HYDRAULIC REPORT

FOR

Public Improvements to Serve Wilshire Hills III

Lee's Summit, Missouri

PREPARED FOR:

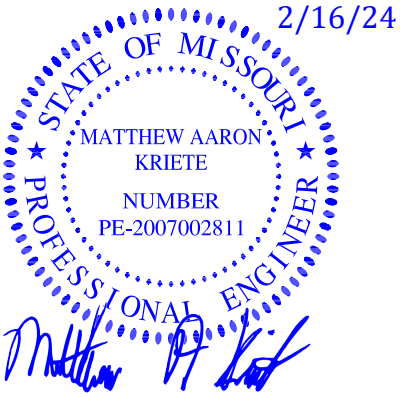
WILSHIRE HILLS III L.P.

206 PEACH WAY

COLUMBIA, MO 54202

JUNE 22, 2023

REVISED: FEBRUARY 16, 2024



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1 INTRODUCTION

The project consists of the construction of a public road and associated utilities to connect existing Wilshire Drive to Strother Road in Lee's Summit, MO. The road and associated storm sewer and sanitary sewer extensions will provide service to Wilshire Hills Phase III on Lot 5 and additional future development. Soil disturbing activities will include clearing and grubbing, installing erosion and sediment controls, grading, installation of underground utilities, and preparation for final seeding, mulching, and landscaping. Public Improvements for the development include the extension of utilities including water, sewer, and electric. Storm sewers will be constructed along with the extension of Wilshire Hill Drive to Strother Road.

The purpose of this report is to demonstrate compliance with the city of Lee's Summit storm water requirements. The report specifically addresses the following.

1. Impact of proposed and future development of storm water runoff from the site and the downstream watershed.
2. Stormwater quality for the proposed development.
3. Design of best management practices during construction.
4. Proposed storm sewer and channel design.

2 POST CONSTRUCTION STORMWATER MANAGEMENT

2.1 Analysis Goals

Design Standard(s):

- *Lee's Summit, Missouri Stormwater Discharge Control Regulations (Code of Ordinance Chapter 34 Article 3)*
- *APWA Section 5300*
- *APWA Section 5608.4*
- *MARC/APWA BMP Manual Chapter 6.*
- *LS Section 5600 – Storm Drainage Systems and Facilities (revised July 2020)*

The purpose of this analysis is to evaluate the hydrological impact of the development of Wilshire Hills Lot 5 and the future lot development. The base data has been collected from aerial imagery, historical data, and maps and analyzed based on the KC-APWA 5600 standards. The KC-APWA standards are summarized by the Comprehensive Control Strategy. These requirements include stream protection, detention, water quality, and erosion control. The allowable runoff specified for detention facilities in Section 5608 is intended to manage maximum storm water release rates to minimize flooding while the water quality aspect of a basin addresses impacts on downstream erosion and the environment.

Stormwater models were created for the 2-. 10- and 100- year storm to determine the effect on the development on May Brook Creek. Figure 1 shows the watershed, May Brook Creek, Wilshire Hills, and Study Point 1. The confluence point of the North end of Wilshire Hills and the upper 490.2-acre watershed.

This analysis includes 490.2 acres of the May Brook Creek watershed. The study point used was the end of the restored stream on the northern property line of Wilshire Hills. This point is approximately 3,000 ft upstream of Lakewood Lake East. The 19 acres of the Wilshire Hills development is approximately 4% of the watershed.

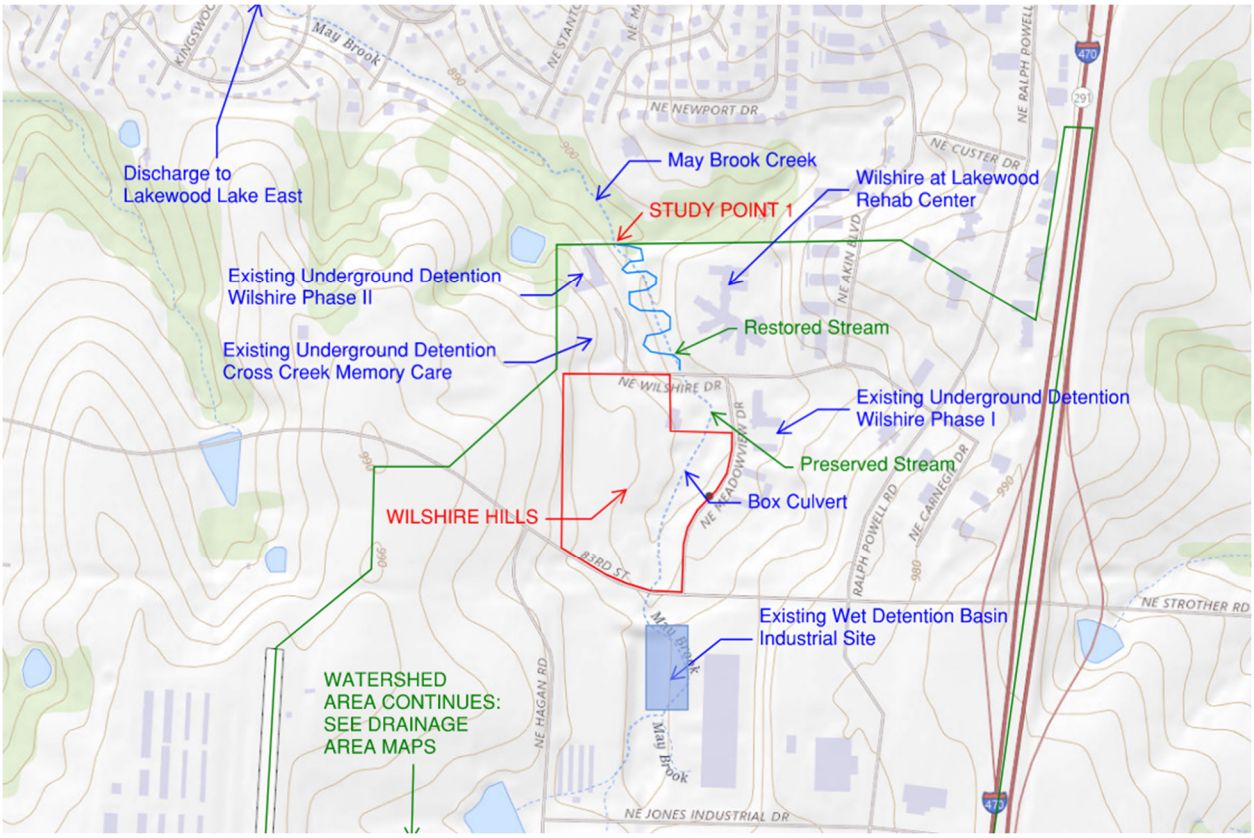

Figure 1: Location Map

2.2 Existing Conditions

The Wilshire Hills development site analyzed with this study includes 19.0 contributing acres separated by NE Meadowview Drive to the east, Strother Road to the south, NE Wilshire Drive to the North, and industrial property to the west. To analyze the impact of the proposed Wilshire Hills Development, we first have to model the predeveloped assumptions of the site prior to the development of Wilshire Hills in 2006. The following describes the existing watershed, history of development, and methods used to develop the predevelopment model.

Due to downstream flooding and sedimentation issues, the study point of the development, shown in Figure 1, is the edge of the Wilshire Hills development. The area contained upstream of this point includes 490.2 acres of May Brook Creek watershed.

The May Brook Creek watershed contains residential, commercial, and industrial development. The south side of the drainage area is composed of Lee's Summit Airport and a large industrial area. The airport mainly consists of concrete with a large amount of grass but has no detention. The industrial area is served

by a large detention pond. This detention offsets the peak storm with the large volume of water contained before being released into the culvert under Strother Road. This detention pond is modeled as a reach in the hydraflow analysis.

Before 2006, May Brook Creek was an incised natural and manmade stream that bisected Wilshire Hills past an above ground detention pond at Lakewood Rehab Center. It discharged out of the detention basin into the existing stream approximately 3000 ft upstream of Lakewood Lake East.

The following table outlines the existing conditions for the May Brook Creek Watershed. See Appendix C for the full report. Appendix E has the pre drainage area map C2.19 that showcases each area and its associated curve number and time of concentration. These curve numbers were calculated using aerial images to measure impervious areas. The Time of concentrations were calculated using contours as well as street photos to analyze slope and water movement.

Table 1: May Brook Creek Watershed Pre-Development to Study Point 1

Section	Area (acres)	Curve Number	Time of Concentration (min)	Q 2-yr (cfs)	Q 10-yr (cfs)	Q 100-yr (cfs)
1	81.7	77	24.3	111.0	228.55	371.96
2	68.0	77	25.5	92.38	190.22	309.59
3	100.8	82	30.2	162.30	306.37	423.43
4	82.5	88	30.7	159.01	273.45	381.91
5	86.9	85	15.6	221.05	394.04	566.77
6	11.3	91	18.6	32.72	53.70	79.63
7	59.0	89	23.9	134.69	227.73	331.06
Total	490.02			660.85	1263.54	2145.77

2.3 Flood Plain

The Federal Emergency Management Agency (FEMA) Flood Boundary and Floodway Map Community Panel Number 2909C0430G classifies all portions of Wilshire Hills as Zone X, area of minimal flood hazard. Portions immediately downstream of the Wilshire Hills property are classified as Zone A with a 1% annual chance of flooding along the creek. The referenced FEMA map is available in Appendix A.

2.4 Soils

Soil maps published by the Natural Resources Conservation Service (NRCS) Web Soil Survey were used to categorize soils located at Wilshire Hills as well as the watershed analysis area. The following table displays the map of soils on the property as well as their hydrological soil group. Appendix A contains the full soil map as well as the soil classifications.

Table 2: Wilshire Hills Soil Classifications

Soil Type	Hydrological Soil Group	Acres	Percent
Greenton-Urban land complex, 5-9 percent slopes	D	4.5	24.4%
Sibley silt loam, 2-5 percent slopes	C	0.2	0.9%
Greenton silty clay loam, 5 to 9 percent slopes	C/D	13.9	74.7%
	Totals for Area of Interest	18.6	100%

Table 3 is a scaled representation of the soil classifications for the entirety of May Brook Creek Watershed.

Table 3: May Brook Creek Soil Classifications

Soil Type	Hydrological Soil Group	Acres	Percent
Greenton-Urban land complex, 5-9 percent slopes	D	277.9	56.7
Sibley-Urban land complex, 2-5 percent slopes	C	133.8	27.3
Other (less than 10%)	C/D	78.4	16.0
	Totals for Area of Interest	490.2	100%

2.5 Proposed Conditions

Post 2006, Wilshire Hills Development has seen new development and changes to the existing conditions. May Brook Creek was enclosed into an 850-foot-long Box Culvert with a large energy dissipator at the outlet. The detention basin for Lakewood Rehab Center was removed and replaced with a restored meandering stream and floodplain.

In addition, Wilshire Hills Phase II and the Cross Creek Memory Care facilities were constructed with underground detention. The underground detention basins impact 8.07 acres and are not modeled in the study. Appendix E contains the Post Drainage Area Map on page C2.20 which outlines the improvements to the Wilshire Hills watershed since 2006.

Wilshire Hills Phase III and associated public improvements are the next phase in completing the development of Wilshire Hills. Public improvement to the site includes the extension of Wilshire Drive, looping the water main, mass grading, as well as sanitary and electric extensions to serve Willshire Hills Phase III.

Future development has been planned for with the extension of public utilities, construction of NE Wilshire Drive, and the detention basin being sized for future development. The current PDP plan calls for commercial and office development for the remaining lots. Impervious areas have been approximated for each area and can be found in Table 8 in Section 2.9 of this report. As development occurs, the constructed impervious are will be subtracted from the total for the basin ensuring all 19 acres will be treated.

The basemap for the predeveloped watershed can be found in Appendix E page C2.19. The curve numbers were calculated using the aerial image as well as soil maps found in Appendix A and section 2.4 in this report. The times of concentration were calculated using the aerial image and contours. The calculations for both curve numbers and time of concentration can be found in Appendix E. The calculations are located in Appendix E. Table 4 includes the areas May Brook Creek Watershed was divided into as well as the associated curve number and time of concentration. The predevelopment flow rate is listed for the 2-, 10-, and 100-yr storm.

Table 4: May Brook Creek Watershed Post-Development to Study Point 1 (no detention)

Section	Area (acres)	Curve Number	Time of Concentration (min)	Q 2-yr (cfs)	Q 10-yr (cfs)	Q 100-yr (cfs)
1	81.7	77	24.3	111.0	228.55	403.79
2	68.0	77	25.3	92.38	190.22	336.08
3	100.8	82	30.2	162.30	306.37	512.72
4	82.5	88	30.7	159.01	273.45	431.92
5	86.9	85	15.6	221.05	394.04	636.00
6	11.3	91	18.6	32.72	53.70	82.47
7A	19.9	89	19.3	54.00	91.08	142.13
7B	7.5	65	20.5	5.01	14.26	29.71
7C	19.0	92	9.3	76.22	122.92	185.23
8	12.6	90	23.9	29.76	49.61	76.90
Total	490.2			943.45	1724.2	2836.95

2.6 Water Quality Analysis

Both designed basins are sized to match KC-APWA 5600 water quality requirements. The basins have been sized using basin stage elevations to calculate the water quality volume required from the runoff calculation. Based on the designed basin stage elevations, the required water quality volume is 52,555 ft^3. The water quality orifice was sized at 4.24 inches. These calculations are available in Appendix C.1.

For ease of construction the outlet was sized to 4 inches for the hydraflow analysis and construction documents. The water quality elevation was 918.12. The basin was designed to hold the water quality storm for the 40-hour detention period. This will include the first flush which helps filtrate out the majority of the sediment and trash accumulation.

2.7 Basin Analysis

Two basins were analyzed and compared to find the most effective way to prevent downstream flooding of May Brook Creek while meeting the intent of the Comprehensive Control Strategy. As shown in Appendix C.2 Area 17 onsite is routed through these basin options. Section 7B shown on page C2.20 in Appendix E shows the area west of the site which currently flows onto Wilshire Hills. These basins are sized to allow this offsite pass through. The "detention basin" meets the flat rate discharge requirements while the "water quality basin" has been analyzed based on its impact to the watershed.

The "detention basin" follows the KC-APWA 5600 requirements that limit the allowable discharge based on the size of the site. The offsite passthrough was added to the allowed rate to maintain the flow requirements. The following calculations and table analyze the design of the APWA Detention Basin.

Total Allowed Basin Discharge = Maximum Site Rate (cfs) + Offsite Pass Through (cfs)
Provided Basin Discharge = Designed Basin Discharge (cfs) + Offsite Pass Through (cfs) + Onsite Bypass (cfs)

Table 5: Basin Discharge Rates

Design Storm	Rate (cfs) Allowable per Acre per APWA	Area Served (acres)	Maximum Site Rate (cfs)	Offsite Pass Through (cfs)	**Total Allowed Basin Discharge (csf)**	**Provided Basin Discharge (cfs)**	Basin Elevation
50% (2-yr)	0.5	19.0	9.50	5.01	**14.51**	**14.36**	917.31
20% (10-yr)	2.0	19.0	38.0	14.26	**52.26**	**41.88**	919.44
1% (100-yr)	3.0	19.0	57.0	35.92	**92.92**	**92.90**	921.73

The "water quality basin" has been designed to meet the intent of the Comprehensive Control strategy to serve the same 19.0 acres Wilshire Hills Development. However, this basin meets all Comprehensive Control Requirements for extended detention but does not meet the allowable flat rate discharge rates for the 2-, 10-, or 100-year storms. However, the 2-yr, 10yr, and 100-yr storms have reduced the post developed peak discharge rate of May Brook Creek at Study Point 1 to less than the predeveloped rate. Furthermore, this basin reduces the 100-yr peak to less than the 100-yr peak from the "Detention Basin." The following table summarizes the discharge rates.

Table 6: Water Quality Basin Discharge Rates

Design Storm	Basin Discharge	Basin Elevation
50% (2-yr)	77.99	918.72
20% (10-yr)	130.58	918.98
1% (100-yr)	201.03	919.48

Site specific (19.0 acres) comparison of discharge rates show the "Water quality basin" discharges at a higher rate than the "Detention basin". The following downstream analysis section will compare the basin discharge rates using the May Brook Watershed to explain the benefits of releasing water ahead of the peak flow.

2.8 Downstream Analysis

Due to the location within the watershed, and the known Lakewood Lake East sedimentation and flooding issues, we have reviewed two detention basins to serve Wilshire Hills. The first "Detention Basin" meets the flat rate discharge requirements set by KC-APWA 5600. The second "Water Quality Basin" has been designed to release runoff earlier and thereby generating a lower peak flow in the watershed versus the "Detention Basin." The following text and Appendices provide analysis and the supporting data for this analysis. Compare to Table 1 to see the development Wilshire Hills in 7c.

Lee's Summit requires basins to meet the APWA release standards for release rates. These slow-release rates can be utilized to prevent flooding, and erosion. However, they can also cause the peak discharge to align the watershed upstream peak, thereby creating a higher peak discharge than if runoff downstream were released earlier. Due to the slower release rates, these basins can delay the peak flow of the watershed. Detention creates a longer peak flow time for the areas downstream.

The 490.2 acres of May Brook Creek analyzed for the downstream analysis includes one large above ground detention basin and three below ground detention basins. When analyzing peak flows for the watershed, it is important to remember that the time of concentration for flow through the underground basins is negated to zero. The above ground detention in the industrial area south of Strother was included in the Hydraflow report as a reach. The following table details the sections, shown on page C2.20.

The "detention basin" was designed to match the flat rate discharge delays of the peak discharge rate from Wilshire Hills to closely match the peak rate time in the watershed. Therefore, the basin discharges earlier, ahead of the watershed. Peak. This earlier discharge provides a lower 100-year discharge rate than the "detention basin". Therefore the "water quality basin" creates a greater benefit for downstream flooding.

Table 7: Downstream Analysis at Study Point 1

	Pre-Developed	Post –Detention Basin	Post –Water Quality Basin
	2-year Storm		
Time to Peak (min)	732	738	736
Peak Flow (cfs)	660.85	603.51	615.93
	10-year Storm		
Time to Peak (min)	732	736	734
Peak Flow (cfs)	1263.54	1193.11	1199.85
	100-year Storm		
Team to Peak (min)	732	736	734
Peak Flow (cfs)	2145.77	2070.16	2065.31

2.9 Final Design Recommendation

The "Water Quality" Basin reduces post development discharge in the May Brook Creek Watershed at Study Point 1, provides the required extended detention for water quality, and provide lower 100-yr discharge than the "Detention Basin" option. We recommend the water quality basin to be constructed to serve Wilshire Hills.

The 100-year level of rise in the basin is 919.48, approximated to 919.5 for construction purposes, and the top of the emergency spillway is 920.0. The clogged water surface elevation is 920.8. The top of dam is 921.5. A spillway for the basin has been designed for the top of the earthen dam in the unlikely event the outfall structure should become completely blocked. Appendix B includes weir calculations that indicate the 100-year flow through the spillway is fully contained in the spillway and will not overtop the dam while providing the necessary freeboard set by Lee's Summit Stormwater Report Requirements.

The following table provides the allowed impervious acreage for each site in the planned development. The current PDP plan shows future lot uses as commercial and office development. The designed amount of impervious as well as curve numbers will ensure future developments are treated by the water quality basin. As impervious area is developed, it will be subtracted from the overall total of the development.

Table 8: Allowed Impervious Area for Future Development in Wilshire Hills

Wilshire Hills	Total Area (acres)	Designed Imperious (acres)	Designed CN	Current Impervious (acres)	Remaining Impervious (acres)
Lot 5 (Wilshire Hills III + Bypass)	2.54	1.25	87	1.18	0.07
Northeast Area (includes Lot 6)	5.39	4	92		4
West Area	3.2	2.5	92	0.82	1.68
Southwest Area	1.6	1.2	92	0.2	1
Southeast Area	6.27	4.9	93	0.09	4.81
Total	**19**	**13.85**	**91**	**2.29**	**11.56**

A waiver is requested for the peak attenuation of stormwater discharge for the proposed development. This waiver is requesting the APWA detention rate allowable requirement be nullified. The "water quality basin" provides greater protection for the May Brook Creek watershed in the 100-year storm. This waiver can be found in Appendix F. The Comprehensive control strategy parameters and KC-APWA Section 5608.4 requirement of 40 hour extended detention for water quality will still be met.

3 Storm Sewer Design

Design Standard(s):

- *Lee's Summit, Missouri Stormwater Discharge Control Regulations (Code of Ordinance Chapter 34 Article 3)*
- *APWA Section 5300*
- *LS Section 5600 – Storm Drainage Systems and Facilities (revised July 2020)*

All storm sewers for the road public improvement project will be public storm sewers. They have been designed to the 25-year storm but can handle the 100-year storm without impeding traffic. Appendix C includes HydraFlow storm sewer calculations. The calculations are based on the Storm Sewer Drainage Area Map in Appendix D. Pipes have been sized to convey the offsite bypass calculated for the detention analysis.

The outfall control structure for the water quality basin is covered by a large grade to prevent debris from entering the structure. The low flow orifice is outfitted with a perforated pipe to prevent clogging. The 10" pipe exits the structure at 90° before bending vertically. The pipe has a cap both on the top of its vertical bend as well as the entrance to the structure wall. The cap inside of the control structure has a

4.55" orifice drilled into it. This restricts the flow to the required water quality storm while providing protection from clogging.

4 Erosion and Sediment Control and Design

Design Standard(s):

- *Missouri Department of Natural Resources (MDNR) Protecting Water Quality Field Guide, 2011*

The Civil Site Plans and project Storm Water Pollution and Prevention Plan (SWPPP) indicate erosion and sediment control Best Management Practices (BMPs) to be utilized throughout construction activities. The proposed water quality basin shall be used as a temporary sediment trap throughout construction. Appendix B includes erosion and sediment control storage calculations. The outfall control structure must be wrapped in filter fabric to an elevation of 919.0 according to these calculations.

Per the city of Lee's Summit, the water quality basin has been lined with an erosion control blanket to assist in bank stabilization while the grass is being established. The basin currently has swales to assist with drainage, the future development will include pipes from the surrounding development. The installation of this fabric in the first stage prepares the basin for future development as well as providing maximum protection.

The swales leading into the basin have temporary erosion control blankets to help protect earthwork while grass is being established. These blankets are not permanent, as are the nature of the swales. The swale was analyzed with only riprap and bare earth as well as vegetated and both were found to be stable. Bare earth was also calculated and resulted in being unstable. A temporary erosion blanket will provide the necessary stability to maintain the swale until vegetation establishes. The check dams and rip rap also provide excess protection and slow the water before entering the basin. The hydraulic results for each option have been included in Appendix B.

The restored portion of May Brook Creek, north of Meadowview Drive and South of Meadowview to the end of the box culvert falls within the requirements of the KC-APWA Section 5605.3 Stream Preservation and Buffer Zones. A stream buffer has been outlined from the Ordinary High-Water Mark and extended onto the site. Part of the platting process for this site development ensured that the stream buffer became a permanent boundary protecting this area from future development. This meander of stream as well as the restored portion north of Meadowview Drive benefit May Brook Creek with water quality enhancement as well as slowing peak flows to reduce the downstream impact. No impact to this stream buffer will occur during development.

5 Conclusion

This hydraulic analysis was completed to evaluate the impact generated by the public improvements and future site development for Wilshire Hills. The project includes 19 acres of development including both commercial and residential living. The site analysis showed an increase in the time to peak in association with the construction of a detention basin.

The "water quality basin" provides the required water quality and reduces the watershed pre vs. post flow 5 cfs more than the "detention basin". Based on these results of the downstream analysis, a water quality

basin provides reduced downstream impact than the "detention basin for the proposed development of Wilshire Hills. A waiver is requested for the peak attenuation of stormwater discharge for the proposed development. This approval is conditional and should be substantiated with each future plat of Wilshire Hills.

Erosion and sediment control has been designed per requirements. The site meets storm water quality requirements for developments within the City of Lee's Summit and is designed for future development on the site. The storm sewers have been designed to convey the 25-year design storm.

APPENDIX A:
MAPS

National Flood Hazard Layer FIRMette

FEMA

94°22'20"W 38°58'29"N

94°21'43"W 38°58'1"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 1/30/2024 at 5:37 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Map Scale: 1:2,260 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 30 60 120 180

Feet: 0 100 200 400 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Jackson County, Missouri
Survey Area Data: Version 25, Aug 22, 2023

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

Date(s) aerial images were photographed: Aug 30, 2022—Sep 8, 2022

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
10024	Greenton-Urban land complex, 5 to 9 percent slopes	4.5	24.4%
10132	Sibley silt loam, 2 to 5 percent slopes	0.2	0.9%
30080	Greenton silty clay loam, 5 to 9 percent slopes	13.9	74.7%
Totals for Area of Interest		**18.6**	**100.0%**

Soil Map—Jackson County, Missouri
(Wilshire Hills Public Improvements)

Map Scale: 1:10,900 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 150 300 600 900

Feet
0 500 1000 2000 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
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- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

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

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

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

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

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

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

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

Soil Survey Area: Jackson County, Missouri
Survey Area Data: Version 25, Aug 22, 2023

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

Date(s) aerial images were photographed: Aug 30, 2022—Sep 8, 2022

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
10024	Greenton-Urban land complex, 5 to 9 percent slopes	242.9	56.7%
10132	Sibley silt loam, 2 to 5 percent slopes	33.7	7.9%
10136	Sibley-Urban land complex, 2 to 5 percent slopes	117.1	27.3%
10143	Snead-Urban land complex, 9 to 30 percent slopes	2.8	0.6%
30080	Greenton silty clay loam, 5 to 9 percent slopes	32.1	7.5%
Totals for Area of Interest		**428.6**	**100.0%**

Approximate AOI used- actual watershed area = 490.2 acres
Acres/ Percent Scaled to remain similar

Jackson County, Missouri

10024—Greenton-Urban land complex, 5 to 9 percent slopes

Map Unit Setting

National map unit symbol: 2qky4
Elevation: 800 to 1,100 feet
Mean annual precipitation: 33 to 41 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 177 to 220 days
Farmland classification: Not prime farmland

Map Unit Composition

Greenton and similar soils: 60 percent
Urban land: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Greenton

Setting

Landform: Hillslopes
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Concave, convex
Parent material: Loess over residuum weathered from limestone and shale

Typical profile

A - 0 to 16 inches: silty clay loam
Bt1 - 16 to 26 inches: silty clay loam
2Bt2 - 26 to 80 inches: silty clay

Properties and qualities

Slope: 5 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 12 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D

Ecological site: R109XY002MO - Loess Upland Prairie
Other vegetative classification: Grass/Prairie (Herbaceous Vegetation)
Hydric soil rating: No

Description of Urban Land

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Across-slope shape: Concave, convex

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Data Source Information

Soil Survey Area: Jackson County, Missouri
Survey Area Data: Version 25, Aug 22, 2023

Jackson County, Missouri

10136—Sibley-Urban land complex, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2ql0j
Elevation: 720 to 1,440 feet
Mean annual precipitation: 33 to 41 inches
Mean annual air temperature: 49 to 55 degrees F
Frost-free period: 155 to 220 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Sibley and similar soils: 60 percent
Urban land: 35 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sibley

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loess

Typical profile

A - 0 to 17 inches: silt loam
Bt - 17 to 65 inches: silty clay loam
C - 65 to 80 inches: silt loam

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C

Ecological site: R107XB002MO - Deep Loess Upland Prairie
Other vegetative classification: Grass/Prairie (Herbaceous Vegetation)
Hydric soil rating: No

Description of Urban Land

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Across-slope shape: Convex

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Minor Components

Macksburg

Percent of map unit: 5 percent
Landform: Ridges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R108XD860IA - Loess Upland Prairie
Hydric soil rating: No

Data Source Information

Soil Survey Area: Jackson County, Missouri
Survey Area Data: Version 25, Aug 22, 2023

Jackson County, Missouri

30080—Greenton silty clay loam, 5 to 9 percent slopes

Map Unit Setting

National map unit symbol: 2xjd9
Elevation: 640 to 1,120 feet
Mean annual precipitation: 35 to 41 inches
Mean annual air temperature: 50 to 57 degrees F
Frost-free period: 177 to 209 days
Farmland classification: Not prime farmland

Map Unit Composition

Greenton and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Greenton

Setting

Landform: Hillslopes
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loess over residuum weathered from limestone and shale

Typical profile

Ap - 0 to 12 inches: silty clay loam
Bt - 12 to 28 inches: silty clay
2Bt - 28 to 30 inches: silty clay
2C - 30 to 79 inches: silty clay

Properties and qualities

Slope: 5 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 12 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C/D
Ecological site: R109XY002MO - Loess Upland Prairie
Hydric soil rating: No

Minor Components

Sampsel

Percent of map unit: 10 percent
Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R109XY002MO - Loess Upland Prairie
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Jackson County, Missouri
Survey Area Data: Version 25, Aug 22, 2023

APPENDIX B:
EROSION AND SEDIMENT CONTROL CALCULATIONS

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www.ess-inc.com ess@ess-inc.com

Project: Wilshire Hills Public Improvements - Erosion Control Date: 2/7/2024 Sheet: ____ of ____

EROSION CONTROL CALCULATIONS

Temporary Sediment Trap

11.3 Acres disturbed to sediment basin

11.3 x 3,600 CF/Ac = 40,680 CF sediment storage required

ELEVATION	CONTOUR AREA (SF)	TOTAL STORAGE (CF)
912	3,000	0
913	4,000	3,488
914	5,000	7,978
915	7,000	13,949
916	8,000	21,443
917	9,000	29,379
918	11,000	39,920
919	12,000	51,415
920	14,000	64,401

40,680 CF of sediment storage is provided at an elevation of 919. The outfall structure must be wrapped with silt fabric below this elevation.

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Project: Wilshire Hills Phase III Date: 10/11/2023

PUBLIC IMPROVEMENTS Sheet: ____ of ____

EROSION CONTROL CALCULATIONS

SILT FENCE - ratio less than 1/4 ac/100 ft = 0.0025 ✓

1) EAST of New Wilshire Drive: STRUTHERS to FES 40
   - DISTURBED AREA: 0.58 Acres
   - SILT FENCE LENGTH: 288 Feet
   - RATIO: 0.58/288 = 0.0020 ✓

2) NORTH of Basin outfall pipe (NE Meadowview Dr)
   - DISTURBED AREA: 0.28 Acres
   - SILT FENCE LENGTH: 305 feet
   - RATIO: 0.28/305 = 0.0009 ✓

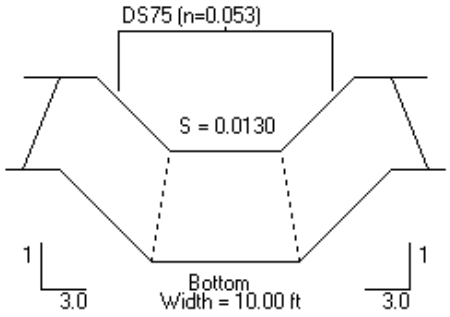
3) SOUTH of Basin outfall pipe (NE Manhatten Terrace)
   - DISTURBED AREA: 1.53 Acres
   - SILT FENCE LENGTH: 634 feet
   - RATIO: 1.53/634 = 0.0024 ✓

INLET PROTECTION - Inlet design < 1/2 acre disturbed area

- CI 41 DISTURBED AREA = 0.14 ✓
- CI 42 DISTURBED AREA = 0.13 ✓
- SOI 6A DISTURBED AREA = 0.419 ✓

HYDRAULIC RESULTS

Discharge (cfs)	Peak Flow Period (hrs)	Velocity (fps)	Area (sq.ft)	Hydraulic Radius(ft)	Normal Depth (ft)
13.4	2.0	1.99	6.74	0.49	0.58



Not to Scale

LINER RESULTS

Reach	Matting Type / Staple Pattern	Stability Analysis	Vegetation Characteristics				Permissible Shear Stress (psf)	Calculated Shear Stress (psf)	Safety Factor	Remarks
			Phase	Class	Type	Density				
Straight	DS75	Unvegetated					1.55	0.47	3.32	STABLE
	Staple D									

"**
NORTH AMERICAN GREEN EROSION CONTROL MATERIALS DESIGN SOFTWARE VERSION 4.2
NORTH AMERICAN GREEN CHANNEL PROTECTION - ENGLISH/S.I.
USER SPECIFIED CHANNEL LINING BACK-UP COMPUTATIONS
****

PROJECT NAME: Wilshire Hills PROJECT NO.: 15925
COMPUTED BY: DATE: 10/12/2023
FROM STATION/REACH: TO STATION/REACH:
DRAINAGE AREA: DESIGN FREQUENCY:

****
INPUT PARAMETERS
****

Channel Discharge : 13.4 cfs (.38 m^3/s)
Peak Flow Period : 2 hours
Channel Slope : 0.013 ft/ft (0.013 m/m)
Channel Bottom Width : 10.0 ft (3.05 m)
Left Side Slope : 3:1
Right Side Slope : 3:1

Channel Lining : DS75 Staple D
Permi. Shear(Tp) :1.55 psf (74.2 Pa)
Phase = 0

****
CALCULATIONS
****

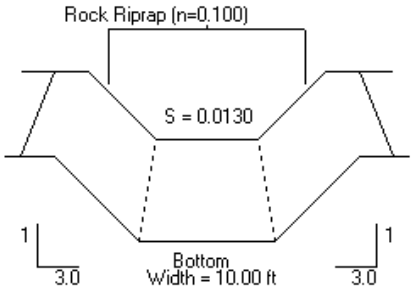
Initial Depth Estimate = 0.16 * (13.4 /(0.013^0.5))^0.375 = 0.96 ft (.29 m)
Final Channel Depth (after 9 iterations) = .58 ft (0.18 m)
Flow Area = (10.0 * 0.6)+(0.5 *0.58^2 * (3.0+3.0)) = 6.7 sq.ft (0.6 m^2)
Wet Per. =10.0 +(0.6*(((3.0^2)+1)^.5 +((3.0^2)+1)^.5)) = 13.6 ft (4.2 m)
Hydraulic Radius = (6.7 / 13.6) = 0.5 ft (0.2 m)
Channel Velocity =(1.486/0.053)*(0.5^0.667)*(0.013^.5) = 2.0 fps (0.6 m/s)

Channel Effective Manning's Roughness = 0.053
Calculated Shear (Td) = 62.4 * 0.58 * 0.013 = 0.47 psf (22.3 Pa)
Safety Factor = (Tp/Td) = (1.55 /0.47) = 3.32

"

HYDRAULIC RESULTS

Discharge (cfs)	Peak Flow Period (hrs)	Velocity (fps)	Area (sq.ft)	Hydraulic Radius(ft)	Normal Depth (ft)
13.4	2.0	1.30	10.27	0.68	0.82



Not to Scale

LINER RESULTS

Reach	Matting Type / Staple Pattern	Stability Analysis	Vegetation Characteristics				Permissible Shear Stress (psf)	Calculated Shear Stress (psf)	Safety Factor	Remarks
			Phase	Class	Type	Density				
Straight	Rock Riprap	Unvegetated					3.33	0.67	4.99	STABLE
	10in									

"**
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NORTH AMERICAN GREEN CHANNEL PROTECTION - ENGLISH/S.I.
USER SPECIFIED CHANNEL LINING BACK-UP COMPUTATIONS
****

PROJECT NAME: Wilshire Hills PROJECT NO.: 15925
COMPUTED BY: DATE: 10/12/2023
FROM STATION/REACH: TO STATION/REACH:
DRAINAGE AREA: DESIGN FREQUENCY:

****
INPUT PARAMETERS
****

Channel Discharge : 13.4 cfs (.38 m^3/s)
Peak Flow Period : 2 hours
Channel Slope : 0.013 ft/ft (0.013 m/m)
Channel Bottom Width : 10.0 ft (3.05 m)
Left Side Slope : 3:1
Right Side Slope : 3:1

Channel Lining : Rock Riprap 10in
Permi. Shear(Tp) :3.33 psf (159.6 Pa)
Phase = 0

****
CALCULATIONS
****

Initial Depth Estimate = 0.16 * (13.4 /(0.013^0.5))^0.375 = 0.96 ft (.29 m)
Final Channel Depth (after 9 iterations) = .82 ft (0.25 m)
Flow Area = (10.0 * 0.8)+(0.5 *0.82^2 * (3.0+3.0)) = 10.3 sq.ft (1.0 m^2)
Wet Per. =10.0 +(0.8*(((3.0^2)+1)^.5 +((3.0^2)+1)^.5)) = 15.2 ft (4.6 m)
Hydraulic Radius = (10.3 / 15.2) = 0.7 ft (0.2 m)
Channel Velocity =(1.486/0.100)*(0.7^0.667)*(0.013^.5) = 1.3 fps (0.4 m/s)

Channel Effective Manning's Roughness = 0.100
Calculated Shear (Td) = 62.4 * 0.82 * 0.013 = 0.67 psf (32.0 Pa)
Safety Factor = (Tp/Td) = (3.33 /0.67) = 4.99

"

Discharge (cfs)	13.4
Peak Flow Period (hrs)	2
Channel Slope (ft/ft)	0.013
Channel Bottom Width (ft)	10.00
Left Side Slope (Horiz. to 1)	3.0
Right Side Slope (Horiz. to 1)	3.0
Existing Channel Bend	○ Yes ◉ No
COMPOSITE CHANNEL LINING?	○ Yes ◉ No

Channel Liner

Matting Type	Unreinforced Vegetation
Vegetation Development Phase	
Vegetation Analysis	
Retardance Class (A-E)	E <2 in
Vegetation Type (Growth Habit)	Sod Former
Vegetation Density	4. Poor <50%
Soil Type	Clay Loam
Manning's 'n'	.024

"**********
NORTH AMERICAN GREEN EROSION CONTROL MATERIALS DESIGN SOFTWARE VERSION 4.2
NORTH AMERICAN GREEN CHANNEL PROTECTION - ENGLISH/S.I.
USER SPECIFIED CHANNEL LINING BACK-UP COMPUTATIONS
****

PROJECT NAME: Wilshire Hills PROJECT NO.: 15925
COMPUTED BY: DATE: 10/12/2023
FROM STATION/REACH: TO STATION/REACH:
DRAINAGE AREA: DESIGN FREQUENCY:

****
INPUT PARAMETERS
****

Channel Discharge : 13.4 cfs (.38 m^3/s)
Peak Flow Period : 2 hours
Channel Slope : 0.013 ft/ft (0.013 m/m)
Channel Bottom Width : 10.0 ft (3.05 m)
Left Side Slope : 3:1
Right Side Slope : 3:1

Channel Lining : Unreinforced Vegetation Sod <50%
Permi. Shear(Tp) :2.16 psf (103.4 Pa)
Phase = 1
Class = E Vegetation
Soil = Clay Loam
Allowable Soil Shear(Ta):0.05 psf (2.39400003567338 Pa)

****
CALCULATIONS
****

Initial Depth Estimate = 0.16 * (13.4 /(0.013^0.5))^0.375 = 0.96 ft (.29 m)
Final Channel Depth (after 10 iterations) = .25 ft (0.08 m)
Flow Area = (10.0 * 0.3)+(0.5 *0.25^2 * (3.0+3.0)) = 2.7 sq.ft (0.3 m^2)
Wet Per. =10.0 +(0.3*(((3.0^2)+1)^.5 +((3.0^2)+1)^.5)) = 11.6 ft (3.5 m)
Hydraulic Radius = (2.7 / 11.6) = 0.2 ft (0.1 m)
Channel Velocity =(1.486/0.013)*(0.2^0.667)*(0.013^.5) = 4.9 fps (1.5 m/s)

Channel Effective Manning's Roughness = 0.013
Calculated Shear (Td) = 62.4 * 0.25 * 0.013 = 0.20 psf (9.8 Pa)
Safety Factor = (Tp/Td) = (2.16 /0.20) = 10.57

Effective Stress on Soil (Te)=0.2*(1-0.44)*(0.0156/0.013)^2 =0.16 psf (7.9 Pa)
Safety Factor = (Ta/Te) = (0.05 /0.165) = 0.30
"

APPENDIX C:
COMPREHENSIVE CONTROL STUDY ANALYSIS

C.1 WATER QUALITY

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Channel Protection & Water Quality - Basin Elevations

Development Name: **Wilshire Hills Phase III Public Improvements**
Location: **Lee's Summit, MO**
Date: **February 6, 2024**
Project No: **15925**

Basin Stage Elevations

Elevation	Area (SF)	Storage (CF)
911.5	3,000	0
912	4,000	4,600
913	5,000	8,000
914	7,000	14,000
915	8,000	21,500
916	9,000	30,000
917	11,000	40,000
918	12,000	51,000
919	14,000	64,500

WQv = 52,555 CF (from calculation)

Elevation of WQv:

$$\frac{917 - 916}{54{,}400 - 52{,}555} = \frac{917 - X}{54{,}400 - 52{,}555}$$

X = WQv Elevation = 918.12

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Water Quality Protection Volume Calculation (WQ_v)

Development Name: **Wilshire Hills Phase III Public Improvements**
Location: **Lee's Summit, MO**
Date: **February 6, 2024**
Project No: **15925**

Runoff Calculation:

$$R_v = 0.05 + 0.009(I)$$

$$WQ_v = \frac{1.2\ R_v\ A}{12}$$

I =	percent of impervious cover (%)
WQ_V =	water quality protection volume (acre-feet)
R_V =	volumetric runoff
A =	total drainage area (acres)

Runoff Calculation Inputs:

Total Drainage Area	19.00	Acres	
% Impervious Area	65%	Acres	
Riparian Buffer Area	0.00	Acres	
Regulated Floodplain Area	0.00	Acres	
Total Conservation Area	0.00	Acres	Site area - ESA - Floodplain.
Reduced Drainage Area	19.00	Acres	
R_V	0.64		
UnReduced WQ_V	**1.207**	**ac-ft**	
Reduced WQ_V	**1.207**	**ac-ft**	

Reduced WQ_V **52,555** **ft^3**

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Water Quality - Orifice Sizing

Development Name: **Wilshire Hills Phase III Public Improvements**
Location: **Lee's Summit, MO**
Date: **February 6, 2024**
Project No: **15925**

H_{max} = WQv elevation - basin bottom elevation (or top of Volume Reduction elevation)

H_{max} = 1026.94 - 1026 = 6.62 (ft)

Q_{avg} = WQv/(24 hr)(3,600 s/hr)

CPv= 52,555 CF (from GA Review Tool Spreadsheet)

Q_{avg} = 0.61 CFS

$Q_{max} = Q_{avg} \times 2$ = 1.22 CFS

$Q = CA(2gH)^{0.5}$ rearanging $A = Q/C(2gH)^{0.5}$

C = discharge coefficient = 0.6
g = acceleration due to gravity (ft/s)= 32.2

A = orifice area = 0.09823 SF

$A = (\pi/4)d^2$ rearanging $d = (4A/\pi)^{0.5}$

d = orifice diameter = 0.35 ft.

d = orifice diameter =	**4.24**	**in.**

WQv Orifice Size > CPv Orifice Size
therefore orifice shall be the CPv Orifice Size

C.2 DETENTION ANALYSIS

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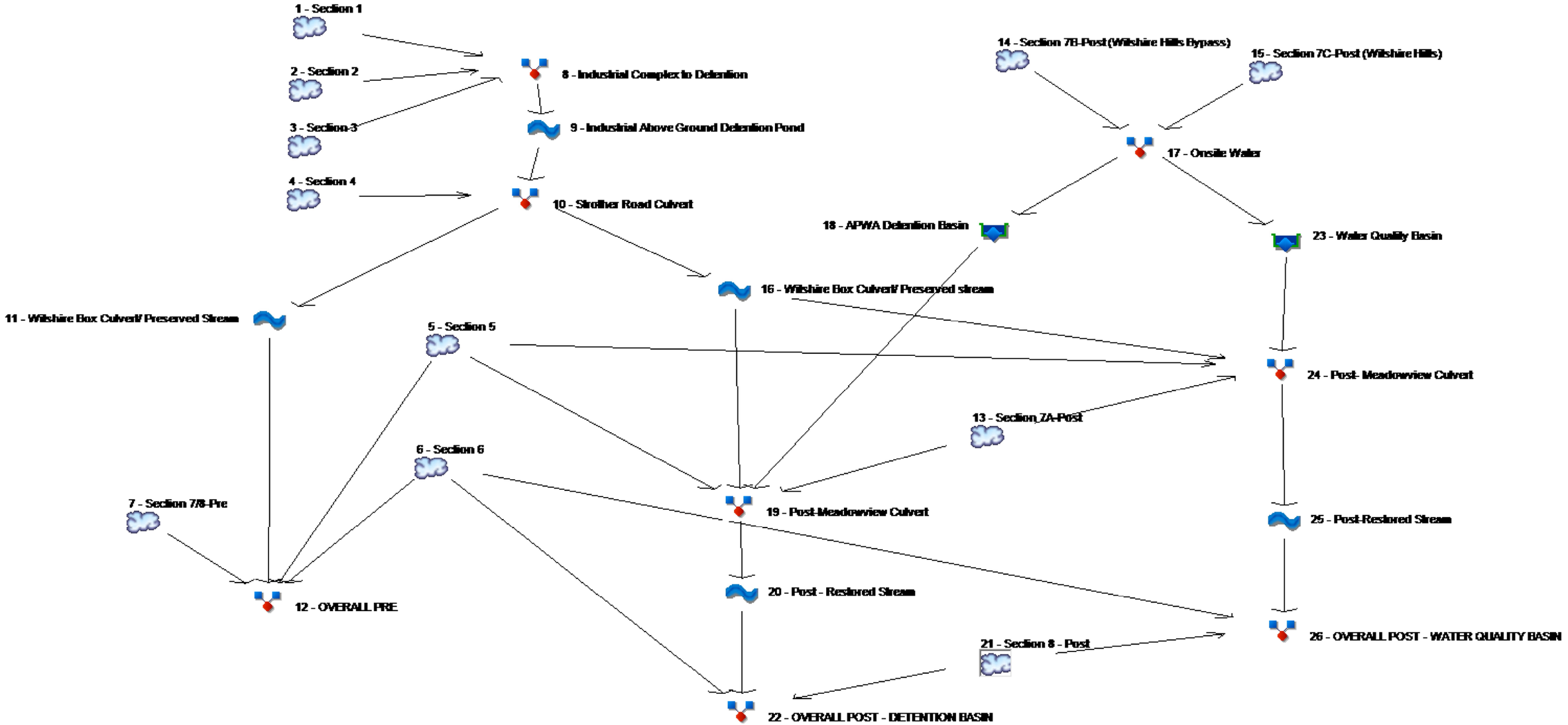
1 - Section 1
2 - Section 2
3 - Section-3
4 - Section 4
8 - Industrial Complex to Detention
9 - Industrial Above Ground Detention Pond
10 - Strollver Road Culvert
11 - Wilshire Box Culvert/ Preserved Stream
5 - Section 5
6 - Section 6
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15 - Section 7C-Post (Wilshire Hills)
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18 - APWA Detention Basin
16 - Wilshire Box Culvert/ Preserved stream
23 - Water Quality Basin
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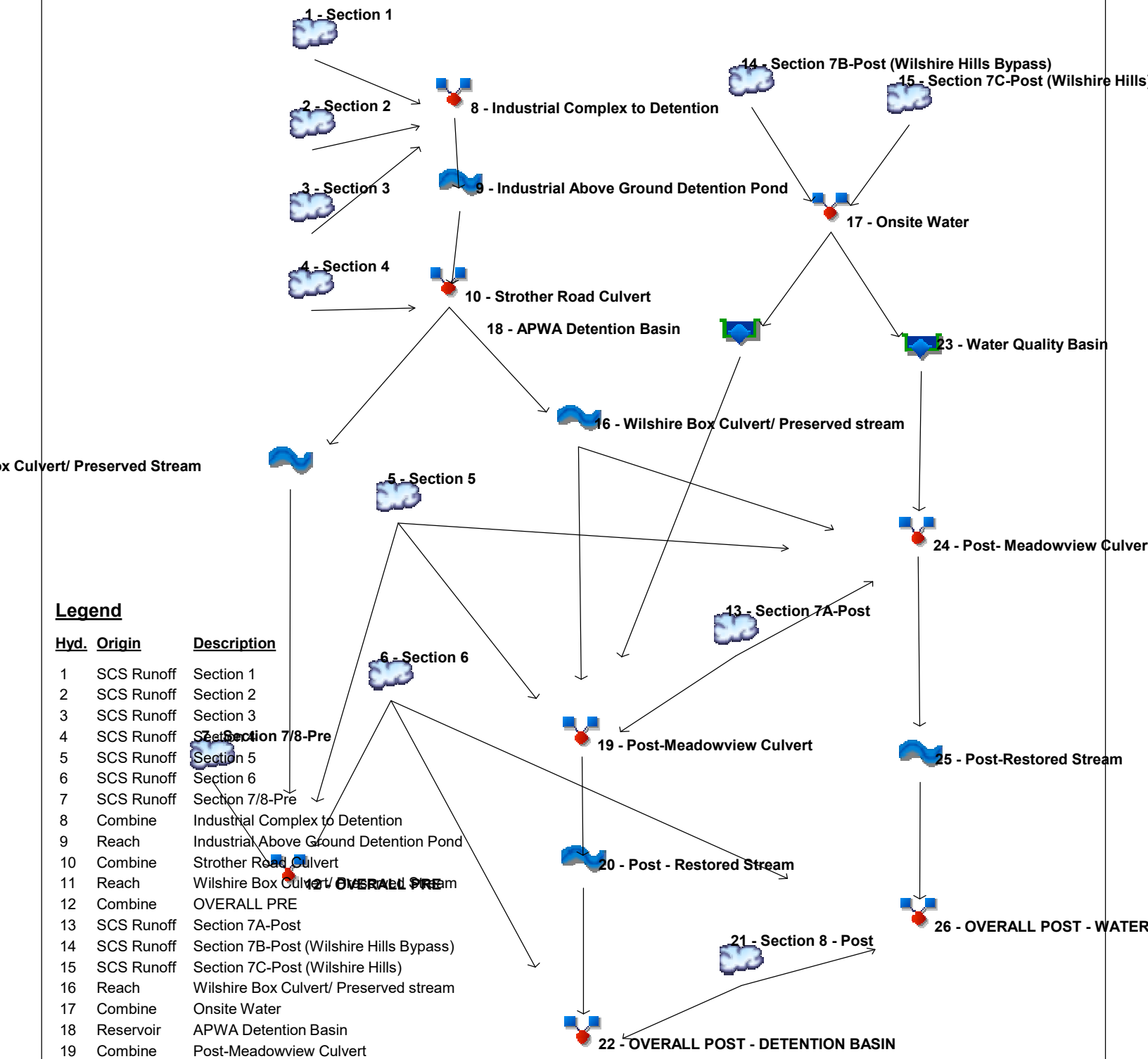
19 - Post-Meadowview Culvert
25 - Post-Restored Stream
20 - Post - Restored Stream
26 - OVERALL POST - WATER QUALITY BASIN
21 - Section 8 - Post
22 - OVERALL POST - DETENTION BASIN

Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	SCS Runoff	Section 1
2	SCS Runoff	Section 2
3	SCS Runoff	Section 3
4	SCS Runoff	Section 4
5	SCS Runoff	Section 5
6	SCS Runoff	Section 6
7	SCS Runoff	Section 7/8-Pre
8	Combine	Industrial Complex to Detention
9	Reach	Industrial Above Ground Detention Pond
10	Combine	Strother Road Culvert
11	Reach	Wilshire Box Culvert/ Preserved Stream
12	Combine	OVERALL PRE
13	SCS Runoff	Section 7A-Post
14	SCS Runoff	Section 7B-Post (Wilshire Hills Bypass)
15	SCS Runoff	Section 7C-Post (Wilshire Hills)
16	Reach	Wilshire Box Culvert/ Preserved stream
17	Combine	Onsite Water
18	Reservoir	APWA Detention Basin
19	Combine	Post-Meadowview Culvert
20	Reach	Post - Restored Stream
21	SCS Runoff	Section 8 - Post
22	Combine	OVERALL POST - DETENTION BASIN
23	Reservoir	Water Quality Basin
24	Combine	Post- Meadowview Culvert
25	Reach	Post-Restored Stream
26	Combine	OVERALL POST - WATER QUALITY BASIN

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	------	-------	111.00	-------	-------	228.55	-------	-------	403.79	Section 1
2	SCS Runoff	------	-------	92.38	-------	-------	190.22	-------	-------	336.08	Section 2
3	SCS Runoff	------	-------	162.30	-------	-------	306.37	-------	-------	512.72	Section 3
4	SCS Runoff	------	-------	159.01	-------	-------	273.45	-------	-------	431.92	Section 4
5	SCS Runoff	------	-------	221.05	-------	-------	394.04	-------	-------	636.00	Section 5
6	SCS Runoff	------	-------	32.72	-------	-------	53.70	-------	-------	82.47	Section 6
7	SCS Runoff	------	-------	134.69	-------	-------	227.73	-------	-------	355.97	Section 7/8-Pre
8	Combine	1, 2, 3,	-------	365.68	-------	-------	722.19	-------	-------	1243.39	Industrial Complex to Detention
9	Reach	8	-------	344.64	-------	-------	695.55	-------	-------	1211.21	Industrial Above Ground Detention Po
10	Combine	4, 9	-------	502.85	-------	-------	966.72	-------	-------	1643.14	Strother Road Culvert
11	Reach	10	-------	470.44	-------	-------	915.90	-------	-------	1570.20	Wilshire Box Culvert/ Preserved Strea
12	Combine	5, 6, 7, 11	-------	660.85	-------	-------	1263.54	-------	-------	2145.77	OVERALL PRE
13	SCS Runoff	------	-------	54.00	-------	-------	91.08	-------	-------	142.13	Section 7A-Post
14	SCS Runoff	------	-------	5.007	-------	-------	14.26	-------	-------	29.71	Section 7B-Post (Wilshire Hills Bypas
15	SCS Runoff	------	-------	76.22	-------	-------	122.92	-------	-------	186.84	Section 7C-Post (Wilshire Hills)
16	Reach	10	-------	478.83	-------	-------	933.75	-------	-------	1596.55	Wilshire Box Culvert/ Preserved strea
17	Combine	14, 15,	-------	78.68	-------	-------	131.81	-------	-------	207.01	Onsite Water
18	Reservoir	17	-------	14.36	-------	-------	41.88	-------	-------	92.90	APWA Detention Basin
19	Combine	5, 13, 16, 18	-------	584.19	-------	-------	1153.86	-------	-------	2001.54	Post-Meadowview Culvert
20	Reach	19	-------	568.94	-------	-------	1130.19	-------	-------	1967.90	Post - Restored Stream
21	SCS Runoff	------	-------	29.76	-------	-------	49.61	-------	-------	76.90	Section 8 - Post
22	Combine	6, 20, 21	-------	603.51	-------	-------	1193.11	-------	-------	2070.16	OVERALL POST - DETENTION BASI
23	Reservoir	17	-------	77.99	-------	-------	130.58	-------	-------	201.03	Water Quality Basin
24	Combine	5, 13, 16, 23	-------	587.83	-------	-------	1148.50	-------	-------	1976.30	Post- Meadowview Culvert
25	Reach	24	-------	577.29	-------	-------	1131.54	-------	-------	1951.86	Post-Restored Stream
26	Combine	6, 21, 25	-------	615.93	-------	-------	1199.85	-------	-------	2065.34	OVERALL POST - WATER QUALITY

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

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	111.00	2	730	417,615	------	------	------	Section 1
2	SCS Runoff	92.38	2	730	347,587	------	------	------	Section 2
3	SCS Runoff	162.30	2	730	652,264	------	------	------	Section 3
4	SCS Runoff	159.01	2	732	687,904	------	------	------	Section 4
5	SCS Runoff	221.05	2	722	620,159	------	------	------	Section 5
6	SCS Runoff	32.72	2	724	104,235	------	------	------	Section 6
7	SCS Runoff	134.69	2	728	496,946	------	------	------	Section 7/8-Pre
8	Combine	365.68	2	730	1,417,466	1, 2, 3,	------	------	Industrial Complex to Detention
9	Reach	344.64	2	734	1,417,464	8	------	------	Industrial Above Ground Detention Po
10	Combine	502.85	2	734	2,105,367	4, 9	------	------	Strother Road Culvert
11	Reach	470.44	2	740	2,105,365	10	------	------	Wilshire Box Culvert/ Preserved Strea
12	Combine	660.85	2	732	3,326,706	5, 6, 7, 11	------	------	OVERALL PRE
13	SCS Runoff	54.00	2	724	170,275	------	------	------	Section 7A-Post
14	SCS Runoff	5.007	2	728	20,838	------	------	------	Section 7B-Post (Wilshire Hills Bypas
15	SCS Runoff	76.22	2	718	181,856	------	------	------	Section 7C-Post (Wilshire Hills)
16	Reach	478.83	2	740	2,105,365	10	------	------	Wilshire Box Culvert/ Preserved strea
17	Combine	78.68	2	718	202,695	14, 15,	------	------	Onsite Water
18	Reservoir	14.36	2	736	202,682	17	917.31	78,756	APWA Detention Basin
19	Combine	584.19	2	734	3,098,485	5, 13, 16, 18	------	------	Post-Meadowview Culvert
20	Reach	568.94	2	740	3,098,366	19	------	------	Post - Restored Stream
21	SCS Runoff	29.76	2	728	110,215	------	------	------	Section 8 - Post
22	Combine	603.51	2	738	3,312,815	6, 20, 21	------	------	OVERALL POST - DETENTION BASI
23	Reservoir	77.99	2	720	202,680	17	918.72	48,204	Water Quality Basin
24	Combine	587.83	2	732	3,098,483	5, 13, 16, 23	------	------	Post- Meadowview Culvert
25	Reach	577.29	2	738	3,098,350	24	------	------	Post-Restored Stream
26	Combine	615.93	2	736	3,312,799	6, 21, 25	------	------	OVERALL POST - WATER QUALITY

