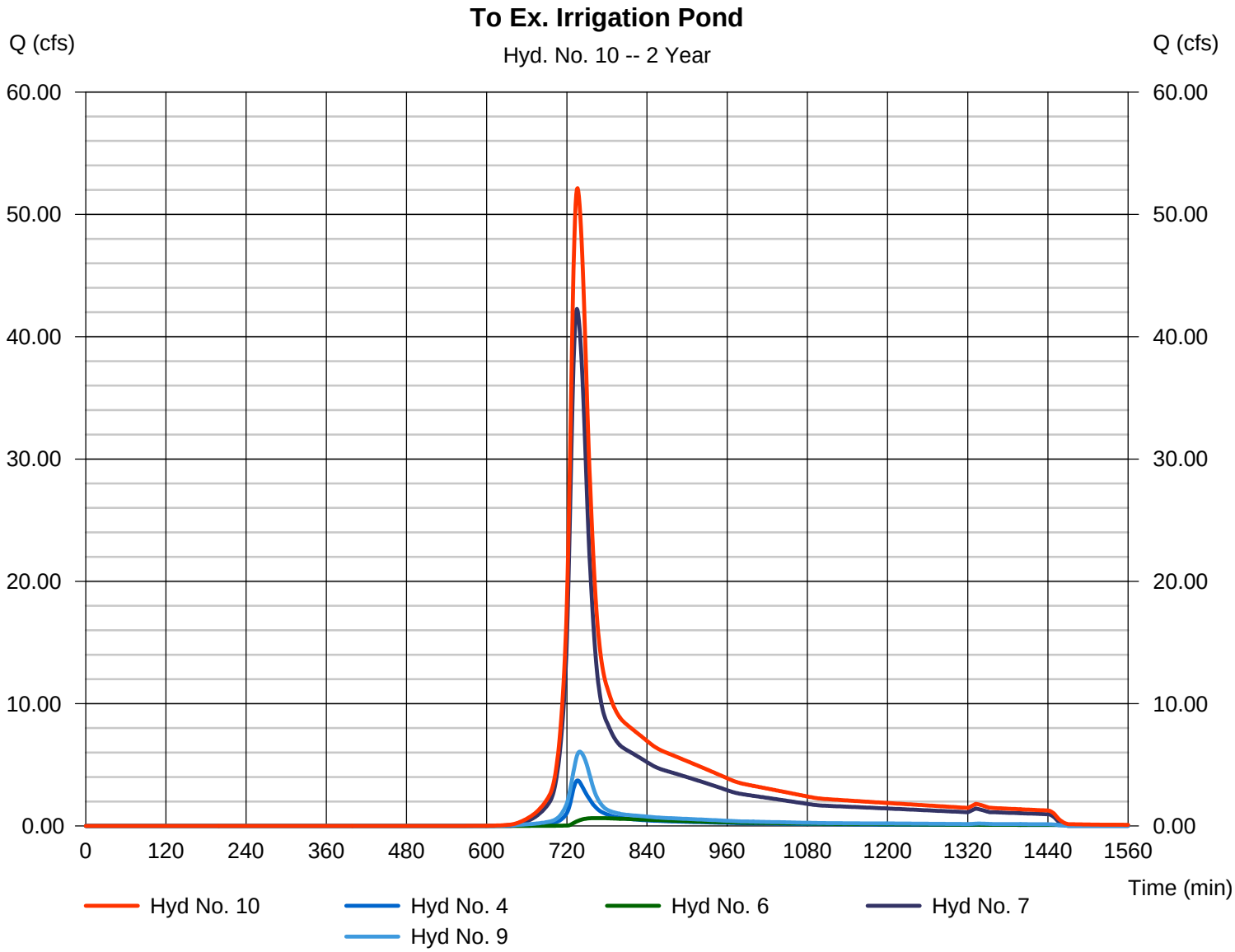


Hydrograph Report

Hyd. No. 10

To Ex. Irrigation Pond

Hydrograph type	= Combine	Peak discharge	= 52.14 cfs
Storm frequency	= 2 yrs	Time to peak	= 736 min
Time interval	= 1 min	Hyd. volume	= 258,221 cuft
Inflow hyds.	= 4, 6, 7, 9	Contrib. drain. area	= 52.700 ac



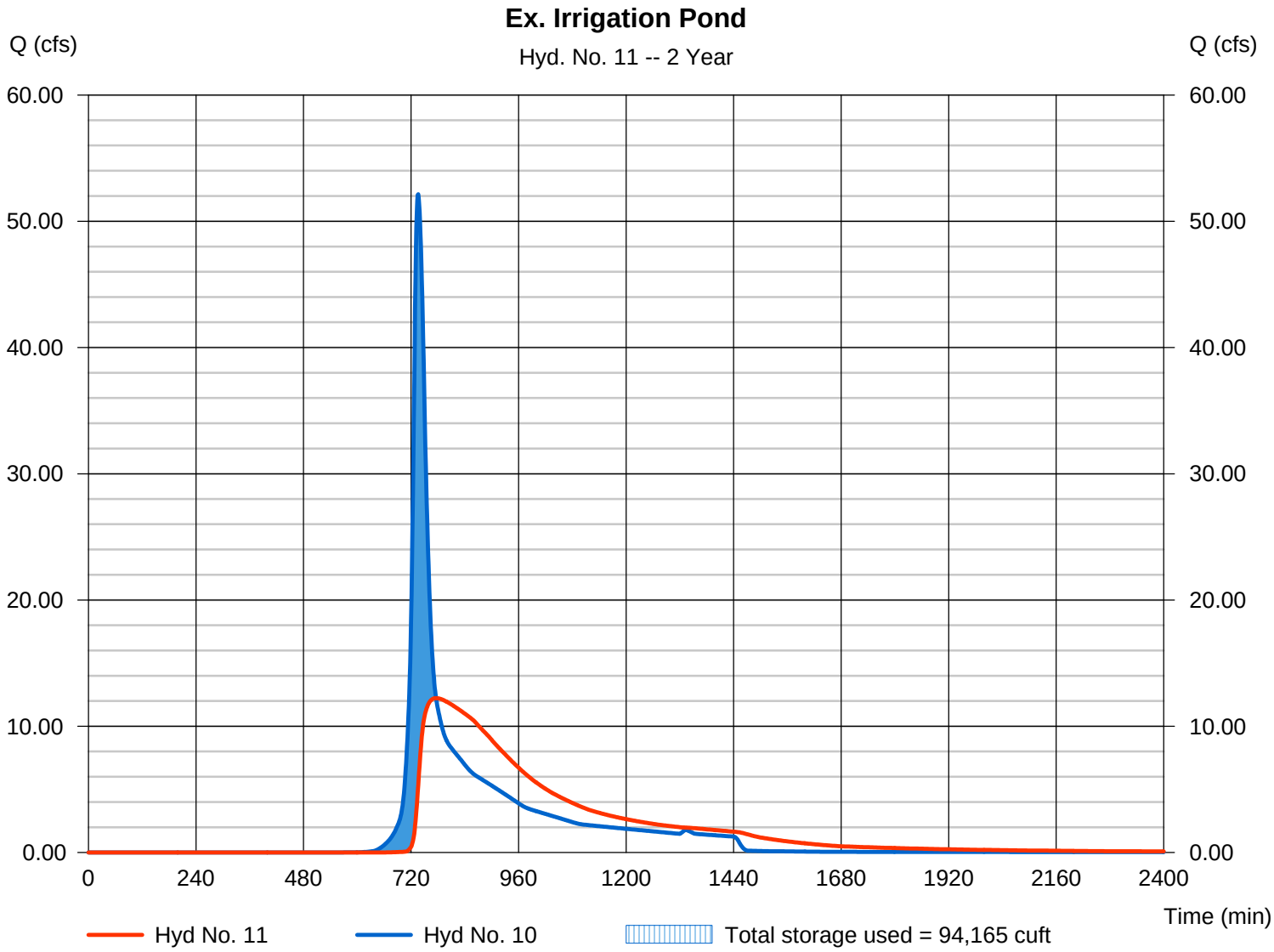
Hydrograph Report

Hyd. No. 11

Ex. Irrigation Pond

Hydrograph type	=	Reservoir	Peak discharge	=	12.23 cfs
Storm frequency	=	2 yrs	Time to peak	=	776 min
Time interval	=	1 min	Hyd. volume	=	252,094 cuft
Inflow hyd. No.	=	10 - To Ex. Irrigation Pond	Max. Elevation	=	164.18 ft
Reservoir name	=	Ex. Irrigation Pond	Max. Storage	=	94,165 cuft

Storage Indication method used.



Pond No. 7 - Ex. Irrigation Pond

Pond Data

Contours - User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 163.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	163.00	72,905	0	0
1.00	164.00	82,201	77,553	77,553
2.00	165.00	98,503	90,352	167,905
2.20	165.20	108,804	20,731	188,636
3.00	166.00	120,265	91,628	280,263

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	0.00	0.00	0.00
Span (in)	= 12.00	0.00	0.00	0.00
No. Barrels	= 4	0	0	0
Invert El. (ft)	= 163.03	0.00	0.00	0.00
Length (ft)	= 21.50	0.00	0.00	0.00
Slope (%)	= 9.10	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)	= 275.00	0.00	0.00	0.00
Crest El. (ft)	= 165.50	0.00	0.00	0.00
Weir Coeff.	= 2.60	3.33	3.33	3.33
Weir Type	= Broad	---	---	---
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).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	163.00	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.10	7,755	163.10	0.09 ic	---	---	---	0.00	---	---	---	---	---	0.087
0.20	15,511	163.20	0.50 ic	---	---	---	0.00	---	---	---	---	---	0.499
0.30	23,266	163.30	1.21 ic	---	---	---	0.00	---	---	---	---	---	1.212
0.40	31,021	163.40	2.19 ic	---	---	---	0.00	---	---	---	---	---	2.191
0.50	38,777	163.50	3.39 ic	---	---	---	0.00	---	---	---	---	---	3.388
0.60	46,532	163.60	4.76 ic	---	---	---	0.00	---	---	---	---	---	4.760
0.70	54,287	163.70	6.24 ic	---	---	---	0.00	---	---	---	---	---	6.237
0.80	62,042	163.80	7.76 ic	---	---	---	0.00	---	---	---	---	---	7.761
0.90	69,798	163.90	9.22 ic	---	---	---	0.00	---	---	---	---	---	9.218
1.00	77,553	164.00	10.44 ic	---	---	---	0.00	---	---	---	---	---	10.44
1.10	86,588	164.10	11.42 ic	---	---	---	0.00	---	---	---	---	---	11.42
1.20	95,623	164.20	12.38 ic	---	---	---	0.00	---	---	---	---	---	12.38
1.30	104,659	164.30	13.27 ic	---	---	---	0.00	---	---	---	---	---	13.27
1.40	113,694	164.40	14.11 ic	---	---	---	0.00	---	---	---	---	---	14.11
1.50	122,729	164.50	14.90 ic	---	---	---	0.00	---	---	---	---	---	14.90
1.60	131,764	164.60	15.65 ic	---	---	---	0.00	---	---	---	---	---	15.65
1.70	140,799	164.70	16.36 ic	---	---	---	0.00	---	---	---	---	---	16.36
1.80	149,835	164.80	17.05 ic	---	---	---	0.00	---	---	---	---	---	17.05
1.90	158,870	164.90	17.70 ic	---	---	---	0.00	---	---	---	---	---	17.70
2.00	167,905	165.00	18.34 ic	---	---	---	0.00	---	---	---	---	---	18.34
2.02	169,978	165.02	18.46 ic	---	---	---	0.00	---	---	---	---	---	18.46
2.04	172,051	165.04	18.59 ic	---	---	---	0.00	---	---	---	---	---	18.59
2.06	174,124	165.06	18.71 ic	---	---	---	0.00	---	---	---	---	---	18.71
2.08	176,197	165.08	18.83 ic	---	---	---	0.00	---	---	---	---	---	18.83
2.10	178,270	165.10	18.95 ic	---	---	---	0.00	---	---	---	---	---	18.95
2.12	180,343	165.12	19.07 ic	---	---	---	0.00	---	---	---	---	---	19.07
2.14	182,416	165.14	19.19 ic	---	---	---	0.00	---	---	---	---	---	19.19
2.16	184,490	165.16	19.31 ic	---	---	---	0.00	---	---	---	---	---	19.31
2.18	186,563	165.18	19.43 ic	---	---	---	0.00	---	---	---	---	---	19.43
2.20	188,636	165.20	19.55 ic	---	---	---	0.00	---	---	---	---	---	19.55
2.28	197,799	165.28	20.01 ic	---	---	---	0.00	---	---	---	---	---	20.01
2.36	206,961	165.36	20.46 ic	---	---	---	0.00	---	---	---	---	---	20.46
2.44	216,124	165.44	20.90 ic	---	---	---	0.00	---	---	---	---	---	20.90
2.52	225,287	165.52	21.34 ic	---	---	---	2.02	---	---	---	---	---	23.36
2.60	234,450	165.60	21.76 ic	---	---	---	22.61	---	---	---	---	---	44.37
2.68	243,612	165.68	22.18 ic	---	---	---	54.61	---	---	---	---	---	76.78
2.76	252,775	165.76	22.59 ic	---	---	---	94.80	---	---	---	---	---	117.38
2.84	261,938	165.84	22.99 ic	---	---	---	141.76	---	---	---	---	---	164.75
2.92	271,101	165.92	23.38 ic	---	---	---	194.63	---	---	---	---	---	218.01

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Ex. Irrigation Pond

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
3.00	280,263	166.00	23.77 ic	---	---	---	252.79	---	---	---	---	---	276.56

...End

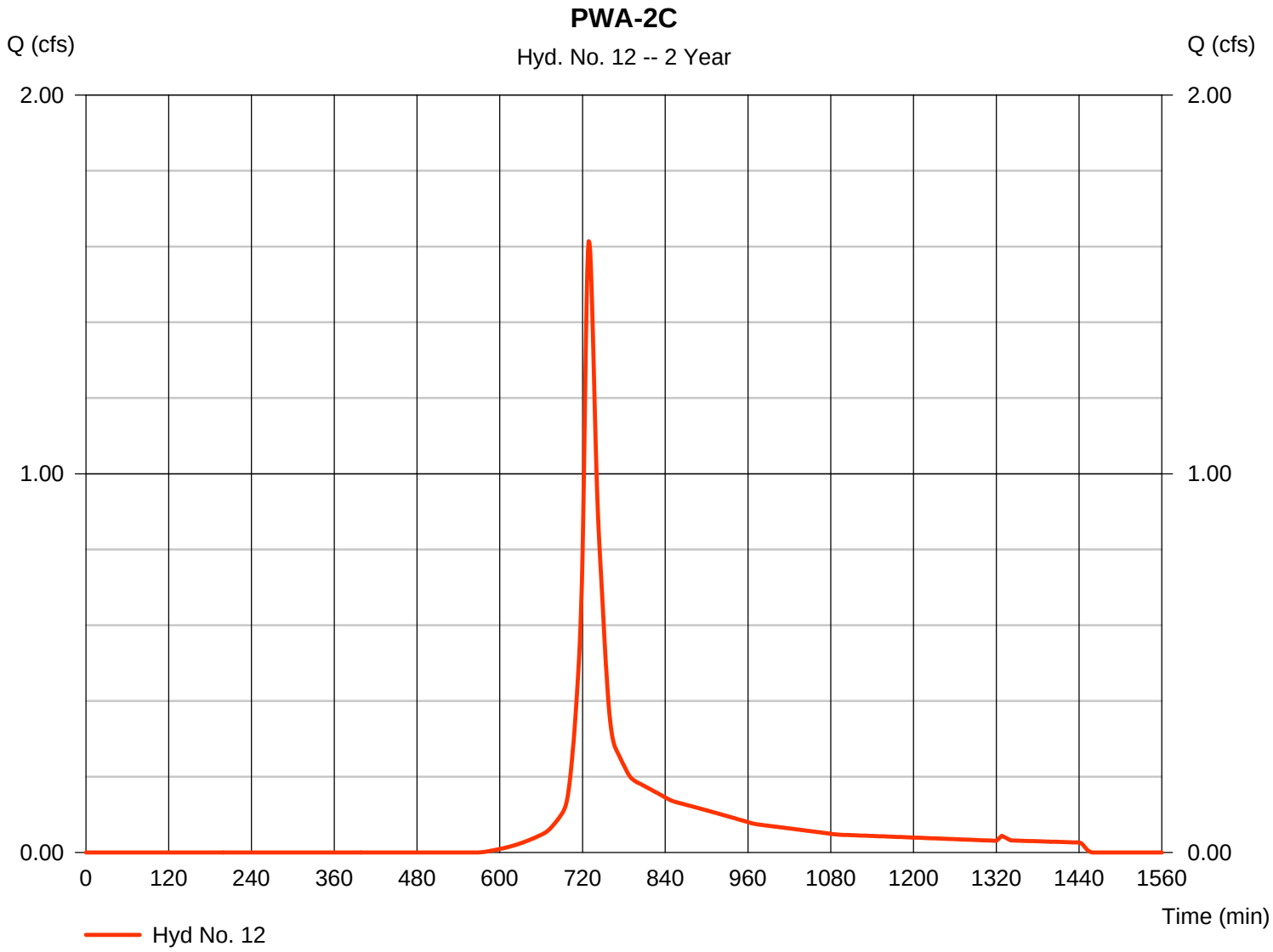
Hydrograph Report

Hyd. No. 12

PWA-2C

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.614 cfs
Storm frequency	=	2 yrs	Time to peak	=	729 min
Time interval	=	1 min	Hyd. volume	=	6,157 cuft
Drainage area	=	1.300 ac	Curve number	=	80*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	12.60 min
Total precip.	=	3.10 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.400 x 98) + (0.900 x 72)] / 1.300



TR55 Tc Worksheet

Hyd. No. 12

PWA-2C

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.011		0.011		0.011		
Flow length (ft)	=	100.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.10		0.00		0.00		
Land slope (%)	=	0.40		0.00		0.00		
Travel Time (min)	**=**	**2.34**	**+**	**0.00**	**+**	**0.00**	**=**	**2.34**
Shallow Concentrated Flow								
Flow length (ft)	=	1542.00		0.00		0.00		
Watercourse slope (%)	=	2.40		0.00		0.00		
Surface description	=	Unpaved		Paved		Paved		
Average velocity (ft/s)	=	2.50		0.00		0.00		
Travel Time (min)	**=**	**10.28**	**+**	**0.00**	**+**	**0.00**	**=**	**10.28**
Channel Flow								
X sectional flow area (sqft)	=	0.00		0.00		0.00		
Wetted perimeter (ft)	=	0.00		0.00		0.00		
Channel slope (%)	=	0.00		0.00		0.00		
Manning's n-value	=	0.015		0.015		0.015		
Velocity (ft/s)	=	0.00		0.00		0.00		
Flow length (ft)	=	0.0		0.0		0.0		
Travel Time (min)	**=**	**0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

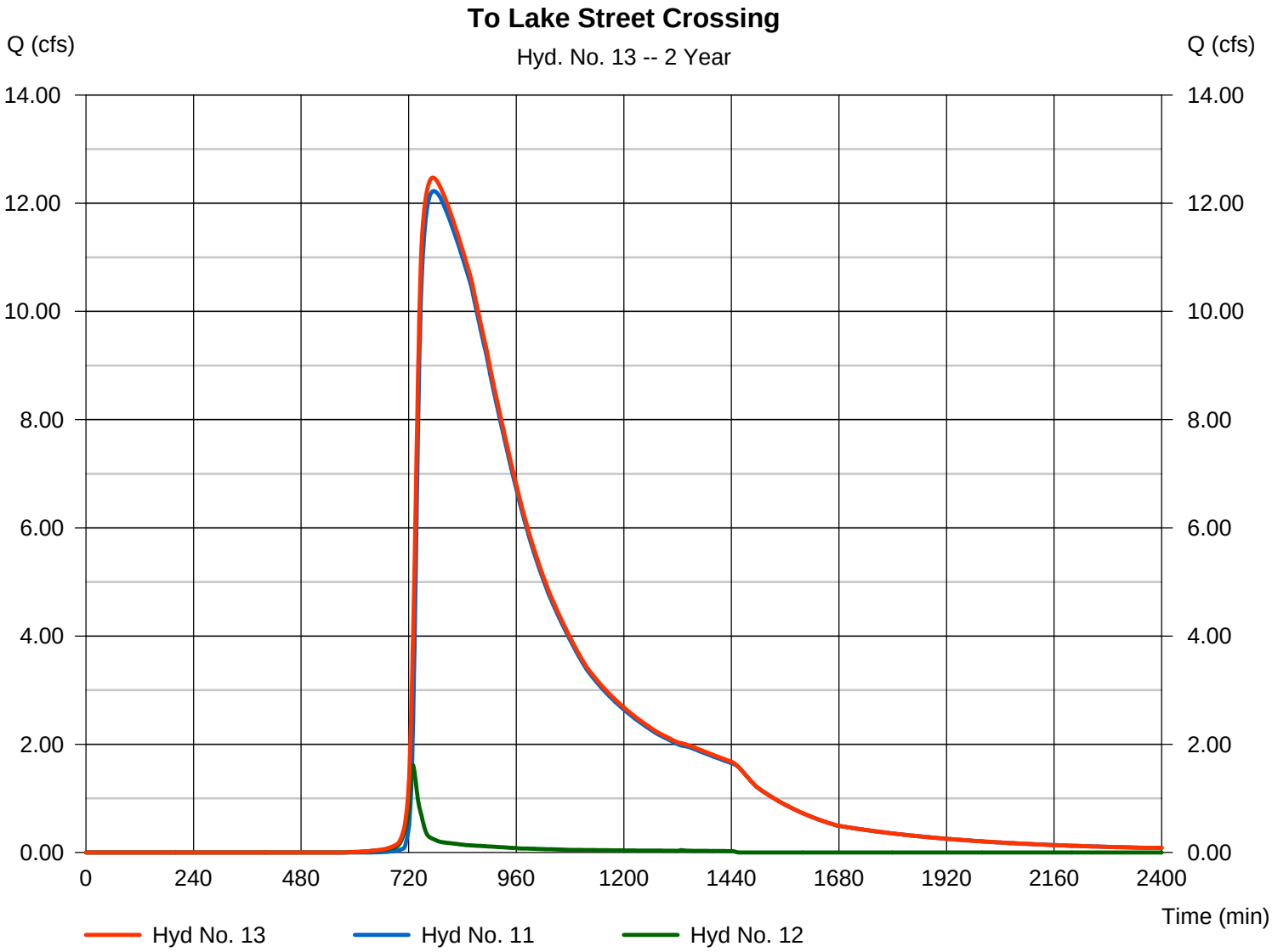
Total Travel Time, Tc ..... 12.60 min

Hydrograph Report

Hyd. No. 13

To Lake Street Crossing

Hydrograph type	= Combine	Peak discharge	= 12.47 cfs
Storm frequency	= 2 yrs	Time to peak	= 774 min
Time interval	= 1 min	Hyd. volume	= 258,251 cuft
Inflow hyds.	= 11, 12	Contrib. drain. area	= 1.300 ac



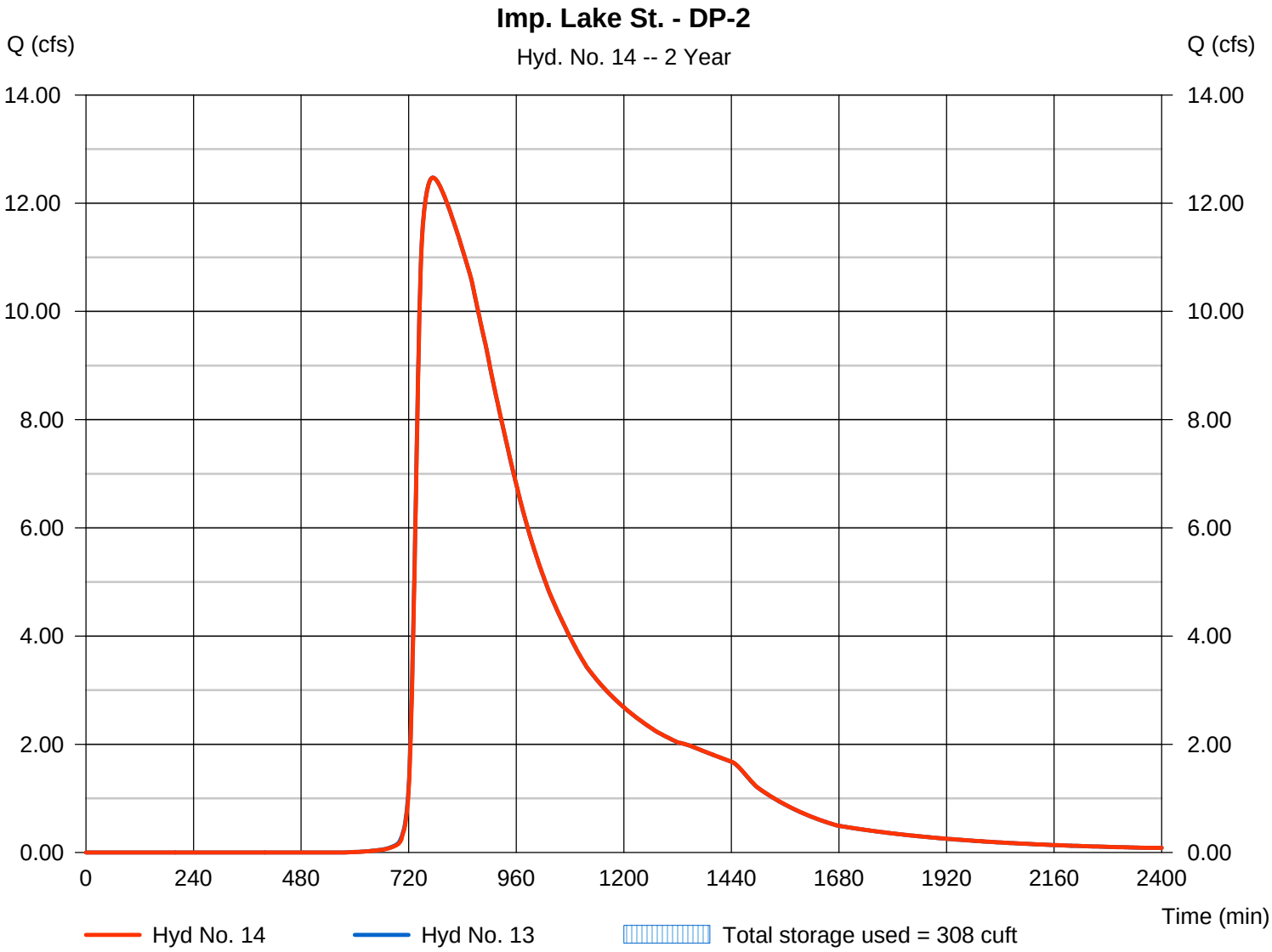
Hydrograph Report

Hyd. No. 14

Imp. Lake St. - DP-2

Hydrograph type	=	Reservoir	Peak discharge	=	12.47 cfs
Storm frequency	=	2 yrs	Time to peak	=	774 min
Time interval	=	1 min	Hyd. volume	=	258,241 cuft
Inflow hyd. No.	=	13 - To Lake Street Crossing	Max. Elevation	=	157.69 ft
Reservoir name	=	Improved Lake Street Crossing	Max. Storage	=	308 cuft

Storage Indication method used.



Pond Report

Pond No. 9 - Improved Lake Street Crossing

Pond Data

Contours - User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 156.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	156.00	00	0	0
2.00	158.00	365	365	365
4.00	160.00	1,538	1,903	2,268
5.00	161.00	5,000	3,269	5,537

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	0.00	0.00	0.00
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 156.00	0.00	0.00	0.00
Length (ft)	= 34.60	0.00	0.00	0.00
Slope (%)	= 2.10	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)	= 100.00	0.00	0.00	0.00
Crest El. (ft)	= 159.80	0.00	0.00	0.00
Weir Coeff.	= 2.60	3.33	3.33	3.33
Weir Type	= Broad	---	---	---
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).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	156.00	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.20	37	156.20	0.25 ic	---	---	---	0.00	---	---	---	---	---	0.250
0.40	73	156.40	0.97 ic	---	---	---	0.00	---	---	---	---	---	0.966
0.60	110	156.60	2.10 ic	---	---	---	0.00	---	---	---	---	---	2.097
0.80	146	156.80	3.58 ic	---	---	---	0.00	---	---	---	---	---	3.575
1.00	183	157.00	5.35 ic	---	---	---	0.00	---	---	---	---	---	5.348
1.20	219	157.20	7.35 ic	---	---	---	0.00	---	---	---	---	---	7.349
1.40	256	157.40	9.46 ic	---	---	---	0.00	---	---	---	---	---	9.463
1.60	292	157.60	11.61 ic	---	---	---	0.00	---	---	---	---	---	11.61
1.80	329	157.80	13.61 ic	---	---	---	0.00	---	---	---	---	---	13.61
2.00	365	158.00	15.12 ic	---	---	---	0.00	---	---	---	---	---	15.12
2.20	555	158.20	16.57 ic	---	---	---	0.00	---	---	---	---	---	16.57
2.40	746	158.40	17.90 ic	---	---	---	0.00	---	---	---	---	---	17.90
2.60	936	158.60	19.13 ic	---	---	---	0.00	---	---	---	---	---	19.13
2.80	1,126	158.80	20.29 ic	---	---	---	0.00	---	---	---	---	---	20.29
3.00	1,317	159.00	21.39 ic	---	---	---	0.00	---	---	---	---	---	21.39
3.20	1,507	159.20	22.43 ic	---	---	---	0.00	---	---	---	---	---	22.43
3.40	1,697	159.40	23.43 ic	---	---	---	0.00	---	---	---	---	---	23.43
3.60	1,887	159.60	24.39 ic	---	---	---	0.00	---	---	---	---	---	24.39
3.80	2,078	159.80	25.31 ic	---	---	---	0.00	---	---	---	---	---	25.31
4.00	2,268	160.00	26.20 ic	---	---	---	23.25	---	---	---	---	---	49.45
4.10	2,595	160.10	26.63 ic	---	---	---	42.72	---	---	---	---	---	69.35
4.20	2,922	160.20	27.06 ic	---	---	---	65.78	---	---	---	---	---	92.83
4.30	3,249	160.30	27.48 ic	---	---	---	91.93	---	---	---	---	---	119.40
4.40	3,576	160.40	27.89 ic	---	---	---	120.84	---	---	---	---	---	148.73
4.50	3,903	160.50	28.30 ic	---	---	---	152.28	---	---	---	---	---	180.58
4.60	4,229	160.60	28.70 ic	---	---	---	186.05	---	---	---	---	---	214.75
4.70	4,556	160.70	29.09 ic	---	---	---	222.01	---	---	---	---	---	251.10
4.80	4,883	160.80	29.48 ic	---	---	---	260.02	---	---	---	---	---	289.50
4.90	5,210	160.90	29.87 ic	---	---	---	299.98	---	---	---	---	---	329.85
5.00	5,537	161.00	30.25 ic	---	---	---	341.78	---	---	---	---	---	372.03

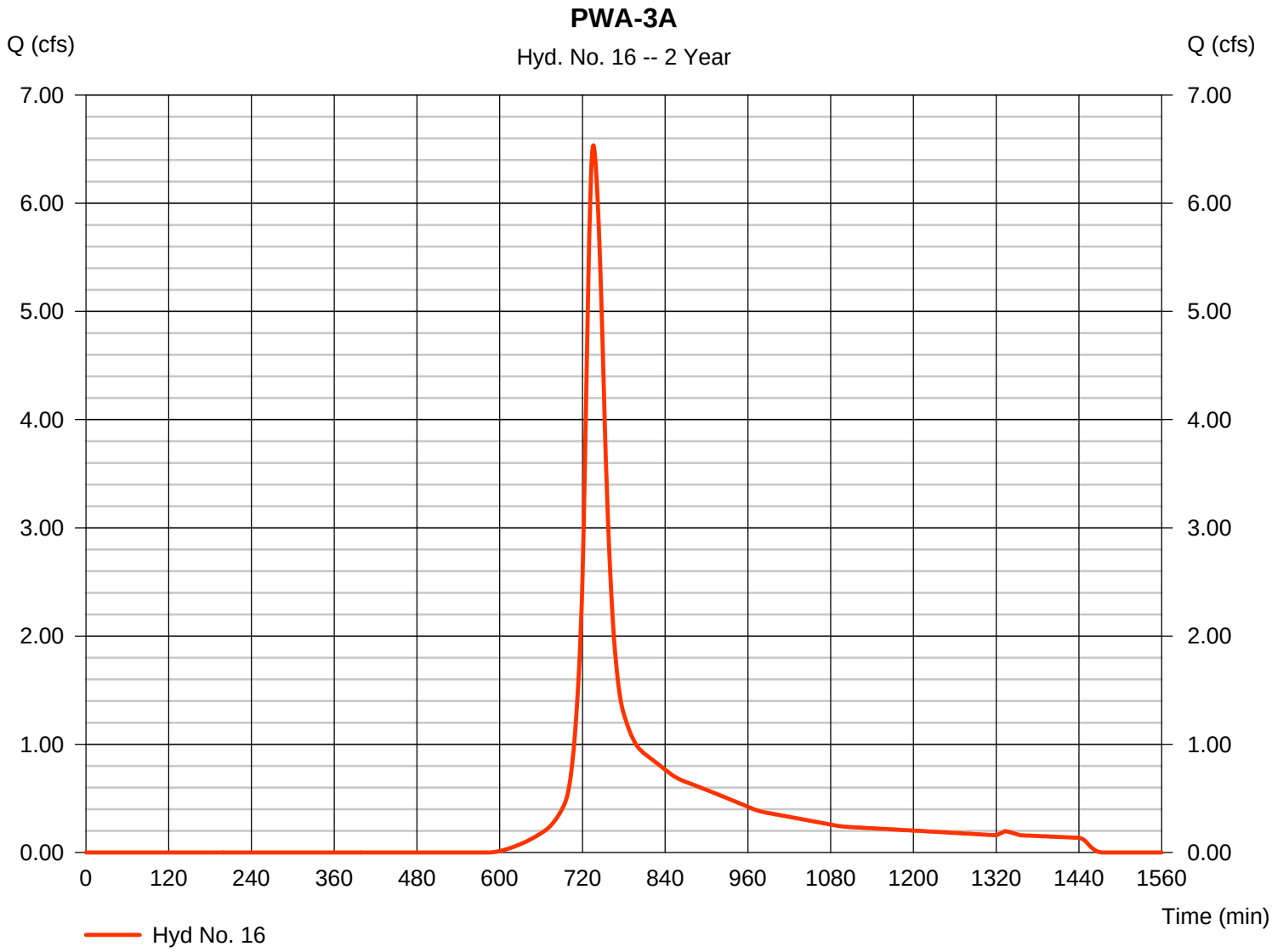
Hydrograph Report

Hyd. No. 16

PWA-3A

Hydrograph type	=	SCS Runoff	Peak discharge	=	6.536 cfs
Storm frequency	=	2 yrs	Time to peak	=	736 min
Time interval	=	1 min	Hyd. volume	=	30,528 cuft
Drainage area	=	6.600 ac	Curve number	=	79*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	21.70 min
Total precip.	=	3.10 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.500 x 98) + (5.100 x 74)] / 6.600



TR55 Tc Worksheet

Hyd. No. 16

PWA-3A

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.10		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 14.50**	**+**	**0.00**	**+**	**0.00**	**=**	**14.50**
Shallow Concentrated Flow							
Flow length (ft)	= 48.00		0.00		0.00		
Watercourse slope (%)	= 3.10		0.00		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	= 2.84		0.00		0.00		
Travel Time (min)	**= 0.28**	**+**	**0.00**	**+**	**0.00**	**=**	**0.28**
Channel Flow							
X sectional flow area (sqft)	= 3.00		3.00		0.00		
Wetted perimeter (ft)	= 6.30		6.30		0.00		
Channel slope (%)	= 1.00		3.20		0.00		
Manning's n-value	= 0.060		0.060		0.015		
Velocity (ft/s)	= 1.51		2.70		0.00		
Flow length (ft)	= 505.0		217.0		0.0		
Travel Time (min)	**= 5.57**	**+**	**1.34**	**+**	**0.00**	**=**	**6.91**

Total Travel Time, Tc ..... 21.70 min

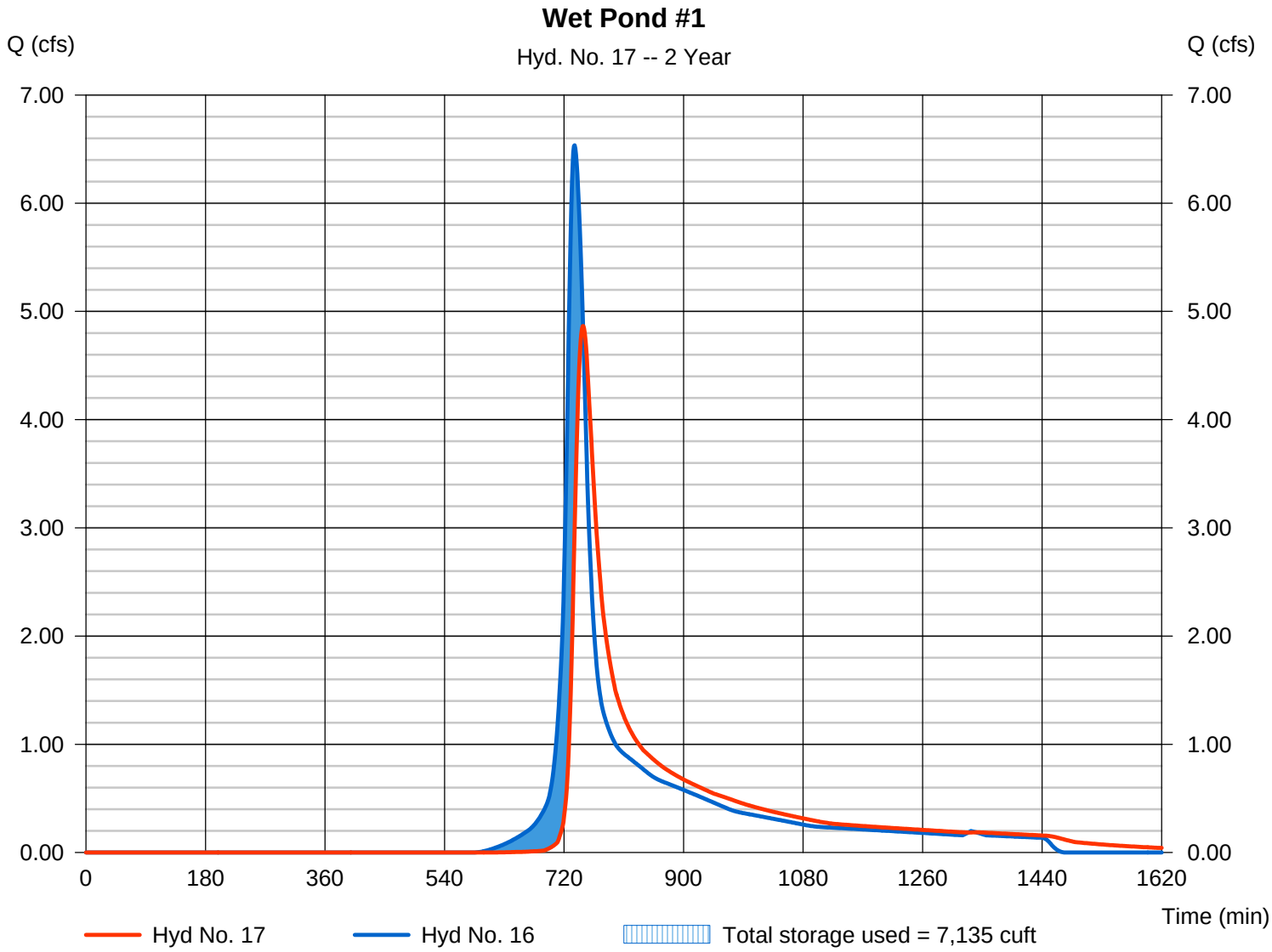
Hydrograph Report

Hyd. No. 17

Wet Pond #1

Hydrograph type	=	Reservoir	Peak discharge	=	4.865 cfs
Storm frequency	=	2 yrs	Time to peak	=	749 min
Time interval	=	1 min	Hyd. volume	=	30,367 cuft
Inflow hyd. No.	=	16 - PWA-3A	Max. Elevation	=	195.94 ft
Reservoir name	=	Wet Pond #1	Max. Storage	=	7,135 cuft

Storage Indication method used.



Pond Report

Pond No. 4 - Wet Pond #1

Pond Data

Contours - User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 194.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	194.50	4,096	0	0
1.50	196.00	5,821	7,438	7,438
3.50	198.00	8,212	14,033	21,471

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	0.00	0.00	0.00
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 192.00	0.00	0.00	0.00
Length (ft)	= 25.00	0.00	0.00	0.00
Slope (%)	= 2.00	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	25.00	0.00	0.00
Crest El. (ft)	= 194.50	197.00	0.00	0.00
Weir Coeff.	= 1.95	2.60	3.33	3.33
Weir Type	= 75 degV	Broad	---	---
Multi-Stage	= Yes	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).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	194.50	0.00	---	---	---	---	0.00	---	---	---	---	0.000
0.15	744	194.65	18.52 ic	---	---	---	0.02	0.00	---	---	---	---	0.017
0.30	1,488	194.80	18.52 ic	---	---	---	0.10	0.00	---	---	---	---	0.096
0.45	2,231	194.95	18.52 ic	---	---	---	0.26	0.00	---	---	---	---	0.265
0.60	2,975	195.10	18.52 ic	---	---	---	0.54	0.00	---	---	---	---	0.543
0.75	3,719	195.25	18.52 ic	---	---	---	0.95	0.00	---	---	---	---	0.949
0.90	4,463	195.40	18.52 ic	---	---	---	1.50	0.00	---	---	---	---	1.498
1.05	5,206	195.55	18.52 ic	---	---	---	2.20	0.00	---	---	---	---	2.202
1.20	5,950	195.70	18.52 ic	---	---	---	3.07	0.00	---	---	---	---	3.074
1.35	6,694	195.85	18.52 ic	---	---	---	4.13	0.00	---	---	---	---	4.127
1.50	7,438	196.00	18.52 ic	---	---	---	5.37	0.00	---	---	---	---	5.371
1.70	8,841	196.20	18.52 ic	---	---	---	7.34	0.00	---	---	---	---	7.344
1.90	10,244	196.40	18.52 ic	---	---	---	9.70	0.00	---	---	---	---	9.698
2.10	11,648	196.60	18.52 ic	---	---	---	12.46	0.00	---	---	---	---	12.46
2.30	13,051	196.80	18.52 ic	---	---	---	15.64	0.00	---	---	---	---	15.64
2.50	14,454	197.00	19.19 ic	---	---	---	19.19 s	0.00	---	---	---	---	19.19
2.70	15,858	197.20	22.22 ic	---	---	---	22.22 s	5.81	---	---	---	---	28.03
2.90	17,261	197.40	24.81 ic	---	---	---	24.81 s	16.44	---	---	---	---	41.26
3.10	18,664	197.60	27.03 ic	---	---	---	27.03 s	30.21	---	---	---	---	57.23
3.30	20,067	197.80	28.91 ic	---	---	---	28.91 s	46.51	---	---	---	---	75.41
3.50	21,471	198.00	30.51 ic	---	---	---	30.51 s	65.00	---	---	---	---	95.51

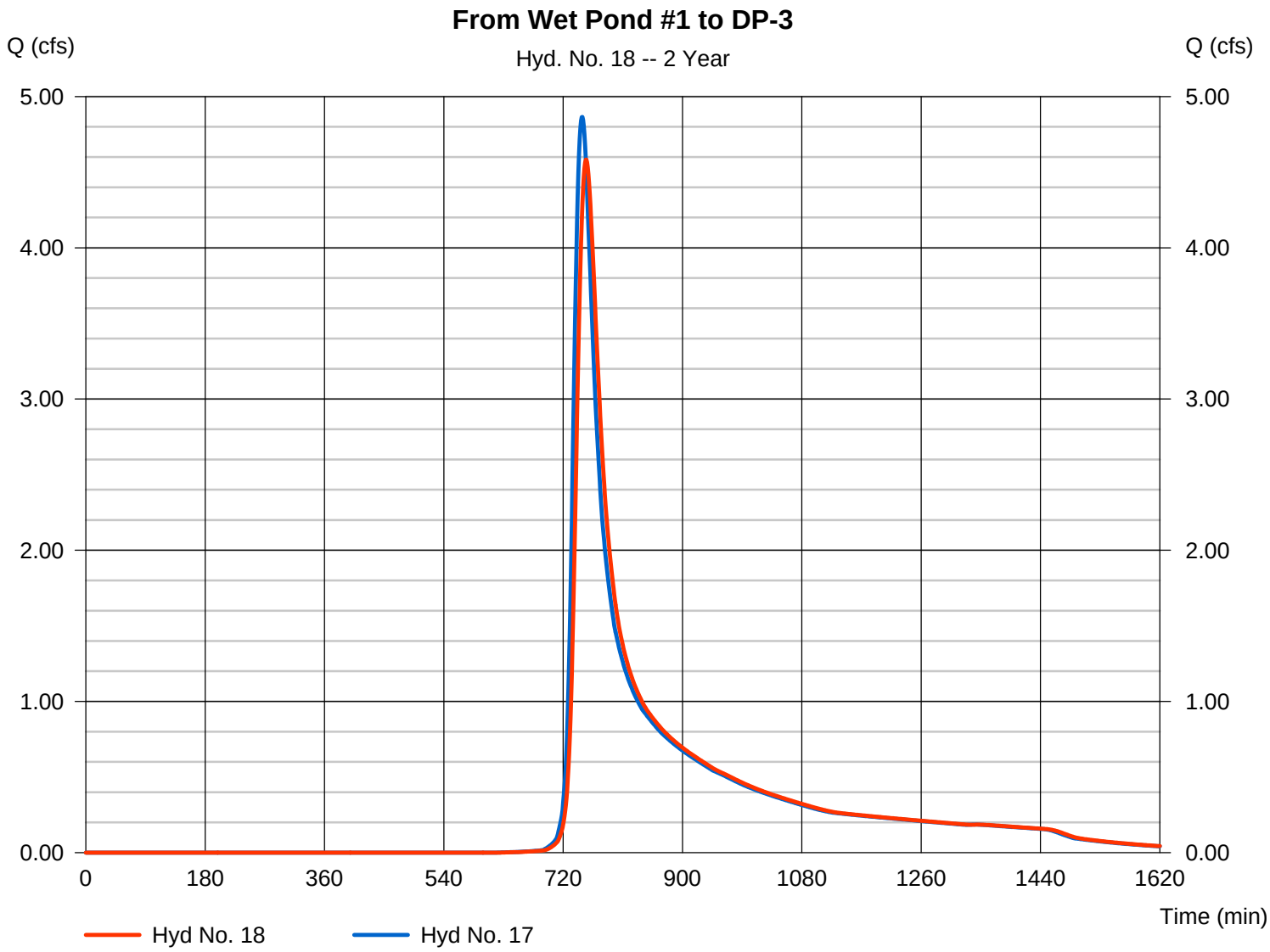
Hydrograph Report

Hyd. No. 18

From Wet Pond #1 to DP-3

Hydrograph type	=	Reach	Peak discharge	=	4.583 cfs
Storm frequency	=	2 yrs	Time to peak	=	755 min
Time interval	=	1 min	Hyd. volume	=	30,090 cuft
Inflow hyd. No.	=	17 - Wet Pond #1	Section type	=	Trapezoidal
Reach length	=	1299.0 ft	Channel slope	=	2.2 %
Manning's n	=	0.026	Bottom width	=	6.0 ft
Side slope	=	3.0:1	Max. depth	=	3.0 ft
Rating curve x	=	2.573	Rating curve m	=	1.344
Ave. velocity	=	3.03 ft/s	Routing coeff.	=	0.1718

Modified Att-Kin routing method used.



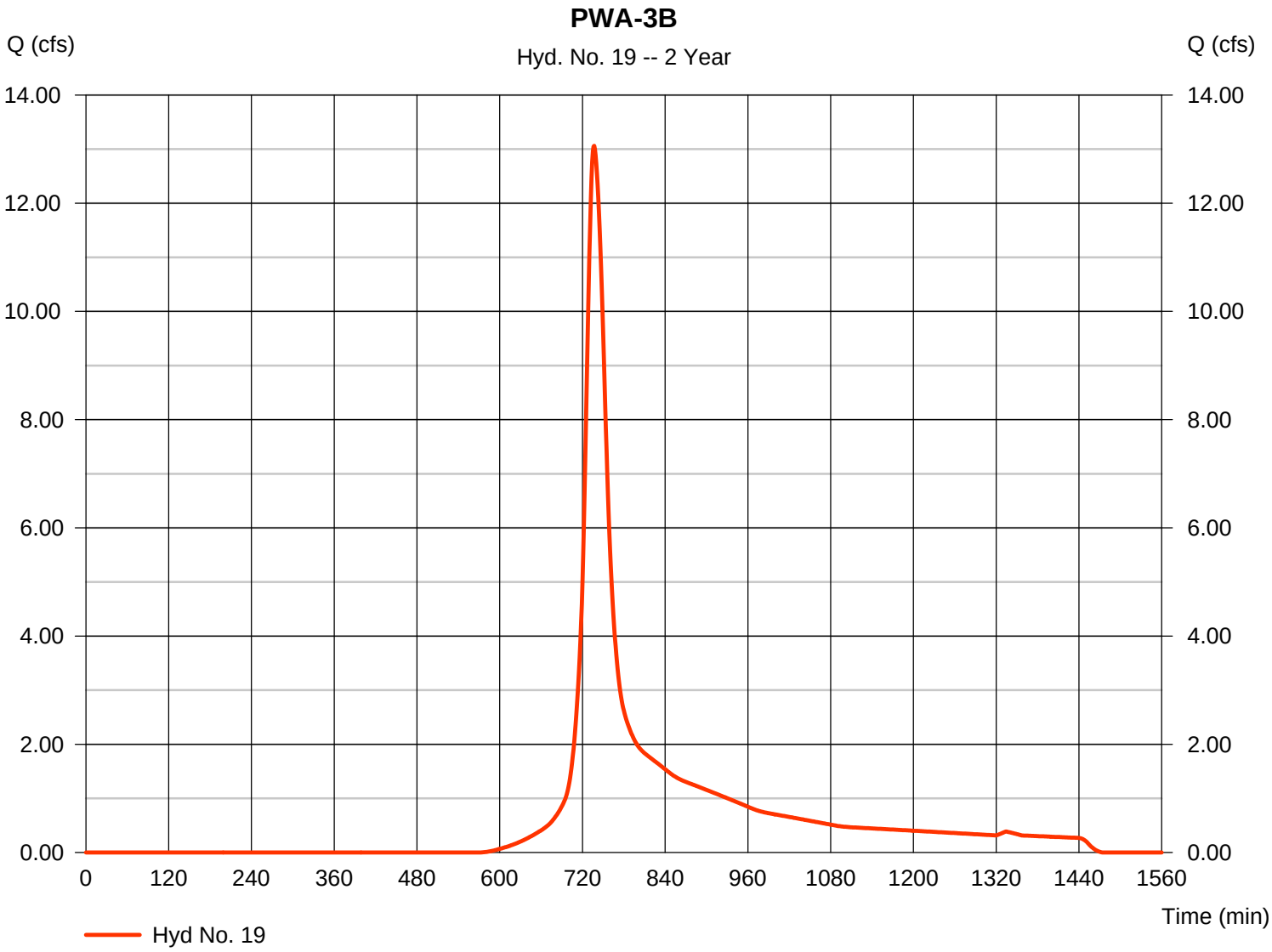
Hydrograph Report

Hyd. No. 19

PWA-3B

Hydrograph type	=	SCS Runoff	Peak discharge	=	13.06 cfs
Storm frequency	=	2 yrs	Time to peak	=	737 min
Time interval	=	1 min	Hyd. volume	=	61,991 cuft
Drainage area	=	13.000 ac	Curve number	=	80*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	22.20 min
Total precip.	=	3.10 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(3.100 x 98) + (1.100 x 72) + (8.800 x 74)] / 13.000



TR55 Tc Worksheet

Hyd. No. 19

PWA-3B

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.10		0.00		0.00		
Land slope (%)	= 1.40		0.00		0.00		
Travel Time (min)	**= 16.72**	**+**	**0.00**	**+**	**0.00**	**=**	**16.72**
Shallow Concentrated Flow							
Flow length (ft)	= 309.00		0.00		0.00		
Watercourse slope (%)	= 4.50		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	= 3.42		0.00		0.00		
Travel Time (min)	**= 1.50**	**+**	**0.00**	**+**	**0.00**	**=**	**1.50**
Channel Flow							
X sectional flow area (sqft)	= 3.00		0.00		0.00		
Wetted perimeter (ft)	= 6.30		0.00		0.00		
Channel slope (%)	= 2.20		0.00		0.00		
Manning's n-value	= 0.060		0.015		0.015		
Velocity (ft/s)	= 2.24		0.00		0.00		
Flow length (ft)	= 535.0		0.0		0.0		
Travel Time (min)	**= 3.98**	**+**	**0.00**	**+**	**0.00**	**=**	**3.98**

Total Travel Time, Tc ..... 22.20 min

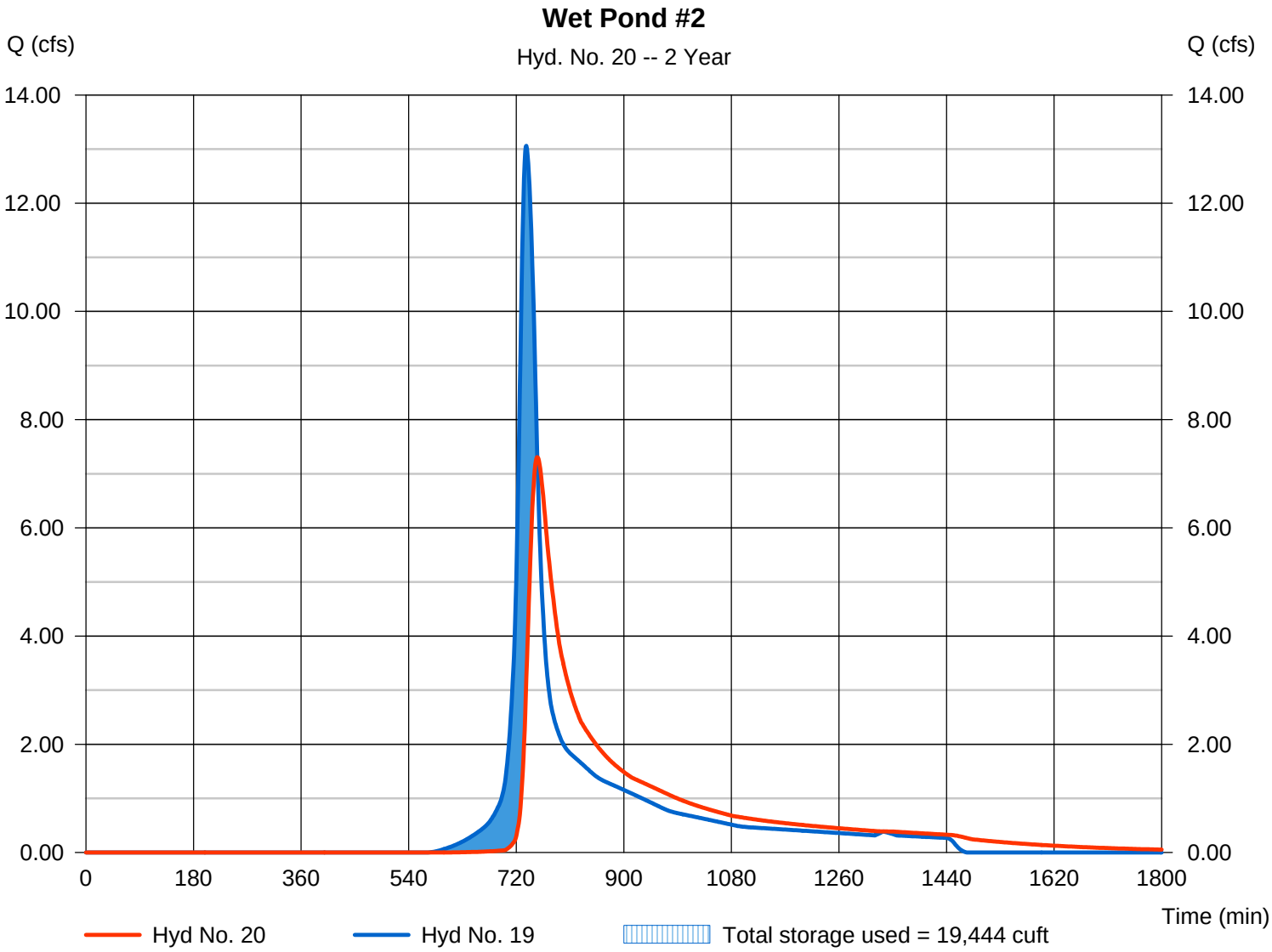
Hydrograph Report

Hyd. No. 20

Wet Pond #2

Hydrograph type	=	Reservoir	Peak discharge	=	7.308 cfs
Storm frequency	=	2 yrs	Time to peak	=	755 min
Time interval	=	1 min	Hyd. volume	=	61,138 cuft
Inflow hyd. No.	=	19 - PWA-3B	Max. Elevation	=	203.62 ft
Reservoir name	=	Wet Pond #2	Max. Storage	=	19,444 cuft

Storage Indication method used.



Pond No. 1 - Wet Pond #2

Pond Data

Contours - User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 202.30 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	202.30	11,217	0	0
1.70	204.00	18,231	25,031	25,031
2.70	205.00	23,622	20,927	45,957
3.70	206.00	33,824	28,723	74,680

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	0.00	0.00	0.00
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 200.00	0.00	0.00	0.00
Length (ft)	= 45.00	0.00	0.00	0.00
Slope (%)	= 0.50	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	10.00	0.00	0.00
Crest El. (ft)	= 202.30	205.00	0.00	0.00
Weir Coeff.	= 3.63	3.33	3.33	3.33
Weir Type	= 110degV	Broad	---	---
Multi-Stage	= Yes	Yes	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).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	202.30	0.00	---	---	---	---	0.00	---	---	---	---	0.000
0.17	2,503	202.47	12.74 oc	---	---	---	0.04	0.00	---	---	---	---	0.043
0.34	5,006	202.64	12.74 oc	---	---	---	0.24	0.00	---	---	---	---	0.244
0.51	7,509	202.81	12.74 oc	---	---	---	0.67	0.00	---	---	---	---	0.674
0.68	10,012	202.98	12.74 oc	---	---	---	1.38	0.00	---	---	---	---	1.383
0.85	12,515	203.15	12.74 oc	---	---	---	2.42	0.00	---	---	---	---	2.416
1.02	15,018	203.32	12.74 oc	---	---	---	3.81	0.00	---	---	---	---	3.811
1.19	17,522	203.49	12.74 oc	---	---	---	5.60	0.00	---	---	---	---	5.603
1.36	20,025	203.66	12.74 oc	---	---	---	7.82	0.00	---	---	---	---	7.823
1.53	22,528	203.83	12.74 oc	---	---	---	10.50	0.00	---	---	---	---	10.50
1.70	25,031	204.00	13.62 oc	---	---	---	13.62 s	0.00	---	---	---	---	13.62
1.80	27,123	204.10	15.45 oc	---	---	---	15.45 s	0.00	---	---	---	---	15.45
1.90	29,216	204.20	17.25 oc	---	---	---	17.25 s	0.00	---	---	---	---	17.25
2.00	31,309	204.30	18.99 oc	---	---	---	18.99 s	0.00	---	---	---	---	18.99
2.10	33,401	204.40	20.65 oc	---	---	---	20.65 s	0.00	---	---	---	---	20.65
2.20	35,494	204.50	22.21 oc	---	---	---	22.20 s	0.00	---	---	---	---	22.20
2.30	37,587	204.60	23.65 oc	---	---	---	23.65 s	0.00	---	---	---	---	23.65
2.40	39,679	204.70	24.97 oc	---	---	---	24.97 s	0.00	---	---	---	---	24.97
2.50	41,772	204.80	26.17 ic	---	---	---	26.17 s	0.00	---	---	---	---	26.17
2.60	43,865	204.90	27.07 ic	---	---	---	27.07 s	0.00	---	---	---	---	27.07
2.70	45,957	205.00	27.87 ic	---	---	---	27.87 s	0.00	---	---	---	---	27.87
2.80	48,830	205.10	28.78 ic	---	---	---	27.72 s	1.05	---	---	---	---	28.78
2.90	51,702	205.20	29.66 ic	---	---	---	26.68 s	2.98	---	---	---	---	29.66
3.00	54,574	205.30	30.44 ic	---	---	---	25.12 s	5.32 s	---	---	---	---	30.44
3.10	57,447	205.40	31.05 ic	---	---	---	24.10 s	6.95 s	---	---	---	---	31.05
3.20	60,319	205.50	31.57 ic	---	---	---	23.33 s	8.23 s	---	---	---	---	31.56
3.30	63,191	205.60	32.04 ic	---	---	---	22.73 s	9.30 s	---	---	---	---	32.03
3.40	66,063	205.70	32.47 ic	---	---	---	22.26 s	10.21 s	---	---	---	---	32.47
3.50	68,936	205.80	32.88 ic	---	---	---	21.88 s	10.99 s	---	---	---	---	32.87
3.60	71,808	205.90	33.27 ic	---	---	---	21.58 s	11.68 s	---	---	---	---	33.26
3.70	74,680	206.00	33.65 ic	---	---	---	21.36 s	12.28 s	---	---	---	---	33.65

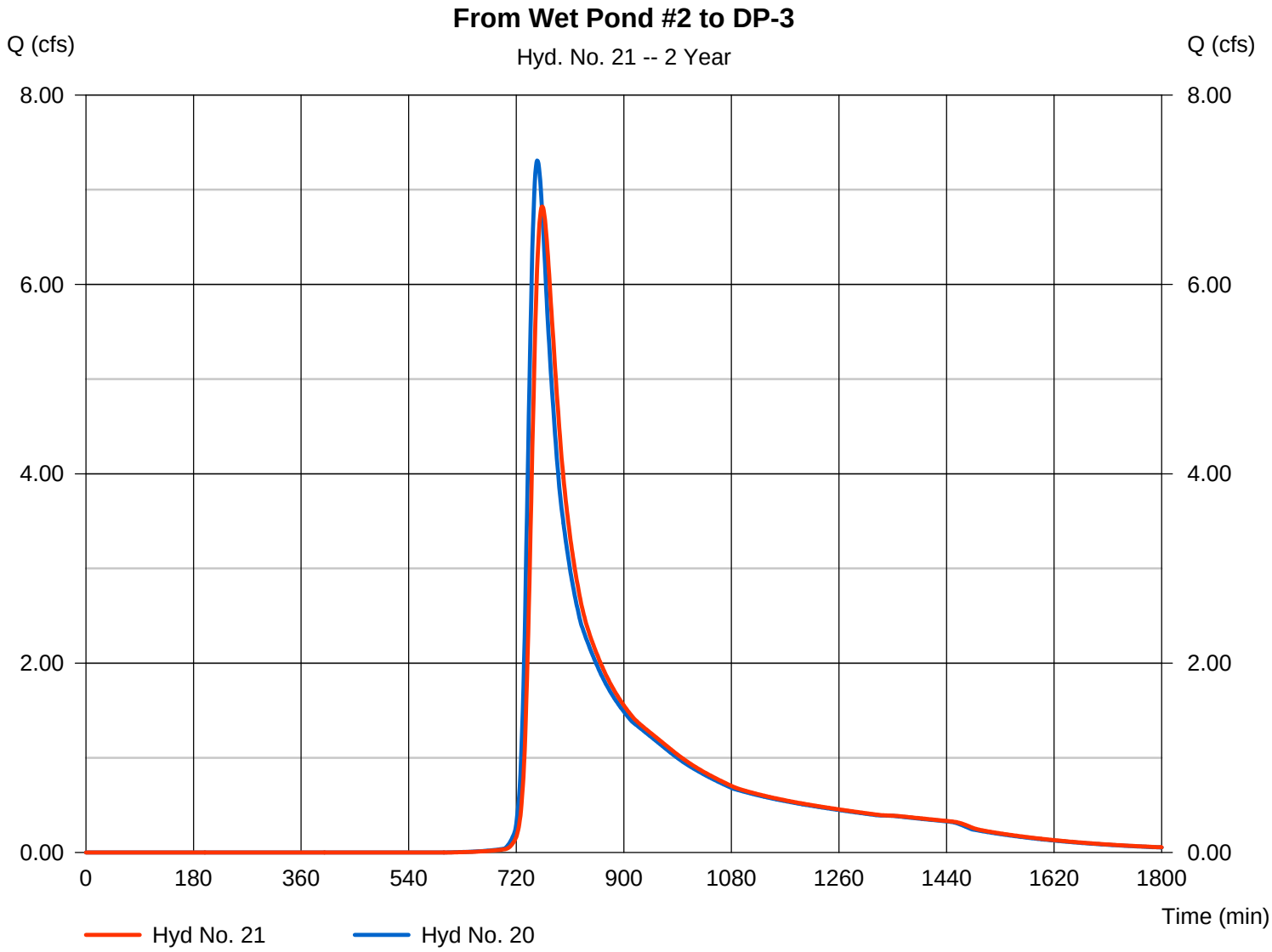
Hydrograph Report

Hyd. No. 21

From Wet Pond #2 to DP-3

Hydrograph type	=	Reach	Peak discharge	=	6.822 cfs
Storm frequency	=	2 yrs	Time to peak	=	763 min
Time interval	=	1 min	Hyd. volume	=	61,131 cuft
Inflow hyd. No.	=	20 - Wet Pond #2	Section type	=	Trapezoidal
Reach length	=	1876.0 ft	Channel slope	=	2.2 %
Manning's n	=	0.026	Bottom width	=	6.0 ft
Side slope	=	3.0:1	Max. depth	=	3.0 ft
Rating curve x	=	2.573	Rating curve m	=	1.344
Ave. velocity	=	3.36 ft/s	Routing coeff.	=	0.1347

Modified Att-Kin routing method used.



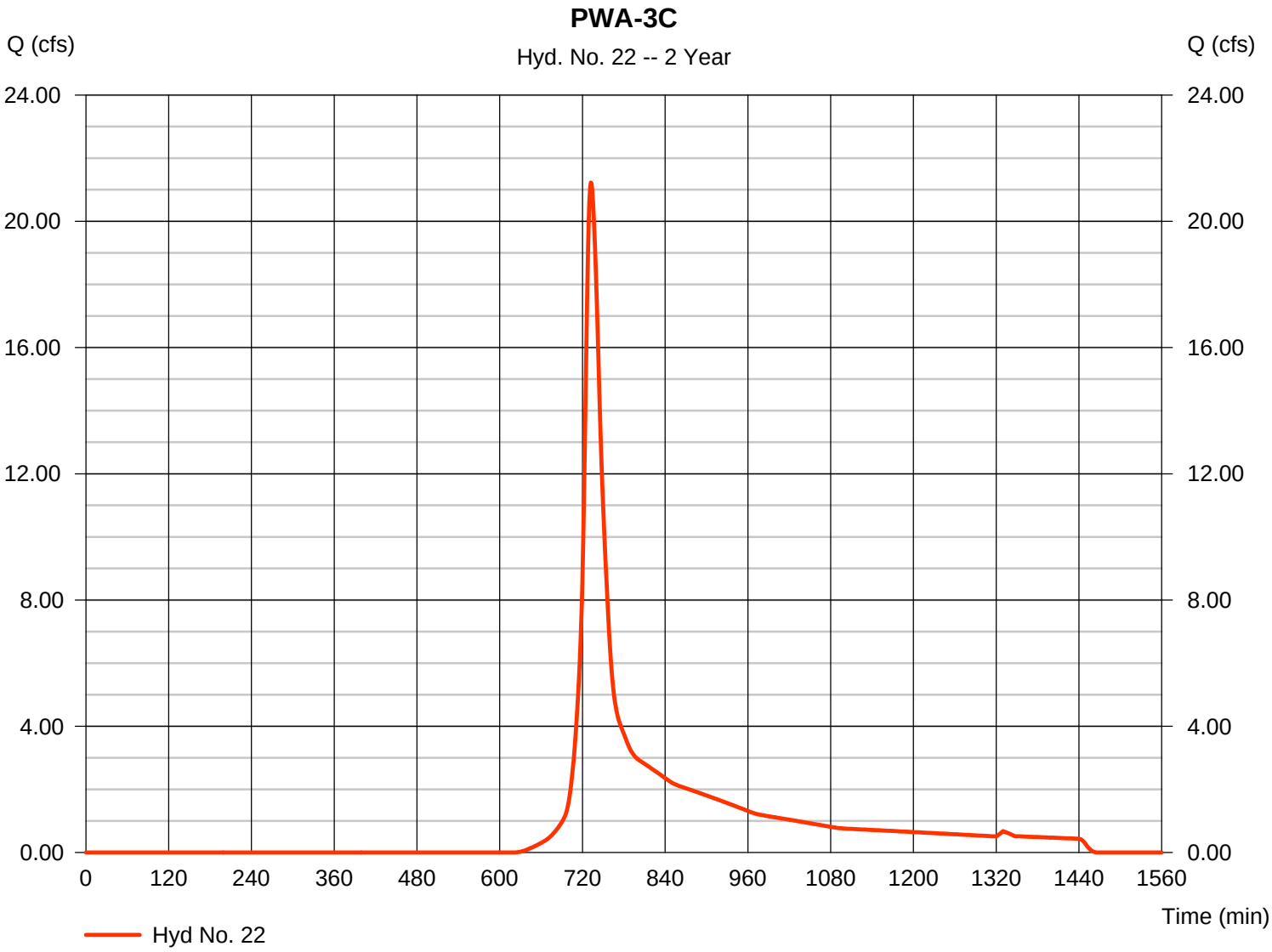
Hydrograph Report

Hyd. No. 22

PWA-3C

Hydrograph type	=	SCS Runoff	Peak discharge	=	21.23 cfs
Storm frequency	=	2 yrs	Time to peak	=	732 min
Time interval	=	1 min	Hyd. volume	=	91,547 cuft
Drainage area	=	23.000 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	16.50 min
Total precip.	=	3.10 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.000 x 98) + (3.100 x 72) + (4.000 x 79) + (14.000 x 74) + (0.900 x 80)] / 23.000



TR55 Tc Worksheet

Hyd. No. 22

PWA-3C

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.240		0.011		0.011		
Flow length (ft)	=	100.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.10		0.00		0.00		
Land slope (%)	=	3.60		0.00		0.00		
Travel Time (min)	**=**	**11.46**	**+**	**0.00**	**+**	**0.00**	**=**	**11.46**
Shallow Concentrated Flow								
Flow length (ft)	=	393.00		525.00		0.00		
Watercourse slope (%)	=	3.90		9.20		0.00		
Surface description	=	Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=	3.19		4.89		0.00		
Travel Time (min)	**=**	**2.06**	**+**	**1.79**	**+**	**0.00**	**=**	**3.84**
Channel Flow								
X sectional flow area (sqft)	=	21.00		0.00		0.00		
Wetted perimeter (ft)	=	12.30		0.00		0.00		
Channel slope (%)	=	2.30		0.00		0.00		
Manning's n-value	=	0.026		0.015		0.015		
Velocity (ft/s)	=	12.44		0.00		0.00		
Flow length (ft)	=	855.0		0.0		0.0		
Travel Time (min)	**=**	**1.15**	**+**	**0.00**	**+**	**0.00**	**=**	**1.15**

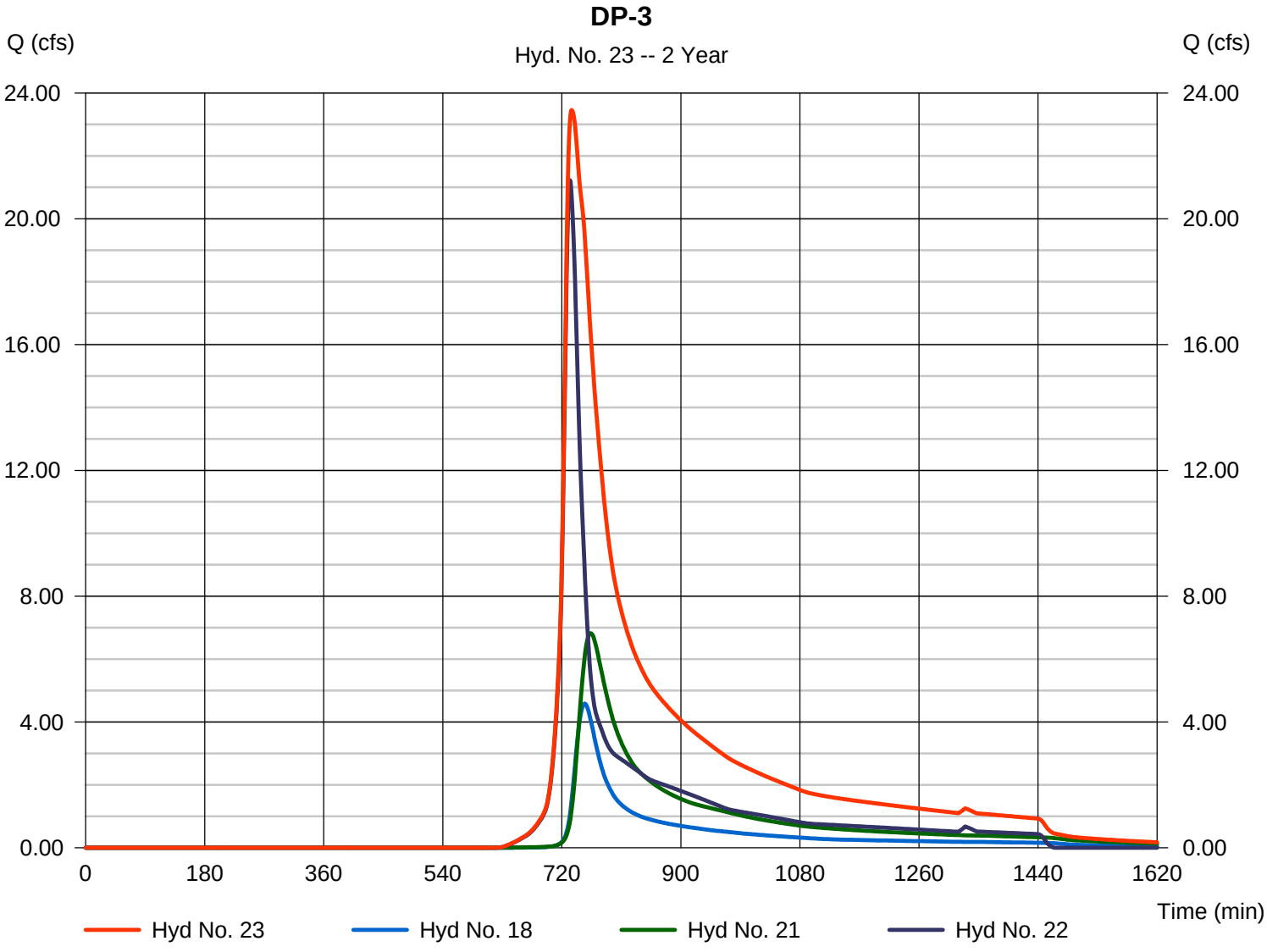
Total Travel Time, Tc ..... 16.50 min

Hydrograph Report

Hyd. No. 23

DP-3

Hydrograph type	=	Combine	Peak discharge	=	23.46 cfs
Storm frequency	=	2 yrs	Time to peak	=	735 min
Time interval	=	1 min	Hyd. volume	=	182,768 cuft
Inflow hyds.	=	18, 21, 22	Contrib. drain. area	=	23.000 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

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	20.18	1	735	92,886	------	------	------	PWA-1 - DP-1
3	SCS Runoff	8.145	1	729	31,005	------	------	------	PWA-2D
4	Reservoir	6.895	1	734	30,966	3	193.14	5,200	Wet Swale #1
5	SCS Runoff	9.009	1	725	28,106	------	------	------	PWA-2E
6	Reservoir	2.282	1	747	25,852	5	184.52	13,038	Infiltration Pond #1
7	SCS Runoff	88.13	1	734	392,241	------	------	------	PWA-2A
8	SCS Runoff	11.98	1	736	56,091	------	------	------	PWA-2B
9	Reach	11.90	1	738	56,090	8	------	------	PWA-2B TO EX. IRR. POND
10	Combine	108.19	1	735	505,149	4, 6, 7, 9	------	------	To Ex. Irrigation Pond
11	Reservoir	20.65	1	781	498,848	10	165.39	210,918	Ex. Irrigation Pond
12	SCS Runoff	3.042	1	729	11,435	------	------	------	PWA-2C
13	Combine	21.06	1	775	510,282	11, 12	------	------	To Lake Street Crossing
14	Reservoir	21.05	1	778	510,271	13	158.94	1,258	Imp. Lake St. - DP-2
16	SCS Runoff	12.56	1	735	57,483	------	------	------	PWA-3A
17	Reservoir	10.41	1	745	57,314	16	196.45	10,604	Wet Pond #1
18	Reach	10.03	1	750	57,045	17	------	------	From Wet Pond #1 to DP-3
19	SCS Runoff	24.64	1	736	115,123	------	------	------	PWA-3B
20	Reservoir	17.42	1	750	114,228	19	204.21	29,412	Wet Pond #2
21	Reach	16.77	1	756	114,222	20	------	------	From Wet Pond #2 to DP-3
22	SCS Runoff	43.31	1	732	180,040	------	------	------	PWA-3C
23	Combine	55.35	1	737	351,307	18, 21, 22	------	------	DP-3

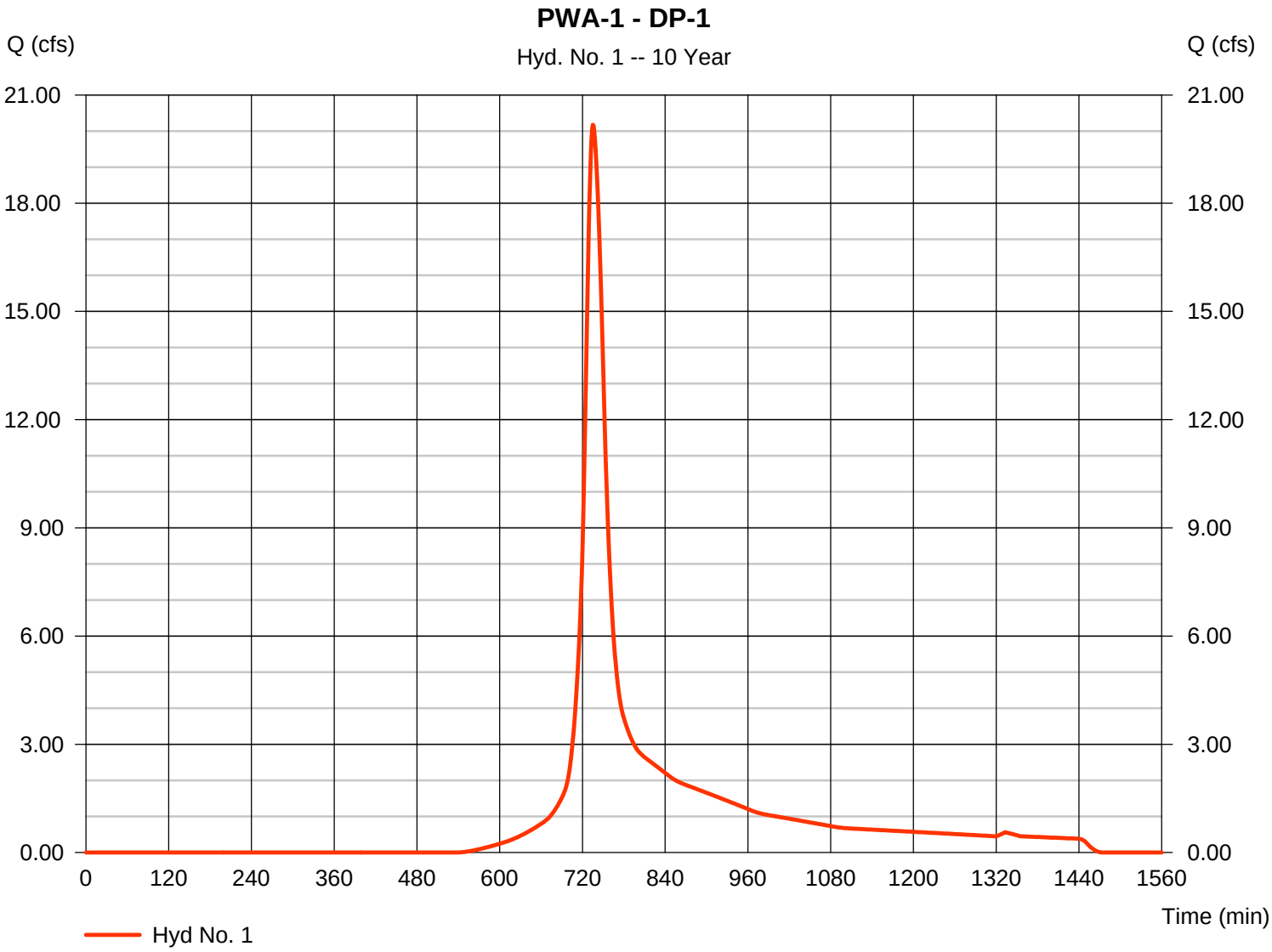
Hydrograph Report

Hyd. No. 1

PWA-1 - DP-1

Hydrograph type	=	SCS Runoff	Peak discharge	=	20.18 cfs
Storm frequency	=	10 yrs	Time to peak	=	735 min
Time interval	=	1 min	Hyd. volume	=	92,886 cuft
Drainage area	=	11.900 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	20.80 min
Total precip.	=	4.50 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.500 x 98) + (5.700 x 72) + (4.700 x 74)] / 11.900



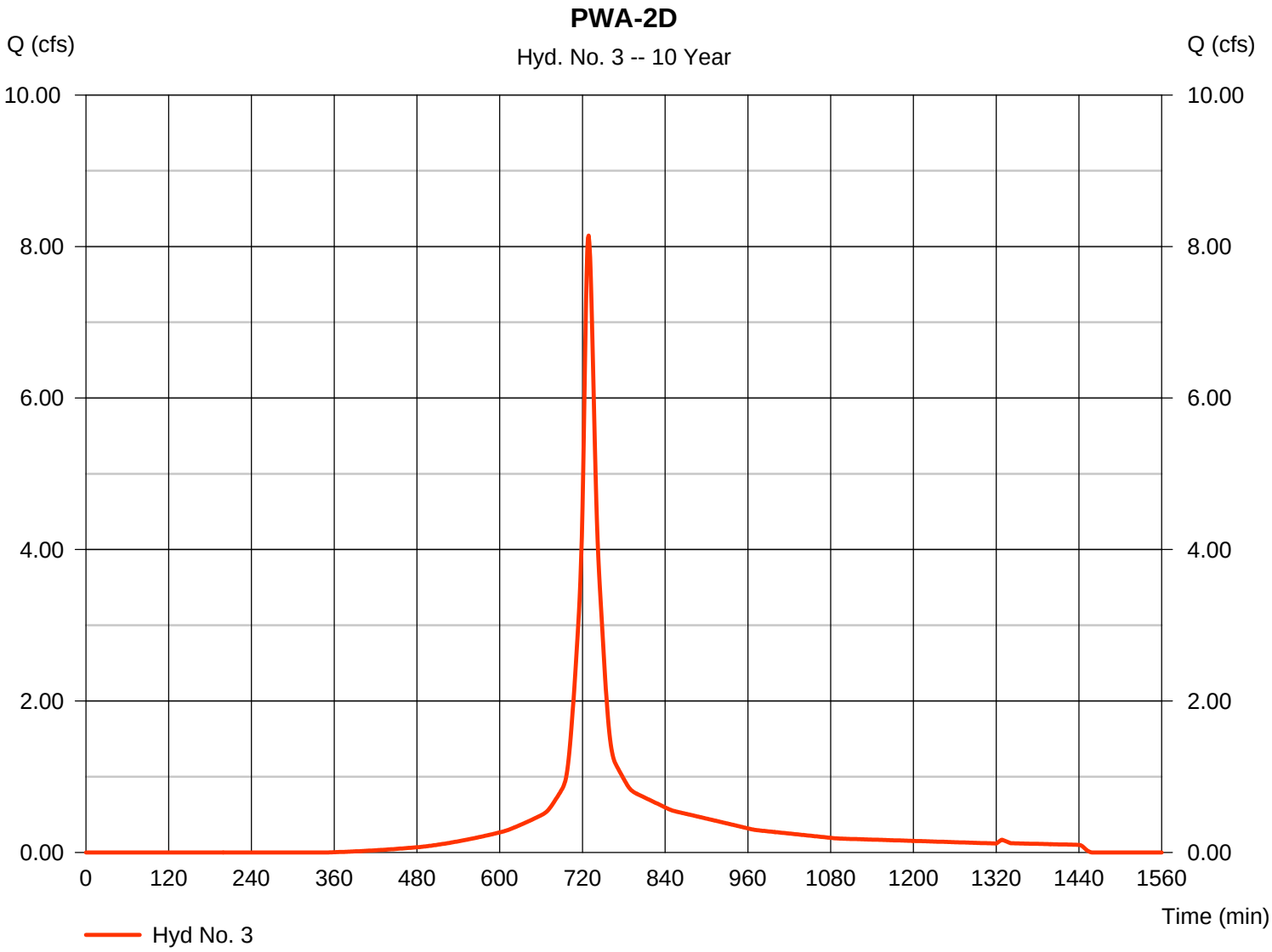
Hydrograph Report

Hyd. No. 3

PWA-2D

Hydrograph type	=	SCS Runoff	Peak discharge	=	8.145 cfs
Storm frequency	=	10 yrs	Time to peak	=	729 min
Time interval	=	1 min	Hyd. volume	=	31,005 cuft
Drainage area	=	2.800 ac	Curve number	=	87*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	12.10 min
Total precip.	=	4.50 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.500 x 98) + (1.300 x 74)] / 2.800



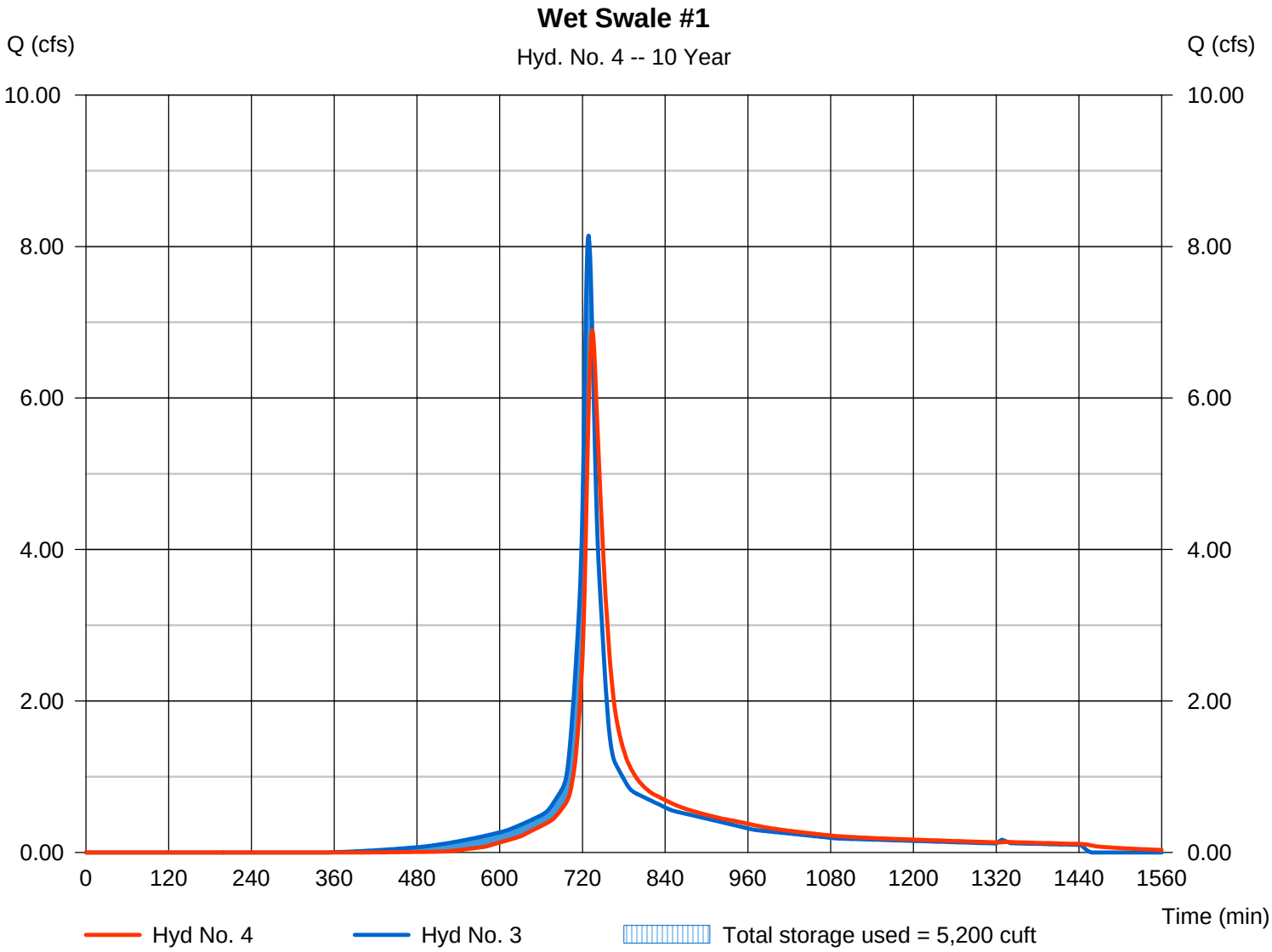
Hydrograph Report

Hyd. No. 4

Wet Swale #1

Hydrograph type	=	Reservoir	Peak discharge	=	6.895 cfs
Storm frequency	=	10 yrs	Time to peak	=	734 min
Time interval	=	1 min	Hyd. volume	=	30,966 cuft
Inflow hyd. No.	=	3 - PWA-2D	Max. Elevation	=	193.14 ft
Reservoir name	=	Wet Swale #1	Max. Storage	=	5,200 cuft

Storage Indication method used.



