STORMWATER REPORT

MARTHA'S VINEYARD REGIONAL HIGH SCHOOL
ATHLETIC FIELD INMPROVEMENTS
PHASE 1

OAK BLUFFS, MASSACHUSETTS

Prepared For:
HUNTRESS ASSOCIATES, INC.

Prepared By:
Marchionda & Associates, LP

January 22, 2020

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STORMWATER REPORT NARRATIVE

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Introduction:

Marchionda & Associates, L.P. has completed a storm water analysis for the *Field Improvement* project proposed at Martha's Vineyard Regional High School in Oak Bluffs, Massachusetts. The purpose of this report is to offer information on the stormwater characteristics of the site in its existing and post construction condition.

For additional information regarding the site's existing conditions and the stormwater management system reference is made to the following plans and report;

- ***Athletic Field Improvements – Phase One***
  Martha's Vineyard Regional High School
  Owner: Martha's Vineyard Regional School District
  Prepared by; Huntress Associates, Inc.
  Dated; 1/22/20

Existing Conditions:

The project site is located at the campus of Martha's Vineyard Regional High School. The subject area is the present site of the school's athletic stadium. It includes an existing multi-purpose natural grass field, a parking area, and supporting structures such as grandstands and storage buildings.

The site is surrounded by the Edgartown Vineyard Haven Road right of way to the north, school facilities to the east, other athletic fields to the south, wooded undeveloped areas to the east. No areas of the site are located within a buffer zone to a wetland area or a designated flood hazard area.

Stormwater from the site presently flows in two main directions. Stormwater from the existing parking area flows to catch basins that connect to infiltration drywells located within the parking area. Stormwater from the stadium area flows overland to the southern project limits and onto adjacent natural grass athletic fields. Refer to the existing conditions plan in project site plan set for specific information on the existing topography and features of the site.

Soils on the site have been mapped as those typically found in the Riverhead Sandy Loam soil series. These soils are well-drained sandy loams over stratified sands and gravels. Information on the site's soils has been included in appendix of the report.

Project Description:

The project consists of the removal of the existing natural grass field and stadium and the construction of a new synthetic grass field, running track, and stadium facility. The improvements include a new grandstand, press box, storage shed, and field house.

This construction will result in approximately 79,500 +/- s.f. of new impervious surfaces. The construction will require shallow excavation and surface preparation and will be take place in areas of the site has been previously disturbed. The remaining open space will be made up of manicured grass and landscape areas.

A comprehensive stormwater management system will be constructed to mitigate the additional stormwater run-off generated. This system will be made up of stone trenches, catch basins, and underground infiltration chambers. Detailed information on the components of the system are included in the project's site plans.

Project Type:

The project will take place in areas previously disturbed. However, for purposes of stormwater management standards the project has not been considered a redevelopment project.

LID Measures:

When possible environmental sensitive site design and LID techniques have been used in the planning of the project. No construction will be required to take place within a wetland resource or buffer zone. All of the proposed construction will be located in areas previously disturbed by the existing facility.

Stormwater Management Standards Compliance:

A description of how this project meets the DEP stormwater standards, along with supporting documentation, is provided herein:

Standard 1: *No New Untreated Stormwater Discharges*

No new point source discharges will be created. The project has been designed to recharge and contain the majority of the storm water flows within the project area.

Standard 2: *No Increase in the Post-Development Peak Discharge Rate*

Peak flow rates were studied under existing and proposed conditions for 2-year, 10-year, 25-year, and 100-year, 24-hour Type III storm events. Two study points (1 & 2) as shown in Figures 1 and 2 and as described below were developed to analyze runoff rates from the project site to the receiving wetland. The subcatchment watersheds to each study point were then delineated for the pre- and post-development conditions.

Study Point "1" represents the portion of the project that drains into the bituminous concrete parking area that abuts the facility to the west. This area has an existing surface drainage system which connects to underground infiltration drywells.

Study Point "2" represents the portion of the site that drains to the southwest limit of the project. This includes the area of the existing stadium and it's supporting structures. In the post construction condition this area will made up of the new stadium facility and stormwater management system.

In terms of the modeling methodology, Technical Release 55 (TR-55) was utilized to obtain weighted curve numbers (CNs) for each of the pre- and post-development subcatchment areas. Inputs for obtaining the weighted CNs were based on ground cover type and hydrologic soil groups (HSGs). TR-55 was also utilized to obtain times of concentration (TCs) for each of the pre- and post-development subcatchment areas. Flow paths were generally broken into segments of sheet flow and shallow concentrated flow. Refer to attached TR-55 TC data (Appendix 1).

CNs and TCs obtained from TR-55 were input into the *Hydraflow*® Hydrographs software package, which utilizes the National Resources Conservation Service (NRCS) method to generate and route hydrographs.

As shown in the attached modeling output and as summarized in Table 1 (below), the peak runoff rate from the site will not increase in the proposed conditions for any of the design storms at any of the study points:

TABLE 1: PEAK RUNOFF RATES FROM THE SITE AT EACH STUDY POINT

Study Point	2-yr storm event (3.6"/24-hr)		10-yr storm event (4.9"/24-hr)		25-yr storm event (5.8"/24-hr)		100-yr storm event (7.22"/24-hr)	
	Pre (cfs)	Post (cfs)	Pre (cfs)	Post (cfs)	Pre (cfs)	Post (cfs)	Pre (cfs)	Post (cfs)
1	***2.8***	***2.8***	***4.7***	***4.7***	***6.0***	***6.0***	***8.0***	***8.0***
2	***0.0***	***0.0***	***0.2***	***0.2***	***1.0***	***0.5***	***3.3***	***1.4***

Standard 3: *Loss of Annual Recharge*

DEP's *Stormwater Management Handbook* prescribes an infiltration volume based on the hydrologic soil group over which impervious area will be constructed as follows:

- HSG A – 0.60 inches of runoff
- HSG B – 0.35 inches of runoff
- HSG C – 0.25 inches of runoff
- HSG D – 0.10 inches of runoff

The proposed construction will include both the creation and removal of impervious surfaces. It appears from soil mapping and on-site soil observation that the entire project area is made up of soils that are considered to be in the hydrologic soil group "A".

As is shown in the pre & post peak discharge calculations, all of the stormwater generated from the proposed impervious areas will be infiltrated into the soils within the project site. As a result the proposed construction will meet and exceed the requirements for the loss of groundwater recharge.

Standard 4: *Water Quality*

The new impervious surfaces created will be athletic track surfaces, walkways, and roof tops. Since these surfaces will not generate pollutant laden suspended solids there will no increase in Total Suspended Solids as a result of the project.

A *Long-Term Stormwater Operation and Maintenance Plan & Pollution Prevention Plan* (Appendix 4) has been developed for the project to comply with this requirement and the requirements of Standard 9.

Standard 5: *Land Uses with Higher Potential Pollutant Loads*

Not applicable – this project does not propose a land use with a higher potential pollutant load.

Standard 6: *Discharges within a Zone II or Interim Wellhead Protection Area*

A portion of the project lies within a Zone II of a surface according to a review of Mass GIS data. The project will however not create any point source discharges.

Standard 7: *Redevelopment*

This project is not considered a redevelopment project as defined in the DEP *Stormwater Management Handbook*.

Standard 8: *Construction-Related Impacts*

A Construction Period *Erosion & Sedimentation Control Plan* has been developed for the project and is included as part of the Definitive Plans. In addition to this plan, the project is subject to the National Pollutant Discharge Elimination System (NPDES) program of the United States Environmental Protection Agency, as it will involve greater than one acre of land disturbance. As such, coverage under the NPDES *General Permit for Stormwater Discharges from Construction Activities* will be required along with a Stormwater Pollution Prevention Plan (SWPPP) prior to land disturbance.

Standard 9: *Long-Term Operation and Maintenance*

A *Long-Term Stormwater Operation and Maintenance Plan & Pollution Prevention Plan* has been developed for the project to comply with this requirement and the requirements of Standard 4. A copy of this plan has been included in the appendix of the report.

Standard 10: *Illicit Discharges*

DEP does not permit illicit discharges, defined by 310 CMR 10.04 as follows, to the stormwater management system:

"Illicit discharge means a discharge that is not entirely comprised of stormwater. Notwithstanding the foregoing, an illicit discharge does not include discharges from the following activities or facilities: firefighting, water line flushing, landscape irrigation, uncontaminated ground water, potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, flows from riparian habitats and wetlands, dechlorinated water from swimming pools, water used for street washing and water used to clean buildings without detergents."

Prior to the discharge of stormwater runoff to the post-construction stormwater system it shall be the project owner's responsibility to prepare an Illicit Discharge Compliance Statement in accordance with Standard 10 certifying that no illicit discharges exist on the site.

EDGARTOWN VINEYARD HAVEN ROAD

SANDERSON AVE.

LIMIT OF SUBCAT

STUDY POINT "1"

STUDY POINT "2"

LIMIT OF STUDY AREA

Tc FLOW PATH (Typ.)

A

B

C

E-1

E-2

Test Pit 1-19

Test Pit 2-19

Test Pit 3-19

Test Pit 4-19

Test Pit 5-19

Test Pit 6-19

EXISTING FOOTBALL FIELD

EXISTING FIELD HOCKEY FIELD

TENNIS COURTS

GREENHOUSE

BUILDING

GARDEN

SNACK HUT

SNACK TRAILER

PROPANE TANKS

ELEC. METER

GARAGE DOORS

CONC. APRON

TRANS PAD

BRICK WALK

3 SIGNS HANDICAPPED PARKING

SIGN "SLOW SCHOOL"

SIGN "STAFF PARKING"

SIGN NO PARKING

BLEACHERS

TOWER

LIGHT TOWER

BACKSTOP

GOAL POST

ANCHOR

PITCHING RUBBER

CONC PAD

ROOF OVERHANG

RAMP

BENCH

GATE

SHED

ELEC. HUT

CABLE HH

SCOREBOARD

ICV

HORIZONTAL SCALE 1"=40'

40 20 0 40 80 120

DRW:	CHK:	DSG:	DESCRIPTION	DATE

PRE-DVELOPMENT WATERSHEDS

MARTHA'S VINEYARD REGIONAL HIGH SCHOOL

in

OAK BLUFFS, MA

Prepared For

HUNTRESS SPORTS

17 TEWKSBURY STREET
ANDOVER, MA 01810

Marchionda & Associates, L.P.

Engineering and Planning Consultants

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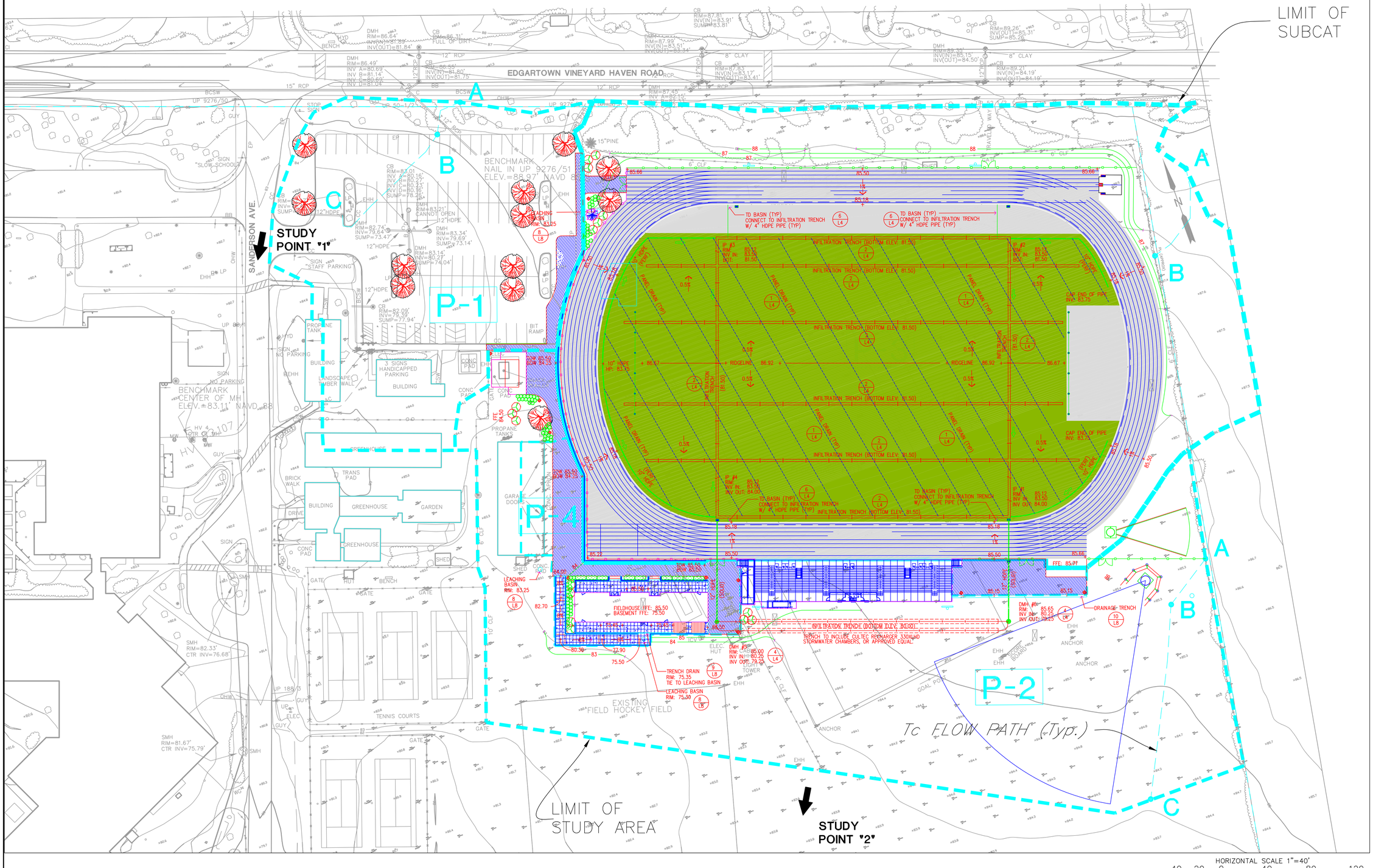
Suite I
Stoneham, MA 02180
TEL: (781) 438-6121
FAX: (781) 438-9654
Email: engineering@marchionda.com
Website: www.marchionda.com

DATE: 12/30/19

...\670-31 MVRHS\DRAINAGE\PRE-DEV.DWG

M. & A. NO.: 670-31 | SCALE: 1"=40'

SHEET 1 OF 1



DRW:	CHK:	DSG:	DESCRIPTION	DATE
				REV.

POST DVELOPMENT WATERSHEDS

MARTHA'S VINEYARD REGIONAL HIGH SCHOOL

in

OAK BLUFFS, MA

Prepared For

HUNTRESS SPORTS

17 TEWKSBURY STREET
ANDOVER, MA 01810

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FAX: (781) 438-9654
Email: engineering@marchionda.com
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DATE: 1/22/20

...\670-31 MVRHS\DRAINAGE\REV POST-DEV.DWG

M. & A. NO.: 670-31 | SCALE: 1"=40'

SHEET 1 OF 1

APPENDIX 1

Standard 2 (Peak Flow)

SOILS INFORMATION

Map Scale: 1:5,090 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 200 400 800 1200

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N 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 1:20,000.

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: Dukes County, Massachusetts
Survey Area Data: Version 16, Sep 12, 2019

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

Date(s) aerial images were photographed: Dec 31, 2009—Nov 5, 2017

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
288A	Riverhead sandy loam, 0 to 3 percent slopes	56.3	90.0%
288B	Riverhead sandy loam, 3 to 8 percent slopes	3.0	4.8%
602	Urban land	3.2	5.2%
Totals for Area of Interest		**62.5**	**100.0%**

Dukes County, Massachusetts

288A—Riverhead sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 98y1
Mean annual precipitation: 41 to 48 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 175 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Riverhead and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Riverhead

Setting

Landform: Outwash plains
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Friable coarse-loamy eolian deposits over loose sandy and gravelly glaciofluvial deposits

Typical profile

H1 - 0 to 4 inches: sandy loam
H2 - 4 to 16 inches: sandy loam
H3 - 16 to 24 inches: loamy sand
H4 - 24 to 60 inches: stratified sand and gravel

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Tisbury
Percent of map unit: 5 percent
Hydric soil rating: No

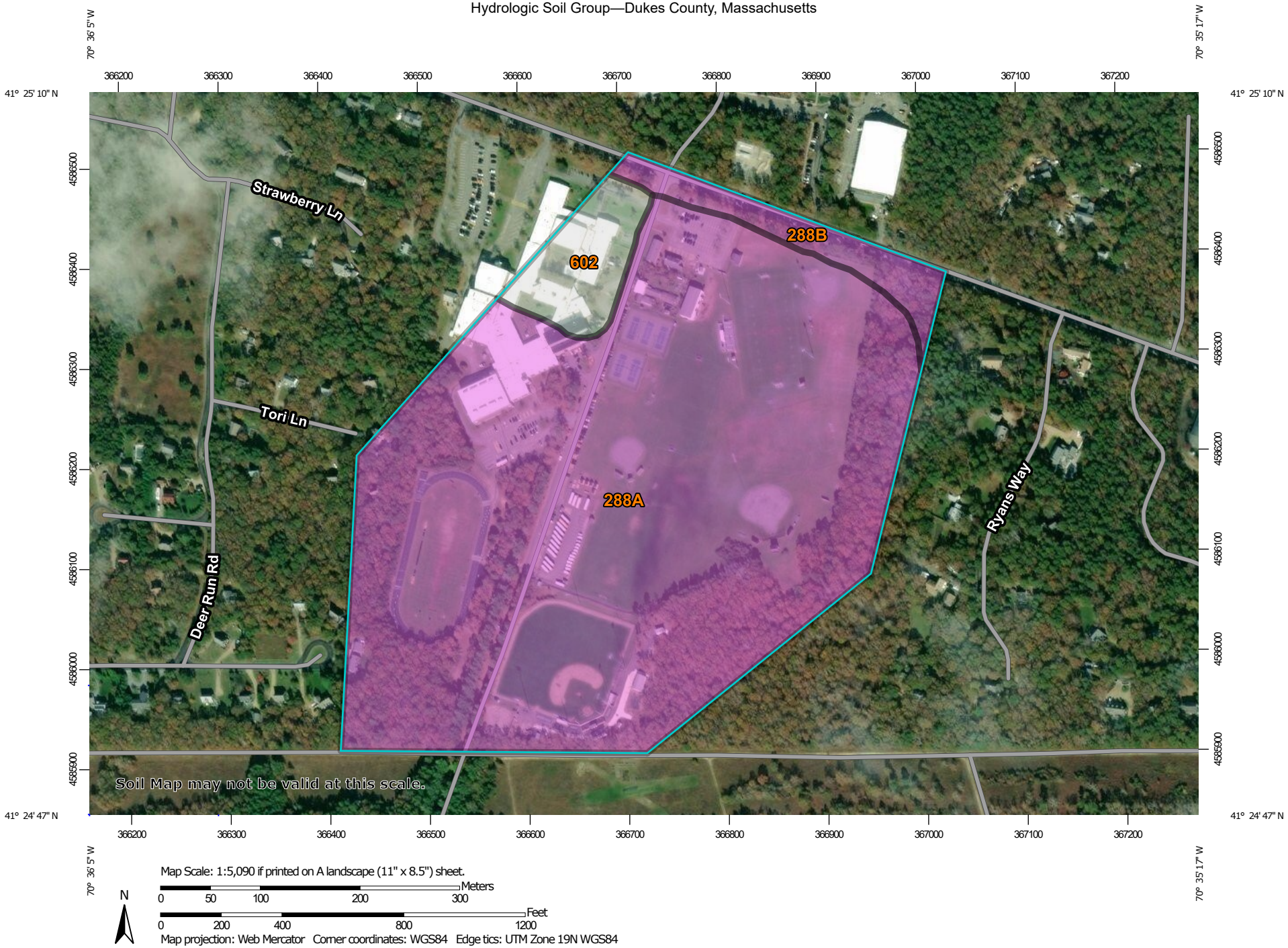
Canton
Percent of map unit: 5 percent
Hydric soil rating: No

Haven
Percent of map unit: 5 percent
Hydric soil rating: No

Klej
Percent of map unit: 5 percent
Hydric soil rating: No

Data Source Information

Soil Survey Area: Dukes County, Massachusetts
Survey Area Data: Version 16, Sep 12, 2019



Map Scale: 1:5,090 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 200 400 800 1200

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Soil Rating Lines

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Soil Rating Points

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Water Features

Streams and Canals

Transportation

Rails
Interstate Highways
US Routes
Major Roads
Local Roads

Background

Aerial Photography

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Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
288A	Riverhead sandy loam, 0 to 3 percent slopes	A	56.3	90.0%
288B	Riverhead sandy loam, 3 to 8 percent slopes	A	3.0	4.8%
602	Urban land		3.2	5.2%
Totals for Area of Interest			**62.5**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Commonwealth of Massachusetts
City/Town of OAK BLUFFS

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

MVRHS

C. On-Site Review (continued)

Deep Observation Hole Number: TP 1-19

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
2	A	10YR 3/2	—			SL.	<5	<5	Gm.	VF	DISTURBED TOP SOIL
NO "B" HORIZON											
76	C-1	10YR 7/8	—			S	10	5	S.G.	LOOSE	STRAT. Med.
88	C-2	10YR 8/2	—			S	15	5	SG	LOOSE	STRAT M/C

Additional Notes:

HOLE OBSERVED BY J. BARROWS, MA SE #84 DATE: 11/21/19
NO H_2O OBSVD, ESHWT > 88", SOME VERIGATED COLORING

Commonwealth of Massachusetts
City/Town of OAK BLUFFS

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

MVRHS

C. On-Site Review (continued)

Deep Observation Hole Number: TP 2-19

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
3	A	10YR 3/2	—			SL	<5	<5	Gm.	VF	GRASS TOP SOIL
NO "B" HORIZON			—								
72	C-1	2.5Y 5/2	—			S	5	5	SG	LOOSE	STRAT, MED
96	C-2	10YR 7/8	—			S	10	5	SG	LOOSE	STRAT M/C

Additional Notes:

HOLE OBSERVED BY: J. BARROWS, MA SE #84, DATE 11/21/19
NO H_2O OBSVD, ESHWT > 96"
SOME VERIGATED COLORING IN STRATIFIED LAYERS

Commonwealth of Massachusetts
City/Town of OAK BLUFFS

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

MVRHS

C. On-Site Review (continued)

Deep Observation Hole Number: TP 3-19

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
6	A	10YR 3/2	—			SL	<5	<5	Gm.	VF	FIELD TOP SOIL
—	NO "B" HORIZON		—								
34	C-1	10YR 3/3	—			S	5	5	SG	Loose	STRAT FINE
96	C-2	2.5Y 5/2	—			S	10	5	SG	Loose	STRAT M/C

Additional Notes:

HOLE OBSERVED BY: J. BARROWS, MA SE#84, DATE 11/21/19
NO H_2O OBSVD, ESHWT > 96
SOME VERIGATED COLORING IN STRATIFIED LAYERS

Commonwealth of Massachusetts
City/Town of OAK BLUFFS

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

MVRHS

C. On-Site Review (continued)

Deep Observation Hole Number: TP 4-19

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
7	A	10YR 3/2	-			SL	<5	<5	Gran.	VF	DKST. TOP SOIL
— No "B" HORIZON —											
37	C-1	2.5Y 7/8	-			S	~~5~~	5	SG	Loose	STRAT. FINE
96	C-2	2.5Y 8/3	-			S	10	5	SG	Loose	STRAT, M/C

Additional Notes:

HOLE OBSERVED BY: J. BARROWS, MA SE#84, DATE 11/21/19
NO H_2O OBSVD, ESHWT > 96"
SOME VERIGATED COLORING IN STRATIFIED LAYERS

Commonwealth of Massachusetts
City/Town of OAK BLUFFS

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

MVRHS

C. On-Site Review (continued)

Deep Observation Hole Number: TP 5-19

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
8	A	10YR 3/2	—			SL	<5	<5	GR1.	VF	DRT TOP SOIL
↓	NO "B"	HORIZON	—			—					
40	C-1	2.5Y 5/3	—			S	10	5	SG	Loose	STRAT MED
54	C-2	2.5Y 5/3	—			S	15	10	SG	Loose	STRAT COARSE
96	C-3	2.5Y 5/3	—			S	10	5	SG	Loose	STRAT F/M

Additional Notes:

HOLE OBSERVED BY: J. BARROWS, MA SE# 84, DATE 11/21/19
NO H_2O OBSVD, ESHWT >96"
SOME VERIGATED COLORING IN STRATIFIED LAYERS

Commonwealth of Massachusetts
City/Town of OAK BLUFFS

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

MVRHS

C. On-Site Review (continued)

Deep Observation Hole Number: TP 6-19

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
4	A	10YR 3/2	—			SL	<5	<5	Gm.	VF	DIST. TOPSOIL
—		NO "B" HORIZON					—				
38	C-1	7.5YR 7/8	—				10	5	SG	Loose	STRAT. F/M
100	C-2	7.5YR 7/8	—				15	5	SG	Loose	STRAT MED.

Additional Notes:

HOLE OBSERVED BY: J. BARROWS, MA SE #84, DATE 11/21/19
NO H_2O OBSVD, ESHWT > 100
SOME VERGATED COLORING N STRATIFIED LAYERS

GEOTECHNICAL REPORT

MARTHA'S VINEYARD HIGH SCHOOL ATHLETIC FIELDS
OAK BLUFFS, MASSACHUSETTS

December 16, 2019

GSI Project No. 219252

Prepared for:

Mr. Chris Huntress
Huntress Sports
17 Tewksbury Street
Andover, MA 01810

Prepared by:

Geotechnical Services, Inc.
55 North Stark Highway
Weare, NH 03281

Geotechnical Services Inc.
Geotechnical Engineering ◣ Environmental Studies ◣ Materials Testing ◣ Construction Monitoring

GEOTECHNICAL SERVICES INC.
Geotechnical Engineering ◢ Environmental Studies ◢ Materials Testing ◢ Construction Monitoring

December 16, 2019

Mr. Chris Huntress
Huntress Sports
17 Tewksbury Street
Andover, MA 01810

Advanced via Email: chris@huntressassociates.com

RE: Geotechnical Investigation Report
Martha's Vineyard High School
Athletic Fields Improvements
Oak Bluffs, Massachusetts
GSI Project No. 219252

Dear Mr. Huntress:

Geotechnical Services, Inc. (GSI) is pleased to submit this report on the proposed design-development of the existing track and athletic fields at the Martha's Vineyard Regional High School located in Oak Bluffs, MA. The report consists of the subsurface data obtained through implementation of an exploration program, evaluation of the subsurface data, a summary of our understanding of the proposed development, and the results of an assessment for earthwork and foundation design options. The work has been undertaken in accordance with our proposal letter, dated January 9, 2019 and your subsequent authorization. The content of this report is subject to the **Limitations** stated in Appendix A.

PROJECT UNDERSTANDING

The project is located at the Martha's Vineyard Regional High School in Oak Bluffs, MA (See Figure 1). We understand that the planned development involves the following:

- A new 400M running track and multi-purpose synthetic turf field with associates features and structures including; a press box, bleachers, sports lighting, and walkways to replace the existing football stadium, and
- Improvements to the existing running track and multi-purpose natural grass turf field (Field #5)

We assume that the synthetic turf system will have a typical cross section consisting of the synthetic turf infill, an 8-in. thick layer of free draining gravel Subbase and a geotextile fabric placed over the existing subgrade soils. The grading for the new synthetic field is assumed to match that of the existing grades with the possibility of re-grading on the order of up to 2-ft (cut/fill).

SUBSURFACE EXPLORATION

Eight (8) test pits, designated as TP-1 to TP-8, were excavated at the site on November 21, 2019 by Farrissey Tele-Com, Inc. located in Oak Bluffs, MA. The test pits were excavated using a small track excavator and/or a vacuum truck under full supervision of a GSI engineer. The test pits were excavated to depths ranging from 6 to 8.4-ft below the existing grades. Each test pit excavation was observed by the GSI engineer and the soils encountered were classified in accordance with the Burmister Classification system. The approximate locations of the test pits are shown on Figures 2 for the proposed new track and synthetic turf field and Figure 3 for Field #5. The finalized logs for the test pits are included in Appendix B. Photographs of the test pits are provided as Appendix C.

SUBSURFACE CONDITIONS

The subsurface conditions encountered in the investigation are similar for both the Synthetic Turf Field/ 400M Track and Field #5. In general, the sites are underlain by the following soil units/deposits, described in order of increasing depth:

Topsoil: Topsoil was encountered at the ground surface in all the test pits. The topsoil was generally 2-in. to 19-in (TP-7) in thickness. In general, the nominal topsoil thickness was about 8-in.

Sand Deposits: All the test pits encountered the Sand Deposits. The Sand Deposits are generally described as a orange to brown, fine SAND with varying amounts of gravel and medium to coarse sand. With the exception of TP-1, all the test pits encountered a 2 to 3-ft thick layer of orange to brown, silty fine SAND immediately below the topsoil layer. All the test pits were terminated within the Sand Deposits.

Groundwater: Groundwater was not encountered in any of the test pits upon completion. Groundwater levels should be expected to vary with season, precipitation, snowmelt, and other factors. As a result, groundwater levels encountered during construction may differ from those encountered in the explorations.

GEOTECHNICAL DESIGN RECOMMENDATIONS

General

As a general guideline, foundation design and construction must conform to the applicable provisions of the Massachusetts Building Code, 9th Edition (Building Code).

Preliminary Light Pole Foundation Geotechnical Design Parameters

For preliminary design, the soil properties recommended for design of the proposed lighting pole foundations are provided as follow:

Sand Deposits

Unit Weight (pcf)	120.0
Submerged Unit Weight (pcf)	60.0
Internal Friction Angle (degrees):	30
Cohesion (psf):	0.0
Coefficient of Variation of Subgrade Reaction, f (tcf):	15.0

Pile deformation can be estimated assuming that the coefficient of subgrade reaction, K_H, increases linearly with increasing depth in accordance with:

$$K_H = (f)*(z)/D \qquad \text{(NAVFAC DM 7.2, p.235)}$$

Where:	K_H	=	coefficient of lateral subgrade reaction (tcf)
	f	=	coefficient of variation of subgrade reaction (tcf)
	z	=	depth (ft)
	D	=	width/diameter of loaded area (ft)

The base of the planned lighting pole foundations may be designed using a design bearing pressures of 3-ksf.

We recommend that the test borings be conducted at the planned light pole foundations to confirm the above design recommendations.

Foundation Recommendations for the Planned Press Box and Bleachers

Based on the subsurface investigation, the foundations for the press box and bleachers will bear upon the Sand Deposits. Specific foundation design recommendations are provided below:

- Footings with a least lateral dimension (width) of 3-ft may be designed using a design bearing pressures of 4.0 ksf.
- For footings with a lateral dimension less than 3-ft, the maximum allowable bearing pressure should be reduced to a value equal to one-third of the maximum allowable bearing pressure given above multiplied by the least lateral dimension of the footing, measured in feet. For example, a 1.5-ft wide footing should be designed using a reduced allowable bearing pressure equal to 1.5-ft x 1/3 x 4 ksf = 2.0-ksf.
- Bottoms of exterior footings should be positioned at least 4-ft below the lowest adjacent ground (finished grade) exposed to freezing temperatures. Footings at heated interior locations should bear at least 18-in. below the adjacent slab surface.

New Track and Synthetic Turf Field Subgrades

We anticipate that the construction of the track and new synthetic turf field will involve the following; stripping off the existing Topsoil, removing/relocating any existing utilities (drainage pipe, electric utilities and any other utilities), grading the track and field to the planned rough grade, proof-rolling the subgrade and constructing the track and synthetic turf system. The Sand Deposits are suitable for support of the synthetic turf system provided the subgrade is prepared using the recommendation provided herein.

Seismic Design Input

Seismic design parameters for the project site have been obtained from Commonwealth of Massachusetts, State Building Code, 9th Edition. Ground motion parameters at the project site (i.e., the design earthquake for the subject facility) are represented by S_s, 0.2 sec. (short period) Spectral Acceleration, and S_1, 1.0-second period Spectral Acceleration. These parameters have been obtained as:

S_s = 0.144 g

S_1= 0.053 g

Site Class for the project site has been established as "Stiff soil profile" with the designation **Site Class D**. Site Coefficient for the Short Period has been established as F_a= 1.6, and Site Coefficient for the 1-sec Period has been established as F_v = 2.4. Parameters F_a, and F_v relate to the potential amplification of the earthquake induced shear stress waves traveling upward through the soil-rock profile underlying the project site. The soils within the project site are not considered liquefaction susceptible.

CONSTRUCTION CONSIDERATIONS

General

In general, all excavation, dewatering, and other construction activities should conform to the requirements of OSHA and all other applicable regulations. The site soils would typically be classified as Type C based on OSHA 29 CFR 1926.

Excavation

Typically, building foundation construction will involve stripping off any vegetation, topsoil, pavement and any other unsuitable soils, preparing subgrades, and then backfilling and filling to normal footing and subgrade design bearing levels.

We anticipate that the excavation for the planned construction and site grading can be accomplished with conventional earth-moving equipment.

Temporary cut soil slopes should, typically, be stable if constructed no steeper than about 1.5H:1V. Some sloughing and raveling should be anticipated in temporary earth slopes.

Construction Dewatering

Based on the available subsurface data it is anticipated that during the general site work, no significant dewatering measures will be necessary to conduct the construction "in-the-dry." It should be anticipated that groundwater control measure will be necessary for this site. Groundwater and surface water must be controlled as necessary to enable all final excavation and foundation construction to be conducted in-the-dry.

The Contractor should take measures to prevent groundwater and storm water to enter into excavated areas, and be prepared to remove ponded surface water by means of localized sumps and pumps. The Contractor should select whichever dewatering procedures may be effective to maintain dry, stable excavation bottoms. Dewatering, including its discharge, should be performed in accordance with all local, state, and federal regulations.

Preparation and Protection of Bearing Surfaces

Final excavation should be conducted in a manner that minimizes disturbance to the subgrade soils. As noted above, all final excavation and footing construction should be conducted in-the-dry. We recommend that the exposed subgrade soils be observed in the field by a geotechnical engineer to confirm the assumed foundation bearing conditions. It may be necessary to over-excavate and replace weak, disturbed or otherwise unacceptable foundation bearing materials.

Filling and Backfilling

Placement of compacted soil fills should not be conducted when air temperatures are low enough (approximately 30 degrees F, or below) to cause freezing of the moisture in the fill during or before placement. Fill materials should not be placed on snow, ice or uncompacted frozen soil. Compacted fill should not be placed on frozen soil. No fill should be allowed to freeze prior to compaction. At the end of each day's operations, the last lift of fill, after compaction, should be rolled by a smooth-wheeled roller to eliminate ridges of uncompacted soil.

Compaction

Minimum compaction requirements refer to percentages of the maximum dry density determined in accordance with ASTM D1557. Typical recommended compaction requirements are as follows:

Location	Minimum Compaction Requirements
Beneath and around footings, beneath slabs	95 %
Parking, roadways and sidewalks	92 % up to 3 ft below finished grade 95 % in the upper 3 ft
Landscaped areas	90 % nominal compaction

Fill and Backfill Materials

A. Crushed Stone

Crushed Stone should consist of durable crushed rock or crushed gravel stone obtained by breaking and crushing rock, or boulders, and it is free from a detrimental quantity of thin, flat, elongated or other objectionable pieces.

The ½-inch crushed stone should have the following gradation:

Sieve Size	Percent Finer by Weight
5/8 inch	100
½ inch	85-100
3/8 inch	15-45
No. 4	0-15
No. 8	0-5

B. Common Fill

Common fill should consist of mineral sandy soil, free from organic matter, plastic, metal, wood, ice, snow or other deleterious material and should have the characteristic that it can be readily placed and compacted. Common fill imported to the site should have a maximum of 80 percent passing the No. 40 sieve and a maximum of 30 percent finer than the No. 200 sieve. The largest particle size for common fill should not exceed 2/3 of the lift thickness. Silty common fill soils may require moisture control during placement and compaction. Common Fill should be placed and compacted in the manner described in "Filling and Backfilling."

