PennEast Pipeline Company, LLC

PENNEAST PIPELINE PROJECT

Multi-Permit Application
for
Freshwater Wetlands Individual Permit
Special Activity Transition Area Waiver
Letter of Interpretation
Water Quality Certificate
Flood Hazard Area Individual Permit
Flood Hazard Hardship Exception Request
Flood Hazard Area Verification

ATTACHMENT M-2 – Etown and Gilbert Interconnects Stormwater Management Report

Submitted to:
New Jersey Department of Environmental Protection
Division of Land Use Regulation

August 2019

Etown and Gilbert Interconnects Stormwater Management Report

PennEast Pipeline Project, Holland Township, Hunterdon County NJ

Date July, 2019

PennEast Pipeline Project
353754-MM-EN-CO-010 Rev0

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Etown and Gilbert Interconnects Stormwater Management Report

PennEast Pipeline Project, Holland Township, Hunterdon County NJ

Date July, 2019

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1 Executive Summary

PennEast proposes to construct, install and operate the Project facilities to provide approximately 1.1 million dekatherms per day (MMDth/d) of year-round transportation service from northern Pennsylvania to markets in New Jersey, eastern and southeastern Pennsylvania and surrounding states. The Project is designed to provide a long-term solution to bring the lowest cost natural gas available in the country, produced in the Marcellus Shale region in northern Pennsylvania, to homes and businesses in New Jersey, Pennsylvania and surrounding states.

The Project facilities include a 36-inch diameter, 115-mile mainline pipeline, extending from Luzerne County, Pennsylvania, to Mercer County, New Jersey. The Project will extend from various receipt point interconnections in the eastern Marcellus region, including interconnections with Transcontinental Gas Pipe Line Company, LLC (Transco) and gathering systems operated by Williams Partners L.P., Energy Transfer Partners, L.P. (formerly Regency Energy Partners, LP), and UGI Energy Services, LLC in Luzerne County, Pennsylvania, to various delivery point interconnections in the heart of major northeastern natural gas-consuming markets, including interconnections with UGI Central Penn Gas, Inc., (Blue Mountain) in Carbon County, Pennsylvania, UGI Utilities, Inc. and Columbia Gas Transmission, LLC in Northampton County, Pennsylvania, and Elizabethtown Gas, NRG REMA, LLC, Texas Eastern Transmission, LP (Texas Eastern) and Algonquin Gas Transmission, LLC (Algonquin) in Hunterdon County, New Jersey. The terminus of the proposed PennEast system will be located at a delivery point with Transco in Mercer County, New Jersey.

2 Introduction/Overview

The Project was developed in response to market demands in New Jersey and Pennsylvania, and interest from shippers that require transportation capacity to accommodate increased demand and greater reliability of natural gas in the region. The Project will include a new pipeline and aboveground facilities that will provide a new source of natural gas supply from the Marcellus Shale producing region to New Jersey, Pennsylvania and surrounding states enhancing the region's supply diversity.

The Etown and Gilbert Interconnect site is located in Holland Township, Hunterdon County, NJ (see Figure 1 for Location Map). The site is bounded by lightly wooded area to the west, open areas to the east and south, and residential areas to the north. Access to the site will be through two adjacent existing permanent access roads off Riegelsville Milford Road towards the north. Approximate latitude/ longitude of the center of site are 40.570749° N/ 75.164741° W in WGS84 geographic coordinate system. Under existing conditions, the site is primarily open space area. The applicant proposes to construct pipeline meter and supporting equipment on a gravel pad.

This stormwater management report addresses the NJDEP Stormwater Management Requirements set forth in N.J.A.C. 7:8 for stormwater quantity, quality, and groundwater recharge. The project will disturb more than one acre of land and will not create any new net impervious cover. Hence, the project will be subject to the stormwater quantity and groundwater recharge requirements of N.J.A.C. 7:8. The succeeding sections of this report will address these requirements and demonstrate compliance by this project. Stormwater Management facilities are proposed to meet the regulatory requirements for this type of development.

This report provides an engineering analysis of the stormwater management practices for Etown and Gilbert Interconnect site, which is a part of the PennEast Pipeline Project. The methods of analysis included use of the stormwater modeling software Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2019 by Autodesk, Inc., hydraulic calculations and summary worksheets. The analysis demonstrates compliance with regulatory requirements for the proposed infiltration basin.

The resulting data for the stormwater facilities can be found in Section 3 and in the appendices. The completed model and worksheets show that the post-construction stormwater runoff meets the required peak flow attenuations and that the volume requirements are met. Groundwater recharge requirements were not met in areas where met, since there is no increase in the 2-year runoff volume. The report shows that the proposed stormwater BMPs for the Etown and Gilbert Interconnect site for the PennEast pipeline will allow the proposed project to comply with the applicable regulatory requirements under NJ Stormwater Best Management Practices Manual.

3 Stormwater Management

3.1 Model Development

Peak flow rates under existing and proposed conditions were developed for the 2-year, 10-year and 100-year recurrence intervals, to demonstrate compliance with regulatory requirements. The site is located in an area for which the Natural Resources Conservation Service (NRCS) Type III rainfall distribution is appropriate, as outlined in Technical Release 55 (TR-55), Urban Hydrology for Small Watersheds, June 1986 edition. The 24-hour rainfall depths were obtained from the published New Jersey 24-hour Rainfall Frequency Data for Hunterdon County, NJ.

Peak flow rates were developed using the Autodesk® Hydraflow Hydrographs 2019 software (hereinafter referred to as Hydraflow), which utilizes the TR-55 and TR-20 methodologies for hydrologic calculations and level-pool routing. **Time of concentrations were calculated for sub-areas and a minimum time of concentration of 10 minutes was utilized when the calculated time was less than 10 minutes.** Runoff curve numbers were selected based on land cover and soil type conditions, and in accordance with TR-55. Detailed soil cover complex breakdown tables are included in the Appendix C of this report.

Comprehensive hydrologic peak flow calculation models were set up for existing and proposed conditions using the Hydraflow software, utilizing the level-pool hydraulic routing method. Peak flow outputs from these models under existing and proposed conditions were compared to achieve regulatory compliance.

3.2 Existing Conditions

The site is located on a topographical divide under existing conditions. The ridge line of the divide traverses the site, sloping downwards in a north-to-south direction. Surface runoff from the site flows to three (3) hydrologic points of interest (POI), POI-1 to the southwest, POI-2 to the southeast, and POI-3 to the northeast. For the purposes of this design, peak runoff flows and volumes from onsite (disturbed) and offsite (undisturbed) areas under existing and proposed conditions were computed and compared at these three POIs to demonstrate compliance with the requirement of N.J.A.C. 7:8. **Total contributing drainage area (hereinafter referred to as the study area) is 2.569 acres. This includes 1.873 acres that will be disturbed for staging and/or construction of the proposed facility. The remaining 0.696 acres comprises of offsite areas that will remain undisturbed but contributes to peak flow rates at each POI.** Refer to the drainage area plans for locations of the POIs. The major portion of the study area is open space under existing conditions, with sections of wooded areas within. Based on the NRCS Web Soil Survey, the underlying soils within the study area are primarily Penn channery silt loam, with approximately 82% of the study area having soils of hydrologic soil group C and the remaining 18% classifying as group D.

Mott MacDonald staff conducted onsite geotechnical investigations to classify soils and determine depth to seasonal high water table (SHWT) in accordance with Appendix E of the NJ Stormwater BMP Manual. The Infiltration Testing Report for this site is included in Appendix G (Note: Etown and Gilbert Interconnects Site shown in Infiltration Report for reference). Table 1 below summarizes the findings of the geotechnical investigation which consisted of three borings and three test pits. Mottling, which is indicative of seasonal high groundwater, was not observed nor was groundwater encountered at any of the three test pits.

Table 1: Summary of Geotechnical Borings Data

Boring No.	Existing Grade El. (feet)	Boring Depth (feet)	Groundwater Depth (feet)	Groundwater El. (feet)	SHWT Elevation (feet)
GB-1	252.0	25	N/A	Not Encountered	N/A
GB-2	246.4	11	N/A	Not Encountered	N/A
GB-3	243.6	23	N/A	Not Encountered	N/A

Table 2: Summary of Geotechnical Test Pit Data

Test Pit No.	Existing Grade El. (feet)	Infiltration Test Depth (feet)	Excavated Test Pit Depth (feet)	Groundwater Depth (feet)	Groundwater El. (feet)	Depth to Mottled Soil (feet)	SHWT Elevation (feet)	Depth to Restrictive Layer (feet)
GLTP-1	235.2	3	3	NOT FOUND	Not Encountered	Not Encountered	N/A	3
GLTP-2	234.7	4	4	NOT FOUND	Not Encountered	Not Encountered	N/A	4
GLTP-3	236.4	3	3	NOT FOUND	Not Encountered	Not Encountered	N/A	3

Borings GB-1 through GB-3 are not located within the proposed infiltration basin. GLTP-1 is located just outside of the basin. GLTP-2 and GLTP- 3 are located within the proposed infiltration basin. Bed rock was encountered and infiltration rates were obtained using the basin flood test as described in the NJ Stormwater BMP Manual Appendix E. **The average design infiltration rate for GLTP-2 and 3 was 0.5 inches/hour.** Due to the location of GLTP-1 as explained earlier, the infiltration rates from GLTP-1 were not considered. The summary of the infiltration tests is indicated in table below.

Table 3: Summary of Infiltration Testing

Test Pit No.	Existing Grade El. (feet)	Testing El. (feet)	Infiltration Rate (in/hr.)
GLTP-1	235.2	232.2	0.0
GLTP-2	234.7	230.7	0.5
GLTP-3	236.4	233.4	0.5
Observed Overall Rate			**0.5**
Design Infiltration Rate*			**0.5**

**The basin flood test provides a design infiltration rate with the safety factor built in, as opposed to an observed infiltration rate with a safety factor applied.*

3.3 Proposed Conditions

As explained in the earlier sections of this report, proposed work will disturb more than 1 acre of land but create no new impervious cover. As such, the water quality requirements of N.J.A.C. 7:8 are not triggered as part of this project. Stormwater must be managed to address the quantity and groundwater recharge requirements of N.J.A.C. 7:8. The equipment pad will be constructed of gravel which is considered not impervious per NJDEP regulations. **Under proposed conditions, of the total 1.873 acres of disturbed areas, 0.733 acres will be converted to gravel cover for the equipment pad, and the remaining 1.14**

acres will be seeded and/or planted at the end of construction activity to stabilize the area. Seeding will include species that are suited for the project area based on USDA plant hardiness zones. Planting will comprise of dense upland shrub planting in the areas adjacent to the creek where disturbance to existing wooded trees is expected. The area along the outfall pipe will be seeded to maintain ease of access for future maintenance activities. Refer to the plans for location, details and schedule of proposed seeding mix and shrub planting.

To meet the regulatory requirements, an infiltration basin will be constructed adjacent to the equipment pad. The equipment pad has been graded to gently slope and maintain sheet flow from north to south, towards the infiltration basin. The infiltration basin is designed to attenuate the runoff peak flows from proposed conditions to meet the reduction requirements of N.J.A.C. 7:8. It has been graded to maintain 2' of separation from the bedrock, as previously noted no evidence of the seasonal high water table was observed within 2' of the basin invert. The primary orifice of the basin will be set 1-ft above the basin invert to provide dead storage for the difference in 2-year runoff volume (Δ2). The bottom of the infiltration basin will be supplemented with 6 inches of K5 sand to facilitate infiltration and groundwater recharge.

3.3.1 Stormwater Quantity (N.J.A.C. 7:8-5.4)

For the purposes of stormwater management calculations, the entire study area was divided into four (4) drainage areas. Under existing conditions, SUB-1 and SUB-4 flow towards POI-1, EXDA-2 flows towards POI-2, and EXDA-3 flows towards POI-3. Due to proposed grading, the drainage patterns will change on site and a major portion will flow towards the proposed basin. Under proposed conditions, SUB-4 and SUB-2 will flow towards POI-1. SUB-1 will be routed through the basin and ultimately outfall at POI-1. SUB-3 will flow towards POI-2, and EXDA-3 will flow towards POI-3. **It is noted that no grading or changes in land cover is proposed within EXDA-3. The work areas within EXDA-3 that will be temporarily disturbed from construction activities will be promptly restored to existing conditions. As such, no change in the time of concentration or peak flow rates are expected at POI-3.** This is demonstrated in the flow summary and hydrographs in the subsequent sections of this report.

To meet the State stormwater quantity requirements, an infiltration basin (BASIN-1) is proposed at this site location, as indicated previously. The bottom of the basin will be at elevation 233.0'. The top of basin berm will be at elevation 237.35', with an emergency spillway at elevation 236.35'.

The infiltration basin will temporarily hold increased stormwater peak flows from the site (SUB-1), provide attenuation, and slowly release the runoff through an outlet structure. The outlet structure will have 6" wide and 4" high rectangular primary orifices located 1.0' above the bottom of the basin (EL. 234.00'), a secondary 5" circular orifice (El. 234.85'), and a riser (El. 235.85') to safely convey up to the 100-year peak flows from the site. **This arrangement will reduce the peak flows under proposed conditions to meet the 50%, 75% and 80% reduction requirements set forth under N.J.A.C. 7:8. Note that for calculation purposes, the reductions are applied only to the areas that will be disturbed for proposed construction work (1.873 acres).**

Peak flow summary table below demonstrate the overall reductions achieved in peak flows under proposed conditions. Existing Total Q represents stormwater peak flow rates generated from actual site existing conditions. Target Q peak flow rates were calculated by applying the reduction criteria to proposed disturbed areas. The proposed Q peak flows represent calculated flows after attenuation by stormwater management facilities. **For EXDA-3 (@ POI-3), no reductions are applied, the target flow is the sum of flows from disturbed and undisturbed areas. It is demonstrated in this report that the proposed hydrograph from EXDA-3 (@ POI-3), for the 2, 10 and 100-year storms do not exceed, at any point in time, the corresponding existing conditions hydrographs.**

Table 4: Peak Flows Summary

	EXISTING CONDITIONS (EXDA-1)			TARGET FLOWS		
RECURRENCE INTERVAL	DISTURBED Q (CFS)	UNDISTURBED Q (CFS)	TOTAL = DIST+UNDIST (CFS)	REDUCTION FACTOR (PER N.J.A.C. 7:8)	REDUCED DISTURBED Q (CFS)	TARGET Q = UNDISTURBED+ REDUCED DISTURBED (CFS)
2	0.70	0.56	1.26	50%	0.35	0.91
10	1.44	0.83	2.28	75%	1.08	1.91
100	2.99	1.35	4.33	80%	2.39	3.73

	EXISTING CONDITIONS (EXDA-4)			TARGET FLOWS		
RECURRENCE INTERVAL	DISTURBED Q (CFS)	UNDISTURBED Q (CFS)	TOTAL = DIST+UNDIST (CFS)	REDUCTION FACTOR (PER N.J.A.C. 7:8)	REDUCED DISTURBED Q (CFS)	TARGET Q = UNDISTURBED+ REDUCED DISTURBED (CFS)
2	0.21	0.26	0.47	50%	0.11	0.37
10	0.43	0.38	0.80	75%	0.32	0.70
100	0.86	0.61	1.47	80%	0.69	1.30

OVERALL FLOWING WEST OF THE SITE TO POI-1

	EXISTING CONDITIONS (EXDA-1 + EXDA-4)			TARGET FLOWS			PROPOSED CONDITIONS (SUB-1 + SUB-2 + EXDA-4)	
RECURRENCE INTERVAL	DISTURBED Q (CFS)	UNDISTURBED Q (CFS)	TOTAL = DIST+UNDIST (CFS)	REDUCTION FACTOR (PER N.J.A.C. 7:8)	REDUCED DISTURBED Q (CFS)	TARGET Q = UNDISTURBED+ REDUCED DISTURBED (CFS)	PROPOSED Q (CFS)	PROPOSED LESS THAN TARGET?
2	0.92	0.82	1.73	50%	0.46	1.28	1.26	YES
10	1.87	1.21	3.08	75%	1.40	2.61	2.42	YES
100	3.84	1.95	5.80	80%	3.08	5.03	4.79	YES

@ POI-2 (FLOWING SOUTH-EAST OF THE SITE)

EXISTING CONDITIONS (EXDA-2)				TARGET FLOWS			PROPOSED CONDITIONS (SUB-3)	
RECURRENCE INTERVAL	DISTURBED Q (CFS)	UNDISTURBED Q (CFS)	TOTAL = DIST+UNDIST (CFS)	REDUCTION FACTOR (PER N.J.A.C. 7:8)	REDUCED DISTURBED Q (CFS)	TARGET Q = UNDISTURBED+ REDUCED DISTURBED (CFS)	PROPOSED Q (CFS)	PROPOSED LESS THAN TARGET?
2	1.04	0.51	1.55	50%	0.52	1.03	0.97	YES
10	2.17	0.76	2.93	75%	1.63	2.39	1.72	YES
100	4.55	1.24	5.78	80%	3.64	4.87	3.21	YES

@ POI-3 (FLOWING NORTH-EAST OF THE SITE)

EXISTING CONDITIONS (EXDA-3)				TARGET FLOWS			PROPOSED CONDITIONS	
RECURRENCE INTERVAL	DISTURBED Q (CFS)	UNDISTURBED Q (CFS)	TOTAL = DIST+UNDIST (CFS)	REDUCTION FACTOR (PER N.J.A.C. 7:8)	REDUCED DISTURBED Q (CFS)	TARGET Q = UNDISTURBED+ REDUCED DISTURBED (CFS)	PROPOSED Q (CFS)	PROPOSED LESS THAN TARGET?
2			0.75	50%	0.00	0.75	0.75	YES
10			1.21	75%	0.00	1.21	1.21	YES
100			2.10	80%	0.00	2.10	2.10	YES

**Note: For EXDA-3, attached hydrographs demonstrate that the proposed conditions hydrograph at no point, exceeds the existing conditions hydrograph, thereby demonstrating compliance with the requirements of N.J.A.C. 7:8. Existing cover will be reinstated in this drainage area at the completion of construction activities. Since no grading or change in land cover is proposed in this drainage area, no change in time of concentration is expected.*

As demonstrated in the peak flow summary tables, the peak flow reduction requirements per N.J.A.C. 7:8-5:4 are met at POIs by the proposed stormwater management design. Detailed peak flow and level pool routing calculations are included in the appendices of this report.

3.3.2 Stormwater Quality (N.J.A.C. 7:8-5.5)

In accordance with the NJDEP requirements set forth in N.J.A.C. 7:8 for stormwater runoff quality, water quality treatment measures are required when a proposed development proposes to introduce 0.25 acres of new impervious cover. Per the NJDEP FAQs section 10.3, new gravel is not considered impervious under the Stormwater Management Rules. **Since the new impervious cover for the project does not exceed 0.25 acres, the stormwater quality requirements set forth in N.J.A.C. 7:8-5.5 do not apply.**

3.3.3 Groundwater Recharge (N.J.A.C. 7:8-5.6)

The project is not located within a PA-1: Metropolitan Development Area, Urban Enterprise Zone, hydric soils or other groundwater recharge exempt area. In addition, as indicated previously, the project proposes to disturb more than 1 acre of land. As such, compliance with groundwater recharge requirements set forth in N.J.A.C. 7:8 is required.

To demonstrate compliance with the groundwater recharge requirements, this stormwater management design proposes to store and completely infiltrate the difference in the 2-year 24-hour runoff volume (Δ2) by means of an infiltration basin, as shown on the plans. **Note that as per the NJDEP requirements, the infiltrated volume lost through recharge is not accounted for in stormwater quantity peak flow calculations. This is a conservative approach, the basin as designed is expected to meet the reduction requirements up to and including the 100-year storm even during an event of temporary failure of infiltration capacity due to clogged media, abnormal high groundwater, or other conditions that can inhibit infiltration.**

As indicated in table below, the difference in 2-year runoff volume between existing and proposed conditions is 3,049 cubic ft (0.07 ac-ft). A total storage of 3,181 cubic ft is provided below the low flow orifice of the infiltration basin to hold the Δ2 runoff volume and infiltrate completely on site. The water surface elevation within the infiltration basin for 3,181 cubic ft is El. 234.00, recall that the bottom of the infiltration basin is at elevation 233.0'. **Using the design infiltration rate of 0.50 inches/hour as indicated previously, the 12 inches (234.00'-233.0') of standing water within the basin is expected to completely infiltrate in (12 inches ÷ 0.50 inches/ hour) 24 hours. The 100-year peak stage in the basin is EL. 235.84', the peak occurs at 12.50 hours. This drains down to El. 234.0' in 18.8 hours. Total, the basin will be empty in 42.80 hours (24+18.80). As such, no prolonged ponding in excess of 72 hours inside the basin that can favor breeding of pests is expected.** The bottom of the infiltration basin will be supplemented with 6 inches of K5 sand to facilitate infiltration and groundwater recharge. Dewatering calculations are provided in the appendices of this report.

Table 5: Runoff Volumes Recharge Summary

DIFFERENCE IN 2-YEAR 24-HOUR RUNOFF VOLUMES	
EXISTING 2-YEAR 24-HR RUNOFF VOLUME, AC-FT	0.370
PROPOSED 2-YEAR 24-HR RUNOFF VOLUME, AC-FT	0.440
DELTA 2-YEAR RUNOFF VOLUME, CU.FT	3,049
INFILTRATION VOLUME PROVIDED	
INFILTRATION VOLUME BELOW PRIMARY ORIFICE IN NORTH-BASIN, CU. FT	3,181
MAXIMUM VOLUME REQUIRED, CU. FT	3,049
TOTAL STORAGE VOLUME PROVIDED GREATER THAN REQUIRED	**YES**

As demonstrated in the volume recharge summary table, the groundwater recharge area will hold and completely infiltrate the difference in the 2-year runoff volume between existing and proposed conditions, thereby meeting the groundwater recharge requirements set forth in N.J.A.C. 7:8-5.6. Detailed Δ2 runoff volume and dewatering calculations are included in the appendices of this report.

3.3.4 Stormwater Conveyance System Design

The proposed pipes are sized to collect and safely convey the peak flows from a 100-year recurrence interval. As indicated earlier, the equipment pad has been graded to gently slope from north to south, towards the infiltration basin. To the west of the proposed site, outflow from the infiltration basin will be collected and conveyed by means of 15" RCP pipes that will ultimately discharge into a scour hole, to dissipate energy prior to runoff entering the existing stream. Past the scour hole, runoff will flow into a small stream to the west of the site. **The scour hole has been sized to adequately dissipate energy for the 100-year outflow from the pipes.**

3.3.5 Soil Erosion and Sediment Control

The soil erosion and sediment control BMPs for this earth disturbance activity have been planned to minimize the extent and duration of the proposed earth disturbance, to protect existing drainage features

and vegetation, minimize soil compaction, and employ measures and controls that minimize the generation of increased runoff. Specific BMPs have been selected for this site to achieve these broad goals. The location of each proposed BMP is shown on the SESC Plan Drawing 025-03-03-003.

Stabilized Construction Entrance

Stabilized construction entrances are specified on the SESC Plan Drawing to control sediment tracking from the construction site at the egress points to the paved roadways. The stabilized construction entrance detail is presented on Drawing 025-03-05-002 (Figure 1).

Compost Filter Sock

Compost filter sock is presented on the SESC Plan Drawing as a perimeter control for disturbed areas at the facility site and the adjacent staging area. The compost filter sock detail is presented on Drawing 025-03-05-002 (Figure 10).

Erosion Control Blanket

In accordance with the notes listed on Drawing 025-03-05-003 (Figure 17), erosion control blanket is to be placed on disturbed slopes 3H:1V and steeper. Areas to be blanketed are indicated on the SESC Plan Drawing.

Compost Sock Sediment Trap

Compost sock sediment traps can be installed, used, and later removed with relatively little disturbance to the area. A compost sock sediment trap is proposed in the southwest corner of the site to provide treatment for site runoff flowing toward the stream.

Waterbars

Two waterbars with a sump outlet at the downstream end of each are proposed in the southwest corner of the site to control runoff flowing toward the stream. The locations of the waterbars are indicated on the SESC Plan Drawing. The waterbar and sump details are presented on Drawing 025-03-05-002 (Figures 9 and 10).

Sediment Basin

The use of a properly designed sediment basin, in combination with other erosion control standards can significantly reduce both volumetric and pollution transport problems associated with soil erosion from construction sites. The proposed infiltration basin on the south side of the proposed pad area (as shown on the SESC Plan Drawing) will be used during construction as a temporary sediment basin, less 6 inches of depth. The final 6 inches of depth will be excavated as part of final site stabilization to convert the sediment basin into the stormwater infiltration basin. Sizing calculations for the sediment basin are located in Appendix I.

3.3.6 Implementation of Non-Structural Stormwater Management

N.J.A.C. 7:8 requires to the maximum extent practicable, the requirements be satisfied by incorporating nonstructural stormwater management strategies into the design. If these measures are not sufficient to satisfy the regulatory requirements, structural management measures may be incorporated into the design. Nonstructural stormwater management measures have been utilized to the maximum extent practicable for this project. To demonstrate compliance with the nonstructural management strategies requirement of N.J.A.C. 7:8, the nine nonstructural strategies identified in the New Jersey Stormwater Best Management Practices Manual have been considered as below.

The first nonstructural stormwater management strategy is to protect areas that provide water quality benefits of areas particularly susceptible to erosion and sediment loss. Soil erosion and sediment control plans have been prepared for this project, and will be submitted to Hunterdon County Soil Conservation District for review and certification prior to commencement of construction. The project has also been located in an existing open space area rather than forested or other sensitive area.

The second nonstructural stormwater management strategy is to minimize impervious surfaces and break up or disconnect the flow of runoff over impervious surfaces. As indicated in earlier sections of this report, no new impervious cover is proposed for this project, the equipment pad will be constructed of gravel.

The third nonstructural stormwater management strategy is to maximize the protection of natural drainage features and vegetation. Soil erosion measures have been implemented to minimize land disturbance beyond the limits of construction. The designated limit of disturbance identified on the plans will extend only to the limit necessary to achieve the project goals. Soil erosion control devices will help demarcate the limit of disturbance and serve as form of perimeter access control. The contractor will not allow his work crews to disturb areas outside of the limit of disturbance as shown on the plans without prior authorization from Hunterdon County Soil Conservation District.

The fourth nonstructural stormwater management strategy is to minimize the decrease in the pre-construction Time of Concentration. This is accomplished through the use of gravel which is rougher than pavement and thus produces a longer time of concentration, minimizing the decrease in time of concentration as required. The infiltration basin also increases the time of concentration by providing attenuation to the peak flows generated from the pad.

The fifth nonstructural stormwater management strategy is to minimize land disturbance, including clearing and grading. Land disturbance for this project will only occur in areas where disturbance is necessary to accomplish the project goals. Soil erosion control devices utilized in the field will help to demarcate the limit of disturbance and serve as form of perimeter access control, thereby preventing any accidental disturbance outside of the project limits. In addition, the pad is located in existing open space to reduce clearing.

The sixth nonstructural management strategy is to minimize soil compaction. Soil compaction will be required only for the basin embankment where it will be necessary to prevent groundwater piping. The plans call for the invert of the infiltration basin to be protected during construction. The equipment pad will be constructed with gravel cover. No additional soil compaction is required for this project.

The seventh nonstructural stormwater management strategy is planting of native vegetation and low maintenance landscaping that encourages retention. Outside of the footprint of the equipment pad and infiltration basin, all other areas will be planted with native vegetation as final surface restoration.

The eighth nonstructural stormwater management strategy is to provide vegetated open channel conveyance systems that discharge into and through stable vegetated areas. The site runoff sheet flow into the infiltration basin. There are no stormwater catchment basins proposed on site.

The ninth nonstructural stormwater management strategy is to provide preventive source controls. As indicated earlier, soil erosion control devices will be implemented during construction to prevent pollutants and sediments from being introduced to stormwater runoff that flows offsite.