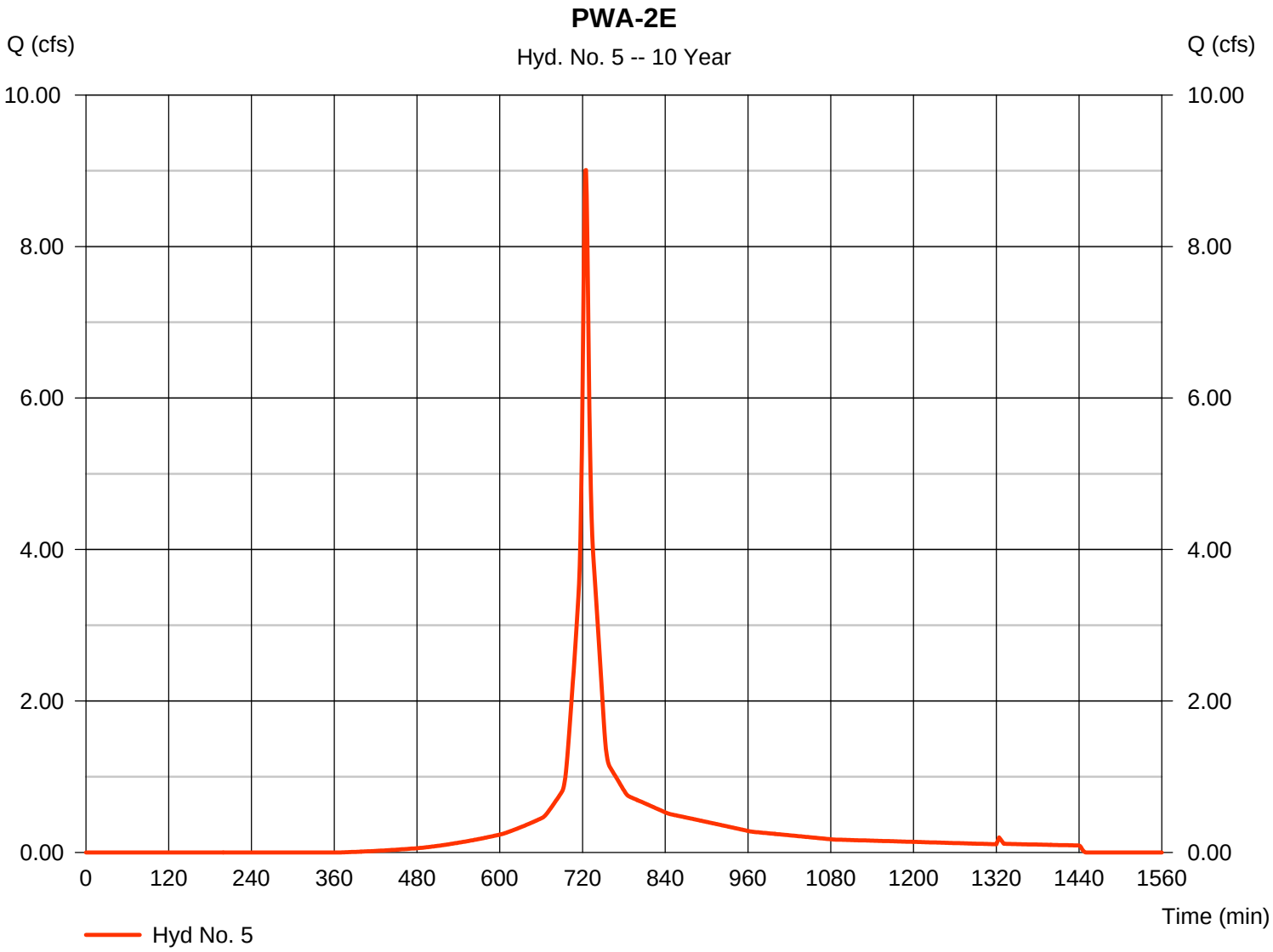
Hydrograph Report

Hyd. No. 5

PWA-2E

Hydrograph type	=	SCS Runoff	Peak discharge	=	9.009 cfs
Storm frequency	=	10 yrs	Time to peak	=	725 min
Time interval	=	1 min	Hyd. volume	=	28,106 cuft
Drainage area	=	2.500 ac	Curve number	=	86*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	USER	Time of conc. (Tc)	=	6.00 min
Total precip.	=	4.50 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.400 x 98) + (1.200 x 74)] / 2.500



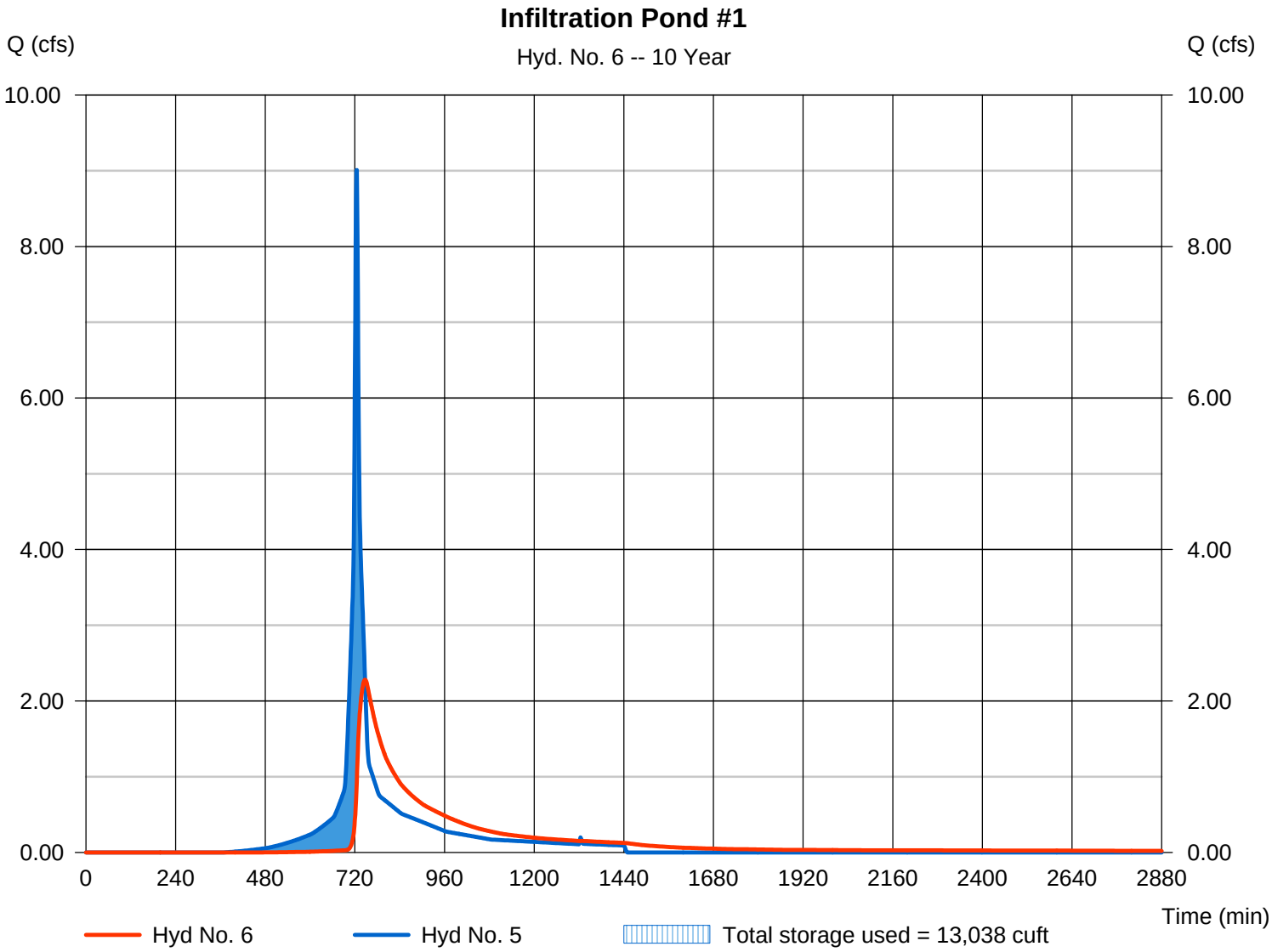
Hydrograph Report

Hyd. No. 6

Infiltration Pond #1

Hydrograph type	=	Reservoir	Peak discharge	=	2.282 cfs
Storm frequency	=	10 yrs	Time to peak	=	747 min
Time interval	=	1 min	Hyd. volume	=	25,852 cuft
Inflow hyd. No.	=	5 - PWA-2E	Max. Elevation	=	184.52 ft
Reservoir name	=	Infiltation Pond #1	Max. Storage	=	13,038 cuft

Storage Indication method used.



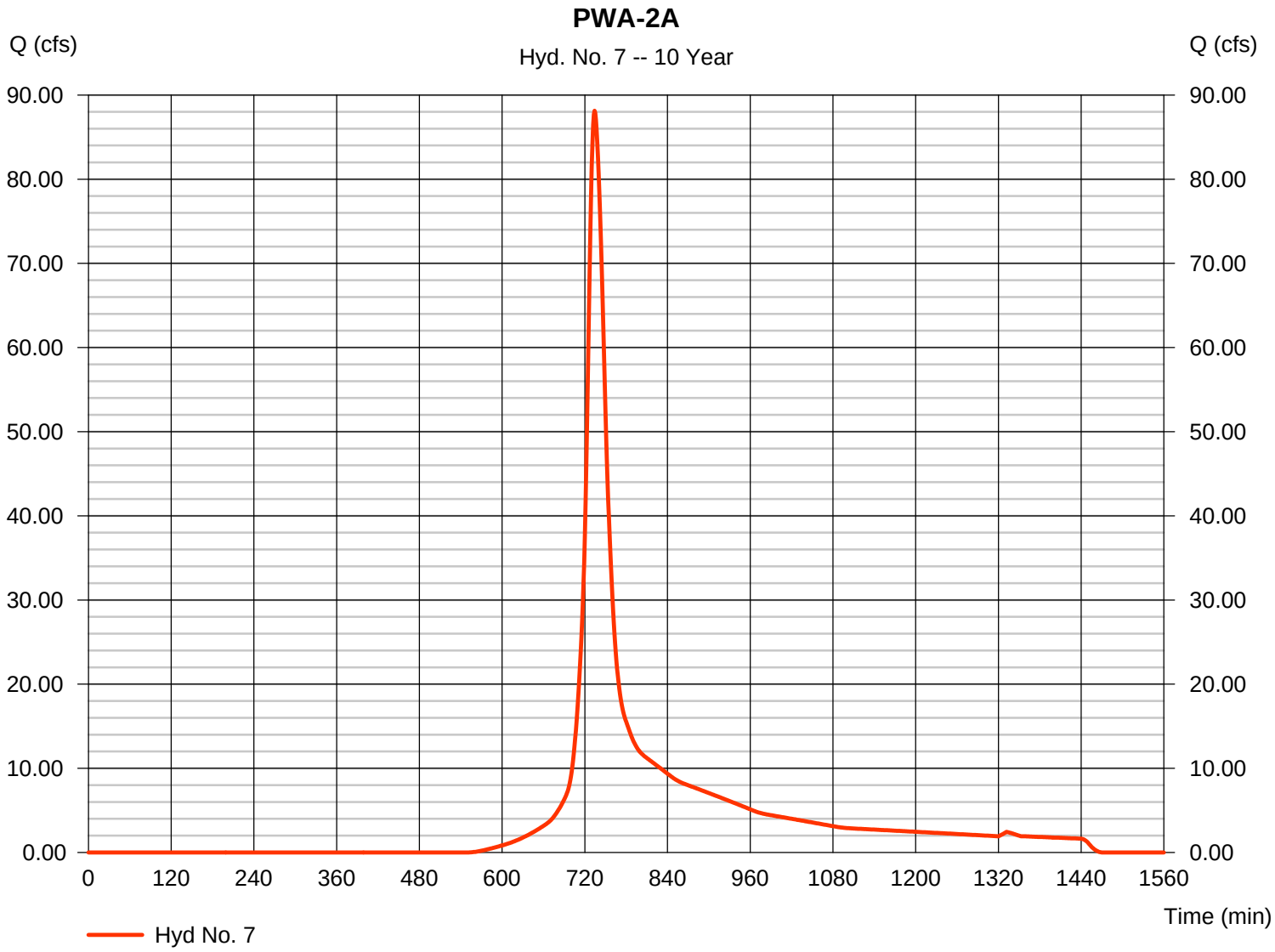
Hydrograph Report

Hyd. No. 7

PWA-2A

Hydrograph type	=	SCS Runoff	Peak discharge	=	88.13 cfs
Storm frequency	=	10 yrs	Time to peak	=	734 min
Time interval	=	1 min	Hyd. volume	=	392,241 cuft
Drainage area	=	52.700 ac	Curve number	=	75*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	19.10 min
Total precip.	=	4.50 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(2.700 x 98) + (5.400 x 72) + (44.600 x 74)] / 52.700



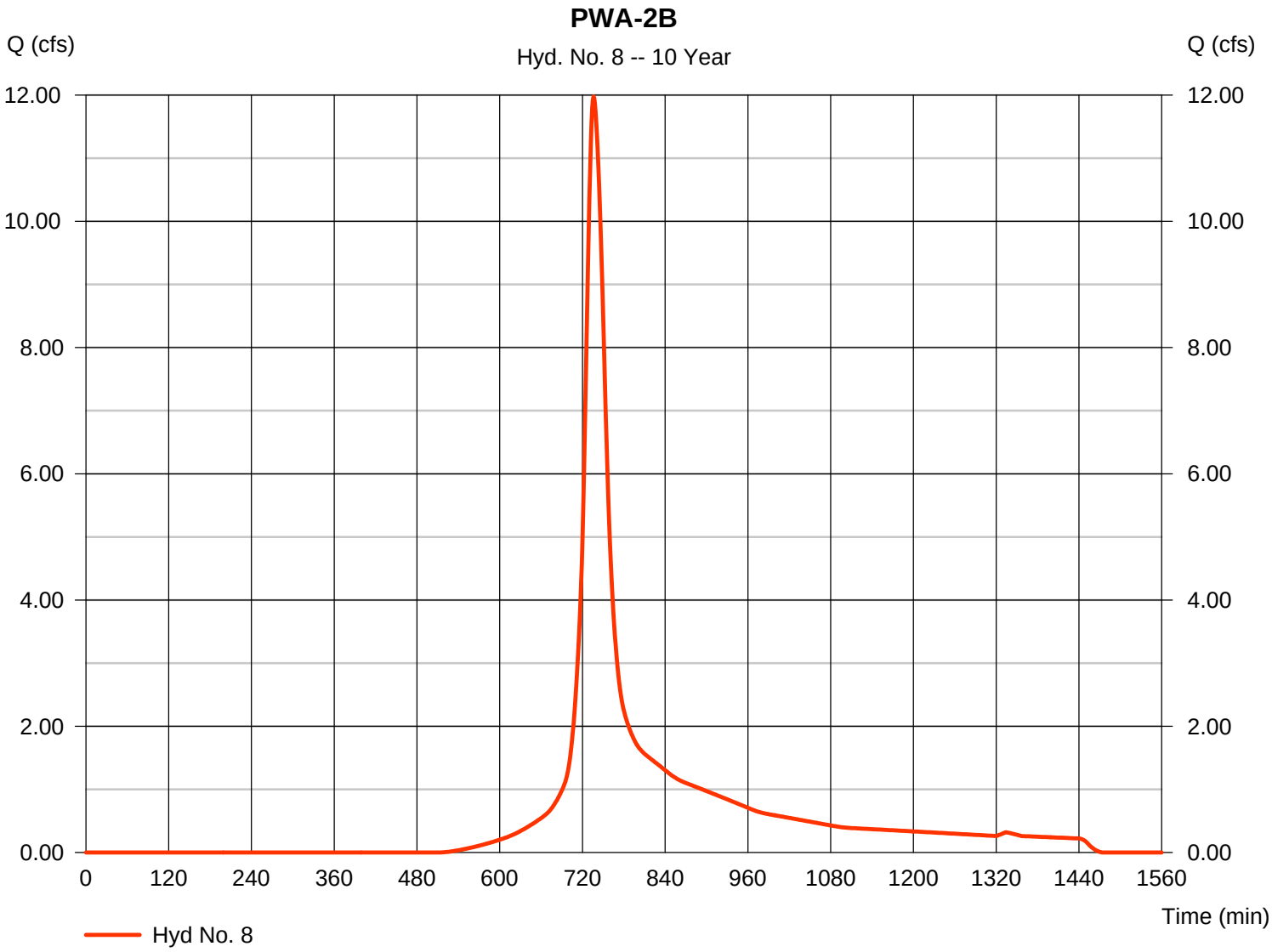
Hydrograph Report

Hyd. No. 8

PWA-2B

Hydrograph type	=	SCS Runoff	Peak discharge	=	11.98 cfs
Storm frequency	=	10 yrs	Time to peak	=	736 min
Time interval	=	1 min	Hyd. volume	=	56,091 cuft
Drainage area	=	6.800 ac	Curve number	=	78*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	22.70 min
Total precip.	=	4.50 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.300 x 98) + (2.700 x 72) + (2.800 x 74)] / 6.800



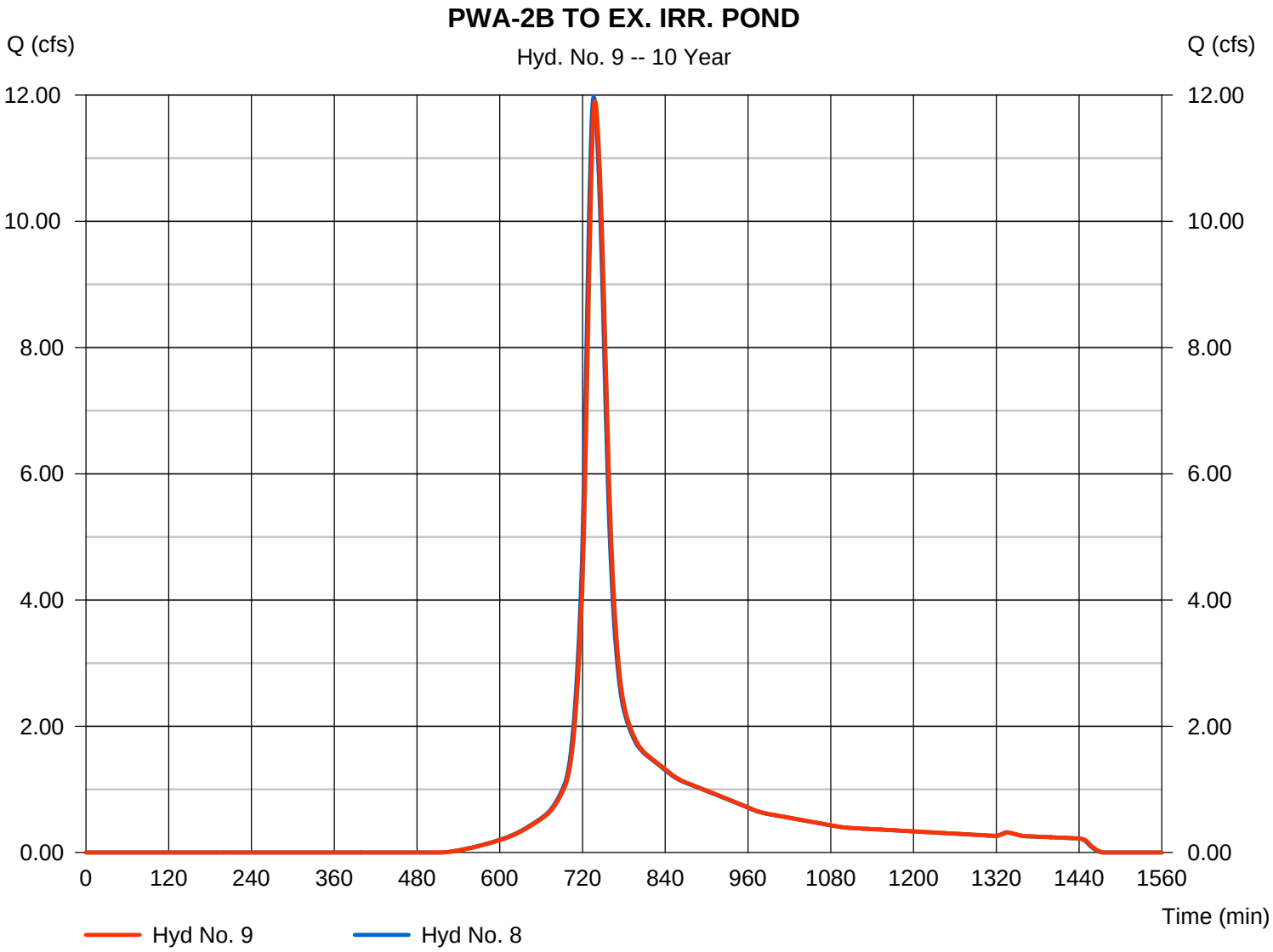
Hydrograph Report

Hyd. No. 9

PWA-2B TO EX. IRR. POND

Hydrograph type	=	Reach	Peak discharge	=	11.90 cfs
Storm frequency	=	10 yrs	Time to peak	=	738 min
Time interval	=	1 min	Hyd. volume	=	56,090 cuft
Inflow hyd. No.	=	8 - PWA-2B	Section type	=	Trapezoidal
Reach length	=	300.0 ft	Channel slope	=	3.0 %
Manning's n	=	0.040	Bottom width	=	5.0 ft
Side slope	=	3.0:1	Max. depth	=	1.0 ft
Rating curve x	=	2.205	Rating curve m	=	1.190
Ave. velocity	=	2.89 ft/s	Routing coeff.	=	0.5116

Modified Att-Kin routing method used.

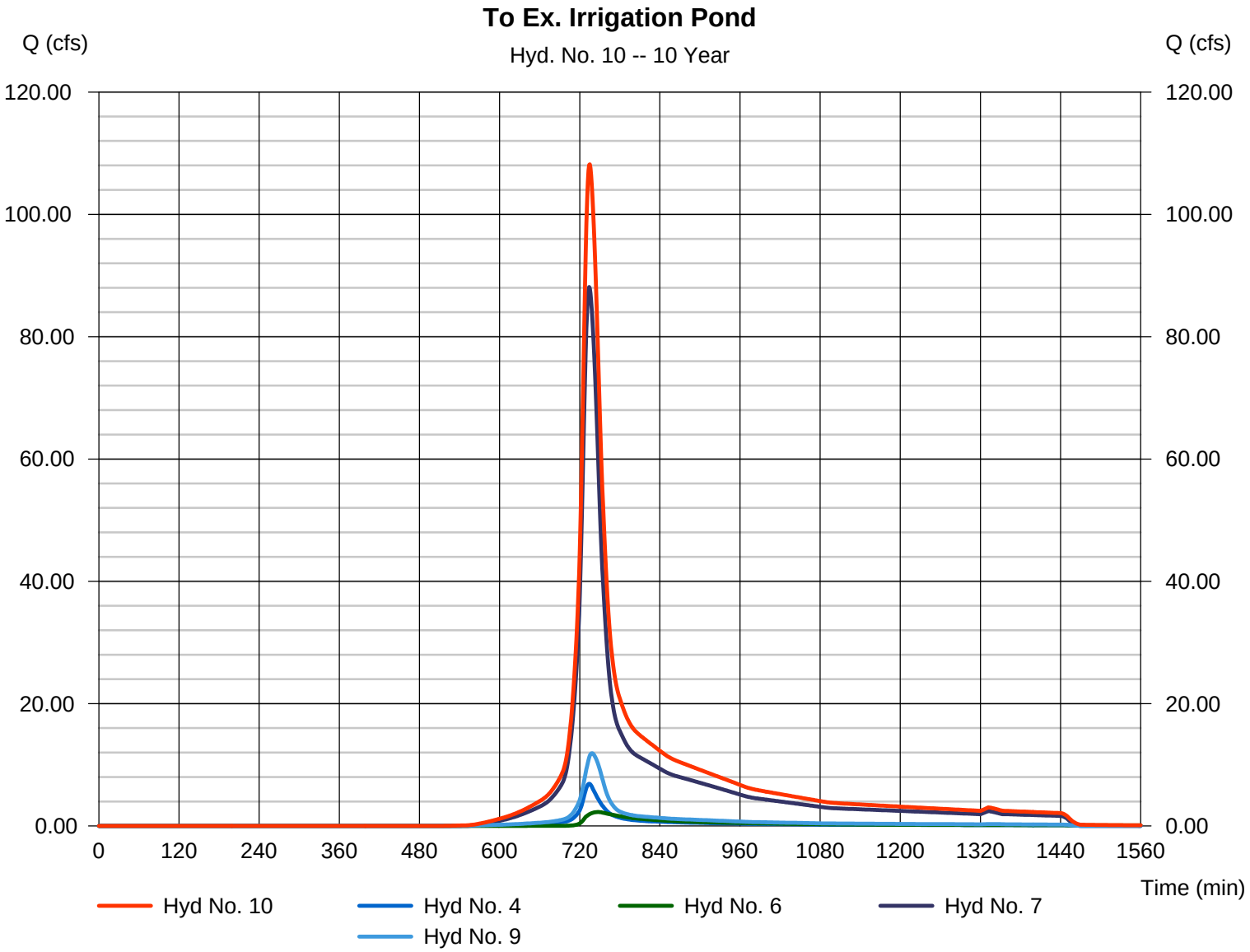


Hydrograph Report

Hyd. No. 10

To Ex. Irrigation Pond

Hydrograph type	= Combine	Peak discharge	= 108.19 cfs
Storm frequency	= 10 yrs	Time to peak	= 735 min
Time interval	= 1 min	Hyd. volume	= 505,149 cuft
Inflow hyds.	= 4, 6, 7, 9	Contrib. drain. area	= 52.700 ac



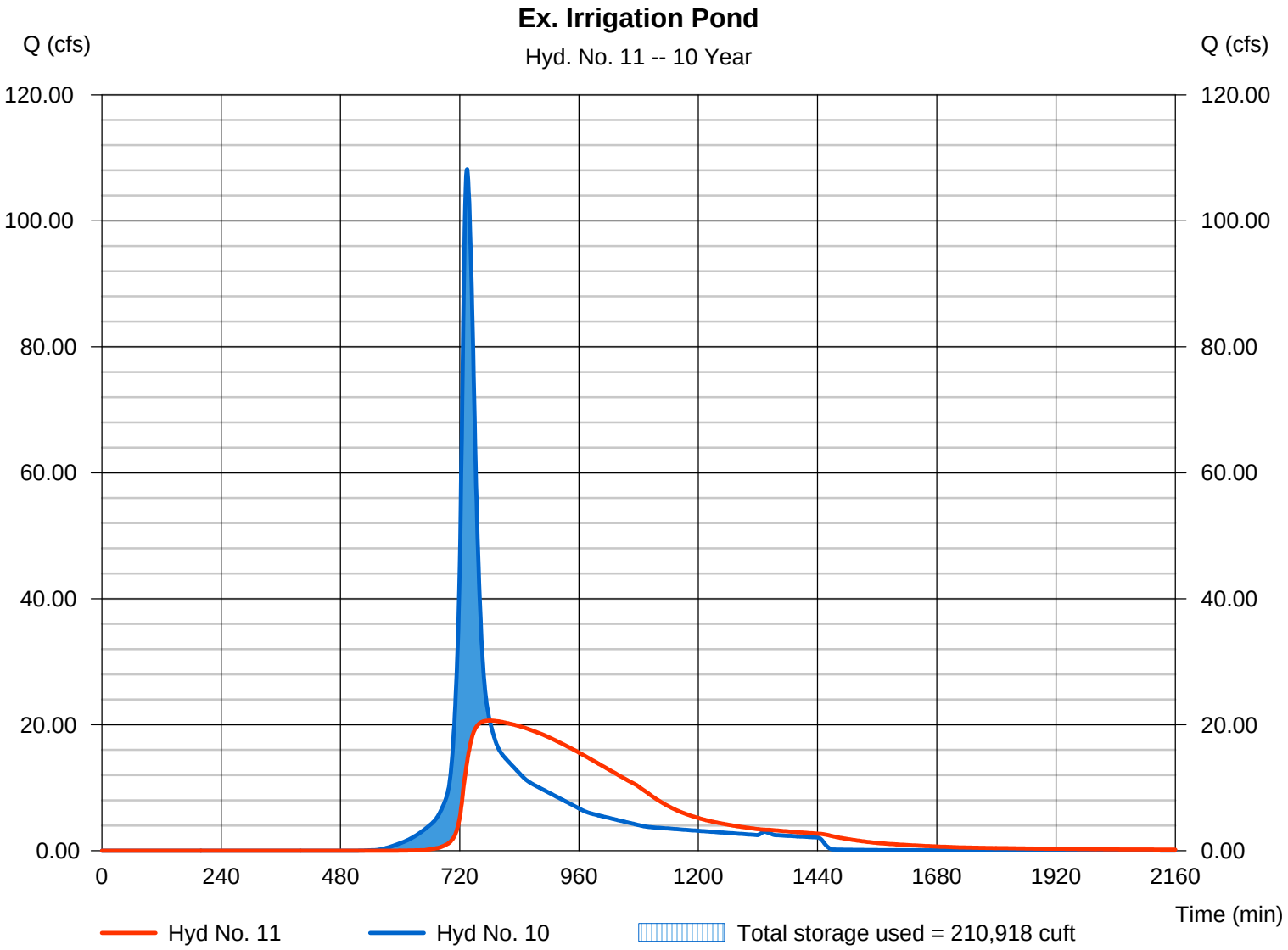
Hydrograph Report

Hyd. No. 11

Ex. Irrigation Pond

Hydrograph type	=	Reservoir	Peak discharge	=	20.65 cfs
Storm frequency	=	10 yrs	Time to peak	=	781 min
Time interval	=	1 min	Hyd. volume	=	498,848 cuft
Inflow hyd. No.	=	10 - To Ex. Irrigation Pond	Max. Elevation	=	165.39 ft
Reservoir name	=	Ex. Irrigation Pond	Max. Storage	=	210,918 cuft

Storage Indication method used.



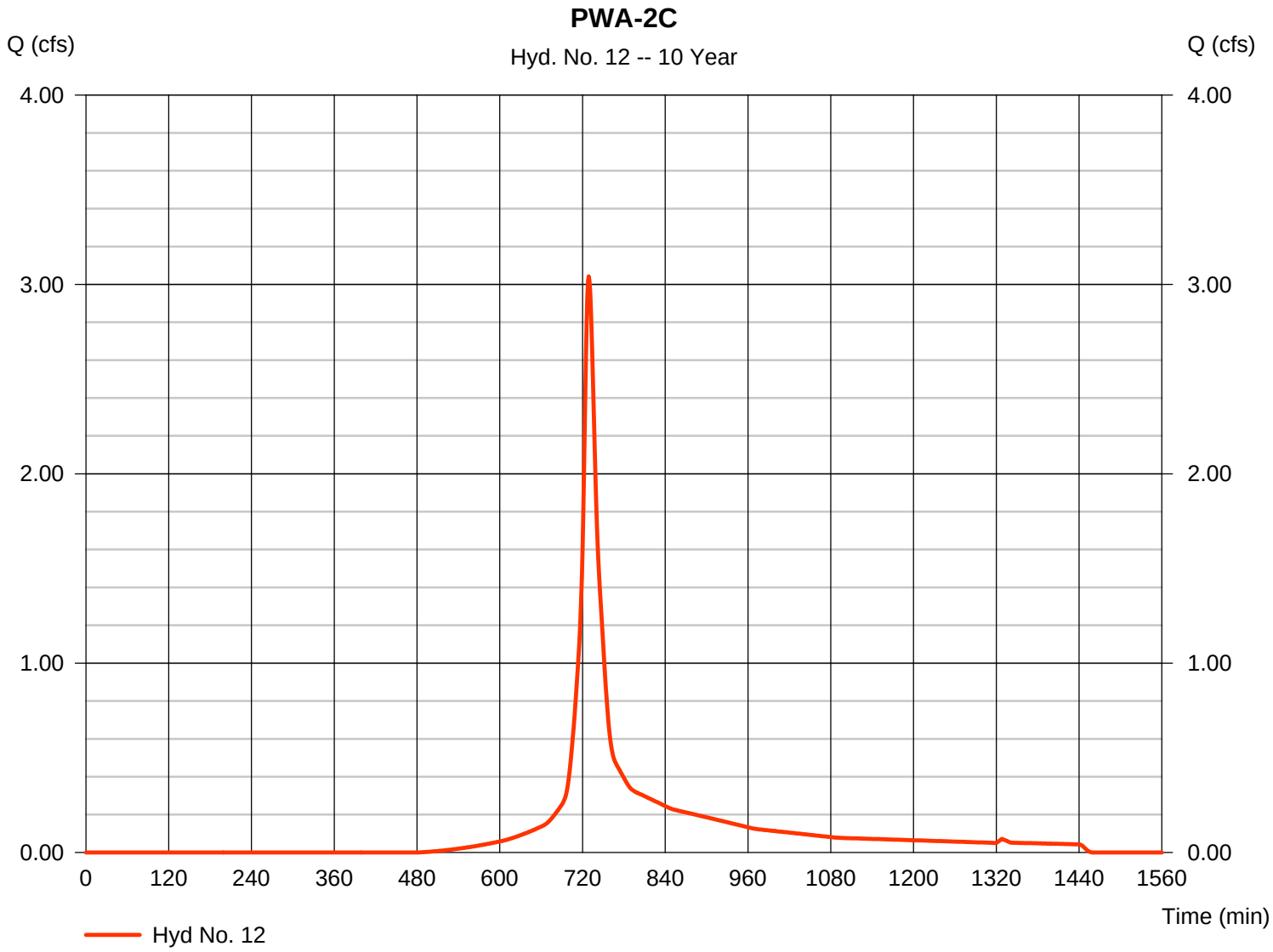
Hydrograph Report

Hyd. No. 12

PWA-2C

Hydrograph type	=	SCS Runoff	Peak discharge	=	3.042 cfs
Storm frequency	=	10 yrs	Time to peak	=	729 min
Time interval	=	1 min	Hyd. volume	=	11,435 cuft
Drainage area	=	1.300 ac	Curve number	=	80*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	12.60 min
Total precip.	=	4.50 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.400 x 98) + (0.900 x 72)] / 1.300

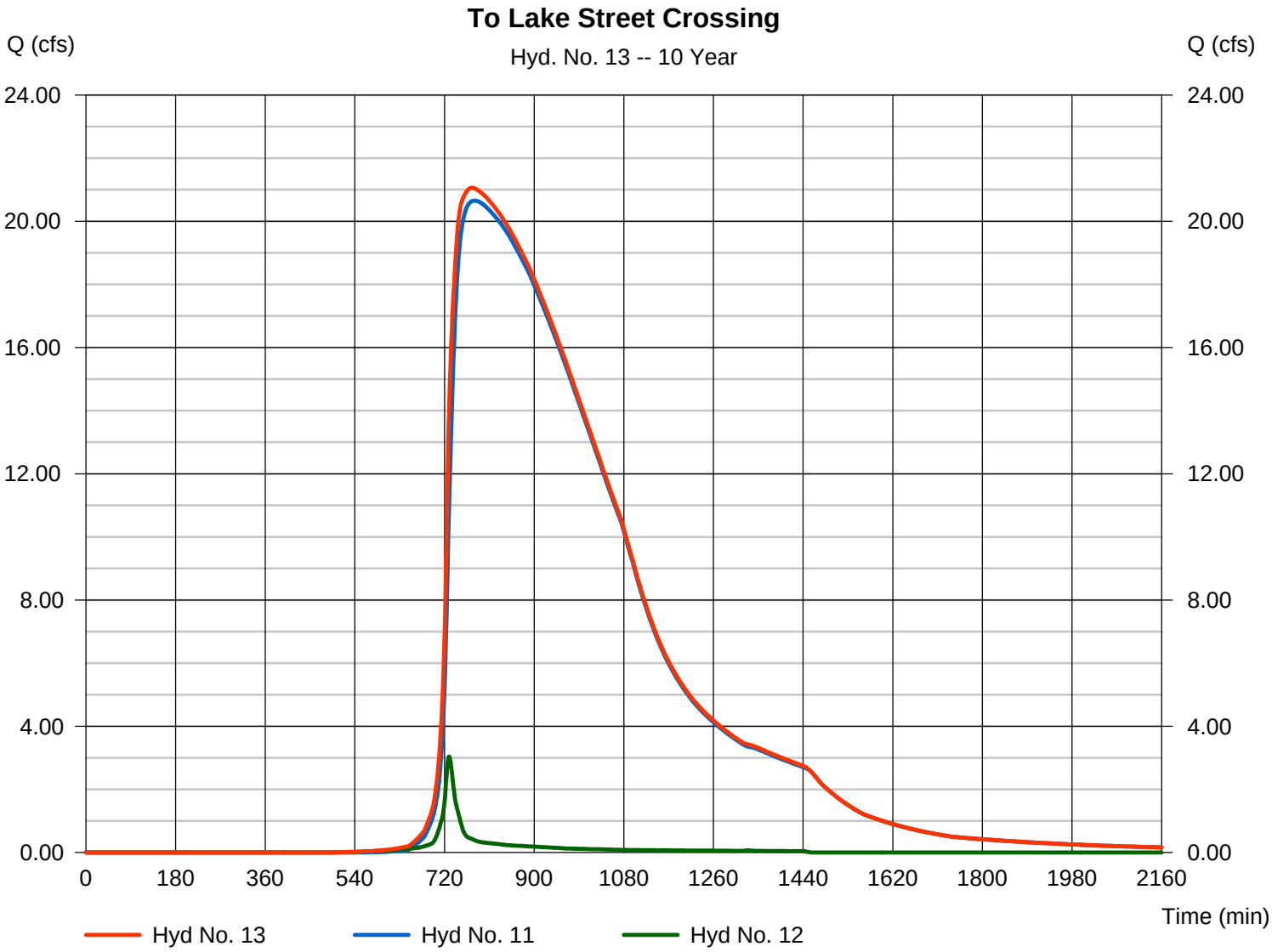


Hydrograph Report

Hyd. No. 13

To Lake Street Crossing

Hydrograph type	=	Combine	Peak discharge	=	21.06 cfs
Storm frequency	=	10 yrs	Time to peak	=	775 min
Time interval	=	1 min	Hyd. volume	=	510,282 cuft
Inflow hyds.	=	11, 12	Contrib. drain. area	=	1.300 ac



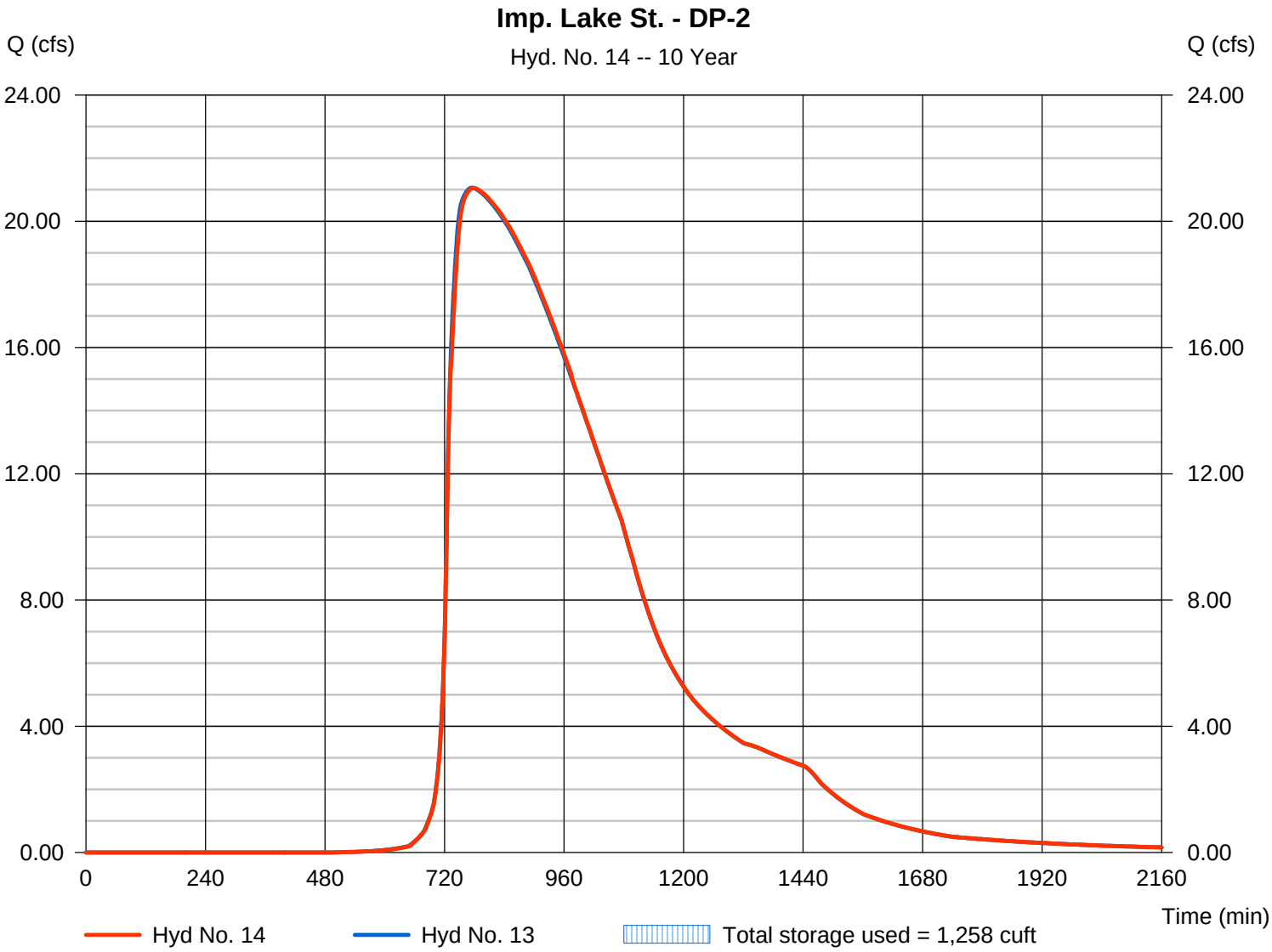
Hydrograph Report

Hyd. No. 14

Imp. Lake St. - DP-2

Hydrograph type	=	Reservoir	Peak discharge	=	21.05 cfs
Storm frequency	=	10 yrs	Time to peak	=	778 min
Time interval	=	1 min	Hyd. volume	=	510,271 cuft
Inflow hyd. No.	=	13 - To Lake Street Crossing	Max. Elevation	=	158.94 ft
Reservoir name	=	Improved Lake Street Crossing	Max. Storage	=	1,258 cuft

Storage Indication method used.



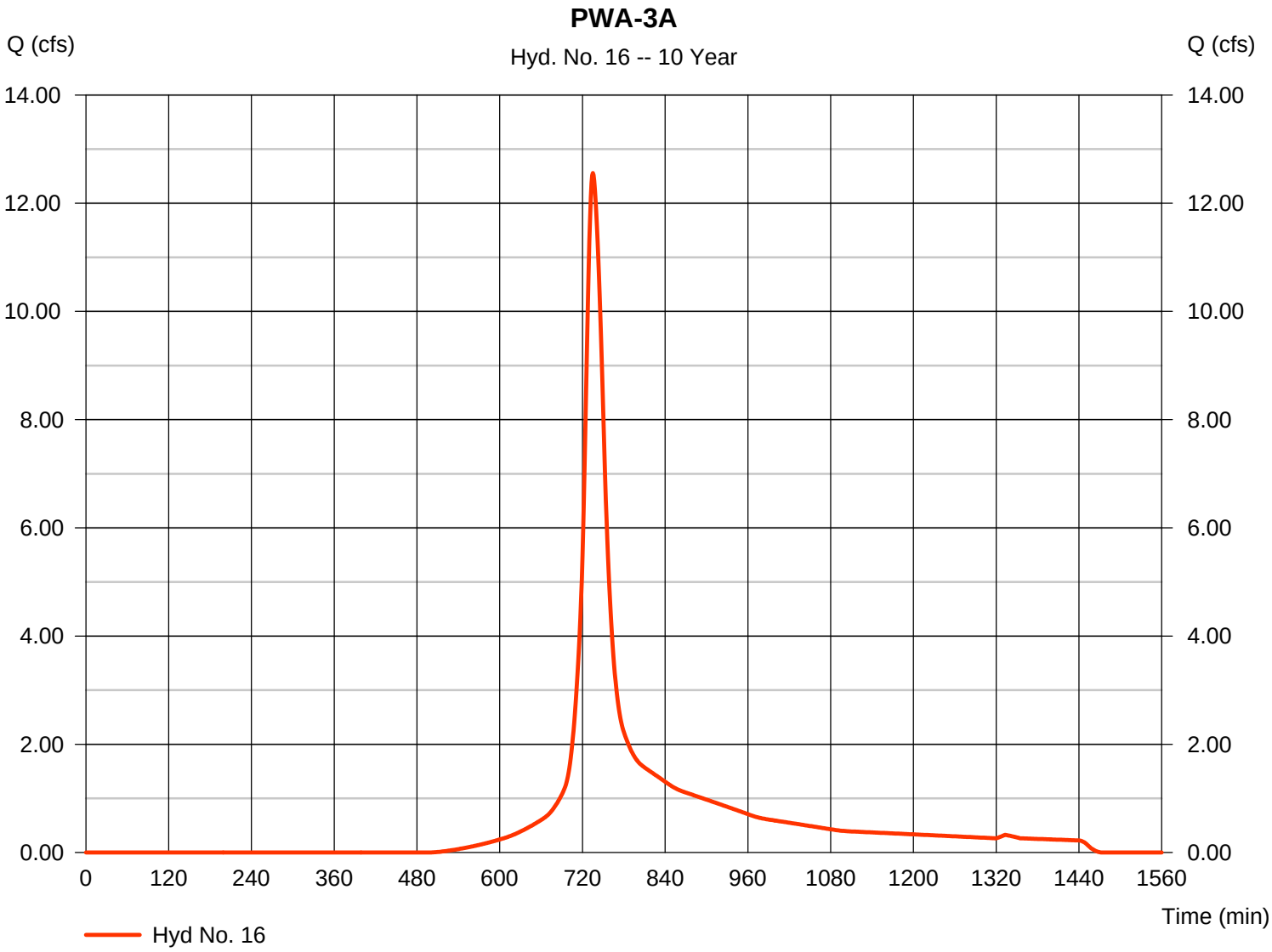
Hydrograph Report

Hyd. No. 16

PWA-3A

Hydrograph type	=	SCS Runoff	Peak discharge	=	12.56 cfs
Storm frequency	=	10 yrs	Time to peak	=	735 min
Time interval	=	1 min	Hyd. volume	=	57,483 cuft
Drainage area	=	6.600 ac	Curve number	=	79*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	21.70 min
Total precip.	=	4.50 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.500 x 98) + (5.100 x 74)] / 6.600



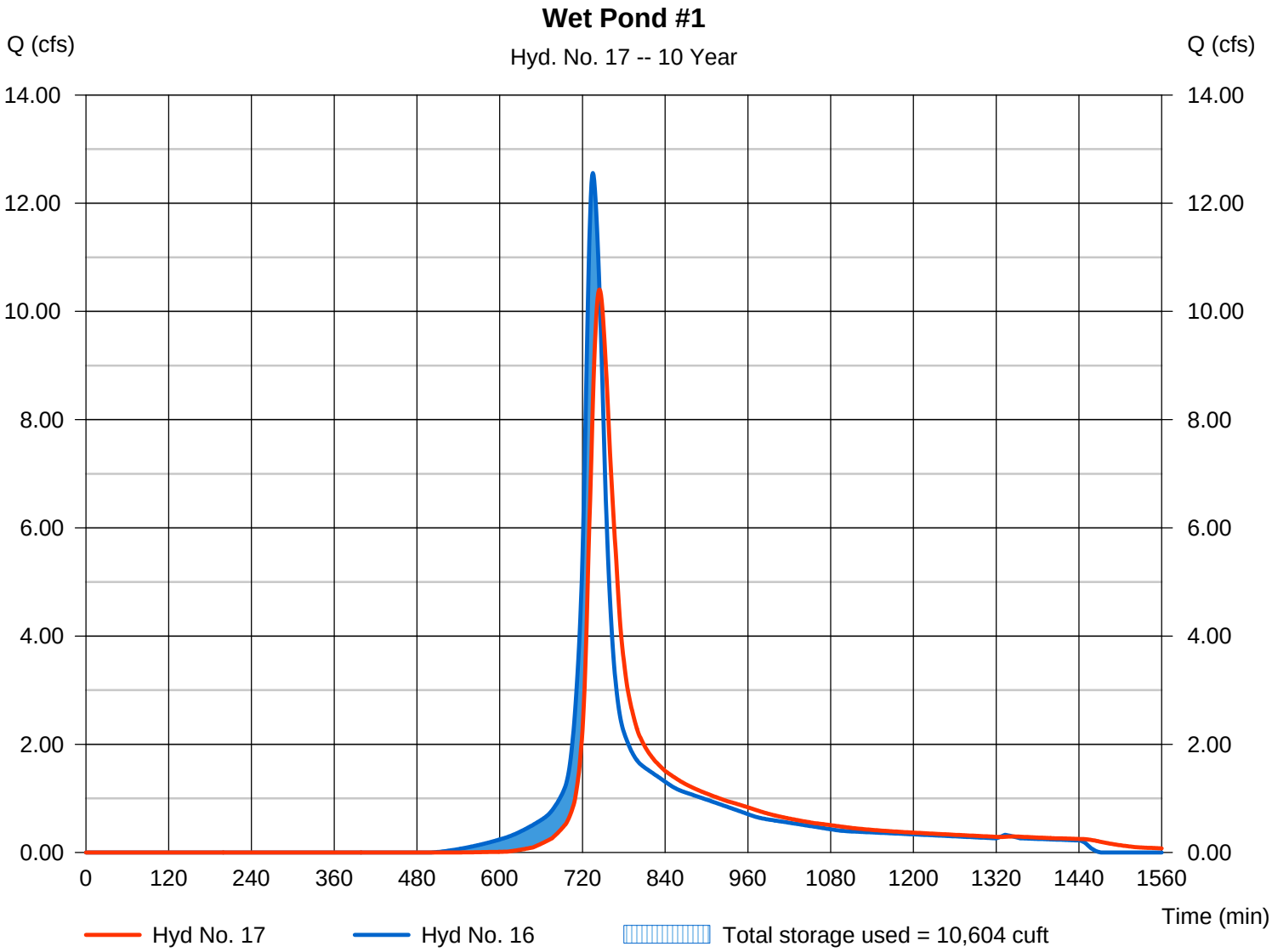
Hydrograph Report

Hyd. No. 17

Wet Pond #1

Hydrograph type	=	Reservoir	Peak discharge	=	10.41 cfs
Storm frequency	=	10 yrs	Time to peak	=	745 min
Time interval	=	1 min	Hyd. volume	=	57,314 cuft
Inflow hyd. No.	=	16 - PWA-3A	Max. Elevation	=	196.45 ft
Reservoir name	=	Wet Pond #1	Max. Storage	=	10,604 cuft

Storage Indication method used.



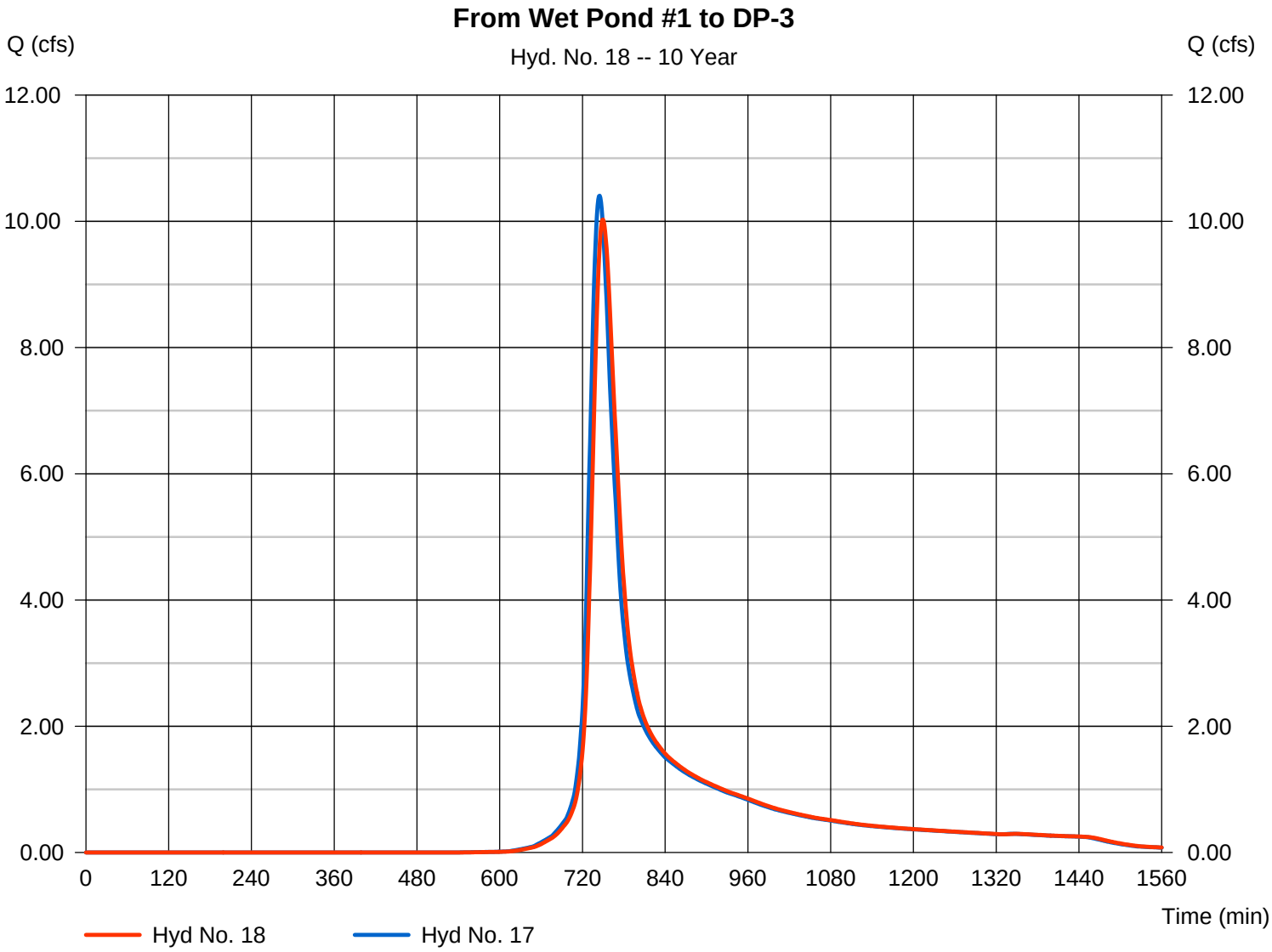
Hydrograph Report

Hyd. No. 18

From Wet Pond #1 to DP-3

Hydrograph type	=	Reach	Peak discharge	=	10.03 cfs
Storm frequency	=	10 yrs	Time to peak	=	750 min
Time interval	=	1 min	Hyd. volume	=	57,045 cuft
Inflow hyd. No.	=	17 - Wet Pond #1	Section type	=	Trapezoidal
Reach length	=	1299.0 ft	Channel slope	=	2.2 %
Manning's n	=	0.026	Bottom width	=	6.0 ft
Side slope	=	3.0:1	Max. depth	=	3.0 ft
Rating curve x	=	2.573	Rating curve m	=	1.344
Ave. velocity	=	3.68 ft/s	Routing coeff.	=	0.2049

Modified Att-Kin routing method used.



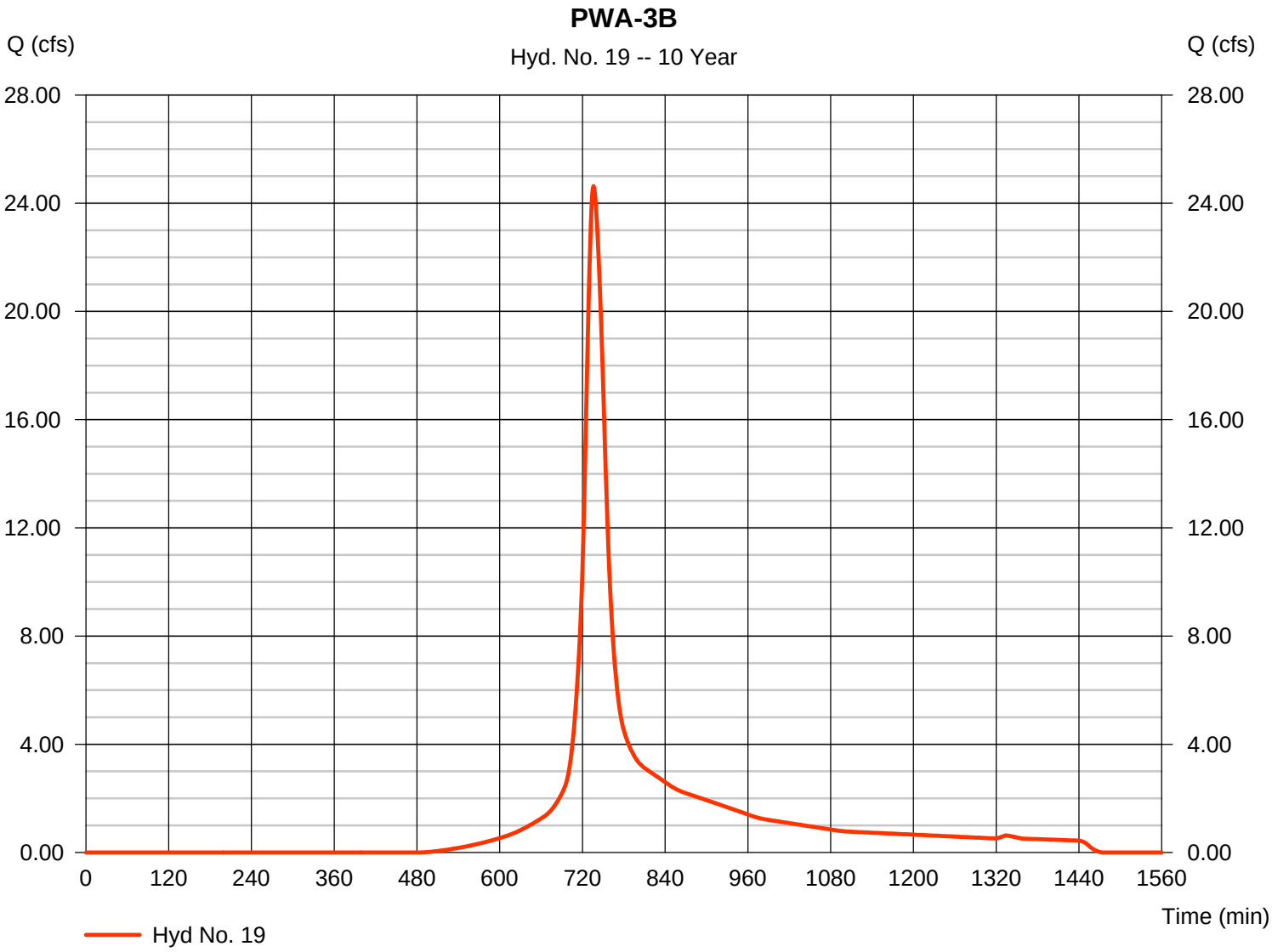
Hydrograph Report

Hyd. No. 19

PWA-3B

Hydrograph type	=	SCS Runoff	Peak discharge	=	24.64 cfs
Storm frequency	=	10 yrs	Time to peak	=	736 min
Time interval	=	1 min	Hyd. volume	=	115,123 cuft
Drainage area	=	13.000 ac	Curve number	=	80*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	22.20 min
Total precip.	=	4.50 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(3.100 x 98) + (1.100 x 72) + (8.800 x 74)] / 13.000



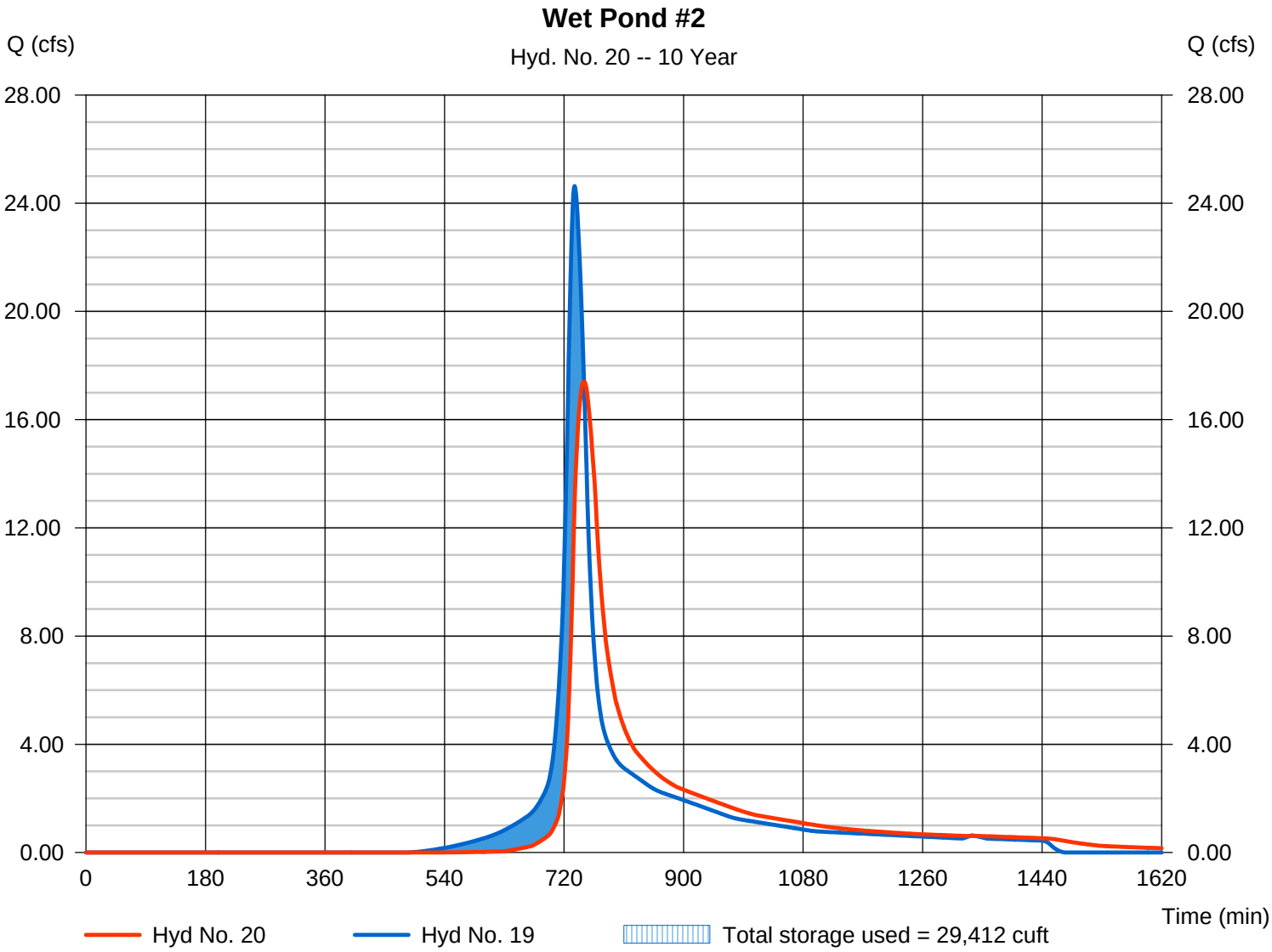
Hydrograph Report

Hyd. No. 20

Wet Pond #2

Hydrograph type	=	Reservoir	Peak discharge	=	17.42 cfs
Storm frequency	=	10 yrs	Time to peak	=	750 min
Time interval	=	1 min	Hyd. volume	=	114,228 cuft
Inflow hyd. No.	=	19 - PWA-3B	Max. Elevation	=	204.21 ft
Reservoir name	=	Wet Pond #2	Max. Storage	=	29,412 cuft

Storage Indication method used.



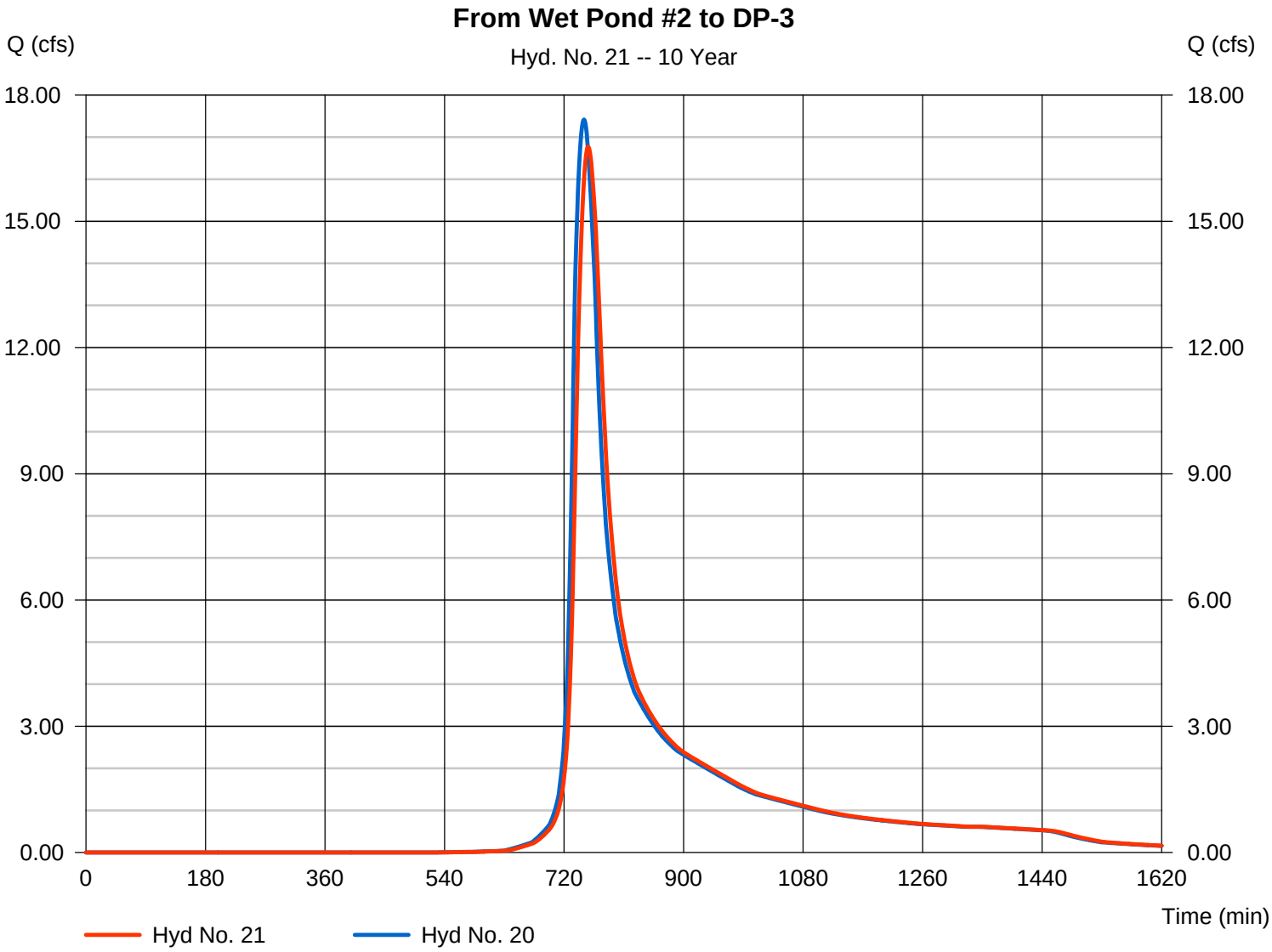
Hydrograph Report

Hyd. No. 21

From Wet Pond #2 to DP-3

Hydrograph type	=	Reach	Peak discharge	=	16.77 cfs
Storm frequency	=	10 yrs	Time to peak	=	756 min
Time interval	=	1 min	Hyd. volume	=	114,222 cuft
Inflow hyd. No.	=	20 - Wet Pond #2	Section type	=	Trapezoidal
Reach length	=	1876.0 ft	Channel slope	=	2.2 %
Manning's n	=	0.026	Bottom width	=	6.0 ft
Side slope	=	3.0:1	Max. depth	=	3.0 ft
Rating curve x	=	2.573	Rating curve m	=	1.344
Ave. velocity	=	4.20 ft/s	Routing coeff.	=	0.1654

Modified Att-Kin routing method used.