C. Granular Fill

Granular Fill should consist of clean, sand and gravel, free of organic material, snow ice, or other objectionable materials and should be well-graded within the following limits:

Sieve Size	Percent Finer by Weight
6 in.	100
No. 4	30 – 90
No. 40	10 – 50
No. 200	0-10

Granular Fill should be placed in 9-inch loose lift thickness, unless otherwise specified. Cobbles exceeding 6 inch in size should be screened and removed prior to compaction. Compaction equipment should be selected to meet the requirements of that particular location in earthwork operation, thus the Contractor should provide both vibratory and static rollers, as well as hand-guided vibratory plate compactors. Where vibratory plate compactor is used the loose

lift thickness should not exceed 6 inch. A minimum of four systematic passes of the compaction equipment should be implemented to compact each lift.

CONSTRUCTION MONITORING

It is recommended that a geotechnical engineer or experienced technician be present during construction to:

- Confirm that soils used as fill and backfill are in accordance with the project plans and specifications, and make judgments on the suitability of excavated soils for reuse as fill.
- Monitor soil excavation.
- Observe preparation of bearing surfaces.
- Observe and test placement and compaction of compacted fills.
- Observe effectiveness of dewatering.

GSI is qualified and will be prepared to undertake such services, including the necessary field and laboratory sampling and testing. This will enable us to observe compliance with the design concepts and assumptions, and to facilitate design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction.

SPECIFICATIONS AND PLAN REVIEW

We recommend that GSI be provided the opportunity to review the final plans and specifications in order to confirm that the recommendations made in this report were interpreted and implemented as intended.

CLOSURE

GSI appreciates the opportunity to serve you on this project, and we look forward for its successful completion. In the meantime, if you have any questions on the content of this report or any related matter, please do not hesitate to contact us.

Very truly yours,
GEOTECHNICAL SERVICES, INC.

Glen V. Zoladz, P.E.
Project Manager

Harry K. Wetherbee, P.E.
Principal Engineer

Figure 1. Project Locus
Figure 2. Exploration Location Plan (New Football Field)
Figure 3. Exploration Location Plan (Field #5)

Appendix A. Limitations
Appendix B. Test Pit Logs
Appendix C. Photographs

FIGURE 1–PROJECT LOCUS

MARTHA'S VINEYARD HIGH SCHOOL
VINEYARD HAVEN, MA
GSI PROJECT NO. 219152

SCALE: NOT TO SCALE

LEGEND:

TP-1

TEST PIT I.D. AND APPROXIMATE LOCATION

FIGURE 2–EXPLORATION LOCATION PLAN

MARTHA'S VINEYARD HIGH SCHOOL
VINEYARD HAVEN, MA
GSI PROJECT NO. 219152

LEGEND:

TP-6

TEST PIT I.D. AND APPROXIMATE LOCATION

FIGURE 3–EXPLORATION LOCATION PLAN

MARTHA'S VINEYARD HIGH SCHOOL
VINEYARD HAVEN, MA
GSI PROJECT NO. 219152

APPENDIX A

LIMITATIONS

LIMITATIONS

Explorations

1. The analyses, recommendations and designs submitted in this report are based in part upon the data obtained from preliminary subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations of this report.

2. The generalized soil profile described in the text is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized and have been developed by interpretation of widely spaced explorations and samples; actual soil transitions are probably more gradual. For specific information, refer to the individual test pit and/or boring logs.

3. Water level readings have been made in the test pits and/or test borings under conditions stated on the logs. These data have been reviewed and interpretations have been made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, and other factors differing from the time the measurements were made.

Review

4. It is recommended that this firm be given the opportunity to review final design drawings and specifications to evaluate the appropriate implementation of the recommendations provided herein.

5. In the event that any changes in the nature, design, or location of the proposed areas are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of the report modified or verified in writing by Geotechnical Services, Inc.

Construction

6. It is recommended that this firm be retained to provide geotechnical engineering services during the earthwork phases of the work. This is to observe compliance with the design concepts, specifications, and recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction.

Use of Report

7. This report has been prepared for the exclusive use of Huntress Sport in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made.

8. This report has been prepared for this project by Geotechnical Services, Inc. This report was completed for preliminary design purposes and may be limited in its scope to complete an accurate bid. Contractors wishing a copy of the report may secure it with the understanding that its scope is limited to evaluation considerations only.

APPENDIX B

TEST PIT LOGS

TEST PIT LOG

Test Pit No. TP-1

Page 1 of 1

Project	Martha's Vineyard High School	**Project No.**	219252
Location	Vineyard Haven, MA	**Project Manager**	G. Zoladz
Client	Huntress Sports	**Field Rep.**	G. Zoladz
Contractor	Farrissey Excavating	**Date**	11/21/19
Equipment	Vaccum Truck	**Weather**	Sunny 40s

Depth (ft)	Sample ID	Stratum Change Depth (ft)	Description of Soils	Obstructions/Remarks
		~0.2	**-TOPSOIL-**	
1			Brown, fine SAND, little m/c sand, tr. gravel	
2				
3			**-SAND DEPOSITS-**	
4				
5				
6				
7			Bottom of Exploration at 7-ft.	
			No groundwater encountered	
8				
9				

Standing Water in Completed Pit:
at depth - ft
Elapsed time after completion of pit:
☐ hours ☐ min.

Boulders:

Diameter (in.)	Number
12 to 24	
> 24	-

Test Pit Dimensions:

Depth	7	ft
Length	2	ft
Width	2	ft

Survey Data:
Ground El. ft
El. Datum

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TEST PIT LOG

Test Pit No. TP-2

Page 1 of 1

Project	Martha's Vineyard High School	**Project No.**	219252
Location	Vineyard Haven, MA	**Project Manager**	G. Zoladz
Client	Huntress Sports	**Field Rep.**	G. Zoladz
Contractor	Farrissey Excavating	**Date**	11/21/19
Equipment	Vaccum Truck	**Weather**	Sunny 40s

Depth (ft)	Sample ID	Stratum Change Depth (ft)	Description of Soils	Obstructions/Remarks
		~0.2	**-TOPSOIL-**	
1			Brown, fine SAND, TR. SILT	
2		~2	Brown, fine SAND, tr. gravel, m. sand	
3			**-SAND DEPOSITS-**	
4				
5				
6			Brown, f/m SAND, tr. gravel	
7				
8			Bottom of Exploration at 8-ft. No groundwater encountered	
9				

Standing Water in Completed Pit:
at depth - ft
Elapsed time after completion of pit:
☐ hours ☐ min.

Boulders:

Diameter (in.)	Number
12 to 24	
> 24	-

Test Pit Dimensions:

Depth	8	ft
Length	2	ft
Width	2	ft

Survey Data:
Ground El. ft
El. Datum

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TEST PIT LOG

Test Pit No. TP-3

Page 1 of 1

Project	Martha's Vineyard High School	**Project No.**	219252
Location	Vineyard Haven, MA	**Project Manager**	G. Zoladz
Client	Huntress Sports	**Field Rep.**	G. Zoladz
Contractor	Farrissey Excavating	**Date**	11/21/19
Equipment	Mini Track Excavator	**Weather**	Sunny 40s

Depth (ft)	Sample ID	Stratum Change Depth (ft)	Description of Soils	Obstructions/Remarks
		~0.5	**-TOPSOIL-**	
1			Brown, silty fine SAND	
2				
		~2.7		
3			Br. fine SAND, tr. gravel, m/c sand (higher percentage of coarser sand with depth)	
			-SAND DEPOSITS-	
4				
5				
6				
7				
8			Bottom of Exploration at 8-ft.	
			No groundwater encountered	
9				

Standing Water in Completed Pit:
at depth - ft
Elapsed time after completion of pit:
☐ hours ☐ min.

Boulders:

Diameter (in.)	Number
12 to 24	
> 24	-

Test Pit Dimensions:

Depth	8	ft
Length	6	ft
Width	2	ft

Survey Data:
Ground El. ft
El. Datum

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TEST PIT LOG

Test Pit No. TP-4

Page 1 of 1

Project	Martha's Vineyard High School	**Project No.**	219252
Location	Vineyard Haven, MA	**Project Manager**	G. Zoladz
Client	Huntress Sports	**Field Rep.**	G. Zoladz
Contractor	Farrissey Excavating	**Date**	11/21/19
Equipment	Mini Track Excavator	**Weather**	Sunny 40s

Depth (ft)	Sample ID	Stratum Change Depth (ft)	Description of Soils	Obstructions/Remarks
		~0.7	**-TOPSOIL-**	
1			Brown, silty fine SAND	
2				
3		~3		
			Orange to br., fine SAND, little m/c sand, tr. gravel	
4			**-SAND DEPOSITS-**	
5				
6				
7				
8			Bottom of Exploration at 8-ft.	
			No groundwater encountered	
9				

Standing Water in Completed Pit:
at depth - ft
Elapsed time after completion of pit:
☐ hours ☐ min.

Boulders:

Diameter (in.)	Number
12 to 24	
> 24	-

Test Pit Dimensions:

Depth	8	ft
Length	6	ft
Width	2	ft

Survey Data:
Ground El. ft
El. Datum

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TEST PIT LOG

Test Pit No. TP-5

Page 1 of 1

Project	Martha's Vineyard High School	**Project No.**	219252
Location	Vineyard Haven, MA	**Project Manager**	G. Zoladz
Client	Huntress Sports	**Field Rep.**	G. Zoladz
Contractor	Farrissey Excavating	**Date**	11/21/19
Equipment	Mini Track Excavator	**Weather**	Sunny 40s

Depth (ft)	Sample ID	Stratum Change Depth (ft)	Description of Soils	Obstructions/Remarks
		~0.6	**-TOPSOIL-**	
1			Brown, silty fine SAND	
2		~2.5		
3			Orange to br., fine SAND, little m/c sand, tr. gravel	
4			**-SAND DEPOSITS-**	
5				
6				
7				
8			Bottom of Exploration at 8-ft.	
9			No groundwater encountered	

Standing Water in Completed Pit:
at depth - ft
Elapsed time after completion of pit:
☐ hours ☐ min.

Boulders:

Diameter (in.)	Number
12 to 24	
> 24	-

Test Pit Dimensions:

Depth	8	ft
Length	6	ft
Width	2	ft

Survey Data:
Ground El. ft
El. Datum

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TEST PIT LOG

Test Pit No. TP-6

Page 1 of 1

Project	Martha's Vineyard High School	**Project No.**	219252
Location	Vineyard Haven, MA	**Project Manager**	G. Zoladz
Client	Huntress Sports	**Field Rep.**	G. Zoladz
Contractor	Farrissey Excavating	**Date**	11/21/19
Equipment	Mini Track Excavator	**Weather**	Sunny 40s

Depth (ft)	Sample ID	Stratum Change Depth (ft)	Description of Soils	Obstructions/Remarks
		~0.3	**-TOPSOIL-**	
1			Brown, silty fine SAND	
2				
3		~3.3		
			Orange to br., fine to medium SAND, tr. gravel (occasional cobbles)	
4			**-SAND DEPOSITS-**	
5				
6				
7				
8				
			Bottom of Exploration at 8.4-ft.	
9			No groundwater encountered	

Standing Water in Completed Pit:

at depth - **ft**

Elapsed time after completion of pit:

☐ hours ☐ min.

Boulders:

Diameter (in.)	Number
12 to 24	
> 24	-

Test Pit Dimensions:

Depth	8.4	**ft**
Length	6	**ft**
Width	2	**ft**

Survey Data:

Ground El. ft

El. Datum

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TEST PIT LOG

Test Pit No. TP-8

Page 1 of 1

Project	Martha's Vineyard High School	**Project No.**	219252
Location	Vineyard Haven, MA	**Project Manager**	G. Zoladz
Client	Huntress Sports	**Field Rep.**	G. Zoladz
Contractor	Farrissey Excavating	**Date**	11/21/19
Equipment	Mini Track Excavator	**Weather**	Sunny 40s

Depth (ft)	Sample ID	Stratum Change Depth (ft)	Description of Soils	Obstructions/Remarks
			-TOPSOIL-	
		~0.7		
1			Brown, silty fine SAND, little to tr. m-sand	
		~2		
2			Orange to br., fine to medium SAND, tr. gravel	
3				
4			**-SAND DEPOSITS-**	
5				
6			Bottom of Exploration at 6-ft.	
			No groundwater encountered	
7				
8				
9				

Standing Water in Completed Pit:
at depth - ft
Elapsed time after completion of pit:
☐ hours ☐ min.

Boulders:

Diameter (in.)	Number
12 to 24	
> 24	-

Test Pit Dimensions:

