# MACRO & MICRO STORM WATER DRAINAGE STUDY

## Lot 294, Newberry Landing

**SITE ACREAGE: 1.79 ACRES**

**Lee's Summit, MO**

***PREPARED ON: FEBRUARY 21, 2024***

***PREPARED BY:***


ENGINEERING SOLUTIONS
ENGINEERING & SURVEYING
50 S.E. 30th Street Lee's Summit, MO 64082
816.623.9888 • engineeringsolutionskc.com


STATE OF MISSOURI
MATTHEW J. SCHLICHT
NUMBER PE-2010018705
PROFESSIONAL ENGINEER

Matthew J. Schlicht, PE

2/21/2024

Revision

| Date | Comment | By |
|---|---|---|
| | | |
| | | |
| | | |

# TABLE OF CONTENTS

## 3. GENERAL INFORMATION

A new commercial development is being proposed on Lot 294, Newberry Landing. The property address is 1460 SE Broadway Drive. The property contains 1.79 acres. The site is part of the previously approved Newberry Commons 1st Plat Master Plan. The proposed improvements will consist of a new 21,250 sf office/warehouse building, parking lot, drive aisle and associated utility infrastructure. The site generally drains from the south to the northeast via sheet and shallow concentrated flow to field inlets located along the northern lot line and to SE Broadway Drive where it is intercepted by a curb inlet and piped to a drainage channel on the east side of the Newberry Landing Master Development. No storm sewer, BMPs detention facilities nor water bodies currently exist on site.

## 4. METHODOLOGY

This Micro Storm Drainage Study has been prepared to evaluate potential hydrologic impacts from the proposed development and recommend improvements to eliminate potential negative downstream impacts. The study conforms to the requirements of the City of Lee's Summit, Missouri "Design and Construction Manual" and all applicable codes and criteria referred to therein.

Using the above criteria, the proposed site was evaluated using the Soil Conservation Service, SCS TR-55 method to calculate storm runoff volumes, peak rates of discharge, pre and post developed hydrographs and required storage volumes for detention facilities. TR-55 was first introduced in 1975 by the SCS particularly for small urbanizing watersheds. The analysis contains results for the 2, 10 and 100-year design storms.

Hydraflow Hydrographs Extension for AutoCAD Civil 3D was utilized to model the various SCS TR-55 stormwater rainfall runoff events. The following SCS TR-55 Unit Hydrograph variables were utilized;

- AMC II Soil Moisture Conditions
- 24-Hour SCS Type II Rainfall Distribution (Shape Factor 484)
- SCS Runoff Curve Numbers per SCS TR-55 (Tables 2-2a to 2-2c)
- Time of Concentration per APWA 5600

Per APWA 5608.4 and City of Lee's Summit criteria, post development peak discharge rates from the site shall not exceed those indicated below:

- 50% storm peak rate less than or equal to 0.5 cfs per site acre
- 10% storm peak rate less than or equal to 2.0 cfs per site acre
- 1% storm peak rate less than or equal to 3.0 cfs per site acre

In addition to mitigation of peak flow rates, APWA Section 5608.4 also requires 40 hour extended detention of runoff from the local 90% mean annual event (1.37"/24-hour rainfall). The proposed detention facility shall release the water quality event over a period of 40-72 hours. Design principles taken from the MARC BMP Manual will be utilized to assist in the design of the detention basin control structure for extended release events.

## 5. EXISTING CONDITIONS ANALYSIS

The existing site is grass covered and generally drains from South to the Northeast via sheet and shallow concentrated flow to field inlets located along the northern lot line and to SE Broadway Drive where it is intercepted by a curb inlet and piped to a drainage channel on the east side of Newberry Landing. The existing site contains two drainage sub-basins labeled as East and West for the purposes of this report. Sub-basin West contains 0.09 acres and is located along the west property line. Sub-basin West drains northerly along the west property line via sheet and shallow concentrated flow where it is intercepted by a field inlet, POI West. Sub-basin East contains 1.70 acres and is located on the central and eastern portions of the property. Sub-basin East

drains to the Northeast via sheet and shallow concentrated flow where it is intercepted by a field inlet located in the northeast corner of the property, POI East. See Exhibit A - Existing Drainage Map for details of each sub-basin. Table 5-1 below details the hydrologic properties for each sub-basin along with peak discharge rates for the 2, 10 and 100-year design storms.

Table 5-1 Existing Conditions Sub-basin Data and Peak Discharge Rates

| Sub-basin | Area (ac.) | CN | Tc (min.) | Q2 (cfs) | Q10 (cfs) | Q100 (cfs) |
|---|---|---|---|---|---|---|
| West | 0.09 | 74 | 7.4 | 0.186 | 0.38 | 0.69 |
| East | 1.70 | 74 | 10.4 | 5.61 | 9.44 | 15.04 |

Exhibit B contains a complete Hydraflow Hydrograph Report with pre and post development hydrographs for each sub-basin along with proposed detention basin data and routed hydrographs.

Allowable release rates are typically comprised of a combination of upstream offsite flows and allowable onsite post development peak flows at each POI. Runoff from Lot 294 will drain to existing master development infrastructure designed to handle existing tributary areas and peak discharge rates. Allowable release rates will be comprised solely of onsite drainage.

Example Calculations:

Allowable Release Rate: POI E (2-Yr) = Onsite East Sub-basin Area x 0.5
Allowable Release Rate: POI E (2-Yr) = 1.70 x 0.5 = 0.85 cfs

The following Table details allowable release rates at each Point of Interest.

Table 5.2 APWA Post Development Allowable Release Rates

| POI | Total Area (ac.) | Onsite Area (ac.) | Q2 (cfs) | Q10 (cfs) | Q100 (cfs) |
|---|---|---|---|---|---|
| West | 0.09 | 0.09 | 0.045 | 0.18 | 0.27 |
| East | 1.70 | 1.70 | 0.85 | 3.40 | 5.10 |

## 6. PROPOSED CONDITIONS ANALYSIS

The proposed improvements will consist of a new 21,250 sf office/warehouse building, parking lot, drive aisle and associated utility infrastructure. The proposed site will consist of three drainage sub-areas referred to as West, East and East 1 for the purposes of this report. Sub-basin West contains 0.07 acres of un-improved land generally located along the west property line. Sub-basin West is an unimproved peripheral area which will free release to a field inlet located on the northwest corner of the property via sheet and shallow concentrated flow. Sub-basin East contains 0.32 acres and is located along the east edge of the property consisting mainly of unimproved area with some paved area. Sub-basin east will drain via sheet and shallow concentrated flow to a curb inlet located on SE Broadway Drive. Sub-basin East 1 contains 1.40 acres and comprises the majority of the proposed improvements. Sub-basin East 1 makes up the remainder of the land and will drain via sheet flow and enclosed storm sewer to a new underground chamber detention system located generally along the east property line of the site. All sub-basins eventually drain to the drainage channel on the east side of Newberry Landing. Exhibit C contains the Proposed Drainage Map. Table 6-1 below details the hydrologic properties for each sub-basin along with peak discharge rates for the 2, 10 and 100-year design storms.

Table 6-1 Proposed Conditions Sub-basin Data and Peak Discharge Rates

| Sub-area | Area (ac.) | Composite CN | Tc (min.) | Q2 (cfs) | Q10 (cfs) | Q100 (cfs) |
|---|---|---|---|---|---|---|
| West | 0.07 | 74 | 7.5 | 0.145 | 0.30 | 0.54 |
| East | 0.32 | 79 | 7.7 | 0.84 | 1.58 | 2.72 |
| East 1 | 1.40 | 94 | 7.9 | 6.14 | 9.46 | 14.29 |

As stated previously, Sub-basin West is an unimproved peripheral area which will free release to a field inlet located on the northwest corner of the property via sheet and shallow concentrated flow. The West Sub-basin will not be evaluated any further in this report. Sub-basins East and East 1 will be combined to determine if the proposed attenuation in Sub-basin East 1 is sufficient to mitigate any potential downstream hydraulic issues.

## 6.1 DETENTION

A new underground chamber detention system is being proposed in the East 1 Sub-basin to attenuate proposed peak discharge rates. Following are a list of design parameters for the detention system.

Designation: East 1 Detention System
Type: Underground Chamber
Chamber: ADS Storm Tech MC-3500
Invert Elevation Down: 996.50
Chamber Effective Rise (ft): 3.50
Chamber Shape: Arch
Chamber Effective Span (ft): 5.60
Chamber Barrel Length (ft): 7.12
Number of Barrels (Chambers): 133*
*131 Full Chambers + 2 additional chambers to account for (8) End Caps for MC-3500 System
Slope (%): 0.00
Headers: No, Not Accounted for in Volume Design (Will be utilized for conveyance)
Stone Encasement: Yes
Bottom Elevation (Stone): 995.50
Width (ft): 7.61 effective width w/ Stone {Width Eff. = Area of Bed / (No. of Barrels x Barrel Length)}
Depth (ft): 5.50 depth including stone (1' over and under chambers)
Stone Voids (%): 40
Use weir or elevated manifold for conveyance to additional (4) chamber rows, see plans for details.

Control Structure: 5'W x 6'L w/ 6" Concrete Weir/Baffle Wall w/ Manhole Access both sides of Baffle Wall
Control Structure Top: 1002.00
Orifices: Water Quality (7) 1" Dia. on 4" Centers (40-Hour Extended Detention)
(1) 9" Dia. at FL EL = 997.50
Overflow Weir: 5' Wide, Crest Elevation = 1000.00, Q(100) = 14.29 cfs, Depth = 0.90', WSE = 1000.90

The Detention System Plan may be found in Exhibit D. Water quality volume calculations may be found in Exhibit E. Emergency overflow calculations may be found in Exhibit F. See Table 6-2 below for a summary of detention basin data.

Table 6-2 Proposed Detention Basin Data

| | Peak Q In (cfs) | Tp In (min.) | Peak Q Out (cfs) | Tp Out (min) | Peak W.S.E. | Max. Storage Vol. (cf) |
|---|---|---|---|---|---|---|
| 2-Year | 6.14 | 718 | 0.183 | 838 | 997.70 | 10,110 |
| 10-Year | 9.46 | 718 | 1.35 | 730 | 998.25 | 13,281 |
| 100-Year | 14.29 | 718 | 2.78 | 728 | 999.50 | 19,685 |

As shown in the table above all proposed peak flowrates have been attenuated. See Table 6-3 below for a summary of proposed peak discharge rates for combined Sub-areas East and East 1. Hydrographs tributary to each area have been combined to determine subsequent peak discharge rates.

Table 6-3 Proposed Conditions Post Detention Peak Discharge Rates

| Sub-Areas | Q2 (cfs) | Q10 (cfs) | Q100 (cfs) |
|---|---|---|---|
| Combined East & East 1 | 0.858 | 2.19 | 4.89 |

As stated previously Sub-area West is periphery to the project and will not be improved. Table 6-4 below provides a comparison of runoff data between Existing and Proposed Conditions for combined Sub-areas East and East 1.

Table 6-4 Peak Discharge Comparison

| | | Q2 (cfs) | Q10 (cfs) | Q100 (cfs) |
|---|---|---|---|---|
| Combined East & East 1 | Proposed | 0.858 | 2.19 | 4.89 |
| | Existing | 5.61 | 9.44 | 15.04 |
| | Difference | -4.75 | -7.25 | -10.15 |
| | Allowable | 0.85 | 3.40 | 5.10 |
| | Difference | 0.008* | -1.21 | -0.21 |

As shown in Table 6-4 above peak discharge rates for combined Sub-areas East and East 1 will be reduced well below existing discharge rates. In addition runoff from the water quality storm event will be detained and released over a minimum 40 hour time period. Proposed peak discharge rates will also meet allowable.

The next sections will aim to evaluate if the proposed onsite detention system meeting the default stormwater management comprehensive protection strategy for the watershed is the most efficient means of providing broad protection for the receiving system, including channel erosion protection and flood peak reductions over a range of return periods.

## 7. ENCLOSED STORM SEWER CAPACITY ANALYSIS

The Newberry Master Development utilizes an enclosed storm sewer system to convey storm water runoff to the adjacent creek running along the east side of the development. The enclosed system conveys runoff from a 32.08 acre tributary, the majority of which is offsite, west of Hamblen Road. See Exhibit G for a Newberry Sub-basin Map showing the tributary area contributing runoff to the Newberry enclosed storm sewer system. The 100-year peak discharge rate for the tributary area is calculated at 192.50 cfs which includes a 1.25 antecedent precipitation factor.

The Point of Interest for the sub-basin is an existing junction box located just upstream of the flared end section at the receiving creek. The last segment of storm sewer consists of 137 lineal feet of 48 inch HDPE pipe at a slope of 1.20%. See Exhibit H Storm Sewer System for details of the enclosed storm sewer system along with capacity data of the last and controlling (highest flow) storm sewer segment. The capacity of the subject storm sewer segment is 204.21 cfs which is greater than the proposed 100-year peak discharge rate.

Based on our findings, which are conservative, the existing storm sewer system has more than adequate capacity to convey stormwater runoff from Newberry Lot 294 without the need for additional onsite stormwater measures. The peak discharge rates are conservative and will be reduced beyond those calculated due to the

regulatory operation of the detention system just upstream of Newberry Landing serving Taylor Made Industries.

## 8. RECEIVING STREAM CAPACITY ANALYSIS

The Newberry Master Development drains to a creek located on the east side of the development. The Point of Interest along the creek is located just south of the outlet of the Newberry enclosed storm sewer system. The creek at the POI conveys approximately 342 acres of runoff. See Exhibit I for a depiction of the Overall Drainage Area Map. The land usage for the analysis was considered to be at buildout and in accordance with City zoning. See Exhibit J for a Land Usage Map of the overall watershed. The Land Usage Map details data used to calculate both the composite runoff coefficient (0.67) and the composite curve number (89) for the watershed. The 100-year peak discharge rate for the tributary area at the POI in the Creek is calculated at 1016.59 cfs per the SCS Method. See Exhibit B for a Hydraflow Report detailing the 2, 10 and 100 year peak discharge rates.

The creek cross section at the Point of Interest is depicted in Exhibit I along with additional data utilized to determine the water depth in the creek at the 100-year peak discharge rate. The calculated water surface (HGL) in the creek is 985.68 which is below the inverts of the Newberry enclosed storm sewer system. The static snapshot analysis of the creek is conservative. The snapshot does not account for any dynamic effects for designed detention systems upstream nor attenuation effects from available storage when transitioning between open and enclosed systems. The watershed was assumed to be at complete buildout in accordance with the City's Zoning Map.

Table 8-1 below details the proposed regulatory peak discharge rates at the creek POI with and without onsite detention being employed for Newberry Lot 294.

Table 8-1 Proposed Peak Discharge Rates

| Hydrograph Desc. | Q2 (cfs) | Q10 (cfs) | Q100 (cfs) |
|---|---|---|---|
| Combined Undetained* | 384.14 | 638.91 | 1012.39 |
| Combined Detained** | 383.82 | 639.46 | 1013.87 |

* Combined Undetained = Prop West + Prop East + Prop East 1 + (Watershed – Lot 294)
** Combined Detained = Prop West + Prop East + Detained East 1 + (Watershed – Lot 294)

As shown in Table 8-1 above the peak discharge rates for the detained condition 10 and 100-year storms are greater than the undetained condition at the receiving stream POI. Indicating that onsite detention for Newberry Lot 294 would be counterproductive to overall watershed protection measures specifically regarding peak flood reduction in lower return event storms. Due to the overall size of the watershed (peak discharges) and receiving channel geometry the higher return event storms will not produce a material impact on channel erosion. The 0.32 cfs increase in runoff from the 2-yr storm (Tc = 7.5) equates to drainage from an additional 0.155 acres of turf or 0.085 acres of composite watershed development. Onsite water quality BMPs may provide some downstream qualitative benefit.

## 9. ONSITE WATER QUALITY BMPS

The City requires onsite BMPs for all new commercial/industrial developments. The City accepts 40-hour extended detention along with other volumetric control BMPs in addition to hydrodynamic separators. Based on the characteristics of the proposed development we recommend the addition of a hydrodynamic separator (HDS). An HDS is effective at removing TSS, hydrocarbons, and trash/debris from stormwater runoff and are often used for standalone treatment or pretreatment to filtration, detention, infiltration and rainwater harvesting systems. The HDS would be located and placed in lieu of the control structure in Exhibit D. The HDS shall be

sized to treat the water quality volume and flow rate in the East 1 Sub-area in addition to having an internal bypass sized to convey the 100-year peak discharge rate of 14.29 cfs. Runoff will be conveyed to the HDS via a roof drain system and a standard 15" enclosed storm sewer. The HDS will also utilize a grated inlet to capture runoff in the northeast corner of the parking lot.

## 10. CONCLUSION & RECOMMENDATIONS

This macro and micro storm water drainage study shows that the development of Newberry Landing Lot 294 will not generate any negative downstream hydraulic impacts. The design of an onsite comprehensive control strategy detention system was determined to be counterproductive to the broad protection of the receiving system particularly in the case of reducing peak discharge rates for low return event storms. Peak discharge rates for low return event storms would be increased, due to the lag effect created by onsite attenuation, in downstream conveyance systems and at the receiving creek. Onsite underground detention would not only be costly for the Owner (Capital & Maintenance) but would ultimately be deleterious to the downstream receiving system for which the regulations are designed to protect. The receiving system made up of enclosed storm sewer and the receiving stream both have more than adequate capacity to convey proposed peak discharge rates from Newberry Lot 294.

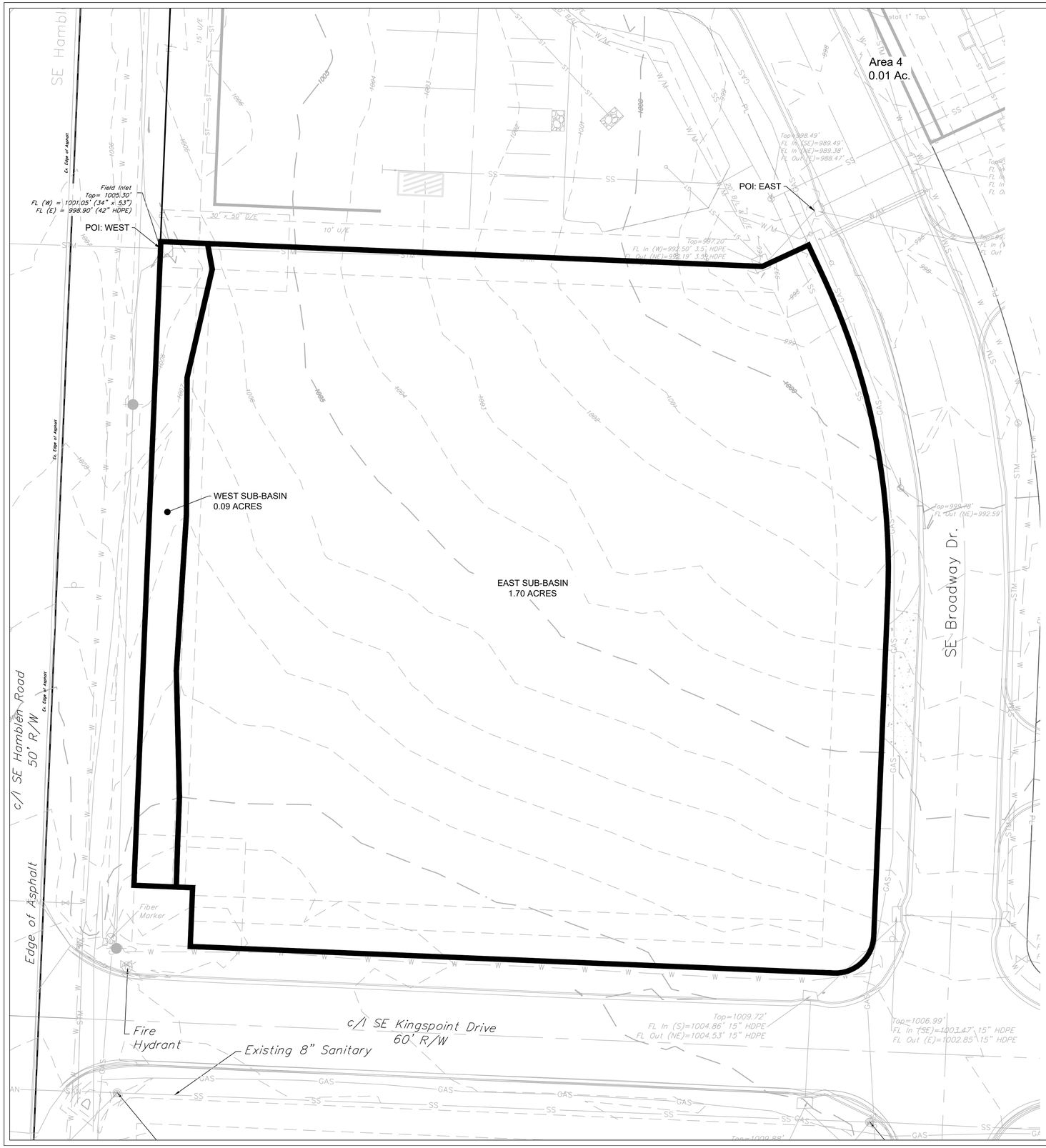
In conclusion, the development of Newberry Landing Lot 294 will not generate any negative downstream hydraulic impacts. The developed site should be drained via the existing enclosed storm sewer system located adjacent to the site. No additional attenuation measures are required on site nor recommended. Onsite BMPs in the form of a hydrodynamic separator will be provided to help improve overall runoff water quality. The study is in conformance with all applicable City of Lee's Summit standards and criteria therefore Engineering Solutions recommends approval of this storm water drainage study and its findings.

## 11. EXHIBITS:

- **Exhibit A – Existing Drainage Area Map**
- **Exhibit B – Hydraflow Hydrograph Calculations**
- **Exhibit C – Proposed Drainage Area Map**
- **Exhibit D – Detention System Plan**
- **Exhibit E – Water Quality Volume Calculations**
- **Exhibit F – Emergency Overflow Calculations**
- **Exhibit G – Newberry Sub-basin Map**
- **Exhibit H –Storm Sewer System (Newberry)**
- **Exhibit I – Overall Drainage Area Map**
- **Exhibit J – Land Usage Map**

# Exhibit A

# Existing Drainage Area Map




North

0 10' 20' 40'

# EXISTING DRAINAGE MAP

SCALE: 1" = 20'


ENGINEERING SOLUTIONS
ENGINEERING & SURVEYING
50 SE 30TH STREET
LEE'S SUMMIT, MO 64082
P:(816) 623-9888 F:(816)623-9849

Professional Registration
Missouri
Engineering 2005032186-D
Surveying 2005008319-D
Kansas
Engineering E-1895
Surveying LS-218
Oklahoma
Engineering 6254
Nebraska
Engineering CA2821


Newberry Landings First Plat
Lee's Summit, Jackson County, Missouri

Project: NEWBERRY LANDING, LSMO

Issue Date: March 12, 2018

EXISTING DRAINAGE MAP
Construction Plans for:
Lot 293, Newberry Landings First Plat
Lee's Summit, Jackson County, Missouri


Matthew J. Schlicht
MO PE 2006019708
KS PE 19071
OK PE 25226


REVISIONS

REV 7-11-19

REV 8-15-19

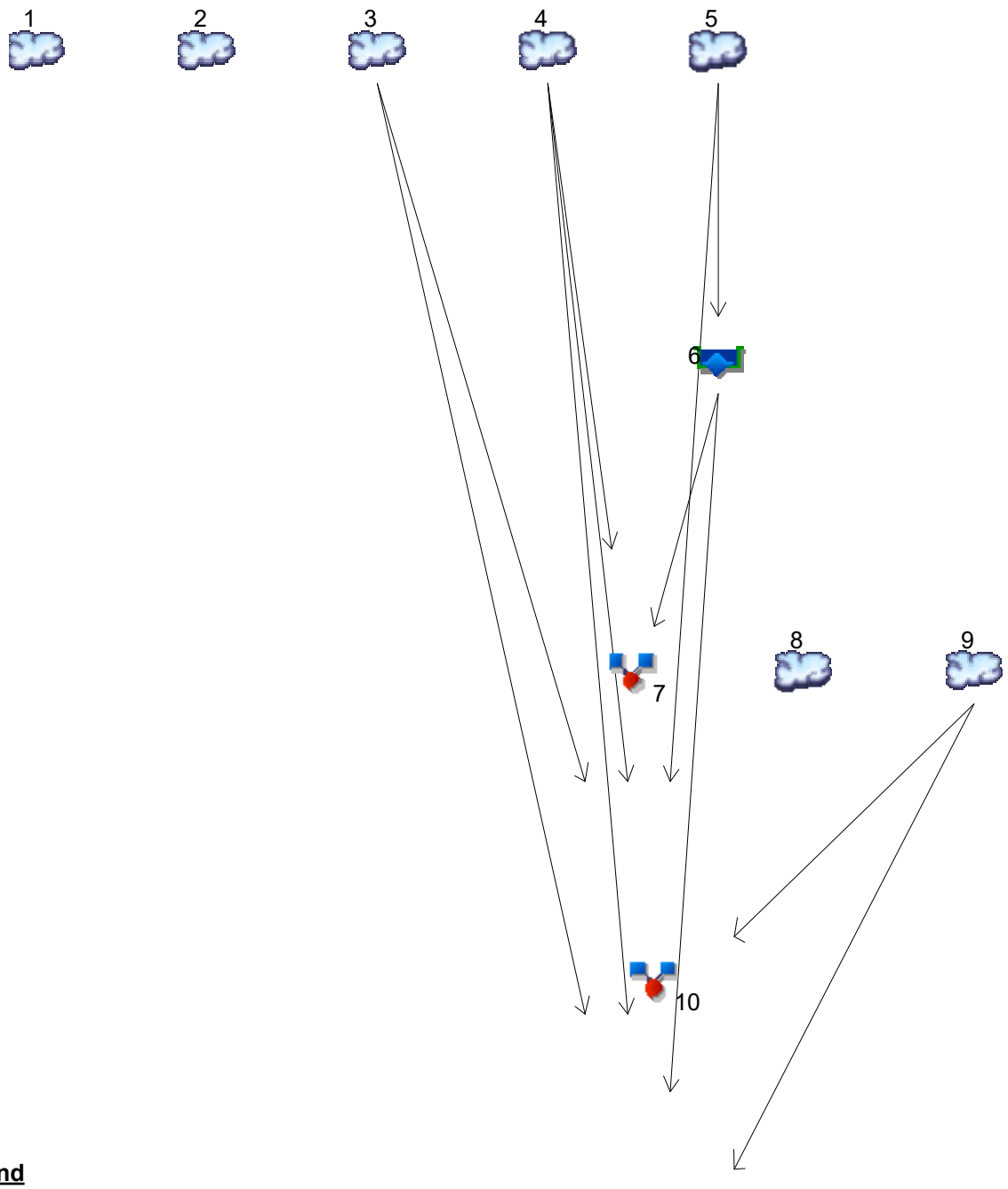
EXHIBIT

# Exhibit B

# Hydraflow Hydrograph Calculations

# Watershed Model Schematic

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




## Legend

| Hyd. | Origin | Description |
|---|---|---|
| 1 | SCS Runoff | EX WEST |
| 2 | SCS Runoff | EX EAST |
| 3 | SCS Runoff | PROP WEST |
| 4 | SCS Runoff | PROP EAST |
| 5 | SCS Runoff | PROP EAST 1 |
| 6 | Reservoir | DETAINED EAST 1 |
| 7 | Combine | COMBINED EAST + DETAINED EAST 1 |
| 8 | SCS Runoff | WATERSHED |
| 9 | SCS Runoff | WATERSHED - LOT 294 |
| 10 | Combine | COMBINED UNDETAINED |
| 11 | Combine | COMBINED DETAINED |
| 12 | SCS Runoff | Erosion Quantification |

# 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 | ------ | ------- | 0.186 | ------- | ------- | 0.380 | ------- | ------- | 0.692 | EX WEST |
| 2 | SCS Runoff | ------ | ------- | 5.610 | ------- | ------- | 9.436 | ------- | ------- | 15.04 | EX EAST |
| 3 | SCS Runoff | ------ | ------- | 0.145 | ------- | ------- | 0.296 | ------- | ------- | 0.539 | PROP WEST |
| 4 | SCS Runoff | ------ | ------- | 0.841 | ------- | ------- | 1.581 | ------- | ------- | 2.717 | PROP EAST |
| 5 | SCS Runoff | ------ | ------- | 6.137 | ------- | ------- | 9.462 | ------- | ------- | 14.29 | PROP EAST 1 |
| 6 | Reservoir | 5 | ------- | 0.183 | ------- | ------- | 1.348 | ------- | ------- | 2.779 | DETAINED EAST 1 |
| 7 | Combine | 4, 6 | ------- | 0.858 | ------- | ------- | 2.189 | ------- | ------- | 4.886 | COMBINED EAST + DETAINED EAS |
| 8 | SCS Runoff | ------ | ------- | 385.69 | ------- | ------- | 641.53 | ------- | ------- | 1016.59 | WATERSHED |
| 9 | SCS Runoff | ------ | ------- | 383.67 | ------- | ------- | 638.18 | ------- | ------- | 1011.27 | WATERSHED - LOT 294 |
| 10 | Combine | 3, 4, 5, 9 | ------- | 384.14 | ------- | ------- | 638.91 | ------- | ------- | 1012.39 | COMBINED UNDETAINED |
| 11 | Combine | 3, 4, 6, 9, | ------- | 383.82 | ------- | ------- | 639.46 | ------- | ------- | 1013.87 | COMBINED DETAINED |
| 12 | SCS Runoff | ------ | ------- | 0.326 | ------- | ------- | 0.532 | ------- | ------- | 0.832 | Erosion Quantification |