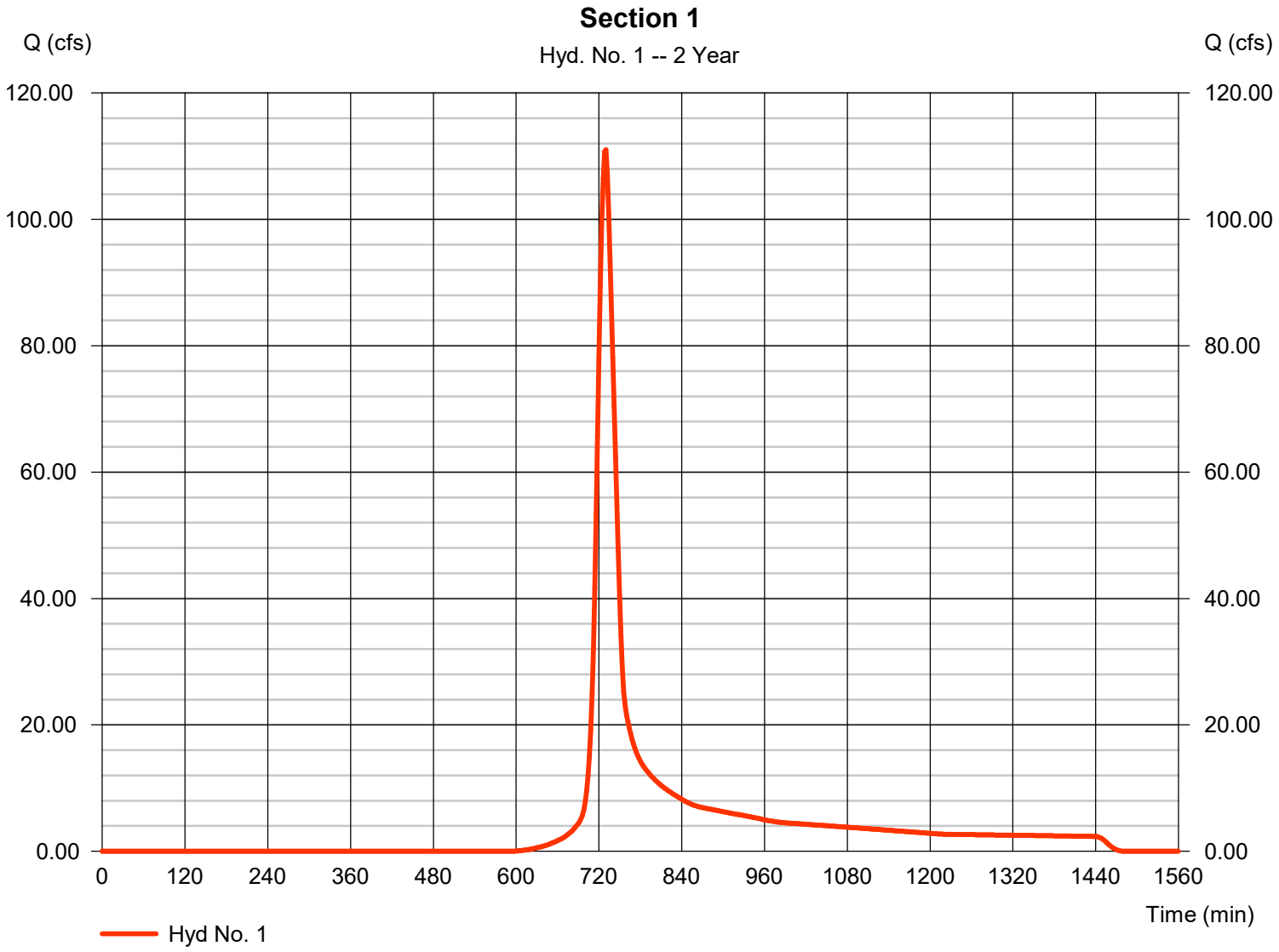
Hydrograph Report

Hyd. No. 1

Section 1

Hydrograph type	=	SCS Runoff	Peak discharge	=	111.00 cfs
Storm frequency	=	2 yrs	Time to peak	=	730 min
Time interval	=	2 min	Hyd. volume	=	417,615 cuft
Drainage area	=	81.700 ac	Curve number	=	77*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	24.30 min
Total precip.	=	3.50 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(3.600 x 81) + (13.500 x 98) + (49.000 x 73) + (15.600 x 69)] / 81.700



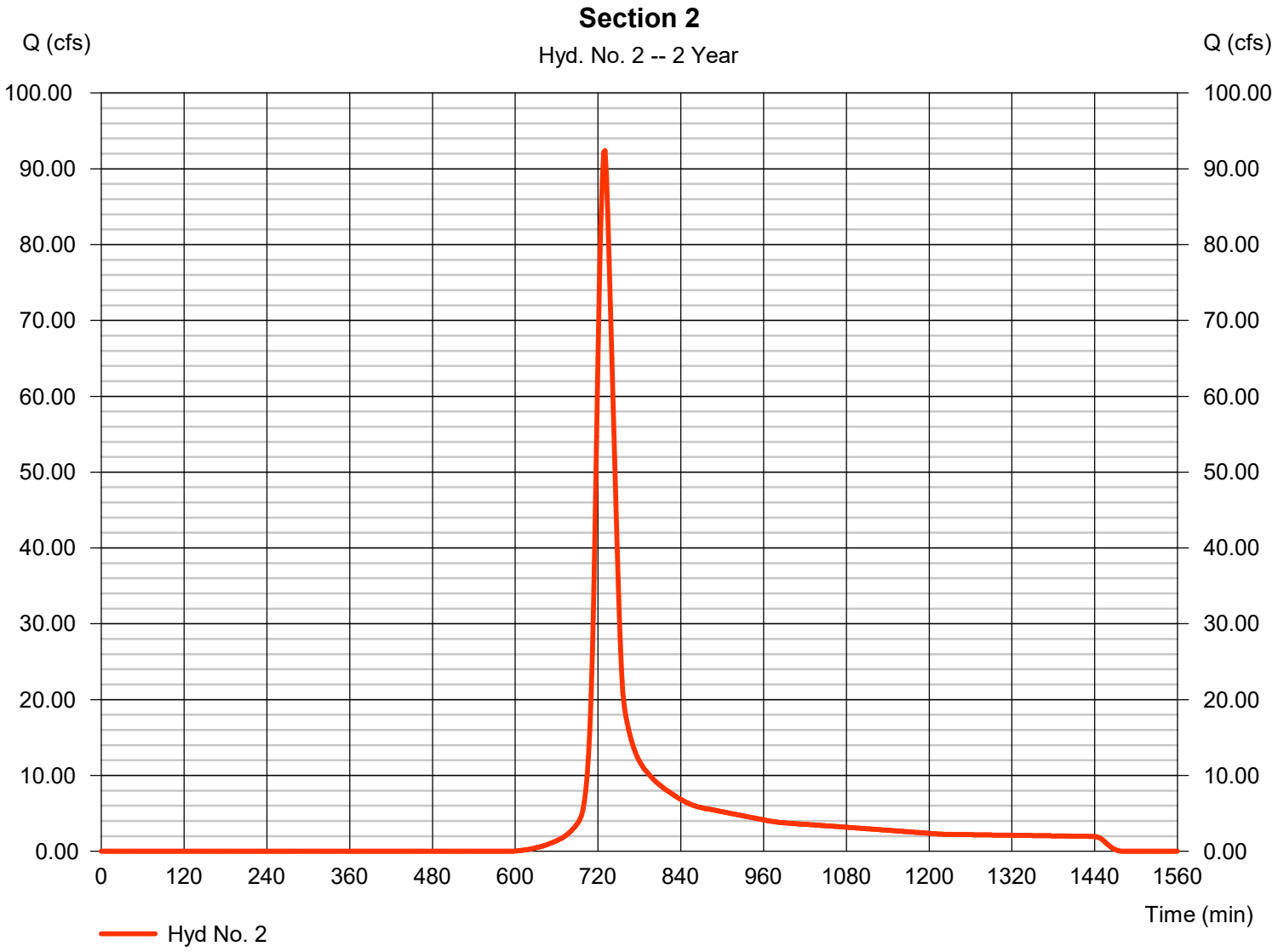
Hydrograph Report

Hyd. No. 2

Section 2

Hydrograph type	=	SCS Runoff	Peak discharge	=	92.38 cfs
Storm frequency	=	2 yrs	Time to peak	=	730 min
Time interval	=	2 min	Hyd. volume	=	347,587 cuft
Drainage area	=	68.000 ac	Curve number	=	77*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	25.30 min
Total precip.	=	3.50 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(8.000 x 98) + (0.500 x 77) + (30.800 x 79) + (28.700 x 69)] / 68.000



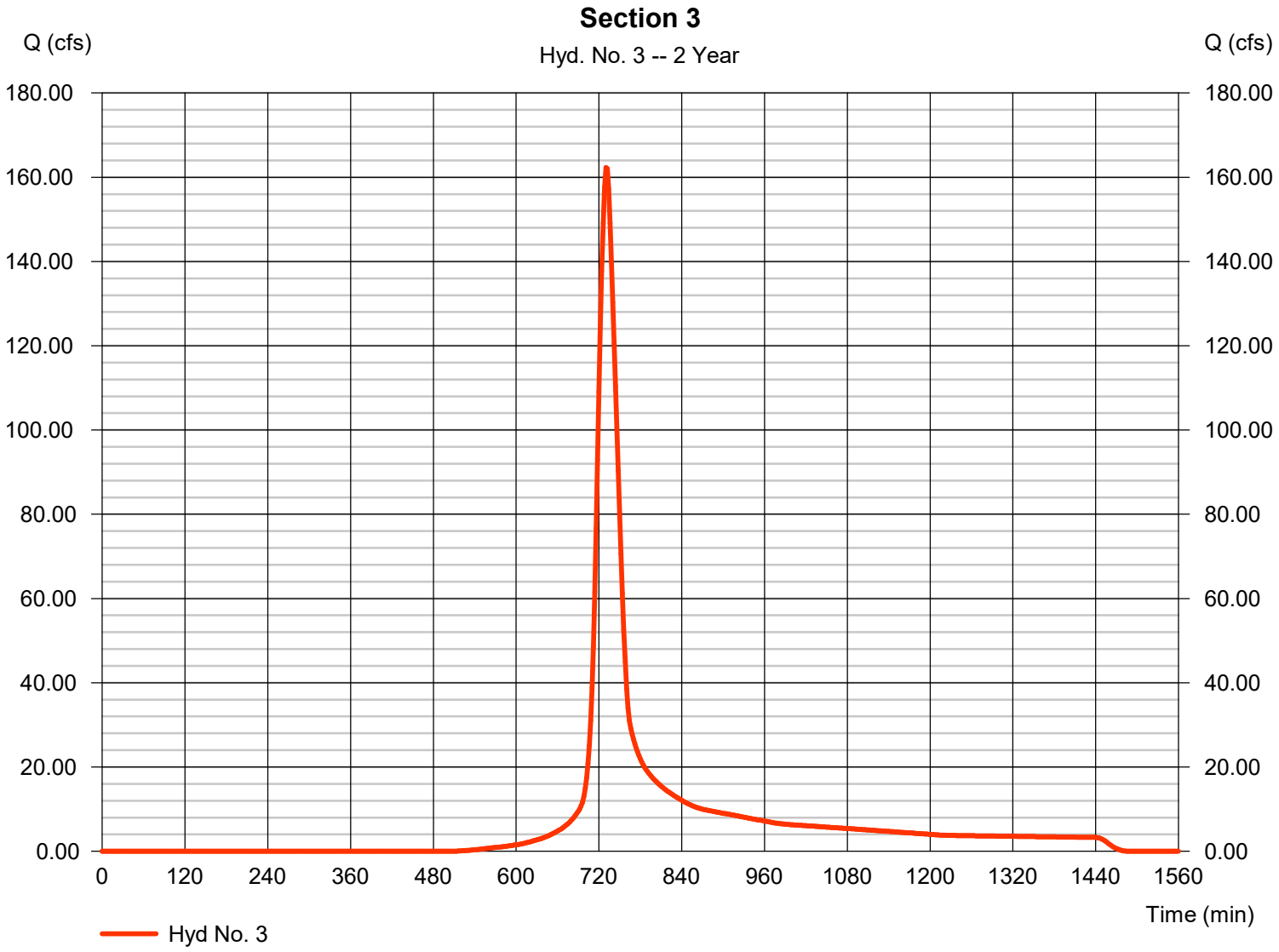
Hydrograph Report

Hyd. No. 3

Section 3

Hydrograph type	=	SCS Runoff	Peak discharge	=	162.30 cfs
Storm frequency	=	2 yrs	Time to peak	=	730 min
Time interval	=	2 min	Hyd. volume	=	652,264 cuft
Drainage area	=	100.800 ac	Curve number	=	82*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	30.20 min
Total precip.	=	3.50 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(18.200 x 98) + (3.000 x 77) + (79.600 x 79)] / 100.800



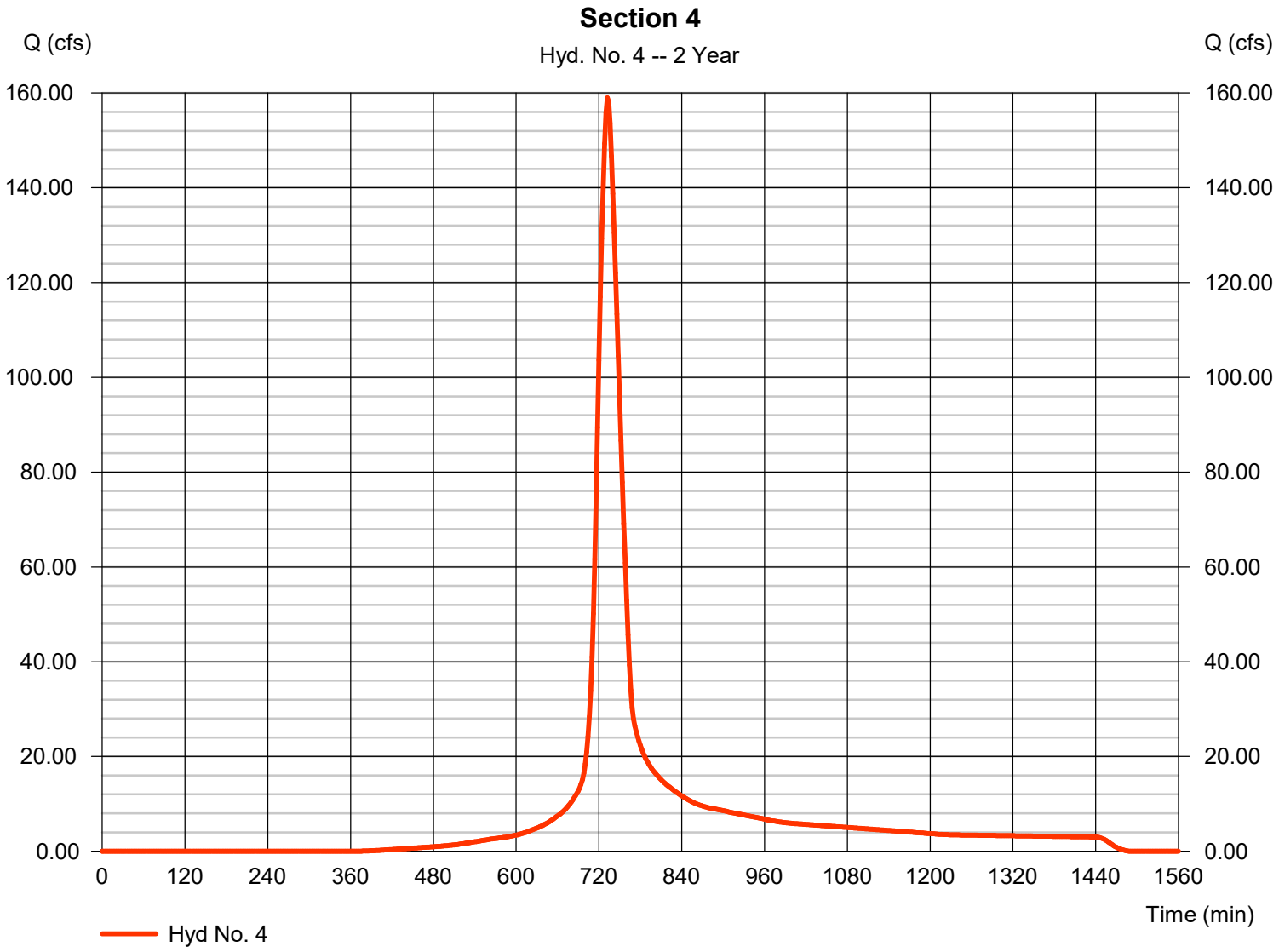
Hydrograph Report

Hyd. No. 4

Section 4

Hydrograph type	=	SCS Runoff	Peak discharge	=	159.01 cfs
Storm frequency	=	2 yrs	Time to peak	=	732 min
Time interval	=	2 min	Hyd. volume	=	687,904 cuft
Drainage area	=	82.500 ac	Curve number	=	88*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	30.70 min
Total precip.	=	3.50 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(49.680 x 98) + (32.820 x 74)] / 82.500



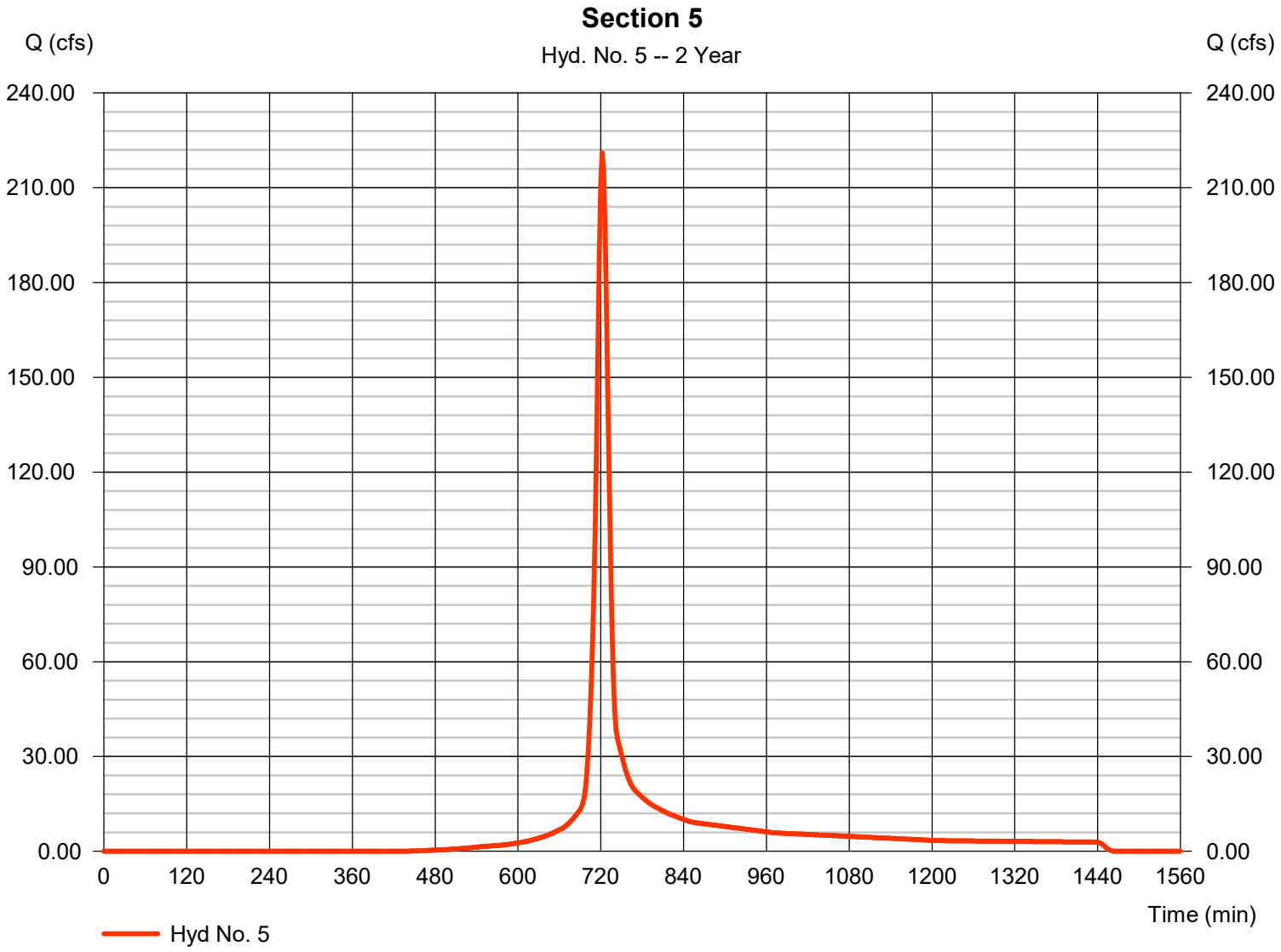
Hydrograph Report

Hyd. No. 5

Section 5

Hydrograph type	=	SCS Runoff	Peak discharge	=	221.05 cfs
Storm frequency	=	2 yrs	Time to peak	=	722 min
Time interval	=	2 min	Hyd. volume	=	620,159 cuft
Drainage area	=	86.900 ac	Curve number	=	85*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	15.60 min
Total precip.	=	3.50 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(40.000 x 98) + (46.900 x 74)] / 86.900



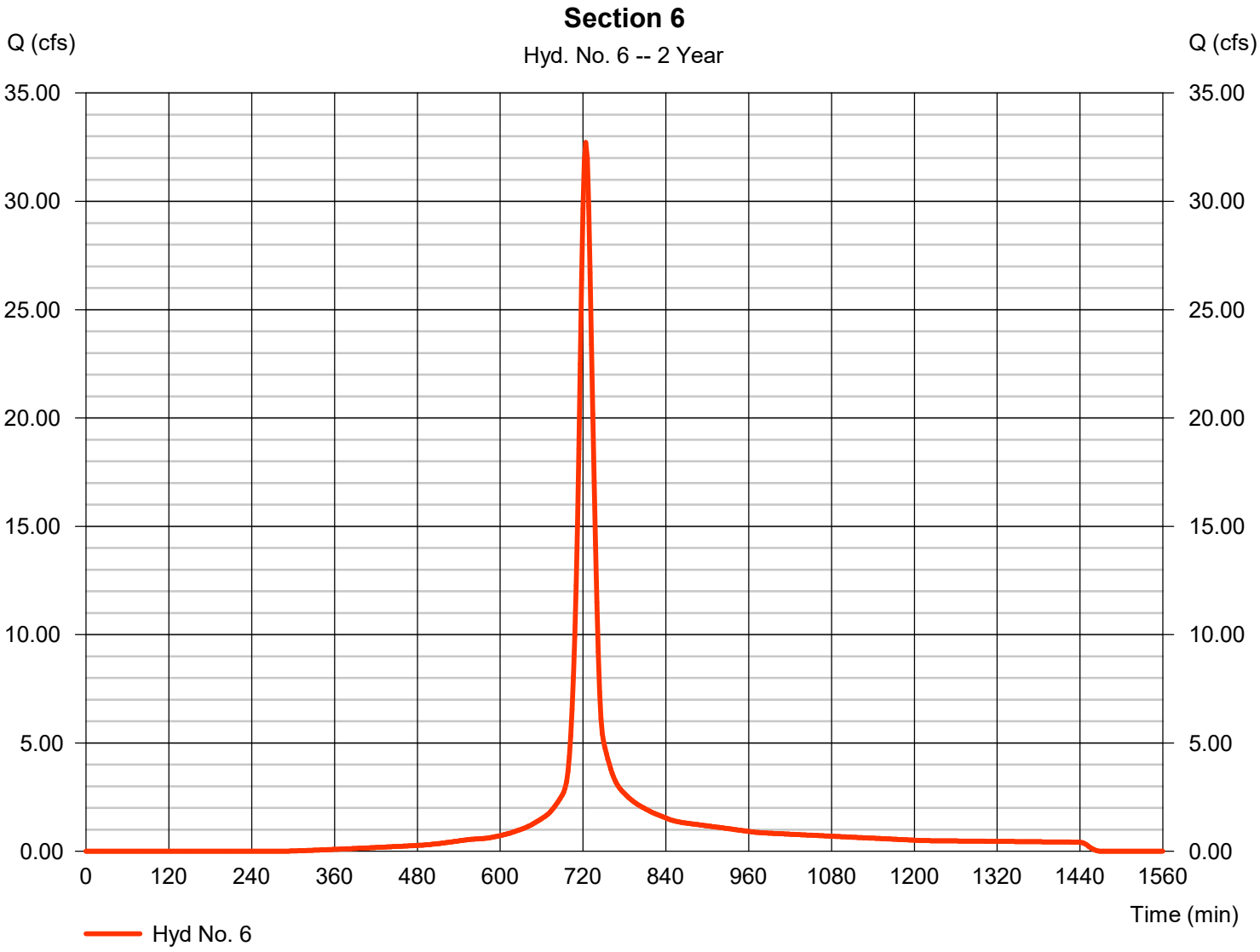
Hydrograph Report

Hyd. No. 6

Section 6

Hydrograph type	=	SCS Runoff	Peak discharge	=	32.72 cfs
Storm frequency	=	2 yrs	Time to peak	=	724 min
Time interval	=	2 min	Hyd. volume	=	104,235 cuft
Drainage area	=	11.300 ac	Curve number	=	91*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	18.60 min
Total precip.	=	3.50 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(11.300 x 91)] / 11.300



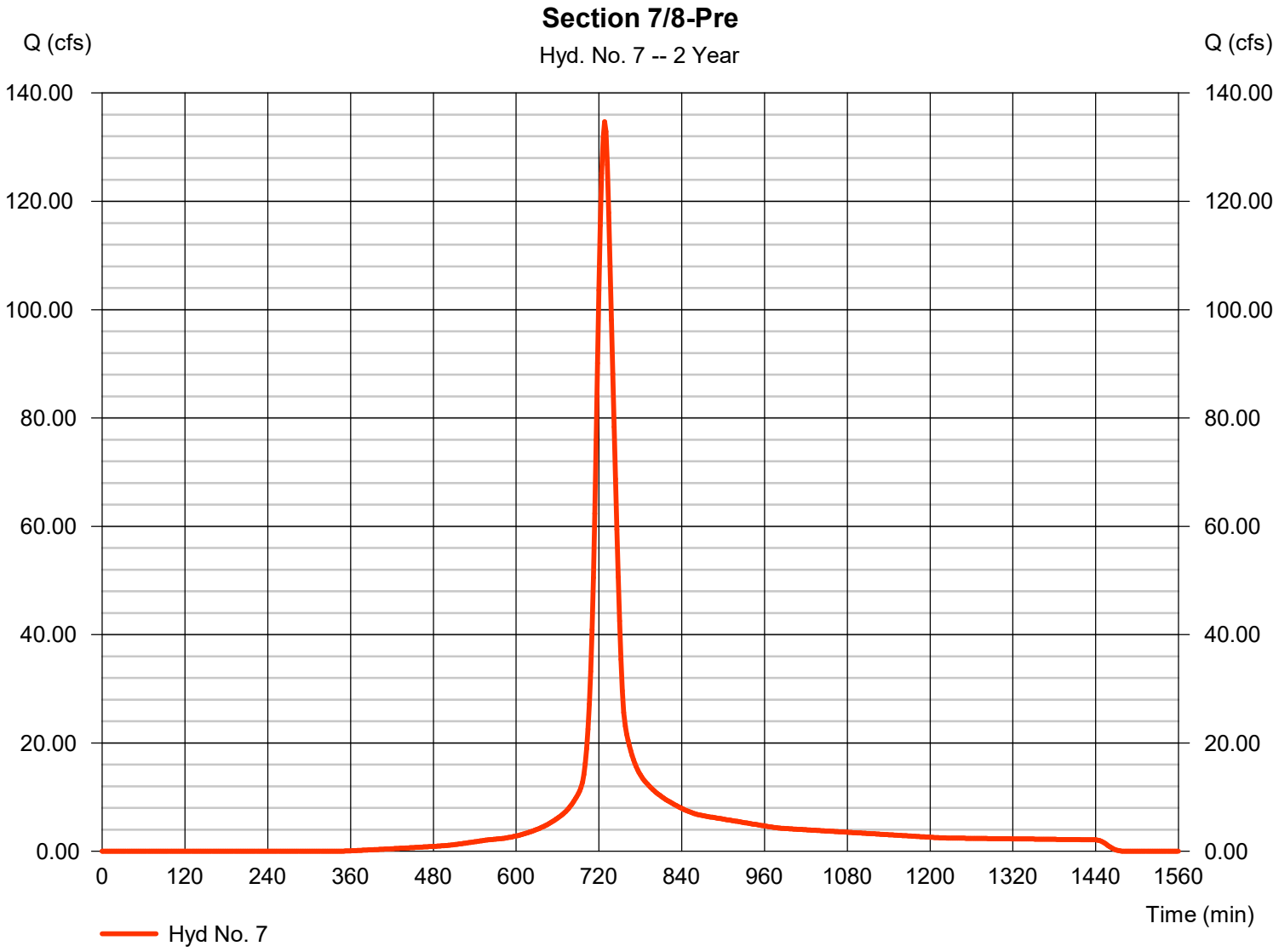
Hydrograph Report

Hyd. No. 7

Section 7/8-Pre

Hydrograph type	=	SCS Runoff	Peak discharge	=	134.69 cfs
Storm frequency	=	2 yrs	Time to peak	=	728 min
Time interval	=	2 min	Hyd. volume	=	496,946 cuft
Drainage area	=	59.000 ac	Curve number	=	89*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	23.90 min
Total precip.	=	3.50 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(59.000 x 79)] / 59.000

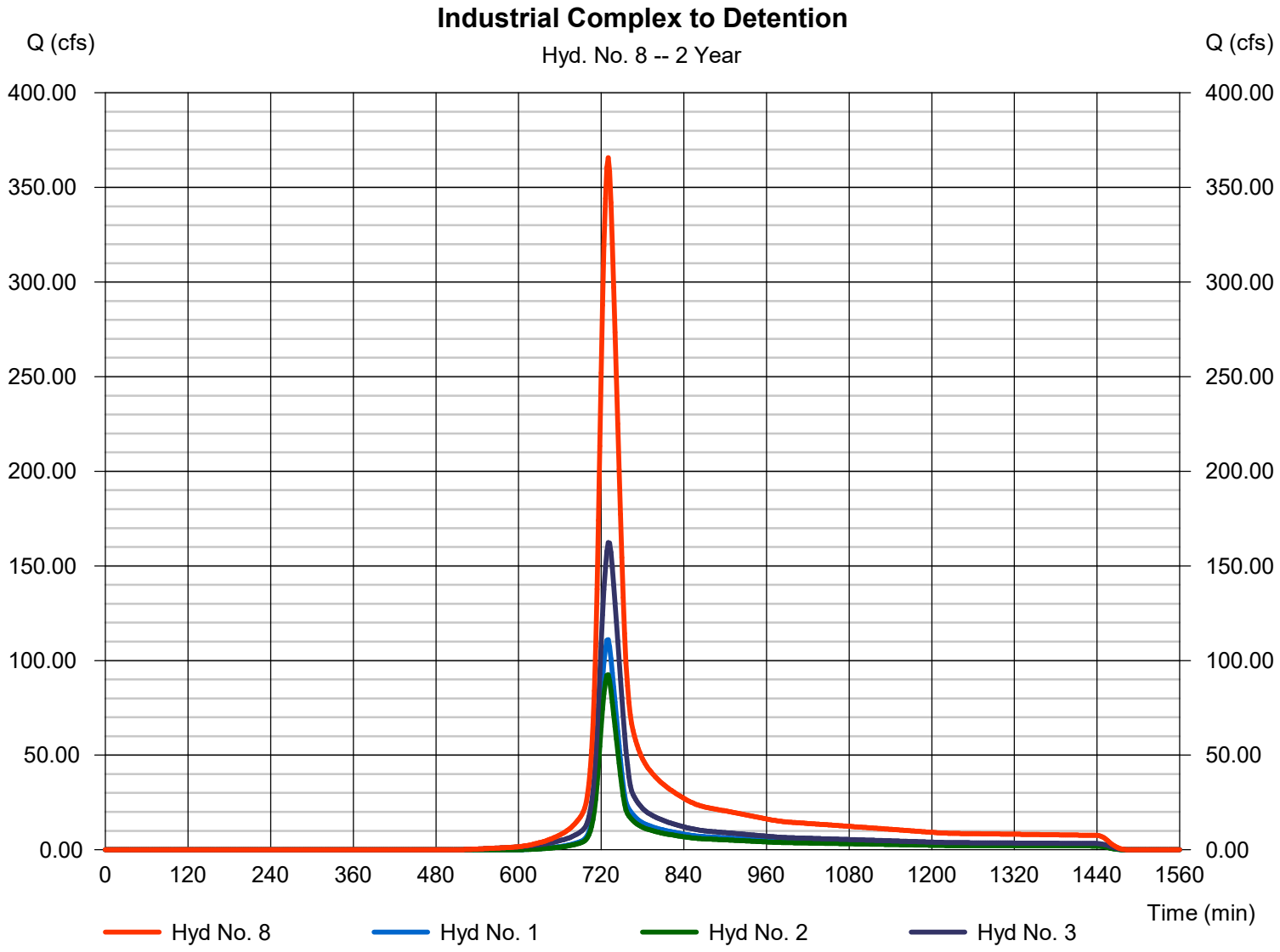


Hydrograph Report

Hyd. No. 8

Industrial Complex to Detention

Hydrograph type	=	Combine	Peak discharge	=	365.68 cfs
Storm frequency	=	2 yrs	Time to peak	=	730 min
Time interval	=	2 min	Hyd. volume	=	1,417,466 cuft
Inflow hyds.	=	1, 2, 3	Contrib. drain. area	=	250.500 ac



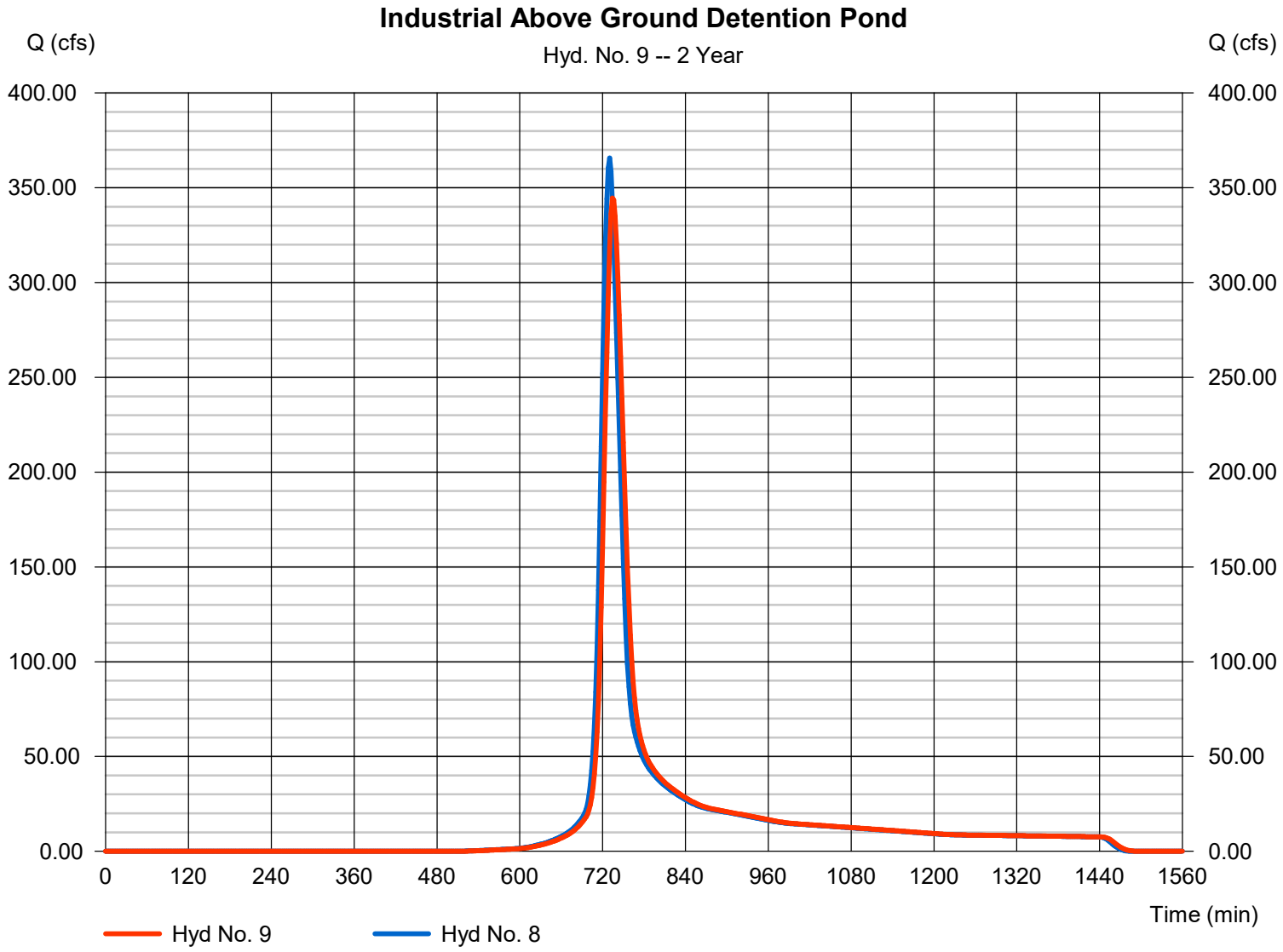
Hydrograph Report

Hyd. No. 9

Industrial Above Ground Detention Pond

Hydrograph type	=	Reach	Peak discharge	=	344.64 cfs
Storm frequency	=	2 yrs	Time to peak	=	734 min
Time interval	=	2 min	Hyd. volume	=	1,417,464 cuft
Inflow hyd. No.	=	8 - Industrial Complex to Detention	Section type	=	Trapezoidal
Reach length	=	1000.0 ft	Channel slope	=	2.0 %
Manning's n	=	0.020	Bottom width	=	150.0 ft
Side slope	=	30.0:1	Max. depth	=	16.0 ft
Rating curve x	=	0.373	Rating curve m	=	1.407
Ave. velocity	=	0.00 ft/s	Routing coeff.	=	0.3748

Modified Att-Kin routing method used.

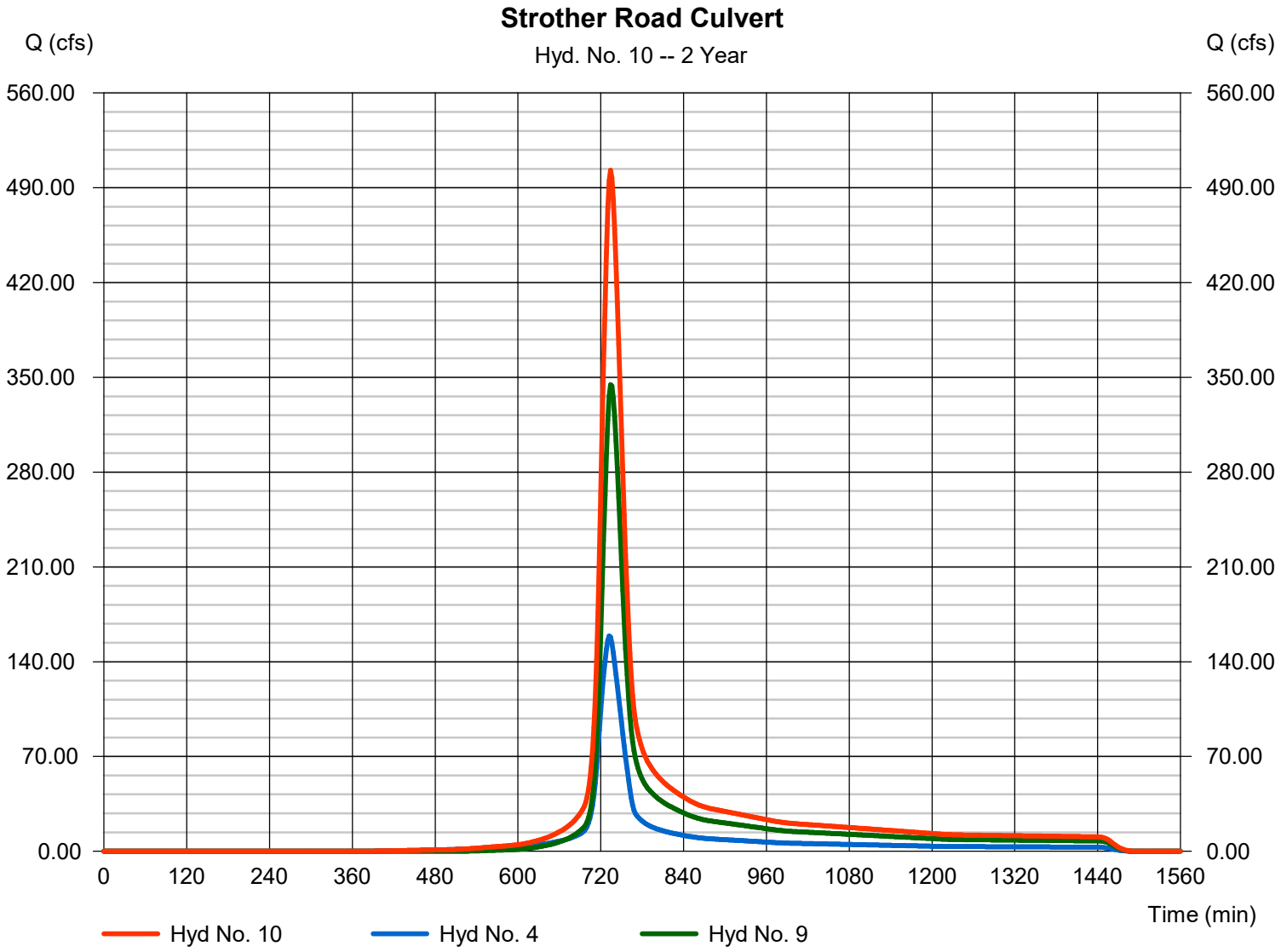


Hydrograph Report

Hyd. No. 10

Strother Road Culvert

Hydrograph type	= Combine	Peak discharge	= 502.85 cfs
Storm frequency	= 2 yrs	Time to peak	= 734 min
Time interval	= 2 min	Hyd. volume	= 2,105,367 cuft
Inflow hyds.	= 4, 9	Contrib. drain. area	= 82.500 ac



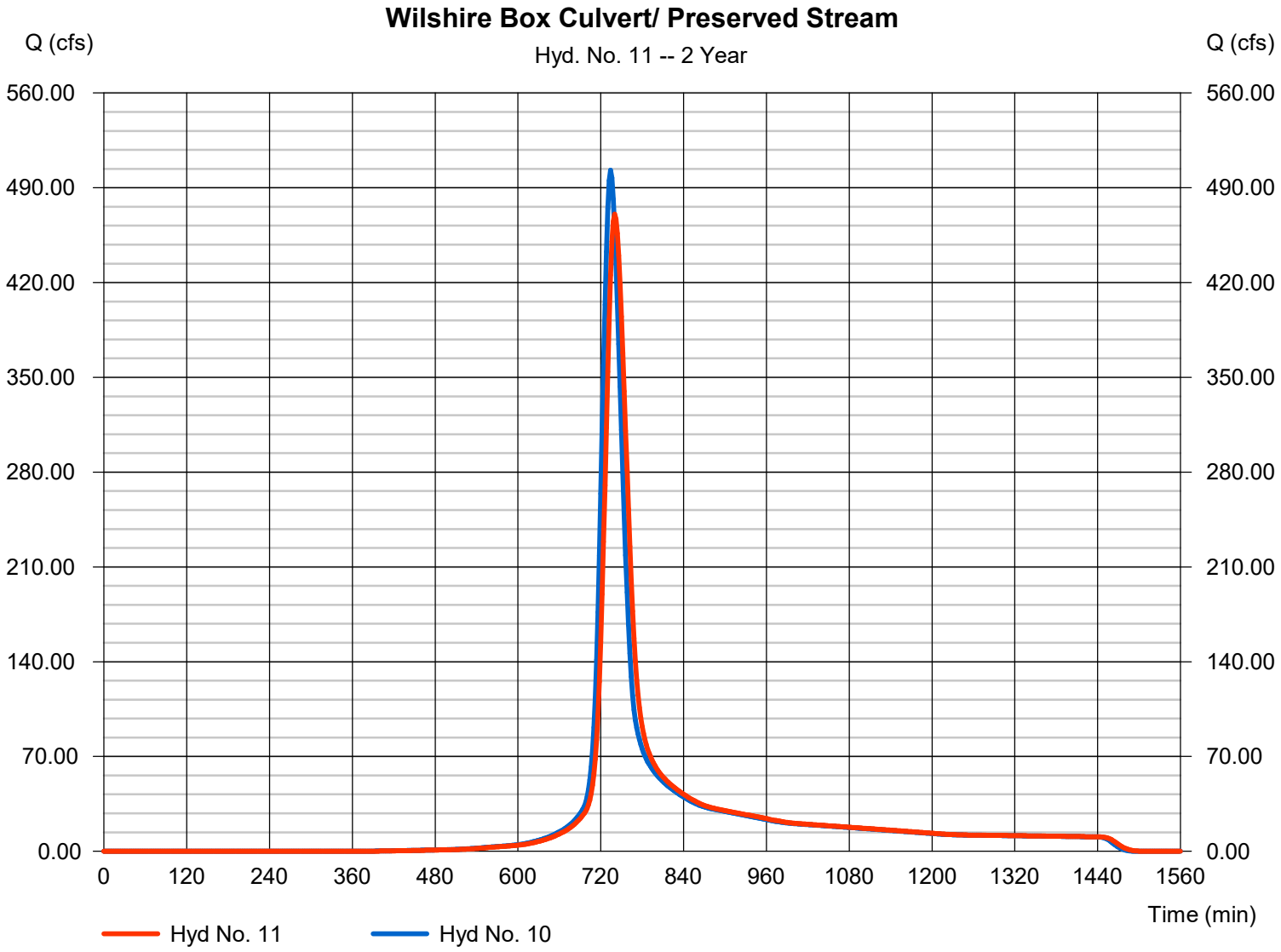
Hydrograph Report

Hyd. No. 11

Wilshire Box Culvert/ Preserved Stream

Hydrograph type	=	Reach	Peak discharge	=	470.44 cfs
Storm frequency	=	2 yrs	Time to peak	=	740 min
Time interval	=	2 min	Hyd. volume	=	2,105,365 cuft
Inflow hyd. No.	=	10 - Strother Road Culvert	Section type	=	Trapezoidal
Reach length	=	2200.0 ft	Channel slope	=	1.4 %
Manning's n	=	0.030	Bottom width	=	5.0 ft
Side slope	=	20.0:1	Max. depth	=	5.0 ft
Rating curve x	=	2.009	Rating curve m	=	1.231
Ave. velocity	=	0.00 ft/s	Routing coeff.	=	0.3193

Modified Att-Kin routing method used.

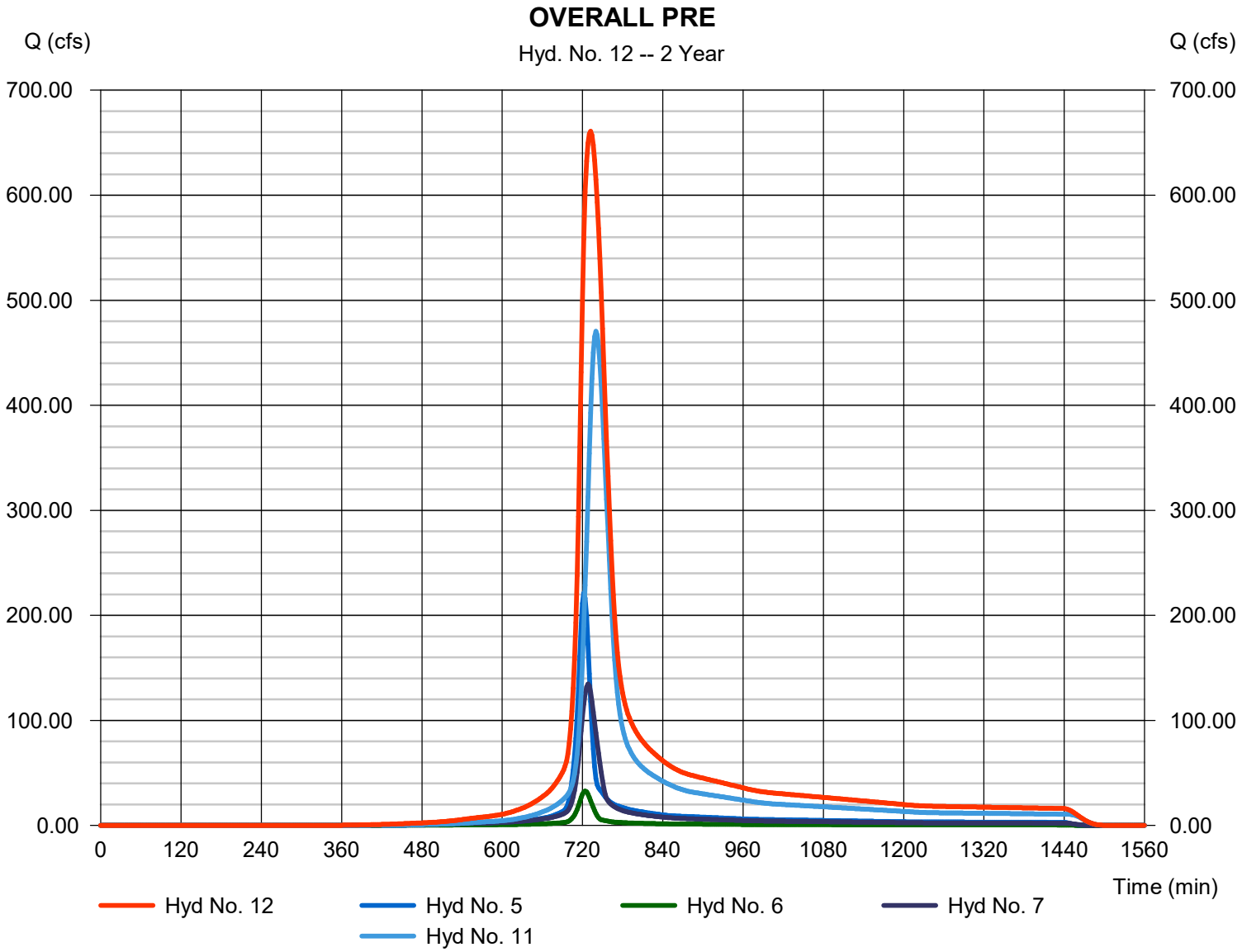


Hydrograph Report

Hyd. No. 12

OVERALL PRE

Hydrograph type	= Combine	Peak discharge	= 660.85 cfs
Storm frequency	= 2 yrs	Time to peak	= 732 min
Time interval	= 2 min	Hyd. volume	= 3,326,706 cuft
Inflow hyds.	= 5, 6, 7, 11	Contrib. drain. area	= 157.200 ac



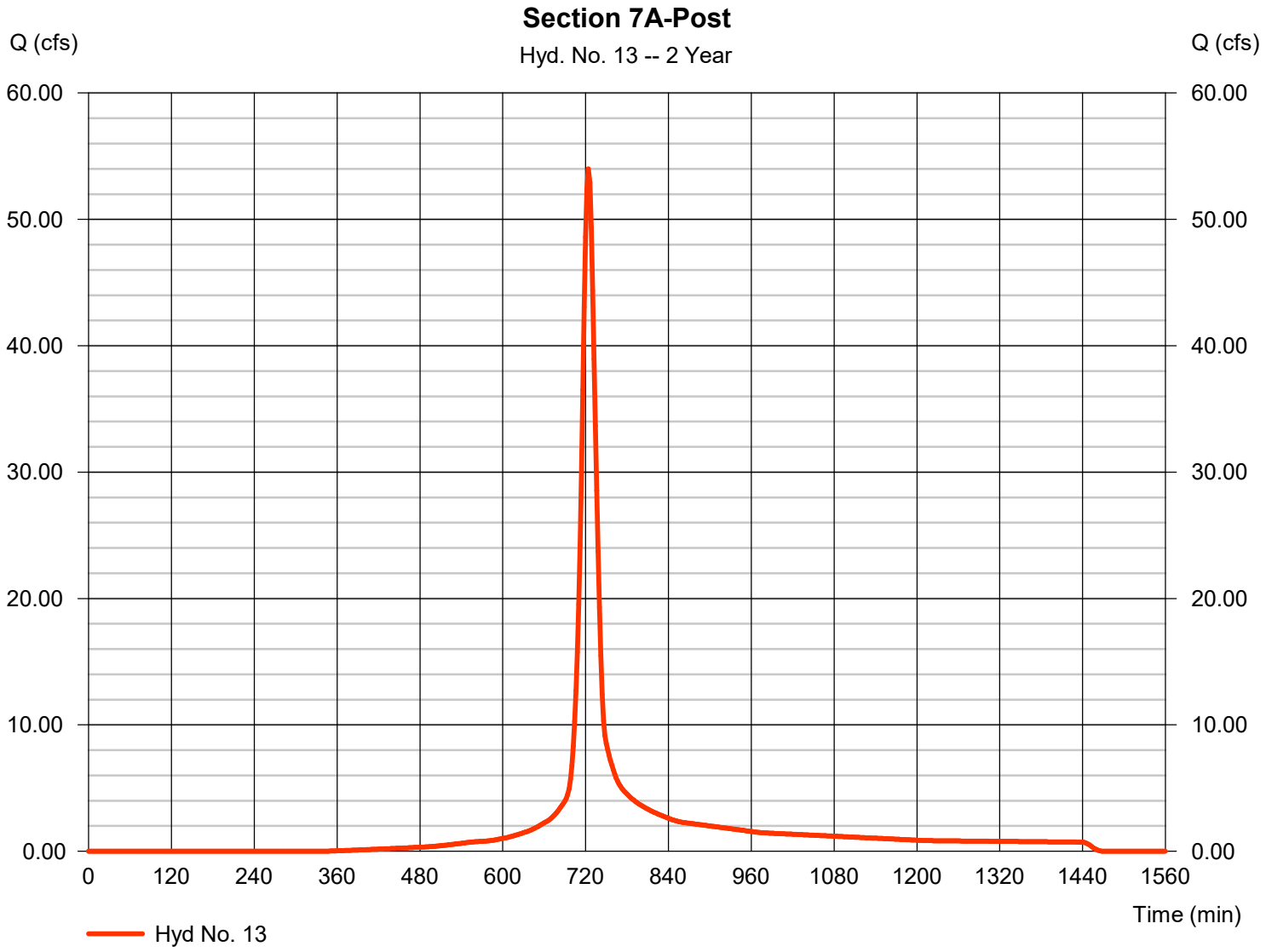
Hydrograph Report

Hyd. No. 13

Section 7A-Post

Hydrograph type	=	SCS Runoff	Peak discharge	=	54.00 cfs
Storm frequency	=	2 yrs	Time to peak	=	724 min
Time interval	=	2 min	Hyd. volume	=	170,275 cuft
Drainage area	=	19.900 ac	Curve number	=	89*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	19.30 min
Total precip.	=	3.50 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(19.900 x 89)] / 19.900



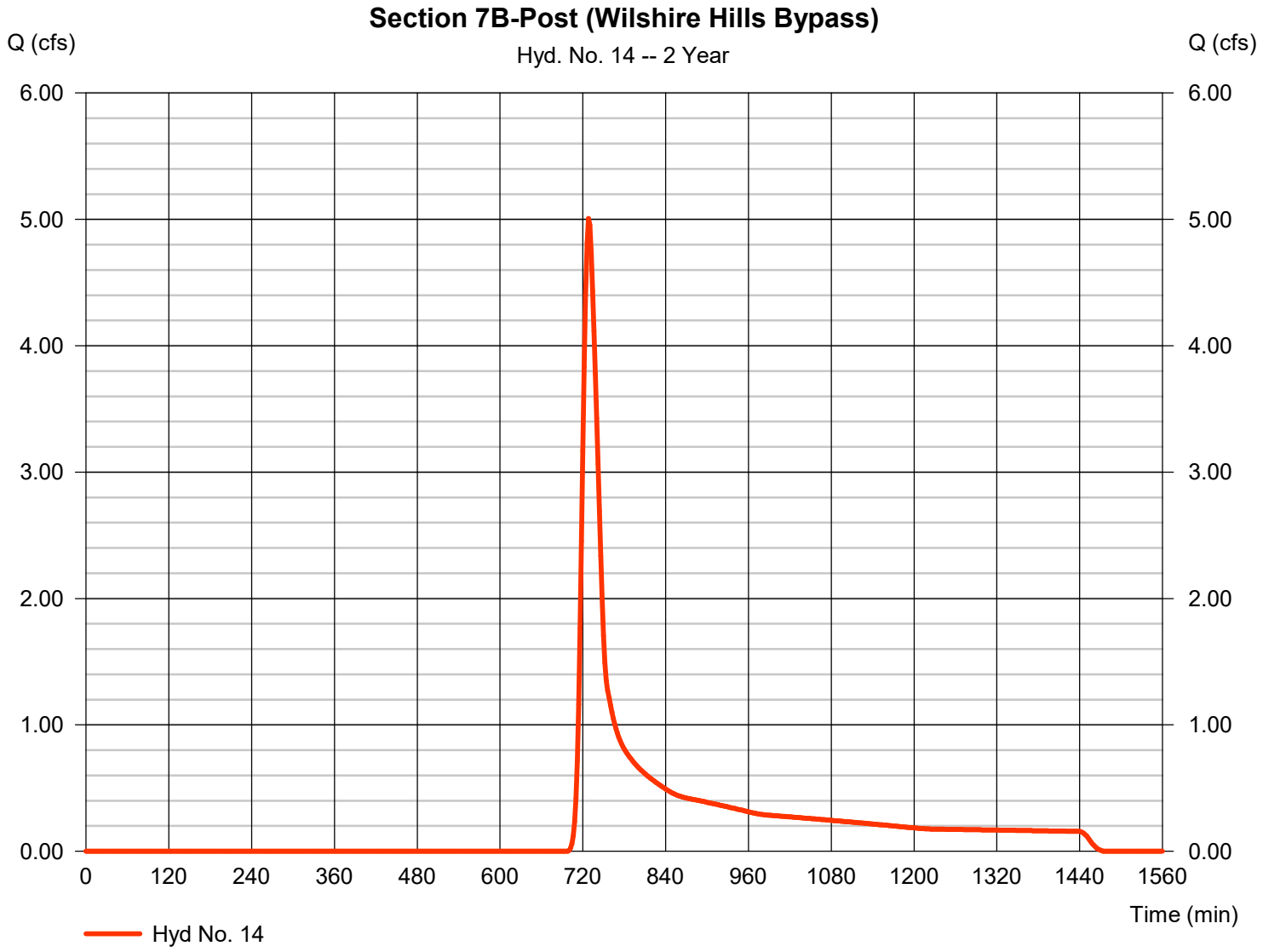
Hydrograph Report

Hyd. No. 14

Section 7B-Post (Wilshire Hills Bypass)