Depth	6	ft
Length	6	ft
Width	2	ft

Survey Data:
Ground El. ft
El. Datum

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APPENDIX C

PHOTOGRAPHS

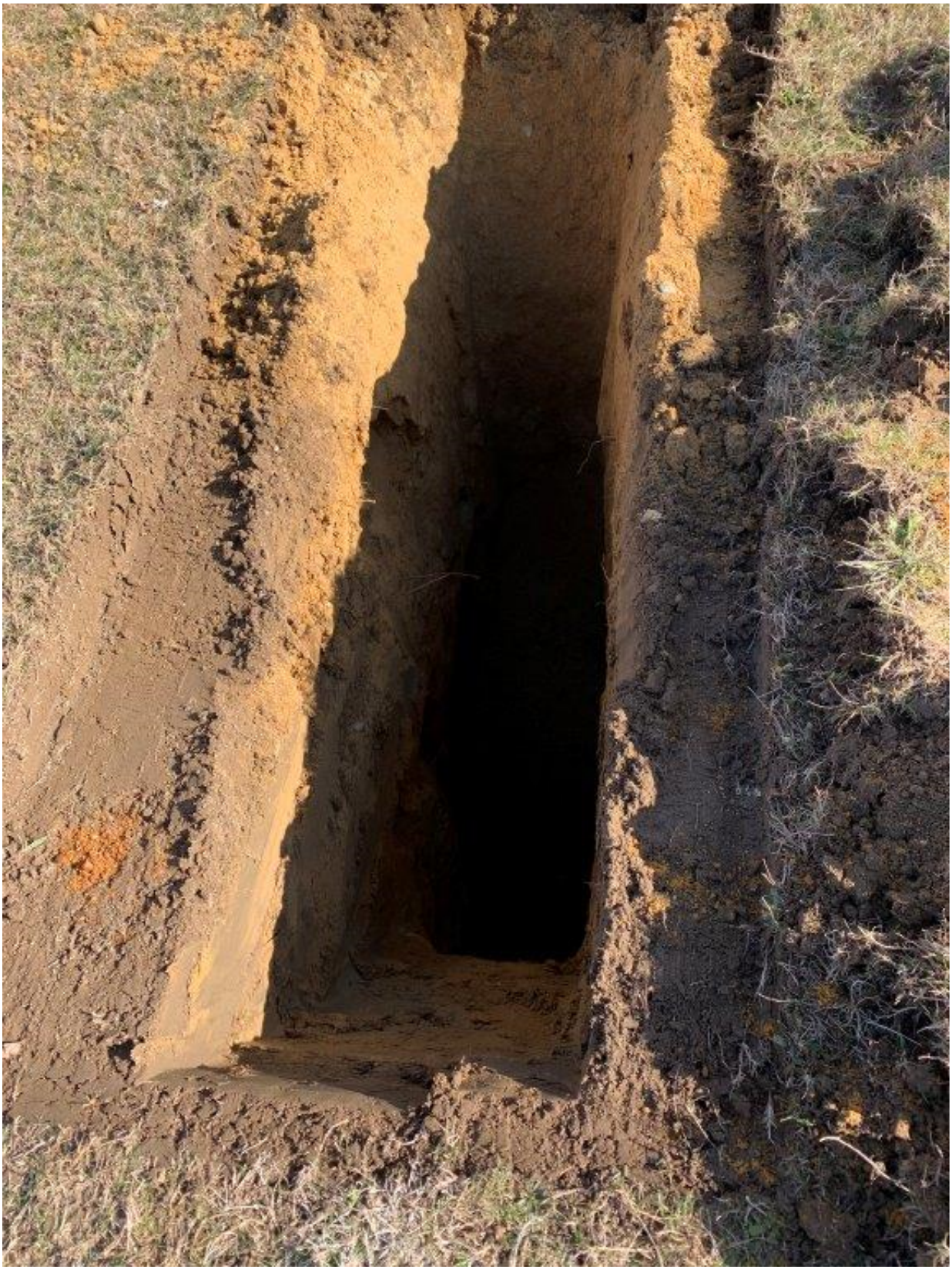


Photo 1 Test Pit No. 4

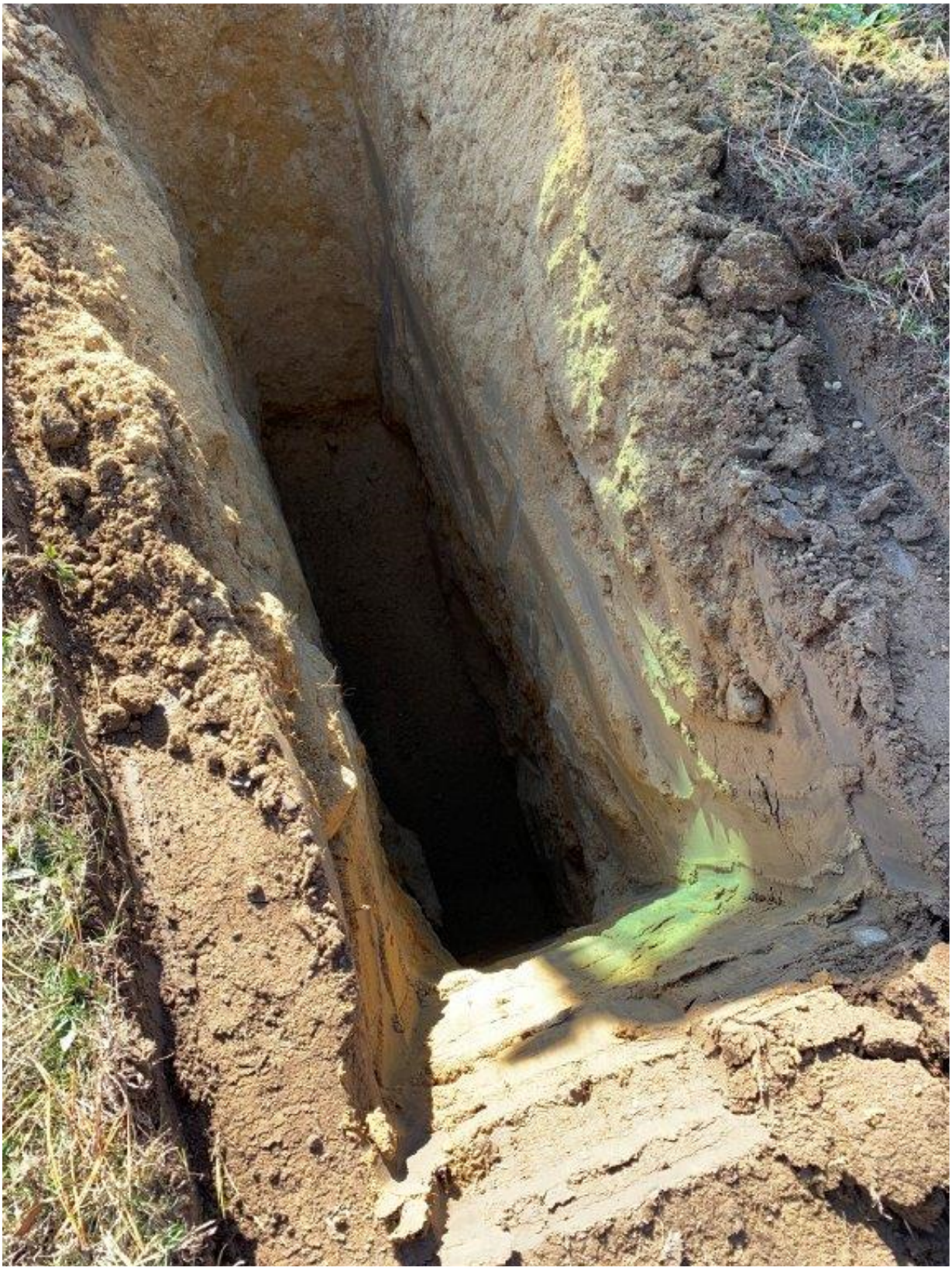


Photo 2 Test Pit No. 5

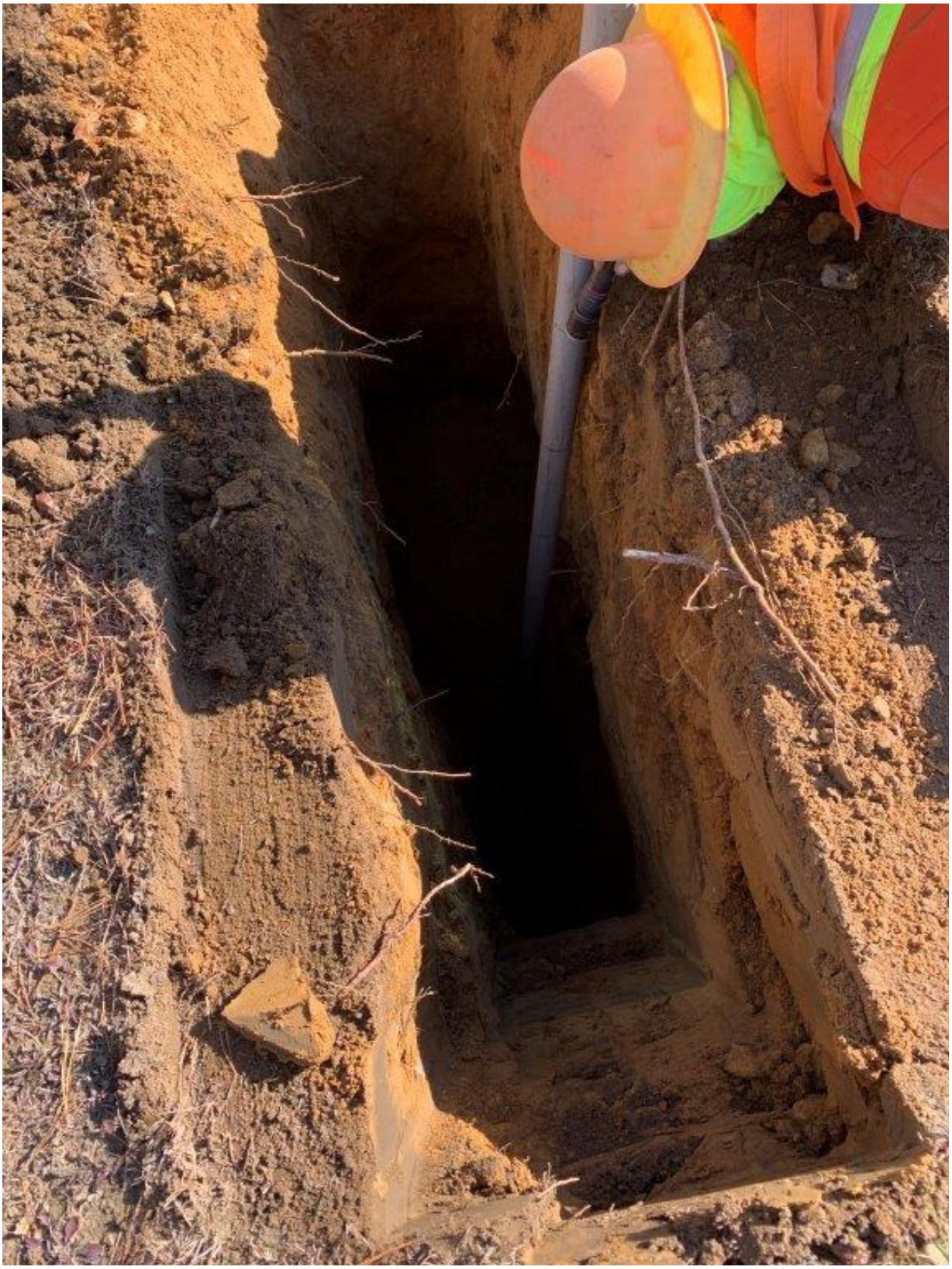


Photo 3 Test Pit No. 6

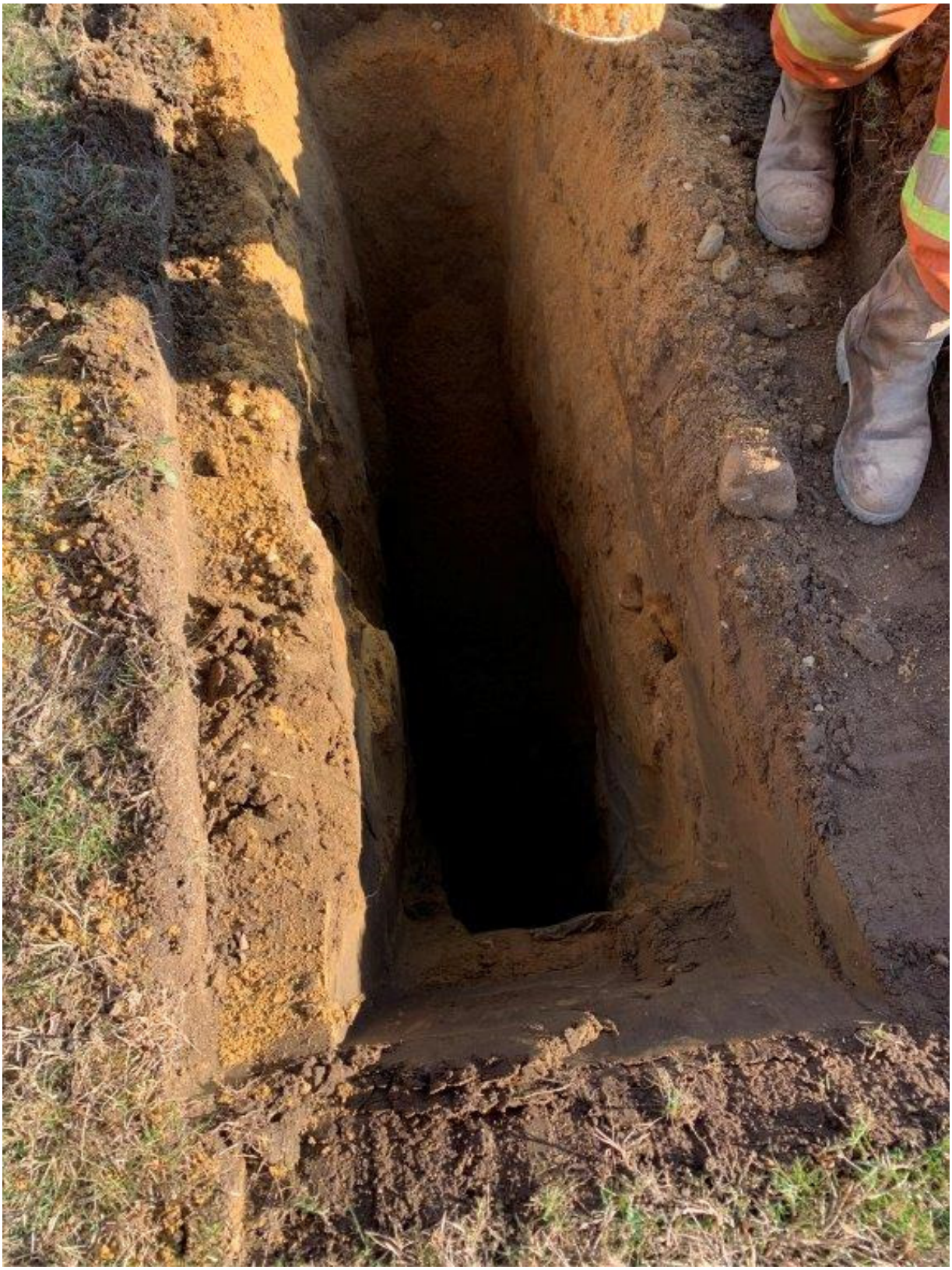


Photo 4 Test Pit No. 7

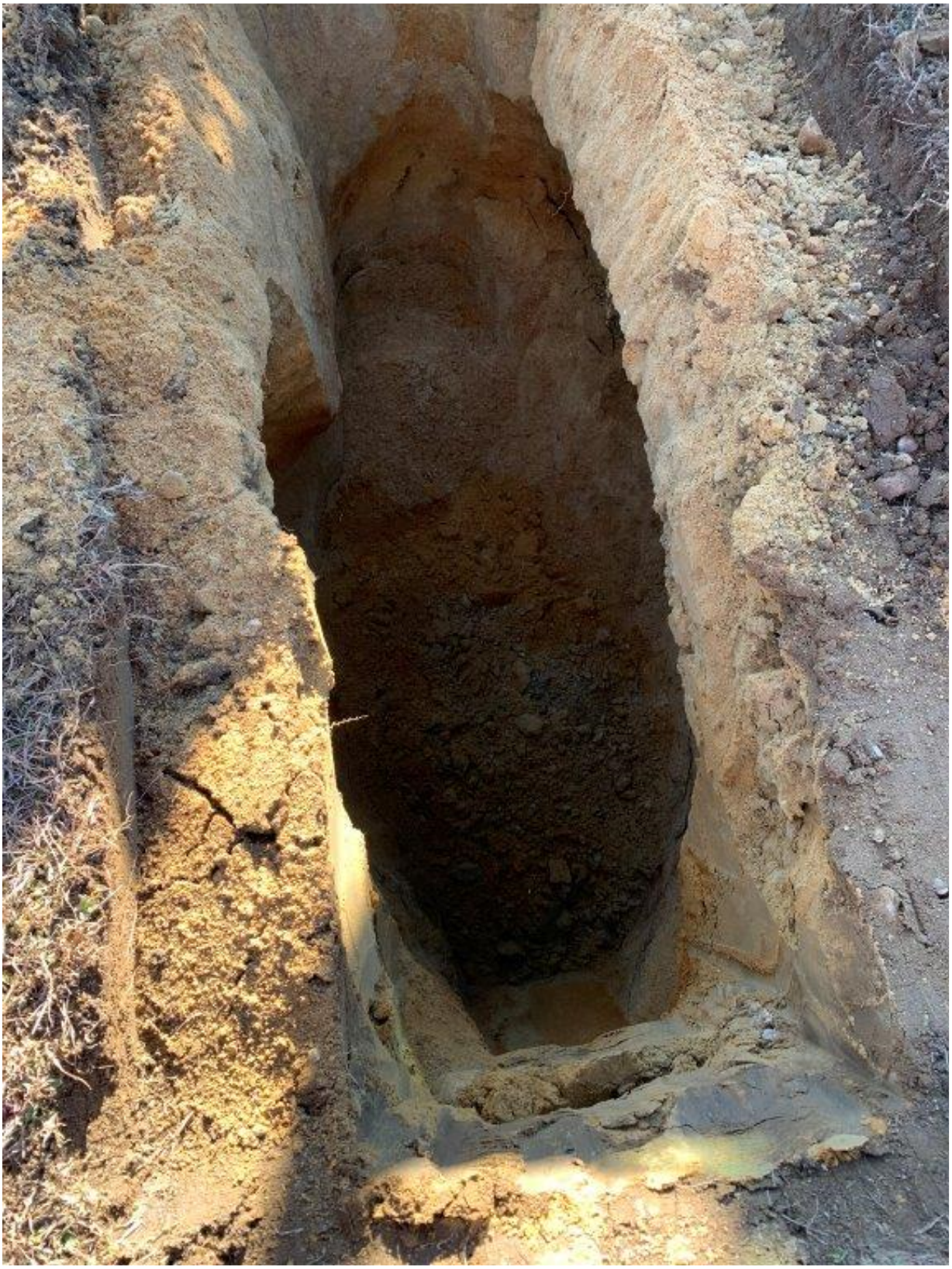


Photo 5 Test Pit No. 8

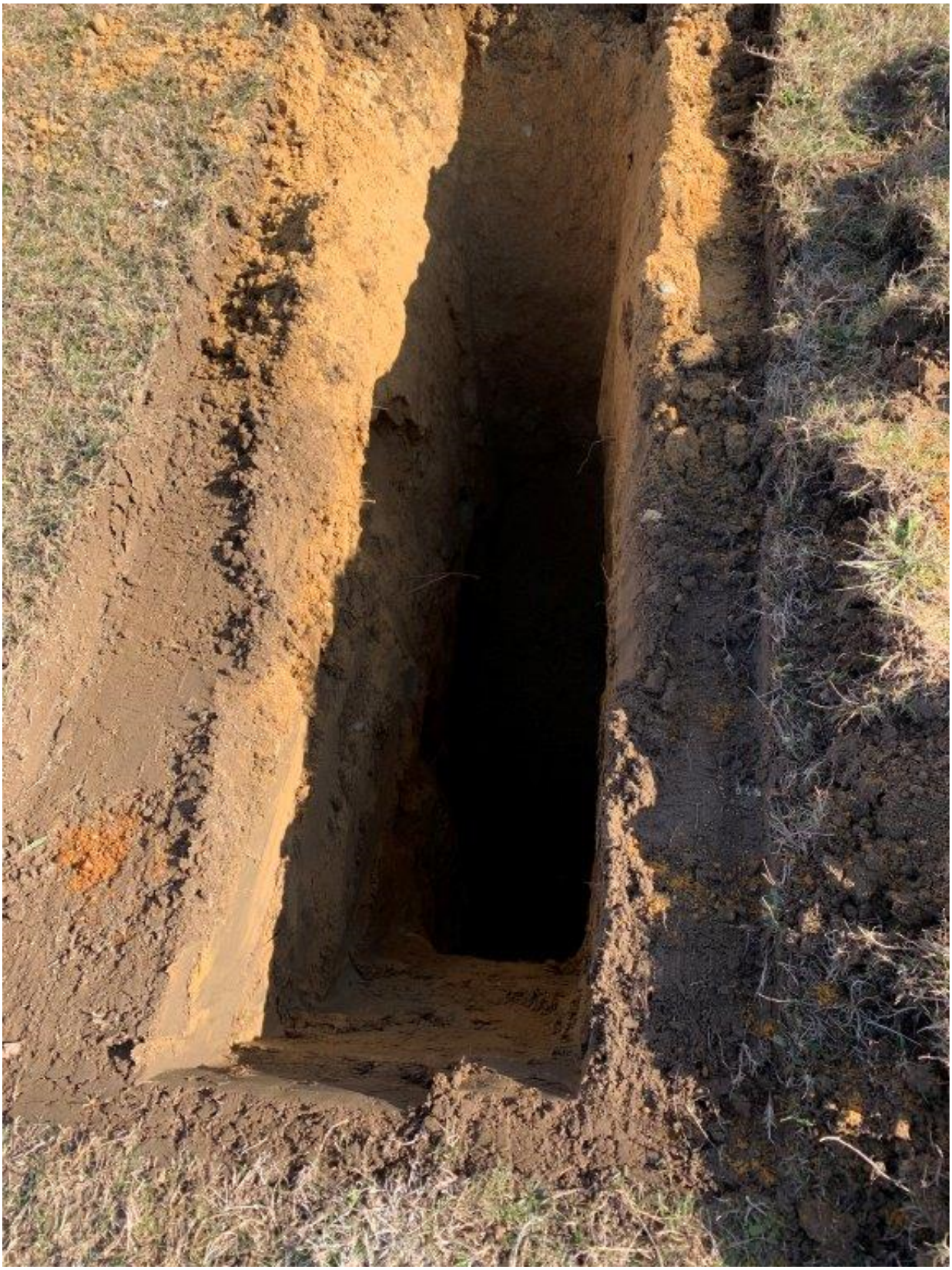


Photo 1 Test Pit No. 4

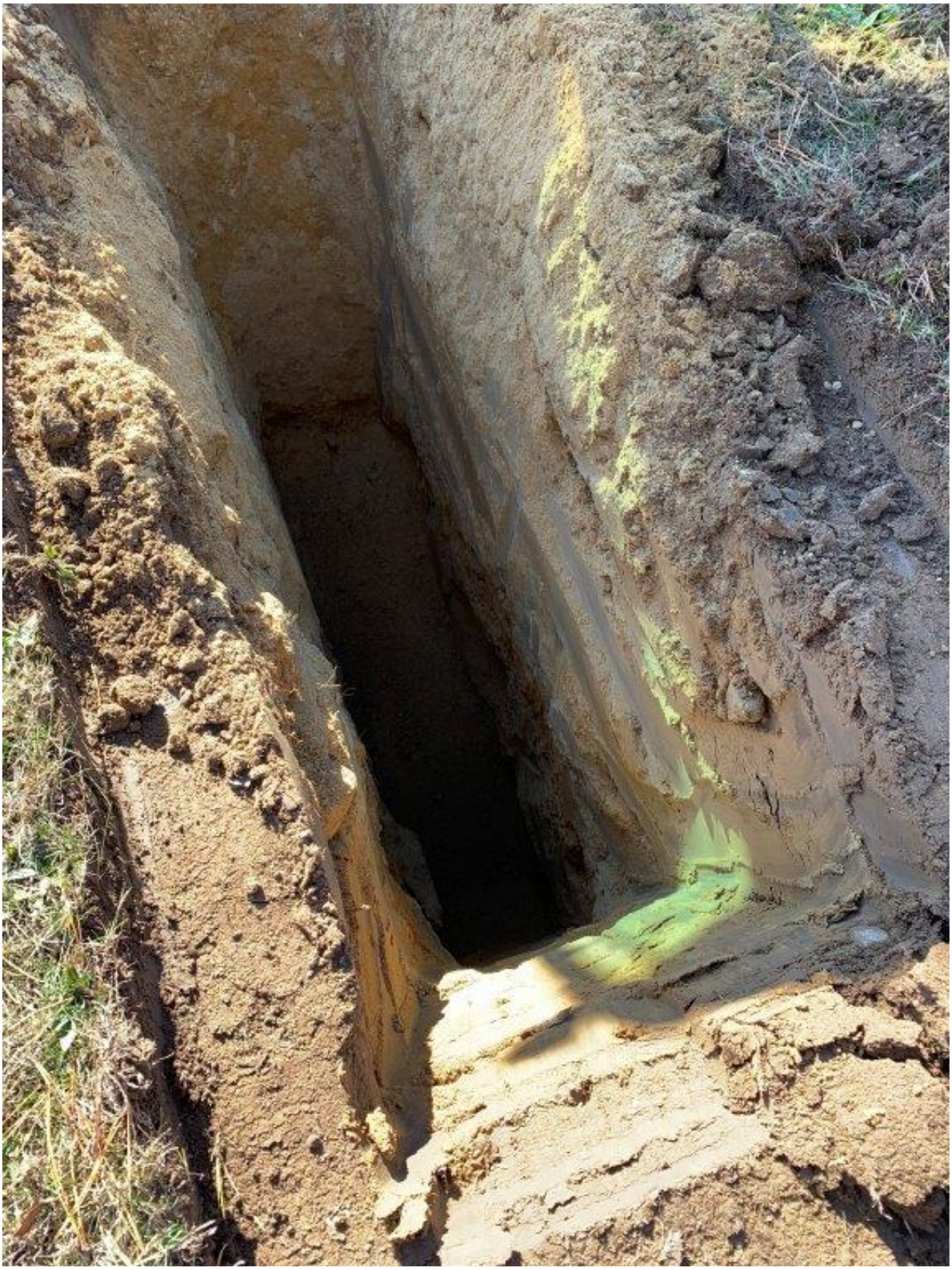


Photo 2 Test Pit No. 5

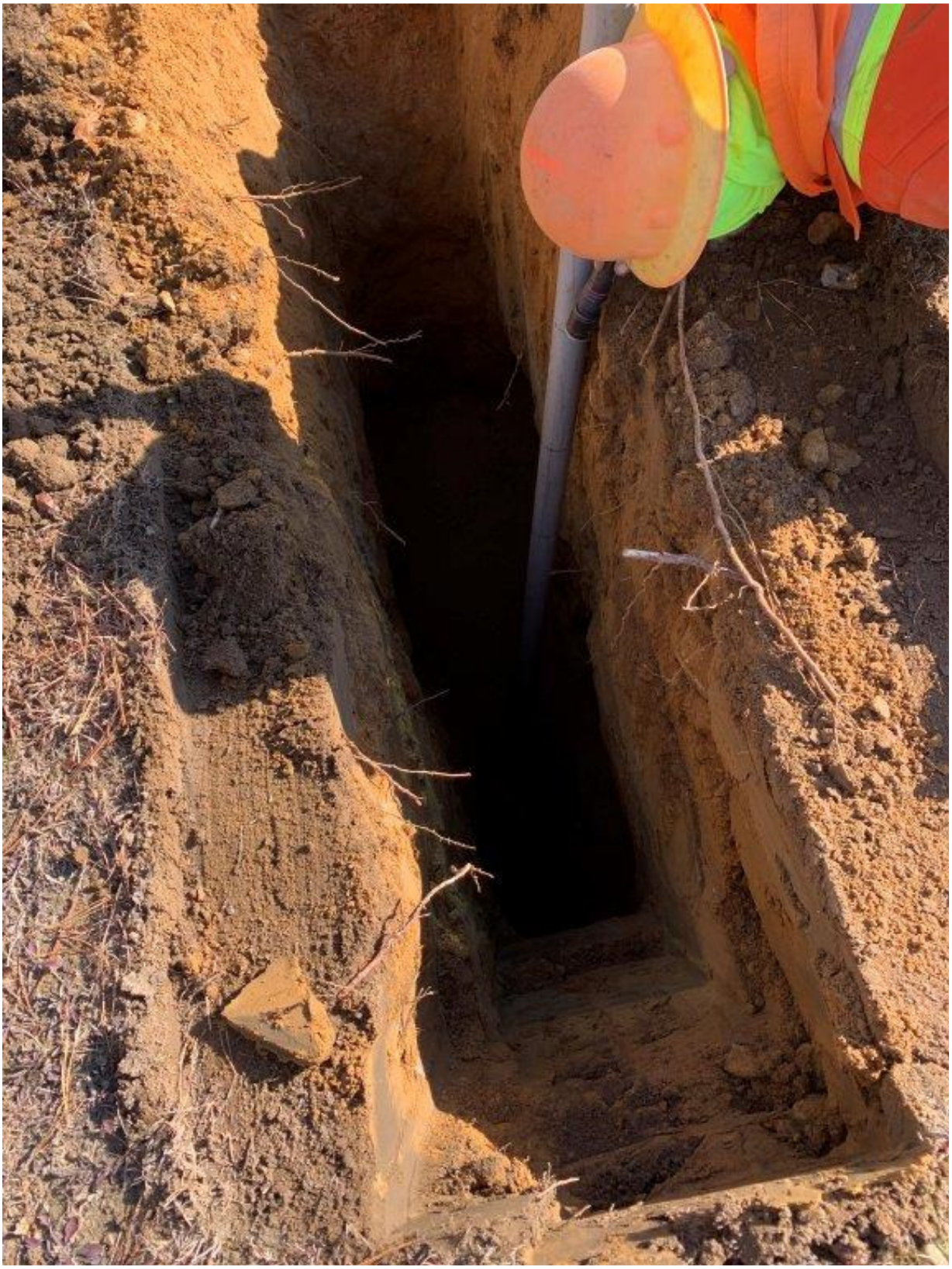


Photo 3 Test Pit No. 6

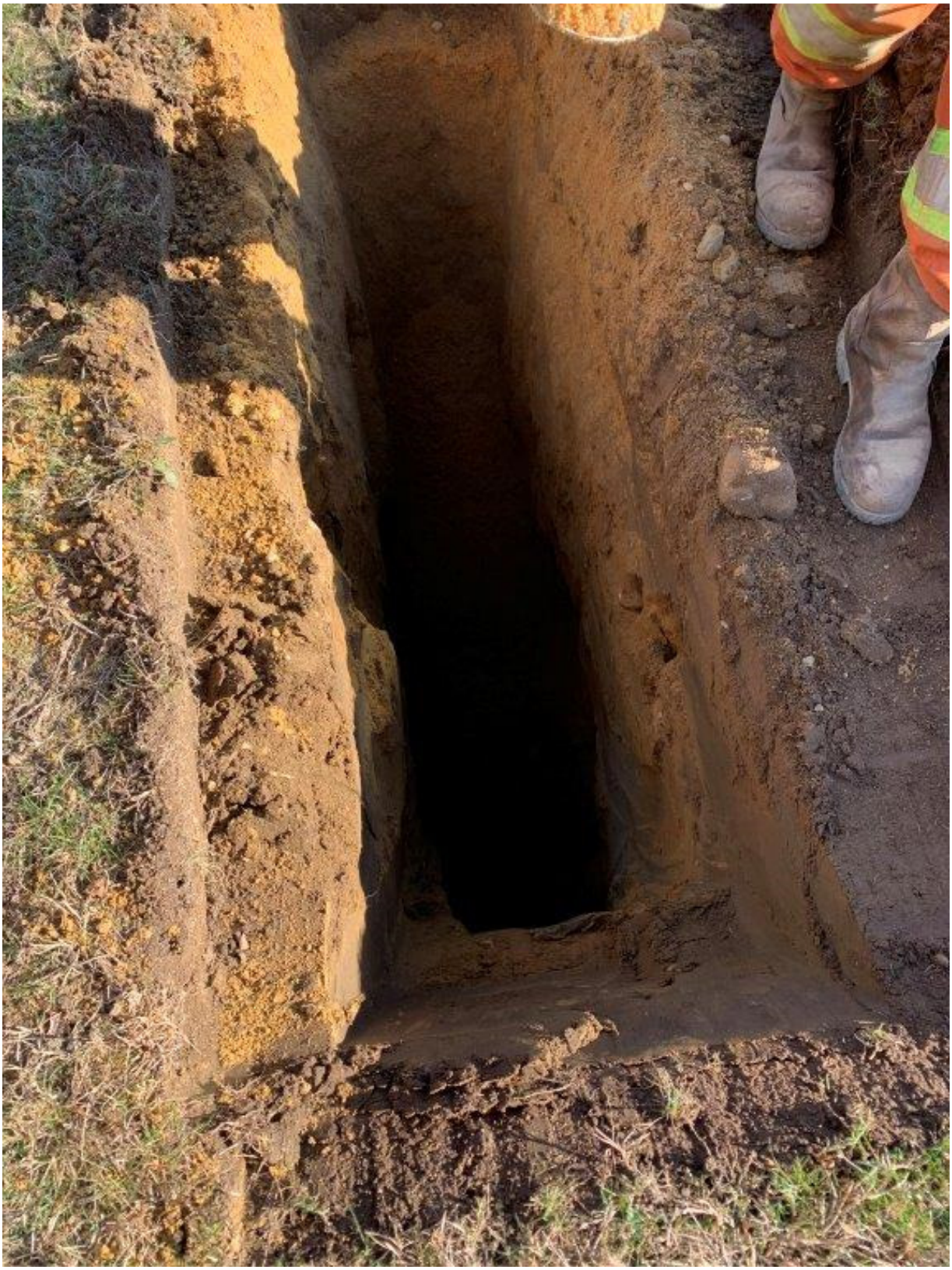


Photo 4 Test Pit No. 7

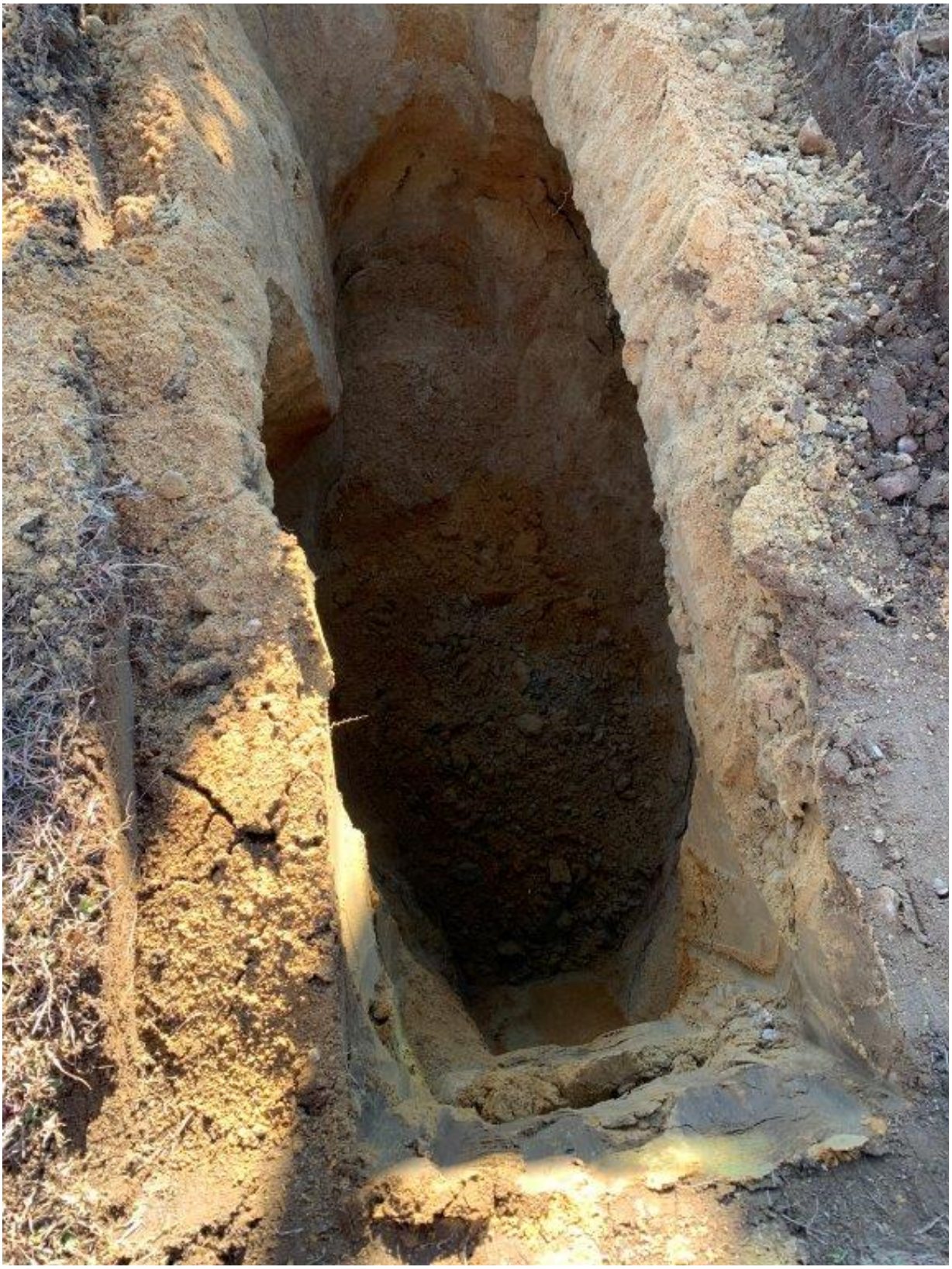


Photo 5 Test Pit No. 8

TIME OF CONCENTRATION

CALCULATIONS

TR55 Tc Worksheet

Hyd. No. 1

E-1

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.400		0.011		0.011		
Flow length (ft)	=	40.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.60		0.00		0.00		
Land slope (%)	=	3.80		0.00		0.00		
Travel Time (min)	**=**	**7.52**	**+**	**0.00**	**+**	**0.00**	**=**	**7.52**
Shallow Concentrated Flow								
Flow length (ft)	=	130.00		0.00		0.00		
Watercourse slope (%)	=	2.30		0.00		0.00		
Surface description	=	Paved		Paved		Paved		
Average velocity (ft/s)	=	3.08		0.00		0.00		
Travel Time (min)	**=**	**0.70**	**+**	**0.00**	**+**	**0.00**	**=**	**0.70**
Channel Flow								
X sectional flow area (sqft)	=	0.00		0.00		0.00		
Wetted perimeter (ft)	=	0.00		0.00		0.00		
Channel slope (%)	=	0.00		0.00		0.00		
Manning's n-value	=	0.015		0.015		0.015		
Velocity (ft/s)	=	0.00		0.00		0.00		
Flow length (ft)	=	0.0		0.0		0.0		
Travel Time (min)	**=**	**0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 8.20 min

TR55 Tc Worksheet

Hyd. No. 2

E-2

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.400		0.011		0.011		
Flow length (ft)	=	90.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.60		0.00		0.00		
Land slope (%)	=	1.80		0.00		0.00		
Travel Time (min)	**=**	**19.41**	**+**	**0.00**	**+**	**0.00**	**=**	**19.41**
Shallow Concentrated Flow								
Flow length (ft)	=	490.00		0.00		0.00		
Watercourse slope (%)	=	0.70		0.00		0.00		
Surface description	=	Unpaved		Paved		Paved		
Average velocity (ft/s)	=	1.35		0.00		0.00		
Travel Time (min)	**=**	**6.05**	**+**	**0.00**	**+**	**0.00**	**=**	**6.05**
Channel Flow								
X sectional flow area (sqft)	=	0.00		0.00		0.00		
Wetted perimeter (ft)	=	0.00		0.00		0.00		
Channel slope (%)	=	0.00		0.00		0.00		
Manning's n-value	=	0.015		0.015		0.015		
Velocity (ft/s)	=	0.00		0.00		0.00		
Flow length (ft)	=	0.0		0.0		0.0		
Travel Time (min)	**=**	**0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 25.50 min

TR55 Tc Worksheet

Hyd. No. 3

P-1

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.400		0.011		0.011		
Flow length (ft)	=	40.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.60		0.00		0.00		
Land slope (%)	=	3.80		0.00		0.00		
Travel Time (min)	**=**	**7.52**	**+**	**0.00**	**+**	**0.00**	**=**	**7.52**
Shallow Concentrated Flow								
Flow length (ft)	=	130.00		0.00		0.00		
Watercourse slope (%)	=	2.30		0.00		0.00		
Surface description	=	Paved		Paved		Paved		
Average velocity (ft/s)	=	3.08		0.00		0.00		
Travel Time (min)	**=**	**0.70**	**+**	**0.00**	**+**	**0.00**	**=**	**0.70**
Channel Flow								
X sectional flow area (sqft)	=	0.00		0.00		0.00		
Wetted perimeter (ft)	=	0.00		0.00		0.00		
Channel slope (%)	=	0.00		0.00		0.00		
Manning's n-value	=	0.015		0.015		0.015		
Velocity (ft/s)	=	0.00		0.00		0.00		
Flow length (ft)	=	0.0		0.0		0.0		
Travel Time (min)	**=**	**0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 8.20 min

TR55 Tc Worksheet

Hyd. No. 4

P-2

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.400		0.011		0.011		
Flow length (ft)	=	60.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.60		0.00		0.00		
Land slope (%)	=	0.50		0.00		0.00		
Travel Time (min)	**=**	**23.42**	**+**	**0.00**	**+**	**0.00**	**=**	**23.42**
Shallow Concentrated Flow								
Flow length (ft)	=	165.00		0.00		0.00		
Watercourse slope (%)	=	0.60		0.00		0.00		
Surface description	=	Unpaved		Paved		Paved		
Average velocity (ft/s)	=	1.25		0.00		0.00		
Travel Time (min)	**=**	**2.20**	**+**	**0.00**	**+**	**0.00**	**=**	**2.20**
Channel Flow								
X sectional flow area (sqft)	=	0.00		0.00		0.00		
Wetted perimeter (ft)	=	0.00		0.00		0.00		
Channel slope (%)	=	0.00		0.00		0.00		
Manning's n-value	=	0.015		0.015		0.015		
Velocity (ft/s)	=	0.00		0.00		0.00		
Flow length (ft)	=	0.0		0.0		0.0		
Travel Time (min)	**=**	**0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 25.60 min

TR55 Tc Worksheet

Hyd. No. 5

P-3 (Field)

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.400		0.011		0.011		
Flow length (ft)	=	90.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.60		0.00		0.00		
Land slope (%)	=	1.80		0.00		0.00		
Travel Time (min)	**=**	**19.41**	**+**	**0.00**	**+**	**0.00**	**=**	**19.41**
Shallow Concentrated Flow								
Flow length (ft)	=	0.00		0.00		0.00		
Watercourse slope (%)	=	0.00		0.00		0.00		
Surface description	=	Paved		Paved		Paved		
Average velocity (ft/s)	=	0.00		0.00		0.00		
Travel Time (min)	**=**	**0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**
Channel Flow								
X sectional flow area (sqft)	=	0.00		0.00		0.00		
Wetted perimeter (ft)	=	0.00		0.00		0.00		
Channel slope (%)	=	0.00		0.00		0.00		
Manning's n-value	=	0.015		0.015		0.015		
Velocity (ft/s)	=	0.00		0.00		0.00		
Flow length (ft)	=	0.0		0.0		0.0		
Travel Time (min)	**=**	**0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 19.40 min

CURVE NUMBER COMPUTATIONS

Worksheet 2: Runoff curve number and runoff

Project	By	Date
MVRHS	JB	12/11/19
Location	**Checked**	**Date**
OAK BLUFFS, MA		

Check one: ☑ Present ☐ Developed "E-1"

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi² ☐ %	Product of CN x area
	IMPERVIOUS	98			1.05	102.90
A	OPEN SPACE (GOOD)	39			0.46	17.94
					Totals ➡	1.51 / 120.84

[1] Use only one CN source per line

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{120.84}{1.51} = 80.0$; Use CN ➡ 80

2. Runoff

	Storm #1	Storm #2	Storm #3
Frequency ..... yr			
Rainfall, P (24-hour) ..... in			
Runoff, Q ..... in			

(Use P and CN with table 2-1, figure 2-1, or equation 2-3 and 2-4)

Worksheet 2: Runoff curve number and runoff

Project	By	Date
MVRHS	JB	12/11/19
Location	**Checked**	**Date**
OAK BLUFFS, MA		

Check one: ☑ Present ☐ Developed "E-2"

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Figure 2-3	CN 1/ Figure 2-4	Area ☑ acres ☐ mi² ☐ %	Product of CN x area
	IMPERVIOUS	98			0.2	19.60
A	OPEN SPACE (GOOD)	39			7.3	284.7
A	WOODS (GOOD)	30			0.9	27.0
1/ Use only one CN source per line				Totals ➡	8.40	331.30

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{331.30}{8.40} = 39.4$; Use CN ➡ 39

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency	yr			
Rainfall, P (24-hour)	in			
Runoff, Q	in			

(Use P and CN with table 2-1, figure 2-1, or equation 2-3 and 2-4)

Worksheet 2: Runoff curve number and runoff

Project	By	Date
MVRHS	JB	12/11/19
Location	**Checked**	**Date**
OAK BLUFFS, MA		

Check one: ☐ Present ☑ Developed "P-1"

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Figure 2-3	CN 1/ Figure 2-4	Area ☑ acres ☐ mi² ☐ %	Product of CN x area
	IMPERVIOUS	98			1.05	102.90
A	OPEN SPACE (good)	39			0.46	17.94

1/ Use only one CN source per line

Totals ➡ 1.51 | 120.84

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{120.84}{1.51} = 80.0$; **Use CN** ➡ 80

2. Runoff

	Storm #1	Storm #2	Storm #3
Frequency ..... yr			
Rainfall, P (24-hour) ..... in			
Runoff, Q ..... in			

(Use P and CN with table 2-1, figure 2-1, or equation 2-3 and 2-4)

Worksheet 2: Runoff curve number and runoff

Project	By	Date
MVRHS	JB	12/11/19
Location	**Checked**	**Date**
OAK BLUFFS, MA		

Check one: ☐ Present ☑ Developed "P-2"

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi² ☐ %	Product of CN x area
	IMPERVIOUS	98			0.11	10.78
	OPEN SPACE (good)	39			2.70	105.30

[1] Use only one CN source per line

Totals ➡ 2.81 | 116.08

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{116.08}{2.81} = 41.3$ **Use CN** ➡ 41

2. Runoff

	Storm #1	Storm #2	Storm #3
Frequency ..... yr			
Rainfall, P (24-hour) ..... in			
Runoff, Q ..... in			

(Use P and CN with table 2-1, figure 2-1, or equation 2-3 and 2-4)

Worksheet 2: Runoff curve number and runoff

Project	By	Date
MVRHS	JB	12/11/19
Location	Checked	Date
OAK BLUFFS, MA		

Check one: ☐ Present ☑ Developed P-3 (FIELD)

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Figure 2-3	CN 1/ Figure 2-4	Area ☑ acres ☐ mi² ☐ %	Product of CN x area
	IMPERVIOUS	98			3.90	382.20
A	OPEN SPACE (GOOD)	39			0.46	17.94
A	WOODS (GOOD)	30			0.76	22.80
1/ Use only one CN source per line				Totals ➡	5.12	422.80

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{422.80}{5.12} = 82.6$; Use CN ➡ 83

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency	yr			
Rainfall, P (24-hour)	in			
Runoff, Q	in			

(Use P and CN with table 2-1, figure 2-1, or equation 2-3 and 2-4)

Worksheet 2: Runoff curve number and runoff

Project	By	Date
MVRHS	JB	12/11/19
Location	**Checked**	**Date**
OAK BLUFFS, MA		

Check one: ☐ Present ☑ Developed "P-4"

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN [1/] Table 2-2	CN [1/] Figure 2-3	CN [1/] Figure 2-4	Area ☑ acres ☐ mi² ☐ %	Product of CN x area
	IMPERVIOUS	98			0.45	44.10
A	OPEN SPACE	39			0.02	0.78
[1/] Use only one CN source per line				Totals ➡	0.47	44.88

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{44.88}{0.47} = 95.4$; Use CN ➡ 95

2. Runoff

	Storm #1	Storm #2	Storm #3
Frequency ..... yr			
Rainfall, P (24-hour) ..... in			
Runoff, Q ..... in			

(Use P and CN with table 2-1, figure 2-1, or equation 2-3 and 2-4)

HYDROGRAPHS

Hydrograph Return Period Recap

Hydraflow Hydrographs by Intelisolve v9.2

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	-------	-------	2.845	-------	-------	4.661	5.957	-------	8.037	E-1
2	SCS Runoff	-------	-------	0.019	-------	-------	0.216	0.960	-------	3.273	E-2
3	SCS Runoff	-------	-------	2.845	-------	-------	4.661	5.957	-------	8.037	P-1
4	SCS Runoff	-------	-------	0.012	-------	-------	0.149	0.503	-------	1.440	P-2
5	SCS Runoff	-------	-------	8.184	-------	-------	12.95	16.33	-------	21.68	P-3 (Field)
6	SCS Runoff	-------	-------	1.516	-------	-------	2.112	2.521	-------	3.165	P-4
7	Reservoir	5	-------	0.884	-------	-------	0.956	0.960	-------	0.966	Field Outflow
8	Combine	6, 7	-------	1.516	-------	-------	2.112	2.521	-------	3.165	Flow to Chambers
9	Reservoir	8	-------	0.000	-------	-------	0.000	0.000	-------	0.000	Chamber outflow
10	Combine	4, 9	-------	0.012	-------	-------	0.149	0.503	-------	1.440	Study Point 2

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.2

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	2.845	1	726	9,171	----	------	------	E-1
2	SCS Runoff	0.019	1	1336	425	----	------	------	E-2
3	SCS Runoff	2.845	1	726	9,171	----	------	------	P-1
4	SCS Runoff	0.012	1	1016	355	----	------	------	P-2
5	SCS Runoff	8.184	1	734	36,111	----	------	------	P-3 (Field)
6	SCS Runoff	1.516	2	724	4,858	----	------	------	P-4
7	Reservoir	0.884	1	768	3,067	5	84.47	15,146	Field Outflow
8	Combine	1.516	1	362	5,496	6, 7	------	------	Flow to Chambers
9	Reservoir	0.000	1	349	0	8	80.29	570	Chamber outflow
10	Combine	0.012	1	1016	355	4, 9	------	------	Study Point 2

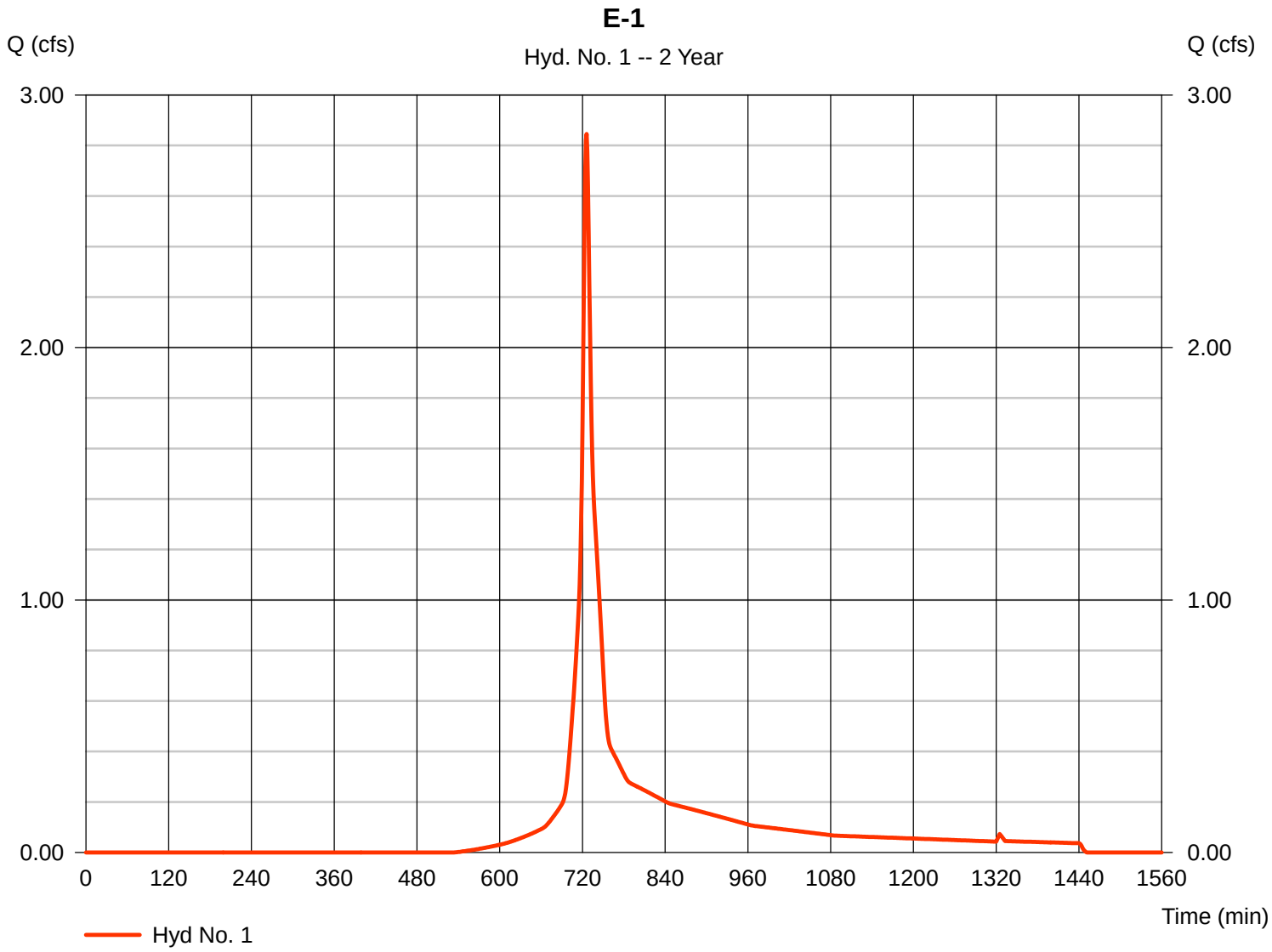
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jan 22, 2020

Hyd. No. 1

E-1

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.845 cfs
Storm frequency	=	2 yrs	Time to peak	=	726 min
Time interval	=	1 min	Hyd. volume	=	9,171 cuft
Drainage area	=	1.510 ac	Curve number	=	80
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	8.20 min
Total precip.	=	3.60 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



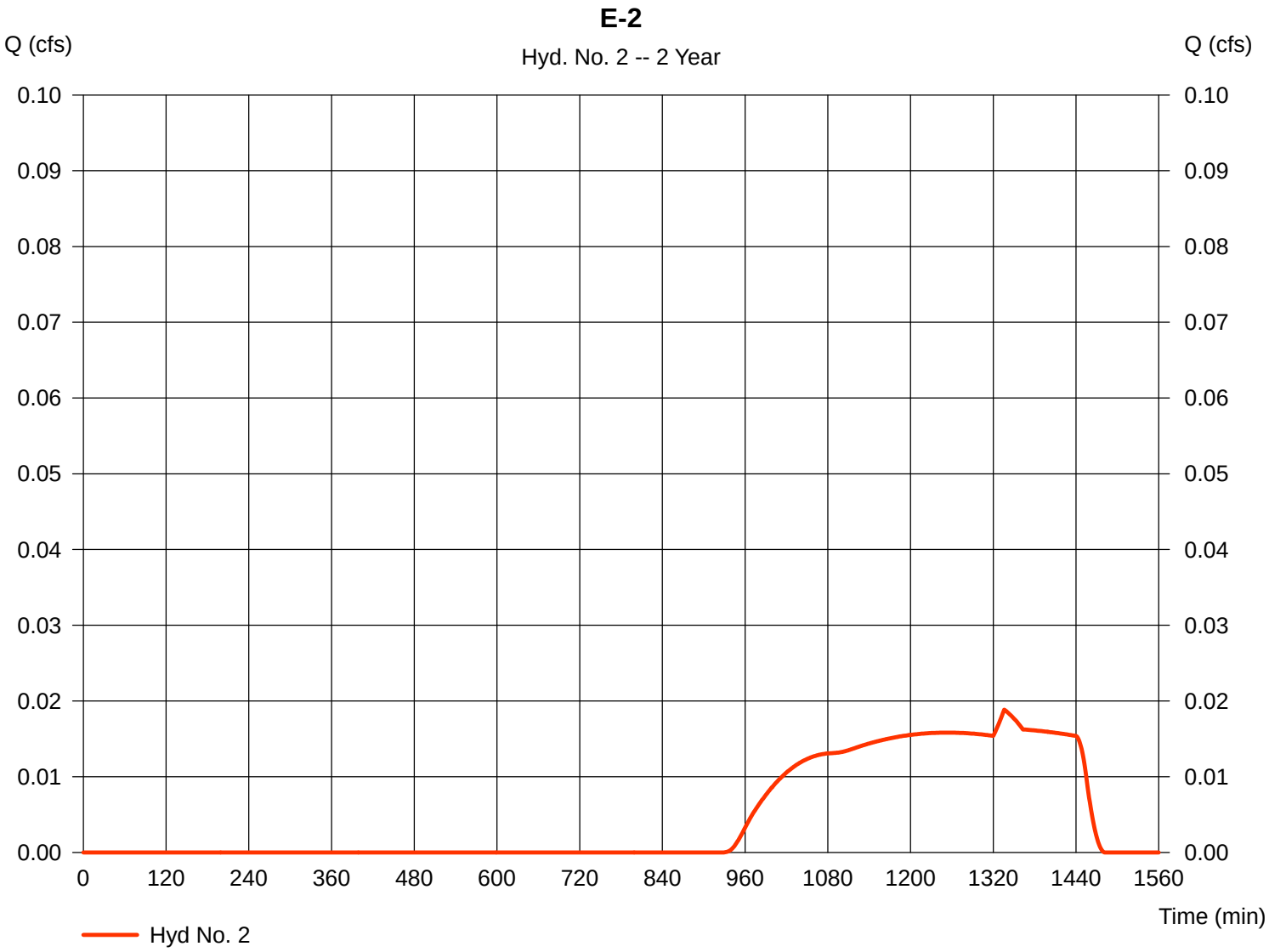
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jan 22, 2020