# 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 | 0.186 | 1 | 719 | 395 | ------ | ------ | ------ | EX WEST |
| 2 | SCS Runoff | 5.610 | 1 | 720 | 13,708 | ------ | ------ | ------ | EX EAST |
| 3 | SCS Runoff | 0.145 | 1 | 719 | 307 | ------ | ------ | ------ | PROP WEST |
| 4 | SCS Runoff | 0.841 | 1 | 719 | 1,774 | ------ | ------ | ------ | PROP EAST |
| 5 | SCS Runoff | 6.137 | 1 | 718 | 14,050 | ------ | ------ | ------ | PROP EAST 1 |
| 6 | Reservoir | 0.183 | 1 | 838 | 6,675 | 5 | 997.70 | 10,110 | DETAINED EAST 1 |
| 7 | Combine | 0.858 | 1 | 719 | 8,448 | 4, 6 | ------ | ------ | COMBINED EAST + DETAINED EAS |
| 8 | SCS Runoff | 385.69 | 1 | 759 | 2,926,671 | ------ | ------ | ------ | WATERSHED |
| 9 | SCS Runoff | 383.67 | 1 | 759 | 2,911,357 | ------ | ------ | ------ | WATERSHED - LOT 294 |
| 10 | Combine | 384.14 | 1 | 759 | 2,927,489 | 3, 4, 5, 9 | ------ | ------ | COMBINED UNDETAINED |
| 11 | Combine | 383.82 | 1 | 759 | 2,920,114 | 3, 4, 6, 9, | ------ | ------ | COMBINED DETAINED |
| 12 | SCS Runoff | 0.326 | 1 | 718 | 709 | ------ | ------ | ------ | Erosion Quantification |

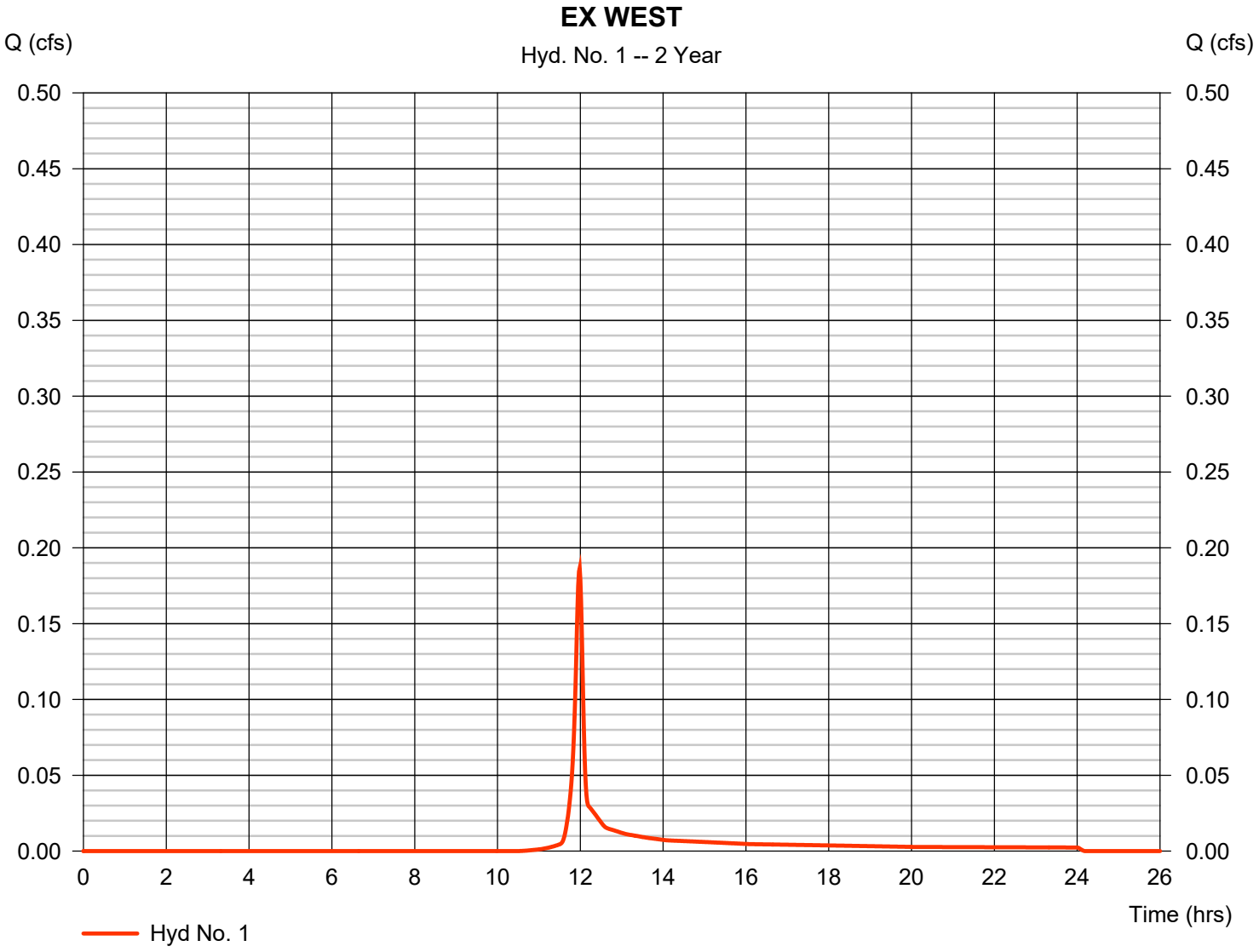
# Hydrograph Report



## Hyd. No. 1

EX WEST

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 0.186 cfs |
| Storm frequency | = | 2 yrs | Time to peak | = | 11.98 hrs |
| Time interval | = | 1 min | Hyd. volume | = | 395 cuft |
| Drainage area | = | 0.090 ac | Curve number | = | 74 |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | User | Time of conc. (Tc) | = | 7.40 min |
| Total precip. | = | 3.50 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |



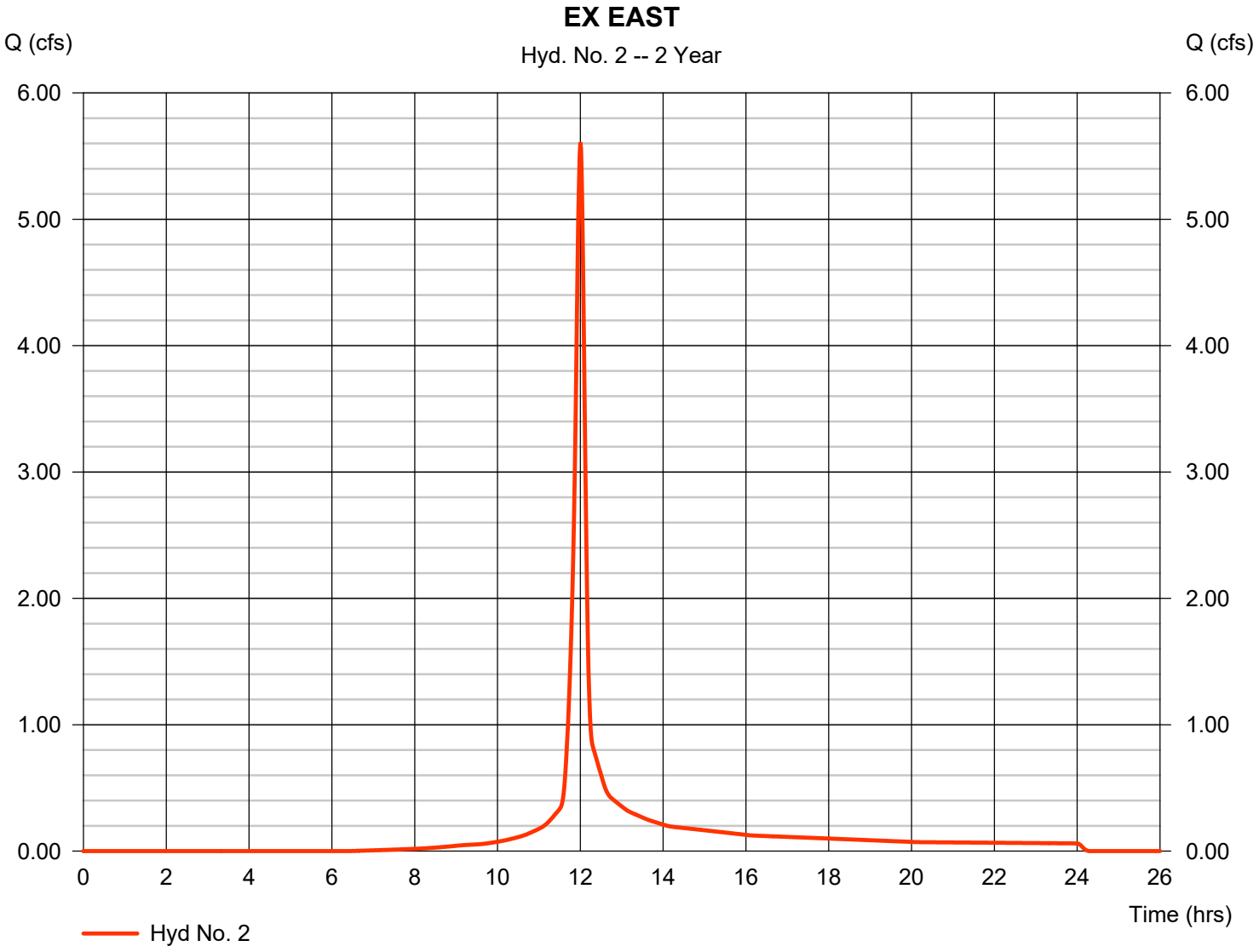
# Hydrograph Report



## Hyd. No. 2

EX EAST

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 5.610 cfs |
| Storm frequency | = | 2 yrs | Time to peak | = | 12.00 hrs |
| Time interval | = | 1 min | Hyd. volume | = | 13,708 cuft |
| Drainage area | = | 1.700 ac | Curve number | = | 87 |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | User | Time of conc. (Tc) | = | 10.40 min |
| Total precip. | = | 3.50 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |



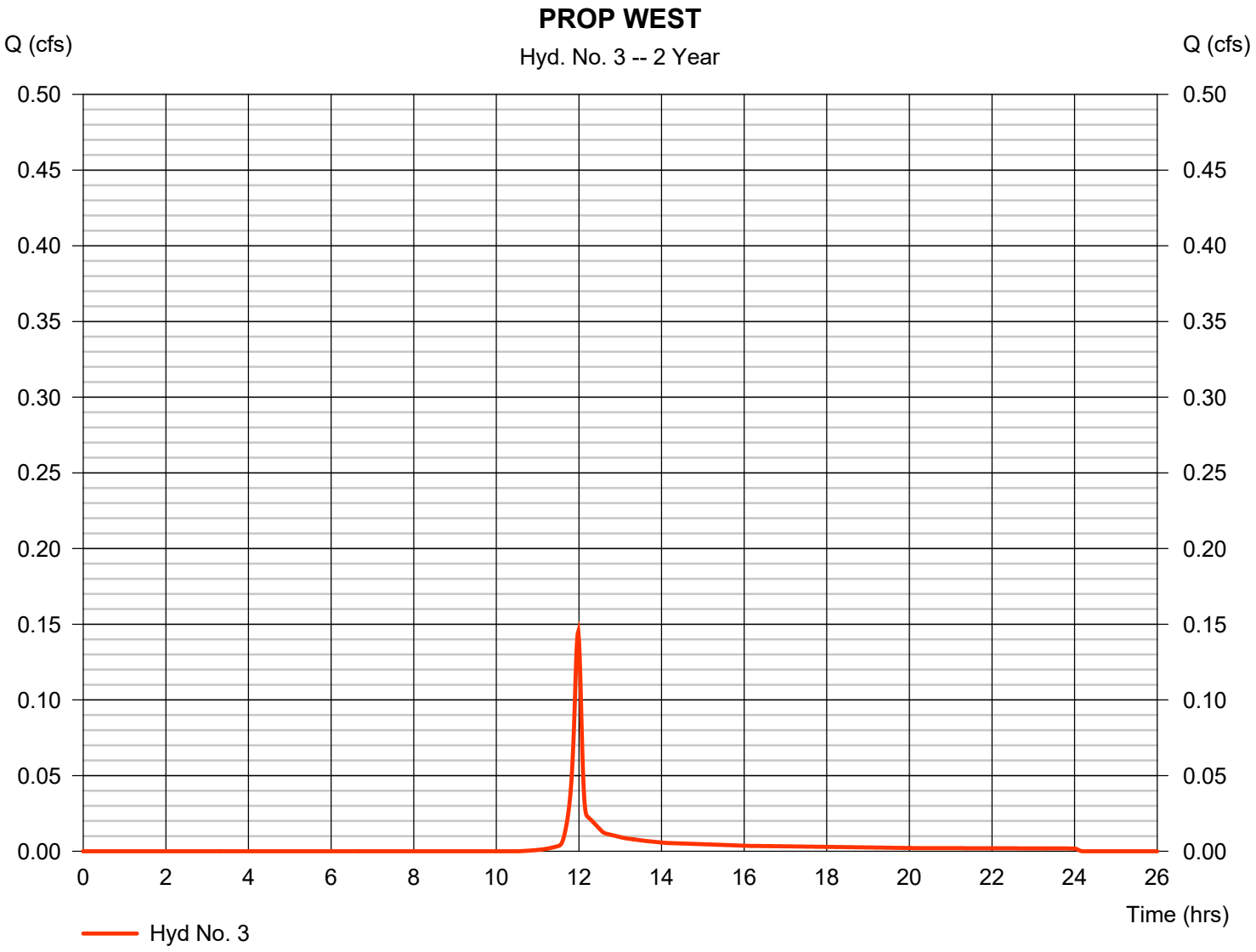
# Hydrograph Report



## Hyd. No. 3

PROP WEST

| | | | |
|---|---|---|---|
| Hydrograph type | = SCS Runoff | Peak discharge | = 0.145 cfs |
| Storm frequency | = 2 yrs | Time to peak | = 11.98 hrs |
| Time interval | = 1 min | Hyd. volume | = 307 cuft |
| Drainage area | = 0.070 ac | Curve number | = 74 |
| Basin Slope | = 0.0 % | Hydraulic length | = 0 ft |
| Tc method | = User | Time of conc. (Tc) | = 7.50 min |
| Total precip. | = 3.50 in | Distribution | = Type II |
| Storm duration | = 24 hrs | Shape factor | = 484 |



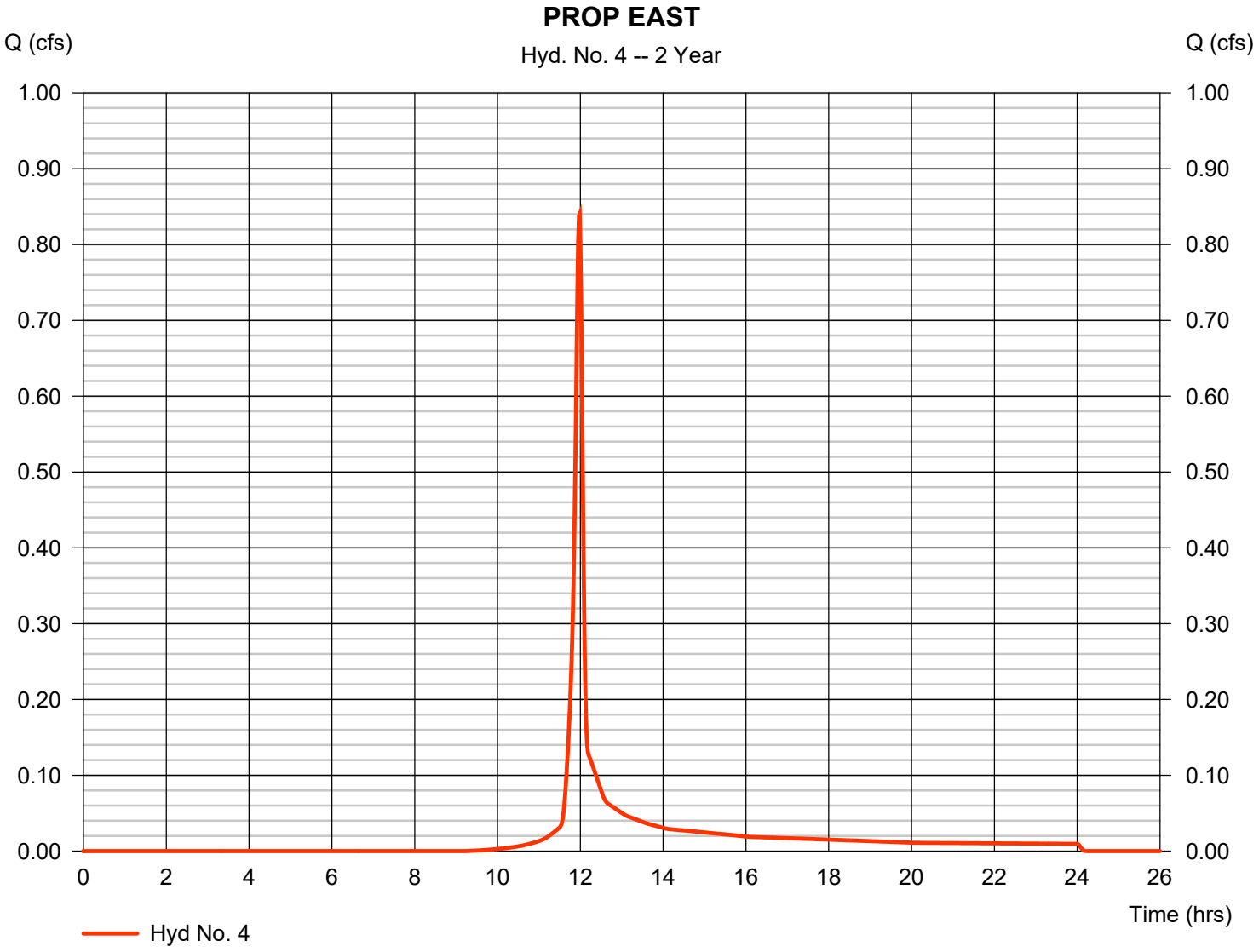
# Hydrograph Report



## Hyd. No. 4

PROP EAST

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 0.841 cfs |
| Storm frequency | = | 2 yrs | Time to peak | = | 11.98 hrs |
| Time interval | = | 1 min | Hyd. volume | = | 1,774 cuft |
| Drainage area | = | 0.320 ac | Curve number | = | 79 |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | User | Time of conc. (Tc) | = | 7.70 min |
| Total precip. | = | 3.50 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |



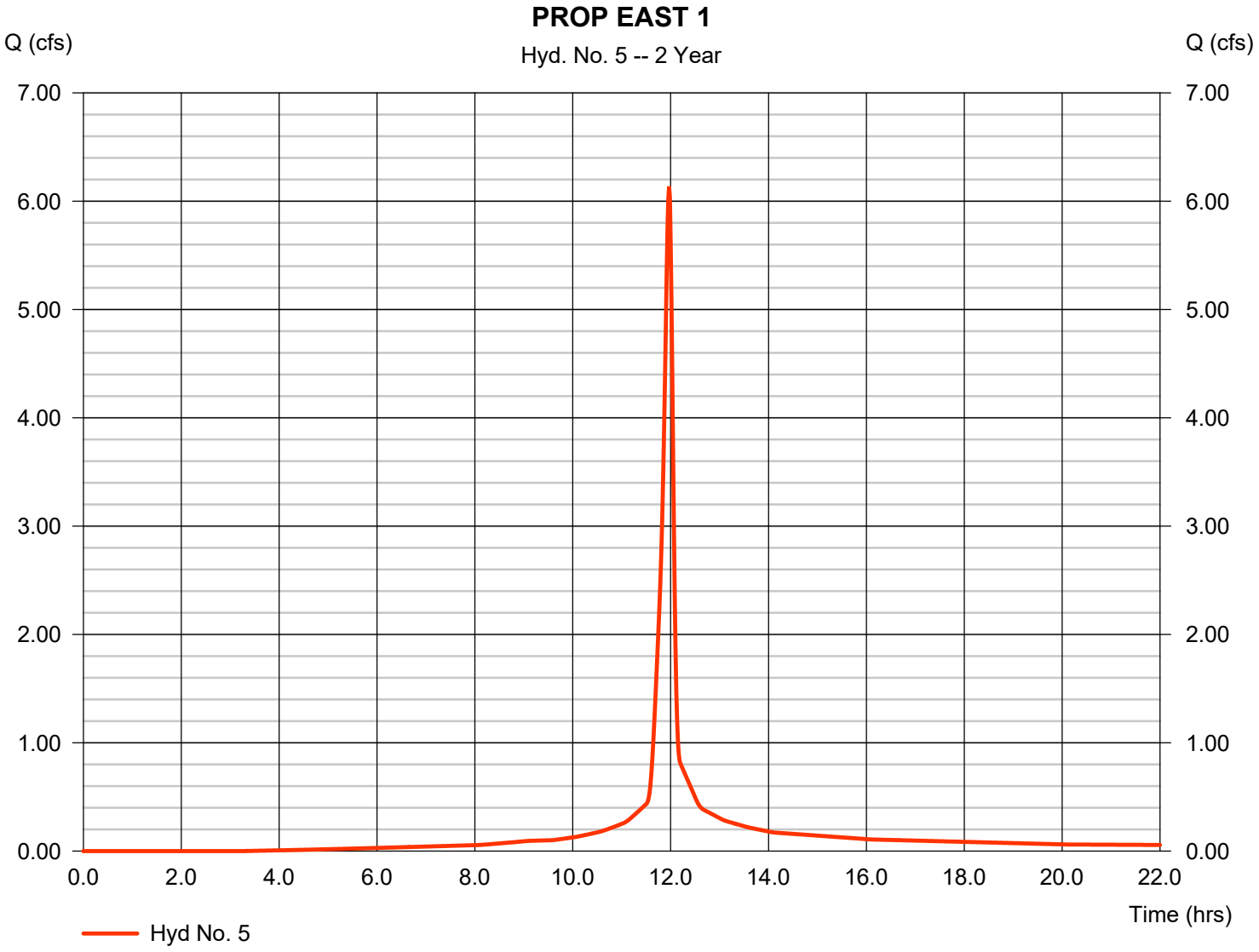
# Hydrograph Report



## Hyd. No. 5

PROP EAST 1

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 6.137 cfs |
| Storm frequency | = | 2 yrs | Time to peak | = | 11.97 hrs |
| Time interval | = | 1 min | Hyd. volume | = | 14,050 cuft |
| Drainage area | = | 1.400 ac | Curve number | = | 94 |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | User | Time of conc. (Tc) | = | 7.90 min |
| Total precip. | = | 3.50 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |



# Hydrograph Report

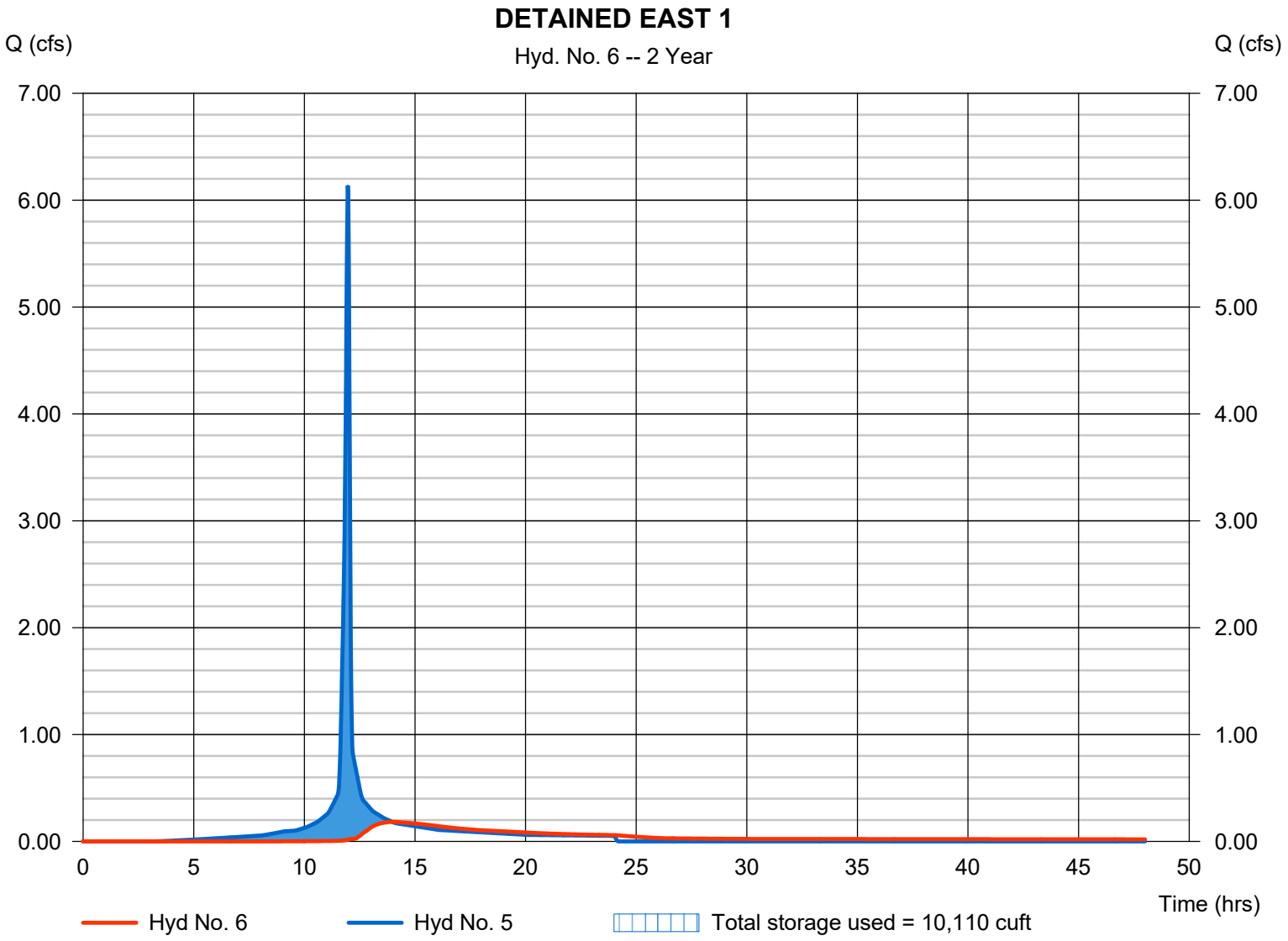


## Hyd. No. 6

DETAINED EAST 1

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | Reservoir | Peak discharge | = | 0.183 cfs |
| Storm frequency | = | 2 yrs | Time to peak | = | 13.97 hrs |
| Time interval | = | 1 min | Hyd. volume | = | 6,675 cuft |
| Inflow hyd. No. | = | 5 - PROP EAST 1 | Max. Elevation | = | 997.70 ft |
| Reservoir name | = | Underground Chamber Detention | Max. Storage | = | 10,110 cuft |

Storage Indication method used.