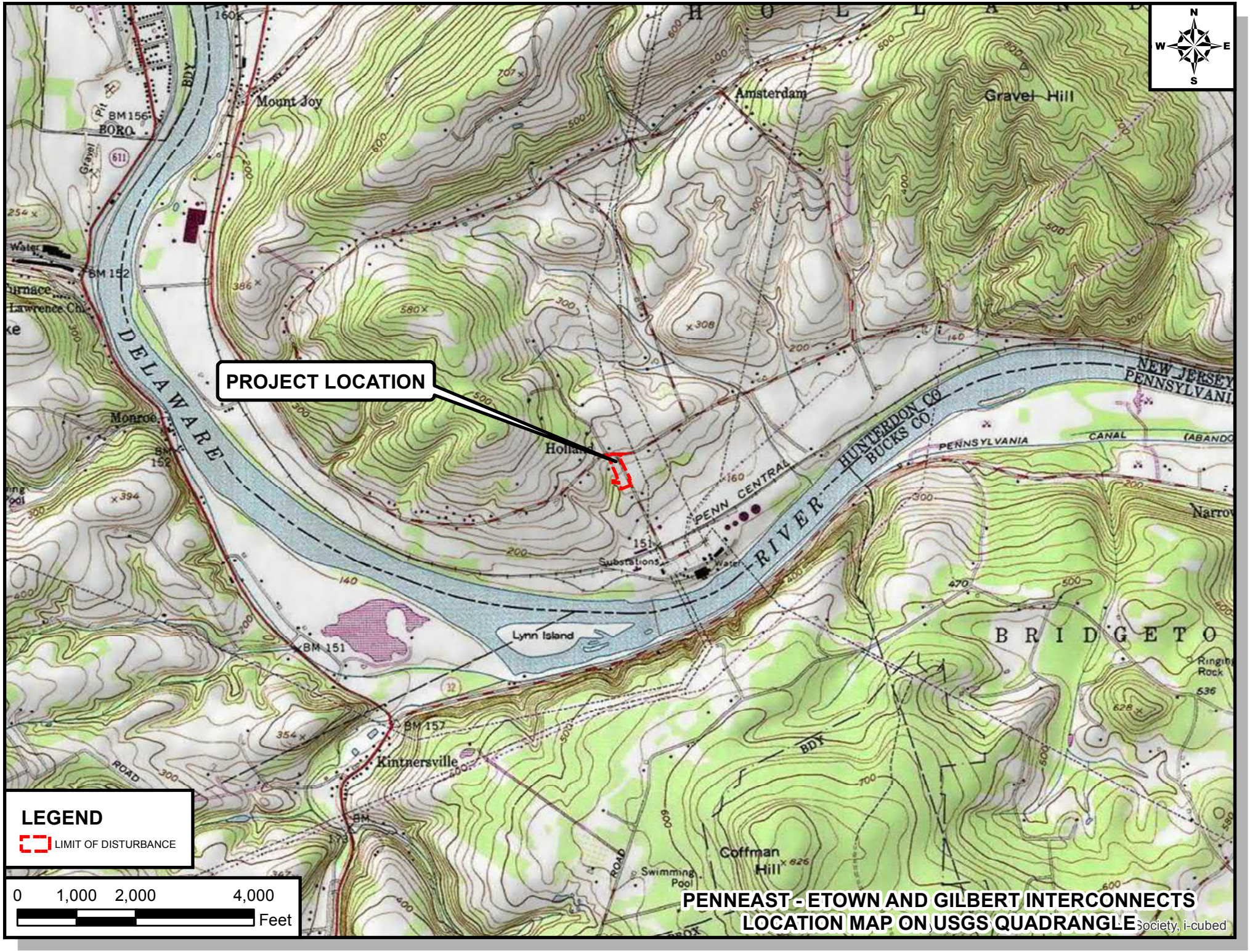
4 Conclusion

As demonstrated in earlier sections of this report, the stormwater management facilities proposed for this site are expected to adequately collect and safely convey the peak runoff flows from the site and offsite areas. The stormwater quantity requirements set forth in N.J.A.C. 7:8-5.4 will be met by providing runoff attenuation in the groundwater recharge area and the infiltration basin proposed on site. Stormwater quality requirements set forth in N.J.A.C. 7:8-5.5 are not triggered since the design creates less than 0.25 acres of new impervious cover. The groundwater recharge requirements set forth in N.J.A.C. 7:8-5.6 will be met by infiltration the difference in 2-year runoff volume in the proposed groundwater recharge area.

Through the use of approved BMPs, the site also meets the soil erosion and sediment control standards as required by N.J.S.A. 4:24-39 et seq. and N.J.A.C. 2:90-1.1 et seq.

Appendices

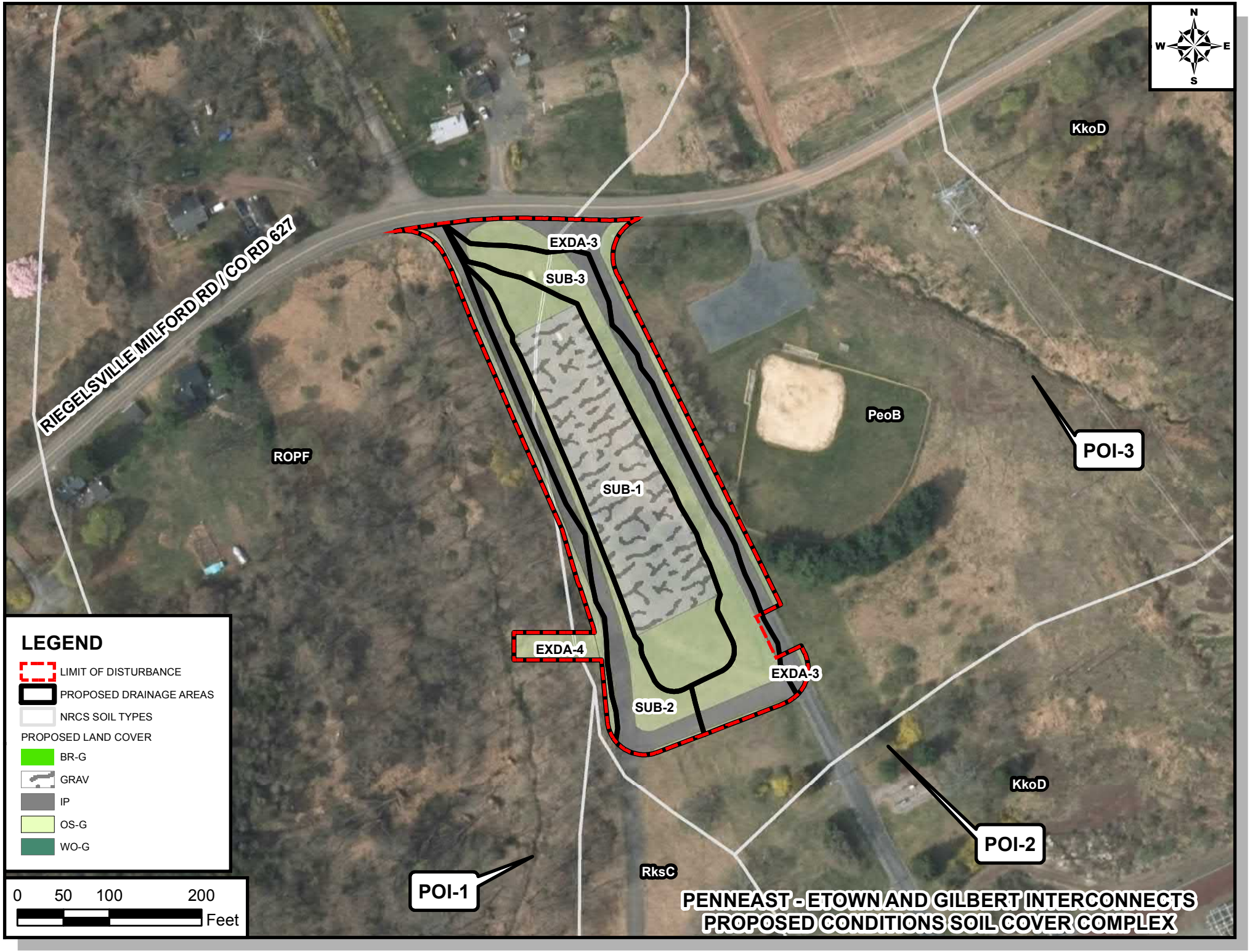
A. Existing and Proposed Drainage Area Plans

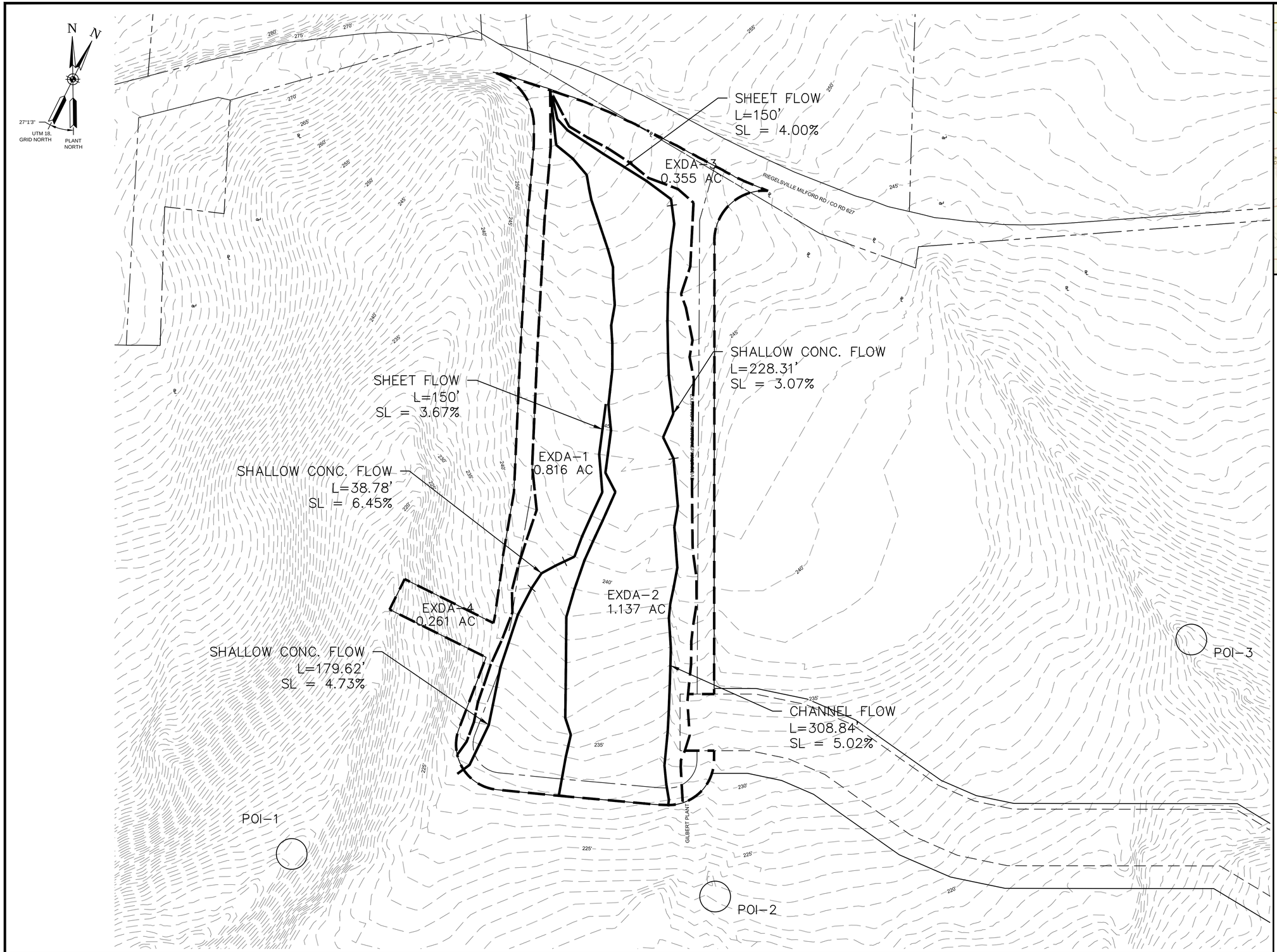


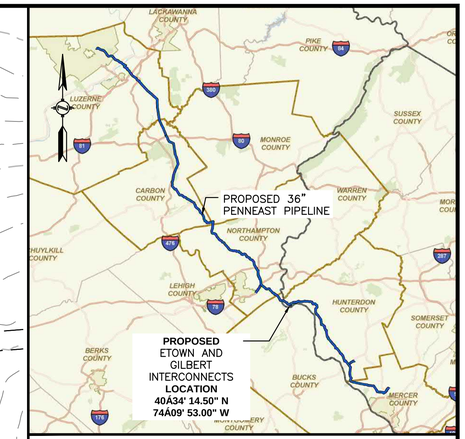
PENNEAST - ETOWN AND GILBERT INTERCONNECTS
LOCATION MAP ON USGS QUADRANGLE

N
W
E
S
RIEGELSVILLE MILFORD RD / CO RD 627
PROJECT LOCATION
POI-3
POI-2
POI-1
LEGEND
LIMIT OF DISTURBANCE
ELEVATION (FT NAVD88)
<225
225-250
250-300
300-400
>400
0 50 100 200
Feet
PENNEAST - ETOWN AND GILBERT INTERCONNECTS
GENERAL TOPOGRAPHY

N
W
E
S
KkoD
RIEGELSVILLE MILFORD RD / CO RD 627
EXDA-3
PeoB
POI-3
ROPF
EXDA-2
EXDA-1
EXDA-4
EXDA-3
KkoD
POI-2
RksC
POI-1
LEGEND
LIMIT OF DISTURBANCE
EXISTING DRAINAGE AREAS
NRCS SOIL TYPES
EXISTING LAND COVER
IP
IP-D
OS-G
OS-G-D
WO-G
WO-G-D
0 50 100 200
Feet
PENNEAST - ETOWN AND GILBERT INTERCONNECTS
EXISTING CONDITIONS SOIL COVER COMPLEX


N
W
E
S
KkoD
RIEGELSVILLE MILFORD RD / CO RD 627
EXDA-3
SUB-3
PeoB
POI-3
ROPF
SUB-1
EXDA-4
EXDA-3
SUB-2
KkoD
POI-2
RksC
POI-1
LEGEND
LIMIT OF DISTURBANCE
PROPOSED DRAINAGE AREAS
NRCS SOIL TYPES
PROPOSED LAND COVER
BR-G
GRAV
IP
OS-G
WO-G
0 50 100 200
Feet
PENNEAST - ETOWN AND GILBERT INTERCONNECTS
PROPOSED CONDITIONS SOIL COVER COMPLEX





LOCATION MAP
SCALE: 1" = 15 MILES

0 40' 80'
SCALE: 1" = 40'

811 Know what's below. Call before you dig.

JOHN R. DENING
PROFESSIONAL ENGINEER
N.J. LIC. NO. 24GE04551700

SIGNATURE DATE

REFERENCE:
1. EXISTING CONTOURS SHOWN WERE SURVEYED BY MOTT MACDONALD DURING 2015 THRU 2019. ADDITIONAL EXISTING CONTOURS WERE PROVIDED BY PICTOMETRY, 2015 AND SUPPLEMENTED FROM USGS.
2. SITE TOPOGRAPHIC AND FEATURE SURVEY PERFORMED BY MOTT MACDONALD 2015 THRU 2019.
3. PROPERTY INFORMATION ON THIS PLAN BASED ON GIS TAX MAP DATA AND RECTIFIED PROPERTY LINES AND ARE NOT THE RESULT OF A BOUNDARY SURVEY.
4. ENVIRONMENTAL INFORMATION PROVIDED BY PS&S 2015 THRU 2019.
5. THE HORIZONTAL COORDINATE SYSTEM IS THE NEW JERSEY STATE PLANE COORDINATE SYSTEM (NAD83) AND VERTICAL DATUM IS THE NORTH AMERICAN DATUM OF 1988 (NAVD88).

REFERENCE DRAWINGS

DWG. NO.	TITLE

REVISIONS

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PREPARED FOR
PennEast PIPELINE

PREPARED BY
MOTT MACDONALD
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CERTIFICATE NO. 24GA28016600

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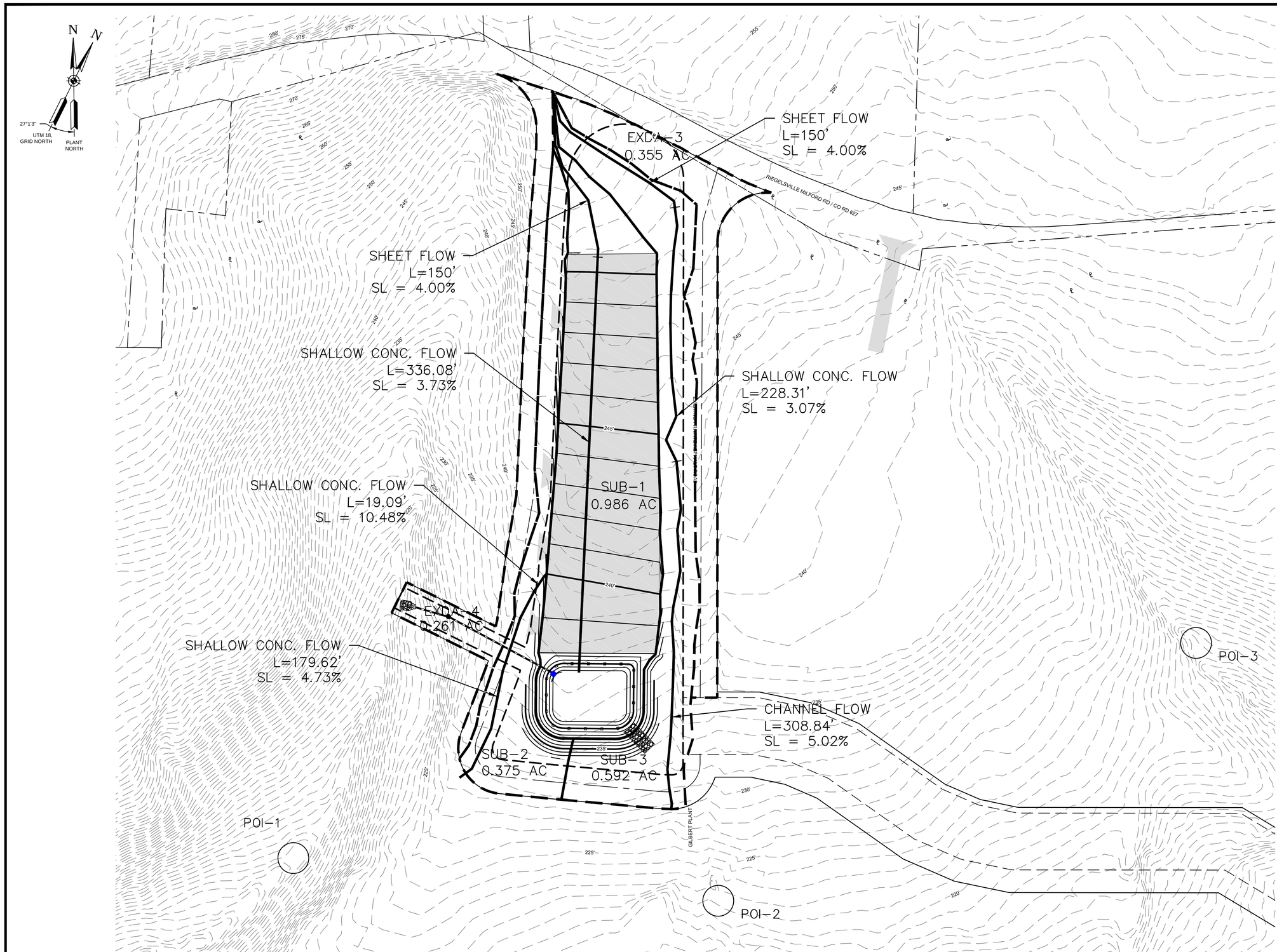
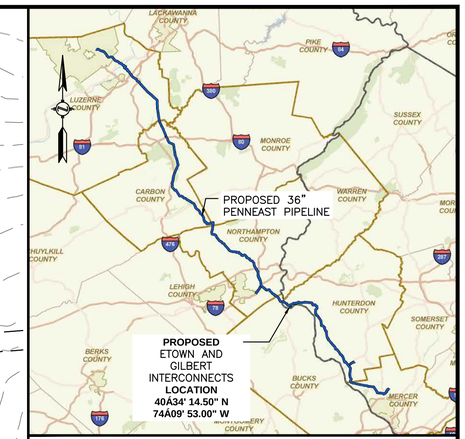
PENNEAST PIPELINE PROJECT
ETOWN AND GILBERT INTERCONNECTS
EXISTING DRAINAGE AREAS PLAN
HUNTERDON COUNTY, NEW JERSEY

DRAWN BY	DATE ISSUED	
CHECKED BY	SCALE	AS SHOWN
APPROVED BY	APPROVED BY	
DWG. NO.		REV. NO.

G:\353754 PENNEAST\STORMWATER\ETOWN AND GILBERT INTERCONNECTS\DWG\PLANS\EXISTING DRAINAGE AREAS PLAN.DWG ZHI76919





LOCATION MAP
SCALE: 1" = 15 MILES

0 40' 80'
SCALE: 1" = 40'

Know what's below. Call before you dig.

JOHN R. DENING
PROFESSIONAL ENGINEER
N.J. LIC. NO. 24GE04551700

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REFERENCE DRAWINGS

DWG. NO.	TITLE

REVISIONS

NO.	DESCRIPTION	DATE	DRAWN	CK	APPR

PREPARED FOR
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PREPARED BY
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PENNEAST PIPELINE PROJECT
ETOWN AND GILBERT INTERCONNECTS
PROPOSED DRAINAGE AREAS PLAN
HUNTERDON COUNTY, NEW JERSEY

DRAWN BY		DATE ISSUED	
CHECKED BY		SCALE	AS SHOWN
APPROVED BY		APPROVED BY	
DWG. NO.			REV. NO.

G:\353754 PENNEAST\STORM\WATER\ETOWN AND GILBERT INTERCONNECTS\DWG\PLANS\PROPOSED DRAINAGE AREAS PLAN.DWG ZHI76919

B. 24-Hour Rainfall Depths

NEW JERSEY DEPARTMENT OF AGRICULTURE
STATE SOIL CONSERVATION COMMITTEE
Chapter 251, PL 1975 as amended,
Engineering Policies- Technical Bulletin

Technical Bulletin: 2004-4.0	**Effective Date:** January 1, 2005
Subject: NRCS revisions to 24 hr design storm depths	**From:** Hunter Birckhead, P.E., Section Chief

1.01 PURPOSE

To distribute the revised 24 hr NRCS design rainfall depth tables for use in runoff modeling with NRCS procedures such as TR-55 and TR-20

1.02 SUMMARY

The National Oceanographic and Atmospheric Administration (NOAA) is responsible for developing statistical estimates of rainfall amounts for various return periods. Based on recent updates by NOAA, these changes have been incorporated by NRCS into their 24 hr design storm depth tables and have been released for use in New Jersey.

The attached table provides the previous and revised 24hr rainfall depths for each county in New Jersey for the 1, 2, 5, 10, 25, 50 and 100 year return periods. These new depths are to be used in calculating stormwater runoff effective January 1, 2005.

NRCS 24 hr Design Storm Rainfall Depths Revised September 2004, 2nd revision

SSCC - NJDA - SCD

Storm Period	1 yr		2 yr		5yr		10yr		25yr		50yr		100yr	
County	old	*new*	old	*new*	old	*new*	old	*new*	old	*new*	old	*new*	old	*new*
Atlantic	2.8	*2.8*	3.5	*3.3*	4.5	*4.3*	5.5	*5.2*	6.2	*6.5*	6.8	*7.6*	7.6	*8.9*
Bergen	2.7	*2.8*	3.3	*3.3*	4.3	*4.3*	5.3	*5.1*	5.7	*6.3*	6.5	*7.3*	7.5	*8.4*
Burlington	2.8	*2.8*	3.4	*3.4*	4.4	*4.3*	5.3	*5.2*	6.0	*6.4*	6.6	*7.6*	7.4	*8.8*
Camden	2.8	*2.8*	3.4	*3.3*	4.4	*4.3*	5.3	*5.1*	5.9	*6.3*	6.6	*7.3*	7.4	*8.5*
Cape May	2.9	*2.8*	3.5	*3.3*	4.6	*4.2*	5.6	*5.1*	6.3	*6.4*	6.9	*7.5*	7.7	*8.8*
Cumberland	2.8	*2.8*	3.4	*3.3*	4.5	*4.2*	5.4	*5.1*	6.0	*6.4*	6.8	*7.5*	7.5	*8.8*
Essex	2.7	*2.8*	3.3	*3.4*	4.3	*4.4*	5.3	*5.2*	5.7	*6.4*	6.4	*7.5*	7.5	*8.7*
Gloucester	2.8	*2.8*	3.4	*3.3*	4.4	*4.2*	5.3	*5.0*	5.9	*6.2*	6.6	*7.3*	7.4	*8.5*
Hudson	2.7	*2.7*	3.3	*3.3*	4.3	*4.2*	5.3	*5.0*	5.7	*6.2*	6.4	*7.2*	7.5	*8.3*
Hunterdon	2.6	*2.9*	3.2	*3.4*	4.2	*4.3*	5.0	*5.0*	5.7	*6.1*	6.5	*7.0*	7.3	*8.0*
Mercer	2.7	*2.8*	3.3	*3.3*	4.3	*4.2*	5.2	*5.0*	5.8	*6.2*	6.4	*7.2*	7.5	*8.3*
Middlesex	2.7	*2.8*	3.3	*3.3*	4.3	*4.3*	5.2	*5.1*	5.9	*6.4*	6.4	*7.4*	7.5	*8.6*
Monmouth	2.8	*2.9*	3.4	*3.4*	4.4	*4.4*	5.3	*5.2*	6.0	*6.5*	6.5	*7.7*	7.5	*8.9*
Morris	2.6	*3.0*	3.3	*3.5*	4.3	*4.5*	5.2	*5.2*	5.7	*6.3*	6.5	*7.3*	7.5	*8.3*
Ocean	2.8	*3.0*	3.5	*3.4*	4.5	*4.5*	5.4	*5.4*	6.2	*6.7*	6.6	*7.9*	7.5	*9.2*
Passaic	2.6	*3.0*	3.3	*3.5*	4.3	*4.4*	5.4	*5.3*	5.7	*6.5*	6.5	*7.5*	7.6	*8.7*
Salem	2.8	*2.8*	3.3	*3.3*	4.4	*4.2*	5.3	*5.0*	5.9	*6.2*	6.6	*7.3*	7.4	*8.5*
Somerset	2.7	*2.8*	3.3	*3.3*	4.3	*4.3*	5.2	*5.0*	5.7	*6.2*	6.5	*7.2*	7.5	*8.2*
Sussex	2.6	*2.7*	3.2	*3.2*	4.2	*4.0*	5.0	*4.7*	5.7	*5.7*	6.6	*6.6*	7.5	*7.6*
Union	2.7	*2.8*	3.3	*3.4*	4.3	*4.4*	5.3	*5.2*	5.8	*6.4*	6.4	*7.5*	7.5	*8.7*
Warren	2.6	*2.8*	3.2	*3.3*	4.1	*4.2*	4.9	*4.9*	5.6	*5.9*	6.5	*6.8*	7.2	*7.8*

C. Soil Cover Complex Calculations

PENNEAST-ETOWN AND GILBERT INTERCONNECT
LAND USE/LAND COVER CONDITIONS CURVE NUMBER INDEX
SCS CURVE NUMBER METHOD

LU Index	Land Cover Description	LU Symbol	Hydrologic Soil Group (HSG)				TR-55 TABLE 2-2a CLASSIFICATION
			A	B	C	D	
1	OPEN SPACE	OS-G	39	61	74	80	OPEN SPACE (LAWN, PARK, GOLF COURSE) - GOOD CONDITION
2	OPEN SPACE (DISTURBED)	OS-G-D	39	61	74	80	OPEN SPACE (LAWN, PARK, GOLF COURSE) - GOOD CONDITION
3	IMPERVIOUS	IP	98	98	98	98	IMPERVIOUS AREAS
4	WOODS	WO-G	30	55	70	77	WOODS-GOOD CONDITION
5	WOODS (DISTURBED)	WO-G-D	30	55	70	77	WOODS-GOOD CONDITION
6	GRAVEL	GRAV	76	85	89	91	GRAVEL (INCLUDING RIGHT OF WAY)
7	BRUSH	BR-G	30	48	65	73	BRUSH-WEED-GRASS MIXTURE WITH BRUSH THE MAJOR ELEMENT
8	IMPERVIOUS (DISTURBED)	IP-D	98	98	98	98	IMPERVIOUS AREAS

Notes:
"-D" REPRESENTS EXISTING AREAS THAT WILL BE DISTURBED FROM PROPOSED CONSTRUCTION WORK

PENNEAST - Etown and Gilbert Interconnect
EXISTING SOIL TYPES INDEX

Source: NRCS Web Soil Survey

Soil Symbol	Soil Description	HSG for SCS CN
HdyDb	Hazleton channery loam, 6 to 18 percent slopes, very stony	B
KkoD	Klinesville channery loam, 12 to 18 percent slopes	D
PeoB	Penn channery silt loam, 2 to 6 percent slopes	C
PeoC2	Penn channery silt loam, 6 to 12 percent slopes, eroded	C
PeoD	Penn channery silt loam, 12 to 18 percent slopes	C
PomAs	Pope fine sandy loam, high bottom, 0 to 2 percent slopes, occasionally flooded	B
RksC	Riverhead gravelly sandy loam, 8 to 15 percent slopes	B
ROPF	Rough broken land, shale	D