Hydrograph type	=	SCS Runoff	Peak discharge	=	5.007 cfs
Storm frequency	=	2 yrs	Time to peak	=	728 min
Time interval	=	2 min	Hyd. volume	=	20,838 cuft
Drainage area	=	7.500 ac	Curve number	=	65*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	20.50 min
Total precip.	=	3.50 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(13.900 x 89)] / 7.500



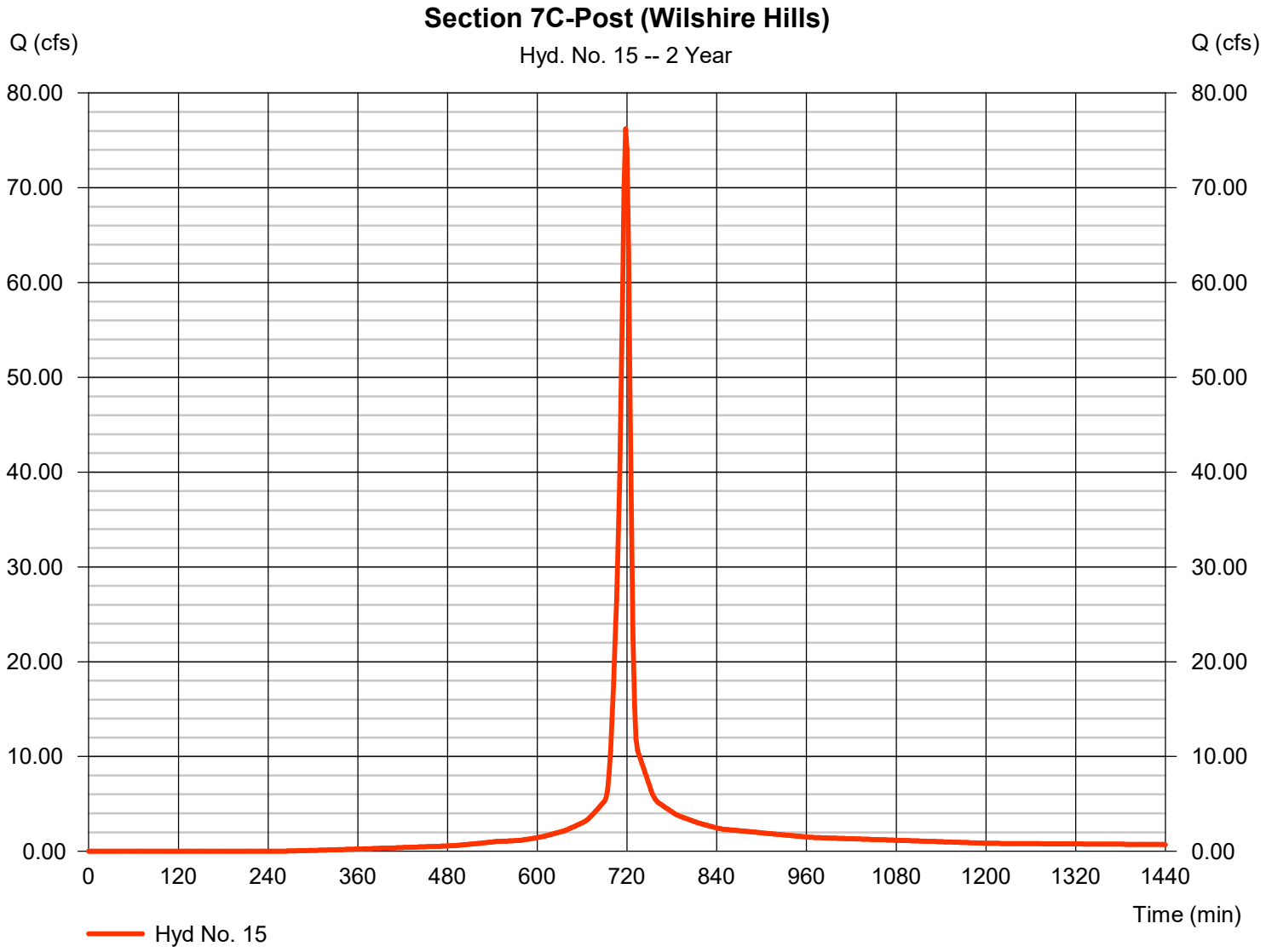
Hydrograph Report

Hyd. No. 15

Section 7C-Post (Wilshire Hills)

Hydrograph type	=	SCS Runoff	Peak discharge	=	76.22 cfs
Storm frequency	=	2 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	181,856 cuft
Drainage area	=	19.000 ac	Curve number	=	92*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	9.28 min
Total precip.	=	3.50 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(14.600 x 98) + (4.400 x 74)] / 19.000



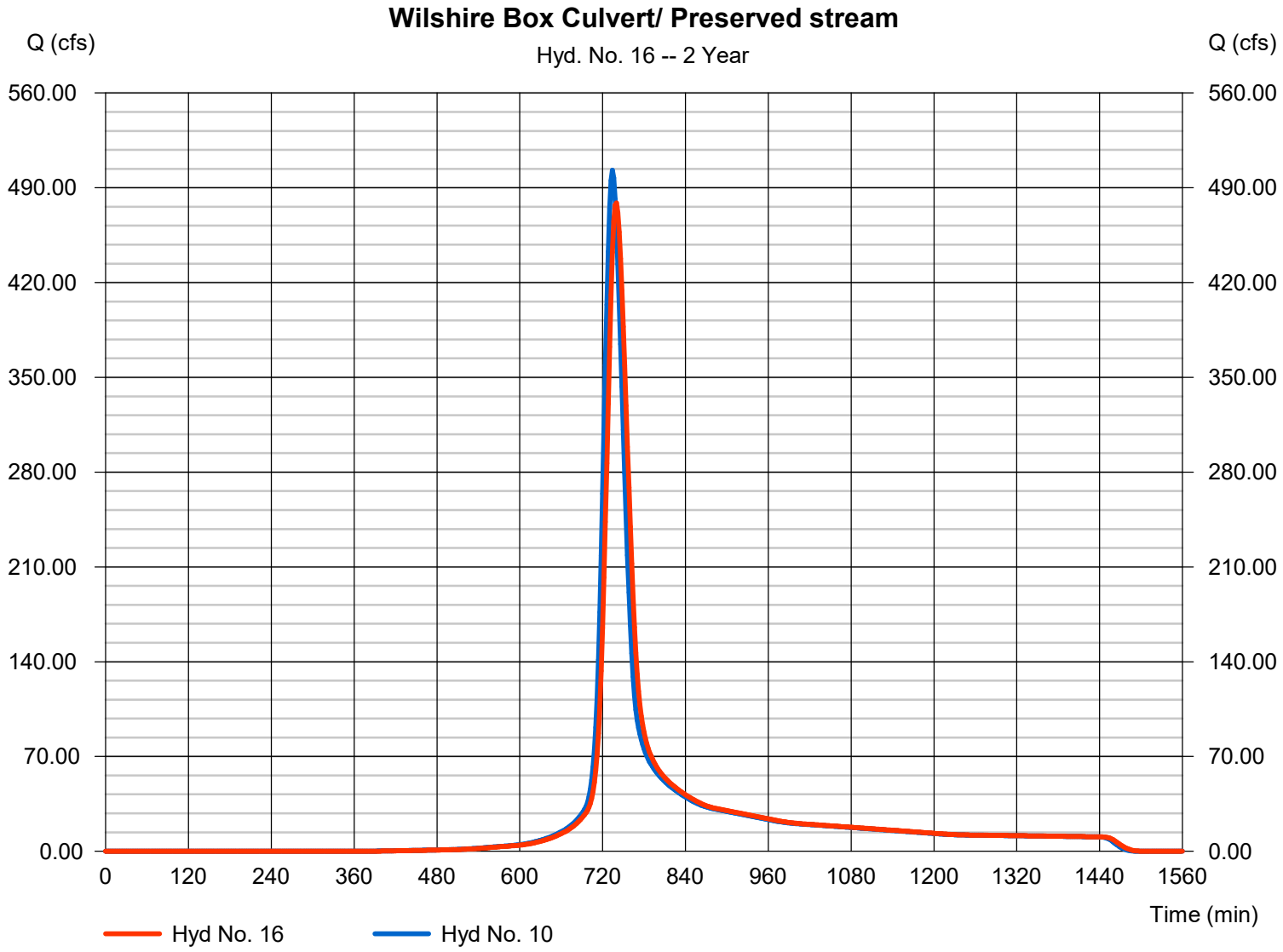
Hydrograph Report

Hyd. No. 16

Wilshire Box Culvert/ Preserved stream

Hydrograph type	=	Reach	Peak discharge	=	478.83 cfs
Storm frequency	=	2 yrs	Time to peak	=	740 min
Time interval	=	2 min	Hyd. volume	=	2,105,365 cuft
Inflow hyd. No.	=	10 - Strother Road Culvert	Section type	=	Trapezoidal
Reach length	=	500.0 ft	Channel slope	=	0.5 %
Manning's n	=	0.100	Bottom width	=	10.0 ft
Side slope	=	14.0:1	Max. depth	=	8.0 ft
Rating curve x	=	0.227	Rating curve m	=	1.318
Ave. velocity	=	0.00 ft/s	Routing coeff.	=	0.3749

Modified Att-Kin routing method used.

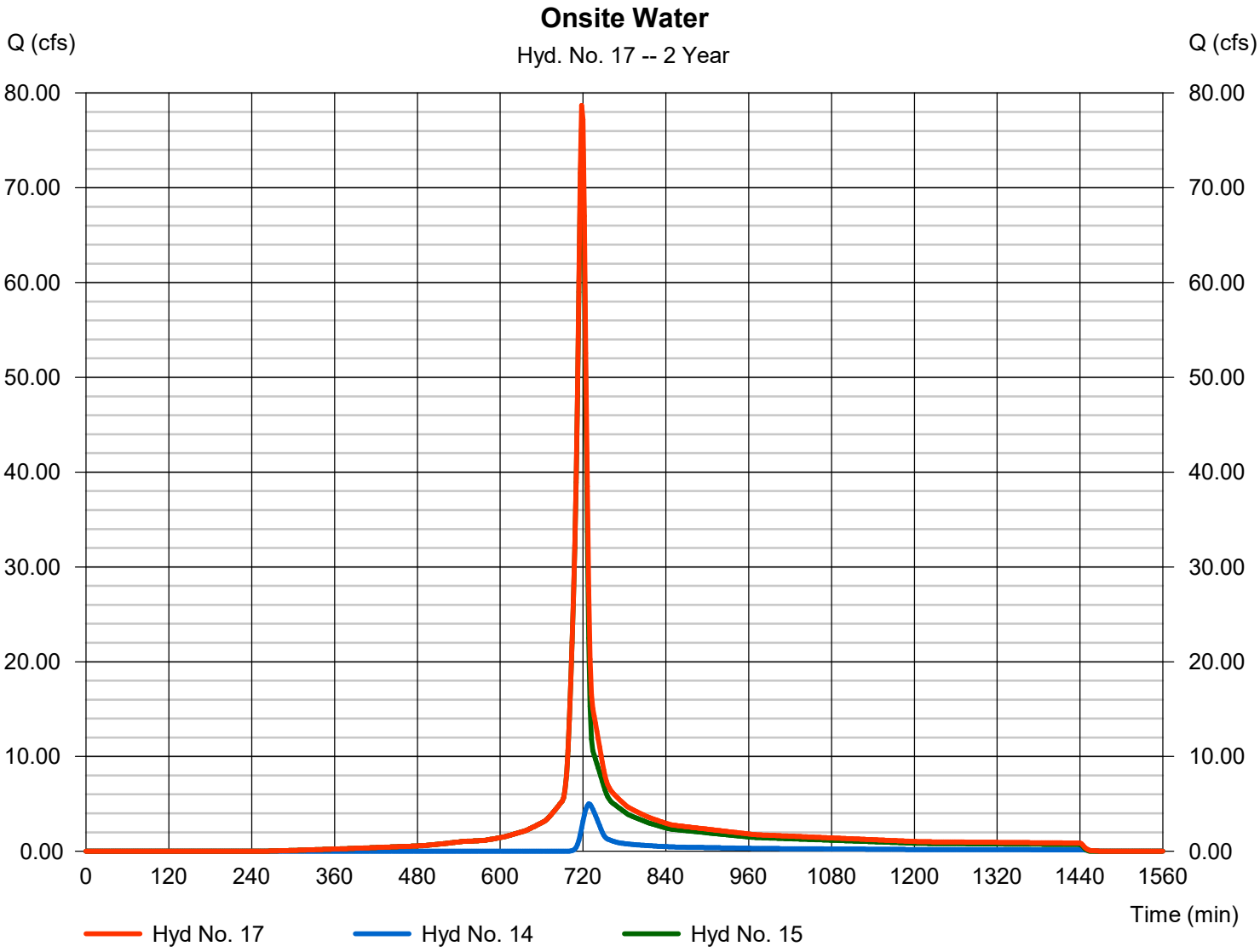


Hydrograph Report

Hyd. No. 17

Onsite Water

Hydrograph type	= Combine	Peak discharge	= 78.68 cfs
Storm frequency	= 2 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 202,695 cuft
Inflow hyds.	= 14, 15	Contrib. drain. area	= 26.500 ac



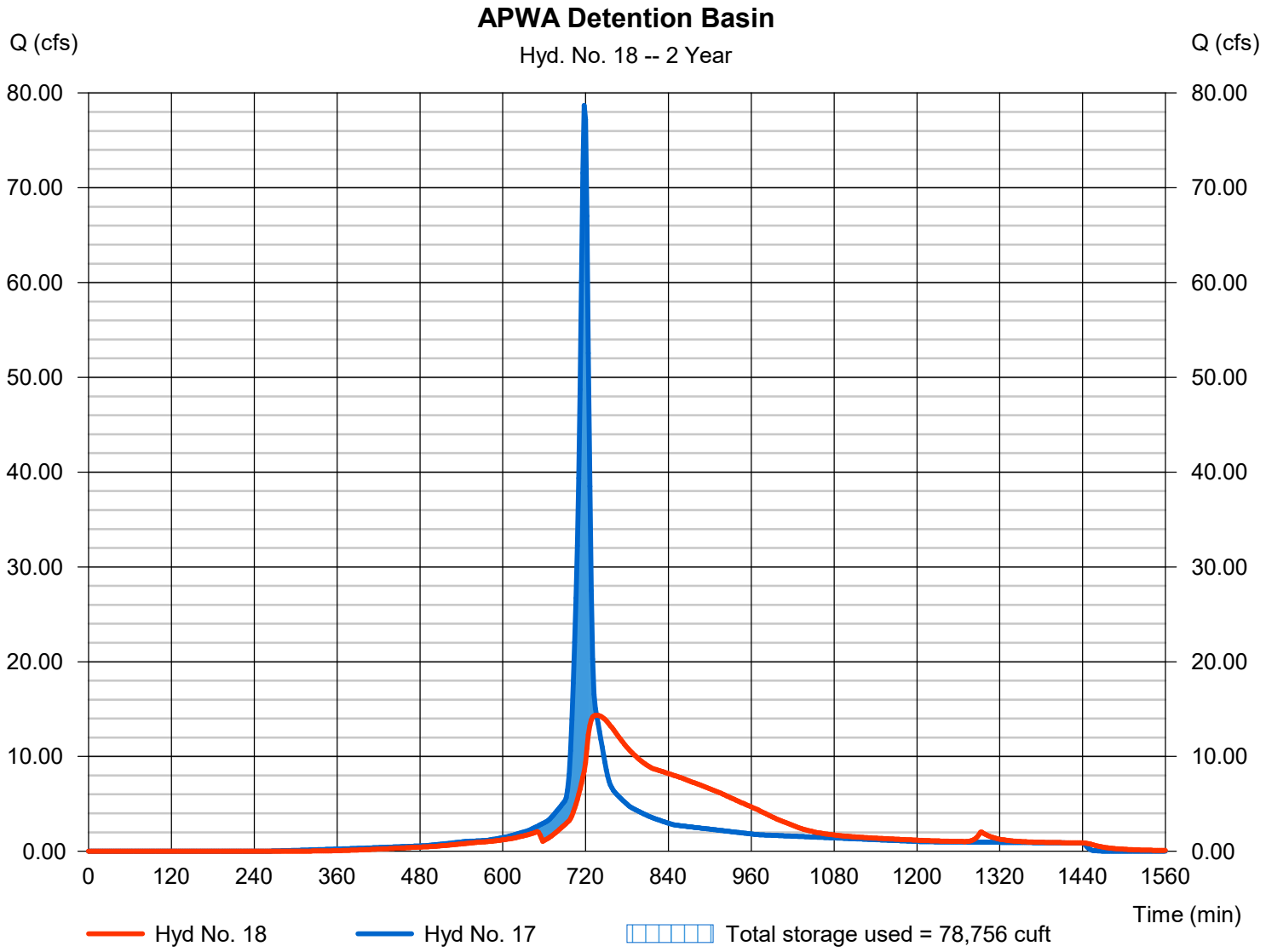
Hydrograph Report

Hyd. No. 18

APWA Detention Basin

Hydrograph type	=	Reservoir	Peak discharge	=	14.36 cfs
Storm frequency	=	2 yrs	Time to peak	=	736 min
Time interval	=	2 min	Hyd. volume	=	202,682 cuft
Inflow hyd. No.	=	17 - Onsite Water	Max. Elevation	=	917.31 ft
Reservoir name	=	Detention Basin	Max. Storage	=	78,756 cuft

Storage Indication method used.



Pond Report

Pond No. 1 - Detention Basin

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 911.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	911.50	3,000	0	0
0.85	912.00	8,300	4,615	4,615
1.85	913.00	10,300	9,281	13,896
2.85	914.00	12,400	11,333	25,229
3.85	915.00	14,600	13,484	38,712
4.85	916.00	16,800	15,686	54,398
5.85	917.00	19,300	18,034	72,432
6.85	918.00	21,800	20,535	92,967
7.85	919.00	24,400	23,085	116,052
8.85	920.00	27,100	25,736	141,788
9.85	921.00	22,900	24,968	166,756
10.85	922.00	32,700	27,652	194,408
11.85	923.00	35,600	34,136	228,545

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 60.00	13.00	Inactive	0.00
Span (in)	= 60.00	13.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 910.00	911.50	0.00	0.00
Length (ft)	= 95.30	0.50	0.00	0.00
Slope (%)	= 0.26	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	Yes	No	No

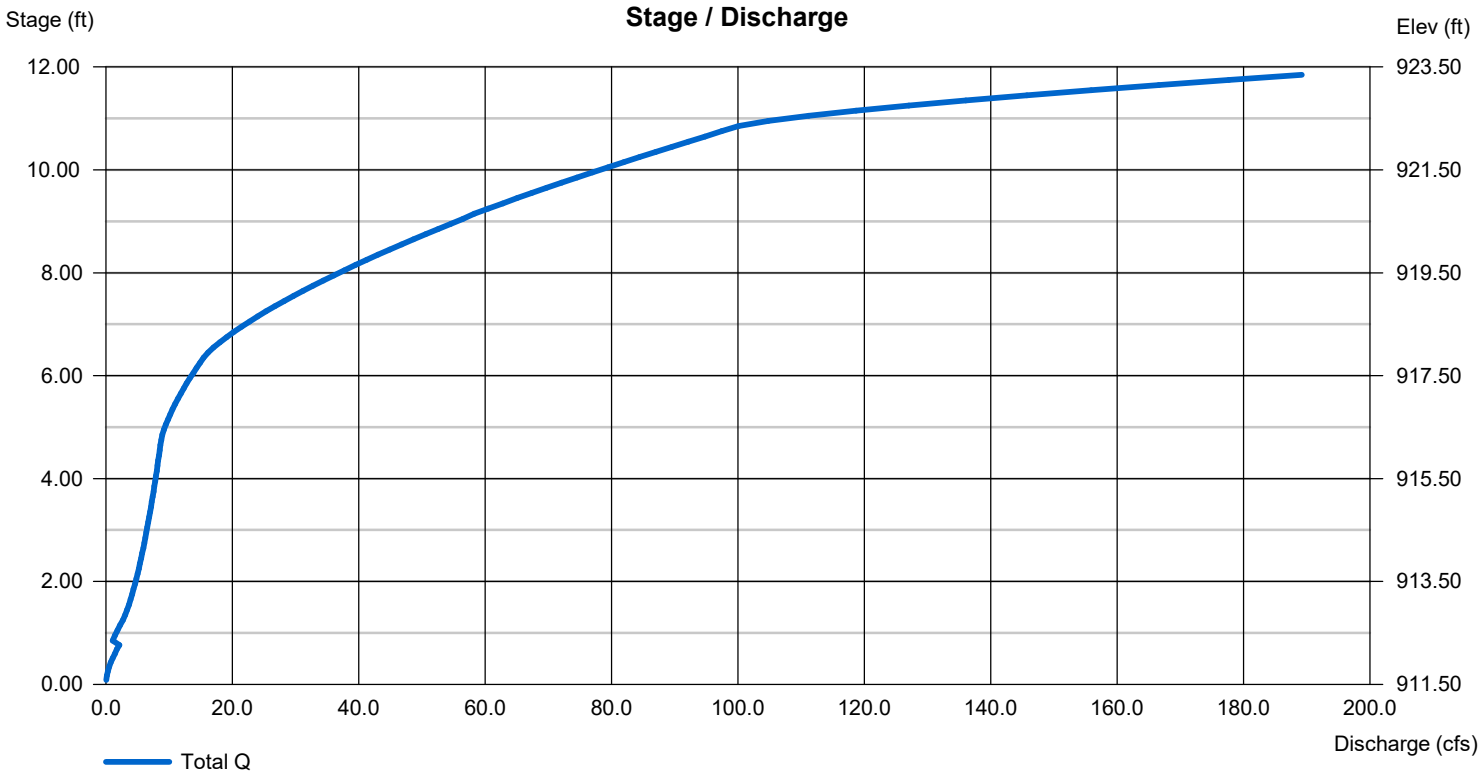
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 19.25	1.62	0.75	Inactive
Crest El. (ft)	= 922.00	917.52	915.90	919.04
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	Rect	Rect	Rect
Multi-Stage	= Yes	Yes	Yes	Yes

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

TW Elev. (ft) = 0.00

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

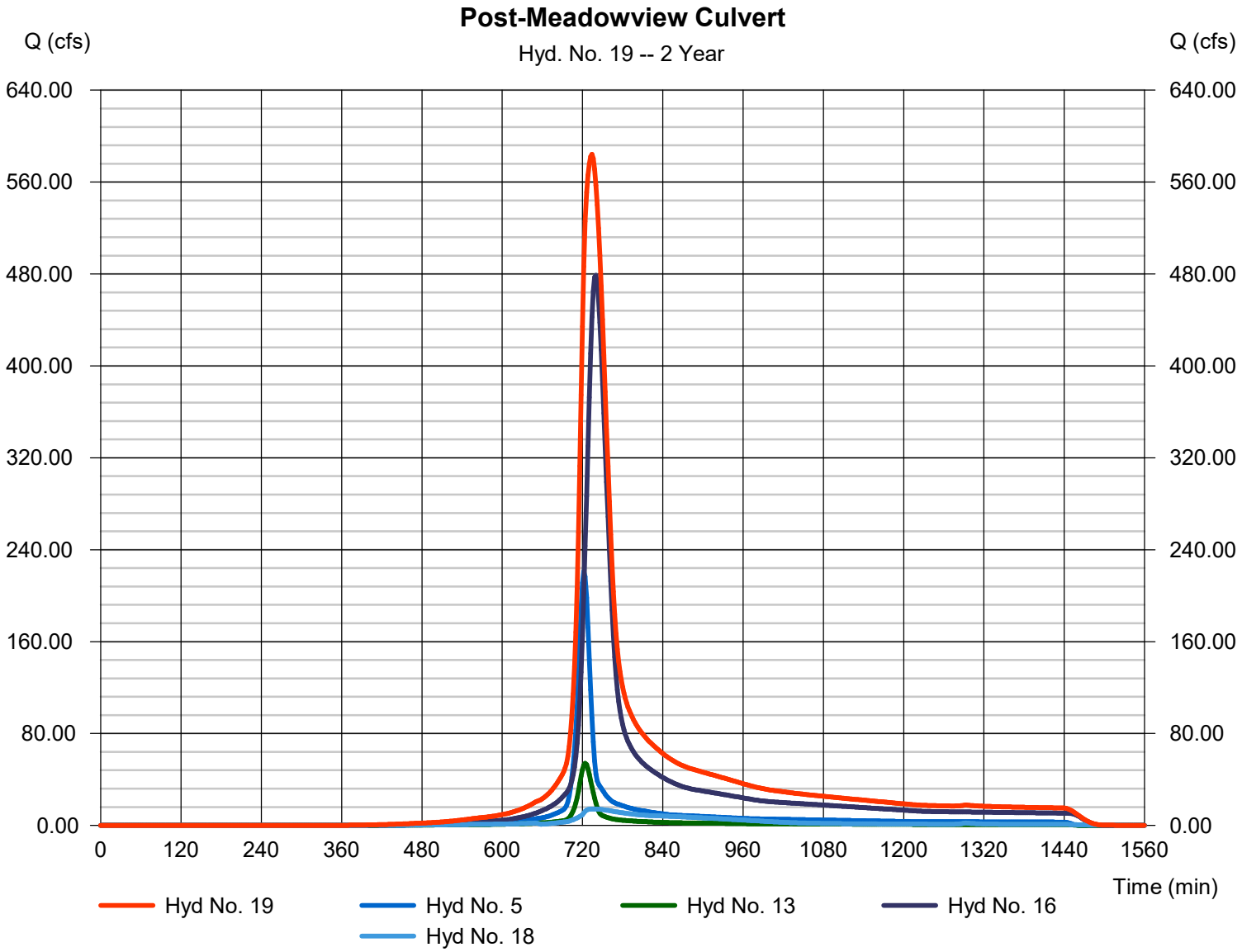


Hydrograph Report

Hyd. No. 19

Post-Meadowview Culvert

Hydrograph type	=	Combine	Peak discharge	=	584.19 cfs
Storm frequency	=	2 yrs	Time to peak	=	734 min
Time interval	=	2 min	Hyd. volume	=	3,098,485 cuft
Inflow hyds.	=	5, 13, 16, 18	Contrib. drain. area	=	106.800 ac



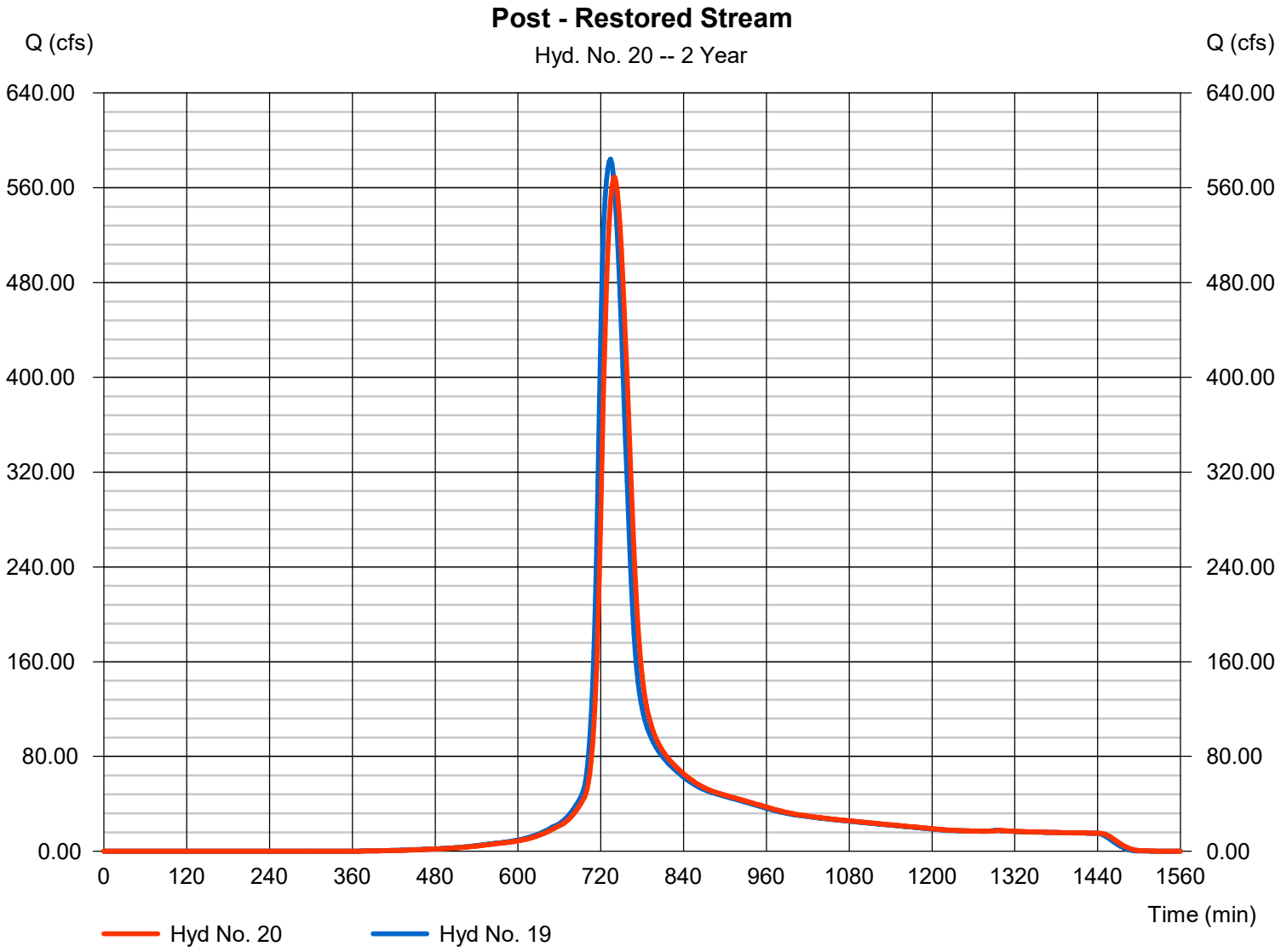
Hydrograph Report

Hyd. No. 20

Post - Restored Stream

Hydrograph type	=	Reach	Peak discharge	=	568.94 cfs
Storm frequency	=	2 yrs	Time to peak	=	740 min
Time interval	=	2 min	Hyd. volume	=	3,098,366 cuft
Inflow hyd. No.	=	19 - Post-Meadowview Culvert	Section type	=	Trapezoidal
Reach length	=	1340.0 ft	Channel slope	=	0.8 %
Manning's n	=	0.030	Bottom width	=	20.0 ft
Side slope	=	10.0:1	Max. depth	=	4.0 ft
Rating curve x	=	0.595	Rating curve m	=	1.345
Ave. velocity	=	0.00 ft/s	Routing coeff.	=	0.3470

Modified Att-Kin routing method used.



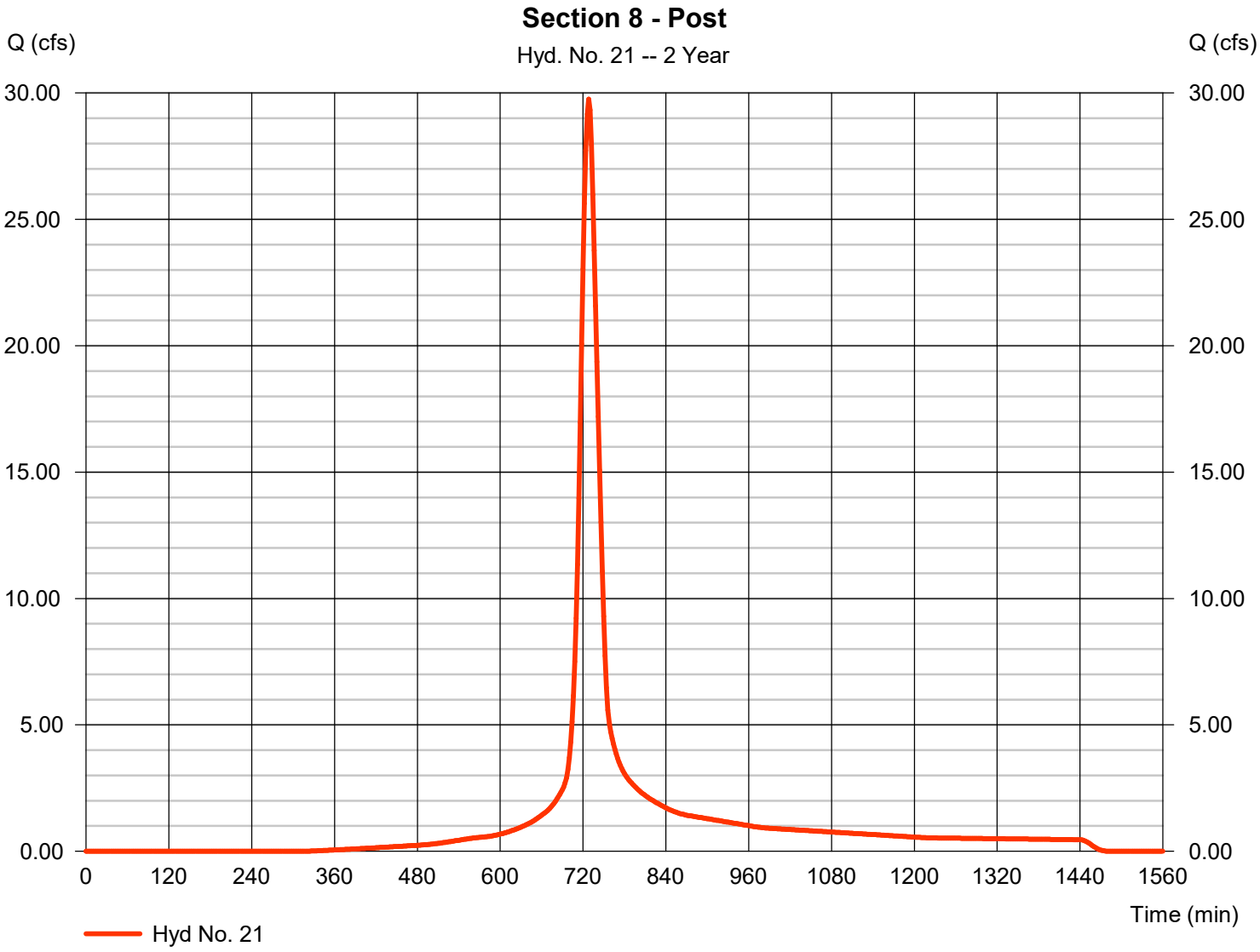
Hydrograph Report

Hyd. No. 21

Section 8 - Post

Hydrograph type	=	SCS Runoff	Peak discharge	=	29.76 cfs
Storm frequency	=	2 yrs	Time to peak	=	728 min
Time interval	=	2 min	Hyd. volume	=	110,215 cuft
Drainage area	=	12.600 ac	Curve number	=	90*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	23.90 min
Total precip.	=	3.50 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(12.600 x 90)] / 12.600

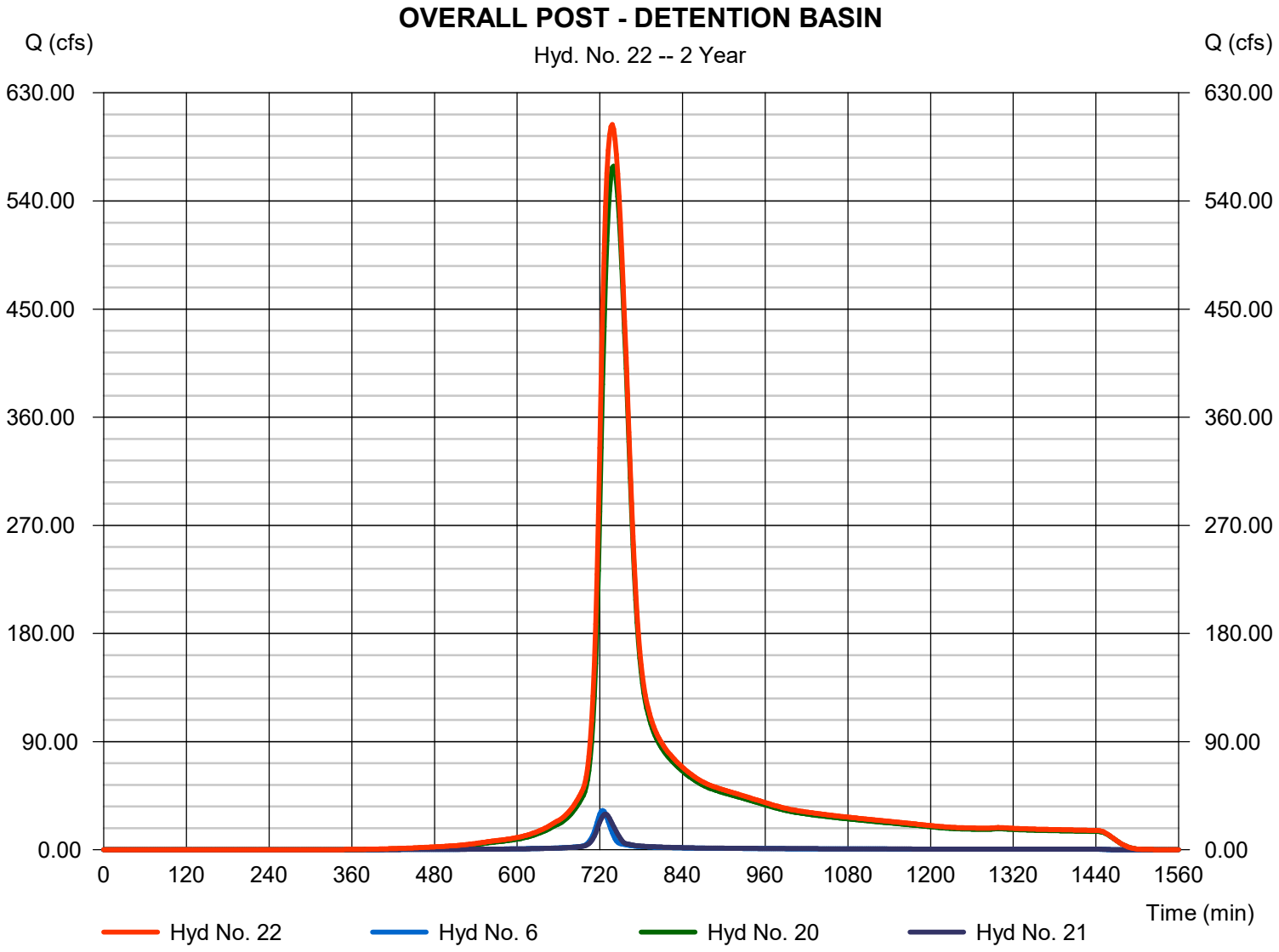


Hydrograph Report

Hyd. No. 22

OVERALL POST - DETENTION BASIN

Hydrograph type	= Combine	Peak discharge	= 603.51 cfs
Storm frequency	= 2 yrs	Time to peak	= 738 min
Time interval	= 2 min	Hyd. volume	= 3,312,815 cuft
Inflow hyds.	= 6, 20, 21	Contrib. drain. area	= 23.900 ac



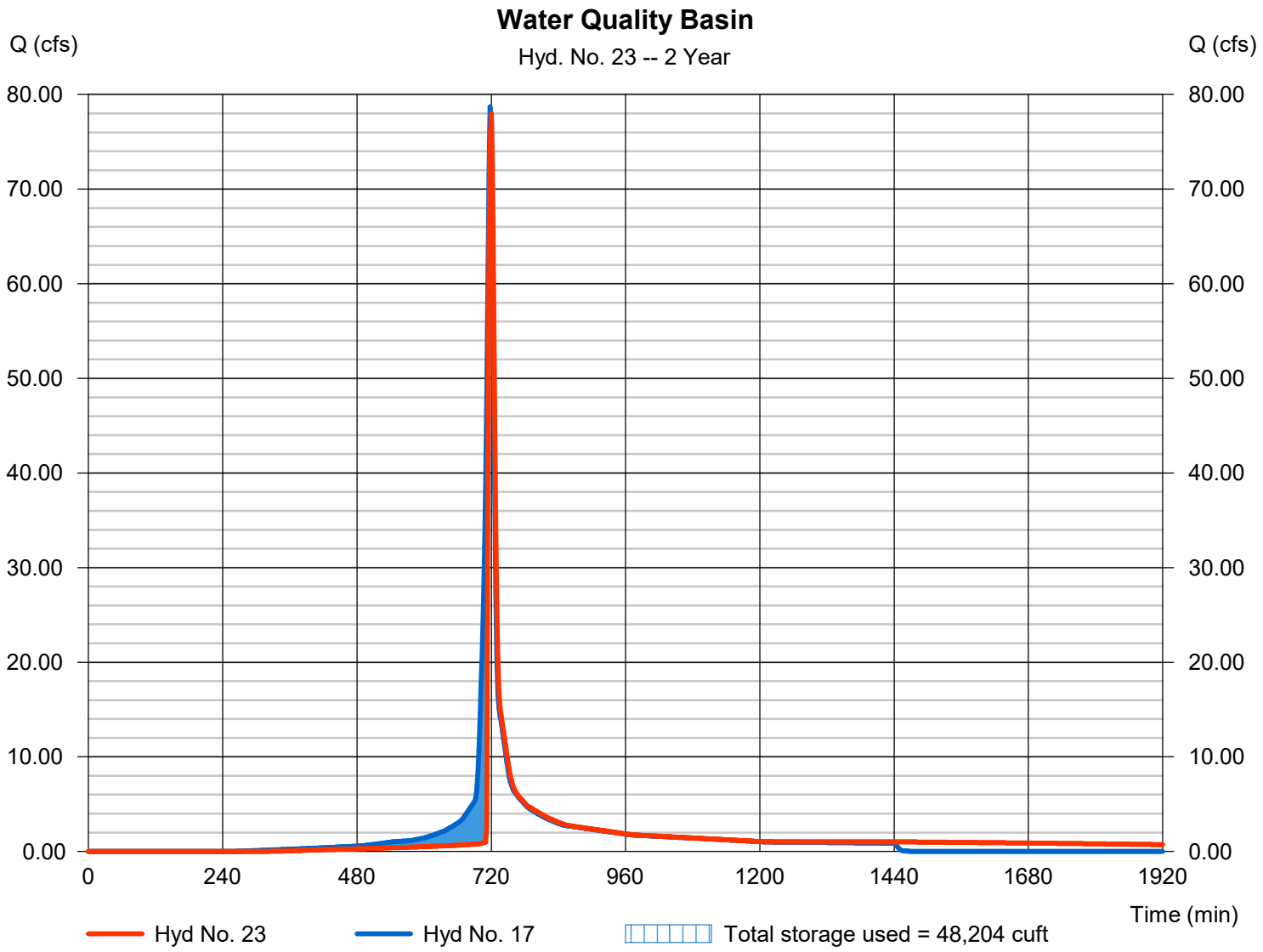
Hydrograph Report

Hyd. No. 23

Water Quality Basin

Hydrograph type	=	Reservoir	Peak discharge	=	77.99 cfs
Storm frequency	=	2 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	202,680 cuft
Inflow hyd. No.	=	17 - Onsite Water	Max. Elevation	=	918.72 ft
Reservoir name	=	Water Quality Basin	Max. Storage	=	48,204 cuft

Storage Indication method used.



Pond Report

Pond No. 2 - Water Quality Basin

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 912.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	912.00	3,000	0	0
1.00	913.00	4,000	3,488	3,488
2.00	914.00	5,000	4,490	7,978
3.00	915.00	7,000	5,971	13,949
4.00	916.00	8,000	7,494	21,443
5.00	917.00	9,000	8,494	29,937
6.00	918.00	11,000	9,982	39,920
7.00	919.00	12,000	11,495	51,415
8.00	920.00	14,000	12,986	64,401

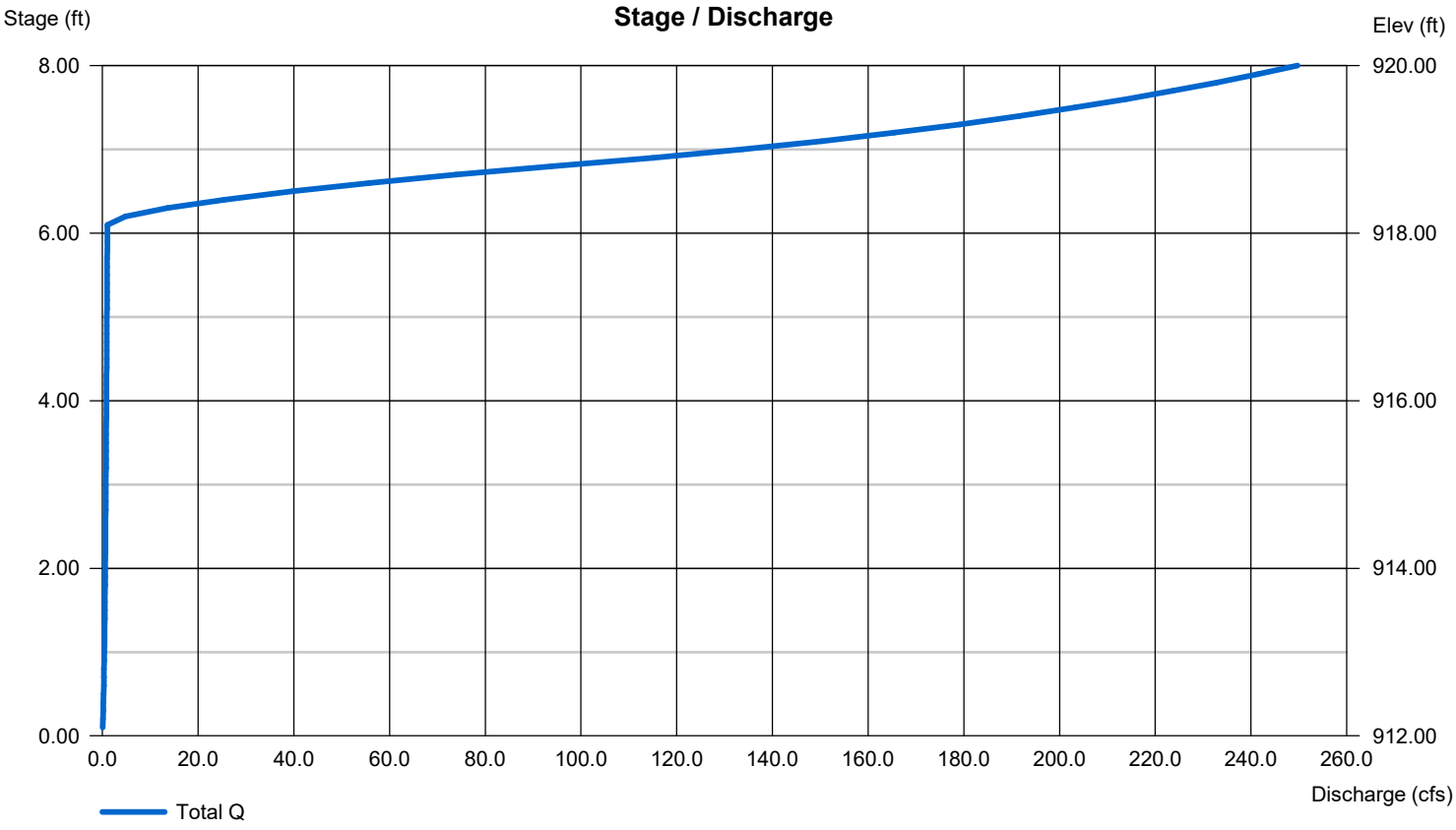
Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 72.00	4.00	Inactive	0.00
Span (in)	= 72.00	4.00	0.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 911.80	912.00	0.00	0.00
Length (ft)	= 42.80	0.00	0.00	0.00
Slope (%)	= 0.20	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	Yes	Yes	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 50.00	Inactive	Inactive	0.00
Crest El. (ft)	= 918.12	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	Rect	Rect	---
Multi-Stage	= Yes	Yes	Yes	No
Exfil.(in/hr)	= 0.000 (by Wet area)			
TW Elev. (ft)	= 0.00			

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

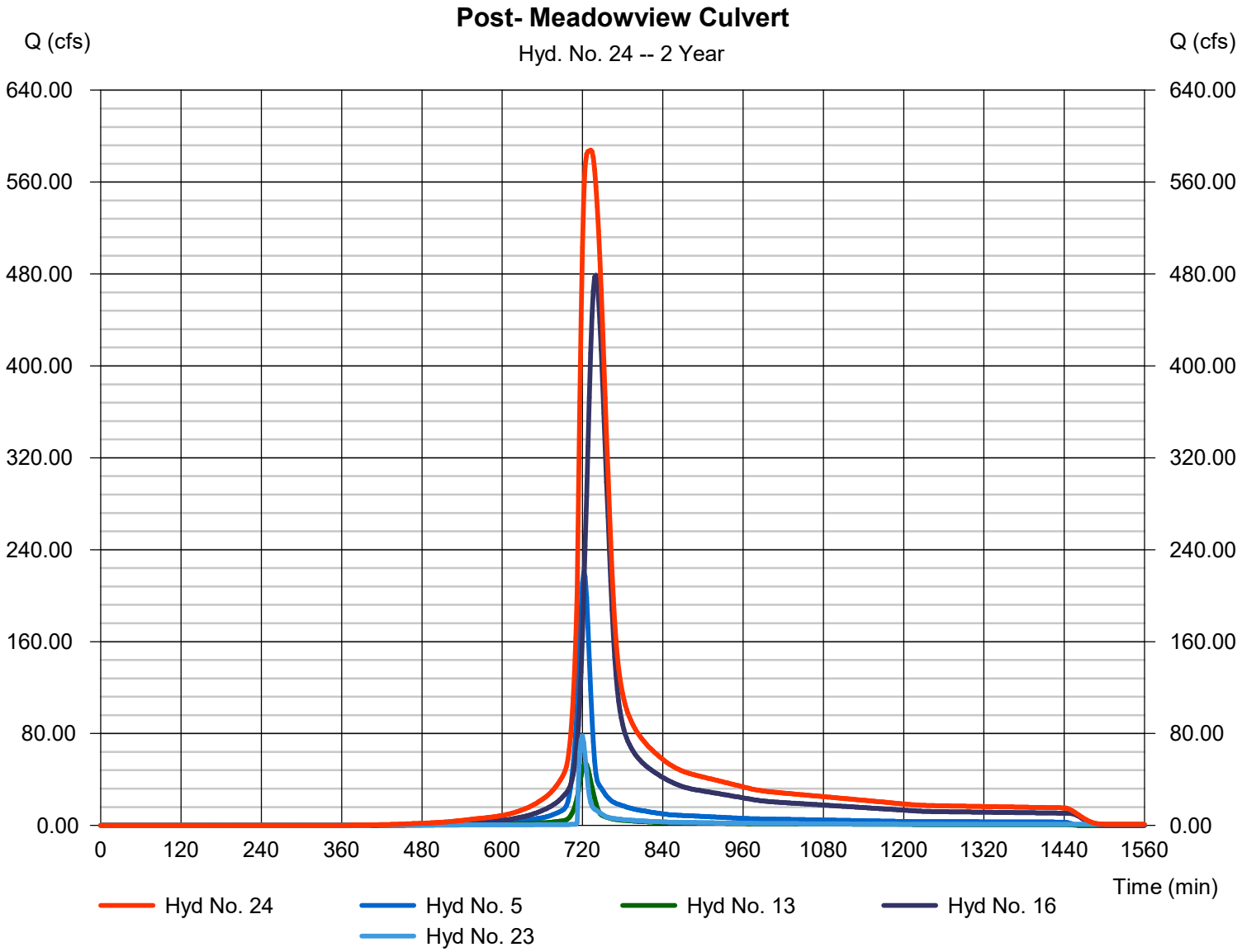


Hydrograph Report

Hyd. No. 24

Post- Meadowview Culvert

Hydrograph type	= Combine	Peak discharge	= 587.83 cfs
Storm frequency	= 2 yrs	Time to peak	= 732 min
Time interval	= 2 min	Hyd. volume	= 3,098,483 cuft
Inflow hyds.	= 5, 13, 16, 23	Contrib. drain. area	= 106.800 ac



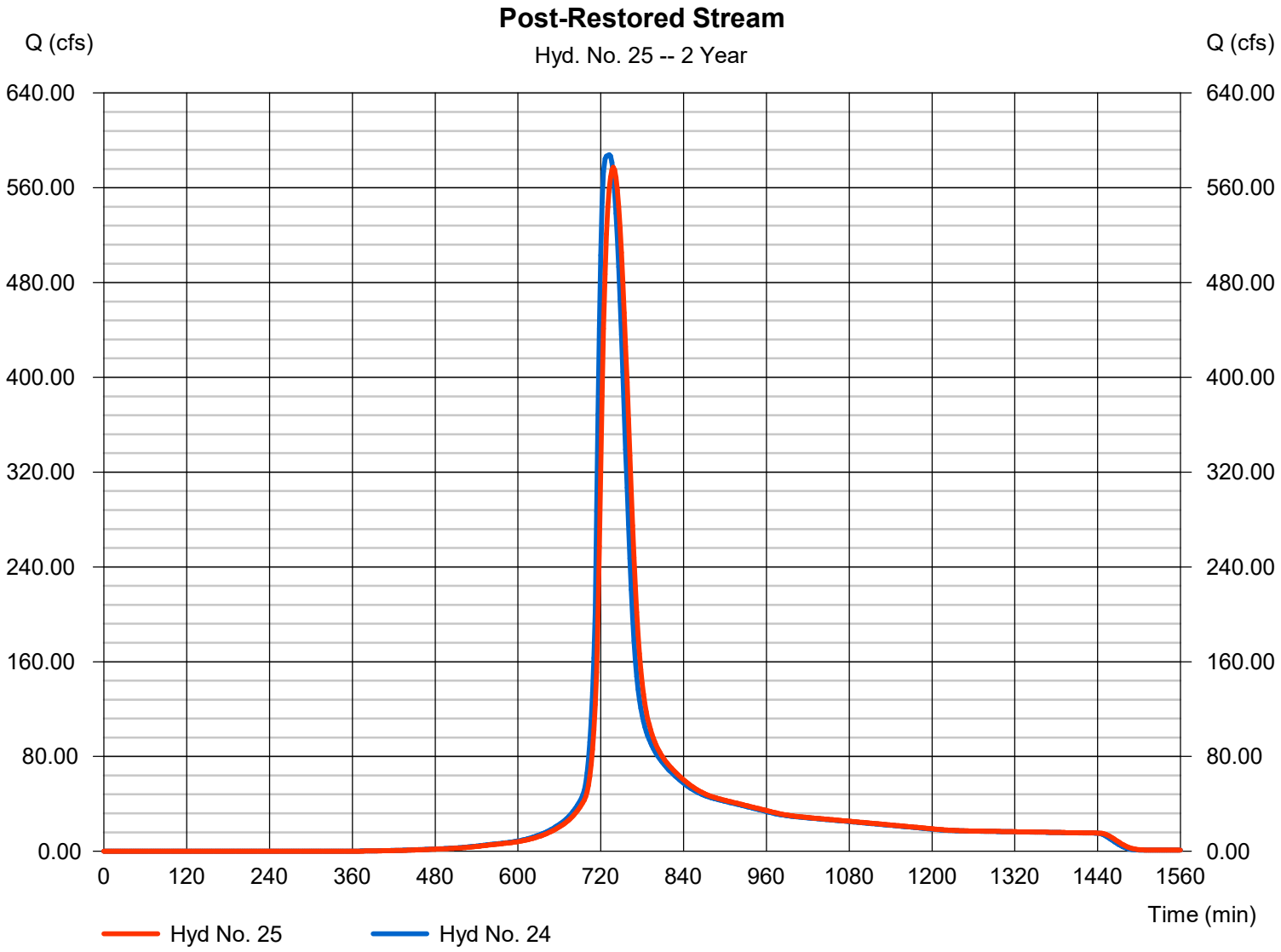
Hydrograph Report

Hyd. No. 25

Post-Restored Stream

Hydrograph type	=	Reach	Peak discharge	=	577.29 cfs
Storm frequency	=	2 yrs	Time to peak	=	738 min
Time interval	=	2 min	Hyd. volume	=	3,098,350 cuft
Inflow hyd. No.	=	24 - Post- Meadowview Culvert	Section type	=	Trapezoidal
Reach length	=	1340.0 ft	Channel slope	=	0.8 %
Manning's n	=	0.030	Bottom width	=	20.0 ft
Side slope	=	10.0:1	Max. depth	=	4.0 ft
Rating curve x	=	0.595	Rating curve m	=	1.345
Ave. velocity	=	0.00 ft/s	Routing coeff.	=	0.3475

Modified Att-Kin routing method used.