# Pond Report





## Pond No. 1 - Underground Chamber Detention

### Pond Data

**UG Chambers -**Invert elev. = 996.50 ft, Rise x Span = 3.50 x 5.60 ft, Barrel Len = 7.12 ft, No. Barrels = 133, Slope = 0.00%, Headers = No
**Encasement -**Invert elev. = 995.50 ft, Width = 7.61 ft, Height = 5.50 ft, Voids = 40.00%

### Stage / Storage Table

| Stage (ft) | Elevation (ft) | Contour area (sqft) | Incr. Storage (cuft) | Total storage (cuft) |
|---|---|---|---|---|
| 0.00 | 995.50 | n/a | 0 | 0 |
| 0.55 | 996.05 | n/a | 1,586 | 1,586 |
| 1.10 | 996.60 | n/a | 1,904 | 3,490 |
| 1.65 | 997.15 | n/a | 3,324 | 6,814 |
| 2.20 | 997.70 | n/a | 3,272 | 10,086 |
| 2.75 | 998.25 | n/a | 3,171 | 13,256 |
| 3.30 | 998.80 | n/a | 3,010 | 16,266 |
| 3.85 | 999.35 | n/a | 2,765 | 19,031 |
| 4.40 | 999.90 | n/a | 2,352 | 21,383 |
| 4.95 | 1000.45 | n/a | 1,636 | 23,020 |
| 5.50 | 1001.00 | n/a | 1,586 | 24,605 |

### Culvert / Orifice Structures

| | [A] | [B] | [C] | [PrfRsr] |
|---|---|---|---|---|
| **Rise (in)** | = 18.00 | 9.00 | 0.00 | 1.00 |
| **Span (in)** | = 18.00 | 9.00 | 0.00 | 1.00 |
| **No. Barrels** | = 1 | 1 | 0 | 1 |
| **Invert El. (ft)** | = 994.80 | 997.50 | 0.00 | 995.00 |
| **Length (ft)** | = 20.77 | 0.00 | 0.00 | 2.08 |
| **Slope (%)** | = 1.50 | 0.00 | 0.00 | n/a |
| **N-Value** | = .013 | .013 | .013 | n/a |
| **Orifice Coeff.** | = 0.60 | 0.60 | 0.60 | 0.60 |
| **Multi-Stage** | = n/a | Yes | No | Yes |

### Weir Structures

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

**Exfil.(in/hr)** = 0.000 (by Wet area)
**TW Elev. (ft)** = 0.00

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

### Stage / Storage / Discharge Table

| Stage ft | Storage cuft | Elevation ft | Clv A cfs | Clv B cfs | Clv C cfs | PrfRsr cfs | Wr A cfs | Wr B cfs | Wr C cfs | Wr D cfs | Exfil cfs | User cfs | Total cfs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0 | 995.50 | 0.00 | 0.00 | --- | 0.00 | --- | --- | --- | --- | --- | --- | 0.000 |
| 0.55 | 1,586 | 996.05 | 2.32 ic | 0.00 | --- | 0.00 | --- | --- | --- | --- | --- | --- | 0.003 |
| 1.10 | 3,490 | 996.60 | 2.32 ic | 0.00 | --- | 0.01 | --- | --- | --- | --- | --- | --- | 0.010 |
| 1.65 | 6,814 | 997.15 | 2.32 ic | 0.00 | --- | 0.02 | --- | --- | --- | --- | --- | --- | 0.018 |
| 2.20 | 10,086 | 997.70 | 2.32 ic | 0.15 ic | --- | 0.03 | --- | --- | --- | --- | --- | --- | 0.176 |
| 2.75 | 13,256 | 998.25 | 2.32 ic | 1.30 ic | --- | 0.04 | --- | --- | --- | --- | --- | --- | 1.341 |
| 3.30 | 16,266 | 998.80 | 2.32 ic | 2.05 ic | --- | 0.05 | --- | --- | --- | --- | --- | --- | 2.096 |
| 3.85 | 19,031 | 999.35 | 2.66 ic | 2.58 ic | --- | 0.06 | --- | --- | --- | --- | --- | --- | 2.645 |
| 4.40 | 21,383 | 999.90 | 3.11 ic | 3.03 ic | --- | 0.07 | --- | --- | --- | --- | --- | --- | 3.101 |
| 4.95 | 23,020 | 1000.45 | 3.50 ic | 3.41 ic | --- | 0.09 | --- | --- | --- | --- | --- | --- | 3.500 |
| 5.50 | 24,605 | 1001.00 | 3.88 ic | 3.76 ic | --- | 0.10 | --- | --- | --- | --- | --- | --- | 3.861 |

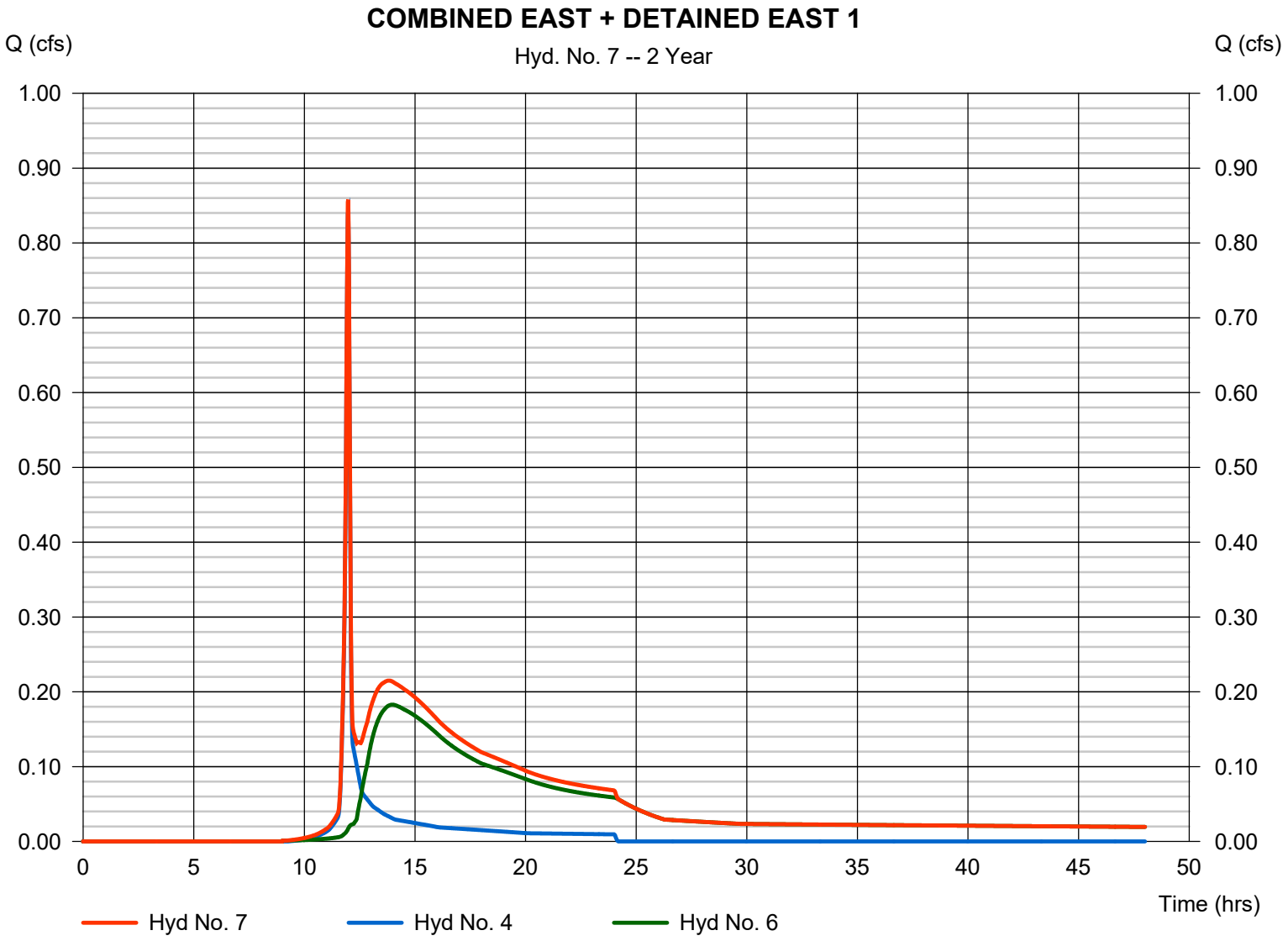
# Hydrograph Report



## Hyd. No. 7

COMBINED EAST + DETAINED EAST 1

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | Combine | Peak discharge | = | 0.858 cfs |
| Storm frequency | = | 2 yrs | Time to peak | = | 11.98 hrs |
| Time interval | = | 1 min | Hyd. volume | = | 8,448 cuft |
| Inflow hyds. | = | 4, 6 | Contrib. drain. area | = | 0.320 ac |



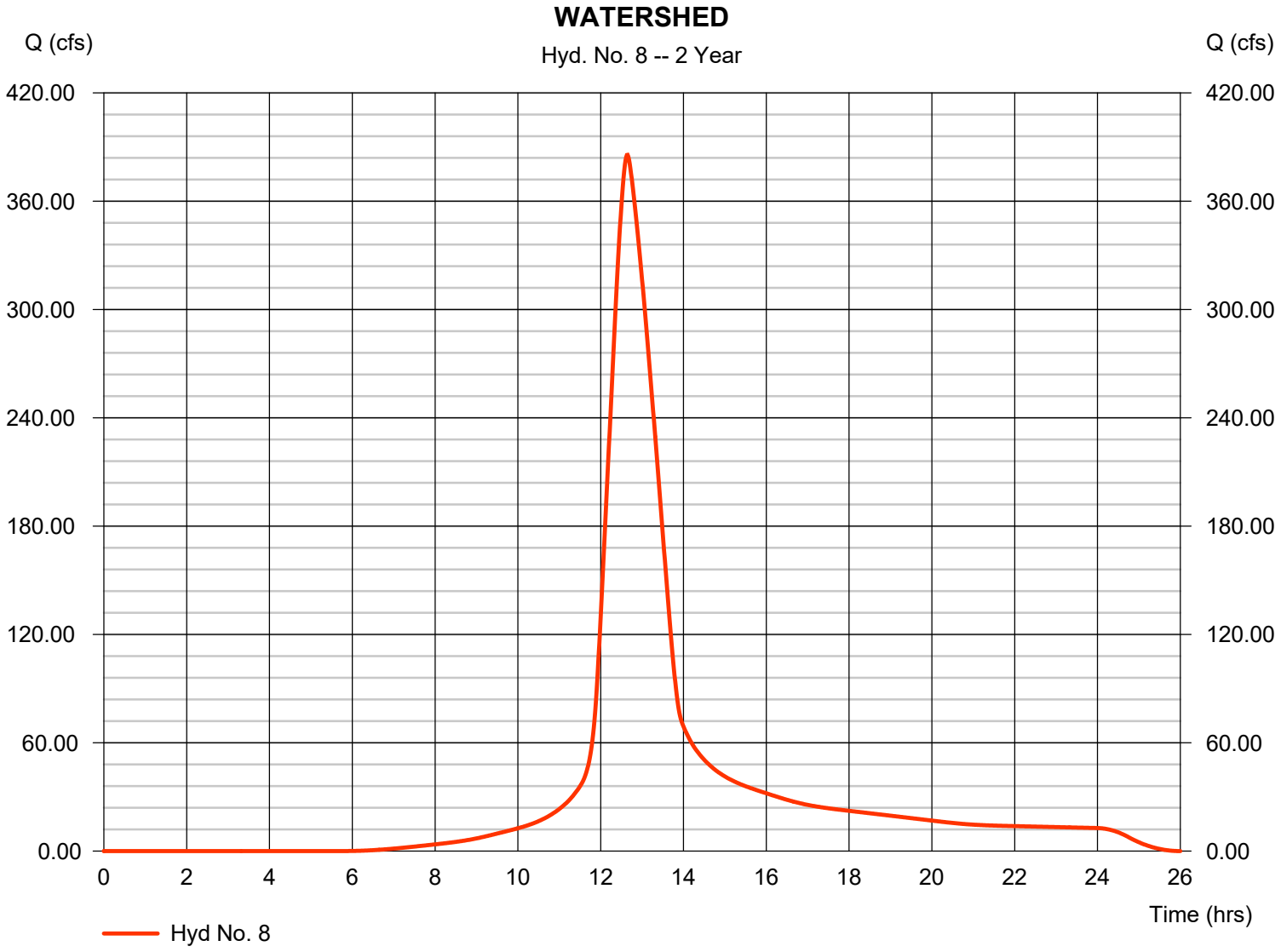
# Hydrograph Report



## Hyd. No. 8

WATERSHED

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 385.69 cfs |
| Storm frequency | = | 2 yrs | Time to peak | = | 12.65 hrs |
| Time interval | = | 1 min | Hyd. volume | = | 2,926,671 cuft |
| Drainage area | = | 342.040 ac | Curve number | = | 89 |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | User | Time of conc. (Tc) | = | 76.10 min |
| Total precip. | = | 3.50 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |



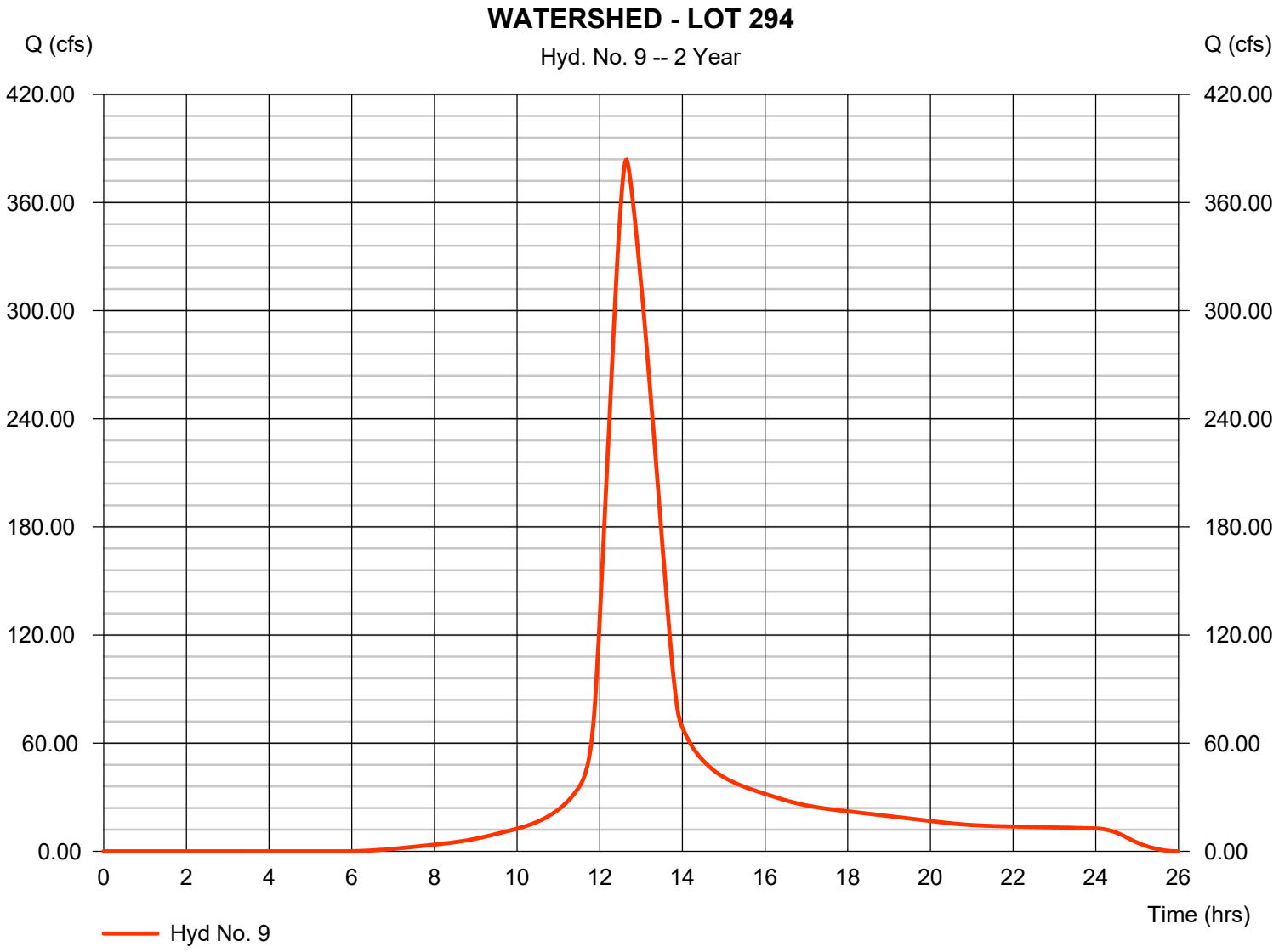
# Hydrograph Report



## Hyd. No. 9

WATERSHED - LOT 294

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 383.67 cfs |
| Storm frequency | = | 2 yrs | Time to peak | = | 12.65 hrs |
| Time interval | = | 1 min | Hyd. volume | = | 2,911,357 cuft |
| Drainage area | = | 340.250 ac | Curve number | = | 89 |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | User | Time of conc. (Tc) | = | 76.10 min |
| Total precip. | = | 3.50 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |



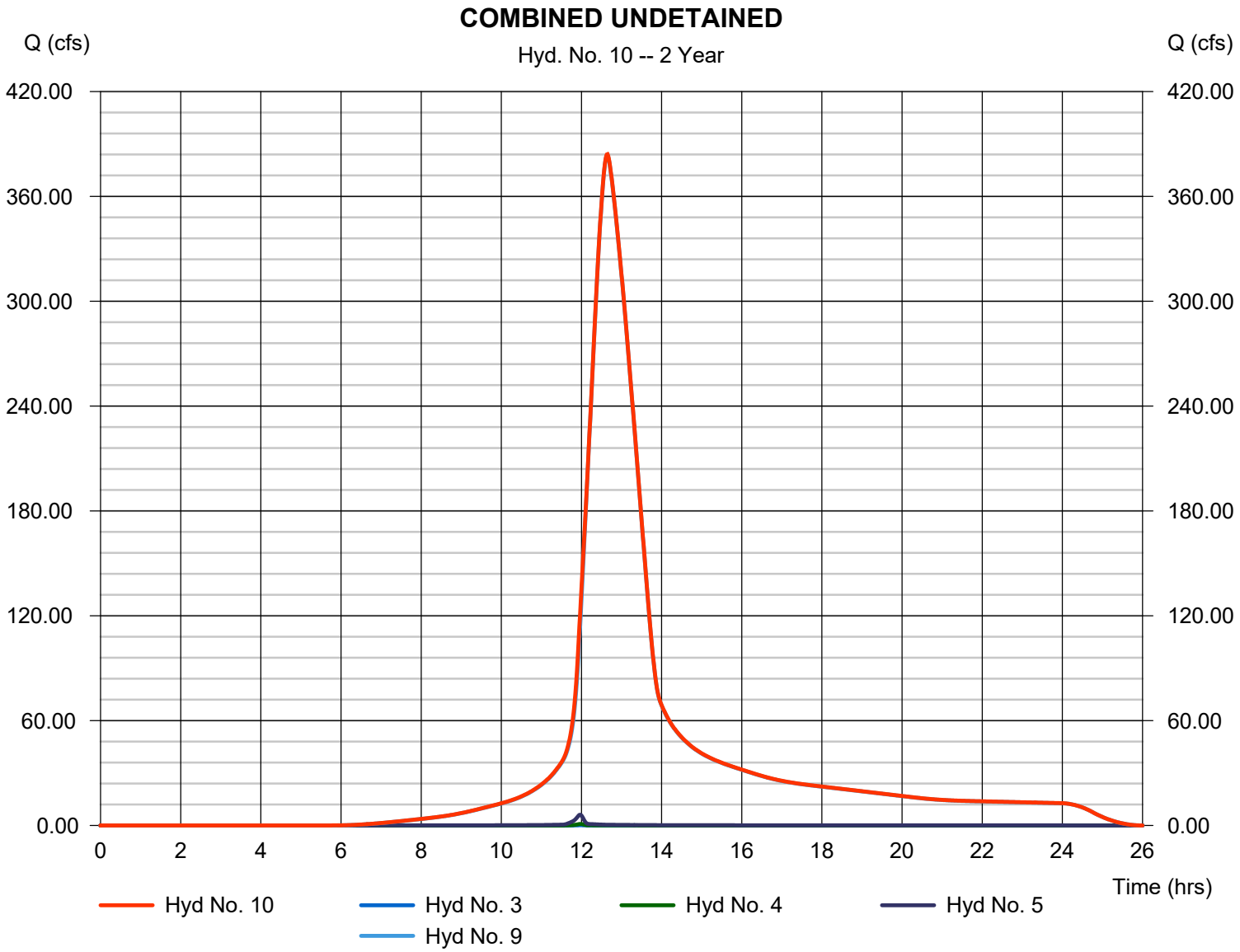
# Hydrograph Report



## Hyd. No. 10

COMBINED UNDETAINED

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | Combine | Peak discharge | = | 384.14 cfs |
| Storm frequency | = | 2 yrs | Time to peak | = | 12.65 hrs |
| Time interval | = | 1 min | Hyd. volume | = | 2,927,489 cuft |
| Inflow hyds. | = | 3, 4, 5, 9 | Contrib. drain. area | = | 342.040 ac |



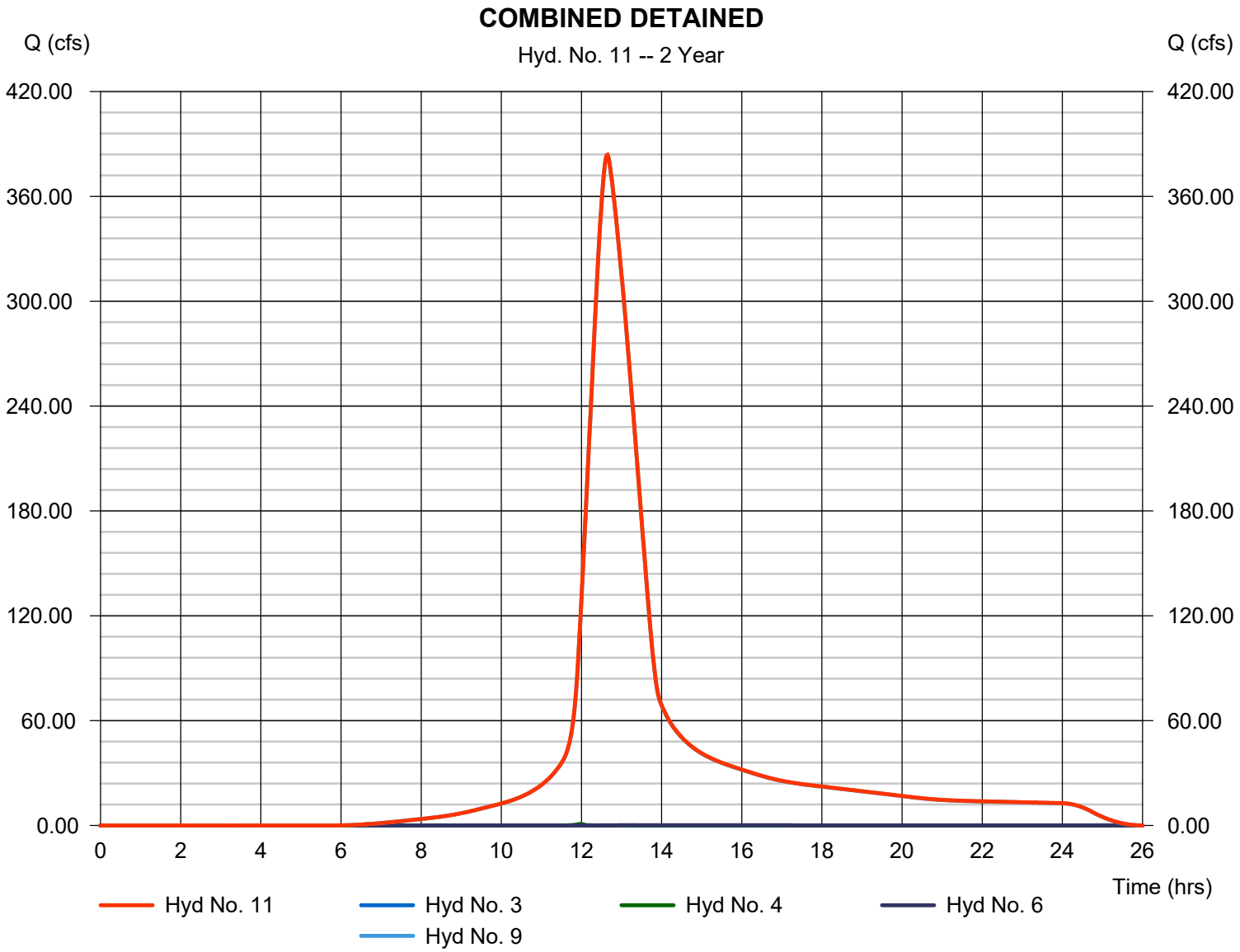
# Hydrograph Report



## Hyd. No. 11

COMBINED DETAINED

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | Combine | Peak discharge | = | 383.82 cfs |
| Storm frequency | = | 2 yrs | Time to peak | = | 12.65 hrs |
| Time interval | = | 1 min | Hyd. volume | = | 2,920,114 cuft |
| Inflow hyds. | = | 3, 4, 6, 9 | Contrib. drain. area | = | 340.640 ac |



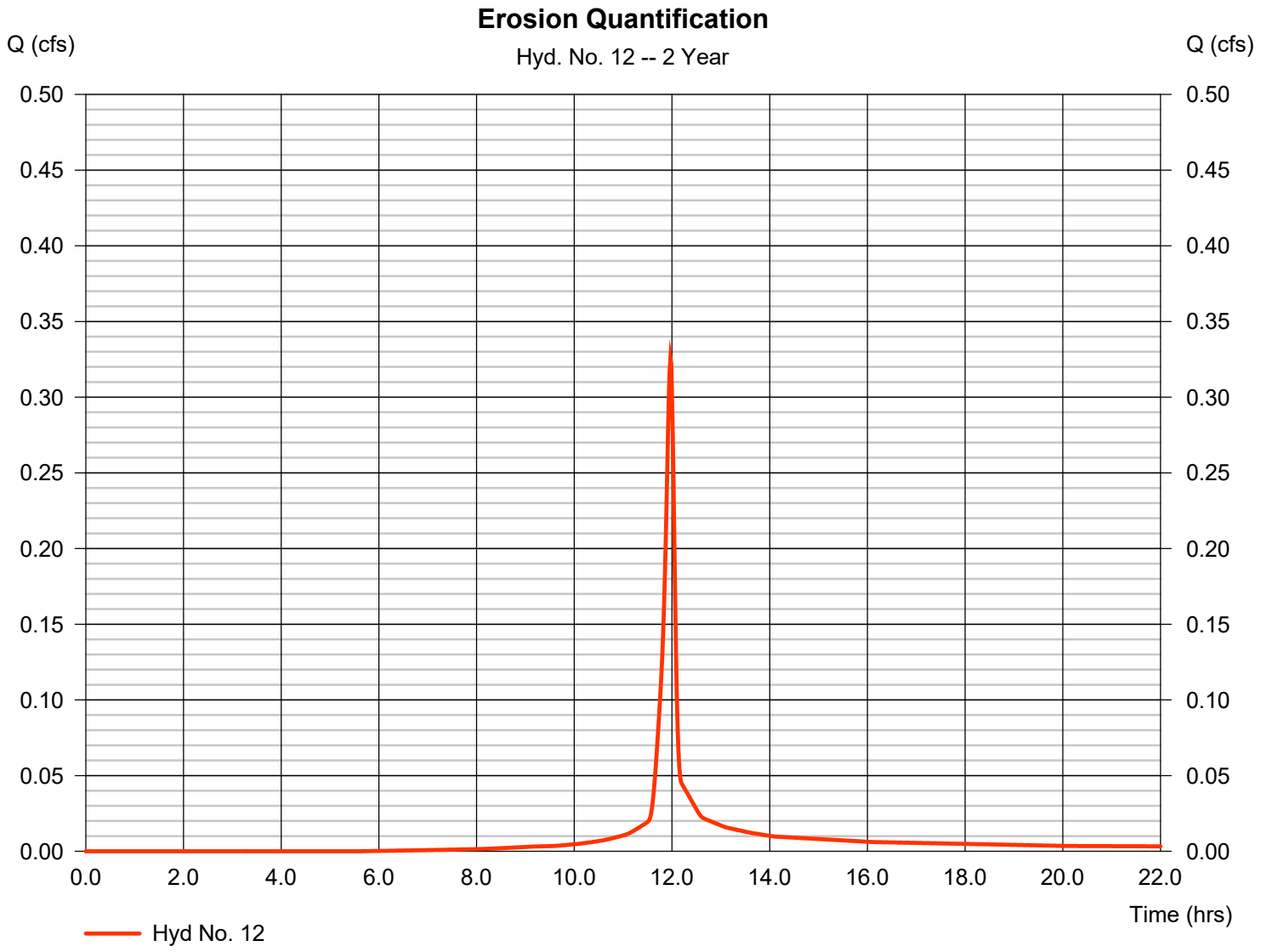
# Hydrograph Report



## Hyd. No. 12

Erosion Quantification

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 0.326 cfs |
| Storm frequency | = | 2 yrs | Time to peak | = | 11.97 hrs |
| Time interval | = | 1 min | Hyd. volume | = | 709 cuft |
| Drainage area | = | 0.085 ac | Curve number | = | 89 |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | User | Time of conc. (Tc) | = | 7.50 min |
| Total precip. | = | 3.50 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |



# 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 | 0.380 | 1 | 718 | 804 | ------ | ------ | ------ | EX WEST |
| 2 | SCS Runoff | 9.436 | 1 | 720 | 23,592 | ------ | ------ | ------ | EX EAST |
| 3 | SCS Runoff | 0.296 | 1 | 718 | 626 | ------ | ------ | ------ | PROP WEST |
| 4 | SCS Runoff | 1.581 | 1 | 718 | 3,369 | ------ | ------ | ------ | PROP EAST |
| 5 | SCS Runoff | 9.462 | 1 | 718 | 22,324 | ------ | ------ | ------ | PROP EAST 1 |
| 6 | Reservoir | 1.348 | 1 | 730 | 14,895 | 5 | 998.25 | 13,281 | DETAINED EAST 1 |
| 7 | Combine | 2.189 | 1 | 721 | 18,264 | 4, 6 | ------ | ------ | COMBINED EAST + DETAINED EAS |
| 8 | SCS Runoff | 641.53 | 1 | 758 | 4,921,330 | ------ | ------ | ------ | WATERSHED |
| 9 | SCS Runoff | 638.18 | 1 | 758 | 4,895,582 | ------ | ------ | ------ | WATERSHED - LOT 294 |
| 10 | Combine | 638.91 | 1 | 758 | 4,921,900 | 3, 4, 5, 9 | ------ | ------ | COMBINED UNDETAINED |
| 11 | Combine | 639.46 | 1 | 758 | 4,914,492 | 3, 4, 6, 9, | ------ | ------ | COMBINED DETAINED |
| 12 | SCS Runoff | 0.532 | 1 | 718 | 1,192 | ------ | ------ | ------ | Erosion Quantification |