Hyd. No. 2

E-2

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.019 cfs
Storm frequency	=	2 yrs	Time to peak	=	1336 min
Time interval	=	1 min	Hyd. volume	=	425 cuft
Drainage area	=	8.400 ac	Curve number	=	39
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	25.50 min
Total precip.	=	3.60 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



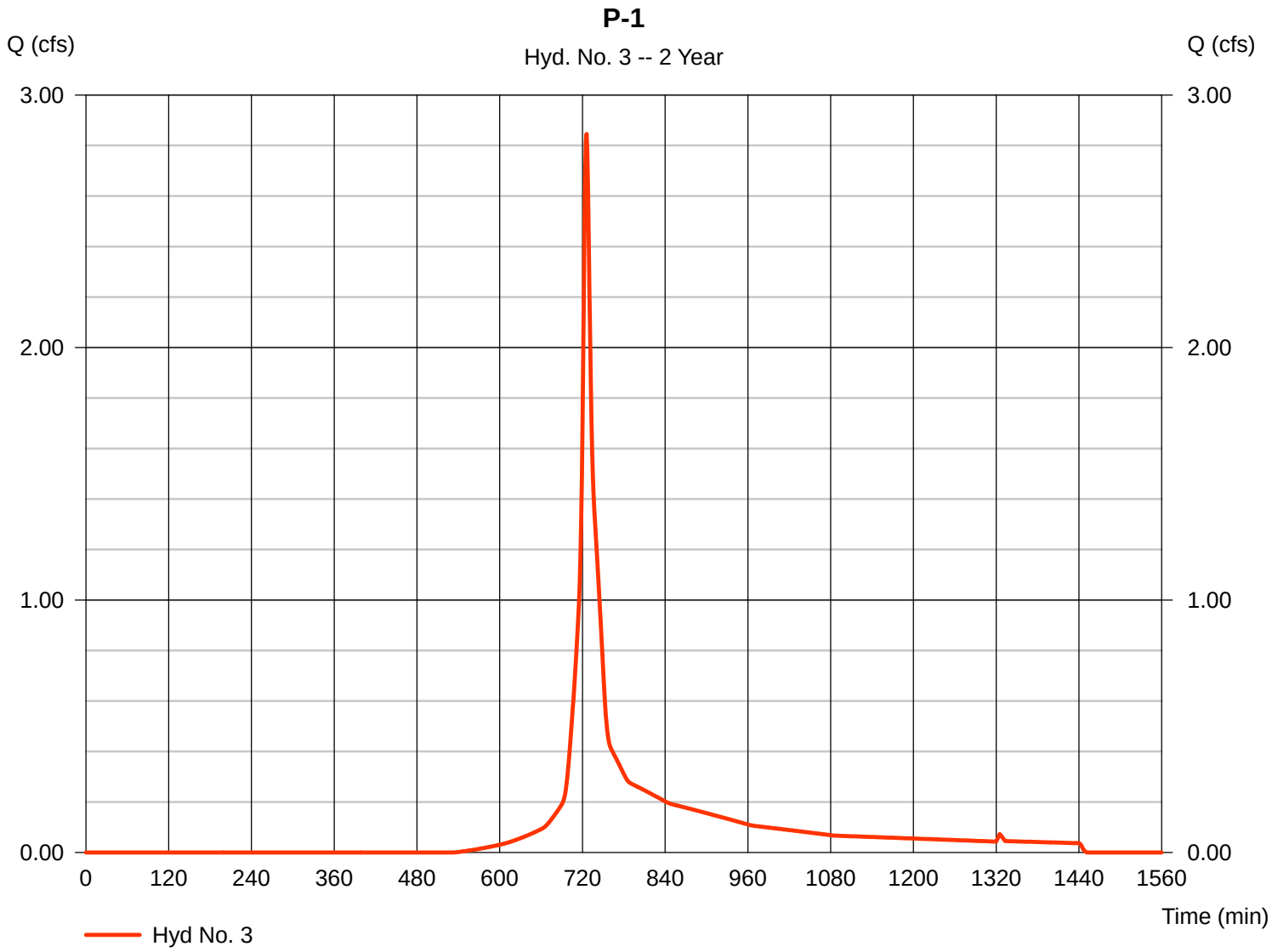
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jan 22, 2020

Hyd. No. 3

P-1

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.845 cfs
Storm frequency	=	2 yrs	Time to peak	=	726 min
Time interval	=	1 min	Hyd. volume	=	9,171 cuft
Drainage area	=	1.510 ac	Curve number	=	80
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	8.20 min
Total precip.	=	3.60 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



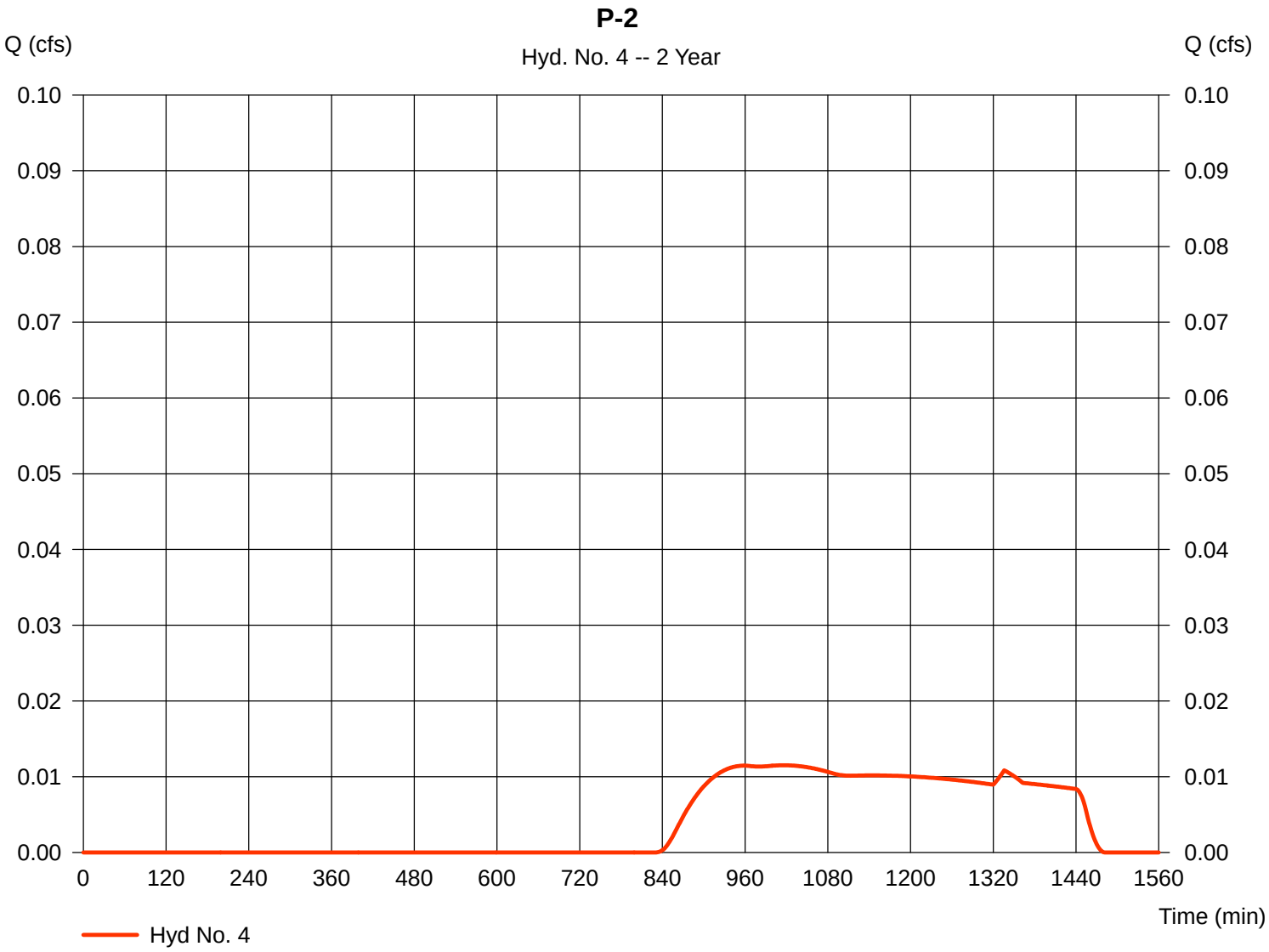
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jan 22, 2020

Hyd. No. 4

P-2

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.012 cfs
Storm frequency	=	2 yrs	Time to peak	=	1016 min
Time interval	=	1 min	Hyd. volume	=	355 cuft
Drainage area	=	2.810 ac	Curve number	=	41
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	25.60 min
Total precip.	=	3.60 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



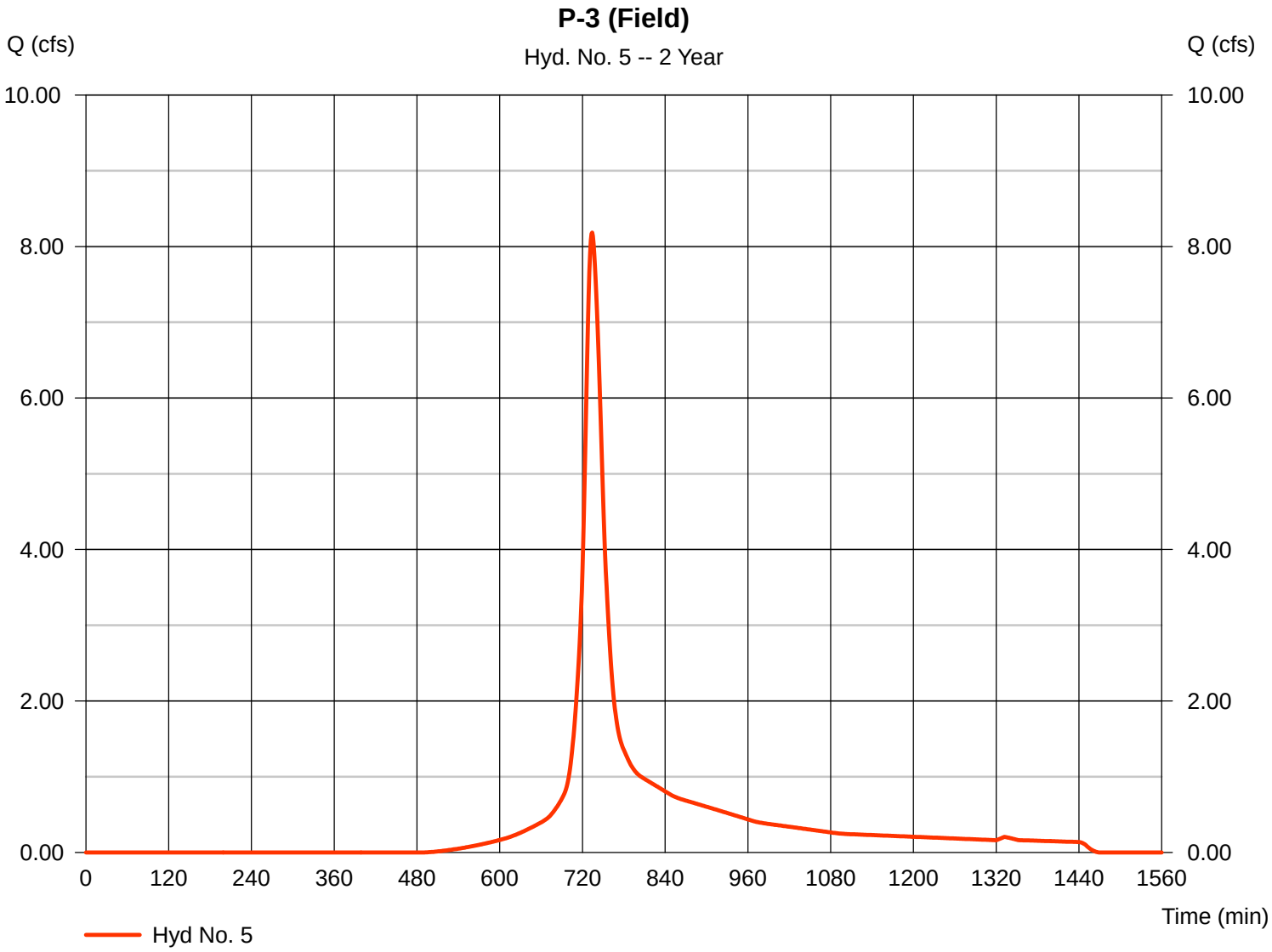
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jan 22, 2020

Hyd. No. 5

P-3 (Field)

Hydrograph type	=	SCS Runoff	Peak discharge	=	8.184 cfs
Storm frequency	=	2 yrs	Time to peak	=	734 min
Time interval	=	1 min	Hyd. volume	=	36,111 cuft
Drainage area	=	5.120 ac	Curve number	=	83
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	19.40 min
Total precip.	=	3.60 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



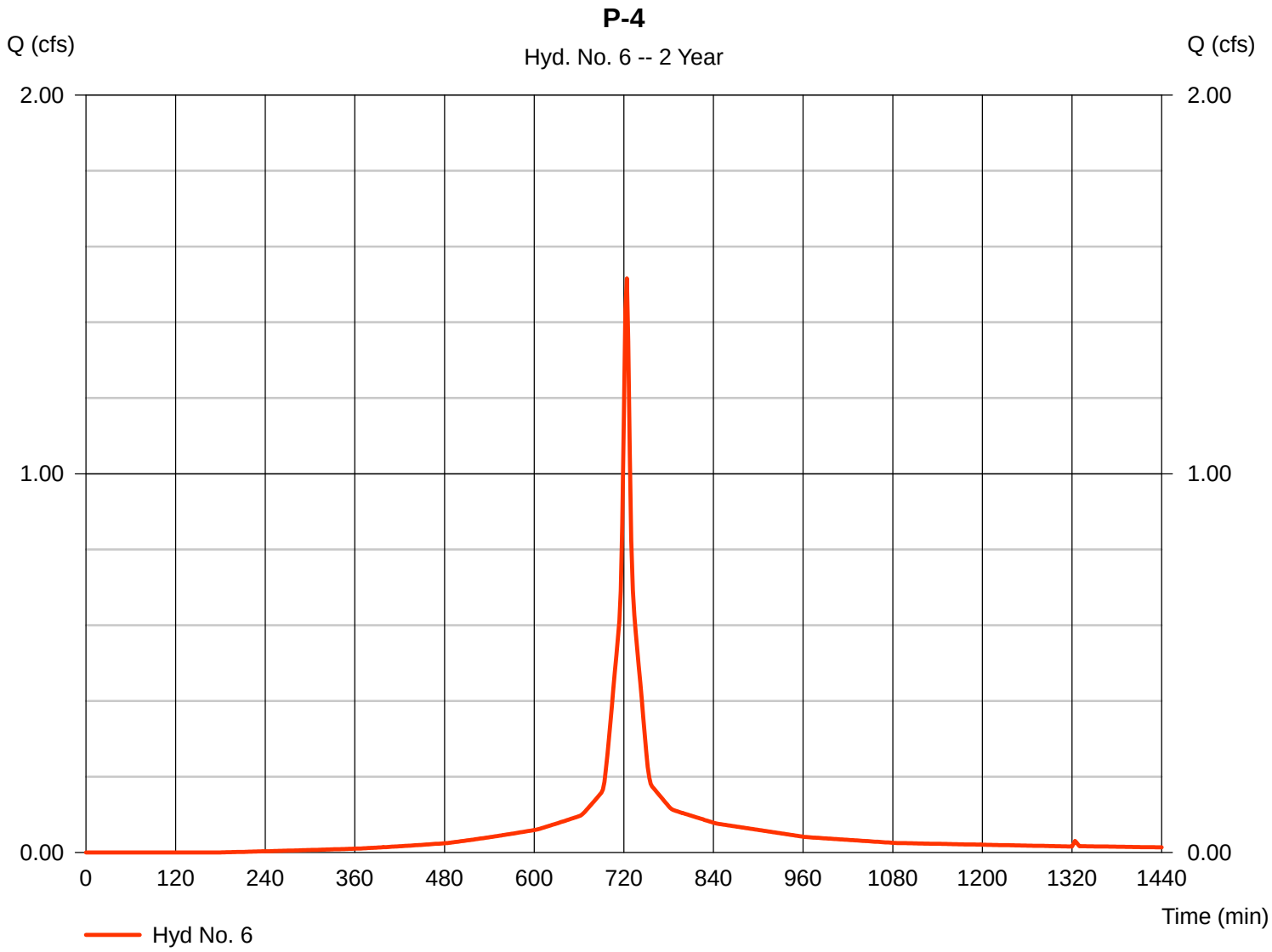
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Wednesday, Jan 22, 2020

Hyd. No. 6

P-4

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.516 cfs
Storm frequency	=	2 yrs	Time to peak	=	724 min
Time interval	=	2 min	Hyd. volume	=	4,858 cuft
Drainage area	=	0.470 ac	Curve number	=	95
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	USER	Time of conc. (Tc)	=	6.00 min
Total precip.	=	3.60 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



Hydrograph Report

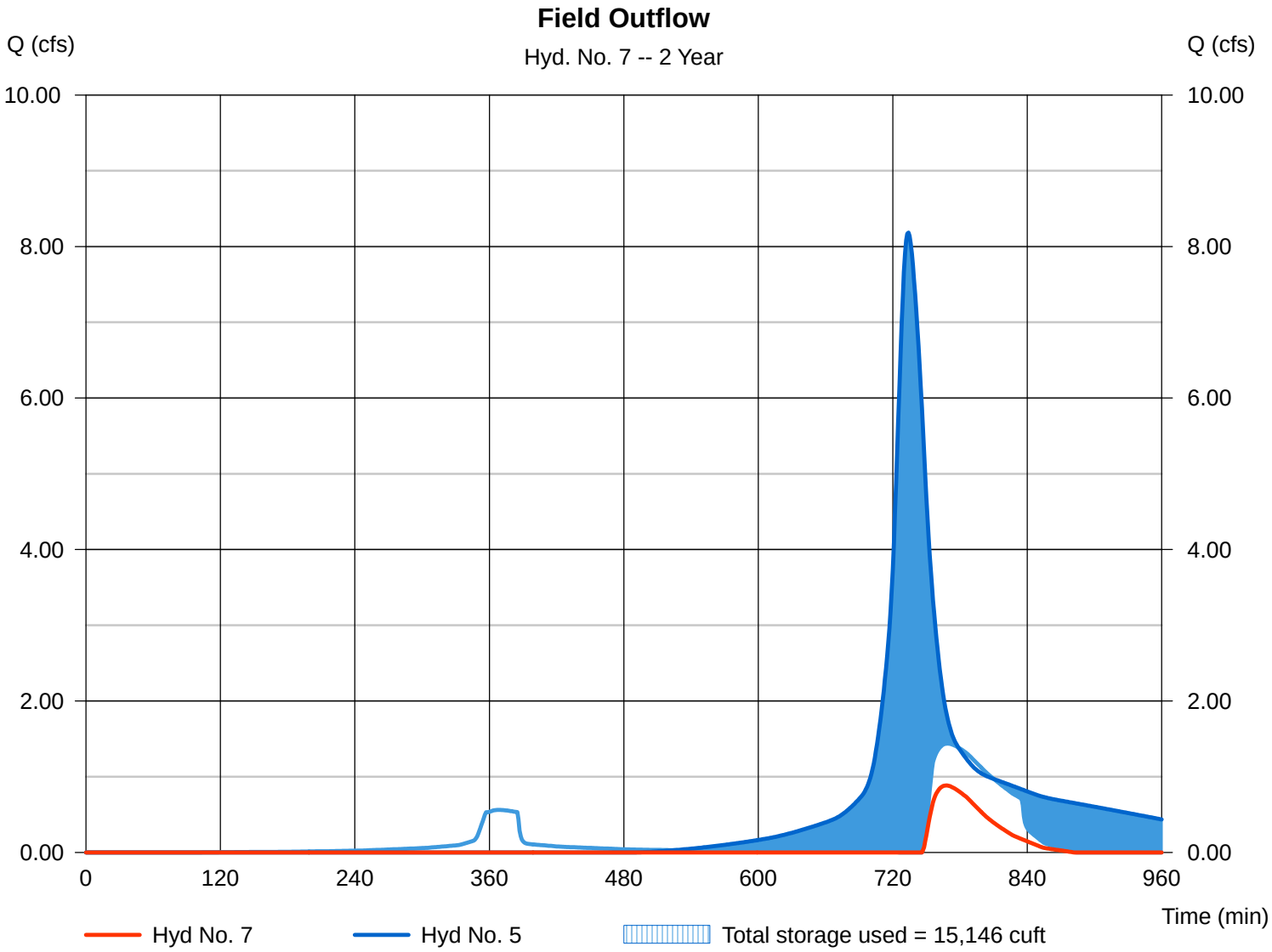
Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jan 22, 2020

Hyd. No. 7

Field Outflow

Hydrograph type	=	Reservoir	Peak discharge	=	0.884 cfs
Storm frequency	=	2 yrs	Time to peak	=	768 min
Time interval	=	1 min	Hyd. volume	=	3,067 cuft
Inflow hyd. No.	=	5 - P-3 (Field)	Max. Elevation	=	84.47 ft
Reservoir name	=	Field Model	Max. Storage	=	15,146 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



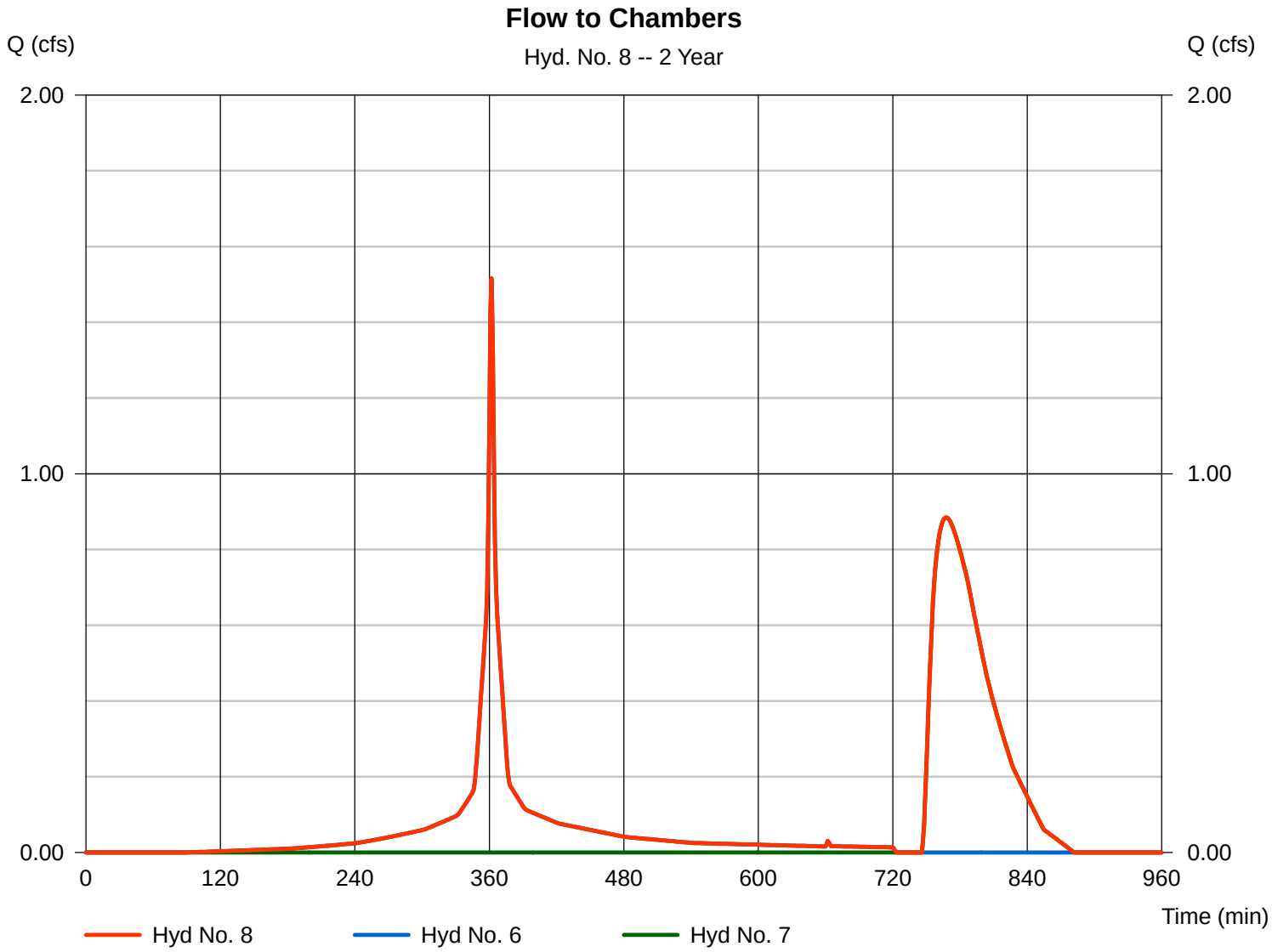
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Wednesday, Jan 22, 2020

Hyd. No. 8

Flow to Chambers

Hydrograph type	=	Combine	Peak discharge	=	1.516 cfs
Storm frequency	=	2 yrs	Time to peak	=	362 min
Time interval	=	1 min	Hyd. volume	=	5,496 cuft
Inflow hyds.	=	6, 7	Contrib. drain. area	=	0.470 ac



Hydrograph Report

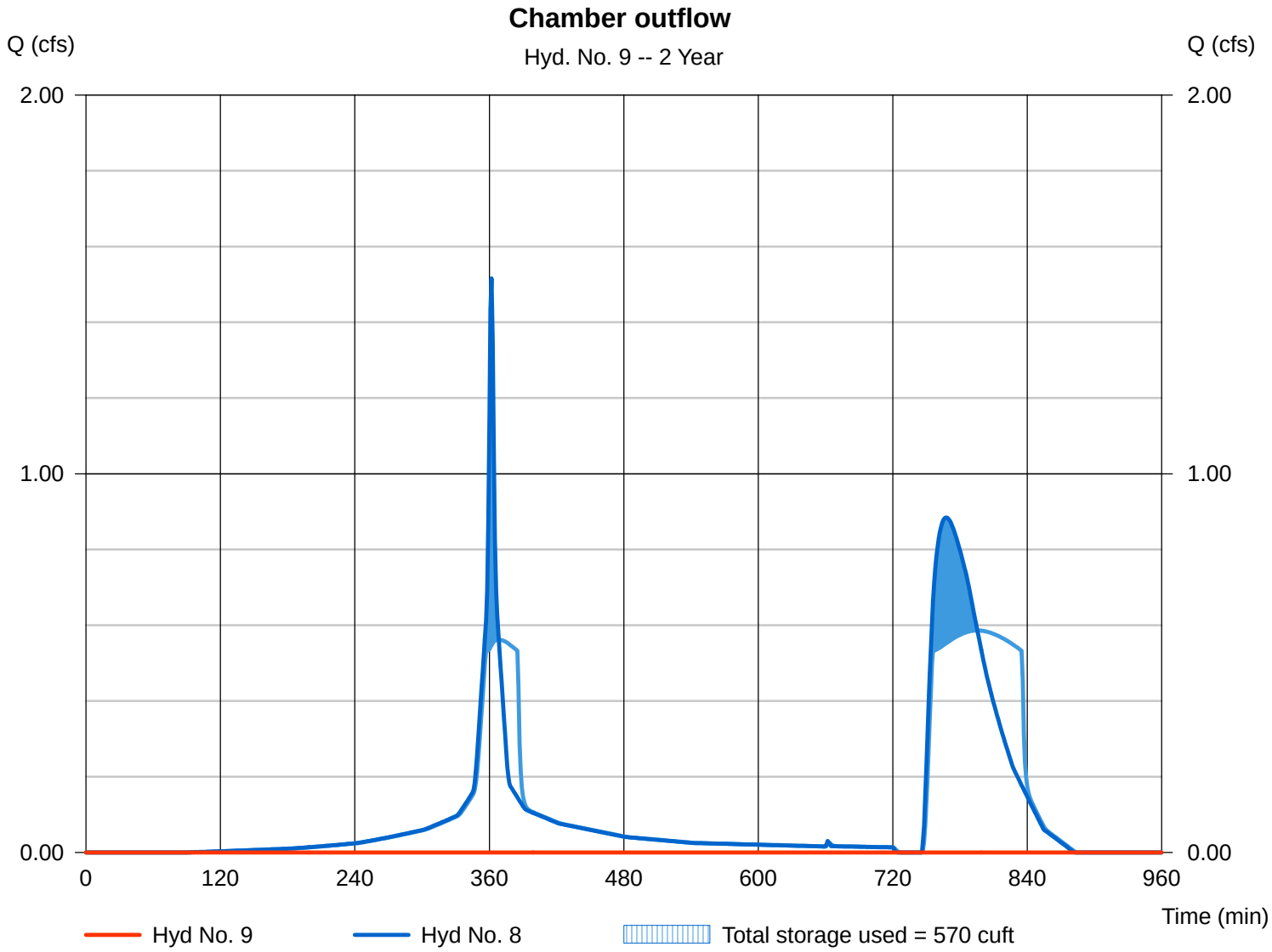
Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jan 22, 2020

Hyd. No. 9

Chamber outflow

Hydrograph type	=	Reservoir	Peak discharge	=	0.000 cfs
Storm frequency	=	2 yrs	Time to peak	=	349 min
Time interval	=	1 min	Hyd. volume	=	0 cuft
Inflow hyd. No.	=	8 - Flow to Chambers	Max. Elevation	=	80.29 ft
Reservoir name	=	Chamber System	Max. Storage	=	570 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



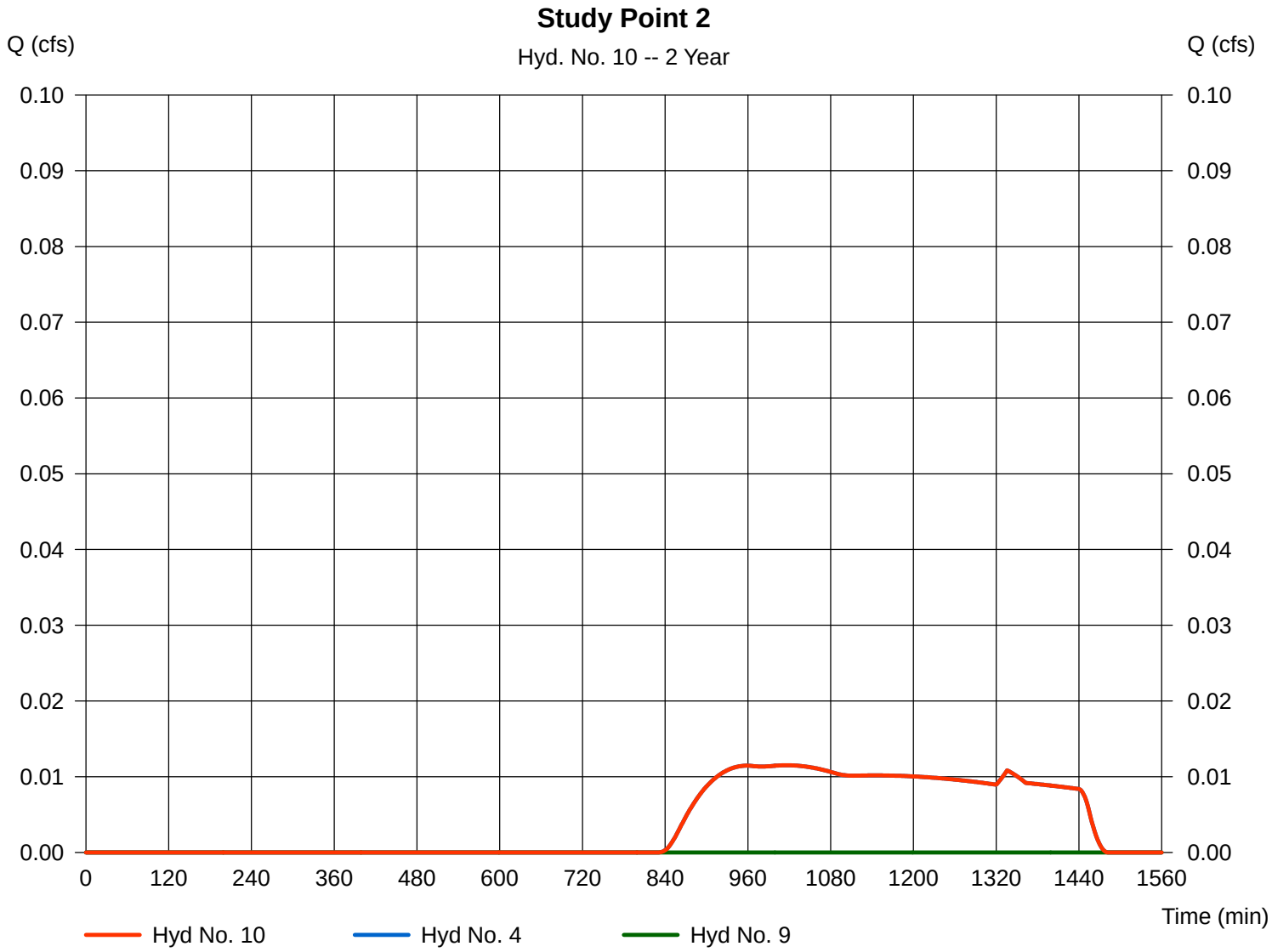
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Wednesday, Jan 22, 2020

Hyd. No. 10

Study Point 2

Hydrograph type	= Combine	Peak discharge	= 0.012 cfs
Storm frequency	= 2 yrs	Time to peak	= 1016 min
Time interval	= 1 min	Hyd. volume	= 355 cuft
Inflow hyds.	= 4, 9	Contrib. drain. area	= 2.810 ac



Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.2

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	4.661	1	726	14,995	----	------	------	E-1
2	SCS Runoff	0.216	1	829	5,540	----	------	------	E-2
3	SCS Runoff	4.661	1	726	14,995	----	------	------	P-1
4	SCS Runoff	0.149	1	764	2,561	----	------	------	P-2
5	SCS Runoff	12.95	1	733	57,314	----	------	------	P-3 (Field)
6	SCS Runoff	2.112	2	724	6,910	----	------	------	P-4
7	Reservoir	0.956	1	737	6,640	5	84.51	15,539	Field Outflow
8	Combine	2.112	1	362	10,096	6, 7	------	------	Flow to Chambers
9	Reservoir	0.000	1	345	0	8	80.77	1,466	Chamber outflow
10	Combine	0.149	1	764	2,561	4, 9	------	------	Study Point 2