PENNEAST-ETOWN & GILBERT INTERCONNECTS
EXISTING CONDITIONS CURVE NUMBER CALCULATIONS

DA	Cover	Soils	HSG	Area	Area (Acres)	CN	CN*A	Weighted CN
EXDA-1	IP	PeoB	C	6713.57	0.154	98.0	15.104	98.0
		ROPF	D	1959.77	0.045	98.0	4.409	98.0
	IP Total				**0.199**		**19.513**	**98.0**
	IP-D	PeoB	C	81.62	0.002	98.0	0.184	98.0
	IP-D Total				**0.002**		**0.184**	**98.0**
	OS-G	PeoB	C	289.05	0.007	74.0	0.491	74.0
	OS-G Total				**0.007**		**0.491**	**74.0**
	OS-G-D	PeoB	C	21008.07	0.482	74.0	35.689	74.0
		ROPF	D	4304.47	0.099	80.0	7.905	80.0
	OS-G-D Total				**0.581**		**43.594**	**75.0**
	WO-G-D	PeoB	C	1194.14	0.027	70.0	1.919	70.0
	WO-G-D Total				**0.027**		**1.919**	**70.0**
EXDA-1 Total					**0.816**		**65.701**	**80.5**
EXDA-2	IP	PeoB	C	7530.87	0.173	98.0	16.943	98.0
		ROPF	D	292.89	0.007	98.0	0.659	98.0
	IP Total				**0.180**		**17.602**	**98.0**
	OS-G	PeoB	C	416.06	0.010	74.0	0.707	74.0
	OS-G Total				**0.010**		**0.707**	**74.0**
	OS-G-D	PeoB	C	31898.16	0.732	74.0	54.189	74.0
		ROPF	D	3511.98	0.081	80.0	6.450	80.0
	OS-G-D Total				**0.813**		**60.639**	**74.6**
	WO-G-D	PeoB	C	5875.59	0.135	70.0	9.442	70.0
	WO-G-D Total				**0.135**		**9.442**	**70.0**
EXDA-2 Total					**1.137**		**88.389**	**77.7**
EXDA-3	IP	PeoB	C	7587.03	0.174	98.0	17.069	98.0
		ROPF	D	1332.46	0.031	98.0	2.998	98.0
	IP Total				**0.205**		**20.067**	**98.0**
	OS-G	PeoB	C	191.01	0.004	74.0	0.324	74.0
	OS-G Total				**0.004**		**0.324**	**74.0**
	OS-G-D	PeoB	C	4242.87	0.097	74.0	7.208	74.0
		ROPF	D	2105.21	0.048	80.0	3.866	80.0
	OS-G-D Total				**0.146**		**11.074**	**76.0**
EXDA-3 Total					**0.355**		**31.465**	**88.7**
EXDA-4	IP	PeoB	C	1550.26	0.036	98.0	3.488	98.0
		ROPF	D	2439.16	0.056	98.0	3.488	62.3
	IP Total				**0.092**		**3.488**	**38.1**
	IP-D	PeoB	C	0.98	0.000	98.0	0.000	0.0
	IP-D Total				**0.000**		**0.000**	**0.0**
	OS-G-D	PeoB	C	2261.16	0.052	74.0	3.841	74.0
		ROPF	D	2390.27	0.055	80.0	4.390	80.0
	OS-G-D Total				**0.107**		**8.231**	**77.1**
	WO-G-D	PeoB	C	666.91	0.015	70.0	1.072	70.0
		ROPF	D	2043.30	0.047	77.0	3.612	77.0
	WO-G-D Total				**0.062**		**4.684**	**75.3**
EXDA-4 Total					**0.261**		**16.402**	**62.9**
Grand Total					**2.569**		**201.958**	**78.6**

$$\text{Weighted CN} = \frac{\sum_{i=1}^{n} CN_i \; x \; Area_i}{\sum_{i=1}^{n} Area_i}$$

PENNEAST-ETOWN&GILBERT INTERCONNECTS
PROPOSED CONDITIONS CURVE NUMBER CALCULATIONS

DA	Cover	Soils	HSG	Area	Area (Acres)	CN	CN*A	Weighted CN
EXDA-3	IP	PeoB	C	7587.03	0.174	98	17.069	98.0
		ROPF	D	1332.46	0.031	98	2.998	98.0
	IP Total				**0.205**		**20.067**	**98.0**
	OS-G	PeoB	C	4433.79	0.102	74	7.532	74.0
		ROPF	D	2105.22	0.048	80	3.866	80.0
	OS-G Total				**0.150**		**11.398**	**75.9**
EXDA-3 Total					**0.355**		**31.465**	**88.7**
EXDA-4	IP	PeoB	C	1551.63	0.036	98	3.491	98.0
		ROPF	D	2438.38	0.056	98	5.486	98.0
	IP Total				**0.092**		**8.977**	**98.0**
	OS-G	PeoB	C	2927.68	0.067	74	4.974	74.0
		ROPF	D	4433.56	0.102	80	8.142	80.0
	OS-G Total				**0.169**		**13.116**	**77.6**
EXDA-4 Total					**0.261**		**22.093**	**84.8**
SUB-1	GRAV	PeoB	C	31028.23	0.712	89	63.396	89.0
		ROPF	D	898.42	0.021	91	1.877	91.0
	GRAV Total				**0.733**		**65.272**	**89.1**
	IP	ROPF	D	200.29	0.005	98	0.451	98.0
	IP Total				**0.005**		**0.451**	**98.0**
	OS-G	PeoB	C	7741.32	0.178	74	13.151	74.0
		ROPF	D	3099.08	0.071	80	5.692	80.0
	OS-G Total				**0.249**		**18.843**	**75.7**
SUB-1 Total					**0.986**		**84.566**	**85.7**
SUB-2	IP	PeoB	C	6796.10	0.156	98	15.290	98.0
		ROPF	D	1759.48	0.040	98	3.958	98.0
	IP Total				**0.196**		**19.248**	**98.0**
	OS-G	PeoB	C	6570.02	0.151	74	11.161	74.0
		ROPF	D	1197.13	0.027	80	2.199	80.0
	OS-G Total				**0.178**		**13.360**	**74.9**
SUB-2 Total					**0.375**		**32.608**	**87.0**
SUB-3	IP	PeoB	C	7530.87	0.173	98	16.943	98.0
		ROPF	D	299.23	0.007	98	0.673	98.0
	IP Total				**0.180**		**17.616**	**98.0**
	OS-G	PeoB	C	15340.60	0.352	74	26.061	74.0
		ROPF	D	2621.82	0.060	80	4.815	80.0
	OS-G Total				**0.412**		**30.876**	**74.9**
SUB-3 Total					**0.592**		**48.492**	**81.9**
Grand Total					**2.569**		**219.223**	**85.3**

$$\text{Weighted CN} = \frac{\sum_{i=1}^{n} CN_i \; x \; Area_i}{\sum_{i=1}^{n} Area_i}$$

Hydrologic Soil Group—Hunterdon County, New Jersey

Map Scale: 1:4,520 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 18N 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

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Hunterdon County, New Jersey
Survey Area Data: Version 13, Oct 6, 2017

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

Date(s) aerial images were photographed: Mar 20, 2011—May 10, 2011

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.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
HdyDb	Hazleton channery loam, 6 to 18 percent slopes, very stony	B	19.6	18.9%
KkoD	Klinesville channery loam, 12 to 18 percent slopes	D	16.9	16.2%
PeoB	Penn channery silt loam, 2 to 6 percent slopes	C	23.2	22.3%
PeoC2	Penn channery silt loam, 6 to 12 percent slopes, eroded	C	3.9	3.7%
PeoD	Penn channery silt loam, 12 to 18 percent slopes	C	1.5	1.5%
PomAs	Pope fine sandy loam, high bottom, 0 to 2 percent slopes, occasionally flooded	B	10.3	9.9%
RksC	Riverhead gravelly sandy loam, 8 to 15 percent slopes	B	2.8	2.7%
ROPF	Rough broken land, shale	D	25.7	24.8%
Totals for Area of Interest			**103.8**	**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

D. Time of Concentration Calculations

EXDA-1 EXISTING CONDITIONS-Tc CALCULATIONS

SHEET FLOW	
Manning's n	0.15
Flow length, ft	150
2-Yr 24-Hr rainfall, in	3.4
Land slope, %	3.67
Sheet flow time, min	**10.32**
SHALLOW CONC. FLOW	
Flow length, ft	38.78
Watercourse slope, %	6.45
Surface Description	unpaved
Velocity, ft/s	4.10
Sh. Conc. Flow time, min	**0.16**
SHALLOW CONC. FLOW	
Flow length, ft	179.617
Watercourse slope, %	4.73
Surface Description	paved
Velocity, ft/s	4.42
Sh. Conc. Flow time, min	**0.68**
TIME OF CONC., mins	**11.15**

EXDA-2 EXISTING CONDITIONS-Tc CALCULATIONS

SHEET FLOW	
Manning's n	0.15
Flow length, ft	150
2-Yr 24-Hr rainfall, in	3.4
Land slope, %	4.00
Sheet flow time, min	**9.96**
SHALLOW CONC. FLOW	
Flow length, ft	228.31
Watercourse slope, %	3.07
Surface Description	unpaved
Velocity, ft/s	2.83
Sh. Conc. Flow time, min	**1.35**
CHANNEL FLOW	
Left side slope, %	33.3333
Right side slope, %	33.3333
bottom width, ft	2
channel flow depth, ft	1.00
Channel flow length, ft	308.84
channel bed slope, %	5.02
Mannings N	0.024
Accn. Due to gravity, ft/sec2	32.2
Freeboard, ft	0
H:V, left	3.00
H:V, right	3.00
bed slope, ft/ft	0.050
top width at flow depth, ft	8.00
top width including freeboard, ft	8.00
wetted area, sq. ft	5.00
wetted peri, ft	8.32
hyd. Radius, ft	0.60
velocity, ft/s	9.90
Discharge, cfs	49.51
Theta, rad	0.05
Froudes Number	1.74
Flow Type	**supercritical**
Channel flow time, mins	**0.52**
TIME OF CONC., mins	**11.83**

SUB-1 PROPOSED CONDITIONS-Tc CALCULATIONS

SHEET FLOW	
Manning's n	0.15
Flow length, ft	150
2-Yr 24-Hr rainfall, in	3.4
Land slope, %	4.00
Sheet flow time, min	**9.96**
SHALLOW CONC. FLOW	
Flow length, ft	336.08
Watercourse slope, %	5.36
Surface Description	unpaved
Velocity, ft/s	3.73
Sh. Conc. Flow time, min	**1.50**
TIME OF CONC., mins	**11.46**

SUB-2 PROPOSED CONDITIONS-Tc CALCULATIONS

SHALLOW CONC. FLOW	
Flow length, ft	19.09
Watercourse slope, %	10.48
Surface Description	unpaved
Velocity, ft/s	5.22
Sh. Conc. Flow time, min	**0.06**
SHALLOW CONC. FLOW	
Flow length, ft	179.617
Watercourse slope, %	4.73
Surface Description	paved
Velocity, ft/s	4.42
Sh. Conc. Flow time, min	**0.68**
TIME OF CONC., mins	**0.74**
NJDEP recommended min. 10 minute Tc used	

SUB-3 PROPOSED CONDITIONS-Tc CALCULATIONS

SHEET FLOW	
Manning's n	0.15
Flow length, ft	150
2-Yr 24-Hr rainfall, in	3.4
Land slope, %	4.00
Sheet flow time, min	**9.96**
SHALLOW CONC. FLOW	
Flow length, ft	228.31
Watercourse slope, %	3.07
Surface Description	unpaved
Velocity, ft/s	2.83
Sh. Conc. Flow time, min	**1.35**
CHANNEL FLOW	
Left side slope, %	33.3333
Right side slope, %	33.3333
bottom width, ft	2
channel flow depth, ft	1.00
Channel flow length, ft	308.84
channel bed slope, %	5.02
Mannings N	0.024
Accn. Due to gravity, ft/sec2	32.2
Freeboard, ft	0
H:V, left	3.00
H:V, right	3.00
bed slope, ft/ft	0.050
top width at flow depth, ft	8.00
top width including freeboard, ft	8.00
wetted area, sq. ft	5.00
wetted peri, ft	8.32
hyd. Radius, ft	0.60
velocity, ft/s	9.90
Discharge, cfs	49.51
Theta, rad	0.05
Froudes Number	1.74
Flow Type	**supercritical**
Channel flow time, mins	**0.52**
TIME OF CONC., mins	**11.83**

E. Summary of Peak Flows and Runoff Volumes

PENNEAST-ETOWN & GILBERT INTERCONNECTS
PEAK FLOW SUMMARY TABLES

@ POI-1 (FLOWING WEST OF THE SITE)

	EXISTING CONDITIONS (EXDA-1)			TARGET FLOWS		
RECURRENCE INTERVAL	DISTURBED Q (CFS)	UNDISTURBED Q (CFS)	TOTAL = DIST+UNDIST (CFS)	REDUCTION FACTOR (PER N.J.A.C. 7:8)	REDUCED DISTURBED Q (CFS)	TARGET Q = UNDISTURBED+ REDUCED DISTURBED (CFS)
2	0.70	0.56	1.26	50%	0.35	0.91
10	1.44	0.83	2.28	75%	1.08	1.91
100	2.99	1.35	4.33	80%	2.39	3.73

@ POI-1 (FLOWING WEST OF THE SITE)

	EXISTING CONDITIONS (EXDA-4)			TARGET FLOWS		
RECURRENCE INTERVAL	DISTURBED Q (CFS)	UNDISTURBED Q (CFS)	TOTAL = DIST+UNDIST (CFS)	REDUCTION FACTOR (PER N.J.A.C. 7:8)	REDUCED DISTURBED Q (CFS)	TARGET Q = UNDISTURBED+ REDUCED DISTURBED (CFS)
2	0.21	0.26	0.47	50%	0.11	0.37
10	0.43	0.38	0.80	75%	0.32	0.70
100	0.86	0.61	1.47	80%	0.69	1.30

OVERALL FLOWING WEST OF THE SITE TO POI-1

	EXISTING CONDITIONS (EXDA-1 + EXDA-4)			TARGET FLOWS			PROPOSED CONDITIONS (SUB-1 + SUB-2 + EXDA-4)	
RECURRENCE INTERVAL	DISTURBED Q (CFS)	UNDISTURBED Q (CFS)	TOTAL = DIST+UNDIST (CFS)	REDUCTION FACTOR (PER N.J.A.C. 7:8)	REDUCED DISTURBED Q (CFS)	TARGET Q = UNDISTURBED+ REDUCED DISTURBED (CFS)	PROPOSED Q (CFS)	PROPOSED LESS THAN TARGET?
2	0.92	0.82	1.73	50%	0.46	1.28	1.26	YES
10	1.87	1.21	3.08	75%	1.40	2.61	2.42	YES
100	3.84	1.95	5.80	80%	3.08	5.03	4.79	YES

@ POI-2 (FLOWING SOUTH-EAST OF THE SITE)

	EXISTING CONDITIONS (EXDA-2)			TARGET FLOWS			PROPOSED CONDITIONS (SUB-3)	
RECURRENCE INTERVAL	DISTURBED Q (CFS)	UNDISTURBED Q (CFS)	TOTAL = DIST+UNDIST (CFS)	REDUCTION FACTOR (PER N.J.A.C. 7:8)	REDUCED DISTURBED Q (CFS)	TARGET Q = UNDISTURBED+ REDUCED DISTURBED (CFS)	PROPOSED Q (CFS)	PROPOSED LESS THAN TARGET?
2	1.04	0.51	1.55	50%	0.52	1.03	0.97	YES
10	2.17	0.76	2.93	75%	1.63	2.39	1.72	YES
100	4.55	1.24	5.78	80%	3.64	4.87	3.21	YES

@ POI-3 (FLOWING NORTH-EAST OF THE SITE)

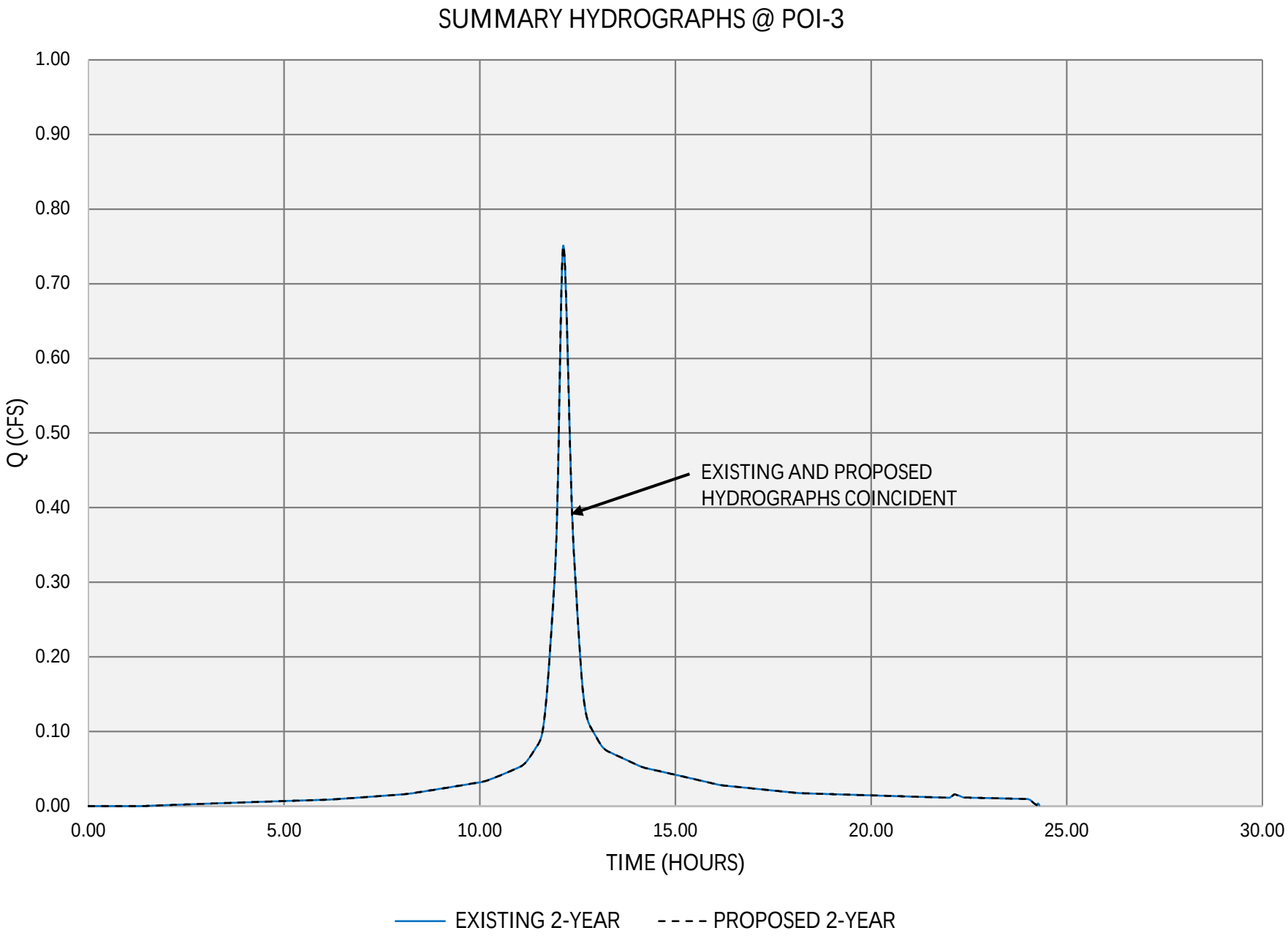
	EXISTING CONDITIONS (EXDA-3)			TARGET FLOWS			PROPOSED CONDITIONS	
RECURRENCE INTERVAL	DISTURBED Q (CFS)	UNDISTURBED Q (CFS)	TOTAL = DIST+UNDIST (CFS)	REDUCTION FACTOR (PER N.J.A.C. 7:8)	REDUCED DISTURBED Q (CFS)	TARGET Q = UNDISTURBED+ REDUCED DISTURBED (CFS)	PROPOSED Q (CFS)	PROPOSED LESS THAN TARGET?
2			0.75			0.75	0.75	YES
10			1.21			1.21	1.21	YES
100			2.10			2.10	2.10	YES

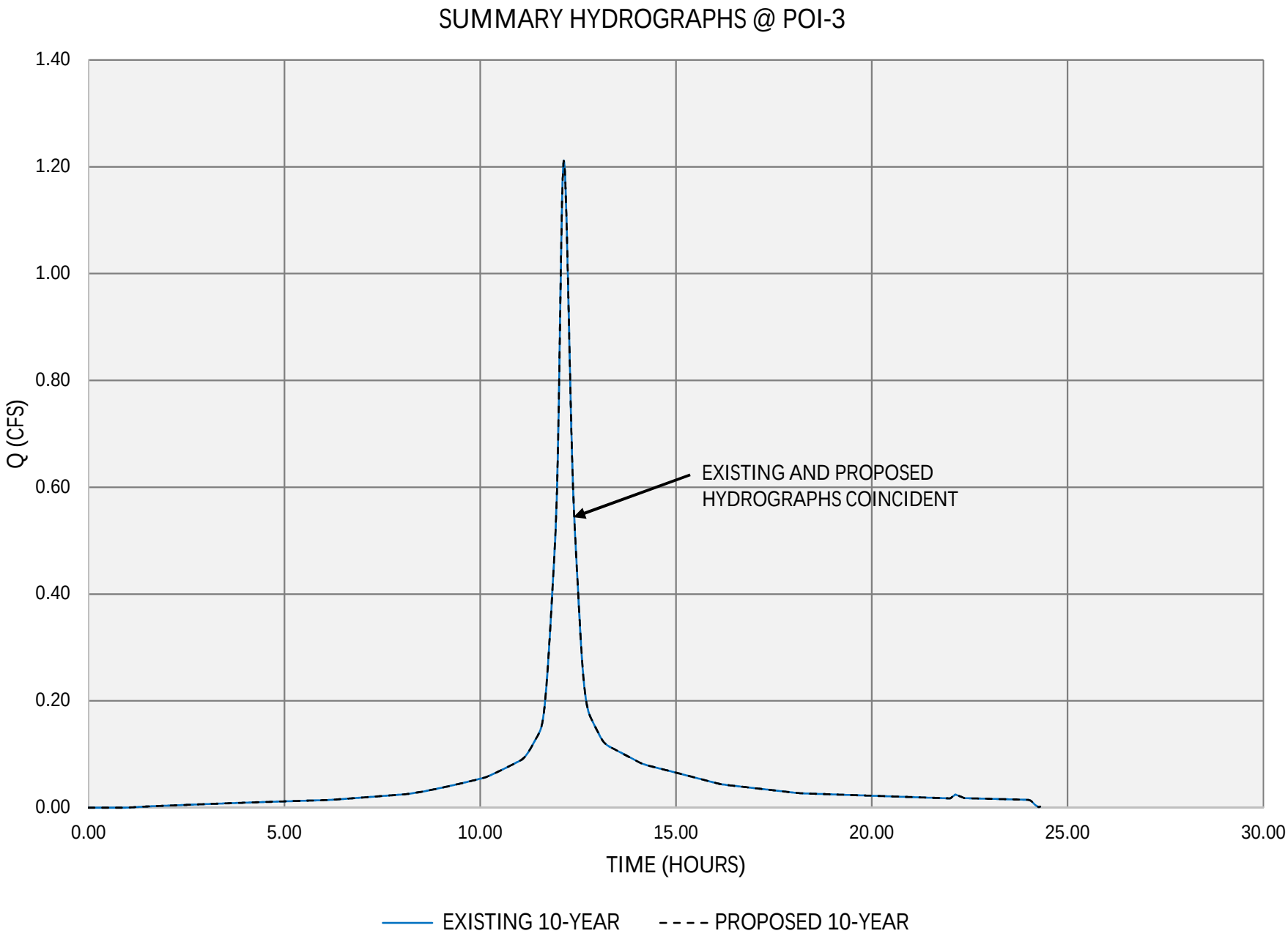
*Note: For EXDA-3, attached hydrographs demonstrate that the proposed conditions hydrograph at no point, exceeds the existing conditions hydrograph, thereby demonstrating compliance with the requirements of N.J.A.C. 7:8. Existing cover will be reinstated in this drainage area at the completion of construction activities. Since no grading or change in land cover is proposed in this drainage area, no change in time of concentration is expected.

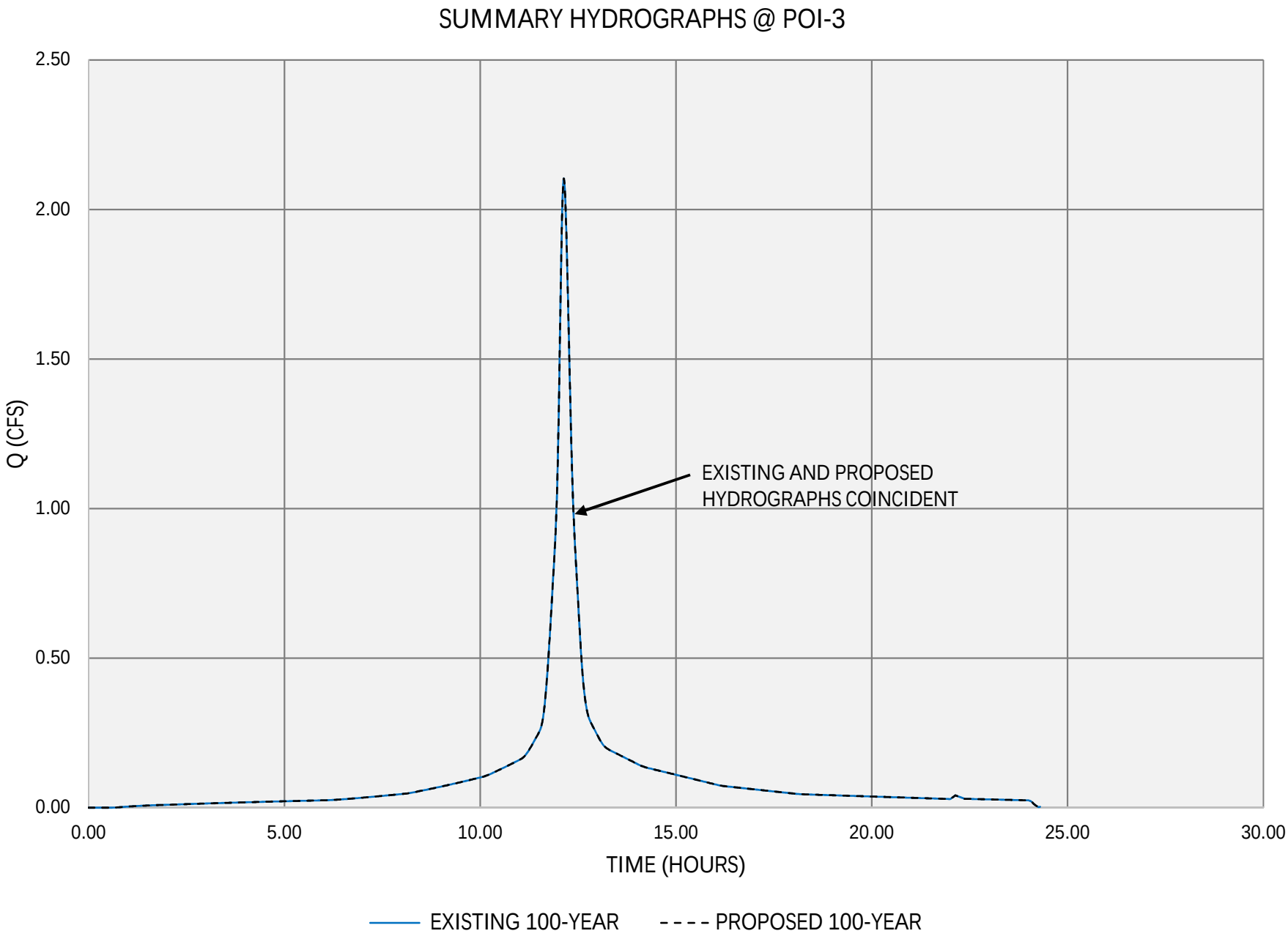
@ POI-3 (FLOWING NORTH-EAST OF THE SITE)

	EXISTING CONDITIONS (EXDA-3)			TARGET FLOWS			PROPOSED CONDITIONS	
RECURRENCE INTERVAL	DISTURBED Q (CFS)	UNDISTURBED Q (CFS)	TOTAL = DIST+UNDIST (CFS)	REDUCTION FACTOR (PER N.J.A.C. 7:8)	REDUCED DISTURBED Q (CFS)	TARGET Q = UNDISTURBED+ REDUCED DISTURBED (CFS)	PROPOSED Q (CFS)	PROPOSED LESS THAN TARGET?
2			0.75			0.75	0.75	YES
10			1.21			1.21	1.21	YES
100			2.10			2.10	2.10	YES

*Note: For EXDA-3, attached hydrographs demonstrate that the proposed conditions hydrograph at no point, exceeds the existing conditions hydrograph, thereby demonstrating compliance with the requirements of N.J.A.C. 7:8. Existing cover will be reinstated in this drainage area at the completion of construction activities. Since no grading or change in land cover is proposed in this drainage area, no change in time of concentration is expected.