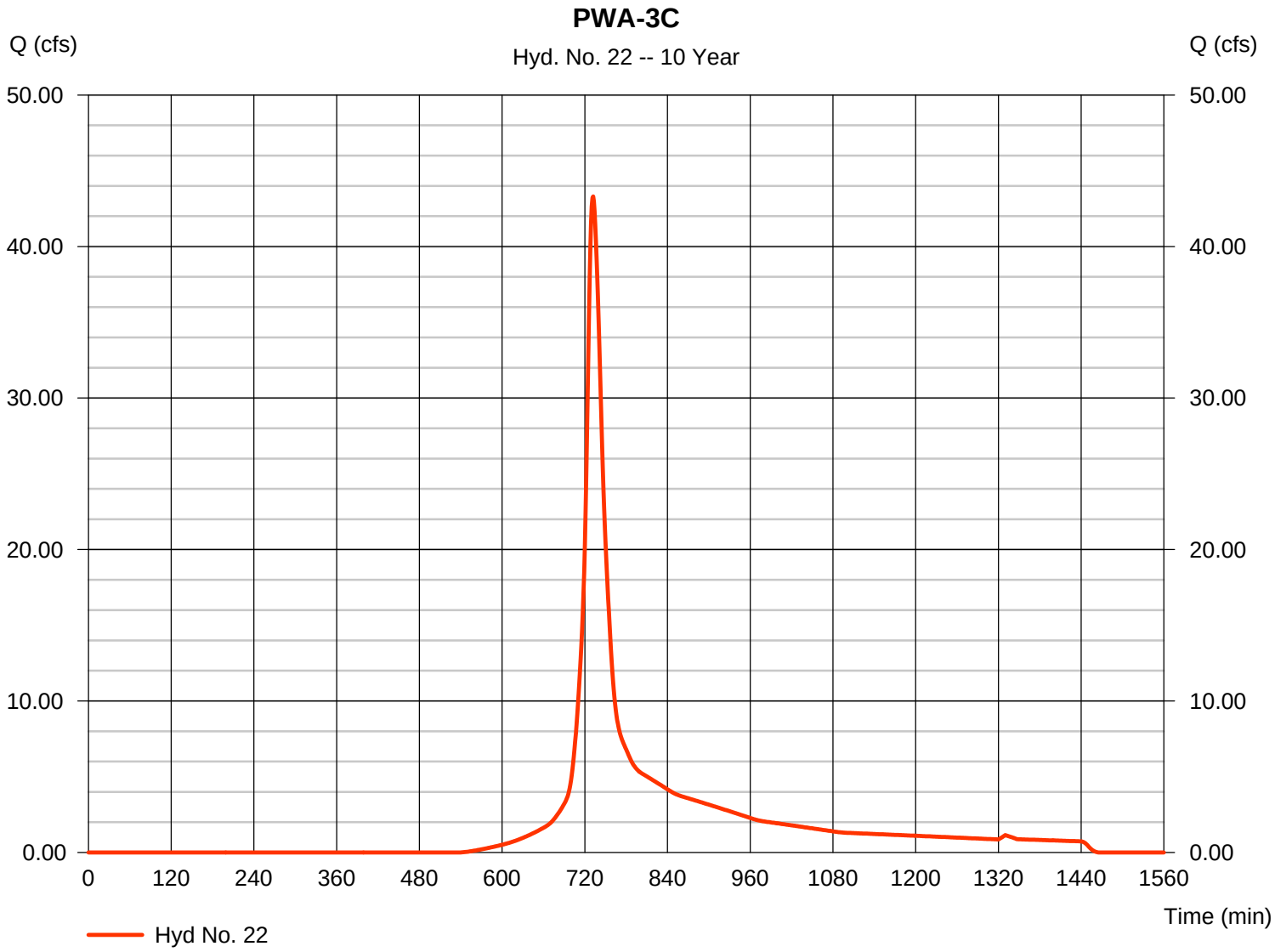
Hydrograph Report

Hyd. No. 22

PWA-3C

Hydrograph type	=	SCS Runoff	Peak discharge	=	43.31 cfs
Storm frequency	=	10 yrs	Time to peak	=	732 min
Time interval	=	1 min	Hyd. volume	=	180,040 cuft
Drainage area	=	23.000 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	16.50 min
Total precip.	=	4.50 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.000 x 98) + (3.100 x 72) + (4.000 x 79) + (14.000 x 74) + (0.900 x 80)] / 23.000

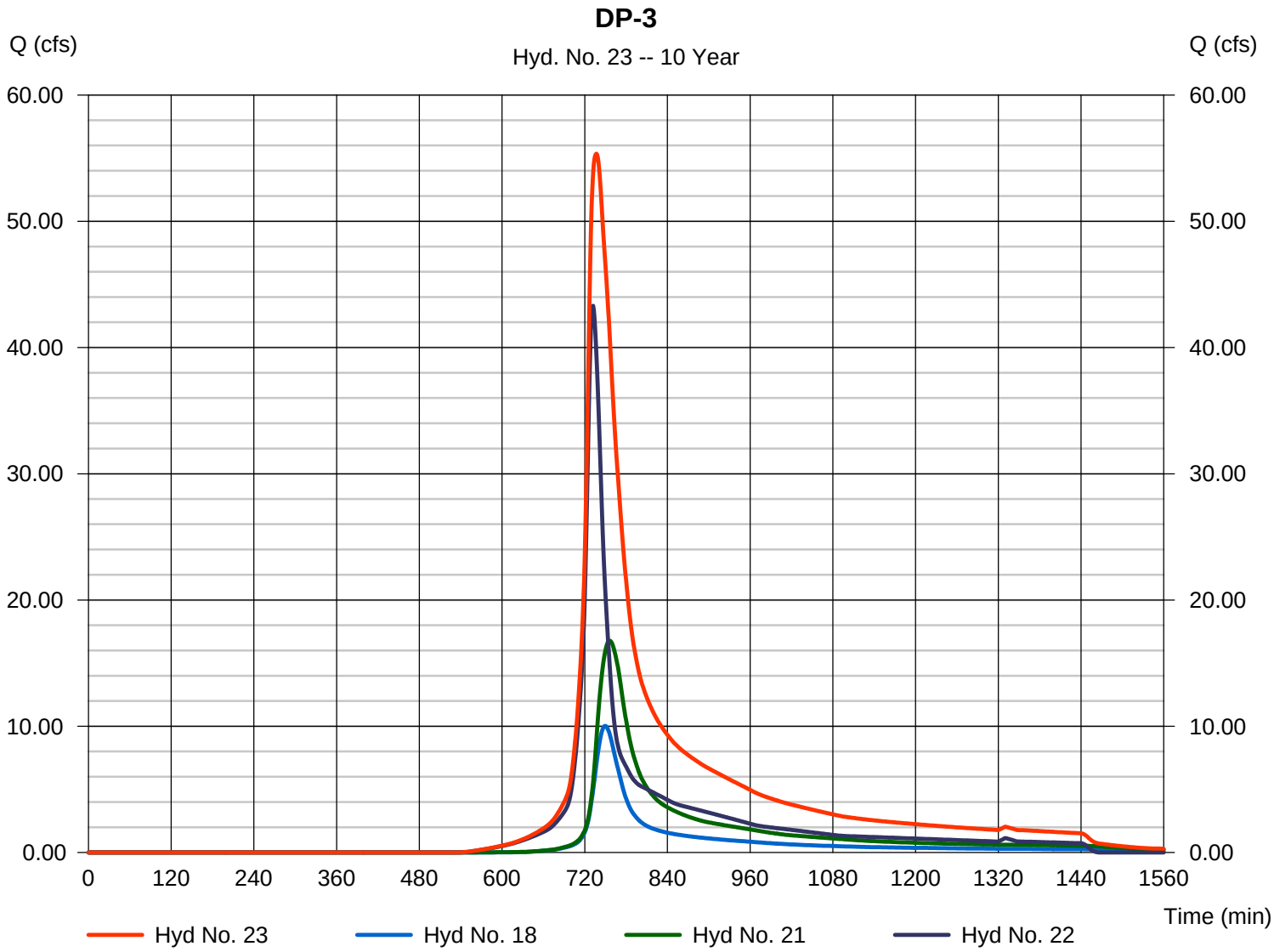


Hydrograph Report

Hyd. No. 23

DP-3

Hydrograph type	=	Combine	Peak discharge	=	55.35 cfs
Storm frequency	=	10 yrs	Time to peak	=	737 min
Time interval	=	1 min	Hyd. volume	=	351,307 cuft
Inflow hyds.	=	18, 21, 22	Contrib. drain. area	=	23.000 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

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	27.34	1	735	125,109	------	------	------	PWA-1 - DP-1
3	SCS Runoff	10.27	1	729	39,475	------	------	------	PWA-2D
4	Reservoir	9.025	1	733	39,435	3	193.24	5,813	Wet Swale #1
5	SCS Runoff	11.43	1	724	35,955	------	------	------	PWA-2E
6	Reservoir	3.727	1	742	33,669	5	184.75	15,539	Infiltration Pond #1
7	SCS Runoff	120.27	1	734	531,321	------	------	------	PWA-2A
8	SCS Runoff	15.99	1	736	74,722	------	------	------	PWA-2B
9	Reach	15.90	1	738	74,721	8	------	------	PWA-2B TO EX. IRR. POND
10	Combine	147.79	1	734	679,146	4, 6, 7, 9	------	------	To Ex. Irrigation Pond
11	Reservoir	82.35	1	752	672,774	10	165.69	244,868	Ex. Irrigation Pond
12	SCS Runoff	4.005	1	729	15,072	------	------	------	PWA-2C
13	Combine	83.60	1	752	687,846	11, 12	------	------	To Lake Street Crossing
14	Reservoir	83.64	1	752	687,834	13	160.16	2,794	Imp. Lake St. - DP-2
16	SCS Runoff	16.66	1	735	76,168	------	------	------	PWA-3A
17	Reservoir	14.33	1	743	75,997	16	196.72	12,476	Wet Pond #1
18	Reach	13.85	1	748	75,730	17	------	------	From Wet Pond #1 to DP-3
19	SCS Runoff	32.45	1	736	151,745	------	------	------	PWA-3B
20	Reservoir	22.78	1	750	150,833	19	204.54	36,323	Wet Pond #2
21	Reach	22.17	1	756	150,827	20	------	------	From Wet Pond #2 to DP-3
22	SCS Runoff	58.60	1	731	242,498	------	------	------	PWA-3C
23	Combine	77.71	1	735	469,055	18, 21, 22	------	------	DP-3

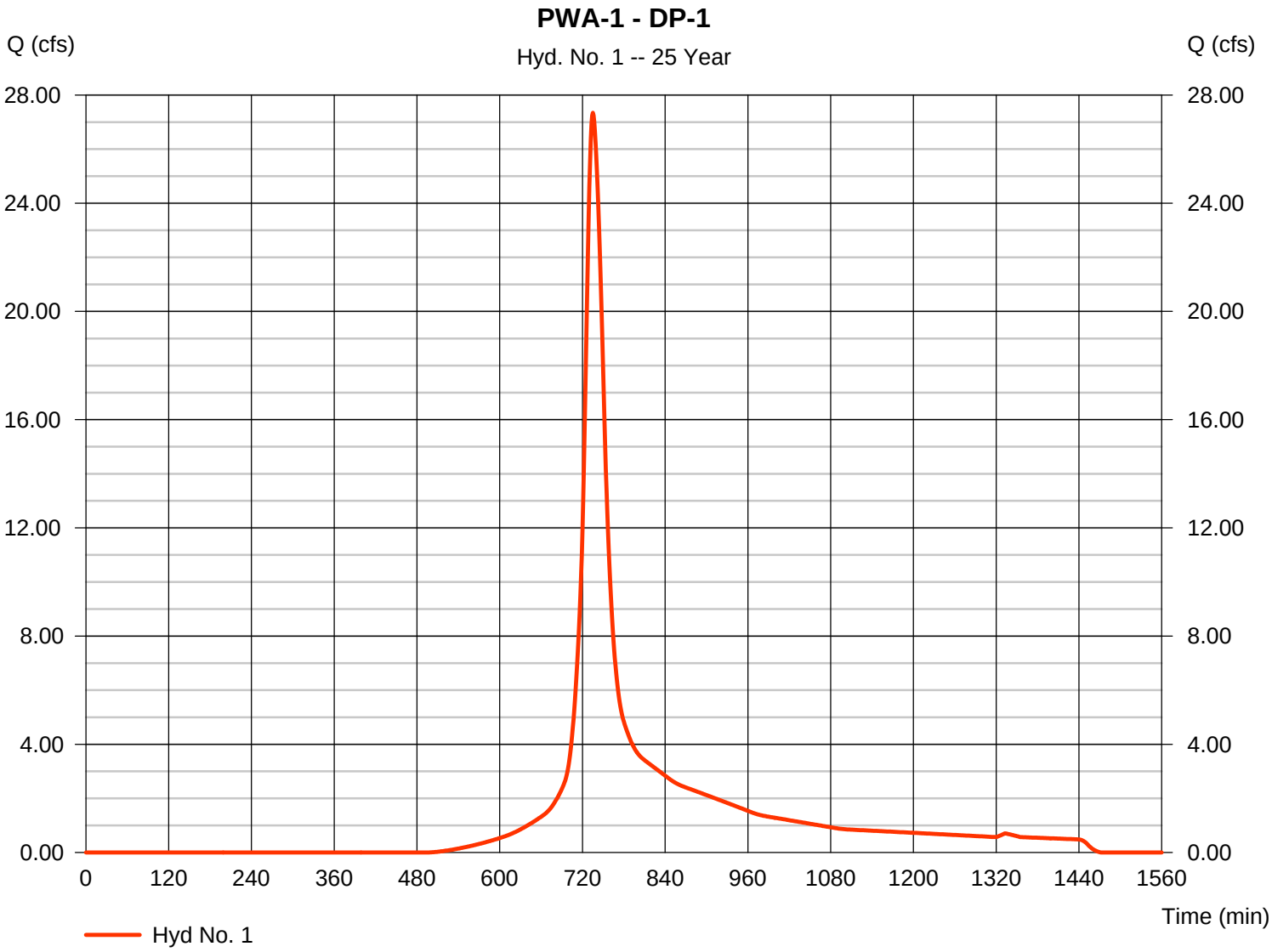
Hydrograph Report

Hyd. No. 1

PWA-1 - DP-1

Hydrograph type	=	SCS Runoff	Peak discharge	=	27.34 cfs
Storm frequency	=	25 yrs	Time to peak	=	735 min
Time interval	=	1 min	Hyd. volume	=	125,109 cuft
Drainage area	=	11.900 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	20.80 min
Total precip.	=	5.40 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.500 x 98) + (5.700 x 72) + (4.700 x 74)] / 11.900



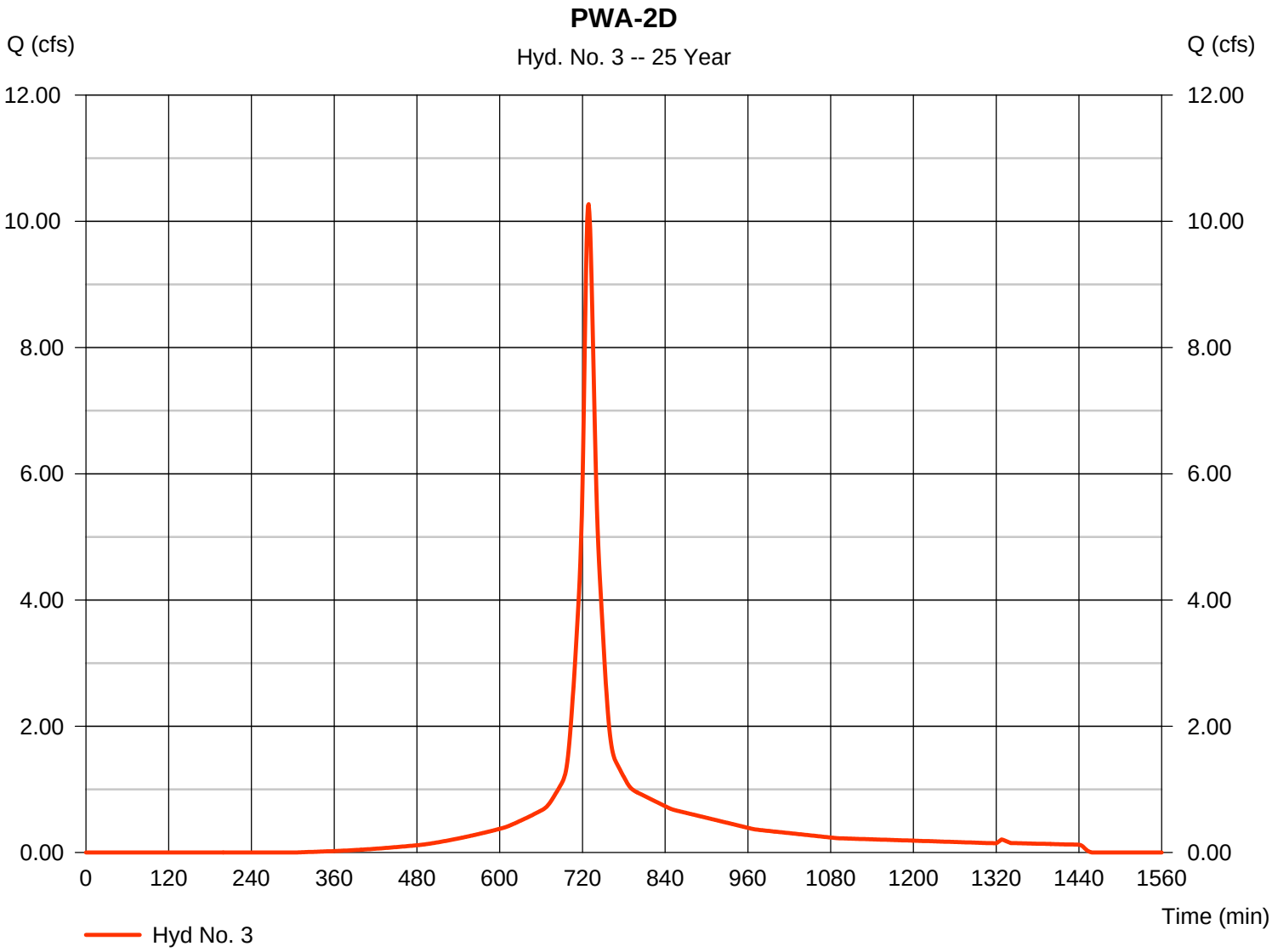
Hydrograph Report

Hyd. No. 3

PWA-2D

Hydrograph type	=	SCS Runoff	Peak discharge	=	10.27 cfs
Storm frequency	=	25 yrs	Time to peak	=	729 min
Time interval	=	1 min	Hyd. volume	=	39,475 cuft
Drainage area	=	2.800 ac	Curve number	=	87*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	12.10 min
Total precip.	=	5.40 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.500 x 98) + (1.300 x 74)] / 2.800



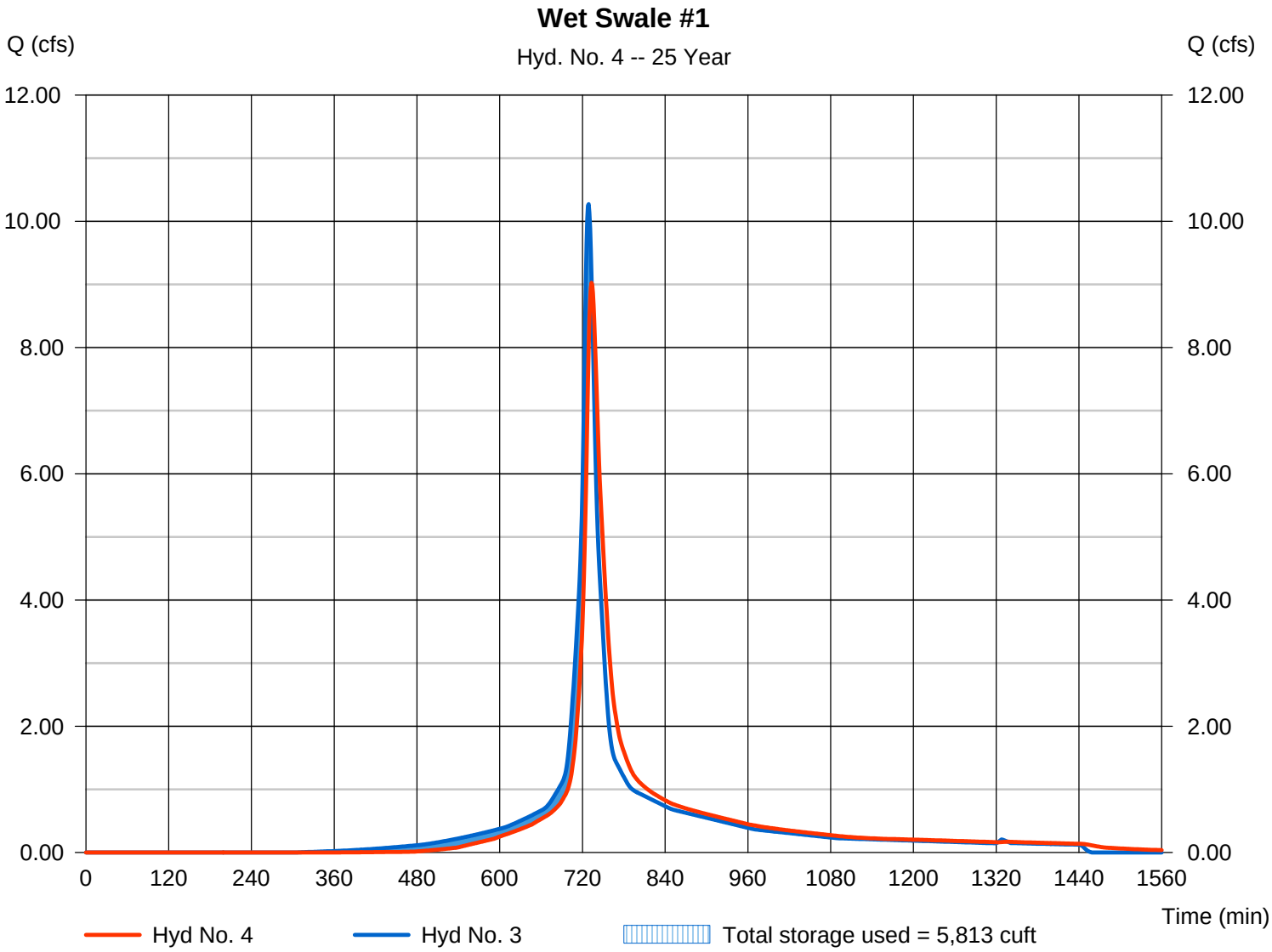
Hydrograph Report

Hyd. No. 4

Wet Swale #1

Hydrograph type	=	Reservoir	Peak discharge	=	9.025 cfs
Storm frequency	=	25 yrs	Time to peak	=	733 min
Time interval	=	1 min	Hyd. volume	=	39,435 cuft
Inflow hyd. No.	=	3 - PWA-2D	Max. Elevation	=	193.24 ft
Reservoir name	=	Wet Swale #1	Max. Storage	=	5,813 cuft

Storage Indication method used.



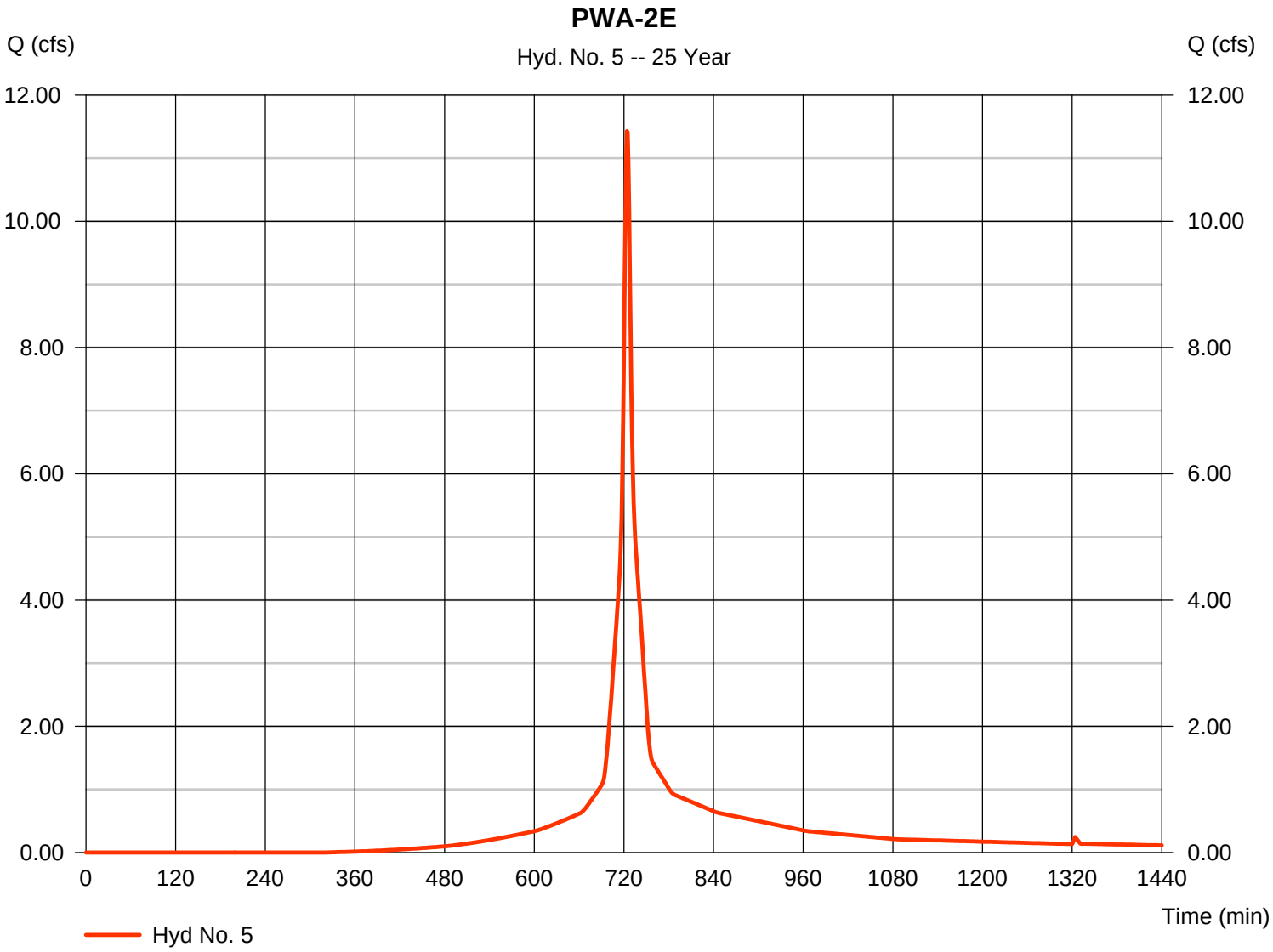
Hydrograph Report

Hyd. No. 5

PWA-2E

Hydrograph type	=	SCS Runoff	Peak discharge	=	11.43 cfs
Storm frequency	=	25 yrs	Time to peak	=	724 min
Time interval	=	1 min	Hyd. volume	=	35,955 cuft
Drainage area	=	2.500 ac	Curve number	=	86*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	USER	Time of conc. (Tc)	=	6.00 min
Total precip.	=	5.40 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.400 x 98) + (1.200 x 74)] / 2.500



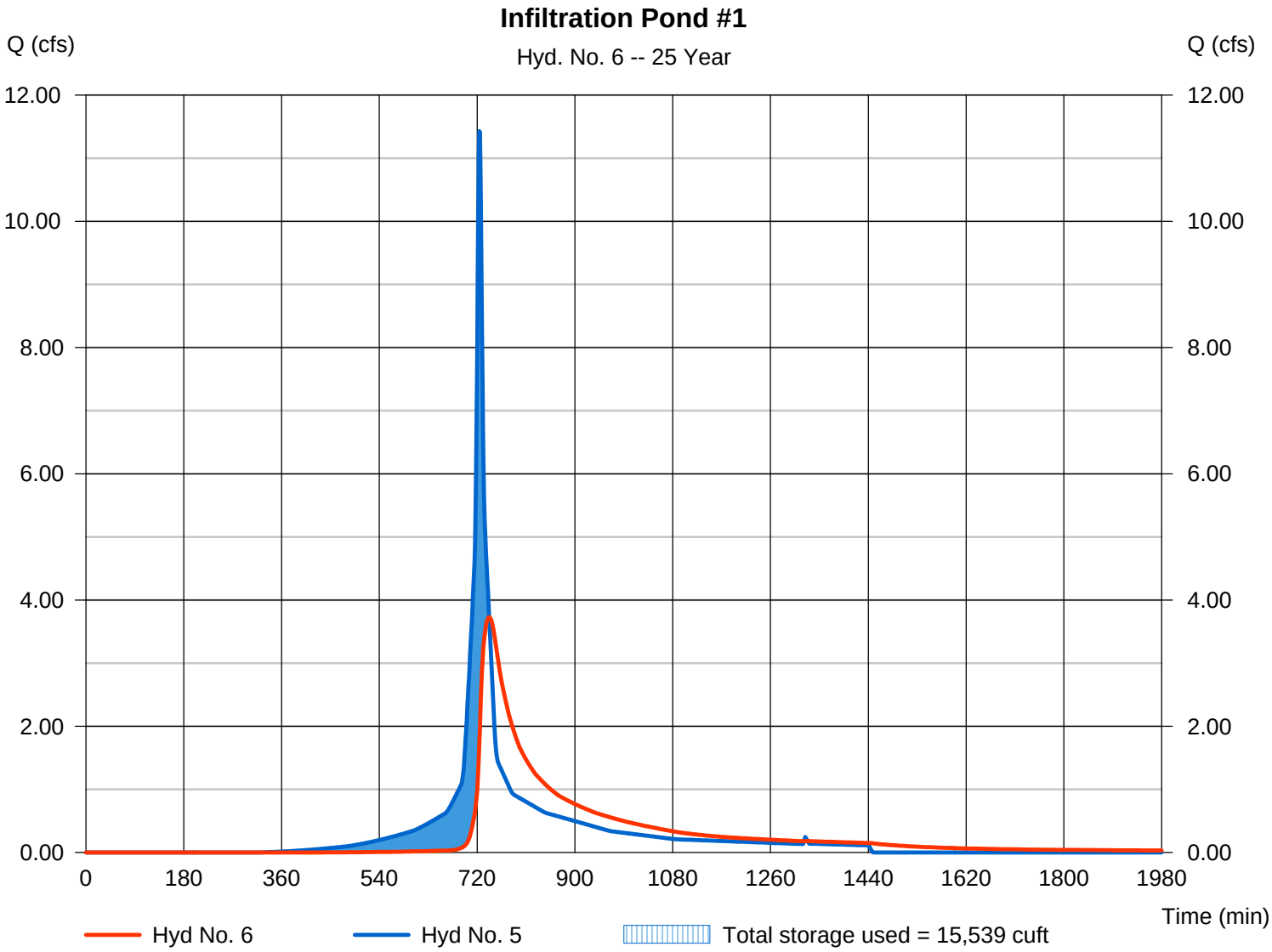
Hydrograph Report

Hyd. No. 6

Infiltration Pond #1

Hydrograph type	=	Reservoir	Peak discharge	=	3.727 cfs
Storm frequency	=	25 yrs	Time to peak	=	742 min
Time interval	=	1 min	Hyd. volume	=	33,669 cuft
Inflow hyd. No.	=	5 - PWA-2E	Max. Elevation	=	184.75 ft
Reservoir name	=	Infiltation Pond #1	Max. Storage	=	15,539 cuft

Storage Indication method used.



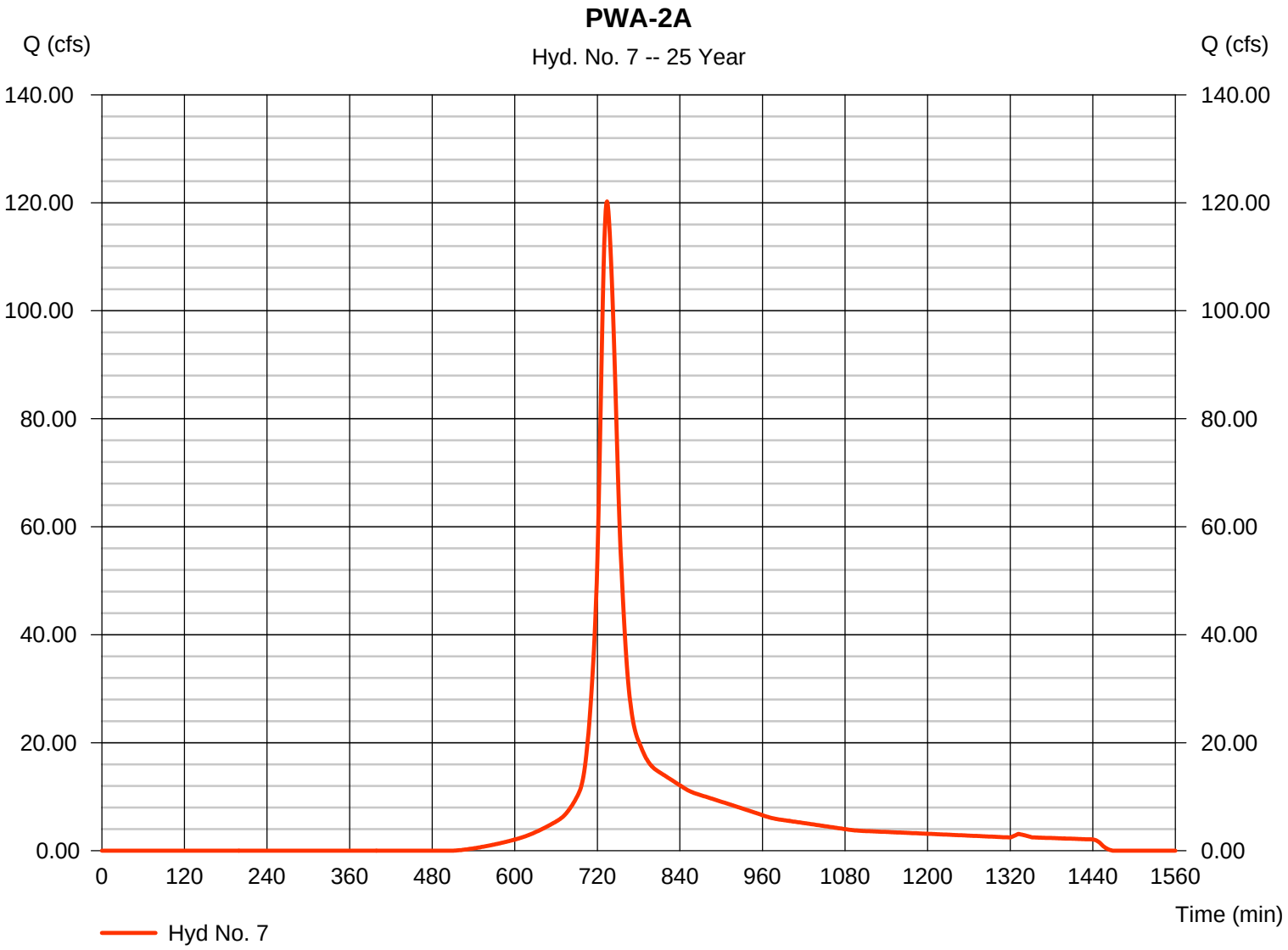
Hydrograph Report

Hyd. No. 7

PWA-2A

Hydrograph type	=	SCS Runoff	Peak discharge	=	120.27 cfs
Storm frequency	=	25 yrs	Time to peak	=	734 min
Time interval	=	1 min	Hyd. volume	=	531,321 cuft
Drainage area	=	52.700 ac	Curve number	=	75*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	19.10 min
Total precip.	=	5.40 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(2.700 x 98) + (5.400 x 72) + (44.600 x 74)] / 52.700



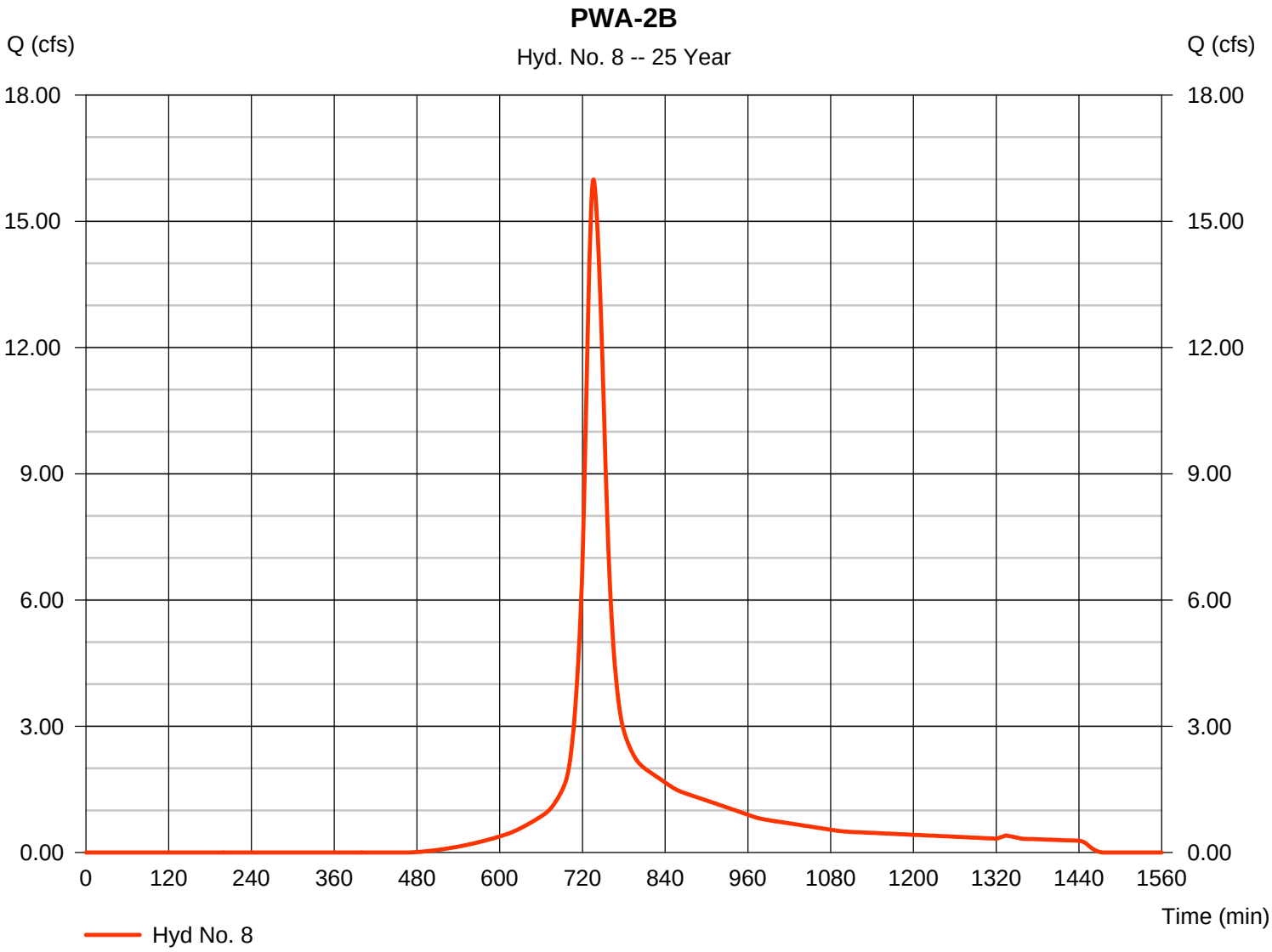
Hydrograph Report

Hyd. No. 8

PWA-2B

Hydrograph type	=	SCS Runoff	Peak discharge	=	15.99 cfs
Storm frequency	=	25 yrs	Time to peak	=	736 min
Time interval	=	1 min	Hyd. volume	=	74,722 cuft
Drainage area	=	6.800 ac	Curve number	=	78*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	22.70 min
Total precip.	=	5.40 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.300 x 98) + (2.700 x 72) + (2.800 x 74)] / 6.800



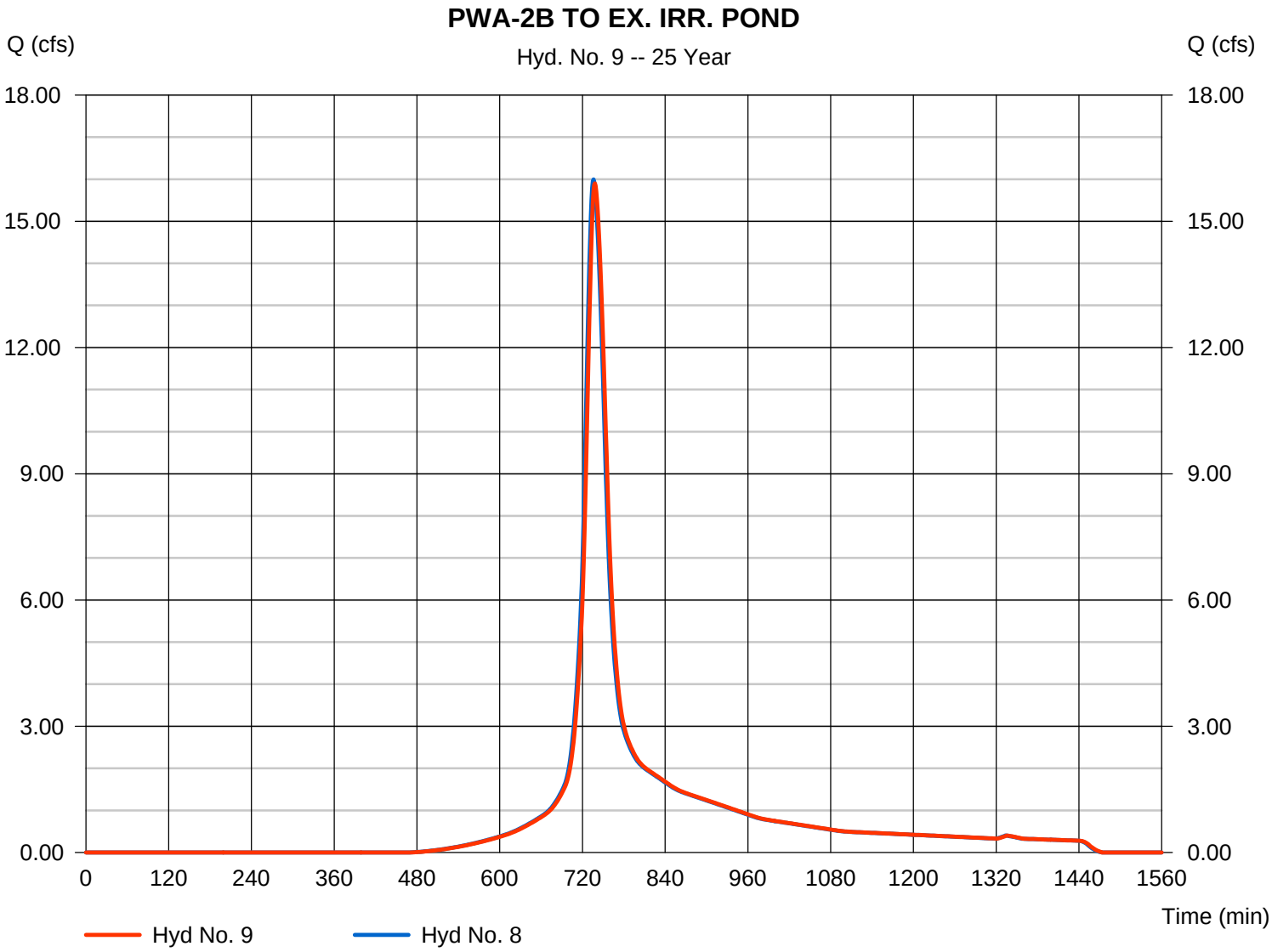
Hydrograph Report

Hyd. No. 9

PWA-2B TO EX. IRR. POND

Hydrograph type	=	Reach	Peak discharge	=	15.90 cfs
Storm frequency	=	25 yrs	Time to peak	=	738 min
Time interval	=	1 min	Hyd. volume	=	74,721 cuft
Inflow hyd. No.	=	8 - PWA-2B	Section type	=	Trapezoidal
Reach length	=	300.0 ft	Channel slope	=	3.0 %
Manning's n	=	0.040	Bottom width	=	5.0 ft
Side slope	=	3.0:1	Max. depth	=	1.0 ft
Rating curve x	=	2.205	Rating curve m	=	1.190
Ave. velocity	=	3.03 ft/s	Routing coeff.	=	0.5293

Modified Att-Kin routing method used.

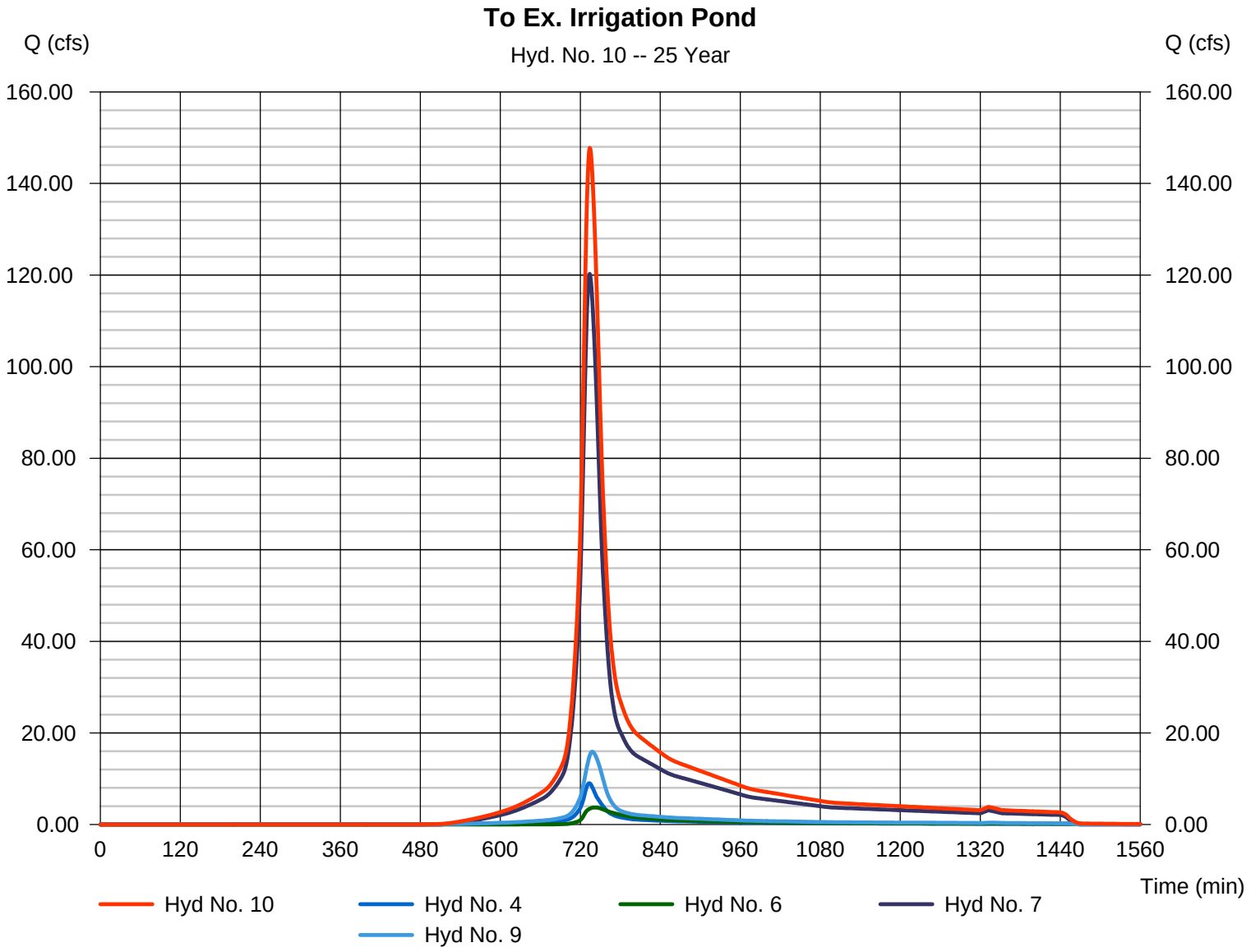


Hydrograph Report

Hyd. No. 10

To Ex. Irrigation Pond

Hydrograph type	= Combine	Peak discharge	= 147.79 cfs
Storm frequency	= 25 yrs	Time to peak	= 734 min
Time interval	= 1 min	Hyd. volume	= 679,146 cuft
Inflow hyds.	= 4, 6, 7, 9	Contrib. drain. area	= 52.700 ac



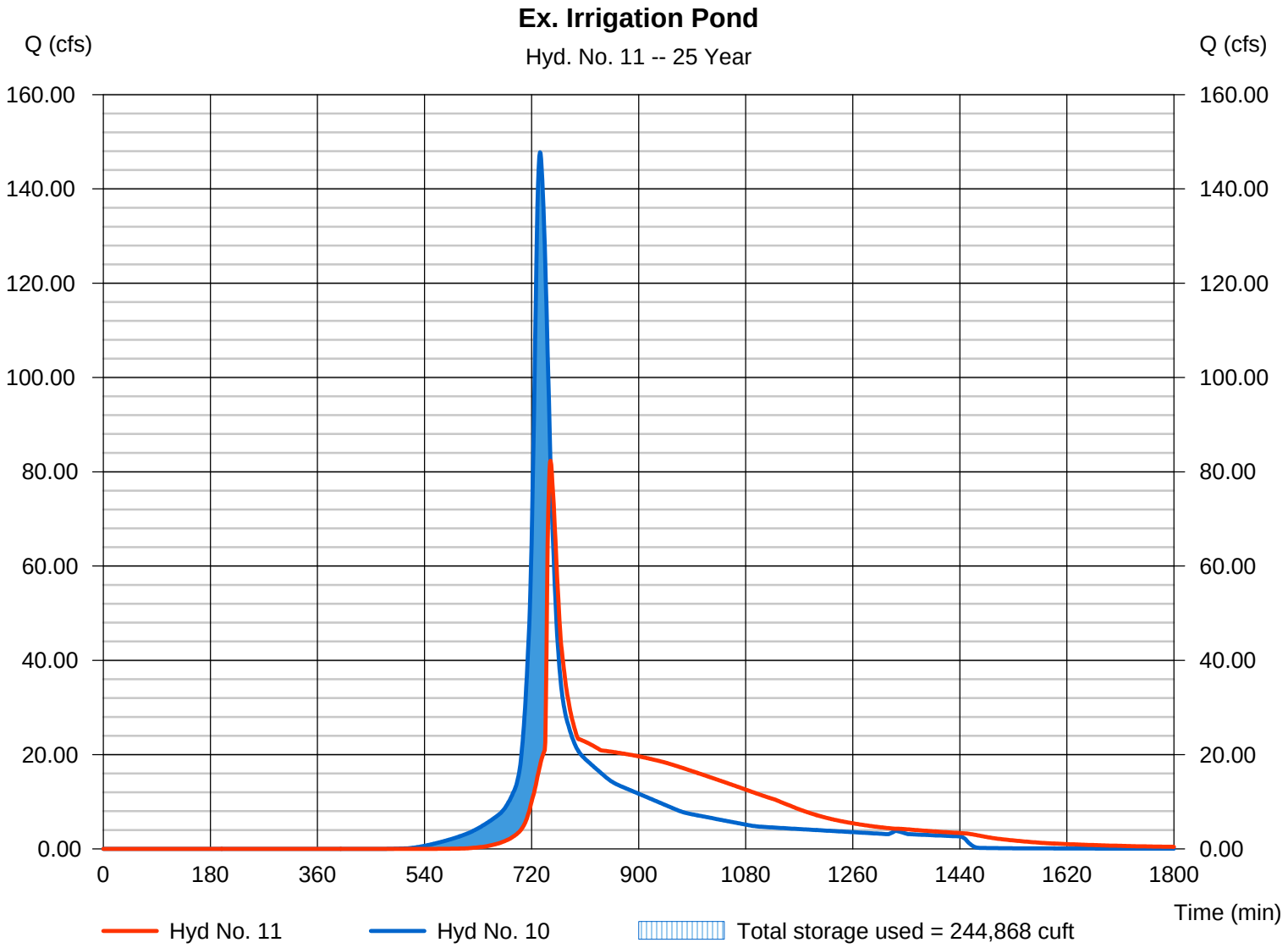
Hydrograph Report

Hyd. No. 11

Ex. Irrigation Pond

Hydrograph type	=	Reservoir	Peak discharge	=	82.35 cfs
Storm frequency	=	25 yrs	Time to peak	=	752 min
Time interval	=	1 min	Hyd. volume	=	672,774 cuft
Inflow hyd. No.	=	10 - To Ex. Irrigation Pond	Max. Elevation	=	165.69 ft
Reservoir name	=	Ex. Irrigation Pond	Max. Storage	=	244,868 cuft

Storage Indication method used.



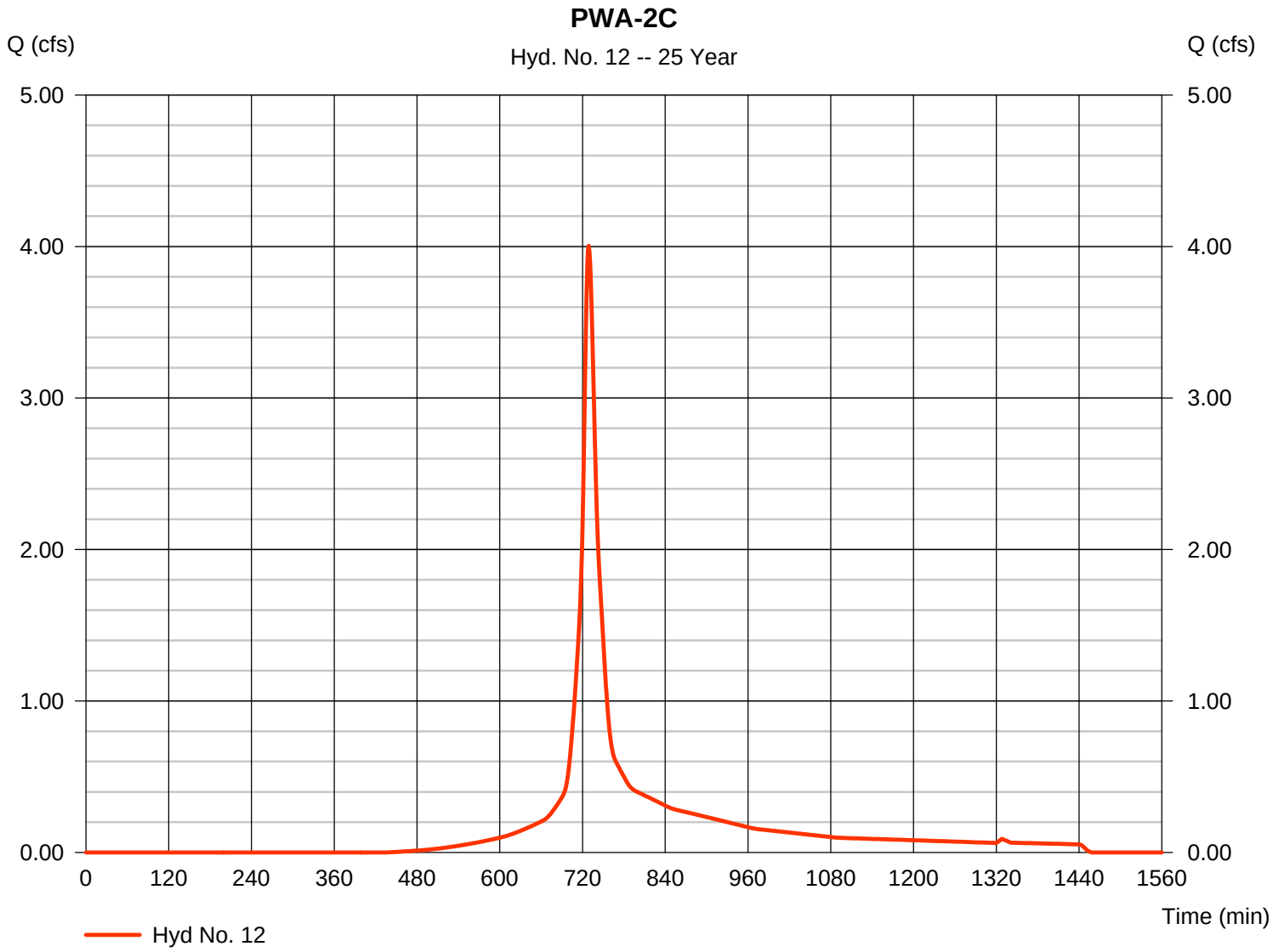
Hydrograph Report

Hyd. No. 12

PWA-2C

Hydrograph type	=	SCS Runoff	Peak discharge	=	4.005 cfs
Storm frequency	=	25 yrs	Time to peak	=	729 min
Time interval	=	1 min	Hyd. volume	=	15,072 cuft
Drainage area	=	1.300 ac	Curve number	=	80*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	12.60 min
Total precip.	=	5.40 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.400 x 98) + (0.900 x 72)] / 1.300

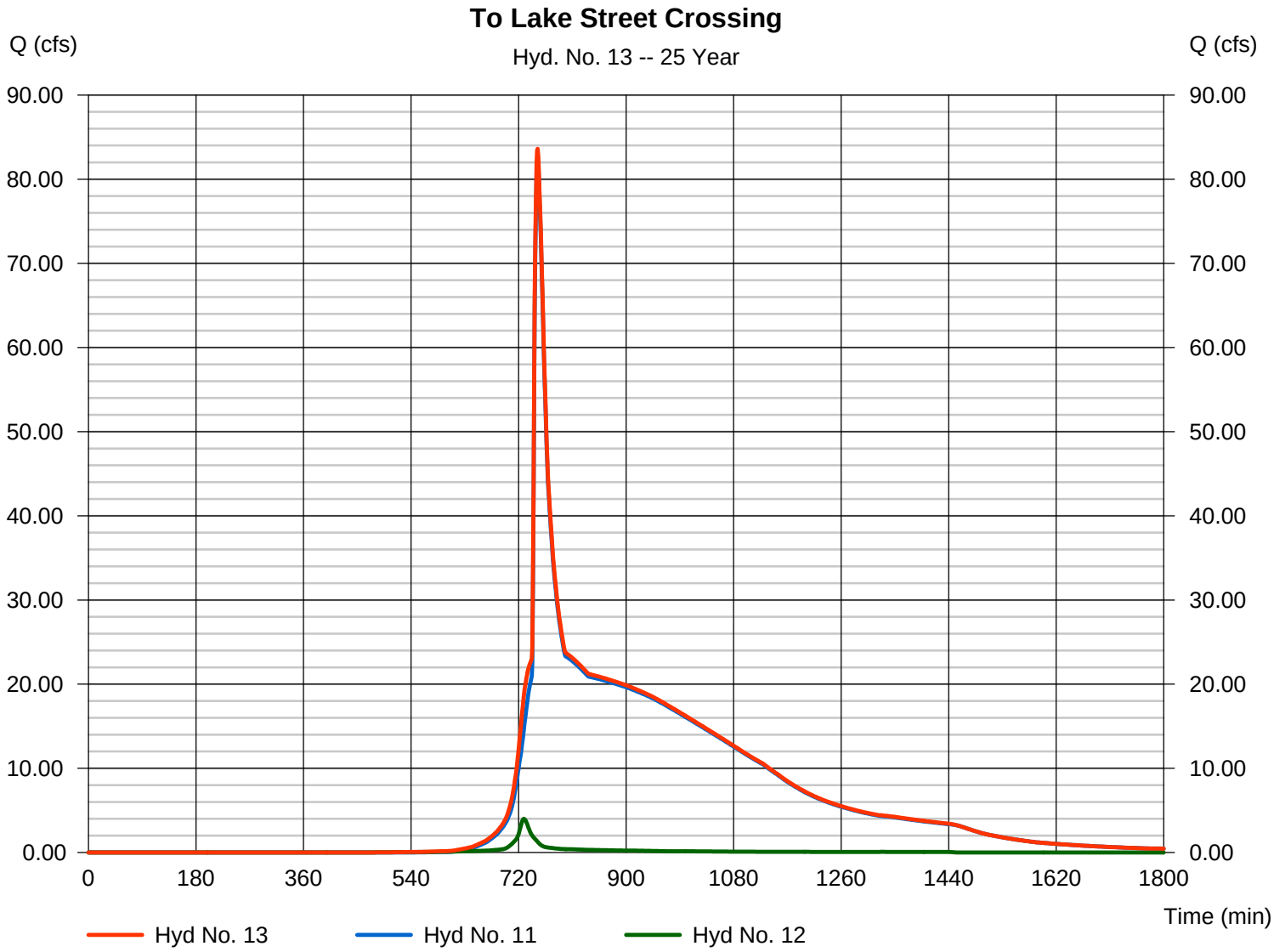


Hydrograph Report

Hyd. No. 13

To Lake Street Crossing

Hydrograph type	=	Combine	Peak discharge	=	83.60 cfs
Storm frequency	=	25 yrs	Time to peak	=	752 min
Time interval	=	1 min	Hyd. volume	=	687,846 cuft
Inflow hyds.	=	11, 12	Contrib. drain. area	=	1.300 ac



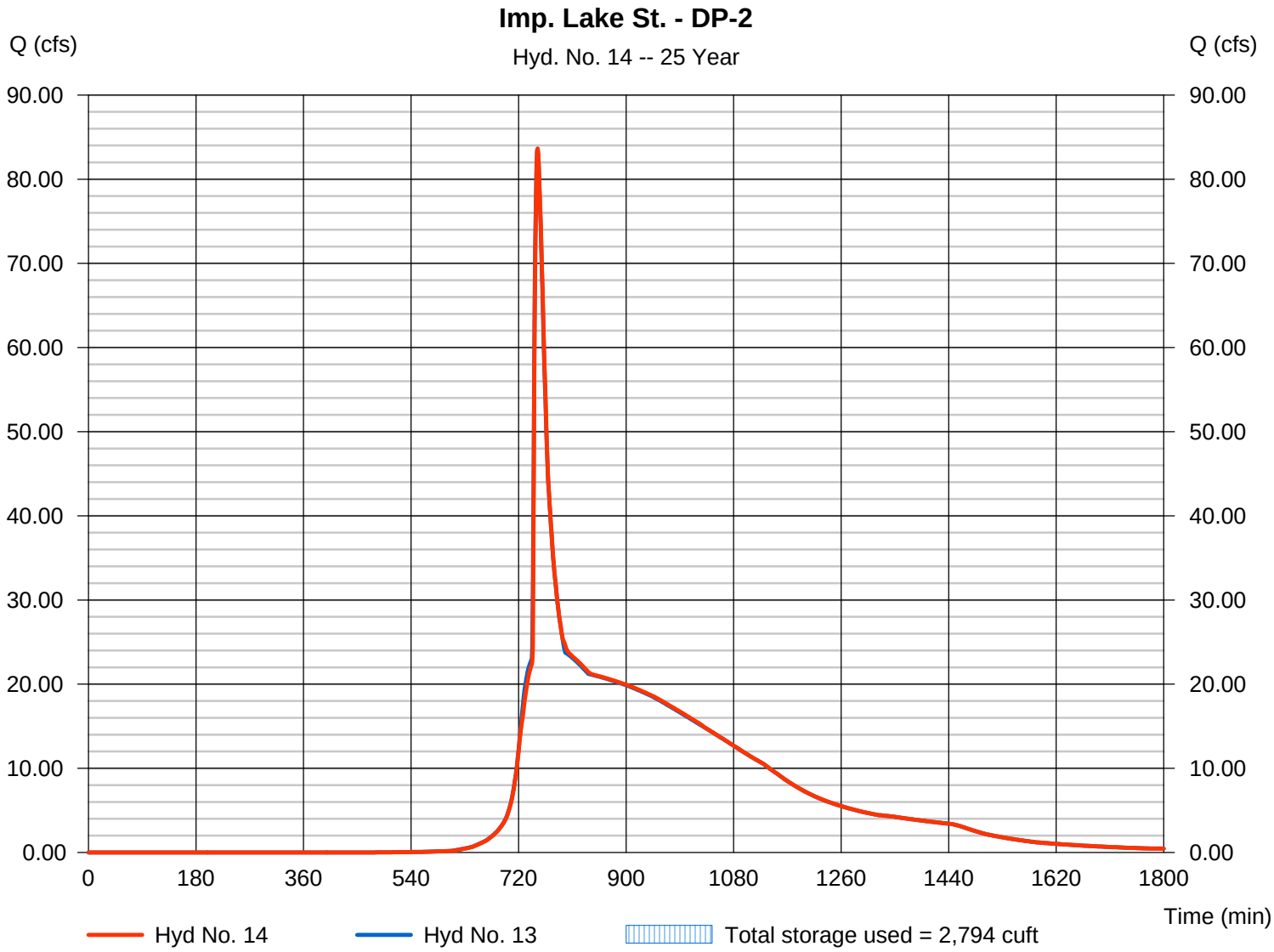
Hydrograph Report

Hyd. No. 14

Imp. Lake St. - DP-2

Hydrograph type	=	Reservoir	Peak discharge	=	83.64 cfs
Storm frequency	=	25 yrs	Time to peak	=	752 min
Time interval	=	1 min	Hyd. volume	=	687,834 cuft
Inflow hyd. No.	=	13 - To Lake Street Crossing	Max. Elevation	=	160.16 ft
Reservoir name	=	Improved Lake Street Crossing	Max. Storage	=	2,794 cuft

Storage Indication method used.



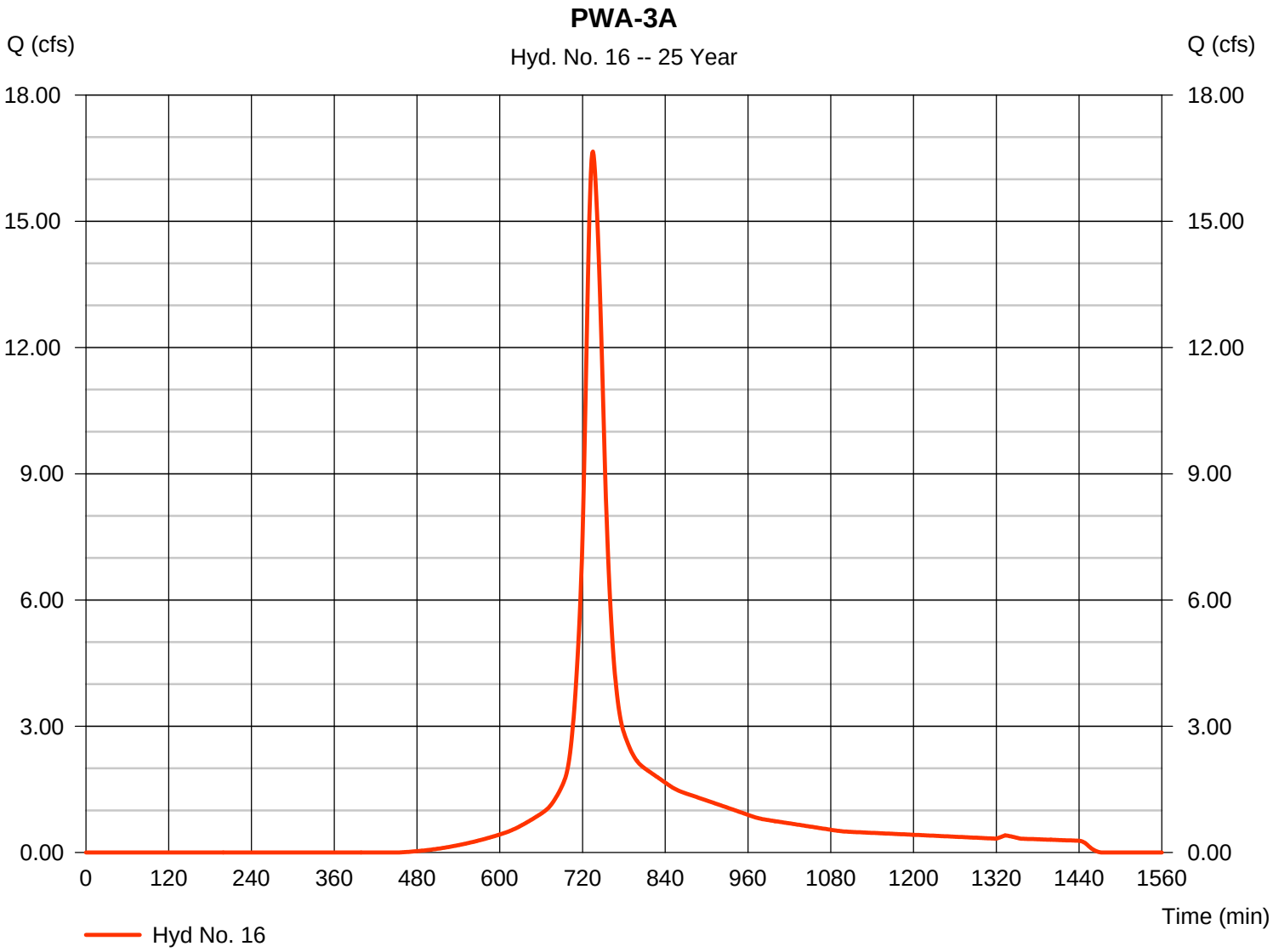
Hydrograph Report

Hyd. No. 16

PWA-3A

Hydrograph type	=	SCS Runoff	Peak discharge	=	16.66 cfs
Storm frequency	=	25 yrs	Time to peak	=	735 min
Time interval	=	1 min	Hyd. volume	=	76,168 cuft
Drainage area	=	6.600 ac	Curve number	=	79*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	21.70 min
Total precip.	=	5.40 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.500 x 98) + (5.100 x 74)] / 6.600



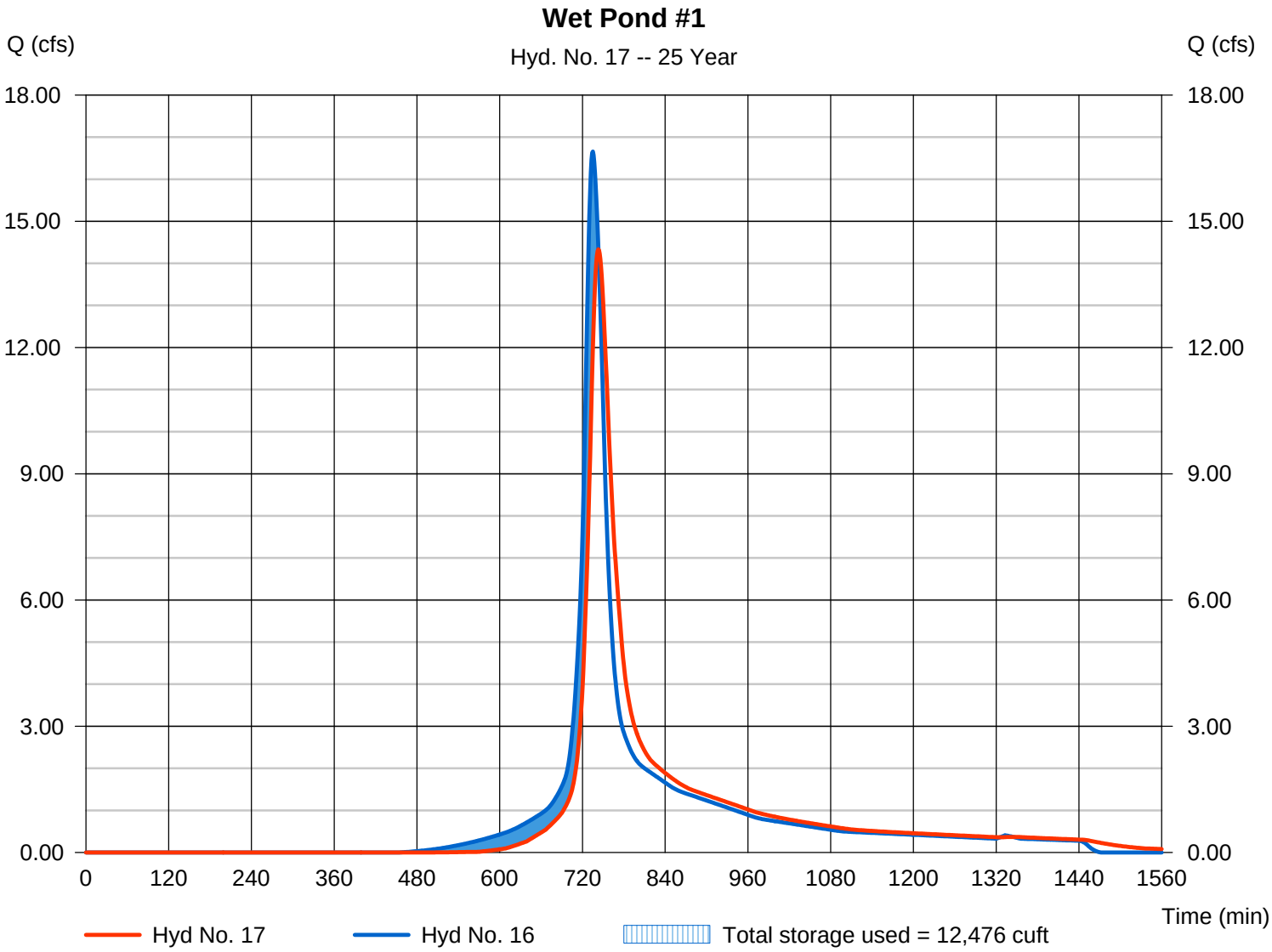
Hydrograph Report

Hyd. No. 17

Wet Pond #1

Hydrograph type	=	Reservoir	Peak discharge	=	14.33 cfs
Storm frequency	=	25 yrs	Time to peak	=	743 min
Time interval	=	1 min	Hyd. volume	=	75,997 cuft
Inflow hyd. No.	=	16 - PWA-3A	Max. Elevation	=	196.72 ft
Reservoir name	=	Wet Pond #1	Max. Storage	=	12,476 cuft

Storage Indication method used.



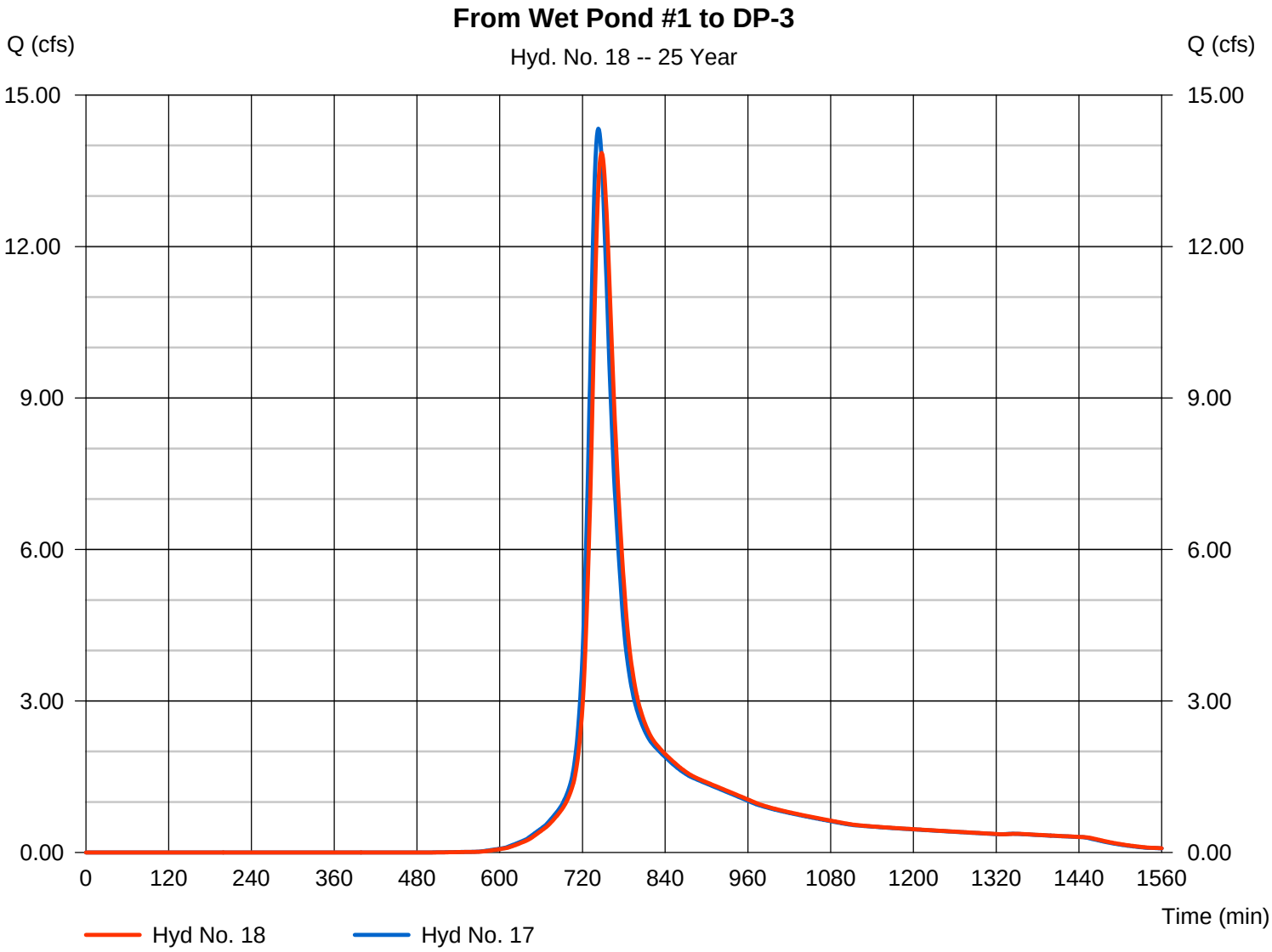
Hydrograph Report

Hyd. No. 18

From Wet Pond #1 to DP-3

Hydrograph type	=	Reach	Peak discharge	=	13.85 cfs
Storm frequency	=	25 yrs	Time to peak	=	748 min
Time interval	=	1 min	Hyd. volume	=	75,730 cuft
Inflow hyd. No.	=	17 - Wet Pond #1	Section type	=	Trapezoidal
Reach length	=	1299.0 ft	Channel slope	=	2.2 %
Manning's n	=	0.026	Bottom width	=	6.0 ft
Side slope	=	3.0:1	Max. depth	=	3.0 ft
Rating curve x	=	2.573	Rating curve m	=	1.344
Ave. velocity	=	3.99 ft/s	Routing coeff.	=	0.2205

Modified Att-Kin routing method used.



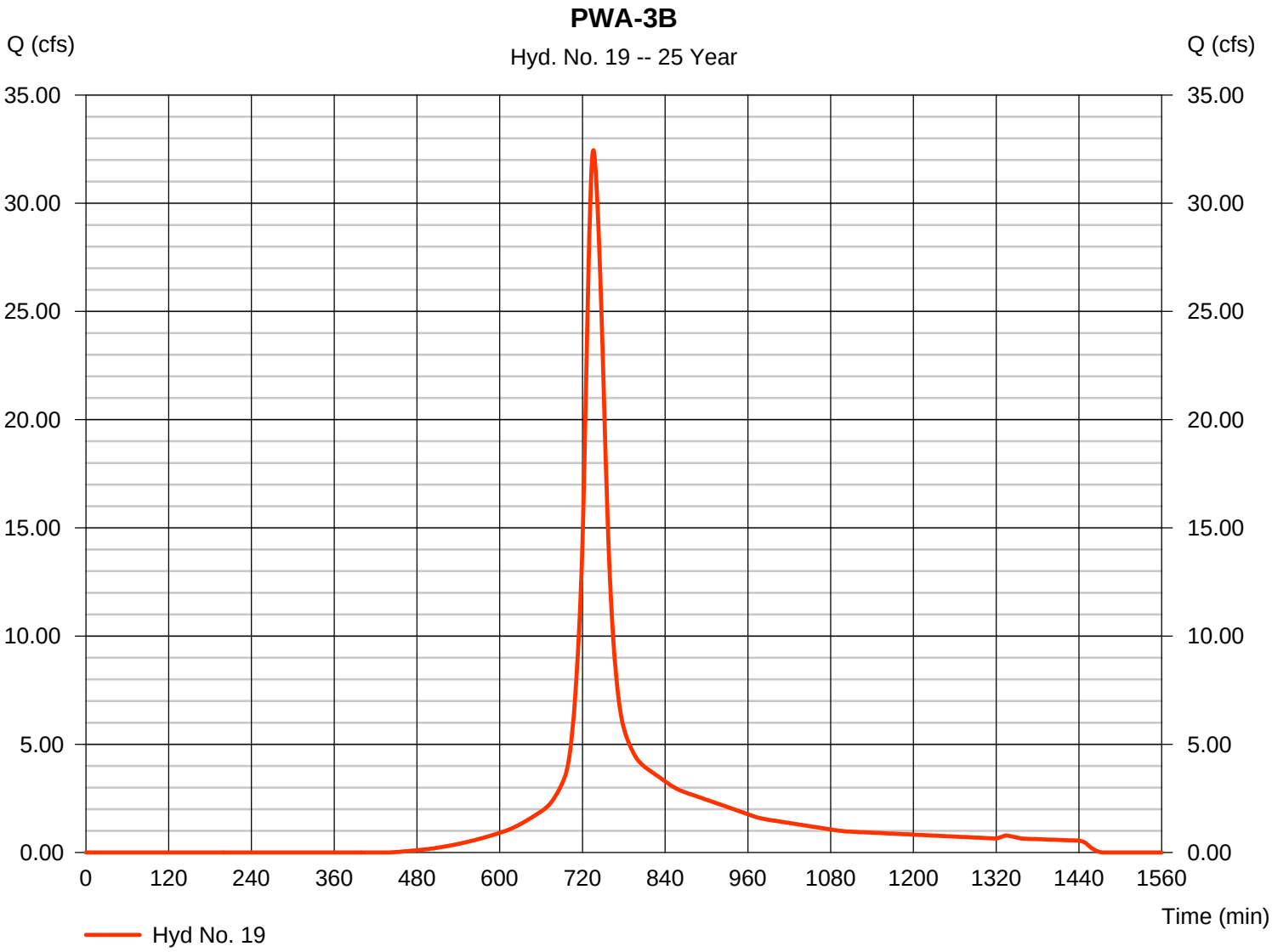
Hydrograph Report

Hyd. No. 19

PWA-3B

Hydrograph type	=	SCS Runoff	Peak discharge	=	32.45 cfs
Storm frequency	=	25 yrs	Time to peak	=	736 min
Time interval	=	1 min	Hyd. volume	=	151,745 cuft
Drainage area	=	13.000 ac	Curve number	=	80*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	22.20 min
Total precip.	=	5.40 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(3.100 x 98) + (1.100 x 72) + (8.800 x 74)] / 13.000



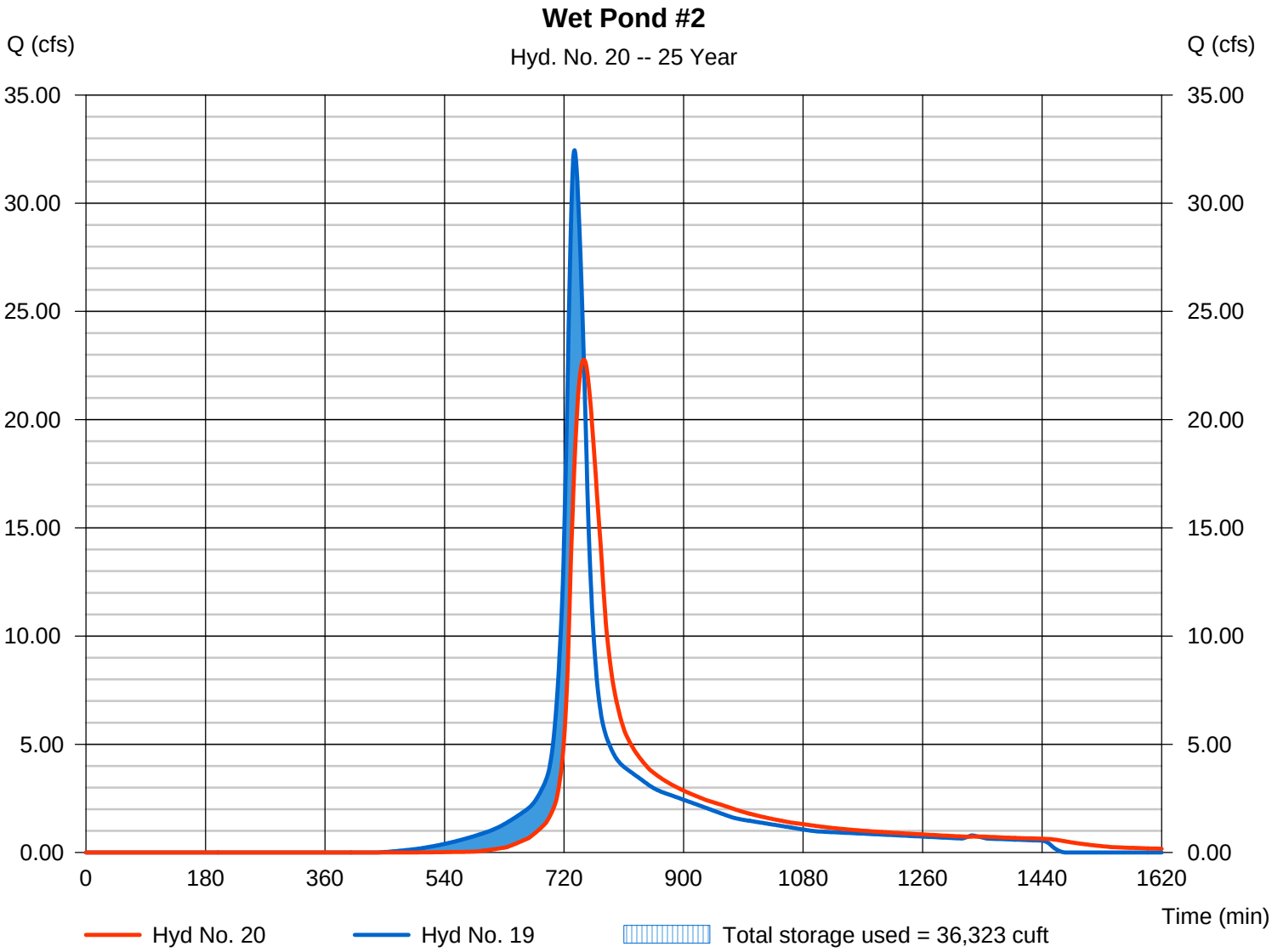
Hydrograph Report

Hyd. No. 20

Wet Pond #2

Hydrograph type	=	Reservoir	Peak discharge	=	22.78 cfs
Storm frequency	=	25 yrs	Time to peak	=	750 min
Time interval	=	1 min	Hyd. volume	=	150,833 cuft
Inflow hyd. No.	=	19 - PWA-3B	Max. Elevation	=	204.54 ft
Reservoir name	=	Wet Pond #2	Max. Storage	=	36,323 cuft

Storage Indication method used.



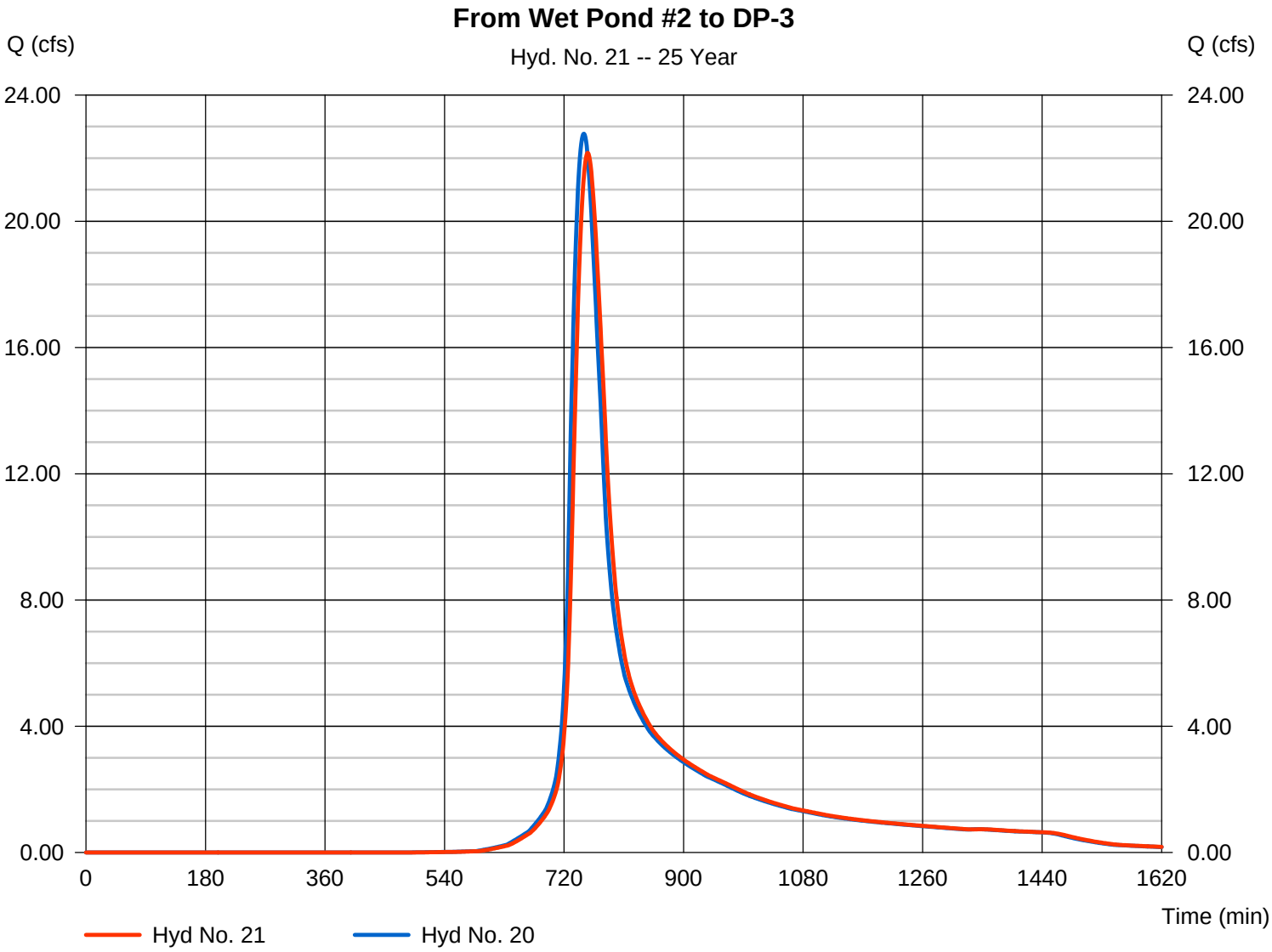
Hydrograph Report

Hyd. No. 21

From Wet Pond #2 to DP-3

Hydrograph type	=	Reach	Peak discharge	=	22.17 cfs
Storm frequency	=	25 yrs	Time to peak	=	756 min
Time interval	=	1 min	Hyd. volume	=	150,827 cuft
Inflow hyd. No.	=	20 - Wet Pond #2	Section type	=	Trapezoidal
Reach length	=	1876.0 ft	Channel slope	=	2.2 %
Manning's n	=	0.026	Bottom width	=	6.0 ft
Side slope	=	3.0:1	Max. depth	=	3.0 ft
Rating curve x	=	2.573	Rating curve m	=	1.344
Ave. velocity	=	4.49 ft/s	Routing coeff.	=	0.1762

Modified Att-Kin routing method used.