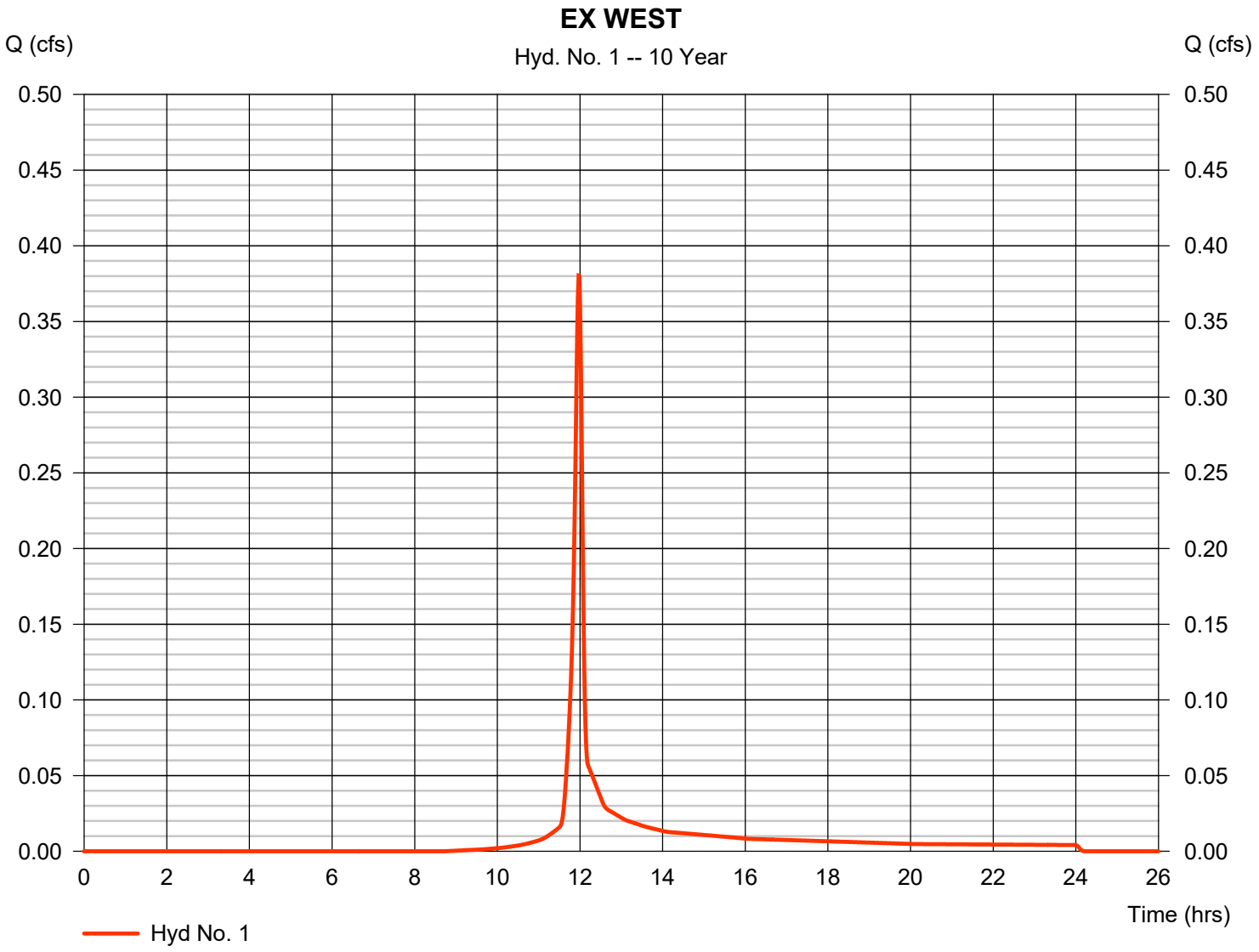
# Hydrograph Report



## Hyd. No. 1

EX WEST

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 0.380 cfs |
| Storm frequency | = | 10 yrs | Time to peak | = | 11.97 hrs |
| Time interval | = | 1 min | Hyd. volume | = | 804 cuft |
| Drainage area | = | 0.090 ac | Curve number | = | 74 |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | User | Time of conc. (Tc) | = | 7.40 min |
| Total precip. | = | 5.20 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |



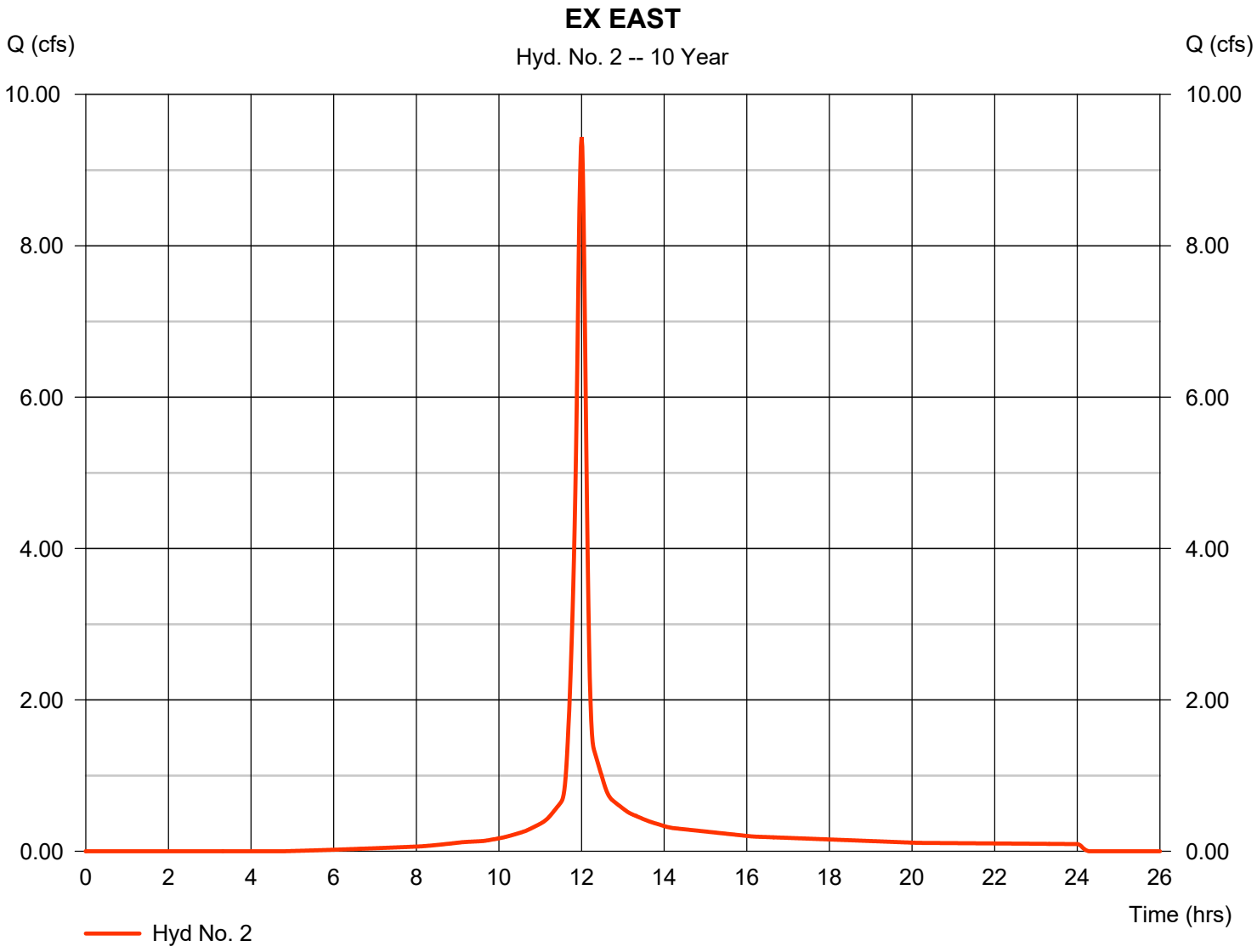
# Hydrograph Report



## Hyd. No. 2

EX EAST

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 9.436 cfs |
| Storm frequency | = | 10 yrs | Time to peak | = | 12.00 hrs |
| Time interval | = | 1 min | Hyd. volume | = | 23,592 cuft |
| Drainage area | = | 1.700 ac | Curve number | = | 87 |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | User | Time of conc. (Tc) | = | 10.40 min |
| Total precip. | = | 5.20 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |



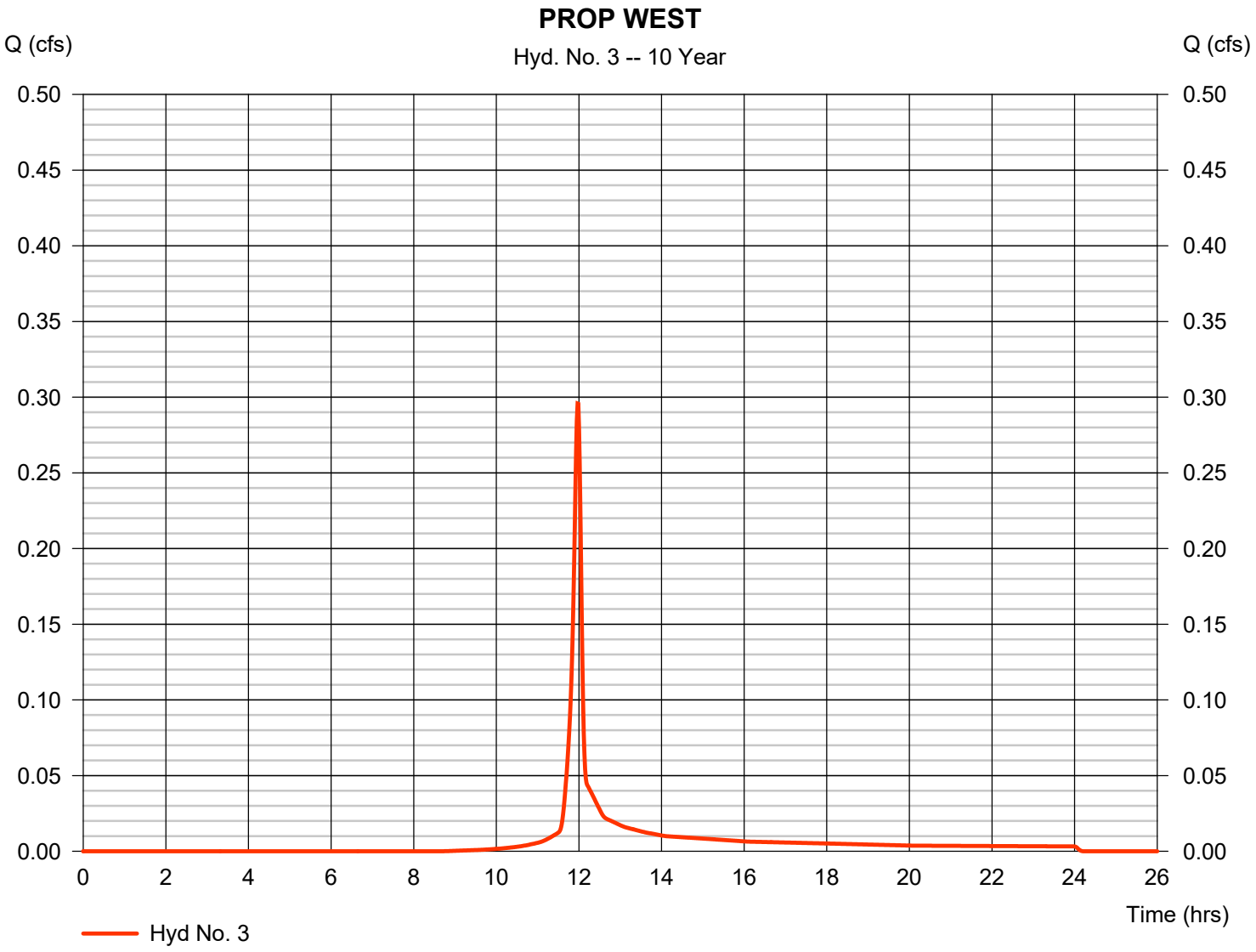
# Hydrograph Report



## Hyd. No. 3

PROP WEST

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 0.296 cfs |
| Storm frequency | = | 10 yrs | Time to peak | = | 11.97 hrs |
| Time interval | = | 1 min | Hyd. volume | = | 626 cuft |
| Drainage area | = | 0.070 ac | Curve number | = | 74 |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | User | Time of conc. (Tc) | = | 7.50 min |
| Total precip. | = | 5.20 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |



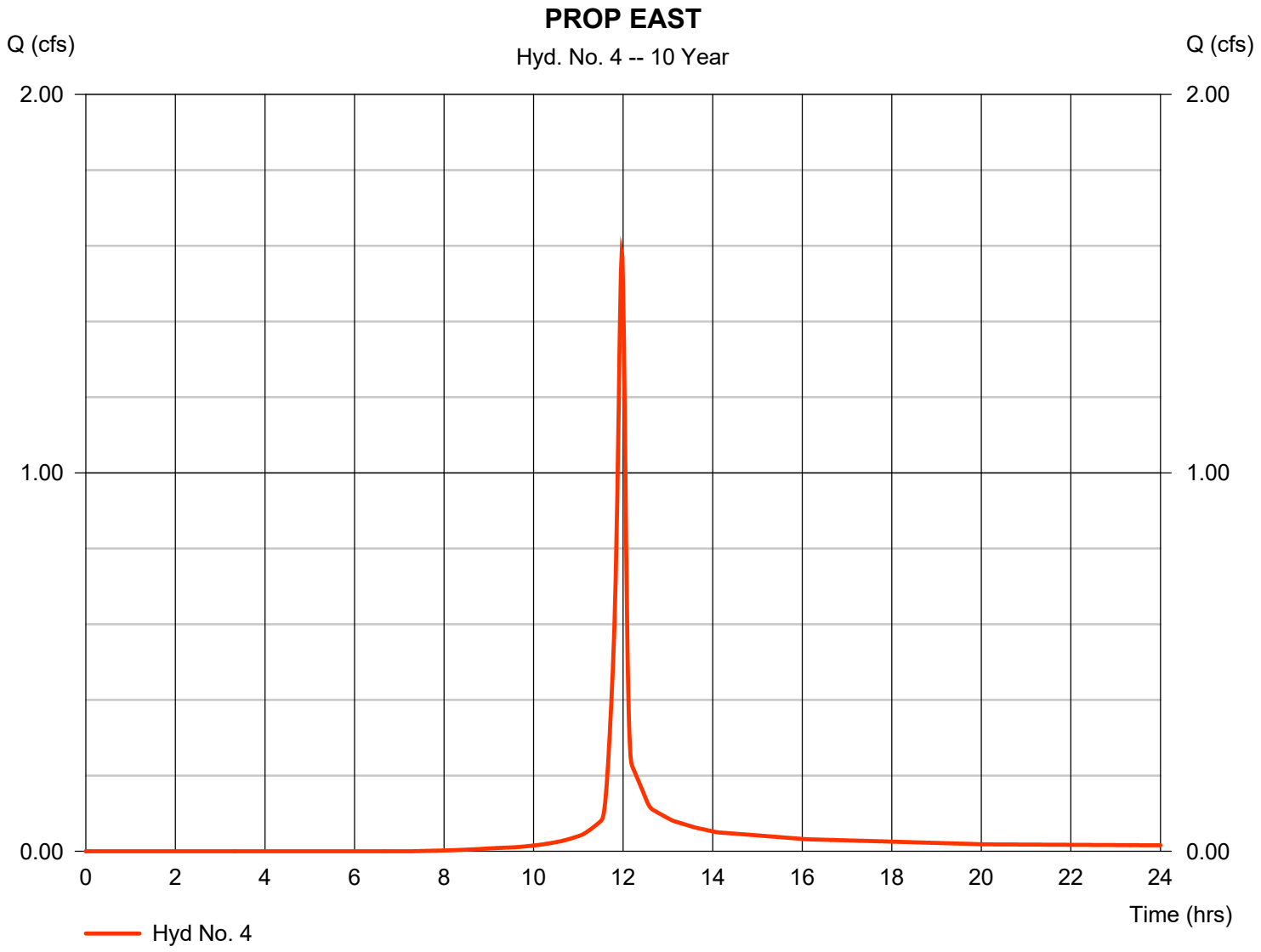
# Hydrograph Report



## Hyd. No. 4

PROP EAST

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 1.581 cfs |
| Storm frequency | = | 10 yrs | Time to peak | = | 11.97 hrs |
| Time interval | = | 1 min | Hyd. volume | = | 3,369 cuft |
| Drainage area | = | 0.320 ac | Curve number | = | 79 |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | User | Time of conc. (Tc) | = | 7.70 min |
| Total precip. | = | 5.20 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |



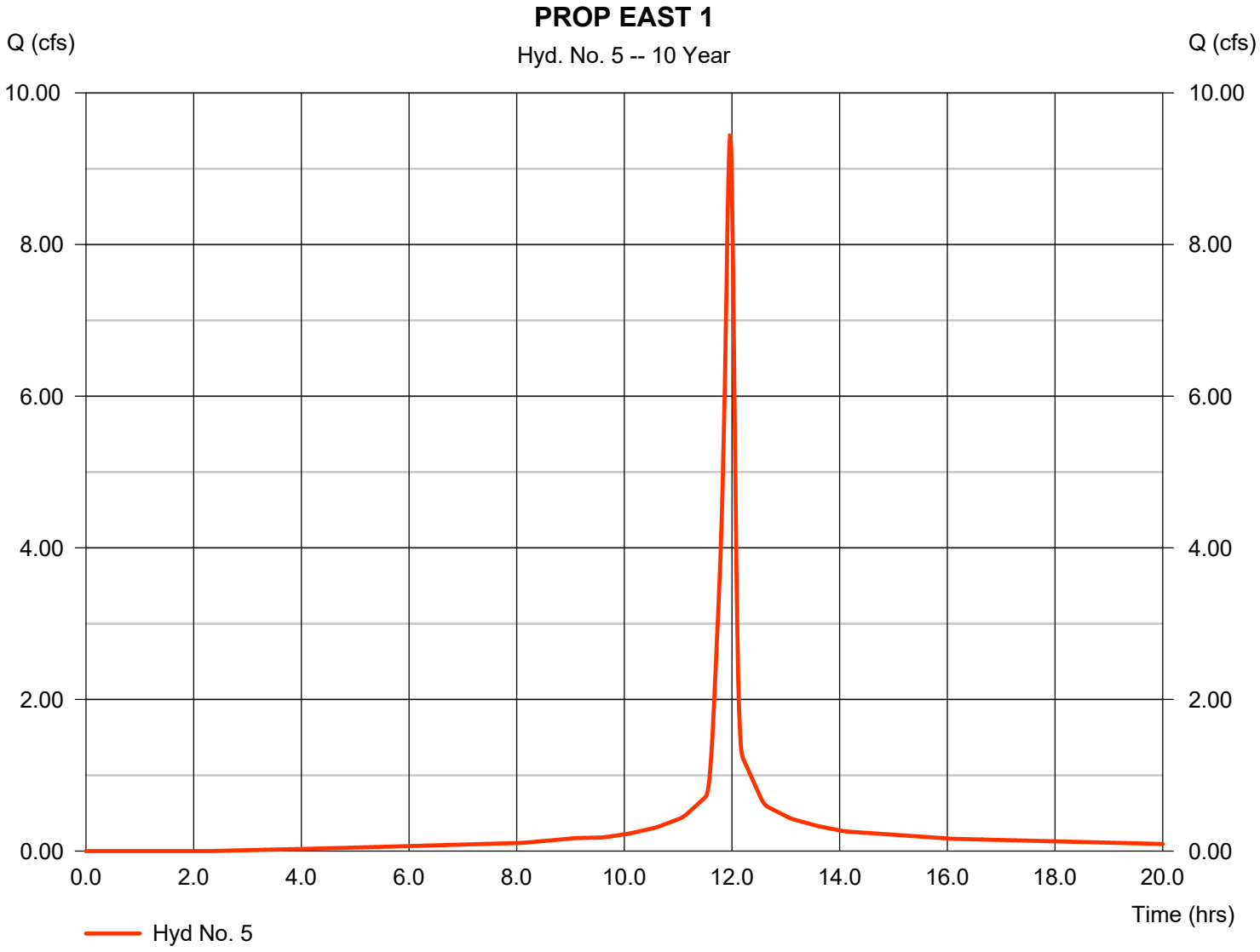
# Hydrograph Report



## Hyd. No. 5

PROP EAST 1

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 9.462 cfs |
| Storm frequency | = | 10 yrs | Time to peak | = | 11.97 hrs |
| Time interval | = | 1 min | Hyd. volume | = | 22,324 cuft |
| Drainage area | = | 1.400 ac | Curve number | = | 94 |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | User | Time of conc. (Tc) | = | 7.90 min |
| Total precip. | = | 5.20 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |



# Hydrograph Report

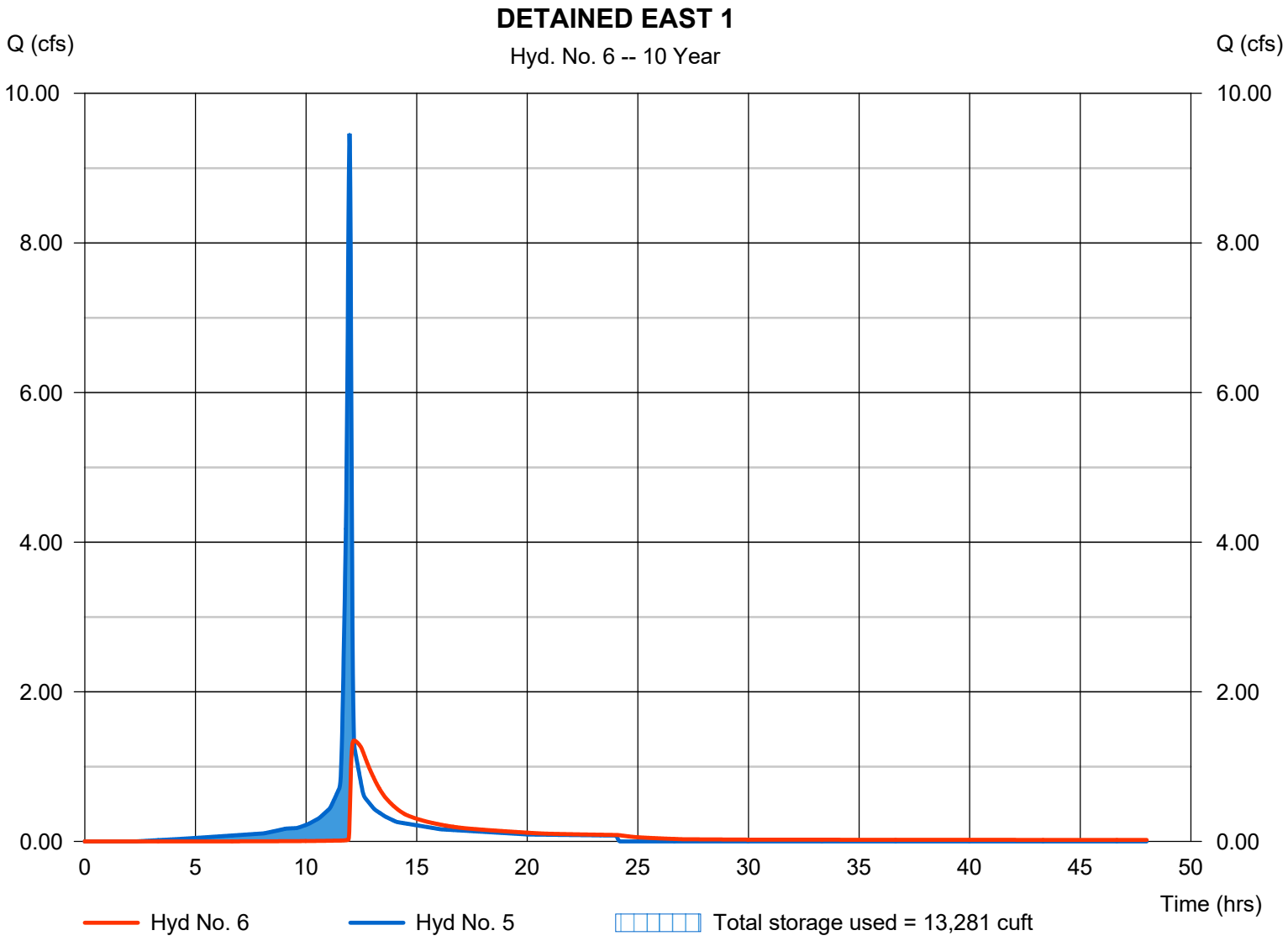


## Hyd. No. 6

DETAINED EAST 1

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | Reservoir | Peak discharge | = | 1.348 cfs |
| Storm frequency | = | 10 yrs | Time to peak | = | 12.17 hrs |
| Time interval | = | 1 min | Hyd. volume | = | 14,895 cuft |
| Inflow hyd. No. | = | 5 - PROP EAST 1 | Max. Elevation | = | 998.25 ft |
| Reservoir name | = | Underground Chamber Detention | Max. Storage | = | 13,281 cuft |

Storage Indication method used.