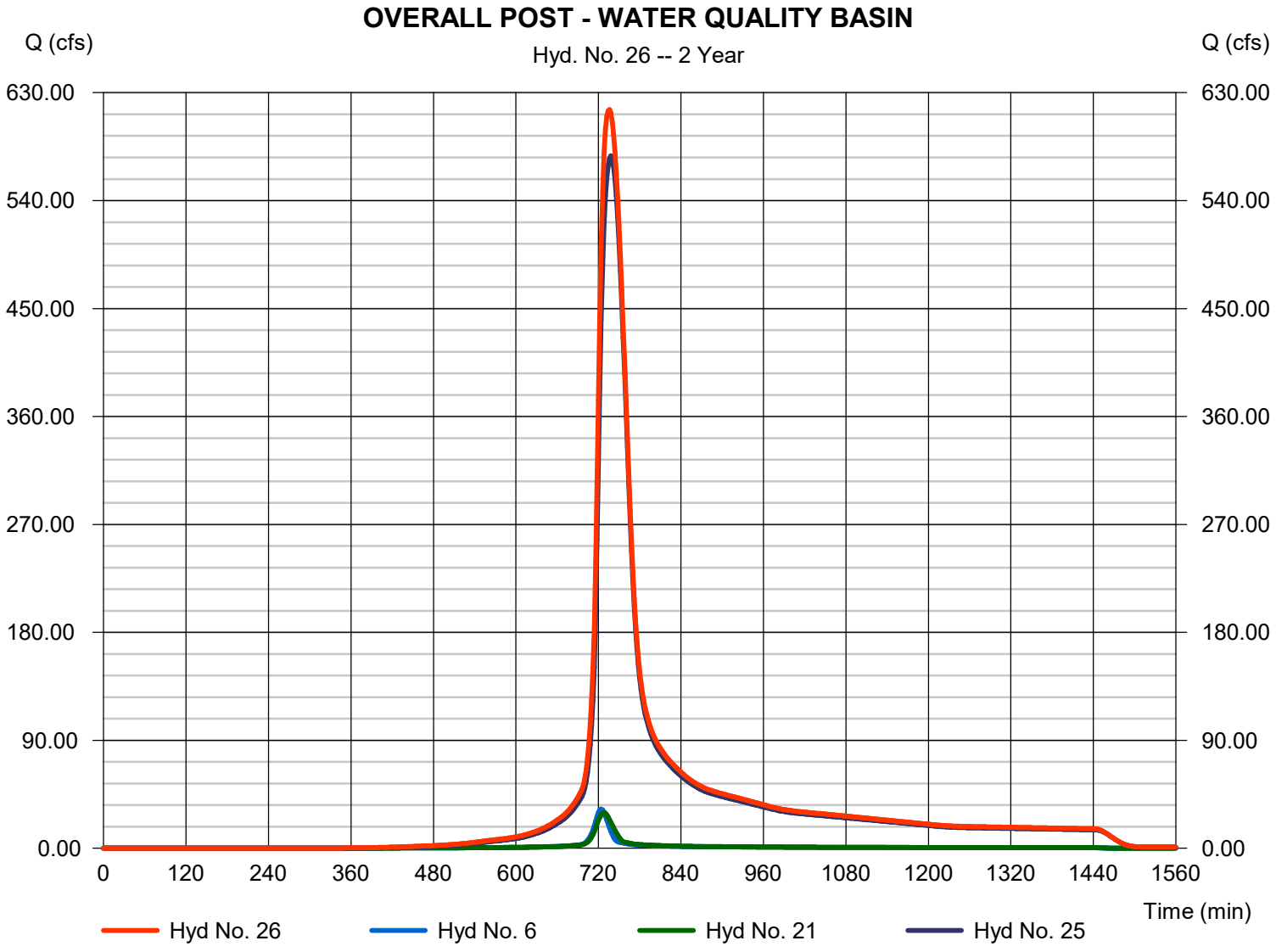


Hydrograph Report

Hyd. No. 26

OVERALL POST - WATER QUALITY BASIN

Hydrograph type	= Combine	Peak discharge	= 615.93 cfs
Storm frequency	= 2 yrs	Time to peak	= 736 min
Time interval	= 2 min	Hyd. volume	= 3,312,799 cuft
Inflow hyds.	= 6, 21, 25	Contrib. drain. area	= 23.900 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

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	228.55	2	728	839,577	------	------	------	Section 1
2	SCS Runoff	190.22	2	728	698,792	------	------	------	Section 2
3	SCS Runoff	306.37	2	730	1,225,319	------	------	------	Section 3
4	SCS Runoff	273.45	2	732	1,199,107	------	------	------	Section 4
5	SCS Runoff	394.04	2	722	1,121,472	------	------	------	Section 5
6	SCS Runoff	53.70	2	724	175,306	------	------	------	Section 6
7	SCS Runoff	227.73	2	728	855,894	------	------	------	Section 7/8-Pre
8	Combine	722.19	2	730	2,763,687	1, 2, 3,	------	------	Industrial Complex to Detention
9	Reach	695.55	2	734	2,763,686	8	------	------	Industrial Above Ground Detention Po
10	Combine	966.72	2	734	3,962,792	4, 9	------	------	Strother Road Culvert
11	Reach	915.90	2	738	3,962,789	10	------	------	Wilshire Box Culvert/ Preserved Strea
12	Combine	1263.54	2	732	6,115,463	5, 6, 7, 11	------	------	OVERALL PRE
13	SCS Runoff	91.08	2	724	293,265	------	------	------	Section 7A-Post
14	SCS Runoff	14.26	2	728	51,439	------	------	------	Section 7B-Post (Wilshire Hills Bypas
15	SCS Runoff	122.92	2	718	302,271	------	------	------	Section 7C-Post (Wilshire Hills)
16	Reach	933.75	2	738	3,962,789	10	------	------	Wilshire Box Culvert/ Preserved strea
17	Combine	131.81	2	718	353,710	14, 15,	------	------	Onsite Water
18	Reservoir	41.88	2	730	353,697	17	919.44	127,270	APWA Detention Basin
19	Combine	1153.86	2	732	5,731,216	5, 13, 16, 18	------	------	Post-Meadowview Culvert
20	Reach	1130.19	2	738	5,731,108	19	------	------	Post - Restored Stream
21	SCS Runoff	49.61	2	728	187,574	------	------	------	Section 8 - Post
22	Combine	1193.11	2	736	6,093,989	6, 20, 21	------	------	OVERALL POST - DETENTION BASI
23	Reservoir	130.58	2	720	353,695	17	918.98	51,224	Water Quality Basin
24	Combine	1148.50	2	732	5,731,216	5, 13, 16, 23	------	------	Post- Meadowview Culvert
25	Reach	1131.54	2	736	5,731,092	24	------	------	Post-Restored Stream
26	Combine	1199.85	2	734	6,093,977	6, 21, 25	------	------	OVERALL POST - WATER QUALITY

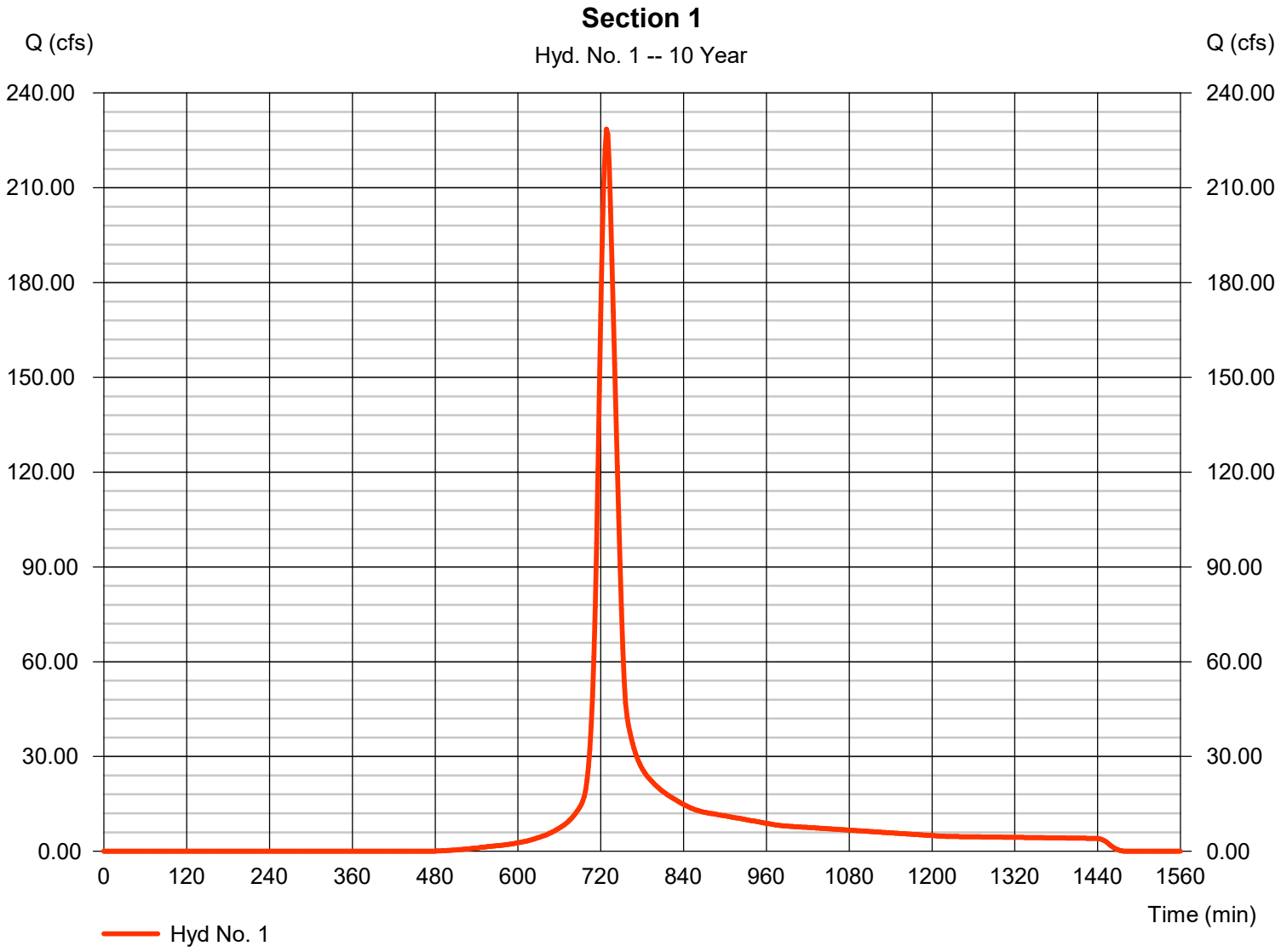
Hydrograph Report

Hyd. No. 1

Section 1

Hydrograph type	=	SCS Runoff	Peak discharge	=	228.55 cfs
Storm frequency	=	10 yrs	Time to peak	=	728 min
Time interval	=	2 min	Hyd. volume	=	839,577 cuft
Drainage area	=	81.700 ac	Curve number	=	77*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	24.30 min
Total precip.	=	5.30 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(3.600 x 81) + (13.500 x 98) + (49.000 x 73) + (15.600 x 69)] / 81.700



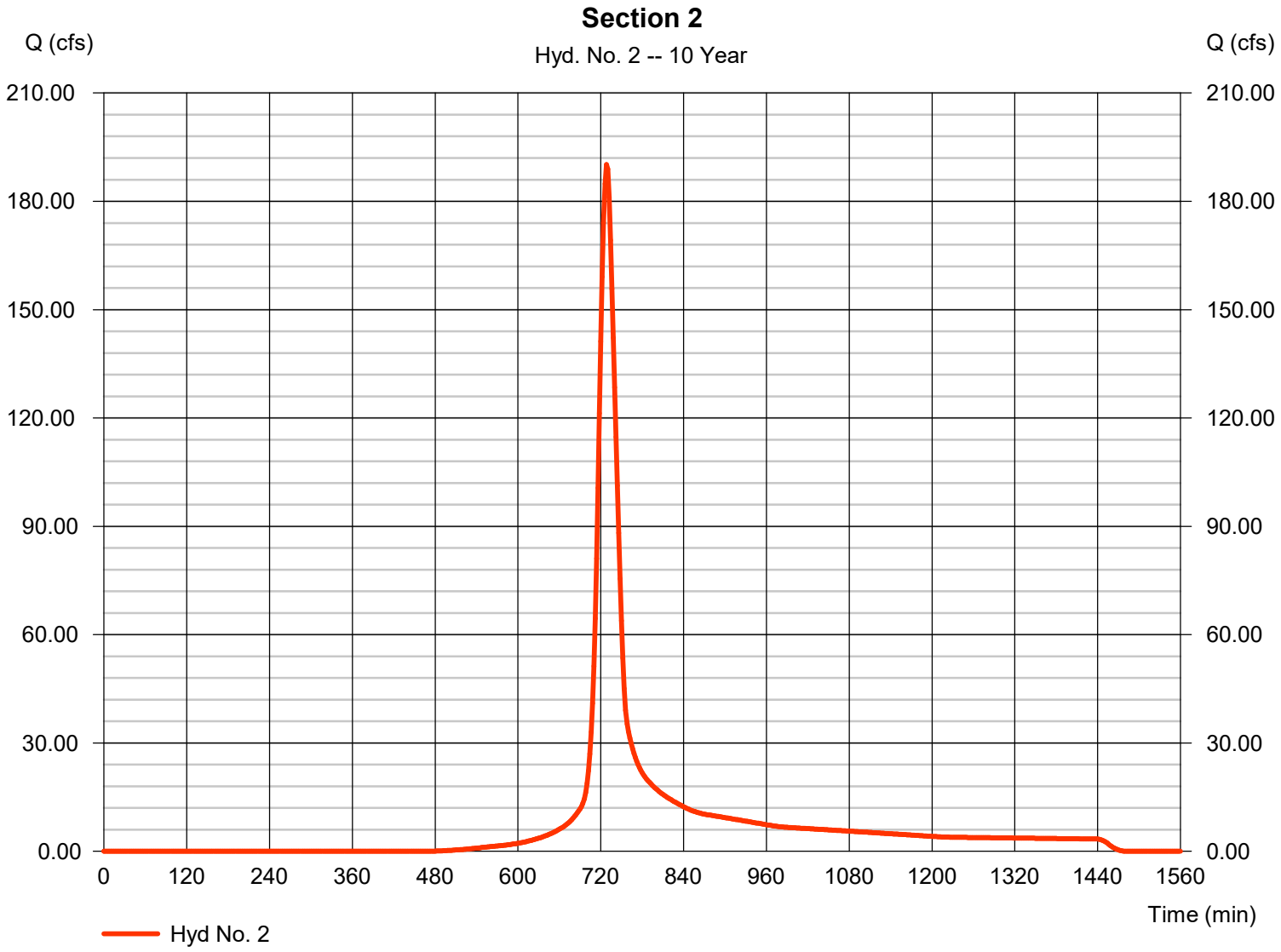
Hydrograph Report

Hyd. No. 2

Section 2

Hydrograph type	=	SCS Runoff	Peak discharge	=	190.22 cfs
Storm frequency	=	10 yrs	Time to peak	=	728 min
Time interval	=	2 min	Hyd. volume	=	698,792 cuft
Drainage area	=	68.000 ac	Curve number	=	77*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	25.30 min
Total precip.	=	5.30 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(8.000 x 98) + (0.500 x 77) + (30.800 x 79) + (28.700 x 69)] / 68.000



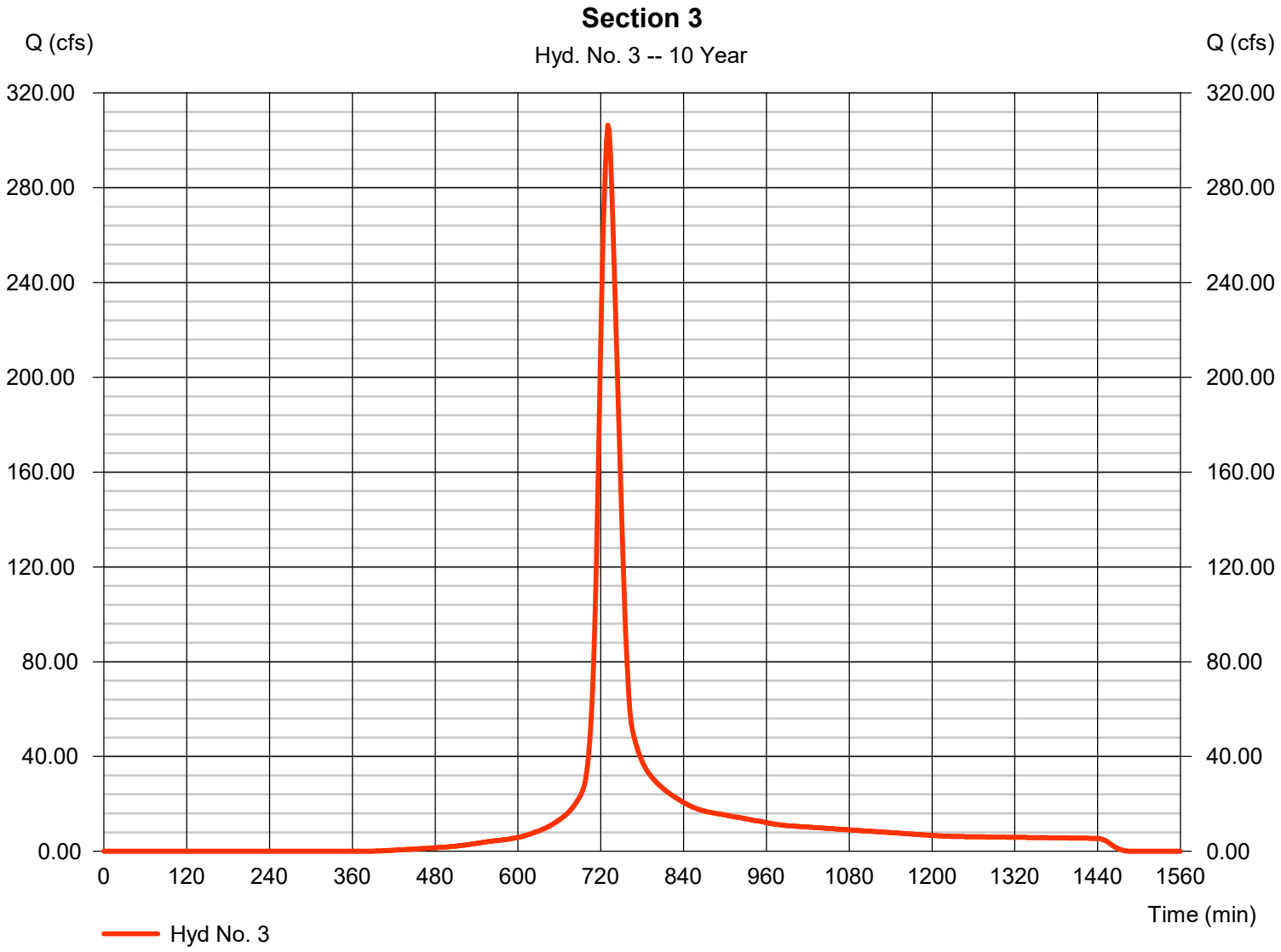
Hydrograph Report

Hyd. No. 3

Section 3

Hydrograph type	=	SCS Runoff	Peak discharge	=	306.37 cfs
Storm frequency	=	10 yrs	Time to peak	=	730 min
Time interval	=	2 min	Hyd. volume	=	1,225,319 cuft
Drainage area	=	100.800 ac	Curve number	=	82*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	30.20 min
Total precip.	=	5.30 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(18.200 x 98) + (3.000 x 77) + (79.600 x 79)] / 100.800



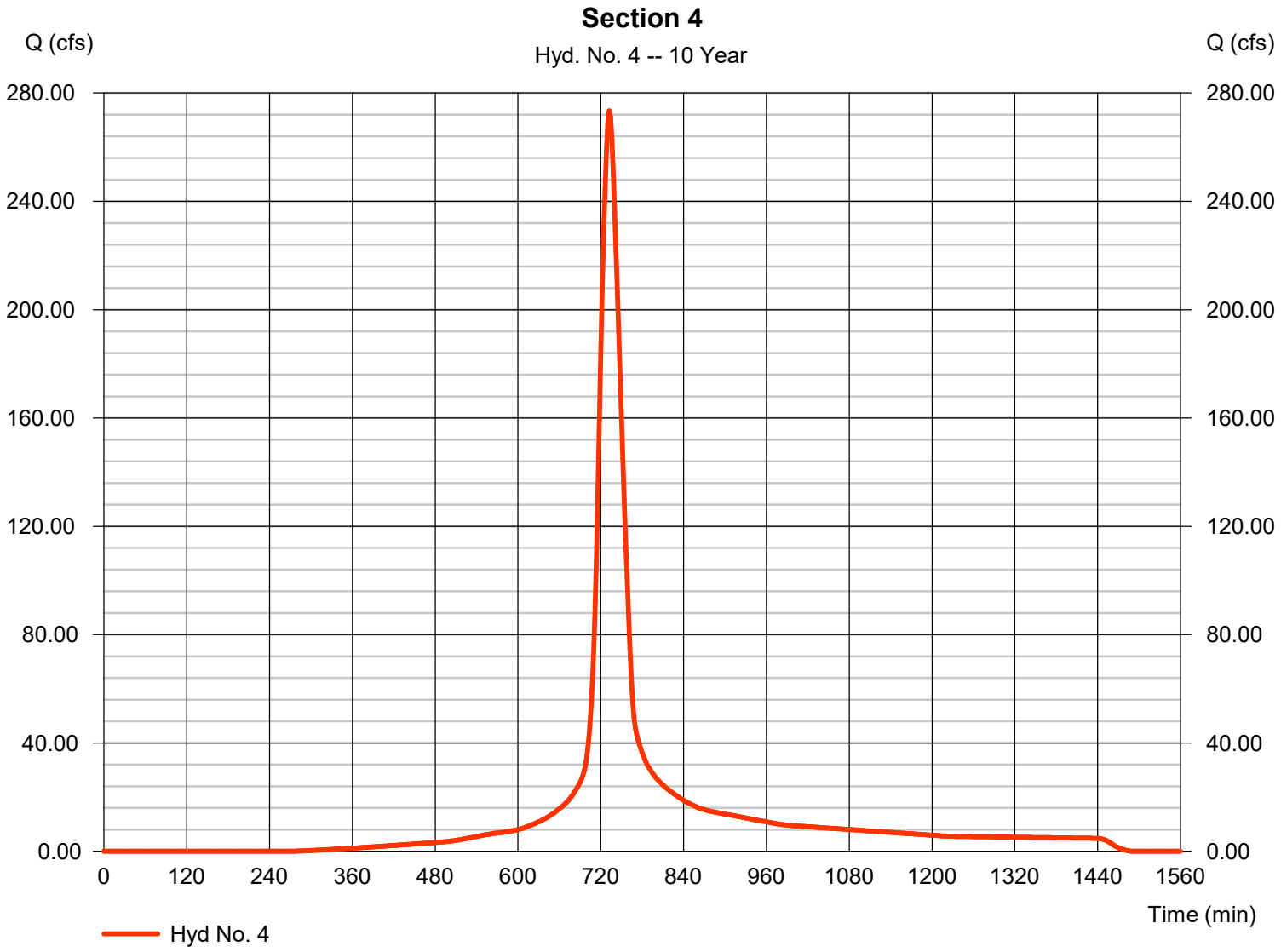
Hydrograph Report

Hyd. No. 4

Section 4

Hydrograph type	=	SCS Runoff	Peak discharge	=	273.45 cfs
Storm frequency	=	10 yrs	Time to peak	=	732 min
Time interval	=	2 min	Hyd. volume	=	1,199,107 cuft
Drainage area	=	82.500 ac	Curve number	=	88*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	30.70 min
Total precip.	=	5.30 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(49.680 x 98) + (32.820 x 74)] / 82.500



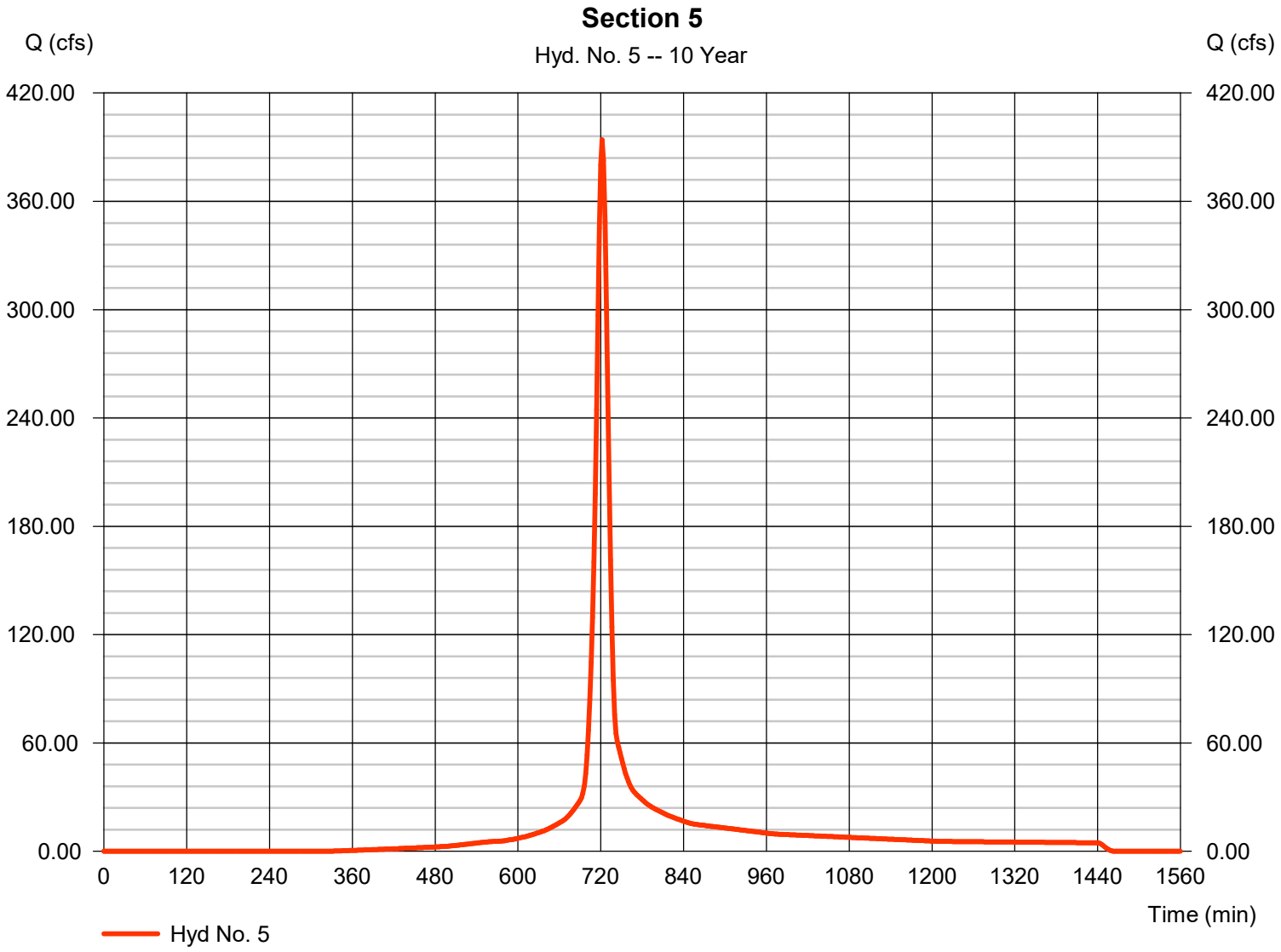
Hydrograph Report

Hyd. No. 5

Section 5

Hydrograph type	=	SCS Runoff	Peak discharge	=	394.04 cfs
Storm frequency	=	10 yrs	Time to peak	=	722 min
Time interval	=	2 min	Hyd. volume	=	1,121,472 cuft
Drainage area	=	86.900 ac	Curve number	=	85*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	15.60 min
Total precip.	=	5.30 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(40.000 x 98) + (46.900 x 74)] / 86.900



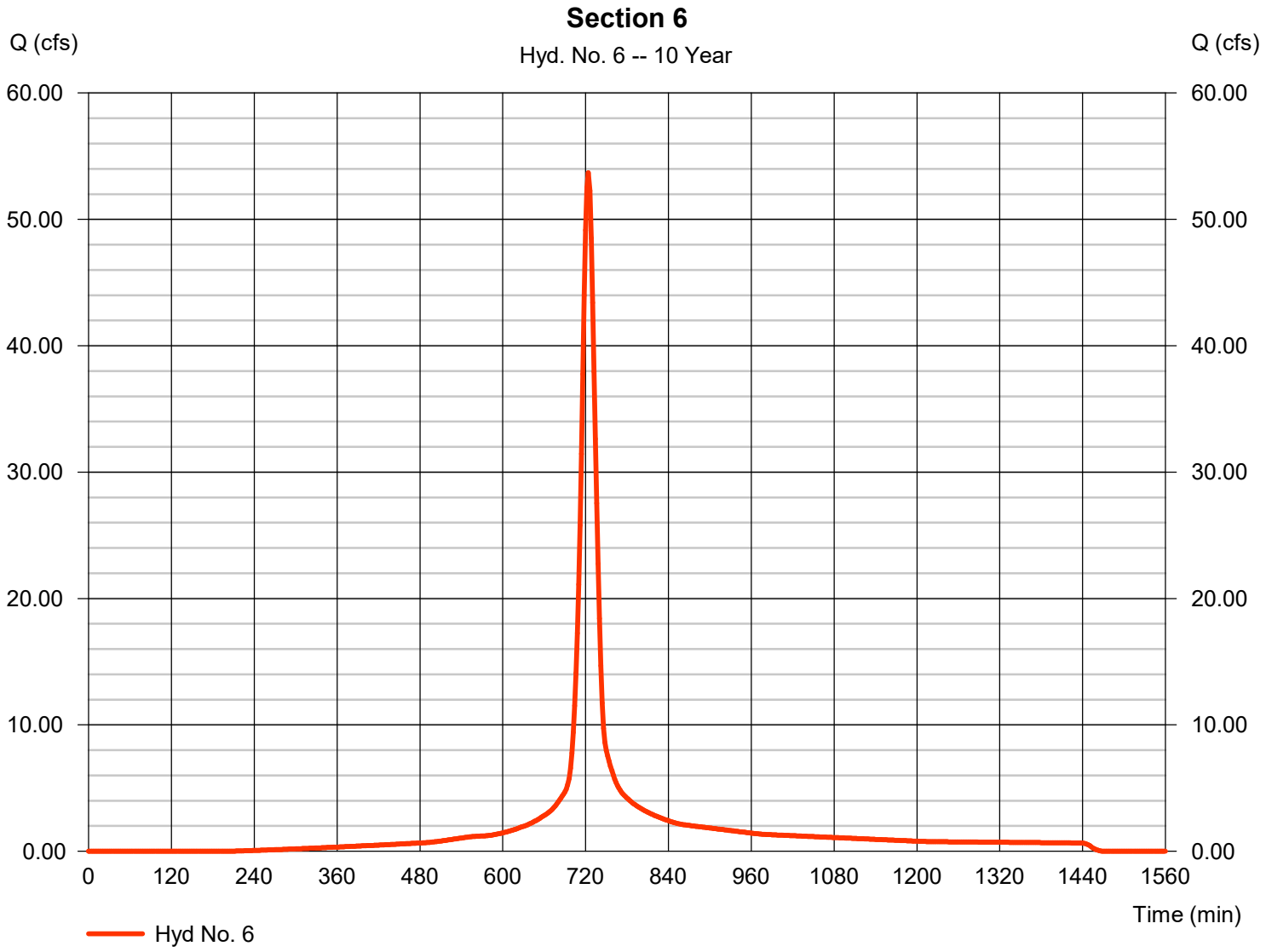
Hydrograph Report

Hyd. No. 6

Section 6

Hydrograph type	=	SCS Runoff	Peak discharge	=	53.70 cfs
Storm frequency	=	10 yrs	Time to peak	=	724 min
Time interval	=	2 min	Hyd. volume	=	175,306 cuft
Drainage area	=	11.300 ac	Curve number	=	91*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	18.60 min
Total precip.	=	5.30 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(11.300 x 91)] / 11.300



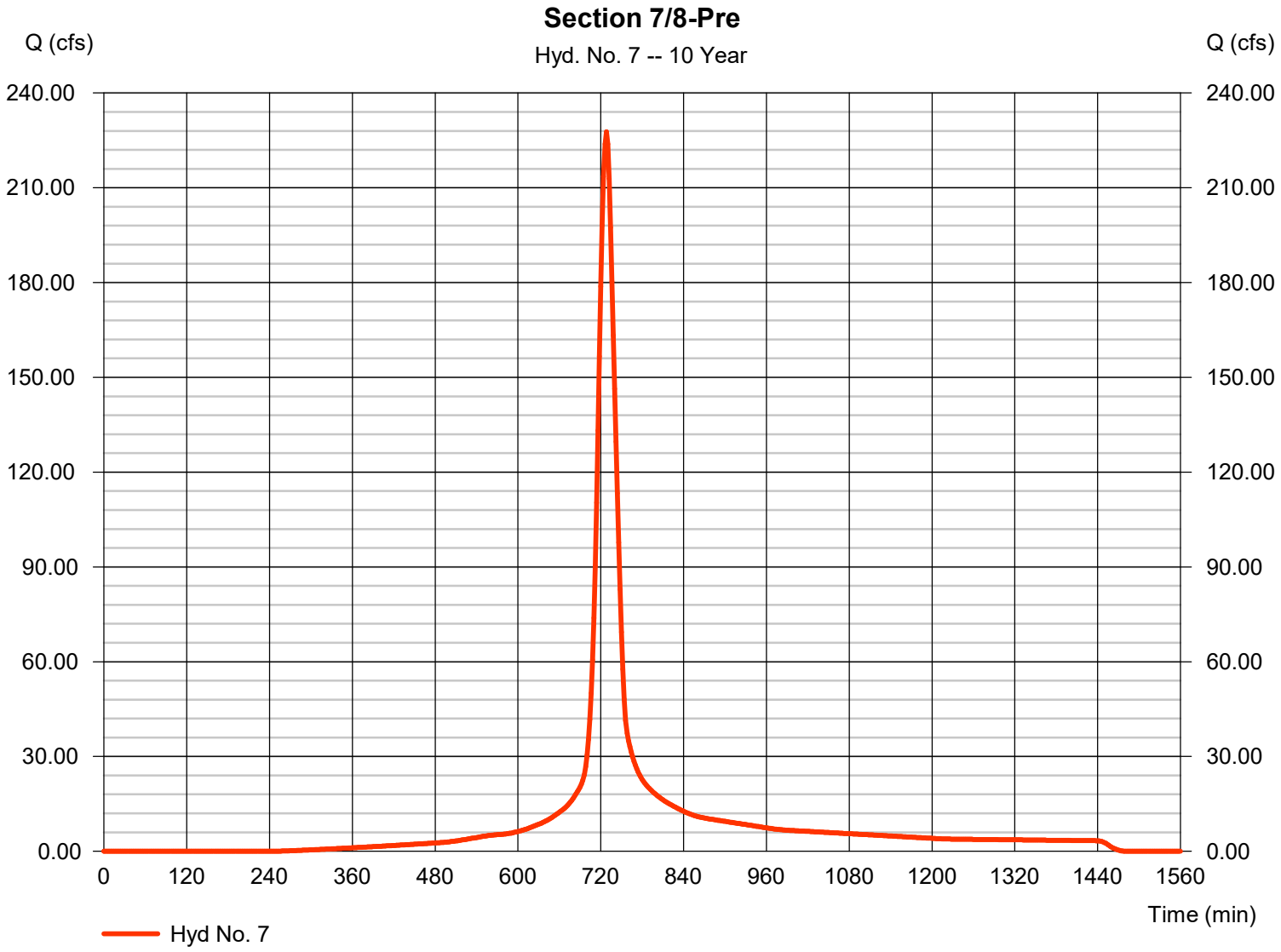
Hydrograph Report

Hyd. No. 7

Section 7/8-Pre

Hydrograph type	=	SCS Runoff	Peak discharge	=	227.73 cfs
Storm frequency	=	10 yrs	Time to peak	=	728 min
Time interval	=	2 min	Hyd. volume	=	855,894 cuft
Drainage area	=	59.000 ac	Curve number	=	89*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	23.90 min
Total precip.	=	5.30 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(59.000 x 79)] / 59.000

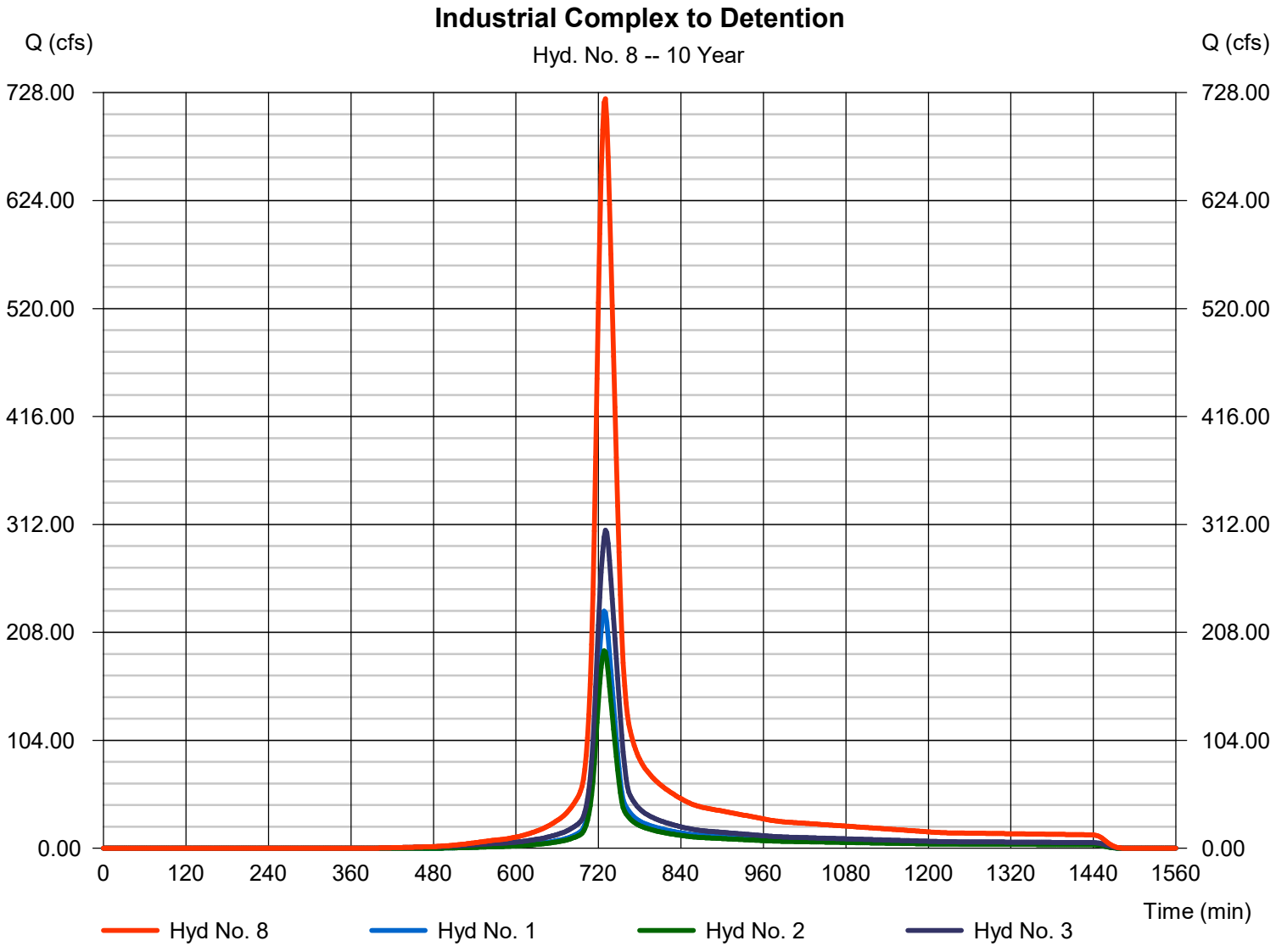


Hydrograph Report

Hyd. No. 8

Industrial Complex to Detention

Hydrograph type	=	Combine	Peak discharge	=	722.19 cfs
Storm frequency	=	10 yrs	Time to peak	=	730 min
Time interval	=	2 min	Hyd. volume	=	2,763,687 cuft
Inflow hyds.	=	1, 2, 3	Contrib. drain. area	=	250.500 ac



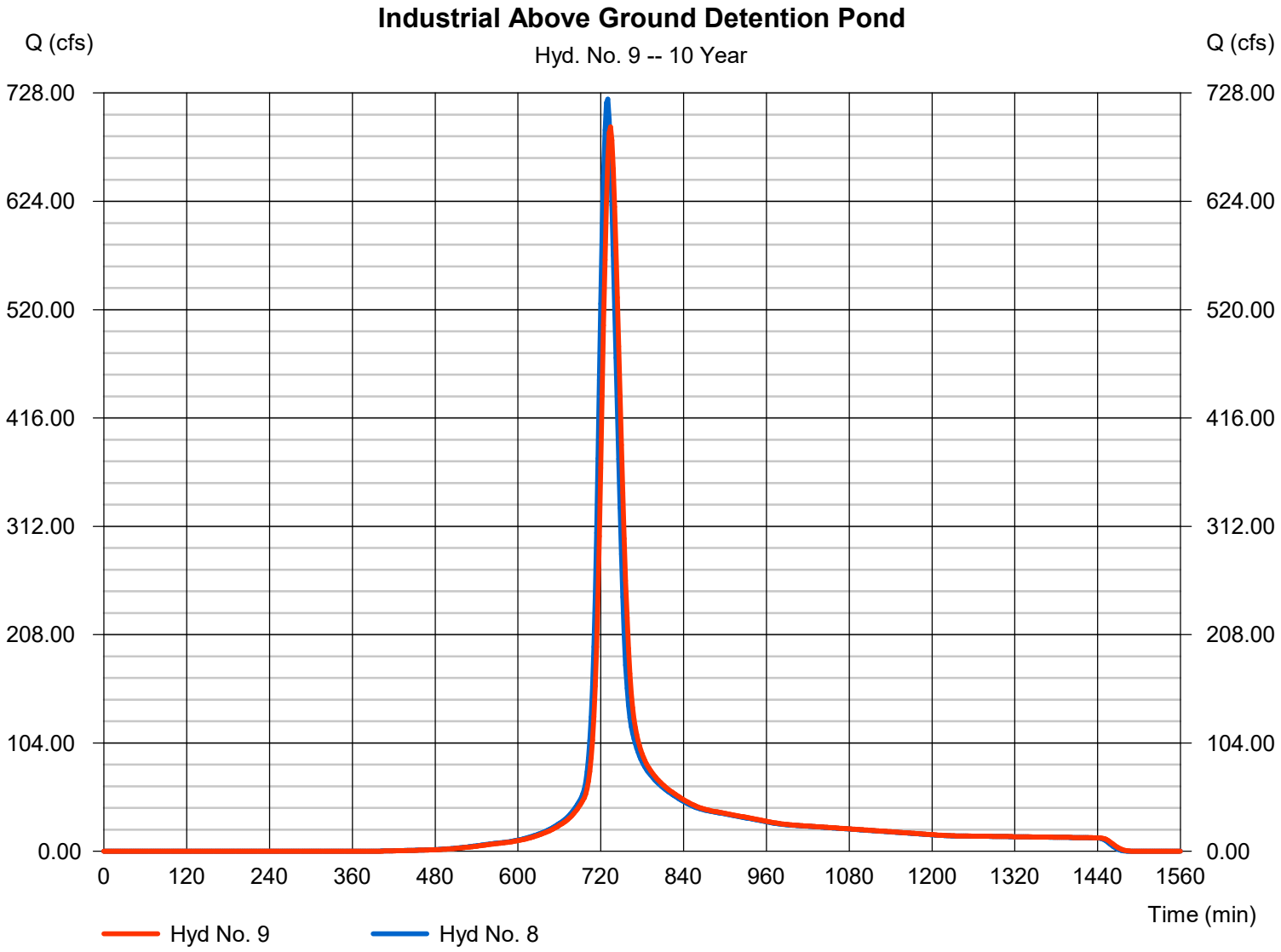
Hydrograph Report

Hyd. No. 9

Industrial Above Ground Detention Pond

Hydrograph type	=	Reach	Peak discharge	=	695.55 cfs
Storm frequency	=	10 yrs	Time to peak	=	734 min
Time interval	=	2 min	Hyd. volume	=	2,763,686 cuft
Inflow hyd. No.	=	8 - Industrial Complex to Detention	Section type	=	Trapezoidal
Reach length	=	1000.0 ft	Channel slope	=	2.0 %
Manning's n	=	0.020	Bottom width	=	150.0 ft
Side slope	=	30.0:1	Max. depth	=	16.0 ft
Rating curve x	=	0.373	Rating curve m	=	1.407
Ave. velocity	=	0.00 ft/s	Routing coeff.	=	0.4384

Modified Att-Kin routing method used.

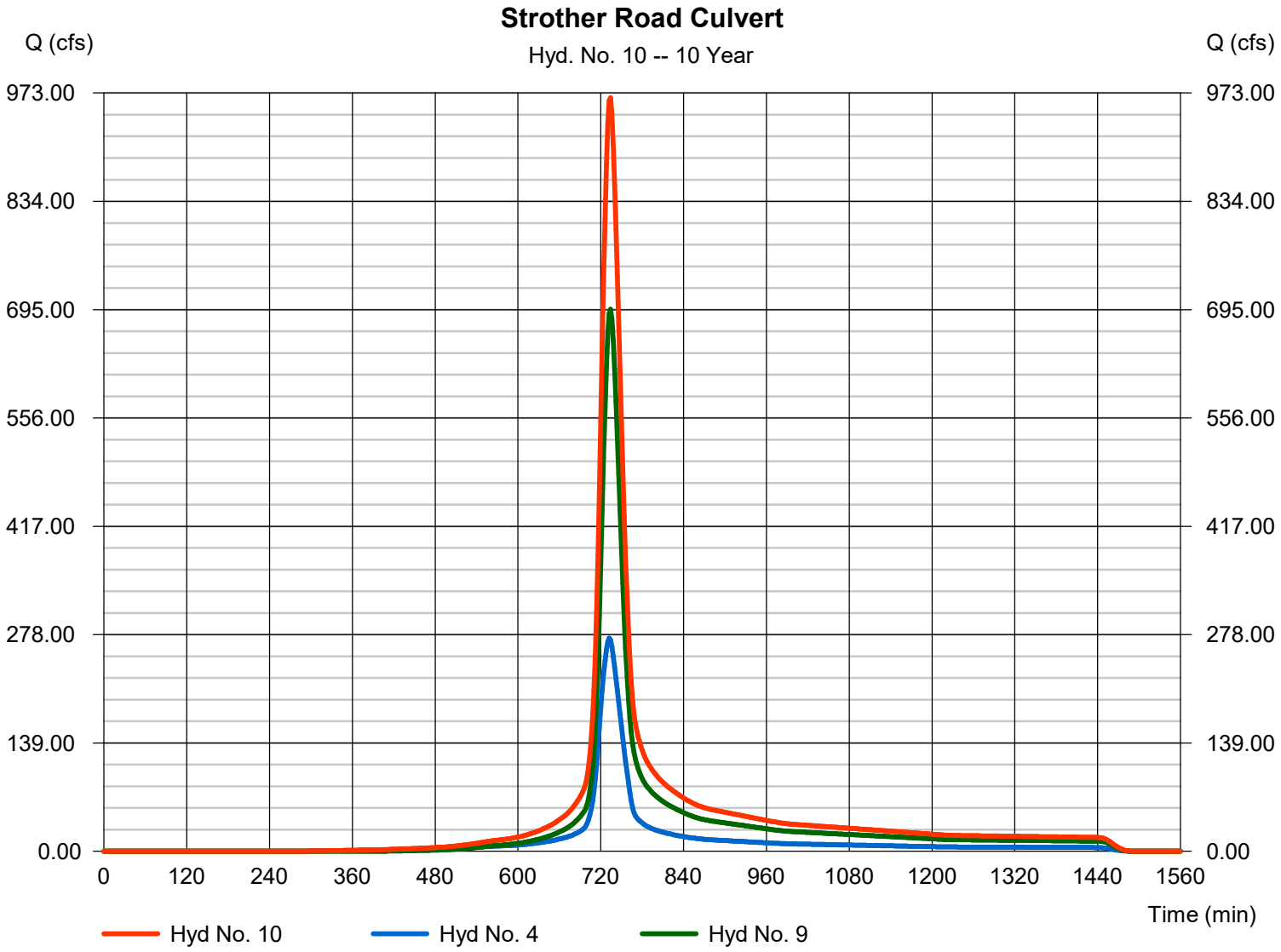


Hydrograph Report

Hyd. No. 10

Strother Road Culvert

Hydrograph type	= Combine	Peak discharge	= 966.72 cfs
Storm frequency	= 10 yrs	Time to peak	= 734 min
Time interval	= 2 min	Hyd. volume	= 3,962,792 cuft
Inflow hyds.	= 4, 9	Contrib. drain. area	= 82.500 ac



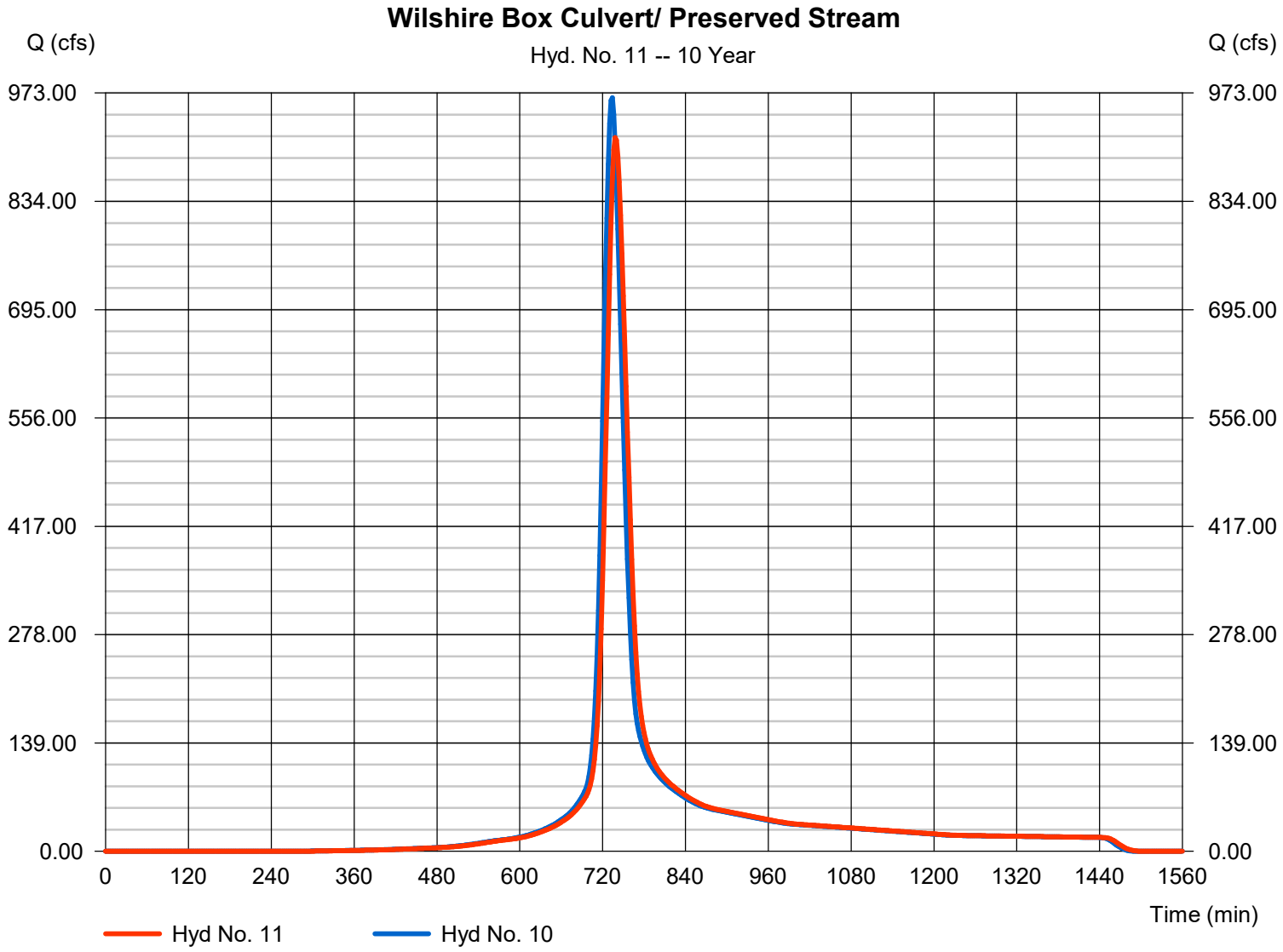
Hydrograph Report

Hyd. No. 11

Wilshire Box Culvert/ Preserved Stream

Hydrograph type	= Reach	Peak discharge	= 915.90 cfs
Storm frequency	= 10 yrs	Time to peak	= 738 min
Time interval	= 2 min	Hyd. volume	= 3,962,789 cuft
Inflow hyd. No.	= 10 - Strother Road Culvert	Section type	= Trapezoidal
Reach length	= 2200.0 ft	Channel slope	= 1.4 %
Manning's n	= 0.030	Bottom width	= 5.0 ft
Side slope	= 20.0:1	Max. depth	= 5.0 ft
Rating curve x	= 2.009	Rating curve m	= 1.231
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.3536

Modified Att-Kin routing method used.