SUMMARY HYDROGRAPHS @ POI-3
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Q (CFS)
0.00
5.00
10.00
15.00
20.00
25.00
30.00
TIME (HOURS)
EXISTING AND PROPOSED
HYDROGRAPHS COINCIDENT
EXISTING 2-YEAR
PROPOSED 2-YEAR


SUMMARY HYDROGRAPHS @ POI-3
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Q (CFS)
EXISTING AND PROPOSED
HYDROGRAPHS COINCIDENT
0.00
5.00
10.00
15.00
20.00
25.00
30.00
TIME (HOURS)
EXISTING 10-YEAR
PROPOSED 10-YEAR


SUMMARY HYDROGRAPHS @ POI-3
2.50
2.00
1.50
1.00
0.50
0.00
Q (CFS)
EXISTING AND PROPOSED
HYDROGRAPHS COINCIDENT
0.00
5.00
10.00
15.00
20.00
25.00
30.00
TIME (HOURS)
EXISTING 100-YEAR
PROPOSED 100-YEAR

PENNEAST-ETOWN & GILBERT INTERCONNECTS											
EXISTING CONDITIONS 2-YEAR 24-HOUR RUNOFF VOLUME											
P (in)	**3.4**										
I_a/S Factor	**0.2**										
ID	**DA**	**Cover**	**Soils**	**HSG**	**Area**	**Area (Acres)**	**CN**	**S(in)**	**I_a (in)**	**Q (in)**	**Q (Ac-Ft)**
	EXDA-1	IP	PeoB	C	6713.566	0.154	98.0	0.20	0.04	3.17	0.041
			ROPF	D	1959.771	0.045	98.0	0.20	0.04	3.17	0.012
		IP-D	PeoB	C	81.622	0.002	98.0	0.20	0.04	3.17	0.000
		OS-G	PeoB	C	289.046	0.007	74.0	3.51	0.70	1.17	0.001
		OS-G-D	PeoB	C	21008.075	0.482	74.0	3.51	0.70	1.17	0.047
			ROPF	D	4304.467	0.099	80.0	2.50	0.50	1.56	0.013
		WO-G-D	PeoB	C	1194.144	0.027	70.0	4.29	0.86	0.95	0.002
	EXDA-2	IP	PeoB	C	7530.872	0.173	98.0	0.20	0.04	3.17	0.046
			ROPF	D	292.887	0.007	98.0	0.20	0.04	3.17	0.002
		OS-G	PeoB	C	416.060	0.010	74.0	3.51	0.70	1.17	0.001
		OS-G-D	PeoB	C	31898.162	0.732	74.0	3.51	0.70	1.17	0.071
			ROPF	D	3511.983	0.081	80.0	2.50	0.50	1.56	0.010
		WO-G-D	PeoB	C	5875.588	0.135	70.0	4.29	0.86	0.95	0.011
	EXDA-3	IP	PeoB	C	7587.035	0.174	98.0	0.20	0.04	3.17	0.046
			ROPF	D	1332.464	0.031	98.0	0.20	0.04	3.17	0.008
		OS-G	PeoB	C	191.009	0.004	74.0	3.51	0.70	1.17	0.000
		OS-G-D	PeoB	C	4242.874	0.097	74.0	3.51	0.70	1.17	0.010
			ROPF	D	2105.207	0.048	80.0	2.50	0.50	1.56	0.006
	EXDA-4	IP	PeoB	C	1550.264	0.036	98.0	0.20	0.04	3.17	0.009
			ROPF	D	2439.162	0.056	98.0	0.20	0.04	3.17	0.015
		IP-D	PeoB	C	0.985	0.000	98.0	0.20	0.04	3.17	0.000
		OS-G-D	PeoB	C	2261.160	0.052	74.0	3.51	0.70	1.17	0.005
			ROPF	D	2390.266	0.055	80.0	2.50	0.50	1.56	0.007
		WO-G-D	PeoB	C	666.905	0.015	70.0	4.29	0.86	0.95	0.001
			ROPF	D	2043.296	0.047	77.0	2.99	0.60	1.36	0.005
					AREA TOTAL (AC)	**2.569**			**PROPOSED 2-YEAR VOLUME (AC-FT)**		**0.370**

PENNEAST-ETOWN & GILBERT INTERCONNECTS											
PROPOSED CONDITIONS 2-YEAR 24-HOUR RUNOFF VOLUME											
P (in)	**3.4**										
I_a/S Factor	**0.2**										
ID	**DA**	**Cover**	**Soils**	**HSG**	**Area**	**Area (Acres)**	**CN**	**S(in)**	**I_a (in)**	**Q (in)**	**Q (Ac-Ft)**
	EXDA-3	IP	PeoB	C	7587.035	0.174	98.0	0.20	0.04	3.17	0.046
	EXDA-3	IP	ROPF	D	1332.464	0.031	98.0	0.20	0.04	3.17	0.008
	EXDA-3	OS-G	PeoB	C	4433.794	0.102	74.0	3.51	0.70	1.17	0.010
	EXDA-3	OS-G	ROPF	D	2105.223	0.048	80.0	2.50	0.50	1.56	0.006
	EXDA-4	IP	PeoB	C	1551.635	0.036	98.0	0.20	0.04	3.17	0.009
	EXDA-4	IP	ROPF	D	2438.381	0.056	98.0	0.20	0.04	3.17	0.015
	EXDA-4	OS-G	PeoB	C	2927.678	0.067	74.0	3.51	0.70	1.17	0.007
	EXDA-4	OS-G	ROPF	D	4433.563	0.102	80.0	2.50	0.50	1.56	0.013
	SUB-1	GRAV	PeoB	C	31028.225	0.712	89.0	1.24	0.25	2.26	0.134
	SUB-1	GRAV	ROPF	D	898.415	0.021	91.0	0.99	0.20	2.45	0.004
	SUB-1	IP	ROPF	D	200.291	0.005	98.0	0.20	0.04	3.17	0.001
	SUB-1	OS-G	PeoB	C	7741.319	0.178	74.0	3.51	0.70	1.17	0.017
	SUB-1	OS-G	ROPF	D	3099.084	0.071	80.0	2.50	0.50	1.56	0.009
	SUB-2	IP	PeoB	C	6796.102	0.156	98.0	0.20	0.04	3.17	0.041
	SUB-2	IP	ROPF	D	1759.479	0.040	98.0	0.20	0.04	3.17	0.011
	SUB-2	OS-G	PeoB	C	6570.016	0.151	74.0	3.51	0.70	1.17	0.015
	SUB-2	OS-G	ROPF	D	1197.129	0.027	80.0	2.50	0.50	1.56	0.004
	SUB-3	IP	PeoB	C	7530.872	0.173	98.0	0.20	0.04	3.17	0.046
	SUB-3	IP	ROPF	D	299.234	0.007	98.0	0.20	0.04	3.17	0.002
	SUB-3	OS-G	PeoB	C	15340.602	0.352	74.0	3.51	0.70	1.17	0.034
	SUB-3	OS-G	ROPF	D	2621.823	0.060	80.0	2.50	0.50	1.56	0.008
					AREA TOTAL (AC)	**2.569**			**PROPOSED 2-YEAR VOLUME (AC-FT)**		**0.440**

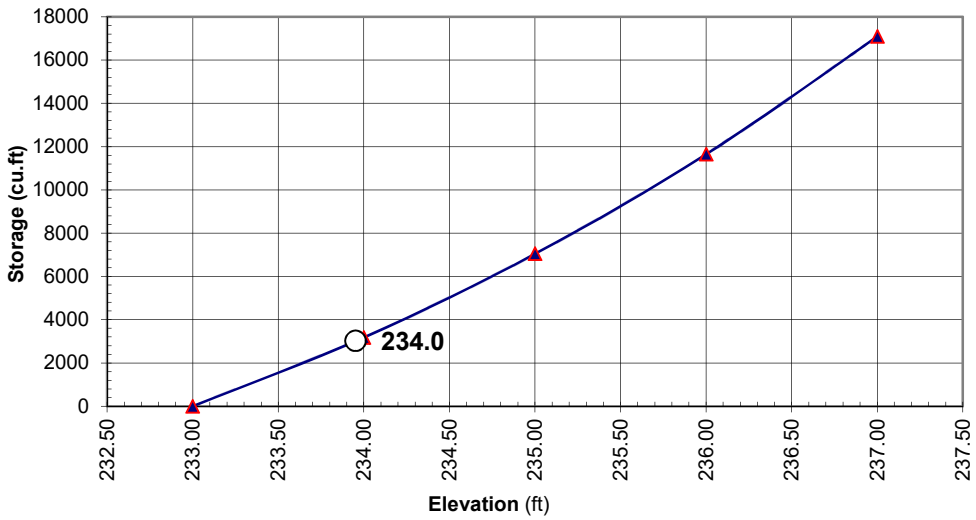
BASIN STAGE STORAGE TABLE - BASIN 1

Infiltration Runoff Volume: 3,027 cf

Target Runoff Elevation: **234.0** **(Primary orifice will be set at this elevation)**

ELEVATION ft	AREA sq.ft	AVG AREA sq.ft	ELEV DIFF ft	INCR VOL cu.ft	CUM VOL cu.ft
233.00	2855.254				0
234.00	3506.832	3181	1.0	3181	3181
235.00	4218.821	3863	1.0	3863	7044
236.00	4995.32	4607	1.0	4607	11651
237.00	5882.746	5439	1.0	5439	17090
		0	0.0	0	

STAGE-STORAGE



F. Conveyance System Calculations

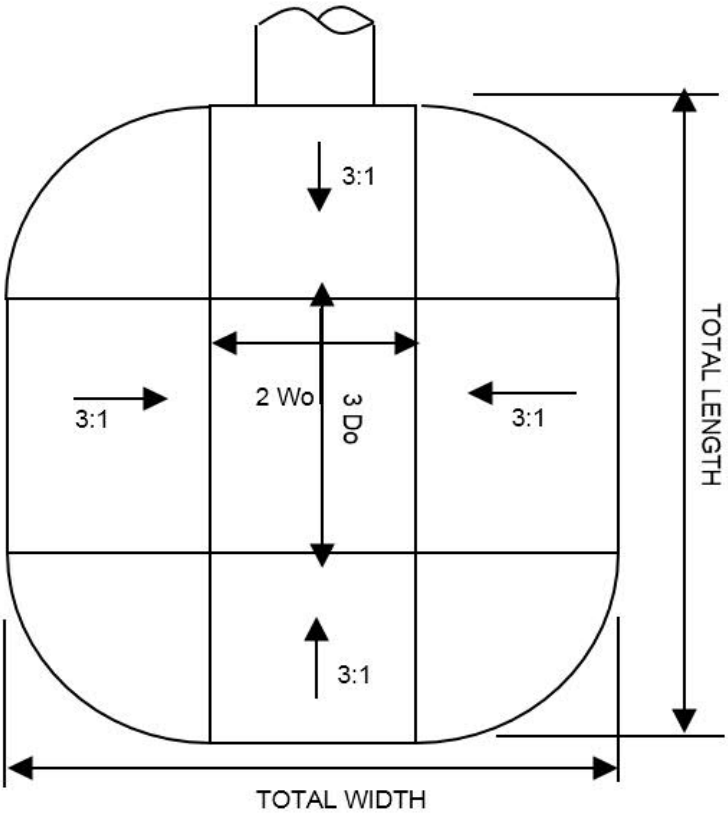
PENNEAST-ETOWN&GILBERT INTERCONNECTS
PROPOSED DRAINAGE PIPES CAPACITY ANALYSIS

Pipe ID	P-1	
Upstream Str	OS-1	
Downstream Str	MH-1	
peak Discharge, cfs	1.75	**100-YEAR BASIN DISCHARGE**
Pipe Diamater, in	15.00	
Manning's N	0.013	
% Slope	2.25	
diameter of pipe, d, ft	1.25	
wetted area, sf =	1.23	
wetted perimeter, P, ft =	3.93	
R =	0.31	
Slope, ft/ft =	0.0225	
Full Flow Velocity, ft/s =	**7.92**	
No. of barrels	**1.00**	
Full Flow Q, cfs =	**9.72**	**Capacity Ok**

Pipe ID	P-2	
Upstream Str	MH-1	
Downstream Str	MH-2	
peak Discharge, cfs	1.75	**100-YEAR BASIN DISCHARGE**
Pipe Diamater, in	15.00	
Manning's N	0.013	
% Slope	2.25	
diameter of pipe, d, ft	1.25	
wetted area, sf =	1.23	
wetted perimeter, P, ft =	3.93	
R =	0.31	
Slope, ft/ft =	0.0225	
Full Flow Velocity, ft/s =	**7.92**	
No. of barrels	**1.00**	
Full Flow Q, cfs =	**9.72**	**Capacity Ok**

Pipe ID	P-3	
Upstream Str	MH-2	
Downstream Str	HW-1	
peak Discharge, cfs	1.75	**100-YEAR BASIN DISCHARGE**
Pipe Diamater, in	15.00	
Manning's N	0.013	
% Slope	2.25	
diameter of pipe, d, ft	1.25	
wetted area, sf =	1.23	
wetted perimeter, P, ft =	3.93	
R =	0.31	
Slope, ft/ft =	0.0225	
Full Flow Velocity, ft/s =	**7.92**	
No. of barrels	**1.00**	
Full Flow Q, cfs =	**9.72**	**Capacity Ok**

PENNEAST - ETOWN&GILERT INTERCONNECTS
PREFORMED SCOUR HOLE DESIGN



Q, cfs	1.75	(Refer to 100-Yr BASIN-1 discharge on Hydraflow outputs)
Do, ft	1.25	15 IN
q (Q/Do)	1.40	
Y, ft	1	
Bottom Length (3Do), ft	3.75	
Bottom Width (2Wo), ft	2.5	
Total Length, ft	9.75	
Total Width, ft	8.5	
Tw, ft	0.25	
D50, ft	0.08	0.94 "
Use D50 (in)	6	
Thickness, in	12	with filter fabric
Stone Volume (CY)	2	

SCOUR HOLE DIMENSIONS

BOTTOM LENGTH, FT	3.75
BOTTOM WIDTH, FT	2.5
TOTAL LENGTH, FT	9.75
TOTAL WIDTH,FT	8.5
D50, INCHES	6
PLACEMENT THICKNESS, INCHES	12

G. Infiltration Memo

MOTT MACDONALD

Subject	PennEast Pipeline Project – ETown & Gilbert Interconnects Infiltration Testing
To	John Dening, CFM, PE
From	Vatsal Shah, Ph.D., PE
Our reference	353754-MM-E-E-093
Office	1001 Corporate Drive, Suite 100, Canonsburg PA 15317
Date	February 13, 2019

Overview

This memorandum addresses the geotechnical considerations of native soils for stormwater design for the ETown & Gilbert Interconnects located in Milford Township, Hunterdon County, New Jersey (site).

A subsurface investigation consisting of three excavated test pits, GLTP-1 through GLTP-3, were conducted between March 23, 2017 and March 26, 2017. Infiltration testing by means of a Basin Flooding Test in accordance with New Jersey Department of Environmental Protection's (NJDEP) Stormwater Best Management Practice Manual (NJBMP) Appendix E was performed within each test pit. A Locus Map showing the area of our investigation is provided as Appendix A.

Surficial Geology

Based on the Natural Resources Conservation Service (NRCS) Web Soil Survey, the surficial soils within the area of interest (AOI) consists of Penn channery silt loam, rough broken land shale.

Bedrock Geology

The United States Geological Survey (USGS) maps the site within the Passaic Formation. The Passaic formation generally consists of a brownish-red pebble conglomerate, medium to coarse grained feldspathic sandstone, and micaceous siltstone.

Subsurface Investigation & Infiltration Testing

Three test pits, GLTP-1 through GLTP-3, were excavated by Craig Test Boring Co., Inc. of Mays Landing, New Jersey using a Kubota KX057 excavator.

Given the presence of shallow bedrock, the Basin Flooding Test procedure in accordance with NJBMP Manual was implemented to determine the infiltration rate of the bedrock stratum. The basin flooding test was prepared and performed in accordance with the following requirements:

- The bottom area of the basin shall be a minimum of 50 square feet.
- The bottom of the basin should be made as level as possible so that high areas of rock do not project above the water level when the basin is flooded.
- Fill the basin floor with 12 inches of water and record the time. If the time required for the basin to drain completely is greater than 24 hours, the test shall be terminated and the limiting zone in question shall be considered to be a "massive rock" stratum.
- If the basin drains completely within 24 hours after the first flooding, immediately refill the basin to a depth of 12 inches and record the time. If the basin drains completely within 24 hours of the second filling, the limiting zone in question shall be considered to be a fractured rock substratum. If water remains in the basin after 24-hours, the limiting zone in question shall be considered to be a massive rock substratum.
- In the event that groundwater is observed within the test basin, the basin flooding test shall not be used.

Test Pit Description & Infiltration Test Results

Results of the infiltration test and visual observation from each test pit are provided below.

GLTP-1

Test Pit GLTP-1 was excavated 3 feet below the existing grade on March 23, 2017. During the basin flooding test, the water within the test pit did not completely drain after one 24-hour period. As a result, the limiting zone in question was classified as a "Massive Rock" substratum in accordance with NJBMP.

The general description of the soil profile observed within the excavated test pits are provided below:

- 0 – 10 inches: Topsoil, dry, dark red brown (5YR3/3) sandy loam with frequent roots.
- 10 – 36 inches: Decomposed rock, dry, dark red (10R3/6) decomposed rock with very cobbly rock fragments.
- 36 inches: Siltstone, dry, dark red (10R3/6) fine grained, moderately to slightly weathered, medium strong to strong rock.

Groundwater or soil mottling was not encountered in this test pit.

GLTP-2

Test Pit GLTP-2 was excavated 4 feet below the existing grade on March 23, 2017. During the basin flooding test, the water within the test pit completely drained after two consecutive introductions of 12 inches of water. Based on this result, a design permeability rate of 0.5 in/hr shall be used at this location.

The general description of the soil profile observed within the excavated test pits are provided below:

- 0 – 10 inches: Topsoil, dry, dark red brown (5YR3/3) loamy sand with frequent roots.
- 10 – 48 inches: Decomposed rock, dry, dark red (10R3/6) decomposed rock with very cobbly rock fragments.
- 48 inches: Siltstone, dry, dark red (10R3/6) fine grained, moderately to slightly weathered, medium strong to strong rock.

Groundwater or soil mottling was not encountered in this test pit.

GLTP-3

Test Pit GLTP-3 was excavated 3 feet below the existing grade on March 25, 2017. During the basin flooding test, the water within the test pit completely drained after two consecutive introductions of 12 inches of water. Based on this result a design permeability rate of 0.5 in/hr shall be used at this location.

The general description of the soil profile observed within the excavated test pits are provided below:

- 0 – 10 inches: Topsoil, dry, dark red brown (5YR3/3) loamy sand with frequent roots.
- 10 – 36 inches: Decomposed rock, dry, dark red (10R3/6) decomposed rock with very cobbly rock fragments.
- 36 inches: Siltstone, dry, dark red (10R3/6) fine grained, slightly weathered, strong rock.

Groundwater or soil mottling was not encountered in this test pit.

Test pit logs are provided in Appendix B.

The following is summary table of the infiltration testing completed at each test pit:

Table 1- Infiltration Test Result

Test Pit No.	Existing Grade El. (feet)	Infiltration Test Depth. (feet)	Infiltration Testing El. (feet)	Depth to Restrictive Layer (feet)	Substratum Designation	Un-Factored Infiltration Rate (in/hr)
GLTP-1	235.2	3.0	232.2	3.0	Massive Rock	0.0
GLTP-2	234.7	4.0	230.7	4.0	Fractured Rock	0.5
GLTP-3	236.4	3.0	233.4	3.0	Fractured Rock	0.5

References

Web Soil Survey. NRCS, websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx. Dec. 2017.

United States Geologic Survey (USGS).

Appendices

- Appendix A – Locus Map
- Appendix B – Test Pit Log and Field Documents

Appendices

Appendix A: Locus Map

NAME	DESCRIPTION	LATITUDE	LONGITUDE
GLTP-1	TEST PIT & PERM. TEST	40.570150°	-75.164406°
GLTP-2	TEST PIT & PERM. TEST	40.570150°	-75.164461°
GLTP-3	TEST PIT & PERM. TEST	40.570122°	-75.164485°

NOTES:
1. SCALE IS APPROXIMATE
2. GOOGLE EARTH AERIAL IMAGERY TAKEN 4/17/2017

75 0 75 150
SCALE IN FEET

MOTT MACDONALD
Certificate No. 24GA28016600
111 Wood Avenue South
Iselin, New Jersey 08830-4112

PENNEAST PIPELINE PROJECT
ETOWN AND GILBERT INTERCONNECTS
HUNTERDON CO., NJ

Designed	Drawn	Checked	Approved	Date
BOC	BOC	TR	VAS	2/12/19

Appendix B: Test Pit Log and Field Documents

MOTT MACDONALD

TEST PIT LOG

SITE LOCATION	Etown & Gilbert Interconnect	**TEST PIT NUMBER**	**GLTP- 1**
PROJECT NUMBER	353754	**MM REPRESENTATIVE**	G. Obamije
GENERAL LOCATION	Hunterdon County, NJ	**CONTRACTOR**	Craig Test Boring Co. Inc.
DATE/TIME OPENED	3/23/2017 / 8:40AM	**DATE/TIME CLOSED**	3/26/2017 / 8:00AM
GROUNDWATER	GW or indicators of seasonal high GWT (e.g. mottling) not encountered	**GROUND SURFACE ELEVATION (ft.)**	235.2
TESTING DEPTH (ft.)	3.0	**FINAL EXCAVATION DEPTH ELEVATION (ft.)**	232.2
BEDROCK DEPTH ELEVATION (ft.)	232.2	**DATE**	3/23/2017 – 3/26/2017

0-10” (Topsoil): Dark red brown (5YR3/3) sandy loam with frequent roots, dry.

10-36” (Decomposed Rock): Dard red (10R3/6) decomposed rock, very cobbly rock fragments, dry.

36”(Siltstone): Dark red (10R3/6) fine grained, moderately to slightly weathered, medium strong to strong rock, dry.

Note: All classifications and descriptions in this log are solely based on visual field observations.
They were developed to generally characterize soils for environmental purposes only.
They are not to be relied for any other purpose.

MOTT MACDONALD

TEST PIT LOG

SITE LOCATION	Etown & Gilbert Interconnect	**TEST PIT NUMBER**	**GLTP- 1**
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GENERAL LOCATION	Hunterdon County, NJ	**CONTRACTOR**	Craig Test Boring Co. Inc.
DATE/TIME OPENED	3/23/2017 / 8:40AM	**DATE/TIME CLOSED**	3/26/2017 / 8:00AM
GROUNDWATER	GW or indicators of seasonal high GWT (e.g. mottling) not encountered	**GROUND SURFACE ELEVATION (ft.)**	235.2
TESTING DEPTH (ft.)	3.0	**VOLUME OF WATER ADDED (gal)**	617
BEDROCK DEPTH ELEVATION (ft.)	232.2	**DATE**	3/23/2017 – 3/26/2017

Basin Flooding Test – Test No. 1

Note: All classifications and descriptions in this log are solely based on visual field observations. They were developed to generally characterize soils for environmental purposes only. They are not to be relied for any other purpose.

MOTT MACDONALD

TEST PIT LOG

SITE LOCATION	Etown & Gilbert Interconnect	**TEST PIT NUMBER**	**GLTP- 1**
PROJECT NUMBER	353754	**MM REPRESENTATIVE**	G. Obamije
GENERAL LOCATION	Hunterdon County, NJ	**CONTRACTOR**	Craig Test Boring Co. Inc.
DATE/TIME OPENED	3/23/2017 / 8:40AM	**DATE/TIME CLOSED**	3/26/2017 / 8:00AM
GROUNDWATER	GW or indicators of seasonal high GWT (e.g. mottling) not encountered	**GROUND SURFACE ELEVATION (ft.)**	235.2
TESTING DEPTH (ft.)	3.0	**VOLUME OF WATER ADDED (gal)**	NA
BEDROCK DEPTH ELEVATION (ft.)	232.2	**DATE**	3/23/2017 – 3/26/2017

Basin Flooding Test – Test No. 1

Note: All classifications and descriptions in this log are solely based on visual field observations. They were developed to generally characterize soils for environmental purposes only. They are not to be relied for any other purpose.

MOTT MACDONALD

TEST PIT LOG

SITE LOCATION	Etown & Gilbert Interconnect	**TEST PIT NUMBER**	**GLTP- 2**	
PROJECT NUMBER	353754	**MM REPRESENTATIVE**	G. Obamije	
GENERAL LOCATION	Hunterdon County, NJ	**CONTRACTOR**	Craig Test Boring Co. Inc.	
DATE/TIME OPENED	3/23/2017 / 8:40AM	**DATE/TIME CLOSED**	3/26/2017 / 8:00AM	
GROUNDWATER	GW or indicators of seasonal high GWT (e.g. mottling) not encountered	**GROUND SURFACE ELEVATION (ft.)**	234.7	
TESTING DEPTH (ft.)	4.0	**FINAL EXCAVATION DEPTH ELEVATION (ft.)**	230.7	
BEDROCK DEPTH ELEVATION (ft.)	230.7	**DATE**	3/23/2017 – 3/26/217	

0-10” (Topsoil): Dark red brown (5YR3/3), loamy sand, medium gravelly, dry.

10-48”(Decomposed Rock): Dark red (10R3/3) decomposed rock, very cobbly rock fragments, dry.

48” (Siltstone): Dark red (10R3/3) fine grained, moderately to slightly weathered, medium strong rock, dry.

Note: All classifications and descriptions in this log are solely based on visual field observations. They were developed to generally characterize soils for environmental purposes only. They are not to be relied for any other purpose.

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TEST PIT LOG

SITE LOCATION	Etown & Gilbert Interconnect	**TEST PIT NUMBER**	**GLTP- 2**
PROJECT NUMBER	353754	**MM REPRESENTATIVE**	G. Obamije
GENERAL LOCATION	Hunterdon County, NJ	**CONTRACTOR**	Craig Test Boring Co. Inc.
DATE/TIME OPENED	3/23/2017 / 8:40AM	**DATE/TIME CLOSED**	3/26/2017 / 8:00AM
GROUNDWATER	GW or indicators of seasonal high GWT (e.g. mottling) not encountered	**GROUND SURFACE ELEVATION (ft.)**	234.7
TESTING DEPTH (ft.)	4.0	**VOLUME OF WATER ADDED (gal)**	393
BEDROCK DEPTH ELEVATION (ft.)	230.7	**DATE**	3/23/2017 – 3/26/217

Basin Flooding Test – Test No. 1

Note: All classifications and descriptions in this log are solely based on visual field observations. They were developed to generally characterize soils for environmental purposes only. They are not to be relied for any other purpose.

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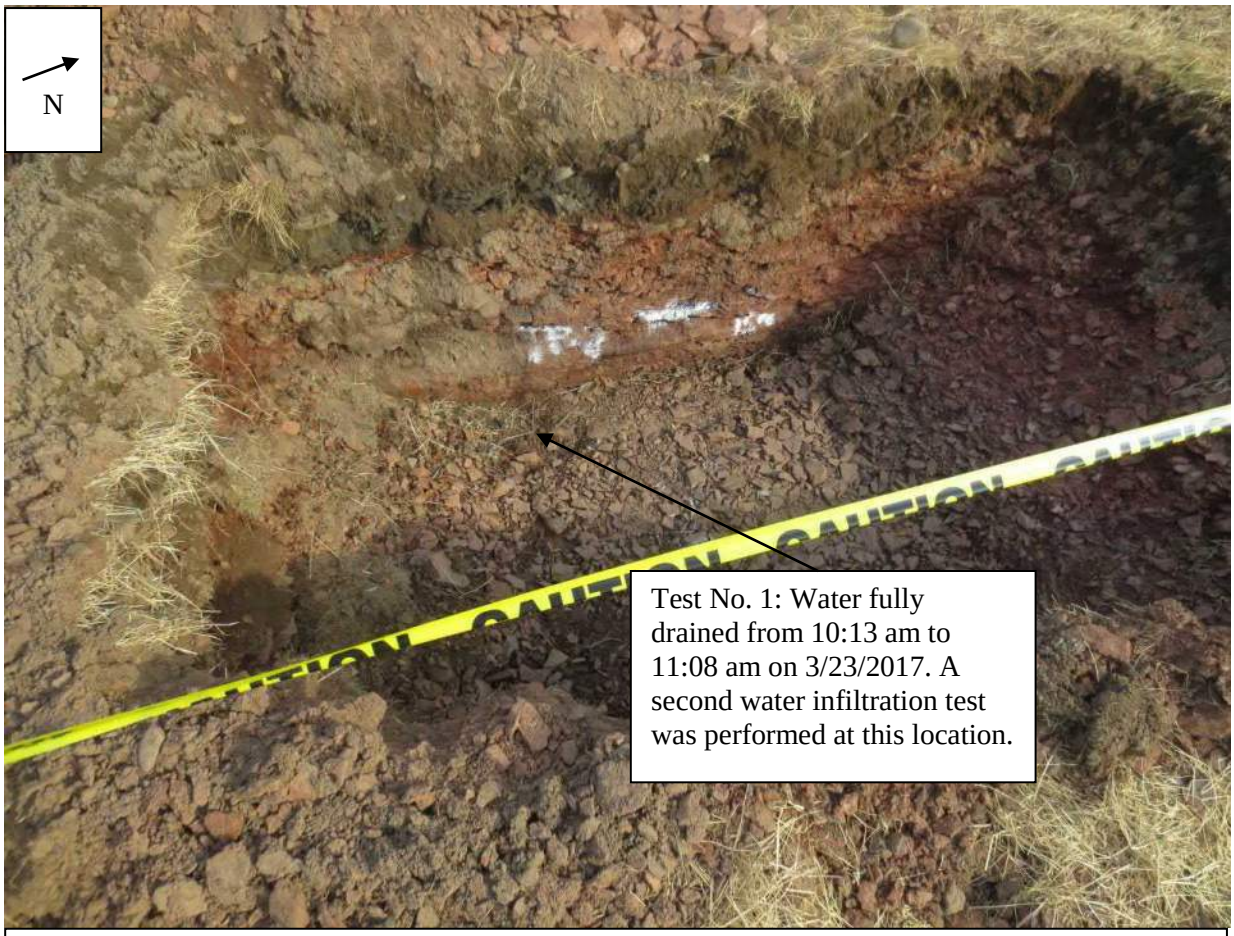
TESTING DEPTH (ft.)	4.0	**VOLUME OF WATER ADDED (gal)**	NA
BEDROCK DEPTH ELEVATION (ft.)	230.7	**DATE**	3/23/2017 – 3/26/217



Basin Flooding Test – Test No. 1

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GROUNDWATER	GW or indicators of seasonal high GWT (e.g. mottling) not encountered	**GROUND SURFACE ELEVATION (ft.)**	234.7
TESTING DEPTH (ft.)	4.0	**VOLUME OF WATER ADDED (gal)**	393
BEDROCK DEPTH ELEVATION (ft.)	230.7	**DATE**	3/23/2017 – 3/26/217

Basin Flooding Test – Test No. 2

Note: All classifications and descriptions in this log are solely based on visual field observations. They were developed to generally characterize soils for environmental purposes only. They are not to be relied for any other purpose.