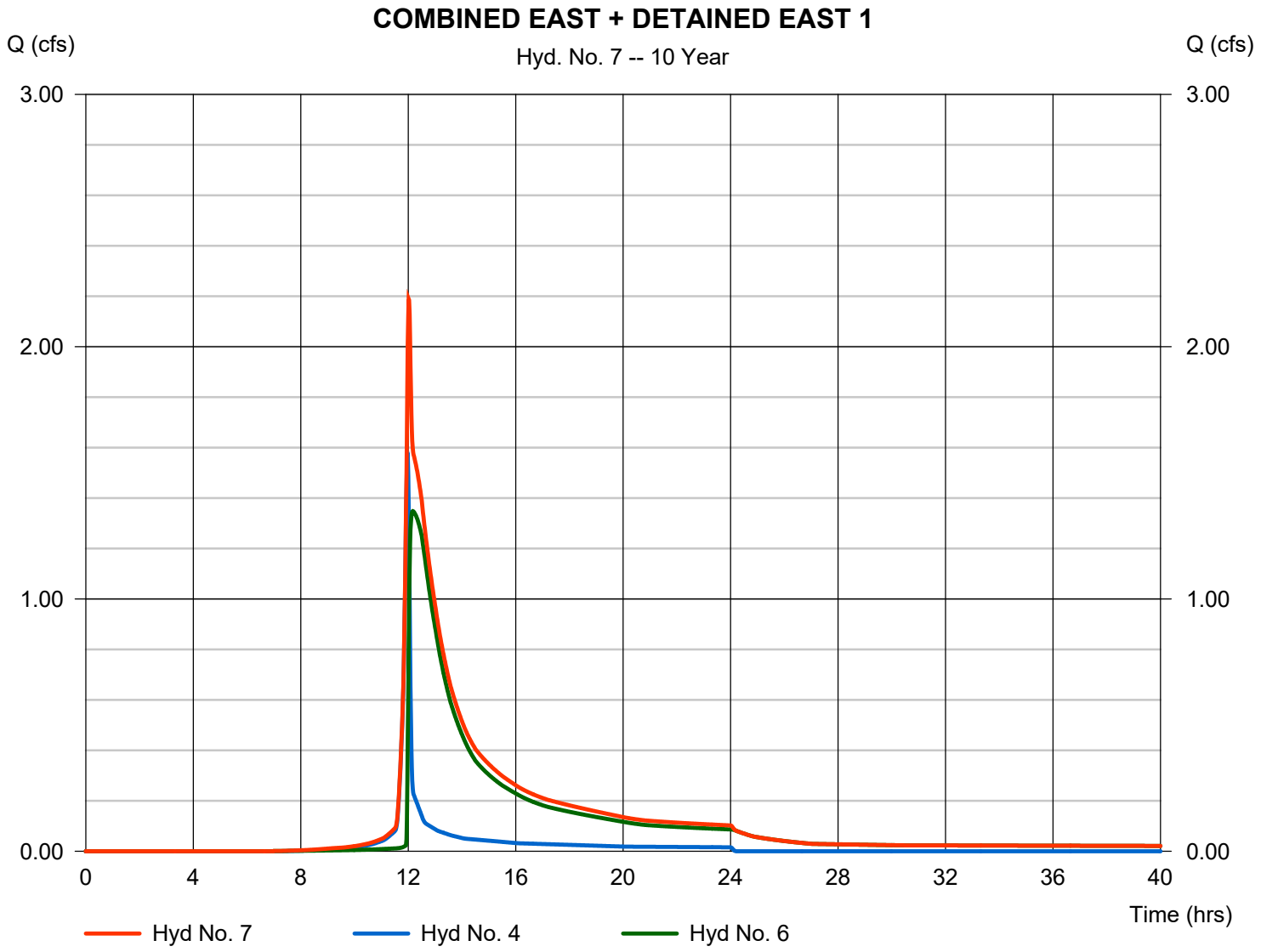
# Hydrograph Report



## Hyd. No. 7

COMBINED EAST + DETAINED EAST 1

| | | | |
|---|---|---|---|
| Hydrograph type | = Combine | Peak discharge | = 2.189 cfs |
| Storm frequency | = 10 yrs | Time to peak | = 12.02 hrs |
| Time interval | = 1 min | Hyd. volume | = 18,264 cuft |
| Inflow hyds. | = 4, 6 | Contrib. drain. area | = 0.320 ac |



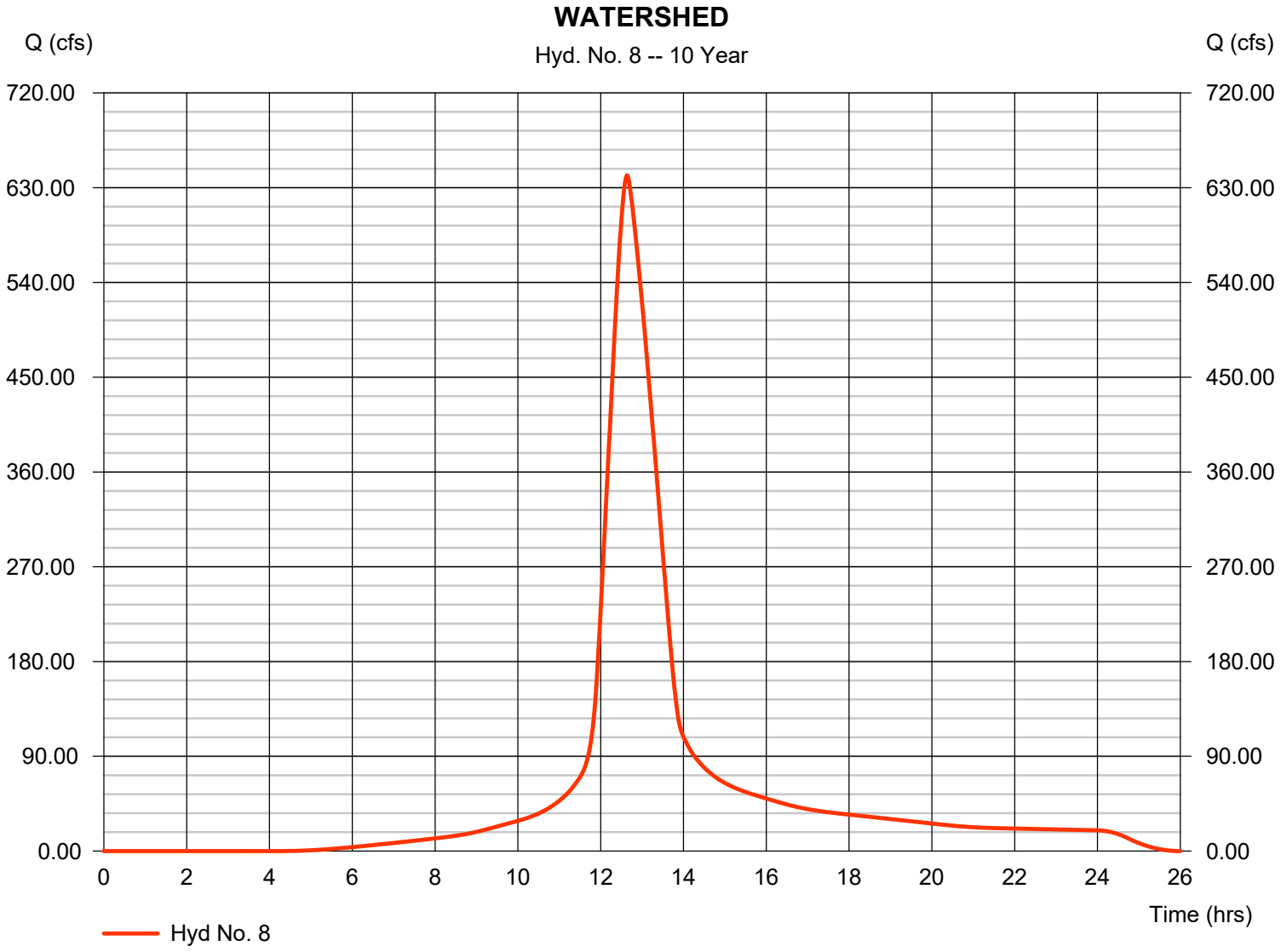
# Hydrograph Report



## Hyd. No. 8

WATERSHED

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 641.53 cfs |
| Storm frequency | = | 10 yrs | Time to peak | = | 12.63 hrs |
| Time interval | = | 1 min | Hyd. volume | = | 4,921,330 cuft |
| Drainage area | = | 342.040 ac | Curve number | = | 89 |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | User | Time of conc. (Tc) | = | 76.10 min |
| Total precip. | = | 5.20 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |



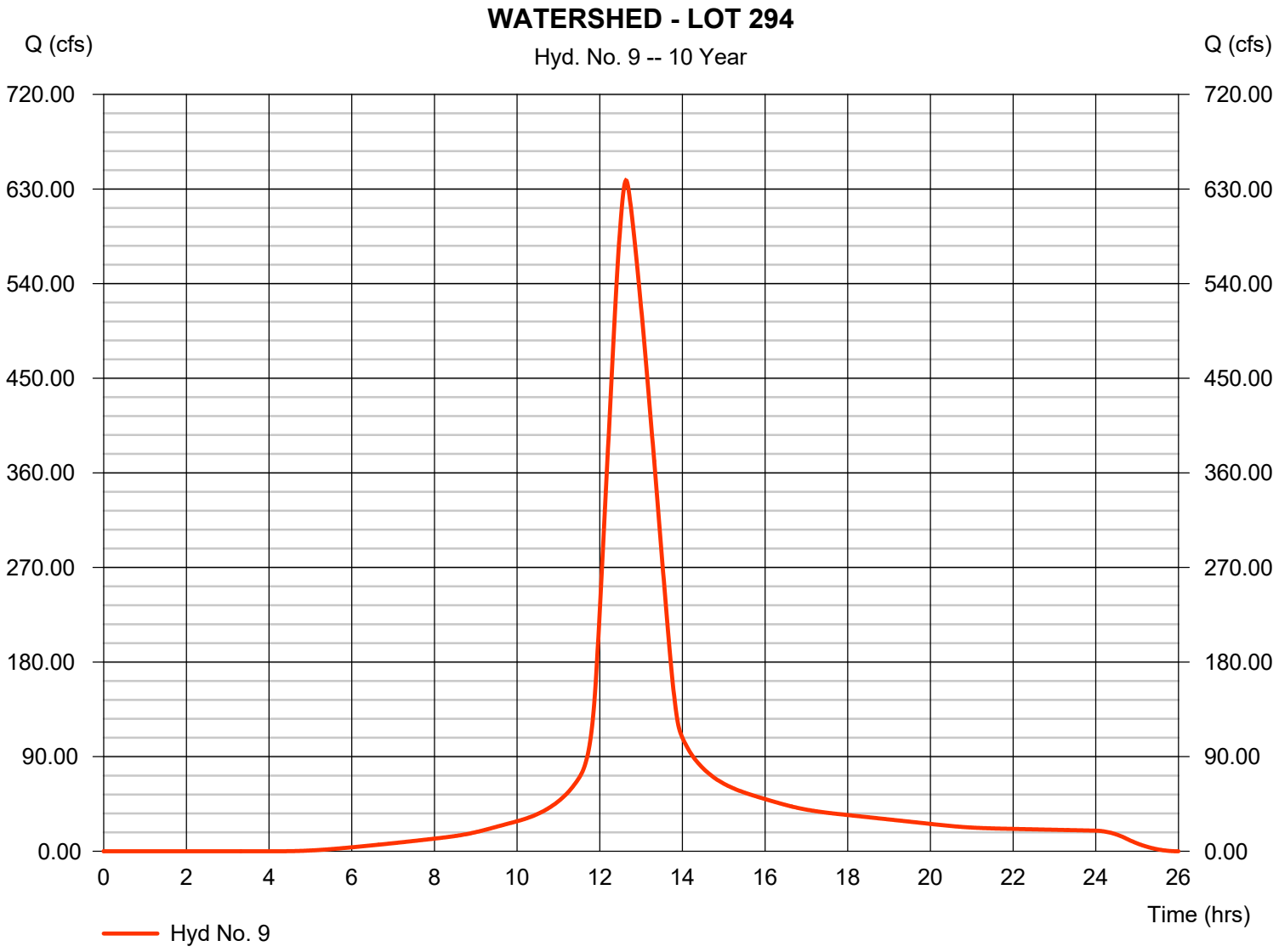
# Hydrograph Report



## Hyd. No. 9

WATERSHED - LOT 294

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 638.18 cfs |
| Storm frequency | = | 10 yrs | Time to peak | = | 12.63 hrs |
| Time interval | = | 1 min | Hyd. volume | = | 4,895,582 cuft |
| Drainage area | = | 340.250 ac | Curve number | = | 89 |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | User | Time of conc. (Tc) | = | 76.10 min |
| Total precip. | = | 5.20 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |



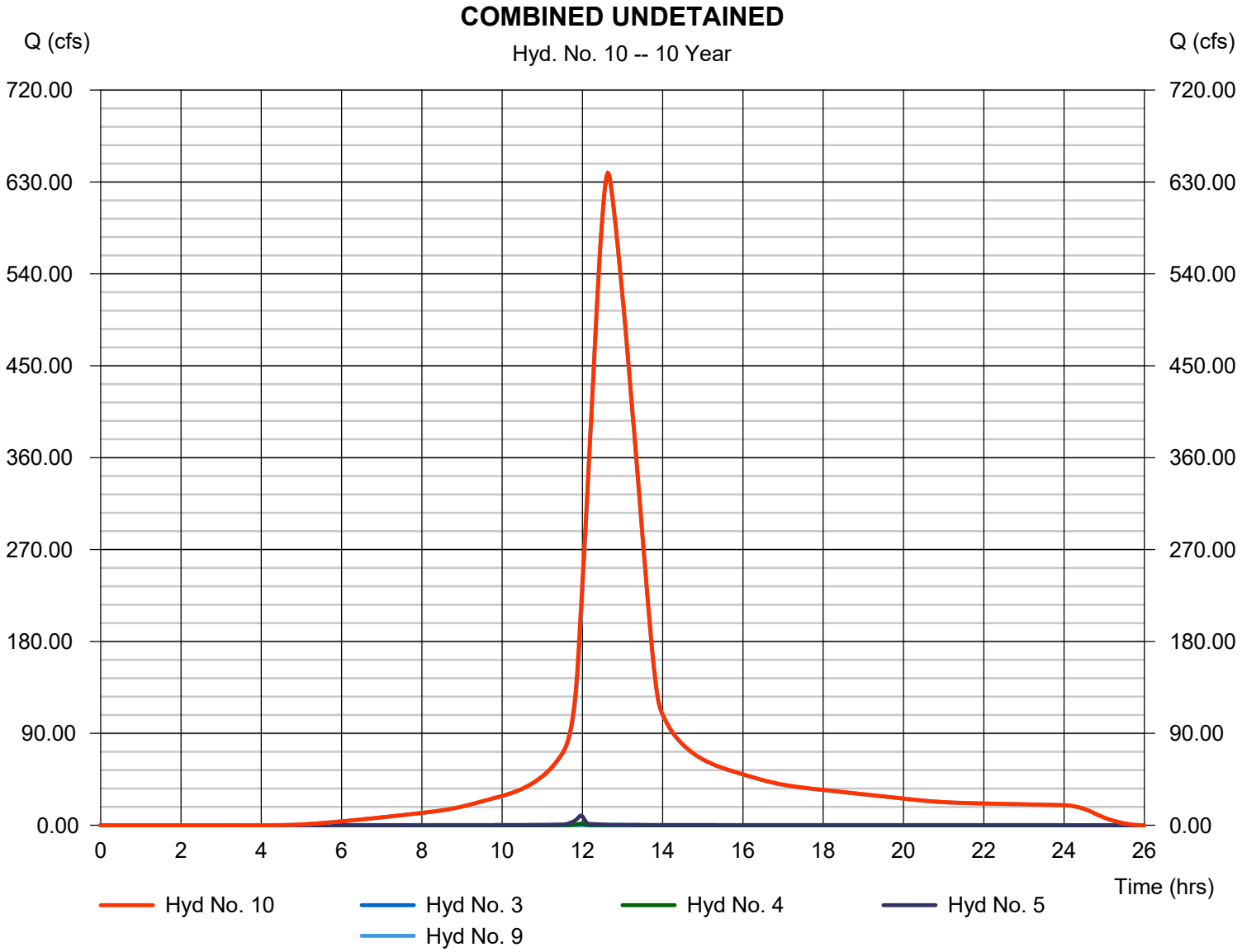
# Hydrograph Report



## Hyd. No. 10

COMBINED UNDETAINED

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | Combine | Peak discharge | = | 638.91 cfs |
| Storm frequency | = | 10 yrs | Time to peak | = | 12.63 hrs |
| Time interval | = | 1 min | Hyd. volume | = | 4,921,900 cuft |
| Inflow hyds. | = | 3, 4, 5, 9 | Contrib. drain. area | = | 342.040 ac |



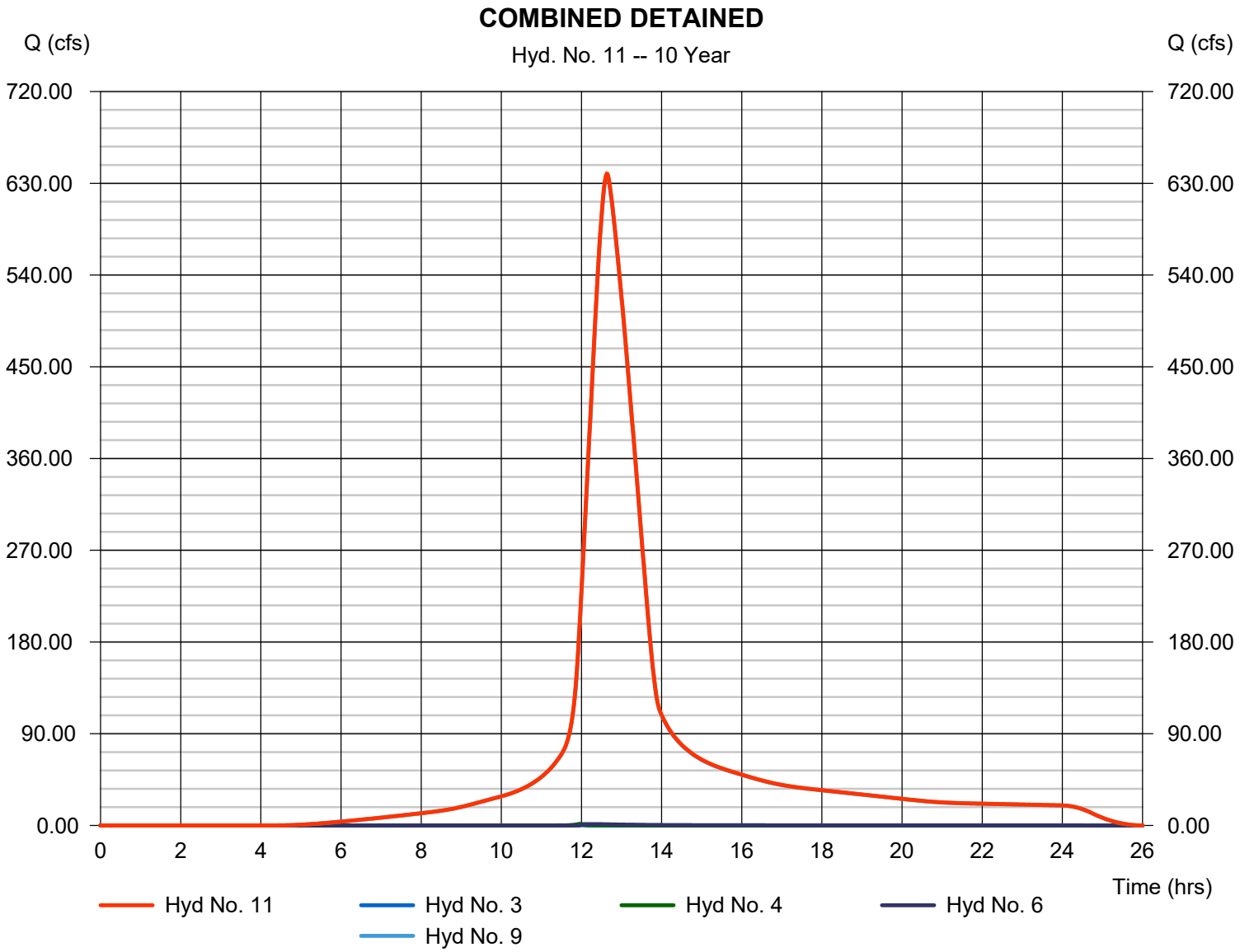
# Hydrograph Report



## Hyd. No. 11

COMBINED DETAINED

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | Combine | Peak discharge | = | 639.46 cfs |
| Storm frequency | = | 10 yrs | Time to peak | = | 12.63 hrs |
| Time interval | = | 1 min | Hyd. volume | = | 4,914,492 cuft |
| Inflow hyds. | = | 3, 4, 6, 9 | Contrib. drain. area | = | 340.640 ac |



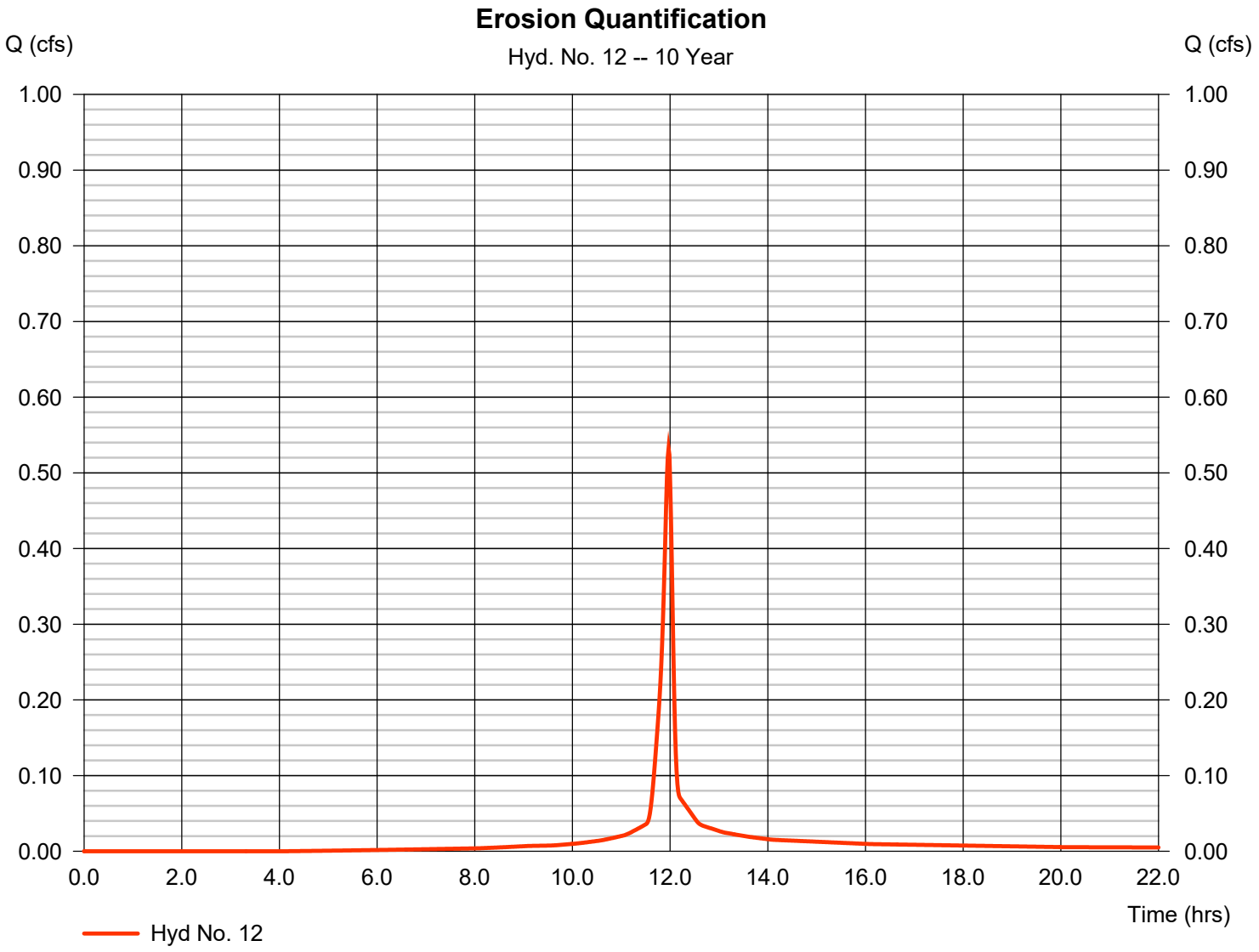
# Hydrograph Report



## Hyd. No. 12

Erosion Quantification

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 0.532 cfs |
| Storm frequency | = | 10 yrs | Time to peak | = | 11.97 hrs |
| Time interval | = | 1 min | Hyd. volume | = | 1,192 cuft |
| Drainage area | = | 0.085 ac | Curve number | = | 89 |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | User | Time of conc. (Tc) | = | 7.50 min |
| Total precip. | = | 5.20 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |



# 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 | 0.692 | 1 | 718 | 1,484 | ------ | ------ | ------ | EX WEST |
| 2 | SCS Runoff | 15.04 | 1 | 720 | 38,679 | ------ | ------ | ------ | EX EAST |
| 3 | SCS Runoff | 0.539 | 1 | 718 | 1,154 | ------ | ------ | ------ | PROP WEST |
| 4 | SCS Runoff | 2.717 | 1 | 718 | 5,922 | ------ | ------ | ------ | PROP EAST |
| 5 | SCS Runoff | 14.29 | 1 | 718 | 34,604 | ------ | ------ | ------ | PROP EAST 1 |
| 6 | Reservoir | 2.779 | 1 | 728 | 27,133 | 5 | 999.50 | 19,685 | DETAINED EAST 1 |
| 7 | Combine | 4.886 | 1 | 719 | 33,056 | 4, 6 | ------ | ------ | COMBINED EAST + DETAINED EAS |
| 8 | SCS Runoff | 1016.59 | 1 | 758 | 7,937,165 | ------ | ------ | ------ | WATERSHED |
| 9 | SCS Runoff | 1011.27 | 1 | 758 | 7,895,628 | ------ | ------ | ------ | WATERSHED - LOT 294 |
| 10 | Combine | 1012.39 | 1 | 758 | 7,937,308 | 3, 4, 5, 9 | ------ | ------ | COMBINED UNDETAINED |
| 11 | Combine | 1013.87 | 1 | 758 | 7,929,871 | 3, 4, 6, 9, | ------ | ------ | COMBINED DETAINED |
| 12 | SCS Runoff | 0.832 | 1 | 718 | 1,923 | ------ | ------ | ------ | Erosion Quantification |

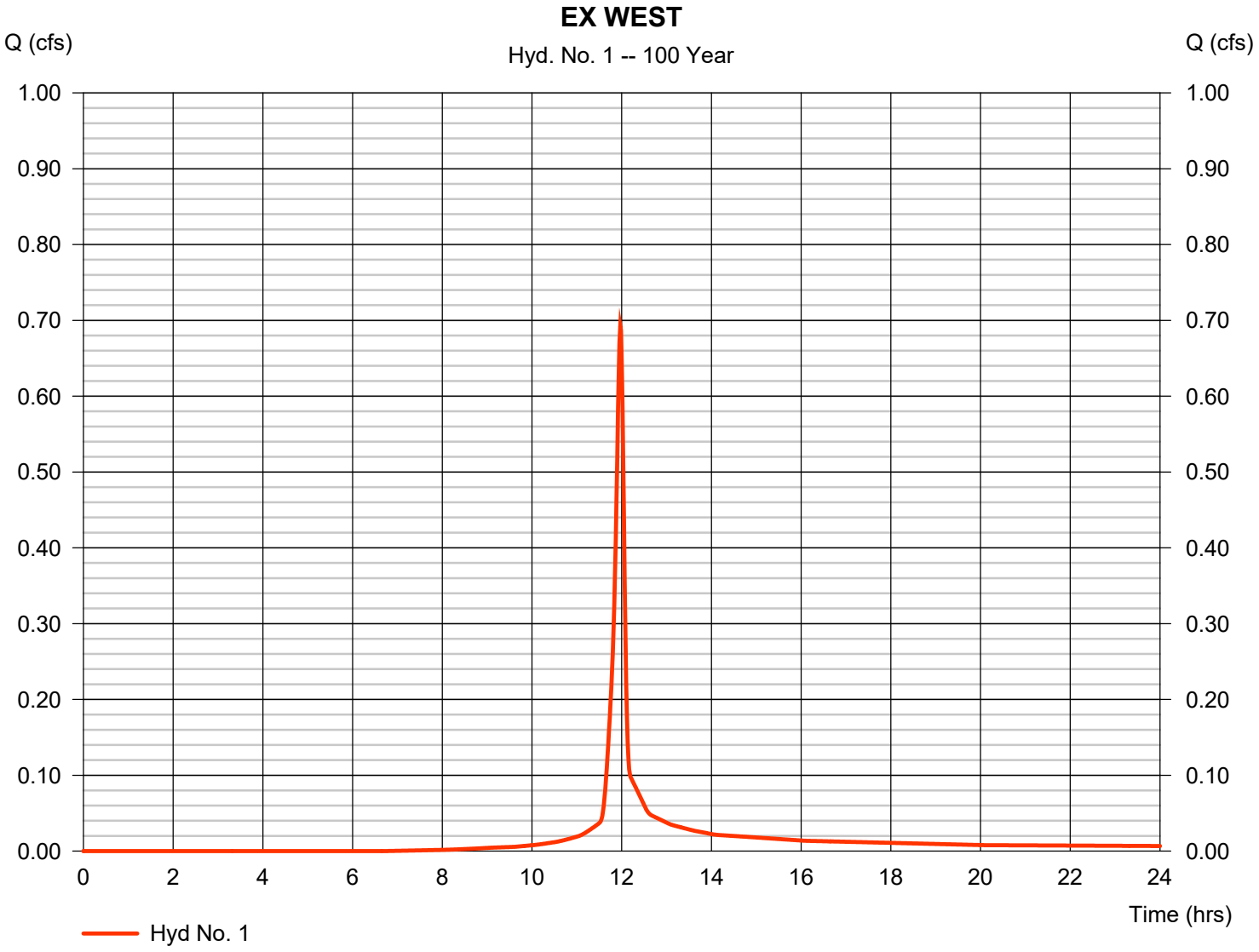
# Hydrograph Report



## Hyd. No. 1

EX WEST

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 0.692 cfs |
| Storm frequency | = | 100 yrs | Time to peak | = | 11.97 hrs |
| Time interval | = | 1 min | Hyd. volume | = | 1,484 cuft |
| Drainage area | = | 0.090 ac | Curve number | = | 74 |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | User | Time of conc. (Tc) | = | 7.40 min |
| Total precip. | = | 7.70 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |