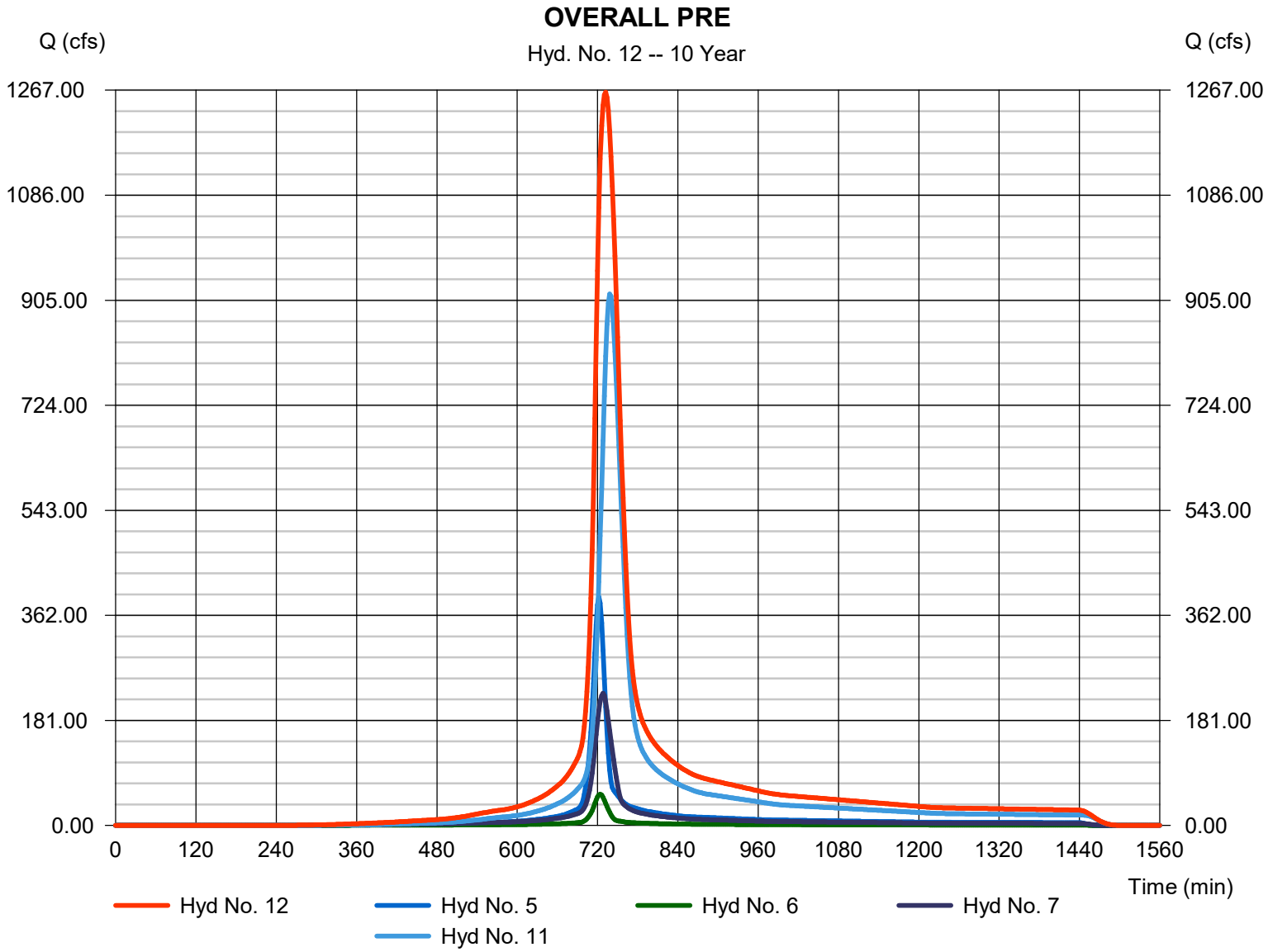


Hydrograph Report

Hyd. No. 12

OVERALL PRE

Hydrograph type	= Combine	Peak discharge	= 1263.54 cfs
Storm frequency	= 10 yrs	Time to peak	= 732 min
Time interval	= 2 min	Hyd. volume	= 6,115,463 cuft
Inflow hyds.	= 5, 6, 7, 11	Contrib. drain. area	= 157.200 ac



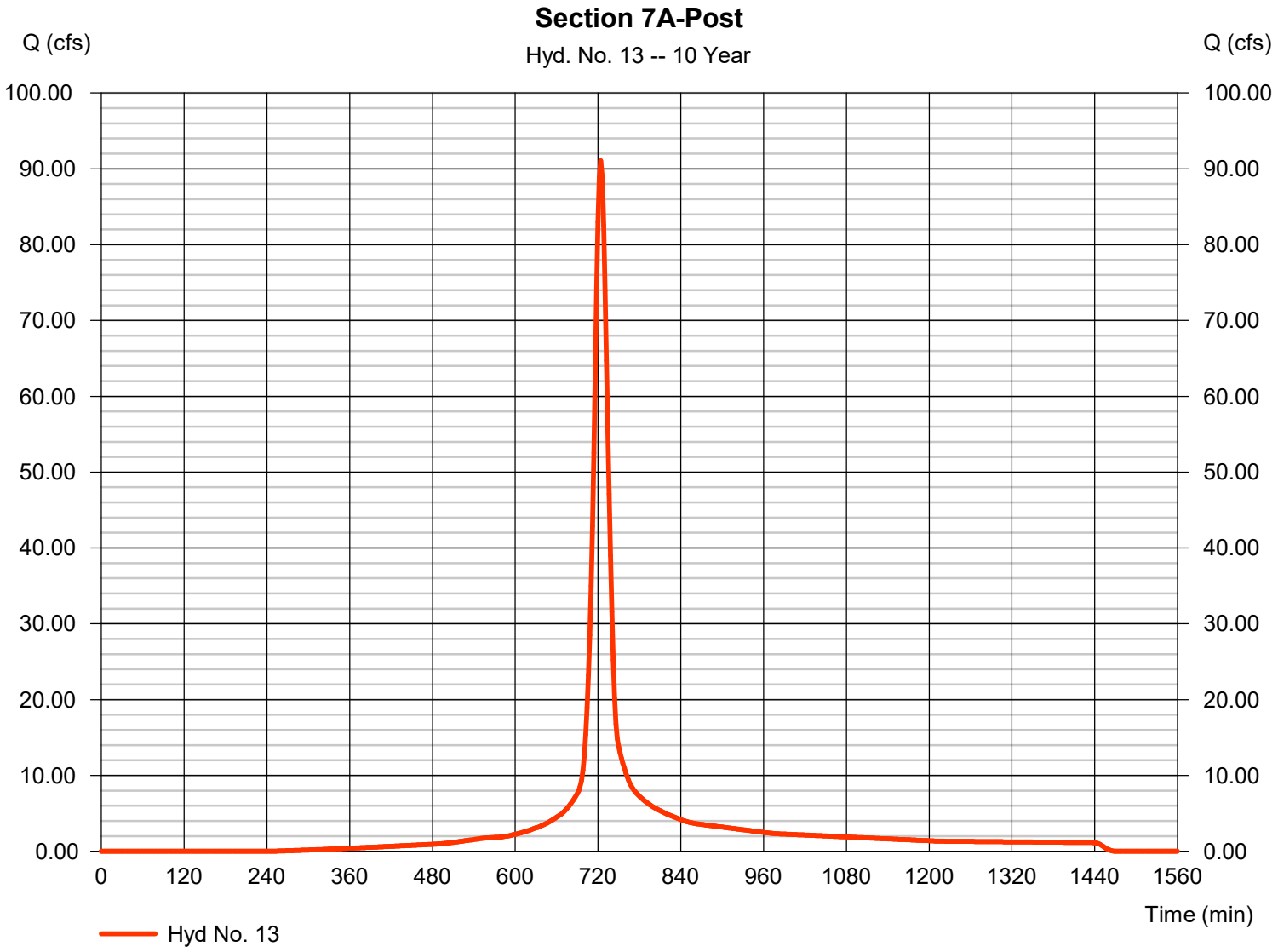
Hydrograph Report

Hyd. No. 13

Section 7A-Post

Hydrograph type	=	SCS Runoff	Peak discharge	=	91.08 cfs
Storm frequency	=	10 yrs	Time to peak	=	724 min
Time interval	=	2 min	Hyd. volume	=	293,265 cuft
Drainage area	=	19.900 ac	Curve number	=	89*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	19.30 min
Total precip.	=	5.30 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(19.900 x 89)] / 19.900



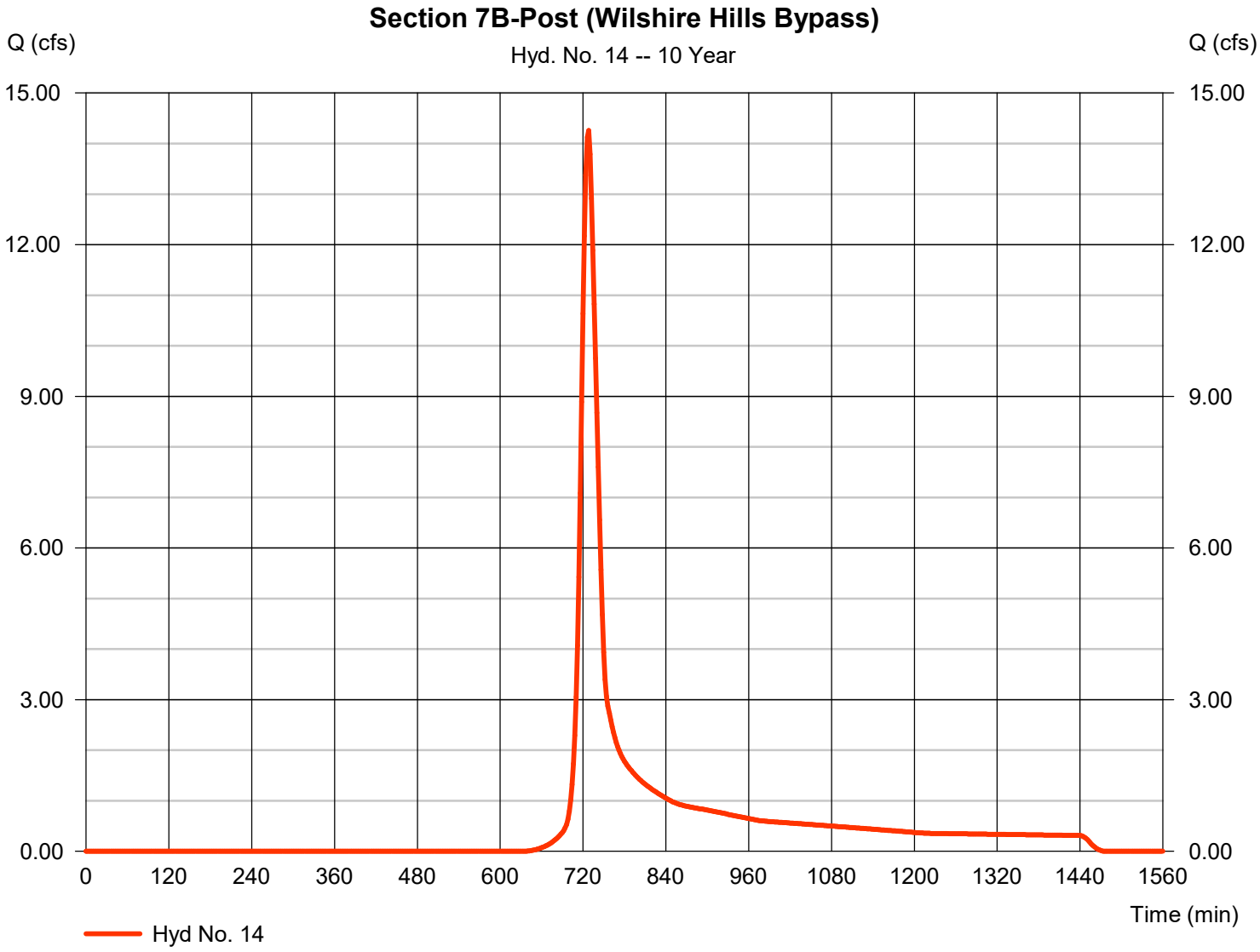
Hydrograph Report

Hyd. No. 14

Section 7B-Post (Wilshire Hills Bypass)

Hydrograph type	=	SCS Runoff	Peak discharge	=	14.26 cfs
Storm frequency	=	10 yrs	Time to peak	=	728 min
Time interval	=	2 min	Hyd. volume	=	51,439 cuft
Drainage area	=	7.500 ac	Curve number	=	65*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	20.50 min
Total precip.	=	5.30 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(13.900 x 89)] / 7.500



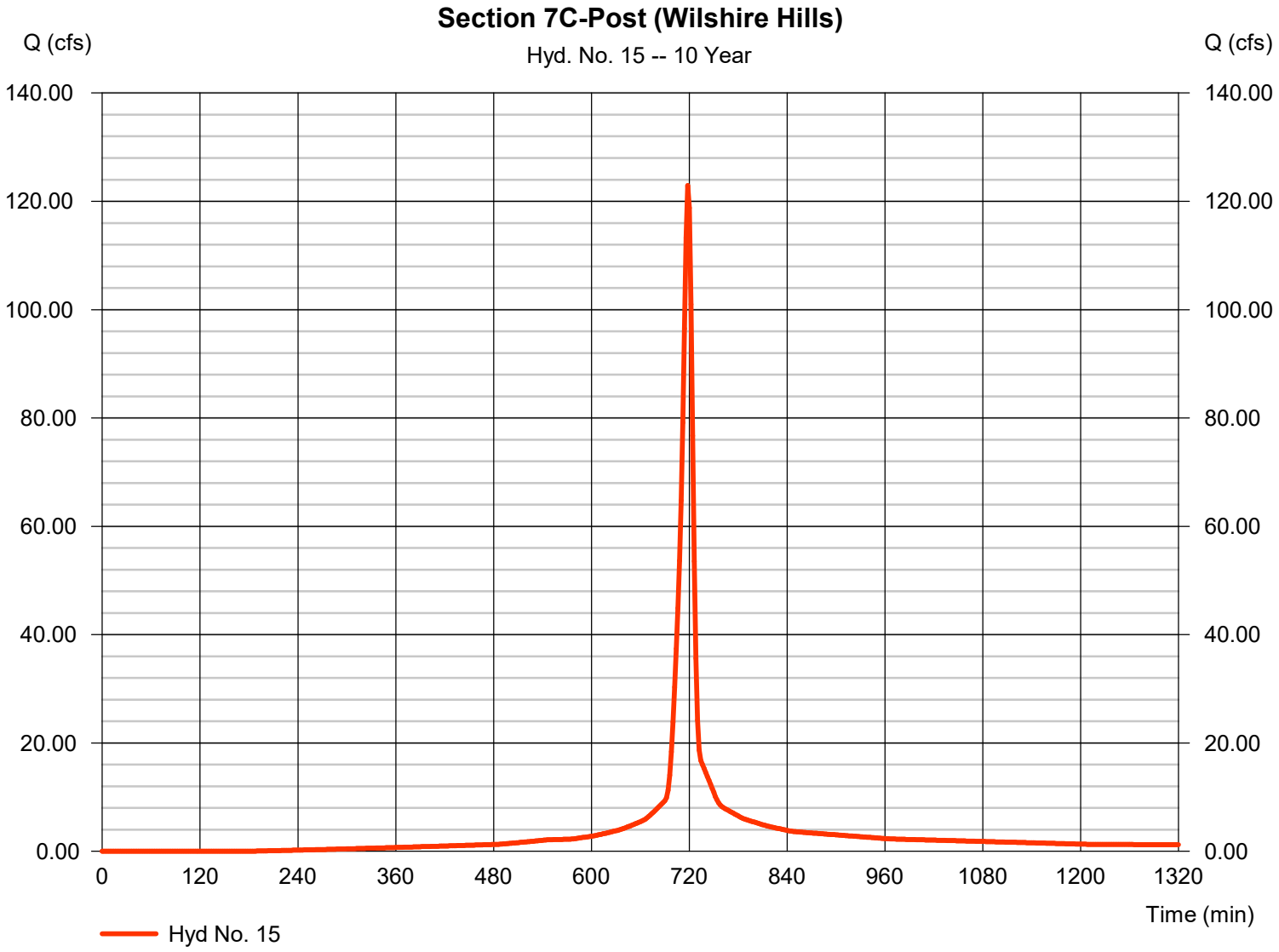
Hydrograph Report

Hyd. No. 15

Section 7C-Post (Wilshire Hills)

Hydrograph type	=	SCS Runoff	Peak discharge	=	122.92 cfs
Storm frequency	=	10 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	302,271 cuft
Drainage area	=	19.000 ac	Curve number	=	92*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	9.28 min
Total precip.	=	5.30 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(14.600 x 98) + (4.400 x 74)] / 19.000



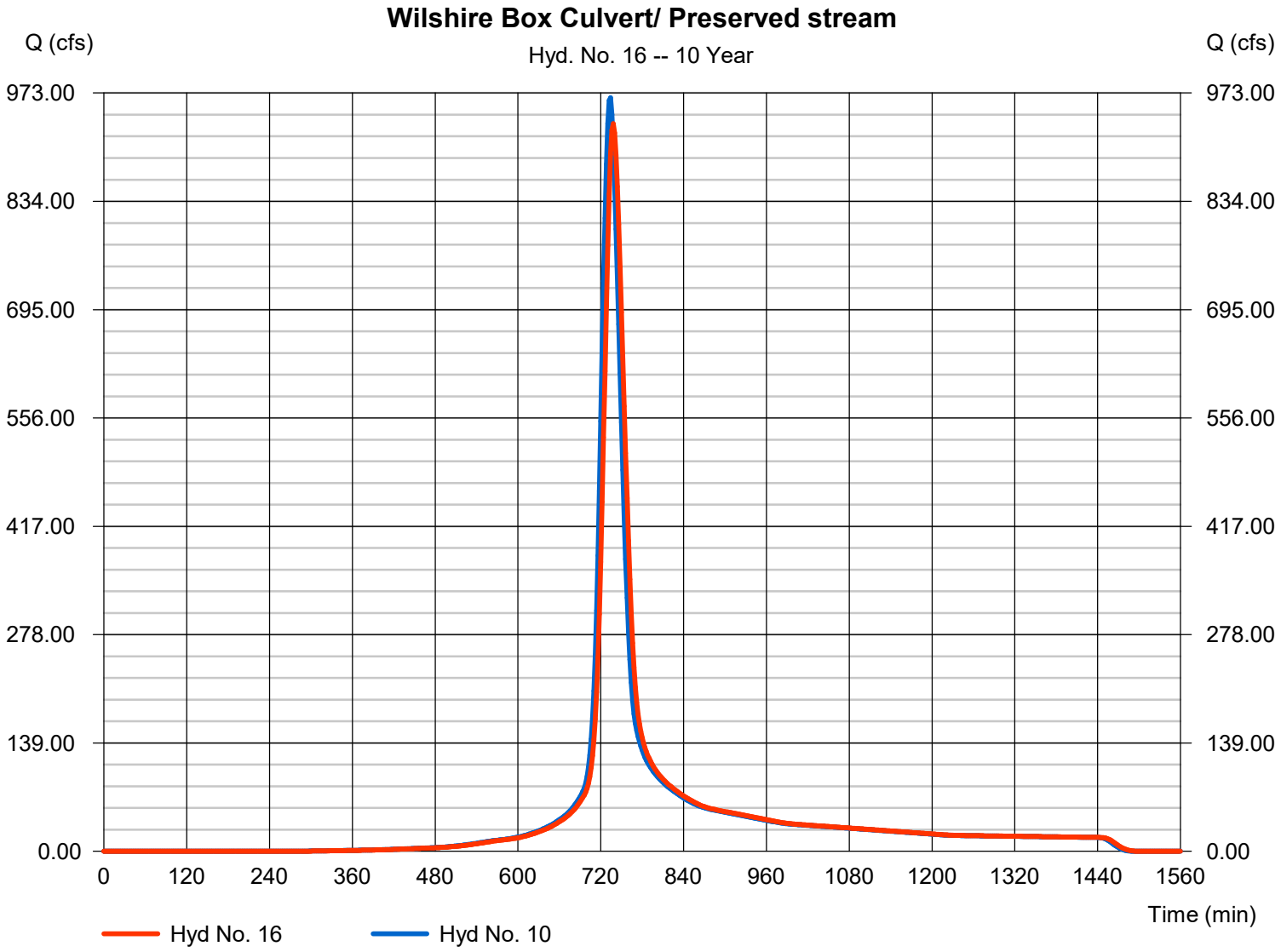
Hydrograph Report

Hyd. No. 16

Wilshire Box Culvert/ Preserved stream

Hydrograph type	=	Reach	Peak discharge	=	933.75 cfs
Storm frequency	=	10 yrs	Time to peak	=	738 min
Time interval	=	2 min	Hyd. volume	=	3,962,789 cuft
Inflow hyd. No.	=	10 - Strother Road Culvert	Section type	=	Trapezoidal
Reach length	=	500.0 ft	Channel slope	=	0.5 %
Manning's n	=	0.100	Bottom width	=	10.0 ft
Side slope	=	14.0:1	Max. depth	=	8.0 ft
Rating curve x	=	0.227	Rating curve m	=	1.318
Ave. velocity	=	0.00 ft/s	Routing coeff.	=	0.4254

Modified Att-Kin routing method used.

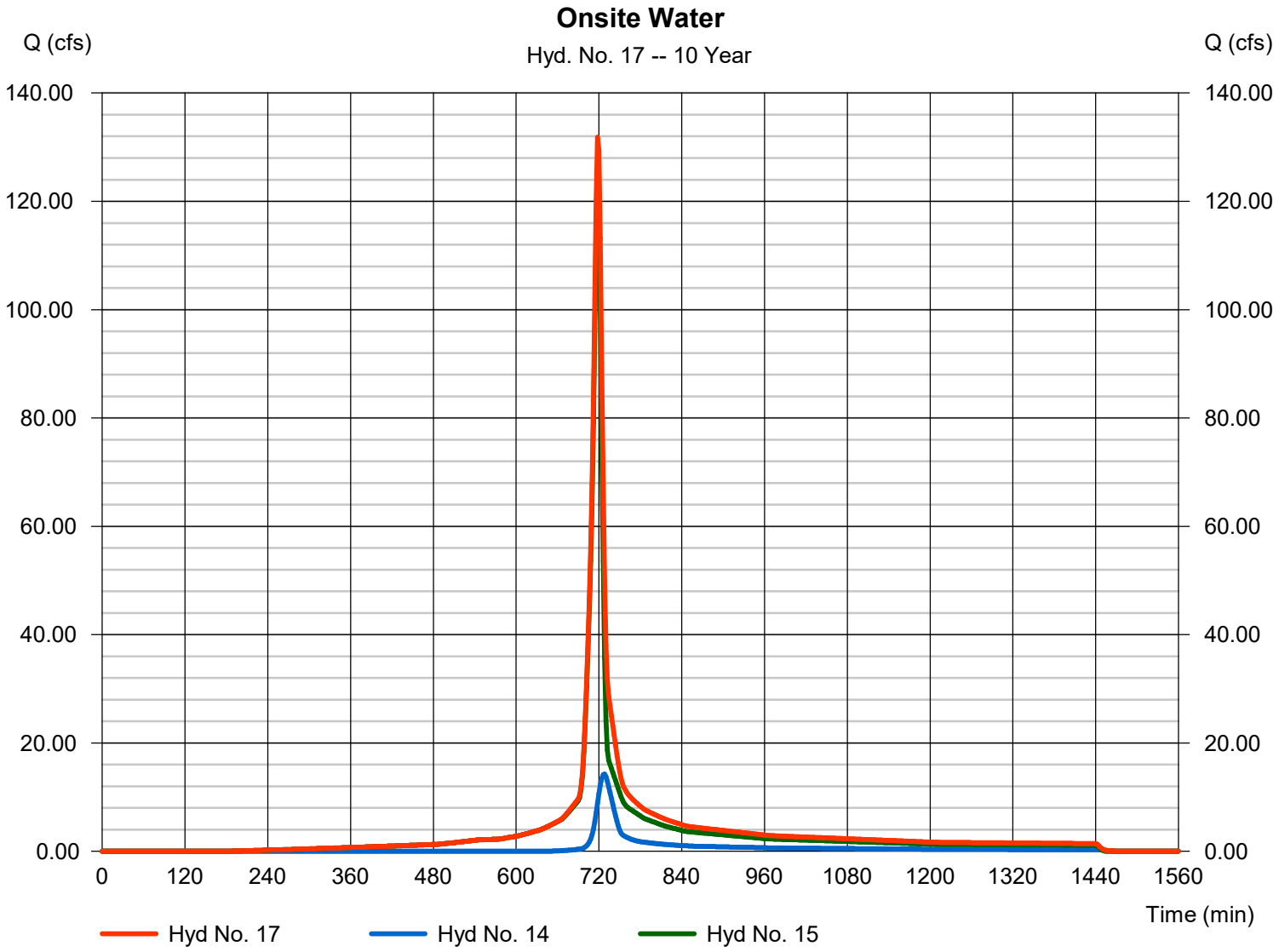


Hydrograph Report

Hyd. No. 17

Onsite Water

Hydrograph type	=	Combine	Peak discharge	=	131.81 cfs
Storm frequency	=	10 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	353,710 cuft
Inflow hyds.	=	14, 15	Contrib. drain. area	=	26.500 ac



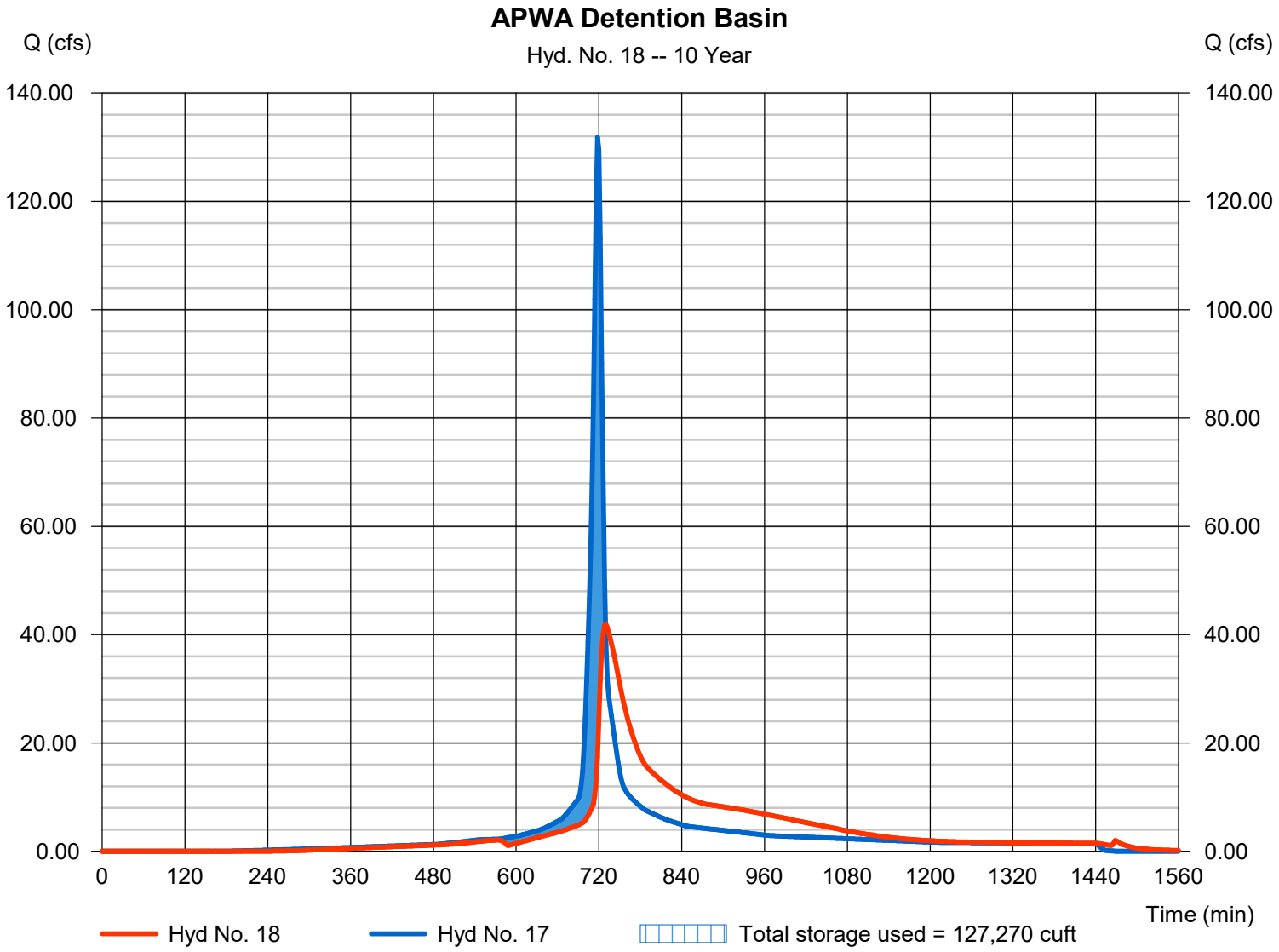
Hydrograph Report

Hyd. No. 18

APWA Detention Basin

Hydrograph type	=	Reservoir	Peak discharge	=	41.88 cfs
Storm frequency	=	10 yrs	Time to peak	=	730 min
Time interval	=	2 min	Hyd. volume	=	353,697 cuft
Inflow hyd. No.	=	17 - Onsite Water	Max. Elevation	=	919.44 ft
Reservoir name	=	Detention Basin	Max. Storage	=	127,270 cuft

Storage Indication method used.

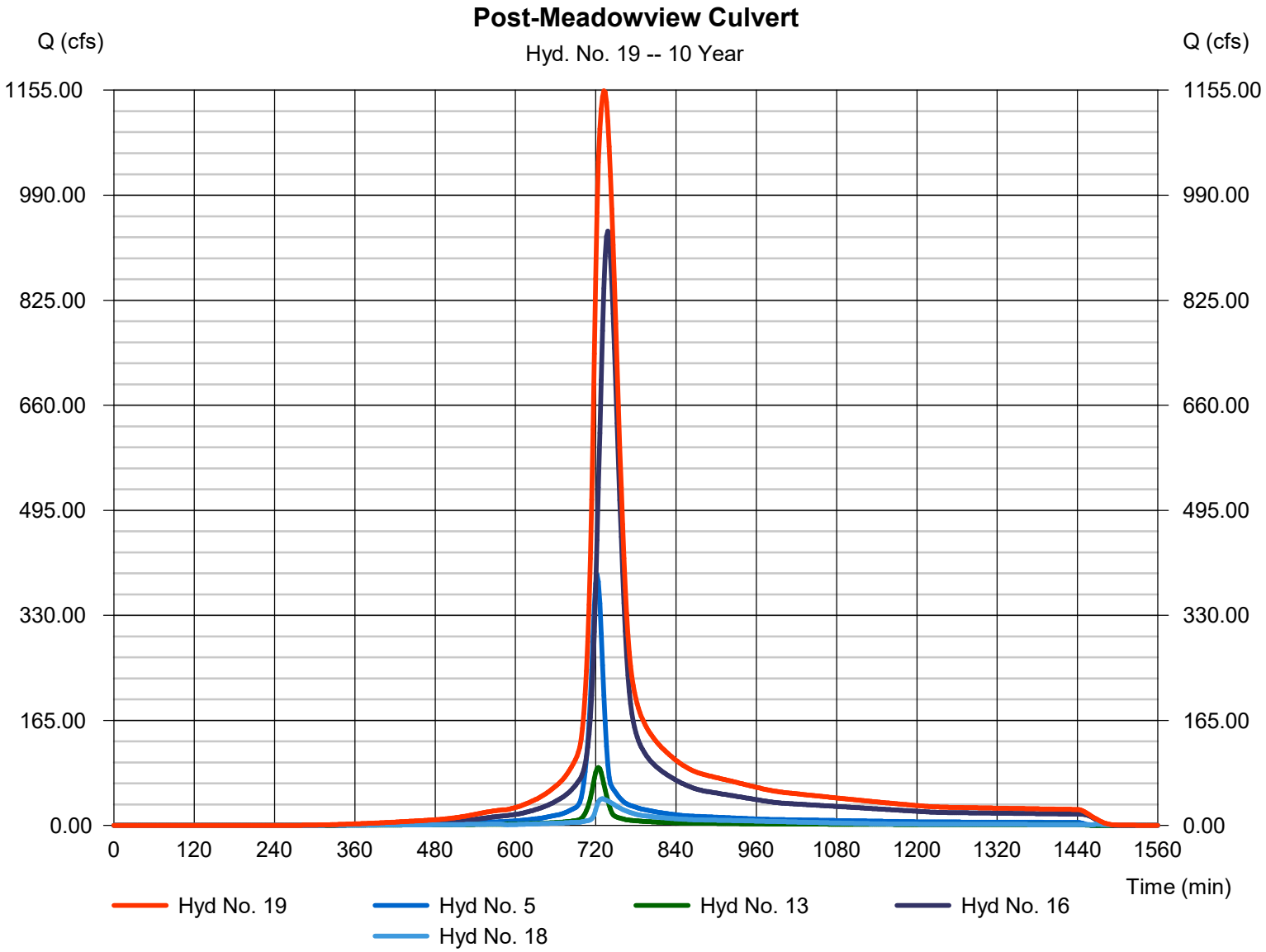


Hydrograph Report

Hyd. No. 19

Post-Meadowview Culvert

Hydrograph type	= Combine	Peak discharge	= 1153.86 cfs
Storm frequency	= 10 yrs	Time to peak	= 732 min
Time interval	= 2 min	Hyd. volume	= 5,731,216 cuft
Inflow hyds.	= 5, 13, 16, 18	Contrib. drain. area	= 106.800 ac



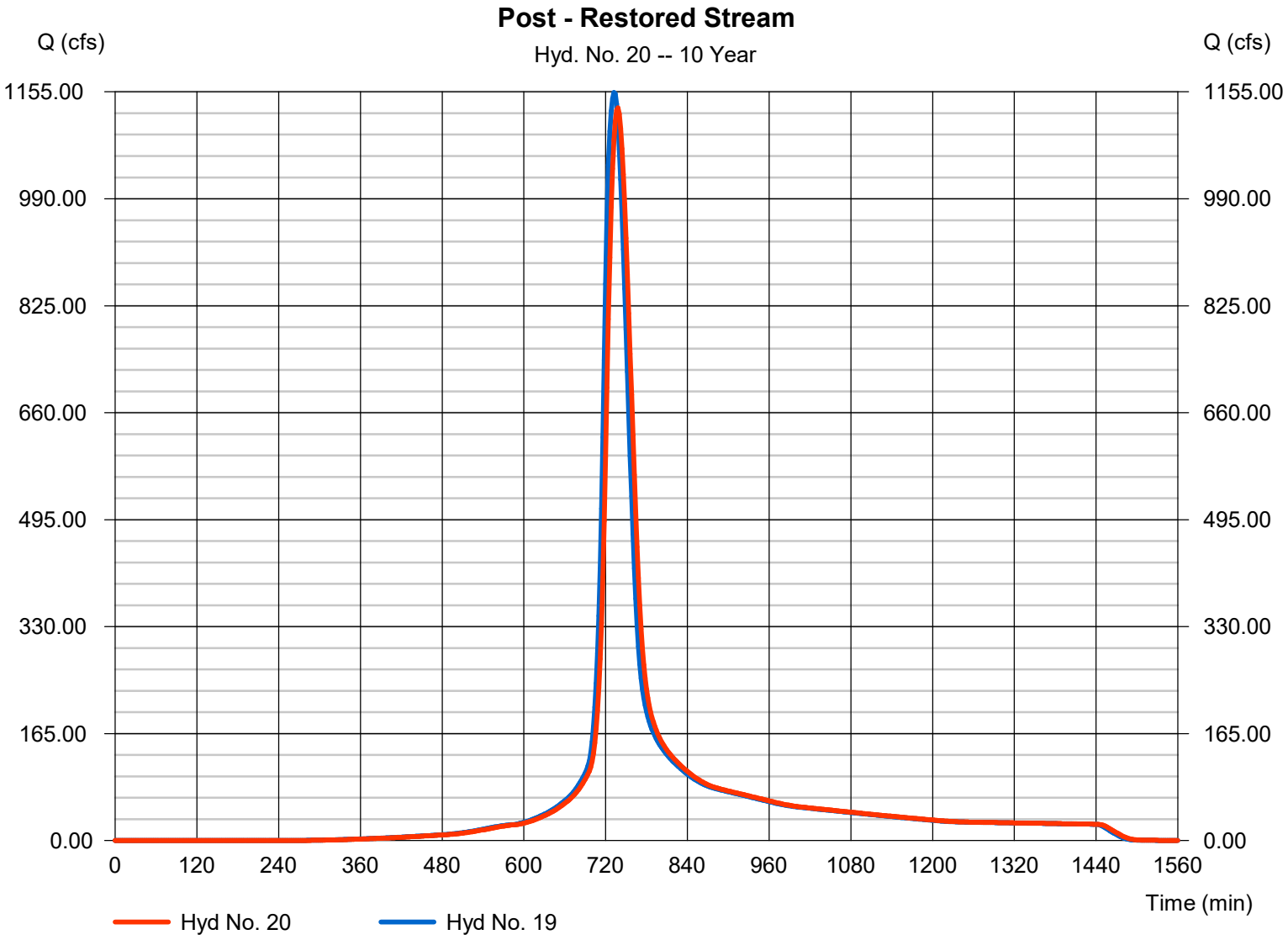
Hydrograph Report

Hyd. No. 20

Post - Restored Stream

Hydrograph type	=	Reach	Peak discharge	=	1130.19 cfs
Storm frequency	=	10 yrs	Time to peak	=	738 min
Time interval	=	2 min	Hyd. volume	=	5,731,108 cuft
Inflow hyd. No.	=	19 - Post-Meadowview Culvert	Section type	=	Trapezoidal
Reach length	=	1340.0 ft	Channel slope	=	0.8 %
Manning's n	=	0.030	Bottom width	=	20.0 ft
Side slope	=	10.0:1	Max. depth	=	4.0 ft
Rating curve x	=	0.595	Rating curve m	=	1.345
Ave. velocity	=	0.00 ft/s	Routing coeff.	=	0.4000

Modified Att-Kin routing method used.



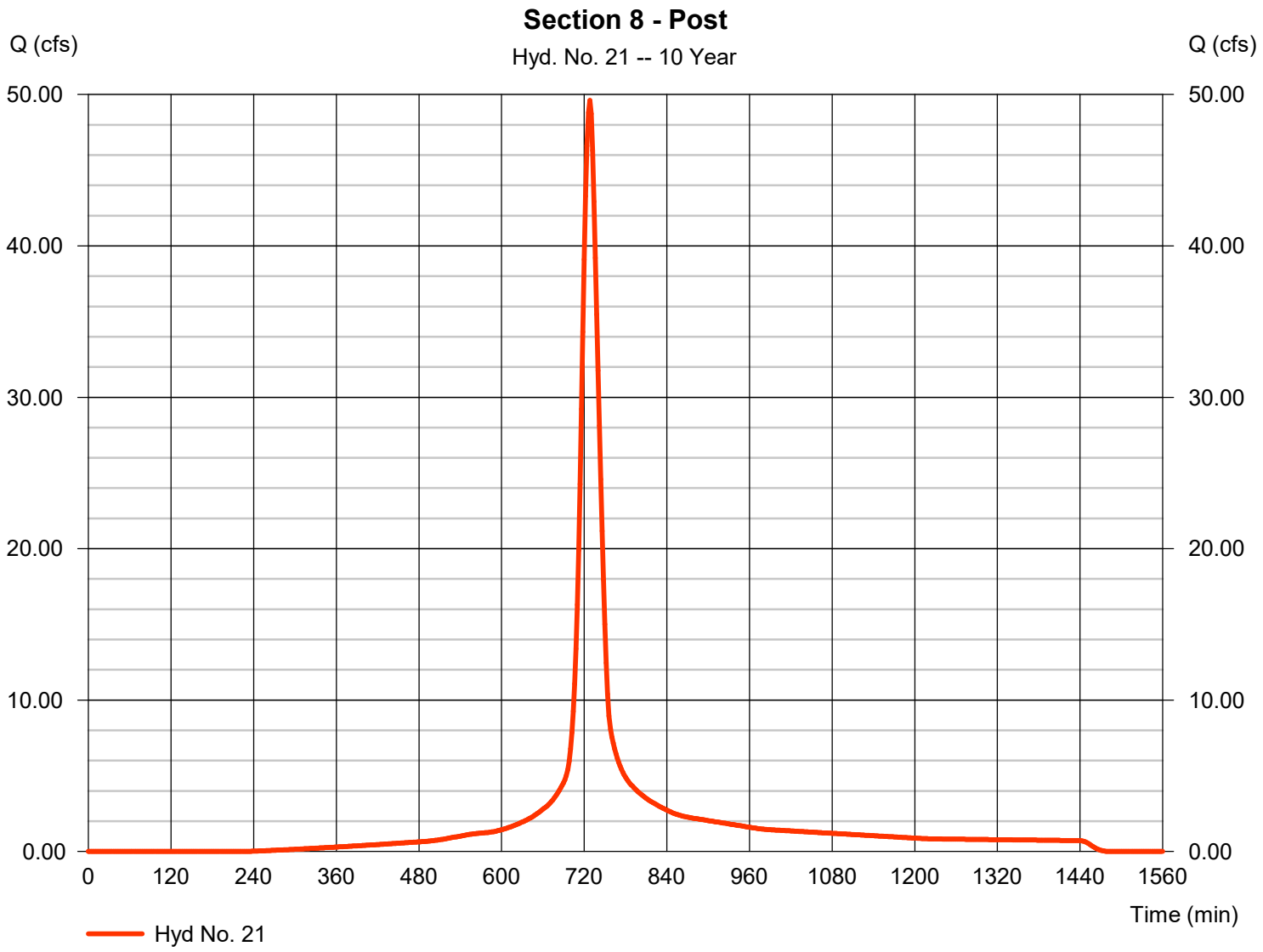
Hydrograph Report

Hyd. No. 21

Section 8 - Post

Hydrograph type	=	SCS Runoff	Peak discharge	=	49.61 cfs
Storm frequency	=	10 yrs	Time to peak	=	728 min
Time interval	=	2 min	Hyd. volume	=	187,574 cuft
Drainage area	=	12.600 ac	Curve number	=	90*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	23.90 min
Total precip.	=	5.30 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(12.600 x 90)] / 12.600

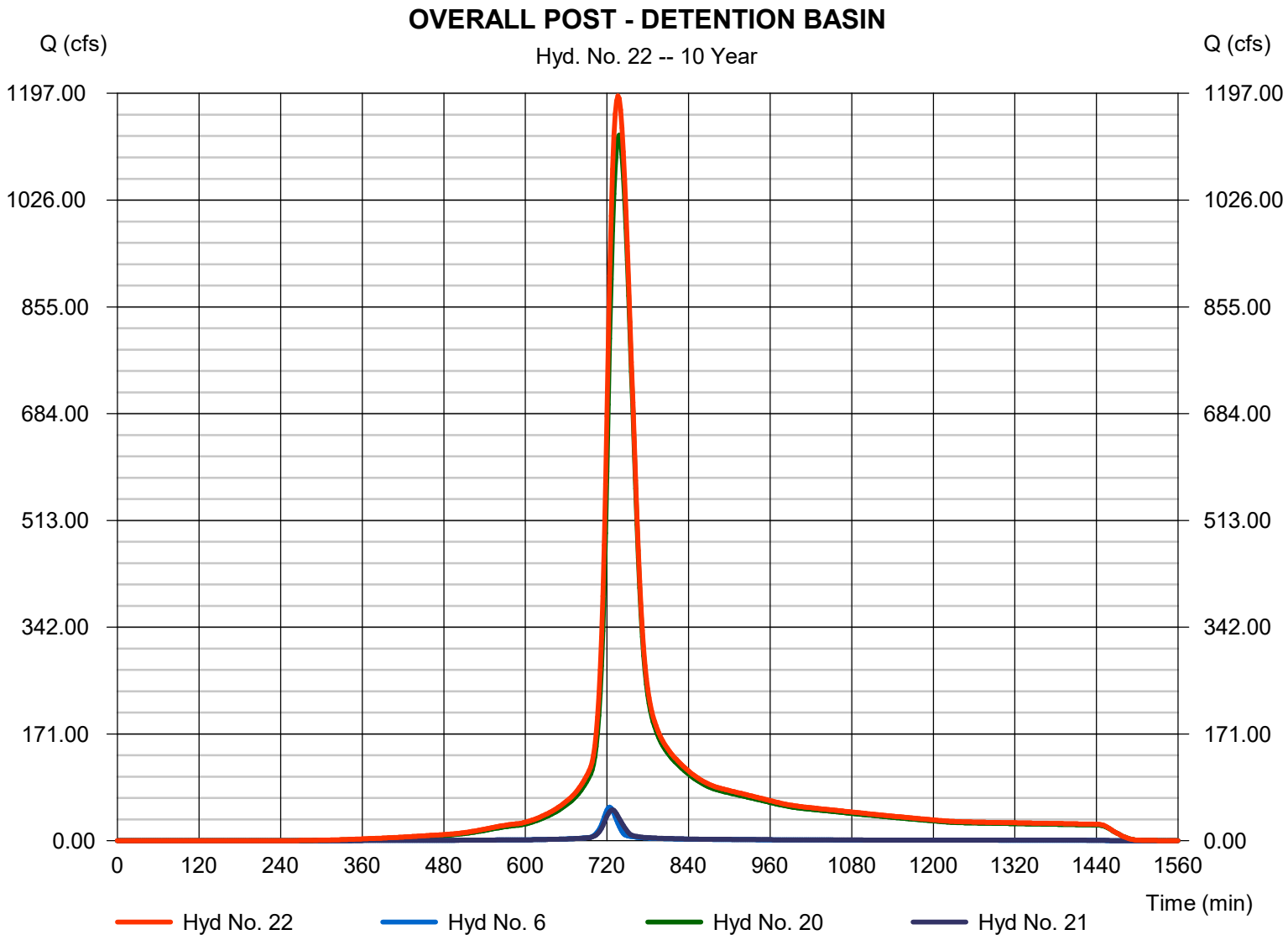


Hydrograph Report

Hyd. No. 22

OVERALL POST - DETENTION BASIN

Hydrograph type	= Combine	Peak discharge	= 1193.11 cfs
Storm frequency	= 10 yrs	Time to peak	= 736 min
Time interval	= 2 min	Hyd. volume	= 6,093,989 cuft
Inflow hyds.	= 6, 20, 21	Contrib. drain. area	= 23.900 ac



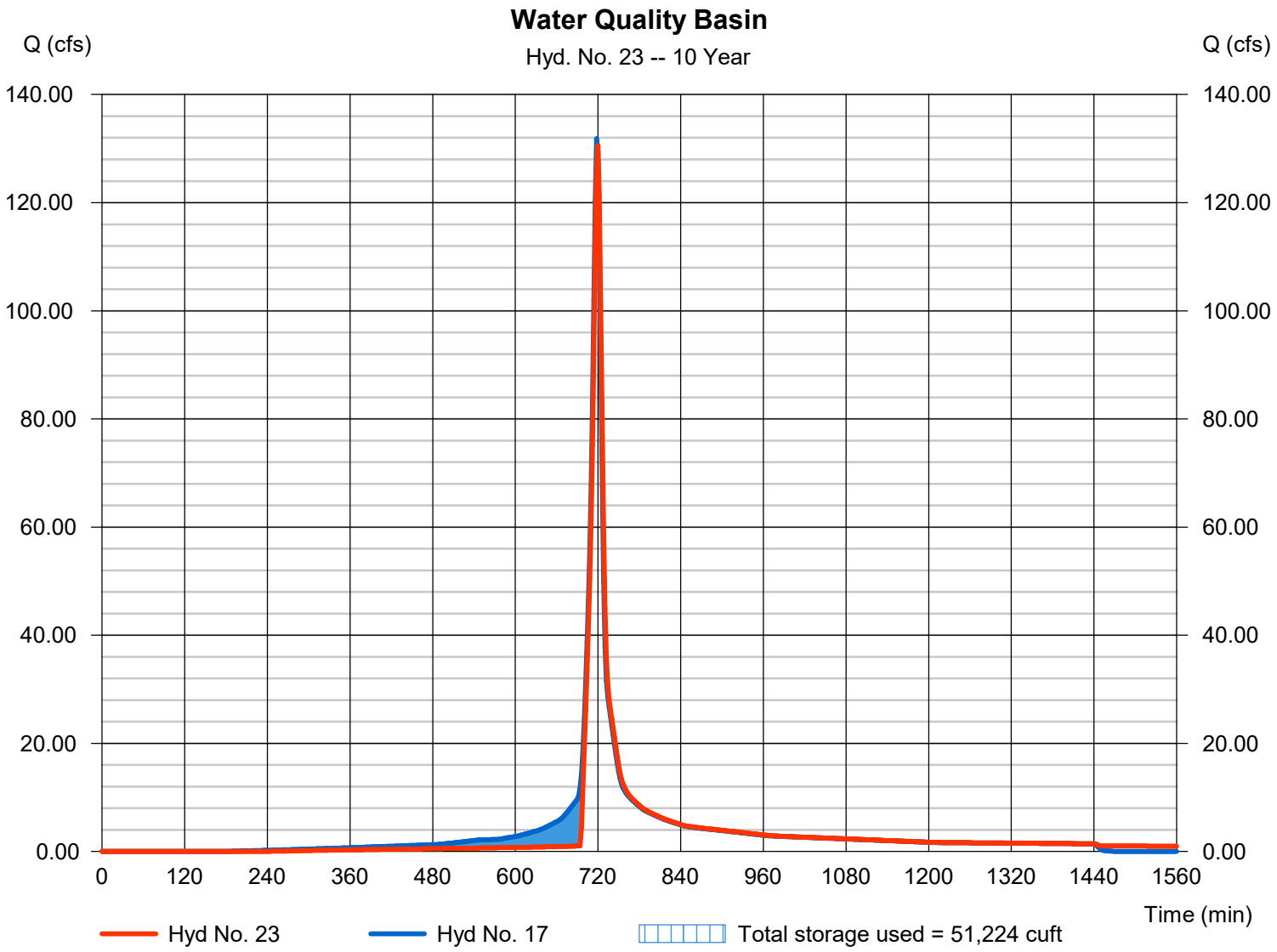
Hydrograph Report

Hyd. No. 23

Water Quality Basin

Hydrograph type	=	Reservoir	Peak discharge	=	130.58 cfs
Storm frequency	=	10 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	353,695 cuft
Inflow hyd. No.	=	17 - Onsite Water	Max. Elevation	=	918.98 ft
Reservoir name	=	Water Quality Basin	Max. Storage	=	51,224 cuft

Storage Indication method used.

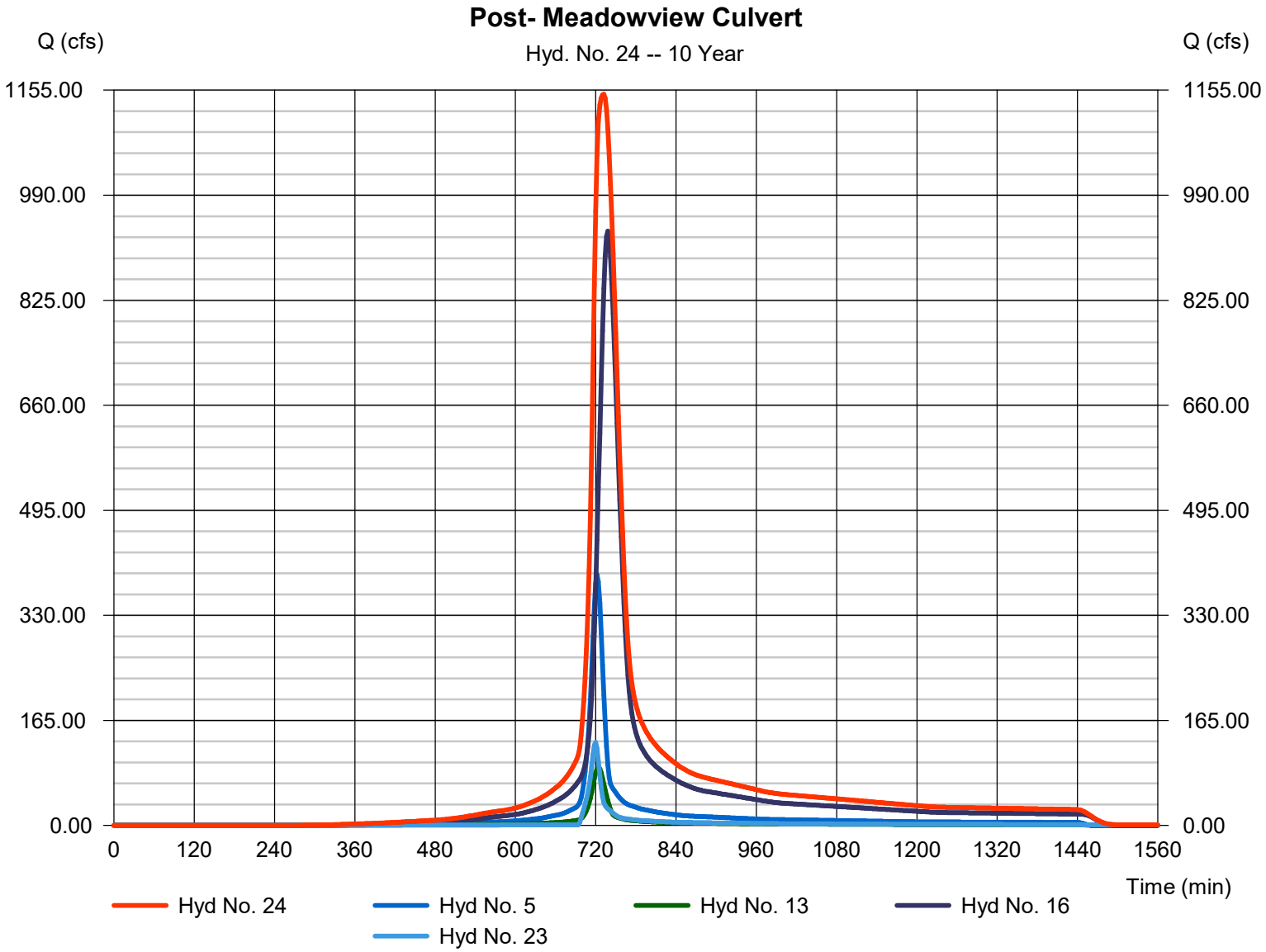


Hydrograph Report

Hyd. No. 24

Post- Meadowview Culvert

Hydrograph type	= Combine	Peak discharge	= 1148.50 cfs
Storm frequency	= 10 yrs	Time to peak	= 732 min
Time interval	= 2 min	Hyd. volume	= 5,731,216 cuft
Inflow hyds.	= 5, 13, 16, 23	Contrib. drain. area	= 106.800 ac



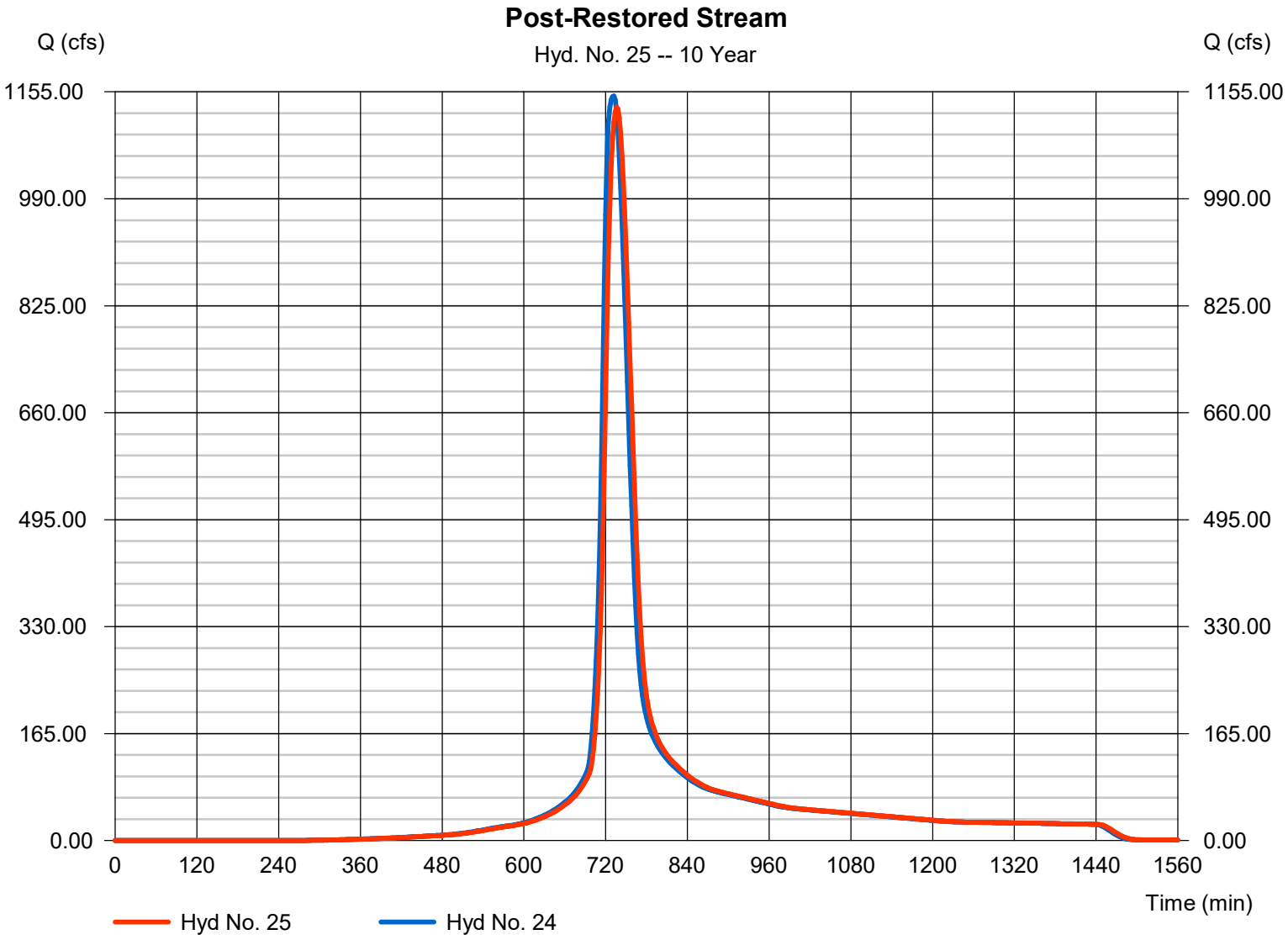
Hydrograph Report

Hyd. No. 25

Post-Restored Stream

Hydrograph type	=	Reach	Peak discharge	=	1131.54 cfs
Storm frequency	=	10 yrs	Time to peak	=	736 min
Time interval	=	2 min	Hyd. volume	=	5,731,092 cuft
Inflow hyd. No.	=	24 - Post- Meadowview Culvert	Section type	=	Trapezoidal
Reach length	=	1340.0 ft	Channel slope	=	0.8 %
Manning's n	=	0.030	Bottom width	=	20.0 ft
Side slope	=	10.0:1	Max. depth	=	4.0 ft
Rating curve x	=	0.595	Rating curve m	=	1.345
Ave. velocity	=	0.00 ft/s	Routing coeff.	=	0.3996

Modified Att-Kin routing method used.