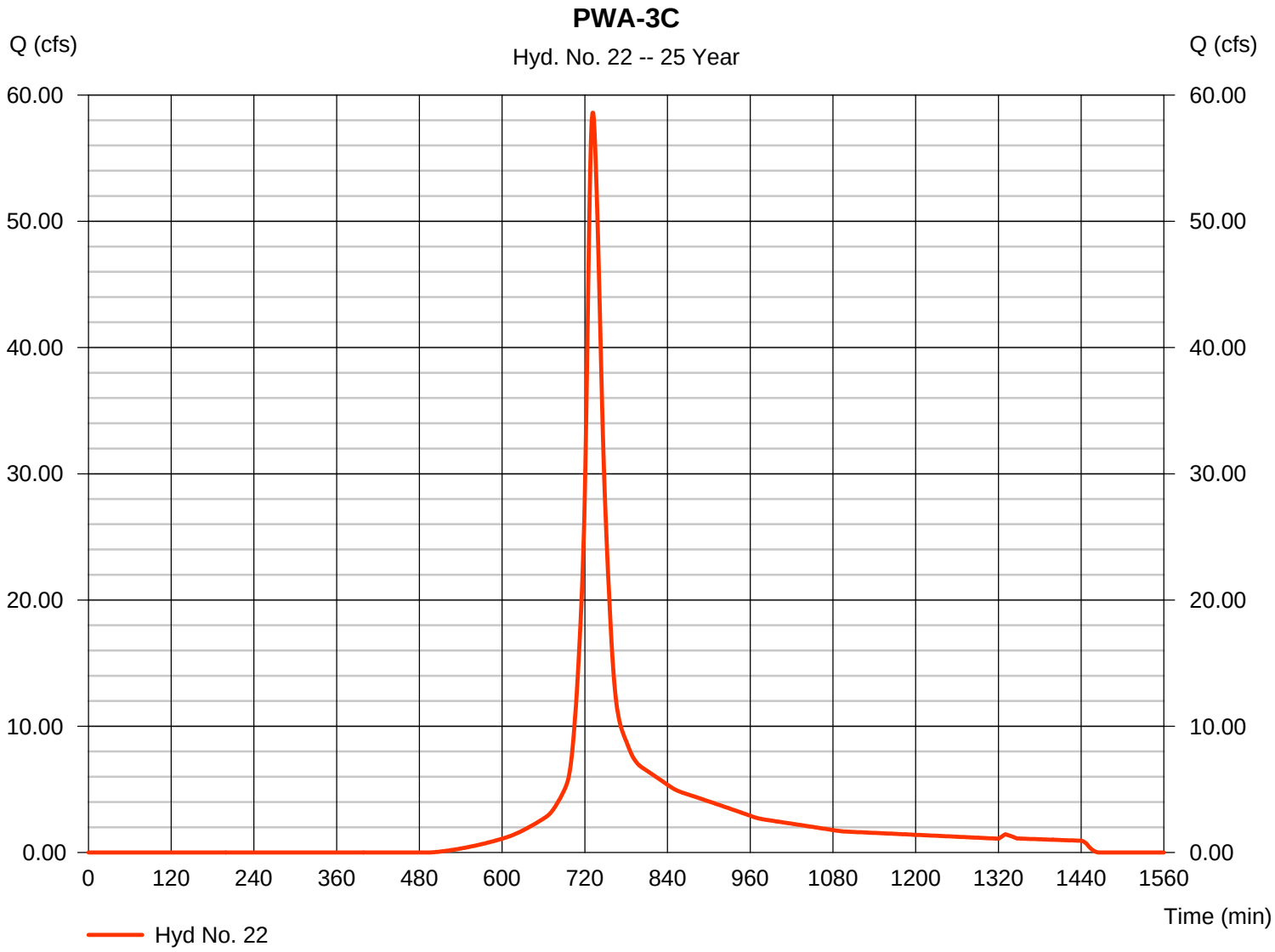
Hydrograph Report

Hyd. No. 22

PWA-3C

Hydrograph type	=	SCS Runoff	Peak discharge	=	58.60 cfs
Storm frequency	=	25 yrs	Time to peak	=	731 min
Time interval	=	1 min	Hyd. volume	=	242,498 cuft
Drainage area	=	23.000 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	16.50 min
Total precip.	=	5.40 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.000 x 98) + (3.100 x 72) + (4.000 x 79) + (14.000 x 74) + (0.900 x 80)] / 23.000

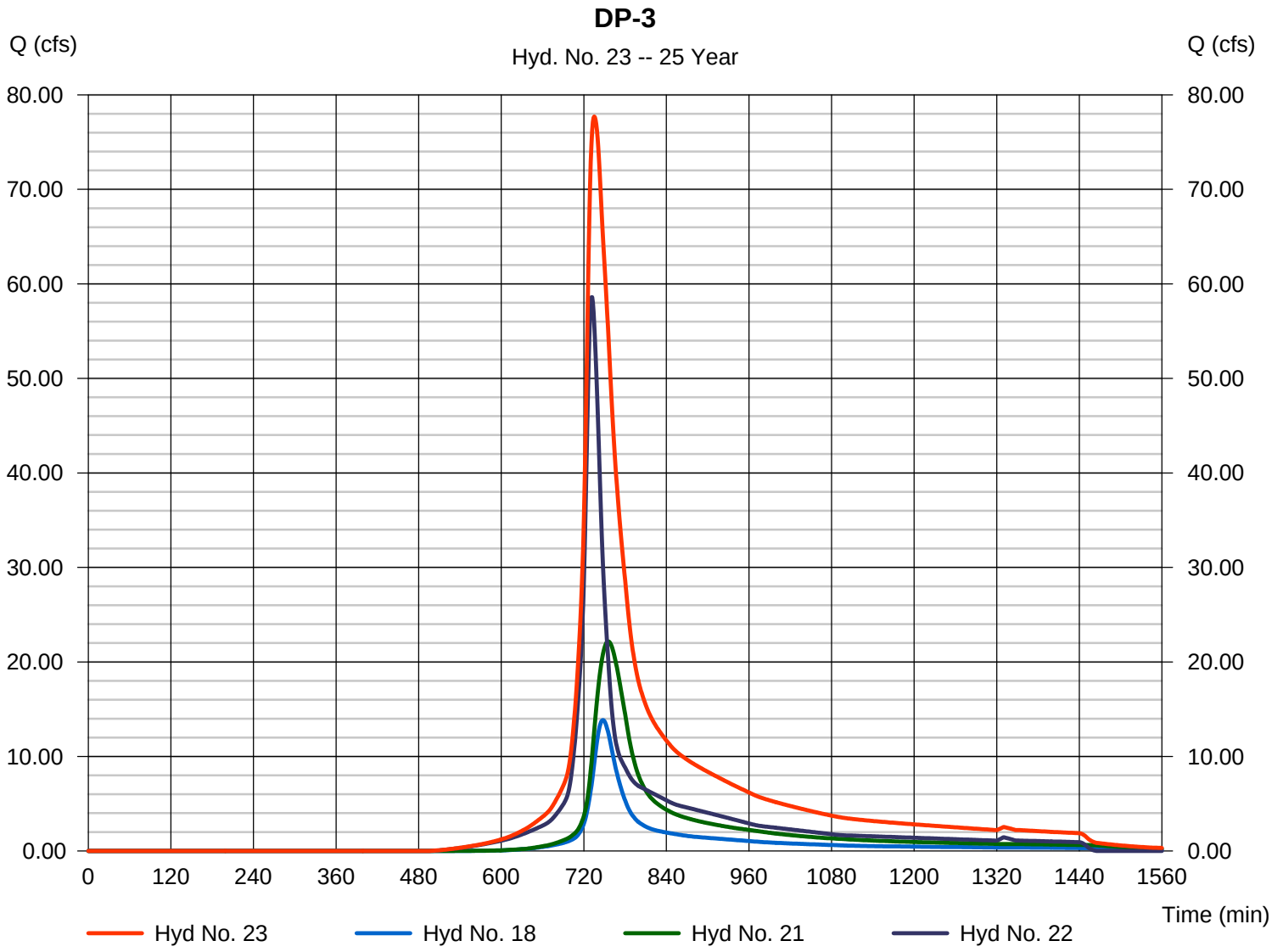


Hydrograph Report

Hyd. No. 23

DP-3

Hydrograph type	=	Combine	Peak discharge	=	77.71 cfs
Storm frequency	=	25 yrs	Time to peak	=	735 min
Time interval	=	1 min	Hyd. volume	=	469,055 cuft
Inflow hyds.	=	18, 21, 22	Contrib. drain. area	=	23.000 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

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	31.42	1	735	143,659	------	------	------	PWA-1 - DP-1
3	SCS Runoff	11.45	1	729	44,239	------	------	------	PWA-2D
4	Reservoir	10.19	1	733	44,199	3	193.28	6,116	Wet Swale #1
5	SCS Runoff	12.77	1	724	40,377	------	------	------	PWA-2E
6	Reservoir	4.614	1	740	38,076	5	184.86	16,790	Infiltration Pond #1
7	SCS Runoff	138.62	1	734	611,593	------	------	------	PWA-2A
8	SCS Runoff	18.27	1	736	85,396	------	------	------	PWA-2B
9	Reach	18.17	1	738	85,395	8	------	------	PWA-2B TO EX. IRR. POND
10	Combine	170.49	1	734	779,263	4, 6, 7, 9	------	------	To Ex. Irrigation Pond
11	Reservoir	120.59	1	747	772,859	10	165.77	253,397	Ex. Irrigation Pond
12	SCS Runoff	4.546	1	729	17,146	------	------	------	PWA-2C
13	Combine	122.44	1	747	790,005	11, 12	------	------	To Lake Street Crossing
14	Reservoir	122.43	1	747	789,994	13	160.31	3,282	Imp. Lake St. - DP-2
16	SCS Runoff	18.97	1	735	86,848	------	------	------	PWA-3A
17	Reservoir	16.57	1	742	86,676	16	196.85	13,420	Wet Pond #1
18	Reach	16.03	1	747	86,410	17	------	------	From Wet Pond #1 to DP-3
19	SCS Runoff	36.85	1	736	172,630	------	------	------	PWA-3B
20	Reservoir	25.41	1	750	171,710	19	204.74	40,431	Wet Pond #2
21	Reach	24.84	1	756	171,705	20	------	------	From Wet Pond #2 to DP-3
22	SCS Runoff	67.37	1	731	278,453	------	------	------	PWA-3C
23	Combine	90.04	1	735	536,569	18, 21, 22	------	------	DP-3

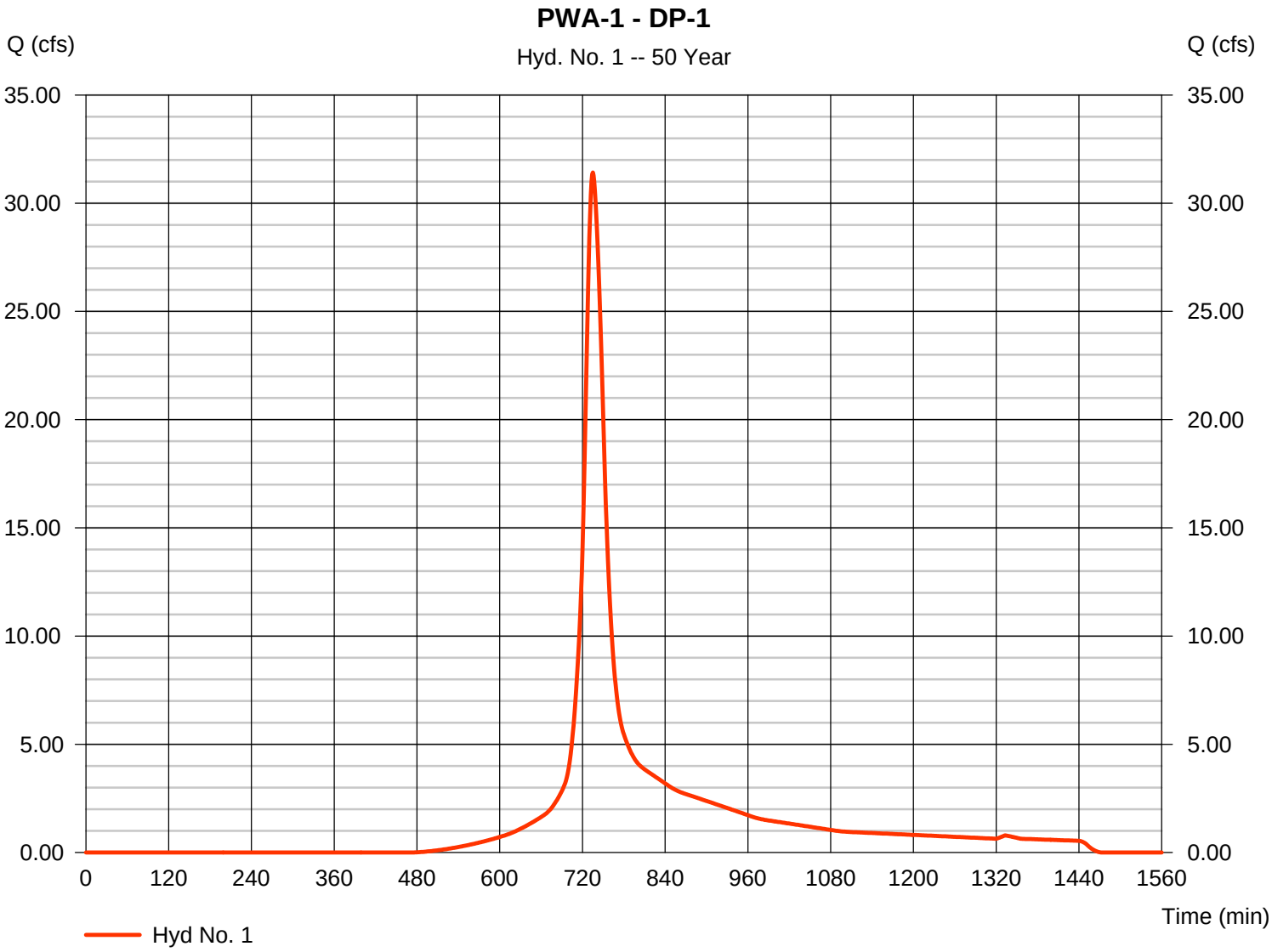
Hydrograph Report

Hyd. No. 1

PWA-1 - DP-1

Hydrograph type	=	SCS Runoff	Peak discharge	=	31.42 cfs
Storm frequency	=	50 yrs	Time to peak	=	735 min
Time interval	=	1 min	Hyd. volume	=	143,659 cuft
Drainage area	=	11.900 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	20.80 min
Total precip.	=	5.90 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.500 x 98) + (5.700 x 72) + (4.700 x 74)] / 11.900



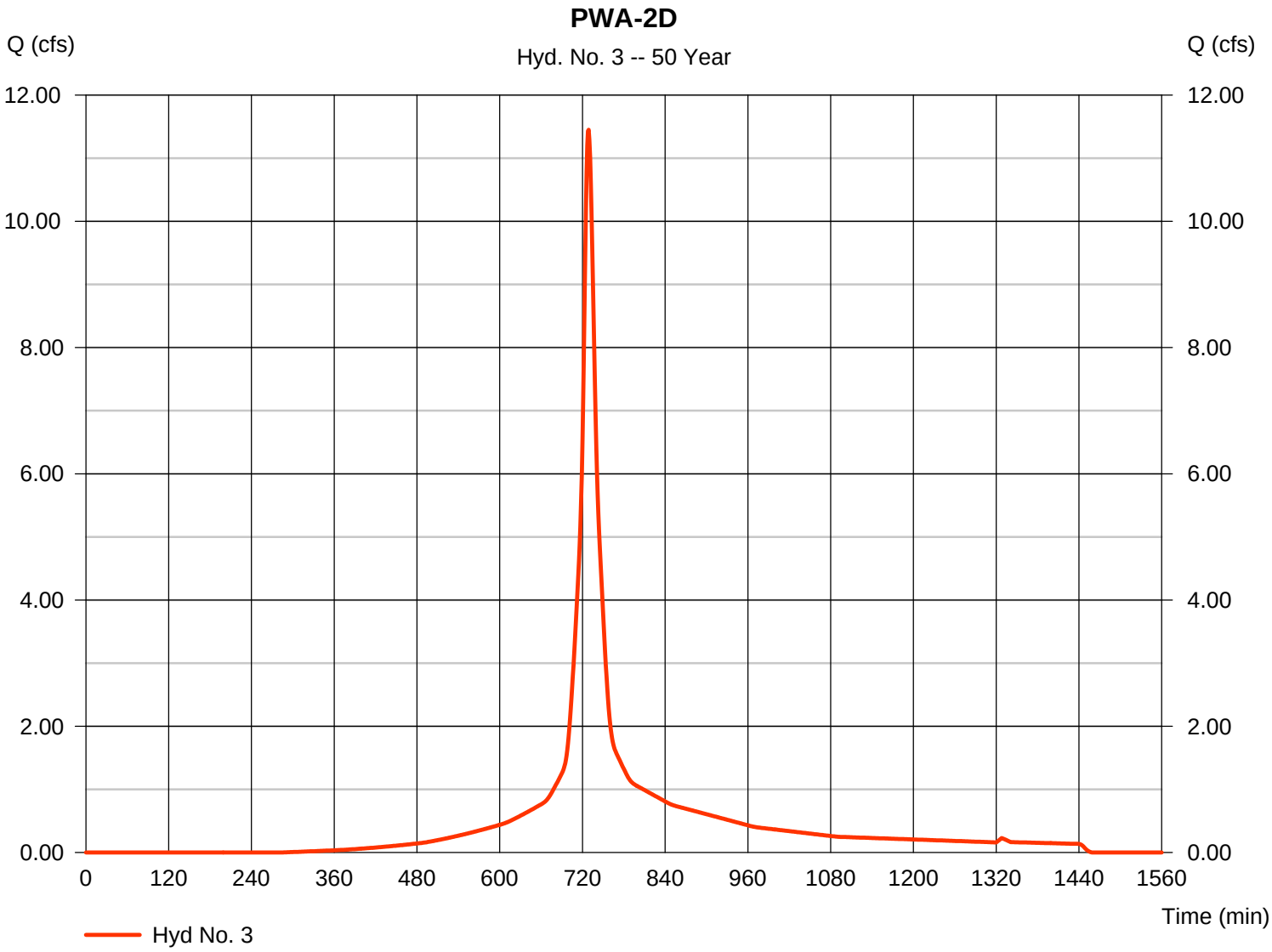
Hydrograph Report

Hyd. No. 3

PWA-2D

Hydrograph type	=	SCS Runoff	Peak discharge	=	11.45 cfs
Storm frequency	=	50 yrs	Time to peak	=	729 min
Time interval	=	1 min	Hyd. volume	=	44,239 cuft
Drainage area	=	2.800 ac	Curve number	=	87*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	12.10 min
Total precip.	=	5.90 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.500 x 98) + (1.300 x 74)] / 2.800



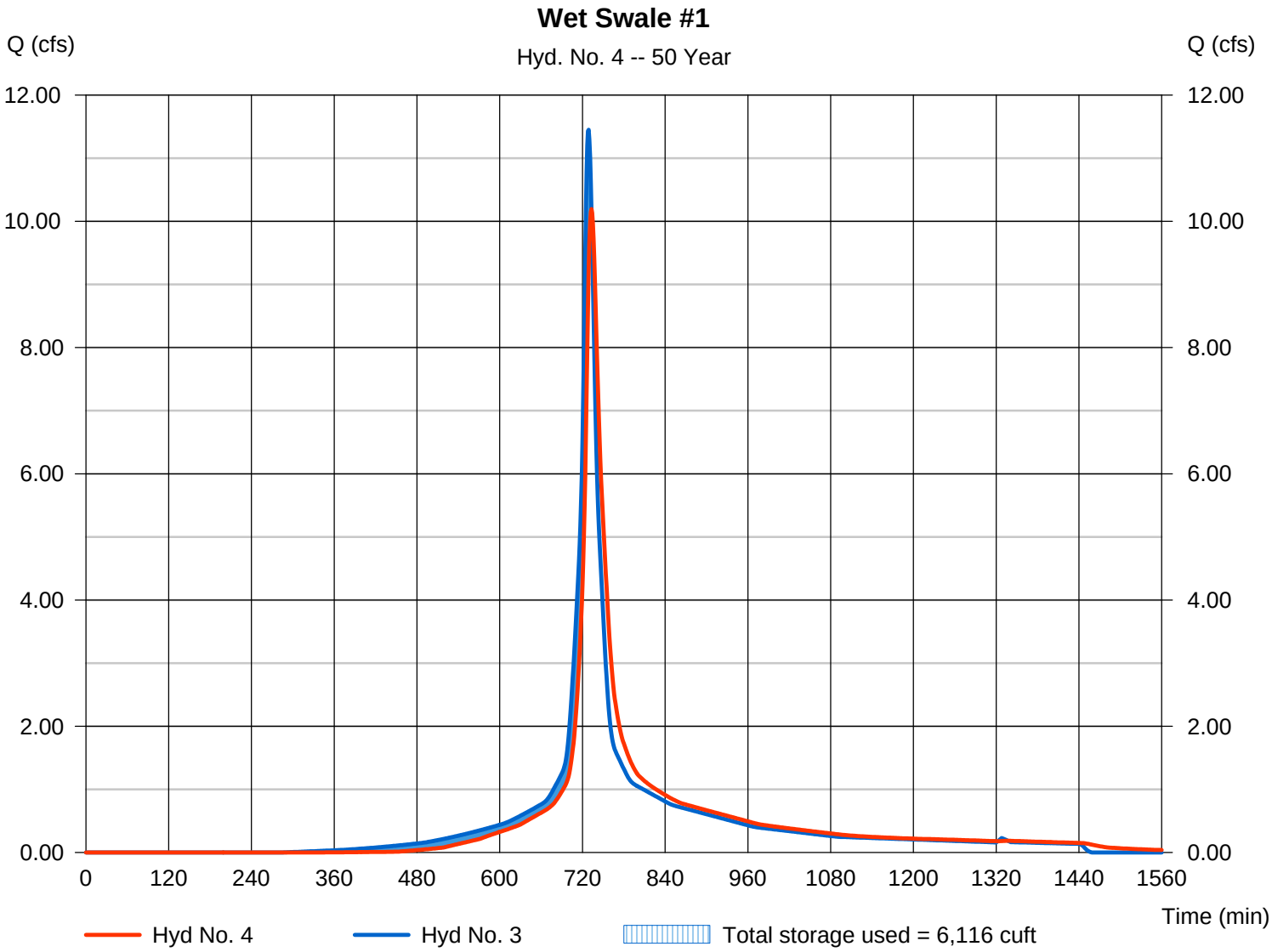
Hydrograph Report

Hyd. No. 4

Wet Swale #1

Hydrograph type	=	Reservoir	Peak discharge	=	10.19 cfs
Storm frequency	=	50 yrs	Time to peak	=	733 min
Time interval	=	1 min	Hyd. volume	=	44,199 cuft
Inflow hyd. No.	=	3 - PWA-2D	Max. Elevation	=	193.28 ft
Reservoir name	=	Wet Swale #1	Max. Storage	=	6,116 cuft

Storage Indication method used.



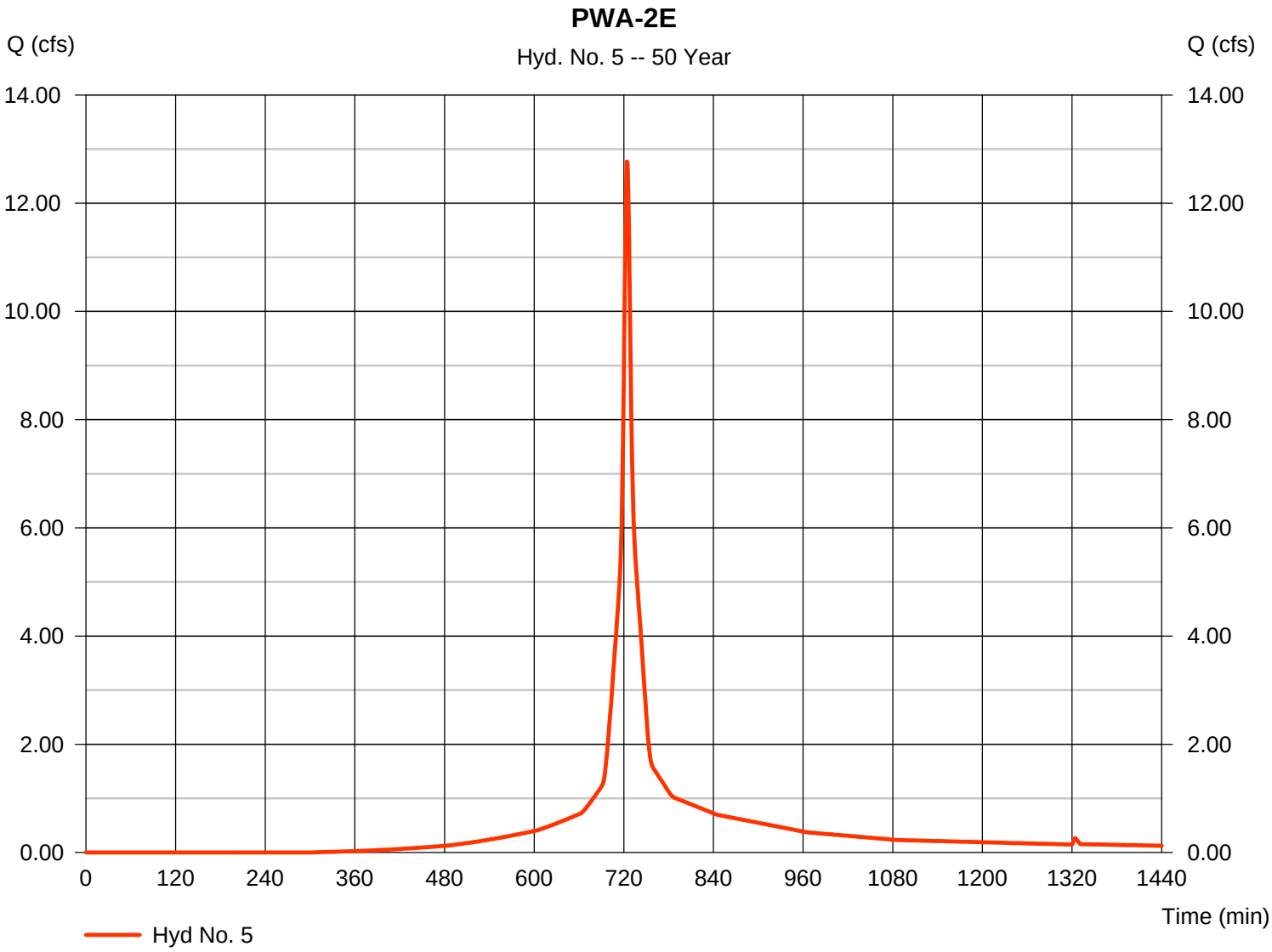
Hydrograph Report

Hyd. No. 5

PWA-2E

Hydrograph type	=	SCS Runoff	Peak discharge	=	12.77 cfs
Storm frequency	=	50 yrs	Time to peak	=	724 min
Time interval	=	1 min	Hyd. volume	=	40,377 cuft
Drainage area	=	2.500 ac	Curve number	=	86*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	USER	Time of conc. (Tc)	=	6.00 min
Total precip.	=	5.90 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.400 x 98) + (1.200 x 74)] / 2.500



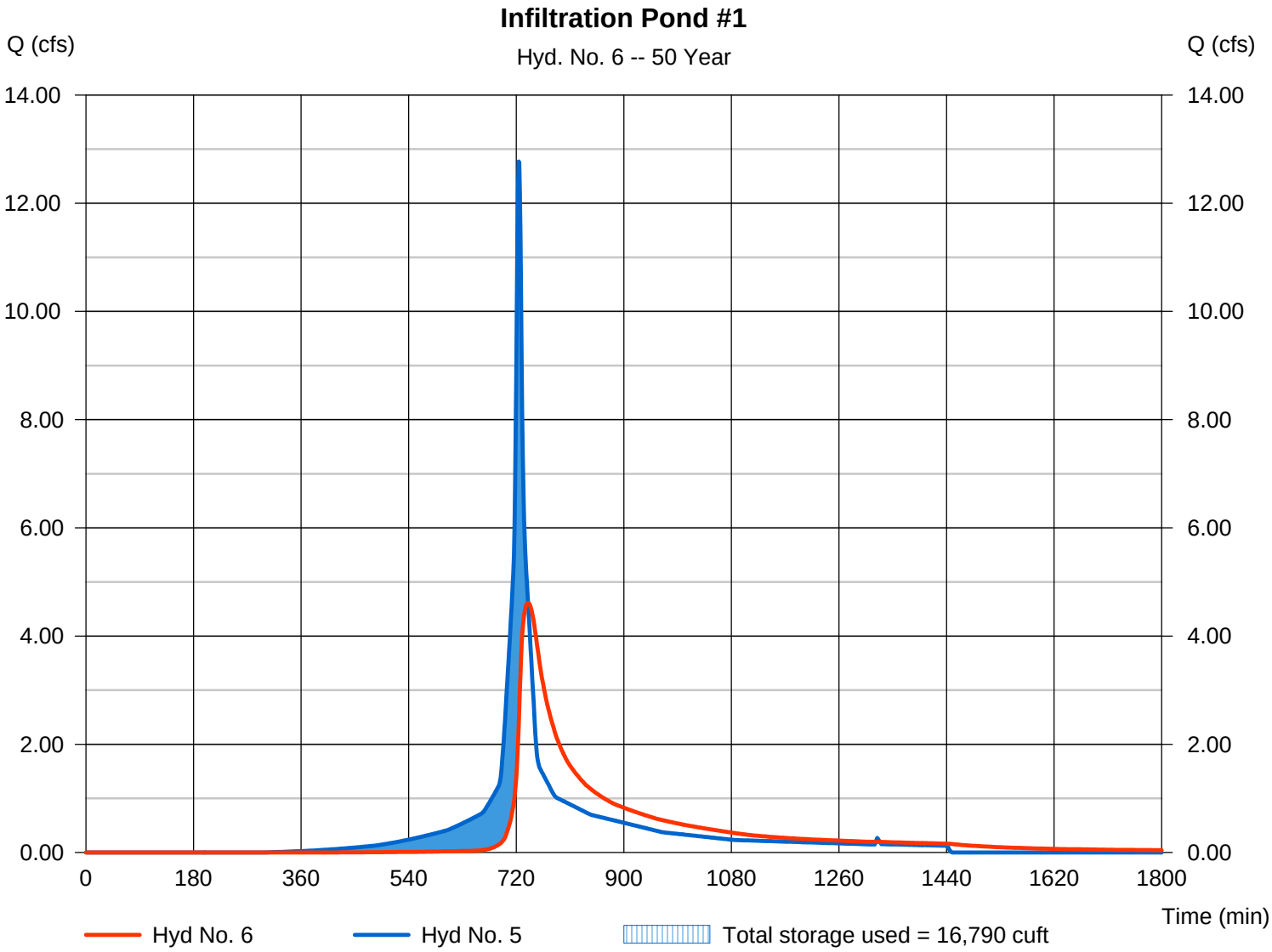
Hydrograph Report

Hyd. No. 6

Infiltration Pond #1

Hydrograph type	=	Reservoir	Peak discharge	=	4.614 cfs
Storm frequency	=	50 yrs	Time to peak	=	740 min
Time interval	=	1 min	Hyd. volume	=	38,076 cuft
Inflow hyd. No.	=	5 - PWA-2E	Max. Elevation	=	184.86 ft
Reservoir name	=	Infiltation Pond #1	Max. Storage	=	16,790 cuft

Storage Indication method used.



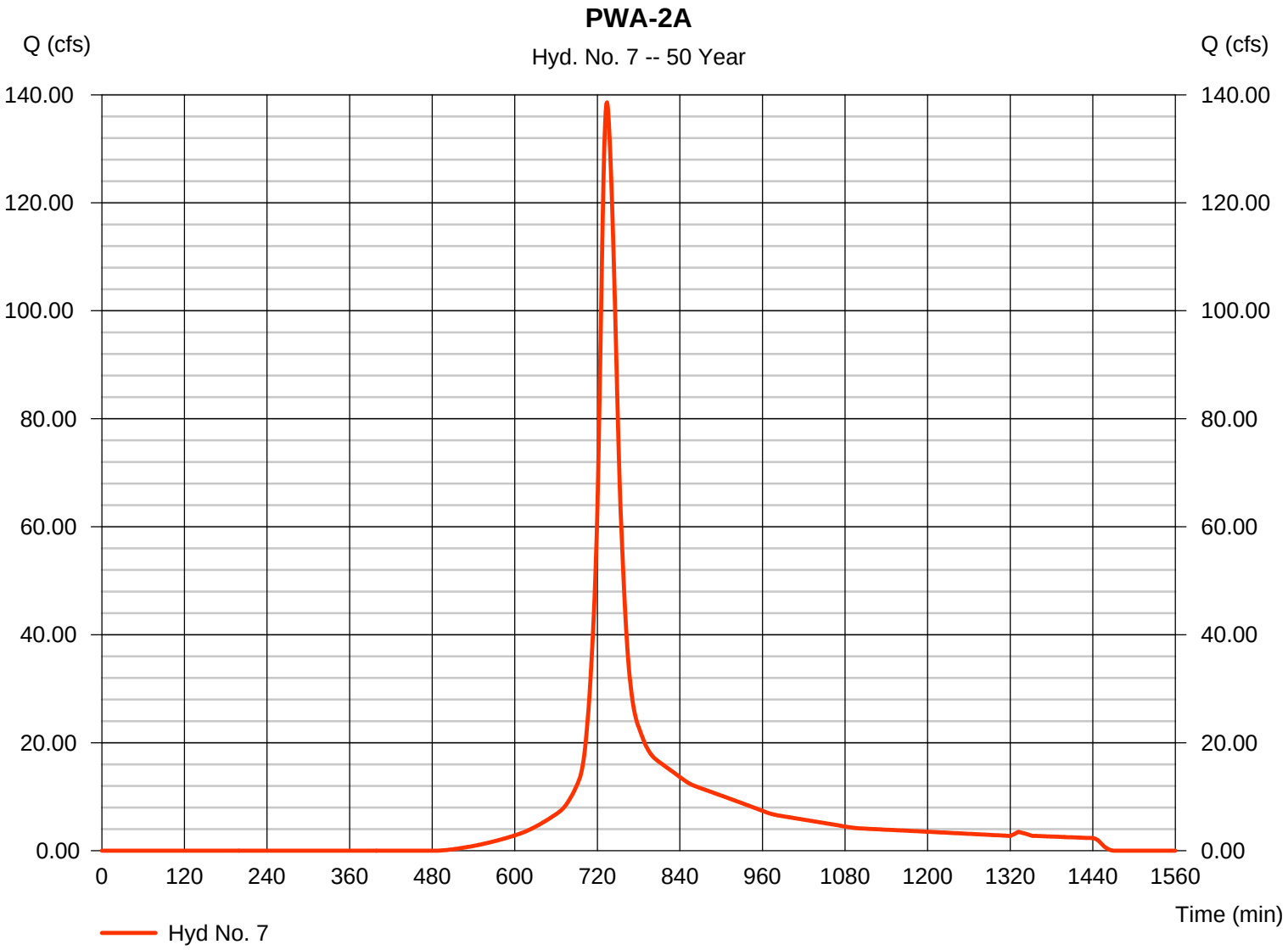
Hydrograph Report

Hyd. No. 7

PWA-2A

Hydrograph type	=	SCS Runoff	Peak discharge	=	138.62 cfs
Storm frequency	=	50 yrs	Time to peak	=	734 min
Time interval	=	1 min	Hyd. volume	=	611,593 cuft
Drainage area	=	52.700 ac	Curve number	=	75*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	19.10 min
Total precip.	=	5.90 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(2.700 x 98) + (5.400 x 72) + (44.600 x 74)] / 52.700



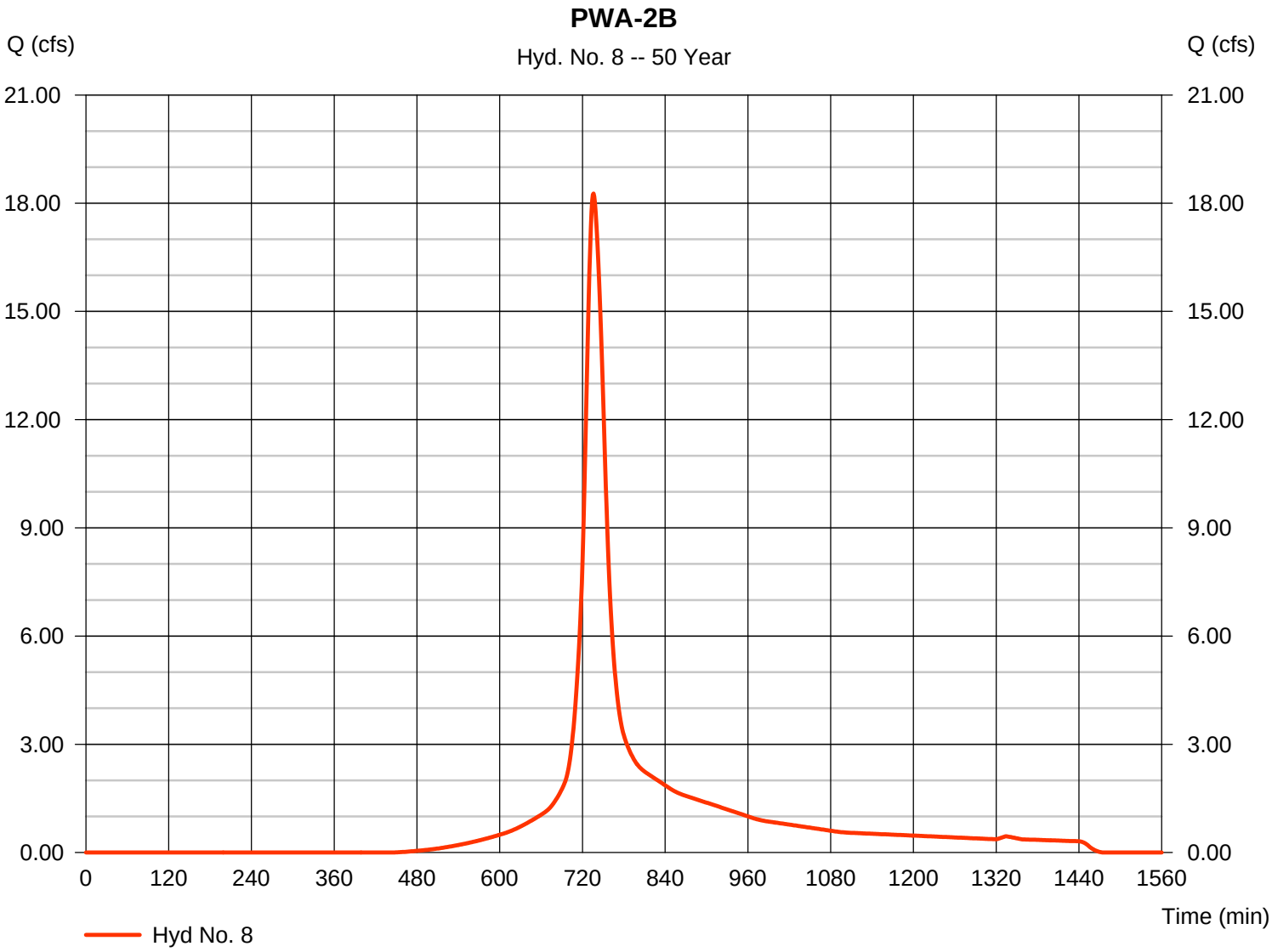
Hydrograph Report

Hyd. No. 8

PWA-2B

Hydrograph type	=	SCS Runoff	Peak discharge	=	18.27 cfs
Storm frequency	=	50 yrs	Time to peak	=	736 min
Time interval	=	1 min	Hyd. volume	=	85,396 cuft
Drainage area	=	6.800 ac	Curve number	=	78*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	22.70 min
Total precip.	=	5.90 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.300 x 98) + (2.700 x 72) + (2.800 x 74)] / 6.800



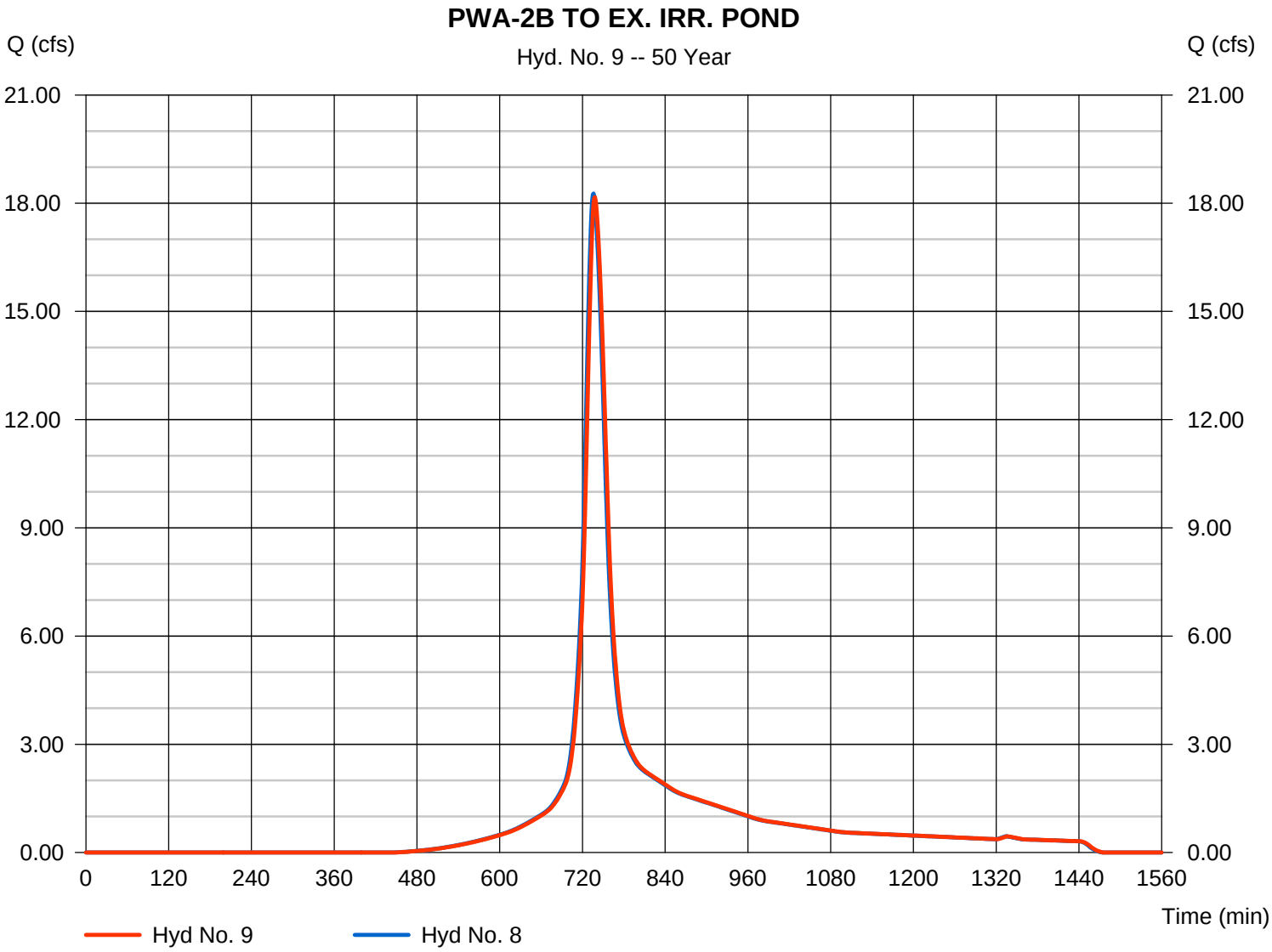
Hydrograph Report

Hyd. No. 9

PWA-2B TO EX. IRR. POND

Hydrograph type	=	Reach	Peak discharge	=	18.17 cfs
Storm frequency	=	50 yrs	Time to peak	=	738 min
Time interval	=	1 min	Hyd. volume	=	85,395 cuft
Inflow hyd. No.	=	8 - PWA-2B	Section type	=	Trapezoidal
Reach length	=	300.0 ft	Channel slope	=	3.0 %
Manning's n	=	0.040	Bottom width	=	5.0 ft
Side slope	=	3.0:1	Max. depth	=	1.0 ft
Rating curve x	=	2.205	Rating curve m	=	1.190
Ave. velocity	=	3.09 ft/s	Routing coeff.	=	0.5376

Modified Att-Kin routing method used.

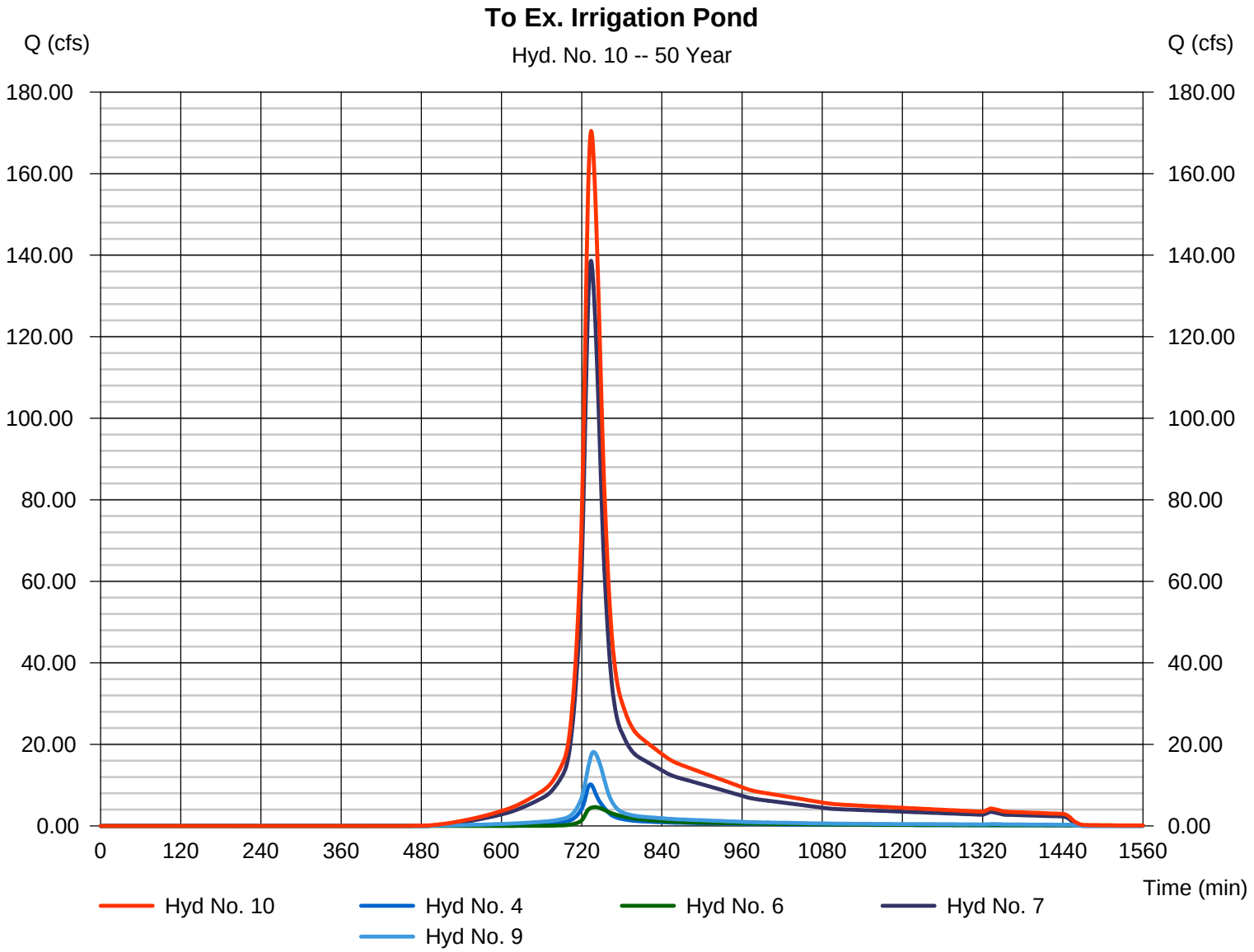


Hydrograph Report

Hyd. No. 10

To Ex. Irrigation Pond

Hydrograph type	= Combine	Peak discharge	= 170.49 cfs
Storm frequency	= 50 yrs	Time to peak	= 734 min
Time interval	= 1 min	Hyd. volume	= 779,263 cuft
Inflow hyds.	= 4, 6, 7, 9	Contrib. drain. area	= 52.700 ac



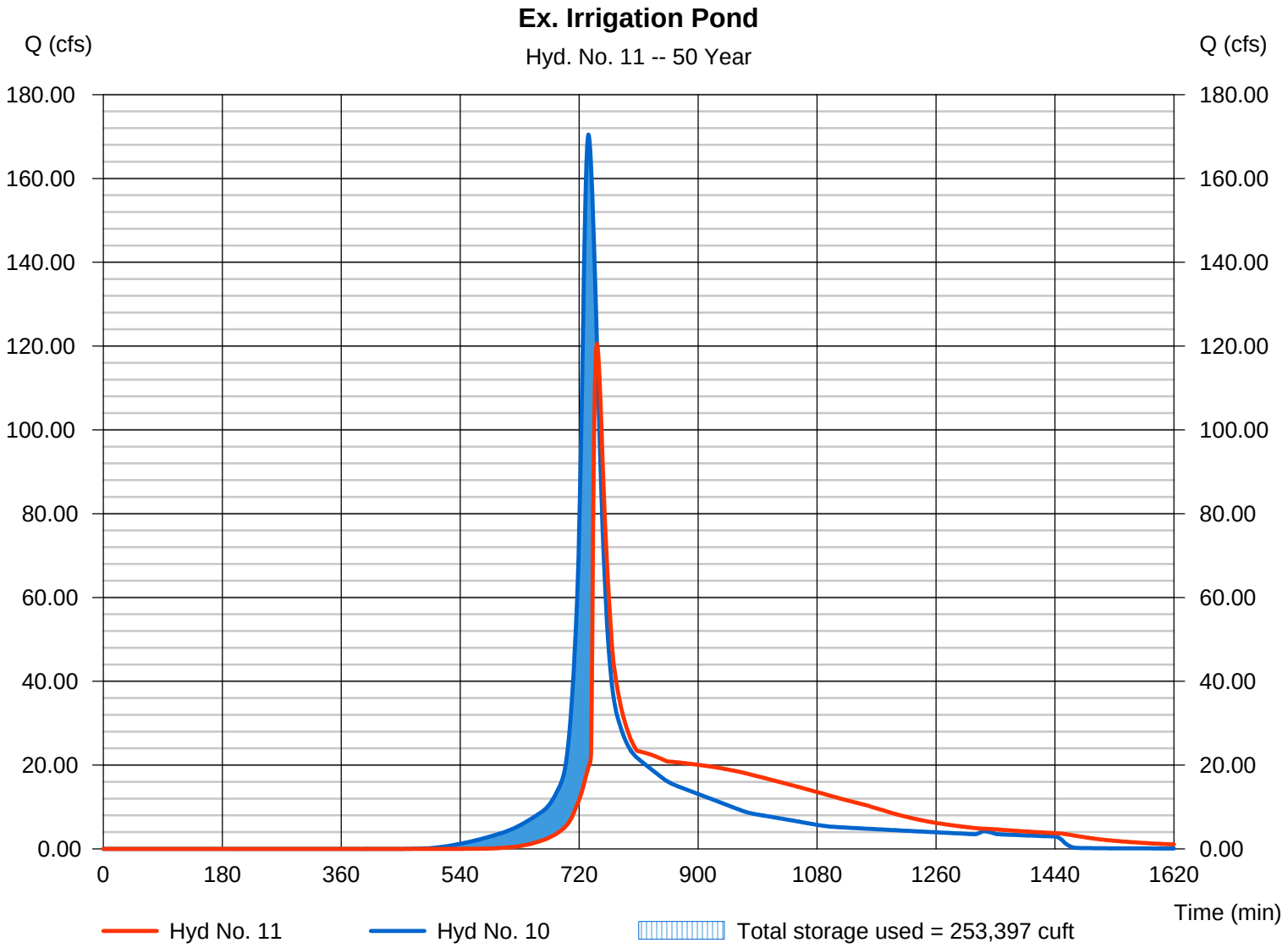
Hydrograph Report

Hyd. No. 11

Ex. Irrigation Pond

Hydrograph type	=	Reservoir	Peak discharge	=	120.59 cfs
Storm frequency	=	50 yrs	Time to peak	=	747 min
Time interval	=	1 min	Hyd. volume	=	772,859 cuft
Inflow hyd. No.	=	10 - To Ex. Irrigation Pond	Max. Elevation	=	165.77 ft
Reservoir name	=	Ex. Irrigation Pond	Max. Storage	=	253,397 cuft

Storage Indication method used.



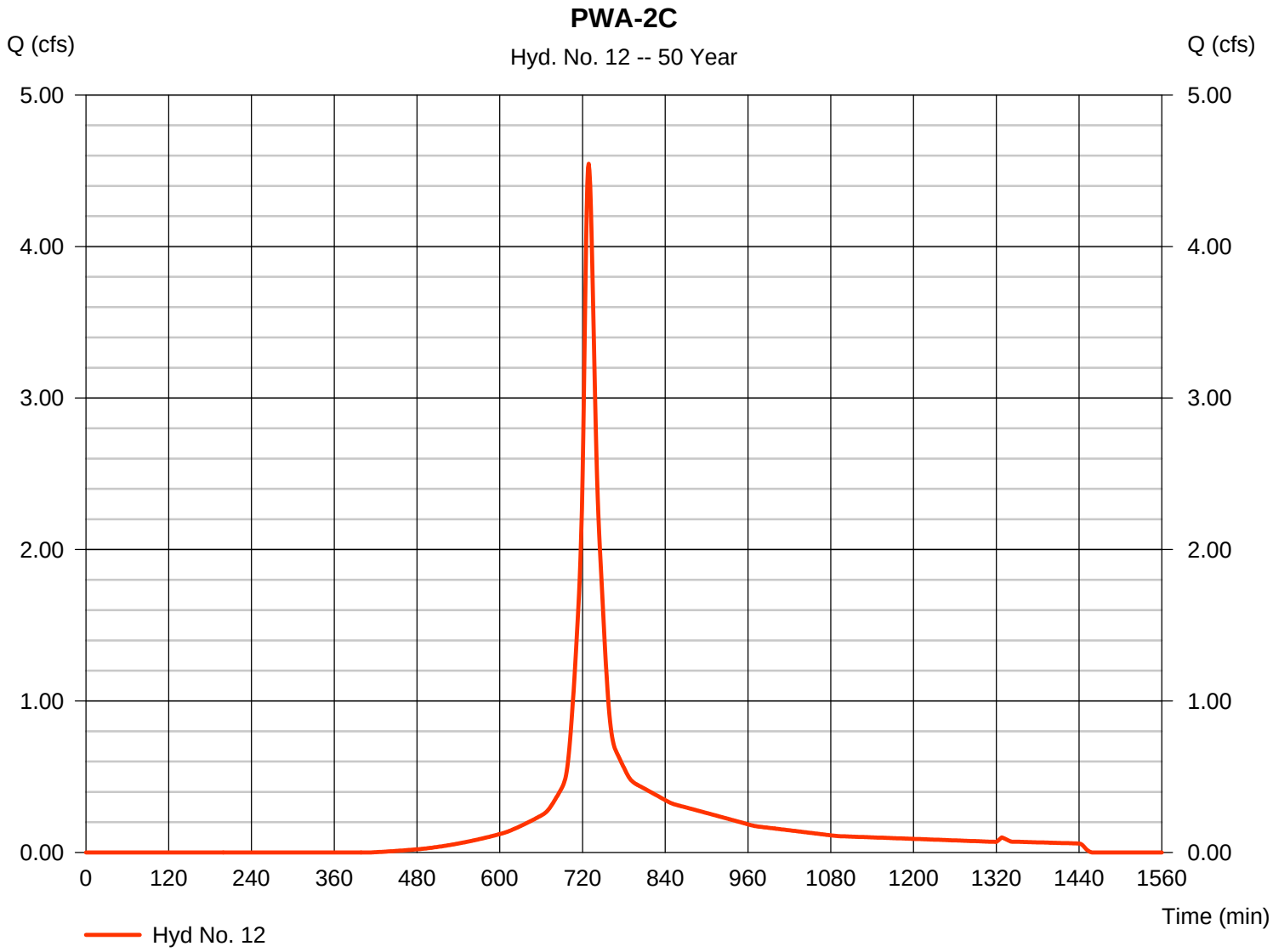
Hydrograph Report

Hyd. No. 12

PWA-2C

Hydrograph type	=	SCS Runoff	Peak discharge	=	4.546 cfs
Storm frequency	=	50 yrs	Time to peak	=	729 min
Time interval	=	1 min	Hyd. volume	=	17,146 cuft
Drainage area	=	1.300 ac	Curve number	=	80*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	12.60 min
Total precip.	=	5.90 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.400 x 98) + (0.900 x 72)] / 1.300

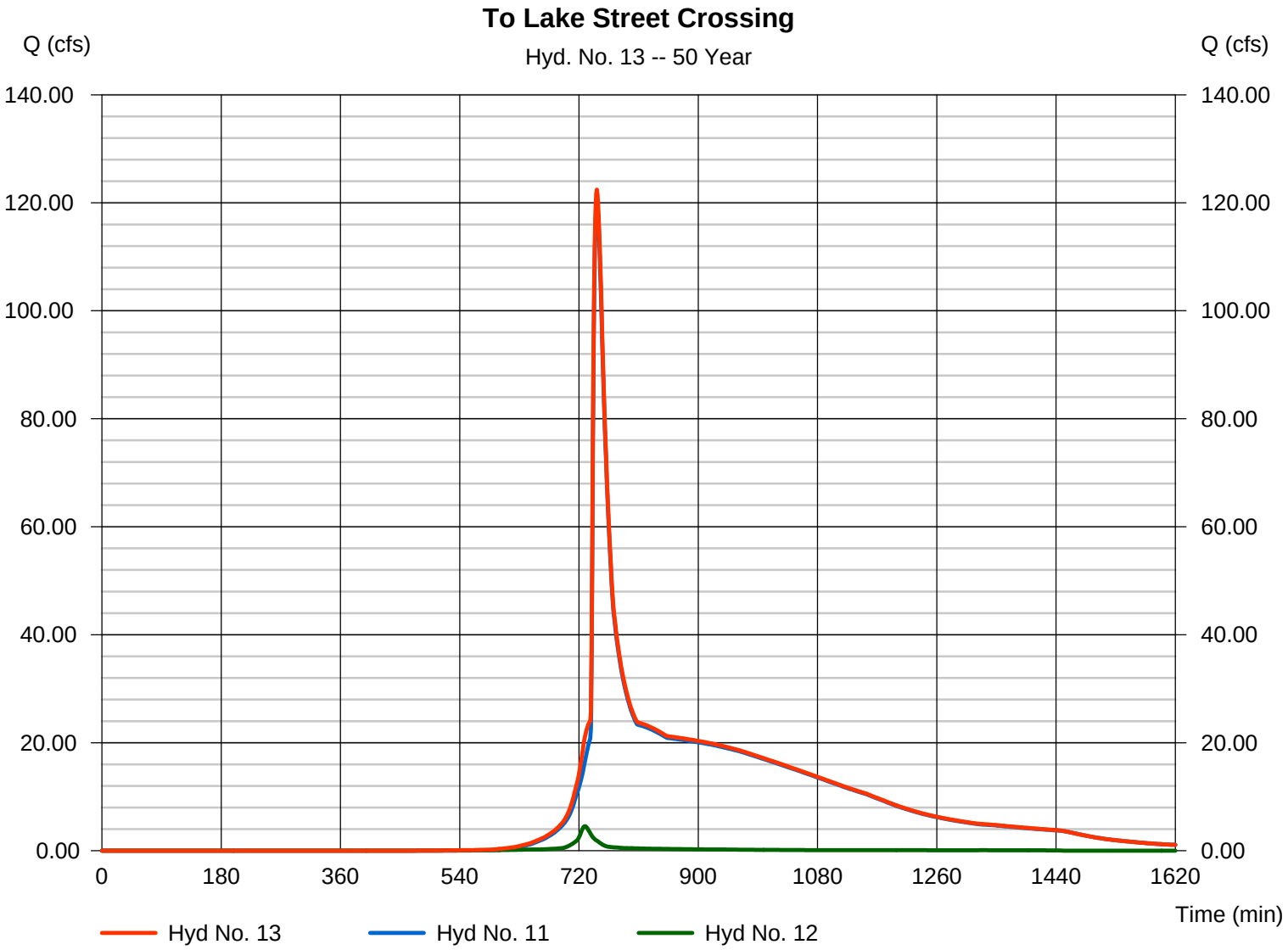


Hydrograph Report

Hyd. No. 13

To Lake Street Crossing

Hydrograph type	=	Combine	Peak discharge	=	122.44 cfs
Storm frequency	=	50 yrs	Time to peak	=	747 min
Time interval	=	1 min	Hyd. volume	=	790,005 cuft
Inflow hyds.	=	11, 12	Contrib. drain. area	=	1.300 ac



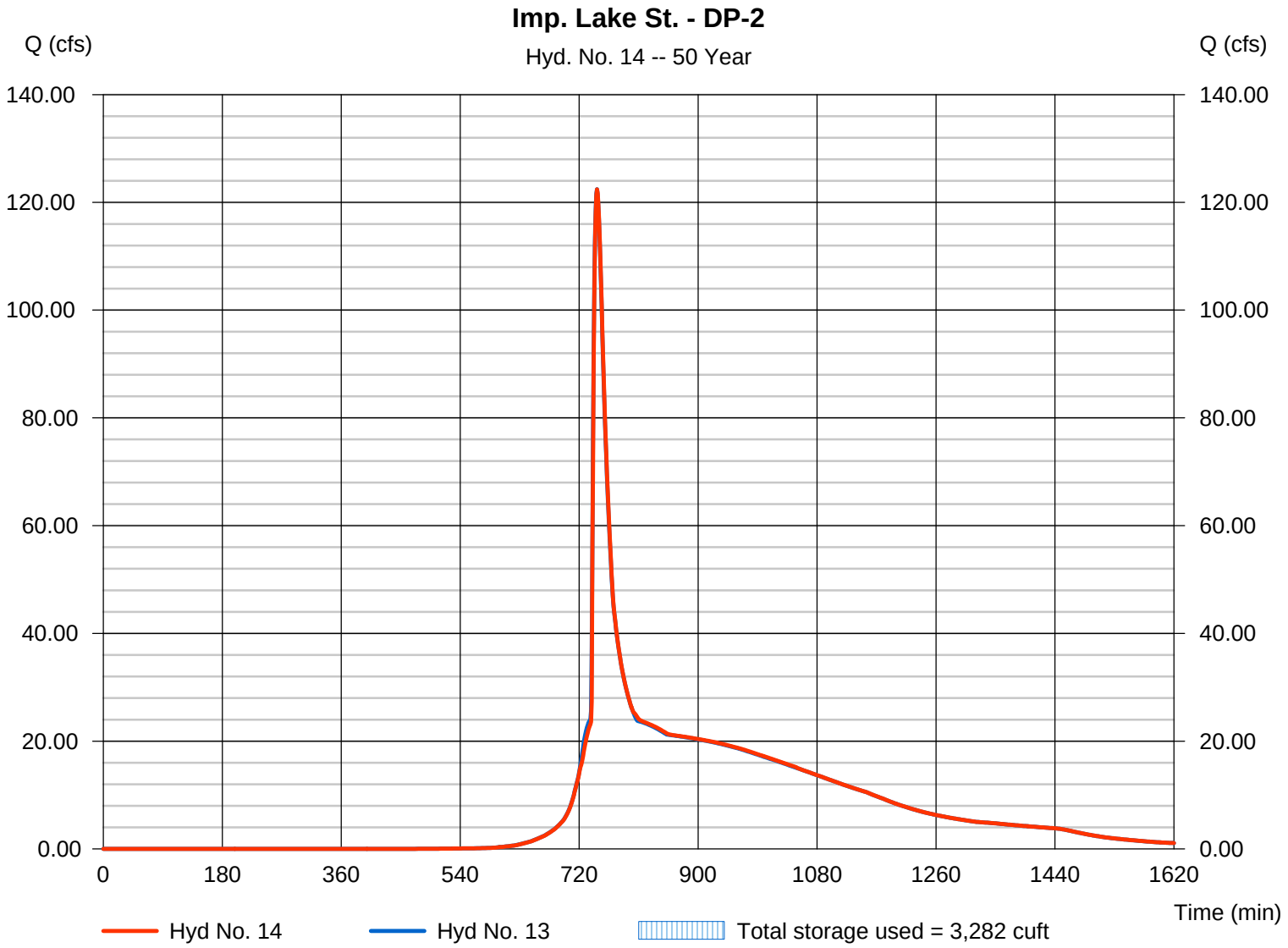
Hydrograph Report

Hyd. No. 14

Imp. Lake St. - DP-2

Hydrograph type	=	Reservoir	Peak discharge	=	122.43 cfs
Storm frequency	=	50 yrs	Time to peak	=	747 min
Time interval	=	1 min	Hyd. volume	=	789,994 cuft
Inflow hyd. No.	=	13 - To Lake Street Crossing	Max. Elevation	=	160.31 ft
Reservoir name	=	Improved Lake Street Crossing	Max. Storage	=	3,282 cuft

Storage Indication method used.



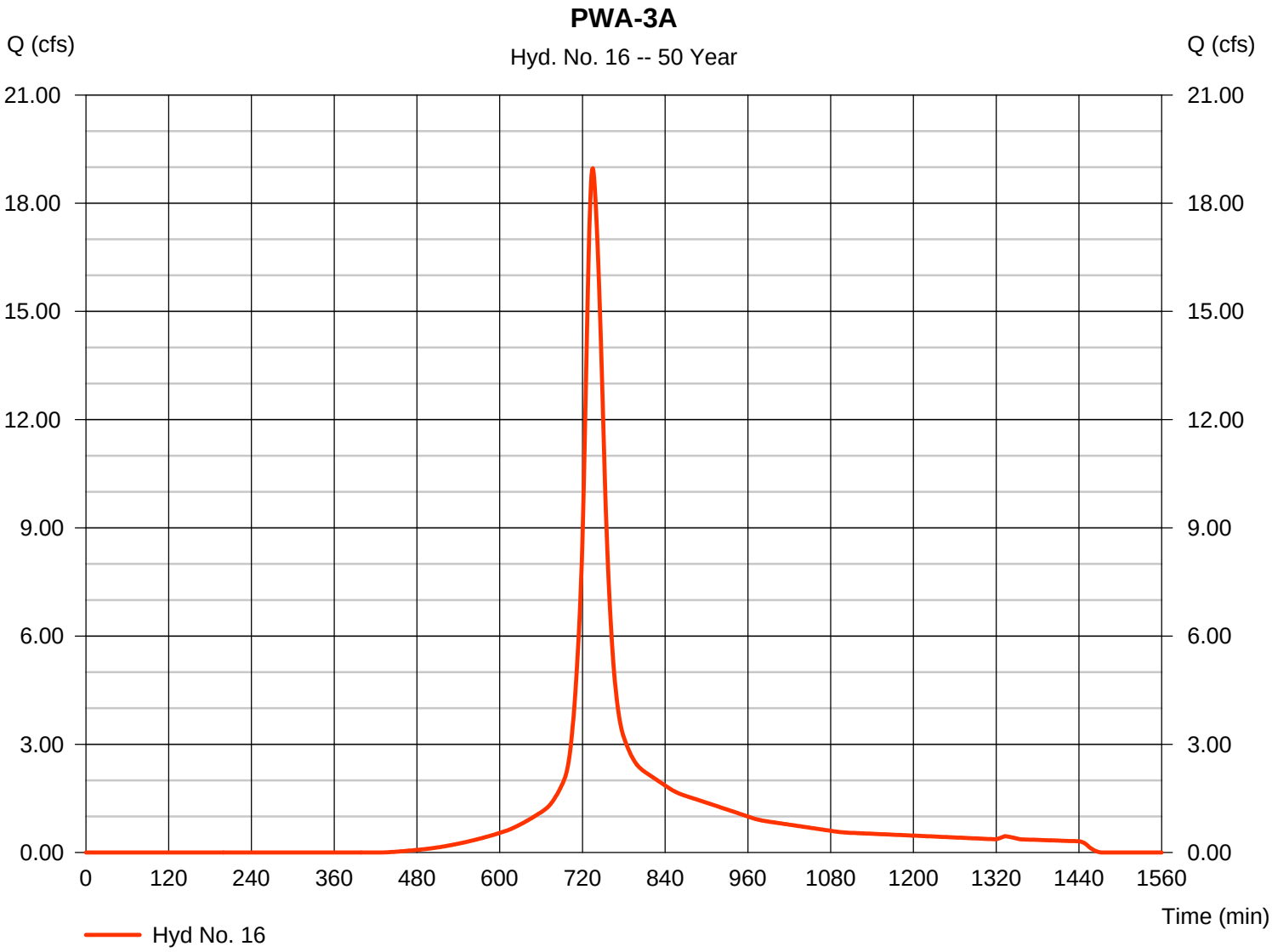
Hydrograph Report

Hyd. No. 16

PWA-3A

Hydrograph type	=	SCS Runoff	Peak discharge	=	18.97 cfs
Storm frequency	=	50 yrs	Time to peak	=	735 min
Time interval	=	1 min	Hyd. volume	=	86,848 cuft
Drainage area	=	6.600 ac	Curve number	=	79*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	21.70 min
Total precip.	=	5.90 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.500 x 98) + (5.100 x 74)] / 6.600



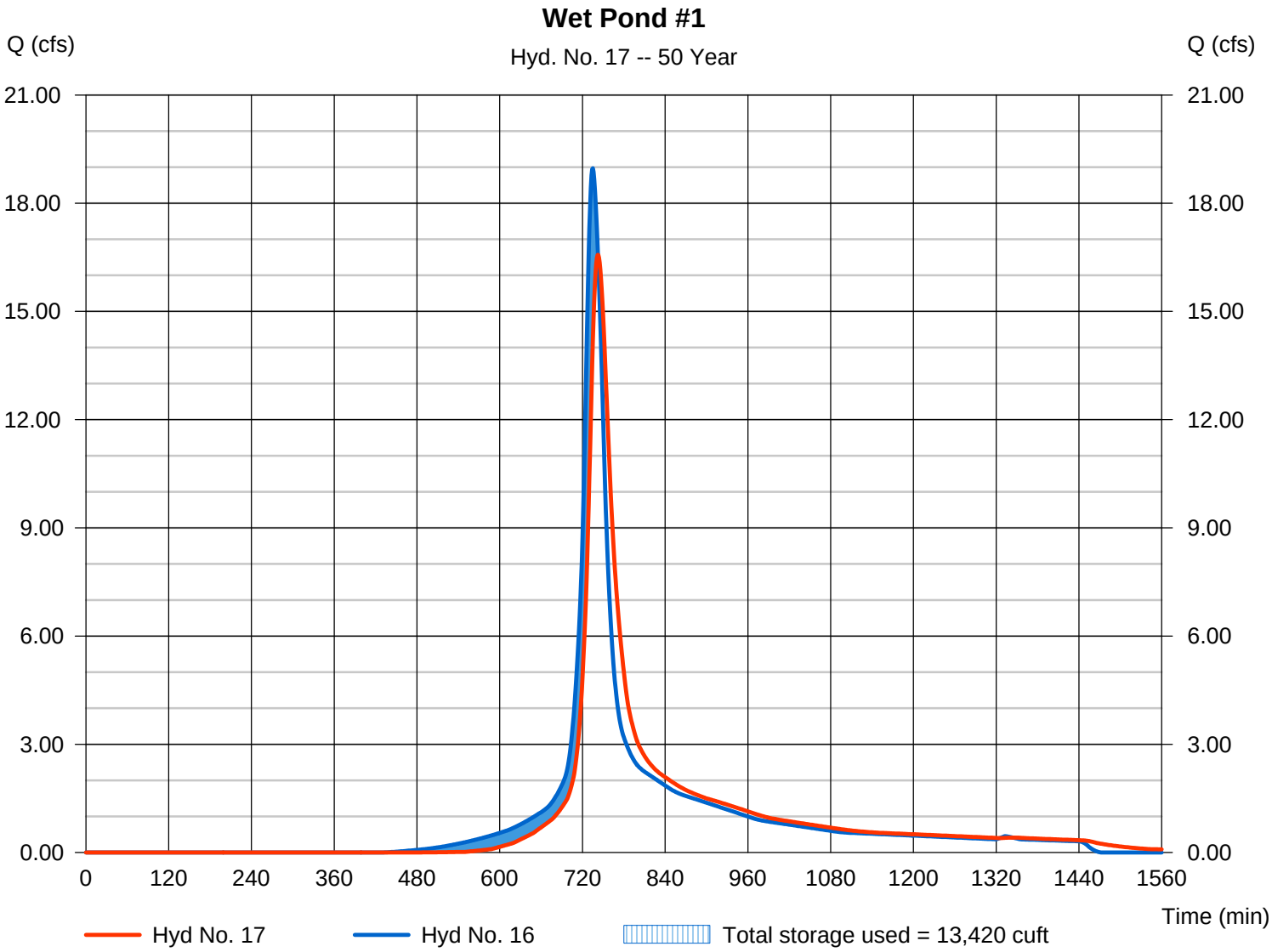
Hydrograph Report

Hyd. No. 17

Wet Pond #1

Hydrograph type	=	Reservoir	Peak discharge	=	16.57 cfs
Storm frequency	=	50 yrs	Time to peak	=	742 min
Time interval	=	1 min	Hyd. volume	=	86,676 cuft
Inflow hyd. No.	=	16 - PWA-3A	Max. Elevation	=	196.85 ft
Reservoir name	=	Wet Pond #1	Max. Storage	=	13,420 cuft

Storage Indication method used.



Hydrograph Report

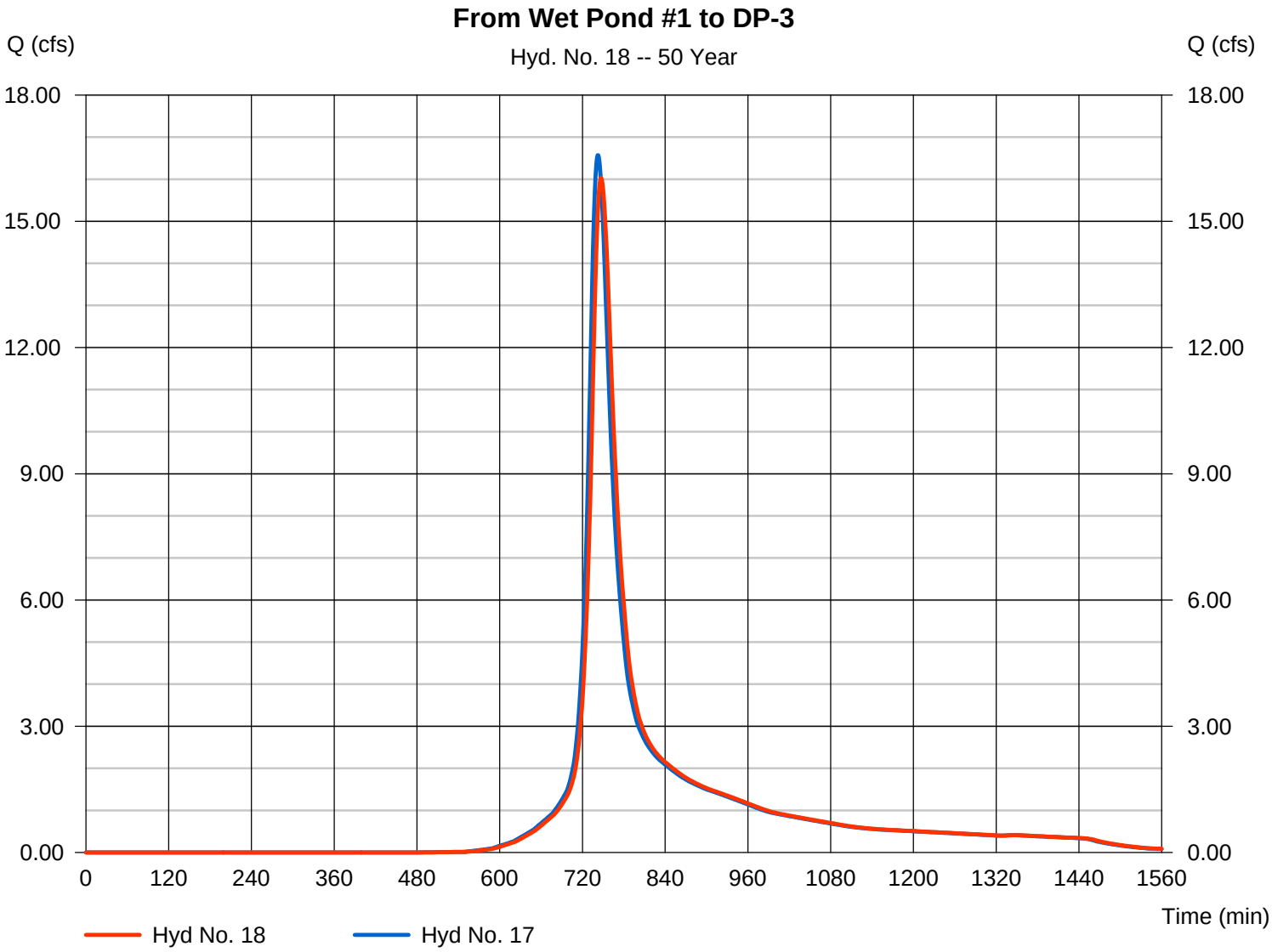
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Wednesday, Nov 11, 2009

Hyd. No. 18

From Wet Pond #1 to DP-3

Hydrograph type	=	Reach	Peak discharge	=	16.03 cfs
Storm frequency	=	50 yrs	Time to peak	=	747 min
Time interval	=	1 min	Hyd. volume	=	86,410 cuft
Inflow hyd. No.	=	17 - Wet Pond #1	Section type	=	Trapezoidal
Reach length	=	1299.0 ft	Channel slope	=	2.2 %
Manning's n	=	0.026	Bottom width	=	6.0 ft
Side slope	=	3.0:1	Max. depth	=	3.0 ft
Rating curve x	=	2.573	Rating curve m	=	1.344
Ave. velocity	=	4.14 ft/s	Routing coeff.	=	0.2279

Modified Att-Kin routing method used.



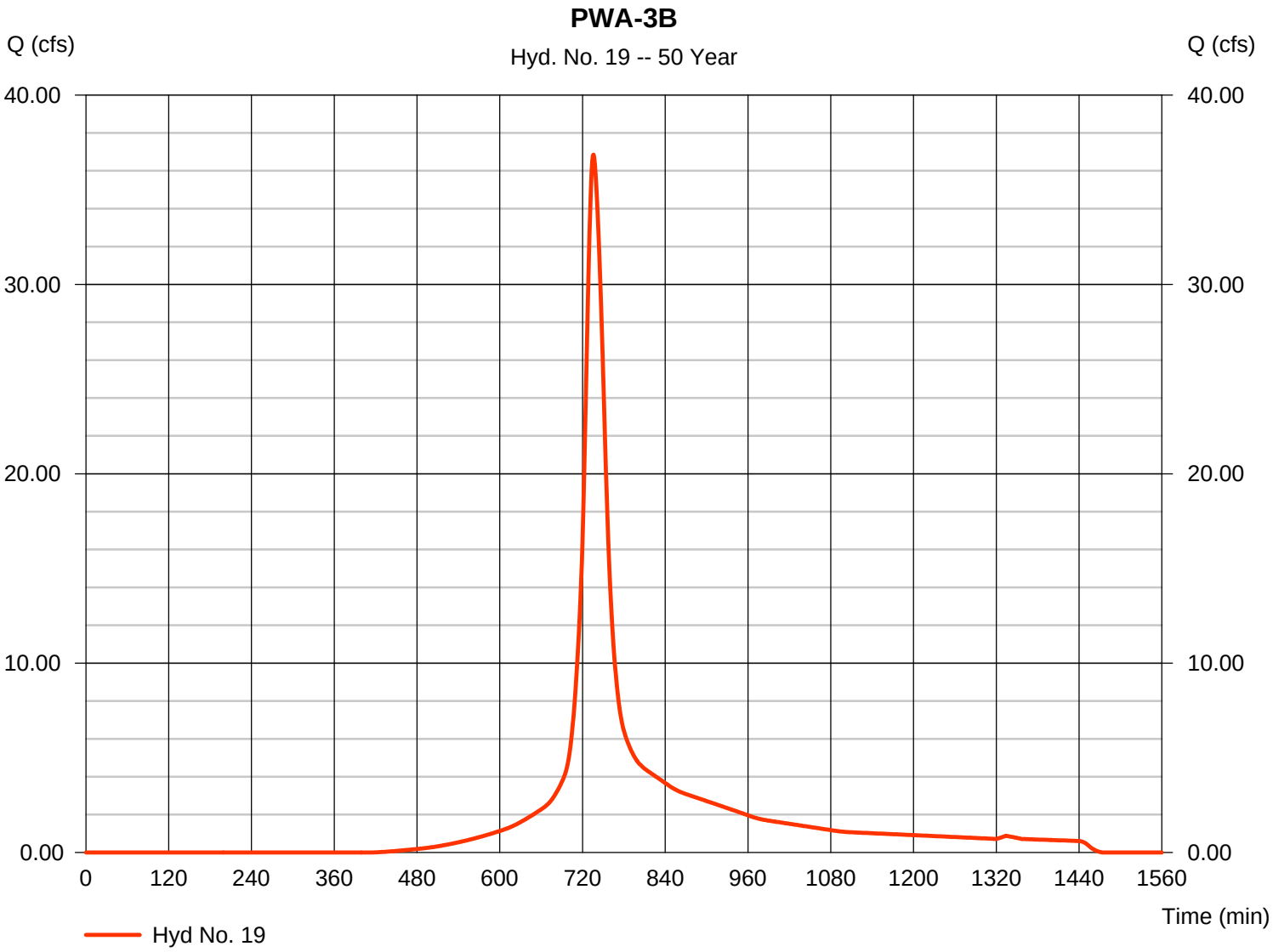
Hydrograph Report

Hyd. No. 19

PWA-3B

Hydrograph type	=	SCS Runoff	Peak discharge	=	36.85 cfs
Storm frequency	=	50 yrs	Time to peak	=	736 min
Time interval	=	1 min	Hyd. volume	=	172,630 cuft
Drainage area	=	13.000 ac	Curve number	=	80*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	22.20 min
Total precip.	=	5.90 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(3.100 x 98) + (1.100 x 72) + (8.800 x 74)] / 13.000



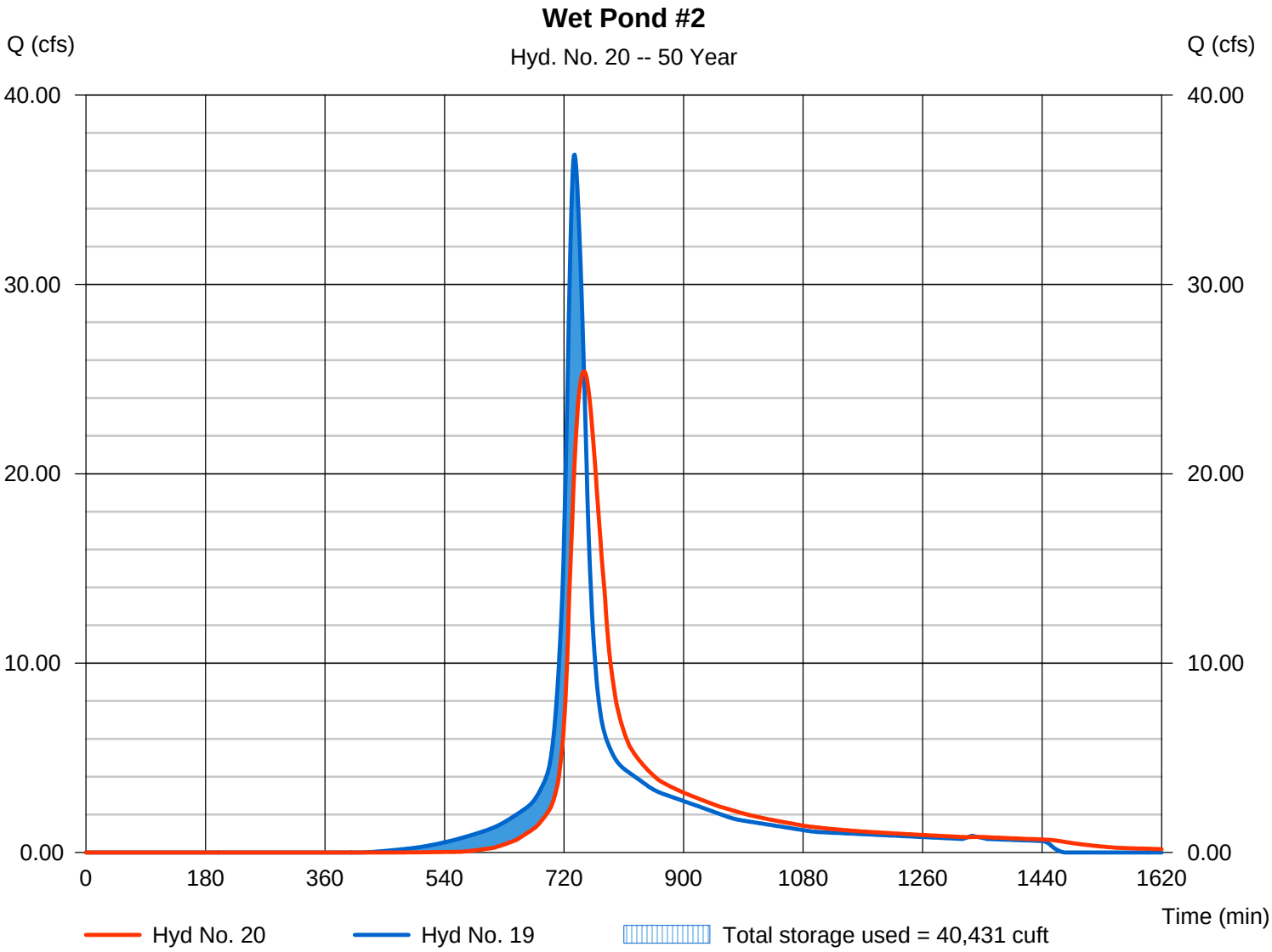
Hydrograph Report

Hyd. No. 20

Wet Pond #2

Hydrograph type	=	Reservoir	Peak discharge	=	25.41 cfs
Storm frequency	=	50 yrs	Time to peak	=	750 min
Time interval	=	1 min	Hyd. volume	=	171,710 cuft
Inflow hyd. No.	=	19 - PWA-3B	Max. Elevation	=	204.74 ft
Reservoir name	=	Wet Pond #2	Max. Storage	=	40,431 cuft

Storage Indication method used.