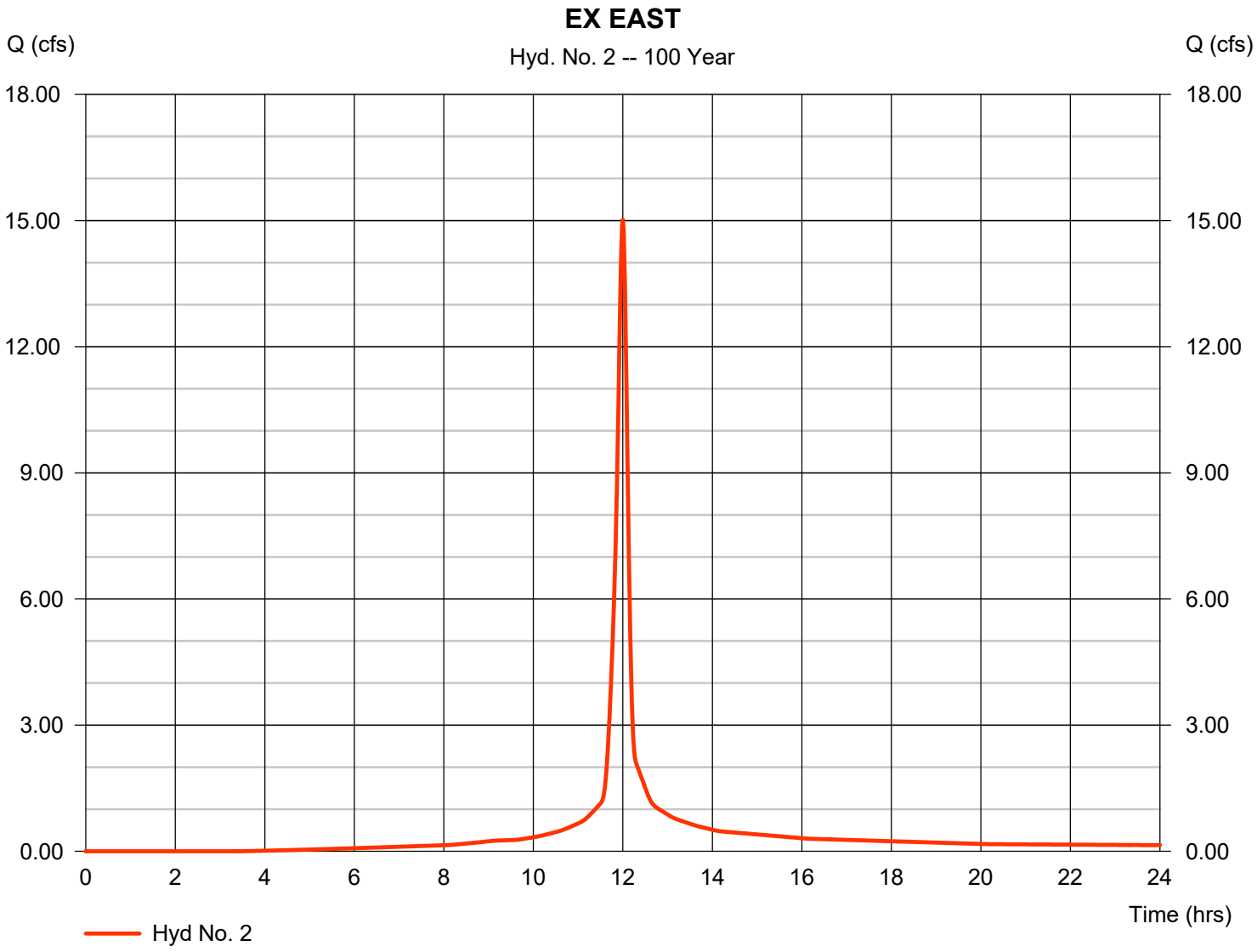
# Hydrograph Report



## Hyd. No. 2

EX EAST

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 15.04 cfs |
| Storm frequency | = | 100 yrs | Time to peak | = | 12.00 hrs |
| Time interval | = | 1 min | Hyd. volume | = | 38,679 cuft |
| Drainage area | = | 1.700 ac | Curve number | = | 87 |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | User | Time of conc. (Tc) | = | 10.40 min |
| Total precip. | = | 7.70 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |



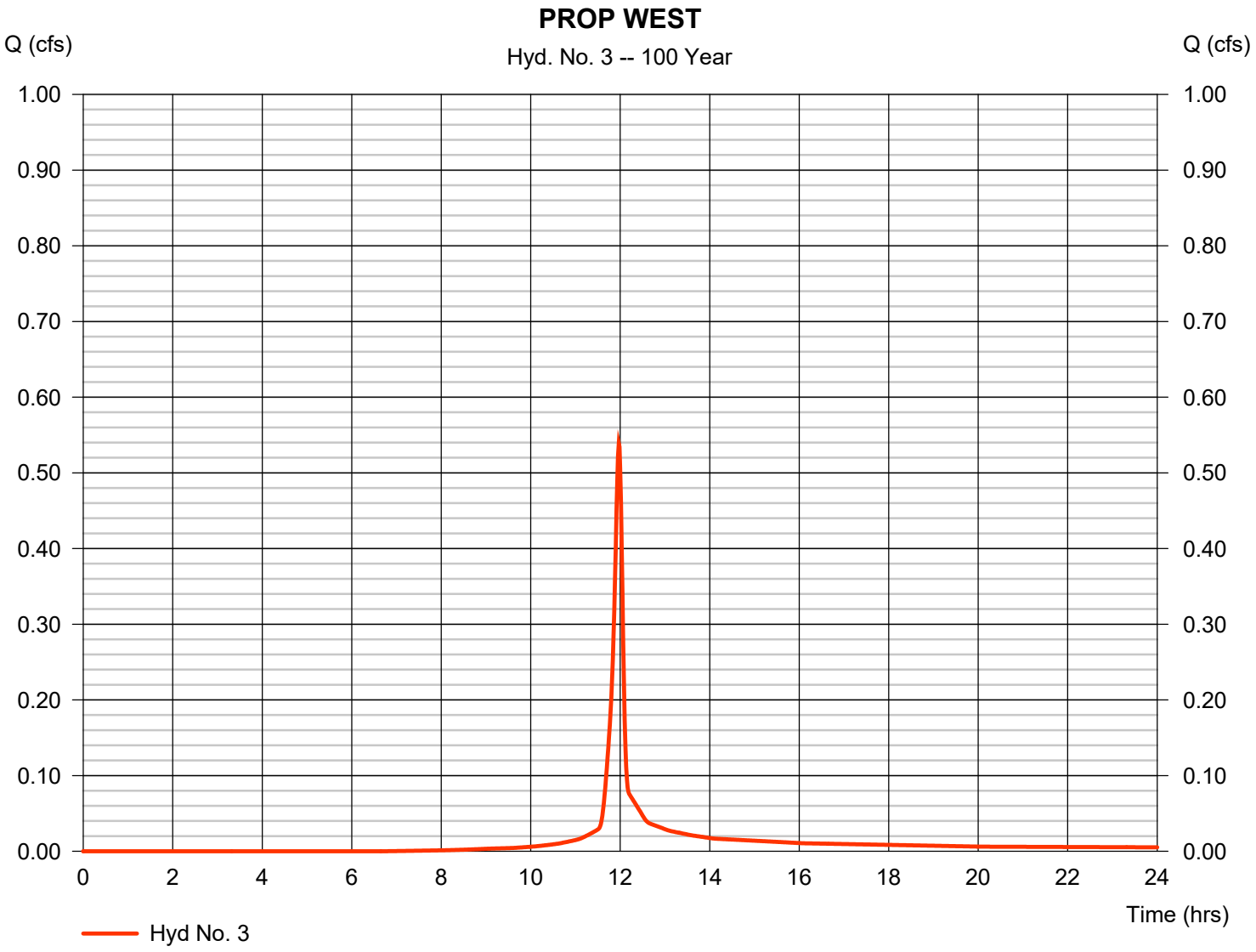
# Hydrograph Report



## Hyd. No. 3

PROP WEST

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 0.539 cfs |
| Storm frequency | = | 100 yrs | Time to peak | = | 11.97 hrs |
| Time interval | = | 1 min | Hyd. volume | = | 1,154 cuft |
| Drainage area | = | 0.070 ac | Curve number | = | 74 |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | User | Time of conc. (Tc) | = | 7.50 min |
| Total precip. | = | 7.70 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |



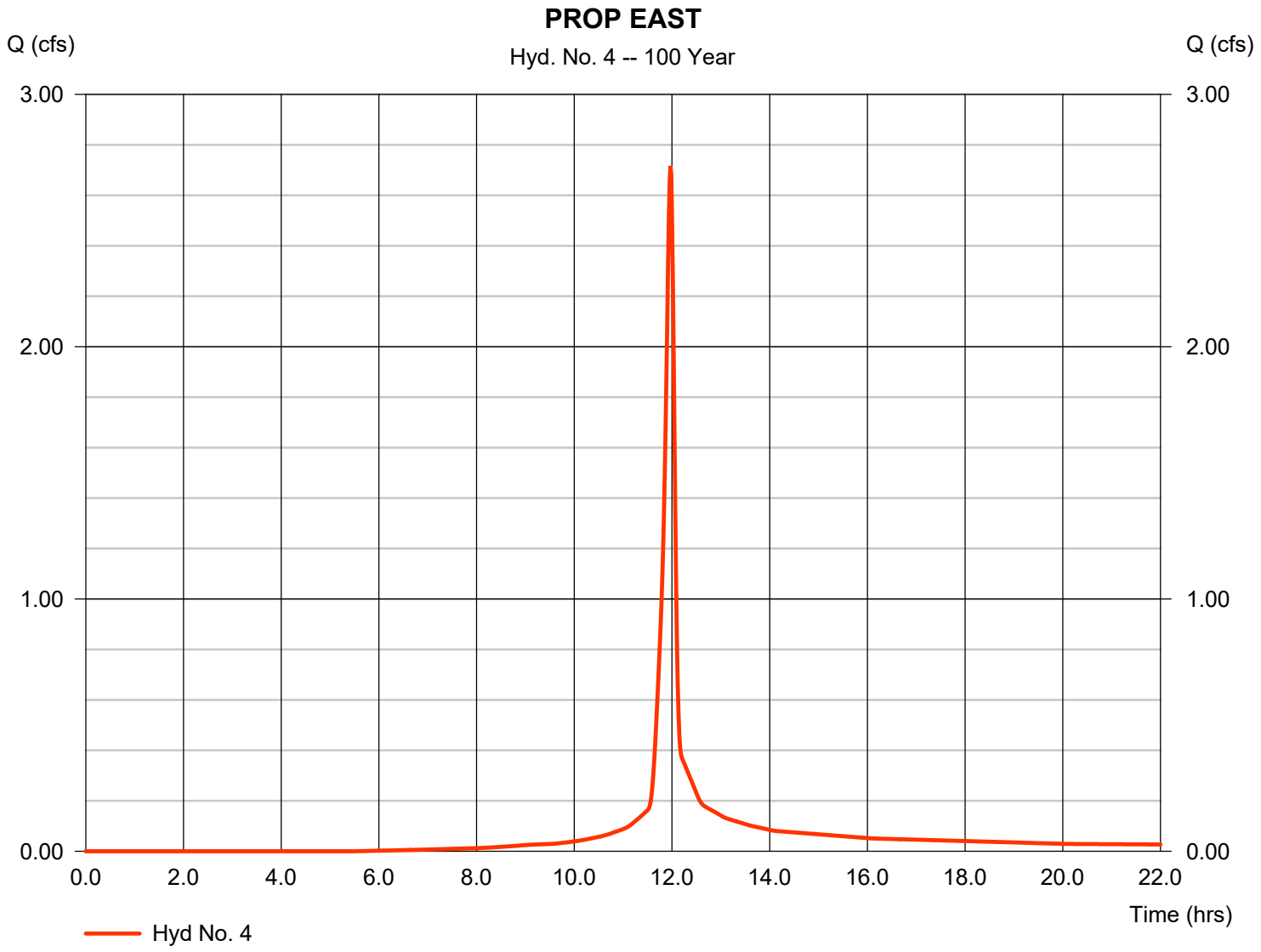
# Hydrograph Report



## Hyd. No. 4

PROP EAST

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 2.717 cfs |
| Storm frequency | = | 100 yrs | Time to peak | = | 11.97 hrs |
| Time interval | = | 1 min | Hyd. volume | = | 5,922 cuft |
| Drainage area | = | 0.320 ac | Curve number | = | 79 |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | User | Time of conc. (Tc) | = | 7.70 min |
| Total precip. | = | 7.70 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |



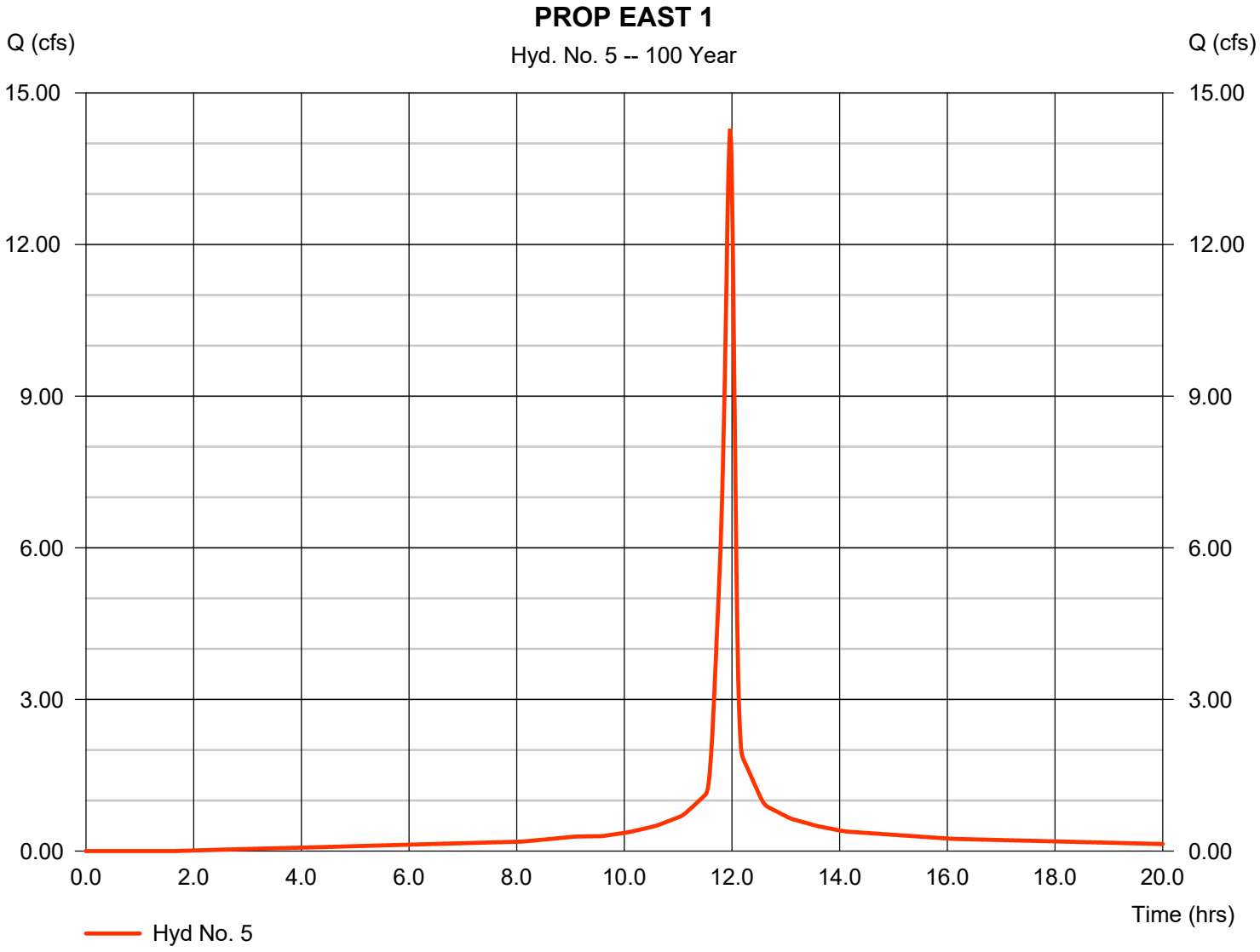
# Hydrograph Report



## Hyd. No. 5

PROP EAST 1

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 14.29 cfs |
| Storm frequency | = | 100 yrs | Time to peak | = | 11.97 hrs |
| Time interval | = | 1 min | Hyd. volume | = | 34,604 cuft |
| Drainage area | = | 1.400 ac | Curve number | = | 94 |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | User | Time of conc. (Tc) | = | 7.90 min |
| Total precip. | = | 7.70 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |



# Hydrograph Report

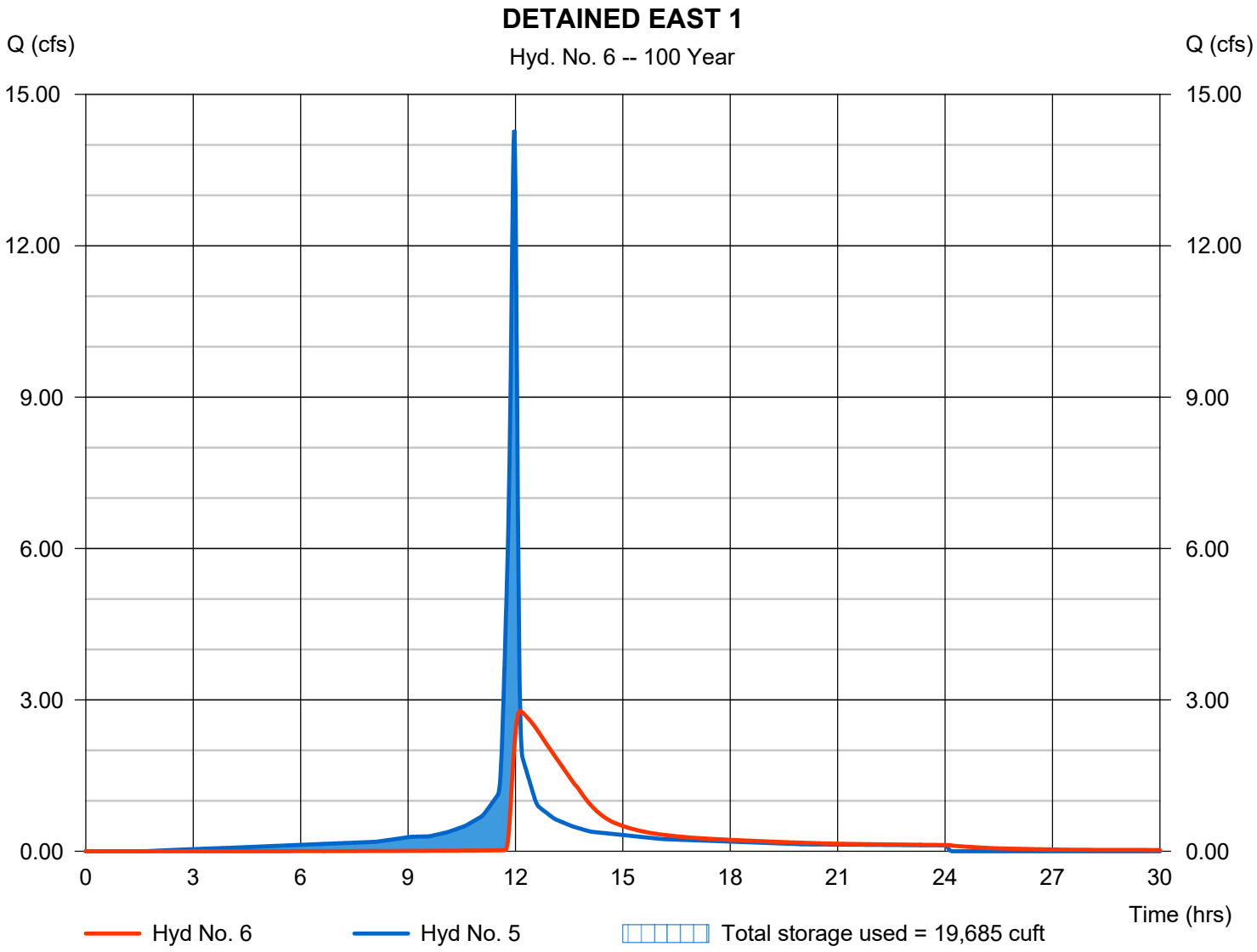


## Hyd. No. 6

DETAINED EAST 1

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | Reservoir | Peak discharge | = | 2.779 cfs |
| Storm frequency | = | 100 yrs | Time to peak | = | 12.13 hrs |
| Time interval | = | 1 min | Hyd. volume | = | 27,133 cuft |
| Inflow hyd. No. | = | 5 - PROP EAST 1 | Max. Elevation | = | 999.50 ft |
| Reservoir name | = | Underground Chamber Detention | Max. Storage | = | 19,685 cuft |

Storage Indication method used.



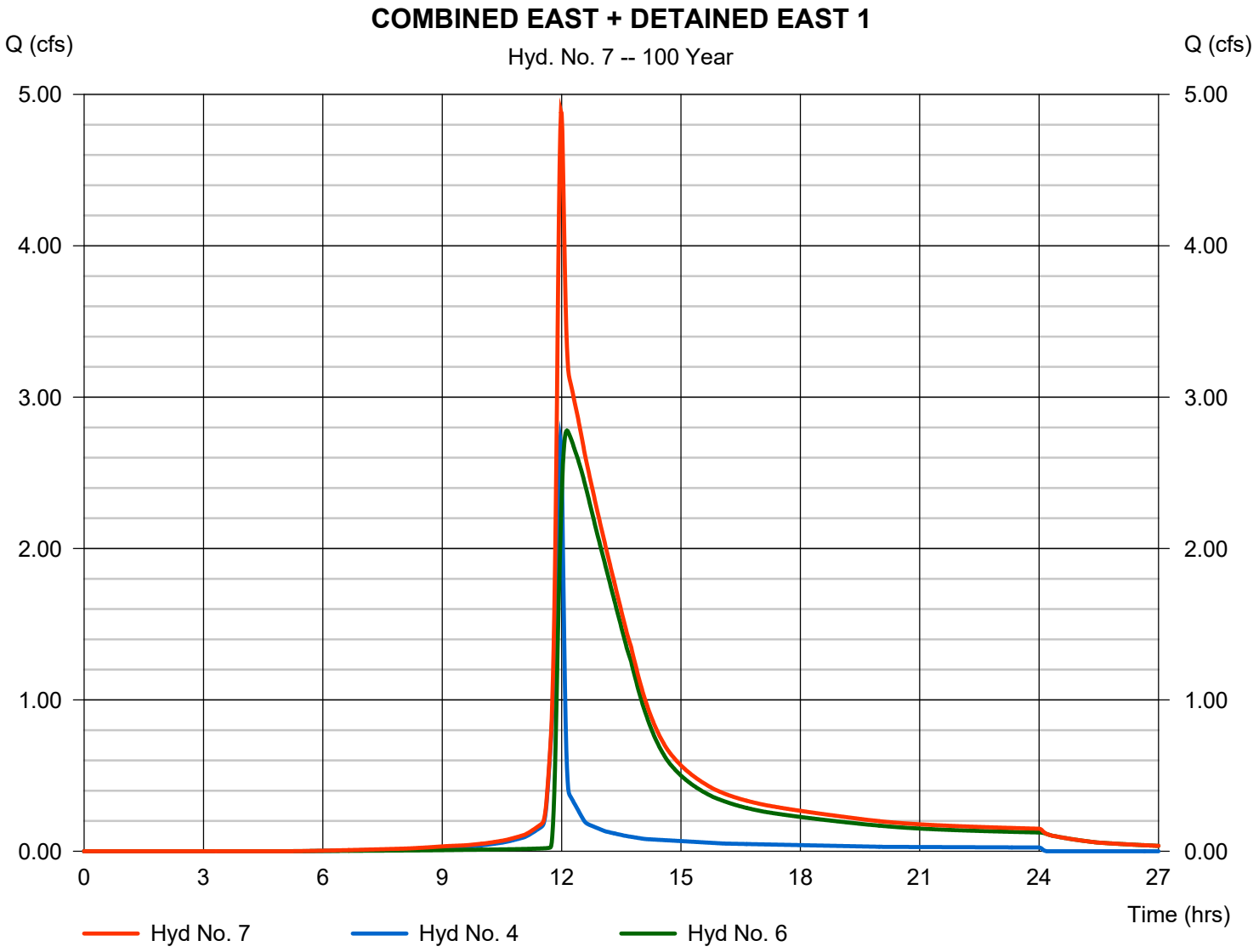
# Hydrograph Report



## Hyd. No. 7

COMBINED EAST + DETAINED EAST 1

| | | | |
|---|---|---|---|
| Hydrograph type | = Combine | Peak discharge | = 4.886 cfs |
| Storm frequency | = 100 yrs | Time to peak | = 11.98 hrs |
| Time interval | = 1 min | Hyd. volume | = 33,056 cuft |
| Inflow hyds. | = 4, 6 | Contrib. drain. area | = 0.320 ac |



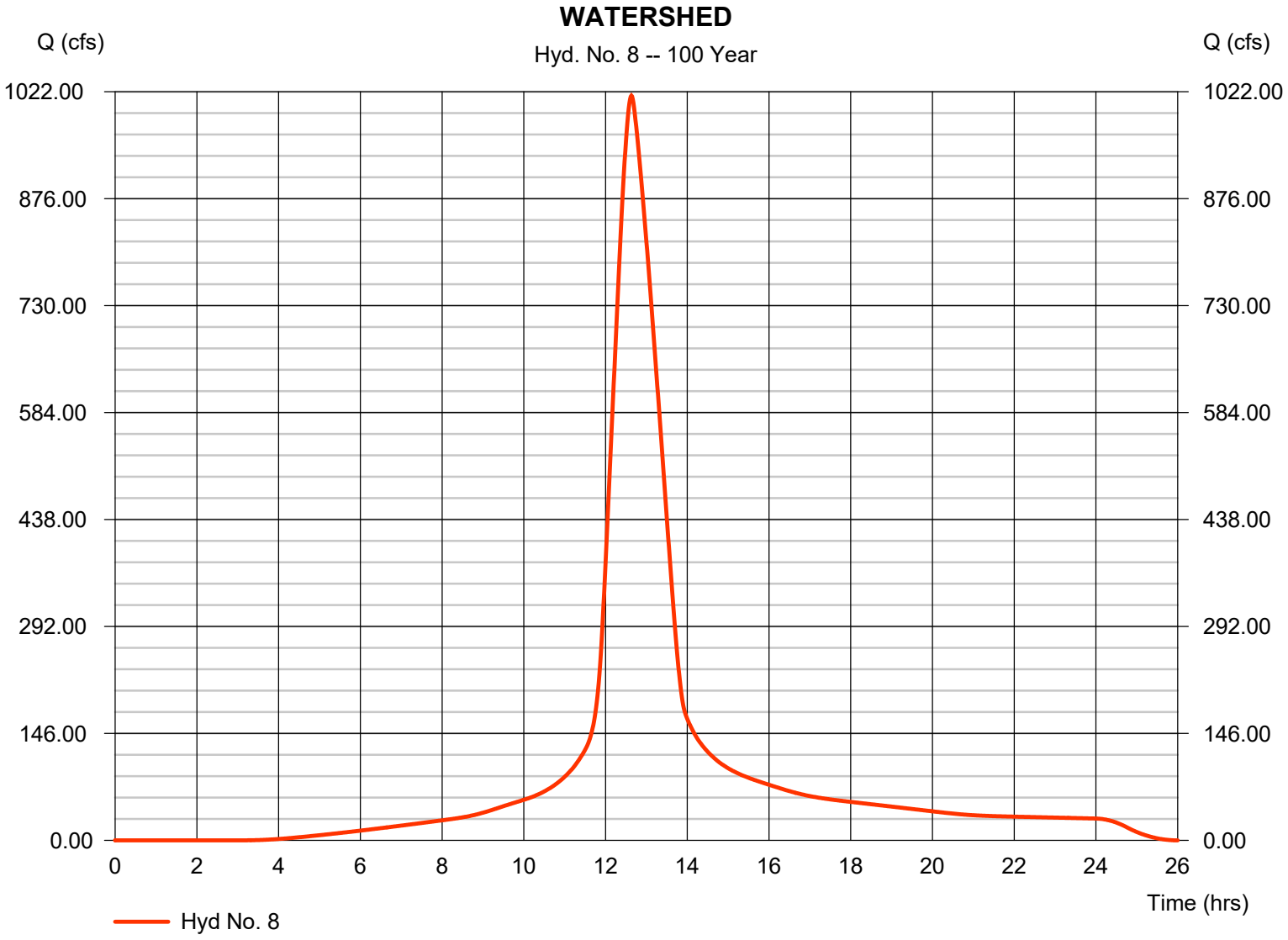
# Hydrograph Report



## Hyd. No. 8

WATERSHED

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 1016.59 cfs |
| Storm frequency | = | 100 yrs | Time to peak | = | 12.63 hrs |
| Time interval | = | 1 min | Hyd. volume | = | 7,937,165 cuft |
| Drainage area | = | 342.040 ac | Curve number | = | 89 |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | User | Time of conc. (Tc) | = | 76.10 min |
| Total precip. | = | 7.70 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |