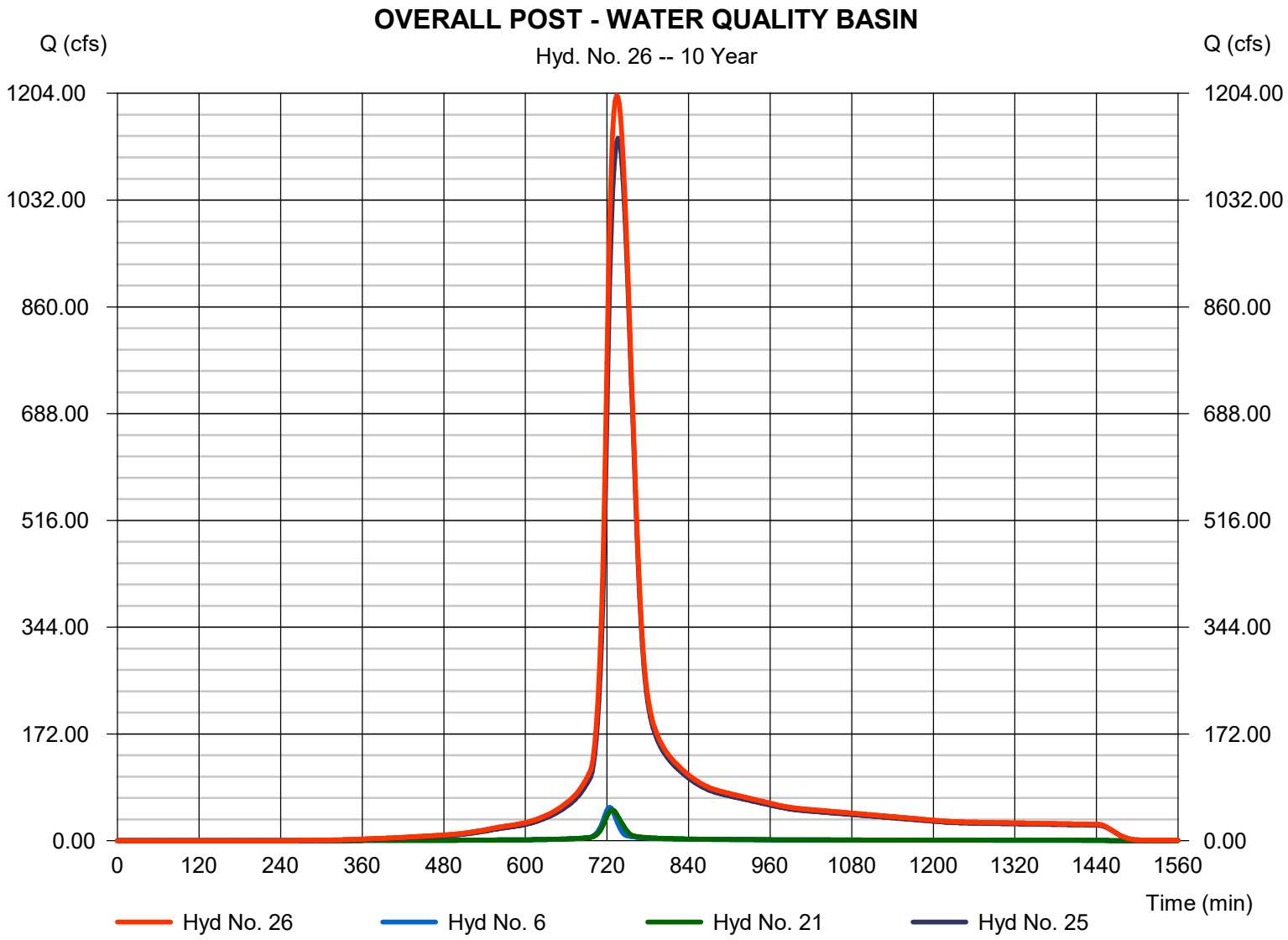


Hydrograph Report

Hyd. No. 26

OVERALL POST - WATER QUALITY BASIN

Hydrograph type	= Combine	Peak discharge	= 1199.85 cfs
Storm frequency	= 10 yrs	Time to peak	= 734 min
Time interval	= 2 min	Hyd. volume	= 6,093,977 cuft
Inflow hyds.	= 6, 21, 25	Contrib. drain. area	= 23.900 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

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	403.79	2	728	1,486,312	------	------	------	Section 1
2	SCS Runoff	336.08	2	728	1,237,077	------	------	------	Section 2
3	SCS Runoff	512.72	2	730	2,074,709	------	------	------	Section 3
4	SCS Runoff	431.92	2	732	1,932,345	------	------	------	Section 4
5	SCS Runoff	636.00	2	722	1,851,646	------	------	------	Section 5
6	SCS Runoff	82.47	2	724	275,937	------	------	------	Section 6
7	SCS Runoff	355.97	2	728	1,368,386	------	------	------	Section 7/8-Pre
8	Combine	1243.39	2	728	4,798,103	1, 2, 3,	------	------	Industrial Complex to Detention
9	Reach	1211.21	2	732	4,798,098	8	------	------	Industrial Above Ground Detention Po
10	Combine	1643.14	2	732	6,730,445	4, 9	------	------	Strother Road Culvert
11	Reach	1570.20	2	738	6,730,444	10	------	------	Wilshire Box Culvert/ Preserved Strea
12	Combine	2145.77	2	732	10,226,410	5, 6, 7, 11	------	------	OVERALL PRE
13	SCS Runoff	142.13	2	724	468,866	------	------	------	Section 7A-Post
14	SCS Runoff	29.71	2	726	103,450	------	------	------	Section 7B-Post (Wilshire Hills Bypas
15	SCS Runoff	186.84	2	718	472,136	------	------	------	Section 7C-Post (Wilshire Hills)
16	Reach	1596.55	2	736	6,730,439	10	------	------	Wilshire Box Culvert/ Preserved strea
17	Combine	207.01	2	718	575,586	14, 15,	------	------	Onsite Water
18	Reservoir	92.90	2	728	575,572	17	921.73	186,922	APWA Detention Basin
19	Combine	2001.54	2	732	9,626,508	5, 13, 16, 18	------	------	Post-Meadowview Culvert
20	Reach	1967.90	2	736	9,626,407	19	------	------	Post - Restored Stream
21	SCS Runoff	76.90	2	728	297,548	------	------	------	Section 8 - Post
22	Combine	2070.16	2	736	10,199,890	6, 20, 21	------	------	OVERALL POST - DETENTION BASI
23	Reservoir	201.03	2	720	575,571	17	919.48	57,662	Water Quality Basin
24	Combine	1976.30	2	730	9,626,497	5, 13, 16, 23	------	------	Post- Meadowview Culvert
25	Reach	1951.86	2	736	9,626,392	24	------	------	Post-Restored Stream
26	Combine	2065.34	2	734	10,199,890	6, 21, 25	------	------	OVERALL POST - WATER QUALITY

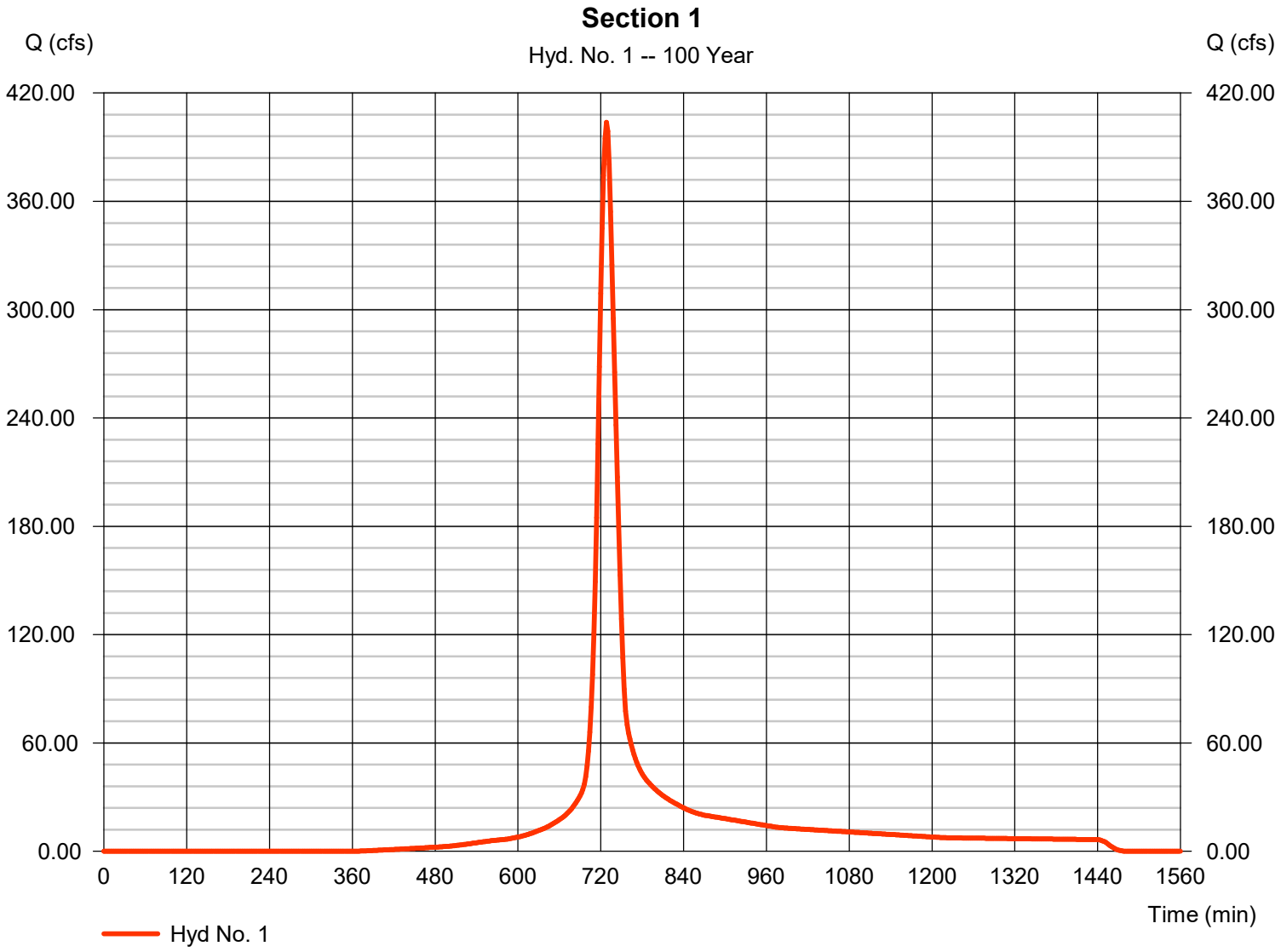
Hydrograph Report

Hyd. No. 1

Section 1

Hydrograph type	=	SCS Runoff	Peak discharge	=	403.79 cfs
Storm frequency	=	100 yrs	Time to peak	=	728 min
Time interval	=	2 min	Hyd. volume	=	1,486,312 cuft
Drainage area	=	81.700 ac	Curve number	=	77*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	24.30 min
Total precip.	=	7.80 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(3.600 x 81) + (13.500 x 98) + (49.000 x 73) + (15.600 x 69)] / 81.700



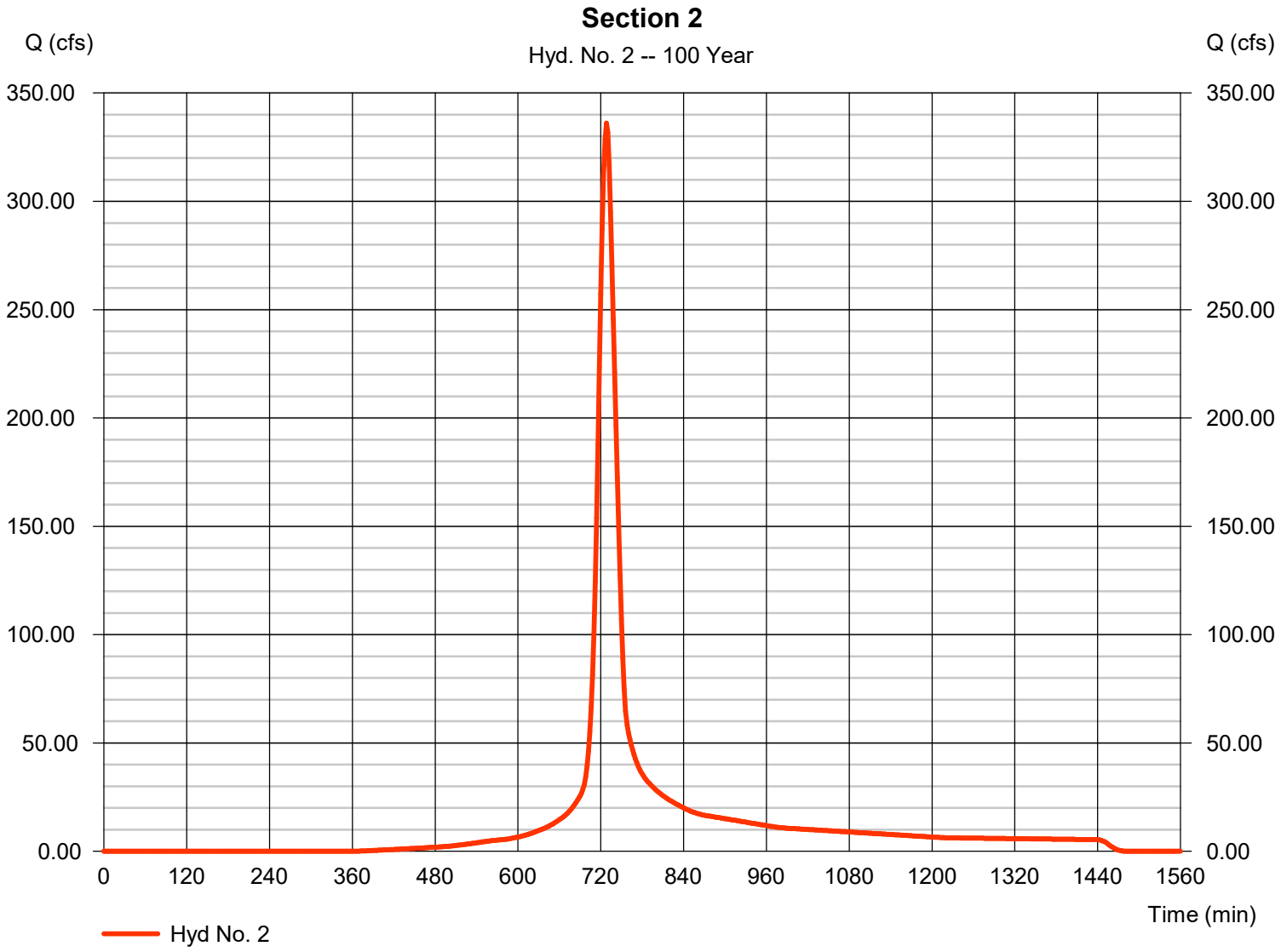
Hydrograph Report

Hyd. No. 2

Section 2

Hydrograph type	=	SCS Runoff	Peak discharge	=	336.08 cfs
Storm frequency	=	100 yrs	Time to peak	=	728 min
Time interval	=	2 min	Hyd. volume	=	1,237,077 cuft
Drainage area	=	68.000 ac	Curve number	=	77*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	25.30 min
Total precip.	=	7.80 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(8.000 x 98) + (0.500 x 77) + (30.800 x 79) + (28.700 x 69)] / 68.000



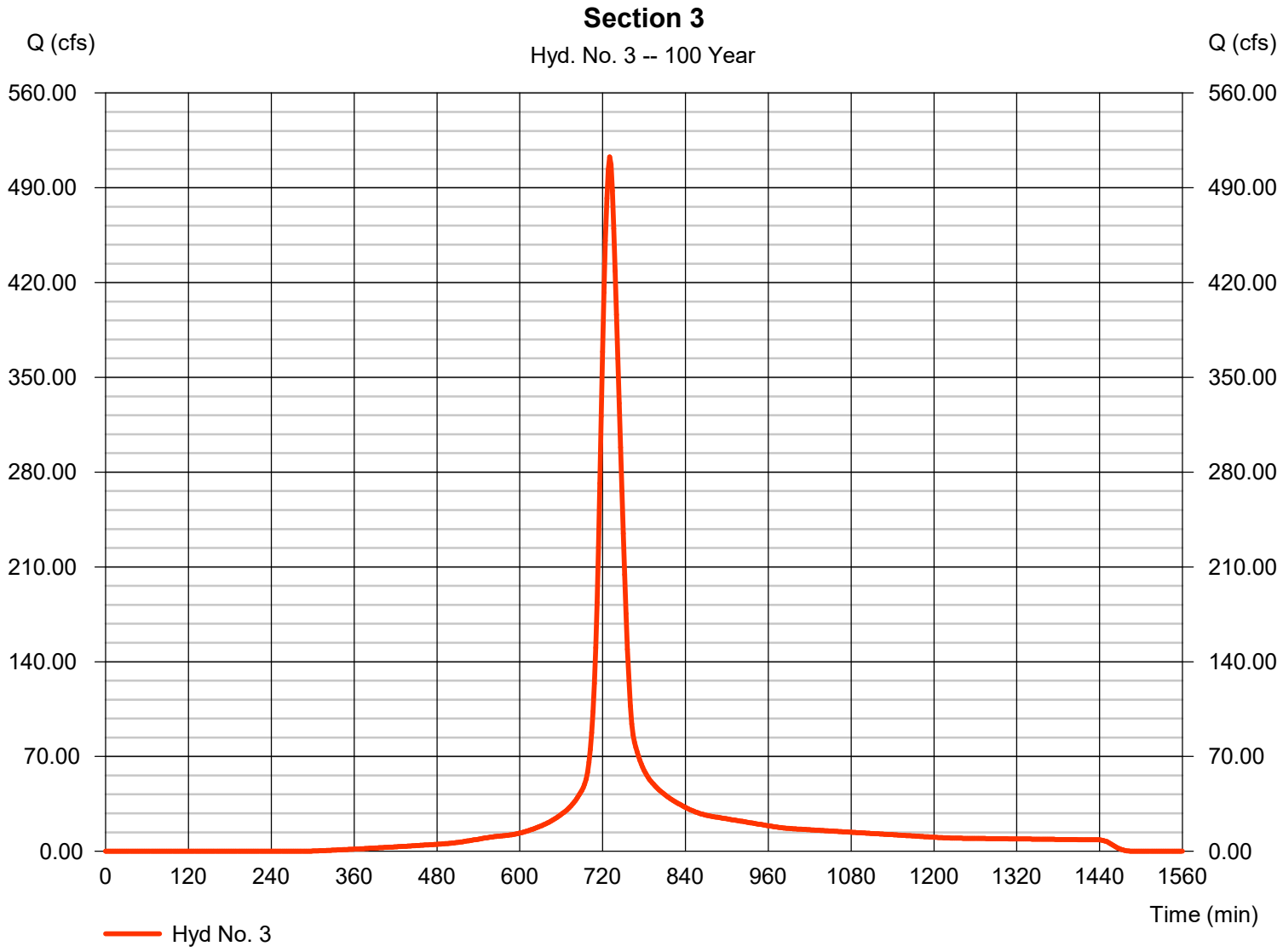
Hydrograph Report

Hyd. No. 3

Section 3

Hydrograph type	=	SCS Runoff	Peak discharge	=	512.72 cfs
Storm frequency	=	100 yrs	Time to peak	=	730 min
Time interval	=	2 min	Hyd. volume	=	2,074,709 cuft
Drainage area	=	100.800 ac	Curve number	=	82*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	30.20 min
Total precip.	=	7.80 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(18.200 x 98) + (3.000 x 77) + (79.600 x 79)] / 100.800



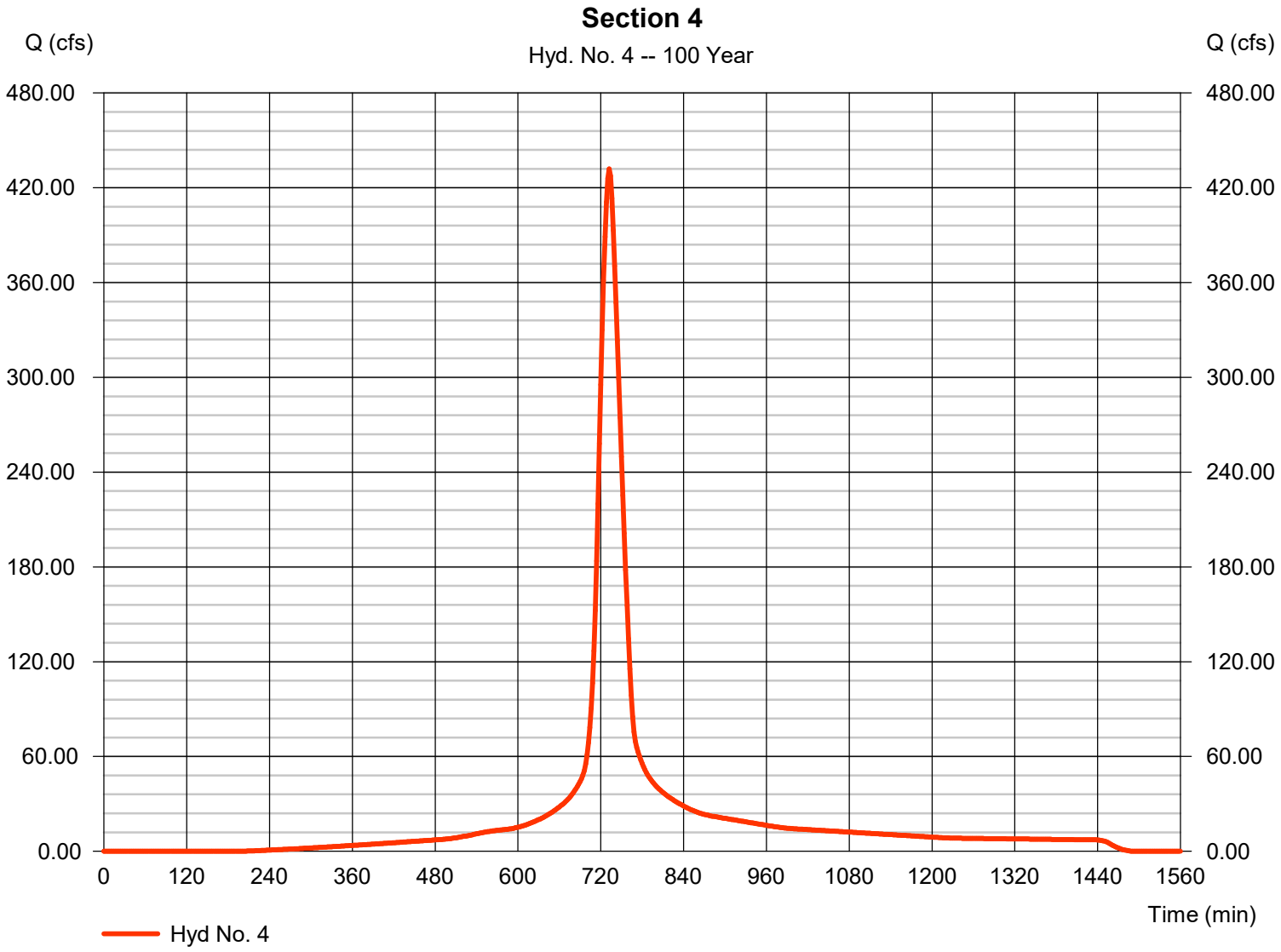
Hydrograph Report

Hyd. No. 4

Section 4

Hydrograph type	=	SCS Runoff	Peak discharge	=	431.92 cfs
Storm frequency	=	100 yrs	Time to peak	=	732 min
Time interval	=	2 min	Hyd. volume	=	1,932,345 cuft
Drainage area	=	82.500 ac	Curve number	=	88*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	30.70 min
Total precip.	=	7.80 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(49.680 x 98) + (32.820 x 74)] / 82.500



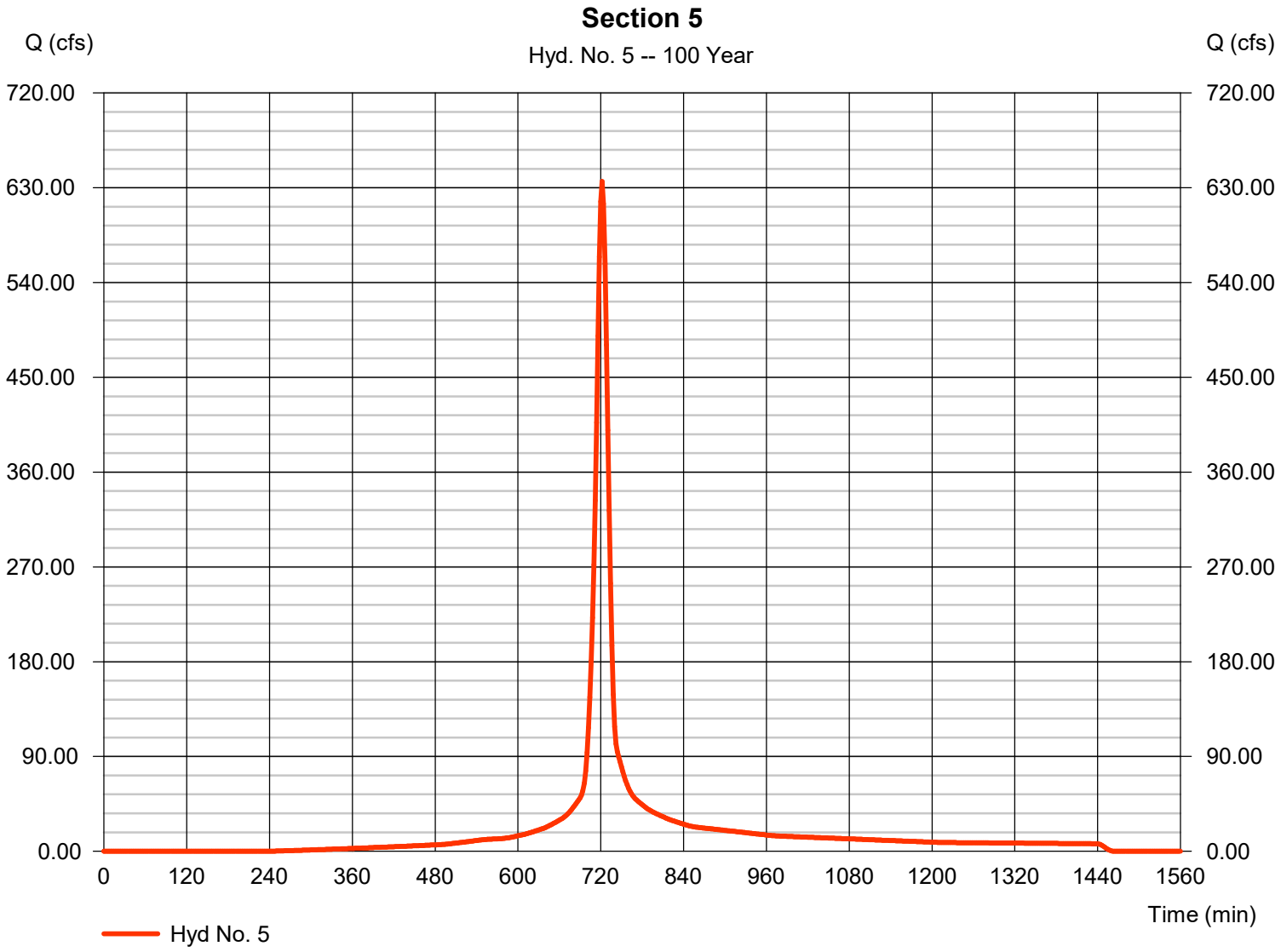
Hydrograph Report

Hyd. No. 5

Section 5

Hydrograph type	=	SCS Runoff	Peak discharge	=	636.00 cfs
Storm frequency	=	100 yrs	Time to peak	=	722 min
Time interval	=	2 min	Hyd. volume	=	1,851,646 cuft
Drainage area	=	86.900 ac	Curve number	=	85*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	15.60 min
Total precip.	=	7.80 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(40.000 x 98) + (46.900 x 74)] / 86.900



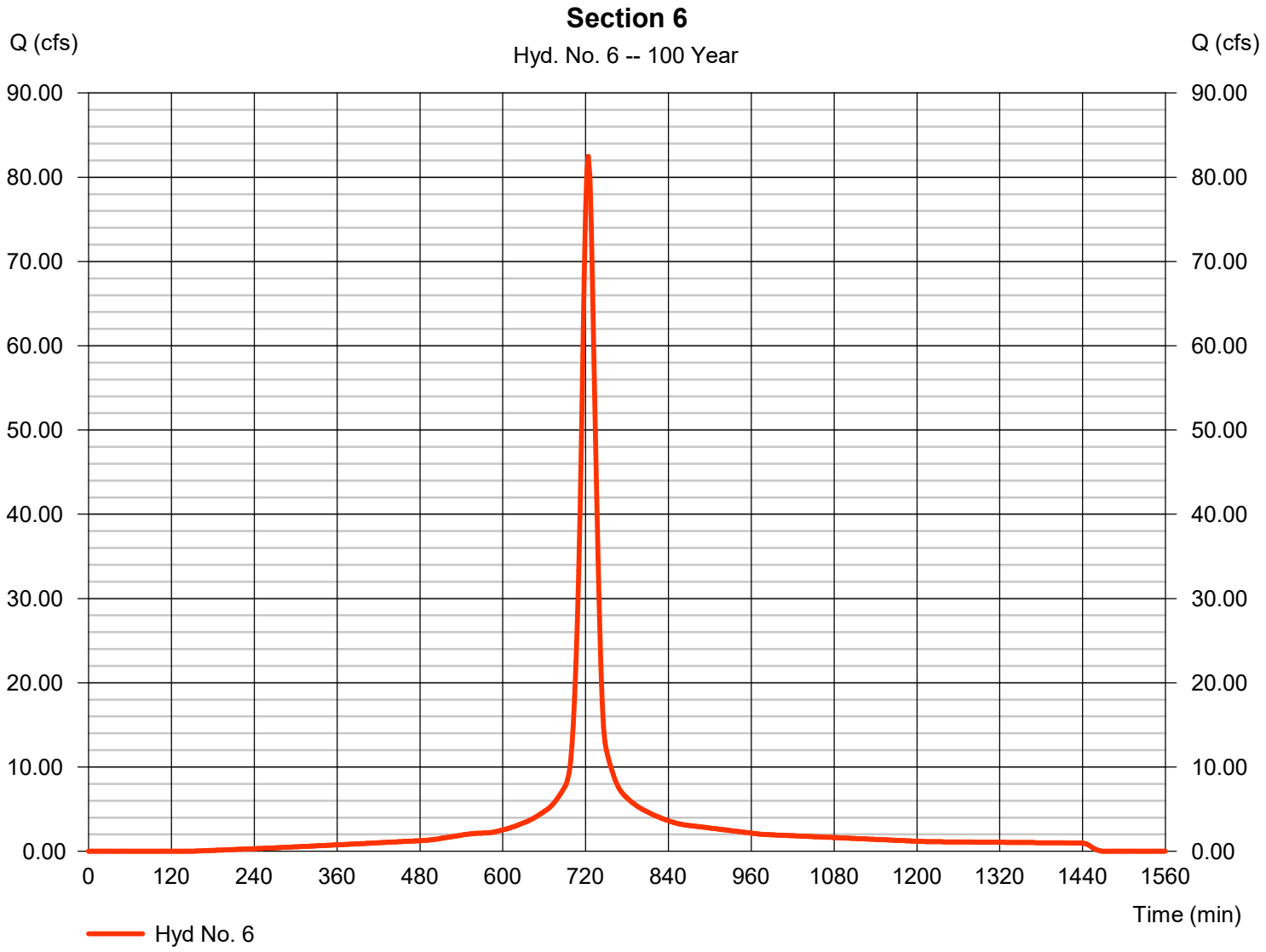
Hydrograph Report

Hyd. No. 6

Section 6

Hydrograph type	=	SCS Runoff	Peak discharge	=	82.47 cfs
Storm frequency	=	100 yrs	Time to peak	=	724 min
Time interval	=	2 min	Hyd. volume	=	275,937 cuft
Drainage area	=	11.300 ac	Curve number	=	91*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	18.60 min
Total precip.	=	7.80 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(11.300 x 91)] / 11.300



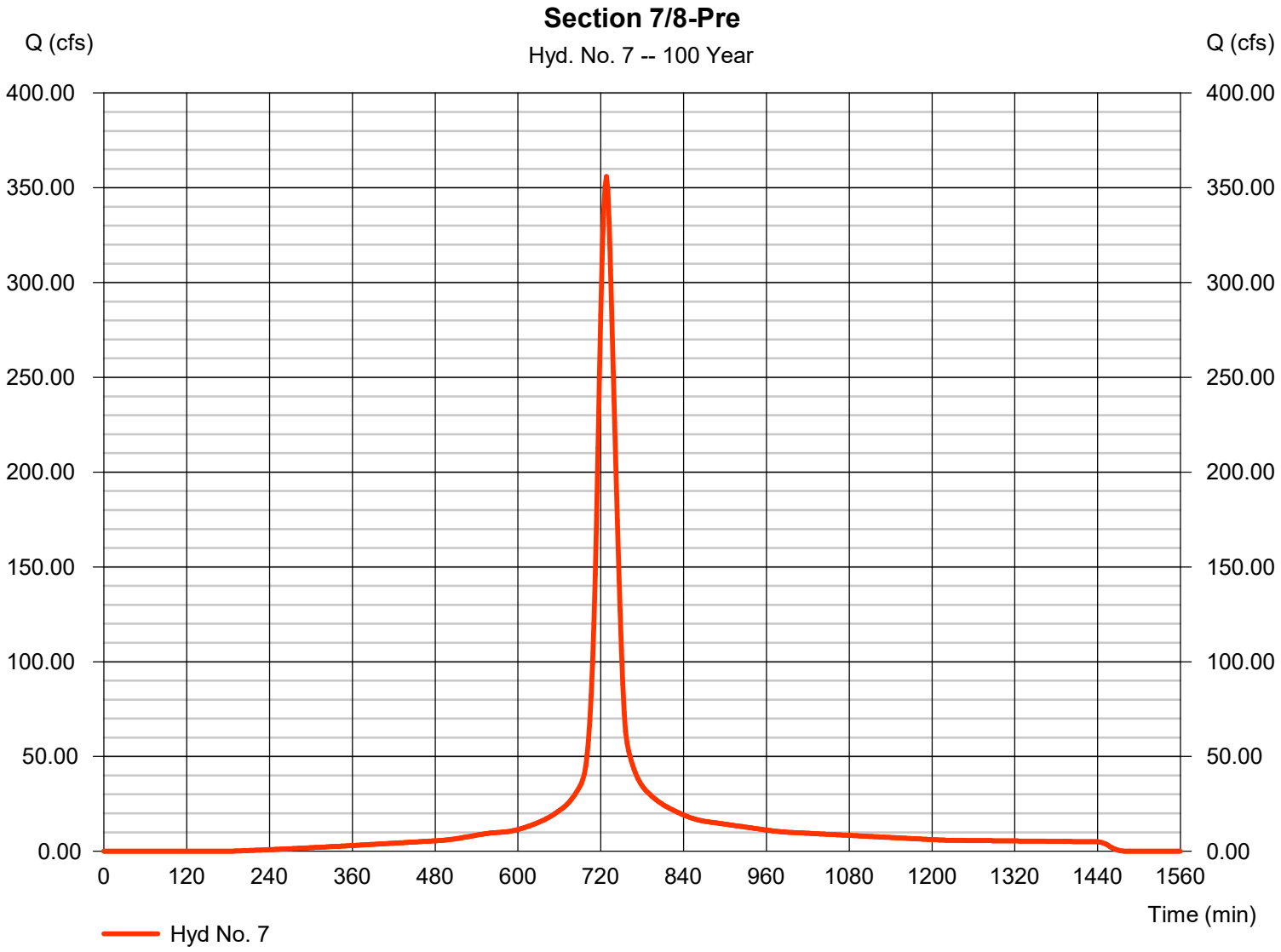
Hydrograph Report

Hyd. No. 7

Section 7/8-Pre

Hydrograph type	=	SCS Runoff	Peak discharge	=	355.97 cfs
Storm frequency	=	100 yrs	Time to peak	=	728 min
Time interval	=	2 min	Hyd. volume	=	1,368,386 cuft
Drainage area	=	59.000 ac	Curve number	=	89*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	23.90 min
Total precip.	=	7.80 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(59.000 x 79)] / 59.000

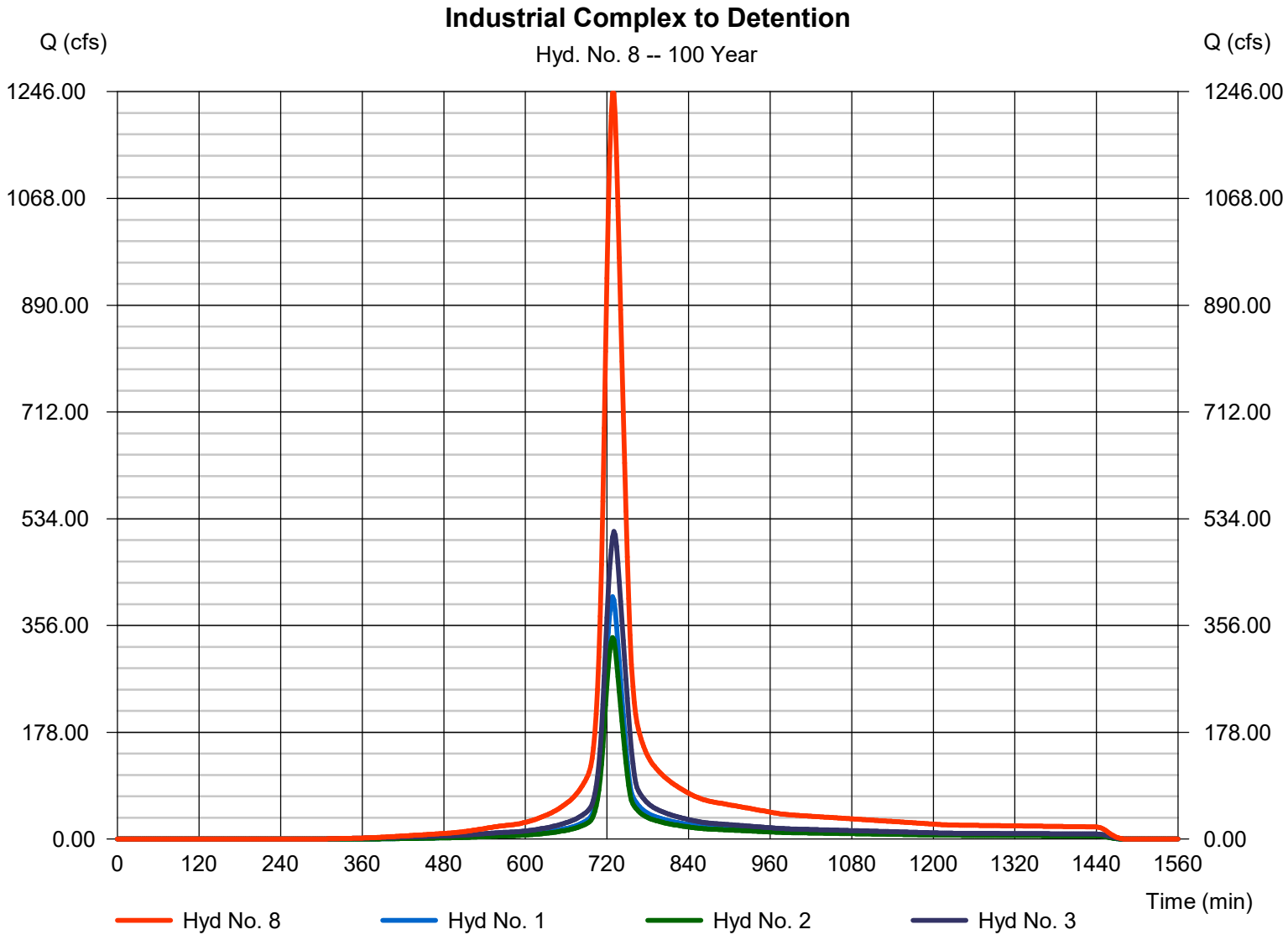


Hydrograph Report

Hyd. No. 8

Industrial Complex to Detention

Hydrograph type	= Combine	Peak discharge	= 1243.39 cfs
Storm frequency	= 100 yrs	Time to peak	= 728 min
Time interval	= 2 min	Hyd. volume	= 4,798,103 cuft
Inflow hyds.	= 1, 2, 3	Contrib. drain. area	= 250.500 ac



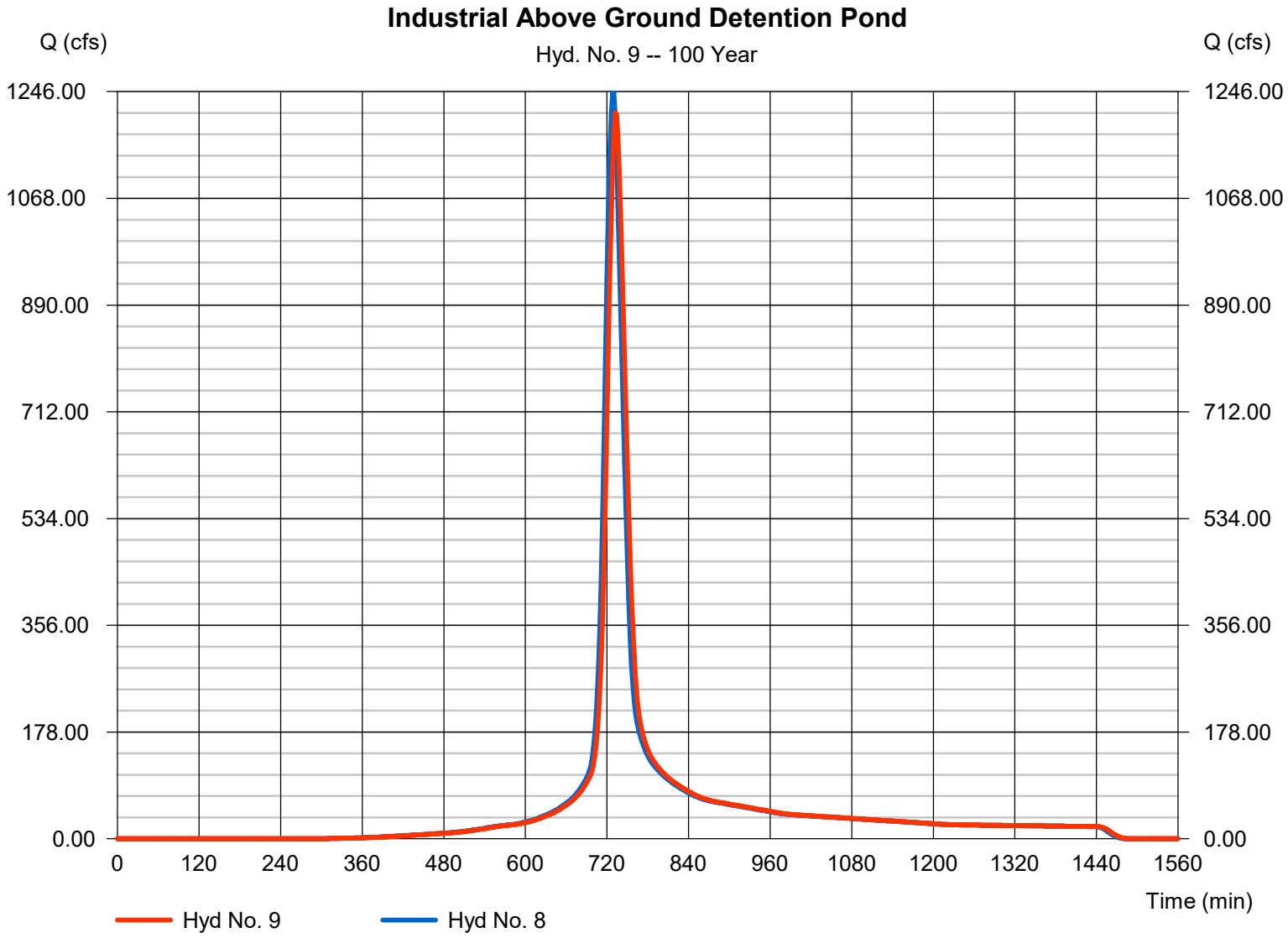
Hydrograph Report

Hyd. No. 9

Industrial Above Ground Detention Pond

Hydrograph type	=	Reach	Peak discharge	=	1211.21 cfs
Storm frequency	=	100 yrs	Time to peak	=	732 min
Time interval	=	2 min	Hyd. volume	=	4,798,098 cuft
Inflow hyd. No.	=	8 - Industrial Complex to Detention	Section type	=	Trapezoidal
Reach length	=	1000.0 ft	Channel slope	=	2.0 %
Manning's n	=	0.020	Bottom width	=	150.0 ft
Side slope	=	30.0:1	Max. depth	=	16.0 ft
Rating curve x	=	0.373	Rating curve m	=	1.407
Ave. velocity	=	0.00 ft/s	Routing coeff.	=	0.4946

Modified Att-Kin routing method used.

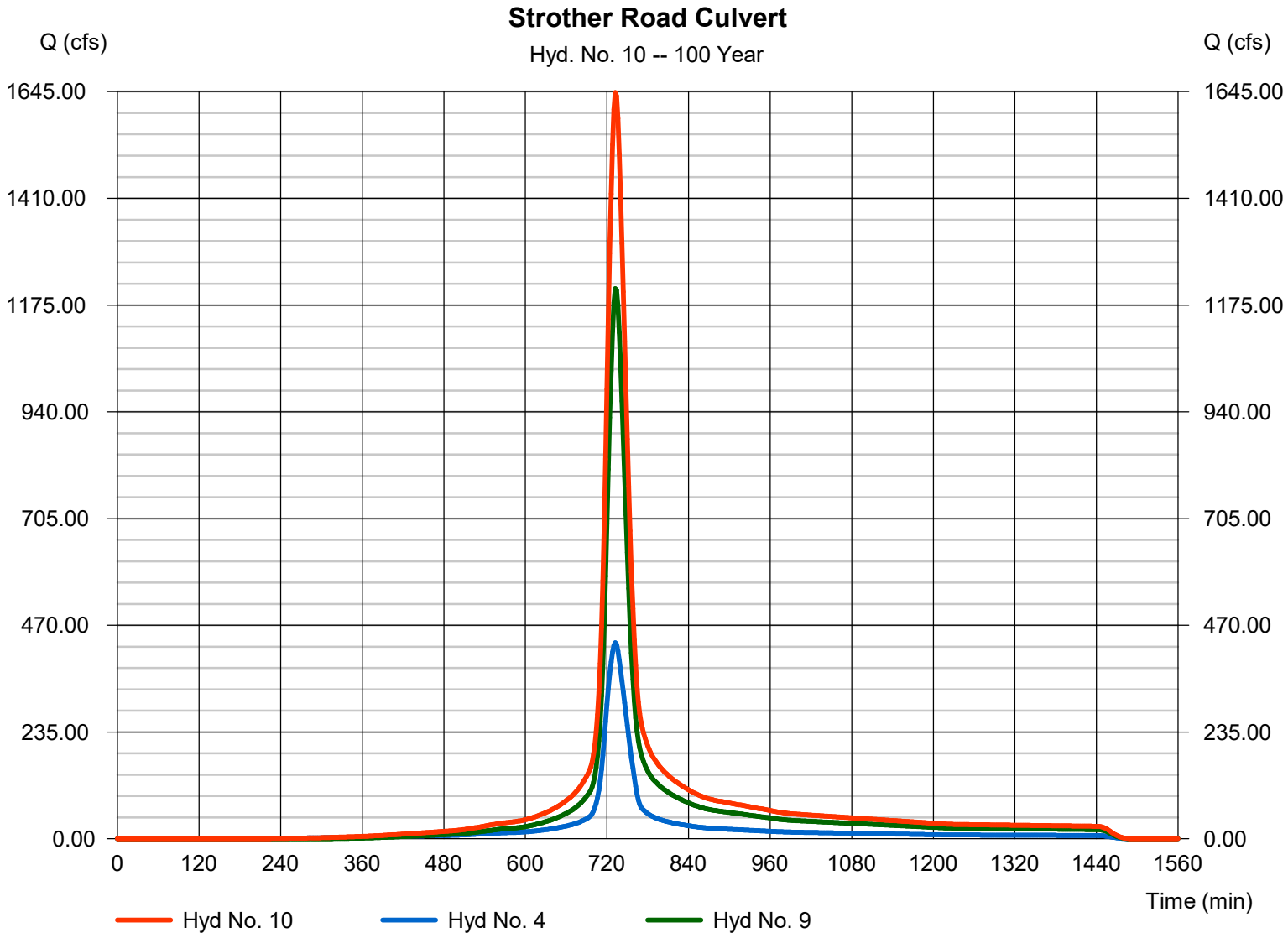


Hydrograph Report

Hyd. No. 10

Strother Road Culvert

Hydrograph type	= Combine	Peak discharge	= 1643.14 cfs
Storm frequency	= 100 yrs	Time to peak	= 732 min
Time interval	= 2 min	Hyd. volume	= 6,730,445 cuft
Inflow hyds.	= 4, 9	Contrib. drain. area	= 82.500 ac



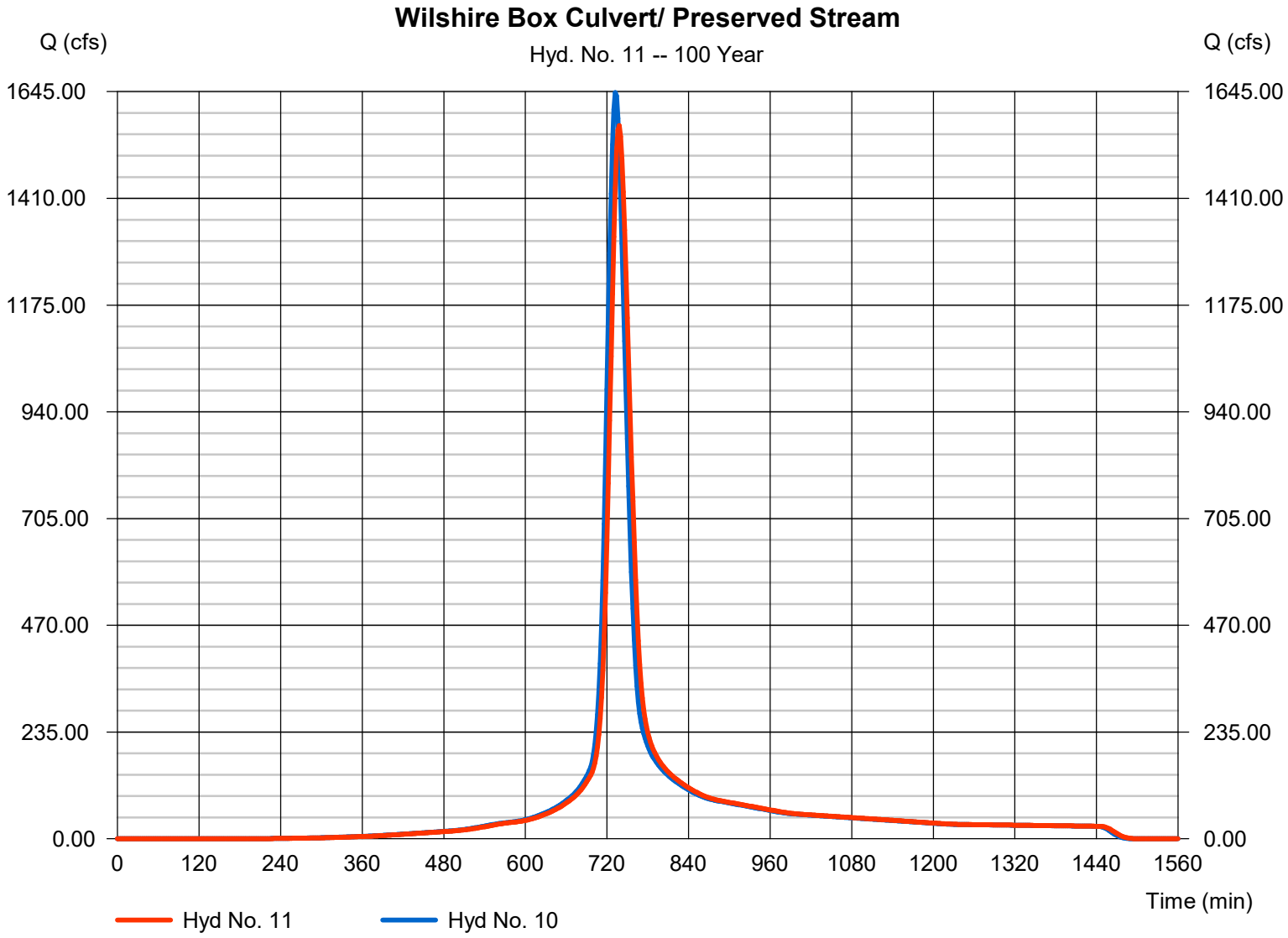
Hydrograph Report

Hyd. No. 11

Wilshire Box Culvert/ Preserved Stream

Hydrograph type	= Reach	Peak discharge	= 1570.20 cfs
Storm frequency	= 100 yrs	Time to peak	= 738 min
Time interval	= 2 min	Hyd. volume	= 6,730,444 cuft
Inflow hyd. No.	= 10 - Strother Road Culvert	Section type	= Trapezoidal
Reach length	= 2200.0 ft	Channel slope	= 1.4 %
Manning's n	= 0.030	Bottom width	= 5.0 ft
Side slope	= 20.0:1	Max. depth	= 5.0 ft
Rating curve x	= 2.009	Rating curve m	= 1.231
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.3835

Modified Att-Kin routing method used.