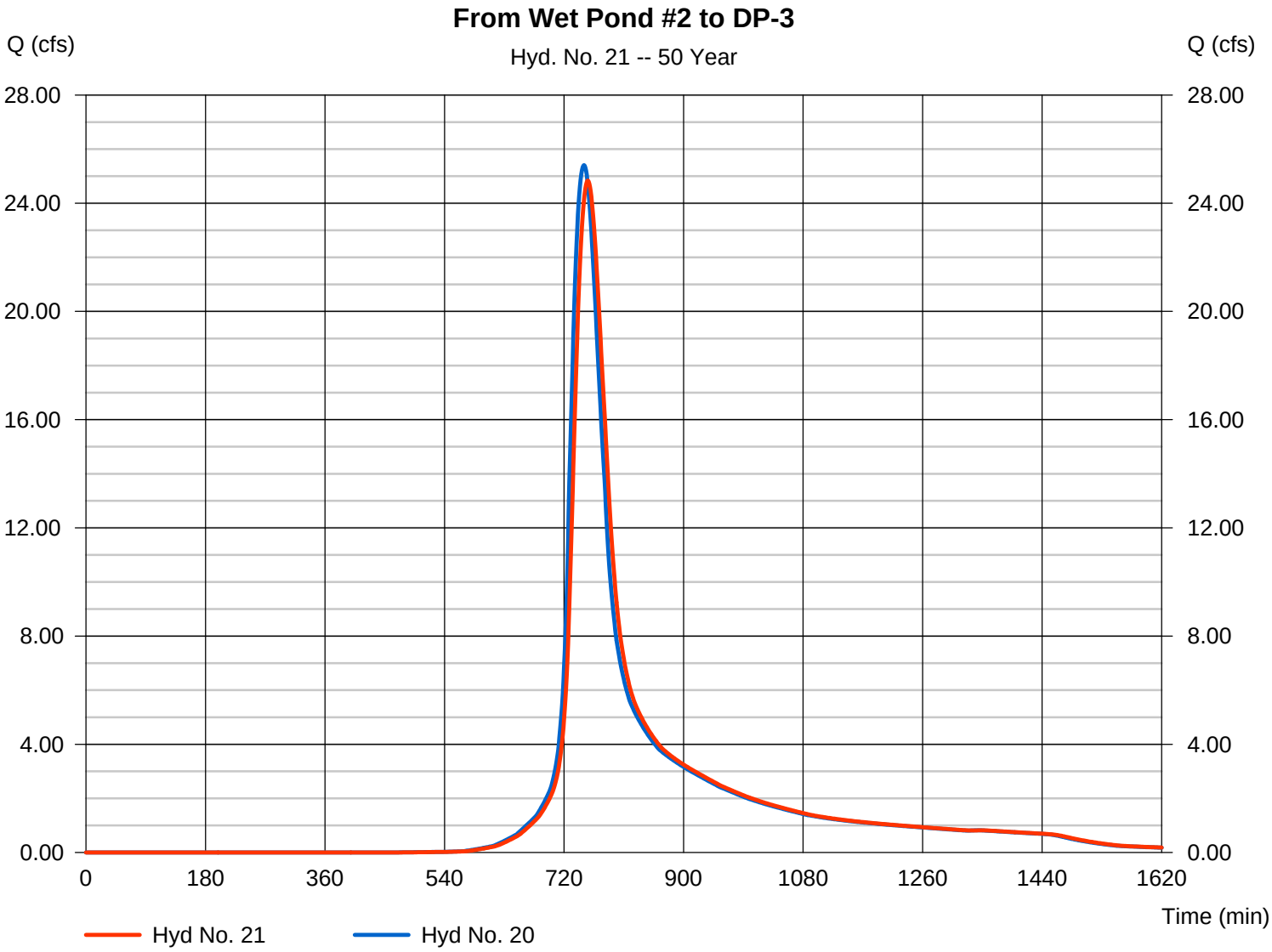
Hydrograph Report

Hyd. No. 21

From Wet Pond #2 to DP-3

Hydrograph type	=	Reach	Peak discharge	=	24.84 cfs
Storm frequency	=	50 yrs	Time to peak	=	756 min
Time interval	=	1 min	Hyd. volume	=	171,705 cuft
Inflow hyd. No.	=	20 - Wet Pond #2	Section type	=	Trapezoidal
Reach length	=	1876.0 ft	Channel slope	=	2.2 %
Manning's n	=	0.026	Bottom width	=	6.0 ft
Side slope	=	3.0:1	Max. depth	=	3.0 ft
Rating curve x	=	2.573	Rating curve m	=	1.344
Ave. velocity	=	4.62 ft/s	Routing coeff.	=	0.1807

Modified Att-Kin routing method used.



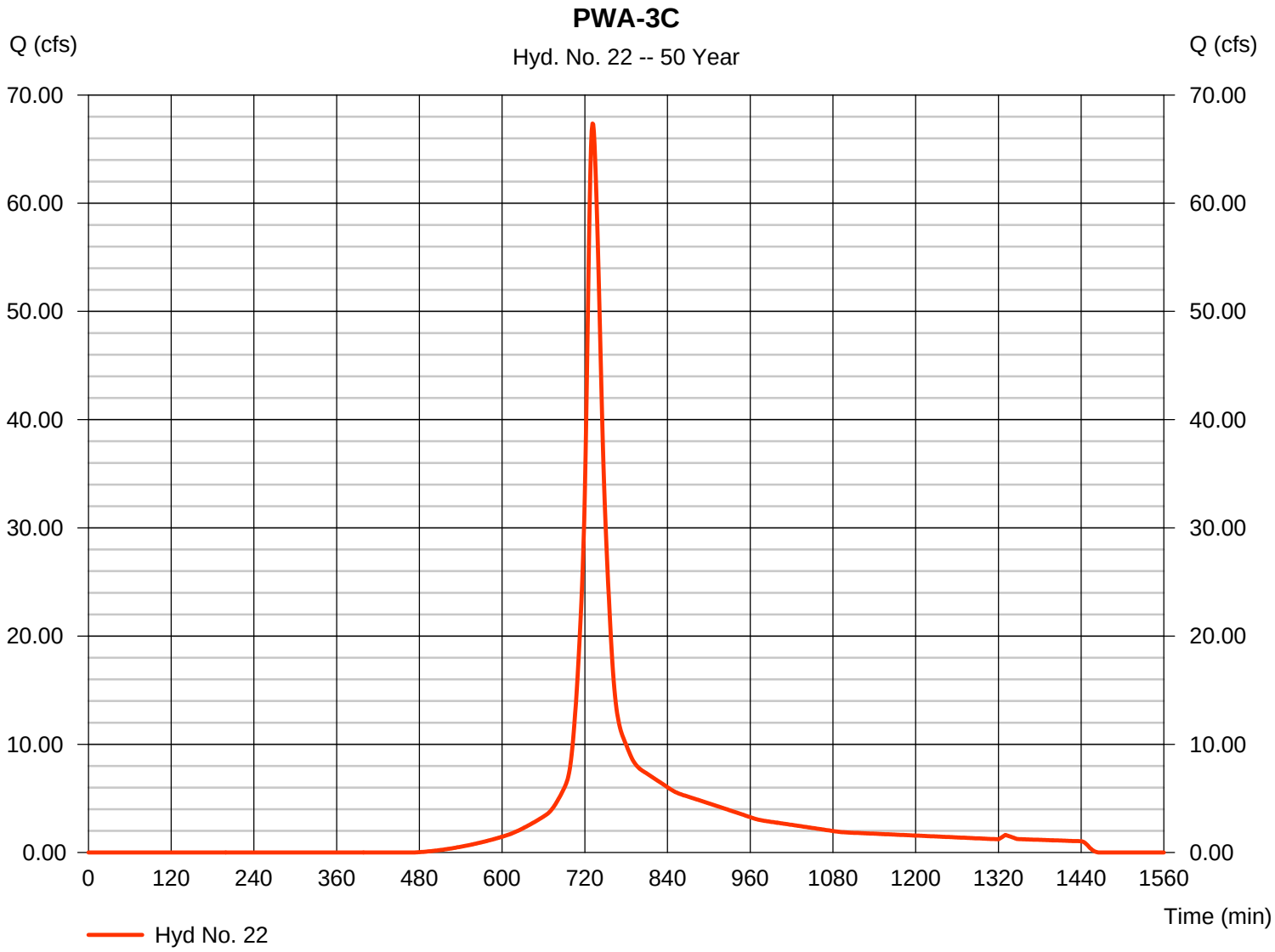
Hydrograph Report

Hyd. No. 22

PWA-3C

Hydrograph type	=	SCS Runoff	Peak discharge	=	67.37 cfs
Storm frequency	=	50 yrs	Time to peak	=	731 min
Time interval	=	1 min	Hyd. volume	=	278,453 cuft
Drainage area	=	23.000 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	16.50 min
Total precip.	=	5.90 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.000 x 98) + (3.100 x 72) + (4.000 x 79) + (14.000 x 74) + (0.900 x 80)] / 23.000

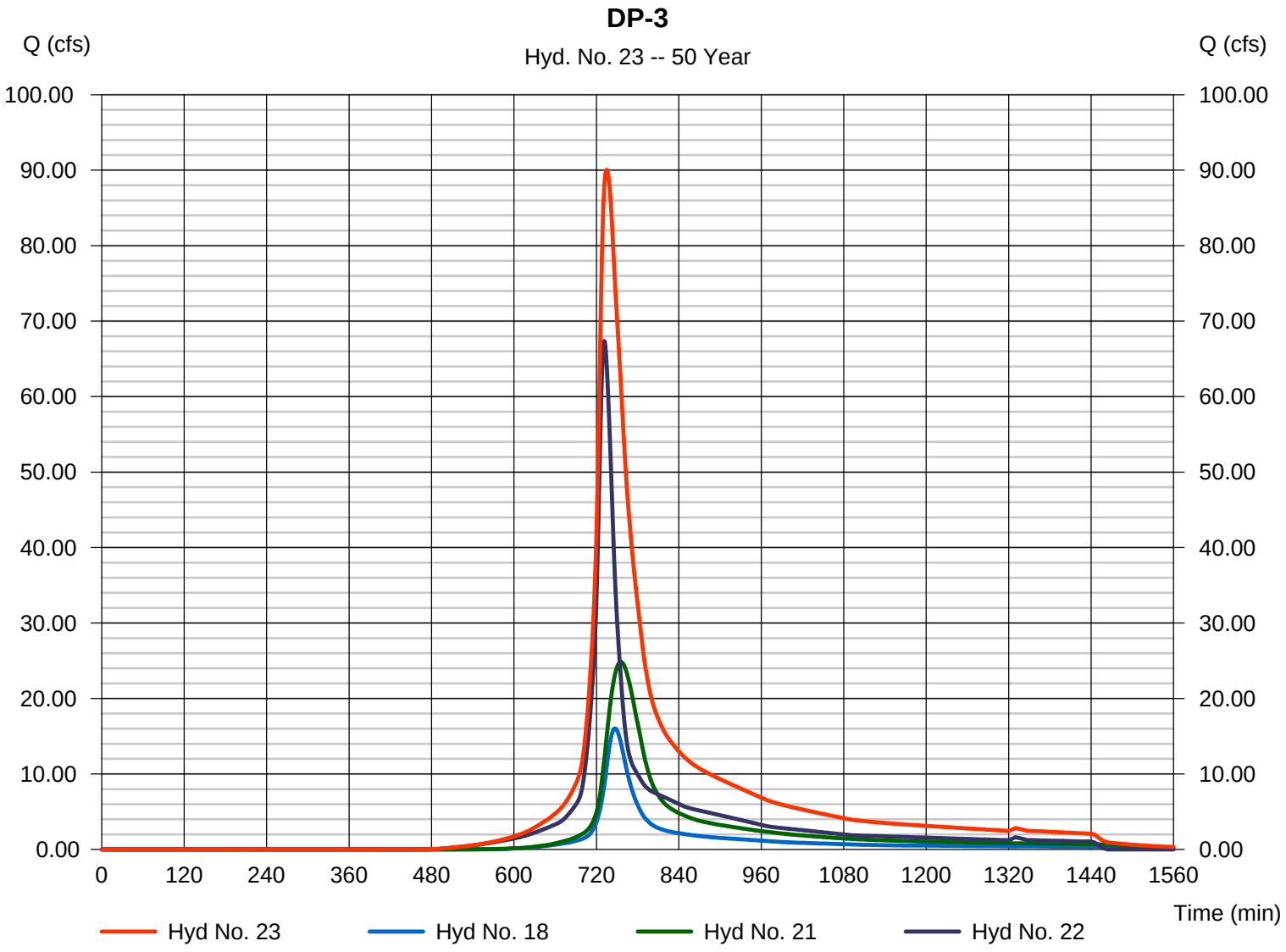


Hydrograph Report

Hyd. No. 23

DP-3

Hydrograph type	=	Combine	Peak discharge	=	90.04 cfs
Storm frequency	=	50 yrs	Time to peak	=	735 min
Time interval	=	1 min	Hyd. volume	=	536,569 cuft
Inflow hyds.	=	18, 21, 22	Contrib. drain. area	=	23.000 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

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	36.38	1	735	166,396	------	------	------	PWA-1 - DP-1
3	SCS Runoff	12.86	1	729	49,996	------	------	------	PWA-2D
4	Reservoir	11.61	1	733	49,956	3	193.34	6,453	Wet Swale #1
5	SCS Runoff	14.38	1	724	45,728	------	------	------	PWA-2E
6	Reservoir	5.736	1	737	43,411	5	184.98	18,186	Infiltration Pond #1
7	SCS Runoff	160.96	1	734	710,131	------	------	------	PWA-2A
8	SCS Runoff	21.03	1	736	98,439	------	------	------	PWA-2B
9	Reach	20.91	1	738	98,438	8	------	------	PWA-2B TO EX. IRR. POND
10	Combine	198.10	1	734	901,937	4, 6, 7, 9	------	------	To Ex. Irrigation Pond
11	Reservoir	162.21	1	743	895,500	10	165.84	261,448	Ex. Irrigation Pond
12	SCS Runoff	5.200	1	729	19,674	------	------	------	PWA-2C
13	Combine	164.74	1	743	915,174	11, 12	------	------	To Lake Street Crossing
14	Reservoir	164.63	1	743	915,164	13	160.45	3,739	Imp. Lake St. - DP-2
16	SCS Runoff	21.77	1	735	99,880	------	------	------	PWA-3A
17	Reservoir	19.36	1	742	99,706	16	197.00	14,481	Wet Pond #1
18	Reach	18.69	1	746	99,441	17	------	------	From Wet Pond #1 to DP-3
19	SCS Runoff	42.17	1	736	198,079	------	------	------	PWA-3B
20	Reservoir	27.84	1	751	197,153	19	205.00	45,862	Wet Pond #2
21	Reach	27.39	1	756	197,148	20	------	------	From Wet Pond #2 to DP-3
22	SCS Runoff	78.02	1	731	322,524	------	------	------	PWA-3C
23	Combine	104.87	1	734	619,113	18, 21, 22	------	------	DP-3

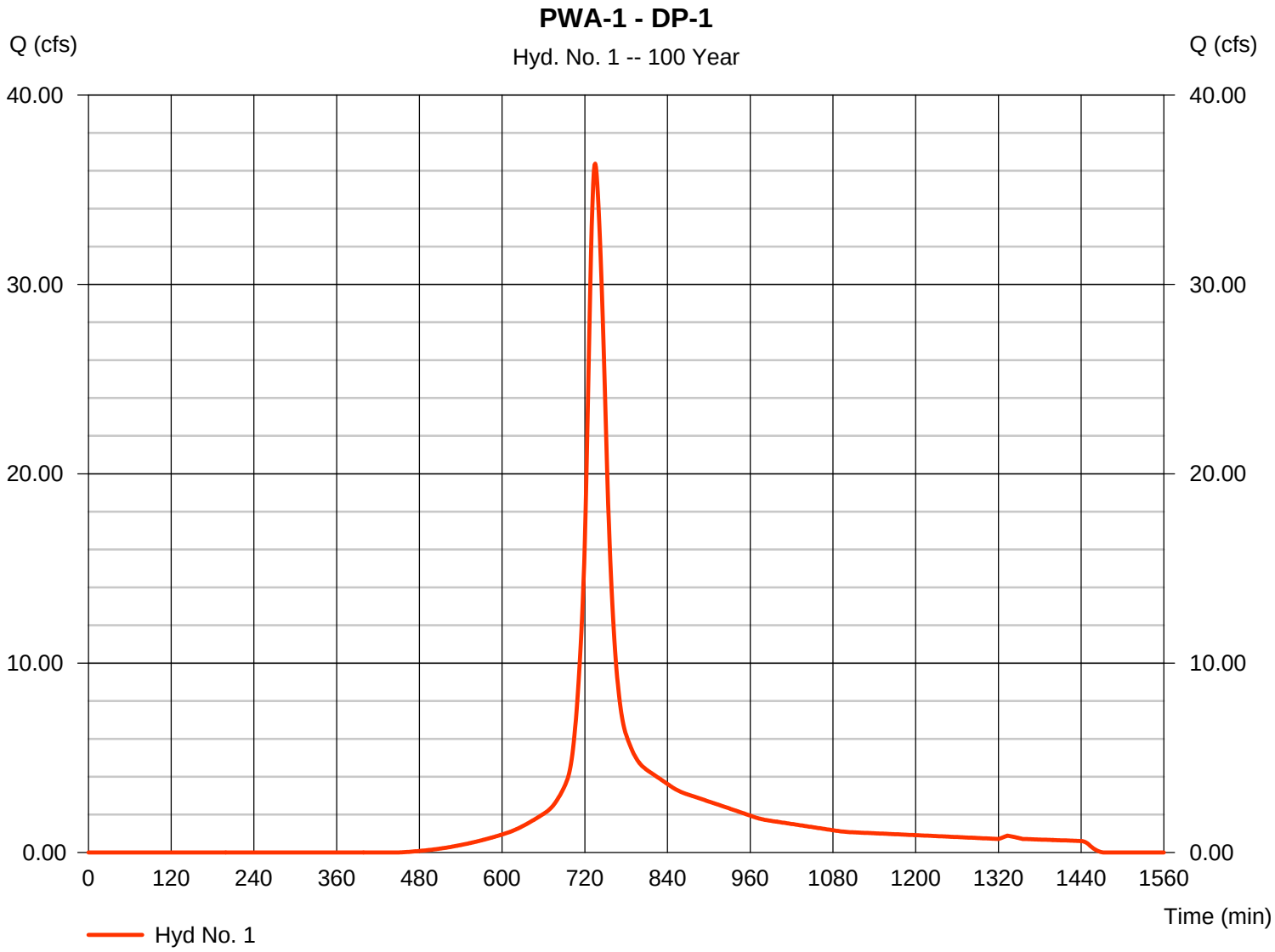
Hydrograph Report

Hyd. No. 1

PWA-1 - DP-1

Hydrograph type	=	SCS Runoff	Peak discharge	=	36.38 cfs
Storm frequency	=	100 yrs	Time to peak	=	735 min
Time interval	=	1 min	Hyd. volume	=	166,396 cuft
Drainage area	=	11.900 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	20.80 min
Total precip.	=	6.50 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.500 x 98) + (5.700 x 72) + (4.700 x 74)] / 11.900



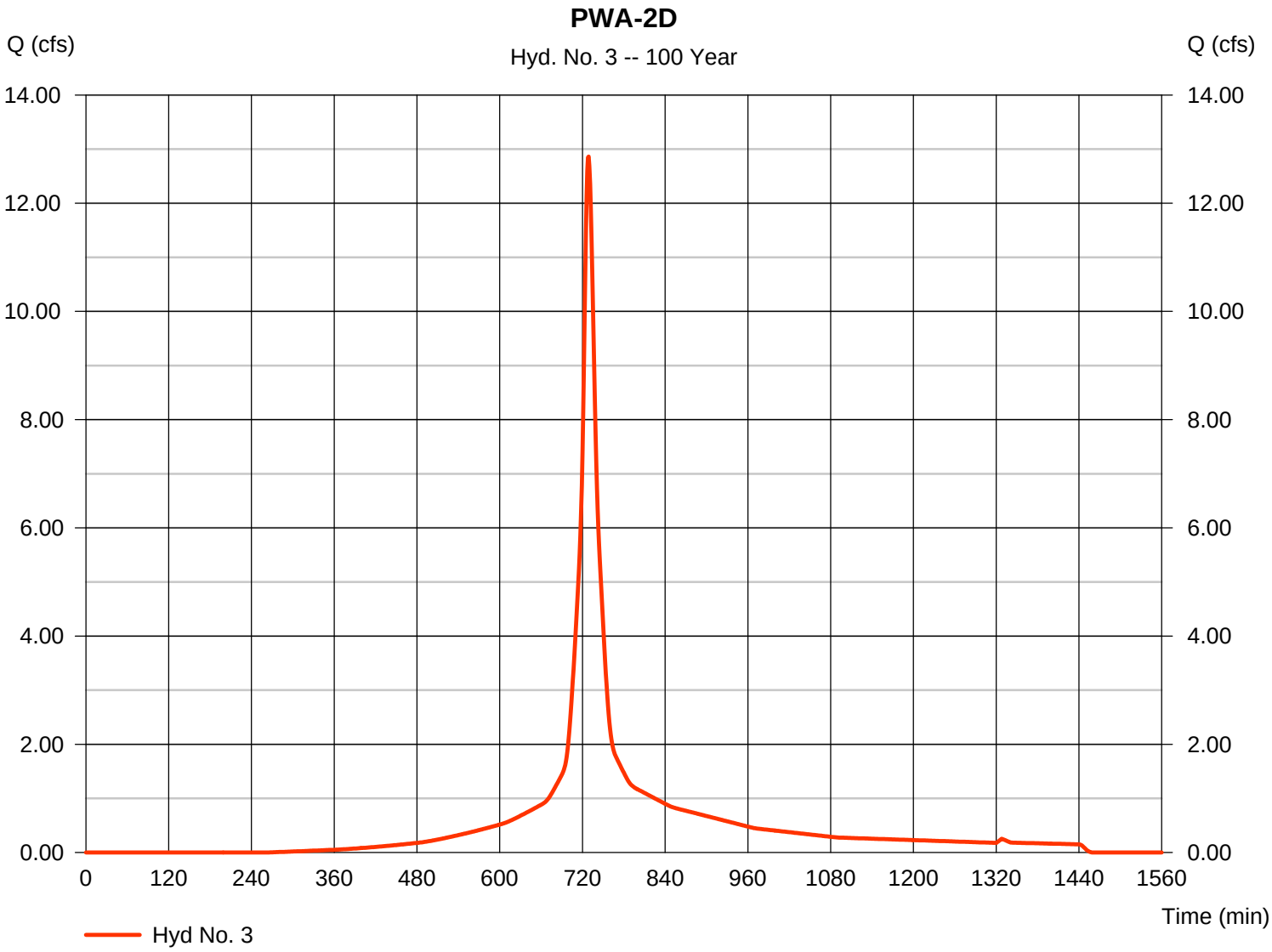
Hydrograph Report

Hyd. No. 3

PWA-2D

Hydrograph type	=	SCS Runoff	Peak discharge	=	12.86 cfs
Storm frequency	=	100 yrs	Time to peak	=	729 min
Time interval	=	1 min	Hyd. volume	=	49,996 cuft
Drainage area	=	2.800 ac	Curve number	=	87*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	12.10 min
Total precip.	=	6.50 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.500 x 98) + (1.300 x 74)] / 2.800



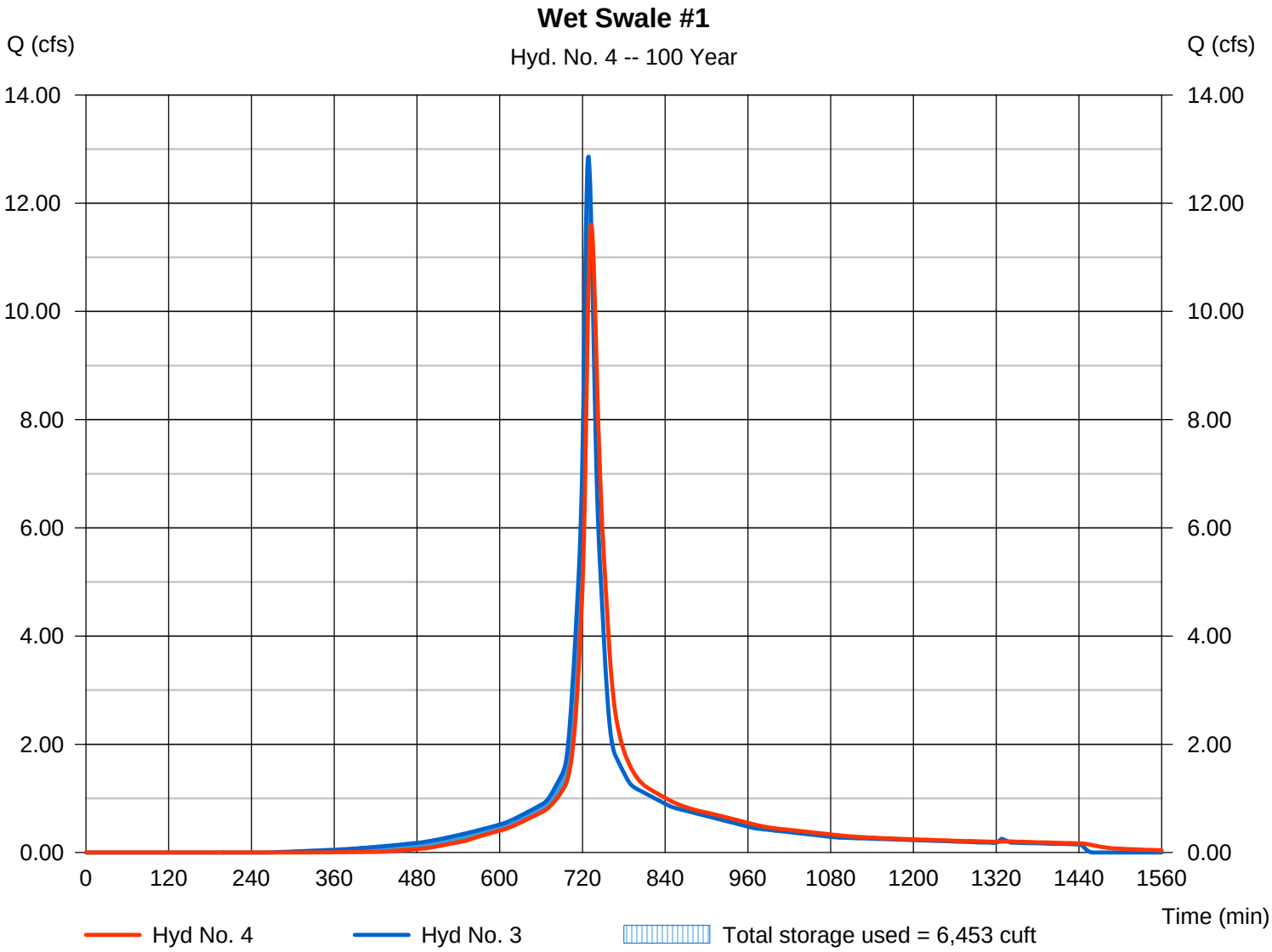
Hydrograph Report

Hyd. No. 4

Wet Swale #1

Hydrograph type	=	Reservoir	Peak discharge	=	11.61 cfs
Storm frequency	=	100 yrs	Time to peak	=	733 min
Time interval	=	1 min	Hyd. volume	=	49,956 cuft
Inflow hyd. No.	=	3 - PWA-2D	Max. Elevation	=	193.34 ft
Reservoir name	=	Wet Swale #1	Max. Storage	=	6,453 cuft

Storage Indication method used.



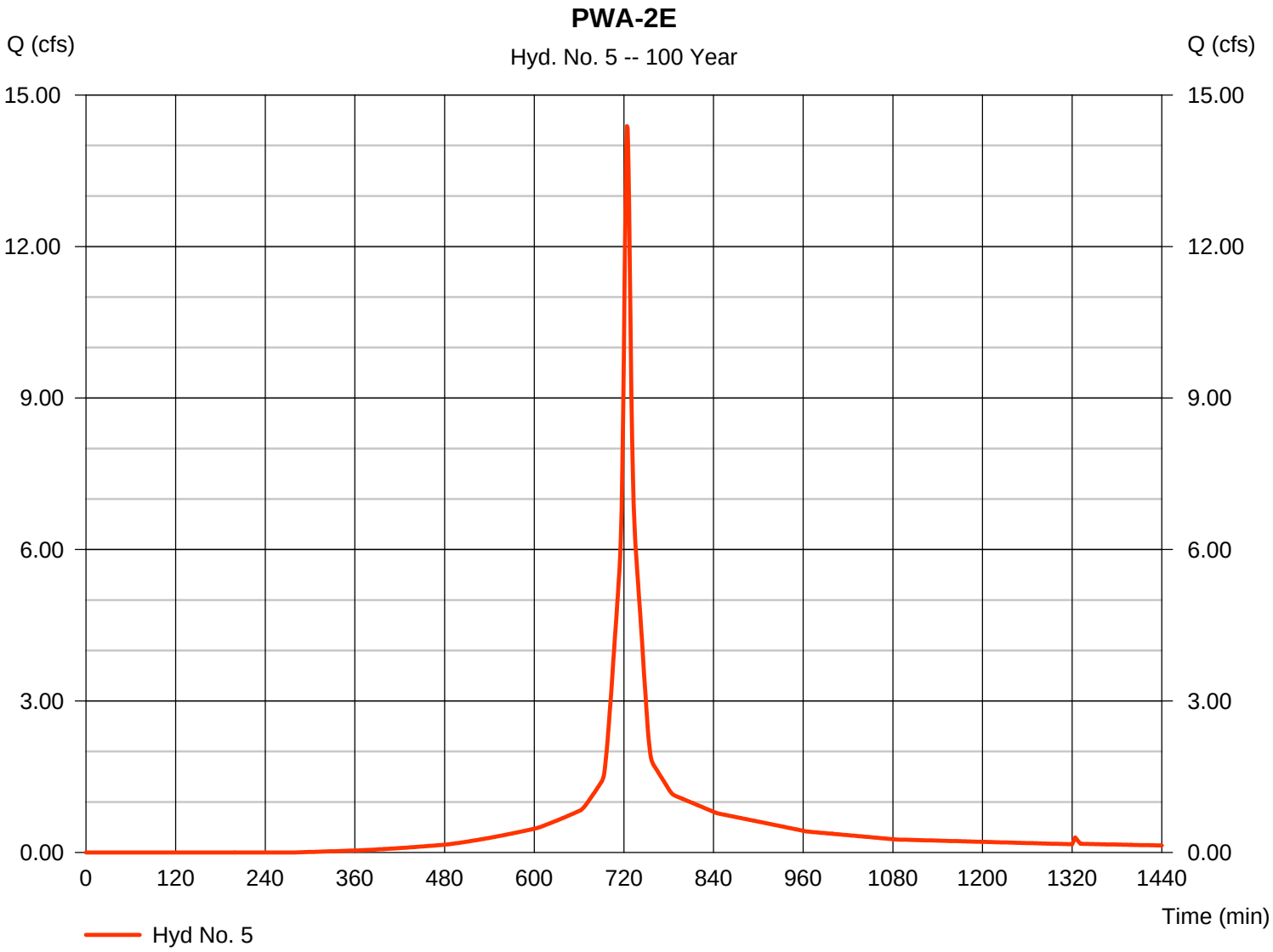
Hydrograph Report

Hyd. No. 5

PWA-2E

Hydrograph type	=	SCS Runoff	Peak discharge	=	14.38 cfs
Storm frequency	=	100 yrs	Time to peak	=	724 min
Time interval	=	1 min	Hyd. volume	=	45,728 cuft
Drainage area	=	2.500 ac	Curve number	=	86*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	USER	Time of conc. (Tc)	=	6.00 min
Total precip.	=	6.50 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.400 x 98) + (1.200 x 74)] / 2.500



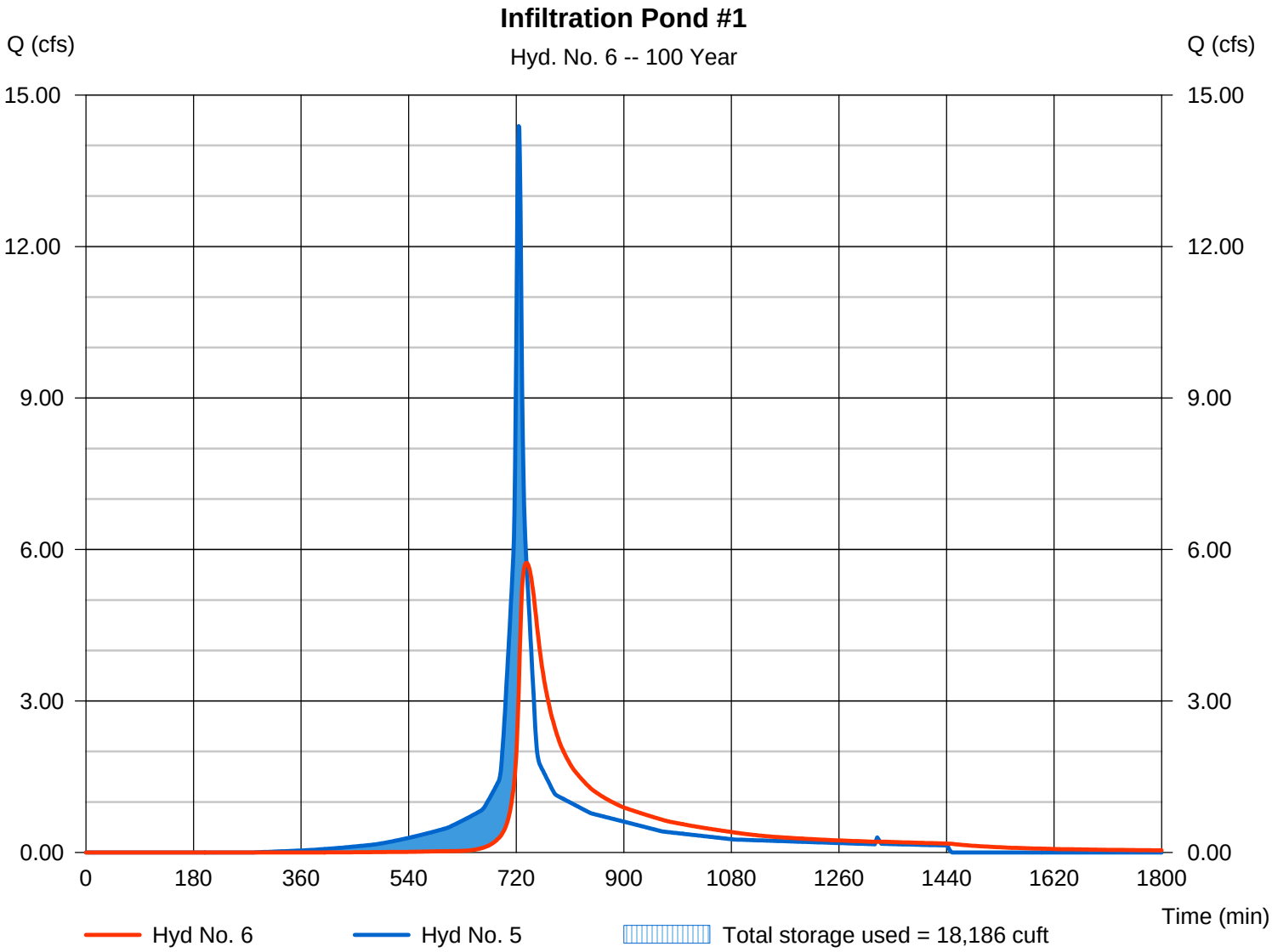
Hydrograph Report

Hyd. No. 6

Infiltration Pond #1

Hydrograph type	=	Reservoir	Peak discharge	=	5.736 cfs
Storm frequency	=	100 yrs	Time to peak	=	737 min
Time interval	=	1 min	Hyd. volume	=	43,411 cuft
Inflow hyd. No.	=	5 - PWA-2E	Max. Elevation	=	184.98 ft
Reservoir name	=	Infiltation Pond #1	Max. Storage	=	18,186 cuft

Storage Indication method used.



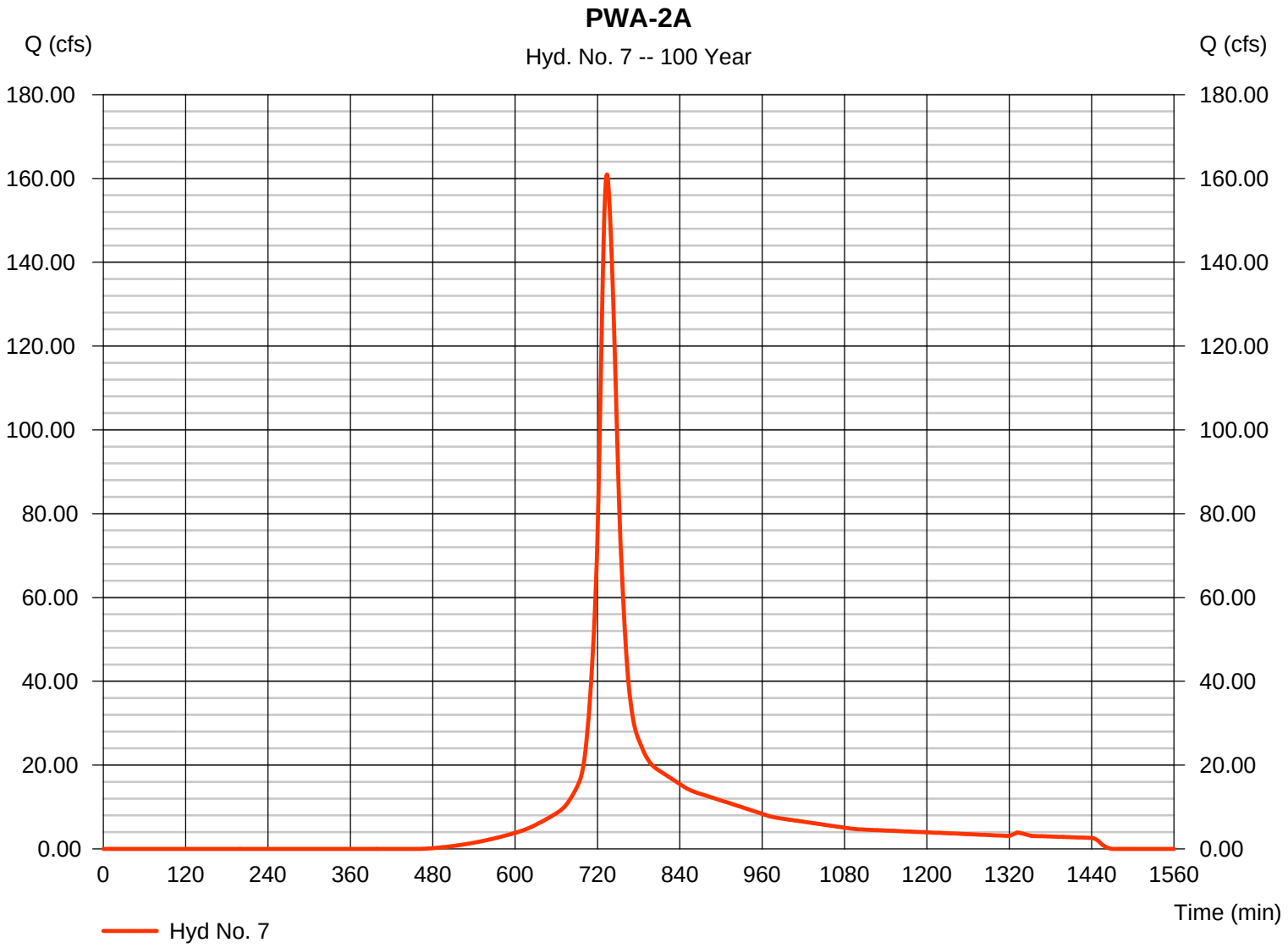
Hydrograph Report

Hyd. No. 7

PWA-2A

Hydrograph type	=	SCS Runoff	Peak discharge	=	160.96 cfs
Storm frequency	=	100 yrs	Time to peak	=	734 min
Time interval	=	1 min	Hyd. volume	=	710,131 cuft
Drainage area	=	52.700 ac	Curve number	=	75*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	19.10 min
Total precip.	=	6.50 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(2.700 x 98) + (5.400 x 72) + (44.600 x 74)] / 52.700



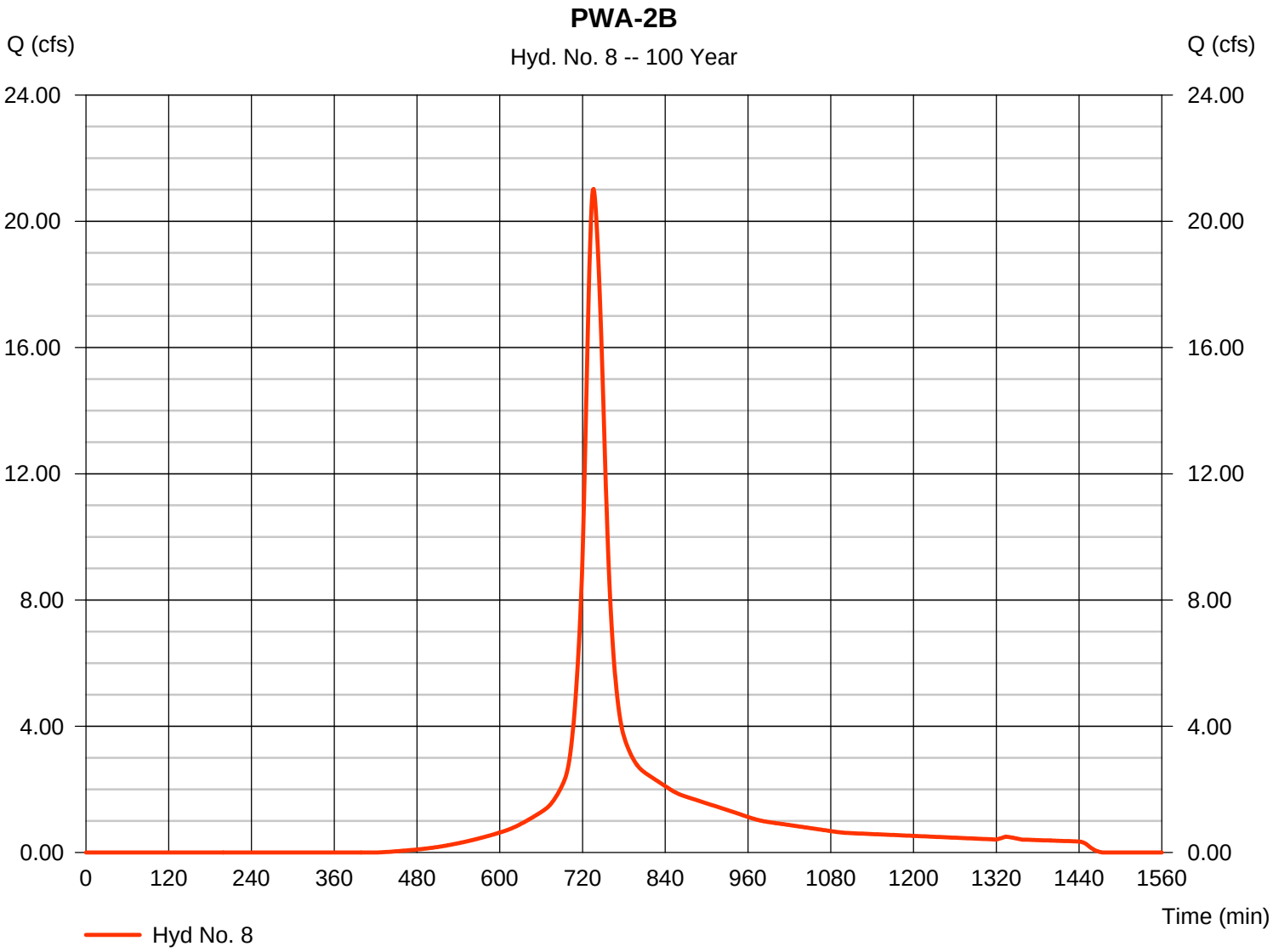
Hydrograph Report

Hyd. No. 8

PWA-2B

Hydrograph type	=	SCS Runoff	Peak discharge	=	21.03 cfs
Storm frequency	=	100 yrs	Time to peak	=	736 min
Time interval	=	1 min	Hyd. volume	=	98,439 cuft
Drainage area	=	6.800 ac	Curve number	=	78*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	22.70 min
Total precip.	=	6.50 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.300 x 98) + (2.700 x 72) + (2.800 x 74)] / 6.800



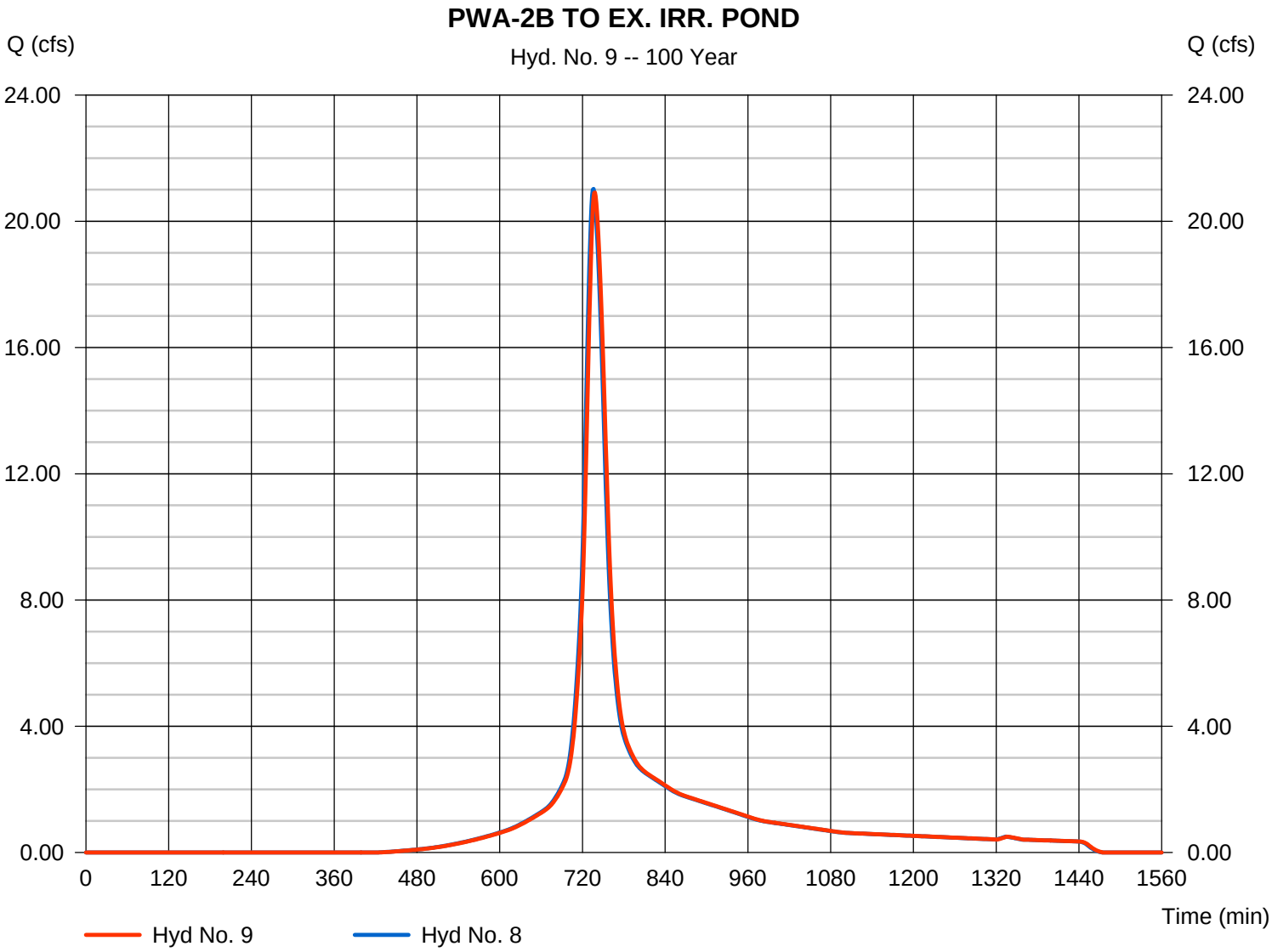
Hydrograph Report

Hyd. No. 9

PWA-2B TO EX. IRR. POND

Hydrograph type	=	Reach	Peak discharge	=	20.91 cfs
Storm frequency	=	100 yrs	Time to peak	=	738 min
Time interval	=	1 min	Hyd. volume	=	98,438 cuft
Inflow hyd. No.	=	8 - PWA-2B	Section type	=	Trapezoidal
Reach length	=	300.0 ft	Channel slope	=	3.0 %
Manning's n	=	0.040	Bottom width	=	5.0 ft
Side slope	=	3.0:1	Max. depth	=	1.0 ft
Rating curve x	=	2.205	Rating curve m	=	1.190
Ave. velocity	=	3.16 ft/s	Routing coeff.	=	0.5465

Modified Att-Kin routing method used.

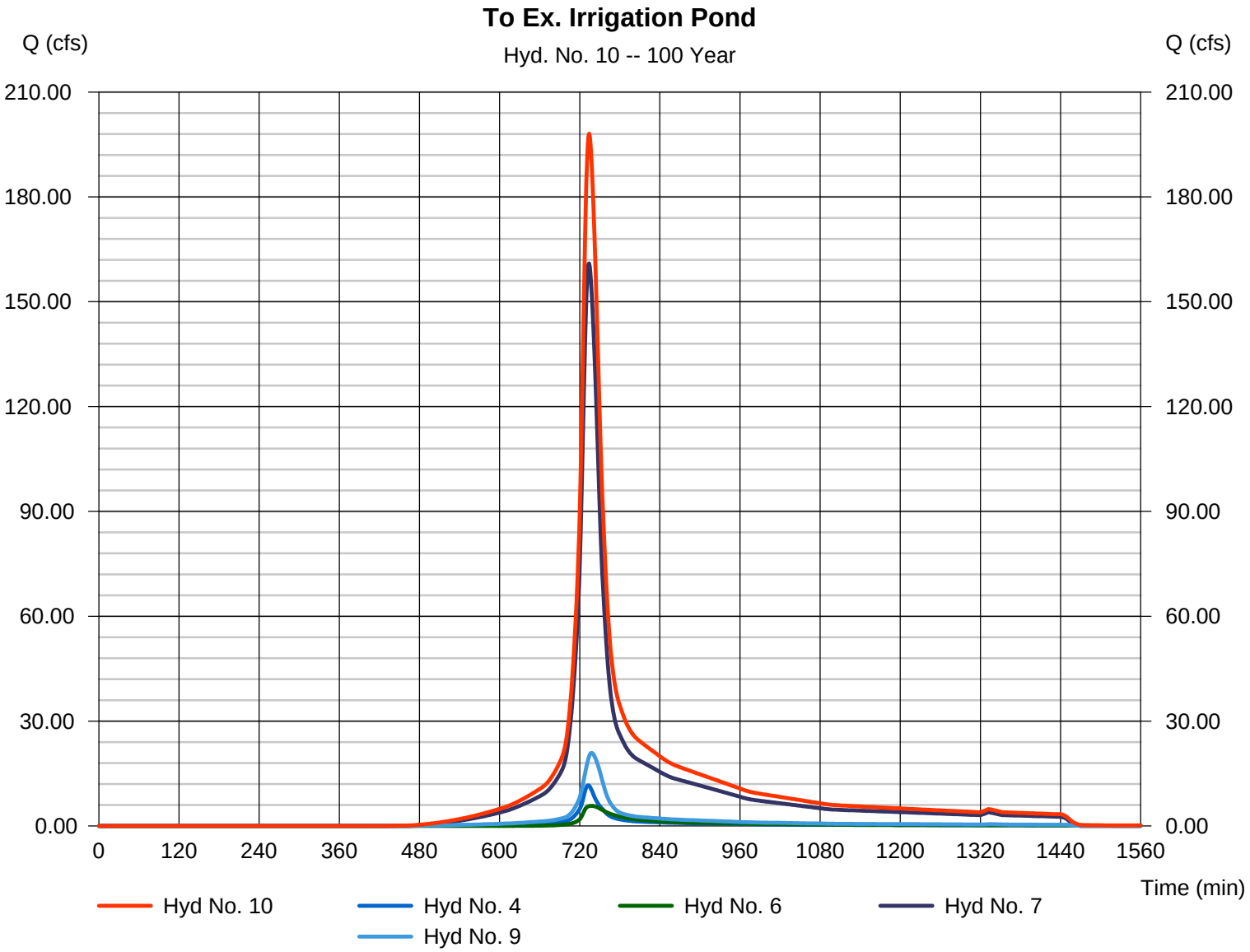


Hydrograph Report

Hyd. No. 10

To Ex. Irrigation Pond

Hydrograph type	= Combine	Peak discharge	= 198.10 cfs
Storm frequency	= 100 yrs	Time to peak	= 734 min
Time interval	= 1 min	Hyd. volume	= 901,937 cuft
Inflow hyds.	= 4, 6, 7, 9	Contrib. drain. area	= 52.700 ac



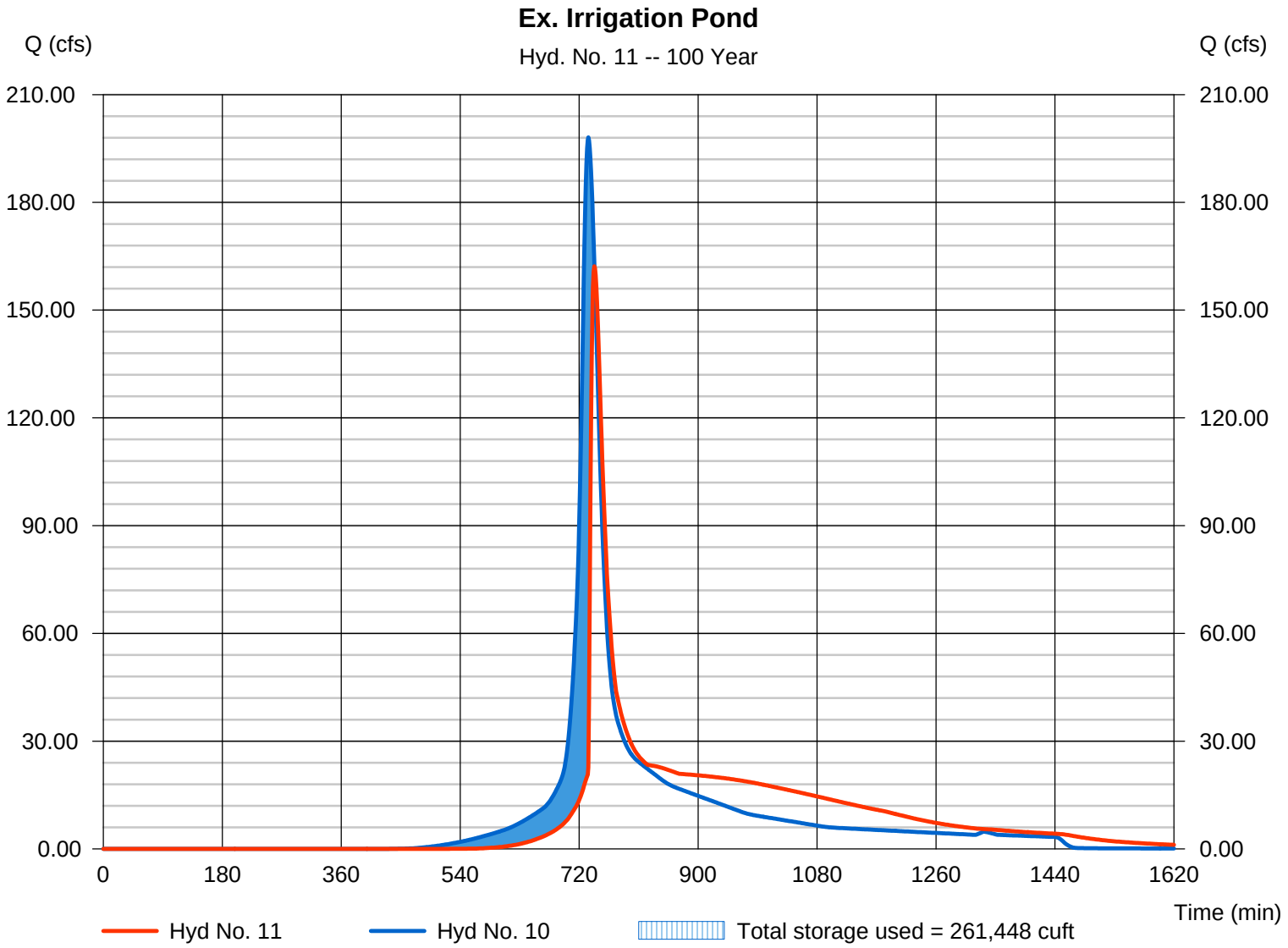
Hydrograph Report

Hyd. No. 11

Ex. Irrigation Pond

Hydrograph type	=	Reservoir	Peak discharge	=	162.21 cfs
Storm frequency	=	100 yrs	Time to peak	=	743 min
Time interval	=	1 min	Hyd. volume	=	895,500 cuft
Inflow hyd. No.	=	10 - To Ex. Irrigation Pond	Max. Elevation	=	165.84 ft
Reservoir name	=	Ex. Irrigation Pond	Max. Storage	=	261,448 cuft

Storage Indication method used.



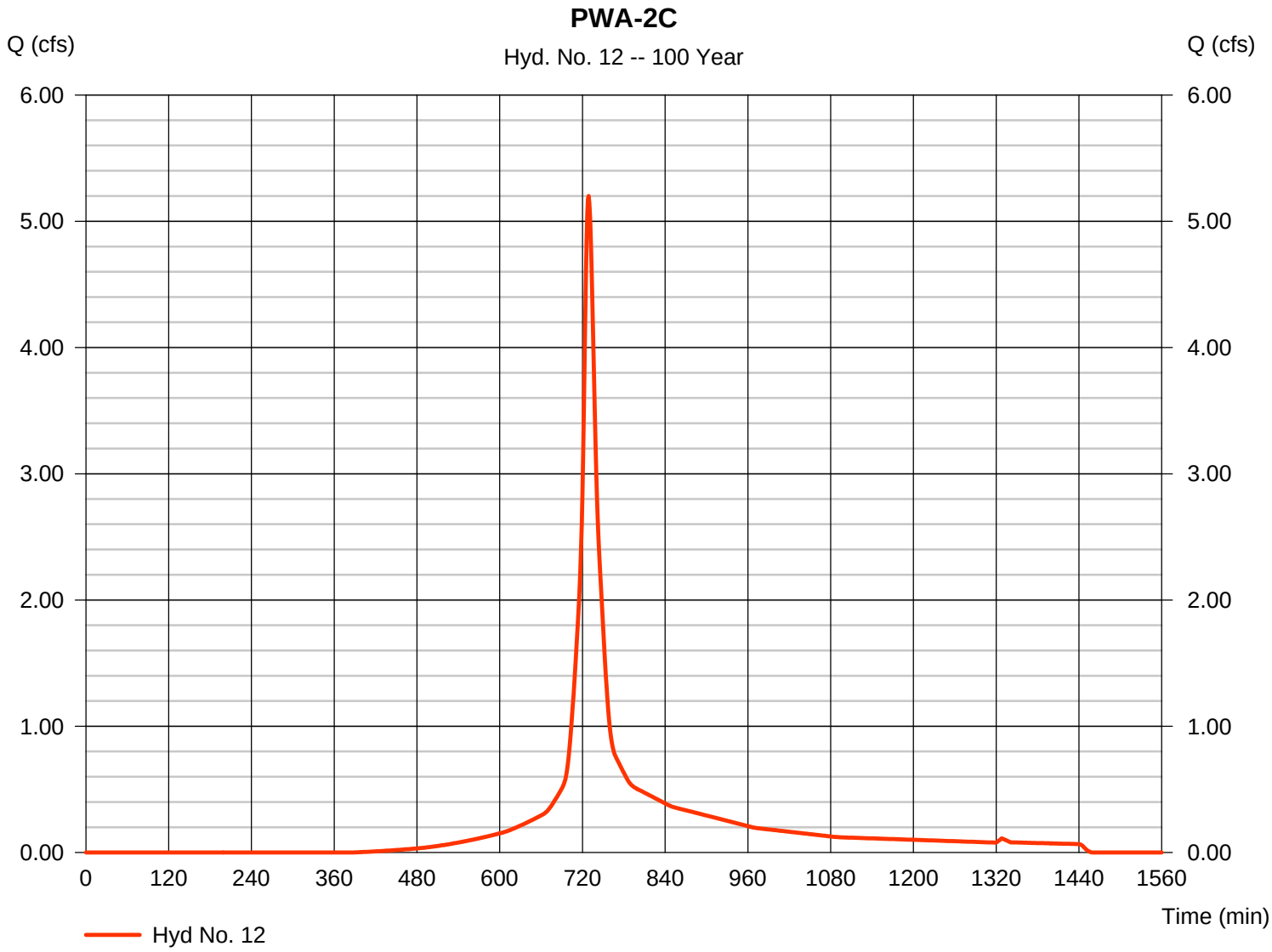
Hydrograph Report

Hyd. No. 12

PWA-2C

Hydrograph type	=	SCS Runoff	Peak discharge	=	5.200 cfs
Storm frequency	=	100 yrs	Time to peak	=	729 min
Time interval	=	1 min	Hyd. volume	=	19,674 cuft
Drainage area	=	1.300 ac	Curve number	=	80*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	12.60 min
Total precip.	=	6.50 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.400 x 98) + (0.900 x 72)] / 1.300

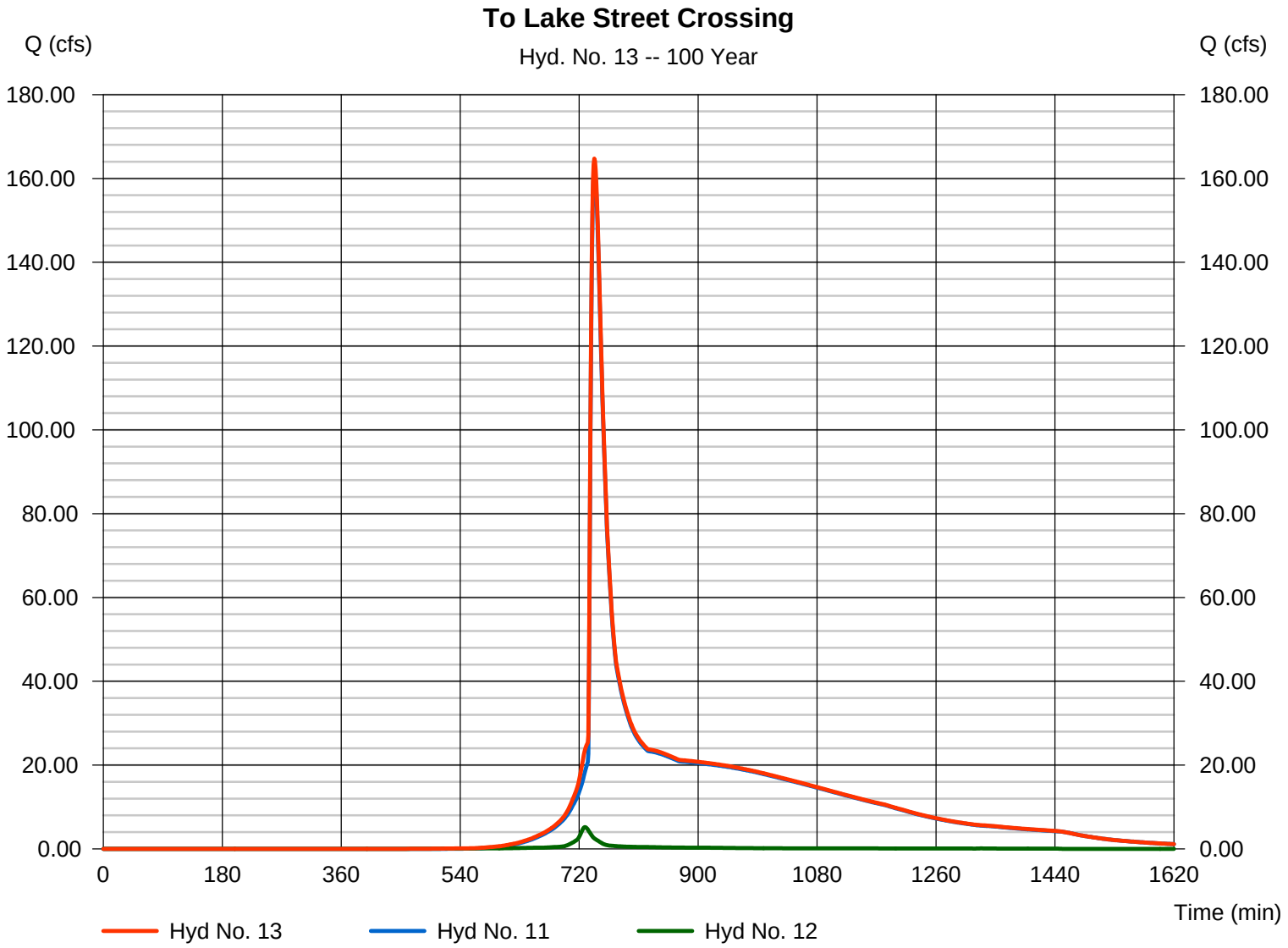


Hydrograph Report

Hyd. No. 13

To Lake Street Crossing

Hydrograph type	=	Combine	Peak discharge	=	164.74 cfs
Storm frequency	=	100 yrs	Time to peak	=	743 min
Time interval	=	1 min	Hyd. volume	=	915,174 cuft
Inflow hyds.	=	11, 12	Contrib. drain. area	=	1.300 ac



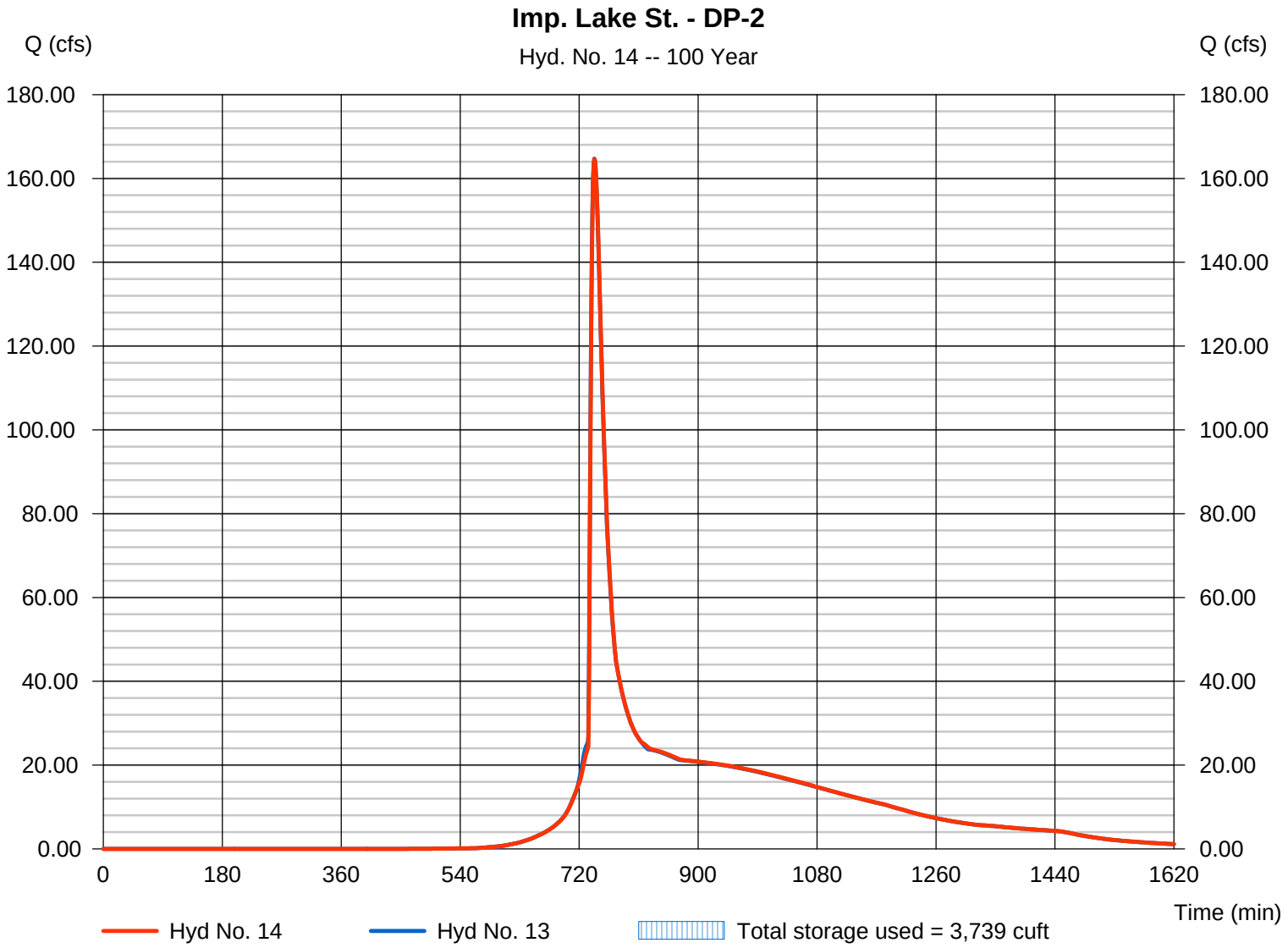
Hydrograph Report

Hyd. No. 14

Imp. Lake St. - DP-2

Hydrograph type	=	Reservoir	Peak discharge	=	164.63 cfs
Storm frequency	=	100 yrs	Time to peak	=	743 min
Time interval	=	1 min	Hyd. volume	=	915,164 cuft
Inflow hyd. No.	=	13 - To Lake Street Crossing	Max. Elevation	=	160.45 ft
Reservoir name	=	Improved Lake Street Crossing	Max. Storage	=	3,739 cuft

Storage Indication method used.



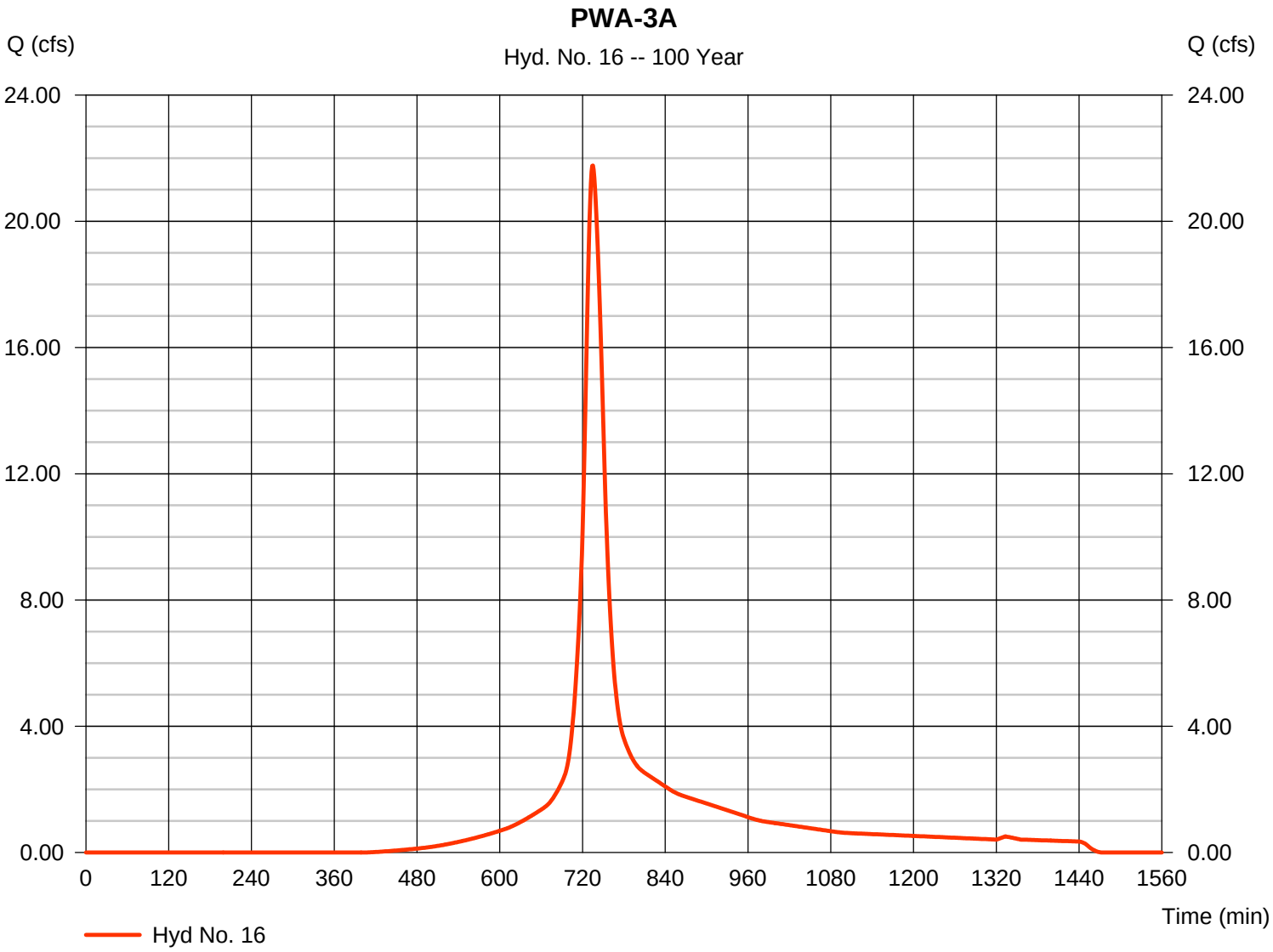
Hydrograph Report

Hyd. No. 16

PWA-3A

Hydrograph type	=	SCS Runoff	Peak discharge	=	21.77 cfs
Storm frequency	=	100 yrs	Time to peak	=	735 min
Time interval	=	1 min	Hyd. volume	=	99,880 cuft
Drainage area	=	6.600 ac	Curve number	=	79*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	21.70 min
Total precip.	=	6.50 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.500 x 98) + (5.100 x 74)] / 6.600



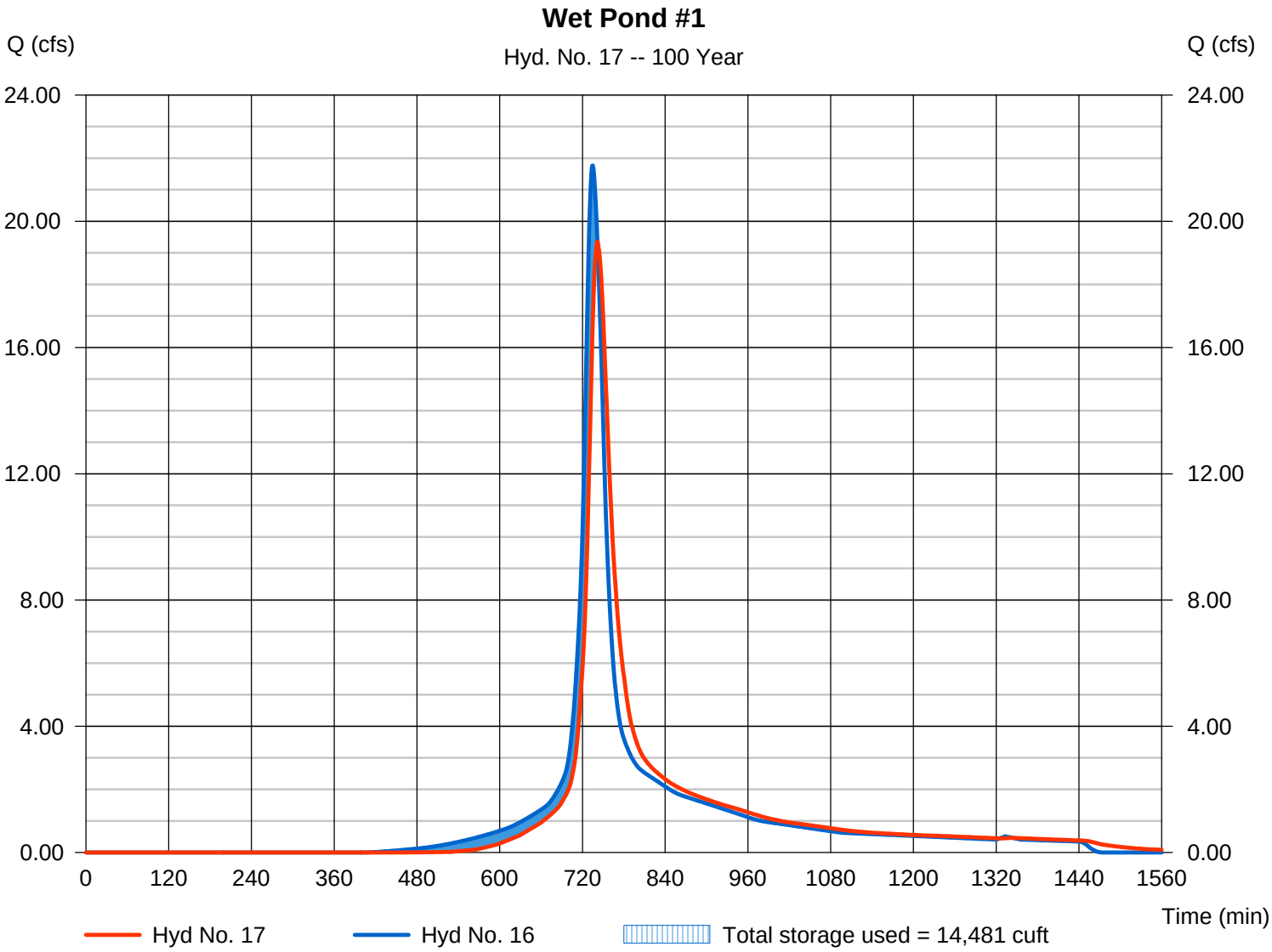
Hydrograph Report

Hyd. No. 17

Wet Pond #1

Hydrograph type	=	Reservoir	Peak discharge	=	19.36 cfs
Storm frequency	=	100 yrs	Time to peak	=	742 min
Time interval	=	1 min	Hyd. volume	=	99,706 cuft
Inflow hyd. No.	=	16 - PWA-3A	Max. Elevation	=	197.00 ft
Reservoir name	=	Wet Pond #1	Max. Storage	=	14,481 cuft

Storage Indication method used.



Hydrograph Report

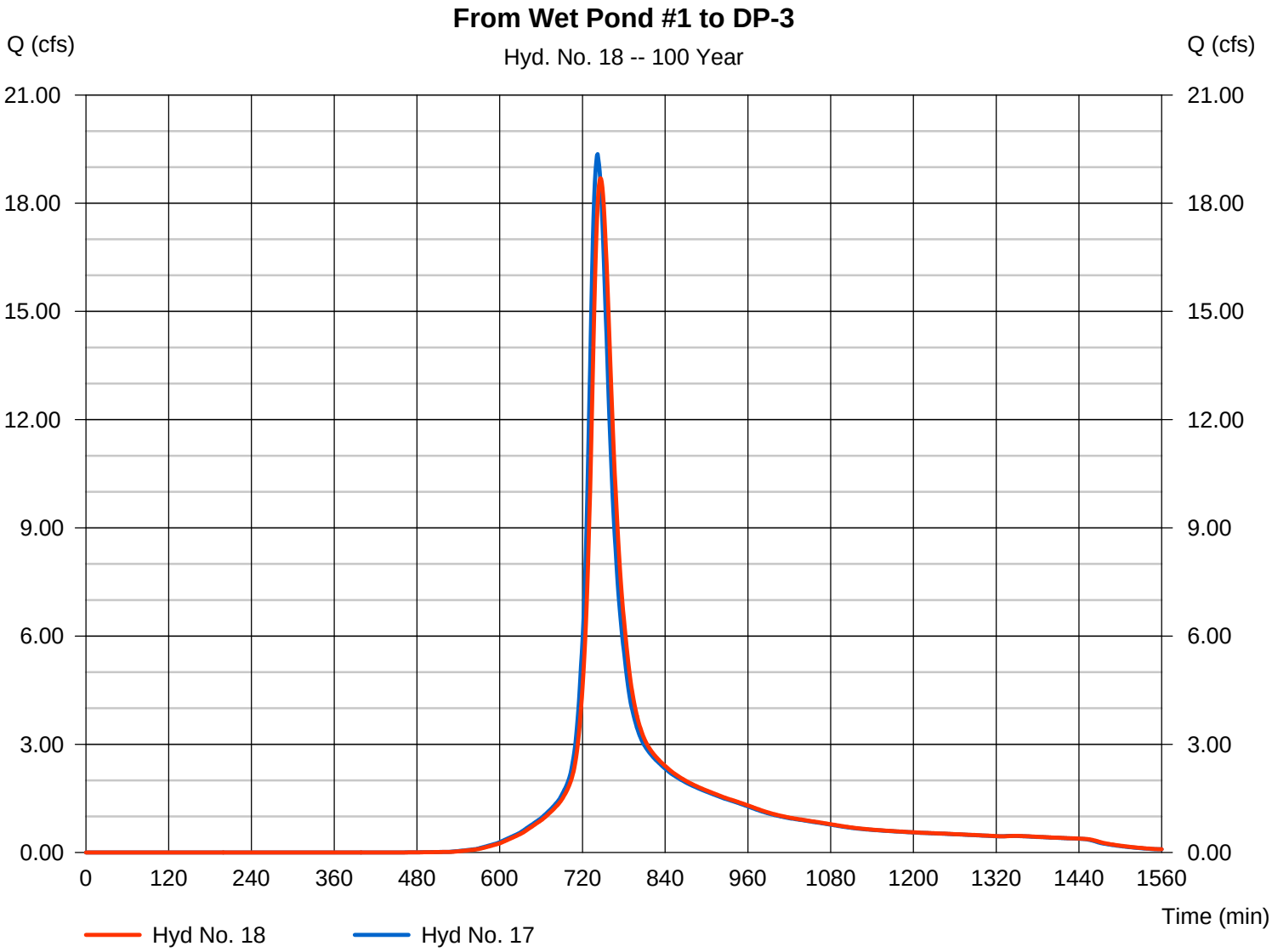
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Wednesday, Nov 11, 2009

Hyd. No. 18

From Wet Pond #1 to DP-3

Hydrograph type	=	Reach	Peak discharge	=	18.69 cfs
Storm frequency	=	100 yrs	Time to peak	=	746 min
Time interval	=	1 min	Hyd. volume	=	99,441 cuft
Inflow hyd. No.	=	17 - Wet Pond #1	Section type	=	Trapezoidal
Reach length	=	1299.0 ft	Channel slope	=	2.2 %
Manning's n	=	0.026	Bottom width	=	6.0 ft
Side slope	=	3.0:1	Max. depth	=	3.0 ft
Rating curve x	=	2.573	Rating curve m	=	1.344
Ave. velocity	=	4.31 ft/s	Routing coeff.	=	0.2360

Modified Att-Kin routing method used.