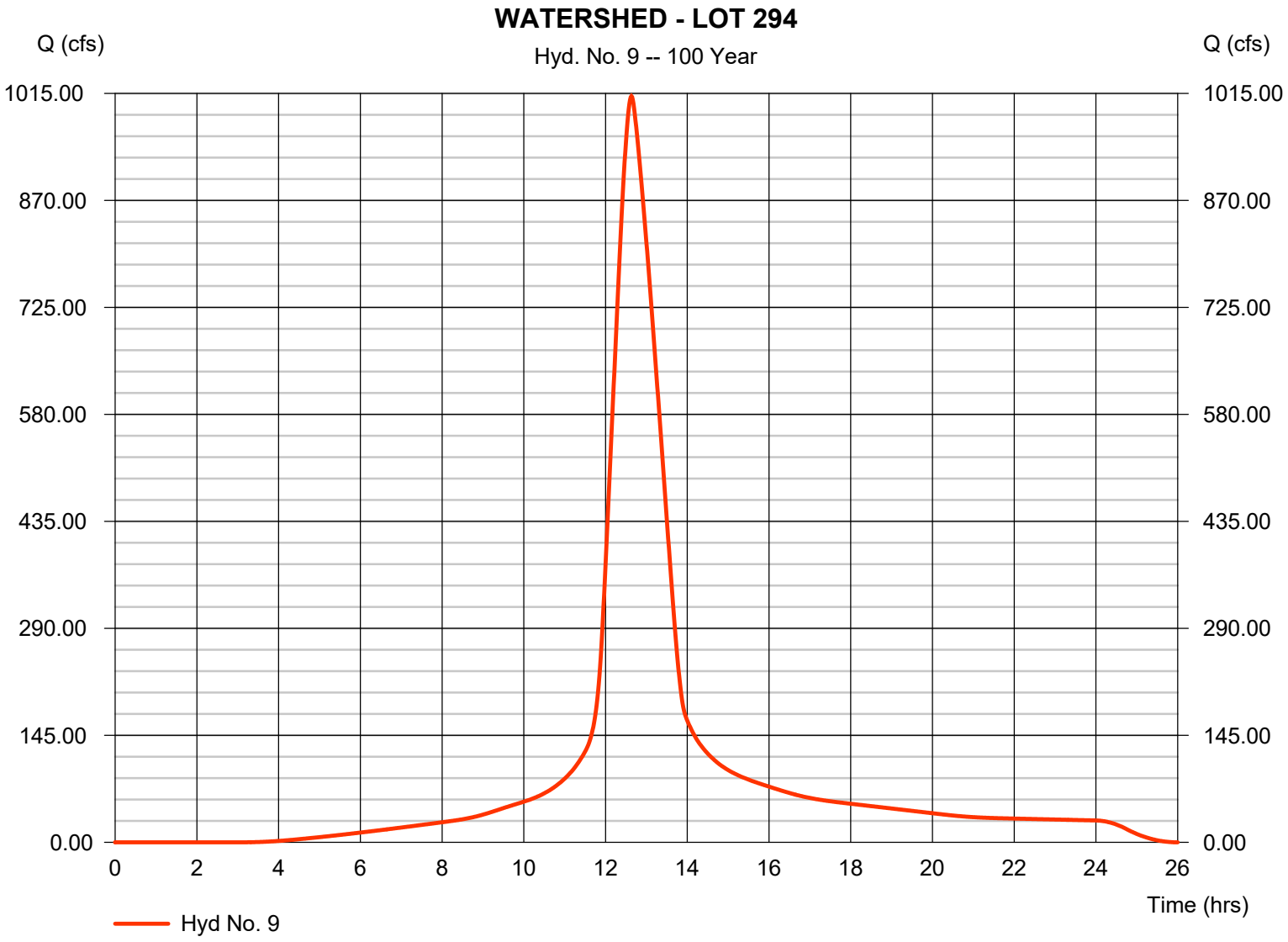
# Hydrograph Report



## Hyd. No. 9

WATERSHED - LOT 294

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 1011.27 cfs |
| Storm frequency | = | 100 yrs | Time to peak | = | 12.63 hrs |
| Time interval | = | 1 min | Hyd. volume | = | 7,895,628 cuft |
| Drainage area | = | 340.250 ac | Curve number | = | 89 |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | User | Time of conc. (Tc) | = | 76.10 min |
| Total precip. | = | 7.70 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |



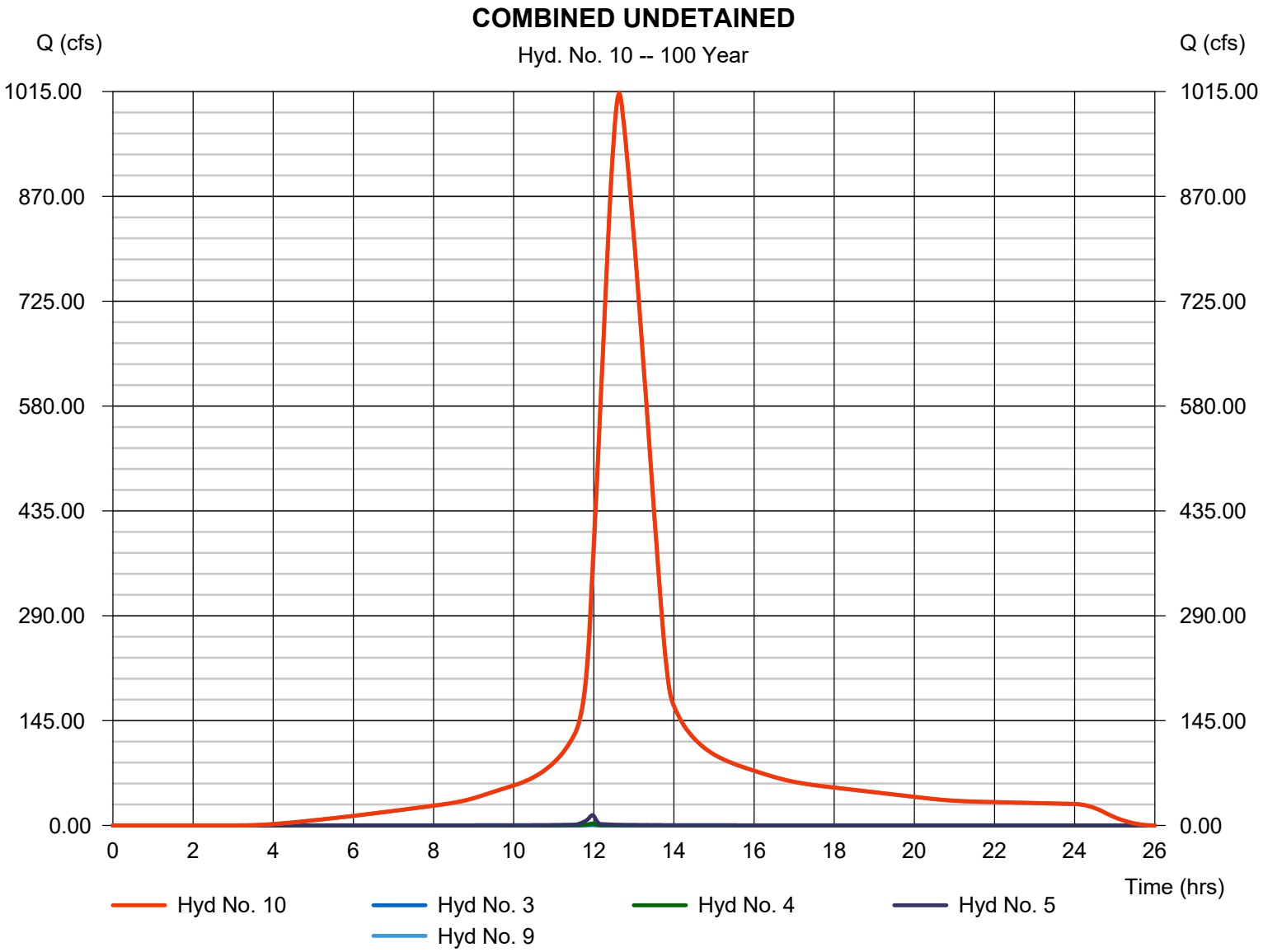
# Hydrograph Report



## Hyd. No. 10

COMBINED UNDETAINED

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | Combine | Peak discharge | = | 1012.39 cfs |
| Storm frequency | = | 100 yrs | Time to peak | = | 12.63 hrs |
| Time interval | = | 1 min | Hyd. volume | = | 7,937,308 cuft |
| Inflow hyds. | = | 3, 4, 5, 9 | Contrib. drain. area | = | 342.040 ac |



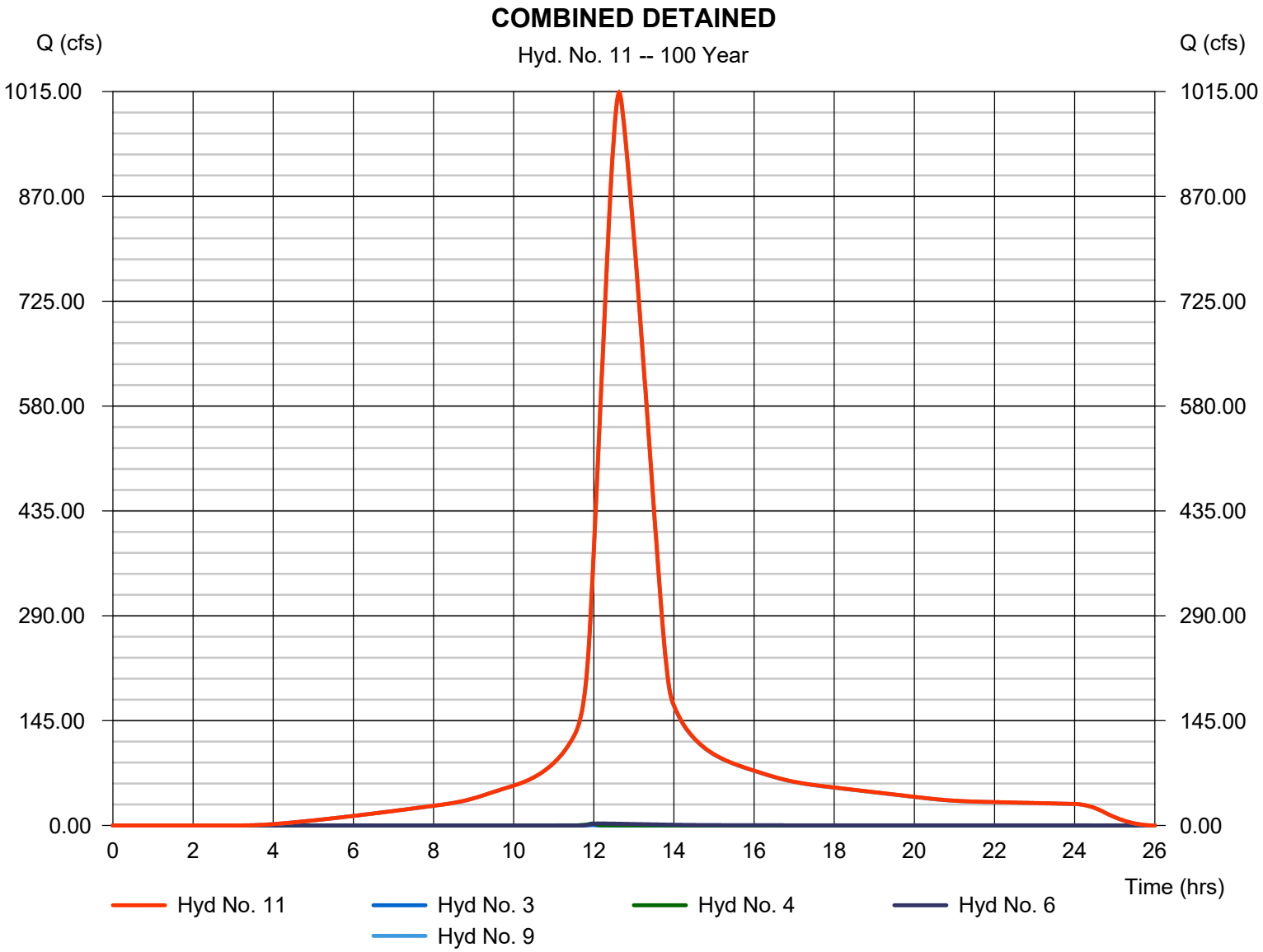
# Hydrograph Report



## Hyd. No. 11

COMBINED DETAINED

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | Combine | Peak discharge | = | 1013.87 cfs |
| Storm frequency | = | 100 yrs | Time to peak | = | 12.63 hrs |
| Time interval | = | 1 min | Hyd. volume | = | 7,929,871 cuft |
| Inflow hyds. | = | 3, 4, 6, 9 | Contrib. drain. area | = | 340.640 ac |



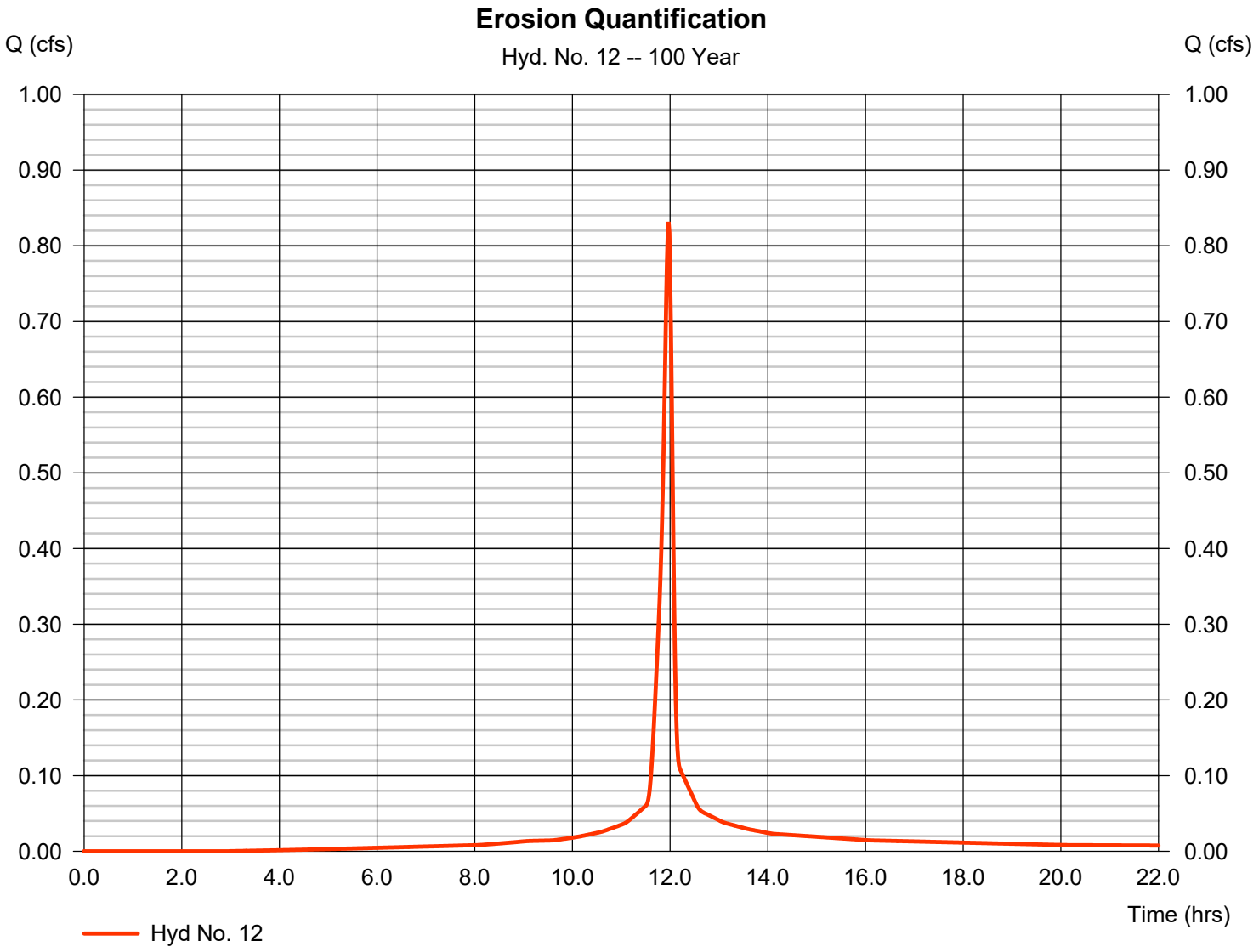
# Hydrograph Report



## Hyd. No. 12

Erosion Quantification

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 0.832 cfs |
| Storm frequency | = | 100 yrs | Time to peak | = | 11.97 hrs |
| Time interval | = | 1 min | Hyd. volume | = | 1,923 cuft |
| Drainage area | = | 0.085 ac | Curve number | = | 89 |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | User | Time of conc. (Tc) | = | 7.50 min |
| Total precip. | = | 7.70 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |



# Hydraflow Rainfall Report



| Return Period (Yrs) | Intensity-Duration-Frequency Equation Coefficients (FHA) | | | |
|---|---|---|---|---|
| | B | D | E | (N/A) |
| 1 | 64.1474 | 17.7000 | 0.8922 | -------- |
| 2 | 95.7859 | 19.2000 | 0.9317 | -------- |
| 3 | 0.0000 | 0.0000 | 0.0000 | -------- |
| 5 | 118.7799 | 19.1000 | 0.9266 | -------- |
| 10 | 125.1300 | 18.2000 | 0.9051 | -------- |
| 25 | 158.9867 | 18.7000 | 0.9180 | -------- |
| 50 | 171.2459 | 18.3000 | 0.9078 | -------- |
| 100 | 187.3624 | 18.1000 | 0.9031 | -------- |

File name: KCMO.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 | 3.96 | 3.31 | 2.86 | 2.52 | 2.25 | 2.04 | 1.87 | 1.72 | 1.60 | 1.49 | 1.40 | 1.32 |
| 2 | 4.92 | 4.13 | 3.56 | 3.14 | 2.81 | 2.54 | 2.32 | 2.14 | 1.98 | 1.85 | 1.73 | 1.63 |
| 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 | 6.23 | 5.23 | 4.51 | 3.98 | 3.56 | 3.22 | 2.94 | 2.71 | 2.52 | 2.35 | 2.20 | 2.07 |
| 10 | 7.27 | 6.09 | 5.26 | 4.63 | 4.14 | 3.75 | 3.43 | 3.16 | 2.93 | 2.74 | 2.57 | 2.42 |
| 25 | 8.70 | 7.30 | 6.30 | 5.54 | 4.96 | 4.49 | 4.10 | 3.78 | 3.51 | 3.27 | 3.07 | 2.89 |
| 50 | 9.83 | 8.24 | 7.11 | 6.26 | 5.60 | 5.07 | 4.64 | 4.27 | 3.97 | 3.70 | 3.47 | 3.27 |
| 100 | 11.00 | 9.21 | 7.95 | 7.00 | 6.26 | 5.67 | 5.19 | 4.78 | 4.44 | 4.14 | 3.89 | 3.66 |

Tc = time in minutes. Values may exceed 60.

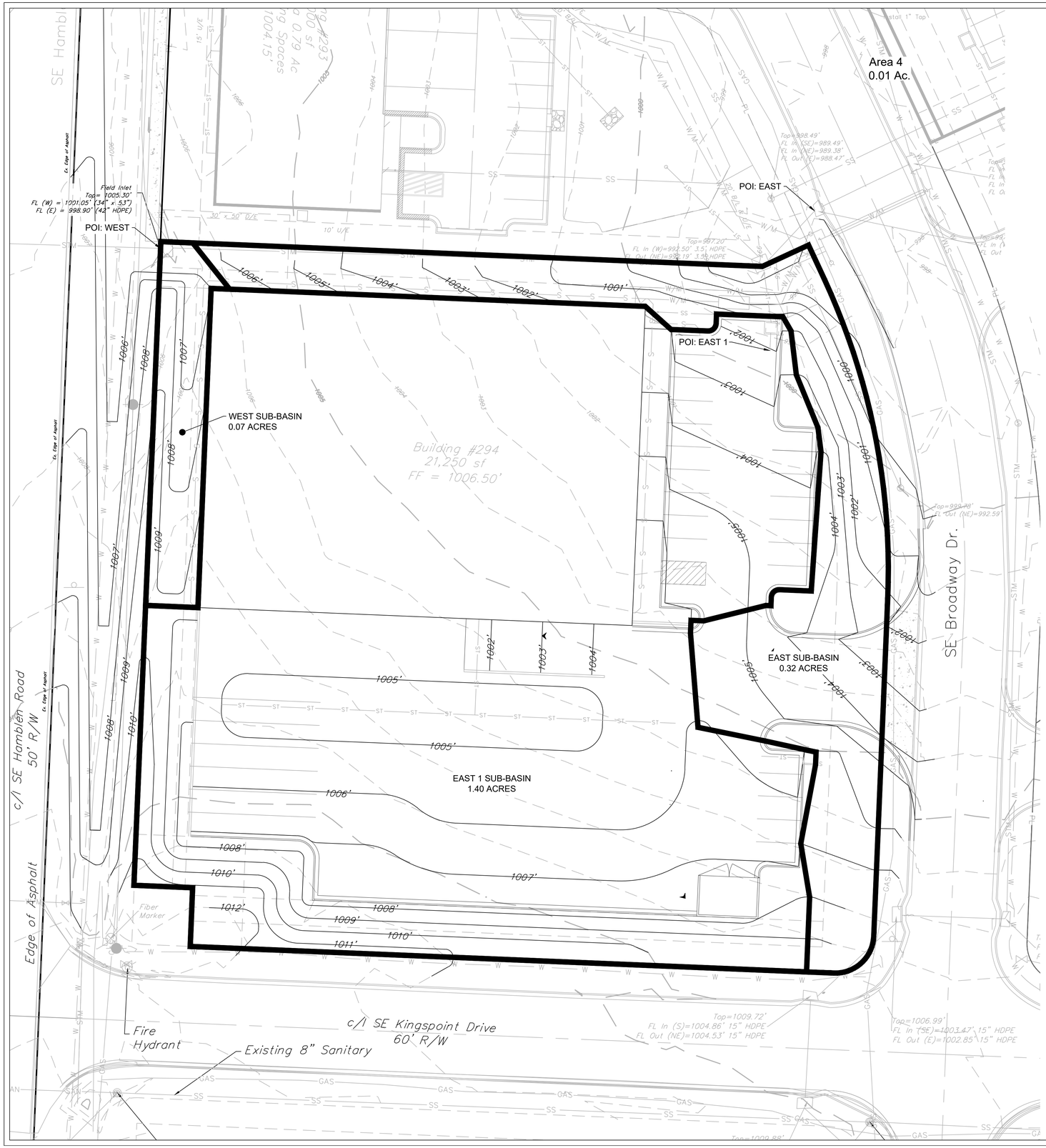
Precip. file name: Z:\acad\KCMO.pcp

| 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 | 1.37 | 3.50 | 0.00 | 3.30 | 5.20 | 6.00 | 6.80 | 7.70 |
| SCS 6-Hr | 0.00 | 1.80 | 0.00 | 0.00 | 2.60 | 0.00 | 0.00 | 4.00 |
| Huff-1st | 0.00 | 1.55 | 0.00 | 2.75 | 4.00 | 5.38 | 6.50 | 8.00 |
| Huff-2nd | 2.49 | 3.10 | 0.00 | 4.01 | 4.64 | 5.52 | 6.21 | 6.90 |
| 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 | 1.55 | 0.00 | 2.75 | 4.00 | 5.38 | 6.50 | 8.00 |
| Custom | 0.00 | 1.75 | 0.00 | 2.80 | 3.90 | 5.25 | 6.00 | 7.10 |

# Hydraflow Table of Contents

# Exhibit C

# Proposed Drainage Area Map




North

0 10' 20' 40'

# PROPOSED DRAINAGE MAP

SCALE: 1" = 20'


ENGINEERING SOLUTIONS
ENGINEERING & SURVEYING
50 SE 30TH STREET
LEE'S SUMMIT, MO 64082
P:(816) 623-9888 F:(816)623-9849

Professional Registration
Missouri
Engineering 2005032186-D
Surveying 2005008319-D
Kansas
Engineering E-1895
Surveying LS-218
Oklahoma
Engineering 6254
Nebraska
Engineering CA2821


Newberry Landings First Plat
Lee's Summit, Jackson County, Missouri

Project: NEWBERRY LANDING, LSMO

Issue Date: March 12, 2018

PROPOSED DRAINAGE MAP
Construction Plans for:
Lot 293, Newberry Landings First Plat
Lee's Summit, Jackson County, Missouri


Matthew J. Schlicht
MO PE 2006019708
KS PE 19071
OK PE 25226


REVISIONS

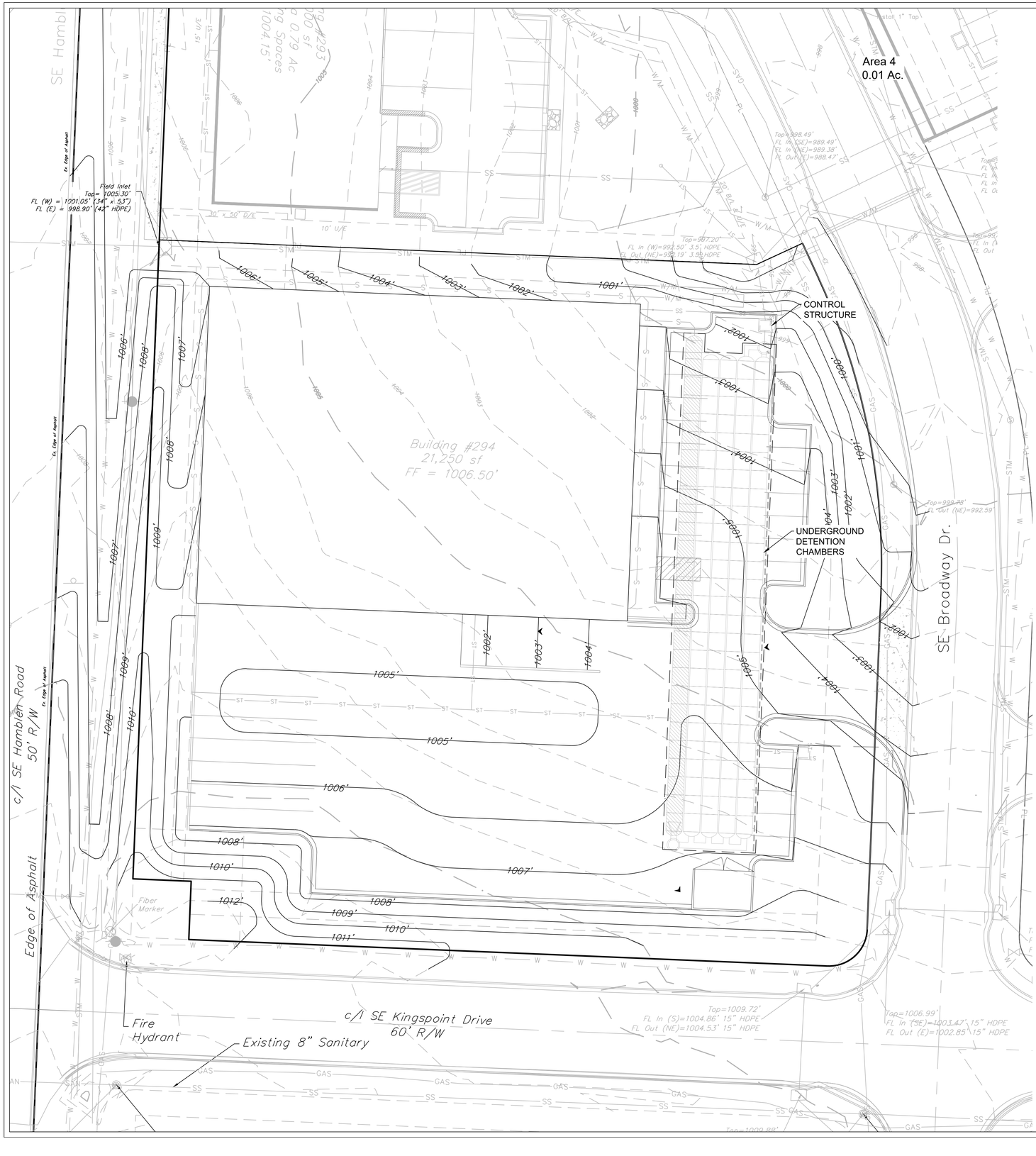
REV 7-11-19

REV 8-15-19

EXHIBIT

# Exhibit D

# Detention System Plan




North

0 10' 20' 40'

# DETENTION SYSTEM PLAN

SCALE: 1" = 20'


ENGINEERING SOLUTIONS
ENGINEERING & SURVEYING
50 SE 30TH STREET
LEE'S SUMMIT, MO 64082
P:(816) 623-9888 F:(816)623-9849

Professional Registration
Missouri
Engineering 2005032186-D
Surveying 2005008319-D
Kansas
Engineering E-1895
Surveying LS-218
Oklahoma
Engineering 6254
Nebraska
Engineering CA2821


Newberry Landings First Plat
Lee's Summit, Jackson County, Missouri

Project: NEWBERRY LANDING, LSMO

Issue Date: January 4, 2024

DETENTION SYSTEM PLAN
Construction Plans for:
Lot 294, Newberry Landings First Plat
Lee's Summit, Jackson County, Missouri


Matthew J. Schlicht
MO PE 2006019708
KS PE 19071
OK PE 25226


REVISIONS

EXHIBIT

# Exhibit E

# Water Quality Volume Calculations

# Calculate Water Quality for Storm Study

Project: Newberry Lot 294 — 2/19/2024

To Calculate: WQv = P * Rv * A

| | |
|---|---|
| P (in) = | 1.37 |
| P (ft) = | 0.11 |
| Impervious Area (sq. ft.) = | 64,974.40 |
| Total Area (sq. ft.) = | 77,972.40 |
| Impervious Area (ac) = | 1.49 |
| Total Area (acre) = | 1.79 |
| Rv = (0.05 * 0.009(I)) = | 0.80 |
| Percent Impervious (I) = | 83.33 |
| $WQ_v$ (cu. ft.) = | 7,121 |
| $WQ_v$ (ac. ft.) = | 0.163 |

Enter data in these Fields

| Unit Conversions |
|---|
| 1 Acre = 43,560 Sq. Ft. |

CN = 94

# 40 HOUR DETENTION CALC.

To Calculate: 40 Hour Detention (EDDB)

I. Basin Water Quality Storage Volume

| | | |
|---|---|---|
| Step 1) Tributary area To EDDB, $A_t$ (ac) = | $A_T$ (ac) = | 1.79 |
| Step 2) Calculate $WQ_v$ using Sec. 6 (ac-ft) = | $WQ_v$ (ac. ft.)= | 0.163 |
| Step 3) Add 20 Percent to Step 2. | $V_{design}$ (ac-ft) = | 0.196 |

II.a. Water Quality Outlet Type

Step 1) Set water quality outlet type
Type 1 = single orifice
Type 2 = perforated riser or plate
Type 3 = v-notch weir

Outlet Type = 2

Step 2) Proceed to Step IIb, IIc, or IId based on selection

## To Calculate $Z_{WQ}$ (ft) interpolate from Storm Study (Sheet 13)

| | | | |
|---|---|---|---|
| Elevation 1 = | 997.15 | Storage 1 = | 6,814.00 |
| Elevation X = | | Storage X = | 7,121.21 |
| Elevation 2 = | 997.70 | Storage 2 = | 10,086.00 |

Elevation X = 997.24

| | |
|---|---|
| Lowest Elevation of Pond = | 995.00 |
| Elevation X = | 997.24 |
| $Z_{WQ}$ (ft) = | 2.24 |

## IIc. Water Quality Outlet, Perforated Riser

| | | |
|---|---|---|
| Step 1) Depth at outlet above lowest perforation: | $Z_{WQ}$ (ft) = | 2.24 |
| Step 2) Recommended maximum outlet area per row: | $A_0$ ($in^2$) = | 0.356 |
| Step 3) Circular perforation diameter per row assuming a single column: | $D_1$ (in) = | 0.260 |
| 1 | $n_c$ (unitless) = | 1 |
| Step 5) Design circular perforation diameter (should be between 1 and 2 inches): | $D_{perf}$ (in) = | 1.000 |
| Step 6) Horizontal perforation column spacing when $n_c > 1$, center to center: | $S_c$ (in) = | 4 |
| Step 7) Number of rows (4" vertical spacing between perforations, center to center): | $n_r$ (unitless) = | 7 |

Calculates the diameter of each hole given the depth of water and the area per row. Assuming 4" spacing. If less than 1" use 1" as $D_{perf}$.