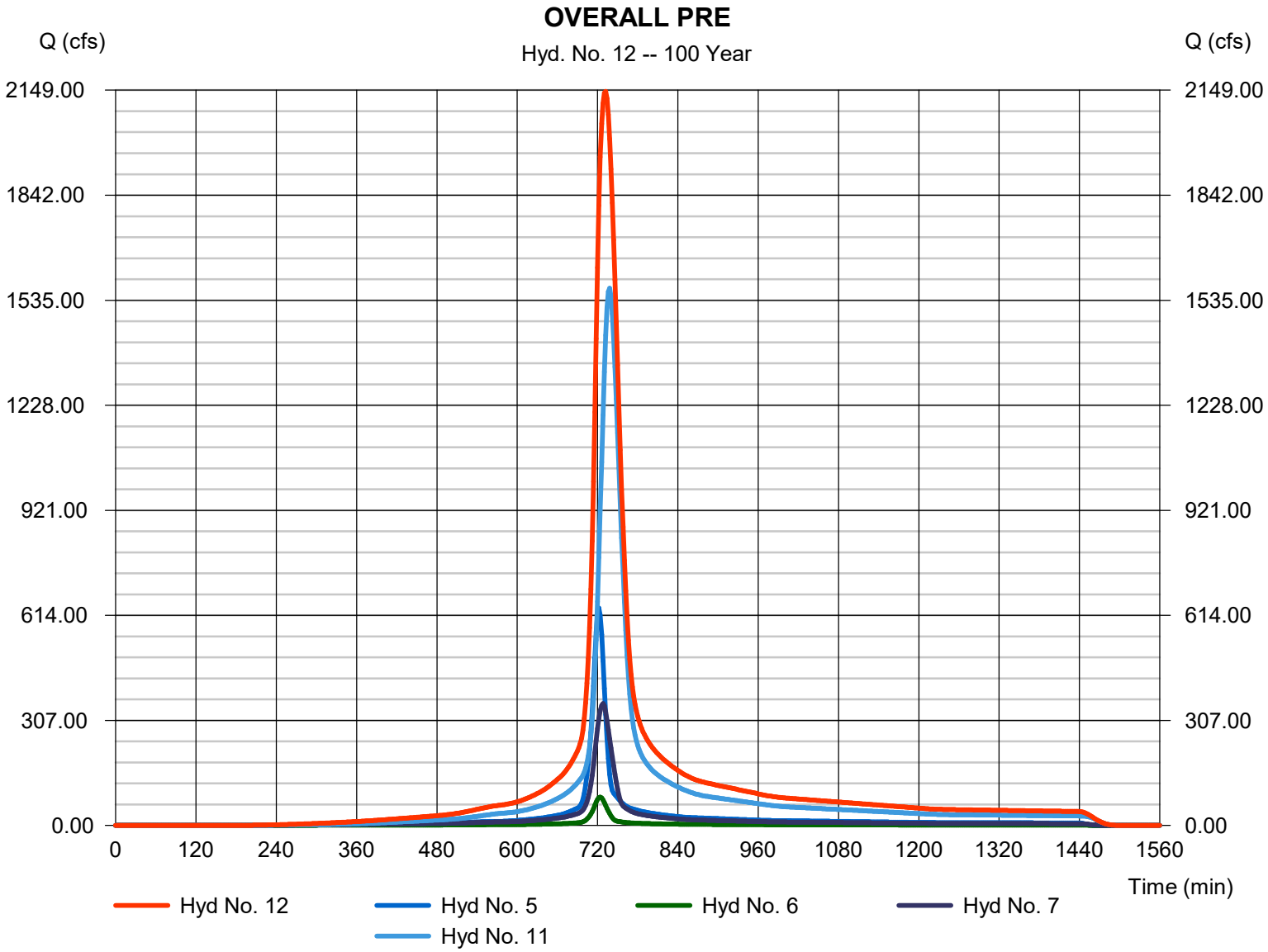


Hydrograph Report

Hyd. No. 12

OVERALL PRE

Hydrograph type	= Combine	Peak discharge	= 2145.77 cfs
Storm frequency	= 100 yrs	Time to peak	= 732 min
Time interval	= 2 min	Hyd. volume	= 10,226,410 cuft
Inflow hyds.	= 5, 6, 7, 11	Contrib. drain. area	= 157.200 ac



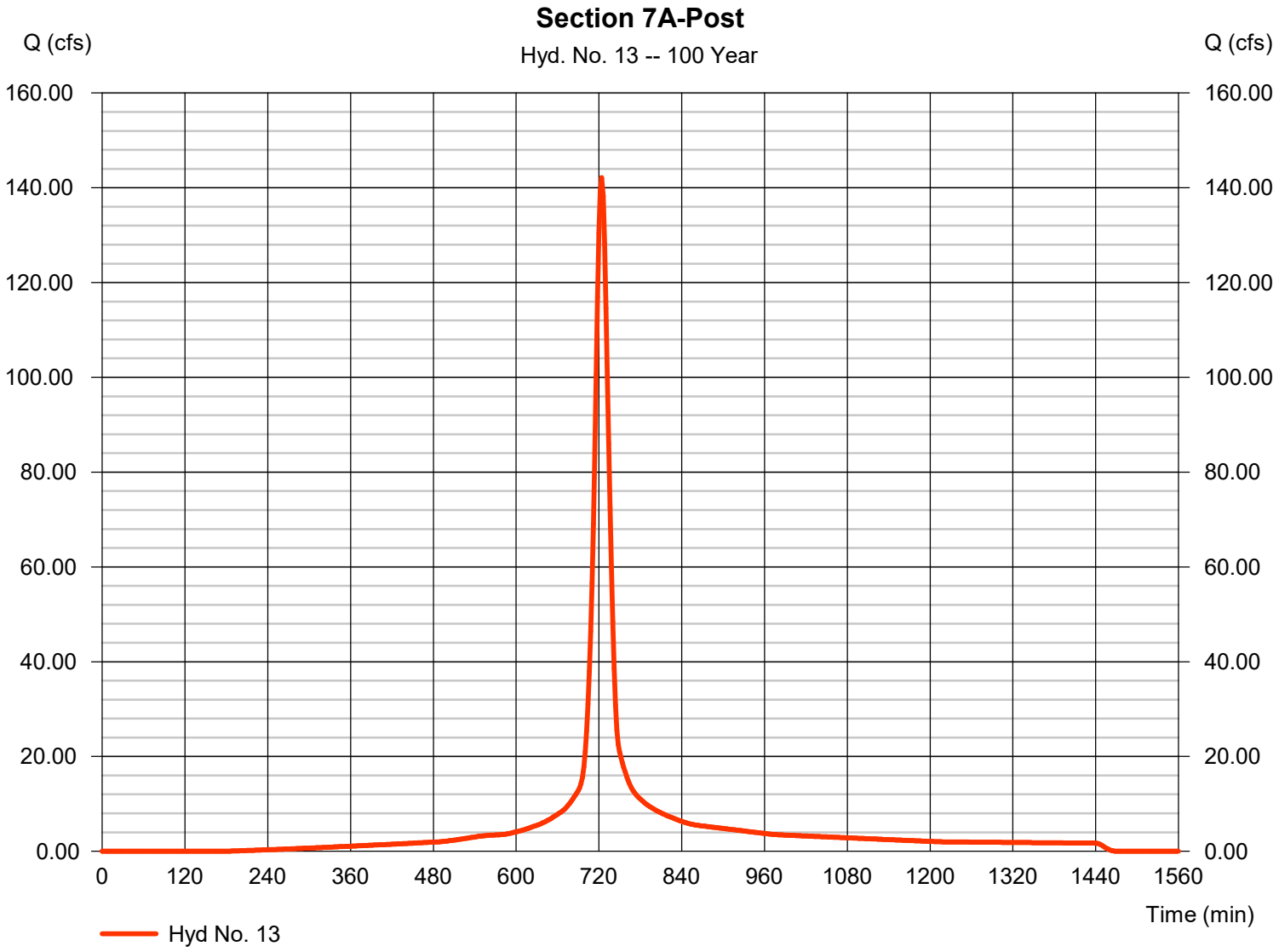
Hydrograph Report

Hyd. No. 13

Section 7A-Post

Hydrograph type	=	SCS Runoff	Peak discharge	=	142.13 cfs
Storm frequency	=	100 yrs	Time to peak	=	724 min
Time interval	=	2 min	Hyd. volume	=	468,866 cuft
Drainage area	=	19.900 ac	Curve number	=	89*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	19.30 min
Total precip.	=	7.80 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(19.900 x 89)] / 19.900



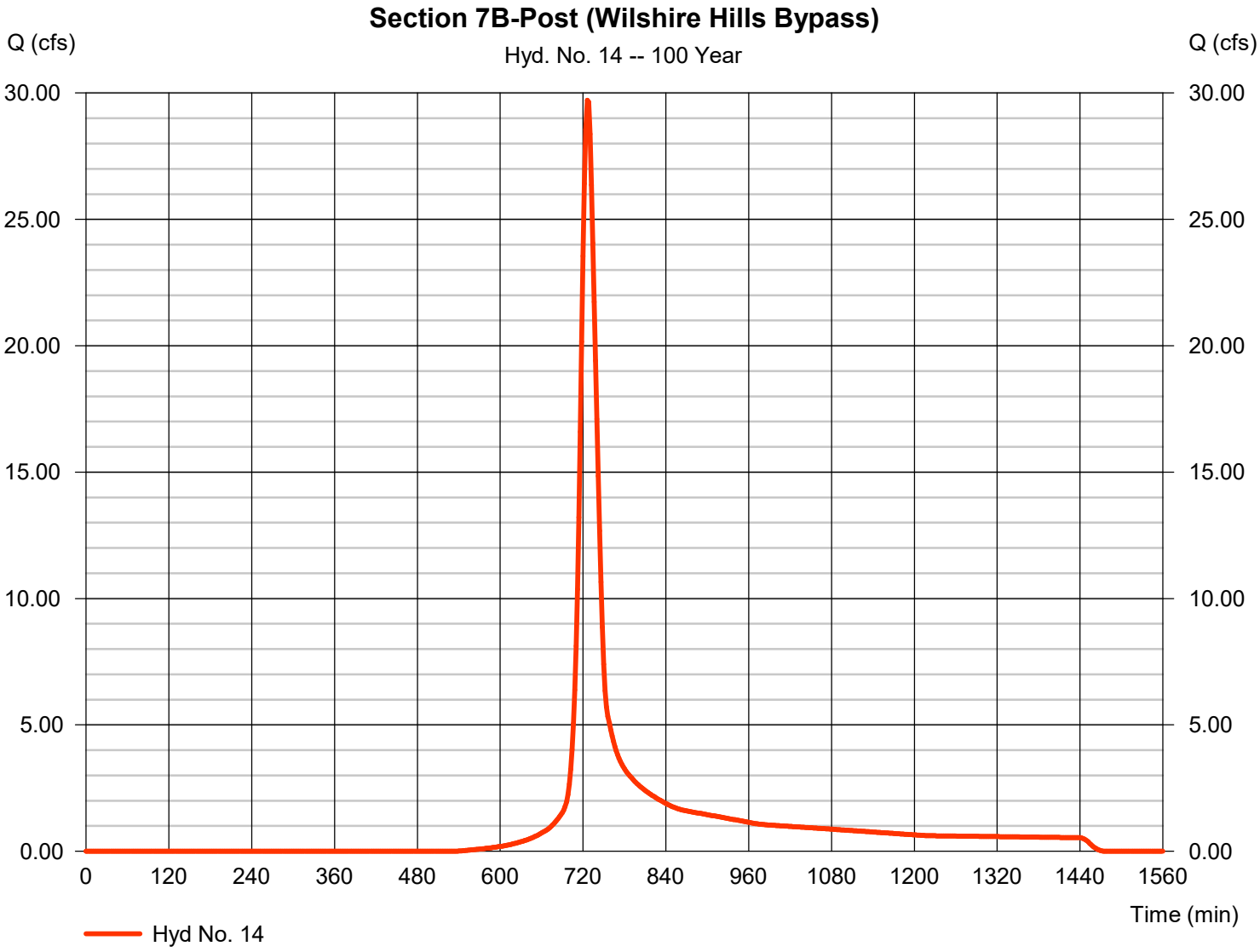
Hydrograph Report

Hyd. No. 14

Section 7B-Post (Wilshire Hills Bypass)

Hydrograph type	=	SCS Runoff	Peak discharge	=	29.71 cfs
Storm frequency	=	100 yrs	Time to peak	=	726 min
Time interval	=	2 min	Hyd. volume	=	103,450 cuft
Drainage area	=	7.500 ac	Curve number	=	65*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	20.50 min
Total precip.	=	7.80 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(13.900 x 89)] / 7.500



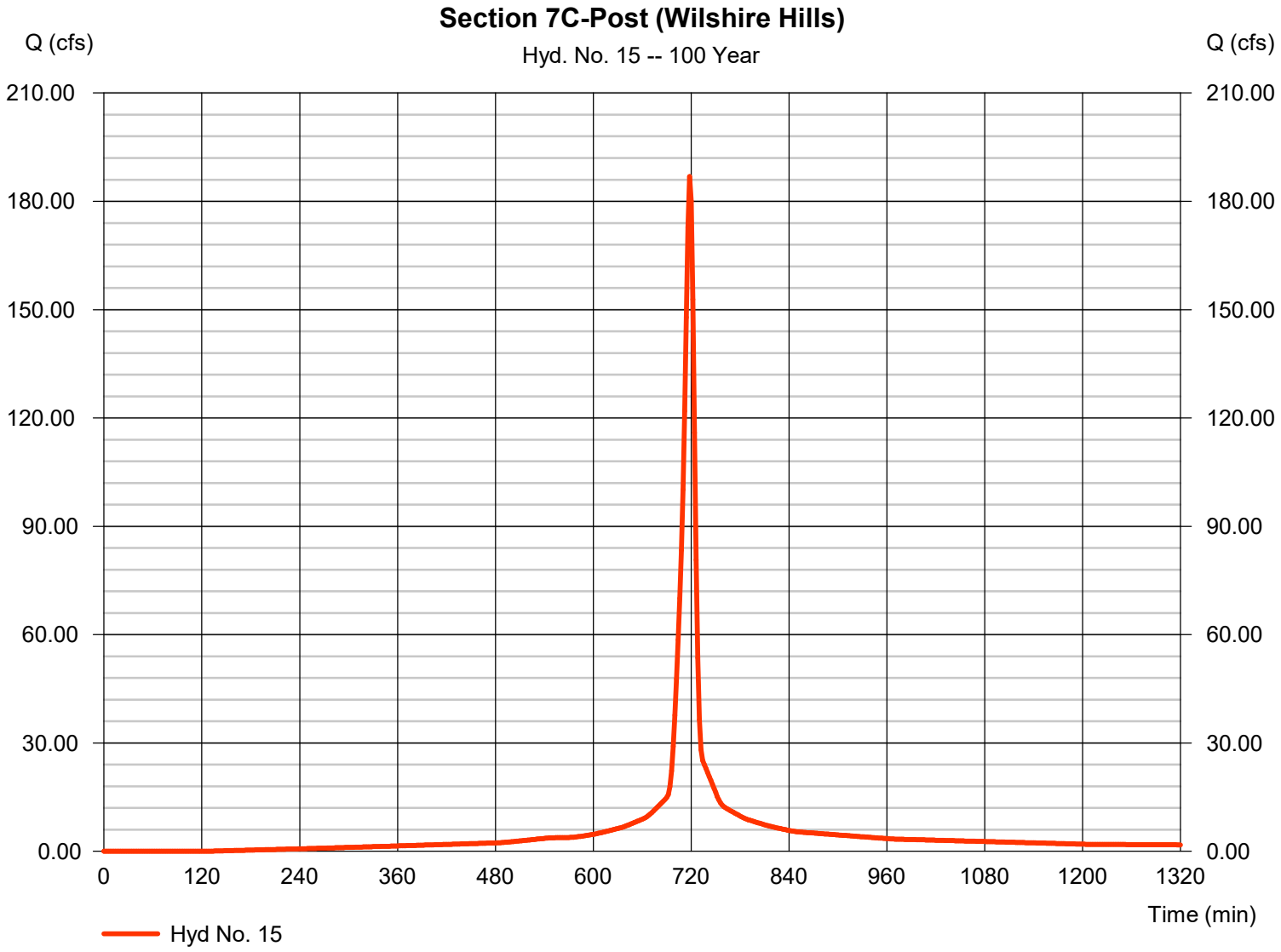
Hydrograph Report

Hyd. No. 15

Section 7C-Post (Wilshire Hills)

Hydrograph type	=	SCS Runoff	Peak discharge	=	186.84 cfs
Storm frequency	=	100 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	472,136 cuft
Drainage area	=	19.000 ac	Curve number	=	92*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	9.28 min
Total precip.	=	7.80 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(14.600 x 98) + (4.400 x 74)] / 19.000



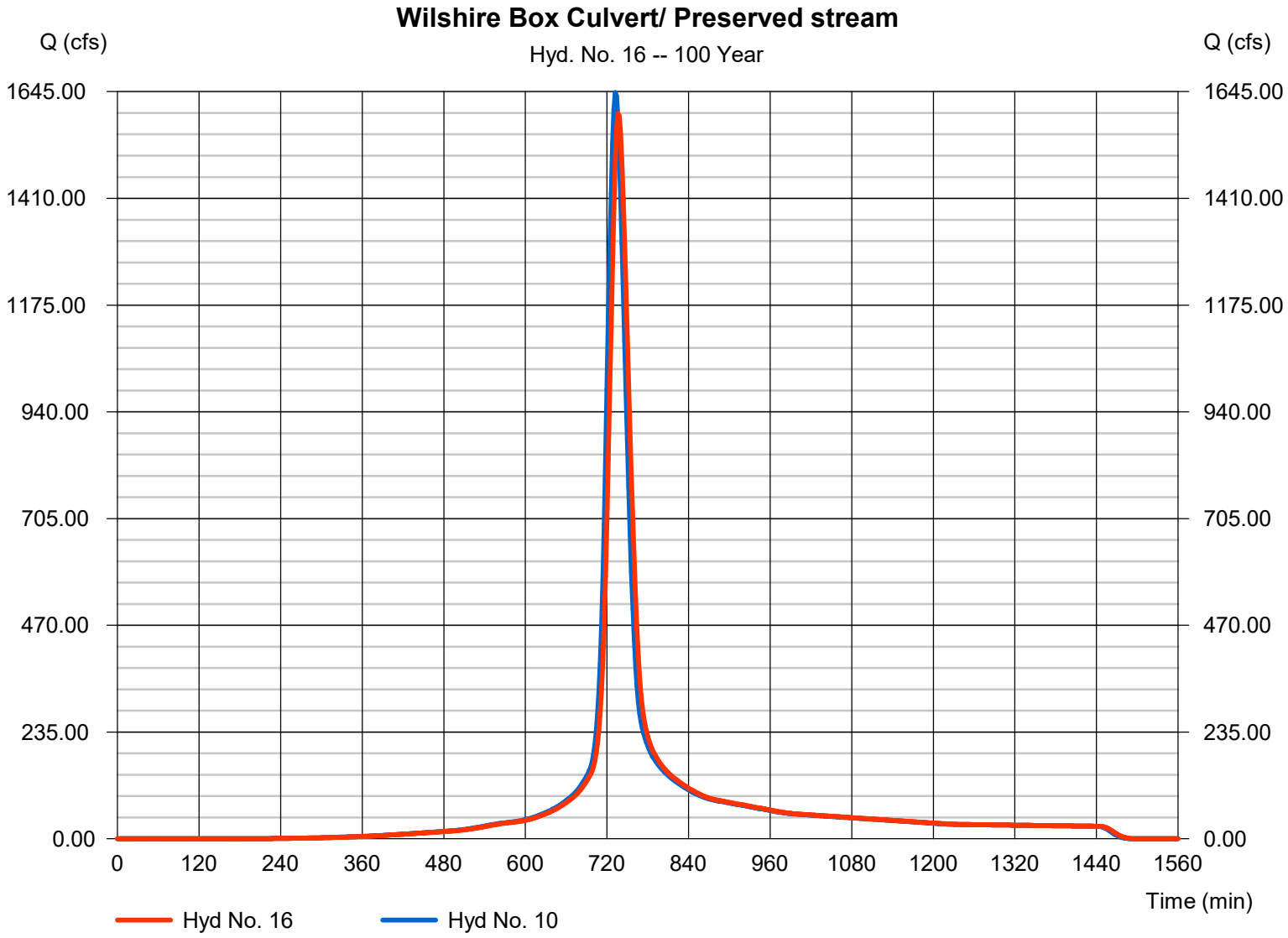
Hydrograph Report

Hyd. No. 16

Wilshire Box Culvert/ Preserved stream

Hydrograph type	= Reach	Peak discharge	= 1596.55 cfs
Storm frequency	= 100 yrs	Time to peak	= 736 min
Time interval	= 2 min	Hyd. volume	= 6,730,439 cuft
Inflow hyd. No.	= 10 - Strother Road Culvert	Section type	= Trapezoidal
Reach length	= 500.0 ft	Channel slope	= 0.5 %
Manning's n	= 0.100	Bottom width	= 10.0 ft
Side slope	= 14.0:1	Max. depth	= 8.0 ft
Rating curve x	= 0.227	Rating curve m	= 1.318
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.4698

Modified Att-Kin routing method used.

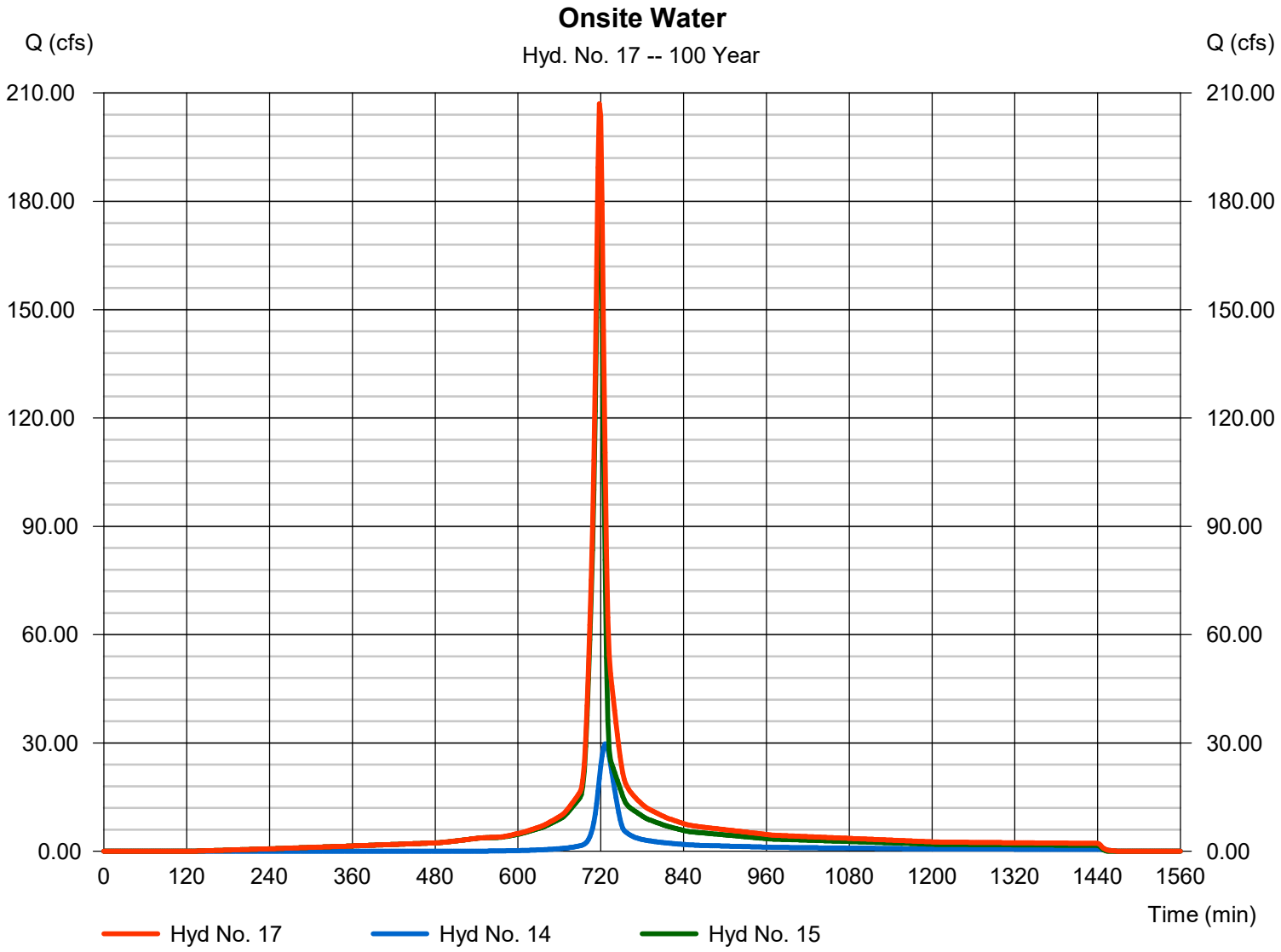


Hydrograph Report

Hyd. No. 17

Onsite Water

Hydrograph type	= Combine	Peak discharge	= 207.01 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 575,586 cuft
Inflow hyds.	= 14, 15	Contrib. drain. area	= 26.500 ac



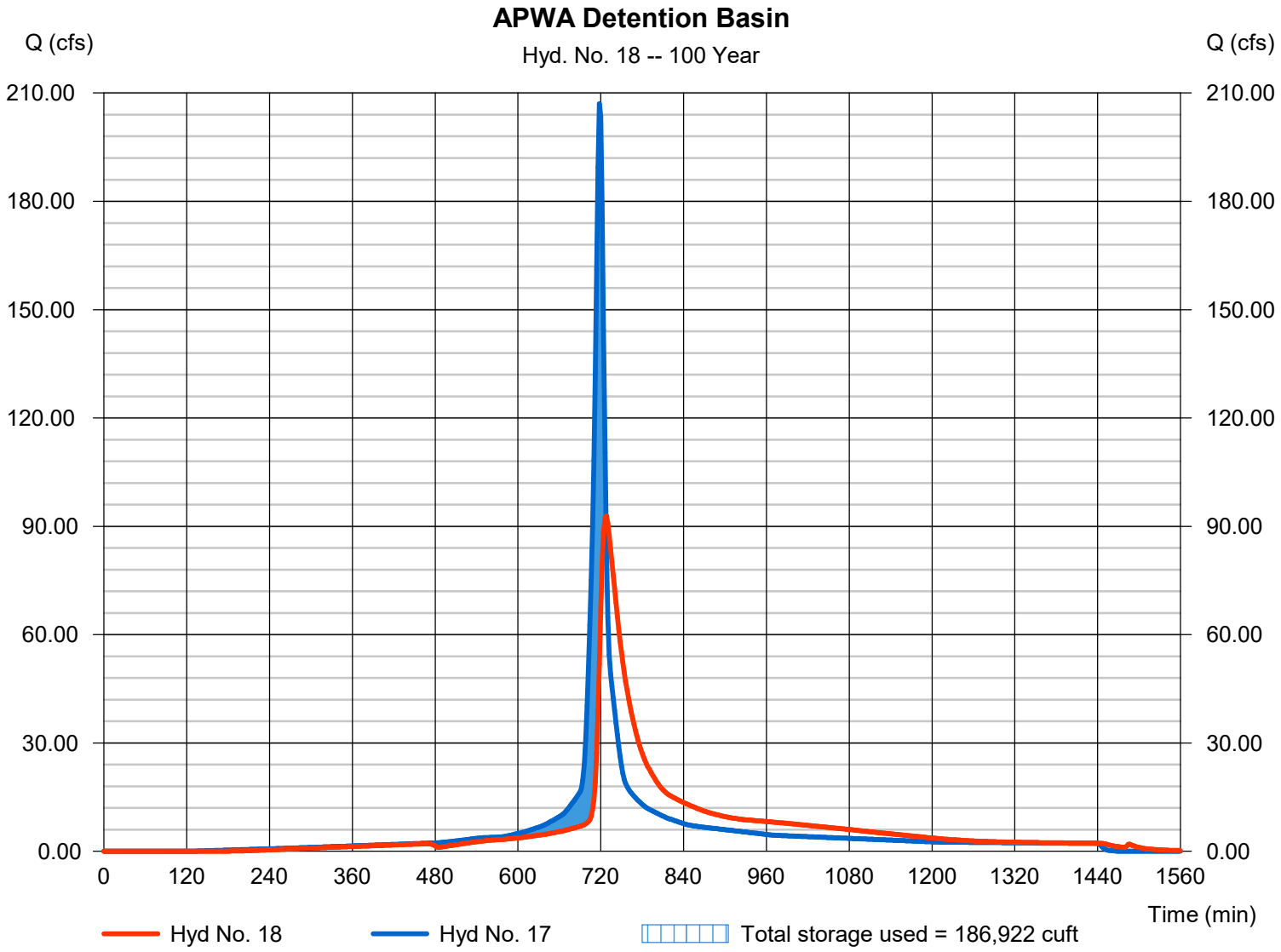
Hydrograph Report

Hyd. No. 18

APWA Detention Basin

Hydrograph type	=	Reservoir	Peak discharge	=	92.90 cfs
Storm frequency	=	100 yrs	Time to peak	=	728 min
Time interval	=	2 min	Hyd. volume	=	575,572 cuft
Inflow hyd. No.	=	17 - Onsite Water	Max. Elevation	=	921.73 ft
Reservoir name	=	Detention Basin	Max. Storage	=	186,922 cuft

Storage Indication method used.

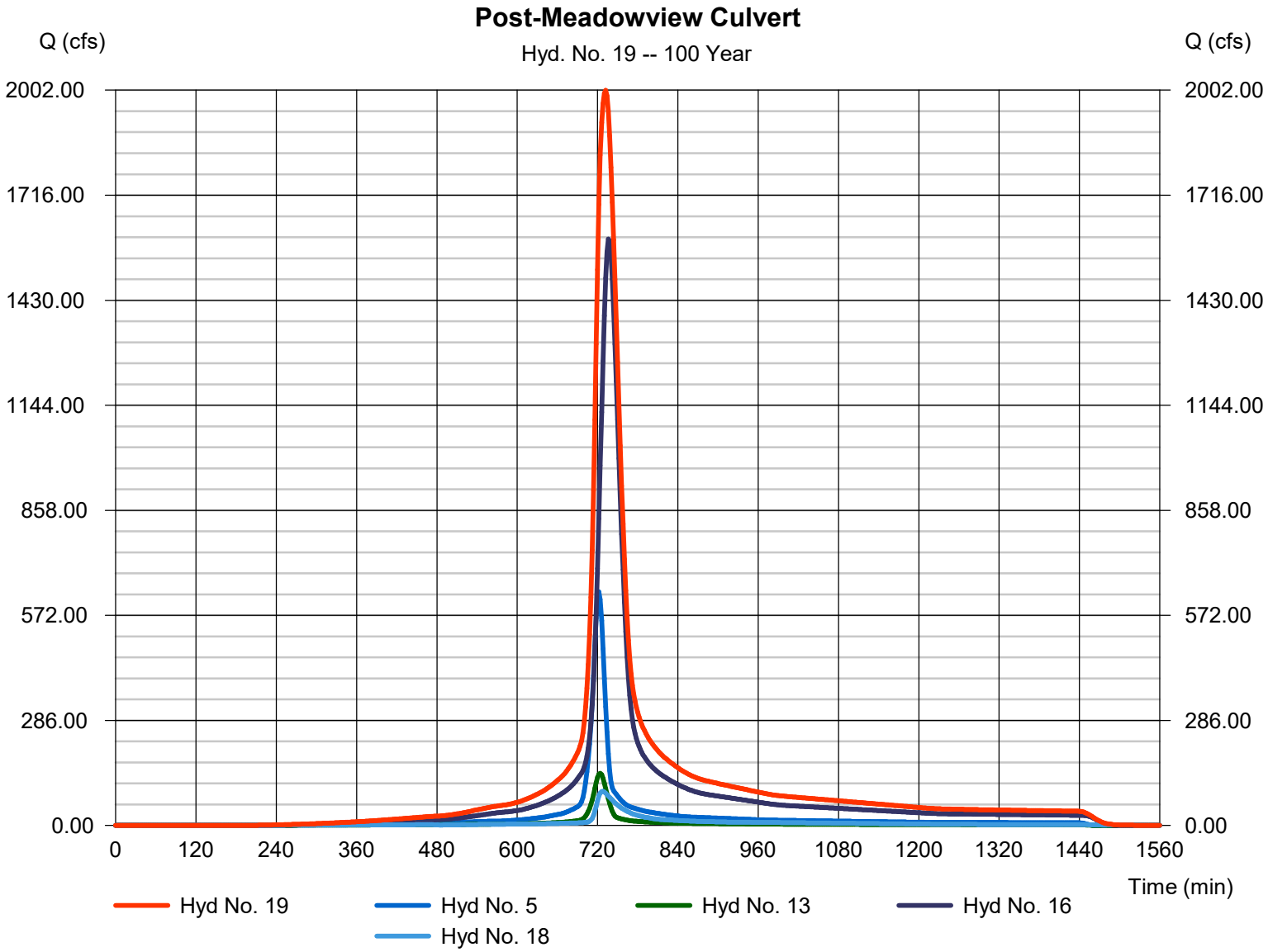


Hydrograph Report

Hyd. No. 19

Post-Meadowview Culvert

Hydrograph type	= Combine	Peak discharge	= 2001.54 cfs
Storm frequency	= 100 yrs	Time to peak	= 732 min
Time interval	= 2 min	Hyd. volume	= 9,626,508 cuft
Inflow hyds.	= 5, 13, 16, 18	Contrib. drain. area	= 106.800 ac



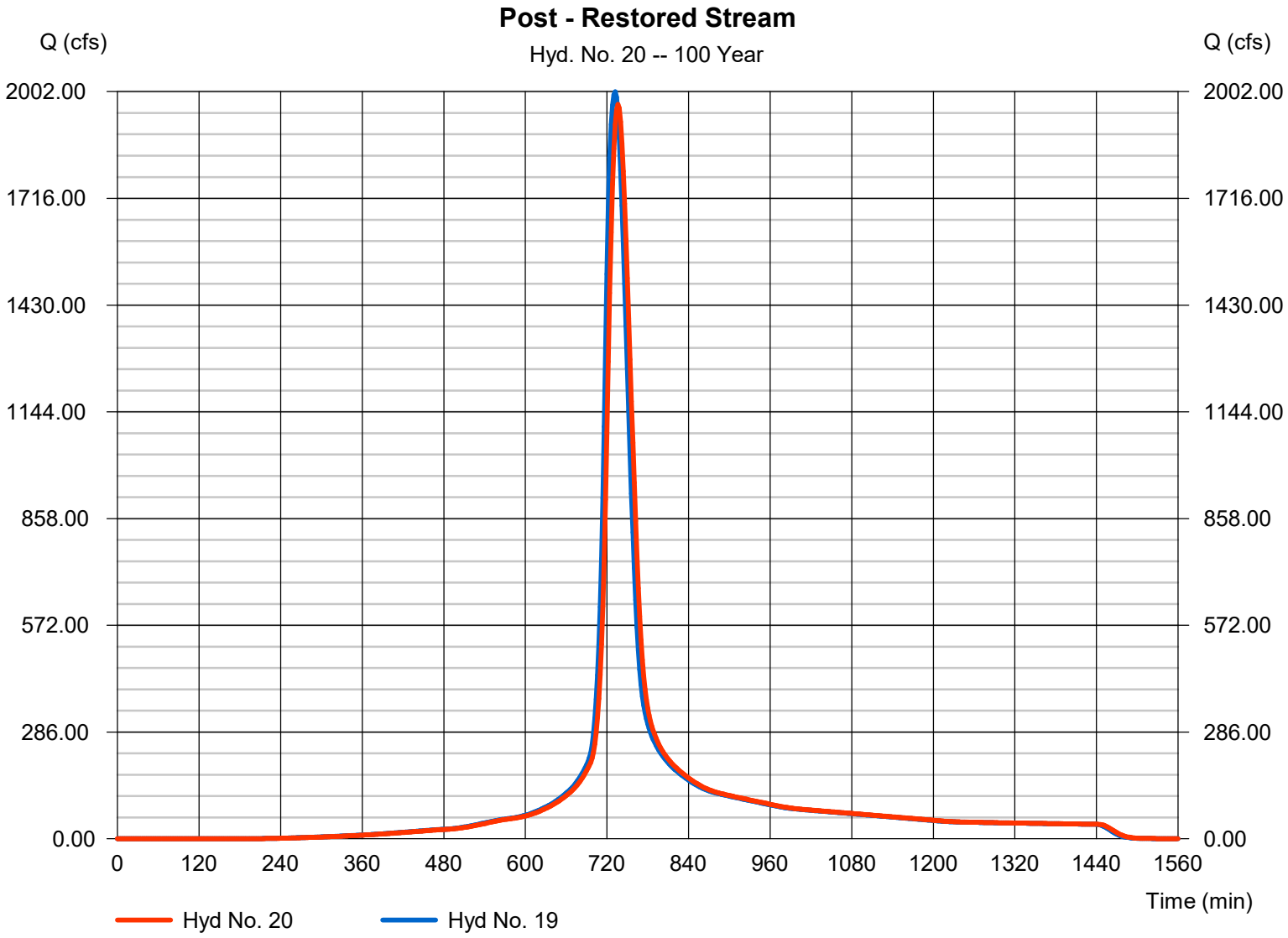
Hydrograph Report

Hyd. No. 20

Post - Restored Stream

Hydrograph type	=	Reach	Peak discharge	=	1967.90 cfs
Storm frequency	=	100 yrs	Time to peak	=	736 min
Time interval	=	2 min	Hyd. volume	=	9,626,407 cuft
Inflow hyd. No.	=	19 - Post-Meadowview Culvert	Section type	=	Trapezoidal
Reach length	=	1340.0 ft	Channel slope	=	0.8 %
Manning's n	=	0.030	Bottom width	=	20.0 ft
Side slope	=	10.0:1	Max. depth	=	4.0 ft
Rating curve x	=	0.595	Rating curve m	=	1.345
Ave. velocity	=	0.00 ft/s	Routing coeff.	=	0.4471

Modified Att-Kin routing method used.



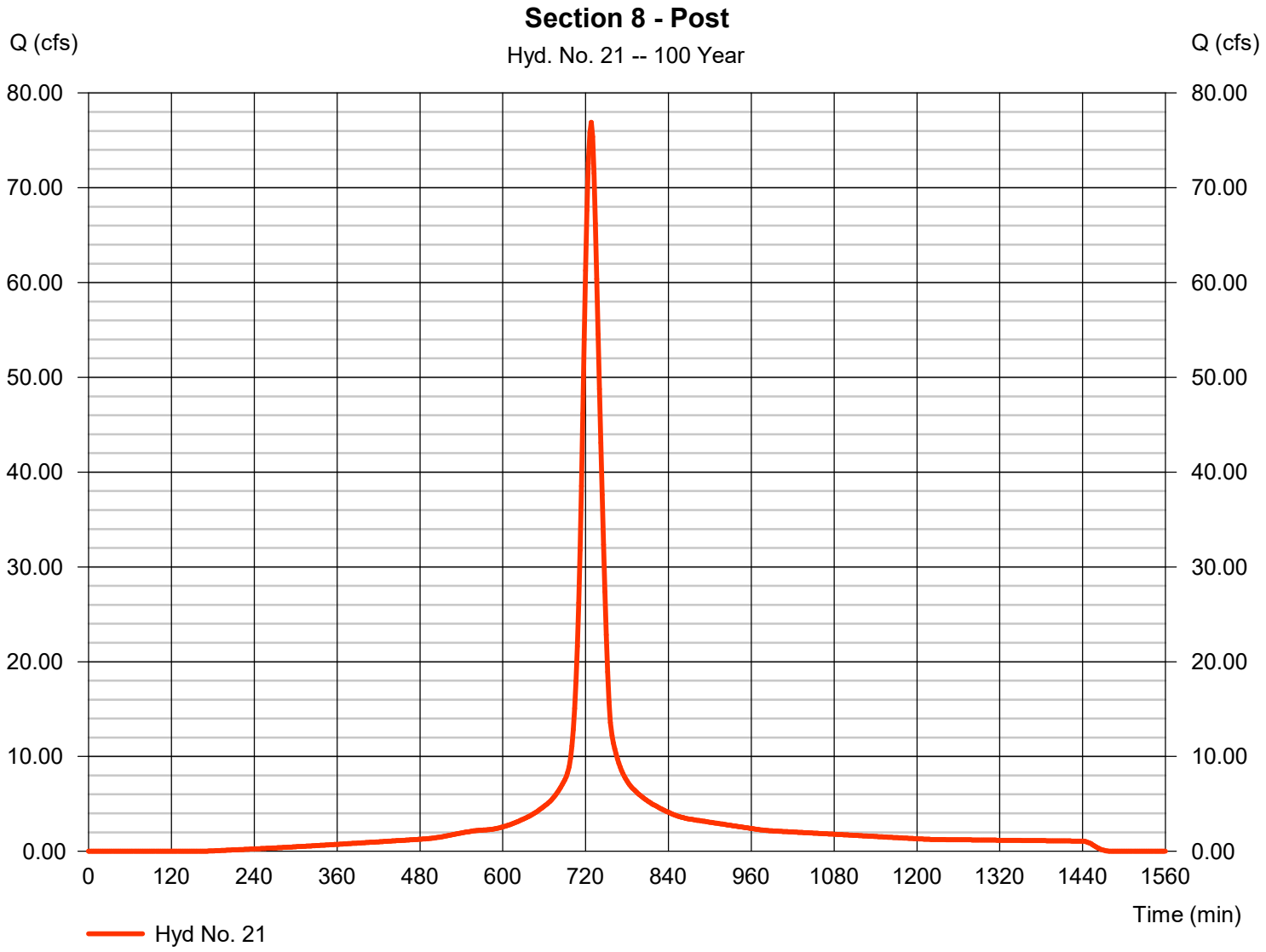
Hydrograph Report

Hyd. No. 21

Section 8 - Post

Hydrograph type	=	SCS Runoff	Peak discharge	=	76.90 cfs
Storm frequency	=	100 yrs	Time to peak	=	728 min
Time interval	=	2 min	Hyd. volume	=	297,548 cuft
Drainage area	=	12.600 ac	Curve number	=	90*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	23.90 min
Total precip.	=	7.80 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(12.600 x 90)] / 12.600

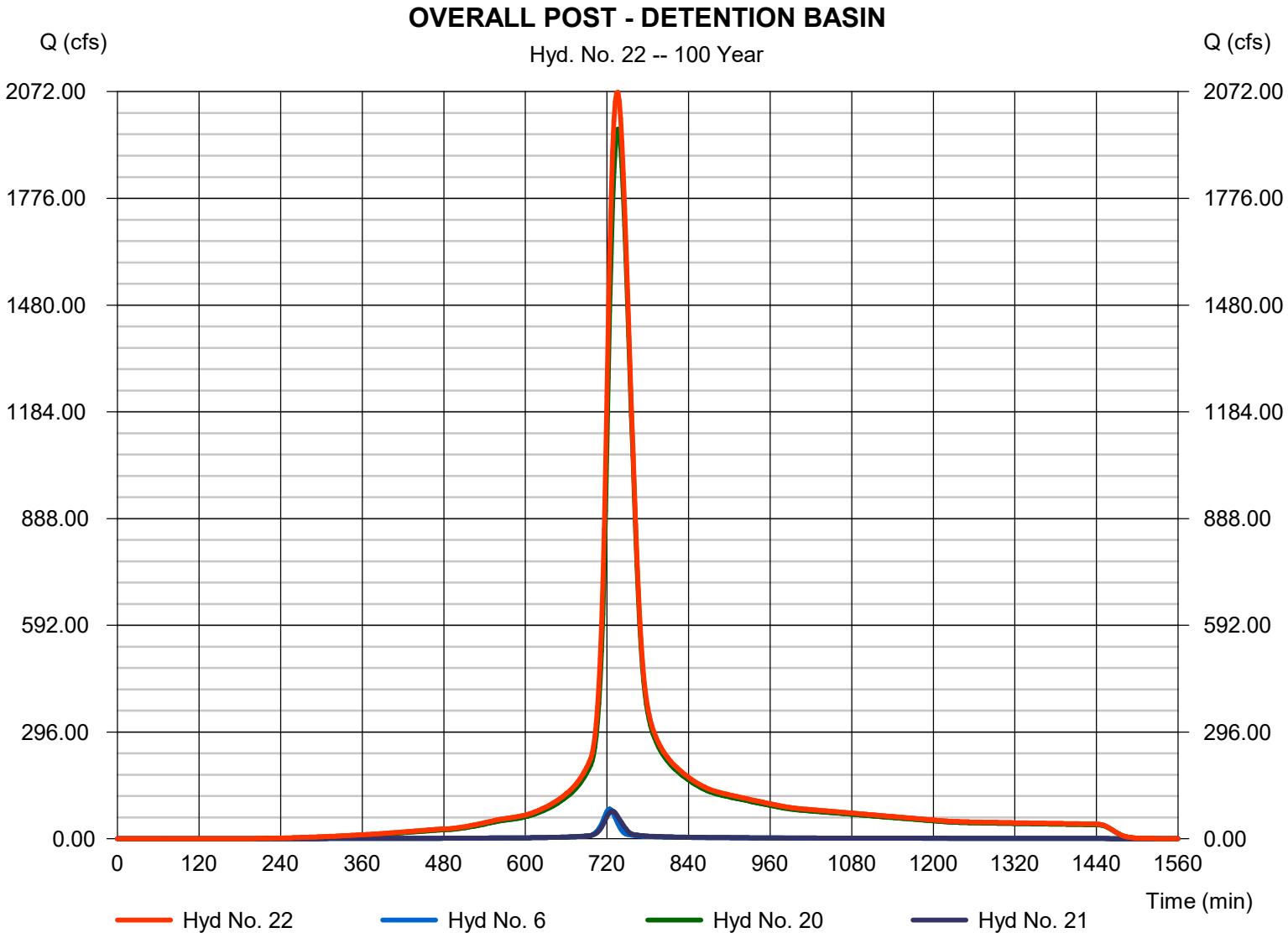


Hydrograph Report

Hyd. No. 22

OVERALL POST - DETENTION BASIN

Hydrograph type	= Combine	Peak discharge	= 2070.16 cfs
Storm frequency	= 100 yrs	Time to peak	= 736 min
Time interval	= 2 min	Hyd. volume	= 10,199,890 cuft
Inflow hyds.	= 6, 20, 21	Contrib. drain. area	= 23.900 ac



Hydrograph Report

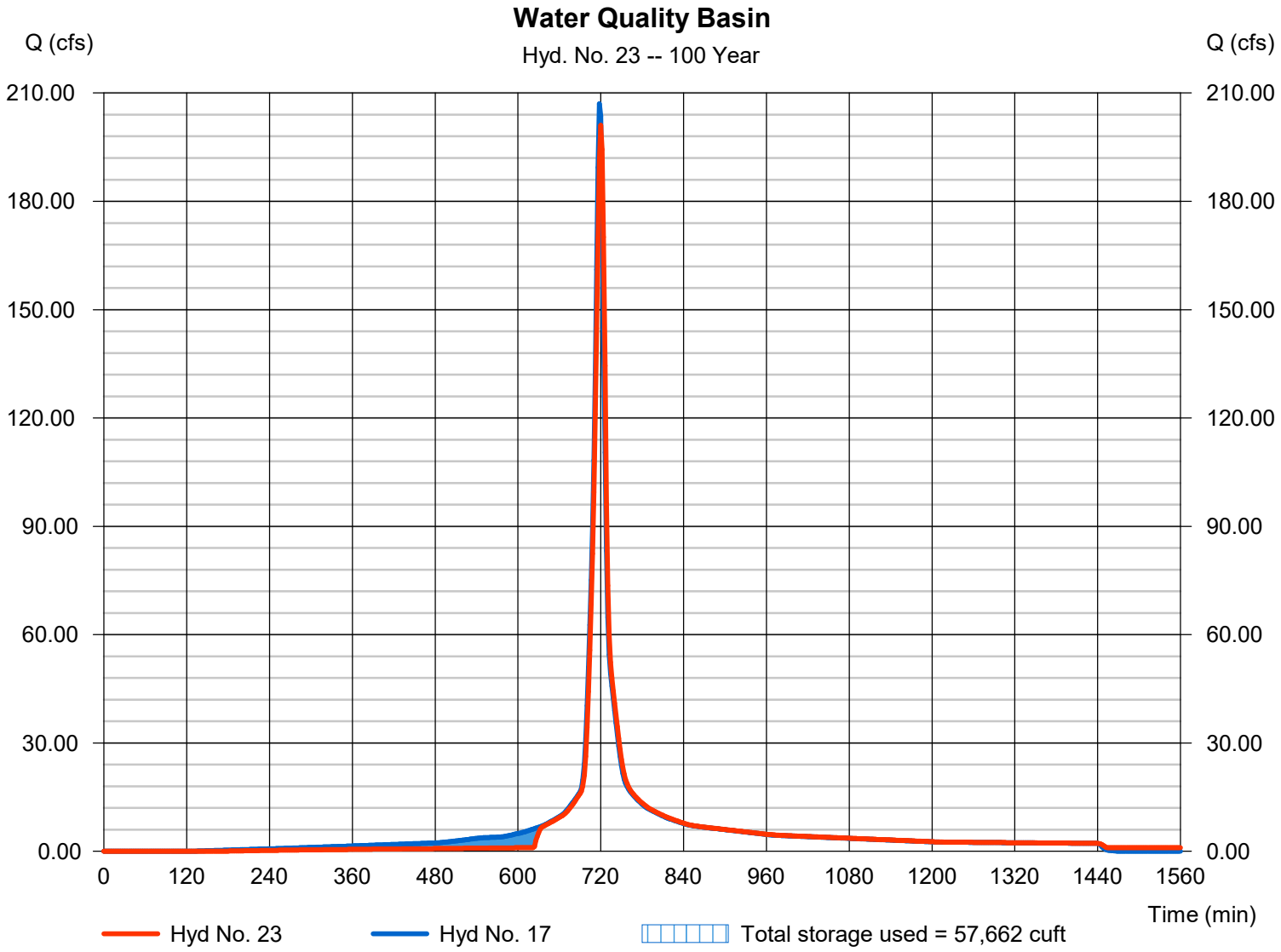
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023 Friday, 02 / 16 / 2024

Hyd. No. 23

Water Quality Basin

Hydrograph type	=	Reservoir	Peak discharge	=	201.03 cfs
Storm frequency	=	100 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	575,571 cuft
Inflow hyd. No.	=	17 - Onsite Water	Max. Elevation	=	919.48 ft
Reservoir name	=	Water Quality Basin	Max. Storage	=	57,662 cuft

Storage Indication method used.

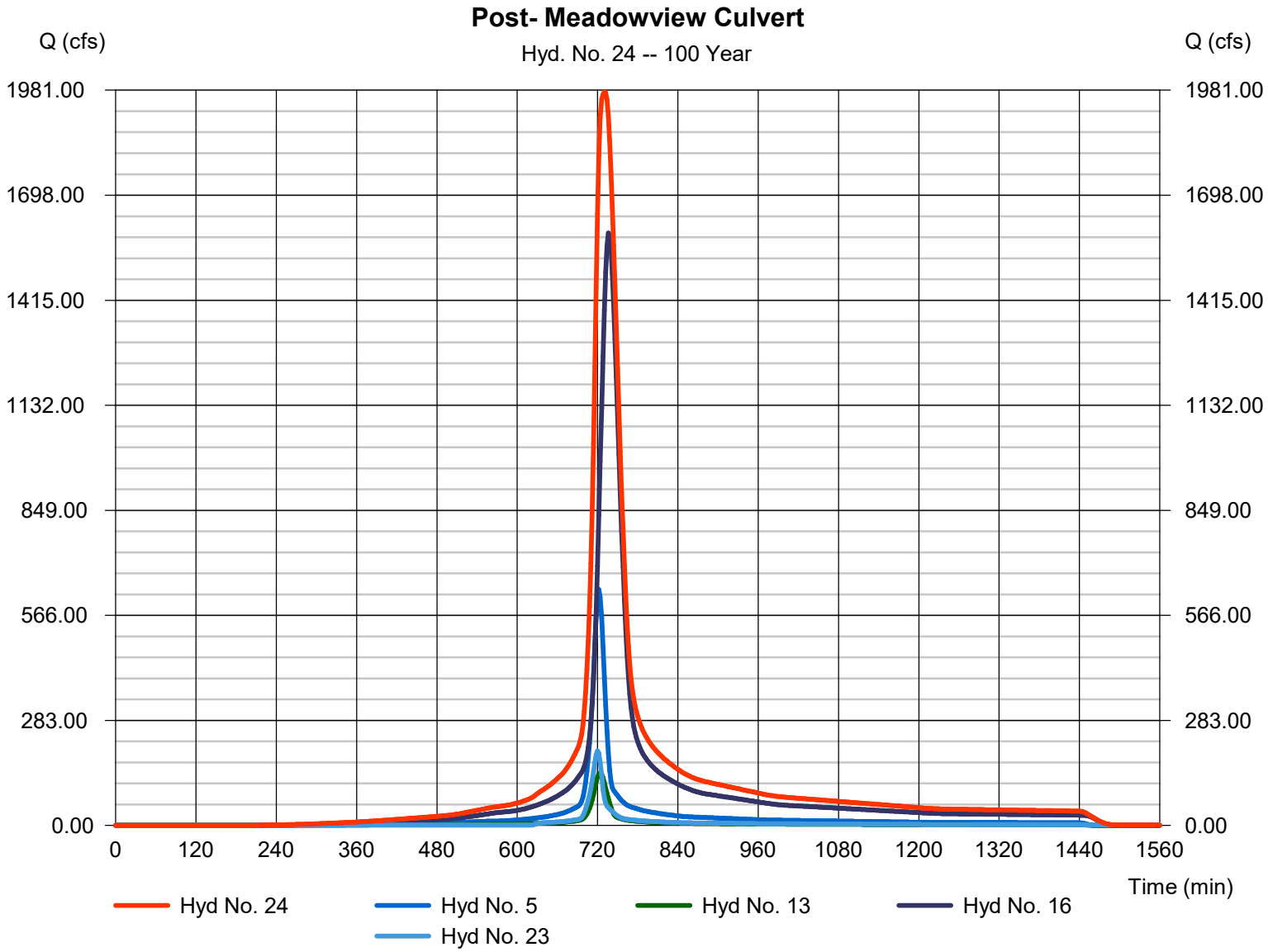


Hydrograph Report

Hyd. No. 24

Post- Meadowview Culvert

Hydrograph type	= Combine	Peak discharge	= 1976.30 cfs
Storm frequency	= 100 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 9,626,497 cuft
Inflow hyds.	= 5, 13, 16, 23	Contrib. drain. area	= 106.800 ac



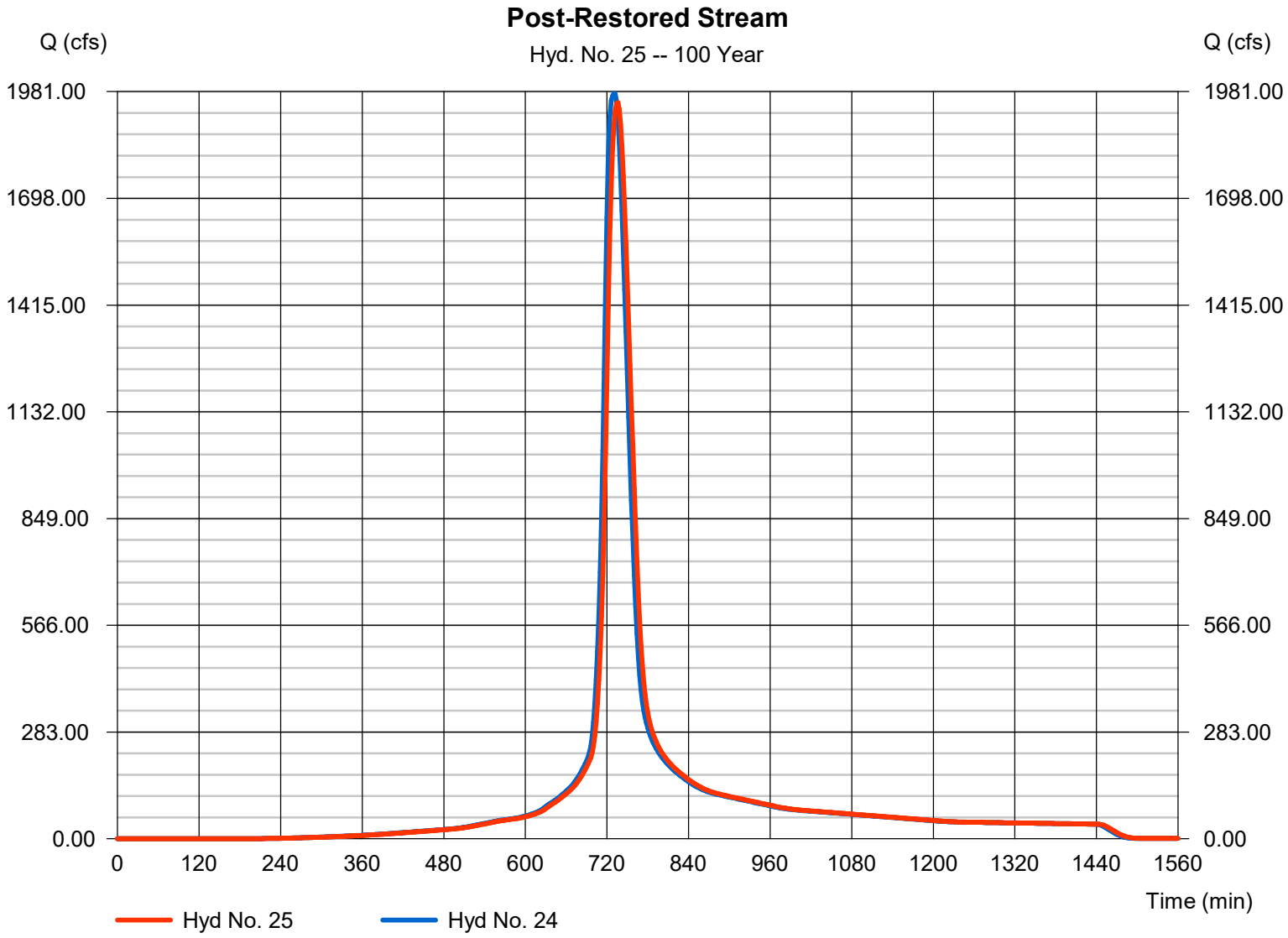
Hydrograph Report

Hyd. No. 25

Post-Restored Stream

Hydrograph type	=	Reach	Peak discharge	=	1951.86 cfs
Storm frequency	=	100 yrs	Time to peak	=	736 min
Time interval	=	2 min	Hyd. volume	=	9,626,392 cuft
Inflow hyd. No.	=	24 - Post- Meadowview Culvert	Section type	=	Trapezoidal
Reach length	=	1340.0 ft	Channel slope	=	0.8 %
Manning's n	=	0.030	Bottom width	=	20.0 ft
Side slope	=	10.0:1	Max. depth	=	4.0 ft
Rating curve x	=	0.595	Rating curve m	=	1.345
Ave. velocity	=	0.00 ft/s	Routing coeff.	=	0.4460

Modified Att-Kin routing method used.

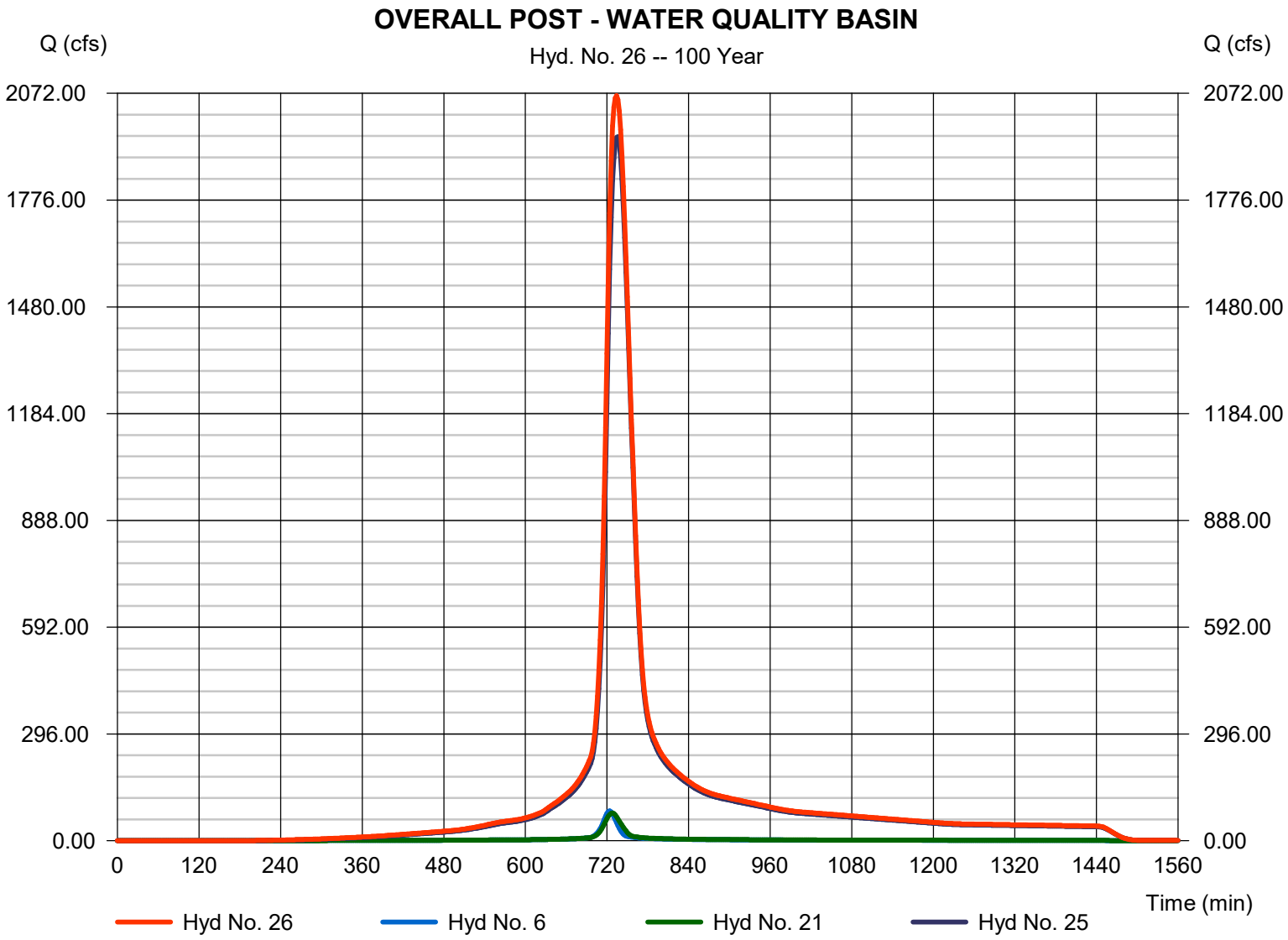


Hydrograph Report

Hyd. No. 26

OVERALL POST - WATER QUALITY BASIN

Hydrograph type	= Combine	Peak discharge	= 2065.34 cfs
Storm frequency	= 100 yrs	Time to peak	= 734 min
Time interval	= 2 min	Hyd. volume	= 10,199,890 cuft
Inflow hyds.	= 6, 21, 25	Contrib. drain. area	= 23.900 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	--------
2	58.7310	12.5000	0.8339	--------
3	0.0000	0.0000	0.0000	--------
5	76.3517	14.4000	0.8324	--------
10	89.1197	15.3000	0.8331	--------
25	108.4324	16.3000	0.8361	--------
50	123.7045	16.9000	0.8383	--------
100	140.0626	17.5000	0.8416	--------

File name: Kansas City, MO Area.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	5.40	4.38	3.70	3.22	2.86	2.58	2.35	2.16	2.00	1.87	1.75	1.65
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	6.47	5.34	4.58	4.02	3.59	3.25	2.97	2.74	2.55	2.38	2.24	2.11
10	7.26	6.04	5.20	4.58	4.10	3.72	3.41	3.15	2.93	2.74	2.58	2.43
25	8.40	7.05	6.09	5.38	4.83	4.39	4.03	3.73	3.47	3.25	3.06	2.89
50	9.31	7.83	6.79	6.01	5.40	4.91	4.51	4.18	3.89	3.65	3.44	3.25
100	10.19	8.61	7.48	6.63	5.97	5.44	5.00	4.63	4.31	4.04	3.81	3.60

Tc = time in minutes. Values may exceed 60.