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TEST PIT LOG

SITE LOCATION	Etown & Gilbert Interconnect	**TEST PIT NUMBER**	**GLTP- 2**
PROJECT NUMBER	353754	**MM REPRESENTATIVE**	G. Obamije
GENERAL LOCATION	Hunterdon County, NJ	**CONTRACTOR**	Craig Test Boring Co. Inc.
DATE/TIME OPENED	3/23/2017 / 8:40AM	**DATE/TIME CLOSED**	3/26/2017 / 8:00AM
GROUNDWATER	GW or indicators of seasonal high GWT (e.g. mottling) not encountered	**GROUND SURFACE ELEVATION (ft.)**	234.7
TESTING DEPTH (ft.)	4.0	**VOLUME OF WATER ADDED (gal)**	NA
BEDROCK DEPTH ELEVATION (ft.)	230.7	**DATE**	3/23/2017 – 3/26/217

Basin Flooding Test – Test No. 2

Note: All classifications and descriptions in this log are solely based on visual field observations. They were developed to generally characterize soils for environmental purposes only. They are not to be relied for any other purpose.

MOTT MACDONALD

TEST PIT LOG

SITE LOCATION	Etown & Gilbert Interconnect	**TEST PIT NUMBER**	**GLTP- 3**
PROJECT NUMBER	353754	**MM REPRESENTATIVE**	G. Obamije
GENERAL LOCATION	Hunterdon County, NJ	**CONTRACTOR**	Craig Test Boring Co. Inc.
DATE/TIME OPENED	3/25/2017 / 8:40AM	**DATE/TIME CLOSED**	3/26/2017 / 8:58AM
GROUNDWATER	GW or indicators of seasonal high GWT (e.g. mottling) not encountered	**GROUND SURFACE ELEVATION (ft.)**	236.4
TESTING DEPTH (ft.)	3.0	**FINAL EXCAVATION DEPTH ELEVATION (ft.)**	233.4
BEDROCK DEPTH ELEVATION (ft.)	233.4	**DATE**	3/25/2017 – 3/26/217

0-10” (Topsoil): Dark red brown (5YR3/3) loamy sand with frequent roots, dry.

10-36” (Decomposed Rock): Dark Red (10R3/6) Decomposed Rock, very cobbly rock fragments, dry.

36” (Siltstone): Dark red (10R3/6) fine grained, slightly weathered, strong rock, dry.

Note: All classifications and descriptions in this log are solely based on visual field observations. They were developed to generally characterize soils for environmental purposes only. They are not to be relied for any other purpose.

MOTT MACDONALD

TEST PIT LOG

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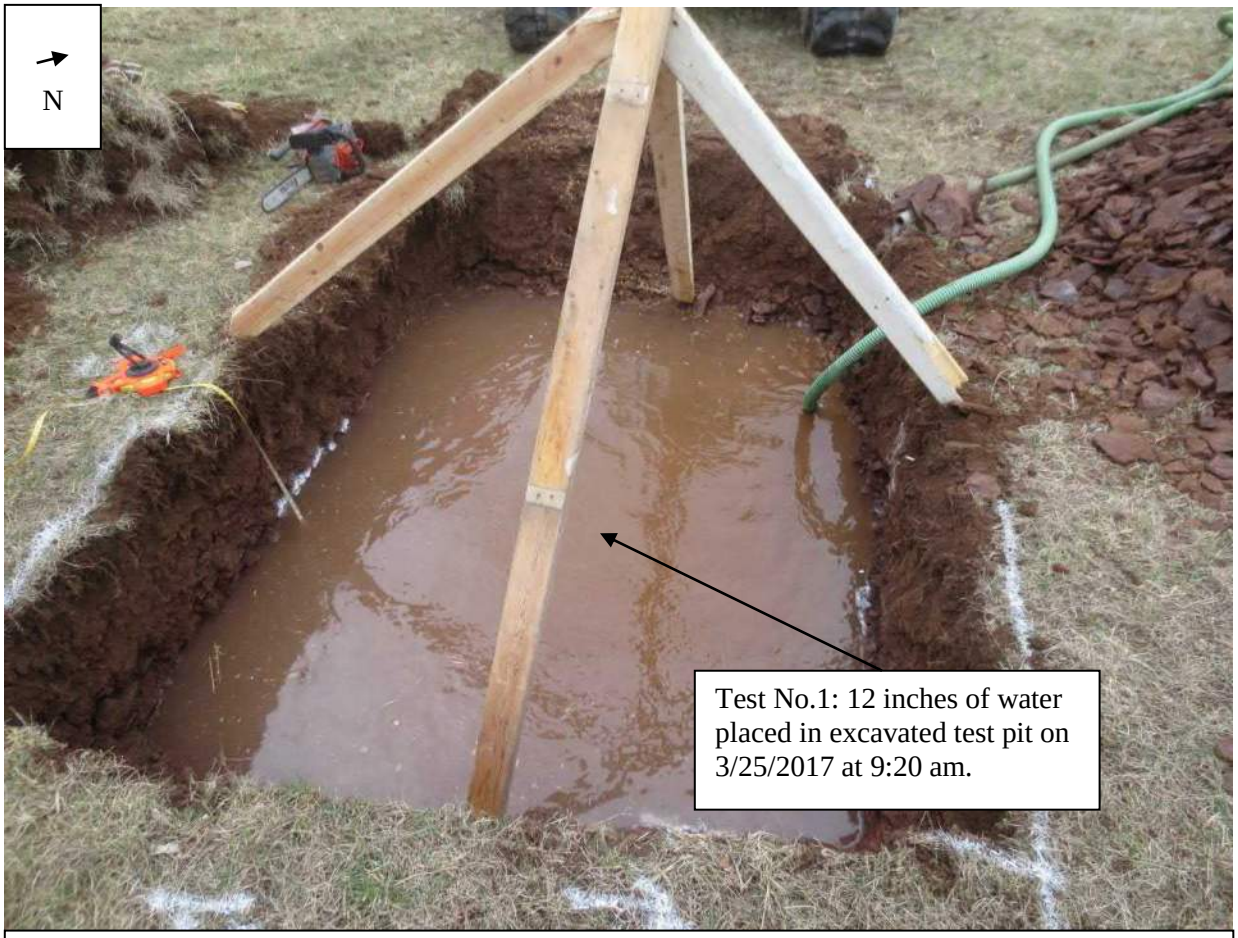
GENERAL LOCATION	Hunterdon County, NJ	**CONTRACTOR**	Craig Test Boring Co. Inc.
DATE/TIME OPENED	3/25/2017 / 8:40AM	**DATE/TIME CLOSED**	3/26/2017 / 8:58AM
GROUNDWATER	GW or indicators of seasonal high GWT (e.g. mottling) not encountered	**GROUND SURFACE ELEVATION (ft.)**	236.4
TESTING DEPTH (ft.)	3.0	**VOLUME OF WATER ADDED (gal)**	393
BEDROCK DEPTH ELEVATION (ft.)	233.4	**DATE**	3/25/2017 – 3/26/217



Basin Flooding Test – Test No. 1

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MOTT MACDONALD

TEST PIT LOG

SITE LOCATION	Etown & Gilbert Interconnect	**TEST PIT NUMBER**	**GLTP- 3**
PROJECT NUMBER	353754	**MM REPRESENTATIVE**	G. Obamije
GENERAL LOCATION	Hunterdon County, NJ	**CONTRACTOR**	Craig Test Boring Co. Inc.
DATE/TIME OPENED	3/25/2017 / 8:40AM	**DATE/TIME CLOSED**	3/26/2017 / 8:58AM
GROUNDWATER	GW or indicators of seasonal high GWT (e.g. mottling) not encountered	**GROUND SURFACE ELEVATION (ft.)**	236.4
TESTING DEPTH (ft.)	3.0	**VOLUME OF WATER ADDED (gal)**	NA
BEDROCK DEPTH ELEVATION (ft.)	233.4	**DATE**	3/25/2017 – 3/26/217

Basin Flooding Test – Test No. 1

Note: All classifications and descriptions in this log are solely based on visual field observations. They were developed to generally characterize soils for environmental purposes only. They are not to be relied for any other purpose.

MOTT MACDONALD

TEST PIT LOG

SITE LOCATION	Etown & Gilbert Interconnect	**TEST PIT NUMBER**	**GLTP- 3**
PROJECT NUMBER	353754	**MM REPRESENTATIVE**	G. Obamije
GENERAL LOCATION	Hunterdon County, NJ	**CONTRACTOR**	Craig Test Boring Co. Inc.
DATE/TIME OPENED	3/25/2017 / 8:40AM	**DATE/TIME CLOSED**	3/26/2017 / 8:58AM
GROUNDWATER	GW or indicators of seasonal high GWT (e.g. mottling) not encountered	**GROUND SURFACE ELEVATION (ft.)**	236.4
TESTING DEPTH (ft.)	3.0	**VOLUME OF WATER ADDED (gal)**	393
BEDROCK DEPTH ELEVATION (ft.)	233.4	**DATE**	3/25/2017 – 3/26/217

Basin Flooding Test – Test No. 2

Note: All classifications and descriptions in this log are solely based on visual field observations. They were developed to generally characterize soils for environmental purposes only. They are not to be relied for any other purpose.

MOTT MACDONALD

TEST PIT LOG

SITE LOCATION	Etown & Gilbert Interconnect	**TEST PIT NUMBER**	**GLTP- 3**
PROJECT NUMBER	353754	**MM REPRESENTATIVE**	G. Obamije
GENERAL LOCATION	Hunterdon County, NJ	**CONTRACTOR**	Craig Test Boring Co. Inc.
DATE/TIME OPENED	3/25/2017 / 8:40AM	**DATE/TIME CLOSED**	3/26/2017 / 8:58AM
GROUNDWATER	GW or indicators of seasonal high GWT (e.g. mottling) not encountered	**GROUND SURFACE ELEVATION (ft.)**	236.4
TESTING DEPTH (ft.)	3.0	**VOLUME OF WATER ADDED (gal)**	NA
BEDROCK DEPTH ELEVATION (ft.)	233.4	**DATE**	3/25/2017 – 3/26/217

Basin Flooding Test – Test No. 2

Note: All classifications and descriptions in this log are solely based on visual field observations. They were developed to generally characterize soils for environmental purposes only. They are not to be relied for any other purpose.

MOTT MACDONALD M M

Sheet 1 of 2

Test Pit / Permeability Test Form

Geotechnical Investigation:

☐ **Project Name:** PENNEAST ☐ **Date:** 3/23/2017 - 3/24/2017

☐ **Job Number:** 353754 ☐ **Site Location:** GILBERT INTERCONNECT MILFORD, NJ

☐ **Contractor:** CRAIG TEST BORING ☐ **Weather/Temp:** 40°F

☐ **Test Pit ID:** GLTP-1 ☐ **Report by:** G. OBAMIJE

☐ **Test Pit Depth:** 36" BELOW GROUND SURFACE ☐ **Permeability Test Method:** Basin Flood Testing (for bedrock)

Test Pit Soil Description:		
Depth Range (inches)		**Description of Soil/Rock Layers**
0	10	TOPSOIL: DARK BROWN FINE SAND AND SILT WITH FREQUENT ROOTS (SM)
10	36	DECOMPOSED/FRACTURED ROCK: RED-BROWN FRACTURED ROCK
36	-	SILTSTONE: RED-BROWN FINE GRAINED MEDIUM STRONG TO STRONG BEDROCK

Description of Bedrock Substratum					
Rock Type	**Geologic Formation**	**Average Fracture Spacing**	**Type of Fractures1**	**Orientation of Fractures2**	**Hardness of Rock3**
SILTSTONE	PASSAIC FORMATION	—	TIGHT (CLOSED)	HORIZONTAL	RIPPABLE BY MACHINE

Basin Flooding Test:						
Basin Test No.	**Test Depth (ft)**	**Area of Test Pit (ft^2)**	**Volume of Water Added (gal)**	**Time of Basin Flooding**	**Result of Basin Flooding4**	**Comments**
1	3	82.45	617	9:55AM	DID NOT DRAIN AFTER 24HRS (9:55AM)	- WATER DID NOT DRAIN COMPLETELY AFTER 24 HOUR PERIOD. READING TAKEN AT 9:55AM ON 3/24/17
2			617	—	—	- SECOND TEST NOT PERFORMED DUE TO CRITERIA STATED IN NJBMP MANUAL - APPENDIX E -

1 Open (width – measured in inches, clean, infill), Tight (Closed)
2 Horizontal (parallel to pit bottom), Inclined, Vertical (parallel to sides of pit)
3 Rippable With Hand Tools, Rippable With Machine, Explosives
4 Indicate whether basin flood test drained within a 24 hour period and time

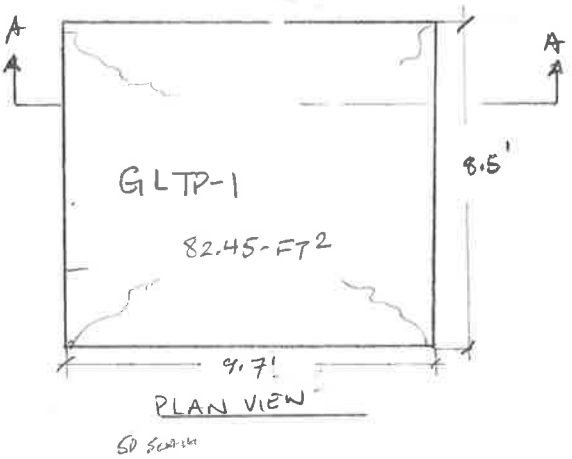
MOTT MACDONALD M M

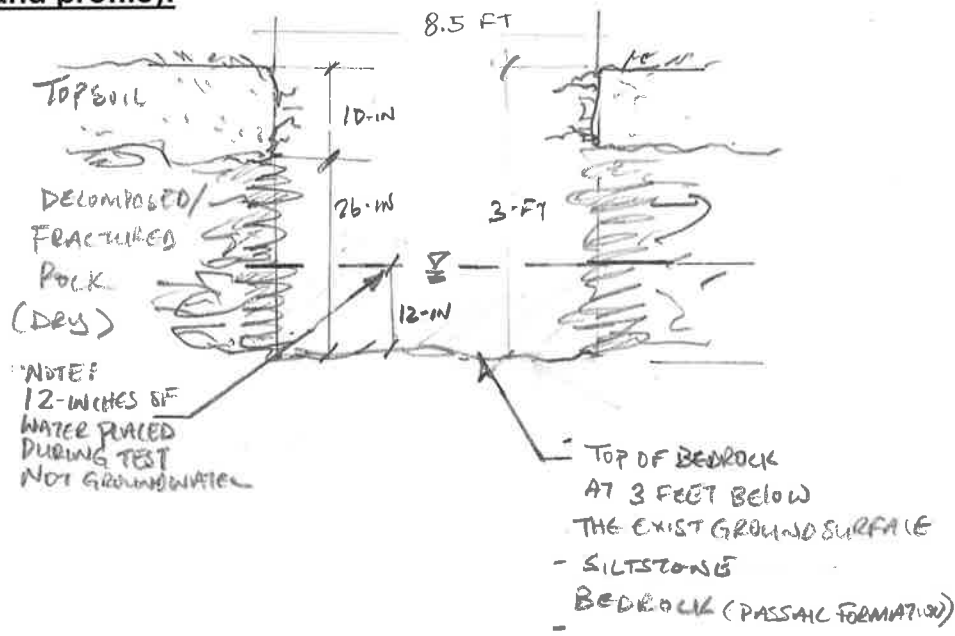
Test Pit/Percolation Test Form Continued from Page 1

Notes:

- TEST PIT EXCAVATION BETWEEN 8:40AM - 9:30AM
- BEDROCK OBSERVED AT 3 FEET BELOW EXISTING GROUND SURFACE
- PERMEABILITY TEST START AT 9:55AM ON 3/23/17 AND CONCLUDED 3/24/17 AT 9:55AM.
- BEDROCK DESCRIPTION: SILTSTONE, PASSAIC FORMATION; FRACTURE SPACING - TIGHT
  BEDROCK NOT RIPPABLE WITH HAND TOOLS, BUT RIPPABLE BY MACHINES
- BASED ON NJBMP, THE LIMITING ZONE IS CONSIDERED TO BE A MASSIVE ROCK STRATUM.

Test Pit Field Sketch (show plan view and profile):





Field Inspector Signature:_____

MOTT MACDONALD M M

Sheet 1 of 2

Test Pit / Permeability Test Form

Geotechnical Investigation:

☐ **Project Name:** PENNEAST

☐ **Date:** 3/23/2017 - 3/24/2017

☐ **Job Number:** 353754

☐ **Site Location :** GILBERT INTERCONNECT MILFORD, NJ

☐ **Contractor:** CRAIG TEST BORING

☐ **Weather/Temp:** 40°F

☐ **Test Pit ID :** GLTP-2

☐ **Report by:** G. OBAMIJE

☐ **Test Pit Depth :** 48" BELOW GROUND SURFACE

☐ **Permeability Test Method:** Basin Flood Testing (for bedrock)

Test Pit Soil Description:

Depth Range (inches)		Description of Soil/Rock Layers
0	10	TOPSOIL / DARK BROWN FINE SAND AND SILT WITH FREQUENT ROOTS (SM)
10	48	FRACTURED ROCK: REDBROWN FRACTURED ROCK
48	—	SILTSTONE: RED-BROWN FINE GRAINED, MEDIUM STRONG, MODERATELY FRACTURED
		MODERATELY TO SLIGHTLY WEATHERED

Description of Bedrock Substratum

Rock Type	Geologic Formation	Average Fracture Spacing	Type of Fractures1	Orientation of Fractures2	Hardness of Rock3
SILTSTONE	PASSAIC FORMATION	—	-OPEN (1/2 INCHES)	HORIZONTAL	RIPPABLE BY MACHINE

Basin Flooding Test:

Basin Test No.	Test Depth (ft)	Area of Test Pit (ft^2)	Volume of Water Added (gal)	Time of Basin Flooding	Result of Basin Flooding4	Comments
1	4	52.5	393	10:13AM	-COMPLETELY DRAINED AT 11:08AM ON 3/23/2017	-TEST FULLY DRAINED -RETEST AFTER 24-HOUR PERIOD
2			393	9:10AM	-DRAINED COMPLETELY AT 10:40AM 3/24/2017	-A MINIMUM INFILTRATION RATE OF 0.5 IN/HR AT GLTP-2 LOCATION

1 Open (width – measured in inches, clean, infill), Tight (Closed)
2 Horizontal (parallel to pit bottom), Inclined, Vertical (parallel to sides of pit)
3 Rippable With Hand Tools, Rippable With Machine, Explosives
4 Indicate whether basin flood test drained within a 24 hour period and time

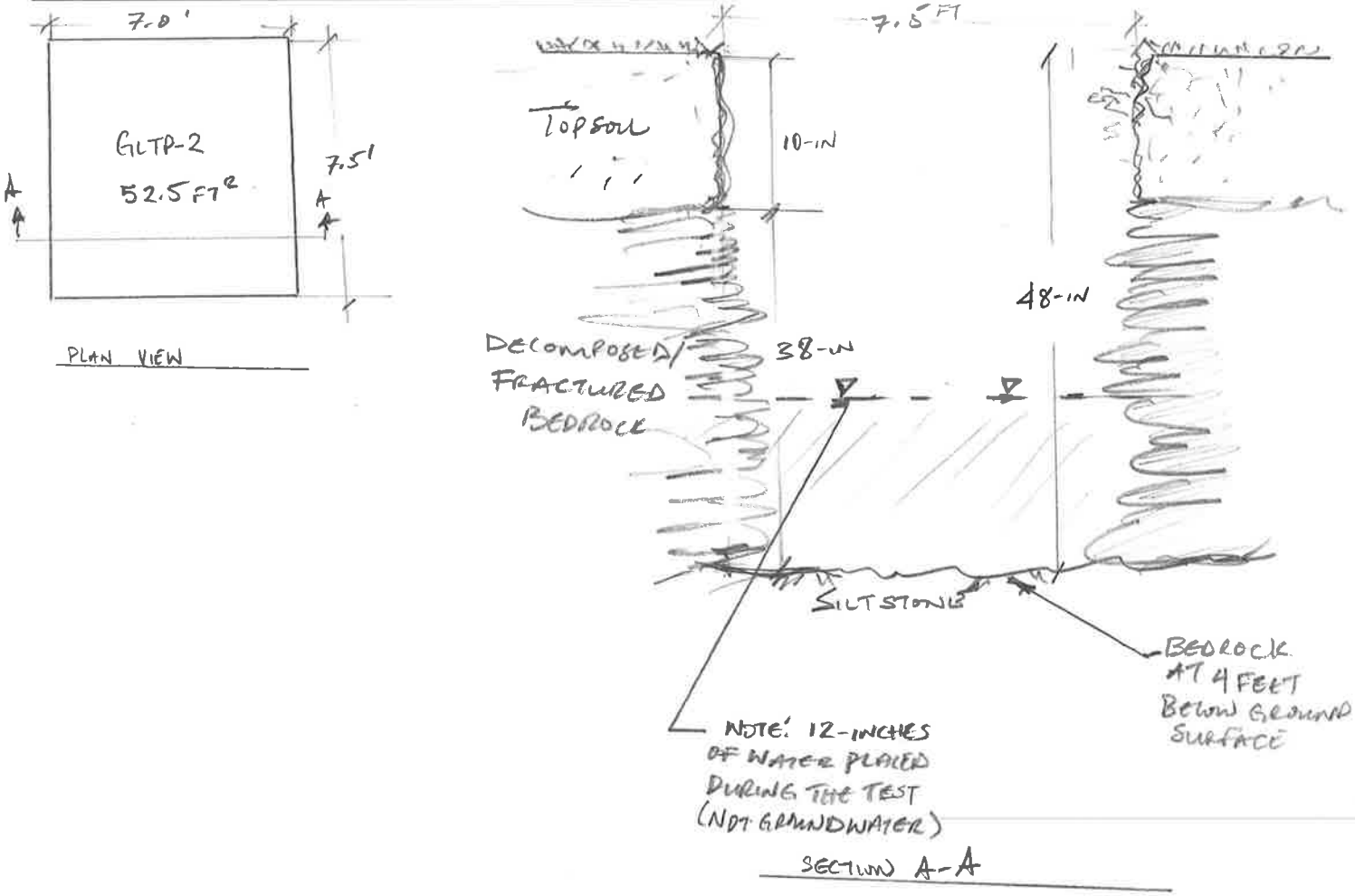
MOTT MACDONALD M M

Test Pit/Percolation Test Form Continued from Page 1

Notes:

- EXCAVATED GLTP-2 AT 9:30AM. CONDUCTED FIRST BASIN FLOODING TEST AT 10:13AM ON 3/23/17. 12-INCHES OF WATER WAS PLACED IN THE OPEN PIT. THE WATER DRAINED COMPLETELY AT 11:08AM ON 3/23/17.
- THE FOLLOWING DAY (3/24/2017) 12 INCHES OF WATER WAS PLACED IN GLTP-2. THE TEST STARTED AT 9:10AM AND COMPLETELY DRAINED AT 10:40AM - 3/24/2017
- A DESIGN PERMEABILITY RATE OF 0.5 IN/HR IS PROVIDED AT THIS LOCATION. FOLLOWING CRITERIA SPECIFIED IN NJBMP MANUAL - APPENDIX E.

Test Pit Field Sketch (show plan view and profile):



MOTT MACDONALD

Sheet 1 of 2

Test Pit / Permeability Test Form

Geotechnical Investigation:

☐ **Project Name:** PENNEAST

☐ **Date:** 3/25/2017 - 3/26/2017

☐ **Job Number:** 353754

☐ **Site Location :** GILBERT INTERCONNECT MILFORD, NJ

☐ **Contractor:** CRAIG TEST BORING

☐ **Weather/Temp:** 45°F

☐ **Test Pit ID :** GLTP-3

☐ **Report by:** G. OBAMIJE

☐ **Test Pit Depth :** 36"

☐ **Permeability Test Method**: Basin Flood Testing (for bedrock)

Test Pit Soil Description:

Depth Range (inches)		Description of Soil/Rock Layers
0	10	TOPSOIL: DARK BROWN FINE SAND AND SILT WITH FREQUENT ROOTS
10	36	FRACTURED ROCK: RED BROWN FRACTURED ROCK
36	–	SILTSTONE: RED-BROWN FINE GRAINED, STRONG, SLIGHTLY WEATHERED

Description of Bedrock Substratum

Rock Type	Geologic Formation	Average Fracture Spacing	Type of Fractures1	Orientation of Fractures2	Hardness of Rock3
SILTSTONE	PASSAIC FORMATION	–	TIGHT (CLOSED)	VERTICAL	RIPPABLE BY MACHINE

Basin Flooding Test:

Basin Test No.	Test Depth (ft)	Area of Test Pit (ft^2)	Volume of Water Added (gal)	Time of Basin Flooding	Result of Basin Flooding4	Comments
1	3	52.5	393	9:20AM	DRAINED COMPLETELY AT 10:20AM ON 3/25/17	– TEST FULLY DRAINED. RETEST AFTER 24 HOURS
2			393	7:30AM	DRAINED COMPLETELY AT 8:25AM ON 3/26/17	– A MINIMUM INFILTRATION RATE OF 0.5 IN/HR AT GLTP-3 LOCATION

1 Open (width – measured in inches, clean, infill), Tight (Closed)
2 Horizontal (parallel to pit bottom), Inclined, Vertical (parallel to sides of pit)
3 Rippable With Hand Tools, Rippable With Machine, Explosives
4 Indicate whether basin flood test drained within a 24 hour period and time

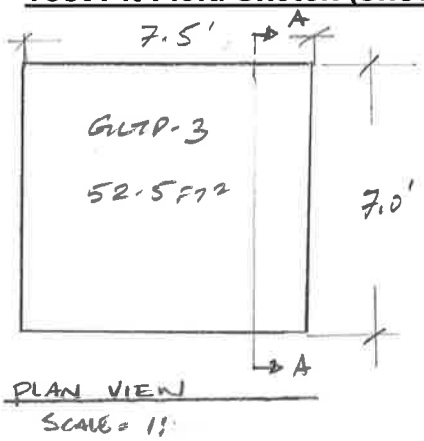
MOTT MACDONALD M M

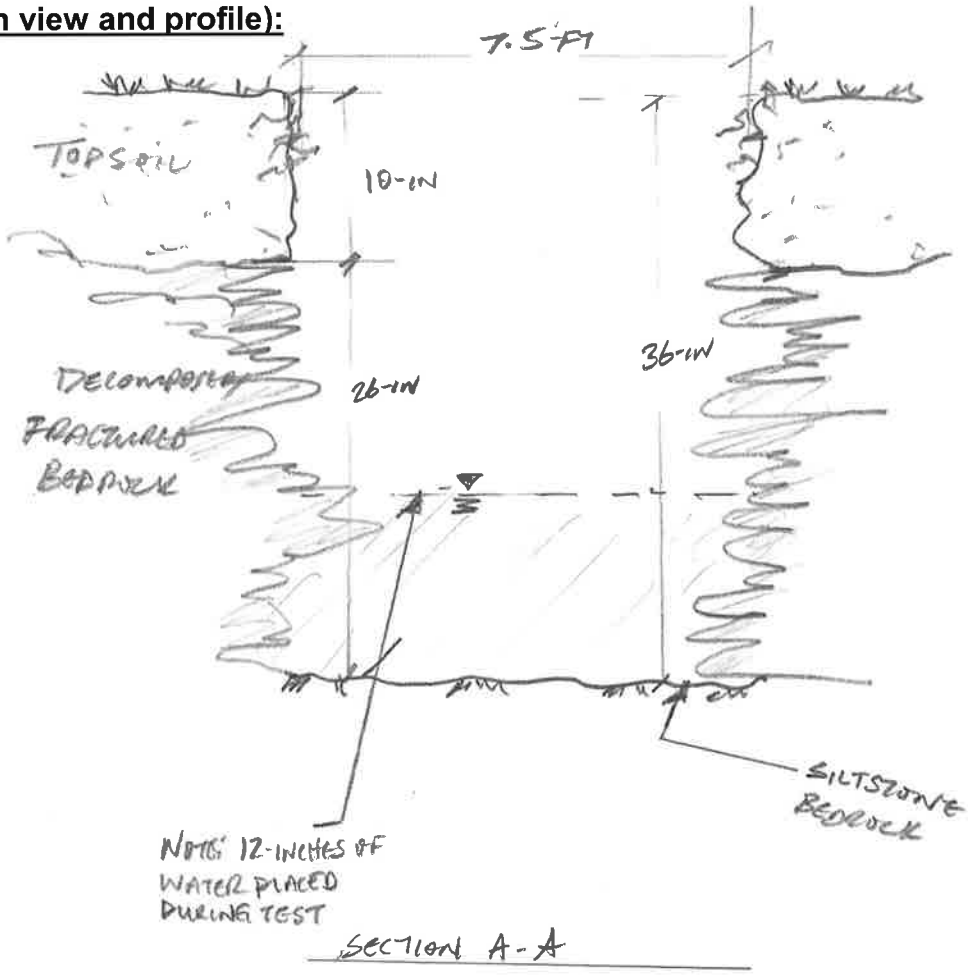
Test Pit/Percolation Test Form Continued from Page 1

Notes:

- EXCAVATED GLTP-3 ON 3/25/2017 AND PERFORMED INFILTRATION TEST AT 9:20AM.
- TEST PIT WAS FILLED WITH 12-INCHES OF WATER AND COMPLETELY DRAINED AT 10:20AM ON 3/25/2017
- SECOND TEST CONDUCTED AT 7:30AM ON 3/26/2017. WATER COMPLETELY DRAINED AT 8:25AM 3/26/2017
- A DESIGN PERMEABILITY RATE OF 0.5 IN/HR WAS PROVIDED AT THIS LOCATION FOLLOWING CRITERIA SPECIFIED IN NJBMP MANUAL - APPENDIX E.