Note: If $D_{perf} \geq 1.0$ inch, $S_c = 4$

Recommended Method: Perforated Riser

# Exhibit F

# Emergency Overflow Calculations

# Weir Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Feb 19 2024

## Emergency Overflow

**Rectangular Weir**

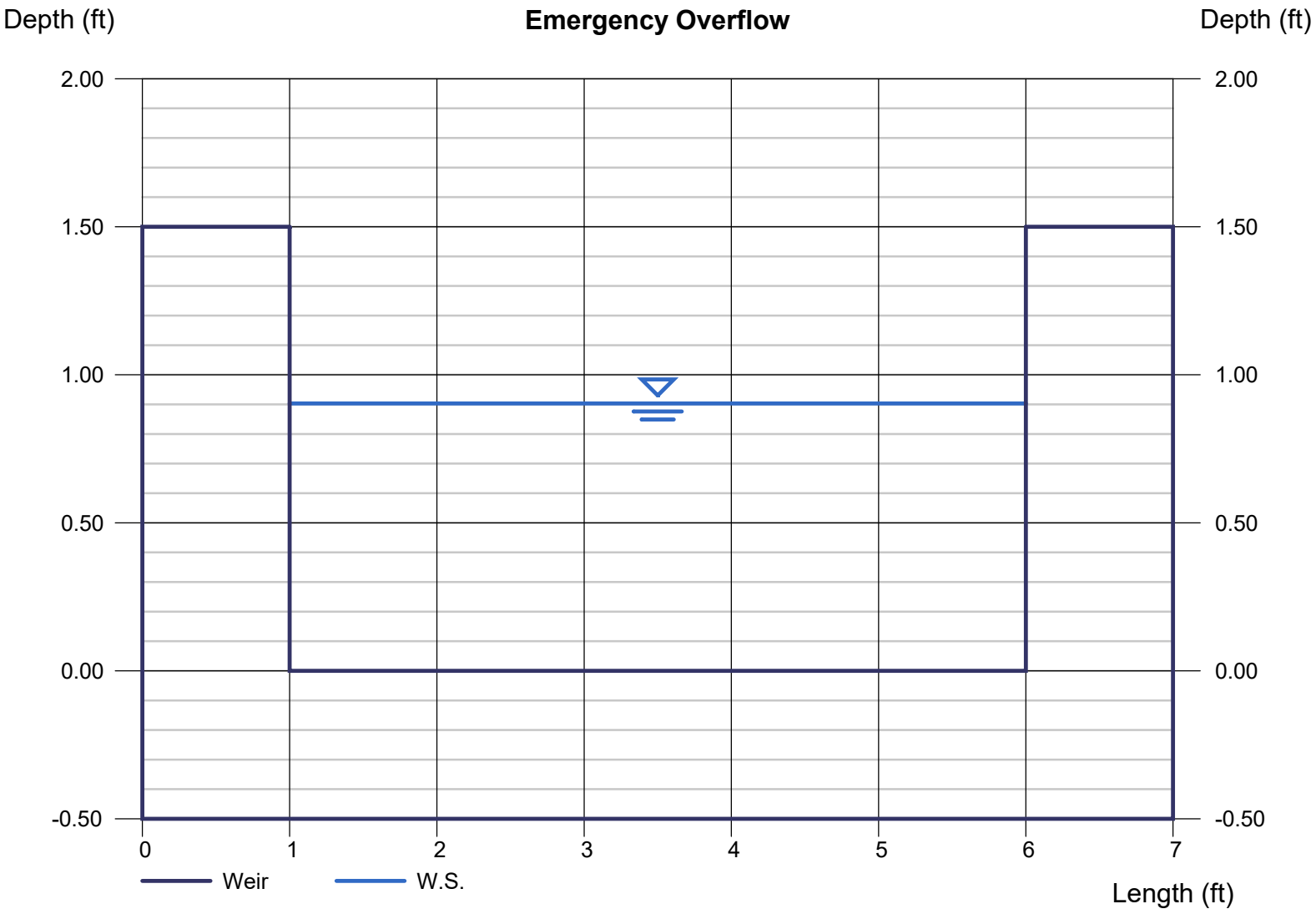
| | |
|---|---|
| Crest | = Sharp |
| Bottom Length (ft) | = 5.00 |
| Total Depth (ft) | = 1.50 |

**Calculations**

| | |
|---|---|
| Weir Coeff. Cw | = 3.33 |
| Compute by: | Known Q |
| Known Q (cfs) | = 14.29 |

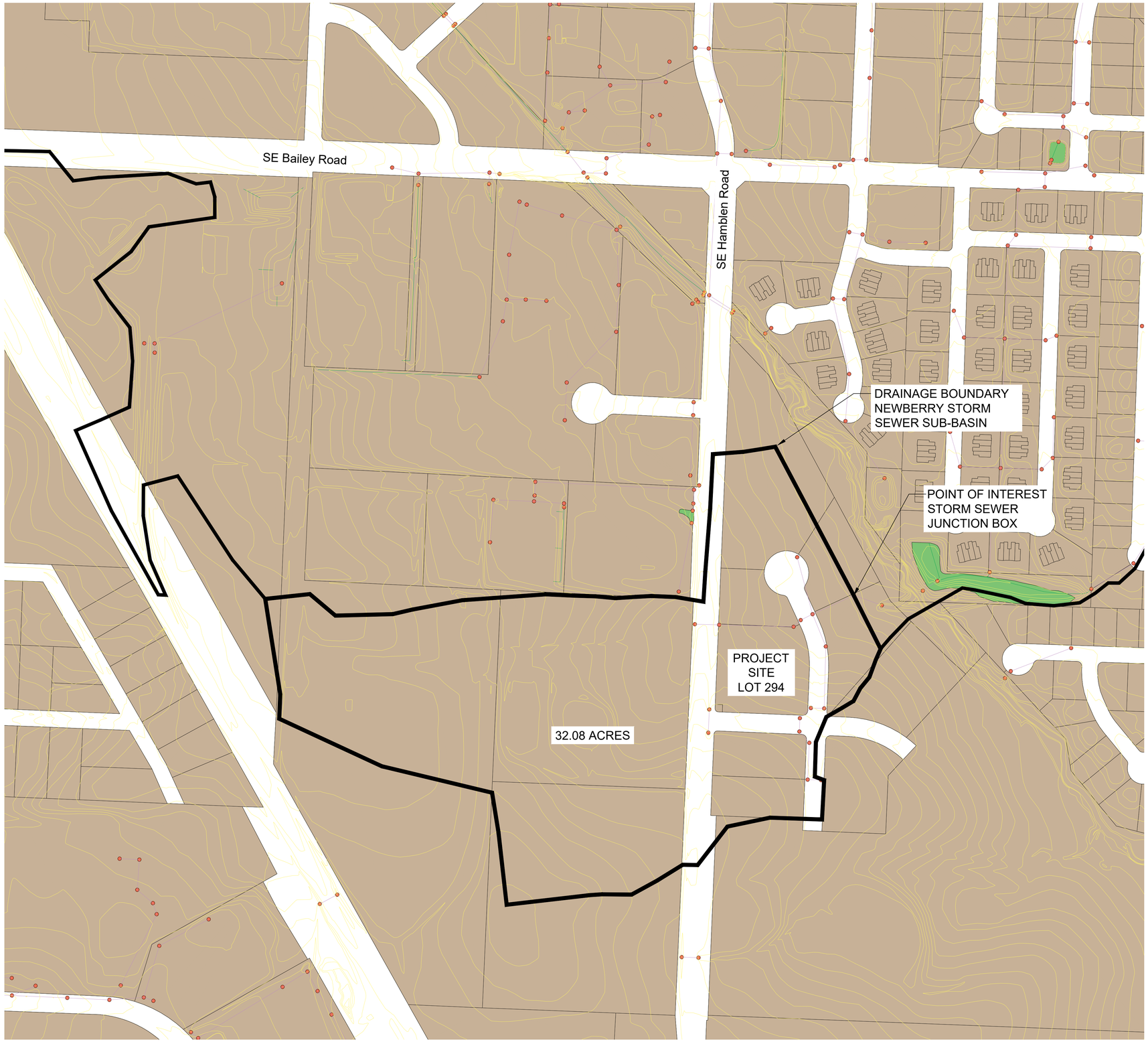
**Highlighted**

| | |
|---|---|
| Depth (ft) | = 0.90 |
| Q (cfs) | = 14.29 |
| Area (sqft) | = 4.52 |
| Velocity (ft/s) | = 3.16 |
| Top Width (ft) | = 5.00 |



# Exhibit G

# Newberry Sub-basin Map




North

0 75' 150' 300'

WATERSHED MAP

SCALE: 1" = 150'

ENGINEERING SOLUTIONS
ENGINEERING & SURVEYING
50 SE 30TH STREET
LEE'S SUMMIT, MO 64082
P:(816) 623-9888 F:(816)623-9849

Professional Registration
Missouri
*Engineering 2005002186-D*
*Surveying 2005008319-D*
Kansas
*Engineering E-1695*
*Surveying LS-218*
*Oklahoma*
*Engineering 6254*
*Nebraska*
*Engineering CA2821*

Newberry Landings First Plat
Lee's Summit, Jackson County, Missouri

Project: NEWBERRY LANDING LSMO

Issue Date: January 4, 2024

WATERSHED MAP – NEWBERRY

Construction Plans for:
Lot 294, Newberry Landings First Plat
Lee's Summit, Jackson County, Missouri

STATE OF MISSOURI
MATTHEW J. SCHLICHT
NUMBER PE-2006019708
PROFESSIONAL ENGINEER

Matthew J. Schlicht
MO PE 2006019708
KS PE 19071
OK PE 25226

REVISIONS

EXHIBIT

# Exhibit H

# Storm Sewer System (Newberry)


## STORM SEWER SYSTEM

SCALE: 1" = 20'

Storm Sewer Capacity - Newberry Development

| D.S. STR. | U.S. STR. | D.S. Inv. | U.S. Inv. | Length (ft) | Slope (ft/ft) | Dia. (in) | Material | n | Capacity (cfs) | Friction Head (ft) | HGL Up | U.S. Rim |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EX JB | EX CI | 986.97 | 988.61 | 137 | 0.0120 | 48 | HDPE | 0.01 | 204.207 | 1.64 | 992.61 | 998.06 |


ENGINEERING SOLUTIONS
ENGINEERING & SURVEYING
50 SE 30TH STREET
LEE'S SUMMIT, MO 64082
P:(816) 623-9888 F:(816)623-9849

Professional Registration
Missouri
Engineering 2005032186-D
Surveying 2005008319-D
Kansas
Engineering E-1895
Surveying LS-218
Oklahoma
Engineering 6254
Nebraska
Engineering CA2821


Newberry Landings First Plat
Lee's Summit, Jackson County, Missouri

Project: NEWBERRY LANDING, LSMO

Issue Date: January 4, 2024

STORM SEWER SYSTEM CAPACITY
Construction Plans for:
Lot 294, Newberry Landings First Plat
Lee's Summit, Jackson County, Missouri

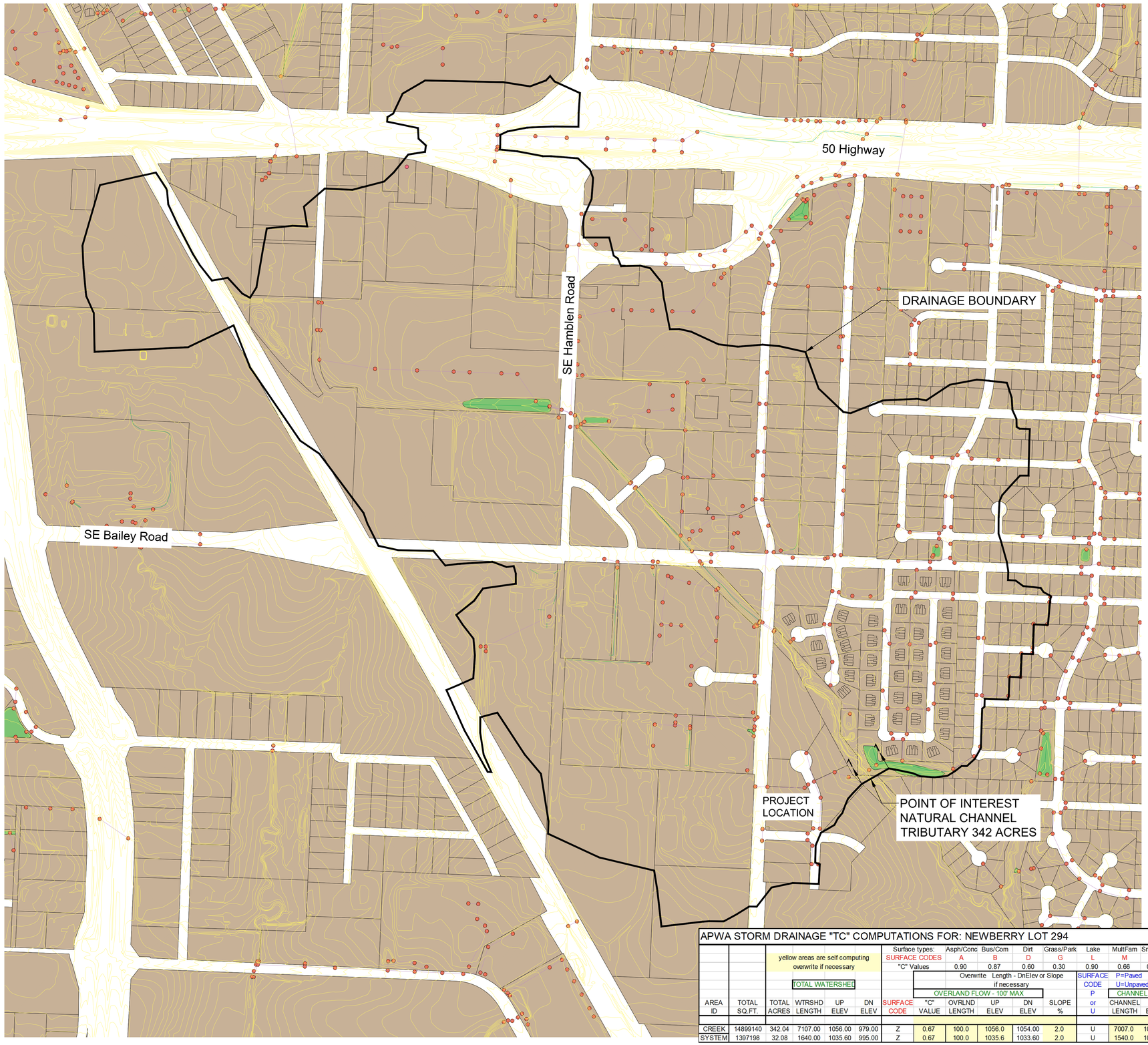

Matthew J. Schlicht
MO PE 2006019708
KS PE 19071
OK PE 25226


REVISIONS

EXHIBIT

# Exhibit I

# Overall Drainage Area Map




North

0 150' 300' 600'

OVERALL WATERSHED MAP

SCALE: 1" = 300'

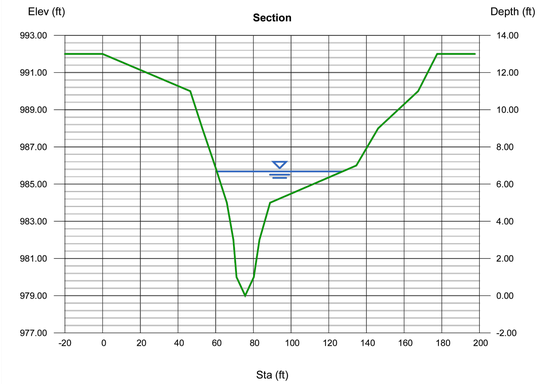
## Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Feb 15 2024

### Creek Cross Section 1-1

| User-defined | | Highlighted | |
|---|---|---|---|
| Invert Elev (ft) | = 979.00 | Depth (ft) | = 6.68 |
| Slope (%) | = 1.07 | Q (cfs) | = 1.017 |
| N-Value | = 0.034 | Area (sqft) | = 139.66 |
| | | Velocity (ft/s) | = 7.28 |
| **Calculations** | | Wetted Perim (ft) | = 69.65 |
| Compute by: | Known Q | Crit Depth, Yc (ft) | = 6.45 |
| Known Q (cfs) | = 1016.59 | Top Width (ft) | = 66.72 |
| | | EGL (ft) | = 7.50 |

**(Sta, El, n)-(Sta, El, n)...**
( 0.00, 992.00)-(48.52, 990.00, 0.035)-(52.90, 988.00, 0.035)-(59.58, 986.00, 0.035)-(65.92, 984.00, 0.035)-(69.39, 982.00, 0.030)-(71.06, 980.00, 0.030) -(75.64, 979.00, 0.030)-(80.22, 980.00, 0.030)-(83.22, 982.00, 0.030)-(88.86, 984.00, 0.035)-(134.64, 986.00, 0.035)-(146.23, 988.00, 0.035)-(167.45, 990.00, 0.035) -(177.53, 992.00, 0.035)




* NO ATTENUATION WAS ACCOUNTED FOR IN THE WATERSHED.
** 100-YR PEAK DISCHARGE RATE CALCULATED BY SCS METHODS.

APWA STORM DRAINAGE "TC" COMPUTATIONS FOR: NEWBERRY LOT 294

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Surface types: | Asph/Conc | Bus/Com | Dirt | Grass/Park | Lake | MultFam | SnglFam | Undev | Other | | | | | | | | | | | | | | | | | |
| | | yellow areas are self computing | | | | SURFACE CODES | A | B | D | G | L | M | S | U | Z | | | | | | | | | | | | | | | | |
| | | overwrite if necessary | | | | "C" Values | 0.90 | 0.87 | 0.60 | 0.30 | 0.90 | 0.66 | 0.51 | 0.3 | | | | | TC COMPUTATION | | | | | | | | | | | |
| | | | TOTAL WATERSHED | | | | Overwrite Length - DnElev or Slope | | | | SURFACE | P=Paved | | Overwrite Slope or Elevations | | | | | | | | | | | | | | | | | |
| | | | | | | | if necessary | | | | CODE | U=Unpaved | | if necessary | | | | Cal | Used | Cal | | | | | | | | | | | |
| | | | | | | | OVERLAND FLOW - 100' MAX | | | | P | CHANNEL FLOW - FIRST REACH | | | | | | Overland | Min 5 | Channel | Total | | | | | | | K | | |
| AREA ID | TOTAL SQ.FT. | TOTAL ACRES | WTRSHD LENGTH | UP ELEV | DN ELEV | SURFACE CODE | "C" VALUE | OVRLND LENGTH | UP ELEV | DN ELEV | SLOPE % | or U | CHANNEL LENGTH | UP ELEV | DN ELEV | SLOPE % | VELOCITY F/S | Flow T(i) | Max 15 T(i) | One T(T) | T© 10 | Intensity 10 I | Intensity 100 I | CFS 10 Q | CFS 100 Q | 1.25 AREA ID |
| CREEK | 14899140 | 342.04 | 7107.00 | 1056.00 | 979.00 | Z | 0.67 | 100.0 | 1056.0 | 1054.00 | 2.0 | U | 7007.0 | 1054.0 | 979.0 | 1.07 | 1.7 | 6.1 | 6.1 | 70.0 | 76.1 | 2.1 | 3.1 | 485.05 | 893.61 | CREEK |
| SYSTEM | 1397198 | 32.08 | 1640.00 | 1035.60 | 995.00 | Z | 0.67 | 100.0 | 1035.6 | 1033.60 | 2.0 | U | 1540.0 | 1033.6 | 995.0 | 2.51 | 2.6 | 6.1 | 6.1 | 10.0 | 16.2 | 5.2 | 7.2 | 111.65 | 192.50 | SYSTEM |


ENGINEERING SOLUTIONS
ENGINEERING & SURVEYING
50 SE 30TH STREET
LEE'S SUMMIT, MO 64082
P:(816) 623-9888 F:(816)623-9849

Professional Registration
Missouri
*Engineering 2005002186-D*
*Surveying 2005000319-D*
Kansas
*Engineering E-1695*
*Surveying LS-218*
Oklahoma
*Engineering 6254*
Nebraska
*Engineering OA2821*


Newberry Landings First Plat
Lee's Summit, Jackson County, Missouri

Project: NEWBERRY LANDING, LSMO
Issue Date: January 4, 2024

OVERALL WATERSHED MAP

Construction Plans for:
Lot 294, Newberry Landings First Plat
Lee's Summit, Jackson County, Missouri

STATE OF MISSOURI
MATTHEW J. SCHLICHT
NUMBER
PE-2006019708
PROFESSIONAL ENGINEER

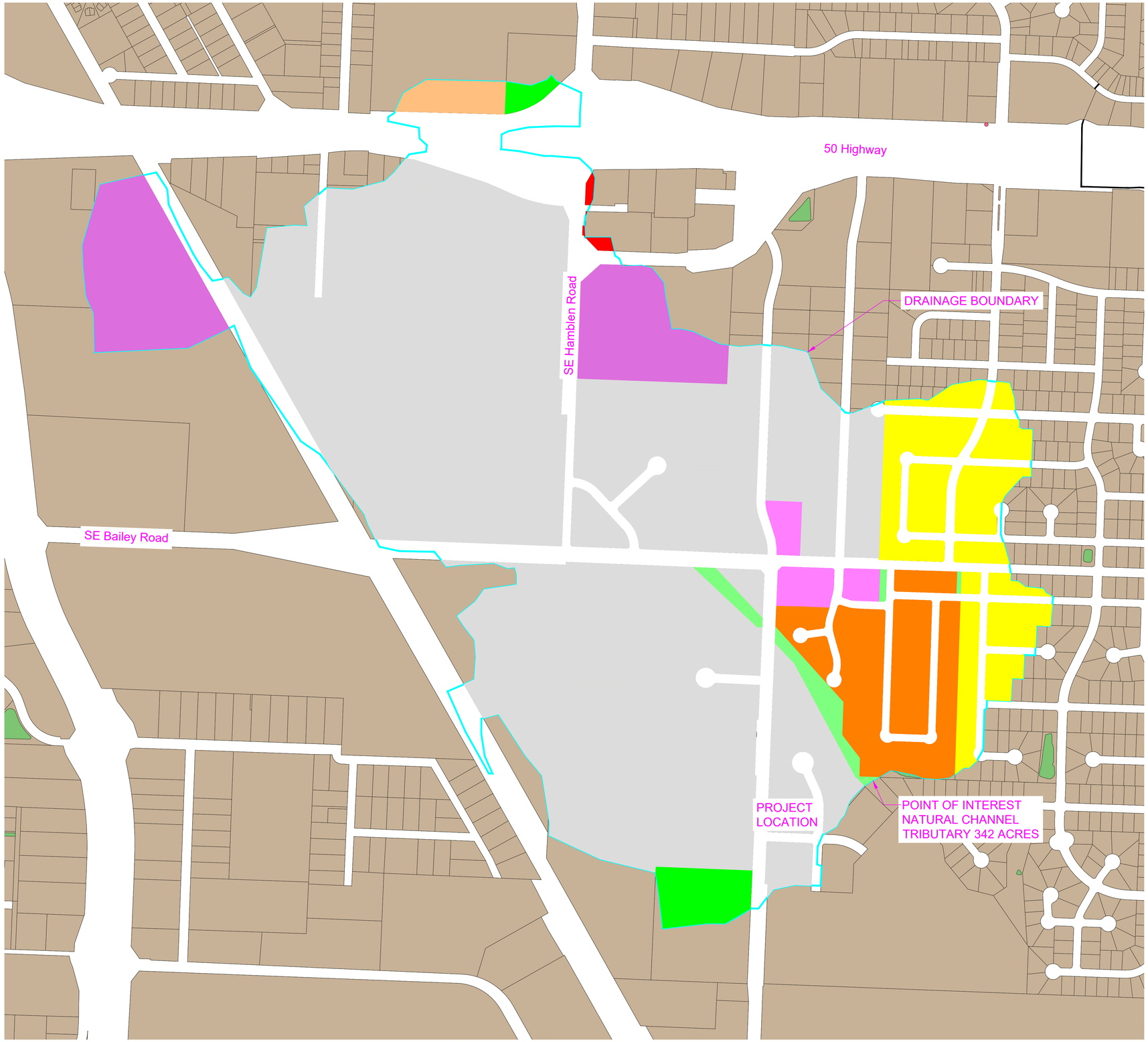

Matthew J. Schlicht
MO PE 2006019708
KS PE 19071
OK PE 25226


REVISIONS

EXHIBIT

# Exhibit J

# Land Usage Map




North

0 150' 300' 600'

LAND USAGE MAP

SCALE: 1" = 300'

| ACREAGE | C | C x A | CN | CN x A | LAND USE | |
|---|---|---|---|---|---|---|
| 5.47 | 0.51 | 2.79 | 82 | 448 | AG | Agricultural |
| 4.43 | 0.81 | 3.59 | 94 | 417 | CP-1 | Planned Neighborhood Commercial |
| 0.45 | 0.81 | 0.36 | 94 | 42 | CP-2 | Planned Community Commercial |
| 204.78 | 0.72 | 147.44 | 91 | 18635 | PI | Planned Industrial |
| 26.73 | 0.81 | 21.65 | 94 | 2513 | PMIX | Planned Mixed Use |
| 23.03 | 0.51 | 11.74 | 82 | 1888 | R-1 | Single Family Residential |
| 2.90 | 0.66 | 1.91 | 88 | 255 | RP-2 | Planned Two Family Residential |
| 18.78 | 0.66 | 12.40 | 88 | 1653 | RP-3 | Planned Residential Mixed Use |
| 3.44 | 0.30 | 1.03 | 74 | 255 | GS | Green Space |
| 52.02 | 0.51 | 26.53 | 82 | 4266 | R-O-W | Right-of-Way |
| 342.04 | 0.67 | 229.46 | 89 | 30372 | | Watershed |

ENGINEERING SOLUTIONS
ENGINEERING & SURVEYING
50 SE 30TH STREET
LEE'S SUMMIT, MO 64082
P:(816) 623-9888 F:(816)623-9849

Professional Registration
Missouri
Engineering 2005002186-D
Surveying 2005008319-D
Kansas
Engineering E-1695
Surveying LS-218
Oklahoma
Engineering 6254
Nebraska
Engineering CA2821

Newberry Landings First Plat
Lee's Summit, Jackson County, Missouri

Project: NEWBERRY LANDING, LSMO

Issue Date: January 4, 2024

WATERSHED MAP
Construction Plans for:
Lot 294, Newberry Landings First Plat
Lee's Summit, Jackson County, Missouri

STATE OF MISSOURI
MATTHEW J. SCHLICHT
PE-2006019708
PROFESSIONAL ENGINEER

Matthew J. Schlicht
MO PE 2006019708
KS PE 19071
OK PE 25226

REVISIONS

EXHIBIT