Precip. file name: C:\MYFILES\Kansas City, MO Area.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	3.00	3.50	0.00	4.60	5.30	6.20	7.00	7.80
SCS 6-Hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Weir Report

Wilshire Hills Water Quality Basin

Trapezoidal Weir

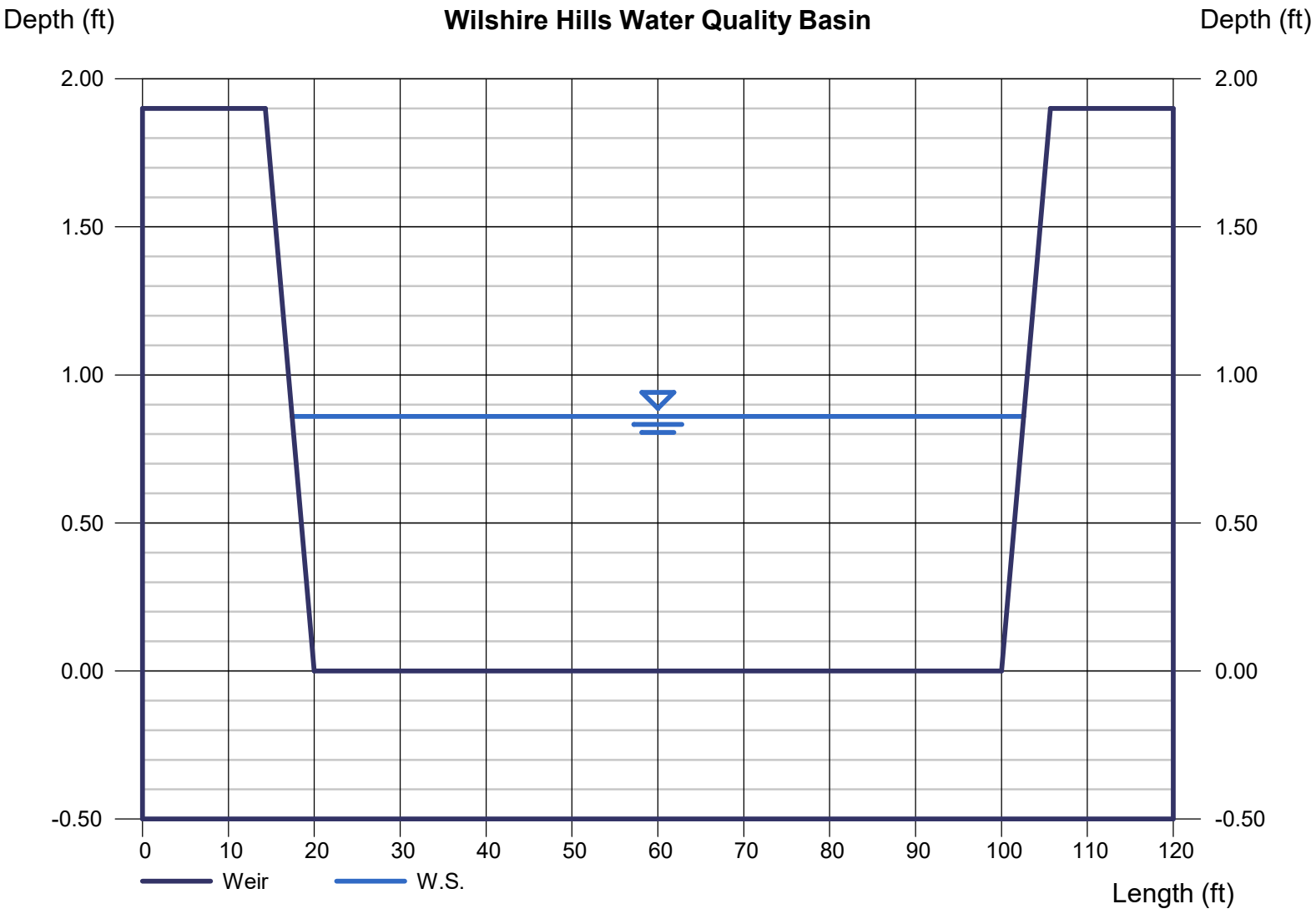
Crest	= Sharp
Bottom Length (ft)	= 80.00
Total Depth (ft)	= 1.90
Side Slope (z:1)	= 3.00

Calculations

Weir Coeff. Cw	= 3.10
Compute by:	Known Q
Known Q (cfs)	= 200.98

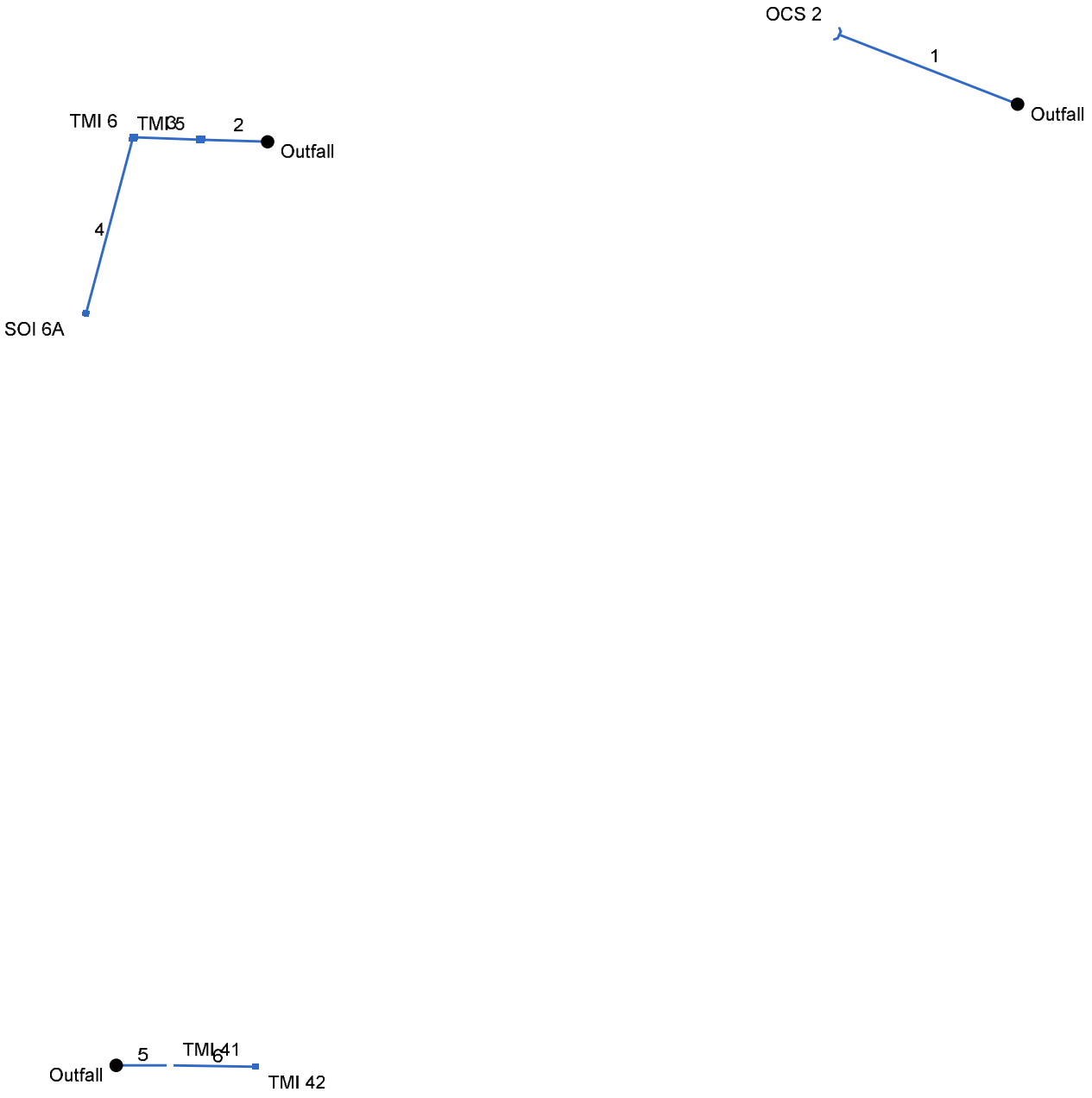
Highlighted

Depth (ft)	= 0.86
Q (cfs)	= 200.98
Area (sqft)	= 71.02
Velocity (ft/s)	= 2.83
Top Width (ft)	= 85.16



APPENDIX D:
STORM SEWER CALCULATIONS

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Storm Sewers-OFFSITE ONLY- 25 Year Storm.stm	Number of lines: 6	Date: 10/4/2023

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	EX WALL	16.63	60	Cir	95.300	910.75	911.15	0.420	912.32	912.27	n/a	912.27 j	End	OpenHeadwall
2	FES 4	33.34	36	Cir	33.145	922.47	922.64	0.513	924.74	924.51	0.40	924.51	End	Curb-Horiz
3	6	32.85	36	Cir	33.000	922.83	923.00	0.515	924.56	924.86	n/a	924.86	2	Curb-Horiz
4	6A	31.80	24	Cir	99.000	923.20	923.69	0.495	925.20*	926.87*	1.59	928.46	3	DropCurb
5	FES 40	1.24	24	Cir	26.463	928.76	929.03	1.020	929.08	929.41	0.07	929.41	End	Curb-Horiz
6	42	0.62	24	Cir	42.000	929.23	929.65	1.000	929.45	929.92	0.09	929.92	5	Curb-Horiz

Project File: Storm Sewers-OFFSITE ONLY- 25 Year Storm.stm | Number of lines: 6 | Run Date: 10/4/2023

NOTES: Return period = 25 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	95.300	0.00	0.00	0.00	0.00	0.00	5.0	5.0	0.0	16.63	182.8	4.10	60	0.42	910.75	911.15	912.32	912.27	0.00	920.00	EX WALL
2	End	33.145	0.16	10.59	0.64	0.10	6.97	5.0	25.2	4.8	33.34	51.75	6.50	36	0.51	922.47	922.64	924.74	924.51	0.00	928.10	FES 4
3	2	33.000	0.36	10.43	0.61	0.22	6.87	5.0	25.2	4.8	32.85	51.86	7.45	36	0.52	922.83	923.00	924.56	924.86	928.10	929.66	6
4	3	99.000	10.07	10.07	0.66	6.65	6.65	25.2	25.2	4.8	31.80	17.24	10.12	24	0.49	923.20	923.69	925.20	926.87	929.66	929.00	6A
5	End	26.463	0.13	0.26	0.58	0.08	0.15	5.0	5.0	8.2	1.24	24.75	3.39	24	1.02	928.76	929.03	929.08	929.41	0.00	934.65	FES 40
6	5	42.000	0.13	0.13	0.58	0.08	0.08	5.0	5.0	8.2	0.62	24.50	2.88	24	1.00	929.23	929.65	929.45	929.92	934.65	934.65	42

Project File: Storm Sewers-OFFSITE ONLY- 25 Year Storm.stm

Number of lines: 6

Run Date: 10/4/2023

NOTES:Intensity = 102.61 / (Inlet time + 16.50) ^ 0.82; Return period =Yrs. 25 ; Pipe travel time suppressed. ; c = cir e = ellip b = box

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q Byp (cfs)	Junc Type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp Line No
							Ht (in)	L (ft)	Area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
1	OCS 2	16.63*	0.00	16.63	0.00	Hdwl	0.0	0.00	0.00	0.00	0.00	Sag	2.00	0.020	0.020	0.013	0.00	0.00	0.00	0.00	0.0	Off
2	TMI 5	0.84	0.00	0.84	0.00	Curb	6.0	2.93	0.00	0.00	0.00	Sag	1.50	0.020	0.020	0.013	0.21	10.48	0.21	10.48	0.0	Off
3	TMI 6	1.81	0.00	1.81	0.00	Curb	6.0	2.93	0.00	0.00	0.00	Sag	1.50	0.020	0.020	0.013	0.35	17.43	0.35	17.43	0.0	Off
4	SOI 6A	31.80	0.00	31.80	0.00	DrCrb	12.0	5.00	0.00	0.00	0.00	Sag	0.00	0.020	0.020	0.013	1.90	95.06	1.90	95.06	0.0	Off
5	TMI 41	0.62	0.00	0.62	0.00	Curb	4.0	1.00	0.00	0.00	0.00	Sag	2.00	0.050	0.020	0.013	0.21	7.55	0.21	7.55	0.0	Off
6	TMI 42	0.62	0.00	0.62	0.00	Curb	6.0	4.00	0.00	0.00	0.00	Sag	2.00	0.050	0.020	0.013	0.17	5.40	0.17	5.40	0.0	Off

Project File: Storm Sewers-OFFSITE ONLY- 25 Year Storm.stm | Number of lines: 6 | Run Date: 10/4/2023

NOTES: Inlet N-Values = 0.016; Intensity = 102.61 / (Inlet time + 16.50) ^ 0.82; Return period = 25 Yrs. ; * Indicates Known Q added. All curb inlets are Horiz throat.

Storm Sewer Inlet Time Tabulation

Line No.	Line ID	Tc Method	Sheet Flow					Shallow Concentrated Flow					Channel Flow							Total Travel Time (min)
			n-Value	flow Length (ft)	2-yr 24h P (in)	Land Slope (%)	Travel Time (min)	flow Length (ft)	Water Slope (%)	Surf Descr	Ave Vel (ft/s)	Travel Time (min)	X-sec Area (sqft)	Wetted Perim (ft)	Chan Slope (%)	n-Value	Vel	flow Length (ft)	Travel Time (min)	
1	EX WALL	User																		5.00
2	FES 4	User																		5.00
3	6	User																		5.00
4	6A	User																		25.20
5	FES 40	User																		5.00
6	42	User																		5.00

Project File: Storm Sewers-OFFSITE ONLY- 25 Year Storm.stm | Min. Tc used for intensity calculations = 5 min | Number of lines: 6 | Date: 10/4/2023

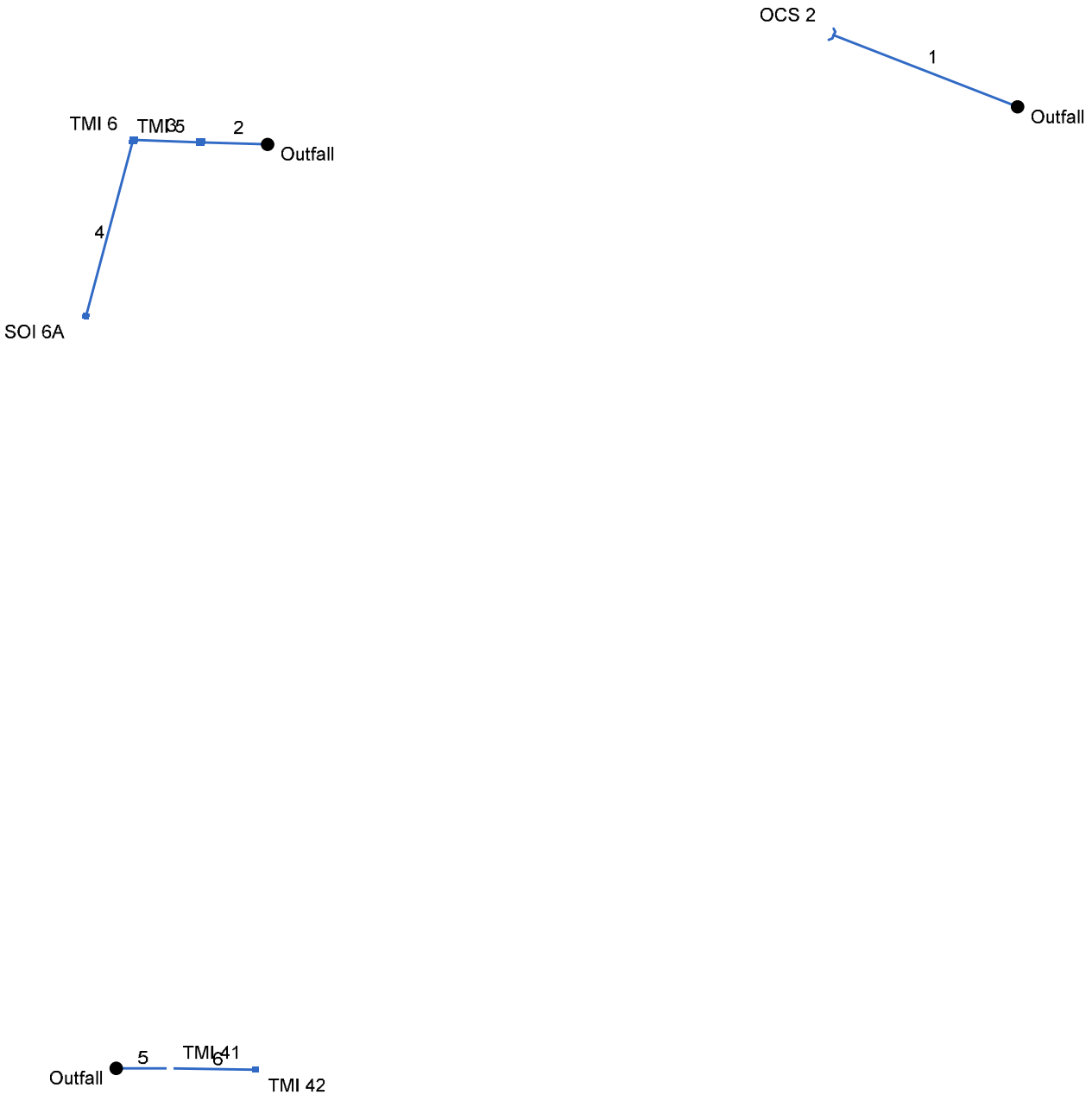
Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
1	60	16.63	910.75	912.32	1.57	3.29	3.15	0.40	912.72	0.000	95.300	911.15	912.27 j	1.12**	3.29	5.05	0.40	912.67	0.000	0.000	n/a	1.00	0.40
2	36	33.34	922.47	924.74	2.27	4.64	5.81	0.80	925.54	0.000	33.145	922.64	924.51	1.87**	4.64	7.18	0.80	925.32	0.000	0.000	n/a	0.50	0.40
3	36	32.85	922.83	924.56	1.73*	4.23	7.76	0.79	925.36	0.000	33.000	923.00	924.86	1.86**	4.60	7.14	0.79	925.65	0.000	0.000	n/a	1.48	n/a
4	24	31.80	923.20	925.20	2.00*	3.14	10.13	1.59	926.79	1.685	99.000	923.69	926.87	2.00	3.14	10.12	1.59	928.46	1.685	1.685	1.668	1.00	1.59
5	24	1.24	928.76	929.08	0.32	0.32	3.83	0.13	929.21	0.000	26.463	929.03	929.41	0.38**	0.42	2.94	0.13	929.55	0.000	0.000	n/a	0.50	0.07
6	24	0.62	929.23	929.45	0.22*	0.19	3.32	0.09	929.54	0.000	42.000	929.65	929.92	0.27**	0.25	2.45	0.09	930.01	0.000	0.000	n/a	1.00	0.09

Project File: Storm Sewers-OFFSITE ONLY- 25 Year Storm.stm | Number of lines: 6 | Run Date: 10/4/2023

Notes: * Normal depth assumed; ** Critical depth.; j-Line contains hyd. jump ; c = cir e = ellip b = box

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Storm Sewers-OFFSITE ONLY- 100 Year Storm.stm	Number of lines: 6	Date: 10/4/2023

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	EX WALL	42.41	60	Cir	98.333	910.75	911.15	0.407	912.40	912.97	n/a	912.97	End	OpenHeadwall
2	FES 4	40.58	36	Cir	33.145	922.47	922.64	0.513	924.74	924.71	n/a	924.71	End	Curb-Horiz
3	6	40.06	36	Cir	33.000	922.83	923.00	0.515	924.81	925.06	n/a	925.06	2	Curb-Horiz
4	6A	38.88	24	Cir	99.000	923.20	923.69	0.495	925.20*	927.69*	2.38	930.07	3	DropCurb
5	FES 40	1.34	24	Cir	26.463	928.76	929.03	1.020	929.08	929.43	0.07	929.43	End	Curb-Horiz
6	42	0.74	24	Cir	42.000	929.23	929.65	1.000	929.47	929.95	0.10	929.95	5	Curb-Horiz

Project File: Storm Sewers-OFFSITE ONLY- 100 Year Storm.stm | Number of lines: 6 | Run Date: 10/4/2023

NOTES: Return period = 100 Yrs. ; *Surcharged (HGL above crown).

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	98.333	0.00	0.00	0.00	0.00	0.00	5.0	5.0	0.0	42.41	180.0	7.03	60	0.41	910.75	911.15	912.40	912.97	0.00	920.00	EX WALL
2	End	33.145	0.16	10.59	0.64	0.10	6.97	5.0	25.4	5.8	40.58	51.75	7.43	36	0.51	922.47	922.64	924.74	924.71	0.00	928.10	FES 4
3	2	33.000	0.36	10.43	0.61	0.22	6.87	5.0	25.3	5.8	40.06	51.86	7.92	36	0.52	922.83	923.00	924.81	925.06	928.10	929.66	6
4	3	99.000	10.07	10.07	0.66	6.65	6.65	25.2	25.2	5.8	38.88	17.24	12.38	24	0.49	923.20	923.69	925.20	927.69	929.66	929.00	6A
5	End	26.463	0.13	0.26	0.58	0.08	0.15	5.0	8.0	8.9	1.34	24.75	3.57	24	1.02	928.76	929.03	929.08	929.43	0.00	934.65	FES 40
6	5	42.000	0.13	0.13	0.58	0.08	0.08	5.0	5.0	9.8	0.74	24.50	3.03	24	1.00	929.23	929.65	929.47	929.95	934.65	934.65	42

Project File: Storm Sewers-OFFSITE ONLY- 100 Year Storm.stm

Number of lines: 6

Run Date: 10/4/2023

NOTES:Intensity = 127.16 / (Inlet time + 17.80) ^ 0.82; Return period =Yrs. 100 ; c = cir e = ellip b = box

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q Byp (cfs)	Junc Type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp Line No
							Ht (in)	L (ft)	Area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
1	OCS 2	42.41*	0.00	42.41	0.00	Hdwl	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.0	Off
2	TMI 5	1.01	0.00	1.01	0.00	Curb	6.0	2.93	0.00	0.00	0.00	Sag	1.50	0.020	0.020	0.013	0.24	11.78	0.24	11.78	0.0	Off
3	TMI 6	2.16	0.00	2.16	0.00	Curb	6.0	2.93	0.00	0.00	0.00	Sag	1.50	0.020	0.020	0.013	0.39	19.60	0.39	19.60	0.0	Off
4	SOI 6A	38.88	0.00	38.88	0.00	DrCrb	12.0	5.00	0.00	0.00	0.00	Sag	0.00	0.020	0.020	0.013	2.59	129.69	2.59	129.69	0.0	Off
5	TMI 41	0.74	0.00	0.74	0.00	Curb	4.0	1.00	0.00	0.00	0.00	Sag	2.00	0.050	0.020	0.013	0.23	8.49	0.23	8.49	0.0	Off
6	TMI 42	0.74	0.00	0.74	0.00	Curb	6.0	4.00	0.00	0.00	0.00	Sag	2.00	0.050	0.020	0.013	0.18	6.07	0.18	6.07	0.0	Off

Project File: Storm Sewers-OFFSITE ONLY- 100 Year Storm.stm | Number of lines: 6 | Run Date: 10/4/2023

NOTES: Inlet N-Values = 0.016; Intensity = 127.16 / (Inlet time + 17.80) ^ 0.82; Return period = 100 Yrs. ; * Indicates Known Q added. All curb inlets are Horiz throat.

Storm Sewer Inlet Time Tabulation

Line No.	Line ID	Tc Method	Sheet Flow					Shallow Concentrated Flow					Channel Flow							Total Travel Time (min)
			n-Value	flow Length (ft)	2-yr 24h P (in)	Land Slope (%)	Travel Time (min)	flow Length (ft)	Water Slope (%)	Surf Descr	Ave Vel (ft/s)	Travel Time (min)	X-sec Area (sqft)	Wetted Perim (ft)	Chan Slope (%)	n-Value	Vel	flow Length (ft)	Travel Time (min)	
1	EX WALL	User																		5.00
2	FES 4	User																		5.00
3	6	User																		5.00
4	6A	User																		25.20
5	FES 40	User																		5.00
6	42	User																		5.00

Project File: Storm Sewers-OFFSITE ONLY- 100 Year Storm.stm | Min. Tc used for intensity calculations = 5 min | Number of lines: 6 | Date: 10/4/2023

Hydraulic Grade Line Computations

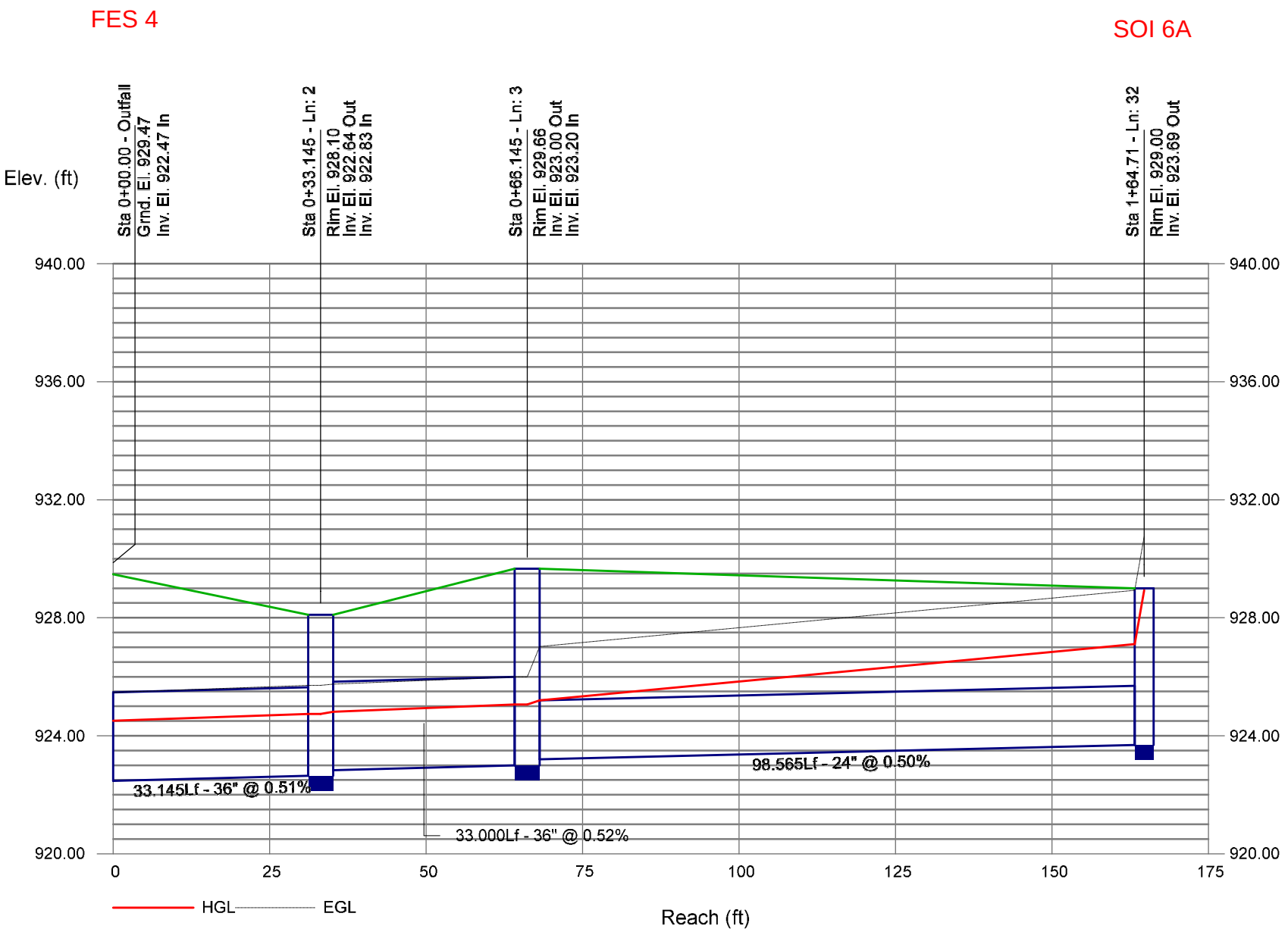
Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf		Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf	Ave Sf	Enrgy loss		
	(in)	(cfs)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(%)	(ft)	(K)	(ft)
1	60	42.41	910.75	912.40	1.65	5.66	7.49	0.67	913.07	0.000	98.333	911.15	912.97	1.82**	6.45	6.57	0.67	913.64	0.000	0.000	n/a	1.00	n/a
2	36	40.58	922.47	924.74	2.27	5.21	7.07	0.94	925.68	0.000	33.145	922.64	924.71	2.07**	5.21	7.79	0.94	925.66	0.000	0.000	n/a	0.50	n/a
3	36	40.06	922.83	924.81	1.98*	4.95	8.09	0.93	925.74	0.000	33.000	923.00	925.06	2.06**	5.17	7.75	0.93	925.99	0.000	0.000	n/a	1.48	n/a
4	24	38.88	923.20	925.20	2.00*	3.14	12.38	2.38	927.58	2.518	99.000	923.69	927.69	2.00	3.14	12.37	2.38	930.07	2.518	2.518	2.493	1.00	2.38
5	24	1.34	928.76	929.08	0.32	0.32	4.13	0.14	929.22	0.000	26.463	929.03	929.43	0.40**	0.45	3.00	0.14	929.57	0.000	0.000	n/a	0.50	0.07
6	24	0.74	929.23	929.47	0.24*	0.21	3.49	0.10	929.57	0.000	42.000	929.65	929.95	0.30**	0.29	2.56	0.10	930.05	0.000	0.000	n/a	1.00	0.10

Project File: Storm Sewers-OFFSITE ONLY- 100 Year Storm.stm | Number of lines: 6 | Run Date: 10/4/2023

Notes: * Normal depth assumed; ** Critical depth. ; c = cir e = ellip b = box

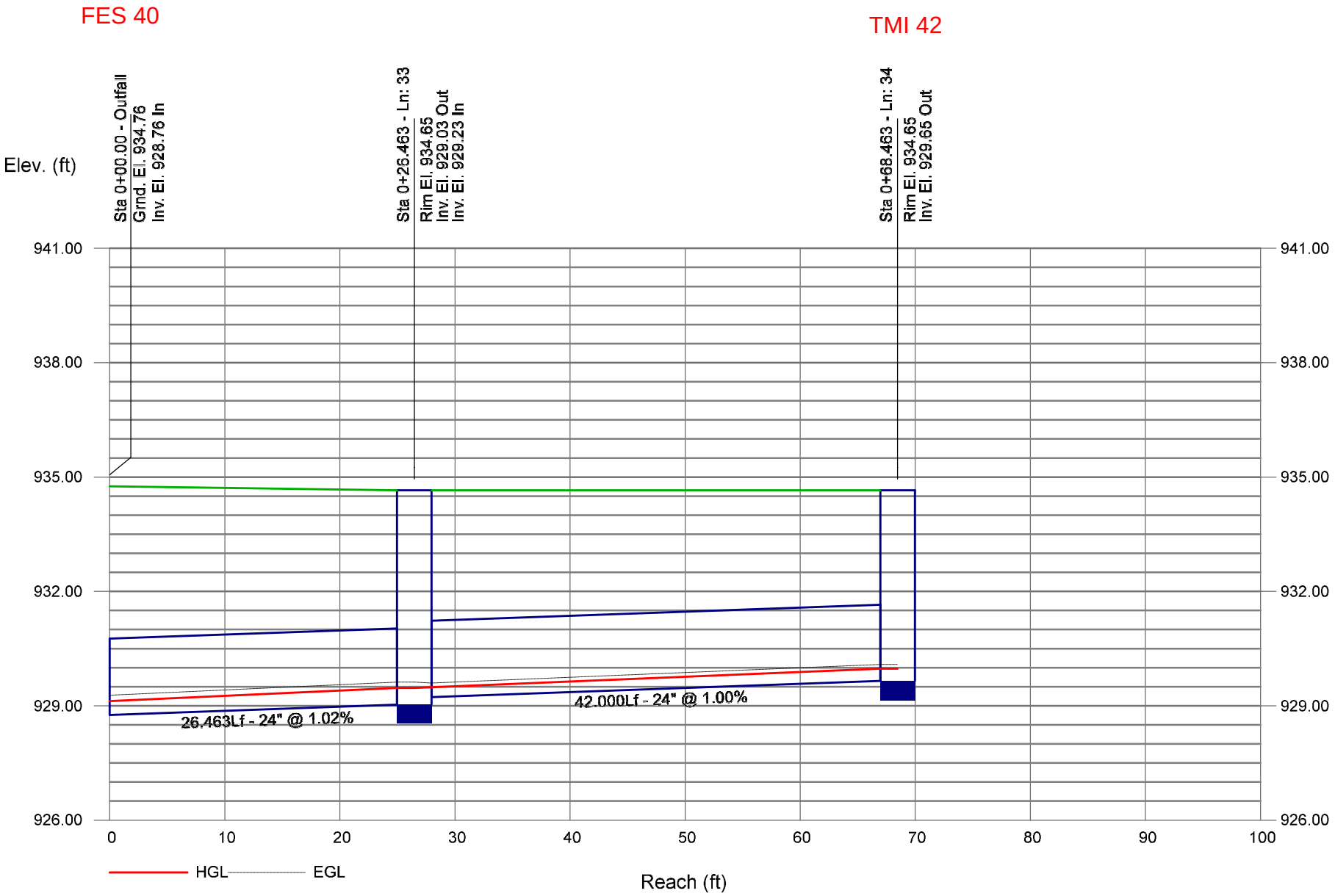
Storm Sewer Profile

Proj. file: STORM SEWERS 6-20-23.stm



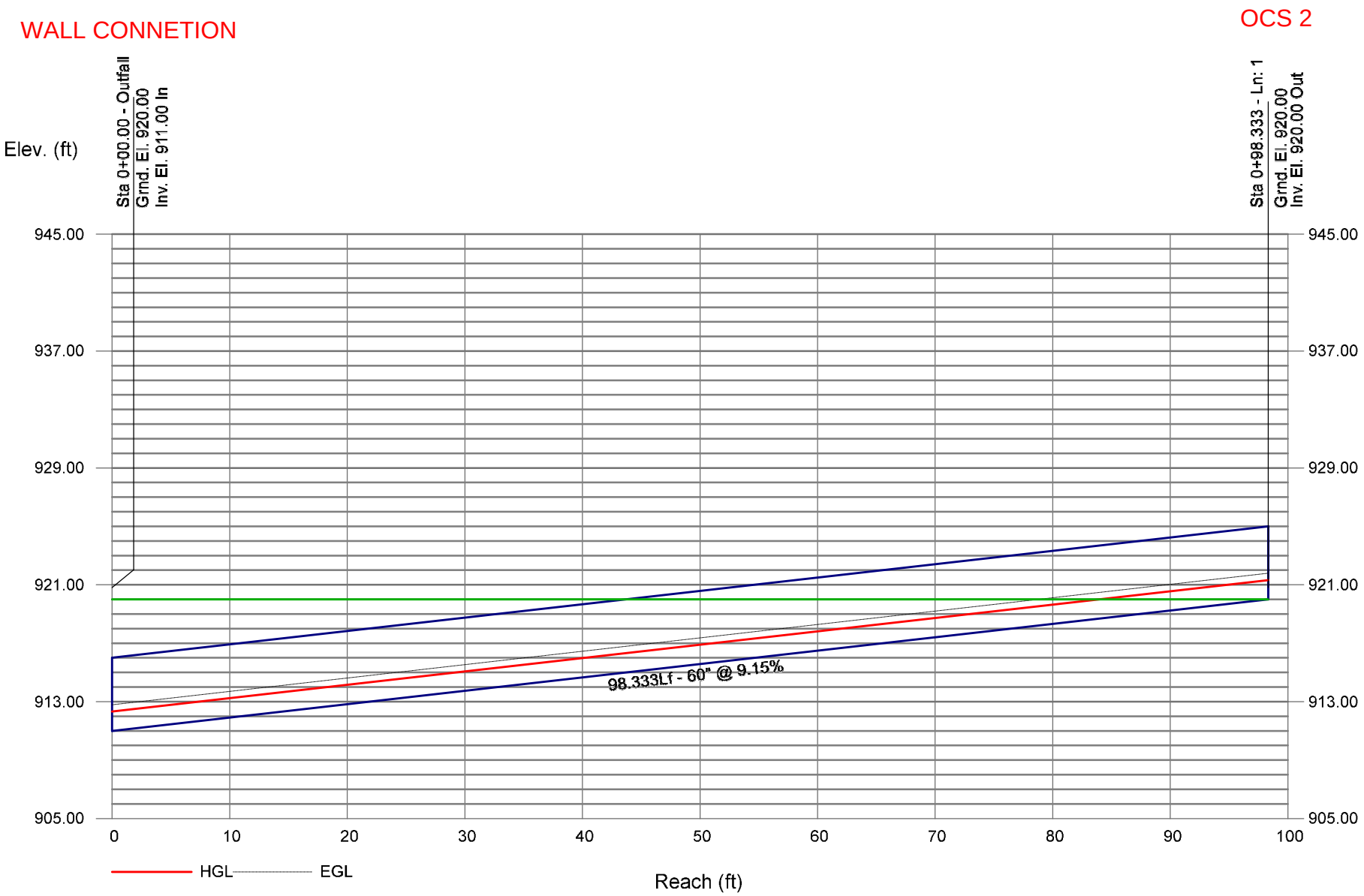
Storm Sewer Profile

Proj. file: STORM SEWERS 6-20-23.stm

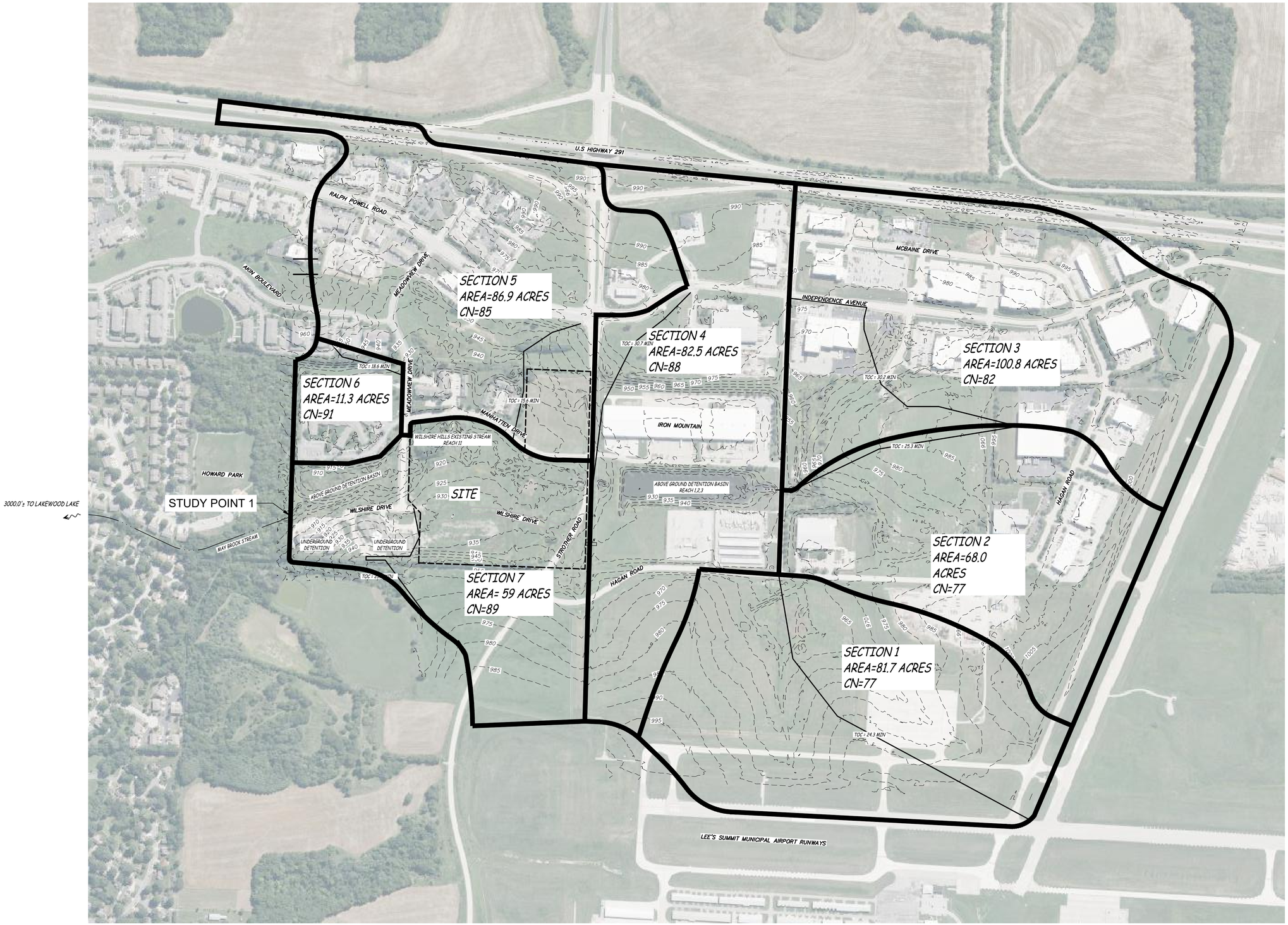


Storm Sewer Profile

Proj. file: STORM SEWERS 6-20-23.stm



APPENDIX E:
DRAINAGE AREA MAP(S)



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N

0 1"
SCALE: 1" = 300'

WILSHIRE HILLS PHASE III

STREET ADDRESS
LEE'S SUMMIT JACKSON COUNTY, MISSOURI

2/16/2024

STATE OF MISSOURI
MATTHEW AARON KRIETE
NUMBER PE-2007002811
PROFESSIONAL ENGINEER

MATTHEW A. KRIETE
PROFESSIONAL ENGINEER
PE-2007002811

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NOVEMBER 28, 2023

Revised
4 FEBRUARY 16, 2024

Design: ST Drawn: ST

PRE DOWNSTREAM ANALYSIS MAP

Sheet
C2.18

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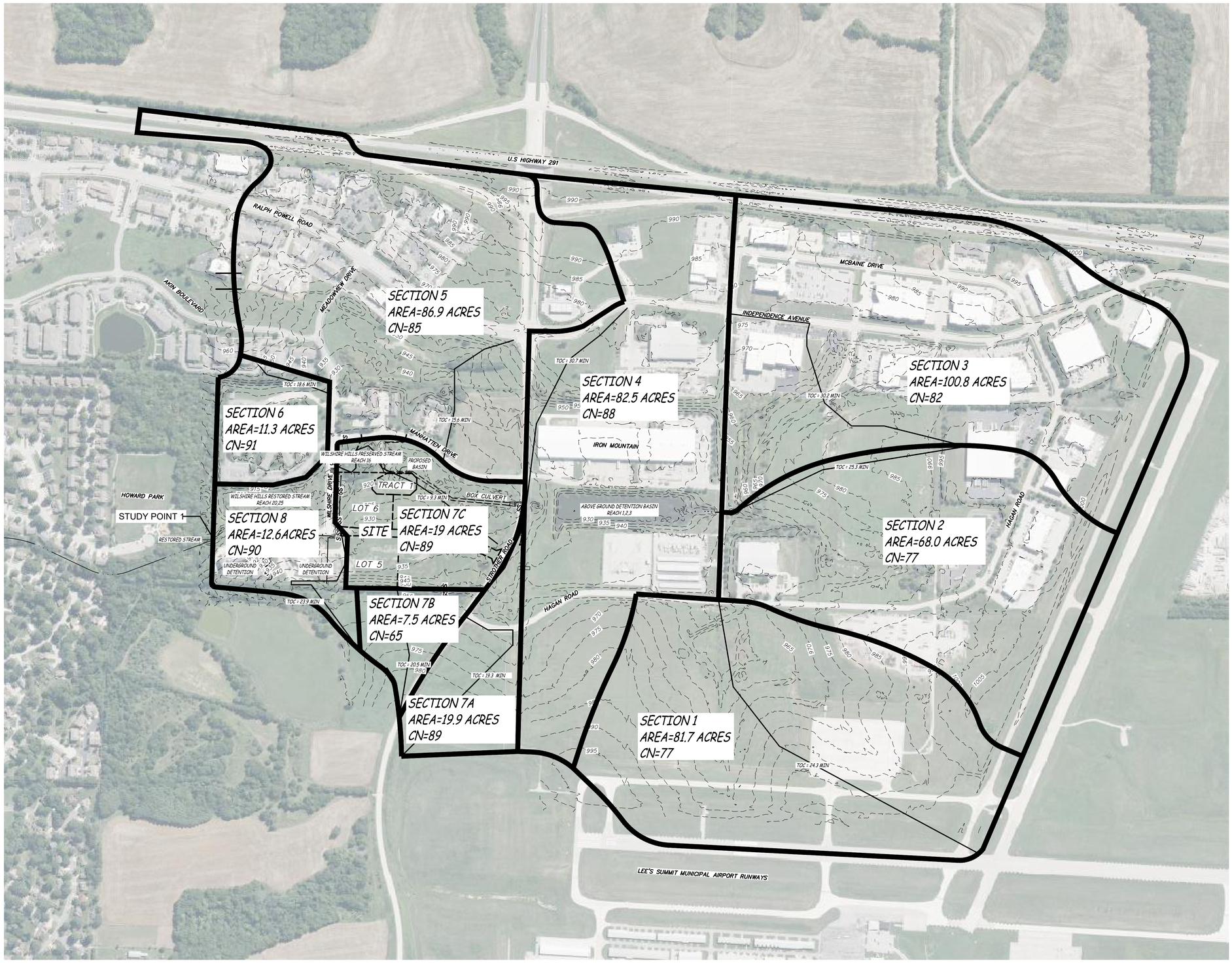

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N

0 1"
SCALE: 1" = 300'

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STREET ADDRESS
LEE'S SUMMIT JACKSON COUNTY, MISSOURI

2/16/2024

STATE OF MISSOURI
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POST DOWNSTREAM ANALYSIS MAP

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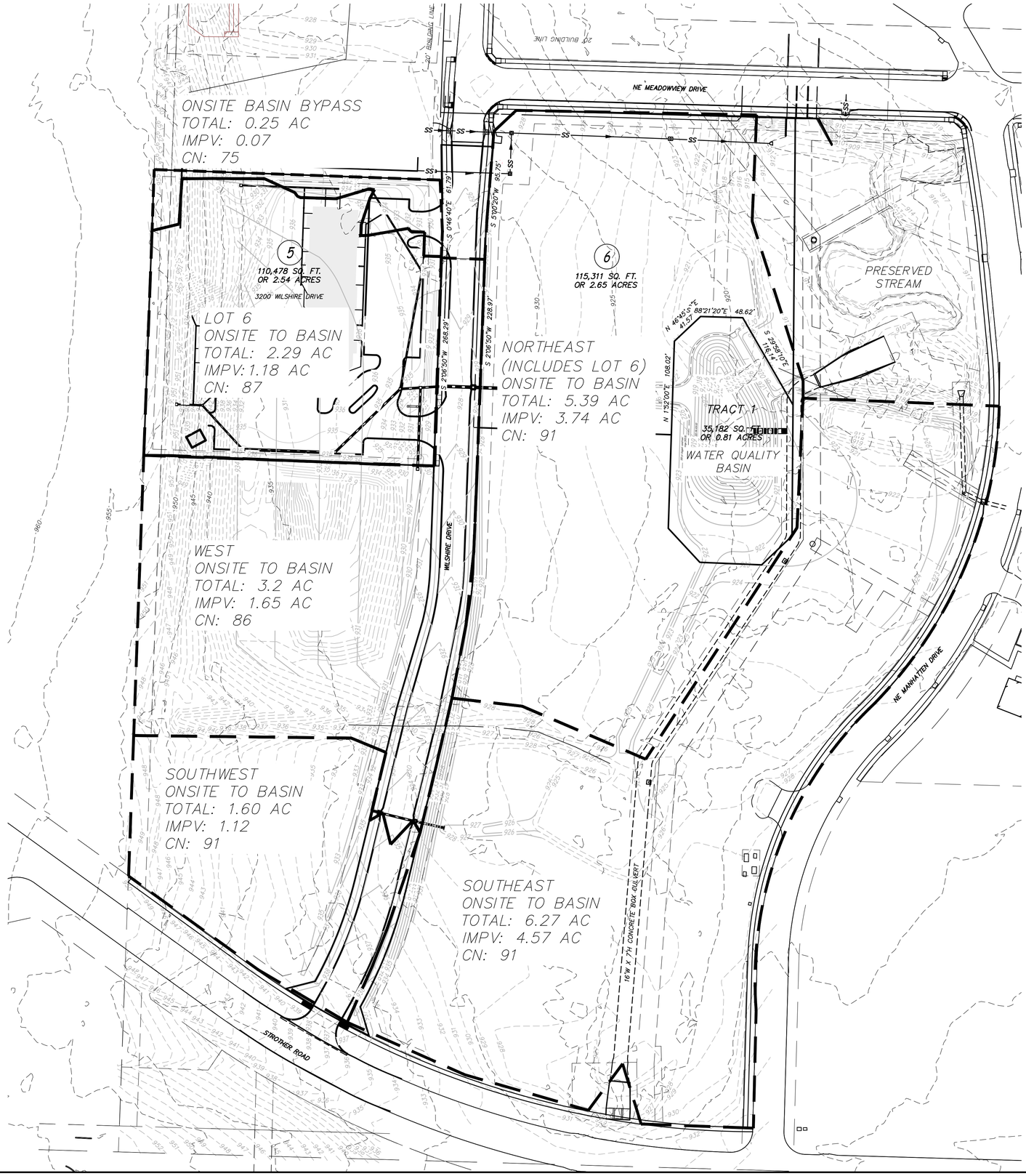
ALLOWED IMPERVIOUS AREA TABLE

Area	Total Area (acres)	Allowed Imperious (acres)	Allowed CN	Current Impervious (acres)	Remaining Impervious (acres)
Lot 5 (Wilshire Hills III + Bypass)	2.54	1.25	87	1.18	0.07
Northeast Area (includes Lot 6 + Tract 1)	5.39	4	92	0	4
West Area	3.2	2.5	92	0.82	1.68
Southwest Area	1.6	1.2	92	0.2	1
Southeast Area	6.27	4.9	93	0.09	4.81
Total	19	13.85	92	2.29	11.56



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N

0 1"
SCALE: 1" = 60'

WILSHIRE HILLS PHASE III
3200 NE MANHATTAN DR
LEE'S SUMMIT JACKSON COUNTY, MISSOURI

2/16/2024
STATE OF MISSOURI
MATTHEW AARON KRIETE
NUMBER PE-2007002811
PROFESSIONAL ENGINEER

MATTHEW A. KRIETE
PROFESSIONAL ENGINEER
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Date
JUNE 30, 2023

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2 NOVEMBER 28, 2023
4 FEBRUARY 16, 2024

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ALLOCATED IMPERVIOUS AREA MAP

Sheet
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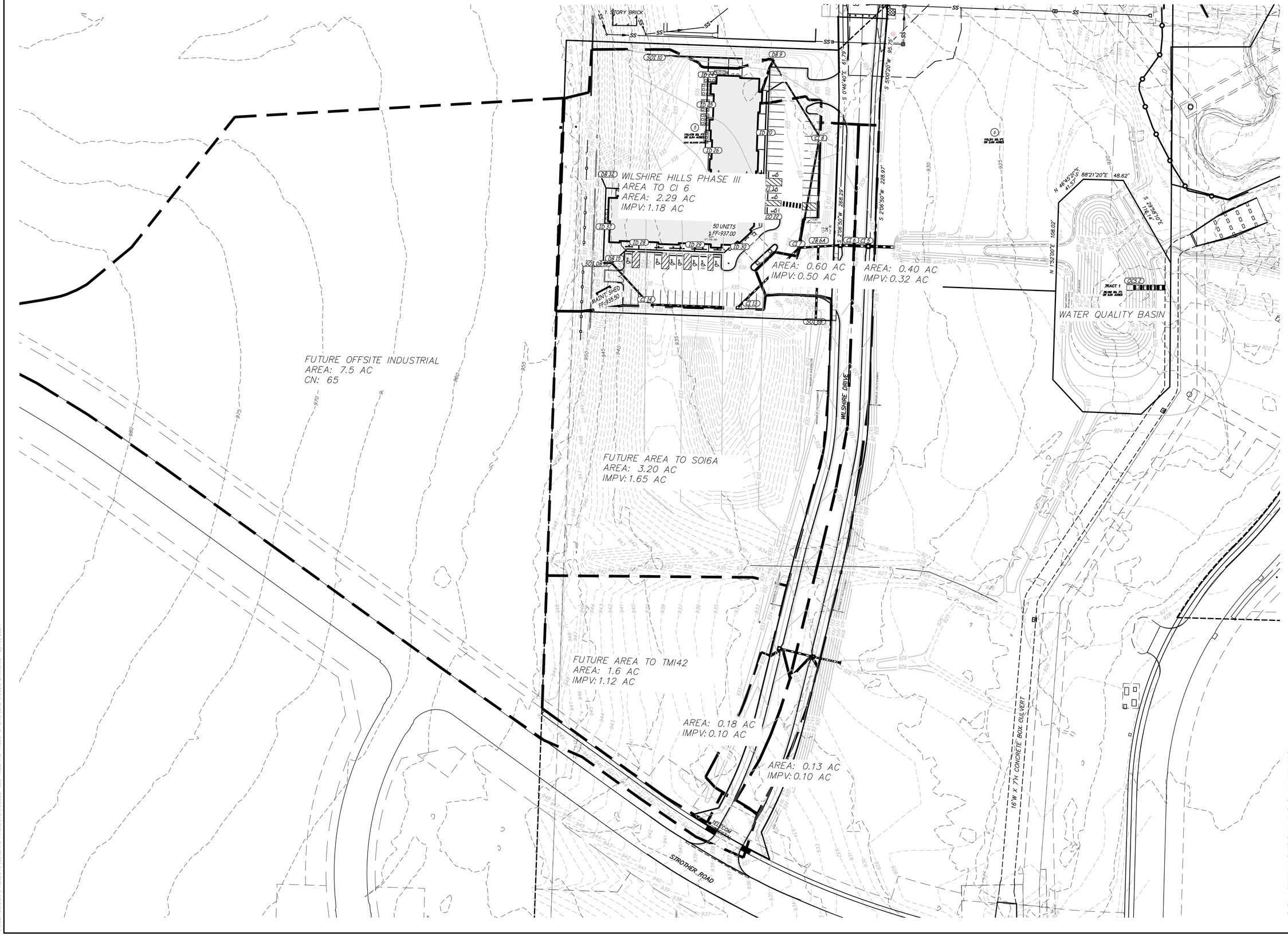

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N

0 1"

SCALE: 1" = 50'

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2/16/2024

STATE OF MISSOURI
MATTHEW AARON KRIETE
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2	OCTOBER 12, 2023
4	FEBRUARY 16, 2024

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STORM SEWER DRAINAGE AREA MAP

Sheet

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APPENDIX F:
STORMWATER WAIVER

LEE'S SUMMIT
MISSOURI

DESIGN & CONSTRUCTION MANUAL
DESIGN CRITERIA MODIFICATION REQUEST

PROJECT NAME: WILSHIRE HILLS PUBLIC IMPROVMENTS

ADDRESS: 3200 NE Manhattan Dr Lee's Summit, MO 64064

PERMIT NUMBER: PRCOM20235681

OWNER'S NAME: Jeffery E. Smith Investment CO

TO: Deputy Director of Public Works / City Engineer

In accordance with the City of Lee's Summit's Design and Construction Manual (DCM), I wish to apply for a modification to one or more provisions of the code as I feel that the spirit and intent of the DCM is observed and the public health, welfare and safety are assured. The following articulates my request for your review and action. (NOTE: Cite specific code sections, justification and all appropriate supporting documents.)

We request detention be watershed based to control the post development discharge rate to less than the predevelopment discharge rate at Study Point 1, in lieu of site based flat rate discharge required by DCM Section 5600. The attached report provides justification for this request.

SUBMITTED BY:
NAME: ____Matthew Kriete_____ ( ) OWNER (X) OWNER'S AGENT
ADDRESS: __1113 Fay Street_____ PHONE #: ____(573)449-2646.227_____
CITY, STATE, ZIP: ___Columbia, MO 65201_____
Email: ____mkriete@ess-inc.com_____ SIGNATURE: _____

SUE PYLES, P.E.
DEVELOPMENT ENGINEERING MANAGER ( ) APPROVAL ( ) DENIAL
SIGNATURE: _____ DATE: _____

JEFF THORN, P.E.
DEPUTY DIRECTOR OF WATER UTILITIES ( ) APPROVED ( ) DENIAL
SIGNATURE: _____ DATE: _____

GEORGE M. BINGER III, P.E.
DEPUTY DIRECTOR OF PUBLIC WORKS / CITY ENGINEER ( ) APPROVED ( ) DENIAL
SIGNATURE: _____ DATE: _____

COMMENTS: _____
_____
_____

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