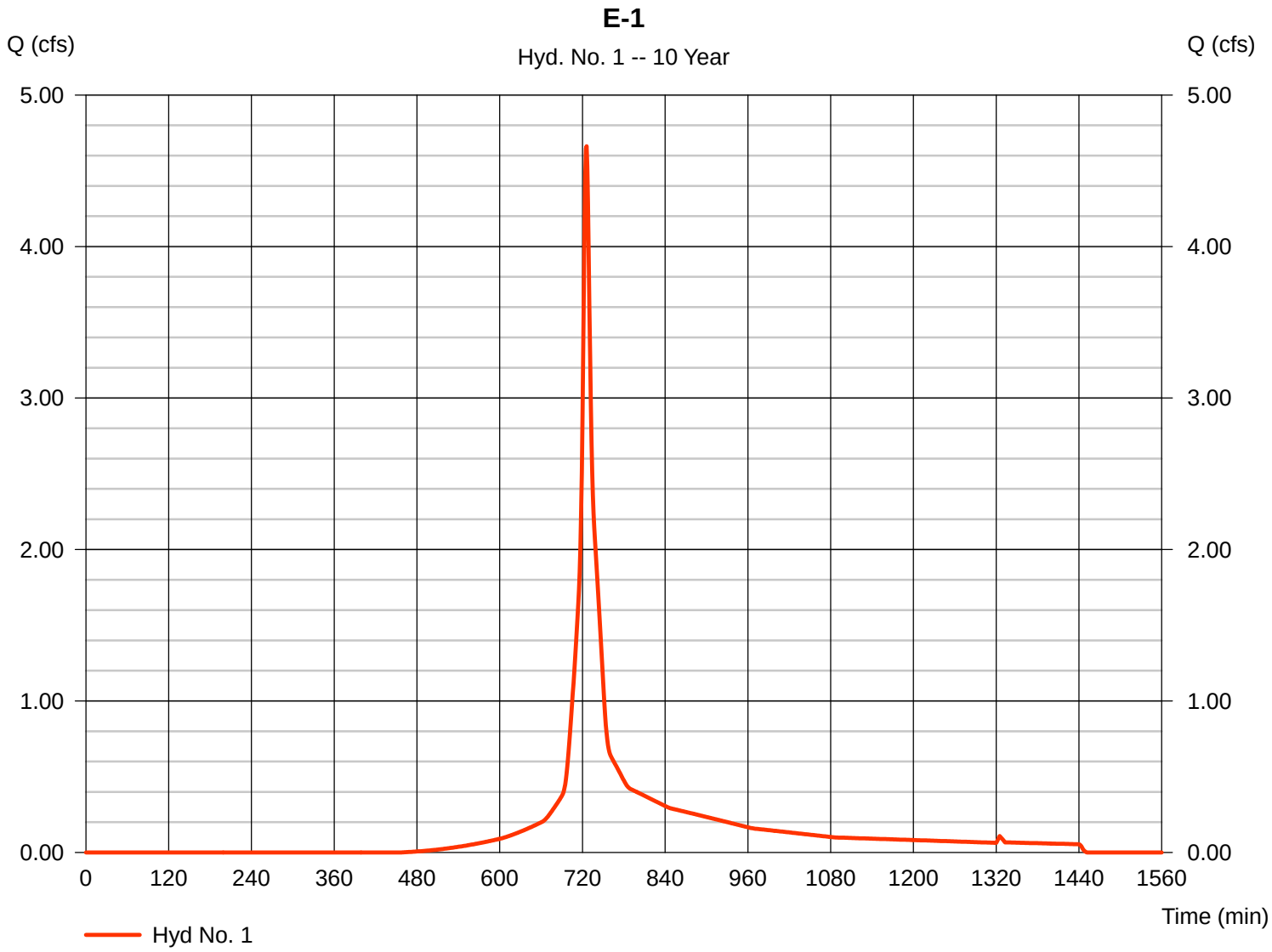
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jan 22, 2020

Hyd. No. 1

E-1

Hydrograph type	=	SCS Runoff	Peak discharge	=	4.661 cfs
Storm frequency	=	10 yrs	Time to peak	=	726 min
Time interval	=	1 min	Hyd. volume	=	14,995 cuft
Drainage area	=	1.510 ac	Curve number	=	80
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	8.20 min
Total precip.	=	4.90 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



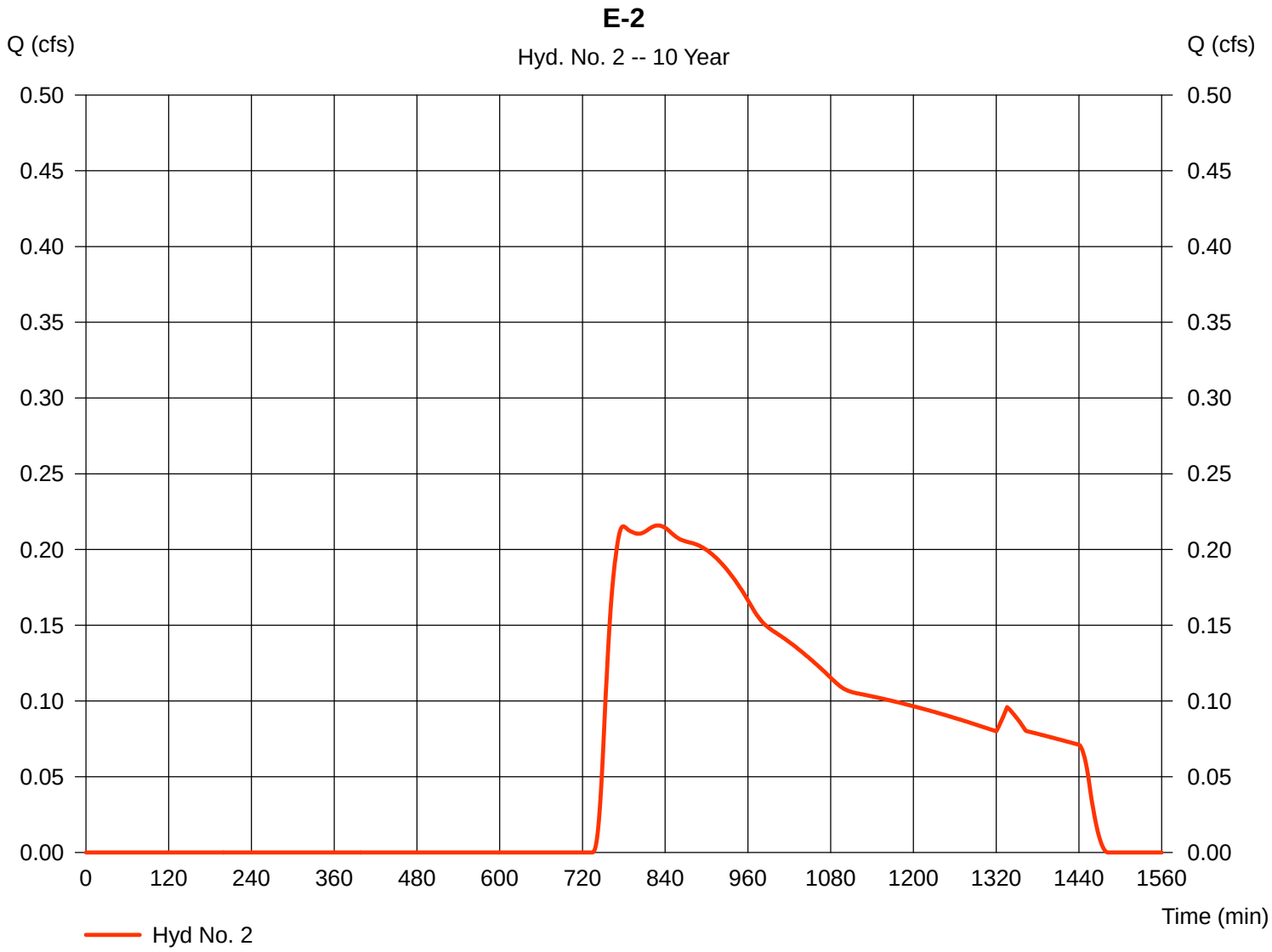
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jan 22, 2020

Hyd. No. 2

E-2

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.216 cfs
Storm frequency	=	10 yrs	Time to peak	=	829 min
Time interval	=	1 min	Hyd. volume	=	5,540 cuft
Drainage area	=	8.400 ac	Curve number	=	39
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	25.50 min
Total precip.	=	4.90 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



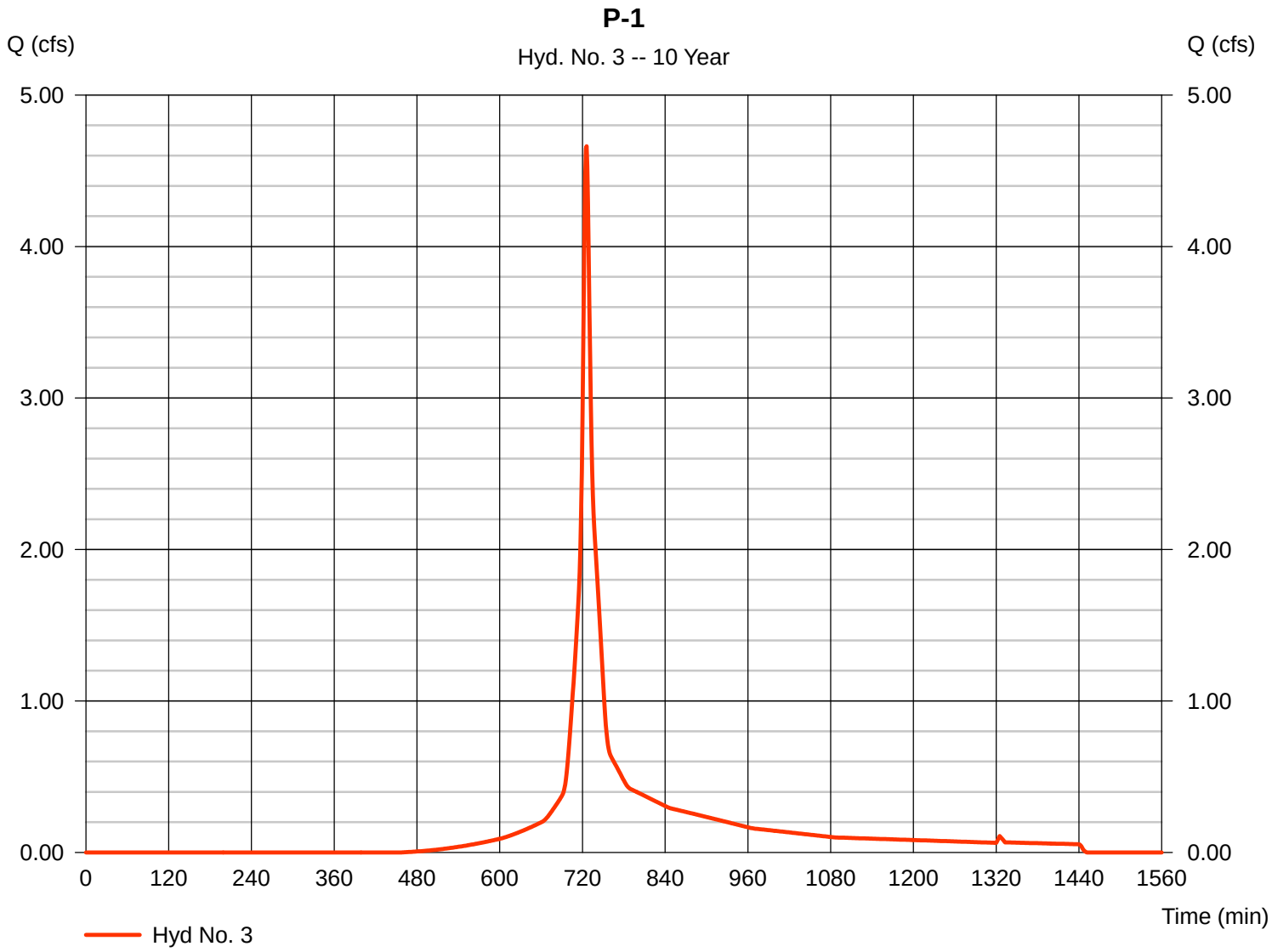
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jan 22, 2020

Hyd. No. 3

P-1

Hydrograph type	=	SCS Runoff	Peak discharge	=	4.661 cfs
Storm frequency	=	10 yrs	Time to peak	=	726 min
Time interval	=	1 min	Hyd. volume	=	14,995 cuft
Drainage area	=	1.510 ac	Curve number	=	80
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	8.20 min
Total precip.	=	4.90 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



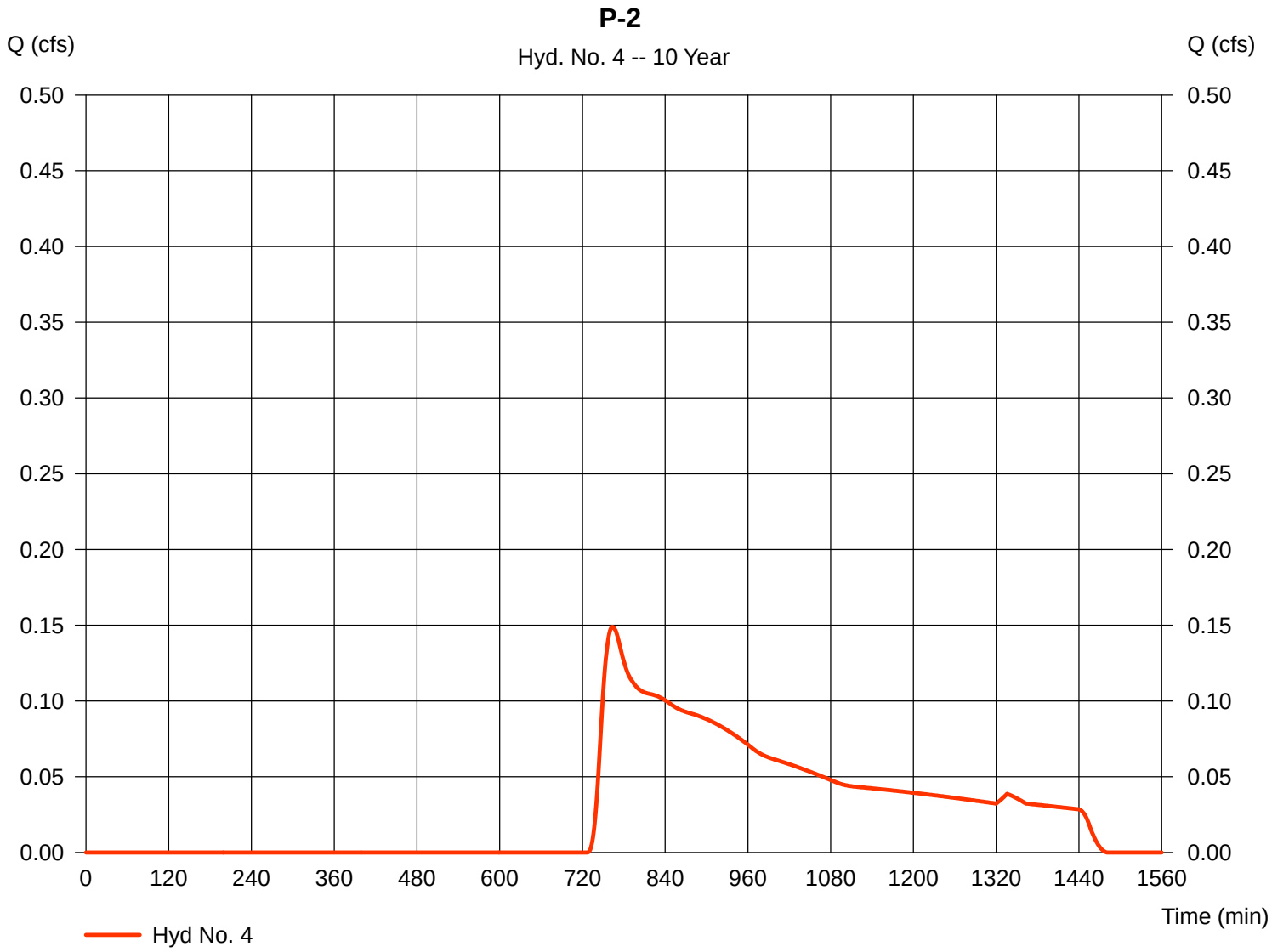
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jan 22, 2020

Hyd. No. 4

P-2

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.149 cfs
Storm frequency	=	10 yrs	Time to peak	=	764 min
Time interval	=	1 min	Hyd. volume	=	2,561 cuft
Drainage area	=	2.810 ac	Curve number	=	41
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	25.60 min
Total precip.	=	4.90 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



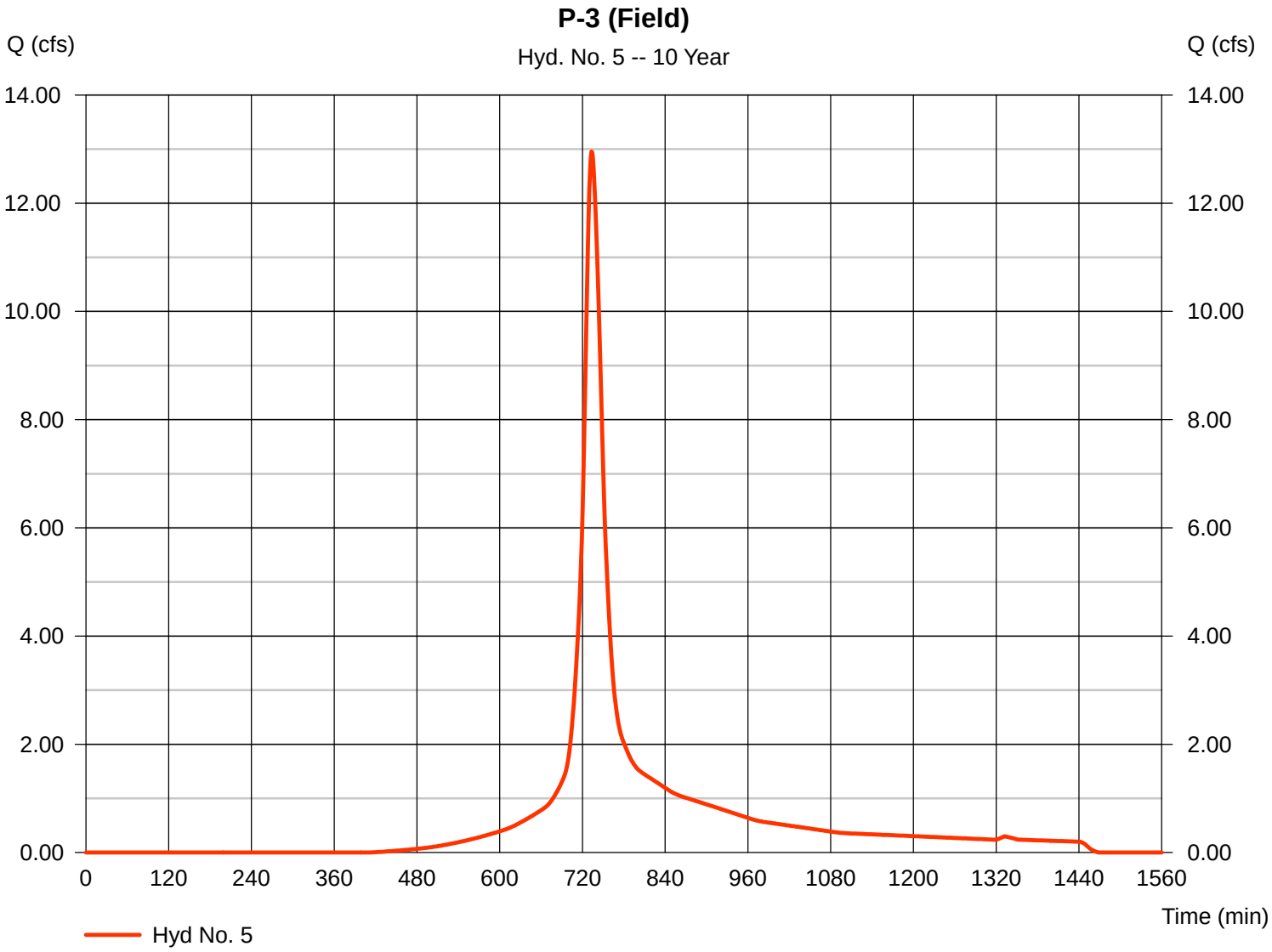
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jan 22, 2020

Hyd. No. 5

P-3 (Field)

Hydrograph type	=	SCS Runoff	Peak discharge	=	12.95 cfs
Storm frequency	=	10 yrs	Time to peak	=	733 min
Time interval	=	1 min	Hyd. volume	=	57,314 cuft
Drainage area	=	5.120 ac	Curve number	=	83
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	19.40 min
Total precip.	=	4.90 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



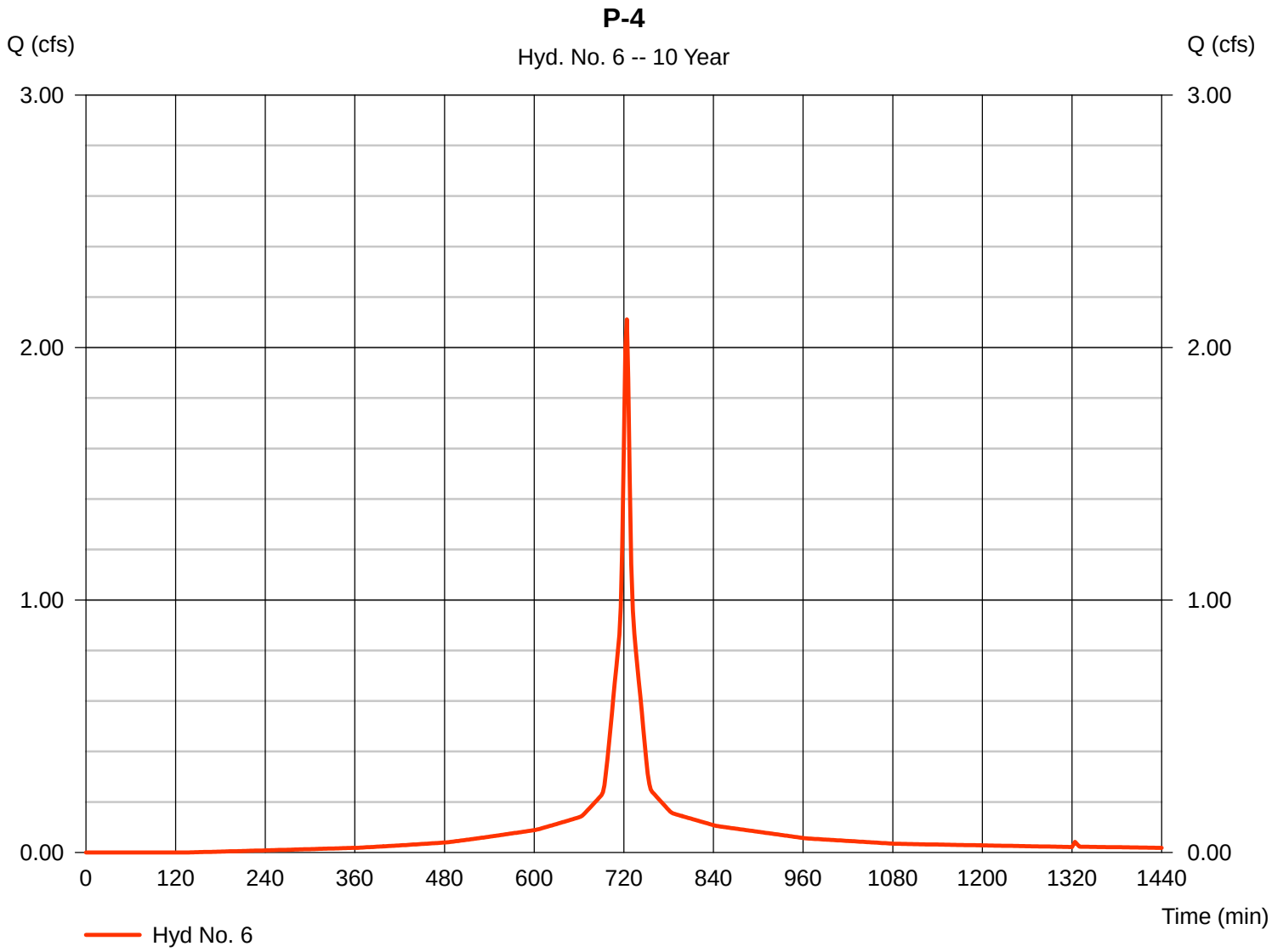
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jan 22, 2020

Hyd. No. 6

P-4

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.112 cfs
Storm frequency	=	10 yrs	Time to peak	=	724 min
Time interval	=	2 min	Hyd. volume	=	6,910 cuft
Drainage area	=	0.470 ac	Curve number	=	95
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	USER	Time of conc. (Tc)	=	6.00 min
Total precip.	=	4.90 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



Hydrograph Report

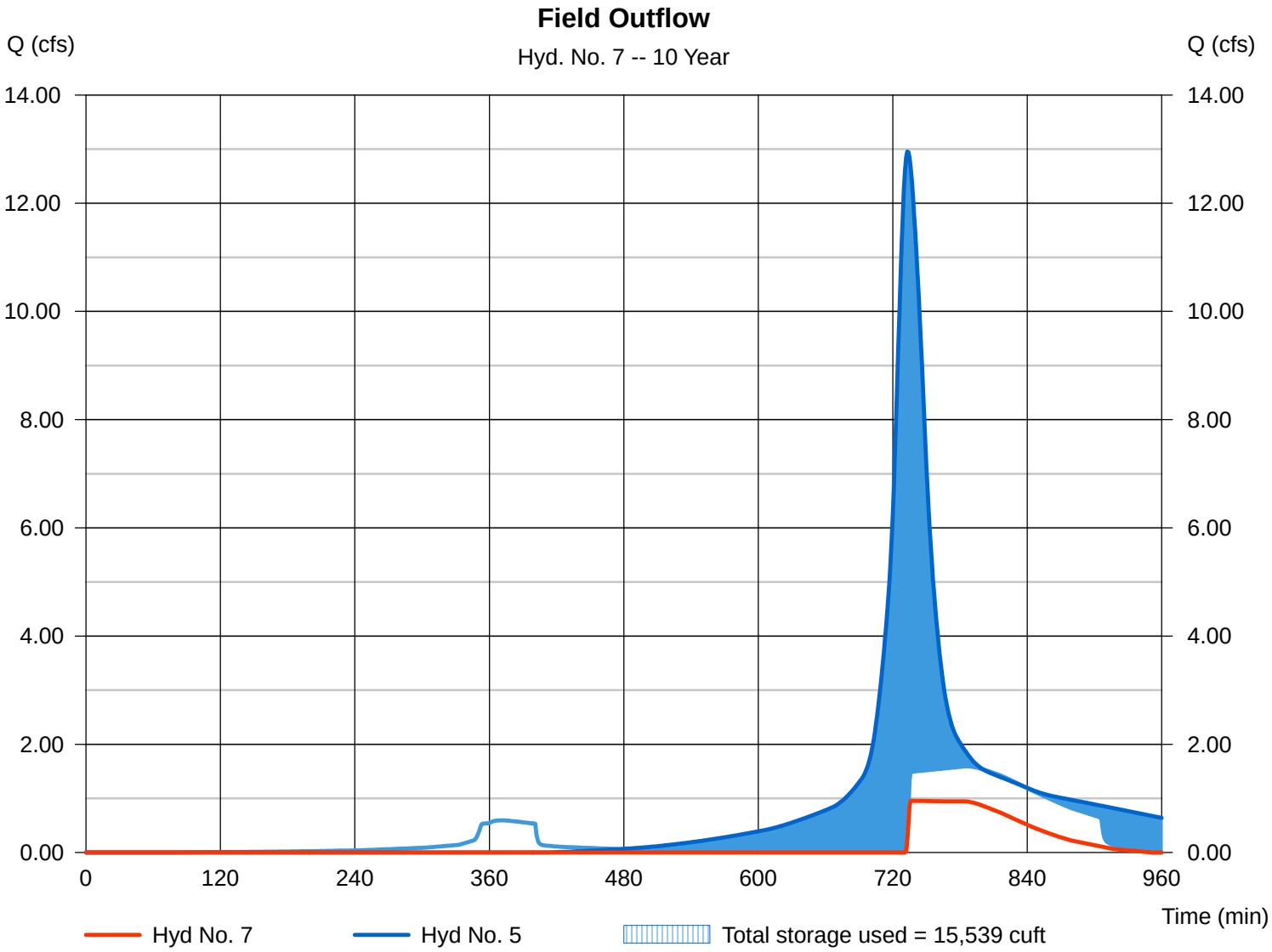
Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jan 22, 2020

Hyd. No. 7

Field Outflow

Hydrograph type	=	Reservoir	Peak discharge	=	0.956 cfs
Storm frequency	=	10 yrs	Time to peak	=	737 min
Time interval	=	1 min	Hyd. volume	=	6,640 cuft
Inflow hyd. No.	=	5 - P-3 (Field)	Max. Elevation	=	84.51 ft
Reservoir name	=	Field Model	Max. Storage	=	15,539 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



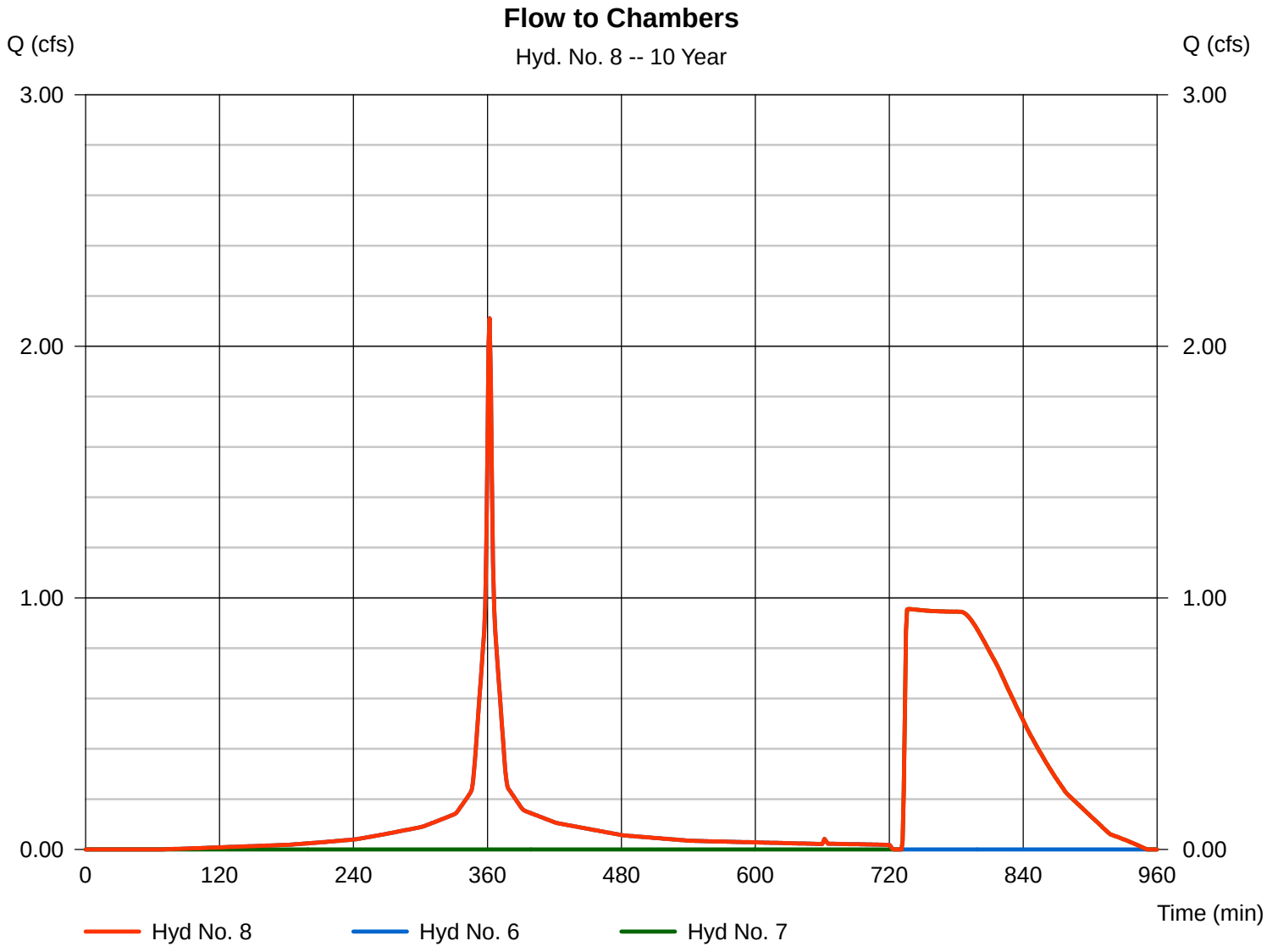
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Wednesday, Jan 22, 2020

Hyd. No. 8

Flow to Chambers

Hydrograph type	=	Combine	Peak discharge	=	2.112 cfs
Storm frequency	=	10 yrs	Time to peak	=	362 min
Time interval	=	1 min	Hyd. volume	=	10,096 cuft
Inflow hyds.	=	6, 7	Contrib. drain. area	=	0.470 ac



Hydrograph Report

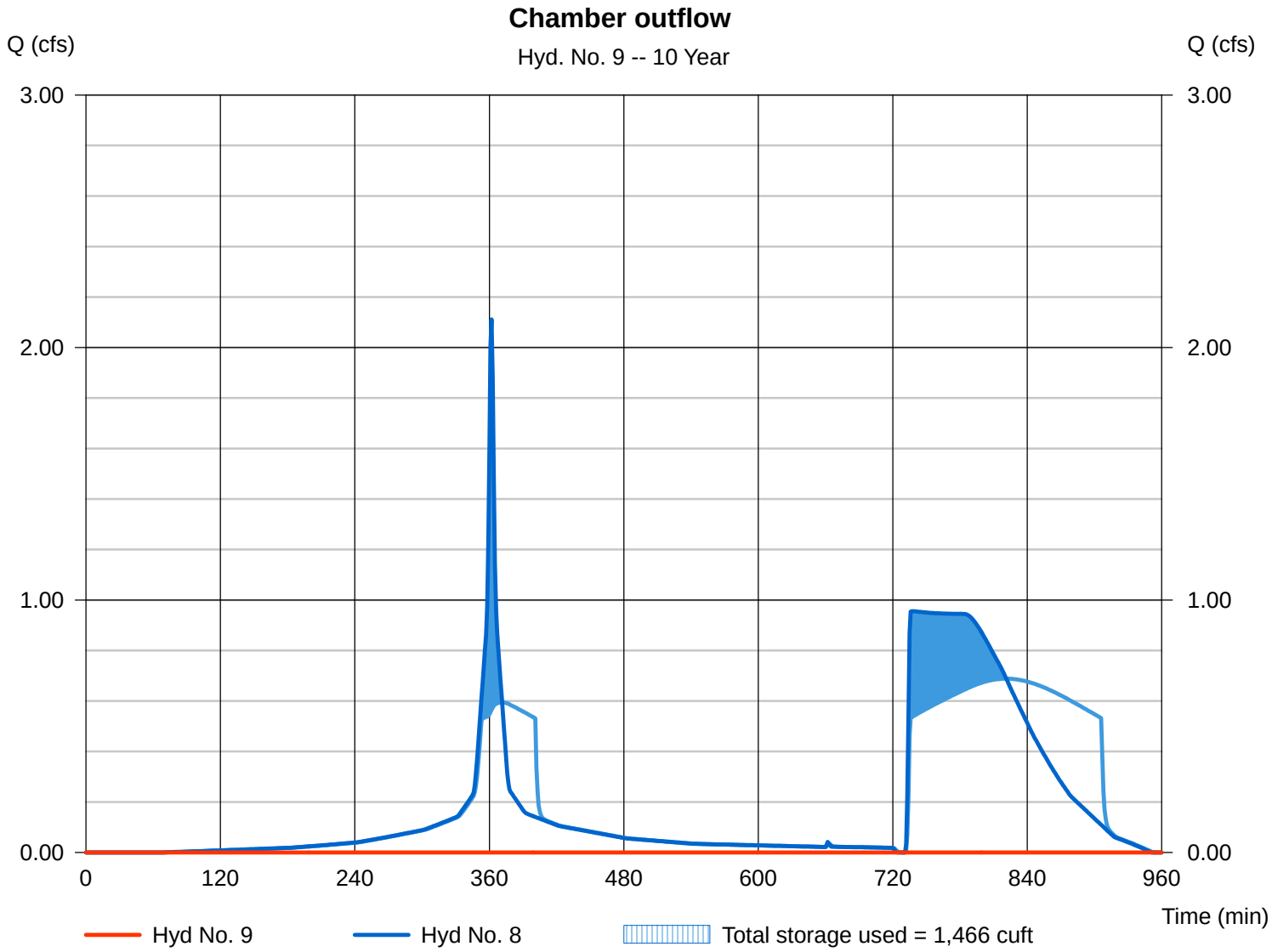
Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jan 22, 2020