Test Pit Field Sketch (show plan view and profile):



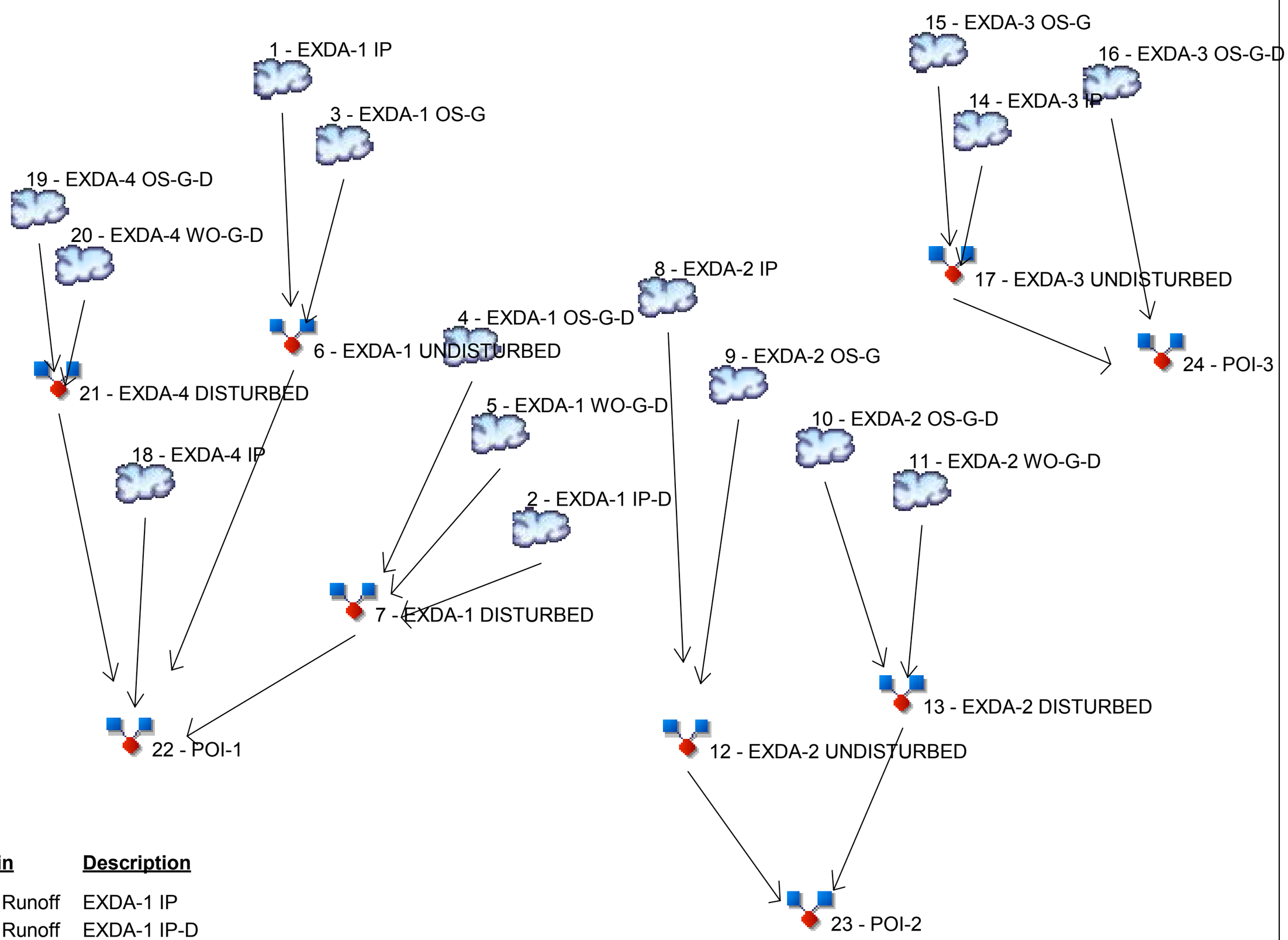


H. Hydrologic Model Outputs

EXISTING CONDITIONS

Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020



Legend

Hyd.	Origin	Description
1	SCS Runoff	EXDA-1 IP
2	SCS Runoff	EXDA-1 IP-D
3	SCS Runoff	EXDA-1 OS-G
4	SCS Runoff	EXDA-1 OS-G-D
5	SCS Runoff	EXDA-1 WO-G-D
6	Combine	EXDA-1 UNDISTURBED
7	Combine	EXDA-1 DISTURBED
8	SCS Runoff	EXDA-2 IP
9	SCS Runoff	EXDA-2 OS-G
10	SCS Runoff	EXDA-2 OS-G-D
11	SCS Runoff	EXDA-2 WO-G-D
12	Combine	EXDA-2 UNDISTURBED
13	Combine	EXDA-2 DISTURBED
14	SCS Runoff	EXDA-3 IP
15	SCS Runoff	EXDA-3 OS-G
16	SCS Runoff	EXDA-3 OS-G-D
17	Combine	EXDA-3 UNDISTURBED
18	SCS Runoff	EXDA-4 IP
19	SCS Runoff	EXDA-4 OS-G-D
20	SCS Runoff	EXDA-4 WO-G-D
21	Combine	EXDA-4 DISTURBED
22	Combine	POI-1
23	Combine	POI-2
24	Combine	POI-3

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)								Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	------	-------	0.552	-------	-------	0.817	-------	-------	1.312	EXDA-1 IP
2	SCS Runoff	------	-------	0.006	-------	-------	0.008	-------	-------	0.013	EXDA-1 IP-D
3	SCS Runoff	------	-------	0.008	-------	-------	0.016	-------	-------	0.034	EXDA-1 OS-G
4	SCS Runoff	------	-------	0.674	-------	-------	1.382	-------	-------	2.855	EXDA-1 OS-G-D
5	SCS Runoff	------	-------	0.023	-------	-------	0.053	-------	-------	0.118	EXDA-1 WO-G-D
6	Combine	1, 3,	-------	0.560	-------	-------	0.833	-------	-------	1.346	EXDA-1 UNDISTURBED
7	Combine	2, 4, 5,	-------	0.702	-------	-------	1.442	-------	-------	2.986	EXDA-1 DISTURBED
8	SCS Runoff	------	-------	0.499	-------	-------	0.739	-------	-------	1.187	EXDA-2 IP
9	SCS Runoff	------	-------	0.011	-------	-------	0.023	-------	-------	0.048	EXDA-2 OS-G
10	SCS Runoff	------	-------	0.922	-------	-------	1.904	-------	-------	3.960	EXDA-2 OS-G-D
11	SCS Runoff	------	-------	0.114	-------	-------	0.263	-------	-------	0.589	EXDA-2 WO-G-D
12	Combine	8, 9,	-------	0.510	-------	-------	0.762	-------	-------	1.235	EXDA-2 UNDISTURBED
13	Combine	10, 11,	-------	1.036	-------	-------	2.166	-------	-------	4.548	EXDA-2 DISTURBED
14	SCS Runoff	------	-------	0.569	-------	-------	0.842	-------	-------	1.352	EXDA-3 IP
15	SCS Runoff	------	-------	0.004	-------	-------	0.009	-------	-------	0.019	EXDA-3 OS-G
16	SCS Runoff	------	-------	0.179	-------	-------	0.360	-------	-------	0.733	EXDA-3 OS-G-D
17	Combine	14, 15,	-------	0.573	-------	-------	0.851	-------	-------	1.371	EXDA-3 UNDISTURBED
18	SCS Runoff	------	-------	0.255	-------	-------	0.378	-------	-------	0.607	EXDA-4 IP
19	SCS Runoff	------	-------	0.139	-------	-------	0.275	-------	-------	0.549	EXDA-4 OS-G-D
20	SCS Runoff	------	-------	0.073	-------	-------	0.149	-------	-------	0.307	EXDA-4 WO-G-D
21	Combine	19, 20	-------	0.212	-------	-------	0.424	-------	-------	0.856	EXDA-4 DISTURBED
22	Combine	6, 7, 18, 21	-------	1.721	-------	-------	3.077	-------	-------	5.795	POI-1
23	Combine	12, 13,	-------	1.534	-------	-------	2.928	-------	-------	5.784	POI-2
24	Combine	16, 17,	-------	0.751	-------	-------	1.211	-------	-------	2.104	POI-3

2-YEAR 24-HOUR

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.552	2	728	2,359	------	------	------	EXDA-1 IP
2	SCS Runoff	0.006	2	728	24	------	------	------	EXDA-1 IP-D
3	SCS Runoff	0.008	2	730	31	------	------	------	EXDA-1 OS-G
4	SCS Runoff	0.674	2	730	2,678	------	------	------	EXDA-1 OS-G-D
5	SCS Runoff	0.023	2	730	96	------	------	------	EXDA-1 WO-G-D
6	Combine	0.560	2	728	2,390	1, 3,	------	------	EXDA-1 UNDISTURBED
7	Combine	0.702	2	730	2,798	2, 4, 5,	------	------	EXDA-1 DISTURBED
8	SCS Runoff	0.499	2	728	2,134	------	------	------	EXDA-2 IP
9	SCS Runoff	0.011	2	730	44	------	------	------	EXDA-2 OS-G
10	SCS Runoff	0.922	2	730	3,674	------	------	------	EXDA-2 OS-G-D
11	SCS Runoff	0.114	2	730	479	------	------	------	EXDA-2 WO-G-D
12	Combine	0.510	2	728	2,178	8, 9,	------	------	EXDA-2 UNDISTURBED
13	Combine	1.036	2	730	4,153	10, 11,	------	------	EXDA-2 DISTURBED
14	SCS Runoff	0.569	2	728	2,430	------	------	------	EXDA-3 IP
15	SCS Runoff	0.004	2	730	18	------	------	------	EXDA-3 OS-G
16	SCS Runoff	0.179	2	730	707	------	------	------	EXDA-3 OS-G-D
17	Combine	0.573	2	728	2,448	14, 15,	------	------	EXDA-3 UNDISTURBED
18	SCS Runoff	0.255	2	728	1,091	------	------	------	EXDA-4 IP
19	SCS Runoff	0.139	2	730	546	------	------	------	EXDA-4 OS-G-D
20	SCS Runoff	0.073	2	730	290	------	------	------	EXDA-4 WO-G-D
21	Combine	0.212	2	730	836	19, 20	------	------	EXDA-4 DISTURBED
22	Combine	1.721	2	728	7,114	6, 7, 18, 21	------	------	POI-1
23	Combine	1.534	2	730	6,330	12, 13,	------	------	POI-2
24	Combine	0.751	2	728	3,155	16, 17,	------	------	POI-3

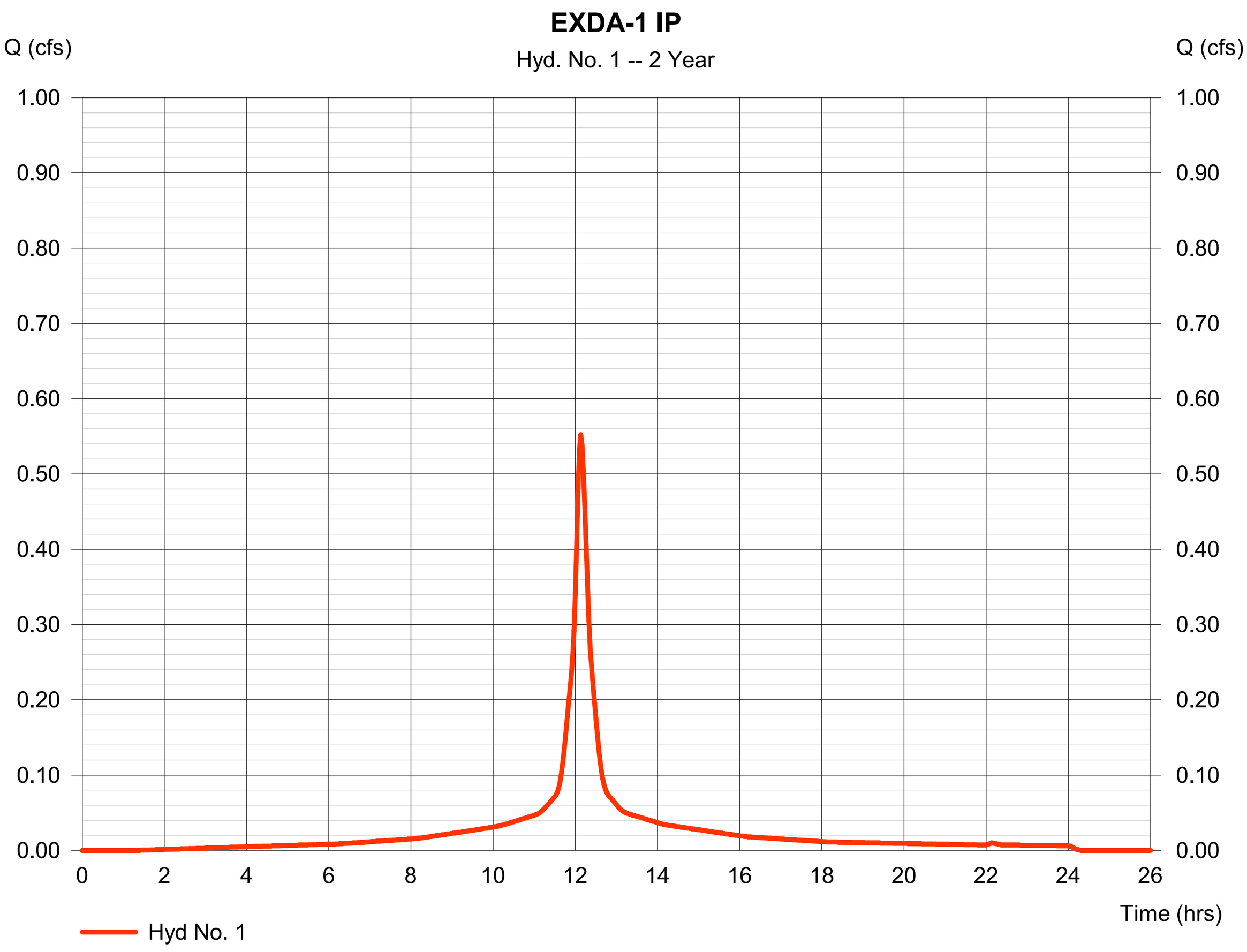
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 1

EXDA-1 IP

Hydrograph type	= SCS Runoff	Peak discharge	= 0.552 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 2,359 cuft
Drainage area	= 0.199 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.10 min
Total precip.	= 3.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



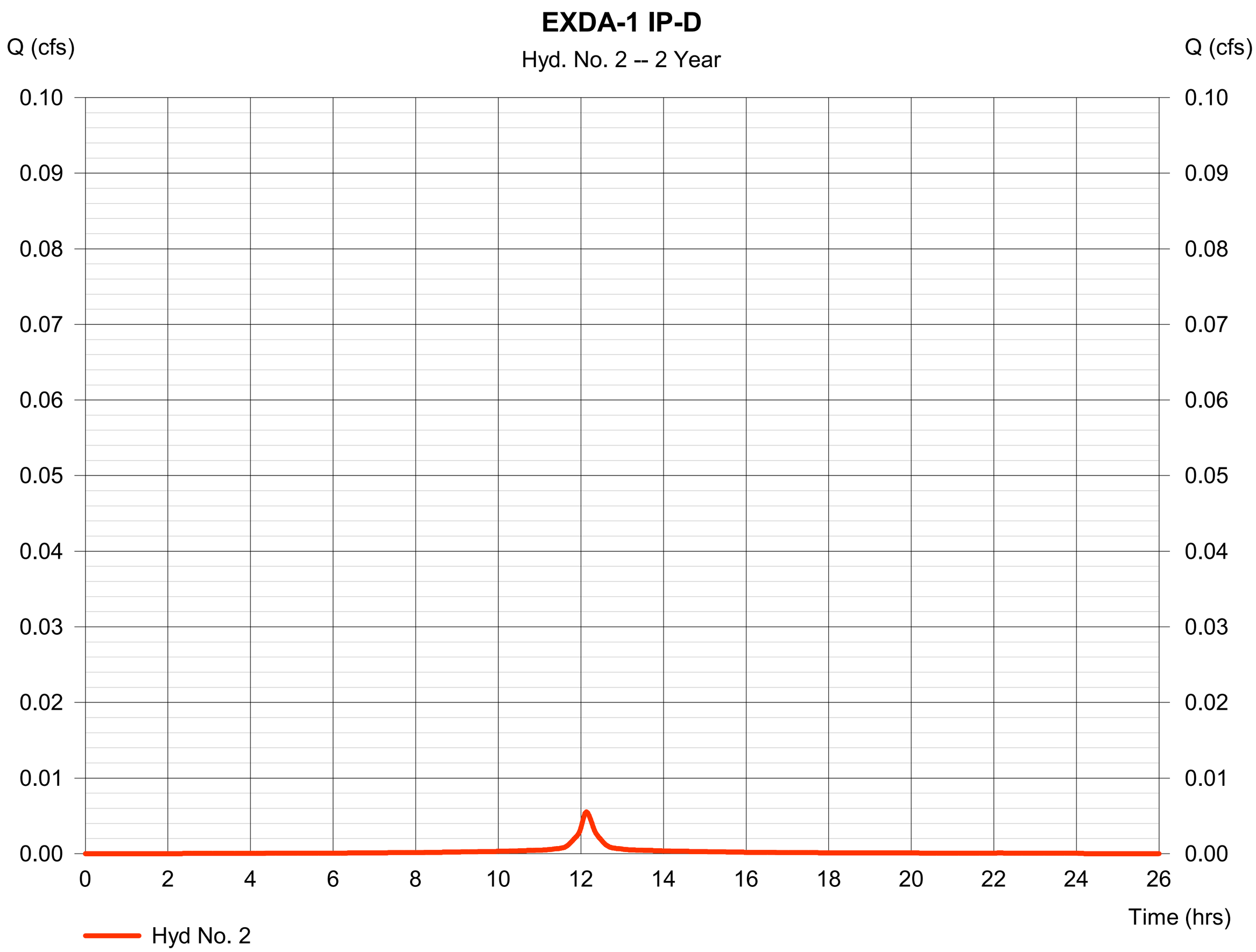
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 2

EXDA-1 IP-D

Hydrograph type	= SCS Runoff	Peak discharge	= 0.006 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 24 cuft
Drainage area	= 0.002 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.15 min
Total precip.	= 3.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



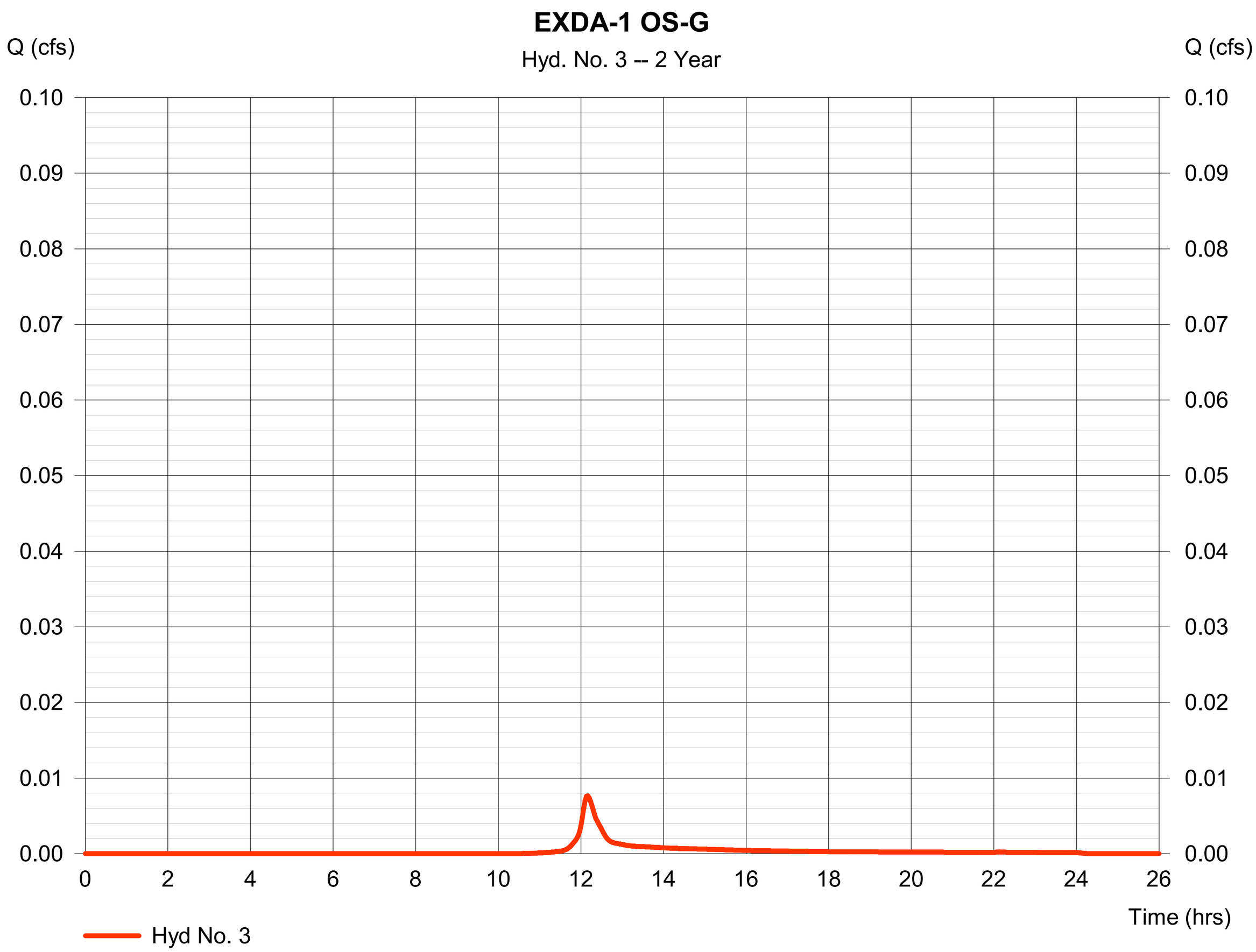
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 3

EXDA-1 OS-G

Hydrograph type	= SCS Runoff	Peak discharge	= 0.008 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 31 cuft
Drainage area	= 0.007 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.10 min
Total precip.	= 3.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



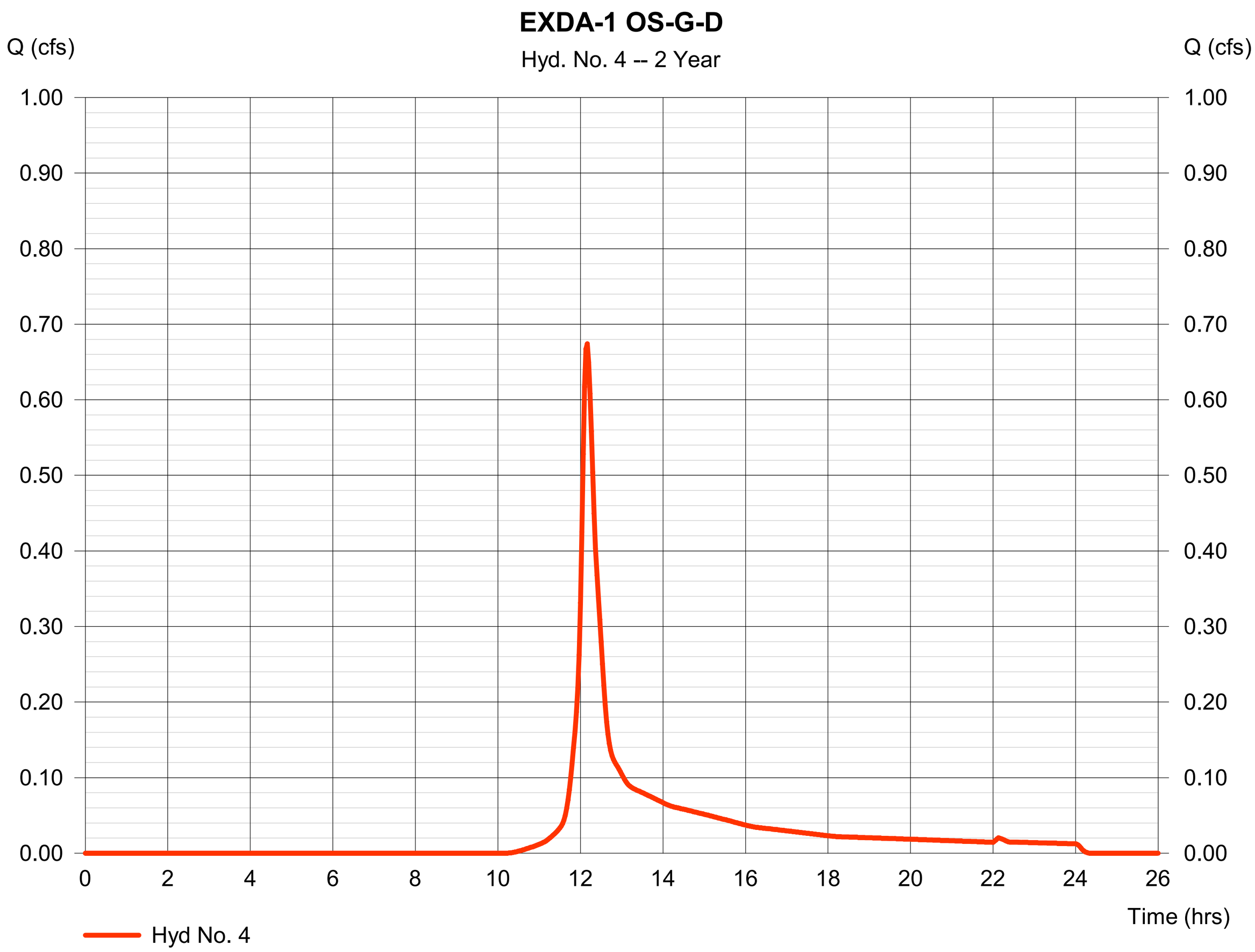
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 4

EXDA-1 OS-G-D

Hydrograph type	= SCS Runoff	Peak discharge	= 0.674 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 2,678 cuft
Drainage area	= 0.581 ac	Curve number	= 75
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.10 min
Total precip.	= 3.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



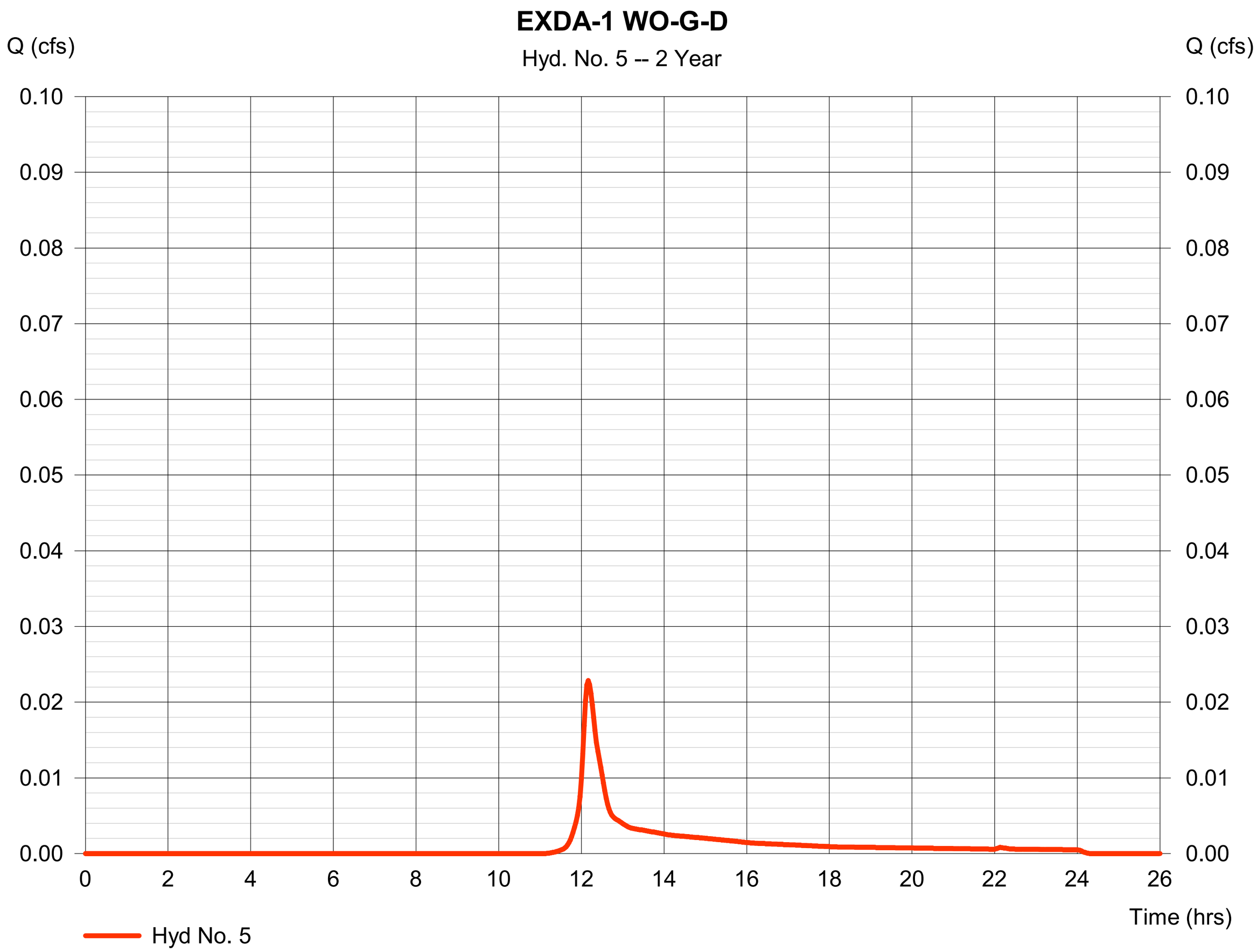
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 5