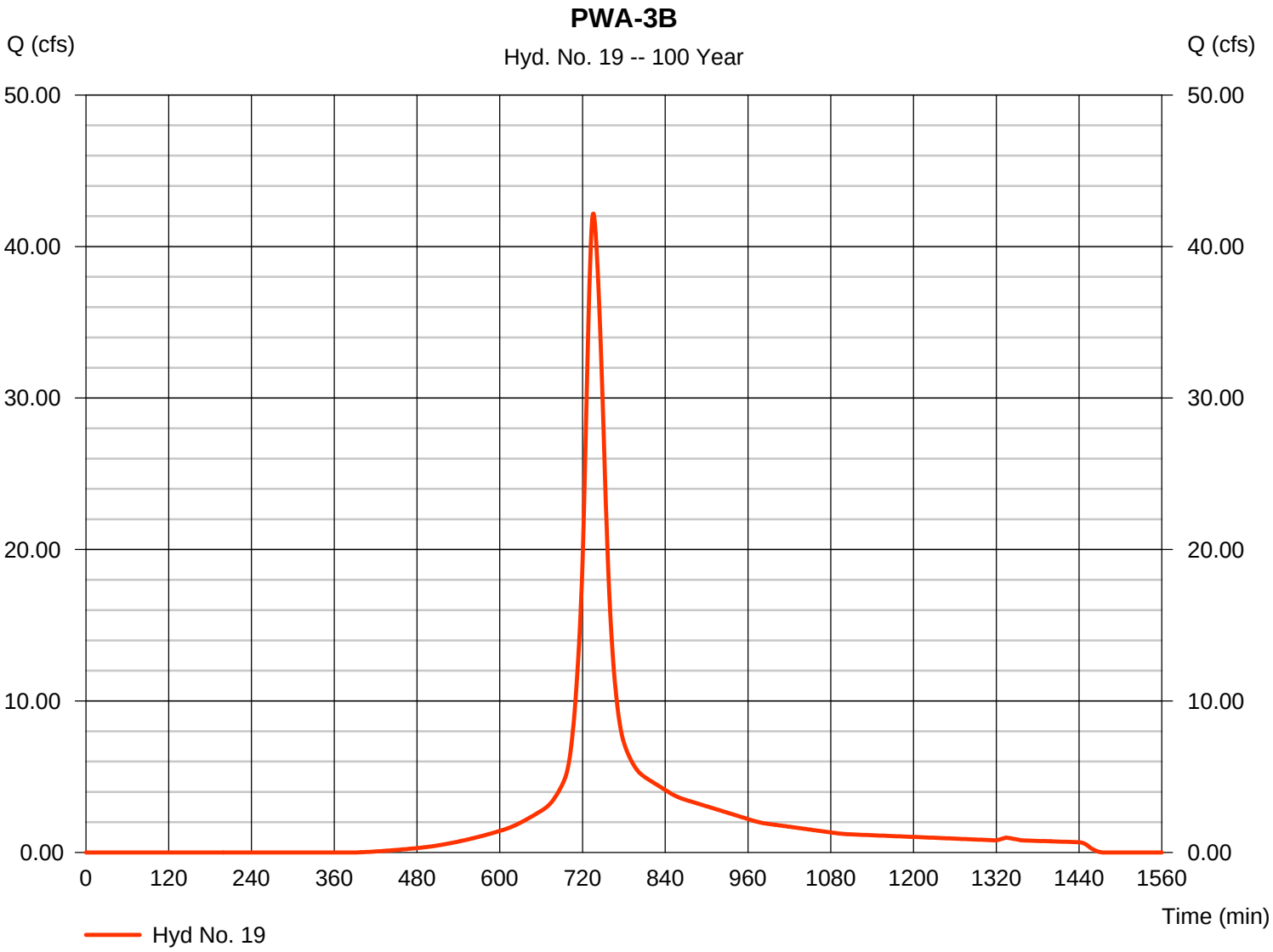
Hydrograph Report

Hyd. No. 19

PWA-3B

Hydrograph type	=	SCS Runoff	Peak discharge	=	42.17 cfs
Storm frequency	=	100 yrs	Time to peak	=	736 min
Time interval	=	1 min	Hyd. volume	=	198,079 cuft
Drainage area	=	13.000 ac	Curve number	=	80*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	22.20 min
Total precip.	=	6.50 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(3.100 x 98) + (1.100 x 72) + (8.800 x 74)] / 13.000



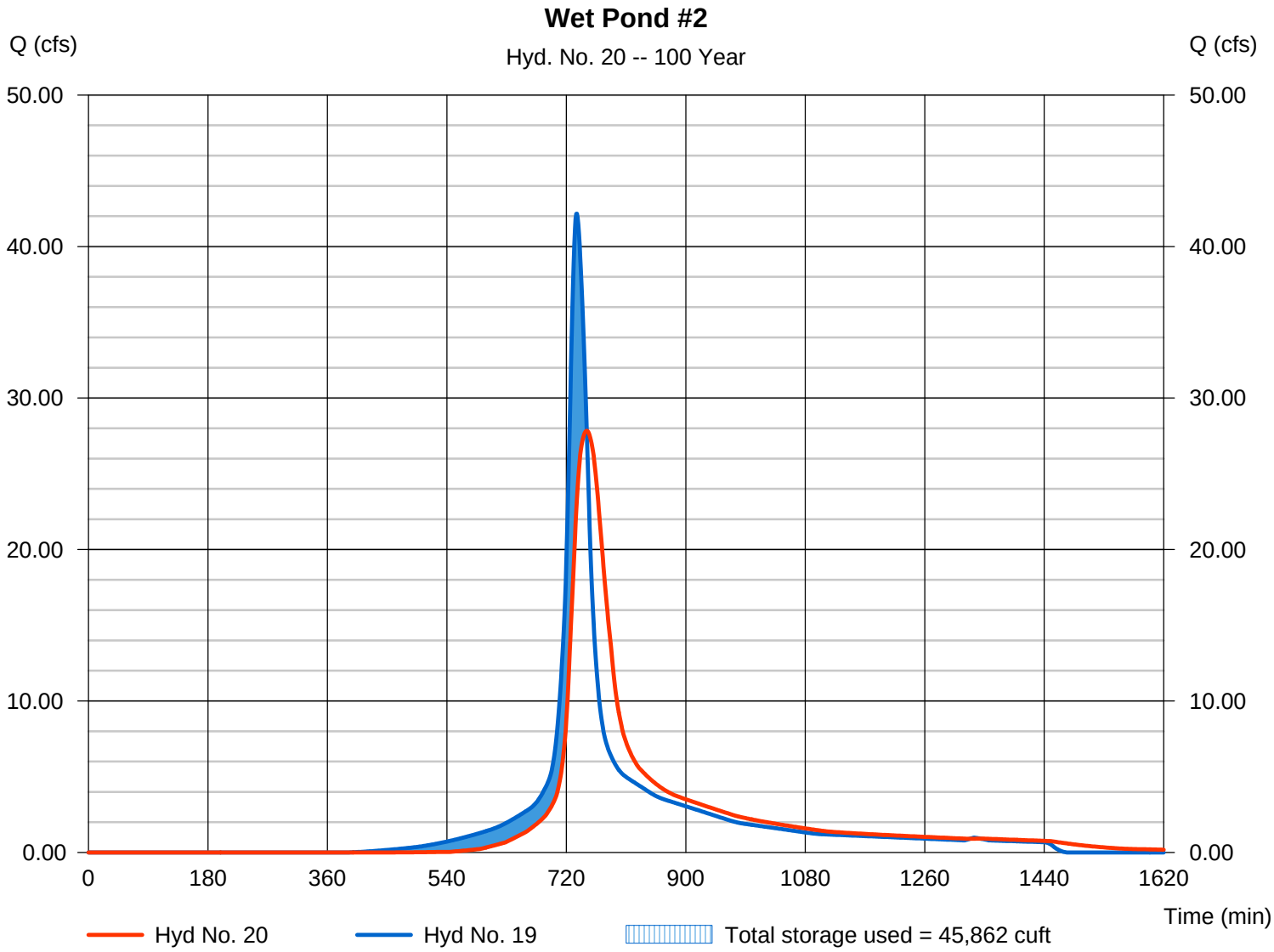
Hydrograph Report

Hyd. No. 20

Wet Pond #2

Hydrograph type	=	Reservoir	Peak discharge	=	27.84 cfs
Storm frequency	=	100 yrs	Time to peak	=	751 min
Time interval	=	1 min	Hyd. volume	=	197,153 cuft
Inflow hyd. No.	=	19 - PWA-3B	Max. Elevation	=	205.00 ft
Reservoir name	=	Wet Pond #2	Max. Storage	=	45,862 cuft

Storage Indication method used.



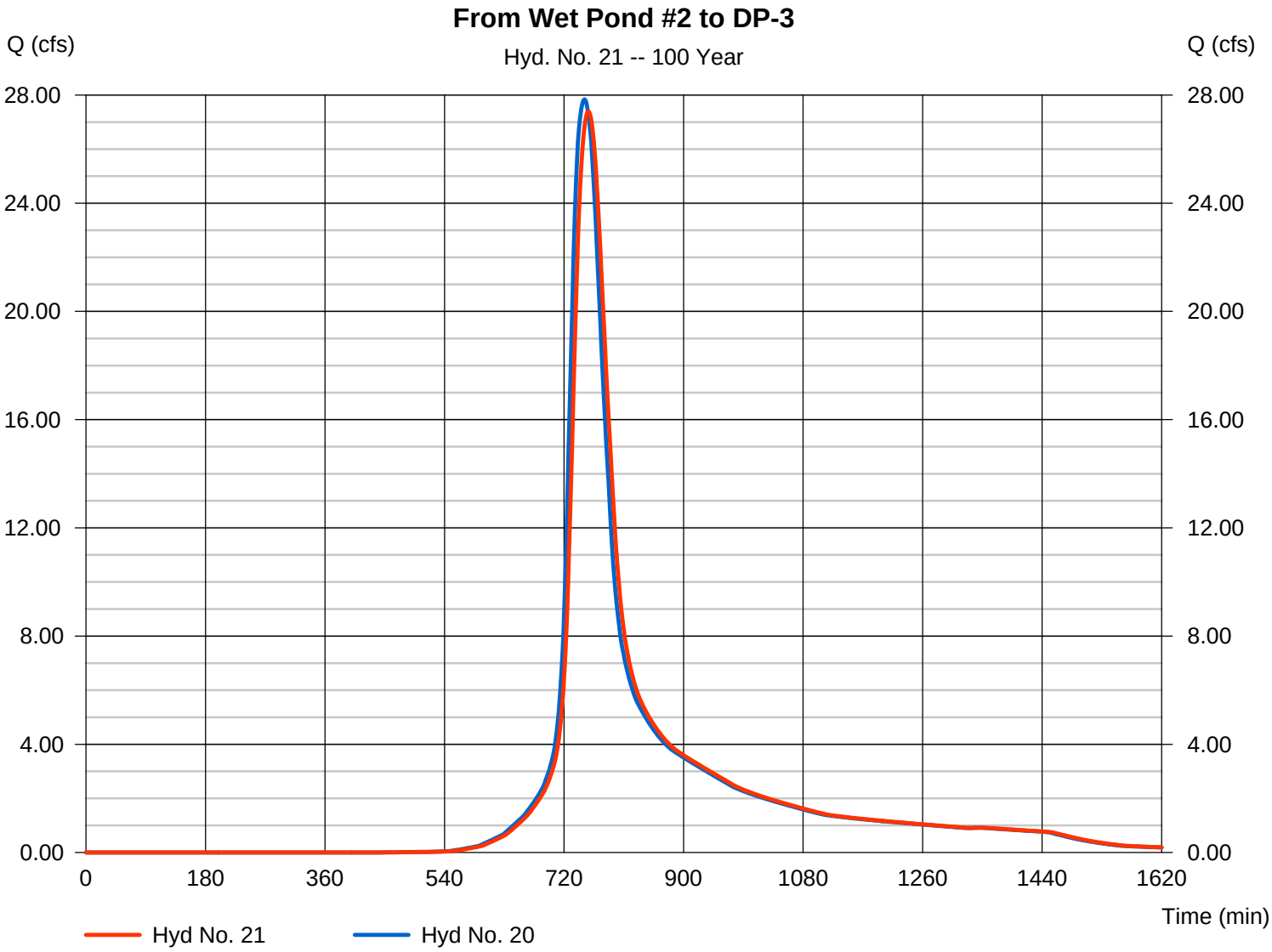
Hydrograph Report

Hyd. No. 21

From Wet Pond #2 to DP-3

Hydrograph type	=	Reach	Peak discharge	=	27.39 cfs
Storm frequency	=	100 yrs	Time to peak	=	756 min
Time interval	=	1 min	Hyd. volume	=	197,148 cuft
Inflow hyd. No.	=	20 - Wet Pond #2	Section type	=	Trapezoidal
Reach length	=	1876.0 ft	Channel slope	=	2.2 %
Manning's n	=	0.026	Bottom width	=	6.0 ft
Side slope	=	3.0:1	Max. depth	=	3.0 ft
Rating curve x	=	2.573	Rating curve m	=	1.344
Ave. velocity	=	4.73 ft/s	Routing coeff.	=	0.1846

Modified Att-Kin routing method used.



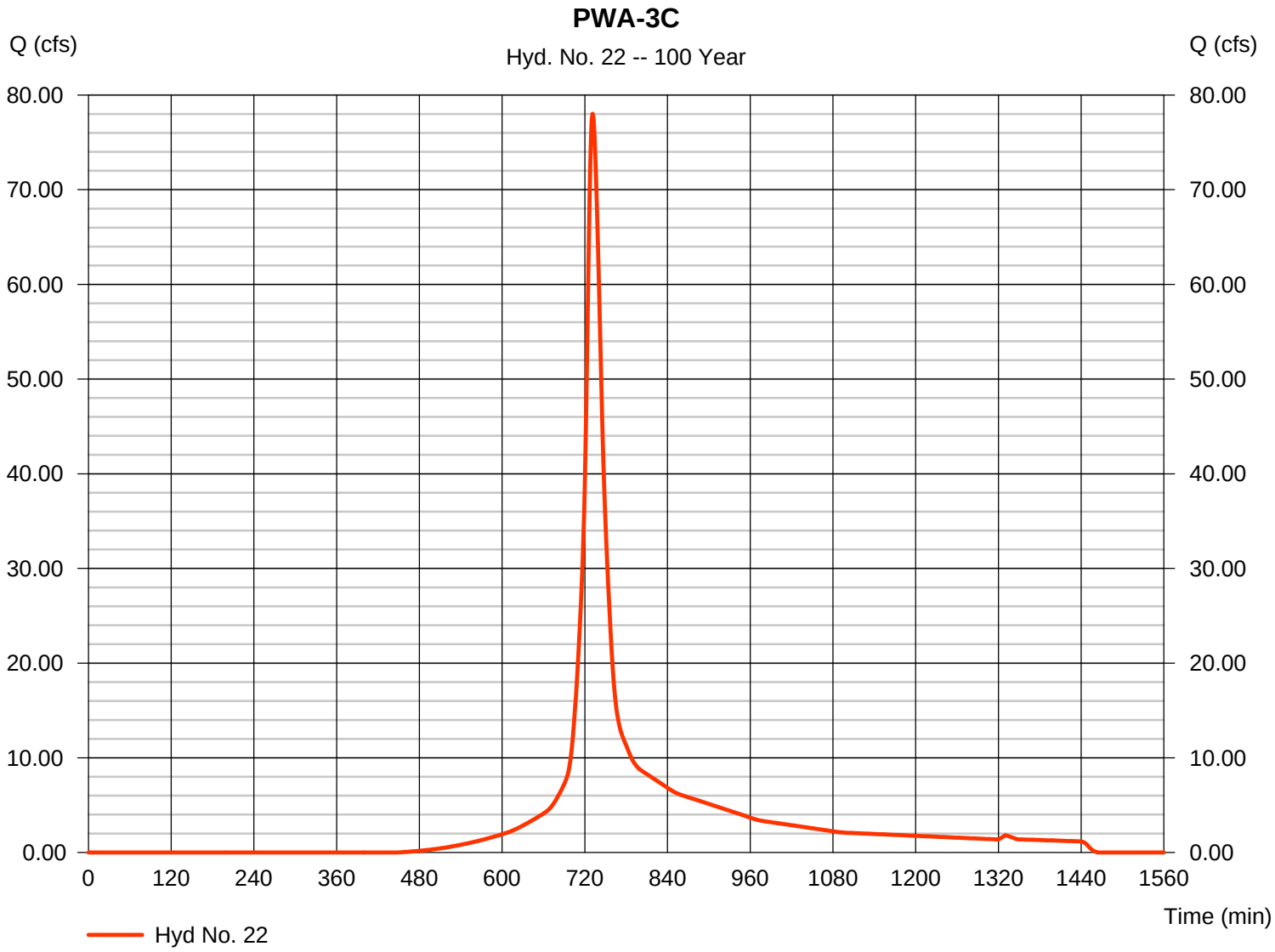
Hydrograph Report

Hyd. No. 22

PWA-3C

Hydrograph type	=	SCS Runoff	Peak discharge	=	78.02 cfs
Storm frequency	=	100 yrs	Time to peak	=	731 min
Time interval	=	1 min	Hyd. volume	=	322,524 cuft
Drainage area	=	23.000 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	16.50 min
Total precip.	=	6.50 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.000 x 98) + (3.100 x 72) + (4.000 x 79) + (14.000 x 74) + (0.900 x 80)] / 23.000

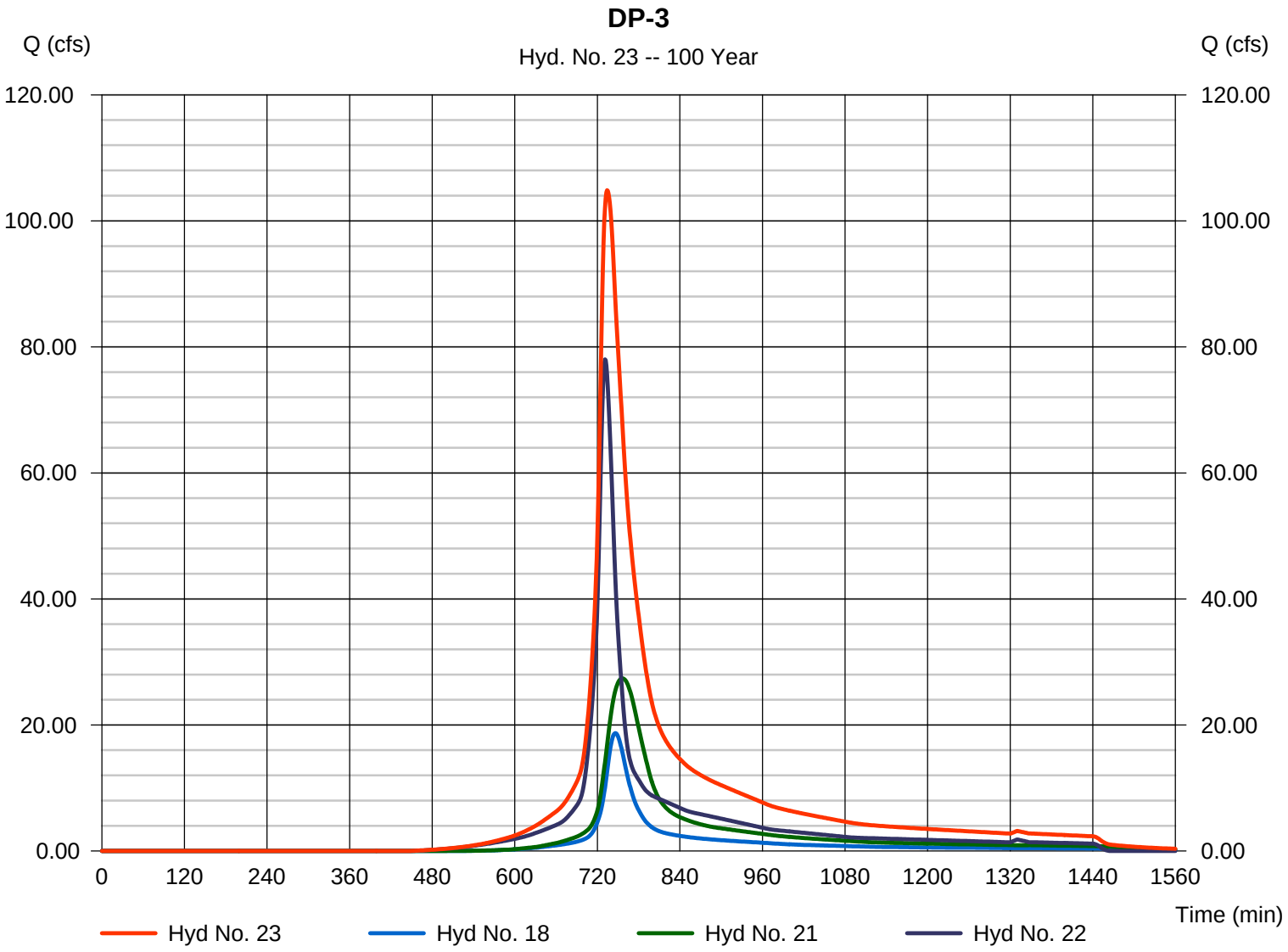


Hydrograph Report

Hyd. No. 23

DP-3

Hydrograph type	=	Combine	Peak discharge	=	104.87 cfs
Storm frequency	=	100 yrs	Time to peak	=	734 min
Time interval	=	1 min	Hyd. volume	=	619,113 cuft
Inflow hyds.	=	18, 21, 22	Contrib. drain. area	=	23.000 ac



TAB 5

Project: Crystal Springs Golf Course
Client: S.E. Cummings & Associates, Inc.
Project Number: 08-0703

Prepared By: James E. Hanley, P.E.
Date: June 10, 2009
Revision: October 14, 2009

CIVIL DESIGN Consultants, Inc.
37 Plaistow Road, Unit 7 - #235 Tel (603) 275-5360
Plaistow, NH 03865 Fax (603) 382-1818

10 YEAR DESIGN STORM - STORMWATER CONVEYANCE SYSTEM

Description	Cover	WATERSHED CHARACTERISTICS Area (SF)	Total A (Acre)	C	CA	Total CA	To Inlet (MIN)	In Pipe (MIN)	Tc (MIN)	I (IPH)	Q (CFS)	PIPE CHARACTORISTICS Rim	Inv. (In)	Inv. (Out)	Dia. (IN)	Length (FT)	Slope (FT/FT)	Cover (FT)	n	FLOW CHARACTSTICS Qf (CFS)	Vf (FT/S)	Q/Qf (%)	V/Vf (%)	V (FT/S)	L/V (MIN)
FRONT NINE DRIVE - REACH #1																									
PCB-1	Pervious	8723	0.200	0.40	0.305		5.00	NONE	5.00	5.29	**1.61**	223.20	-	219.00	12	7.2	0.005	3.20	0.013	2.52	3.21	64%	92%	2.95	0.04
	Impervious	10864	0.249	0.90																					
			0.450	0.68																					
PCB-2	Pervious	7907	0.182	0.40	0.314		5.00		5.00	5.29	**1.66**	223.20	-	219.00	12	15.3	0.005	3.20	0.013	2.52	3.21	66%	93%	2.98	0.09
	Impervious	11680	0.268	0.90																					
			0.450	0.70																					
PDMH-1	-	-	-	-	-	0.618	5.00	0.09	5.09	5.26	**3.26**	223.21	218.96	218.32	18	153.1	0.010	2.79	0.013	10.50	5.94	31%	75%	4.43	0.58
													218.92												
PCB-3	Pervious	1663	0.038	0.40	0.080		5.00	NONE	5.00	5.29	**0.42**	220.80	-	216.60	12	2.9	0.005	3.20	0.013	2.52	3.21	17%	62%	2.00	0.02
	Impervious	3124	0.072	0.90																					
			0.110	0.73																					
PDMH-2	-	-	-	-	-	0.698	5.09	0.58	5.66	5.12	**3.58**	221.00	216.79	216.49	18	48.1	0.010	2.91	0.013	10.50	5.94	34%	77%	4.55	0.18
													216.59												
PCB-4	Pervious	26437	0.607	0.40	0.572		5.00	NONE	5.00	5.29	**3.02**	220.39	-	216.19	12	5.5	0.010	3.20	0.013	3.56	4.54	85%	100%	4.53	0.02
	Impervious	15918	0.365	0.90																					
			0.972	0.59																					
PDMH-3	-	-	-	-	-	1.270	5.66	0.18	5.84	5.08	**6.46**	221.00	216.00	215.90	18	110.3	0.015	3.50	0.013	12.87	7.28	50%	86%	6.24	0.29
													216.14												
PFES-1	-	-	-	-	-	-	-	-	-	-	-	-	214.25		-	-	-	-	-	-	-	-	-	-	-

Description	Cover	WATERSHED CHARACTERISTICS Area (SF)	Total A (Acre)	C	CA	Total CA	To Inlet (MIN)	In Pipe (MIN)	Tc (MIN)	I (IPH)	Q (CFS)	PIPE CHARACTORISTICS Rim	Inv. (In)	Inv. (Out)	Dia. (IN)	Length (FT)	Slope (FT/FT)	Cover (FT)	n	FLOW CHARACTSTICS Qf (CFS)	Vf (FT/S)	Q/Qf (%)	V/Vf (%)	V (FT/S)	L/V (MIN)
FRONT NINE DRIVE - REACH #2																									
PCB-5	Pervious	9685	0.222	0.40	0.313		5.00	NONE	5.00	5.29	**1.65**	215.50	-	212.30	12	23.5	0.005	2.20	0.013	2.52	3.21	66%	93%	2.97	0.13
	Impervious	10841	0.249	0.90																					
			0.471	0.66																					
PCB-6	Pervious	6978	0.160	0.40	0.303		5.00		5.00	5.29	**1.60**	215.50	-	212.30	12	18.5	0.005	2.20	0.013	2.52	3.21	64%	92%	2.94	0.10
	Impervious	11557	0.265	0.90																					
			0.426	0.71																					
PDMH-4	-	-	-	-	-	0.616	5.00	0.13	5.13	5.25	**3.23**	214.94	212.18	212.08	12	117.0	0.010	1.76	0.013	3.56	4.54	91%	102%	4.62	0.42
													212.21												
PFES-4	-	-	-	-	-	-	-	-	-	-	-	-	210.91		-	-	-	-	-	-	-	-	-	-	-

10 YEAR DESIGN STORM - STORMWATER CONVEYANCE SYSTEM

Description	Cover	Area (SF)	Total A (Acre)	C	CA	Total CA	To Inlet (MIN)	In Pipe (MIN)	Tc (MIN)	I (IPH)	Q (CFS)	Rim	Inv. (In)	Inv. (Out)	Dia. (IN)	Length (FT)	Slope (FT/FT)	Cover (FT)	n	Qf (CFS)	Vf (FT/S)	Q/Qf (%)	V/Vf (%)	V (FT/S)	L/V (MIN)
FRONT NINE DRIVE - REACH #3																									
PCB-7	Pervious	9893	0.227	0.40	0.500		5.00	NONE	5.00	5.29	**2.64**	211.16		207.96	12	37.1	0.010	2.20	0.013	3.56	4.54	74%	96%	4.35	0.14
	Impervious	19786	0.454	0.90																					
			0.681	0.73																					
PCB-8	Pervious	10138	0.233	0.40	0.512		5.00		5.00	5.29	**2.71**	211.16	-	207.96	12	22.4	0.010	2.20	0.013	3.56	4.54	76%	97%	4.39	0.09
	Impervious	20275	0.465	0.90																					
			0.698	0.73																					
PDMH-5	-	-	-	-	-	1.012	5.00	0.14	5.14	5.25	**5.31**	212.10	207.59	207.09	18	105.0	0.010	3.01	0.013	10.50	5.94	51%	86%	5.11	0.34
													207.74												
PFES-5	-	-	-	-	-	-	-	-	-	-	-	-	206.04		-	-	-	-	-	-	-	-	-	-	-

Description	Cover	Area (SF)	Total A (Acre)	C	CA	Total CA	To Inlet (MIN)	In Pipe (MIN)	Tc (MIN)	I (IPH)	Q (CFS)	Rim	Inv. (In)	Inv. (Out)	Dia. (IN)	Length (FT)	Slope (FT/FT)	Cover (FT)	n	Qf (CFS)	Vf (FT/S)	Q/Qf (%)	V/Vf (%)	V (FT/S)	L/V (MIN)
FRONT NINE DRIVE - REACH #4																									
PCB-13	Pervious	1024	0.024	0.40	0.162		5.00	NONE	5.00	5.29	**0.86**	210.46	-	208.26	12	15.2	0.005	3.20	0.013	2.52	3.21	34%	77%	2.46	0.10
	Impervious	7396	0.170	0.90																					
			0.193	0.84																					
PCB-12	Pervious	4850	0.111	0.40	0.263		5.00		5.00	5.29	**1.39**	210.46	-	208.26	12	6.9	0.005	3.20	0.013	2.52	3.21	55%	88%	2.83	0.04
	Impervious	10559	0.242	0.90																					
			0.354	0.74																					
PDMH-7	-	-	-	-	-	0.425	5.00	0.04	5.04	5.28	**2.24**	210.59	208.18	208.08	12	165.4	0.005	1.41	0.013	2.52	3.21	89%	101%	3.25	0.85
													208.23												
24" Culvert	Pervious	219388	5.036	0.40	2.574		5.00		5.00	5.29	**13.61**	-	-	207.65	24	24.8	0.020	-	0.013	31.99	10.18	43%	82%	8.32	0.05
	Impervious	27072	0.621	0.90																					
			5.658	0.45																					
PDMH-6	-	-	-	-	-	2.999	5.04	0.85	5.89	5.07	**15.21**	212.13	207.26	207.05	24	16.8	0.020	3.08	0.013	31.99	10.18	48%	84%	8.59	0.03
													207.15												
PFES-6	-	-	-	-	-	-	-	-	-	-	-	-	206.72		-	-	-	-	-	-	-	-	-	-	-

10 YEAR DESIGN STORM - STORMWATER CONVEYANCE SYSTEM

		WATERSHED CHARACTERISTICS										PIPE CHARACTORISTICS								FLOW CHARACTSTICS					
Description	Cover	Area (SF)	Total A (Acre)	C	CA	Total CA	To Inlet (MIN)	In Pipe (MIN)	Tc (MIN)	I (IPH)	Q (CFS)	Rim	Inv. (In)	Inv. (Out)	Dia. (IN)	Length (FT)	Slope (FT/FT)	Cover (FT)	n	Qf (CFS)	Vf (FT/S)	Q/Qf (%)	V/Vf (%)	V (FT/S)	L/V (MIN)
FRONT NINE DRIVE - REACH #5 & PHASE I PARKING AREA																									
PCB-15	Pervious	2167	0.050	0.40	0.255		5.00	NONE	5.00	5.29	**1.35**	199.25	-	195.05	12	16.3	0.005	3.20	0.013	2.52	3.21	54%	87%	2.80	0.10
	Impervious	11394	0.262	0.90																					
			0.311	0.82																					
PCB-16	Pervious	2638	0.061	0.40	0.105		5.00		5.00	5.29	**0.56**	199.25	-	195.05	12	36.2	0.005	3.20	0.013	2.52	3.21	22%	68%	2.17	0.28
	Impervious	3922	0.090	0.90																					
			0.151	0.70																					
PDMH-8	-	-	-	-	-	0.361	5.00	0.28	5.28	5.22	**1.88**	200.60	194.97	194.77	12	181.3	0.005	4.73	0.013	2.52	3.21	75%	96%	3.09	0.98
													194.87												
POS-5	Pervious	0	0.000	0.40	0.206		5.00		5.00	5.29	**1.09**	206.66	-	202.46	12	173.2	0.030	3.20	0.013	6.17	7.86	18%	63%	4.98	0.58
Roof Top	Impervious	9980	0.229	0.90																					
			0.229	0.90																					
PCB-17	Pervious	1090	0.025	0.40	0.370		5.00		5.00	5.29	**1.95**	201.00	-	196.80	12	16.4	0.005	3.20	0.013	2.52	3.21	78%	97%	3.12	0.09
	Impervious	17404	0.400	0.90																					
			0.425	0.87																					
PCB-17A	Pervious	0	0.000	0.40	0.486		5.00		5.00	5.29	**2.57**	202.00	-	197.80	12	11.9	0.010	3.20	0.013	3.56	4.54	72%	95%	4.32	0.05
	Impervious	23520	0.540	0.90																					
			0.540	0.90																					
PDMH-9	-	-	-	-	-	1.422	5.28	0.98	6.26	4.99	**7.09**	201.00	193.86	193.36	18	19.9	0.010	5.64	0.013	10.50	5.94	68%	93%	5.55	0.06
													196.72												
													197.68					-							
													197.26												
PFES-9	-	-	-	-	-	-	-	-	-	-	-	-	193.16		-	-	-	-	-	-	-	-	-	-	-

FRONT NINE DRIVE - REACH #5																									
PCB-19	Pervious	0	0.000	0.40	0.167		5.00	NONE	5.00	5.29	**0.88**	192.28	-	189.08	12	13.3	0.005	2.20	0.013	2.52	3.21	35%	77%	2.48	0.09
	Impervious	8073	0.185	0.90																					
			0.185	0.90																					
PCB-18	Pervious	0	0.000	0.40	0.098		5.00		5.00	5.29	**0.52**	192.39	-	189.19	12	53.7	0.005	2.20	0.013	2.52	3.21	21%	66%	2.12	0.42
	Impervious	4740	0.109	0.90																					
			0.109	0.90																					
PDMH-10 (STORMCEPTOR STC 900)	-	-	-	-	-	0.265	5.00	0.42	5.42	5.18	**1.37**	192.50	189.01	188.82	12	89.0	0.005	2.58	0.013	2.52	3.21	54%	88%	2.82	0.53
													188.92												
PFES-11	-	-	-	-	-	-	-	-	-	-	-	-	188.38	-	-	-	-	-	-	-	-	-	-	-	-

10 YEAR DESIGN STORM - STORMWATER CONVEYANCE SYSTEM

Description	Cover	WATERSHED CHARACTERISTICS Area (SF)	Total A (Acre)	C	CA	Total CA	To Inlet (MIN)	In Pipe (MIN)	Tc (MIN)	I (IPH)	Q (CFS)	PIPE CHARACTORISTICS Rim	Inv. (In)	Inv. (Out)	Dia. (IN)	Length (FT)	Slope (FT/FT)	Cover (FT)	n	FLOW CHARACTSTICS Qf (CFS)	Vf (FT/S)	Q/Qf (%)	V/Vf (%)	V (FT/S)	L/V (MIN)
BACK NINE DRIVE - REACH #1																									
PCB-20	Pervious	4091	0.094	0.40	0.116		5.00		5.00	5.29	**0.61**	191.08	-	187.88	12	25.7	0.005	2.20	0.013	2.52	3.21	24%	69%	2.23	0.19
	Impervious	3778	0.087	0.90																					
			0.181	0.64																					
PCB-21	Pervious	4091	0.094	0.40	0.116	0.231	5.00	0.19	5.00	5.29	**1.22**	191.08		187.88	12	3.1	0.005	2.20	0.013	2.52	3.21	49%	85%	2.72	0.02
	Impervious	3778	0.087	0.90																					
			0.181	0.64																					
PDMH-10A (STORMCEPTOR STC 900)	-	-	-	-	-	0.231	5.00	0.19	5.19	5.24	**1.21**	191.00	187.75 187.86	187.65	12	25.3	0.005	2.25	0.013	2.52	3.21	48%	85%	2.72	0.16
PFES-12	-	-	-	-	-	-	-	-	-	-	-	-	187.53		-	-	-	-	-	-	-	-	-	-	-
BACK NINE DRIVE - REACH #2																									
PCB-22	Pervious	13543	0.311	0.40	0.350		5.00	NONE	5.00	5.29	**1.85**	190.25		186.45	12	21.9	0.005	2.80	0.013	2.52	3.21	73%	96%	3.07	0.12
	Impervious	10898	0.250	0.90																					
			0.561	0.62																					
PCB-23	Pervious	9119	0.209	0.40	0.323		5.00		5.00	5.29	**1.70**	190.25	-	186.45	12	20.7	0.005	2.80	0.013	2.52	3.21	68%	93%	3.00	0.12
	Impervious	11559	0.265	0.90																					
			0.475	0.68																					
PDMH-11	-	-	-	-	-	0.672	5.00	0.12	5.12	5.26	**3.53**	190.00	186.34 186.35	185.84	18	49.1	0.005	2.16	0.013	7.43	4.20	48%	84%	3.55	0.23
PDMH-12	-	-	-	-	-	0.672	5.12	0.23	5.35	5.20	**3.49**	189.63	185.60 -	185.50	18	87.0	0.005	188.13	0.013	7.43	4.20	47%	84%	3.54	0.41
PCB-24	Pervious	1810	0.042	0.40	0.063		5.00	NONE	5.00	5.29	**0.33**	188.50		185.20	12	43.0	0.005	2.30	0.013	2.52	3.21	13%	58%	1.87	0.38
	Impervious	2262	0.052	0.90																					
			0.093	0.68																					
PCB-25	Pervious	20284	0.466	0.40	0.627		5.00		5.00	5.29	**3.31**	188.22	-	184.92	12	25.4	0.010	2.30	0.013	3.56	4.54	93%	103%	4.65	0.09
	Impervious	21339	0.490	0.90																					
			0.956	0.66																					
PDMH-13	-	-	-	-	-	1.363	5.12	0.41	5.53	5.16	**7.03**	189.00	184.67 184.99 185.06	184.14	18	149.0	0.005	2.83	0.013	7.43	4.20	95%	103%	4.33	0.57
PFES-13	-	-	-	-	-	-	-	-	-	-	-	-	183.40		-	-	-	-	-	-	-	-	-	-	-

DATE 5/15/09 TIME 11:15 AM # 1

STILL BRZ WINDY DRY HUMID 70°

LAND USE: WOODS LAWN (MEADOW) GARDEN - RESIDENTIAL COMMERCIAL INDUSTRIAL

SLOPE : NONE (SLIGHT) MODERATE STEEP V- STEEP

LEDGE BOULDERS - NO OUTCROPPINGS

VEGETATION: (CONIFEROUS) DECIDUOUS TREES (GRASS) FAC-WET OBL (UPLAND)

LANDFORM: OUTWASH PLAIN TERRACE KAME ESKER TILL RIDGE DRUMLIN MORAINE LAKEBED

POSITION ON LANDSCAPE: TOP BOTTOM MIDDLE / SLOPE (SADDLE) RIDGE TERRACE

DISTANCES: OPEN WATER BODY +100' POSSIBLE WET AREA +100' Muni/H2O or WELL —

DRAINAGE WAY +100' PROPERTY LINE +100' OTHER —

Rep. JEH BACKHOE MIKE MARONY TOWN WITNESS NONE - DECLINED

DEEP OBSERVATION PIT LOG # 1

STILL TO SEWER OUT = ____

FULL ½ - CELLAR

CRAWL SPACE

Sump pump

PERC @ ____

BEGIN SAT @ +15

@12" @ 9" @ 6"

____MIN / 1"

depth	Soil Horizon or Layer	Soil Matrix color-moist (Munsell)	Redoximorphic Features: Depth	color	percent	Soil Texture (USDA)	Coarse fragments % by volume: gravel	cobbles	Soil Structure	Soil Consistence (moist)
	O a i									
0" TO 12"	A (p) B w g h E Cldgr R Fill	2.5 1 1 / 5 y (yr) 2 2 / 7.5 3 (3) / (10) 4 4 / 1 Gley 5 5 / 2 Gley 6 6 / 7 7 / 8 8		2.5 / 5 (Y) / 7.5 / 10 YR GL		Sand Gravel 1 LS C early 1 L-sm C SL I SiL S ilt	—	—	Gr plty Blck Sq (mass) (-)struct weak strong Compact	(Loose) Friable Firm v. firm hard Cementitious Roots
12" 20"	A p B w g h E Cldgr R Fill	2.5 1 1 / 5 y (yr) 2 2 / 7.5 3 3 / (10) 4 4 / 1 Gley (5) 5 / 2 Gley 6 (6) / 7 7 / 8 8		2.5 / 5 (Y) / 7.5 / 10 YR GL		Sandy LOAM Gr 1 LS C 1 L C SL I SiL S	5%	—	Gr plty Blck Sq (mass) (-)struct weak strong	(Loose) Friable Firm v. firm hard Roots
20" 34"	A p B w g h E (Cl) dgr R Fill	2.5 1 1 / 5 y (yr) 2 2 / 7.5 3 3 / (10) 4 4 / 1 Gley 5 5 / 2 Gley (6) (6) / 7 7 / 8 8		2.5 / 5 Y / 7.5 / 10 YR GL		S Gr 1 (LS) C 1 L C SL I SiL S	15%	—	(Gr) plty (Blck) Sq mass (-)struct weak strong Sat (Damp)	Loose Friable (Firm) v. firm hard Vry Roots Vrgt Stra
34" 56"	B w g h E (C) (2) dgr R Fill	2.5 1 1 / 5 y yr 2 2 / 7.5 3 3 / (10) 4 4 / 1 Gley 5 5 / 2 Gley 6 (6) / 7 7 / 8 8	24"	2.5 / 5 Y / 7.5 / 10 YR (4/3) GL	+/-10%	S Gr 1 (LS) C 1 L C SL I SiL S	15%	10%	(Gr) plty (Blck) Sq mass (-)struct weak strong Sat (Damp)	Loose Friable Firm (v. firm) hard Vr Vrg Str
56"	E C dgr (R) Fill	2.5 1 1 / 5 y yr 2 2 / 7.5 3 3 / 10 4 4 / 1 Gley 5 5 / 2 Gley 6 6 / 7 7 / 8 8		2.5 / 5 Y / 7.5 / 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vrg Str
	C dgr R Fill	2.5 1 1 / 5 y yr 2 2 / 7.5 3 3 / 10 4 4 / 1 Gley 5 5 / 2 Gley 6 6 / 7 7 / 8 8		2.5 / 5 Y / 7.5 / 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm y. firm hard Vr Vr Str

Additional notes: LESS < 48" CI

1/16" – 3" GRAVEL
3" – 12" COBBLES
BONEY
ANGULAR ROUNDED

Depth Weeping from Pit Face: N.A.

Standing Water in the Hole N.A.

2 5/13/09 STILL BRZ WINDY DRY HUMID 70%

LAND USE: WOODS LAWN MEADOW GARDEN - RESIDENTIAL COMMERCIAL INDUSTRIAL
SLOPE : NONE SLIGHT MODERATE STEEP V- STEEP
LEDGE BOULDERS - NONE
VEGETATION: CONIFEROUS DECIDUOUS TREES GRASS FAC-WET OBL UPLAND
LANDFORM: OUTWASH PLAIN TERRACE KAME ESKER TILL RIDGE DRUMLIN MORAINE LAKEBED
POSITION ON LANDSCAPE: TOP BOTTOM MIDDLE / SLOPE SADDLE RIDGE TERRACE
DISTANCES: OPEN WATER BODY +100' POSSIBLE WET AREA +100' Muni/H2O or WELL
DRAINAGE WAY +100' PROPERTY LINE +100' OTHER —

Rep. JEH BACKHOE MM TOWN WITNESS —

FULL ½ - CELLAR
CRAWL SPACE
PERC @
BEGIN SAT @ +15
@12" @ 9" @ 6"
MIN / 1"

DEEP OBSERVATION PIT LOG # 2

depth	Soil Horizon or Layer	Soil Matrix color-moist (Munsell)	Redoximorphic Features: Depth	color	percent	Soil Texture (USDA)	Coarse fragments % by volume: gravel	cobbles	Soil Structure	Soil Consistence (moist)
	O a i									
0" / 8"	A p B w g h E Cldgr R Fill	2.5 1 1; 5 y yr 2 2; 7.5 3 3; 10 4 4; 1 Gley 5 5; 2 Gley 6 6; 7 7; 8 8		2.5 5 Y 7.5 10 YR GL		S Gravel 1 LS C 1 Loam C SL I SiL S silt			Gr plty Blck; Sq mass; (-)struct weak strong	Loose Friable Firm v. firm hard Cementitil Compact Roots
8" / 14"	A p B w g h E Cldgr R Fill	2.5 1 1; 5 y yr 2 2; 7.5 3 3; 10 4 4; 1 Gley 5 5; 2 Gley 6 6; 7 7; 8 8		2.5 5 Y 7.5 10 YR GL		SANDY LOAM Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck; Sq mass; (-)struct weak strong	Loose Friable Firm v. firm hard Roots
14" / 24"	A p B w g h E Cl dgr R Fill	2.5 1 1; 5 y yr 2 2; 7.5 3 3; 10 4 4; 1 Gley 5 5; 2 Gley 6 6; 7 7; 8 8		2.5 5 Y 7.5 10 YR GL		SANDY LOAM Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck; Sq mass; (-)struct weak strong; Sat Damp	Loose Friable Firm FINE v. firm hard Vry Roots Vrgt Stra
24" / 66"	B w g h E Cl dgr R Fill	2.5 1 1; 5 y yr 2 2; 7.5 3 3; 10 4 4; 1 Gley 5 5; 2 Gley 6 6; 7 7; 8 8	48"	2.5 5 Y 7.5 10 YR GL 5/8	+10%	S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck; Sq mass; (-)struct weak strong; Sat Damp	Loose Friable Firm v. firm hard Vr Vr Str
	E C dgr R Fill	2.5 1 1; 5 y yr 2 2; 7.5 3 3; 10 4 4; 1 Gley 5 5; 2 Gley 6 6; 7 7; 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck; Sq mass; (-)struct weak strong; Sat Damp	Loose Friable Firm v. firm hard Vr Vr Str
	C dgr R Fill	2.5 1 1; 5 y yr 2 2; 7.5 3 3; 10 4 4; 1 Gley 5 5; 2 Gley 6 6; 7 7; 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Hvy Blck; Sq mass; (-)struct weak strong; Sat Damp	Loose Friable Firm y. firm hard Vr Vr Str

Additional notes: LESS < 48" C1

1/16" – 3" GRAVEL
3" – 12" COBBLES
BONEY
ANGULAR ROUNDED

Depth Weeping from Pit Face: NONE
Standing Water in the Hole 66"

3 5/13/09 STILL BRZ WINDY DRY HUMID 70°

LAND USE: WOODS LAWN MEADOW GARDEN - RESIDENTIAL COMMERCIAL INDUSTRIAL
SLOPE: NONE SLIGHT MODERATE STEEP V-STEEP
LEDGE BOULDERS NONE
VEGETATION: CONIFEROUS DECIDUOUS TREES GRASS FAC-WET OBL UPLAND
LANDFORM: OUTWASH PLAIN TERRACE KAME ESKER TILL RIDGE DRUMLIN MORAINE LAKEBED
POSITION ON LANDSCAPE: TOP BOTTOM MIDDLE / SLOPE SADDLE RIDGE TERRACE
DISTANCES: OPEN WATER BODY - SEE SKETCH POSSIBLE WET AREA Muni/H2O or WELL
DRAINAGE WAY PROPERTY LINE OTHER

FULL ½ - CELLAR
CRAWL SPACE
PERC @
BEGIN SAT @
+15
@12"
@ 9"
@ 6"
MIN / 1"

Rep. JEH BACKHOE MM TOWN WITNESS

DEEP OBSERVATION PIT LOG # 3

depth	Soil Horizon or Layer	Soil Matrix color-moist (Munsell)	Redoximorphic Features: Depth	color	percent	Soil Texture (USDA)	Coarse fragments % by volume: gravel	cobbles	Soil Structure	Soil Consistence (moist)
	O a i									
0" – 10"	A p B w g h E Cldgr R Fill	2.5 1 1; 5 y yr 2 2; 7.5 3 3; 10 4 4; 1 Gley 5 5; 2 Gley 6 6; 7 7; 8 8		2.5 5 Y 7.5 10 YR GL		Sandy LOAM Gravelly LS C 1 L C SL I SiL S ilt	—	—	Gr plty Blck Sq mass (-)struct weak strong Compact	Loose Friable Firm v. firm hard Cemented Roots
10" – 18"	A p B w g h E Cldgr R Fill	2.5 1 1; 5 y yr 2 2; 7.5 3 3; 10 4 4; 1 Gley 5 5; 2 Gley 6 6; 7 7; 8 8		2.5 5 Y 7.5 10 YR GL		SANDY LOAM Gr 1 LS C 1 L C SL I SiL S	—	—	Gr plty Blck Sq mass (-)struct weak strong	Loose Friable Firm v. firm hard Roots
18" – 42"	A p B w g h E Cl dgr R Fill	2.5 1 1; 5 y yr 2 2; 7.5 3 3; 10 4 4; 1 Gley 5 5; 2 Gley 6 6; 7 7; 8 8	28"	2.5 5 Y 7.5 10 YR 3/6 GL	10%	S Gr 1 LS C 1 L C SL I SiL S	5	5	Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vry Roots Vrgt Strat
42" – 54"	B w g h E Cl2 dgr R Fill	2.5 1 1; 5 y yr 2 2; 7.5 3 3; 10 4 4; 1 Gley 5 5; 2 Gley 6 6; 7 7; 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S	15	6	Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vrg Str
	E C dgr R Fill	2.5 1 1; 5 y yr 2 2; 7.5 3 3; 10 4 4; 1 Gley 5 5; 2 Gley 6 6; 7 7; 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vrg Str
	C dgr R Fill	2.5 1 1; 5 y yr 2 2; 7.5 3 3; 10 4 4; 1 Gley 5 5; 2 Gley 6 6; 7 7; 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vr Str

Additional notes: LESS < 48" Cl

1/16" – 3" GRAVEL
3" – 12" COBBLES
BONEY
ANGULAR ROUNDED

Depth Weeping from Pit Face: 48"
Standing Water in the Hole 54"

4 5/13/09 STILL BRZ WINDY DRY HUMID 70°

LAND USE: WOODS LAWN MEADOW GARDEN - RESIDENTIAL COMMERCIAL INDUSTRIAL
SLOPE : NONE SLIGHT MODERATE STEEP V- STEEP
LEDGE BOULDERS NONE
VEGETATION: CONIFEROUS DECIDUOUS TREES GRASS FAC-WET OBL UPLAND
LANDFORM: OUTWASH PLAIN TERRACE KAME ESKER TILL RIDGE DRUMLIN MORAINE LAKEBED
POSITION ON LANDSCAPE: TOP BOTTOM MIDDLE / SLOPE SADDLE RIDGE TERRACE
DISTANCES: OPEN WATER BODY LAKE STREAM POSSIBLE WET AREA Muni/H2O or WELL
DRAINAGE WAY PROPERTY LINE OTHER

Rep. JER BACKHOE MM TOWN WITNESS

FULL ½ - CELLAR
CRAWL SPACE
PERC @
BEGIN SAT @ +15
@12" @ 9" @ 6"
MIN / 1"

DEEP OBSERVATION PIT LOG # 4

depth	Soil Horizon or Layer	Soil Matrix color-moist (Munsell)	Redoximorphic Features: Depth	color	percent	Soil Texture (USDA)	Coarse fragments % by volume: gravel	cobbles	Soil Structure	Soil Consistence (moist)
	O a i									
0"/16"	A p B w g h E Cldgr R Fill	2.5 1 1; 5 y yr 2 2; 7.5 3 3; 10 4 4; 1 Gley 5 5; 2 Gley 6 6; 7 7; 8 8		2.5 5 Y 7.5 10 YR GL		Sandy Loam Gravel 1 LS C 1 L C SL I SiL S lt			Gr plty Blck Sq mass (-)struct weak strong	Loose Friable Firm v. firm hard cemental Compact Roots
	A p B w g h E Cldgr R Fill	2.5 1 1; 5 y yr 2 2; 7.5 3 3; 10 4 4; 1 Gley 5 5; 2 Gley 6 6; 7 7; 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong	Loose Friable Firm v. firm hard Roots
	A p B w g h E Cl dgr R Fill	2.5 1 1; 5 y yr 2 2; 7.5 3 3; 10 4 4; 1 Gley 5 5; 2 Gley 6 6; 7 7; 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vry Roots Vrgt Strat
	B w g h E Cl dgr R Fill	2.5 1 1; 5 y yr 2 2; 7.5 3 3; 10 4 4; 1 Gley 5 5; 2 Gley 6 6; 7 7; 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vr St
	E C dgr R Fill	2.5 1 1; 5 y yr 2 2; 7.5 3 3; 10 4 4; 1 Gley 5 5; 2 Gley 6 6; 7 7; 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vr Str
	C dgr R Fill	2.5 1 1; 5 y yr 2 2; 7.5 3 3; 10 4 4; 1 Gley 5 5; 2 Gley 6 6; 7 7; 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm y. firm hard Vr Vr Str

Additional notes: LESS < 48" Cl

1/16"–3" GRAVEL
3"–12" COBBLES
BONEY
ANGULAR ROUNDED

Depth Weeping from Pit Face: 16"
Standing Water in the Hole 16"

5 5/13/09 STILL BRZ WINDY DRY HUMID 70°

LAND USE: WOODS LAWN MEADOW GARDEN - RESIDENTIAL COMMERCIAL INDUSTRIAL
SLOPE : NONE SLIGHT MODERATE STEEP V- STEEP
LEDGE BOULDERS NONE
VEGETATION: CONIFEROUS DECIDUOUS TREES GRASS FAC-WET OBL UPLAND
LANDFORM: OUTWASH PLAIN TERRACE KAME ESKER TILL RIDGE DRUMLIN MORAINE LAKEBED
POSITION ON LANDSCAPE: TOP BOTTOM MIDDLE / SLOPE SADDLE RIDGE TERRACE
DISTANCES: OPEN WATER BODY TREE POSSIBLE WET AREA Muni/H2O or WELL
DRAINAGE WAY INLET/OUT PROPERTY LINE OTHER

Rep. JEL BACKHOE MM TOWN WITNESS

FULL ½ - CELLAR
CRAWL SPACE
PERC @
BEGIN SAT @
+15
@12"
@ 9"
@ 6"
MIN / 1"

DEEP OBSERVATION PIT LOG # 5

depth	Soil Horizon or Layer	Soil Matrix color-moist (Munsell)	Redoximorphic Features: Depth	color	percent	Soil Texture (USDA)	Coarse fragments % by volume: gravel	cobbles	Soil Structure	Soil Consistence (moist)
	O a i									
0" / 4"	A p B w g h E C1dgr R Fill	2.5 1 1 / 5 y yr 2 2 / 7.5 3 3 / 10 4 4 / 1 Gley 5 5 / 2 Gley 6 6 / 7 7 / 8 8		2.5 5 Y 7.5 10 YR GL		SANDY LOAM Gravel 1 LS C 1 L C SL I SiL S	—	—	Gr plty Blck Sq mass (-)struct weak strong Compact	Loose Friable Firm v. firm hard Cemented Roots
4" / 10"	A p B w g h E C1dgr R Fill	2.5 1 1 / 5 y yr 2 2 / 7.5 3 3 / 10 4 4 / 1 Gley 5 5 / 2 Gley 6 6 / 7 7 / 8 8		2.5 5 Y 7.5 10 YR GL		SANDY LOAM Gr 1 LS C 1 L C SL I SiL S	—	—	Gr plty Blck Sq mass (-)struct weak strong	Loose Friable Firm v. firm hard Roots
10" / 18"	A p B w g h E C1 dgr R Fill	2.5 1 1 / 5 y yr 2 2 / 7.5 3 3 / 10 4 4 / 1 Gley 5 5 / 2 Gley 6 6 / 7 7 / 8 8	20"	2.5 5 Y 7.5 10 YR GL	3/16	S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vry Roots Vrgt Stra
18"	B w g h E C2 dgr R Fill	2.5 1 1 / 5 y yr 2 2 / 7.5 3 3 / 10 4 4 / 1 Gley 5 5 / 2 Gley 6 6 / 7 7 / 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm Compact v. firm hard Vr Vra Str
	E C dgr R Fill	2.5 1 1 / 5 y yr 2 2 / 7.5 3 3 / 10 4 4 / 1 Gley 5 5 / 2 Gley 6 6 / 7 7 / 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vra Str
	C dgr R Fill	2.5 1 1 / 5 y yr 2 2 / 7.5 3 3 / 10 4 4 / 1 Gley 5 5 / 2 Gley 6 6 / 7 7 / 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm y. firm hard Vr Vr Str

Additional notes: LESS < 48" C1

1/16"–3" GRAVEL
3"–12" COBBLES
BONEY
ANGULAR ROUNDED

Depth Weeping from Pit Face: 32"
Standing Water in the Hole 36"

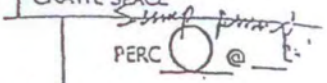
#6

STILL BRZ WINDY DRY HUMID 70°

LAND USE: WOODS LAWN MEADOW GARDEN - RESIDENTIAL COMMERCIAL INDUSTRIAL
SLOPE: NONE SLIGHT MODERATE STEEP V-STEEP
LEDGE BOULDERS NONE
VEGETATION: CONIFEROUS DECIDUOUS TREES GRASS FAC-WET OBL UPLAND
LANDFORM: OUTWASH PLAIN TERRACE KAME ESKER TILL RIDGE DRUMLIN MORAINE LAKEBED
POSITION ON LANDSCAPE: TOP BOTTOM MIDDLE / SLOPE SADDLE RIDGE TERRACE
DISTANCES: OPEN WATER BODY ~~POSSIBLE~~ WET AREA 50'+ Muni/H2O or WELL
DRAINAGE WAY PROPERTY LINE OTHER

Rep. SJW BACKHOE MM TOWN WITNESS NONE

FULL ½ - CELLAR
CRAWL SPACE



PERC @

BEGIN SAT @
+15
@12"
@ 9"
@ 6"
MIN / 1"

DEEP OBSERVATION PIT LOG # 6

depth	Soil Horizon or Layer	Soil Matrix color-moist (Munsell)	Redoximorphic Features: Depth	color	percent	Soil Texture (USDA)	Coarse fragments % by volume: gravel	cobbles	Soil Structure	Soil Consistence (moist)
	O a i									
0" / 10"	A p B w g h E Cldgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		SaL LOAM Gravel 1 LS C 1 L C SL I SiL S Silt			Gr plty Blck Sq mass (-)struct weak strong Compact	Loose Friable Firm v. firm hard cemented Roots
10" / 19"	A p B w g h E Cldgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		SANDY LOAM Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong	Loose Friable Firm v. firm hard Roots
19" / 36"	A p B w g h E Cl dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8	19"	2.5 5 Y 7.5 10 YR GL 3/4	5%	S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vry Roots Vrgt Strat
36" / 60"	B w g h E Cl dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vr Str
	E C dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vr Str
	C dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Hardy Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm y. firm hard Vr Vr Str

Additional notes: LESS < 48" Cl

1/16"–3" GRAVEL
3"–12" COBBLES
BONEY
ANGULAR ROUNDED

Depth Weeping from Pit Face: 36"
Standing Water in the Hole 60"

#

STILL BRZ WINDY DRY HUMID 70°

LAND USE: WOODS LAWN MEADOW GARDEN - RESIDENTIAL COMMERCIAL INDUSTRIAL
SLOPE : NONE SLIGHT MODERATE STEEP V- STEEP
LEDGE BOULDERS NONE
VEGETATION: CONIFEROUS DECIDUOUS TREES GRASS FAC-WET OBL UPLAND
LANDFORM: OUTWASH PLAIN TERRACE KAME ESKER TILL RIDGE DRUMLIN MORAINE LAKEBED
POSITION ON LANDSCAPE: TOP BOTTOM MIDDLE / SLOPE SADDLE RIDGE TERRACE
DISTANCES: OPEN WATER BODY ~~POSSIBLE~~ WET AREA 50'± Muni/H2O or WELL
DRAINAGE WAY PROPERTY LINE OTHER

Rep. SJW BACKHOE MM TOWN WITNESS N/A

DEEP OBSERVATION PIT LOG # 7

FULL ½ - CELLAR
CRAWL SPACE
Sump pump
PERC @
BEGIN SAT @
+15
@12"
@ 9"
@ 6"
MIN / 1"

depth	Soil Horizon or Layer	Soil Matrix color-moist (Munsell)	Redoximorphic Features: Depth	color	percent	Soil Texture (USDA)	Coarse fragments % by volume: gravel	cobbles	Soil Structure	Soil Consistence (moist)
	O a i									
0" / 12"	A p B w g h E Cldgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		SANDY LOAM Gravel 1 LS C sand 1 Loam C SL I SiL S silt			Gr plty Blck Sq mass (-)struct weak strong Cemented Conglom	Loose Friable Firm v. firm hard Roots
12" / 22"	A p B w g h E Cldgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		SANDY LOAM Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong	Loose Friable Firm v. firm hard Roots
22" / 36"	A p B w g h E Cl dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8	24"	2.5 5 Y 7.5 10 YR GL 5/0	10%	S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vry Roots Vrgt Stra
36" / 58"	B w g h E Cl dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		~~2.5~~ ~~5 Y~~ 7.5 10 YR GL ~~5/0~~		S Gr 1 loam LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vrg Str
	E C dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vrg Str
	C dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm y. firm hard Vr Vr Str

Additional notes: LESS < 48" CI

1/16" – 3" GRAVEL
3" – 12" COBBLES
BOULDERS
ANGULAR ROUNDED

Depth Weeping from Pit Face: 24"
Standing Water in the Hole 58"

8 5/13/09 STILL BRZ WINDY DRY HUMID 72°

LAND USE: WOODS LAWN MEADOW GARDEN - RESIDENTIAL COMMERCIAL INDUSTRIAL

SLOPE : NONE SLIGHT MODERATE STEEP V- STEEP

LEDGE BOULDERS NOT OBSERVED

VEGETATION: CONIFEROUS DECIDUOUS TREES GRASS FAC-WET OBL UPLAND

LANDFORM: OUTWASH PLAIN TERRACE KAME ESKER TILL RIDGE DRUMLIN MORAINE LAKEBED

POSITION ON LANDSCAPE: TOP BOTTOM MIDDLE / SLOPE SADDLE RIDGE TERRACE

DISTANCES: OPEN WATER BODY SEE POSSIBLE WET AREA Muni/H2O or WELL

DRAINAGE WAY SKETCH PROPERTY LINE OTHER

Rep. JEN BACKHOE MM TOWN WITNESS

FULL ½ - CELLAR CRAWL SPACE

PERC @

BEGIN SAT @ +15

@12" @ 9" @ 6" MIN / 1"

DEEP OBSERVATION PIT LOG # 8

depth	Soil Horizon or Layer	Soil Matrix color-moist (Munsell)	Redoximorphic Features: Depth	color	percent	Soil Texture (USDA)	Coarse fragments % by volume: gravel	cobbles	Soil Structure	Soil Consistence (moist)
	O a i									
0" 6"	A p B w g h E Cldgr R Fill	2.5 5 y yr 7.5 10 1 Gley 2 Gley; 1 2 3 4 5 6 7 8		2.5 5 Y 7.5 10 YR GL		Sandy LoAm Gravel 1 LS C 1 L C SL I SiL S	—	—	Gr plty Blck Sq mass (-)struct weak strong	Loose Friable Firm v. firm hard Roots
6" 16"	A p B w g h E Cldgr R Fill	2.5 5 y yr 7.5 10 1 Gley 2 Gley; 1 2 3 4 5 6 7 8		2.5 5 Y 7.5 10 YR GL		Sandy LoAm Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong	Loose Friable Firm v. firm hard Roots
16" 46"	A p B w g h E Cl dgr R Fill	2.5 5 y yr 7.5 10 1 Gley 2 Gley; 1 2 3 4 5 6 7 8	18"	2.5 5 Y 7.5 10 YR GL	5/8 10%	S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vry Roots Vrgt Stra
	B w g h E Cl dgr R Fill	2.5 5 y yr 7.5 10 1 Gley 2 Gley; 1 2 3 4 5 6 7 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vrg Str
	E C dgr R Fill	2.5 5 y yr 7.5 10 1 Gley 2 Gley; 1 2 3 4 5 6 7 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vrg Str
	C dgr R Fill	2.5 5 y yr 7.5 10 1 Gley 2 Gley; 1 2 3 4 5 6 7 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm y. firm hard Vr Vr Str

Additional notes: LESS < 48" C1

1/16"–3" GRAVEL
3"–12" COBBLES
BONEY
ANGULAR ROUNDED

Depth Weeping from Pit Face: 24"

Standing Water in the Hole 46"

9 — 5/17 — STILL BRZ WINDY DRY HUMID 70°

LAND USE: WOODS LAWN MEADOW GARDEN - RESIDENTIAL COMMERCIAL INDUSTRIAL

SLOPE : NONE SLIGHT MODERATE STEEP V- STEEP

LEDGE BOULDERS NONE

VEGETATION: CONIFEROUS DECIDUOUS TREES GRASS FAC-WET OBL UPLAND

LANDFORM: OUTWASH PLAIN TERRACE KAME ESKER TILL RIDGE DRUMLIN MORAINE LAKEBED

POSITION ON LANDSCAPE: TOP BOTTOM MIDDLE / SLOPE SADDLE RIDGE TERRACE

DISTANCES: OPEN WATER BODY SEE SKETCH POSSIBLE WET AREA Muni/H2O or WELL

DRAINAGE WAY PROPERTY LINE OTHER

Rep. JEH BACKHOE MM TOWN WITNESS —

FULL ½ - CELLAR CRAWL SPACE

PERC @

BEGIN SAT @ +15

@12" @ 9" @ 6" MIN / 1"

DEEP OBSERVATION PIT LOG # 9

depth	Soil Horizon or Layer	Soil Matrix color-moist (Munsell)	Redoximorphic Features: Depth	color	percent	Soil Texture (USDA)	Coarse fragments % by volume: gravel	cobbles	Soil Structure	Soil Consistence (moist)
	O a i									
OR	A p B w g h E C1dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		SAND LOAM Gr 1 LS C 1 L C SL I SiL S lt	—	—	Gr plty Blck Sq mass (-)struct weak strong	Loose Friable Firm v. firm hard Roots
	A p B w g h E C1dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		SAND-FINE Gr 1 LS C 1 L C SL I SiL S	—	—	Gr plty Blck Sq mass (-)struct weak strong	Loose Friable Firm v. firm hard Roots
	A p B w g h E Cl dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8	24"	2.5 5 Y 7.5 10 YR GL	5/8	SANDY LOAM Gr 1 LS C 1 L C SL I SiL S	20%	10%	Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vry Roots Vrgt Strat
	B w g h E Cl dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vrg Str
	E C dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vrg Str
	C dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm y. firm hard Vr Vr Str

Additional notes: LESS < 48" Ci

1/16"–3" GRAVEL
3"–12" COBBLES
BONEY
ANGULAR ROUNDED

Depth Weeping from Pit Face: 20"

Standing Water in the Hole 24"

DATE: TIME: 5/13 700

10 STILL BRZ WINDY DRY HUMID

LAND USE: WOODS LAWN MEADOW GARDEN - RESIDENTIAL COMMERCIAL INDUSTRIAL

SLOPE : NONE SLIGHT MODERATE STEEP V- STEEP

LEDGE BOULDERS

VEGETATION: CONIFEROUS DECIDUOUS TREES GRASS FAC-WET OBL UPLAND

LANDFORM: OUTWASH PLAIN TERRACE KAME ESKER TILL RIDGE DRUMLIN MORAINE LAKEBED

POSITION ON LANDSCAPE: TOP BOTTOM MIDDLE / SLOPE SADDLE RIDGE TERRACE

DISTANCES: OPEN WATER BODY SEE SKETCH POSSIBLE WET AREA Muni/H2O or WELL

DRAINAGE WAY PROPERTY LINE OTHER

Rep. JEL BACKHOE MK TOWN WITNESS

STILL TO SEWER OUT = ____

FULL ½ - CELLAR

CRAWL SPACE

Sump pump

PERC @ ____

BEGIN SAT @ +15

@12" ____

@ 9" ____

@ 6" ____

____ MIN / 1"

DEEP OBSERVATION PIT LOG # 10

depth	Soil Horizon or Layer	Soil Matrix color-moist (Munsell)	Redoximorphic Features: Depth	color	percent	Soil Texture (USDA)	Coarse fragments % by volume: gravel	cobbles	Soil Structure	Soil Consistence (moist)
	O a i									
0" / 12"	A p B w g h E Cldgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		SANDY LOAM Gravel 1 LS C sand 1 L C SL I SiL S silt	—	—	Gr plty Blck Sq mass (-)struct weak strong Compact	Loose Friable Firm v. firm hard cemented Roots
12" / 16"	A p B w g h E Cldgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		SAND-FINE Gr 1 LS C 1 L C SL I SiL S	—	—	Gr plty Blck Sq mass (-)struct weak strong	Loose Friable Firm v. firm hard Roots
16" / 80"	A p B w g h E Cl dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8	32"	2.5 5 Y 7.5 10 YR GL	5/8 10	S Gr 1 LS C 1 L C SL I SiL S	15	15	Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Roots Vrgt Stra
	B w g h E Cl dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vrg Str
	E C dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vrg Str
	C dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vrg Str

Additional notes: LESS < 48" CI

1/16"–3" GRAVEL
3"–12" COBBLES
BONEY
ANGULAR ROUNDED

Depth Weeping from Pit Face: 50"

Standing Water in the Hole 80"

1 (1ST TEE)

STILL BRZ WINDY DRY HUMID

LAND USE: WOODS LAWN MEADOW GARDEN - RESIDENTIAL COMMERCIAL INDUSTRIAL
SLOPE: NONE SLIGHT MODERATE STEEP V-STEEP
LEDGE BOULDERS
VEGETATION: CONIFEROUS DECIDUOUS TREES GRASS FAC-WET OBL UPLAND
LANDFORM: OUTWASH PLAIN TERRACE KAME ESKER TILL RIDGE DRUMLIN MORAINE LAKEBED
POSITION ON LANDSCAPE: TOP BOTTOM MIDDLE / SLOPE SADDLE RIDGE TERRACE
DISTANCES: OPEN WATER BODY POSSIBLE WET AREA Muni/H2O or WELL
DRAINAGE WAY PROPERTY LINE OTHER

SIL TO SEWER OUT =
FULL Yr - CELLAR
CRAWL SPACE
PERC @
BEGIN SAT @
+15
@12"
@ 9"
@ 6"
MIN / 1"

Rep. SC BACKHOE mm TOWN WITNESS

DEEP OBSERVATION PIT LOG # 11

depth	Soil Horizon or Layer	Soil Matrix color-moist (Munsell)	Redoximorphic Features: Depth	color	percent	Soil Texture (USDA)	Coarse fragments % by volume: gravel	cobbles	Soil Structure	Soil Consistence (moist)
	O a i									H2O. OBSER. @ 30"
0-18	(A) (p) B w g h E Cldgr R \ Fill	2.5 1 (1) 5 y yr 2 2 7.5 (3) 3 (10) 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		S Gravel 1 LS C 1 L C (SL) I SiL S lt			Gr plty (Blck) Sq mass (-)struct weak strong Compact	(Friable) Firm v. firm hard Cemental Roots
18-28	A p (B) w g h E Cldgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 (10) 4 4 1 Gley 5 5 2 Gley (6) 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C (SL) I SiL S			Gr plty (Blck) Sq mass (-)struct weak strong	Loose (Friable) Firm v. firm hard Roots
28-38	A p B w g h E (Cl) dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 (10) 4 4 1 Gley 5 5 2 Gley (6) (6) 7 7 8 8		2.5 5 Y 7.5 10 YR GL @ 32"		S Gr 1 (LS) C 1 L C SL I SiL S			Gr plty Blck Sq (mass) (-)struct weak strong (Sat Damp)	Loose (Friable) Firm v. firm hard Vr Roots Vrgt Strat
38-60"	B w g h E (Cl) dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 (10) 4 4 1 Gley 5 5 2 Gley (6) 6 7 7 8 (8)		2.5 5 Y 7.5 10 YR GL		S (Gr) 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq (mass) (-)struct weak strong Sat Damp	Loose Friable (Firm) v. firm hard Vr Vrg Str
	E C dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vrg Str
	C dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vr Str

Additional notes: LESS < 48" Ci

1/16"—3" GRAVEL
3"—12" COBBLES
BONEY
ANGULAR ROUNDED

Depth Weeping from Pit Face: —
Standing Water in the Hole —

STILL BRZ WINDY DRY HUMID

LAND USE: WOODS LAWN MEADOW GARDEN - RESIDENTIAL COMMERCIAL INDUSTRIAL
SLOPE : NONE SLIGHT MODERATE STEEP V- STEEP
LEDGE BOULDERS
VEGETATION: CONIFEROUS DECIDUOUS TREES GRASS FAC-WET OBL UPLAND
LANDFORM: OUTWASH PLAIN TERRACE KAME ESKER TILL RIDGE DRUMLIN MORAINE LAKEBED
POSITION ON LANDSCAPE: TOP BOTTOM MIDDLE / SLOPE SADDLE RIDGE TERRACE
DISTANCES: OPEN WATER BODY POSSIBLE WET AREA Muni/H2O or WELL
DRAINAGE WAY PROPERTY LINE OTHER

Rep. SC BACKHOE mon TOWN WITNESS

DEEP OBSERVATION PIT LOG # B

SIZE TO SEPTIC OUT =
FULL ½ - CELLAR
CRAWL SPACE

PERC @

BEGIN SAT @
+15

@12"
@ 9"
@ 6"
MIN / 1"

depth	Soil Horizon or Layer	Soil Matrix color-moist (Munsell)	Redoximorphic Features: Depth	color	percent	Soil Texture (USDA)	Coarse fragments % by volume: gravel	cobbles	Soil Structure	Soil Consistence (moist)
	O a i								SUIT @ 20"	H2O OBS @ 50"
0-8"	A p B w g h E Cldgr R Fill	2.5 1 1 / 5 y yr 2 2 / 7.5 3 3 / 10 4 4 / 1 Gley 5 5 / 2 Gley 6 6 / 7 7 / 8 8		2.5 5 Y 7.5 10 YR GL		Sand Loam/SOD Gravel 1 LS C clay 1 L C SL I SiL Silt			Gr plty Blck Sq mass (-)struct weak strong Compact	Loose Friable Firm v. firm hard Cemental Roots
8-24	A p B w g h E Cldgr R Fill	2.5 1 1 / 5 y yr 2 2 / 7.5 3 3 / 10 4 4 / 1 Gley 5 5 / 2 Gley 6 6 / 7 7 / 8 8		2.5 5 Y 7.5 5/8 10 YR GL @ 20		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong	Loose Friable Firm v. firm hard Roots
24-68	A p B w g h E Cl dgr R Fill	2.5 1 1 / 5 y yr 2 2 / 7.5 3 3 / 10 4 4 / 1 Gley 5 5 / 2 Gley 6 6 / 7 7 / 8 8		2.5 5 Y 7.5 5/8 10 YR GL		SAND Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vry Roots Vrgt Strat
	B w g h E Cl dgr R Fill	2.5 1 1 / 5 y yr 2 2 / 7.5 3 3 / 10 4 4 / 1 Gley 5 5 / 2 Gley 6 6 / 7 7 / 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vri Str
	E C dgr R Fill	2.5 1 1 / 5 y yr 2 2 / 7.5 3 3 / 10 4 4 / 1 Gley 5 5 / 2 Gley 6 6 / 7 7 / 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vri Str
	C dgr R Fill	2.5 1 1 / 5 y yr 2 2 / 7.5 3 3 / 10 4 4 / 1 Gley 5 5 / 2 Gley 6 6 / 7 7 / 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vri Str

Additional notes: LESS < 48" C1

1/16"–3" GRAVEL
3"–12" COBBLES
BONEY
ANGULAR ROUNDED

Depth Weeping from Pit Face: _
Standing Water in the Hole _

_____ STILL BRZ WINDY DRY HUMID

LAND USE: WOODS LAWN MEADOW GARDEN - RESIDENTIAL COMMERCIAL INDUSTRIAL
SLOPE : NONE SLIGHT MODERATE STEEP V- STEEP
LEDGE BOULDERS
VEGETATION: CONIFEROUS DECIDUOUS TREES GRASS FAC-WET OBL UPLAND
LANDFORM: OUTWASH PLAIN TERRACE KAME ESKER TILL RIDGE DRUMLIN MORAINE LAKEBED
POSITION ON LANDSCAPE: TOP BOTTOM MIDDLE / SLOPE SADDLE RIDGE TERRACE
DISTANCES: OPEN WATER BODY POSSIBLE WET AREA Muni/H2O or WELL
DRAINAGE WAY PROPERTY LINE OTHER

STU TO SEWER OUT = ____
FULL ½ - CELLAR
CRAWL SPACE

PERC ____ @ ____

BEGIN SAT @
+15
@12" ____
@ 9" ____
@ 6" ____
____MIN / 1"

Rep. SC BACKHOE MM TOWN WITNESS ____

DEEP OBSERVATION PIT LOG # 4

depth	Soil Horizon or Layer	Soil Matrix color-moist (Munsell)	Redoximorphic Features: Depth	color	percent	Soil Texture (USDA)	Coarse fragments % by volume: gravel	cobbles	Soil Structure	Soil Consistence (moist)
	O a i							SHWT @ 38"		
0-6"	A p B w g h E Cldgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		S and Gravel 1 LS C 1 L C SL I SiL S lt			Gr plty Blck Sq mass (-)struct weak strong	Loose Friable Firm v. firm hard Cemented Compact Roots
6-24"	A p B w g h E Cldgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong	Loose Friable Firm v. firm hard Roots
24-72"	A p B w g h E Cl dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 5/8 10 YR GL @ 38		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vry Roots Vrgt Strat
	B w g h E Cl dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 sm LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vr Str
	E C dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vr Str
	C dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vr Str

Additional notes: LESS < 48" C1

1/16"–3" GRAVEL
3"–12" COBBLES
BOKEY
ANGULAR ROUNDED

Depth Weeping from Pit Face: ____
Standing Water in the Hole ____

_____ STILL BRZ WINDY DRY HUMID

LAND USE: WOODS LAWN MEADOW GARDEN - RESIDENTIAL COMMERCIAL INDUSTRIAL
SLOPE : NONE SLIGHT MODERATE STEEP V- STEEP
LEDGE BOULDERS
VEGETATION: CONIFEROUS DECIDUOUS TREES GRASS FAC-WET OBL UPLAND
LANDFORM: OUTWASH PLAIN TERRACE KAME ESKER TILL RIDGE DRUMLIN MORAINE LAKEBED
POSITION ON LANDSCAPE: TOP BOTTOM MIDDLE / SLOPE SADDLE RIDGE TERRACE
DISTANCES: OPEN WATER BODY POSSIBLE WET AREA Muni/H2O or WELL
DRAINAGE WAY PROPERTY LINE OTHER

Rep. SC BACKHOE Ron TOWN WITNESS

DEEP OBSERVATION PIT LOG # 15

BSC TO SEWER OUT = ____
FULL ½ - CELLAR
CRAWL SPACE
Sump pump
PERC @ ____
BEGIN SAT @
+15
@12"
@ 9"
@ 6"
____MIN / 1"

depth	Soil Horizon or Layer	Soil Matrix color-moist (Munsell)	Redoximorphic Features: Depth	color	percent	Soil Texture (USDA)	Coarse fragments % by volume: gravel	cobbles	Soil Structure	Soil Consistence (moist)
	O a i									
10"	A p B w g h E Cldgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		S and Gravel 1 LS C 1 L C SL I SiL S ilt			Gr plty Blck Sq mass (-)struct weak strong Compact	Loose Friable Firm v. firm hard Cementitl Roots
24"	A p B w g h E Cldgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong	Loose Friable Firm v. firm hard Roots
62"	A p B w g h E Cl dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vry Roots Vrgt Strat
	B w g h E Cl dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vr Str
	E C dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vr Str
	C dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vr Str

Additional notes: LESS < 48" CI

• 1/16"–3" GRAVEL
3"–12" COBBLES
BONEY
ANGULAR ROUNDED

Depth Weeping from Pit Face: ____
Standing Water in the Hole ____

_____ STILL BRZ WINDY DRY HUMID

LAND USE: WOODS LAWN MEADOW GARDEN - RESIDENTIAL COMMERCIAL INDUSTRIAL
SLOPE : NONE SLIGHT MODERATE STEEP V- STEEP
LEDGE BOULDERS
VEGETATION: CONIFEROUS DECIDUOUS TREES GRASS FAC-WET OBL UPLAND
LANDFORM: OUTWASH PLAIN TERRACE KAME ESKER TILL RIDGE DRUMLIN MORAINE LAKEBED
POSITION ON LANDSCAPE: TOP BOTTOM MIDDLE / SLOPE SADDLE RIDGE TERRACE
DISTANCES: OPEN WATER BODY POSSIBLE WET AREA Muni/H2O or WELL
DRAINAGE WAY PROPERTY LINE OTHER

Rep. SC BACKHOE mm TOWN WITNESS _____

STILL TO SEWER OUT = ____
FULL ½ - CELLAR
CRAWL SPACE

PERC @ ____

BEGIN SAT @ ____
+15 ____
@12" ____
@ 9" ____
@ 6" ____
____MIN / 1"

DEEP OBSERVATION PIT LOG # 16

depth	Soil Horizon or Layer	Soil Matrix color-moist (Munsell)	Redoximorphic Features: Depth	color	percent	Soil Texture (USDA)	Coarse fragments % by volume: gravel	cobbles	Soil Structure	Soil Consistence (moist)
	O a i									H2O OBS @ 24"
0-12"	A p B w g h E Cldgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		S sil Gravel 1 LS C 1 L C SL I SiL S lt			Gr plty Blck Sq mass (-)struct weak strong Compact	Loose Friable Firm v. firm hard cemented Roots
12"-28"	A p B w g h E Cldgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong	Loose Friable Firm v. firm hard Roots
28-60	A p B w g h E Cl dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vry Roots Vrgt Strat
	B w g h E Cl dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vr Str
	E C dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vr Str
	C dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vr Str

Additional notes: LESS < 48" CI

• 1/16"–3" GRAVEL
3"–12" COBBLES
BONEY
ANGULAR ROUNDED

Depth Weeping from Pit Face: ____
Standing Water in the Hole ____

_____ STILL BRZ WINDY DRY HUMID

LAND USE: WOODS LAWN MEADOW GARDEN - RESIDENTIAL COMMERCIAL INDUSTRIAL
SLOPE : NONE SLIGHT MODERATE STEEP V- STEEP
LEDGE BOULDERS
VEGETATION: CONIFEROUS DECIDUOUS TREES GRASS FAC-WET OBL UPLAND
LANDFORM: OUTWASH PLAIN TERRACE KAME ESKER TILL RIDGE DRUMLIN MORAINE LAKEBED
POSITION ON LANDSCAPE: TOP BOTTOM MIDDLE / SLOPE SADDLE RIDGE TERRACE
DISTANCES: OPEN WATER BODY POSSIBLE WET AREA Muni/H2O or WELL
DRAINAGE WAY PROPERTY LINE OTHER

Rep. SC BACKHOE ZOW TOWN WITNESS

STU TO SEWER OUT = ____
FULL ½ - CELLAR
CRAWL SPACE

PERC @ ____

BEGIN SAT @
+15
@12"
@ 9"
@ 6"
____MIN / 1"

DEEP OBSERVATION PIT LOG # 7

depth	Soil Horizon or Layer	Soil Matrix color-moist (Munsell)	Redoximorphic Features Depth	color	percent	Soil Texture (USDA)	Coarse fragments % by volume gravel	cobbles	Soil Structure	Soil Consistence (moist)
	O a i							SHST @ 30"		
0-12"	A p B w g h E Cldgr R Fill	2.5 1 1 / 5 y yr 2 2 / 7.5 3 / 10 4 4 / 1 Gley 5 5 / 2 Gley 6 6 / 7 7 / 8 8		2.5 5 Y 7.5 10 YR GL		S Gravel 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Cement Compact	Loose Friable Firm v. firm hard Roots
24"	A p B w g h E Cldgr R Fill	2.5 1 1 / 5 y yr 2 2 / 7.5 3 3 / 10 4 4 / 1 Gley 5 5 / 2 Gley 6 6 / 7 7 / 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong	Loose Friable Firm v. firm hard Roots
38"	A p B w g h E Cl dgr R Fill	2.5 1 1 / 5 y yr 2 2 / 7.5 3 3 / 10 4 4 / 1 Gley 5 5 / 2 Gley 6 6 / 7 7 / 8 8		2.5 5 Y 7.5 5/8 10 YR GL @ 30"		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vry Roots Vrgt Stra
68"	B w g h E Cl dgr R Fill	2.5 1 1 / 5 y yr 2 2 / 7.5 3 3 / 10 4 4 / 1 Gley 5 5 / 2 Gley 6 6 / 7 7 / 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vr Str
	E C dgr R Fill	2.5 1 1 / 5 y yr 2 2 / 7.5 3 3 / 10 4 4 / 1 Gley 5 5 / 2 Gley 6 6 / 7 7 / 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vr Str
	C dgr R Fill	2.5 1 1 / 5 y yr 2 2 / 7.5 3 3 / 10 4 4 / 1 Gley 5 5 / 2 Gley 6 6 / 7 7 / 8 8		2.5 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm y. firm hard Vr Vr Str

Additional notes: LESS < 48" CI

1/16" – 3" GRAVEL
3" – 12" COBBLES
BONEY
ANGULAR ROUNDED

Depth Weeping from Pit Face: ___
Standing Water in the Hole ____

#

STILL BRZ WINDY DRY HUMID

LAND USE: WOODS LAWN MEADOW GARDEN - RESIDENTIAL COMMERCIAL INDUSTRIAL

SLOPE: NONE SLIGHT MODERATE STEEP V- STEEP

LEDGE BOULDERS

VEGETATION: CONIFEROUS DECIDUOUS TREES GRASS FAC-WET OBL UPLAND

LANDFORM: OUTWASH PLAIN TERRACE KAME ESKER TILL RIDGE DRUMLIN MORAINE LAKEBED

POSITION ON LANDSCAPE: TOP BOTTOM MIDDLE / SLOPE SADDLE RIDGE TERRACE

DISTANCES: OPEN WATER BODY POSSIBLE WET AREA Muni/H2O or WELL

DRAINAGE WAY PROPERTY LINE OTHER

Rep. SC BACKHOE Ron TOWN WITNESS

DEEP OBSERVATION PIT LOG # 18

STILL TO SEWER OUT =

FULL ☐ - CELLAR

CRAWL SPACE

PERC @

BEGIN SAT @

+15

@12"

@ 9"

@ 6"

MIN / 1"

depth	Soil Horizon or Layer	Soil Matrix color-moist (Munsell)	Redoximorphic Features: Depth	color	percent	Soil Texture (USDA)	Coarse fragments % by volume: gravel	cobbles	Soil Structure	Soil Consistence (moist)
	O a i								SHWT @ 28"	
12"	A p B w g h E Cldgr R Fill	2.5 1 1 / 5 y yr 2 2 / 7.5 3 3 / 10 4 4 / 1 Gley 5 5 / 2 Gley 6 6 / 7 7 / 8 8		2.5 / 5 Y / 7.5 / 10 YR / GL		S Sa Gravel 1 LS C I L C SL I SiL S Silt			Gr plty Blck Sq mass (-)struct weak strong	Loose Friable Firm v. firm hard Cemental Compact Roots
28"	A p B w g h E Cldgr R Fill	2.5 1 1 / 5 y yr 2 2 / 7.5 3 3 / 10 4 4 / 1 Gley 5 5 / 2 Gley 6 6 / 7 7 / 8 8		2.5 / 5 Y / 7.5 / 10 YR 5/8 / GL @ 22"		S Gr 1 LS C I L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong	Loose Friable Firm v. firm hard Roots
42"	A p B w g h E Cl dgr R Fill	2.5 1 1 / 5 y yr 2 2 / 7.5 3 3 / 10 4 4 / 1 Gley 5 5 / 2 Gley 6 6 / 7 7 / 8 8		2.5 / 5 Y / 7.5 / 10 YR / GL		S Gr 1 LS C I L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vry Roots Vrgt Strat
	B w g h E Cl dgr R Fill	2.5 1 1 / 5 y yr 2 2 / 7.5 3 3 / 10 4 4 / 1 Gley 5 5 / 2 Gley 6 6 / 7 7 / 8 8		2.5 / 5 Y / 7.5 / 10 YR / GL		S Gr 1 LS C I L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vr Str
	E C dgr R Fill	2.5 1 1 / 5 y yr 2 2 / 7.5 3 3 / 10 4 4 / 1 Gley 5 5 / 2 Gley 6 6 / 7 7 / 8 8		2.5 / 5 Y / 7.5 / 10 YR / GL		S Gr 1 LS C I L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vr Str
	C dgr R Fill	2.5 1 1 / 5 y yr 2 2 / 7.5 3 3 / 10 4 4 / 1 Gley 5 5 / 2 Gley 6 6 / 7 7 / 8 8		2.5 / 5 Y / 7.5 / 10 YR / GL		S Gr 1 LS C I L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vr Str

Additional notes: LESS < 48" C1

1/16" – 3" GRAVEL
3" – 12" COBBLES
BONEY
ANGULAR ROUNDED

Depth Weeping from Pit Face: ___

Standing Water in the Hole ___

_____ STILL BRZ WINDY DRY HUMID

LAND USE: WOODS LAWN MEADOW GARDEN - RESIDENTIAL COMMERCIAL INDUSTRIAL
SLOPE : NONE SLIGHT MODERATE STEEP V-STEEP
LEDGE BOULDERS
VEGETATION: CONIFEROUS DECIDUOUS TREES GRASS FAC-WET OBL UPLAND
LANDFORM: OUTWASH PLAIN TERRACE KAME ESKER TILL RIDGE DRUMLIN MORAINE LAKEBED
POSITION ON LANDSCAPE: TOP BOTTOM MIDDLE / SLOPE SADDLE RIDGE TERRACE
DISTANCES: OPEN WATER BODY POSSIBLE WET AREA Muni/H2O or WELL
DRAINAGE WAY PROPERTY LINE OTHER
Rep. SC BACKHOE Ron TOWN WITNESS

SLL TO SEWER OUT = ____
FULL ½ - CELLAR
CRAWL SPACE
PERC @ ____
BEGIN SAT @ +15
@12" ____
@ 9" ____
@ 6" ____
MIN / 1"

DEEP OBSERVATION PIT LOG #19

depth	Soil Horizon or Layer	Soil Matrix color-moist (Munsell)	Redoximorphic Features: Depth	color	percent	Soil Texture (USDA)	Coarse fragments % by volume: gravel	cobbles	Soil Structure	Soil Consistence (moist)
	O a i									
6"	A p B w g h E Cldgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 Y 5 Y 7.5 10 YR GL		S Sand Gravel 1 LS C early 1 L ate C SL I SiL S Silt			Gr plty Blck Sq mass (-)struct weak strong	Loose Friable Firm v. firm hard Cemental Compact Roots
18"	A p B w g h E Cldgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 Y 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong	Loose Friable Firm v. firm hard Roots
60"	A p B w g h E Cl dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 Y 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vry Roots Vrgt Stra
	B w g h E Cl dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 Y 5 Y 7.5 10 YR GL		S Gr 1 lower LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vr Str
	E C dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 Y 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vr Str
	C dgr R Fill	2.5 1 1 5 y yr 2 2 7.5 3 3 10 4 4 1 Gley 5 5 2 Gley 6 6 7 7 8 8		2.5 Y 5 Y 7.5 10 YR GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vr Str

Additional notes: LESS < 48" C1

1/16" – 3" GRAVEL
3" – 12" COBBLES
BONEY
ANGULAR ROUNDED

Depth Weeping from Pit Face: ____
Standing Water in the Hole ____

#1

STILL BRZ WINDY DRY HUMID

LAND USE: WOODS LAWN MEADOW GARDEN - RESIDENTIAL COMMERCIAL INDUSTRIAL

SLOPE: NONE SLIGHT MODERATE STEEP V-STEEP

LEDGE BOULDERS

VEGETATION: CONIFEROUS DECIDUOUS TREES GRASS FAC-WET OBL UPLAND

LANDFORM: OUTWASH PLAIN TERRACE KAME ESKER TILL RIDGE DRUMLIN MORAINE LAKEBED

POSITION ON LANDSCAPE: TOP BOTTOM MIDDLE / SLOPE SADDLE RIDGE TERRACE

DISTANCES: OPEN WATER BODY POSSIBLE WET AREA Muni/H2O or WELL

DRAINAGE WAY PROPERTY LINE OTHER

Rep. S.C. BACKHOE ROD TOWN WITNESS

DEEP OBSERVATION PIT LOG #20

SIZE TO SEPTIC OUT = ____

FULL ½ - CELLAR

CRAWL SPACE

Simple Pass

PERC @ ____

BEGIN SAT @

+15

@12" ____

@ 9" ____

@ 6" ____

MIN / 1" ____

depth	Soil Horizon or Layer	Soil Matrix color-moist (Munsell)	Redoximorphic Features: Depth	color	percent	Soil Texture (USDA)	Coarse fragments % by volume: gravel	cobbles	Soil Structure	Soil Consistence (moist)
	O a i									
10"	A p B w g h E C1dgr R Fill	2.5 1 1 / 5 y yr 2 2 / 7.5 3 3 / 10 4 4 / 1 Gley 5 5 / 2 Gley 6 6 / 7 7 / 8 8		2.5 / 5 Y / 7.5 / 10 YR / GL		S Gravel 1 LS C L C SL I SiL S Silt			Gr plty Blck / Sq mass (-)struct weak strong Compact	Loose Friable Firm v. firm hard Cemented Roots
22"	A p B w g h E C1dgr R Fill	2.5 1 1 / 5 y yr 2 2 / 7.5 3 3 / 10 4 4 / 1 Gley 5 5 / 2 Gley 6 6 / 7 7 / 8 8		2.5 / 5 Y / 7.5 / 10 YR / GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck / Sq mass (-)struct weak strong STONY	Loose Friable Firm v. firm hard Roots
34"	A p B w g h E C1 dgr R Fill	2.5 1 1 / 5 y yr 2 2 / 7.5 3 3 / 10 4 4 / 1 Gley 5 5 / 2 Gley 6 6 / 7 7 / 8 8		2.5 / 5 Y / 7.5 / 10 YR / GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck / Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vry Roots Vrgt Strat
64"	B w g h E C1 dgr R Fill	2.5 1 1 / 5 y yr 2 2 / 7.5 3 3 / 10 4 4 / 1 Gley 5 5 / 2 Gley 6 6 / 7 7 / 8 8		2.5 / 5 Y / 7.5 / 10 YR / GL		S Gravel 1 LS C 1 L C SL I SiL STONY			Gr plty Blck / Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vr Str
	E C dgr R Fill	2.5 1 1 / 5 y yr 2 2 / 7.5 3 3 / 10 4 4 / 1 Gley 5 5 / 2 Gley 6 6 / 7 7 / 8 8		2.5 / 5 Y / 7.5 / 10 YR / GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck / Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm v. firm hard Vr Vr Str
	C dgr R Fill	2.5 1 1 / 5 y yr 2 2 / 7.5 3 3 / 10 4 4 / 1 Gley 5 5 / 2 Gley 6 6 / 7 7 / 8 8		2.5 / 5 Y / 7.5 / 10 YR / GL		S Gr 1 LS C 1 L C SL I SiL S			Gr plty Blck / Sq mass (-)struct weak strong Sat Damp	Loose Friable Firm y. firm hard Vr Vr Str

Additional notes: LESS < 48" Cl

1/16" – 3" GRAVEL
3" – 12" COBBLES
BONEY
ANGULAR ROUNDED

Depth Weeping from Pit Face: ____

Standing Water in the Hole ____

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

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

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

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

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

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

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

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

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

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

2 *Poor:* <50%) ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: > 75% ground cover and lightly or only occasionally grazed.