Hyd. No. 9

Chamber outflow

Hydrograph type	=	Reservoir	Peak discharge	=	0.000 cfs
Storm frequency	=	10 yrs	Time to peak	=	345 min
Time interval	=	1 min	Hyd. volume	=	0 cuft
Inflow hyd. No.	=	8 - Flow to Chambers	Max. Elevation	=	80.77 ft
Reservoir name	=	Chamber System	Max. Storage	=	1,466 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



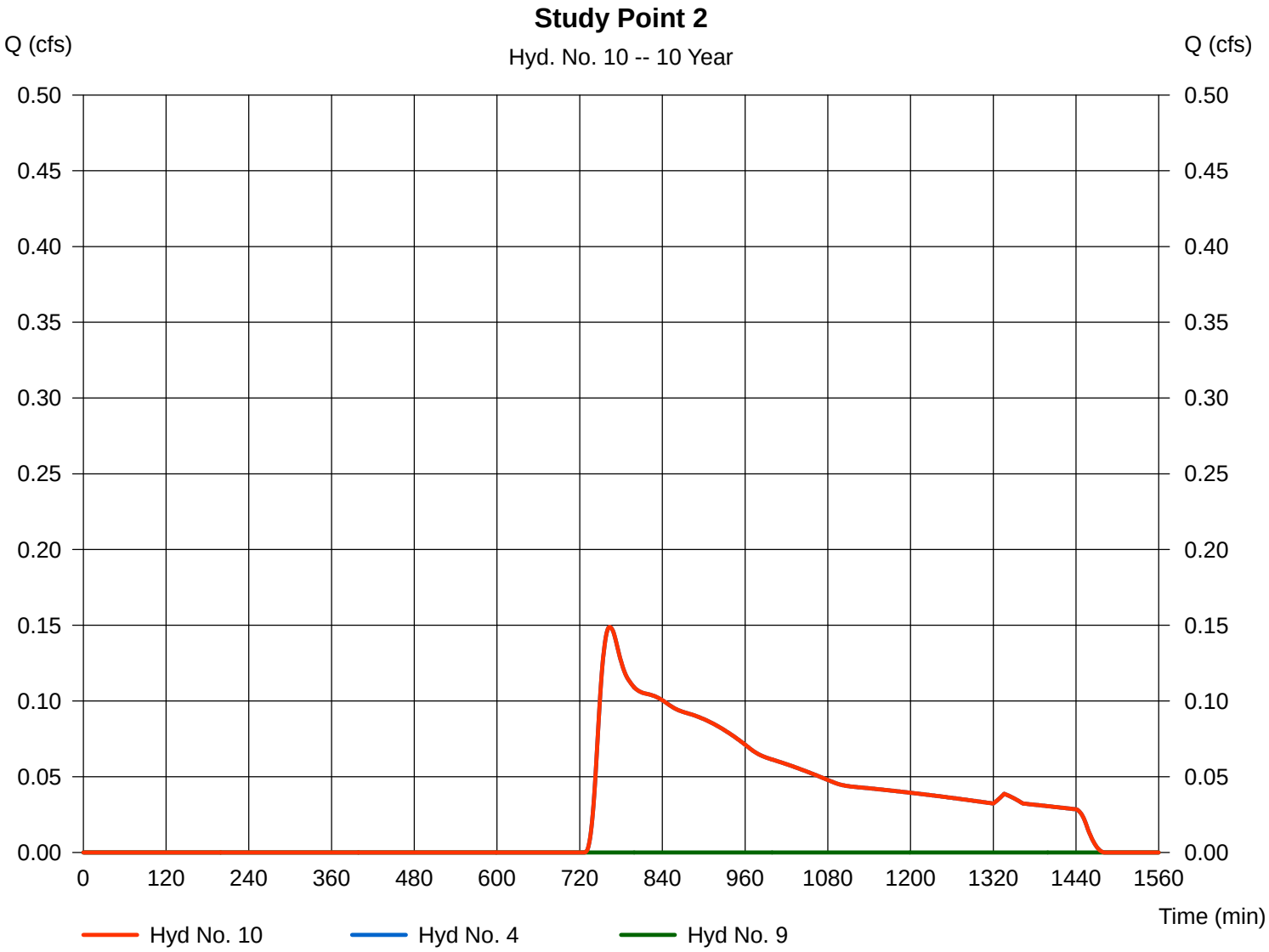
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Wednesday, Jan 22, 2020

Hyd. No. 10

Study Point 2

Hydrograph type	=	Combine	Peak discharge	=	0.149 cfs
Storm frequency	=	10 yrs	Time to peak	=	764 min
Time interval	=	1 min	Hyd. volume	=	2,561 cuft
Inflow hyds.	=	4, 9	Contrib. drain. area	=	2.810 ac



Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.2

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	5.957	1	726	19,246	----	------	------	E-1
2	SCS Runoff	0.960	1	758	11,978	----	------	------	E-2
3	SCS Runoff	5.957	1	726	19,246	----	------	------	P-1
4	SCS Runoff	0.503	1	755	5,069	----	------	------	P-2
5	SCS Runoff	16.33	1	733	72,598	----	------	------	P-3 (Field)
6	SCS Runoff	2.521	2	724	8,338	----	------	------	P-4
7	Reservoir	0.960	1	731	8,743	5	84.51	15,635	Field Outflow
8	Combine	2.521	1	362	12,912	6, 7	------	------	Flow to Chambers
9	Reservoir	0.000	1	413	0	8	80.97	1,837	Chamber outflow
10	Combine	0.503	1	755	5,069	4, 9	------	------	Study Point 2

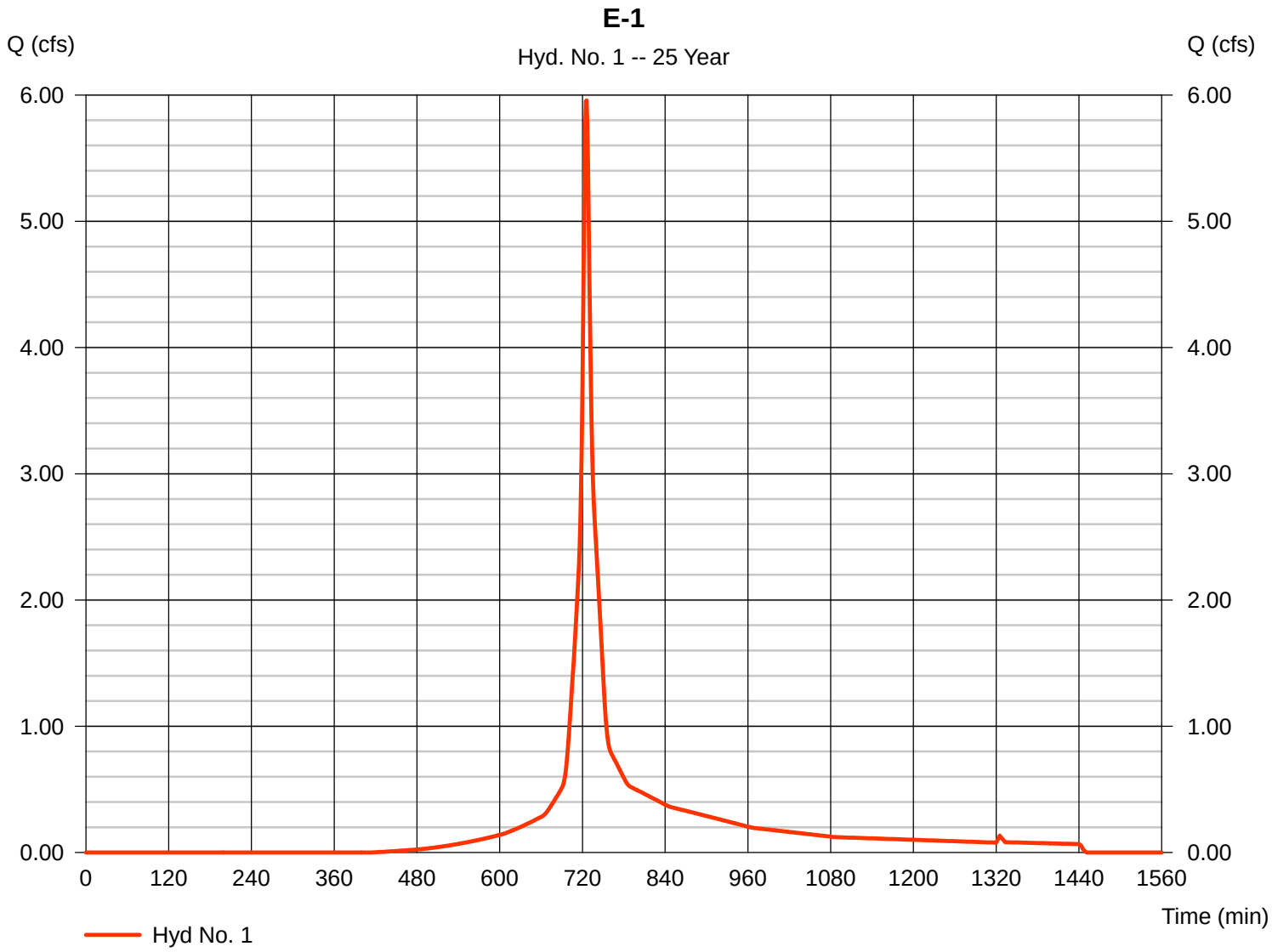
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jan 22, 2020

Hyd. No. 1

E-1

Hydrograph type	=	SCS Runoff	Peak discharge	=	5.957 cfs
Storm frequency	=	25 yrs	Time to peak	=	726 min
Time interval	=	1 min	Hyd. volume	=	19,246 cuft
Drainage area	=	1.510 ac	Curve number	=	80
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	8.20 min
Total precip.	=	5.80 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



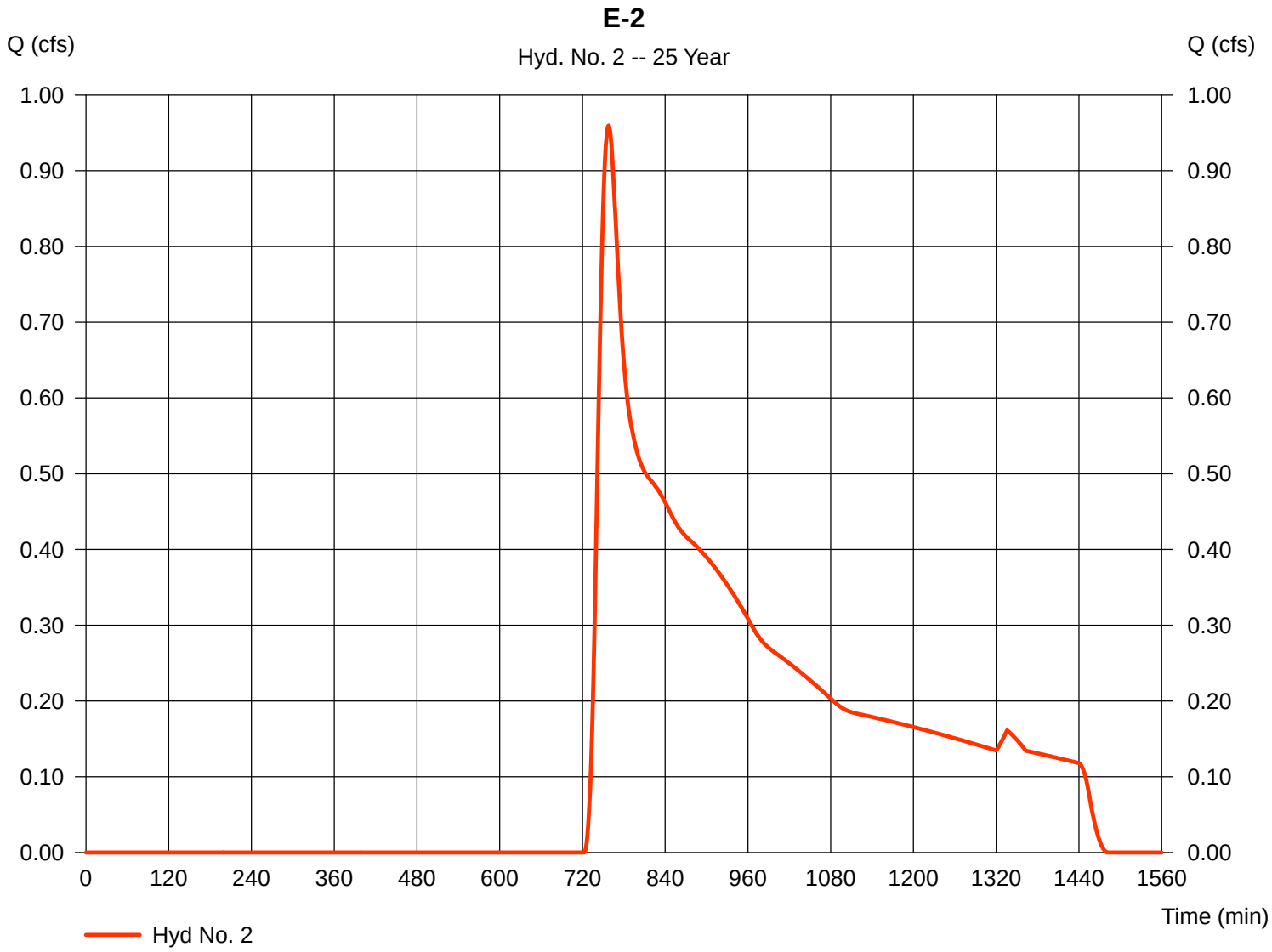
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jan 22, 2020

Hyd. No. 2

E-2

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.960 cfs
Storm frequency	=	25 yrs	Time to peak	=	758 min
Time interval	=	1 min	Hyd. volume	=	11,978 cuft
Drainage area	=	8.400 ac	Curve number	=	39
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	25.50 min
Total precip.	=	5.80 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



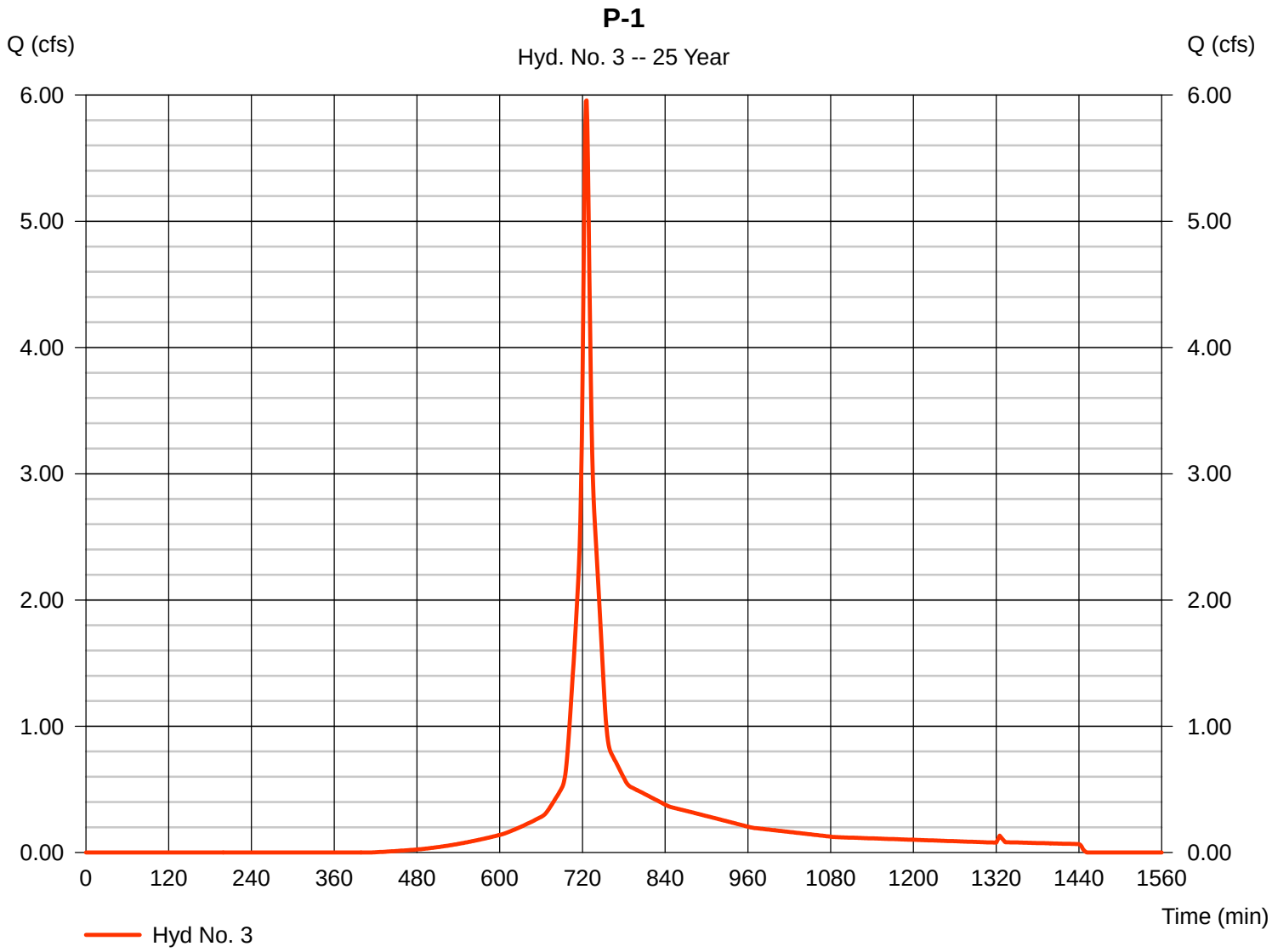
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jan 22, 2020

Hyd. No. 3

P-1

Hydrograph type	=	SCS Runoff	Peak discharge	=	5.957 cfs
Storm frequency	=	25 yrs	Time to peak	=	726 min
Time interval	=	1 min	Hyd. volume	=	19,246 cuft
Drainage area	=	1.510 ac	Curve number	=	80
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	8.20 min
Total precip.	=	5.80 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



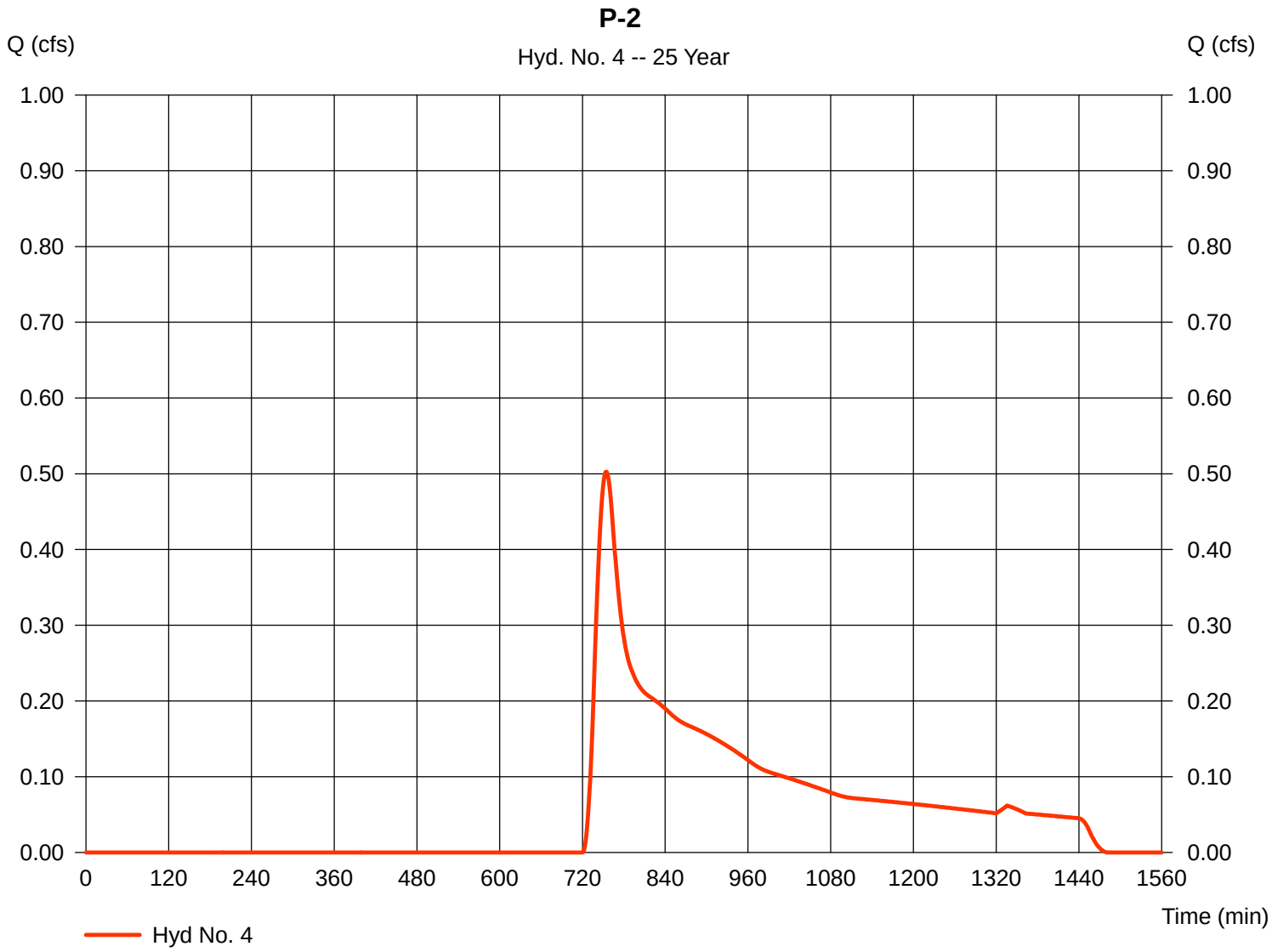
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jan 22, 2020

Hyd. No. 4

P-2

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.503 cfs
Storm frequency	=	25 yrs	Time to peak	=	755 min
Time interval	=	1 min	Hyd. volume	=	5,069 cuft
Drainage area	=	2.810 ac	Curve number	=	41
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	25.60 min
Total precip.	=	5.80 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



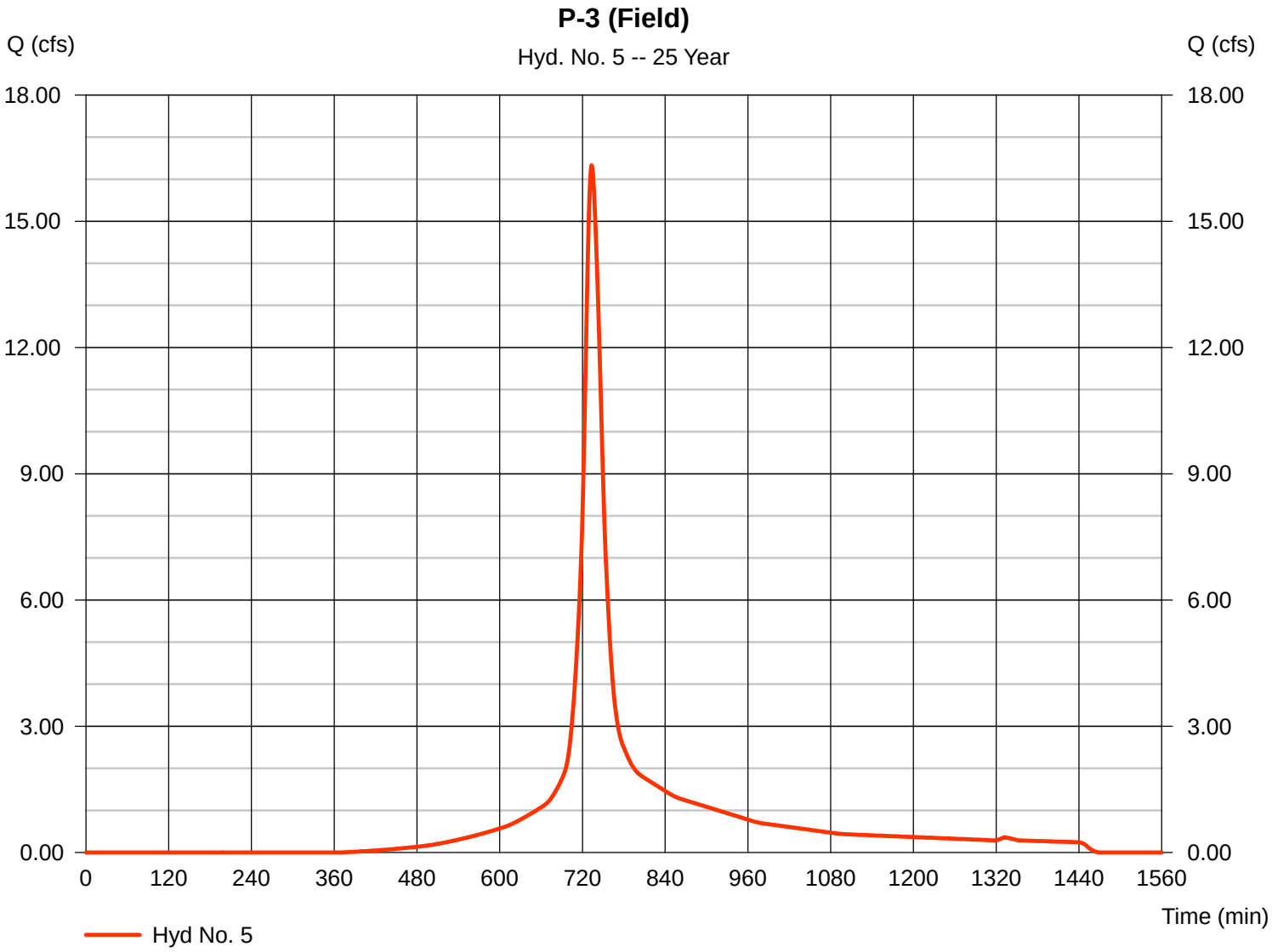
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jan 22, 2020

Hyd. No. 5

P-3 (Field)

Hydrograph type	=	SCS Runoff	Peak discharge	=	16.33 cfs
Storm frequency	=	25 yrs	Time to peak	=	733 min
Time interval	=	1 min	Hyd. volume	=	72,598 cuft
Drainage area	=	5.120 ac	Curve number	=	83
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	19.40 min
Total precip.	=	5.80 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



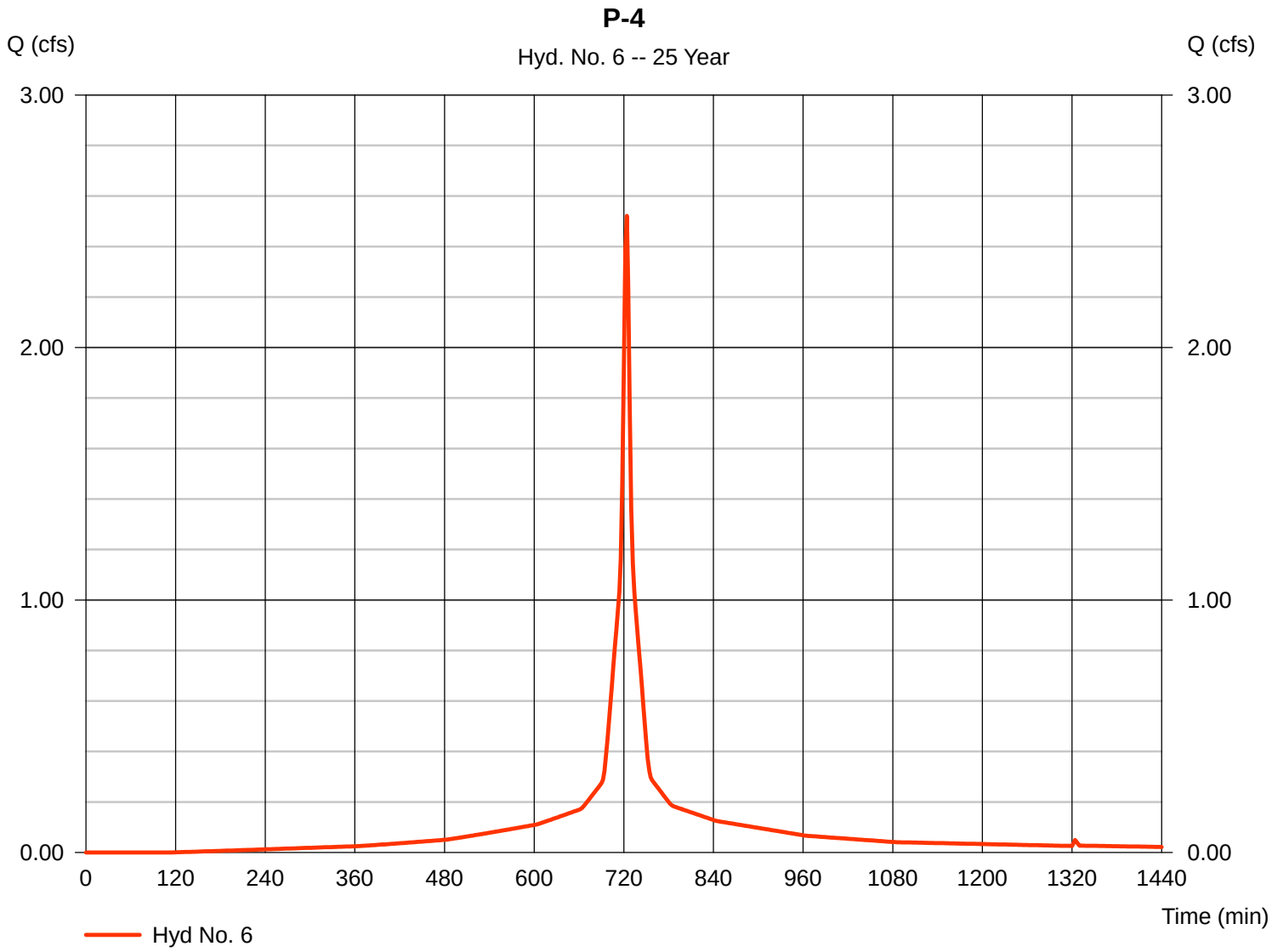
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jan 22, 2020

Hyd. No. 6

P-4

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.521 cfs
Storm frequency	=	25 yrs	Time to peak	=	724 min
Time interval	=	2 min	Hyd. volume	=	8,338 cuft
Drainage area	=	0.470 ac	Curve number	=	95
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	USER	Time of conc. (Tc)	=	6.00 min
Total precip.	=	5.80 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



Hydrograph Report

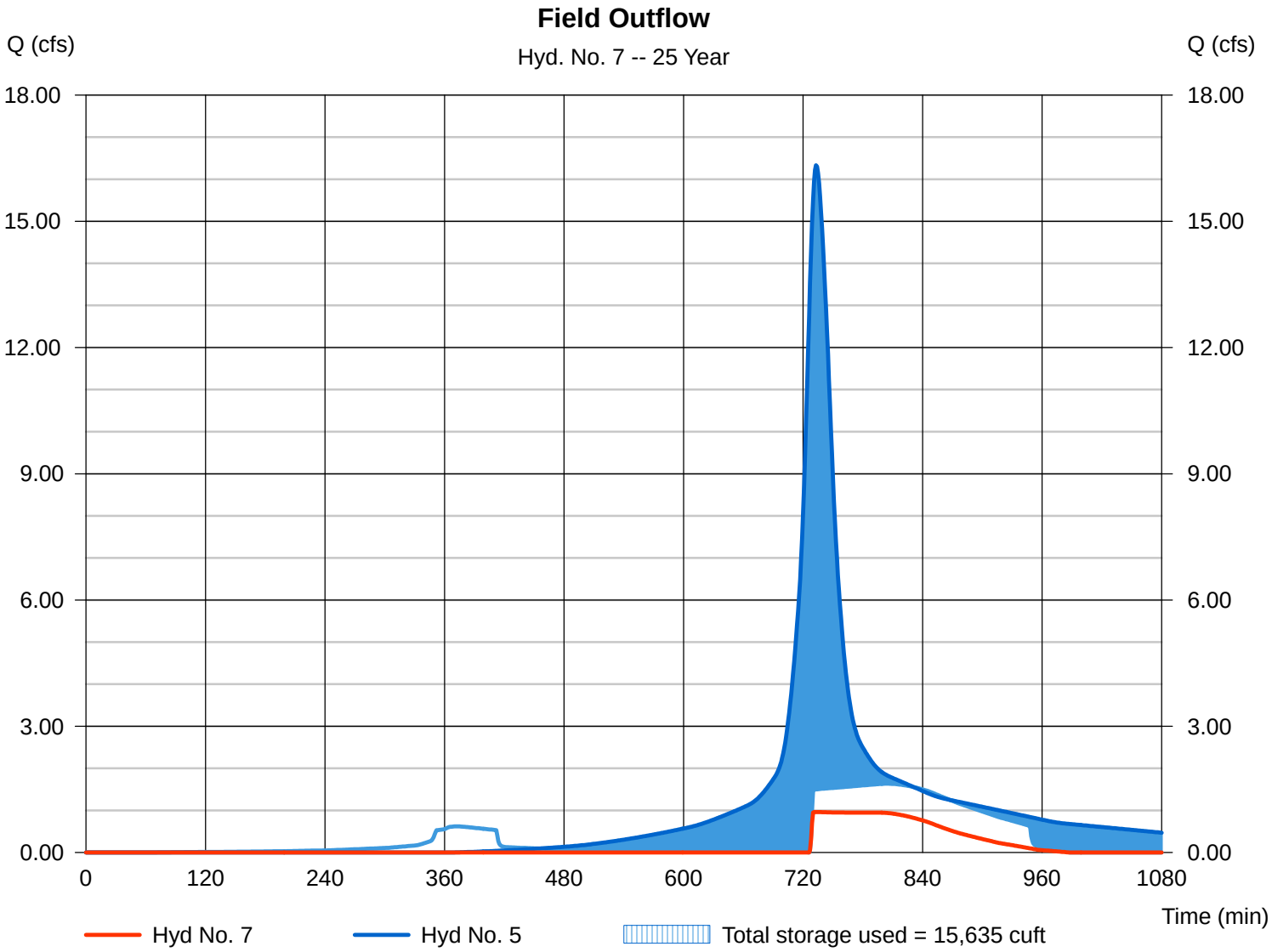
Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jan 22, 2020

Hyd. No. 7

Field Outflow

Hydrograph type	=	Reservoir	Peak discharge	=	0.960 cfs
Storm frequency	=	25 yrs	Time to peak	=	731 min
Time interval	=	1 min	Hyd. volume	=	8,743 cuft
Inflow hyd. No.	=	5 - P-3 (Field)	Max. Elevation	=	84.51 ft
Reservoir name	=	Field Model	Max. Storage	=	15,635 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