EXDA-1 WO-G-D

Hydrograph type	= SCS Runoff	Peak discharge	= 0.023 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 96 cuft
Drainage area	= 0.027 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.15 min
Total precip.	= 3.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



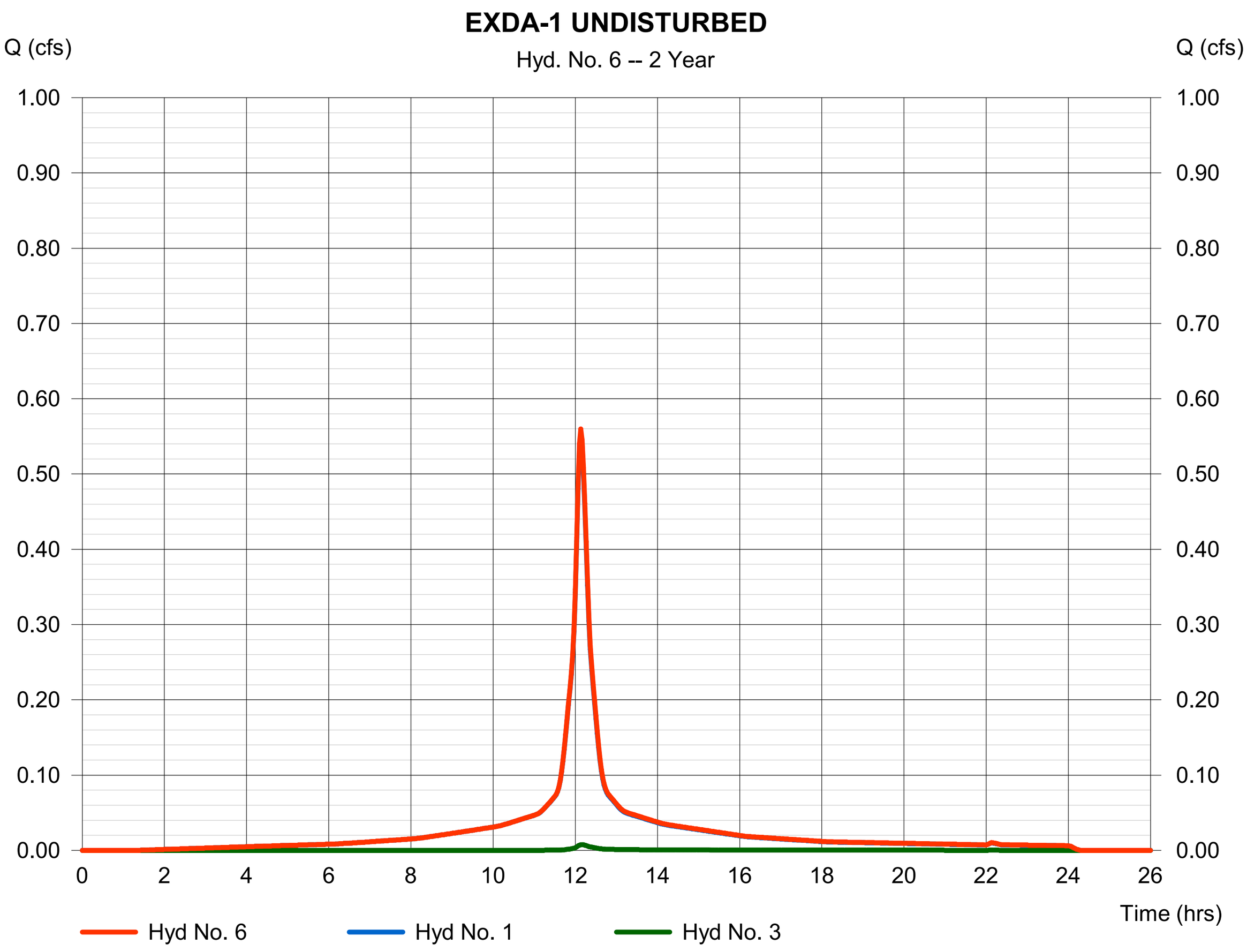
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 6

EXDA-1 UNDISTURBED

Hydrograph type	= Combine	Peak discharge	= 0.560 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 2,390 cuft
Inflow hyds.	= 1, 3	Contrib. drain. area	= 0.206 ac



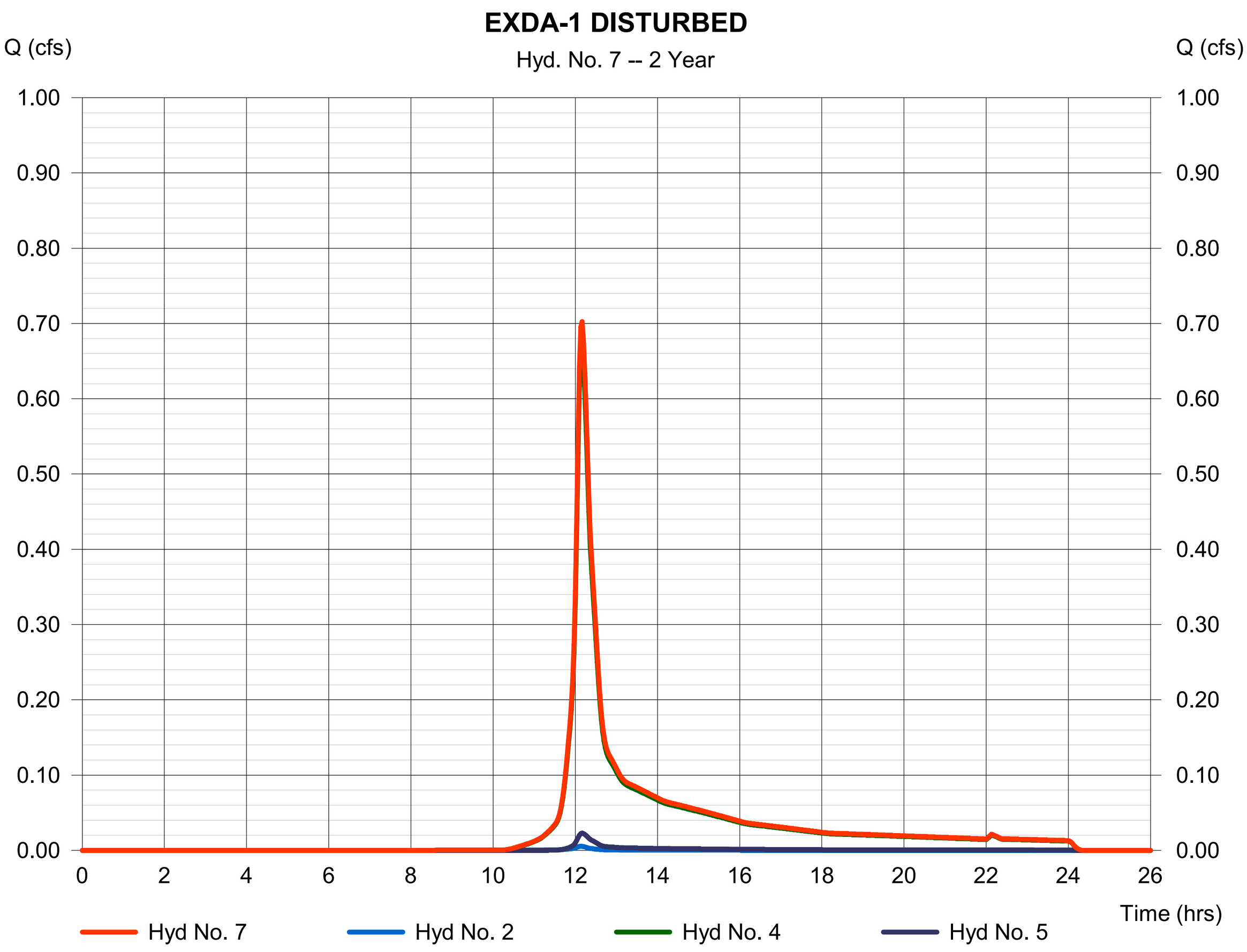
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 7

EXDA-1 DISTURBED

Hydrograph type	= Combine	Peak discharge	= 0.702 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 2,798 cuft
Inflow hyds.	= 2, 4, 5	Contrib. drain. area	= 0.610 ac



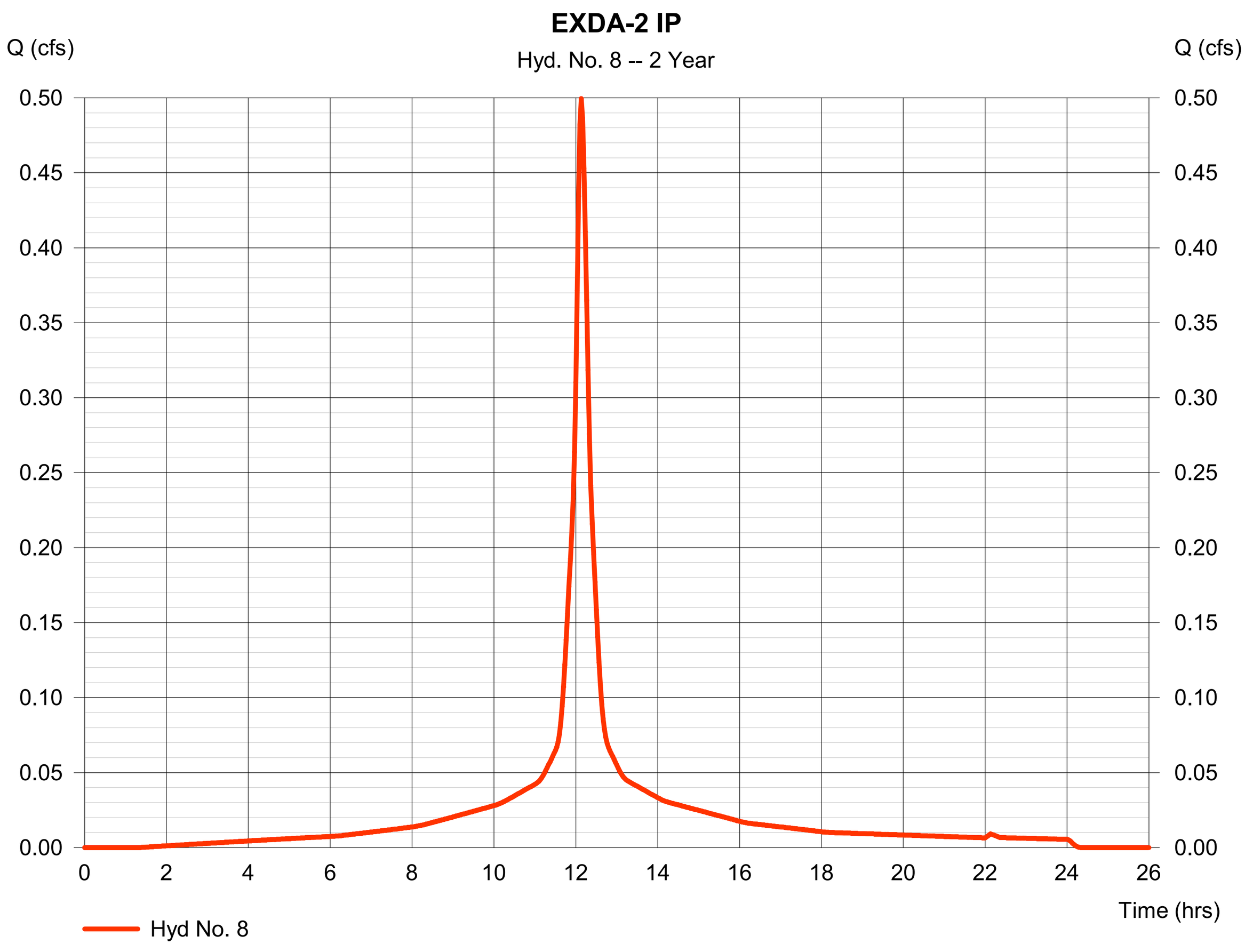
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 8

EXDA-2 IP

Hydrograph type	= SCS Runoff	Peak discharge	= 0.499 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 2,134 cuft
Drainage area	= 0.180 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.80 min
Total precip.	= 3.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



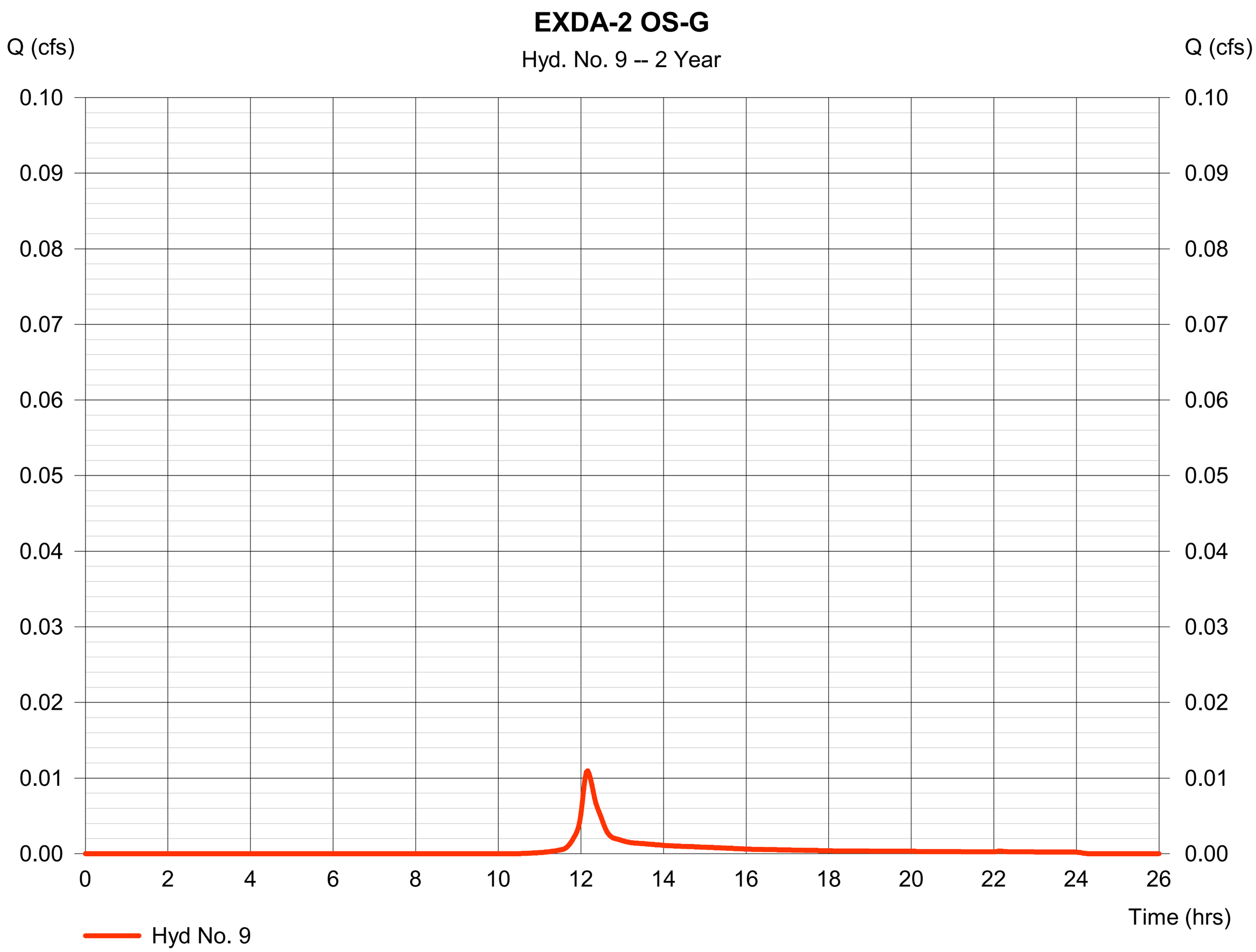
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 9

EXDA-2 OS-G

Hydrograph type	= SCS Runoff	Peak discharge	= 0.011 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 44 cuft
Drainage area	= 0.010 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.80 min
Total precip.	= 3.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



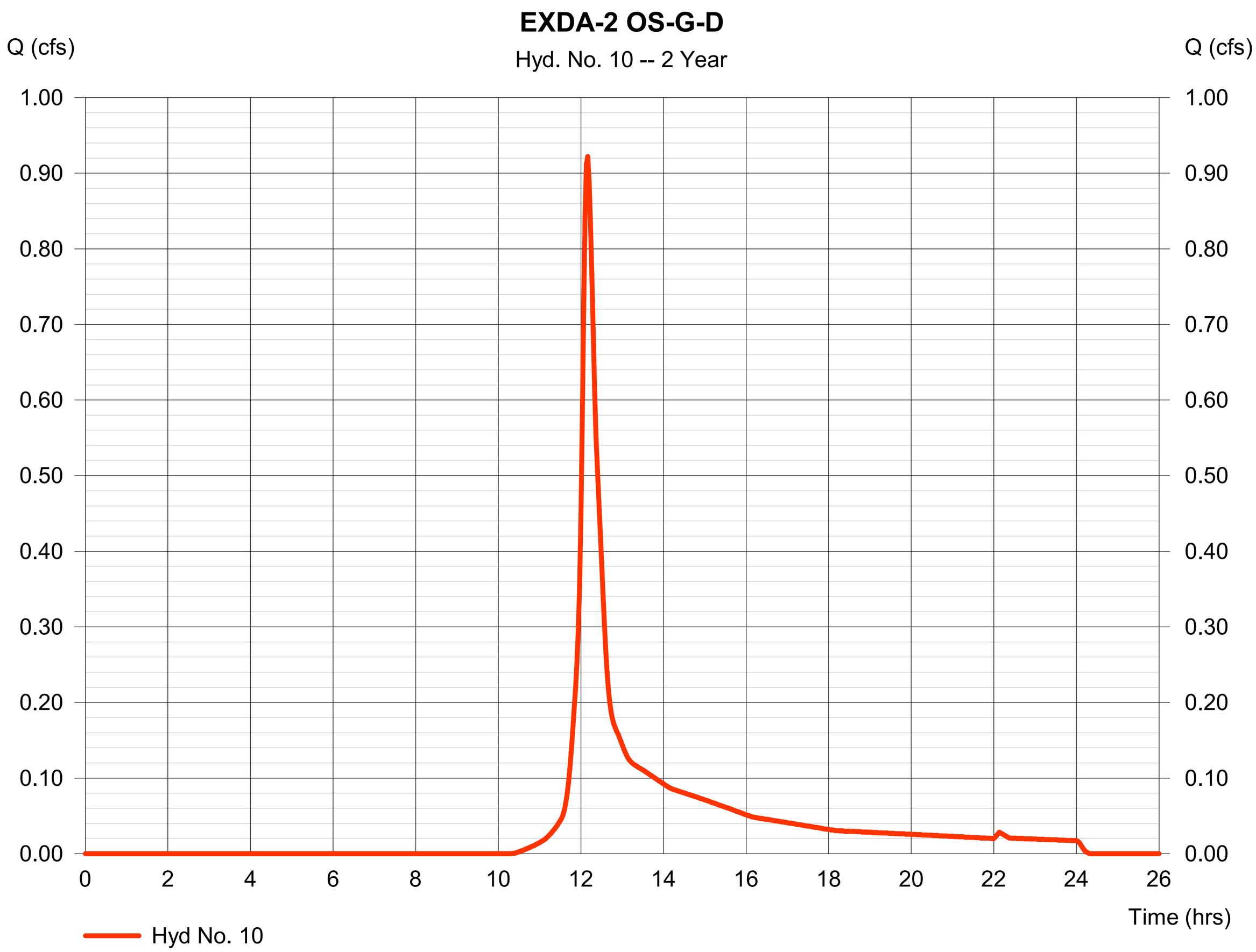
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 10

EXDA-2 OS-G-D

Hydrograph type	= SCS Runoff	Peak discharge	= 0.922 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 3,674 cuft
Drainage area	= 0.813 ac	Curve number	= 74.6
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.80 min
Total precip.	= 3.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



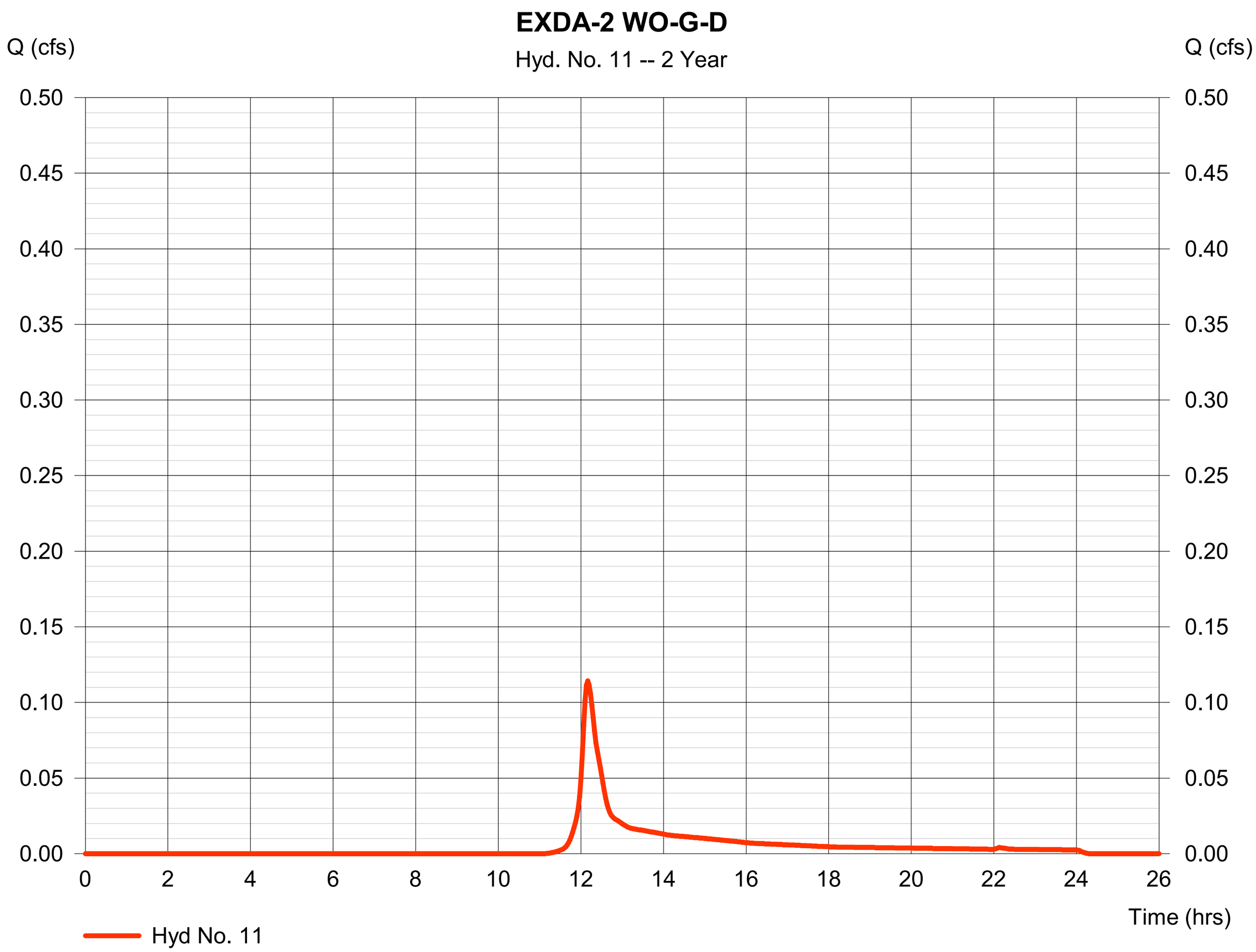
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 11

EXDA-2 WO-G-D

Hydrograph type	= SCS Runoff	Peak discharge	= 0.114 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 479 cuft
Drainage area	= 0.135 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.83 min
Total precip.	= 3.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



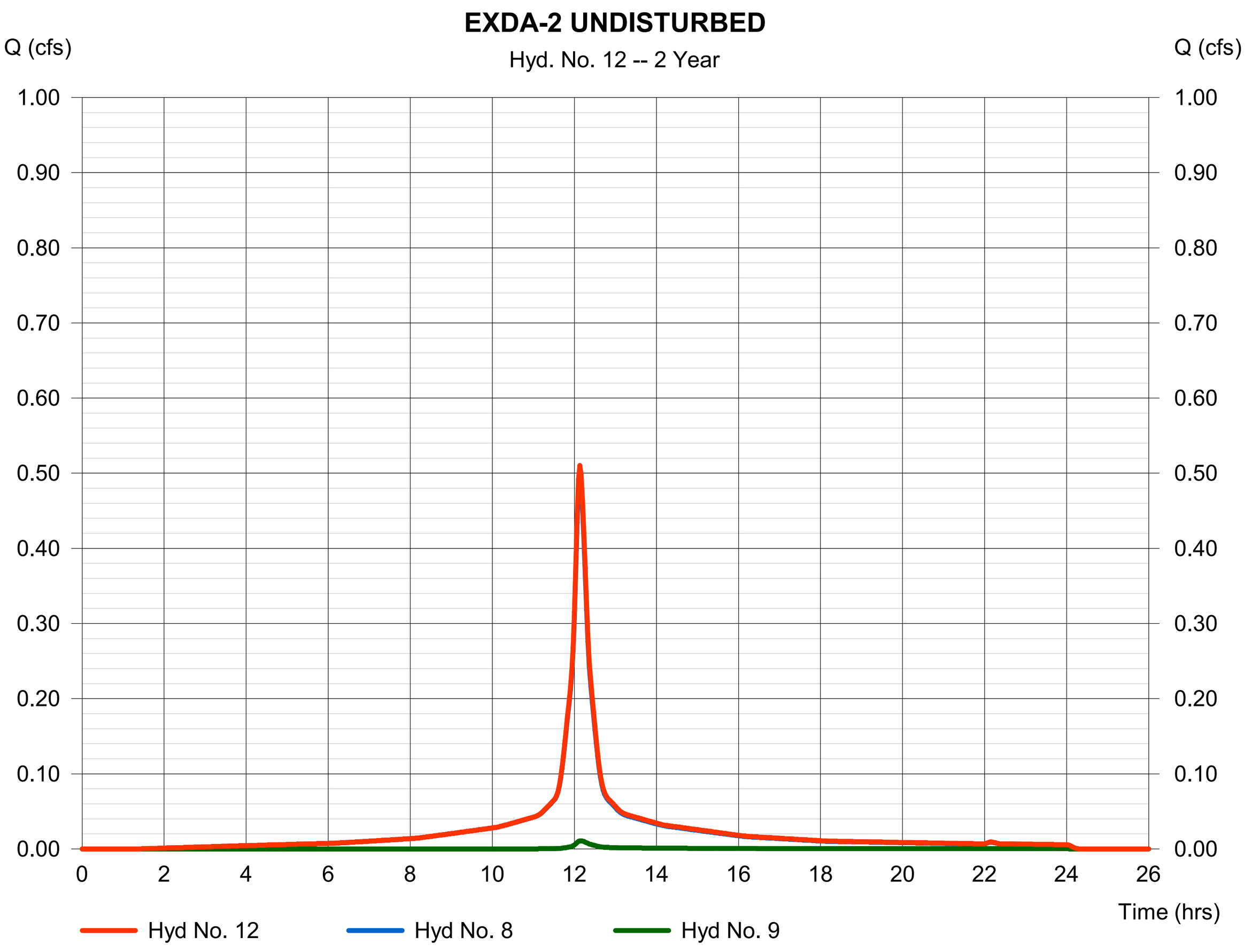
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 12

EXDA-2 UNDISTURBED

Hydrograph type	= Combine	Peak discharge	= 0.510 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 2,178 cuft
Inflow hyds.	= 8, 9	Contrib. drain. area	= 0.190 ac