3 *Poor:* <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.

4 Actual curve number is less than 30; use CN = 30 for runoff computations.

5 CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

6 *Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

Sheet flow

Sheet flow is flow over plane surfaces. It usually occurs in the headwater of streams. With sheet flow, the friction value (Manning's n) is an effective roughness coefficient that includes the effect of raindrop impact; drag over the plane surface; obstacles such as litter, crop ridges, and rocks; and erosion and transportation of sediment. These n values are for very shallow flow depths of about 0.1 foot or so. Table 3-1 gives Manning's n values for sheet flow for various surface conditions.

Table 3-1 Roughness coefficients (Manning's n) for sheet flow

Surface description	n [1]
Smooth surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover ≤20%	0.06
Residue cover >20%	0.17
Grass:	
Short grass prairie	0.15
Dense grasses [2]	0.24
Bermudagrass	0.41
Range (natural)	0.13
Woods: [3]	
Light underbrush	0.40
Dense underbrush	0.80

1 The n values are a composite of information compiled by Engman (1986).

2 Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.

3 When selecting n , consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

For sheet flow of less than 300 feet, use Manning's kinematic solution (Overtop and Meadows 1976) to compute T_t:

$$T_t = \frac{0.007(nL)^{0.8}}{(P_2)^{0.5} s^{0.4}} \qquad \text{[eq. 3-3]}$$

where:

T_t = travel time (hr),
n = Manning's roughness coefficient (table 3-1)
L = flow length (ft)
P_2 = 2-year, 24-hour rainfall (in)
s = slope of hydraulic grade line (land slope, ft/ft)

This simplified form of the Manning's kinematic solution is based on the following: (1) shallow steady uniform flow, (2) constant intensity of rainfall excess (that part of a rain available for runoff), (3) rainfall duration of 24 hours, and (4) minor effect of infiltration on travel time. Rainfall depth can be obtained from appendix B.

Shallow concentrated flow

After a maximum of 300 feet, sheet flow usually becomes shallow concentrated flow. The average velocity for this flow can be determined from figure 3-1, in which average velocity is a function of watercourse slope and type of channel. For slopes less than 0.005 ft/ft, use equations given in appendix F for figure 3-1. Tillage can affect the direction of shallow concentrated flow. Flow may not always be directly down the watershed slope if tillage runs across the slope.

After determining average velocity in figure 3-1, use equation 3-1 to estimate travel time for the shallow concentrated flow segment.

Open channels

Open channels are assumed to begin where surveyed cross section information has been obtained, where channels are visible on aerial photographs, or where blue lines (indicating streams) appear on United States Geological Survey (USGS) quadrangle sheets. Manning's equation or water surface profile information can be used to estimate average flow velocity. Average flow velocity is usually determined for bankfull elevation.

Manning's n-Values

Previous Top

Description	Manning's "n"
Pipes	
Reinforced concrete	0.013
Vitrified clay pipe	0.013
Smooth welded pipe	0.011
Corrugated metal pipe	0.023
Polyvinyl chloride (PVC)	0.010
Natural Channels	
Gravel beds, Straight	0.025
Gravel beds, large boulders	0.040
Earth, straight, some grass	0.026
Earth, winding, no vegetation	0.030
Earth, winding	0.050
Miscellaneous	
Smooth surfaces (concrete, asphalt, bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils	0.06-0.17
Short grass	0.15
Dense grass	0.24
Bermuda grass	0.41
Light underbrush woods	0.40
Dense underbrush woods	0.80

Constructed Swale 0.60
(Assumes 2"to 6" Grass Height)

Source: Soil Conservation Service TR-55

Appendix B Synthetic Rainfall Distributions and Rainfall Data Sources

The highest peak discharges from small watersheds in the United States are usually caused by intense, brief rainfalls that may occur as distinct events or as part of a longer storm. These intense rainstorms do not usually extended over a large area and intensities vary greatly. One common practice in rainfall-runoff analysis is to develop a synthetic rainfall distribution to use in lieu of actual storm events. This distribution includes maximum rainfall intensities for the selected design frequency arranged in a sequence that is critical for producing peak runoff.

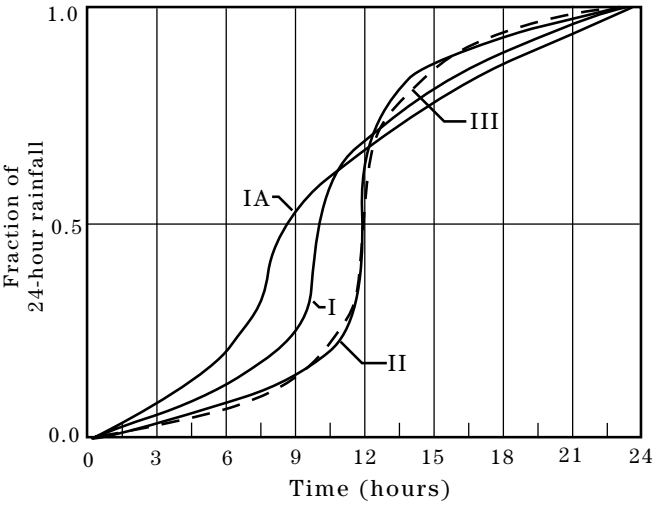
Synthetic rainfall distributions

The length of the most intense rainfall period contributing to the peak runoff rate is related to the time of concentration (T_c) for the watershed. In a hydrograph created with NRCS procedures, the duration of rainfall that directly contributes to the peak is about 170 percent of the T_c. For example, the most intense 8.5-minute rainfall period would contribute to the peak discharge for a watershed with a T_c of 5 minutes. The most intense 8.5-hour period would contribute to the peak for a watershed with a 5-hour T_c.

Different rainfall distributions can be developed for each of these watersheds to emphasize the critical rainfall duration for the peak discharges. However, to avoid the use of a different set of rainfall intensities for each drainage area size, a set of synthetic rainfall distributions having "nested" rainfall intensities was developed. The set "maximizes" the rainfall intensities by incorporating selected short duration intensities within those needed for longer durations at the same probability level.

For the size of the drainage areas for which NRCS usually provides assistance, a storm period of 24 hours was chosen the synthetic rainfall distributions. The 24-hour storm, while longer than that needed to determine peaks for these drainage areas, is appropriate for determining runoff volumes. Therefore, a single storm duration and associated synthetic rainfall distribution can be used to represent not only the peak discharges but also the runoff volumes for a range of drainage area sizes.

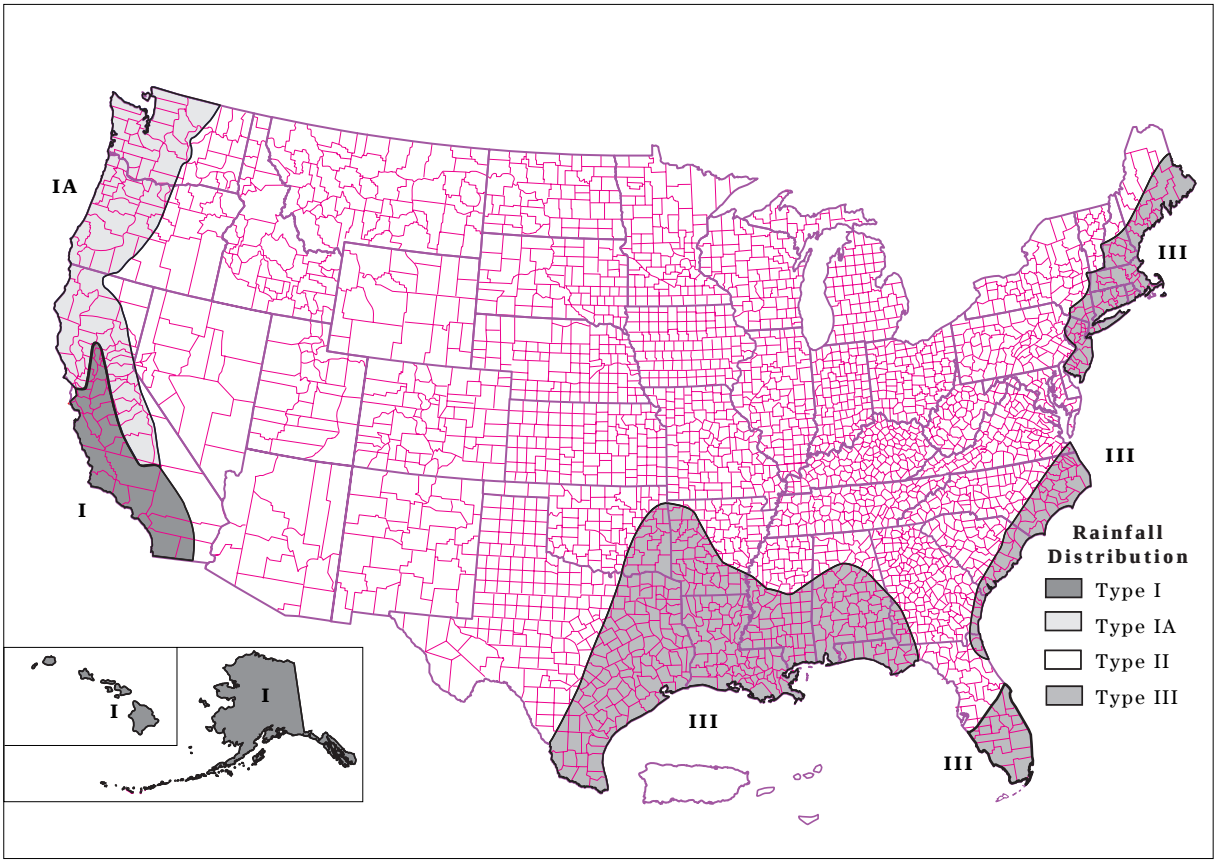
Figure B-1 SCS 24-hour rainfall distributions



The intensity of rainfall varies considerably during a storm as well as geographic regions. To represent various regions of the United States, NRCS developed four synthetic 24-hour rainfall distributions (I, IA, II, and III) from available National Weather Service (NWS) duration-frequency data (Hershfield 1061; Frederick et al., 1977) or local storm data. Type IA is the least intense and type II the most intense short duration rainfall. The four distributions are shown in figure B-1, and figure B-2 shows their approximate geographic boundaries.

Types I and IA represent the Pacific maritime climate with wet winters and dry summers. Type III represents Gulf of Mexico and Atlantic coastal areas where tropical storms bring large 24-hour rainfall amounts. Type II represents the rest of the country. For more precise distribution boundaries in a state having more than one type, contact the NRCS State Conservation Engineer.

Figure B-2 Approximate geographic boundaries for NRCS (SCS) rainfall distributions



Rainfall data sources

This section lists the most current 24-hour rainfall data published by the National Weather Service (NWS) for various parts of the country. Because NWS Technical Paper 40 (TP-40) is out of print, the 24-hour rainfall maps for areas east of the 105th meridian are included here as figures B-3 through B-8. For the area generally west of the 105th meridian, TP-40 has been superseded by NOAA Atlas 2, the Precipitation-Frequency Atlas of the Western United States, published by the National Ocean and Atmospheric Administration.

East of 105th meridian

Hershfield, D.M. 1961. Rainfall frequency atlas of the United States for durations from 30 minutes to 24 hours and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 40. Washington, DC. 155 p.

West of 105th meridian

Miller, J.F., R.H. Frederick, and R.J. Tracey. 1973. Precipitation-frequency atlas of the Western United States. Vol. I Montana; Vol. II, Wyoming; Vol III, Colorado; Vol. IV, New Mexico; Vol V, Idaho; Vol. VI, Utah; Vol. VII, Nevada; Vol. VIII, Arizona; Vol. IX, Washington; Vol. X, Oregon; Vol. XI, California. U.S. Dept. of Commerce, National Weather Service, NOAA Atlas 2. Silver Spring, MD.

Alaska

Miller, John F. 1963. Probable maximum precipitation and rainfall-frequency data for Alaska for areas to 400 square miles, durations to 24 hours and return periods from 1 to 100 years. U.S. Dept. of Commerce, Weather Bur. Tech. Pap. No. 47. Washington, DC. 69 p.

Hawaii

Weather Bureau. 1962. Rainfall-frequency atlas of the Hawaiian Islands for areas to 200 square miles, durations to 24 hours and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 43. Washington, DC. 60 p.

Puerto Rico and Virgin Islands

Weather Bureau. 1961. Generalized estimates of probable maximum precipitation and rainfall-frequency data for Puerto Rico and Virgin Islands for areas to 400 square miles, durations to 24 hours, and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 42. Washington, DC. 94 P.

Figure B-3 2-year, 24-hr rainfall

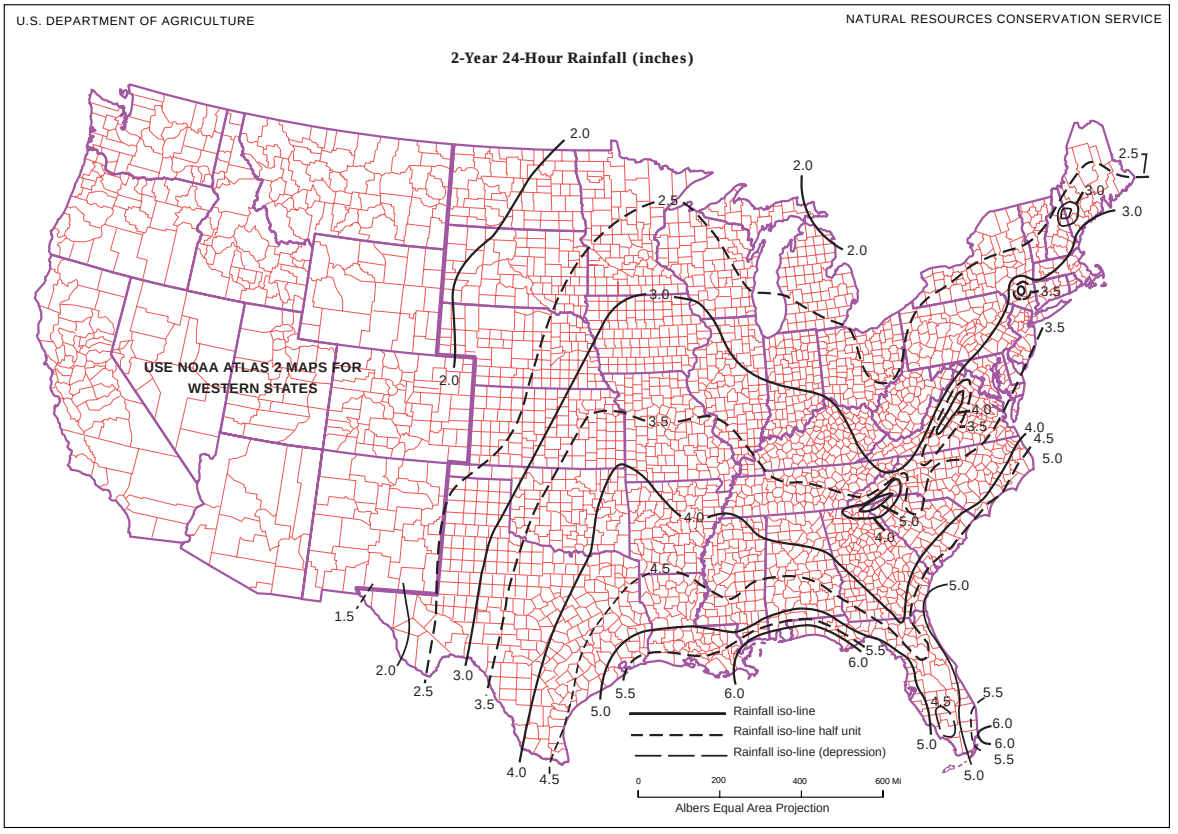


Figure B-4 5-year, 24-hour rainfall

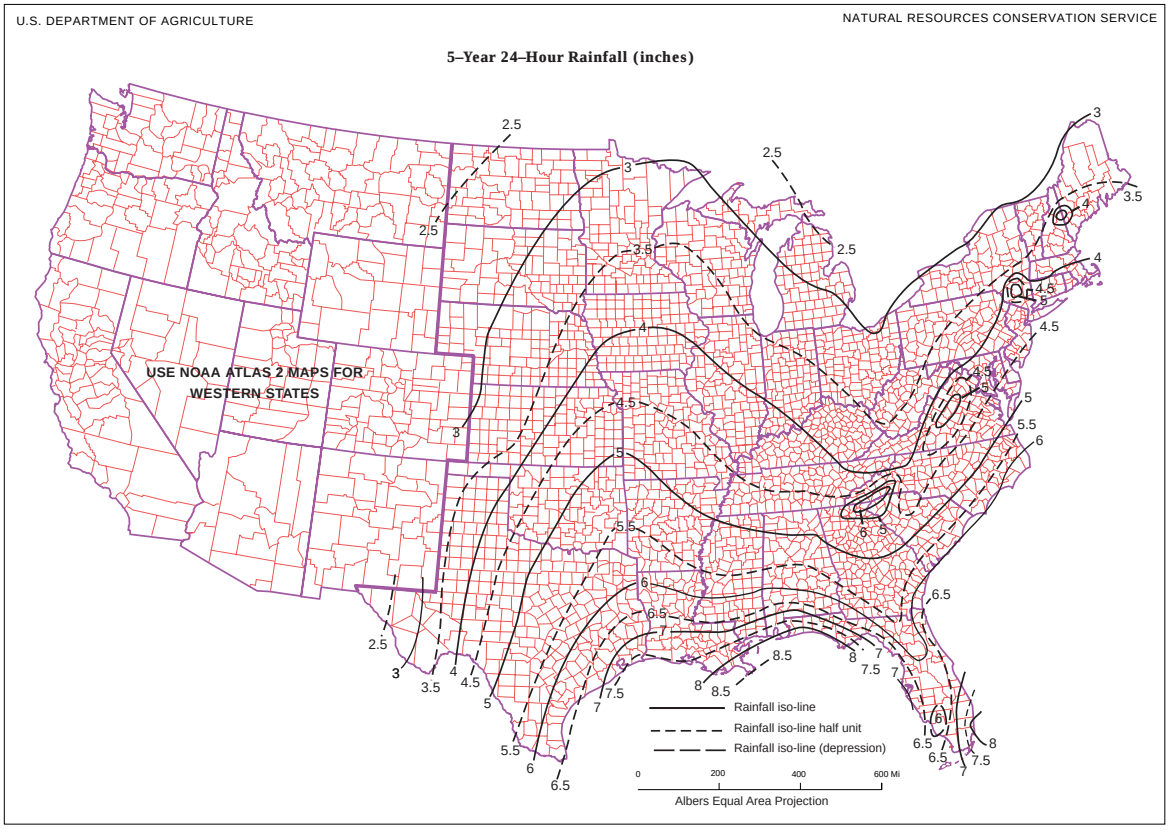


Figure B-5 10-year, 24-hour rainfall

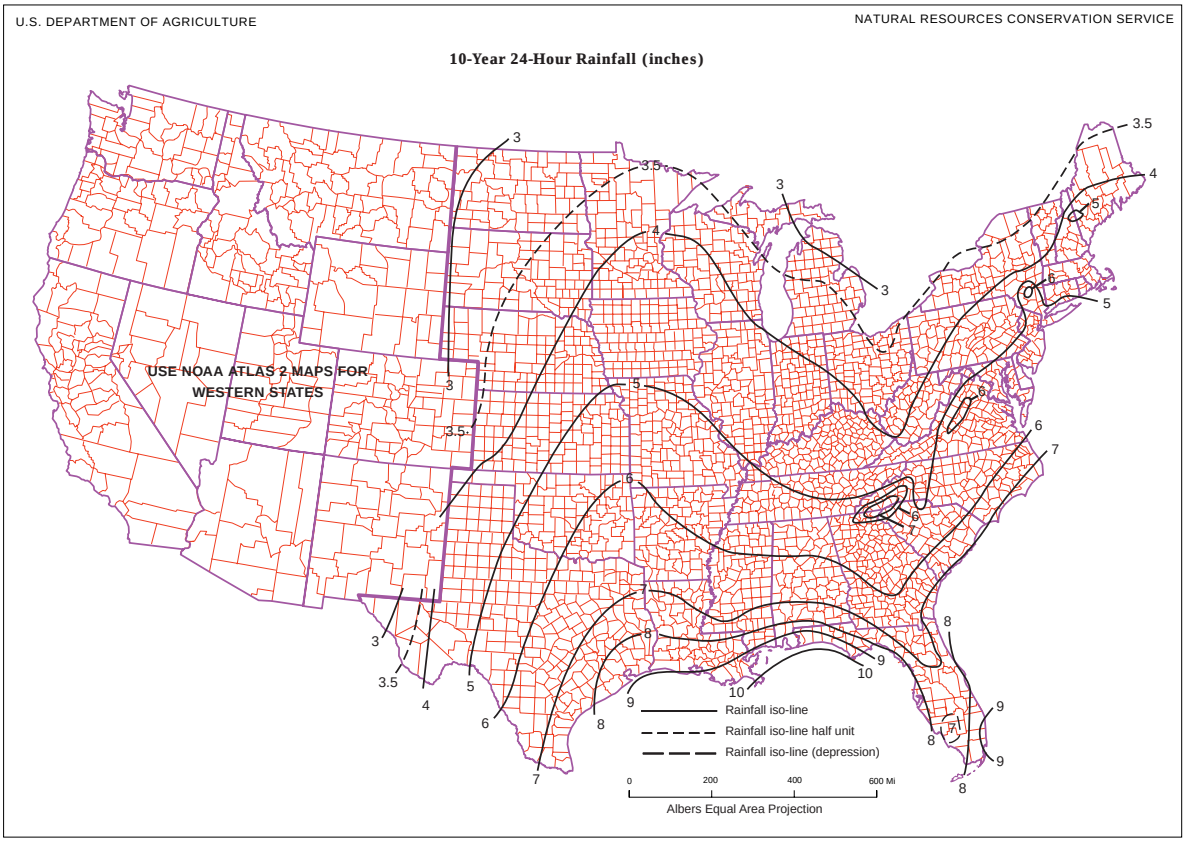


Figure B-6 25-year, 24-hour rainfall

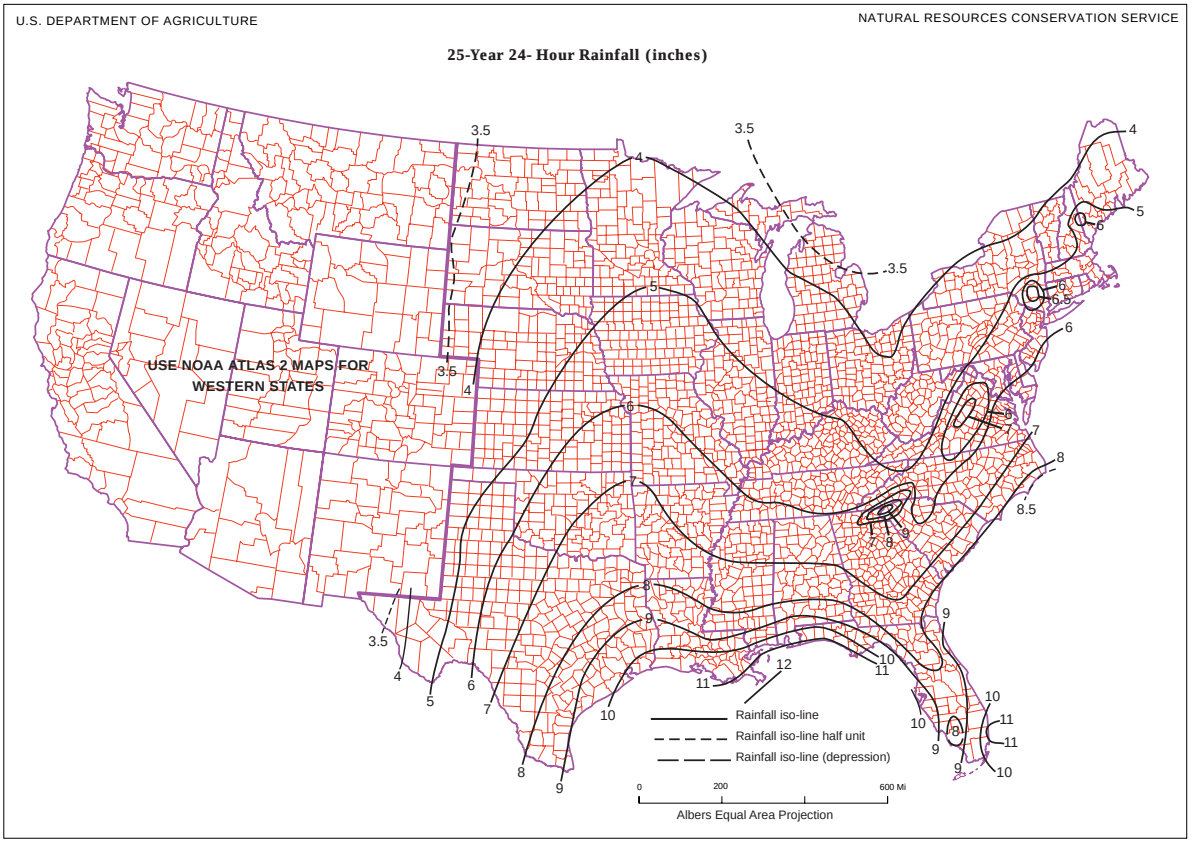


Figure B-7 50-year, 24-hour rainfall

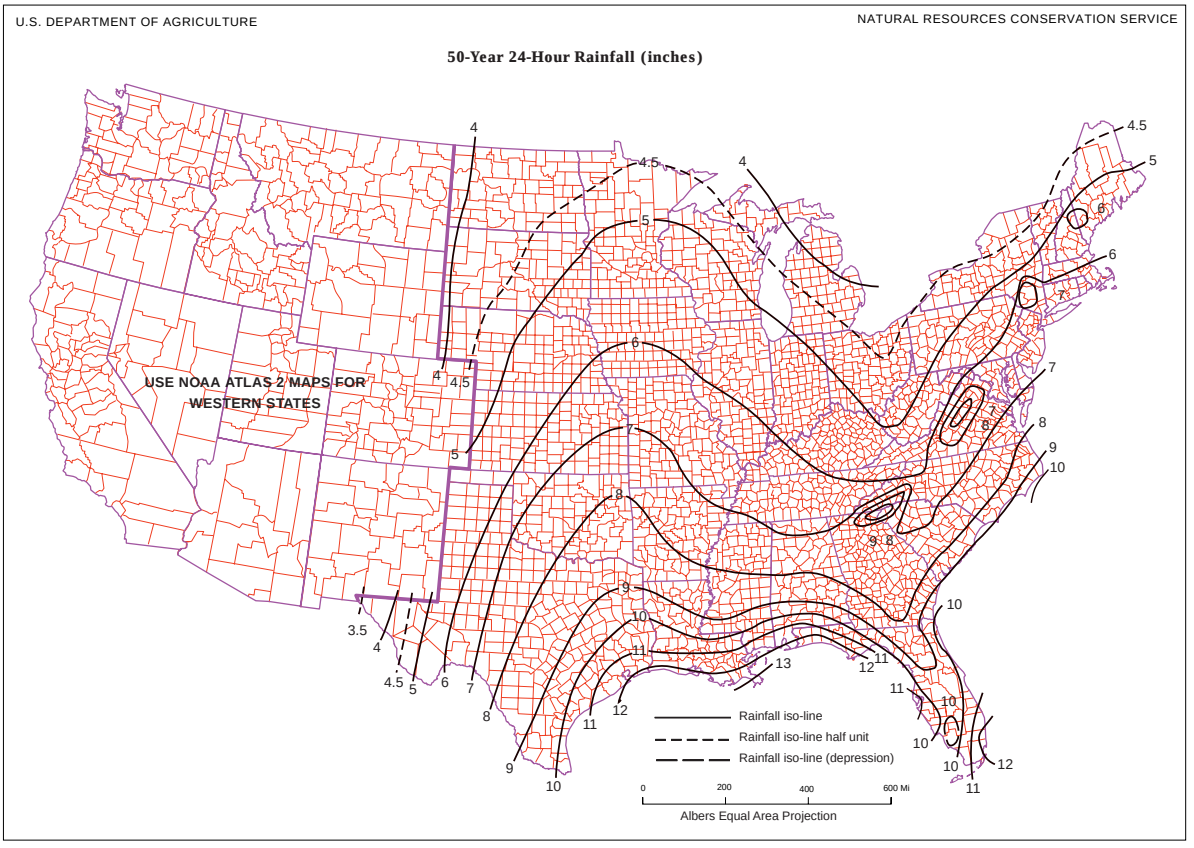
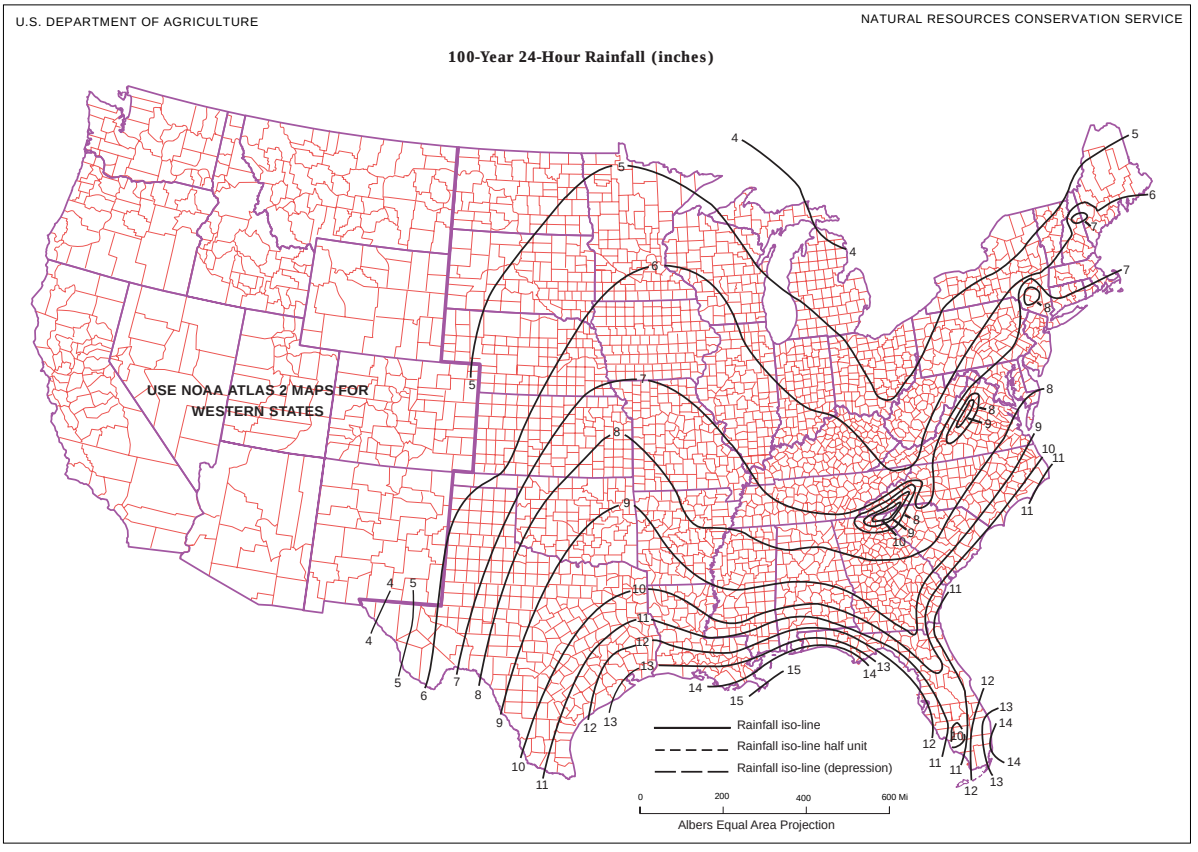


Figure B-8 100-year, 24-hour rainfall



LOCATION MONTAUK NY+CT MA NH

Established Series
Rev. RLM-JWW-MFF
01/2005

MONTAUK SERIES

The Montauk series consists of very deep, well drained soils formed in till derived primarily from granitic materials. These soils are on upland till plains and moraines. Slope ranges from 0 to 35 percent. Saturated hydraulic conductivity is moderately high or high in the solum and low to moderately high in the substratum. Mean annual temperature is about 49 degrees F, and mean annual precipitation is about 45 inches.

TAXONOMIC CLASS: Coarse-loamy, mixed, subactive, mesic Oxyaquic Dystrudepts

TYPICAL PEDON: Montauk sandy loam on a 5 percent slope in a forested area. (Colors are for moist soil unless otherwise noted.)

A--0 to 2 inches; brown (10YR 4/3) sandy loam; weak fine granular structure; very friable; many fine and common coarse roots; less than 1 percent rock fragments; strongly acid; abrupt smooth boundary. (2 to 4 inches thick)

Bw1--2 to 17 inches; yellowish brown (10YR 5/6) fine sandy loam; weak medium subangular blocky structure parting to weak fine granular; very friable; few fine and coarse roots; many fine and medium pores; 5 percent rock fragments; very strongly acid; clear smooth boundary.

Bw2--17 to 27 inches; yellowish brown (10YR 5/6) fine sandy loam; weak medium subangular blocky structure becoming weak medium platy in lower two inches; friable; few fine and coarse roots; many fine and medium pores; 5 percent rock fragments; strongly acid; abrupt smooth boundary. (Combined thickness of the Bw horizons is 12 to 34 inches)

2Cd1--27 to 40 inches; brown (7.5YR 4/4) sandy loam; weak thick platy structure; firm, brittle; few fine roots; many fine pores; 10 percent rock fragments; strongly acid; clear wavy boundary. (7 to 30 inches thick)

3Cd2-- 40 to 72 inches; reddish brown (5YR 4/4) loamy sand with areas of light brown (7.5YR 6/4); massive clods part to single grain; firm, brittle; many fine pores; 10 percent rock fragments; strongly acid.

TYPE LOCATION: Suffolk County, New York, Town of East Hampton; on dirt road, 0.5 mile east of Long Lane, 0.3 mile north of Stephan Hand's Path. USGS East Hampton, NY topographic quadrangle; latitude 40 degrees, 58 minutes, 54 seconds N. and longitude 72 degrees, 13 minutes, 19 seconds W. NAD 1927.

RANGE IN CHARACTERISTICS: Thickness of the solum and depth to the firm till substratum typically ranges from 20 to 38 inches but the range currently includes 18 to 38. Rock fragments range from 3 to 35 percent in the solum and 5 to 50 percent in the C horizon. The soil ranges from extremely

acid to moderately acid toout.

The A or Ap horizon has hue of 7.5YR or 10YR, value of 2 to 5, and chroma of 1 to 4. Texture of the fine-earth fraction is silt loam, loam, fine sandy loam, or sandy loam. Structure is weak or moderate, fine and medium granular. Consistence is friable or very friable. Some pedons have an E horizon just below the A horizon with pale brown, light brown, or brown colors.

The upper part of the B horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 8. The lower part has hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 3 to 6. Texture of the fine-earth fraction is silt loam, loam, fine sandy loam, or sandy loam. Structure is subangular blocky parting to granular except it is massive in the lower part in some pedons. Consistence is friable or very friable. Some pedons have an E horizon immediately above the Cd.

The Cd horizon has hue of 5YR to 5Y, value of 4 to 6, and chroma of 1 to 6. Texture of the fine-earth fraction ranges from coarse sand to fine sandy loam, and at least one subhorizon of the Cd is loamy fine sand or coarser. The horizon has plate-like divisions or is massive. Consistence is firm or very firm, and is brittle. Some pedons have firm dark reddish brown bands up to 1/2 inch thick that are spaced 5 to 8 inches apart. Silt coatings on the upper side of stones and pebbles are common in many pedons.

COMPETING SERIES: There are no competing series in the same family.

The Amostown, Bernardston, Broadbrook, Horseneck (T), Maggodee, Nantucket, Paxton, Pollux, Scituate, and Wethersfield series are similar soils in related families. Maggodee soils are from outside LRR R. Amostown and Pollux soils are underlain by stratified very fine sand or silt within a depth of 40 inches. Bernardston soils have more than 50 percent silt plus very fine sand throughout. Broadbrook and Paxton soils lack a loamy fine sand or coarser layer in the substratum. In addition, Broadbrook soils have a lithological discontinuity and a solum with more than 65 percent silt plus very fine sand. Horseneck (T), Maggodee, and Scituate soils have redoximorphic features in the subsoil. soils are moderately well drained. Nantucket soils lack a loamy fine sand or coarser layer in the substratum and have a stickness class of slightly sticky or moderately sticky in the substratum. Wethersfield soils have 5YR or redder hue in the subsoil and substratum.

GEOGRAPHIC SETTING: Montauk soils are on glaciated uplands and moraines. Slopes range form 0 to 35 percent. The landscape in some areas has many closed depressions, some of which are filled by perennial ponds or wet spots. The soils formed in thick moderately coarse or medium textured glacial till mantles underlain by firm sandy till. Some areas have very stony or extremely stony surfaces. The climate is humid and cool temperate. Mean annual precipitation ranges from 35 to 56 inches; mean annual temperature ranges from 46 to 52 degrees F., and the mean annual frost-free period ranges from 120 to 200 days. Elevation ranges from 10 to 400 feet above sea level.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the well drained Charlton, Chatfield, Riverhead, Canton and Haven soils which lack Cd horizons; the excessively drained, sandy Carver and Plymouth soils; the moderately well drained Sutton, and Woodbridge soils; the poorly drained Leicester and Ridgebury soils; the very poorly drained Whitman soils; and the shallow Hollis soils.

DRAINAGE AND PERMEABILITY: Well drained. Runoff is low to high. Saturated hydraulic conductivity is moderately high or high in the solum and low to moderately high in the substratum.

USE AND VEGETATION: Many of the nearly level and gently sloping areas are cleared and used for production of potatoes and vegetable crops, hay, silage corn and pasture. Steeper and uneven areas are

largely forested. Woodland contains red oak, white oak, and occasionally yellow poplar, white pine, red pine, sugar maple, beech and birch.

DISTRIBUTION AND EXTENT: New York, Connecticut, Massachusetts, New Hampshire and possibly New Jersey. MLRA's 149B, 144A, and 145. The series is of large extent.

MLRA OFFICE RESPONSIBLE: Amherst, Massachusetts

SERIES ESTABLISHED: Suffolk County, New York, 1970.

REMARKS: Montauk soils were originally classified as Typic Fragiochrepts and later to Dystrochrepts because of fundamental changes in describing dense, firm layers found in this soil.

Diagnostic horizons and features recognized in this pedon include:

1) Ochric epipedon from 0 to 2 inches (A horizon)
2) Cambic horizon - from 2 to 27 inches (Bw1 & Bw2 horizons)
3) Oxyaquic subgroup - based on a perched a water table above the dense substratum (Cd horizons). Field investigation has shown saturation within 40 inches 1 month or more per year in 6 or more years out of 10 years.

Soil Interpretation Record No.: NY0012, NY0244, NY0421

National Cooperative Soil Survey
U.S.A.

LOCATION RIDGEBURY MA +CT NH NJ NY RI

Established Series
Rev. WHT-SMF-TDT
12/2005

RIDGEBURY SERIES

The Ridgebury series consists of very deep, somewhat poorly and poorly drained soils formed in till derived mainly from granite, gneiss and schist. They are commonly shallow to a densic contact. They are nearly level to gently sloping soils in low areas in uplands. Slope ranges from 0 to 15 percent. Saturated hydraulic conductivity ranges from moderately low to high in the solum and very low to moderately low in the substratum. Mean annual temperature is about 49 degrees F. and the mean annual precipitation is about 45 inches.

TAXONOMIC CLASS: Loamy, mixed, active, acid, mesic, shallow Aeric Endoaquepts

TYPICAL PEDON: Ridgebury sandy loam - on a 3 to 8 percent slope in an extremely stony wooded area at an elevation of about 1095 feet. (Colors are for moist soil.)

A--0 to 5 inches (0 to 12 cm.); black (N 2/0) fine sandy loam; weak medium and coarse granular structure; friable; many very fine, fine and medium tree roots; 5 percent gravel and 5 percent cobbles; very strongly acid; abrupt smooth boundary. (2 to l0 inches thick)

Bw--5 to 9 inches (12 to 22 cm.); brown (10YR 4/3) sandy loam; weak medium subangular blocky structure; friable; few fine tree roots; 5 percent gravel and 5 percent cobbles; very strongly acid; abrupt wavy boundary. (3 to 9 inches thick)

Bg--9 to 18 inches (22 to 46 cm.); dark gray (10YR 4/1) gravelly sandy loam; massive; friable; 10 percent gravel and 5 percent cobbles; common fine prominent yellowish brown (10YR 5/6) and common medium distinct reddish brown (5YR 4/4) masses of iron accumulation; very strongly acid; gradual wavy boundary. (4 to 17 inches thick)

Cd--18 to 65 inches (46 to 165 cm.); gray (5Y 5/1) gravelly sandy loam; massive; firm; l0 percent gravel and 5 percent cobbles; common fine prominent reddish yellow (7.5YR 6/8) masses of iron accumulation; very strongly acid.

TYPE LOCATION: Hampshire County, Massachusetts; Town of Pelham; 1,600 feet east of Route 202 at a point 3,950 feet south of its junction with Amherst Road; USGS Shutesbury quadrangle; latitude 42 degrees 22 minutes 53 seconds N. and longitude 72 degrees 23 minutes 45 second W., NAD 27.

RANGE IN CHARACTERISTICS: Depth to the dense till commonly is 14 to 19 inches. The A horizon has 5 to 25 percent gravel, 0 to 10 percent cobbles, and 0 to 25 percent stones by volume. The B and C horizons have 5 to 25 percent gravel, 0 to 5 percent cobbles and 0 to 5 percent stones. Rock fragments within the soil range from 5 to 35 percent by volume and are subangular fragments. The unlimed soil ranges from very strongly acid through moderately acid but some horizon within a depth of 40 inches is moderately acid.

The O horizon, where present, has hue of 7.5YR to 2.5Y, value of 2, 2.5, or 3 and chroma of 0 to 2.

The A or Ap horizon is neutral or has hue of l0YR to 5Y, value of 2, 2.5, or 3 and chroma of 0 to 2. Texture is sandy loam, fine sandy loam or loam in the fine-earth fraction.

Some pedons have a thin E horizon with hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. Texture is the same as the A horizon.

The B horizon is neutral or has hue of 7.5YR to 5Y, value of 4 to 6, and chroma of 0 to 3. The chroma is 4 in some places. Chroma of 3 or 4 is restricted to subhorizons. Redoximorphic features are few to many and are distinct or prominent. Texture is sandy loam, fine sandy loam, very fine sandy or loam in the fine earth fraction with fifteen percent or more fine sand or coarser and clay content less than 18 percent. The B horizon has subangular blocky structure, weak to moderate very thin to medium platy structure or is massive. It is very friable or friable.

The Cd layer has hue of l0YR to 5Y, value of 3 to 6, and chroma of l to 4. It commonly has distinct or prominent redoximorphic features which generally become less abundant with depth but the range includes faint. Texture is coarse sandy loam, sandy loam, fine sandy loam, very fine sandy or loam in the fine-earth fraction. Consistence is firm or very firm and brittle. It is massive or has plates. Any physical aggregation is considered to not be pedogenic.

Some pedons have a C horizon below the Cd that is firm but not brittle.

COMPETING SERIES: There are no series currently in the same family.

The Painesville, Punsit, and Sun series are in a closely related family. Painesville soils lack a densic contact. Punsit soils have more than 60 percent silt plus very fine sand in the particle size control section. Sun soils formed in till derived from limestone and sandstone.

GEOGRAPHIC SETTING: The nearly level to gently sloping Ridgebury soils are in slightly concave areas and shallow drainageways of till uplands. Slope ranges from 0 to 15 percent. The soils formed in loamy till derived mainly from granite, gneiss and schist. Mean annual air temperature ranges from 45 to 52 degrees F. and mean annual precipitation ranges from 40 to 50 inches. Mean growing season ranges from l00 to l95 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These include the Charlton, Chatfield, Hollis, Leicester, Paxton and Sutton, Whitman and Woodbridge soils. Ridgebury is a member of a drainage sequence that includes the well drained Paxton, moderately well drained Woodbridge, and very poorly drained Whitman soils. Charlton and Sutton soils are better drained and have friable substrata. Chatfield and Hollis soils have bedrock within depths of 40 and 20 inches respectively. Leicester soils do not have a densic contact.

DRAINAGE AND PERMEABILITY: Commonly poorly drained but the range includes the wetter part of somewhat poorly drained. Runoff is negligible to medium. Saturated hydraulic conductivity ranges from moderately low to high in the solum and very low to moderately low in the substratum. A perched, fluctuating water table above the dense till saturates the solum to or near the surface for 7 to 9 months of the year.

USE AND VEGETATION: Largely forested to gray birch, yellow birch, red maple, hemlock, elm, spruce and balsam fir. Cleared areas are used mainly for hay and pasture.

DISTRIBUTION AND EXTENT: Glaciated landforms in Connecticut, Massachusetts, New Hampshire, New Jersey, New York, and Rhode Island. (MLRAs 142, 144A, 145, and 149B) The series is extensive.

MLRA OFFICE RESPONSIBLE: Amherst, Massachusetts.

SERIES ESTABLISHED: Franklin County, Vermont, l948.

REMARKS: An analysis of Ridgebury soils in 2002 for 38 surveys showed that this series most commonly has a densic contact at 16 to 24 inches including 8 surveys with the depth to a densic contact at 20 inches. The average depth to a densic contact was 20 inches - the data showed an almost even split between depth class occurrences. A review of characterization data for Ridgebury soils shows a very slight dominance in the acid reaction class. Any physical aggregation in the Cd is considered to not be pedogenic. The type location is currently within the officially designated mesic zone in Massachusetts.

Diagnostic horizons and features in this pedon include:

1. Ochric epipedon - the zone from 0 to 5 inches (A horizon).
2. Aeric feature 100 percent of the zone from 5 to 9 inches has hue of 10YR and both color value moist of 4 and chroma moist of 3 (Bw1 horizon).
3. Cambic horizon - the zone from 5 to 18 inches (Bw and Bg horizons).
3. Densic contact root limiting material begins at 18 inches (Cd).
4. Endosaturation the zone from 9 to 18 inches is saturated above the densic contact (Bw2 horizon). A seasonal high water table is perched above the densic materials.
5. Reaction - the pH in the zone from 10 to 18 inches (control section for reaction) is presumed less than 5.0 in 0.01 M CaCl2 (1:2) (see remarks).
6. Series control section - the zone from 0 to 28 inches.

ADDITIONAL DATA: Reference samples from pedons S00CT013002, S58MA015006, S57MA023004, S77MA005003, S95NH013005, S96NH013002 from Connecticut, Massachusetts, and New Hampshire, samples by NSSL, Lincoln, NE, various years.

National Cooperative Soil Survey
U.S.A.

LOCATION WHITMAN MA+CT NH NJ NY RI

Established Series
Rev. DGG-WHT-SMF
05/2006

WHITMAN SERIES

The Whitman series consists of very deep, very poorly drained soils formed in glacial till derived mainly from granite, gneiss, and schist. They are shallow to a densic contact. These soils are nearly level or gently sloping soils in depressions and drainageways on uplands. Permeability is moderate or moderately rapid in the solum and slow or very slow in the substratum. Mean annual precipitation is about 45 inches and mean annual temperature is about 49 degrees.

TAXONOMIC CLASS: Loamy, mixed, active, acid, mesic, shallow Typic Humaquepts

TYPICAL PEDON: Whitman loam - on a 0 percent slope in an idle area at an elevation of about 702 feet. (Colors are for moist soils.)

Ap--0 to 10 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak medium granular structure; friable; 10 percent rock fragments; common medium distinct red (2.5YR 4/8) masses of iron accumulation lining pores; moderately acid; abrupt wavy boundary. (4 to 12 inches thick)

Bg--10 to 18 inches; gray (5Y 5/1) fine sandy loam; massive; friable; 10 percent rock fragments, few medium distinct pale olive (5Y 6/4) and light olive brown (2.5Y 5/4) masses of iron accumulation; strongly acid; abrupt wavy boundary. (5 to 25 inches thick)

Cd1--18 to 31 inches; gray (5Y 6/1) fine sandy loam; moderate medium plates; firm; 10 percent rock fragments; many medium distinct light olive brown (2.5Y 5/4) masses of iron accumulation; moderately acid; clear wavy boundary. (6 to 40 inches thick)

Cd2--31 to 48 inches; olive (5Y 4/3) fine sandy loam; massive; firm; 10 percent rock fragments; few medium prominent dark reddish brown (2.5YR 3/4) masses of iron accumulation; moderately acid; gradual wavy boundary. (0 to 40 inches thick)

Cd3--48 to 65 inches; olive (5Y 5/3) fine sandy loam; massive; firm; 10 percent rock fragments; moderately acid.

TYPE LOCATION: Worcester County, Massachusetts; Town of Leominster, 1 mile west intersection of Pleasant and Wachusett Streets, and 500 feet north of Wachusett Street. USGS Sterling quadrangle; Latitude 42 degrees 30 minutes 4 seconds N.; longitude 71 degrees 47 minutes 42 seconds W., NAD 27.

RANGE IN CHARACTERISTICS: Depth to a densic contact commonly is 12 to 20 inches. The A horizon has 5 to 25 percent gravel, 0 to 15 percent cobbles, and 0 to 25 percent stones by volume. The B and C horizons have 5 to 25 percent gravel, 0 to 5 percent stones and 0 to 5 percent cobbles. The soil reaction, unless limed, ranges from very strongly acid to slightly acid however, some horizon within a depth of 40 inches is moderately acid or slightly acid.

Some pedons have organic horizons overlying the A horizon. They are fibric hemic or sapric material, and are up to 5 inches thick.

The A horizon is neutral or has hue of 7.5YR or 10YR, value of 2 to 3, and chroma of 0 to 2. It sandy loam, fine sandy loam, very fine sandy loam, loam, or silt loam in the fine earth fraction. Structure is weak granular or subangular blocky or the horizon is massive. Consistence is very friable or friable.

The Bg horizon is neutral or has hue of 10YR to 5Y, value of 4 to 6, and chroma of 0 to 2. Redox concentrations range from few to many where matrix chroma is 2 and none to many where chroma is 1. Texture is sandy loam, fine sandy loam or loam in the fine earth fraction. It has fifteen percent or more fine sand or coarser with clay content less than 18 percent. Structure is weak granular or subangular blocky or the horizon is massive. Consistence is very friable or friable.

The Cd layer is neutral or has hue of 10YR to 5Y, value of 4 to 6, and chroma of 0 to 2. The chroma is 3 in some places. Redoximorphic features range from few to many. Texture is loam, fine sandy loam or sandy loam in the fine earth fraction. Consistence commonly is firm to extremely firm and the layer may be brittle in some part. The structure is geogenically derived, commonly appearing in the form of weak or moderate thin plates in the upper part or is massive throughout.

COMPETING SERIES: There are no series currently in the same family.

GEOGRAPHIC SETTING: Whitman soils are nearly level and gently sloping soils in depressions and in drainage ways of glacial uplands. Slopes are typically 0 to 2 percent but range up to 8 percent where wetness is due to seepage water. The soils formed in loamy, glacial till derived mainly from granite, gneiss and schist. Mean annual precipitation ranges from 40 to 56 inches and mean annual temperature ranges from 45 to 52 degrees F. The frost free period is 100 to 195 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Charlton, Chatfield, Hollis, Leicester, Paxton, Ridgebury, Sutton and Woodbridge soils. The well drained Paxton, moderately well drained Woodbridge, and somewhat poorly and poorly drained Ridgebury soils are in a drainage sequence with Whitman soils. Charlton, Leicester, and Sutton soils have friable substrata. Chatfield and Hollis soils have bedrock within depths of 40 and 20 inches respectively.

DRAINAGE AND PERMEABILITY: Very poorly drained. Permeability is moderate or moderately rapid above the dense till and slow or very slow within it. Saturated hydraulic conductivity ranges from moderately high or high in the solum to very low to moderately high in the densic material. Runoff potential is negligible to high. A perched water table, or excess seepage water, is at or near the surface for about 9 months of the year.

USE AND VEGETATION: Nearly all areas are forested. Only a few areas are cleared and drained and used for pasture. Alder, gray birch, red maple, hemlock, elm, spruce, balsam fir, sedges, rushes, cattails, and other water-tolerant plants are the principal vegetation.

DISTRIBUTION AND EXTENT: Connecticut, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont. (MLRAs 142, 144A, 145, and 149B) The series is extensive.

MLRA OFFICE RESPONSIBLE: Amherst, Massachusetts.

SERIES ESTABLISHED: Plymouth County, Massachusetts, 1911.

REMARKS: Location revised to 500 feet north of Wachusetts Street after review of soil map showed no Whitman map unit 50 feet north of road. Some pedons have previously been correlated as Whitman that are moderately deep to a densic contact.

Diagnostic horizons and features in this pedon include:

1, Umbric epipedon - the zone from the soil surface to a depth of 10 inches (Ap horizon).
2. Cambic horizon - the zone from 10 to 18 inches (Bg horizon).
3. Aquic conditions - as evidenced by chroma of 1 in the Bg horizon.
4. Densic contact - root limiting layer begins at 18 inches.
5. Shallow depth class depth to a densic contact is less than 20 inches (Cd1 is at 18 inches.).

ADDITIONAL DATA: Reference samples from pedons S0CT013001, S77MA005002, S77MA005004, S77MA005005 from Connecticut and Massachusetts, NSSL, Lincoln, NE, 1977 and 2000.

National Cooperative Soil Survey
U.S.A.

LOCATION WOODBRIDGE CT +MA NH NY RI

Established Series
Rev. MFF-SMF-TDT
05/2005

WOODBRIDGE SERIES

The Woodbridge series consists of moderately well drained loamy soils formed in subglacial till. They are very deep to bedrock and moderately deep to a densic contact. They are nearly level to moderately steep soils on till plains, hills, and drumlins. Slope ranges from 0 to 25 percent. Saturated hydraulic conductivity ranges from moderately low or moderately high in the surface layer and subsoil and low or moderately low in the dense substratum. Mean annual temperature is about 48 degrees F., and mean annual precipitation is about 46 inches.

TAXONOMIC CLASS: Coarse-loamy, mixed, active, mesic Aquic Dystrudepts

TYPICAL PEDON: Woodbridge fine sandy loam - grass field, at an elevation of about 580 feet. (Colors are for moist soil unless otherwise noted.)

Ap--0 to 7 inches; very dark grayish brown (10YR 3/2) fine sandy loam, light brownish gray (10YR 6/2) dry; moderate medium granular structure; friable; many fine and medium roots; few very dark brown (10YR 2/2) earthworm casts; 5 percent gravel; moderately acid; abrupt wavy boundary. (4 to 10 inches thick)

Bw1--7 to 18 inches; dark yellowish brown (10YR 4/4) fine sandy loam; weak medium subangular blocky structure; friable; common fine roots; few very dark brown (10YR 2/2) earthworm casts; 10 percent gravel; moderately acid; gradual wavy boundary.

Bw2--18 to 26 inches; dark yellowish brown (10YR 4/4) fine sandy loam; weak medium subangular blocky structure; friable; common fine roots; few very dark brown (10YR 2/2) earthworm casts; 10 percent gravel; few medium prominent strong brown (7.5YR 5/6) masses of iron accumulation and light brownish gray (10YR 6/2) iron depletions; moderately acid; gradual wavy boundary.

Bw3--26 to 30 inches; light olive brown (2.5Y 5/4) fine sandy loam; weak medium subangular blocky structure; friable; few fine roots; 10 percent gravel; common medium prominent strong brown (7.5YR 5/6) masses of iron accumulation and light brownish gray (10YR 6/2) iron depletions; moderately acid; clear wavy boundary. (Combined thickness of the Bw horizons is 12 to 37 inches.)

Cd1--30 to 43 inches; light olive brown (2.5Y 5/4) gravelly fine sandy loam; weak thick platy structure; very firm, brittle; 20 percent gravel; many medium prominent strong brown (7.5YR 5/8) masses of iron accumulation and light brownish gray (10YR 6/2) iron depletions; moderately acid; gradual wavy boundary. (3 to 29 inches thick)

Cd2--43 to 65 inches; light olive brown (2.5Y 5/4) gravelly fine sandy loam; weak thick platy structure; very firm, brittle; few fine prominent very dark brown (10YR 2/2) coatings on plates; 25 percent gravel; common fine prominent strong brown (7.5YR 5/8) masses of iron accumulation; moderately acid.

TYPE LOCATION: Tolland County, Connecticut; town of Mansfield, 0.75 mile south of the intersection of Connecticut Routes 275 and 195, and 0.25 mile east on the University of Connecticut Agronomy Farm, 800 feet north of the greenhouses near the corner of a brushy field. USGS Spring Hill topographic quadrangle, latitude 41 degrees 47 minutes 53 seconds N., longitude 72 degrees 13 minutes 48 seconds W., NAD 27.

RANGE IN CHARACTERISTICS: Thickness of the solum ranges from 18 to 40 inches. Depth to densic materials commonly is 20 to 40 inches but the range currently includes 18 to 40 inches. Depth to bedrock is commonly more than 6 feet. Rock fragments commonly range from 5 to 35 percent by volume but in some places the range in the surface layers is 2 to 35 percent. Except where the surface is stony, the fragments are mostly subrounded gravel and typically make up 60 percent or more of the total rock fragments. Unless limed, reaction ranges from very strongly acid to moderately acid.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 to 4. Dry value is 6 or more. Undisturbed pedons have a thin A horizon with value of 2 or 3 and chroma of 1 or 2. The Ap or A horizon is loam, fine sandy loam, or sandy loam in the fine-earth fraction. It has weak or moderate granular structure and is friable or very friable.

Some pedons have a thin E horizon below the A horizon. It has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 3. Texture, structure, and consistence are like the A horizon.

The upper part of the Bw horizon has hue of 7.5YR to 2.5Y, value of 3 to 6, and chroma of 3 to 8. The lower part of the Bw horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 3 to 6. Iron depletions are within a 24 inch depth. The Bw horizon is loam, fine sandy loam, or sandy loam with less than 65 percent silt plus very fine sand. It has weak granular or subangular blocky structure, or it is massive. Consistence is friable or very friable.

Some pedons have a thin BC horizon with value and chroma like the lower part of the Bw horizon, but is typically yellower by one hue. The BC horizon has texture, structure, and consistence similar to the Bw horizon.

Some pedons have an E or E' horizon up to 3 inches thick below the B horizon. It has hue of 10YR to 5Y, value of 5 or 6, chroma of 2 or 3, and has redoximorphic features. Typically, it is coarser-textured than the overlying horizon.

The Cd horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 to 4. It commonly has redoximorphic features. Texture is loam, fine sandy loam, sandy loam, or coarse sandy loam in the fine-earth fraction. The structure is not pedogenetically derived, and appears in the form of weak medium to very thick plates, or it is massive. Consistence is firm or very firm.

COMPETING SERIES: These are the Chautauqua, Pittstown, Pompton, Rainbow, Sutton, Wapping, and Wilbraham series. Watchaug is in a similar family. Chautauqua, Pompton, Sutton, Wapping, and Watchaug soils do not have a dense substratum. Pittstown and Rainbow soils have more than 65 percent silt plus very fine sand in the solum. Wilbraham soils are wetter and have iron depletions throughout the B horizon.

GEOGRAPHIC SETTING: Woodbridge soils are nearly level to moderately steep and are on till plains, hills and drumlins. Slope commonly is less than 8 percent, but the range includes 0 to 25 percent. The soils formed in acid till derived mostly from schist, gneiss, and granite. Mean annual temperature ranges from 45 to 52 degrees F., mean annual precipitation ranges from 37 to 49 inches, and the growing

season ranges from 115 to 180 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Rainbow and Sutton soils and the Bernardston, Broadbrook, Canton, Charlton, Chatfield, Georgia, Hollis, Leicester, Montauk, Paxton, Ridgebury, Scituate, Wapping, and Whitman soils on nearby landscapes. The well drained Paxton, somewhat poorly and poorly drained Ridgebury, and the very poorly drained Whitman soils are associated in a drainage sequence. Bernardston and Broadbrook soils are well drained and are finer textured. Canton and Charlton soils are well drained and do not have a dense substratum. Chatfield and Hollis soils have bedrock within depths of 20 to 40 and 10 to 20 inches respectively. Georgia soils are calcareous within 80 inches. Leicester soils are poorly drained and do not have a dense substratum. Montauk soils are well drained and are coarser textured. Scituate soils have a loamy sand substratum.

DRAINAGE AND PERMEABILITY: Moderately well drained. Surface runoff is negligible to high. Saturated hydraulic conductivity ranges from moderately low or moderately high in the surface layer and subsoil and low or moderately low in the dense substratum.

USE AND VEGETATION: Many areas are cleared and used for cultivated crops, hay, or pasture. Scattered areas are used for community development. Some areas are wooded. Common trees are red, white, and black oak, hickory, white ash, sugar maple, red maple, hemlock, and white pine.

DISTRIBUTION AND EXTENT: Glaciated uplands of Connecticut, Massachusetts, New Hampshire, eastern New York, and Rhode Island; MLRAs 144A, 145, and 149B. The series is of large extent. Woodbridge soils were previously used in Maine. Soil temperature studies in Maine have resulted in the use of the frigid soil temperature regime for soils in areas formerly identified as mesic.

MLRA OFFICE RESPONSIBLE: Amherst, Massachusetts

SERIES ESTABLISHED: Essex County, Massachusetts, 1925.

REMARKS: Cation exchange activity class placement determined from a review of limited lab data and similar or associated soils.

Historically, Woodbridge soils have been previously classified as Aquic Dystrochrepts and before that as Typic Fragiochrepts.

Diagnostic horizons and features recognized in this pedon are:

1. Ochric epipedon - the zone from 0 to 7 inches (Ap horizon).
2. Cambic horizon - the zone from 7 to 30 inches (Bw horizons).
3. Aquic feature - low chroma iron depletions within a 24 inch depth (Bw2 horizon).
4. Densic materials - the zone from 30 to 65 inches (Cd1 and Cd2 horizons).

National Cooperative Soil Survey
U.S.A.

TAB 6

CIVIL DESIGN
Consultants, Inc.
37 Plaistow Road, Unit 7 - #235 Tel: (603) 275-5369
Plaistow, NH 03865 Fax: (603) 382-1818

November 12, 2009

Robert E. Moore, Jr.
Conservation Department
City Hall, Room 210
4 Summer Street
Haverhill, MA 01830

Tel: (978) 374-2334
Fax: (978) 374-2337

CDCI File #: 08-0703
Crystal Springs Golf Course
940 North Broadway
Haverhill, MA 01832

Response to Recommendations

Mr. Moore,

Civil Design Consultants, Inc. (CDCI) is pleased to provide the enclosed information prepared to address a review letter prepared by the Horsley Witten Group dated October 26, 2009 of the proposed stormwater management system for the *Crystal Springs Residential Cluster Development*. The following information is provided for your review and consideration:

- Response Letter prepared by CDCI dated November 12th, 2009.
- Site Development Plans entitled *Definitive Residential Cluster Development – Crystal Springs – North Broadway – Haverhill, MA* prepared by SEC & Associates, Inc. and CDCI dated June 10th, 2009 with revisions through November 12th, 2009.
- Drainage Report –Crystal Springs Golf Course – Revision #2 dated November 12th, 2009.

In addition, the following responses have been prepared to address the recommendations as itemized in the October 29th, 2009 Meeting Notes prepared for your Commission. The following summary of the modifications made to the plans has been prepared for your review and consideration:

1. As requested, sheet C15 entitled Site Grading and Drainage Plan has been revised as specified below:
   - The obsolete erosion control line located east of Proposed Wet Swale #1 has been deleted,
   - BVW flag numbers C4-C11 have been added along the relocated wetland boundary east of Proposed Wet Swale #1,
   - A note has been added at the location of the Buffer Zone Enhancements east of the Phase I parking area to see Sheet D-8 entitled Construction Details for additional information.
   - Wetland shrub plantings have been provided along the BVW boundary from wetland flags E1-EE4, H1-H9, S1-S6 and C-3-C10 to curb the potential for mowing within the resource area. In addition, note 5 has been added specifying that the wetland shrub plantings are to be a Highbush Blueberry (Vaccinium Corymbosum) 24" to 36" or approved equal.
   - The potential to discharge PDMH-10 to the existing driveway culvert under Front Nine Drive was considered. However, the capacity of the existing culvert to accommodate the additional flow from PDMH-10 is questionable. Therefore, PFES-11 has been relocated approximately 25-FT up-gradient, from the edge of the BVW, and rock rip-rap has been placed to stabilize the discharge location and dissipate discharge velocities.

2. As requested, sheet C16 entitled Site Grading and Drainage Plan has been revised as specified below:
   - The erosion control line has been reconfigured beyond the limit of the 25-FT No Disturbance Zone, and where possible, beyond the limit of disturbance (tree cut).
   - PFES-8 has been relocated further to the north-west to further reduce the required tree cutting.

3. As requested, sheet C24 and C25 entitled Sewer Plan and Profile have been revised to specify the location of the proposed trail easement and extend the easement further to the east, across from #569 Lake Street.

4. As requested, the Lake Street Drainage Improvements Detail on Sheet D8 entitled Construction Details has been revised to include a note specifying that the *Contractor to coordinate with the engineer and local health technician to confirm the limit of clearing prior to any tree clearing operations*.

5. As requested, sheet D10 entitled Construction Details has been revised to include a typical seed mix for the side slopes for each of the stormwater management facilities.

6. As requested, a note has been added to Sheets C23, C25 and C26 specifying that the *proposed sewer to be placed in ductile iron sleeve as specified. Sleeve to be driven at appropriate elevation and grade with no additional direct impact to the resource area.*

7. As requested, sheet C28 entitled Watermain Improvement Plan – North Broadway has been revised to include a note along the roadway swale improvements specifying that *the Contractor to coordinate with the engineer and local health technician to confirm the limit of clearing prior to any tree clearing operations.*

8. As requested, CDCI has prepared a separate letter dated November 12th, 2009 addressing each of the remaining comments provided by the Commission's consultant. A copy of this letter, revised project plans and revised drainage report have been provided with this letter.

Please note that a copy of the review letter referenced above, as well as the response letter and supplemental information prepared to address the review letter is provided in Tab 6 of the revised drainage report. If you have any questions or comments, or require additional information, please do not hesitate to contact this office.

Very Truly Yours,

CIVIL DESIGN CONSULTANTS, INC.

James E. Hanley, PE
President

Copy to: DEP NERO – Wetlands Program – 205B Lowell Street – Wilmington, MA 01887 (1 Copy)
Mike Maroney – Premiere Realty Trust (1 Copy)
Mike Seekamp – Seekamp Environmental Consulting, Inc. (1 Copy)
CDCI File #: 08-0703 (1 Copy)

MEMO TO: Haverhill Conservation Commission
FROM: Robert E. Moore, Jr., Environmental Health Technician
DATE: October 29, 2009
RE: October 29, 2009 Meeting Notes

NOTICES OF INTENT

1. #33-1265 Nicholas Lazos for Vale Street ("Lazos Circle") – RECOMMENDATION: At the verbal request of the applicant's engineer, I recommend this item be continued in accordance with the Commission's Policy #2000-01, "Deadlines for Information Submittal".

2. #33-1279 Premiere Realty Trust for 890 North Broadway ("Crystal Springs") – I reviewed the new information and found many of our comments to have been addressed. I would request the following final comments be resolved with the submittal of a final plan prior to the issuance of the Order:

- Sheet C15: Remove the old erosion control line along the new BVW line;
  Add the new BVW flag numbers;
  Provide buffer zone enhancements between the parking lot slope and the new BVW line;
  To curb BVW mowing, provide a wetland shrub planting at each flag from E1-EE4, H1-H9, S1-S6, and C3-swale #1 outfall to demarcate the BVW boundaries going forward; and
  Look at the possibility of moving the PDMH10 discharge as far from the "A" wetland as possible by using the manhole to pick-up the existing drain as well.
- Sheet C16: Move the erosion control lines out to the 25'-NDZ or the Limits of Work, whichever is farther;
  Move PFES8 westerly to the existing grass area, reducing tree cutting.
- Sheets C24 & C25: Identify the trail easement. Can it be extended further along the property, between the fence and the road?
- Sheet D8: The Lake St drainage improvement is much needed. However, what mitigation is proposed for the loss of trees and alterations to the resource area?
- Sheet D10: Add the side slope seed mix spec. to the notes
- Provide a construction/restoration sequence on the plans for the multiple stream crossings associated with the sewer.
- Sheet C28: Provide note to minimize tree clearing associated with North Broadway swale.
- Address comments 4 and 8 in the new peer review report.
- John Pettis has informed me that his comments may be addressed prior to Planning Board endorsement.

RECOMMENDATION: Many of the remaining comments are relatively minor plan revisions. Should the Commission concur, I would recommend the issuance of an Order of Conditions approving the project, with conditions typical of single-family residential subdivisions, subject to the applicant providing the necessary plan revisions within 30 days (by November 28th). Should the applicant not meet this deadline, the Commission's vote shall expire and the Notice shall be returned to the next available agenda.

CIVIL DESIGN
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November 12, 2009

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CDCI File #: 08-0703
Crystal Springs Golf Course
940 North Broadway
Haverhill, MA 01832

Response Letter #2

Mr. Moore,

Civil Design Consultants, Inc. (CDCI) is pleased to provide this response to a review letter prepared by the Horsley Witten Group dated October 26th, 2009 for the *Crystal Springs Residential Cluster Development*. The following responses have been prepared consistent with the format of the review letter. Only the specific comments which require responses have been addressed.

General Stormwater Comments

1. As requested, sheet C29 entitled Erosion Control Plan has been revised to include the extent of construction (Limit of Work) and a note at has been added at Proposed Infiltration Basin #1 referencing Sheet D10 entitled Construction Details for a Temporary Construction By-Pass Detail.

   Sheet D10 entitled Construction Details has been revised to include the Temporary Construction By-Pass Detail provided to illustrate temporary grading around Infiltration Basin #1 to avoid the accumulation of sedimentation and reduce the potential for clogging within the infiltration basin.

3. During the preliminary design, roadway swales and "country drainage" was considered throughout the site. However, as discussed with the Commission, the cluster development format presents significant challenges to the implementation of this type of drainage. The cluster allows for reduced frontage and reduced front yard setbacks. These reduced dimensional controls would result in significant grading throughout the proposed front yards, resulting in little to no usable space and a significant impact to the aesthesis of the development. Due to these considerations, and the considerations previously noted (ie: high groundwater and shallow relief), a typical closed drainage system was developed in lieu of the country drainage alternative.

4. As requested, the Post Development *Improved Lake Street Crossing* pond in the Drainage Report has been revised to reduce the contour area associated with elevation 156 from 355-SF to 0-SF consistent with the project plans.

8. As requested, the Operations and Maintenance Plan has been revised to specify that the deep sump catch basins be inspected and/or cleaned at least four times per year and at the end of the foliage and snow removal seasons. In addition, it has been noted that sediment be removed four times per year or whenever the depth of the deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the basin.

I believe this information, along with the revised design documents and drainage report address each of the items provided in the comment letter. If you have any questions or comments, or require additional information, please do not hesitate to contact this office.

Very Truly Yours,

CIVIL DESIGN CONSULTANTS, INC.

James E. Hanley, PE
President

Horsley Witten Group
Sustainable Environmental Solutions
30 Green Street • Newburyport, MA • 01950
Phone - 978-499-0601 • Fax - 978-499-0602 • www.horsleywitten.com

October 26, 2009

Mr. Robert E. Moore, Jr.
Environmental Health Technician
Conservation Department, City Hall Room 210
4 Summer Street
Haverhill, MA 01830

Re: Second Engineering Peer Review, 940 North Broadway
Residential Cluster Development, "Crystal Springs," Haverhill, MA
MA DEP File Number: 033-1279

Dear Mr. Moore:

The Horsley Witten Group, Inc. (HW) is pleased to submit the second peer review of stormwater management design for the Crystal Springs residential development in Haverhill, Massachusetts. In preparing this letter, HW reviewed the following documents received on Friday, October 16 directly from the Applicant's engineer, S.E.C & Associates, Inc.:

- Definitive Residential Cluster Development Crystal Springs (40 sheets), dated October 12, 2009, S.E.C & Associates, Inc.;
- Drainage Report for Crystal Springs Golf Course, dated October 14, 2009, Civil Design Consultants, Inc.; and
- Response Letter #1, dated October 14, 2009, Civil Design Consultants, Inc. (included in the Drainage Report).

HW has reviewed the Applicant's responses to HW's September 8, 2009 review letter of Crystal Springs Residential Cluster Development.

Based upon the above documents received to date, HW offers the following comments. Our original comments are presented in italics, followed by comments related to the Applicant's response letter in regular font. In summary, the only remaining outstanding issues pertain to comments # 1, 3, 4, and 8 below, which could be addressed via conditions of approval in the Order of Conditions approving this project..

General Stormwater Comments

1. *Based on the plan set dated June 10, 2009, the Applicant has provided an Erosion and Sediment Control Plan; however, the scale of the drawing makes it difficult to see where*

and what erosion and sediment control measures are being proposed for the site. HW recommends the Applicant provide an adequate Erosion and Sediment Control plan for review.

The Applicant has partially addressed this comment by providing silt fence and construction entrance locations on sheets C-15 through C-18. However, HW recommends the Applicant show the extent of construction (limit of work) and clearly show on the Erosion Control Plan that the proposed infiltration basins will not be used to manage erosion and site runoff during construction. HW recommends that this can be a condition of approval.

2. *The Applicant has proposed the use of sediment forebays as a pre-treatment practice. Under the MSMS, sediment forebays need to be sized to hold a minimum of 0.1 inch/impervious acre to pre-treat the water quality volume. HW recommends the Applicant provide sizing calculations for the proposed sediment forebays.*

   The Applicant has addressed this comment by providing sediment forebay sizing calculations showing that all sediment forebays have been adequately sized to hold a minimum of 0.1 inch/impervious acre.

3. *HW recommends the Applicant consider using other low impact development practices for this development, in addition to what has been proposed. For example a bioretention system (lined or unlined, depending on the soil investigation) can be implemented in the proposed parking areas or the cul-de-sac island. Bioretention systems can treat stormwater to effectively remove a significant percentage of Total Suspended Solids (TSS), metals and nutrients prior to being discharged into the adjacent wetland.*

   The Applicant has stated that the use of LID (specifically, bioretention systems), is not feasible with the use of the proposed closed drainage system. However, an important aspect of LID is the use of open drainage systems, such as grass swales, to convey runoff. Such techniques appear feasible at this site and HW recommends that the applicant consider the use of open drainage systems in some portions of the proposed development. However, we note that the Applicant's latest revised plan has met the requirements of the MA Stormwater Standards under the existing design, with appropriate conditions.