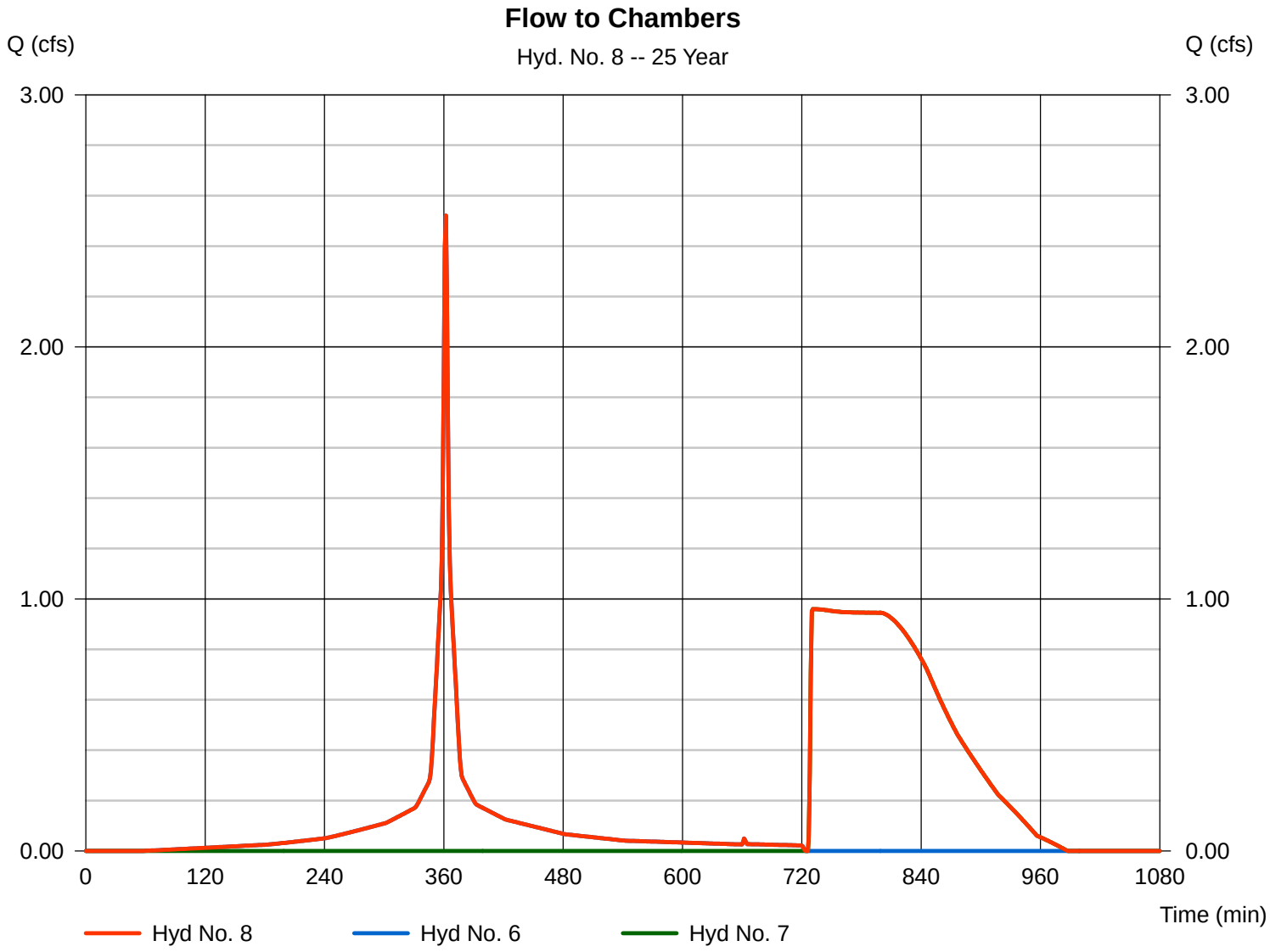
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Wednesday, Jan 22, 2020

Hyd. No. 8

Flow to Chambers

Hydrograph type	=	Combine	Peak discharge	=	2.521 cfs
Storm frequency	=	25 yrs	Time to peak	=	362 min
Time interval	=	1 min	Hyd. volume	=	12,912 cuft
Inflow hyds.	=	6, 7	Contrib. drain. area	=	0.470 ac



Hydrograph Report

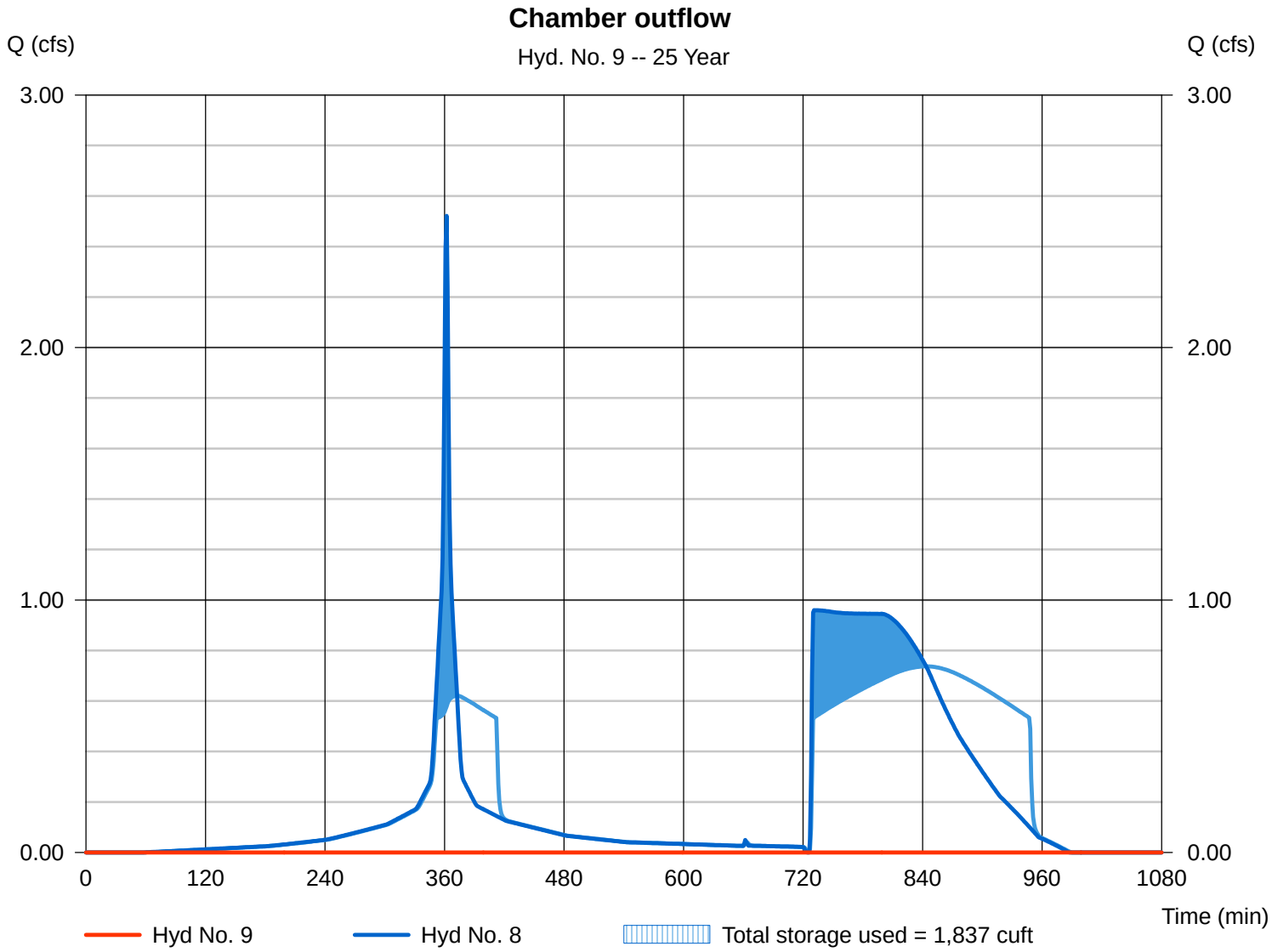
Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jan 22, 2020

Hyd. No. 9

Chamber outflow

Hydrograph type	=	Reservoir	Peak discharge	=	0.000 cfs
Storm frequency	=	25 yrs	Time to peak	=	413 min
Time interval	=	1 min	Hyd. volume	=	0 cuft
Inflow hyd. No.	=	8 - Flow to Chambers	Max. Elevation	=	80.97 ft
Reservoir name	=	Chamber System	Max. Storage	=	1,837 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



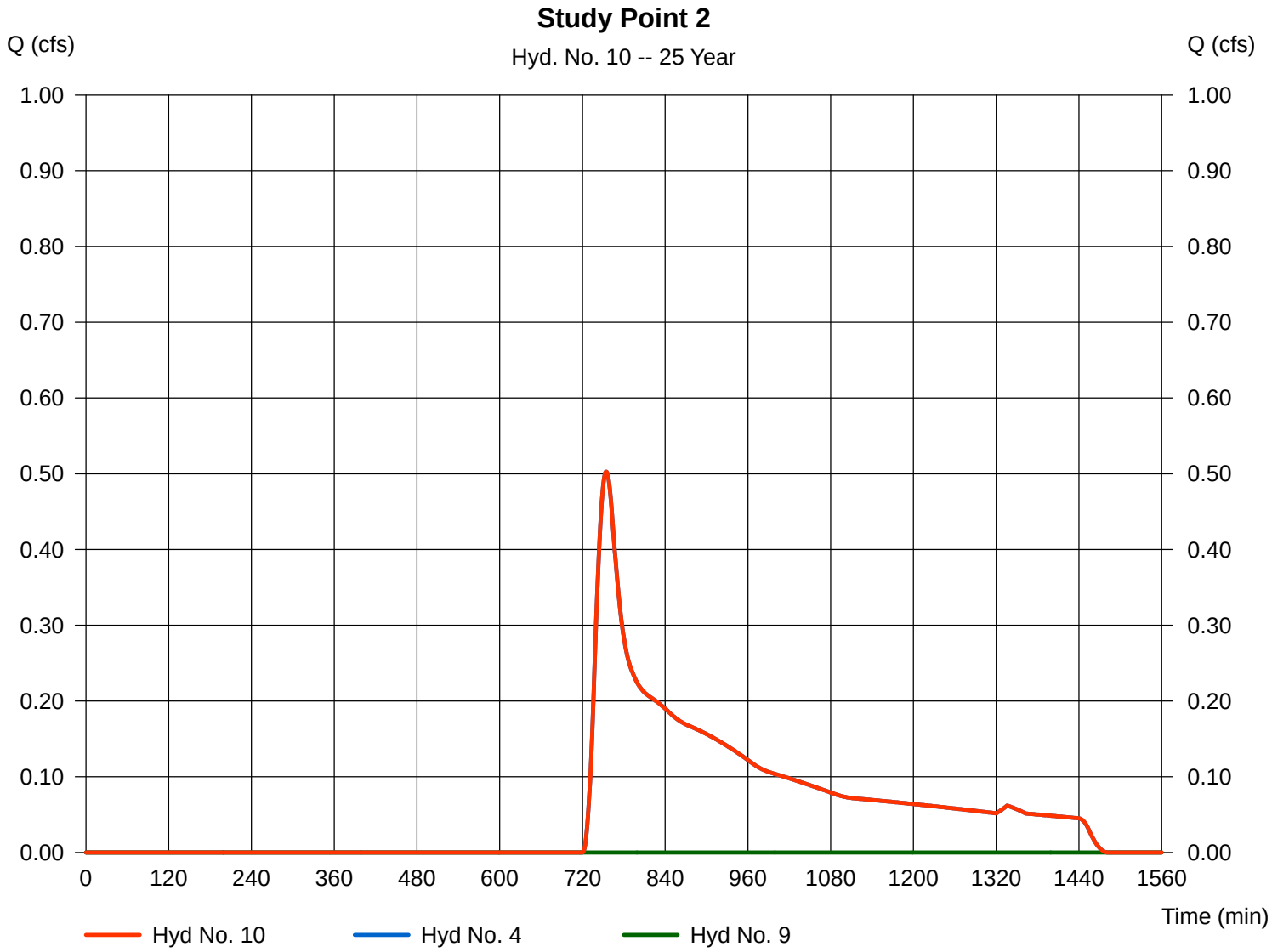
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jan 22, 2020

Hyd. No. 10

Study Point 2

Hydrograph type	= Combine	Peak discharge	= 0.503 cfs
Storm frequency	= 25 yrs	Time to peak	= 755 min
Time interval	= 1 min	Hyd. volume	= 5,069 cuft
Inflow hyds.	= 4, 9	Contrib. drain. area	= 2.810 ac



Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.2

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	8.037	1	725	26,176	----	------	------	E-1
2	SCS Runoff	3.273	1	751	26,073	----	------	------	E-2
3	SCS Runoff	8.037	1	725	26,176	----	------	------	P-1
4	SCS Runoff	1.440	1	749	10,346	----	------	------	P-2
5	SCS Runoff	21.68	1	733	97,309	----	------	------	P-3 (Field)
6	SCS Runoff	3.165	2	724	10,596	----	------	------	P-4
7	Reservoir	0.966	1	736	11,778	5	84.51	15,862	Field Outflow
8	Combine	3.165	1	362	17,076	6, 7	------	------	Flow to Chambers
9	Reservoir	0.000	1	321	0	8	81.22	2,269	Chamber outflow
10	Combine	1.440	1	749	10,346	4, 9	------	------	Study Point 2

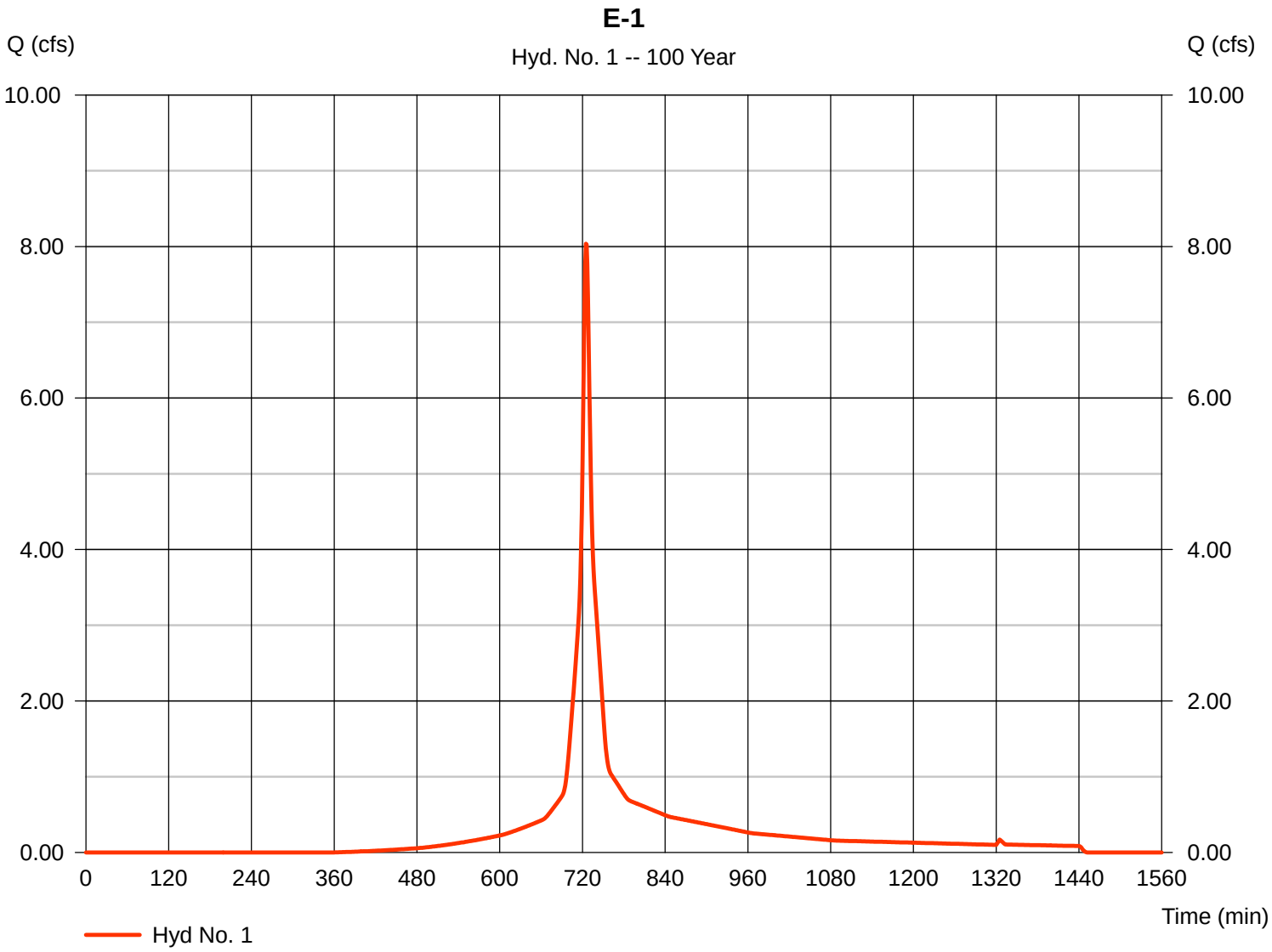
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jan 22, 2020

Hyd. No. 1

E-1

Hydrograph type	=	SCS Runoff	Peak discharge	=	8.037 cfs
Storm frequency	=	100 yrs	Time to peak	=	725 min
Time interval	=	1 min	Hyd. volume	=	26,176 cuft
Drainage area	=	1.510 ac	Curve number	=	80
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	8.20 min
Total precip.	=	7.22 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



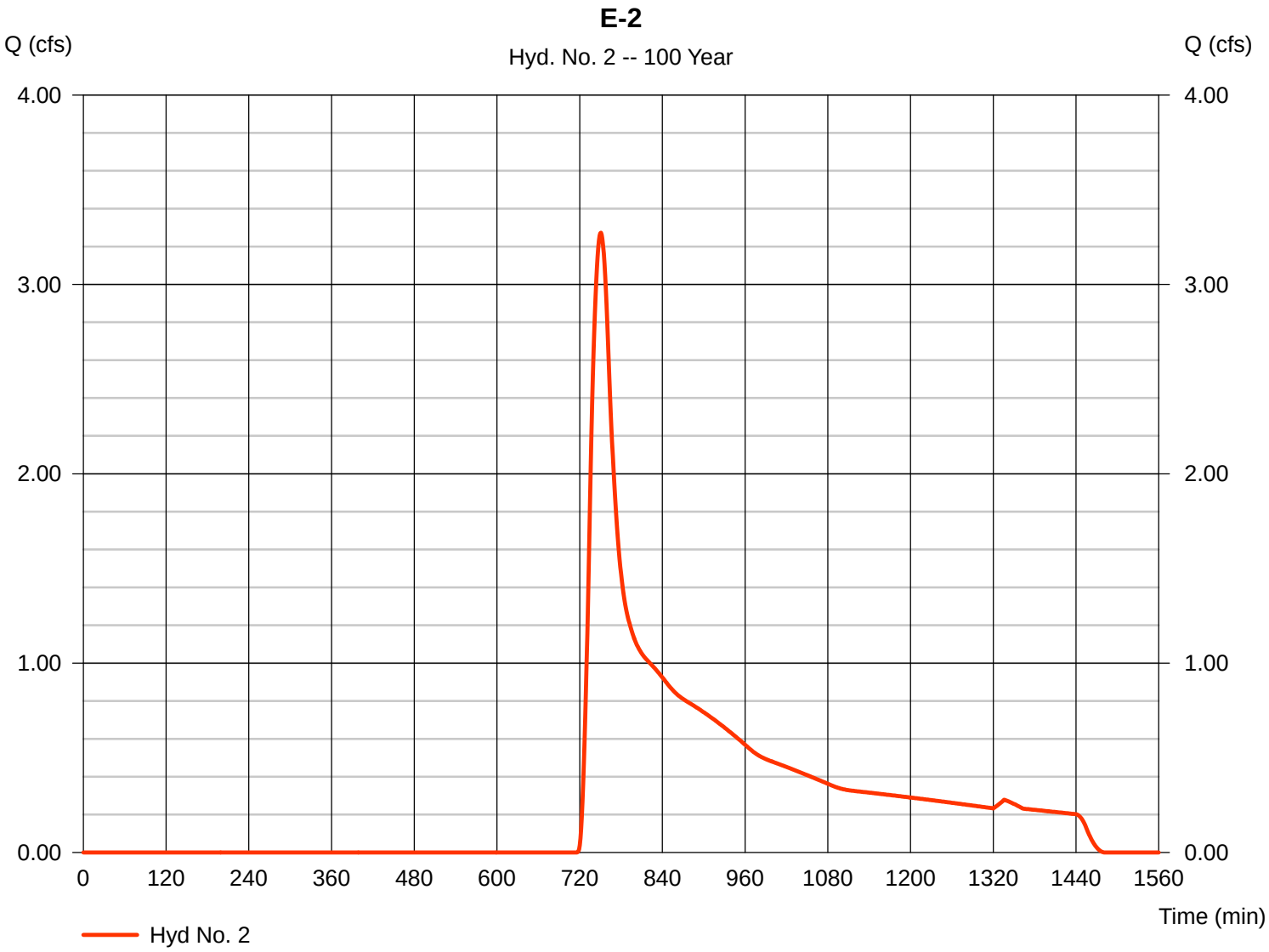
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jan 22, 2020

Hyd. No. 2

E-2

Hydrograph type	=	SCS Runoff	Peak discharge	=	3.273 cfs
Storm frequency	=	100 yrs	Time to peak	=	751 min
Time interval	=	1 min	Hyd. volume	=	26,073 cuft
Drainage area	=	8.400 ac	Curve number	=	39
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	25.50 min
Total precip.	=	7.22 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



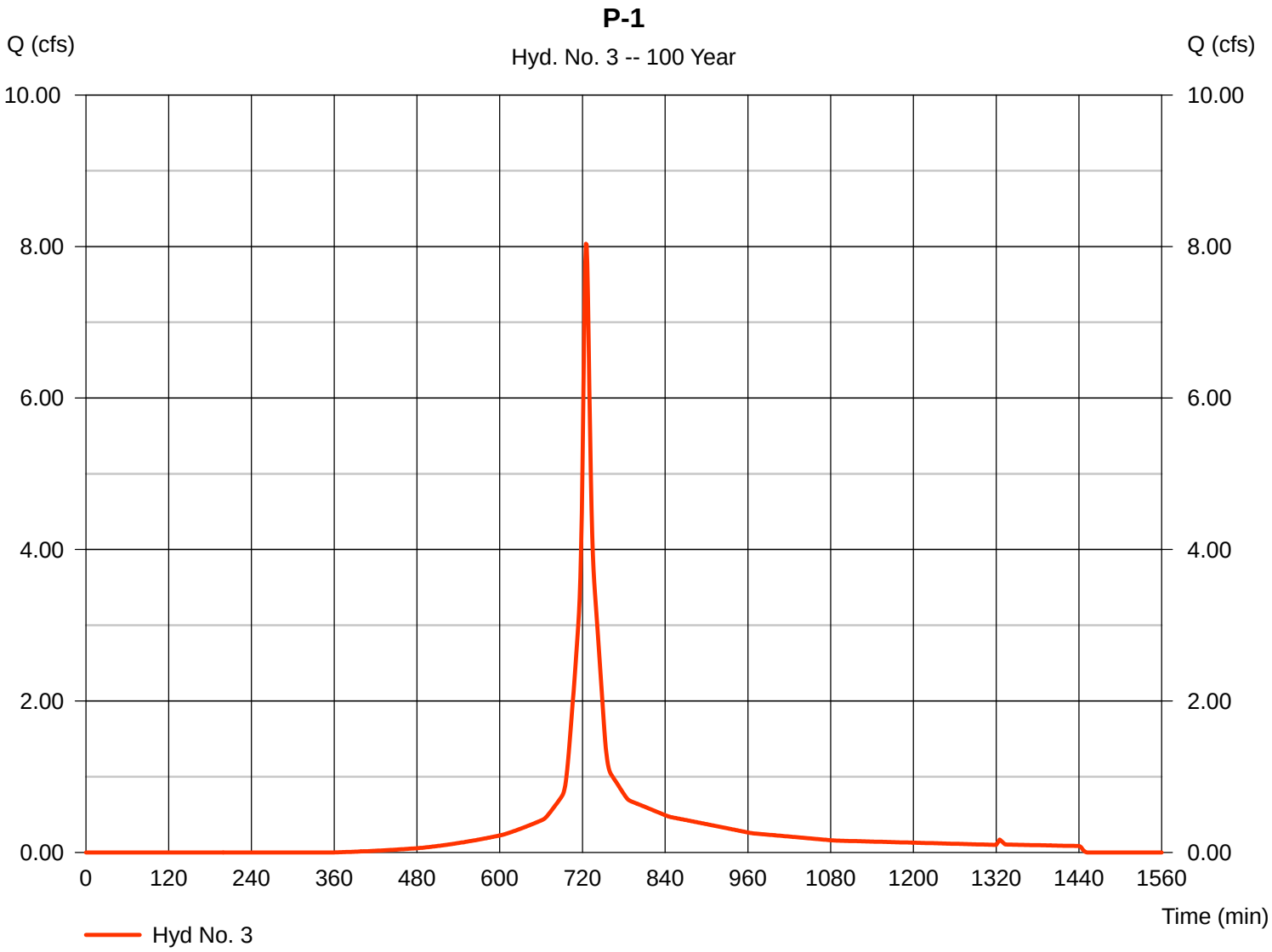
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jan 22, 2020

Hyd. No. 3

P-1

Hydrograph type	=	SCS Runoff	Peak discharge	=	8.037 cfs
Storm frequency	=	100 yrs	Time to peak	=	725 min
Time interval	=	1 min	Hyd. volume	=	26,176 cuft
Drainage area	=	1.510 ac	Curve number	=	80
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	8.20 min
Total precip.	=	7.22 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



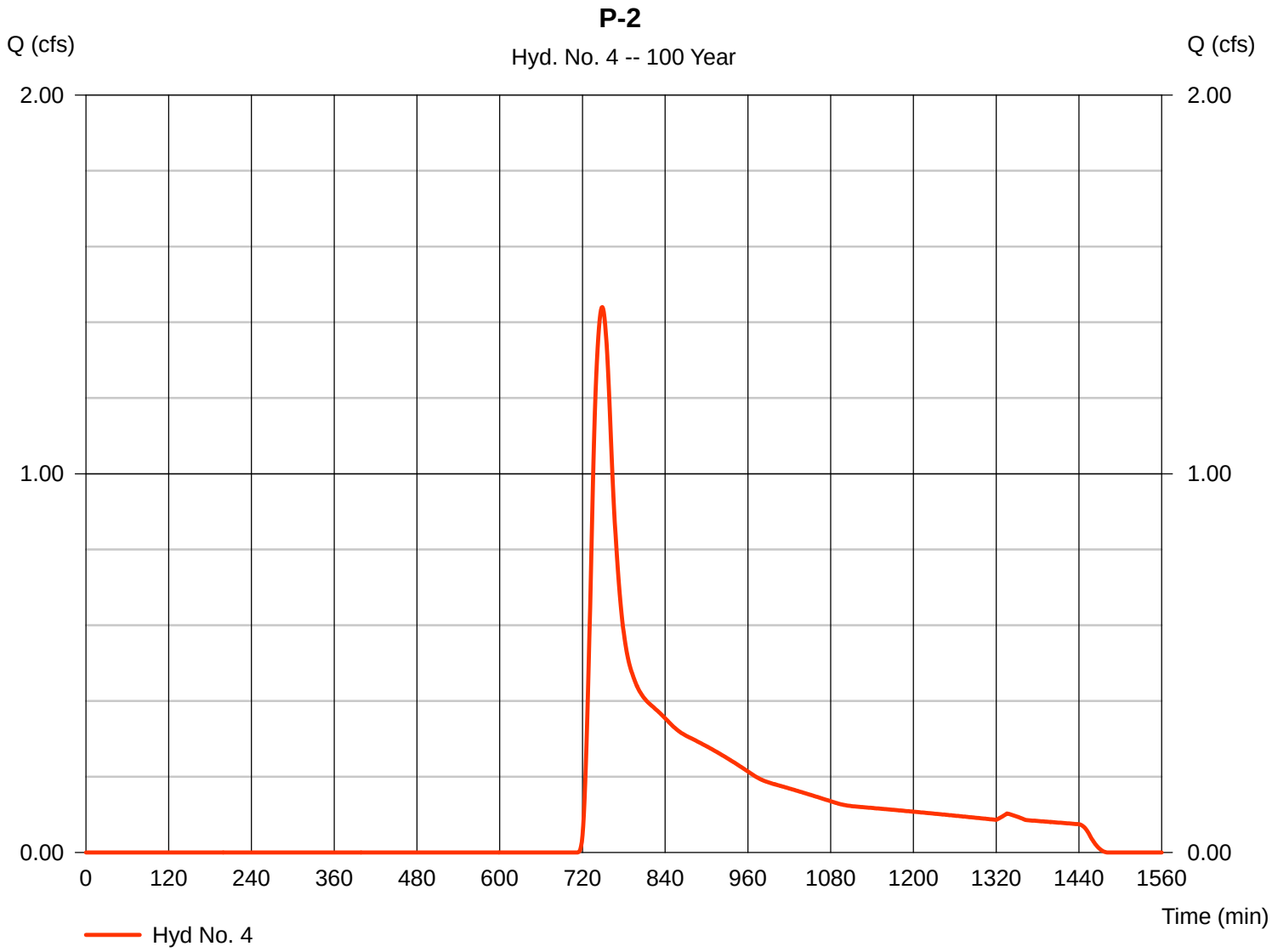
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jan 22, 2020

Hyd. No. 4

P-2

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.440 cfs
Storm frequency	=	100 yrs	Time to peak	=	749 min
Time interval	=	1 min	Hyd. volume	=	10,346 cuft
Drainage area	=	2.810 ac	Curve number	=	41
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	25.60 min
Total precip.	=	7.22 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



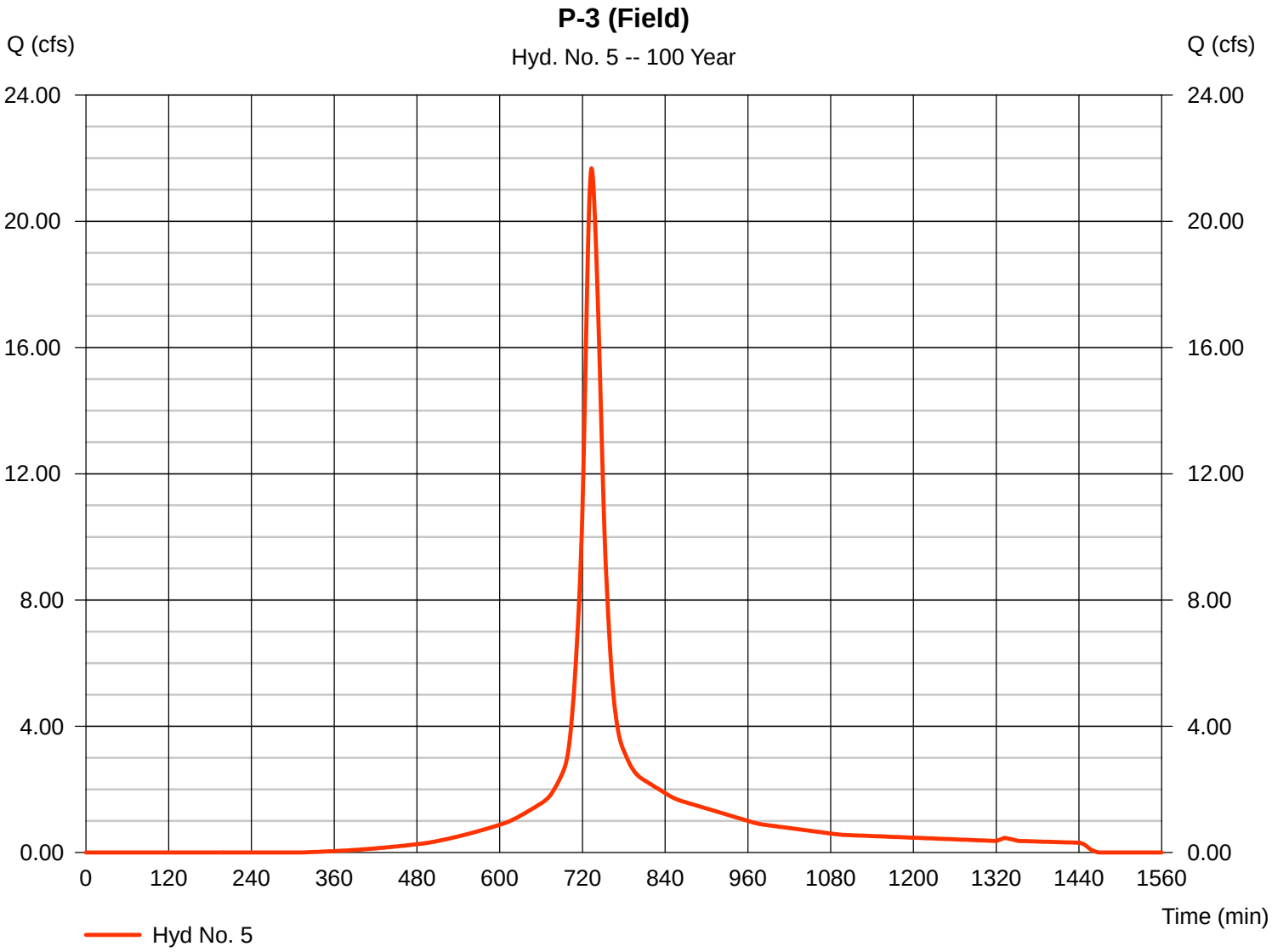
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jan 22, 2020

Hyd. No. 5

P-3 (Field)

Hydrograph type	=	SCS Runoff	Peak discharge	=	21.68 cfs
Storm frequency	=	100 yrs	Time to peak	=	733 min
Time interval	=	1 min	Hyd. volume	=	97,309 cuft
Drainage area	=	5.120 ac	Curve number	=	83
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	19.40 min
Total precip.	=	7.22 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



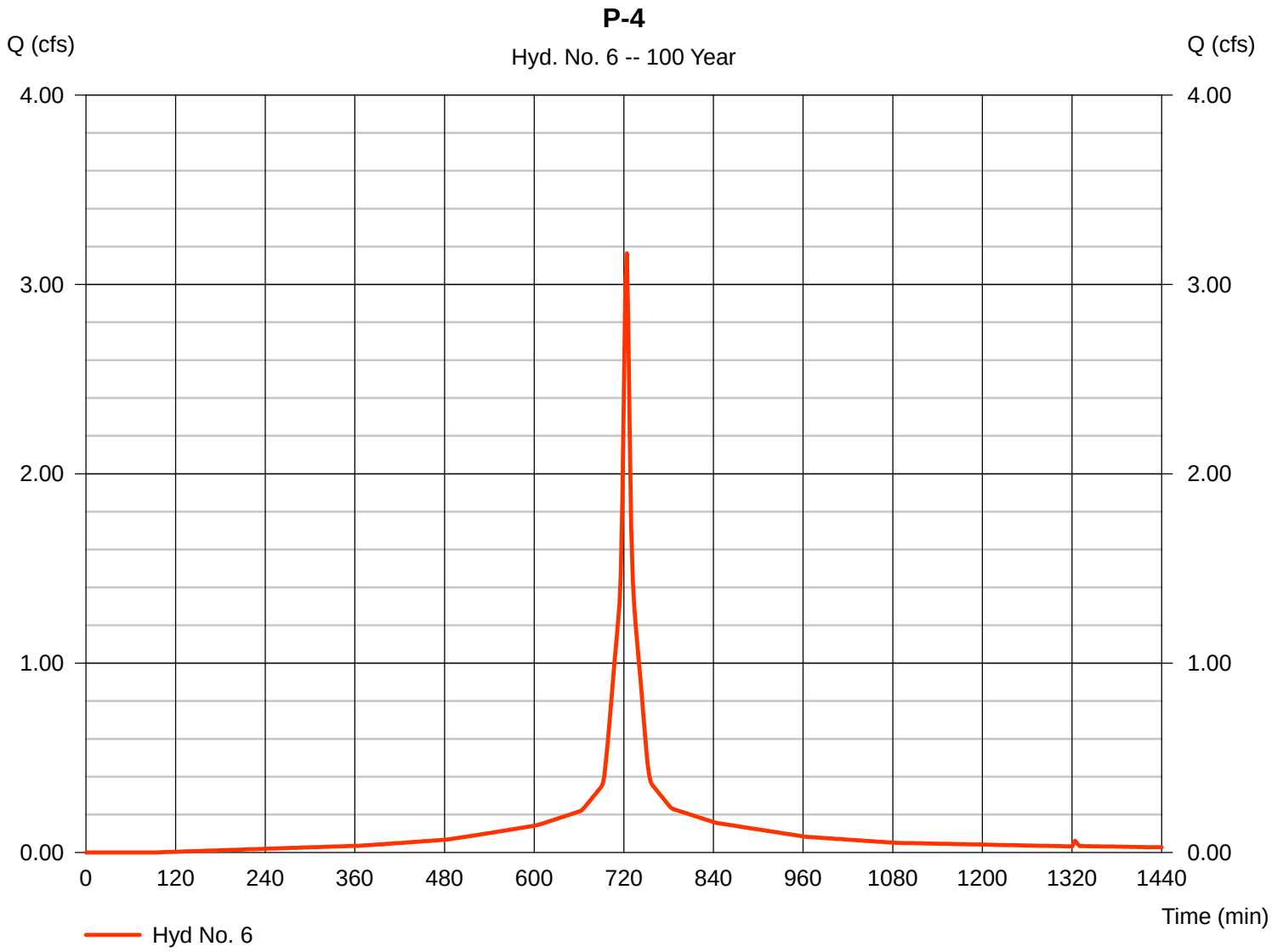
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jan 22, 2020

Hyd. No. 6

P-4

Hydrograph type	=	SCS Runoff	Peak discharge	=	3.165 cfs
Storm frequency	=	100 yrs	Time to peak	=	724 min
Time interval	=	2 min	Hyd. volume	=	10,596 cuft
Drainage area	=	0.470 ac	Curve number	=	95
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	USER	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.22 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



Hydrograph Report

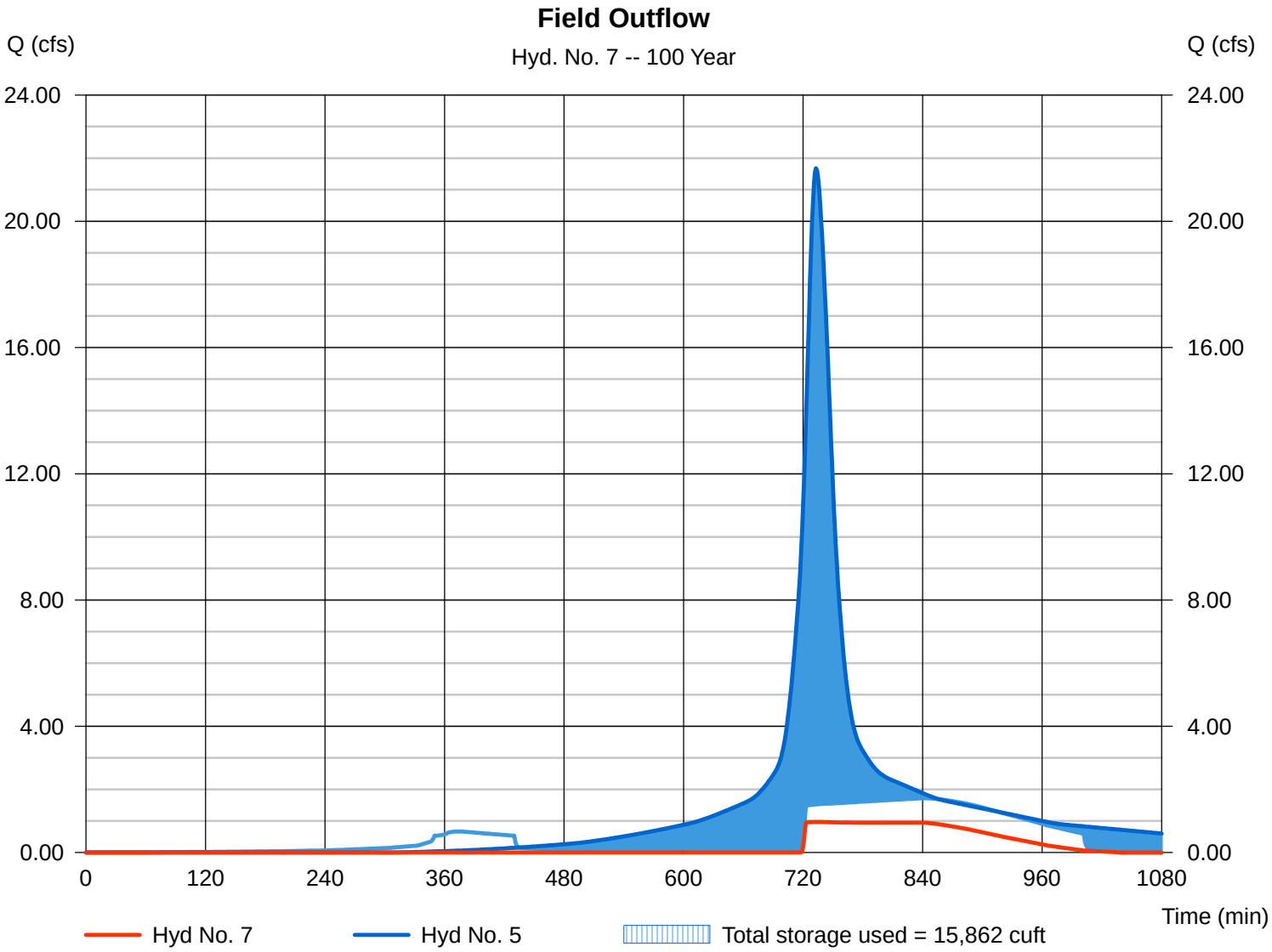
Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jan 22, 2020

Hyd. No. 7

Field Outflow

Hydrograph type	=	Reservoir	Peak discharge	=	0.966 cfs
Storm frequency	=	100 yrs	Time to peak	=	736 min
Time interval	=	1 min	Hyd. volume	=	11,778 cuft
Inflow hyd. No.	=	5 - P-3 (Field)	Max. Elevation	=	84.51 ft
Reservoir name	=	Field Model	Max. Storage	=	15,862 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



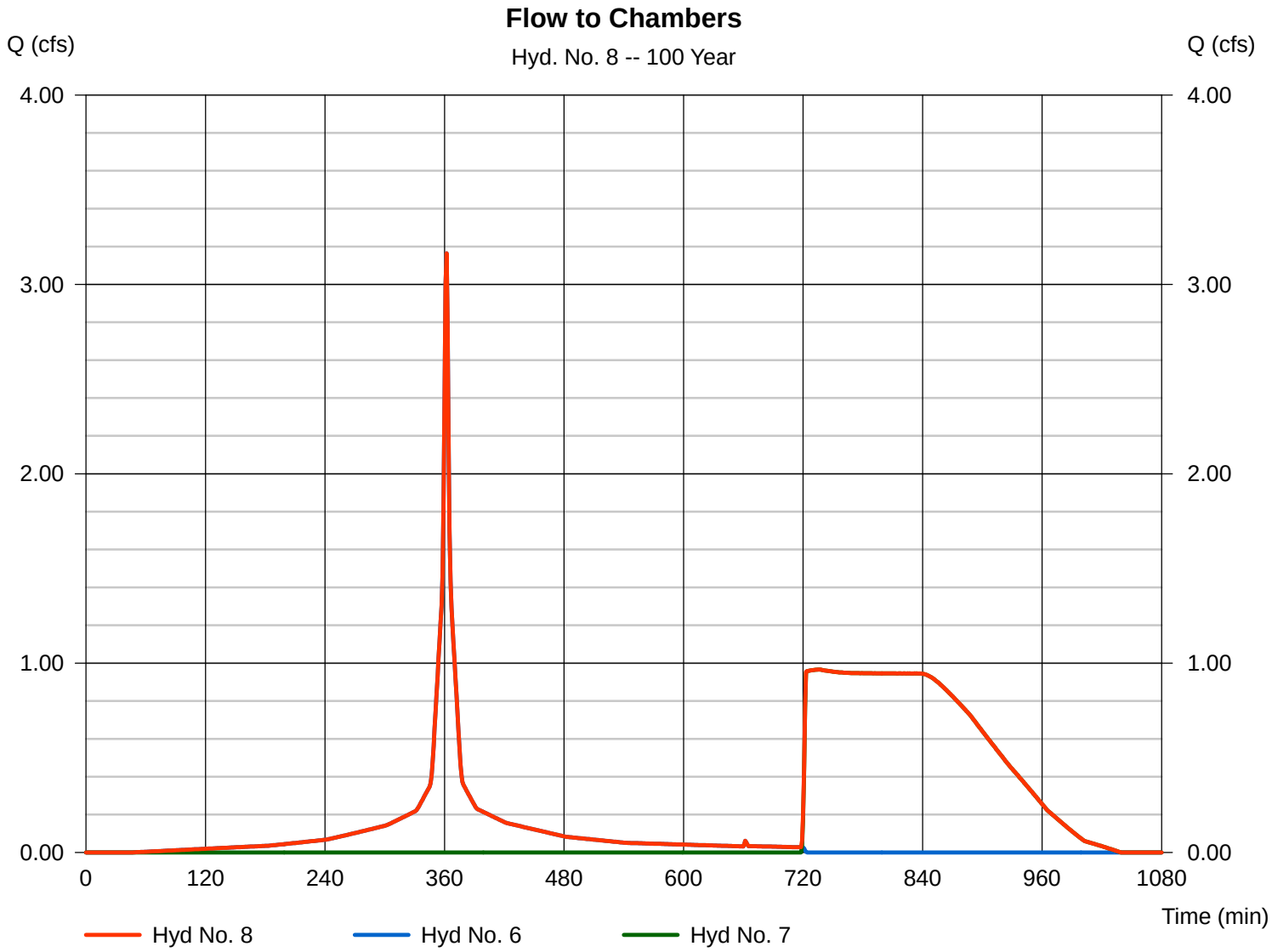
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Wednesday, Jan 22, 2020

Hyd. No. 8

Flow to Chambers

Hydrograph type	=	Combine	Peak discharge	=	3.165 cfs
Storm frequency	=	100 yrs	Time to peak	=	362 min
Time interval	=	1 min	Hyd. volume	=	17,076 cuft
Inflow hyds.	=	6, 7	Contrib. drain. area	=	0.470 ac



Hydrograph Report

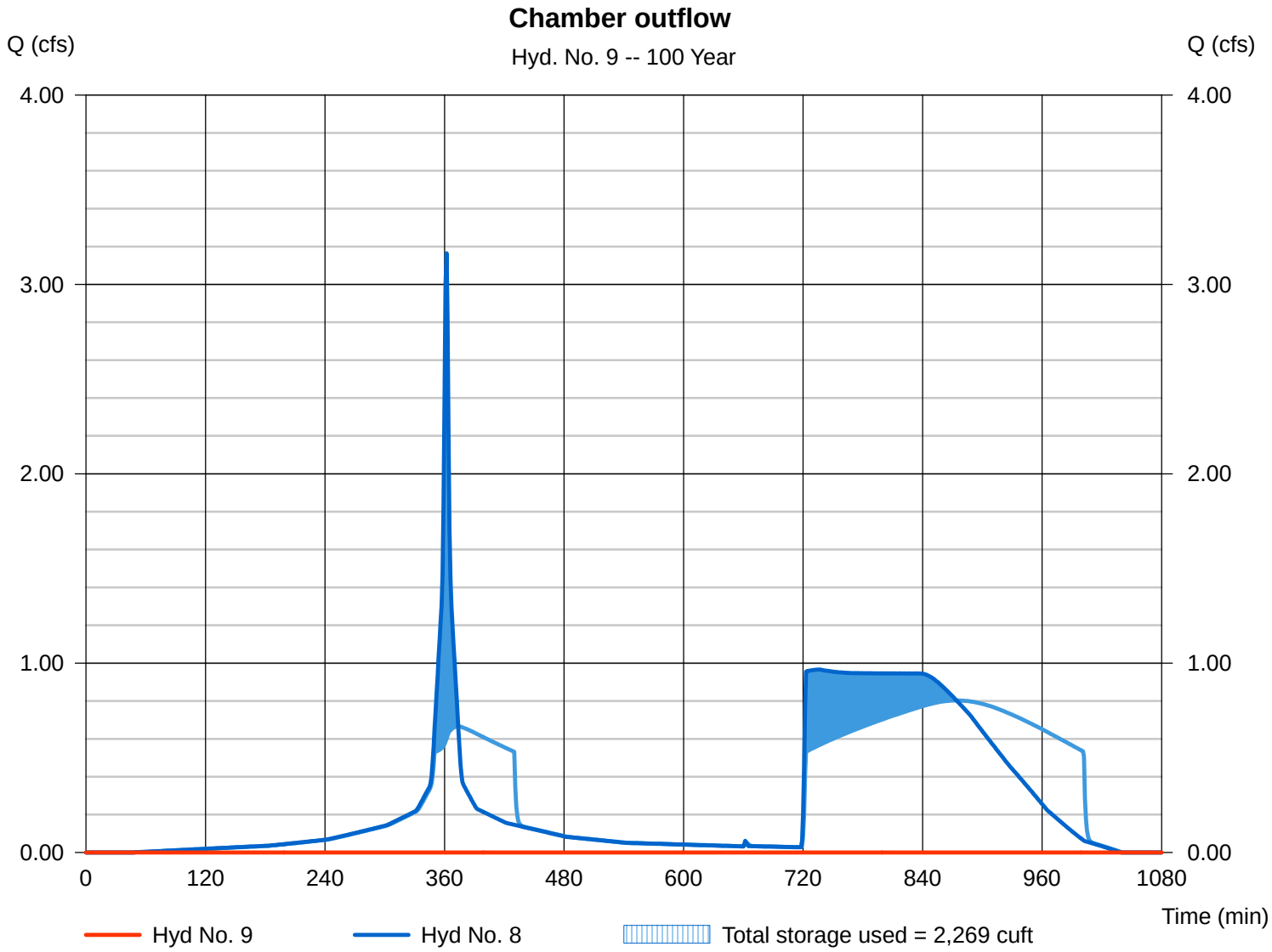
Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jan 22, 2020

Hyd. No. 9

Chamber outflow

Hydrograph type	=	Reservoir	Peak discharge	=	0.000 cfs
Storm frequency	=	100 yrs	Time to peak	=	321 min
Time interval	=	1 min	Hyd. volume	=	0 cuft
Inflow hyd. No.	=	8 - Flow to Chambers	Max. Elevation	=	81.22 ft
Reservoir name	=	Chamber System	Max. Storage	=	2,269 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



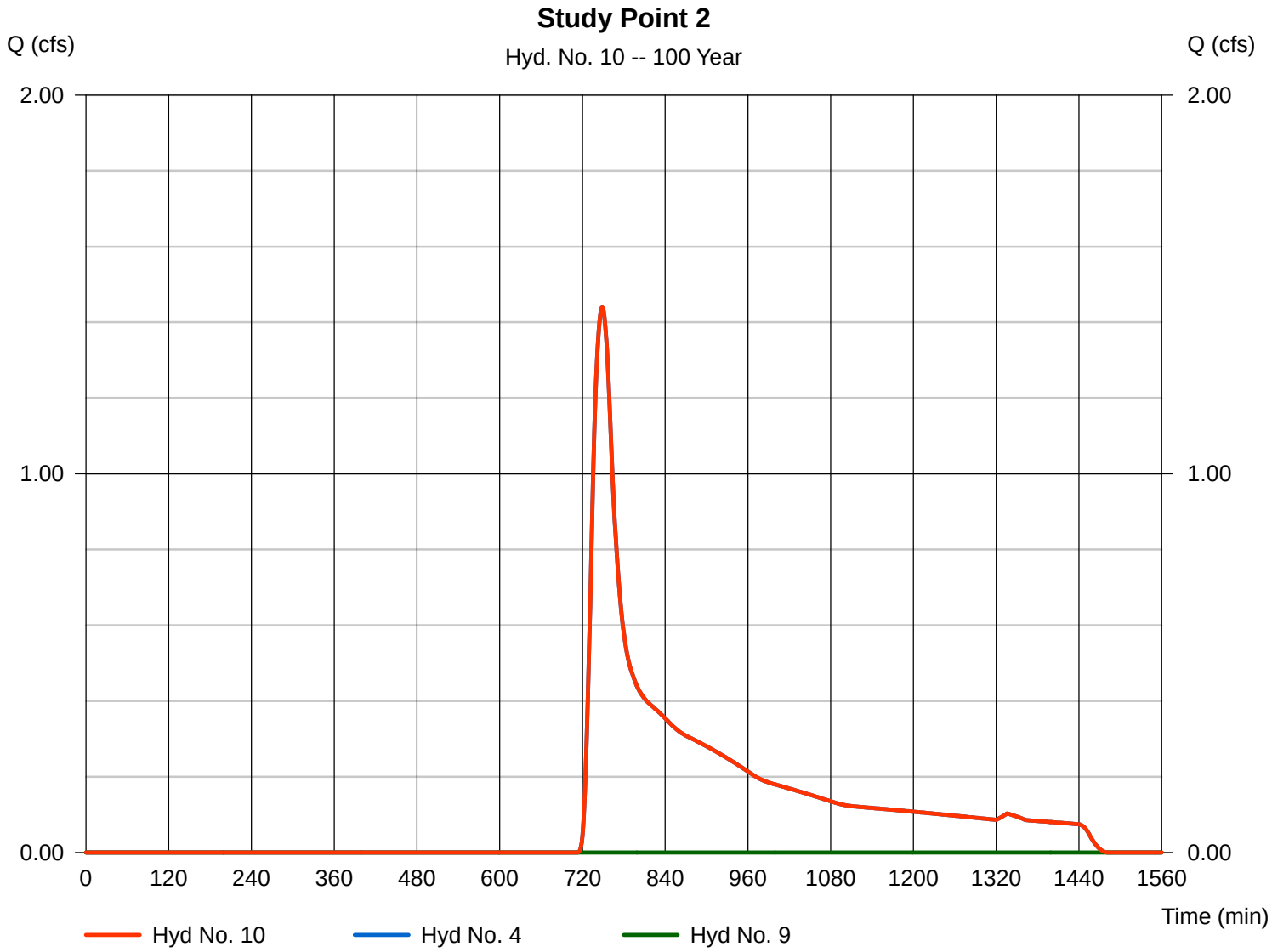
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Wednesday, Jan 22, 2020

Hyd. No. 10

Study Point 2

Hydrograph type	=	Combine	Peak discharge	=	1.440 cfs
Storm frequency	=	100 yrs	Time to peak	=	749 min
Time interval	=	1 min	Hyd. volume	=	10,346 cuft
Inflow hyds.	=	4, 9	Contrib. drain. area	=	2.810 ac



Pond Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jan 22, 2020

Pond No. 1 - Field Model

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 81.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	81.50	5,096	0	0
1.00	82.50	5,096	5,095	5,095
2.00	83.50	5,096	5,095	10,191
3.00	84.50	5,096	5,095	15,286
3.01	84.51	105,250	445	15,731
3.30	84.80	105,250	30,519	46,251

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 6.00	Inactive	0.00	0.00
Span (in)	= 6.00	0.00	0.00	0.00
No. Barrels	= 2	1	0	0
Invert El. (ft)	= 84.00	0.00	0.00	0.00
Length (ft)	= 84.00	0.00	0.00	0.00
Slope (%)	= 1.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

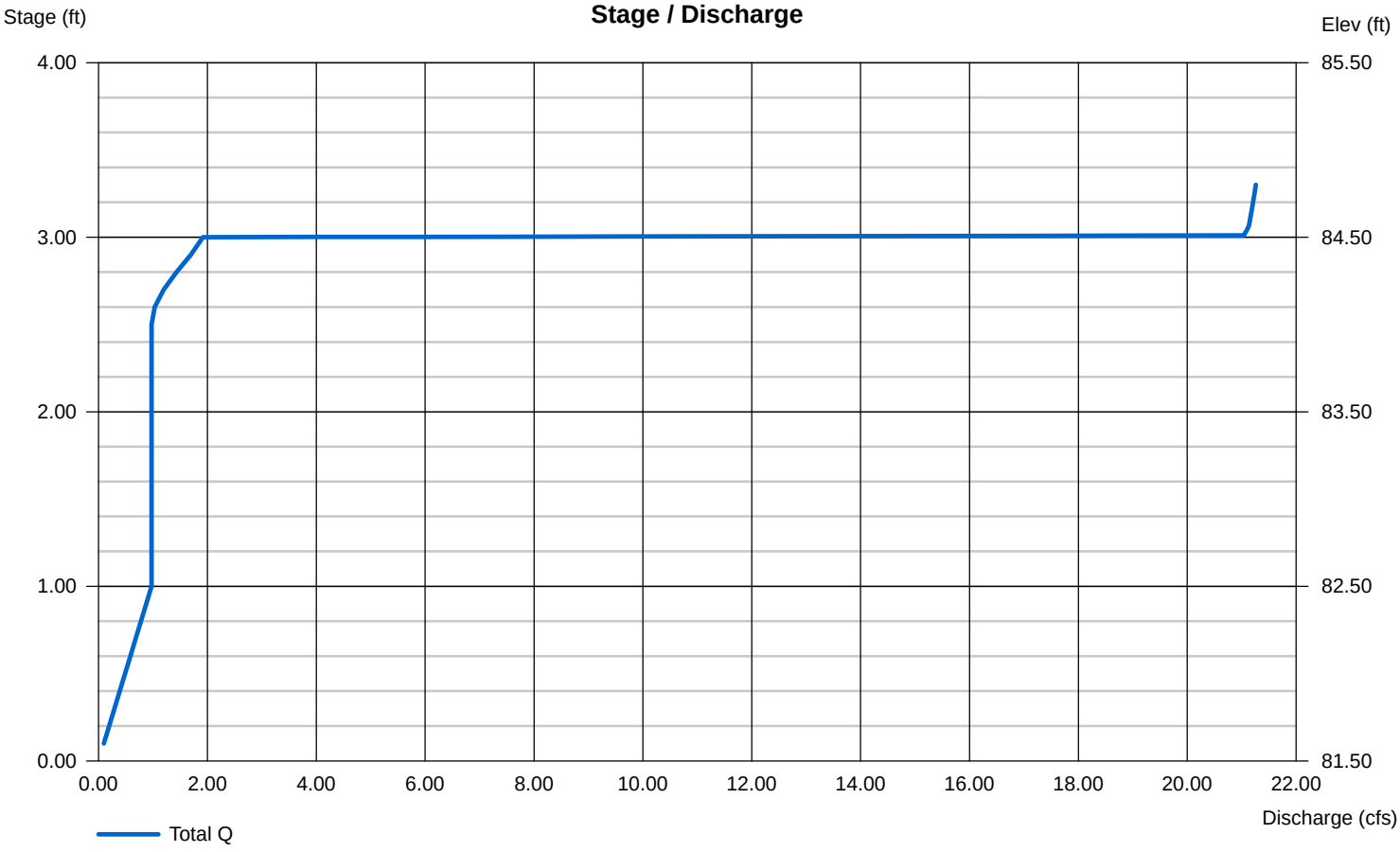
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	Inactive	4.00	0.00	0.00
Crest El. (ft)	= 84.70	389.70	0.00	0.00
Weir Coeff.	= 3.33	2.60	3.33	3.33
Weir Type	= Rect	Broad	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 8.240 (by Contour)

TW Elev. (ft) = 0.00

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



Pond Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Jan 22, 2020

Pond No. 2 - Chamber System

Pond Data

UG Chambers - Invert elev. = 80.00 ft, Rise x Span = 2.50 x 4.33 ft, Barrel Len = 224.00 ft, No. Barrels = 2, Slope = 0.00%, Headers = No

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	80.00	n/a	0	0
0.25	80.25	n/a	484	484
0.50	80.50	n/a	479	964
0.75	80.75	n/a	469	1,433
1.00	81.00	n/a	454	1,887
1.25	81.25	n/a	433	2,320
1.50	81.50	n/a	405	2,725
1.75	81.75	n/a	368	3,093
2.00	82.00	n/a	320	3,413
2.25	82.25	n/a	254	3,667
2.50	82.50	n/a	142	3,810

Culvert / Orifice Structures

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

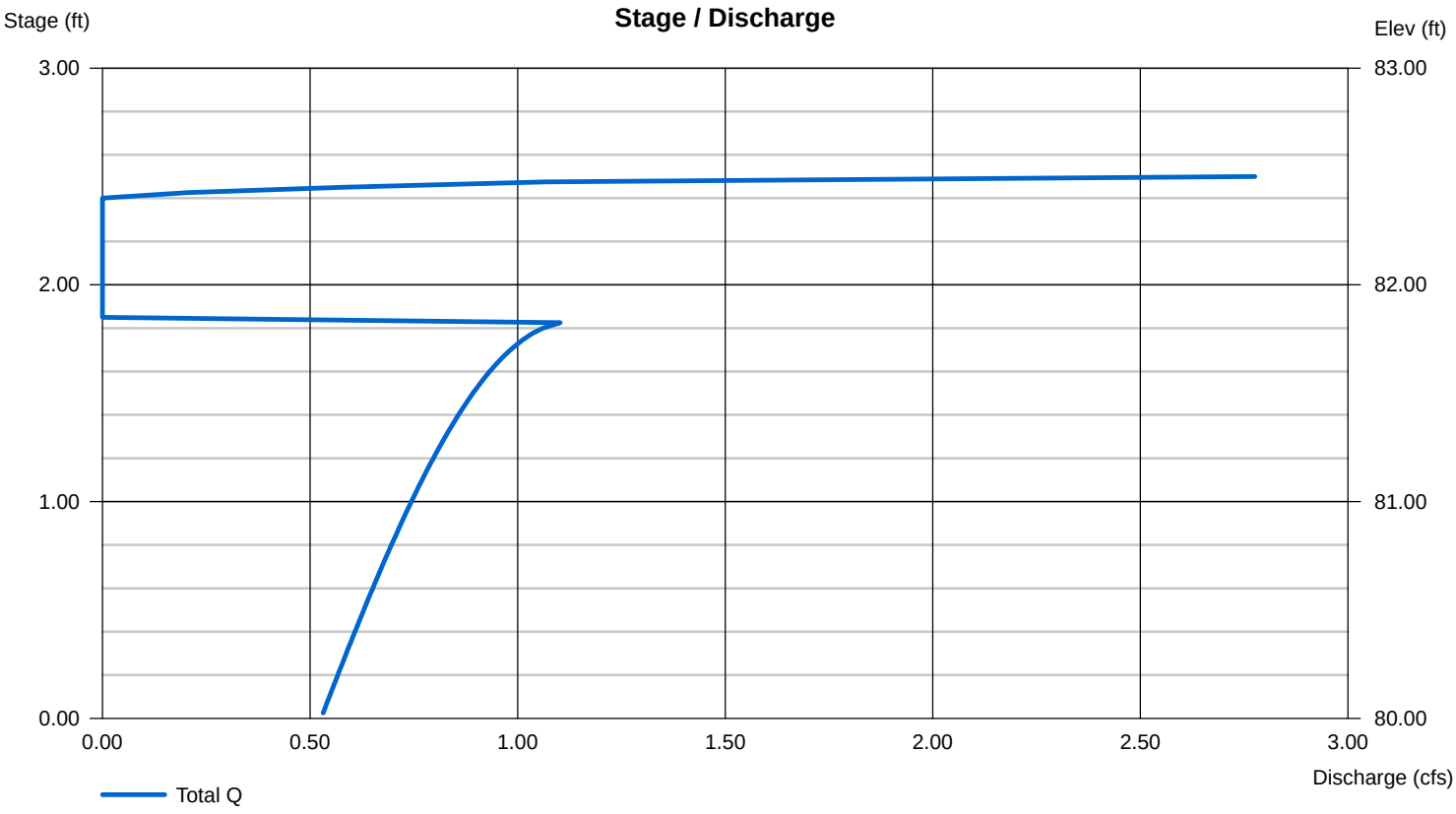
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 20.00	0.00	0.00	0.00
Crest El. (ft)	= 82.40	0.00	0.00	0.00
Weir Coeff.	= 2.60	3.33	3.33	3.33
Weir Type	= Broad	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 8.240 (by Wet area)

TW Elev. (ft) = 0.00

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



APPENDIX 2

Operation & Maintenance Plan

OPERATION AND MAINTENANCE
&
LONG TERM POLLUTION PREVENTION PLAN
FOR POST-CONSTRUCTION STORM WATER CONTROLS

MVRHS FIELD IMPROVEMENT– OAK BLUFFS, MASSACHUSETTS

January 22, 2020

GENERAL

The Best Management Practices (BMPs) used in the design of the MVRHS Field project were chosen for their effectiveness at reducing peak discharge, treating the required Water Quality Volume for total suspended solids (TSS), and infiltrating groundwater. Routine maintenance is required for the BMPs, as proper maintenance is essential in achieving the desired result of improved water quality. This Operations and Maintenance (O&M) and Long Term Pollution Prevention Plan (LTPPP) is intended to cover the post-construction maintenance of the permanent BMPs[1] and site specific pollution prevention.

MAINTENANCE REQUIREMENTS

Qualified personnel shall inspect all components of the stormwater management system as outlined below. To be considered "qualified", personnel should have a working knowledge of the maintenance requirements of storm water BMP's and must be approved by the Oak Bluffs DPW. Qualified personnel shall be responsible for overseeing the required inspections and shall file annual reports with the town of Oak Bluffs officials. Additionally, a copy of the Inspection/Maintenance Log, as further described herein, shall be provided to town of Oak Bluffs officials on an annual basis.

SUMMARY OF MAINTENANCE REQUIREMENTS

BMP	MIN. FREQUENCY	RESPONSIBLE PARTY
Walk & Patio Sweeping	once/quarter	MVRHS
Trash Removal	Inspect once/month Clean as necessary	MVRHS
Catch Basins	Inspect 4x/year Clean once/year	MVRHS
Turf Field (incl. Drainage System)	Inspect once/year Clean as necessary	MVRHS

[1] Operations and maintenance of temporary erosion and sedimentation controls utilized during construction will be covered by a *Stormwater Pollution Prevention Plan* as required by the National Pollutant Discharge Elimination System program of the Environmental Protection Agency, and is not part of this O&M Plan.

RESPONSIBILITY TO ADMINISTER O&M PLAN

During construction, the general contractor will be responsible for maintaining the stormwater management system in accordance with this O&M Plan until such time that ownership of the project or phases thereof are turned over to the owner. The owner is then responsible for maintaining the portions of the stormwater management system under their ownership in accordance with this O&M Plan. This section below (names and signatures) shall be updated with every change in ownership and/or person(s) responsible for administering/financing the O&M of the system.

Owner(s) of the stormwater management system:

Name: _____ Name: _____

Signature: _____ Signature: _____

Person(s) responsible for financing maintenance and emergency repairs:

_____

_____

INSPECTION AND MAINTENANCE LOG

A sample inspection and maintenance log to be used is attached to the end of this O&M Plan. At a minimum, any inspection and maintenance log used shall include the following items:

- Date activity performed
- Specific inspection/maintenance task
- Structural components inspected/maintained
- Staff person or contractor performing activity
- Supervisor verification of maintenance activity
- Recommended additional maintenance tasks

An Annual Report shall be submitted to the Town of Oak Bluff to meet the requirements of the town's Stormwater Management and Erosion Control Regulations.

PROPOSED BMPS AND CORRESPONDING O&M REQUIREMENTS:

WALK AND DRIVEWAY SWEEPING:

Sweeping of impervious surfaces shall be conducted once per quarter. All sweepings shall be handled and disposed of in accordance with applicable local, state and federal guidelines and regulations.

TRASH REMOVAL:

The field areas shall be inspected for litter and trash monthly as part of overall site maintenance. Any accumulated trash, litter and discarded materials in these areas shall be removed.

No disposal of materials will be permitted within the landscaped areas or wooded areas on the Site. This prohibition applies to trash, fill material, construction debris, grass clippings, collected leaves and cut branches.

CATCH BASINS:

The catch basins shall be inspected four times per year for build-up of sediment, oil, and/or other debris which could decrease the effectiveness of the sumps. A qualified company specializing in the cleaning of catch basins shall perform the inspection of catch basins.

Typically a dipstick tube equipped with a ball valve, such as a Sludge Judge®, is used to measure the approximate oil and sediment depth, and a vacuum truck is used to clean out the catch basin. Catch basins shall be cleaned once per year, or sooner if the depth of sediment is found to reach 12 inches. If visual inspection observes any evidence of hydrocarbons, the material shall be immediately cleaned and disposed in accordance with all applicable local, state and federal guidelines and regulations.

As part of the inspection, catch basins should be inspected for structural soundness. Hoods and associated hardware should be inspected to ensure that they are correctly attached and functioning properly. Catch basins shall be repaired or replaced as necessary to ensure proper operation.

Frames and grates should be inspected and repaired or replaced as necessary to ensure proper operation.

SYNTHETIC SPORTS FIELD:

The groundwater recharge system consists of a bed of crushed stone located under the field surface. The purpose of the bed is to infiltrate stormwater runoff back into the aquifer, and as such it is important to preserve the integrity of the field surface.

It is important to occasionally inspect the field to ensure it will continue to function efficiently for the long term. The owner should complete the required maintence as recommended by the manufacturer of the field components.

The field should be inspected annually. If the inspection determine that the field fails to fully drain within 72 hours of a storm event, the responsible party shall retain a qualified engineer to assess the reason for infiltration failure and to recommend corrective action for restoring infiltration function.

LONG TERM POLLUTION PREVENTION:

MAINTENANCE OF LANDSCAPED AREAS:

Fertilizers used for landscaping and lawn areas shall be slow release, low-nitrogen types (<5%) and shall not be used within 25 feet of a wetland resource area, and pesticides/herbicides shall not be used within 100 feet of a wetland resource area. Furthermore, the use of any fertilizers, pesticides, and herbicides shall be in accordance with the manufacturer's recommendations.

WINTER MAINTENANCE OF WALKS AND DRIVES:

Snow storage shall take place on pervious surfaces to the extent practicable to allow the snowmelt to filter through the soil, leaving behind sand and debris that can be removed in the springtime. Snow shall not be stockpiled in drainage collection areas or conveyance channels as this may block the system causing flooding. Furthermore, snow shall not be stored in or within 25 feet of a wetland resource area. No road salt, sodium chloride, or other deicing chemicals shall be used on paved surfaces within 25 feet of a wetland resource area.

STORAGE OF WASTE PRODUCTS:

Any outdoor storage of waste products shall be covered to prevent rainfall from picking up contaminants from the waste. This requirement shall include any dumpster(s) which shall have the lid(s) closed when not being loaded or unloaded.

ILLICIT DISCHARGES:

There shall be no illicit discharges to the stormwater management system. Illicit discharges are defined by 310 CMR 10.04 as follows:

"Illicit discharge means a discharge that is not entirely comprised of stormwater. Notwithstanding the foregoing, an illicit discharge does not include discharges from the following activities or facilities: firefighting, water line flushing, landscape irrigation, uncontaminated ground water, potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, flows from riparian habitats and wetlands, dechlorinated water from swimming pools, water used for street washing and water used to clean residential buildings without detergents."

Prior to the discharge of stormwater runoff to the post-construction stormwater best management practices, an Illicit Discharge Compliance Statement shall be submitted to the Oak Bluff Planning Board verifying that no illicit discharges exist on the site.

EMERGENCY SPILLS

The owner shall provide personnel with a list of emergency contact phone numbers to use to report a spill. At a minimum the list should include the DEP Emergency Response Section, an environmental cleanup contractor such as Clean Harbors, Inc., the Oak Bluff Fire Department, and a contact person/phone number for the owner:

- DEP Emergency Response **1(888)304-1133**
- Clean Harbors, Inc. **1(800)645-8265**
- Oak Bluffs Fire Department **911 or (508) 693-0077**
- Owner (MVRHS) **(508) 693-1033**

While the above-listed phone numbers are current as of the writing of this O&M Plan, the owner shall be responsible for verifying these numbers prior to distribution to the homeowners. Additionally, the owner shall update and redistribute a list of emergency contact phone numbers to the homeowners every other year, or sooner should any changes occur.