4. *In the drainage report, the Applicant has modeled a storage pond at the Lake Street Crossing area under proposed conditions. Based on the size of this storage pond and the location shown on the Lake Street Improvement detail on Sheet 23, HW is uncertain on how the proposed storage pond will fit at this location. The Hydrograph reports indicate the storage pond will be eight feet deep with a total storage capacity of approximately 27,200 cubic feet. HW recommends the applicant revise the plan set to clearly show the layout of this proposed storage pond.*

The Applicant has addressed this comment by providing additional topographic information along the existing depression located directly up-stream of the Lake Street crossing. However, on sheet D-8, the lowest contour elevation is shown as 158 feet, but in the Applicant's calculations the depression is modeled with a bottom elevation of 156 feet. HW recommends the applicant clarify the actual bottom elevation and update the plans or calculations accordingly. HW recommends that this change can be a condition of approval.

5. *The following comments are specific to the Construction Detail Sheets provided in the plans dated June 10, 2009 and August 11, 2009:*

    a. *The Applicant has proposed the use of wet ponds, a wet swale, and infiltration basins on the development, however no details of these practices of been provided. HW recommends the Applicant include cross section and plan view details of the above noted stormwater management practices on their Construction Detail Sheet.*

        The applicant has addressed this comment by adding sheets D10 and D11, entitled Construction Details, which include plan views, cross sections, profiles, and other details and notes needed for the construction of the proposed stormwater management practices.

    b. *The Applicant has shown two details titled "Typical Drain Manholes" on their Construction Detail Sheet. HW is unclear on which drainage manhole configuration is being proposed. HW recommends the Applicant clarify which drainage manhole configuration will be used on site.*

        The Applicant has addressed this comment by relabeling the detail on sheet D5.

    c. *On the Proposed Outlet Structure Details, the invert elevation for POS-4 does not correspond to what is shown on the plans. HW recommends the Applicant verify the correct invert elevations.*

        The Applicant has addressed this comment by updating this information in the construction detail on Sheet D5 to correspond with what is shown on the plans.

    d. *The Applicant has provided a detail of the proposed underground infiltration system. However, HW is uncertain on the location of the cleanouts on the plan view. HW recommends the Applicant clearly label them on the detail sheet.*

        The Applicant has addressed this comment by revising sheet D-7 to clearly label the location of cleanouts. The Applicant has also modified the plan to provide an overflow pipe to PDMH-9. It appears that the underground infiltration system is

sized to accommodate the required recharge volume and any volume greater than that will overflow to PDMH-9 and will discharge to Wet Swale #1.

e. *The Applicant has provided a detail of a concrete headwall with wing walls. HW is uncertain of the location of these headwalls on the proposed development. HW recommends the Applicant clearly indicate the location of these structures on the plan set.*

The Applicant has addressed this comment by providing the locations of the concrete headwalls with wing walls throughout the site on sheets D8, C11, and C17.

f. *HW recommends the Applicant provide a detail of the proposed sewer line crossing the piped section of the intermittent stream.*

The Applicant has addressed this comment by providing additional detail on sheet C23 entitled Sewer Plan and Profile – Cross Country. This detail shows the proposed sewer line crossing above the pipe section of the intermittent stream and the applicant has shown a minimum of 6-inch separation between the pipes, which appears to be appropriate for this design.

g. *The Applicant has provided a detail of the proposed storage pond/drainage swale at the Lake Street drainage improvement area. However, this does not accurately show what was modeled in the Hydrograph Report. The Hydrograph Report shows an eight foot deep pond. HW recommends the Applicant revise the detail to properly reflect the proposed storage pond/drainage swale at this location.*

The Applicant has addressed this comment by updating the detail and the Hydrograph Report for the proposed storage pond/drainage swale at the Lake Street drainage improvement area. The detail now includes proposed topography. However, as previously stated in Comment 4, HW recommends the applicant clarify the actual bottom elevation of the pond and update the plans or calculations accordingly.

h. *HW recommends the Applicant provide a detail of the proposed culvert replacement at the Lake Street crossing.*

The Applicant has addressed this comment by revising sheet D8 to include a cross section of the Lake Street drainage improvements. According to the calculations, under existing conditions, stormwater overtops Lake Street during a 2-year, 24-hour storm event. The proposed design will prevent overtopping of Lake Street during eth 2-year and 10-year, 24-hour storm events.

i. *HW recommends the Applicant show the existing tree locations (HW recommends 8 inches in diameter at breast height, and greater) in the vicinity of the Lake Street drainage improvements and indicate which trees are proposed to be removed so that the Commission may evaluate the potential impacts to these trees.*

   The Applicant has addressed this comment by revising sheet D8 to include the location of trees at least 8-inch in diameter at breast height within the improvements area and have labeled the 7 trees to be removed. It should also be noted that the Applicant stated that they are coordinating all proposed off-site improvements with the City of Haverhill Tree Warden.

6. *In order for the applicant to claim Total Suspended Solids (TSS) Removal Rate of 5% for street sweeping, a specific type of sweeper and sweeping frequency must be stated in the Operation and Maintenance (O&M) Plan. HW recommends the Applicant update their O&M plan to indicate the appropriate type and schedule of street sweeping.*

   The Applicant has addressed this comment by updating the O&M Plan to include the appropriate type and schedule of street sweeping in order to meet the TSS removal rate of 5%.

7. *The Applicant has proposed the use of a proprietary treatment system (Stormceptor 450i) to treat the runoff from the front portion of the roadway for both the Front and Back Nine Drive. The Applicant has applied an 80% TSS removal rate for this treatment system. Under the MSMS, the Stormceptor 450i does not have Massachusetts Department of Environmental Protection (MassDEP) TSS removal efficiency rating, therefore, the University of Massachusetts Stormwater Technologies Clearinghouse (www.mastep.net) should be reviewed. Under this program, the Stormceptor 450i has been tested and have an estimated Suspended Sediment Concentration (SSC) removal rate of approximately 60%. While SSC is a different measurement than TSS, they are similar and HW recommends that a TSS removal rate of not more than 60% be used by the Applicant in their calculations.*

   The Applicant has addressed this comment by replacing the Stormceptor 450i with the Stormceptor STC 900. The Applicant is using a 77% TSS removal efficiency rate which has been determined by the Massachusetts Strategic Envirotechnology Partnership (STEP) program and has updated their TSS calculations accordingly.

8. *HW recommends the Applicant revise their O&M to meet the MSMS requirement for deep sump catch basins. Deep sump catch basins should be inspected or cleaned at least four times per year and at the end of the foliage and snow removal seasons. Sediments must also be removed four times per year or whenever the depth of deposits is greater*

than or equal to one half the depth from the bottom of the invert of the lowest pipe in the basin.

The Applicant has stated in their response letter that the O&M plan was revised to match the Stormwater Management Standards, however the O&M plan still states that the deep sump catch basin should be cleaned biannually. HW recommends the Applicant update the O&M plan accordingly, and this is a condition of approval.

Front Nine Drive

9. *The Applicant has proposed the use of an underground infiltration system for the roof runoff from the proposed club house. The Applicant has not provided any design calculations for this infiltration system. HW does not know what design storm the system is designed to infiltrate or the infiltration rate used in the calculations. Based on the review of the plan and detail of this system, there appears to be no overflow outlet. HW suggests the Applicant provide more information on the design of this system.*

   The Applicant has addressed this comment by providing Subsurface Infiltration System Sizing Calculations and has provided a plan view showing an overflow system that discharges to the proposed wet swale. It appears that the underground infiltration system is sized to accommodate the required recharge volume, and any volume greater than that will overflow to the proposed wet swale.

10. *Based on the plans dated June 10, 2009, at the location of Wet Swale #1, the seasonal high groundwater (SHGW) is estimated to be at elevation 189 feet. The SHGW was estimated based on test pit information provided by the Applicant. Test Pit 16 (TP-16) located in the proposed Wet Swale #1 shows the seasonal high groundwater 24 inches below existing grade. The existing grade elevation in the vicinity of TP-16 is approximately 191 feet, resulting in an estimated SHGW elevation of 189 feet.*

    The bottom elevation of Wet Swale #1 is shown as 187 feet and the rim elevation of the swale is shown as 189 feet. Based on the estimated SHGW, Wet Swale #1 would be inundated with groundwater during the seasonal high period. Therefore, no additional storage would be available during any rain event during this period. Upon review of the applicant's Hydraflow model for Wet Swale #1, the Applicant has not taken this inundation into account in their design. HW recommends that the Applicant not account for storage volume below the SHGW when sizing Wet Swale #1 and the associated sediment forebay.

    The Applicant has addressed this comment by revising Water Quality Swale #1 moving it further up-gradient and raising the bottom elevation of the swale to account for SHGW. The swale has also been extended to allow for a more shallow design.

11. *Based on the plans dated June 10, 2009, at the location of Wet Pond #1, the SHGW is estimated to be approximately 195 feet based on TP-6 and TP-7. The bottom of the wet pond is at an elevation of 188 feet. The Applicant has modeled the bottom of the wet pond at elevation of 192 feet, presumably to account for the groundwater elevation. However, SHGW is three feet higher, at elevation 195 feet. Similar to the comment above, HW recommends that the Applicant not account for storage in the wet pond below 195 feet.*

    The Applicant has addressed this comment by revising Wet Pond #1 to account for SHGW. The Applicant has provided a detail which appropriately represents the wet pond. The drainage report has been updated to account for the appropriate storage.

12. *Based on the plans dated June 10, 2009, the Applicant has shown a drainage pipe connecting the sediment forebay to Wet Pond #1. The invert of this outlet is set at 205 feet and the bottom of the sediment forebay is shown as 206 feet. HW recommends the Applicant adjust the outlet elevation for this sediment forebay to be above the bottom elevation of the basin and above the required pre-treatment volume elevation. HW suggests the Applicant refer to the MSMS for more detailed design criteria for sediment forebays.*

    The Applicant has addressed this comment by revising the discharge pipe from the sediment forebay to Wet Pond #1 to be above pre-treatment volume elevation. The Applicant has also provided sediment forebay calculations to ensure proper design and elevation.

13. *Based on the plans dated June 10, 2009, the Applicant has proposed one catch basin (PCB-17) to capture all the pavement runoff in the westerly parking lot and one catch basin (PCB-14) in the easterly parking lot. Based on best engineering practices, HW suggests that the Applicant provide more then one catch basin in each of the parking lots in case the grate becomes covered by debris.*

    The Applicant has addressed this comment by providing an additional catch basin in the parking area.

14. *Drainage pipes PCB-14 (located in the easterly parking lot by the proposed Club House) and PCB -25 (located at the end of the cul-de-sac of the Back Nine Drive), do not have sufficient capacity to handle a 10-year storm event. HW recommends the Applicant revise the pipe size accordingly.*

    The Applicant has addressed this comment by increasing the slope of PCB-25 from 0.5% to 1.5% to provide sufficient capacity to handle a 10-year storm event. The Applicant has eliminated PCB-14, allowing sheet flow of runoff to flow across the parking area and into to the sediment forebay.

15. *The time of concentration (TC) for proposed drainage area PWA-3B is greater than the corresponding existing drainage area EWA-3. The contributing area for PWA-3B is smaller, the travel path is shorter compared to EWA-3, and the land cover is the same, therefore, the travel time should be less for PWA-3B. In addition, the Applicant assumed the channel slope of 1.3% in these drainage areas, but HW estimates it to be closer to 3%, which may also affect the TC calculation. HW recommends the Applicant review their TC assumptions. A reduction in TC will affect the storage calculations and may require larger storage capacity to offset peak flow rates.*

    The applicant has addressed this comment by recalculating and revising the TC for proposed drainage area PWA-3B.

Back Nine Drive

16. *The Applicant has revised the design of Infiltration Basin #1 on September 2, 2009. Based on this new layout, there now appears to be adequate (2 feet) separation from the bottom of the infiltration basin to the SHGW. However, HW recommends the Applicant revise the overflow weir invert elevation to reflect the change made to the basin elevation. In addition, HW recommends the Applicant check the sediment forebay elevations to ensure it will still overflow into the infiltration basin.*

    The Applicant has addressed this comment by updating the elevation of the proposed 10-foot wide broad crested emergency overflow weir to reflect the updated contours for proposed Infiltration Basin #1.

17. *HW is uncertain on the actual exfiltration rate used in the design of Infiltration Basin #1. HW recommends the Applicant clarify the exfiltration rate that was used in the design of Infiltration Basin #1.*

    The Applicant has addressed this comment by providing Infiltration System Sizing Calculations using an infiltration rate of 0.17 in/hr which corresponds to soil encountered during the test pit evaluation.

18. *The new layout of Infiltration Basin #1 provided on the plans dated September 2, 2009 indicates SHGW at 176.1 feet. This number should be corrected show SHGW at 180 feet based on the TP-10 soil log.*

    The Applicant has addressed this comment by revising the elevation of the SHGW to 180 feet.

19. *The catch basin (PCB-26) shown on the June 10, 2009 plan set should be offline from the drainage network. The MSMS states that all deep sump catch basins must be offline in order for the Applicant to claim 25% TSS removal.*

    The Applicant has addressed this comment by taking PCB-26 offline from the drainage network.

20. *HW recommends the Applicant re-delineate drainage area PWA-2E to include the back of the lots on the south side of Back Nine Drive. The plan set shows a drainage pipe running along the back lots collecting surface flow and discharging to Infiltration Basin #1. The drainage calculations should also be revised to reflect this change in drainage area.*

    The applicant has addressed this comment by explaining that the Proposed Infiltration Basin #1 has been designed to account for the stormwater volume generated from the roadway and driveways, and only the roof top runoff (which is considered clean) from lots 9 – 15 will be conveyed by a swale and discharge down gradient of Infiltration Basin #1.

We appreciate the opportunity to provide these comments to assist the Conservation Commission in reviewing of the proposed project. Please do not hesitate to contact me at 978-499-0601 with any questions.

Sincerely,

HORSLEY WITTEN GROUP, INC.

Ellie Stewart Baker
Senior Environmental Planner

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October 14, 2009

Robert E. Moore, Jr.
Conservation Department
City Hall, Room 210
4 Summer Street
Haverhill, MA 01830

Tel: (978) 374-2334
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CDCI File #: 08-0703
Crystal Springs Golf Course
940 North Broadway
Haverhill, MA 01832

Response Letter #1

Mr. Moore,

Civil Design Consultants, Inc. (CDCI) is pleased to provide this response to a review letter prepared by the Horsley Witten Group dated September 8th, 2009 for the *Crystal Springs Residential Cluster Development*. The following responses have been prepared consistent with the format of the review letter.

General Stormwater Comments

1. Sheet C29 entitled Erosion Control Plan has been revised to include Note 3 which states *This plan has been prepared to provide an overview of the erosion and sediment control practices proposed on-site. The Contractor is directed to Sheets C15-C18 entitled Site Grading and Drainage Plans for additional information and specific erosion and sediment control practice locations.*

2. As requested, Sediment Forebay Sizing Calculations have been provided in the supplemental information portion of this response letter. Each forebay has been designed to provide a minimum volume of 0.1-IN times the total impervious surface.

3. Bio-retention was considered at the center of each of the cul-de-sacs as well as along the perimeter of the parking areas. However, site constraints have made bio-retention difficult to implement. The closed drainage system passes under the cul-de-sacs approximately 4-FT to 4.5-FT below the proposed grade. In order to implement bio-retention pretreatment is required. Considering the limited area within the cul-de-sac centers (1,600-SF +/-) and the cuts that would be required to daylight the closed drainage system, the cul-de-sac centers are not well suited for the placement of bio-retention areas.

   Bio-retention was also considered along the perimeter of the parking areas west of the proposed club house. In this area insufficient head is available to construct the system and daylight the underdrain above the permanent pool elevation of Wet Pond #2.

   The stormwater management facilities throughout the site have been designed to address the stormwater management standards and enhance the existing golf course and proposed residential community. Wet basins and water quality swales have many of the same characteristics as constructed wetlands, and these facilities will add to the recreation, wildlife habitat and aesthetic values of the property.

4. As requested, additional topographic information has been generated along the existing depression located directly up-stream of the Lake Street crossing. The depression is drained through two separate outlets. The first outlet is the existing 12-IN RCP at elevation 156.9. The second outlet is the centerline of the roadway, adjacent to the crossing, and is modeled as a broad crested weir with an overflow elevation of 159.8. The storage provided from elevation 160 to 160 is an estimate, and consistent in both the pre-development and post-development conditions analysis. This allows a means to compare the impact of the propose development, and the proposed Lake Street crossing improvements, on the existing system.

The Lake Street Crossing Pond Data provided in the revised Drainage Report has been revised to reflect the findings of the additional topographic survey information. The Lake Street culvert improvements allow for the 2-year (3.1-IN) and most of the 10-year (4.5-IN) 24-hour storm events to pass before the roadway is overtopped. This improvement to the drainage system will not result in an increase in peak discharge downstream of the culvert for up to and including the 100-year, 24-hour storm event.

5. The following responses are prepared to address comments specific to the construction detail:
    a. As requested, sheets D10 and D11 entitled Construction Details have been developed to include detailed plan views, cross sections, profiles, appropriate details and notes for each of the proposed stormwater management practices.
    b. As requested, sheet D5 entitled Construction Details has been revised to re-label the typical catch basin detail appropriately.
    c. As requested, the Proposed Outlet Structure Invert Schedule provided on sheet D5 entitled Construction Details has been revised to reflect the modifications made to the proposed stormwater management facilities.
    d. As requested, sheet D7 entitled Construction Details has been revised to clearly label the location of the proposed sub-surface infiltration system clean-outs access ports, as well as, the modifications made to provide an overflow pipe to PDMH-9.
    e. Five (5) 24-IN headwalls are proposed throughout the proposed development. One set of headwalls is located at the proposed Lake Street drainage improvements as illustrated on sheet D8 entitled Construction Details. The second set of 24" headwalls is located along Front Nine Drive at STA 9+35 +/- as illustrated on Sheet C11 entitled Front Nine Drive – Roadway Plan and C.L. Profile. This set of headwalls has been added to address modifications to the location and configuration of Wet Pond #2. The last headwall is at the cart path crossing, from PFES-1 to the sediment forebay leading to Wet Pond #1 as illustrated on sheet C-17.
    f. Test pits were conducted to determine the location and elevation of the piped section of the intermittent stream. Additional detail of the proposed cross country sewer line crossing the piped section of the intermittent stream between PSMH#14 and PSMH#15 has been added to sheet C23 entitled Sewer Plan and Profile – Cross Country.
    g. As requested, the Lake Street Drainage Improvements detail provided on Sheet D8 entitled Construction Details has been revised to include proposed topography and the Improved Lake Street Crossing Pond Data provided in the revised drainage report has been updated to reflect this additional information.
    h. As requested, sheet D8 entitled Construction Details has been revised to include Detail C-C illustrating a cross section of the Lake Street drainage improvements.
    i. As requested, the Lake Street Drainage Improvements Detail provided on Sheet D8 entitled Construction Details has been revised to include existing trees 8-IN in diameter at breast height within the improvements area. In addition, it should be noted that the Applicant has coordinated all proposed off-site improvements with the City of Haverhill Tree Warden.

6. As requested, the Operations and Maintenance Plan provided in the revised Drainage Report has been updated to specify that street sweeping will be performed on a monthly basis with a high efficiency vacuum sweeper. It should be noted that the proposed development, including the parking lots and roadways, will be under private ownership, and therefore, maintenance will be the responsibility of the Applicant.

7. As requested, the Stormceptor 450i's located at both Front Nine Drive and Back Nine Drive have been replaced with Stormceptor STC 900. The STC 900 are approved for a 77% TSS removal efficiency rate as documented in the Fact Sheet provided in the supplemental information portion of this response letter. In addition, the TSS Removal Rate calculations have revised and provided in the supplemental information portion of this response letter.

8. As requested, the Operations and Maintenance Plan provided in the revised Drainage Report has been updated to specify a maintenance program consistent with the TSS removal rate calculations and the Stormwater Management Standards.

FRONT NINE DRIVE

9. As requested, Subsurface Infiltration System Sizing Calculations are provided in the supplemental information portion of this letter. The system has been designed to infiltrate the recharge volume generated by the roof area of the proposed club house in an attempt to comply with the *maximum extent practicable* threshold outlined in Standard 3. In excess of 20 test pits have been conducted throughout the design phase of this project to determine the potential for recharge. However, high estimated seasonal high ground water elevations (SHGW) preclude the use of infiltration practices throughout most of the site. No signs of SHGW were observed within 5-FT of the existing surface in the Phase 1 parking area, and therefore, this location has been selected to provide infiltration.

10. The location and configuration of Water Quality Swale #1 have been revised to account for an adjustment to the delineation of the adjacent wetland resource. The swale is located further up-gradient and is extended to allow for a more shallow design. The existing high contour elevation in the vicinity of the swale is approximately 194.0, resulting in a SHGW elevation of approximately 192.0. The bottom of the swale will be at elevation 191.0, below the permanent pool elevation of 192.0, and planted with a wetland meadow seed mix. The water quality volume will be provided from elevation 192.0 to 193.0. Sheet D10 entitled Construction Details have been developed to include detailed plan view, cross section, profile, appropriate details and notes of Water Quality Swale #1. Finally, the post-development conditions analysis has been revised to only account for the volume provided above the permanent pool elevation of 192.0.

11. As requested, the configuration of Wet Pond #1 has been revised to account for the SHGW elevation. As indicated by the test pits in the area, the SHGW table is approximately 18-IN below grade. The existing high contour elevation above the aquatic bench is approximately 196.0, resulting in a SHGW and permanent pool elevation of approximately 194.5. The aquatic bench will be set at elevation 193.5, below the permanent pool elevation of 194.5, and planted with a wetland meadow seed mix. Again, sheet D10 entitled Construction Details have been developed to include detailed plan view, profile, appropriate details and notes of Wet Pond #1. In addition, the post-development conditions analysis has been revised to only account for the volume provided above the permanent pool elevation of 194.5.

12. As requested, the discharge pipe from the sediment forebay to Wet Pond #1 has been revised to be above pre-treatment volume elevation as illustrated on sheet C17 entitled Site Grading and Drainage Plan. In addition, Sediment Forebay Sizing Calculations have been provided in the supplemental information portion of this response letter specifying that each forebay has been designed to provide a minimum volume of 0.1-IN times the total impervious surface.

13. As requested, an additional catch basin (PCB-17) has been added to the closed drainage system servicing the Phase 1 parking area as illustrated on sheet C15 entitled Site Grading and Drainage Plan. In addition, the closed drainage system calculations provided in the revised drawing report have been updated to reflect this modification.

14. As requested, the slope of the discharge pipe from PCB-25 has been increased from 0.5% to 1.5% to provide sufficient capacity to accommodate the anticipated design flow. In addition, PCB-14 has been eliminated, and the proposed grading has been revised, to encourage sheet flow from the parking area to the sediment forebay. The 10 Year Design Storm – Stormwater Conveyance System calculations provided in the revised Drainage Report, as well as design documents, have been revised to reflect these changes.

15. As requested, the Time of Concentration (Tc) calculation has been reviewed for watershed PWA-3B. It was determined that the entire length of the Tc flow path (945-FT) was used as the length of the Channel Flow segment, resulting in a longer Tc and decreased peak discharge for the contributing

watershed to Wet Pond #2. The revised drainage report has been updated to accurately reflect a 535-FT channel flow path length.

It should also be noted that the post-development model has been updated to include a reach, from both Wet Pond #1 and Wet Pond #2, to account for the travel time from the pond outlets to Design Point #3.

BACK NINE DRIVE

16. As requested, the elevation of the proposed 10-FT wide broad crested emergency overflow weir at proposed Infiltration Basin #1 has been revised to reflect the updated contours as illustrated on sheet C18 entitled Site Grading and Drainage Plan. In addition, additional detail has also been provided to ensure the overflow from the sediment forebay will discharge to the infiltration pond.

17. As requested, Infiltration System Sizing Calculations have been prepared and are included in the supplemental information portion of this letter. These calculations clarify the information used to develop the exfiltration rate for Infiltration Basin #1.

18. As requested, the SHGW elevation associated with TP-10 has been revised to elevation 180.00 to account for the updated topographic information as illustrated on Sheet C18 entitled Site Grading and Drainage Plan.

19. As requested, PCB-26 has been revised to be off-line from the drainage network as illustrated on Sheet C18 entitled Site Grading and Drainage Plan.

20. The portion of watershed PWA-2E located south of Back Nine Drive is limited to the rear of lots 9-15 and includes a portion of the existing golf course at the intersection of North Broadway and Lake Street as delineated on sheet 2 entitled Proposed Watershed Plan. Proposed impervious surface within this portion of the watershed is limited to the roof area of lots 9-15, and therefore is considered clean and exempt from the treatment requirement of Standard 3. Infiltration Basin #1 has been over sized to reduce peak discharge and account for the water quality and recharge volume generated by Back Nine Drive in its entirety. To ensure the system functions consistent with the post-development drainage calculations, a swale has been provided at the tow of the berm, to direct discharge from this portion of the watershed to the existing swale, located down gradient of Infiltration Basin #1 as illustrated on sheet C18 entitled Site Grading and Drainage Plan

I believe this information, along with the revised design documents, drainage report and supplemental calculations address each of the items provided in the comment letter. I look forward to meeting with you on the 29th to discuss these modifications in further detail. If you have any questions or comments, or require additional information, please do not hesitate to contact this office.

Very Truly Yours,

CIVIL DESIGN CONSULTANTS, INC.

James E. Hanley, PE
President

TEST PIT RESULTS

S.E. CUMMINGS & ASSOCIATES
P.O. BOX 1337 PLAISTOW, N.H. 03865
TELEPHONE (603)-382-5065 FAX (603)-382-5216

Location: CRYSTAL SPRINGS	
Date: 9-14-09	Evaluator: SC
Witnessed by:	Title:

Test Pit	~~Lot~~ Hole #	STK #	E.S.H.W.T.	
1 of 4	9	425	@ 32"	
Terminated @ 52"	Refusal? Y (N) (LARGE BOULDER)	Observed H2O @ 42"	Roots to: N/O	

DEPTH	COLOR	TEXTURE	STRUCTURE	CONSISTENCE	MOTTLES
0-8"	10YR 2/2	LOAM	GRAN.	FRIABLE	
8-28"	10 YR 4/6	SANDY LOAM	"	"	
28-52"	10 YR 6/6	LOAMY SAND	"	"	

Test Pit	Hole ~~Lot~~ #	STK #	E.S.H.W.T.	
2 of 4	9 (DET AREA)	426	@ 30"	
Terminated @ 48	Refusal? Y (N) (FIRM + STONY)	Observed H2O @ 36"	Roots to: N/O	

DEPTH	COLOR	TEXTURE	STRUCTURE	CONSISTENCE	MOTTLES
0-12"	10YR 2/2	LOAM	GRAN.	FRIABLE	
12-26"	10 YR 4/4	SANDY LOAM	BLOCKY	"	
26-48"	10 YR 6/4	STONY GRAVEL	GRAN.	"	FIRM

TEST PIT RESULTS

S.E. CUMMINGS & ASSOCIATES
P.O. BOX 1337 PLAISTOW, N.H. 03865
TELEPHONE (603)-382-5065 FAX (603)-382-5216

Location: CRYSTAL SPRINGS	
Date: 9-14-09	Evaluator: SC
Witnessed by:	Title:

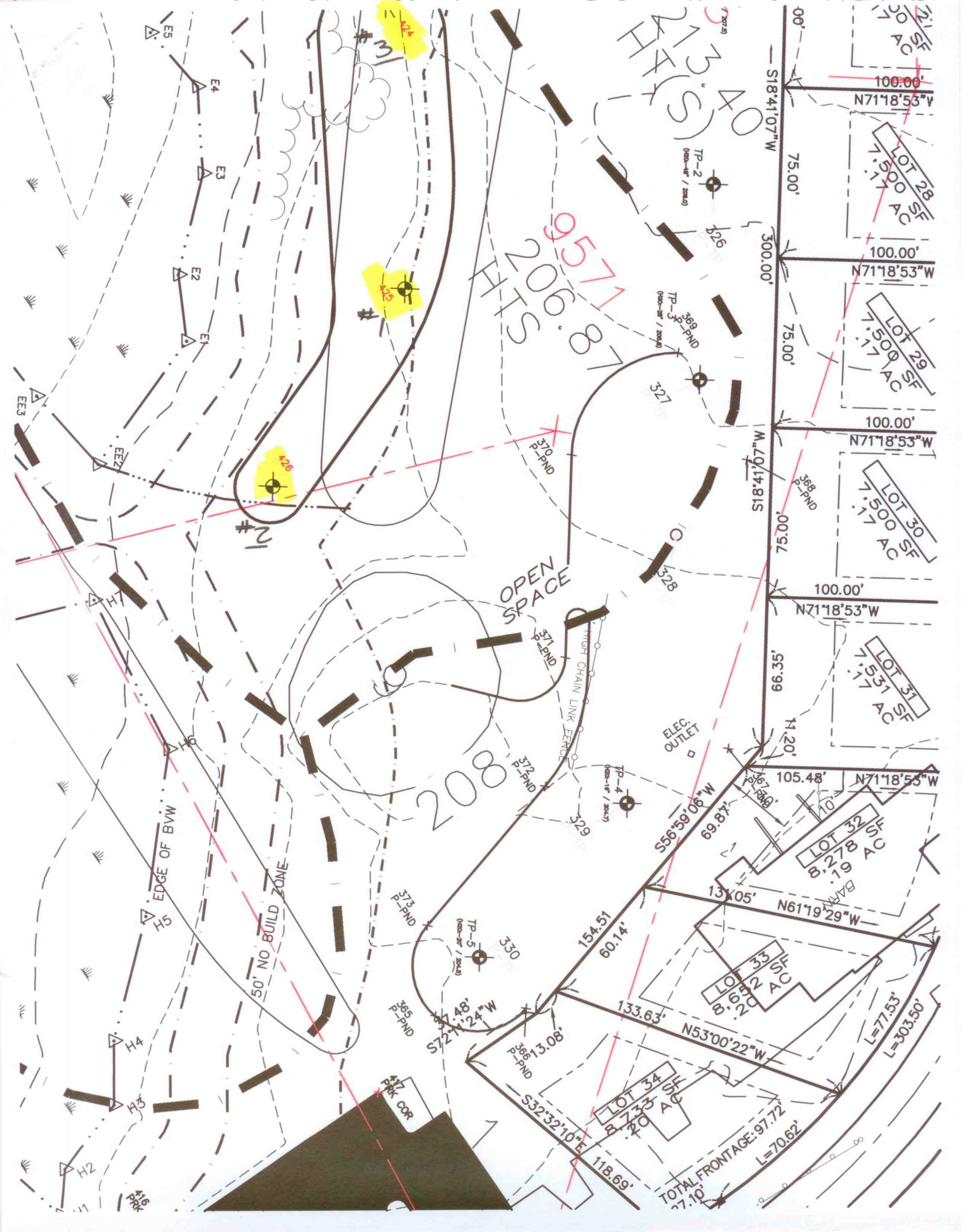
Test Pit	~~Lot~~ Hole #	Stk #	E.S.H.W.T.	
3 of 4	9	424	@ 50"	
Terminated @	Refusal?	Observed H2O	Roots to:	
60"	Y (N)	@ N/O	30"	

DEPTH	COLOR	TEXTURE	STRUCTURE	CONSISTENCE	MOTTLES
0-12"	10YR 2/2	LOAM	GRAN.	FRIABLE	
12-30"	10YR 5/4	SANDY LOAM	"	"	
30-60"	10YR 6/6	LOAMY SAND	"	"	

Test Pit	~~Lot #~~	CENTER SAC FRONT NINE DRIVE	E.S.H.W.T.	
4 of 4			@ N/O	
Terminated @	Refusal?	Observed H2O	Roots to:	
62"	Y (N)	@ N/O	N/O	

LEDGE ALL AROUND

DEPTH	COLOR	TEXTURE	STRUCTURE	CONSISTENCE	MOTTLES
0-8"	10YR 3/3	LOAM	GRAN.	FRIABLE	
8-22"	10YR 5/8	SANDY LOAM	"	"	
22-62"	10YR 6/6	LOAMY SAND	"	"	



LOT 28
7,500 SF
.17 AC
LOT 29
7,500 SF
.17 AC
LOT 30
7,500 SF
.17 AC
LOT 31
7,531 SF
.17 AC
LOT 32
8,278 SF
.19 AC
LOT 33
8,652 SF
.20 AC
LOT 34
8,733 SF
.20 AC
100.00'
N71°18'53"W
S18°41'07"W
75.00'
300.00'
66.35'
11.20'
105.48'
69.87'
S56°59'06"W
131.05'
N61°19'29"W
154.51
60.14'
133.63'
N53°00'22"W
13.08'
S72°11'24"W
118.69'
S32°32'10"E
TOTAL FRONTAGE: 97.72'
L=77.53'
L=303.50'
L=70.62'
OPEN SPACE
HIGH CHAIN LINK FENCE
ELEC. OUTLET
BARN
EDGE OF BVW
50' NO BUILD ZONE
TP-2
TP-3
TP-4
TP-5
326
327
328
329
330
365 P-PND
366 P-PND
368 P-PND
369 P-PND
370 P-PND
371 P-PND
372 P-PND
373 P-PND
417 PRK COR
416 PRK
E1
E2
E3
E4
E5
EE3
H2
H3
H4
H5
H6
H7
9571
206.87
HTS
213.40
HTS
208
424
425
426
#1
#2
#3

CIVIL DESIGN
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Project: Crystal Springs Golf Course
Client: Premiere Realty Trust
Project Number: 08-0703

Prepared By: James E. Hanley, PE
Date: October 14, 2009

SEDIMENT FOREBAY SIZING CALCULATIONS

Determine Minimum Sediment Forebay Volume

	(Ai)	
PFES-1 @ Wet Pond #1:	**41586**	SF
Determine Minimum Sediment Forebay Volume (0.1-IN x Ai):	347	CF

Determine Actual Sediment Forebay Volume @ PFES-9

Elevation	Contour Area (SF)	Inc. Storage (CF)	Total Storage (CF)	
200.00	**911**	---	---	
201.00	**1532**	1222	1222	**O.K.**

Determine Minimum Sediment Forebay Volume

PFES-4 @ Wet Pond #2:	**22398**	SF
PFES-5 @ Wet Pond #2:	**22665**	SF
24" Roadway Culvert @ Wet Pond #2:	**53780**	SF
Phase 2 Parking Lot @ Wet Pond #2:	**30206**	SF
Total Impervious Area to Wet Pond #2:	129049	SF
Determine Minimum Sediment Forebay Volume (0.1-IN x Ai):	1075	CF

Determine Actual Sediment Forebay Volume @ Wet Pond #2

Elevation	Contour Area (SF)	Inc. Storage (CF)	Total Storage (CF)	
204.00	**749**	---	---	
205.00	**1730**	1240	1240	**O.K.**

Determine Minimum Sediment Forebay Volume

	(Ai)	
PFES-9 @ ater Quality (Wet) Swale #1:	**66220**	SF
Determine Minimum Sediment Forebay Volume (0.1-IN x Ai):	552	CF

Determine Actual Sediment Forebay Volume @ PFES-9

Elevation	Contour Area (SF)	Inc. Storage (CF)	Total Storage (CF)	
191.00	**381**	---	---	
192.00	**739**	560	560	**O.K.**

Determine Minimum Sediment Forebay Volume

PFES-13 @ Infiltration Basin #1: **60984** SF

Determine Minimum Sediment Forebay Volume (0.1-IN x AT): 508 CF

Determine Actual Sediment Forebay Volume @ PFES-12

Elevation	Contour Area (SF)	Inc. Storage (CF)	Total Storage (CF)	
183.00	**300**	---	---	
184.00	**816**	558	558	**O.K.**

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TOTAL SUSPENDED SOLIDS (TSS) REMOVAL RATE CALCULATIONS

Wet Pond #1	Removal Rate											
Street Sweeping	5%	1.00	x	5%	=	0.05	1.00	-	0.05	=	0.95	
Deep Sump Catch Basins	25%	0.95	x	25%	=	0.24	0.95	-	0.24	=	0.71	
Sediment Forebay & Wet Pond	80%	0.71	x	80%	=	0.57	0.71	-	0.57	=	0.14	
Total Anticpated TSS Removal:											85.8%	**O.K.**

Wet Pond #2	Removal Rate											
Parking Lot Sweeping	10%	1.00	x	10%	=	0.1	1.00	-	0.10	=	0.90	
Sediment Forebay & Wet Pond	80%	0.90	x	80%	=	0.72	0.90	-	0.72	=	0.18	
Total Anticpated TSS Removal:*											82.0%	**O.K.**

A small portion of the watershed at the Phase 2 parking area west of the proposed club house sheet flows into the proposed sediment forebay, therefore, the credit for deep sump catch basins has been eliminated from the calculation.

Water Quality (Wet) Swale	Removal Rate											
Parking Lot Sweeping	10%	1.00	x	10%	=	0.1	1.00	-	0.10	=	0.90	
Deep Sump Catch Basins	25%	0.90	x	25%	=	0.23	0.90	-	0.23	=	0.68	
Sediment Forebay & WQS	70%	0.68	x	70%	=	0.47	0.68	-	0.47	=	0.20	
Total Anticpated TSS Removal:											79.8%	**O.K.**

Stormceptor STC 900	Removal Rate											
Street Sweeping	10%	1.00	x	10%	=	0.1	1.00	-	0.10	=	0.90	
Deep Sump Catch Basins	25%	0.90	x	25%	=	0.23	0.90	-	0.23	=	0.68	
Stormceptor STC 900	77%	0.68	x	77%	=	0.52	0.68	-	0.52	=	0.16	
Total Anticpated TSS Removal:											84.5%	**O.K.**

This calculation is provided for the discharge from both PFES-11 and FES from PDMH-10A

Infiltation Pond	Removal Rate													
Street Sweeping	10%	1.00	x	10%	=	0.1	1.00	-	0.10	=	0.90			
Deep Sump Catch Basins	25%	0.90	x	25%	=	0.23	0.90	-	0.23	=	0.68			
Sediment Forebay & infiltation Por	80%	0.68	x	80%	=	0.54	0.68	-	0.54	=	0.14			
Total Anticpated TSS Removal:											86.5%	**O.K.**		

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INFILTRATION SYSTEM SIZING CALCULATIONS (Page 1 of 1)

Subsurface Infiltration System

Determine Required Recharge Volume			
Hydrologic Soils Group	**C**		
Impervious Surface (Roof Area)	**9,980**	SF	
Target Factor (Table 2.3.2 - Chapter 1 / Volume 3):	**0.25**	IN	
Recharge Volume (Rv):	208	CF	
Determine Storage Volume			
Volume per Chamber (Cultec 180 HD):	**35.37**	CF	
Number of Units:	**8**	EA	
Storage Volume (Sv) Provided @ Overflow Weir (ELE: 205.61):	250	CF	**O.K.**
Determine Drawdown Time			
Bottom Area of System (52.6' x 5'):	**263**	SF	
Infiltration Rate (Table 2.3.3 - Chapter 1 / Volume 3):	**0.17**	IN/HR	
Exfiltration Rate:	**0.001**	CFS	
Draw Down:	**67**	HR	**O.K.**

Infiltration Basin #1

Determine Required Recharge Volume			
Hydrologic Soils Group:	**C**		
Total Impervious Surface at Back Nine Drive (A_{IT}):	**76,230**	SF	
Impervious Surface to Infiltration Basin:	**46,058**	SF	
Target Factor (Table 2.3.2 - Chapter 1 / Volume 3):	**0.25**	IN	
Recharge Volume (Rv):	960	CF	
Determine Storage Volume			
Storage Volume (Sv) Provided from 183.00 to 183.50:	3,042	CF	**O.K.**
Determine Drawdown Time			
Bottom Area of System (@ 183.00):	**5,823**	SF	
Infiltration Rate (Table 2.3.3 - Chapter 1 / Volume 3):	**0.17**	IN/HR	
Exfiltration Rate:	**0.023**	CFS	
Draw Down:	**37**	HR	**O.K.**
Capture Area Adjustment Calculations			
- A_{IT} / $A_{I\ Draining\ to\ Infiltration\ Pond\ 1}$:	**166%**		
- Adjusted Minimum Storage Volume:	1,588	CF	**O.K.**

CULTEC, Inc.
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custservice@cultec.com

CULTEC

Number of chambers -	8
Stone Void -	0.40
Base of Stone Elevation -	203.40

Given: 6" stone base
6" stone above units
39" center to center

CULTEC Recharger 180 Incremental Storage Volumes

Height of System (in)	Chamber Ht (in)	Incremental Chamber (ft^3)	Incremental Stone (ft^3)	Incremental Chamber & Stone (ft^3)	Cumulative Storage per Chamber (ft^3)	Cumulative Storage for System (ft^3)	Elevation
32.5		0.00	0.69	0.69	35.37	282.97	206.11
31.5		0.00	0.69	0.69	34.69	277.48	206.03
30.5		0.00	0.69	0.69	34.00	272.00	205.94
29.5		0.00	0.69	0.69	33.31	266.51	205.86
28.5		0.00	0.69	0.69	32.63	261.02	205.78
27.5		0.00	0.69	0.69	31.94	255.54	205.69
26.5	20.5	0.00	0.34	0.34	31.26	250.05	205.61
26	20	0.24	0.59	0.83	30.91	247.31	205.57
25	19	0.38	0.53	0.91	30.08	240.67	205.48
24	18	0.57	0.46	1.03	29.17	233.36	205.40
23	17	0.74	0.39	1.13	28.14	225.14	205.32
22	16	0.85	0.34	1.20	27.01	216.10	205.23
21	15	0.95	0.31	1.26	25.81	206.51	205.15
20	14	1.02	0.28	1.30	24.56	196.47	205.07
19	13	1.08	0.25	1.34	23.26	186.09	204.98
18	12	1.15	0.23	1.37	21.93	175.41	204.90
17	11	1.22	0.20	1.42	20.55	164.42	204.82
16	10	1.25	0.18	1.44	19.13	153.07	204.73
15	9	1.28	0.17	1.45	17.70	141.57	204.65
14	8	1.30	0.16	1.47	16.24	129.95	204.57
13	7	1.32	0.16	1.48	14.78	118.20	204.48
12	6	1.37	0.14	1.51	13.30	106.36	204.40
11	5	1.39	0.13	1.52	11.79	94.32	204.32
10	4	1.40	0.13	1.53	10.27	82.14	204.23
9	3	1.41	0.12	1.53	8.74	69.94	204.15
8	2	1.41	0.12	1.53	7.21	57.71	204.07
7	1	1.47	0.10	1.57	5.69	45.48	203.98
6		0.00	0.69	0.69	4.11	32.92	203.90
5		0.00	0.69	0.69	3.43	27.43	203.82
4		0.00	0.69	0.69	2.74	21.94	203.73
3		0.00	0.69	0.69	2.06	16.46	203.65
2		0.00	0.69	0.69	1.37	10.97	203.57
1		0.00	0.69	0.69	0.69	5.49	203.48
TOTALS		21.81	13.56	35.37	35.37	282.97	

BET TOP OF OVER FLOW WEIR IN DISCHARGE MANHOLE @ ELE 205.61. THIS WILL PROVIDE 250.05 CF OF STORAGE - DISCHARGE THROUGH 12" PIPE @ ½% (MIN).

Created on: 10/9/2009

Fact Sheet #4

Stormwater Technology: Stormceptor

(Hydro Conduit, formerly CSR New England Pipe)

Revised February 2003

*The **Stormceptor Fact Sheet** is one in a series of fact sheets for stormwater technologies and related performance evaluations, which are undertaken by the **Massachusetts STrategic Envirotechnology Partnership (STEP).***

The STEP evaluation entitled, *Technology Assessment, Stormceptor CSR New England Pipe*, January 1998 is the information source for this fact sheet. When a more thorough understanding of a system is required, the full *Technology Assessment* should be reviewed. Copies are available for downloading from the STEP Web site (www.STEPSITE.org/) or by contacting the STEP Program (Phone: 617/626/1197, FAX: 617/626/1180, email: linda.benevides@state.ma.us). This fact sheet is subject to future updates as additional performance information becomes available.

Description/Definition

Stormceptor is a prefabricated, underground unit that separates oils, grease, and sediment from stormwater runoff when installed with an existing or new pipe conveyance system. The unit is divided into two chambers–a treatment and a flow bypass chamber. During typical storm events, runoff is directed by the inflow weir through a drop pipe into the lower treatment chamber where sediment, oil, and grease are separated from the flow by gravity. The bypass chamber is designed to convey excess stormwater, which overtops the inflow weir, through the system without treatment.

Equipment and Sizing

The on-line Stormceptor units are available in eight sizes ranging from six and twelve feet in diameter with capacities of 900 to 7200 gallons. Since issuing the STEP assessment in 1998, the manufacturer has expanded the Stormceptor product line to include a storm drain inlet (STC 450i) and three units (Models STC 11000, STC 13000, and STC16000). These systems are not included in the STEP evaluation. Users and decision-makers may require additional field test results and new data for these new systems in order to accept performance ratings, particularly if they are higher than those reported in the STEP technology assessment and this fact sheet.

Stormceptor units are available in either precast concrete or fiberglass for special applications. Concrete units are pre-engineered for HS-20 min. traffic loading at the surface. Fiberglass units can be used in areas where there is a potential for oil and chemical spills.

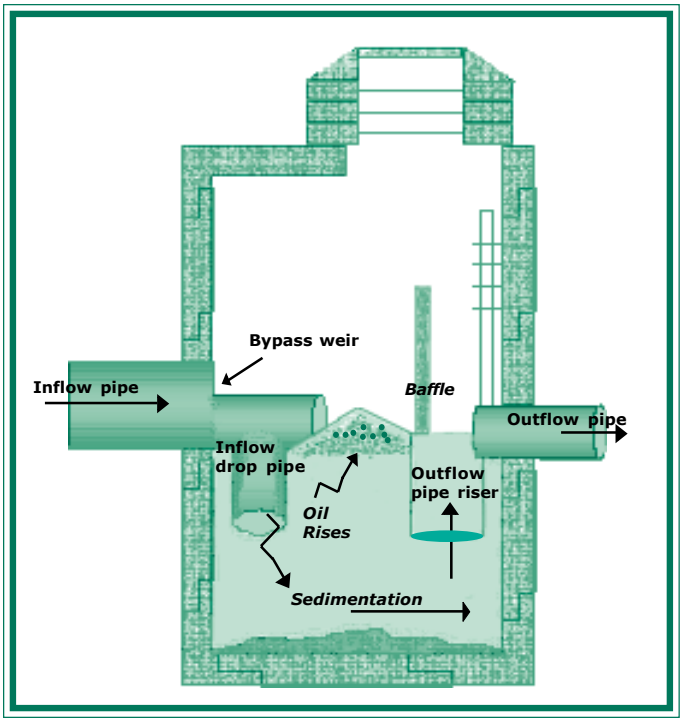

Figure 1. Stormceptor operation during average flow conditions.

Performance/Effectiveness

The system is designed to provide separation of sediment, oil, and grease from stormwater by routing runoff into a low-turbulence environment where solids settle and oils float out of solution. The system sizing is based on the drainage area, historical rainfall data, and the solids removal efficiency required. It is recommended that the system be used in combination with other stormwater controls to conform with the Massachusetts Stormwater Management Policy and standards.

An Imperial Model STC 2000 (equivalent to the Model STC 2400) in Edmonton, Canada treats flow from a 9.8 acre commercial parking lot. This system was monitored during four storm events in 1996 and shown to have an average total suspended solids (TSS) removal efficiency of 52 percent. In designing a system to achieve a comparable removal efficiency, the relationship between system size and impervious drainage area should be considered, as detailed in Table 1 and the Technology Assessment Report.

A Model STC 1200 in Westwood, Massachusetts treats flow from 0.65 acres consisting of a paved truck loading area at a manufacturing facility. The unit was monitored for six storm events in 1997, but only four events had measurable TSS influent concentrations. Of these four events, the average TSS removal efficiency was calculated to be 77 percent, which is less than the 80 percent removal targeted by the manufacturer.

Based on these field monitoring results, and when the unit sizing follows the guidance in Table 1, removal efficiencies between 52 percent and 77 percent may be achieved where installations have similar rainfall and land use characteristics as those reviewed for the STEP evaluation. It is recommended that additional field research and new data be evaluated to validate performance ratings higher than those verified by STEP.

Specific performance claims for oil and grease were not evaluated by STEP. However, total petroleum hydrocarbons (TPH) were analyzed during the Westwood study. Results indicated that the unit was effective in capturing oils.

Stormceptor Model Number	Maximum Impervious Area (acres)	
	77% TSS removal	52% TSS removal
STC 900	0.45	0.9
STC 1200	0.7	1.45
STC 1800	1.25	2.55
STC 2400	1.65	3.35
STC 3600	2.6	5.3
STC 4800	3.6	7.25
STC 6000	4.6	9.25
STC 7200	5.55	11.25

Table 1: Sizing for TSS removal (adapted from the manufacturer's sizing in the 1998 STEP Report) Use the table to determine a TSS removal rate. Use the new Rinker method for sizing Stormceptor units. The sizing method has been changed since publication of the STEP Report. **Note:** To achieve 52% and 77% TSS removal rates on some sites, it may be necessary to use lower maximum impervious areas than those in Table 1.

Technology Status

The Stormceptor system provides greater solids separation and higher TSS removal efficiencies than oil and grit separators. Stormceptor systems are among the category of hydrodynamic separators, which are flow-through devices with the capacity to settle or separate grit, oil, sediment, or other pollutants from stormwater. According to the U.S. Environmental Protection Agency, "Hydrodynamic separators are most effective where the materials to be removed from runoff are heavy particulates - which can be settled - or floatables - which can be captured, rather than solids with poor settleability or dissolved pollutants."

The field studies evaluated for the STEP assessment predate the Stormwater Best Management Practice Demonstration Tier II Protocol (2001), which is applicable in Massachusetts and other states in the Technology Acceptance Reciprocity Partnership (TARP), to ensure quality controlled studies that can be shared among participating states. Therefore, interstate reciprocity is not available to the manufacturer, based on performance claims that were evaluated by STEP in 1998. If the TARP Protocol requirements are fulfilled in the future, the manufacturer could pursue reciprocal verification for Stormceptor systems in participating TARP states. More information on the TARP Protocol is available on the following Web site: www.dep.state.pa.us/dep/deputate/pollprev/techservices/tarp.

Applications/Advantages

- Stormceptor systems identified in Table 1 should be used in combination with other BMPs to remove 80 percent of the average annual load of TSS (DEP Stormwater Policy Standard 4). Systems may be well suited for pretreatment in a mixed component system designed for stormwater recharge.
- Performance data show that Stormceptor may provide TSS removal rates in the range of 52 percent to 77 percent when sized according to Table 1. Higher TSS removal rates were achieved during low flow, low intensity storms with less than one third of an inch of runoff. Also, by reducing the impervious drainage area, relative to the system size, the STEP Technology Assessment Report indicated that higher removal efficiencies may be achievable. However, STEP recommends collection of additional data "representing a varied set of operating conditions over a realistic maintenance cycle to verify TSS removal rates greater than 80 percent."
- The Stormceptor system is suitable for new and retrofit applications. For retrofit applications, it should not

take the place of a catch basin for the systems that have been verified. Also, for retrofit applications, it should be installed in lateral lines and not main trunk lines.

- The system is particularly well suited in constricted areas and where space is limited.
- It also is suitable for use in areas of high potential pollutant loads (DEP Stormwater Policy Standard 5), where it may be used effectively in capturing and containing oil and chemical spills. *Web site:* www.state.ma.us/dep/brp/stormwtr/stormpub.htm.

Considerations/Limitations

- Systems are not expected to provide significant nutrient (nitrogen and phosphorus) or fecal coliform removal.
- The systems are not recommended for use in critical areas, such as public drinking water supplies, certified vernal pools, public swimming beaches, shellfish growing areas, cold water fisheries, and some Areas of Critical Environmental Concern (ACECs), except as a pretreatment device for BMPs that have been approved by DEP for use in critical areas. The structural BMPs approved for use in critical areas are described in Standard 6 of the Stormwater Management Policy, www.state.ma.us/dep/brp/stormwtr/stormpub.htm.
- There is a limited set of useful data for predicting the relationship between treatment efficiency and loading rates. Removal efficiencies have not been demonstrated for all unit sizes.
- Further research is needed to determine how much TSS bypasses the treatment chamber during certain, higher velocity storm events which recur less frequently.
- Systems require regular maintenance to minimize the potential for washout of the accumulated sediments.

Reliability/Maintenance

All BMPs require scheduled, routine maintenance to ensure that they operate as efficiently as possible. Although maintenance requirements are site specific, a general relationship between cleaning needs and depths of sediment has been established by the manufacturer. Inspection of the Stormceptor interior should be done after major storm events, particularly in the first year of operation. It is recommended that material in the treatment chamber be pumped out by a vacuum truck semiannually, or when the sediment and pollutant loads reach about 15 percent of the total storage. If the unit is used for spill containment, it should be pumped after the event is contained. Typical cleaning costs were estimated by the manufacturer in 1998 to be $250, with disposal costs averaging $300 to $500. The expected life of a system has been estimated to be 50 to 100 years.

Sediment Depths Indicating Required Maintenance	
Model Number	**Sediment Depth (feet)**
STC 900	0.5
STC 1200	0.75
STC 1800	1
STC 2400	1
STC 3600	1.25
STC 4800	1
STC 6000	1.5
STC 7200	1.25

Table 2: The Stormceptor clean out is based on 15 percent of the sediment storage volume in the

References

Winkler, E.S. 1998. "Technology Assessment, Stormceptor." University of Massachusetts, Amherst, MA. *STEP Web site:* www.STEPSITE.org/

Massachusetts Department of Environmental Protection and Office of Coastal Zone Management. 1997. "Stormwater Management Handbooks, Volumes One and Two." Boston, MA. *Handbooks Web site:* www.state.ma.us/dep/brp/stormwtr/stormpub.htm.

United States Environmental Protection Agency. "Storm Water Technology Fact Sheet Hydrodynamic Separators." EPA 832-F-99-017.

Stormceptor Web sites: www.rinkermaterials.com/stormceptor

TARP Web site: www.dep.state.pa.us/dep/deputate/pollprev/techservices/tarp

STEP Verification vs. Regulatory Approval

STEP assistance to developers of innovative technologies and STEP verification of stormwater treatment systems is not required to receive necessary approvals from conservation commissions or the Department of Environmental Protection (DEP). However, if a system has received verfication, a conservation commission shall presume that the technology will function as proposed, provided the conditions are similar to those in which performance was verified. STEP reports are not technology approvals, and do not constitute an endorsement or recommendation for use. Questions on regulatory issues should be referred to the DEP regional offices.

OPERATIONS AND MAINTENANCE PLAN

(Revision #1 – October 14, 2009)

This Operations and Maintenance (O&M) Plan has been prepared in accordance with the Stormwater Management Policy issued by the Department of Environmental Protection (DEP) for the proposed residential subdivision and golf course improvements located at Crystal Springs Golf Course at 940 North Broadway in Haverhill, MA. The project consists of the construction of a 2,400-FT +/- roadway (Front Nine Drive) supporting 34-single family residential lots, a separate 590-FT +/- roadway (Back Nine Drive) supporting 16-single family residential lots, a 10,000-SF +/- clubhouse, a 2,000-SF +/- maintenance building as well as associated infrastructure including parking areas, driveways, sidewalks, landscaping, drainage facilities and utilities. This plan is comprised of two separate sections. Section I addresses Stormwater Management Standard 8 and discusses the applicant's obligations to address construction period pollution prevention. Section II addresses Stormwater Management Standard 9 and discusses the applicant's obligations to address long term operations and maintenance of the facility.

Owner / Responsible Party: Premiere Realty Trust
423 East Street
Haverhill, Massachusetts

SECTION I – CONSTRUCTION PERIOD POLLUTION PREVENTION PROGRAM

The proposed project includes a comprehensive set of mitigation methods to protect the wetland resource area and adjacent property and roadways surrounding the site during construction and operation phases of the project. An Erosion Control and Sedimentation Control program will be implemented to prevent indirect impact to the existing wetland, existing roadways, and surrounding sites during the construction of the proposed improvements. The program incorporates Best Management Practices (BMP's) as specified in the guidelines developed by DEP. These measures include the installation of temporary erosion and sedimentation controls and construction sequencing. Areas of exposed soil will be kept to a minimum during construction and a permanent vegetative cover or other forms of stabilization will be established as soon as practicable.

Proper implementation of the erosion and sedimentation control program will:

- Minimize exposed soils through temporary mulching or seeding or by sequencing so that the amount of exposed soil is kept to a minimum.
- Place erosion controls structures to manage erosion and site runoff.
- Manage the control structures through the life of the construction activities and repair all damaged structures as well as remove trapped silt as soon as recommended.
- Establish a permanent vegetative cover or other forms of stabilization as soon as practicable.

The following erosion and sedimentation control BMP's are presented in the sequence to which they will be implemented at the site. The measures will be inspected on a weekly basis or immediately before and or after storm events. The controls will be routinely maintained throughout the duration of the project. Any damaged controls will be repaired and or replaced immediately. The locations of the specified sedimentation and erosion control measures are depicted on the proposed design drawings.

Erosion Control Barriers

Erosion control barriers will be installed and inspected by the appropriate authority at the down gradient limit of work prior to construction. The barriers will consist of siltation fence and/or hay bales and will be entrenched into the substrate to prevent under flow. When necessary, additional hay bales and/or silt fence barriers will be installed immediately down gradient of the erosion prone areas, such as the base of steep exposed slopes, around material stockpile areas, siltation ponds, throughout the construction phase of the project. A sufficient supply of material shall be kept on site to facilitate the repair or replacement of the proposed barriers.

Temporary Surface and Slope Stabilization

Any area of exposed soil that will remain unstabilized for a period of more than twenty days will be covered with a layer of hay or mulch until the time of final loam and seeding.

Temporary Seeding

A temporary vegetative cover of fast growing indigenous grasses will be established on areas of exposed soils that remain unstabilized for a period of 45 days. Depending on the slope, the seeded surfaces will be covered with a layer of mulch.

Permanent Seeding

Upon completion of the final grading, any area not covered by pavement, other forms of stabilization, or other landscaped methods, will be loamed and seeded with New England Erosion Control/Restoration Mix (for dry sites) produced by New England Wetland Plants, Inc. (or approved equivalent). This mix includes grasses and broad leaf herbaceous plants that are indigenous to northeastern Massachusetts. Depending on slope the seeded area will be covered with mulch or erosion control blanket. The seed mix will be applied at a rate of 35-lbs/acre.

Catch Basin Inlet Protection

The inlets to the catch basins will be protected from sedimentation inflow during construction by surrounding them with a barrier of staked hay bales placed in accordance with the approved plans. These protection measures will be utilized until the drainage area tributary to each inlet has been stabilized and pavement is in place.

Pavement Sweeping

Street sweeping shall be performed upon the accumulation of sediment on the existing roadways providing access to and from the site.

All of the erosion and sedimentation controls shall be inspected on at least a weekly basis and before/after a rainfall event in excess of 0.5 inches. Sediment that collects behind or in the controls will be removed when it reaches a depth of 6 inches. Any damaged controls will be repaired within 48 hours of discovery.

Construction Sequencing

Described below are the major construction activities. They are presented in the order (or sequence) they are expected to begin, but each activity will not necessarily be completed before the next begins. Also, these activities could occur in a different order if necessary to maintain adequate erosion and sedimentation control. All activities and the timeframe (beginning and ending dates) shall be recorded by the General Contractor:

1. Contractor to verify trees to be saved have been marked with orange construction fence by project architect.

2. Install stabilized construction entrance.

3. Cut and clear trees within the area of disturbance, unless otherwise noted.

4. Construct temporary and permanent erosion control facilities prior to any earth moving operations.

5. Rough grade. All slopes shall be stabilized immediately after grading. All disturbed areas shall be stabilized no later than 72-hours after construction activities cease. If earthwork temporarily ceases on a portion of or on the entire site, and will not resume within 21-days, the area shall be stabilized. (Stabilize proposed pavement areas with compacted gravels and other disturbed areas with temporary grass seed). An area shall be considered stabile if one of the following has occurred:

    A. Base course gravels have been installed in areas to be paved;
    B. A minimum of 85% vegetated growth has been established;
    C. A minimum of 3" of non-erosive material such as stone or rip-rap has been installed; or
    D. Erosion control blankets have been properly installed.

6. Construct culverts and sedimentation basin. Place rip-rap and other drainage facilities according to the plan. The Contractor shall stabilize all ditches, swales and ponds/basins prior to directing flow to them.

7. Install all underground utilities.

8. Construct roadways / parking lot and finish grade sites according to the plan. All slopes shall be stabilized immediately after grading.

9. Inspect and maintain all erosion and sedimentation control measures periodically and immediately after storm events.

10. Complete permanent seeding and landscaping.

11. Remove temporary erosion control measures once all areas are stabilized with a suitable stand of grass, pavement or compacted gravels.

The general construction sequence presented above does not preclude the requirements for additional controls identified earlier in this report or utilization of any other appropriate techniques to limit erosion and sedimentation at the site. Any measures deemed necessary by the Zoning Board, Town Engineer or Conservation Commission representative will be implemented with 48 hours.

SECTION II – LONG TERM OPERATIONS AND MAINTENANCE PROGRAM

Upon a period beginning twelve months after the completion of the roadway, all structural BMP's shall be inspected twice annually, once in April and once in November. The inspection shall be performed as indicated below:

Street Sweeping
Street sweeping can be an effective method to reduce pollutant loading in runoff generated from pavement. Street sweeping shall be performed monthly (on average), with sweeping scheduled primarily in the spring and fall, by a high efficiency vacuum sweeper.

Snow Storage / Removal
Snow plowed from the proposed roadway will be placed or disposed of in accordance with the policy developed by DEP. Any snow that accumulates over the grates of each catch basin shall be removed to ensure that the drainage systems functions properly. Under no circumstances shall snow plowed or removed from the road be stockpiled within wetland resource areas or the 50 ft wetland buffer.

Catch Basins
The sump/hooded catch basins will be inspected on a biannual basis. If sediment is greater than 12" it will be removed and disposed of with a truck-mounted vacuum unit or other appropriate apparatus. The sediment will be disposed of at an approved offsite location in accordance with all applicable local, state, and federal regulations.

Stormceptor
Units should be inspected post construction, prior to being put into service. Inspect every six months for the first year to determine the oil and sediment accumulation rate. In subsequent years, inspections can be based on first-year observations or local requirements. Cleaning is required once the sediment depth reaches 15% of storage capacity, (generally taking one year or longer). Local regulations for maintenance frequency may vary. Inspect the unit immediately after an oil, fuel or chemical spill. A licensed waste management company should remove oil and sediment and dispose responsibly.

Drainage Outfalls
The outlets of the storm water management system will be inspected biannually. Any evidence of erosion or other damage will be reported to the appropriate town representative and repaired as soon as possible. Any sediment should be removed from the outlet structures.

Subsurface Infiltration System
The Cultec Recharge 180 HD HDPE subsurface infiltration system shall be inspected twice annually, once in April and once in November. Any and all debris and/or sediments shall be removed from the units and be disposed of at an approved offsite location in accordance with all applicable local, state, and federal regulations.

Sediment Basins
Sediments and associated pollutants are removed only when sediment forebays are actually cleaned out, so regular maintenance is essential. Frequently removing accumulated sediments will make it less likely that sediments will be re-suspended. At a minimum, inspect sediment forebays monthly and clean them out at least four times per year. Stabilize the floor and sidewalls of the sediment forebay before making it operational, otherwise the practice will discharge excess amounts of suspended sediments. When mowing grasses, keep the grass height no greater than 6 inches. Set mower blades no lower than 3 to 4 inches. Check for signs of rilling and gullying and repair as needed. After removing the sediment, replace any vegetation damaged during the clean-out by either reseeding or resodding. When reseeding, incorporate practices such as hydroseeding with a tackifier, blanket, or similar practice to ensure that no scour occurs in the forebay, while the seeds germinate and develop roots.

Infiltration Ponds
Infiltration basins are prone to clogging and failure, so it is imperative to develop and implement aggressive maintenance plans and schedules. Installing the required pretreatment BMPs will significantly reduce maintenance requirements for the basin. The Operation and Maintenance Plan required by Standard 9 must

include inspections and preventive maintenance at least twice a year, and after every time drainage discharges through the high outlet orifice. The Plan must require inspecting the pretreatment BMPs in accordance with the minimal requirements specified for those practices and after every major storm event. A major storm event is defined as a storm that is equal to or greater than the 2-year, 24-hour storm.

Once the basin is in use, inspect it after every major storm for the first few months to ensure it is stabilized and functioning properly and if necessary take corrective action. Note how long water remains standing in the basin after a storm; standing water within the basin 48 to 72 hours after a storm indicates that the infiltration capacity may have been overestimated. If the ponding is due to clogging, immediately address the reasons for the clogging (such as upland sediment erosion, excessive compaction of soils, or low spots).

Thereafter, inspect the infiltration basin at least twice per year. Important items to check during the inspection include:

- Signs of differential settlement,
- Cracking,
- Erosion,
- Leakage in the embankments,
- Tree growth on the embankments,
- Condition of riprap,
- Sediment accumulation and
- The health of the turf.

At least twice a year, mow the buffer area, side slopes, and basin bottom. Remove grass clippings and accumulated organic matter to prevent an impervious organic mat from forming. Remove trash and debris at the same time. Use deep tilling to break up clogged surfaces, and revegetate immediately. Remove sediment from the basin as necessary, but wait until the floor of the basin is thoroughly dry. Use light equipment to remove the top layer so as to not compact the underlying soil. Deeply till the remaining soil, and revegetate as soon as possible. Inspect and clean pretreatment devices associated with basins at least twice a year, and ideally every other month.

Wet Ponds

Inspect wet basins at least once per year to ensure they are operating as designed. Inspect the outlet structure for evidence of clogging or excessive outflow releases. Potential problems to check include: subsidence, erosion, cracking or tree growth on the embankment, damage to the emergency spillway, sediment accumulation around the outlet, inadequacy of the inlet/outlet channel erosion control measures, changes in the condition of the pilot channel, erosion within the basin and banks, and the emergence of invasive species. Make any necessary repairs immediately. During inspections, note any changes to the wet basin or the contributing watershed area because these may affect basin performance. At least twice a year, mow the upper-stage, side slopes, embankment and emergency spillway. At this time, also check the sediment forebay for accumulated material, sediment, trash, and debris and remove it. Remove sediment from the basin as necessary, and at least once every 10 years. Providing an on-site sediment disposal area will reduce the overall sediment removal costs.

Water Quality Swales

Incorporate a maintenance and inspection schedule into the design to ensure the effectiveness of water quality swales. Inspect swales during the first few months after installation to make sure that the vegetation in the swales becomes adequately established. Thereafter, inspect swales twice a year. During the inspections, check the swales for slope integrity, soil moisture, vegetative health, soil stability, soil compaction, soil erosion, ponding and sedimentation.

Regular maintenance includes mowing, fertilizing, liming, watering, pruning, and weed and pest control. Mow swales at least once per year. Do not cut the grass shorter than three to four inches, otherwise the effectiveness of the vegetation in reducing flow velocity and removing pollutants may be reduced. Do not let grass height exceed 6 inches.

Horsley Witten Group
Sustainable Environmental Solutions
30 Green Street • Newburyport, MA • 01950
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September 8, 2009

Mr. Robert E. Moore, Jr.
Environmental Health Technician
Conservation Department, City Hall Room 210
4 Summer Street
Haverhill, MA 01830

Re: Engineering Peer Review, 940 North Broadway
Residential Cluster Development, "Crystal Springs," Haverhill, MA
MA DEP File Number: 033-1279

Dear Mr. Moore:

The Horsley Witten Group, Inc. (HW) is pleased to submit this peer review of stormwater management design for the Crystal Springs residential development in Haverhill, Massachusetts. In preparing this letter, HW reviewed the following documents received from the Haverhill Conservation Commission (the Commission):

- Definitive Residential Cluster Development Crystal Springs (38 sheets), dated June 10, 2009, S.E.C & Associates, Inc.;
- Drainage Report for Crystal Springs Golf Course, dated June 10, 2009, Civil Design Consultants, Inc.;
- Notices of Intent (033-1279) for the Residential Cluster Development;
- MassDEP Stormwater Management Standards Compliance Summary, dated June 25, 2009, Civil Design Consultants, Inc.;
- Definitive Residential Cluster Development Crystal Springs (38 sheets), revised August 11, 2009, S.E.C & Associates, Inc.;
- Memo to: Haverhill Planning Board (2 pages), August 25, 2009, John H. Pettis III, PE, City Engineer; and
- Infiltration Basin #1 updated layout and HydroCAD information via E-mail, Civil Design Consultants, Inc, September 2, 2009.

The peer review is based on the above noted information provided. Both plan sets dated June 10, 2009 and revised August 11, 2009 were incomplete. On the plan set dated June 10, 2009, Sheets

7-13, 18-20, and 32-36 were missing. On the revised plan set dated August 11, 2009, the sheet numbering appears to have changed slightly, and Sheets 2, 5, 9, 14-20, 27-29, 31-33, and 35-38 were missing. HW understands that some sheets may not have been revised, therefore, were not included in the revised plan set. HW comments were based on the information provided.

In addition, HW visited the site on August 26, 2009, with the Applicant team and City Conservation staff.

The proposed project is required to meet the 2008 Massachusetts Stormwater Management Standards (MSMS) under the Massachusetts *Wetlands Protection Act* and *Wetlands Protection Regulations* (310 CMR 10.00). HW has applied the MSMS, the state wetlands regulations, local Haverhill Wetland Protection Ordinance, and standard engineering practices in the review of the proposed drainage and stormwater management aspects of the proposed project. Based upon the above documents received to date, HW offers the following comments.

Project Understanding

The proposed project includes a 50-lot residential subdivision on the 136-acre Crystal Springs Golf Course property. The proposed project consists of two clusters of residential units on two proposed drives, a new golf clubhouse, and parking areas. The two proposed developments run perpendicular to North Broadway.

The road to the north of the project is Front Nine Drive and the second road, to the south of the site, is Back Nine Drive. Front Nine Drive consists of 34 proposed residential units, the proposed golf club house, and associated parking areas. Back Nine Drive consists of 16 proposed residential units.

The stormwater management system for Front Nine Drive consists of a closed drainage system conveying stormwater runoff to wet ponds and wet swales for treatment prior to being discharged into the adjacent Bordering Vegetated Wetland (BVW) and intermittent stream. Sediment forebays and grassed swales are also being used for pre-treatment. The following is a summary of the Applicant's proposed stormwater management practices at the site.

Front Nine Drive and Clubhouse Area:

- At the intersection of North Broadway, stormwater runoff from the lower portion of the roadway will be captured via two deep sump catch basins and conveyed to a Stormceptor for treatment prior to being discharged into BVW Series A.

- Runoff from the proposed parking lot west of the proposed club house (westerly parking lot) and a portion of Front Nine Drive will be captured via deep sump catch basins and conveyed to a wet swale (Wet Swale #1) for treatment, which will ultimately discharge to an existing intermittent stream.

- Roof runoff from the proposed Club House will be directed to a proposed subsurface infiltration system located under the westerly parking lot.

- Stormwater runoff from the proposed easterly parking lot and a portion of Front Nine Drive will be captured via deep sump catch basins conveyed to sediment forebays for pre-treatment and a wet pond (Wet Pond #2) for treatment.

- An infiltration basin is proposed for a section of Front Nine Drive with an overflow to the Wet Pond #2.

- Drywells are also proposed to infiltrate roof runoff from the proposed houses on Lots 1 – 27.

- Stormwater from the remaining length of Front Nine Drive, including the proposed cul-de-sac, will be captured via deep sump catch basins and directed to a proposed rock rip rap swale which will flow to another wet pond (Wet Pond #1). Wet Pond #1 and Wet Pond #2 will ultimately flow to an existing BVW, Series E.

Back Nine Drive:

- Stormwater runoff from the Back Nine Drive will be collected by a closed drainage system that will convey stormwater to an existing drainage swale and a proposed infiltration basin (Infiltration Basin #1).

- Runoff from the front portion of Back Nine Drive will be captured via two deep sump catch basins and conveyed to a Stormceptor for treatment prior to being discharged an existing drainage swale.

- Stormwater runoff from the proposed cul-de-sac and remaining section of roadway will be captured via deep sump catch basins conveyed to Infiltration Basin #1. Overland flows from Lots 9-16, will also be directed to Infiltration Basin #1.

- Infiltration Basin #1 will ultimately overflow to an existing irrigation pond. The existing irrigation pond currently outlets to a 12-inch diameter reinforced concrete (RCP) culvert, that crosses Lake Street. The Applicant proposes to remove the existing 12-inch RCP and replace it with a 24-inch high density polyethylene (HDPE) culvert. This improvement will allow for the 2-year and 10-year 24-hour storm event to pass the before the roadway is overtopped during the 25-year storm event.

General Stormwater Comments

1. Based on the plan set dated June 10, 2009, the Applicant has provided an Erosion and Sediment Control Plan; however, the scale of the drawing makes it difficult to see where and what erosion and sediment control measures are being proposed for the site. HW recommends the Applicant provide an adequate Erosion and Sediment Control plan for review.

2. The Applicant has proposed the use of sediment forebays as a pre-treatment practice. Under the MSMS, sediment forebays need to be sized to hold a minimum of 0.1 inch/impervious acre to pre-treat the water quality volume. HW recommends the Applicant provide sizing calculations for the proposed sediment forebays.

3. HW recommends the Applicant consider using other low impact development practices for this development, in addition to what has been proposed. For example a bioretention system (lined or unlined, depending on the soil investigation) can be implemented in the proposed parking areas or the cul-de-sac island. Bioretention systems can treat stormwater to effectively remove a significant percentage of Total Suspended Solids (TSS), metals and nutrients prior to being discharged into the adjacent wetland.

4. In the drainage report, the Applicant has modeled a storage pond at the Lake Street Crossing area under proposed conditions. Based on the size of this storage pond and the location shown on the Lake Street Improvement detail on Sheet 23, HW is uncertain on how the proposed storage pond will fit at this location. The Hydrograph reports indicate the storage pond will be eight feet deep with a total storage capacity of approximately 27,200 cubic feet. HW recommends the applicant revise the plan set to clearly show the layout of this proposed storage pond.

5. The following comments are specific to the Construction Detail Sheets provided in the plans dated June 10, 2009 and August 11, 2009:

    a. The Applicant has proposed the use of wet ponds, a wet swale, and infiltration basins on the development, however no details of these practices of been provided. HW recommends the Applicant include cross section and plan view details of the above noted stormwater management practices on their Construction Detail Sheet.

    b. The Applicant has shown two details titled “Typical Drain Manholes” on their Construction Detail Sheet. HW is unclear on which drainage manhole configuration is being proposed. HW recommends the Applicant clarify which drainage manhole configuration will be used on site.

c. On the Proposed Outlet Structure Details, the invert elevation for POS-4 does not correspond to what is shown on the plans. HW recommends the Applicant verify the correct invert elevations.

d. The Applicant has provided a detail of the proposed underground infiltration system. However, HW is uncertain on the location of the cleanouts on the plan view. HW recommends the Applicant clearly label them on the detail sheet.

e. The Applicant has provided a detail of a concrete headwall with wing walls. HW is uncertain of the location of these headwalls on the proposed development. HW recommends the Applicant clearly indicate the location of these structures on the plan set.

f. HW recommends the Applicant provide a detail of the proposed sewer line crossing the piped section of the intermittent stream.

g. The Applicant has provided a detail of the proposed storage pond/drainage swale at the Lake Street drainage improvement area. However, this does not accurately show what was modeled in the Hydrograph Report. The Hydrograph Report shows an eight foot deep pond. HW recommends the Applicant revise the detail to properly reflect the proposed storage pond/drainage swale at this location.

h. HW recommends the Applicant provide a detail of the proposed culvert replacement at the Lake Street crossing.

i. HW recommends the Applicant show the existing tree locations (HW recommends 8 inches in diameter at breast height, and greater) in the vicinity of the Lake Street drainage improvements and indicate which trees are proposed to be removed so that the Commission may evaluate the potential impacts to these trees.

6. In order for the applicant to claim Total Suspended Solids (TSS) Removal Rate of 5% for street sweeping, a specific type of sweeper and sweeping frequency must be stated in the Operation and Maintenance (O&M) Plan. HW recommends the Applicant update their O&M plan to indicate the appropriate type and schedule of street sweeping.

7. The Applicant has proposed the use of a proprietary treatment system (Stormceptor 450i) to treat the runoff from the front portion of the roadway for both the Front and Back Nine Drive. The Applicant has applied an 80% TSS removal rate for this treatment system. Under the MSMS, the Stormceptor 450i does not have Massachusetts Department of Environmental Protection (MassDEP) TSS removal efficiency rating, therefore, the University of Massachusetts Stormwater Technologies Clearinghouse (www.mastep.net) should be reviewed. Under this program, the Stormceptor 450i has been tested and have

an estimated Suspended Sediment Concentration (SSC) removal rate of approximately 60%. While SSC is a different measurement than TSS, they are similar and HW recommends that a TSS removal rate of not more than 60% be used by the Applicant in their calculations.

8. HW recommends the Applicant revise their O&M to meet the MSMS requirement for deep sump catch basins. Deep sump catch basins should be inspected or cleaned at least four times per year and at the end of the foliage and snow removal seasons. Sediments must also be removed four times per year or whenever the depth of deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the basin.

Front Nine Drive

9. The Applicant has proposed the use of an underground infiltration system for the roof runoff from the proposed club house. The Applicant has not provided any design calculations for this infiltration system. HW does not know what design storm the system is designed to infiltrate or the infiltration rate used in the calculations. Based on the review of the plan and detail of this system, there appears to be no overflow outlet. HW suggests the Applicant provide more information on the design of this system.

10. Based on the plans dated June 10, 2009, at the location of Wet Swale #1, the seasonal high groundwater (SHGW) is estimated to be at elevation 189 feet. The SHGW was estimated based on test pit information provided by the Applicant. Test Pit 16 (TP-16) located in the proposed Wet Swale #1 shows the seasonal high groundwater 24 inches below existing grade. The existing grade elevation in the vicinity of TP-16 is approximately 191 feet, resulting in an estimated SHGW elevation of 189 feet.

    The bottom elevation of Wet Swale #1 is shown as 187 feet and the rim elevation of the swale is shown as 189 feet. Based on the estimated SHGW, Wet Swale #1 would be inundated with groundwater during the seasonal high period. Therefore, no additional storage would be available during any rain event during this period. Upon review of the applicant's Hydraflow model for Wet Swale #1, the Applicant has not taken this inundation into account in their design. HW recommends that the Applicant not account for storage volume below the SHGW when sizing Wet Swale #1 and the associated sediment forebay.

11. Based on the plans dated June 10, 2009, at the location of Wet Pond #1, the SHGW is estimated to be approximately 195 feet based on TP-6 and TP-7. The bottom of the wet pond is at an elevation of 188 feet. The Applicant has modeled the bottom of the wet pond at elevation of 192 feet, presumably to account for the groundwater elevation. However, SHGW is three feet higher, at elevation 195 feet. Similar to the comment

above, HW recommends that the Applicant not account for storage in the wet pond below 195 feet.

12. Based on the plans dated June 10, 2009, the Applicant has shown a drainage pipe connecting the sediment forebay to Wet Pond #1. The invert of this outlet is set at 205 feet and the bottom of the sediment forebay is shown as 206 feet. HW recommends the Applicant adjust the outlet elevation for this sediment forebay to be above the bottom elevation of the basin and above the required pre-treatment volume elevation. HW suggests the Applicant refer to the MSMS for more detailed design criteria for sediment forebays.

13. Based on the plans dated June 10, 2009, the Applicant has proposed one catch basin (PCB-17) to capture all the pavement runoff in the westerly parking lot and one catch basin (PCB-14) in the easterly parking lot. Based on best engineering practices, HW suggests that the Applicant provide more then one catch basin in each of the parking lots in case the grate becomes covered by debris.

14. Drainage pipes PCB-14 (located in the easterly parking lot by the proposed Club House) and PCB -25 (located at the end of the cul-de-sac of the Back Nine Drive), do not have sufficient capacity to handle a 10-year storm event. HW recommends the Applicant revise the pipe size accordingly.

15. The time of concentration (TC) for proposed drainage area PWA-3B is greater than the corresponding existing drainage area EWA-3. The contributing area for PWA-3B is smaller, the travel path is shorter compared to EWA-3, and the land cover is the same, therefore, the travel time should be less for PWA-3B. In addition, the Applicant assumed the channel slope of 1.3% in these drainage areas, but HW estimates it to be closer to 3%, which may also affect the TC calculation. HW recommends the Applicant review their TC assumptions. A reduction in TC will affect the storage calculations and may require larger storage capacity to offset peak flow rates.

<u>Back Nine Drive</u>

16. The Applicant has revised the design of Infiltration Basin #1 on September 2, 2009. Based on this new layout, there now appears to be adequate (2 feet) separation from the bottom of the infiltration basin to the SHGW. However, HW recommends the Applicant revise the overflow weir invert elevation to reflect the change made to the basin elevation. In addition, HW recommends the Applicant check the sediment forebay elevations to ensure it will still overflow into the infiltration basin.

17. HW is uncertain on the actual exfiltration rate used in the design of Infiltration Basin #1. HW recommends the Applicant clarify the exfiltration rate that was used in the design of Infiltration Basin #1.

18. The new layout of Infiltration Basin #1 provided on the plans dated September 2, 2009 indicates SHGW at 176.1 feet. This number should be corrected show SHGW at 180 feet based on the TP-10 soil log.

19. The catch basin (PCB-26) shown on the June 10, 2009 plan set should be offline from the drainage network. The MSMS states that all deep sump catch basins must be offline in order for the Applicant to claim 25% TSS removal.

20. HW recommends the Applicant re-delineate drainage area PWA-2E to include the back of the lots on the south side of Back Nine Drive. The plan set shows a drainage pipe running along the back lots collecting surface flow and discharging to Infiltration Basin #1. The drainage calculations should also be revised to reflect this change in drainage area.

We appreciate the opportunity to provide these comments to assist the Conservation Commission in reviewing of the proposed project. Please do not hesitate to contact me at 978-499-0601 with any questions.

Sincerely,

HORSLEY WITTEN GROUP, INC.

Ellie Stewart Baker
Senior Environmental Planner

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENERGY & ENVIRONMENTAL AFFAIRS
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Lieutenant Governor

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Secretary

LAURIE BURT
Commissioner

RECEIVED
AUG 0 6 2009
Conservation Department

DATE: August 04, 2009

Municipality HAVERHILL (city/town)

RE: NOTIFICATION OF WETLANDS PROTECTION ACT FILE NUMBER

The Department of Environmental Protection has received a Notice of Intent filed in accordance with the Wetlands Protection Act (M.G.L. c. 131, §40):

Applicant:	PREMIERE REALTY TRUST	Owner:	
Address:	423 EAST BROADWAY HAVERHILL, MA 01830	Address:	
LOCUS:	890 NORTH BROADWAY		

This project has been assigned the following file # : NE 033-1279

ISSUANCE OF A FILE NUMBER INDICATES ONLY COMPLETENESS OF SUBMITTAL, NOT APPROVAL OF APPLICATION

Although a file # is being issued, please note the following:

Stormceptor 450i is not an acceptable BMP for terminal or primary treatment nor have they been STEP rated. Applicant cannot claim 80% TSS removal for this size Stormceptor. Manufacture claims they are to be used as in inlet system to replace a catchbasin. These are proposed in two treatment trains and should be replaced with anohter BMP. Why is the impervious surface for the drainage to North Broadway not included in the total amount of impervious surface? There appears to be an intermittent stream located under the proposed sewer line. Is the sewer line going over or under this stream? All "ditches" need to be evaluted to see if BVW is present, if so they are considered jurisdictional. What is the function of the "wet ponds"? PCB-26 should not be on-line. What are the implications of replacing the 12" culvert with a 30 " culvert? Has a hydro study been conducted?

If you have any questions regarding this letter, please contact: JILL PROVENCAL @ (978)-694-3250

Cc: Haverhill Conservation Commission, City Hall 4 Summer Street, Haverhill, MA, 01830

Haverhill Conservation Commission
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