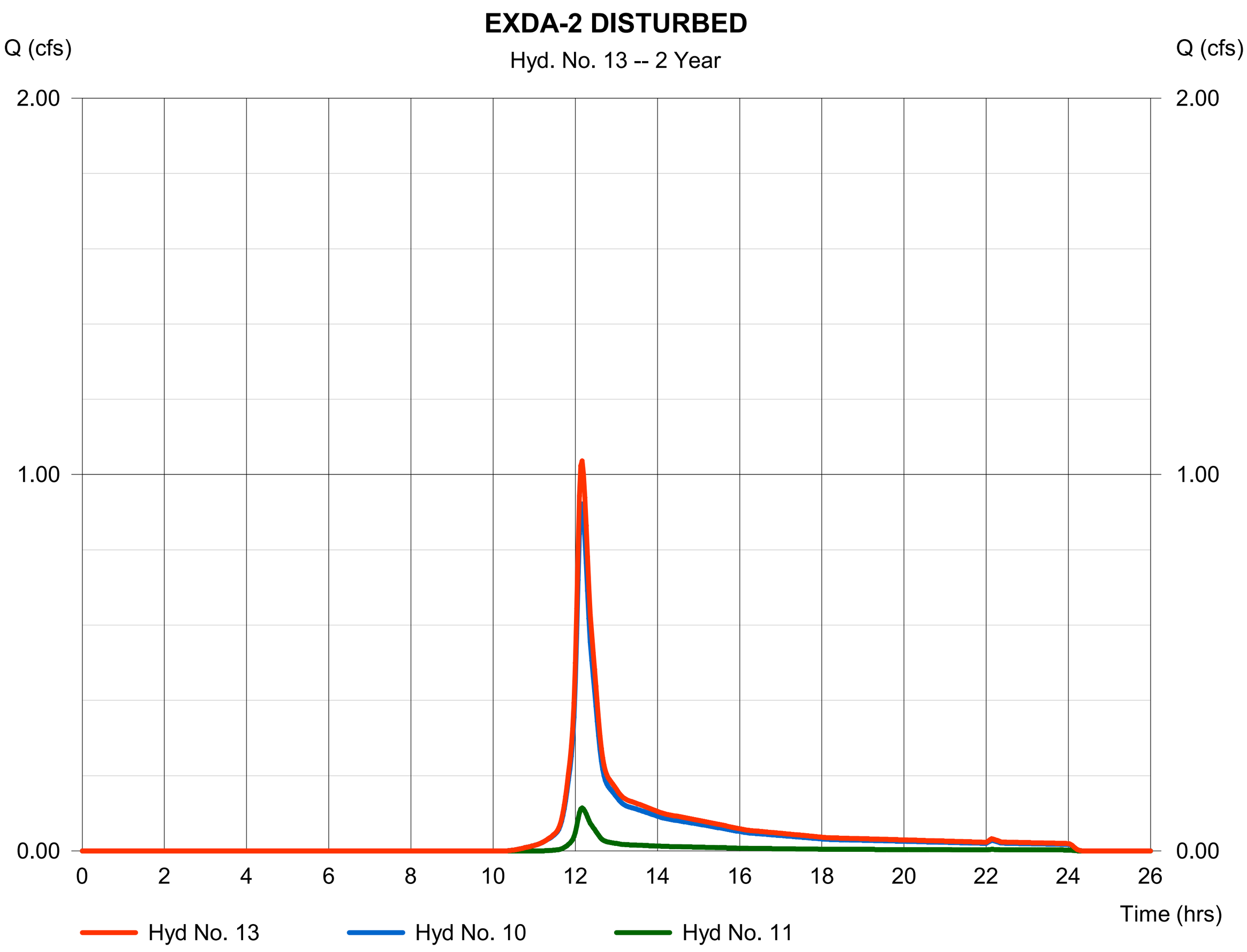
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 13

EXDA-2 DISTURBED

Hydrograph type	= Combine	Peak discharge	= 1.036 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 4,153 cuft
Inflow hyds.	= 10, 11	Contrib. drain. area	= 0.948 ac



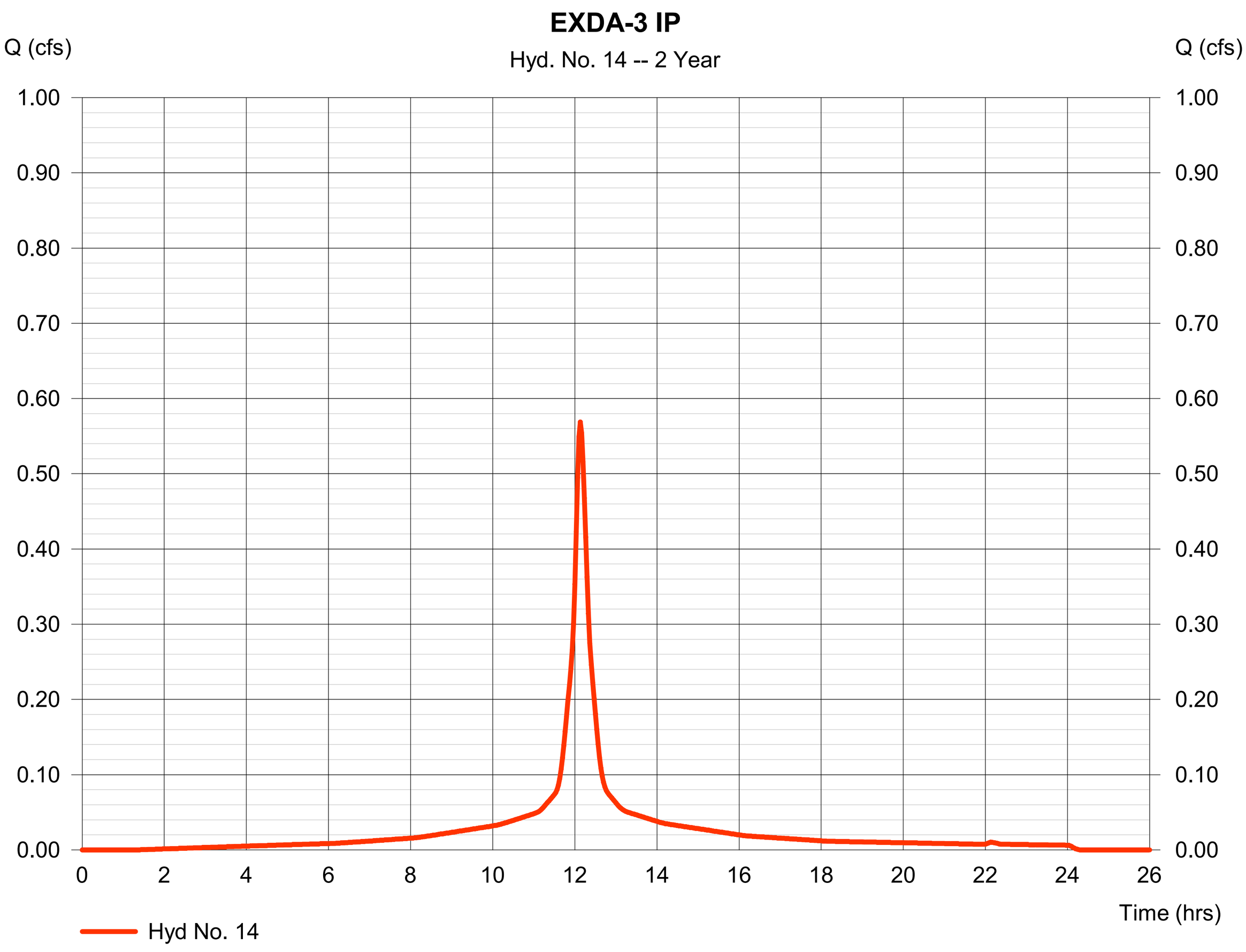
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 14

EXDA-3 IP

Hydrograph type	= SCS Runoff	Peak discharge	= 0.569 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 2,430 cuft
Drainage area	= 0.205 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 3.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



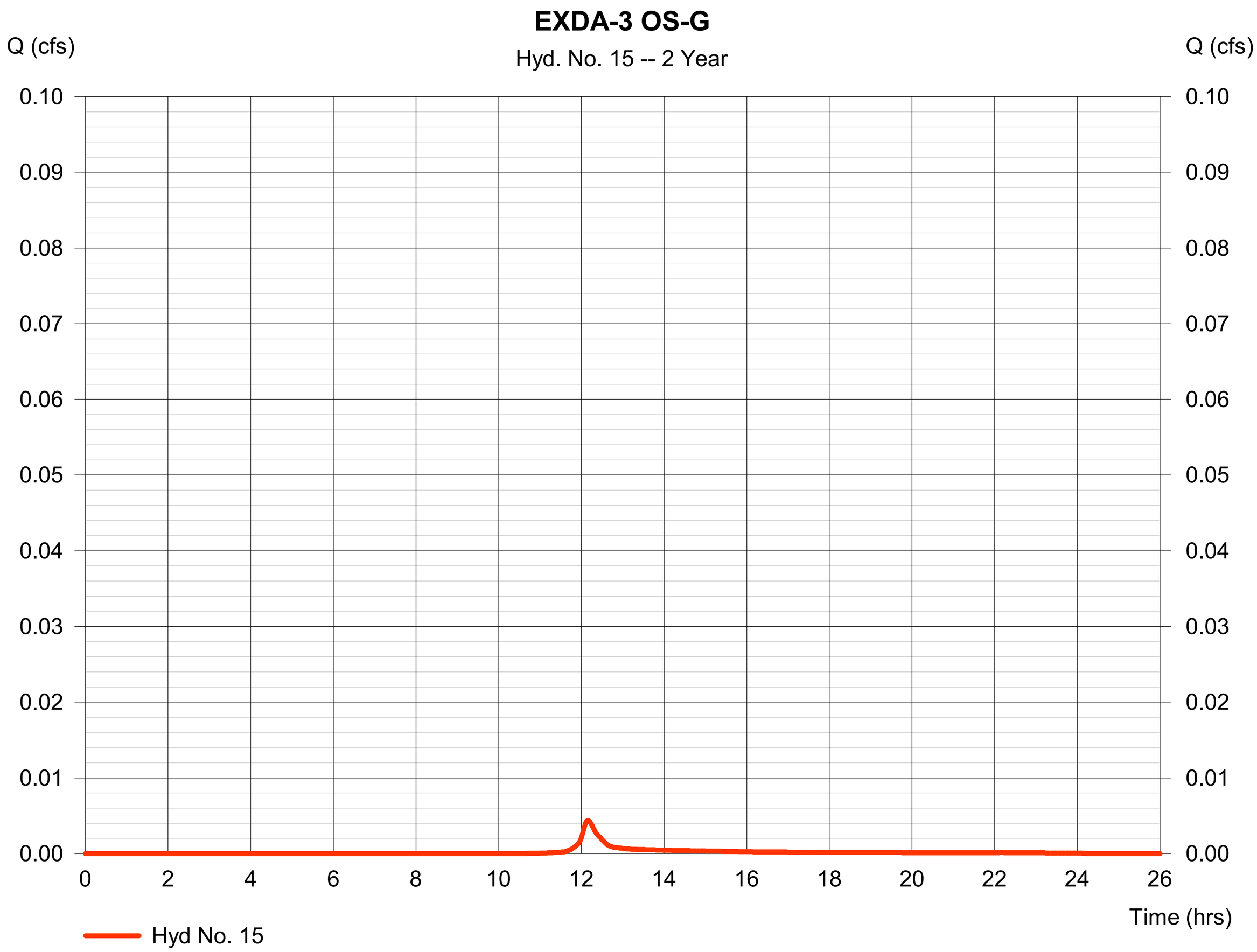
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 15

EXDA-3 OS-G

Hydrograph type	= SCS Runoff	Peak discharge	= 0.004 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 18 cuft
Drainage area	= 0.004 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 3.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



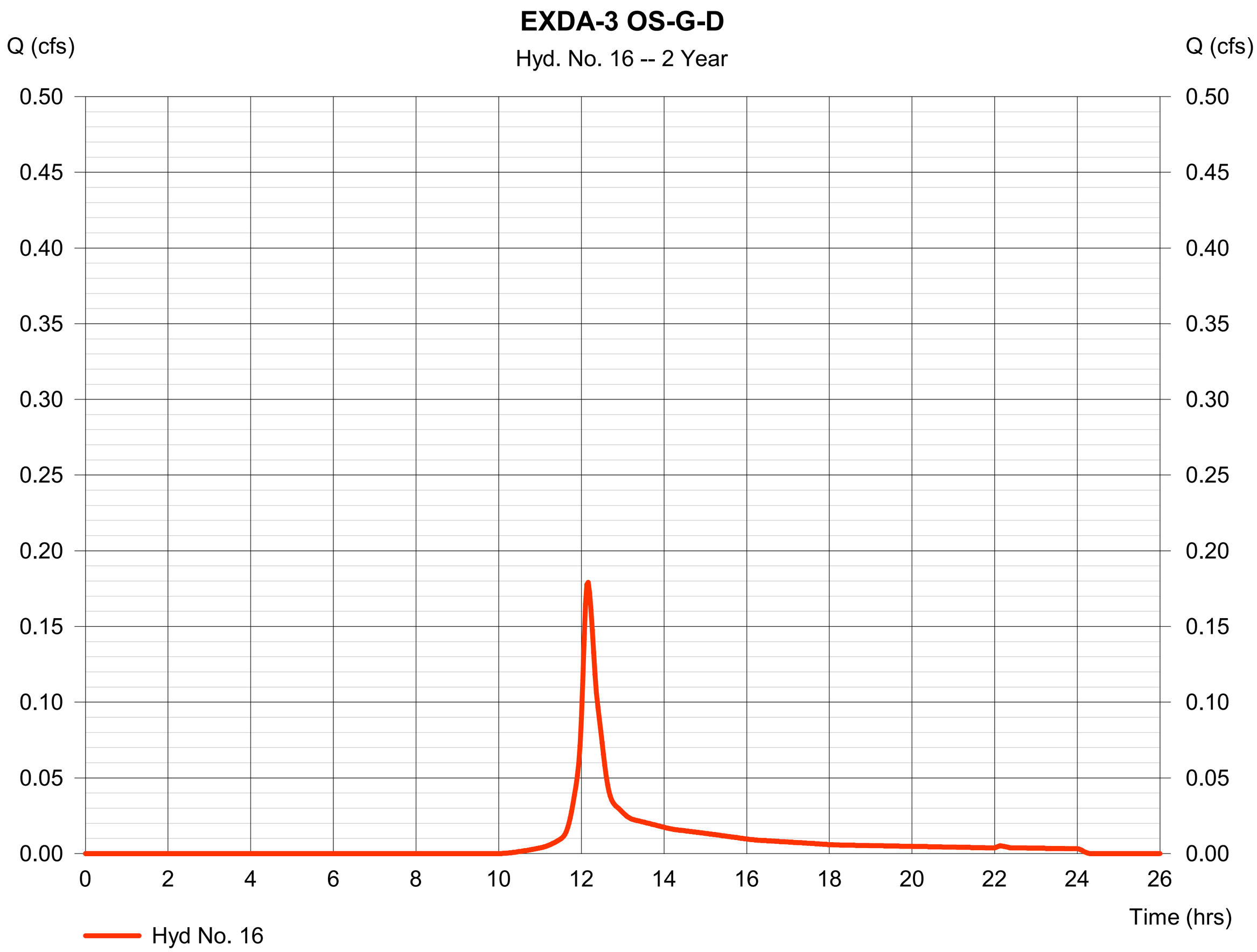
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 16

EXDA-3 OS-G-D

Hydrograph type	= SCS Runoff	Peak discharge	= 0.179 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 707 cuft
Drainage area	= 0.146 ac	Curve number	= 76
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 3.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



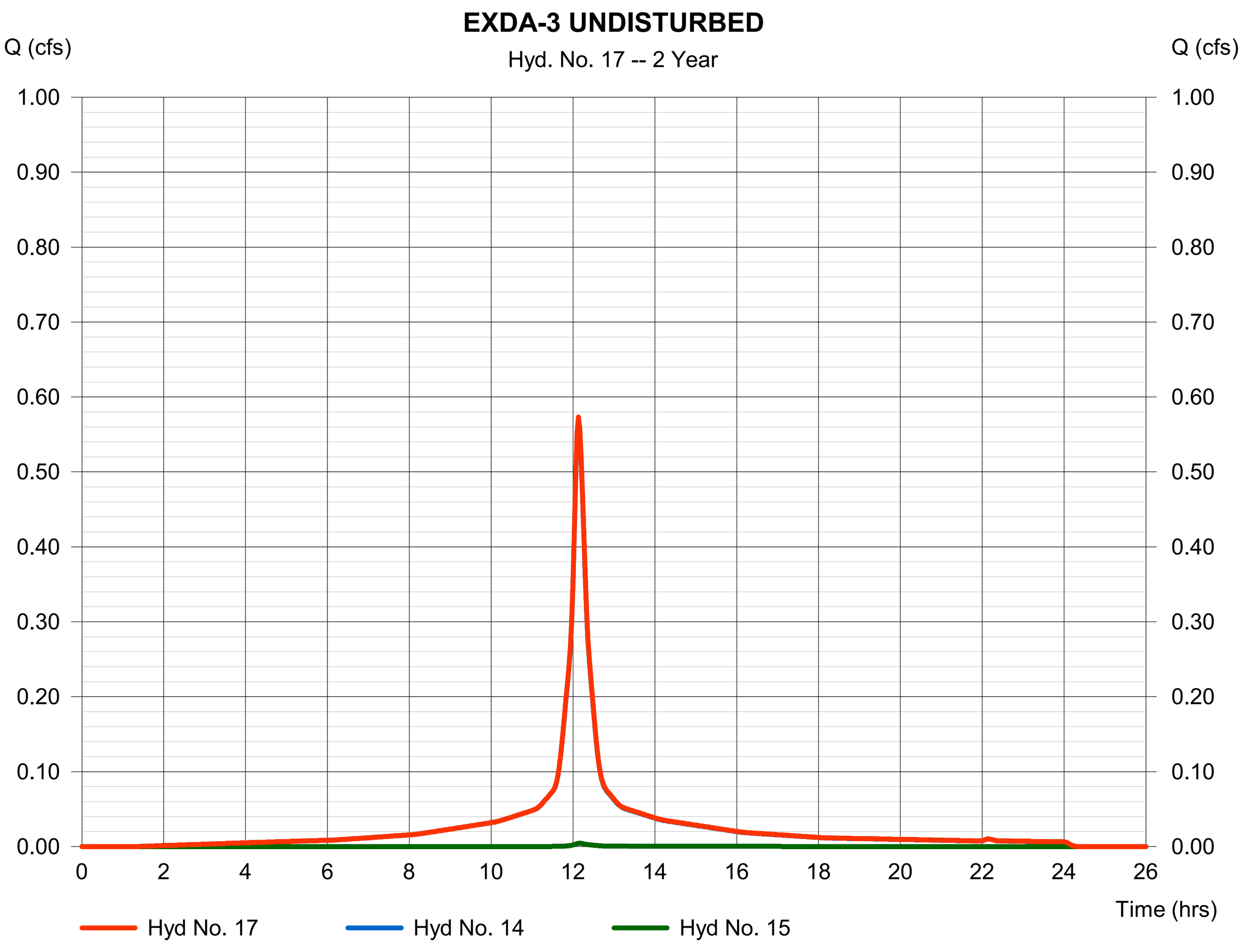
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 17

EXDA-3 UNDISTURBED

Hydrograph type	= Combine	Peak discharge	= 0.573 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 2,448 cuft
Inflow hyds.	= 14, 15	Contrib. drain. area	= 0.209 ac



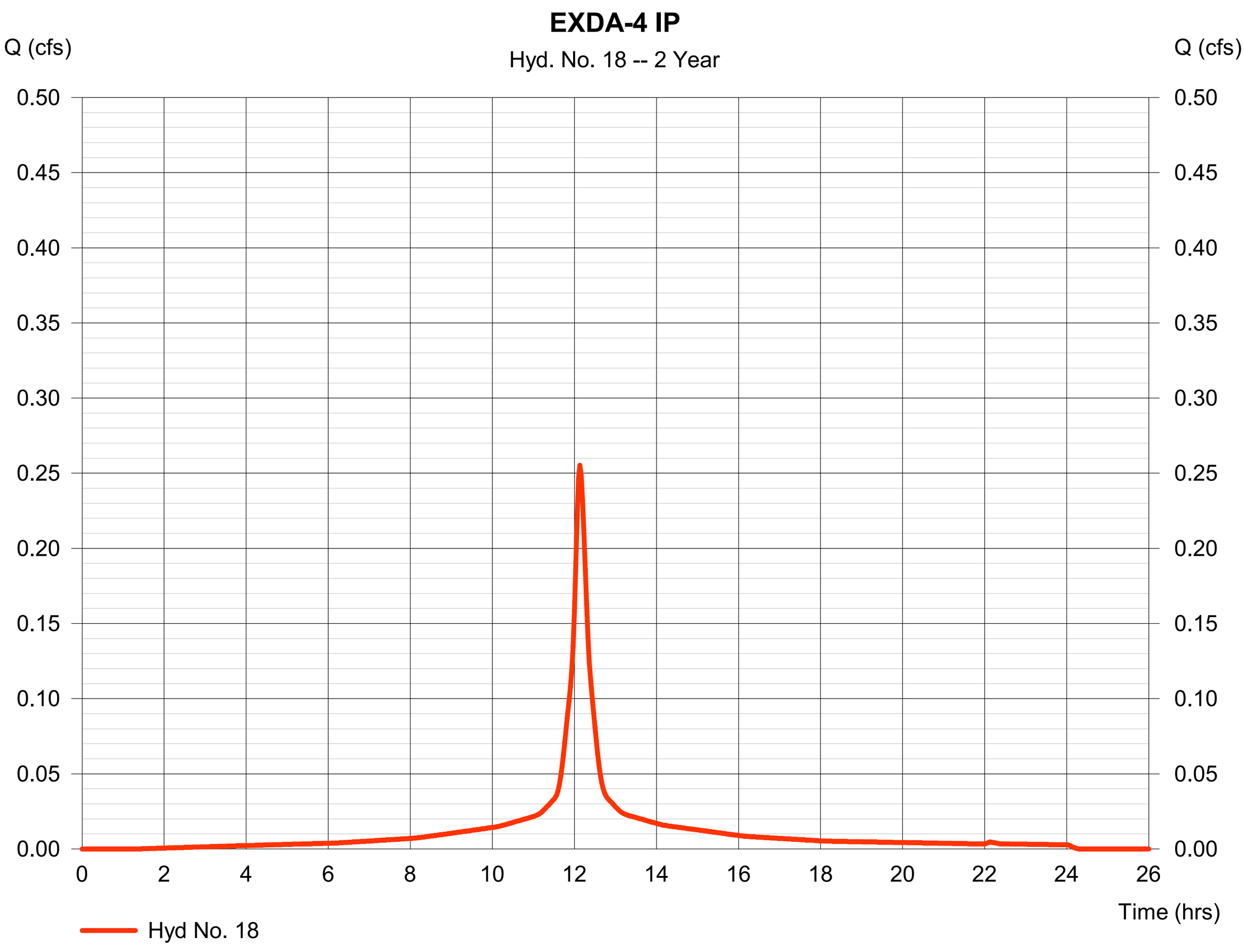
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 18

EXDA-4 IP

Hydrograph type	= SCS Runoff	Peak discharge	= 0.255 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 1,091 cuft
Drainage area	= 0.092 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 3.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



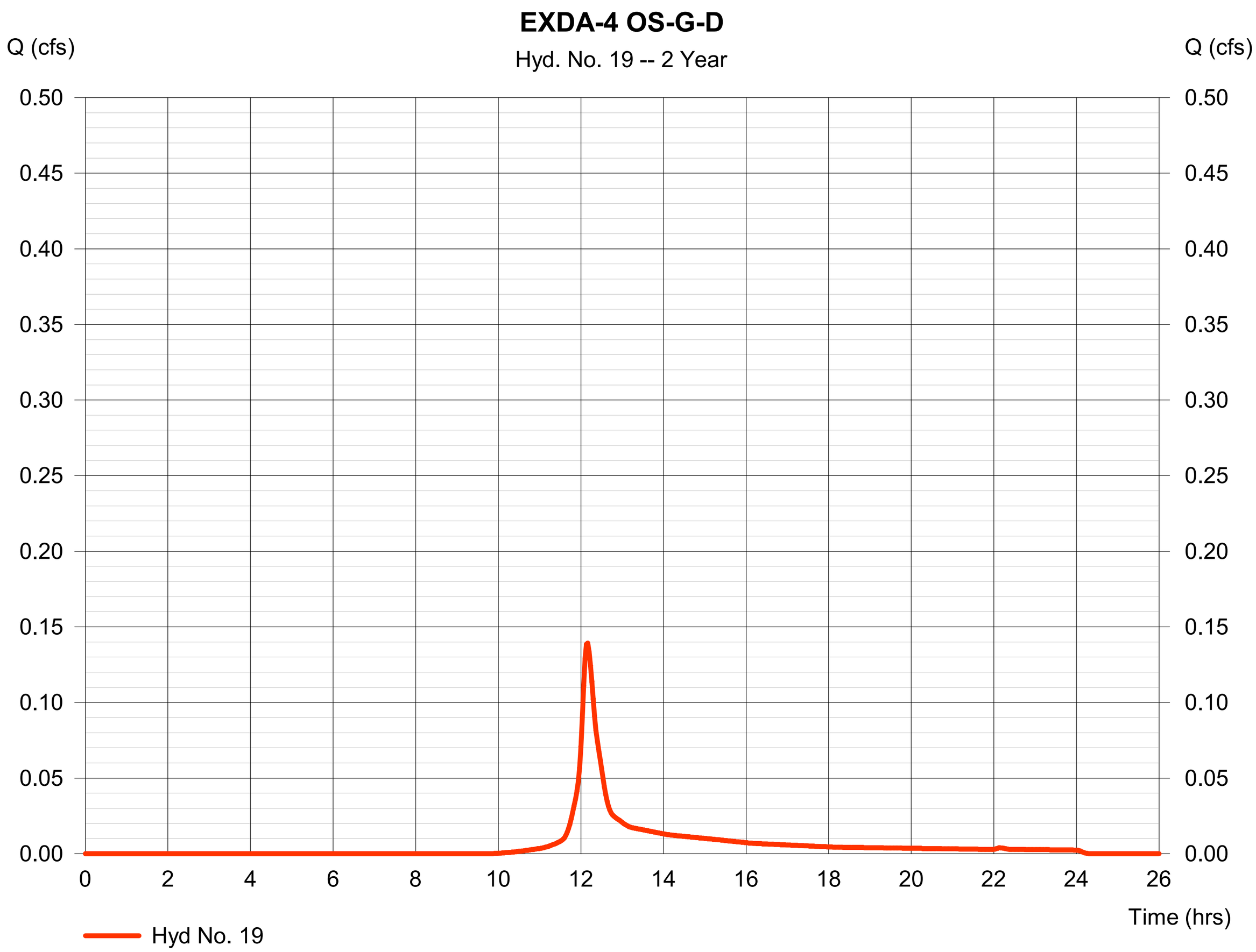
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 19

EXDA-4 OS-G-D

Hydrograph type	= SCS Runoff	Peak discharge	= 0.139 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 546 cuft
Drainage area	= 0.107 ac	Curve number	= 77.1
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 3.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



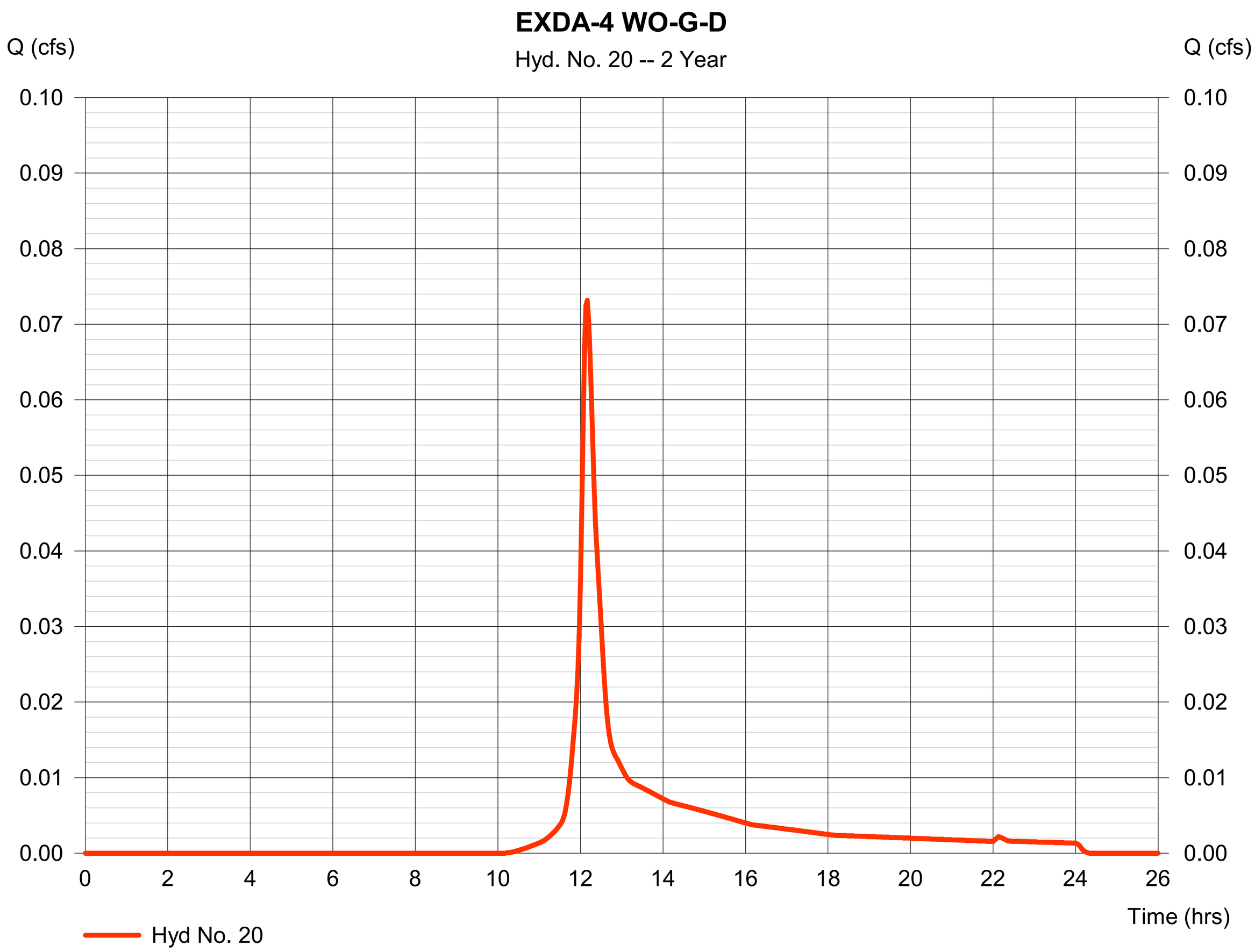
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 20

EXDA-4 WO-G-D

Hydrograph type	= SCS Runoff	Peak discharge	= 0.073 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 290 cuft
Drainage area	= 0.062 ac	Curve number	= 75.3
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 3.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



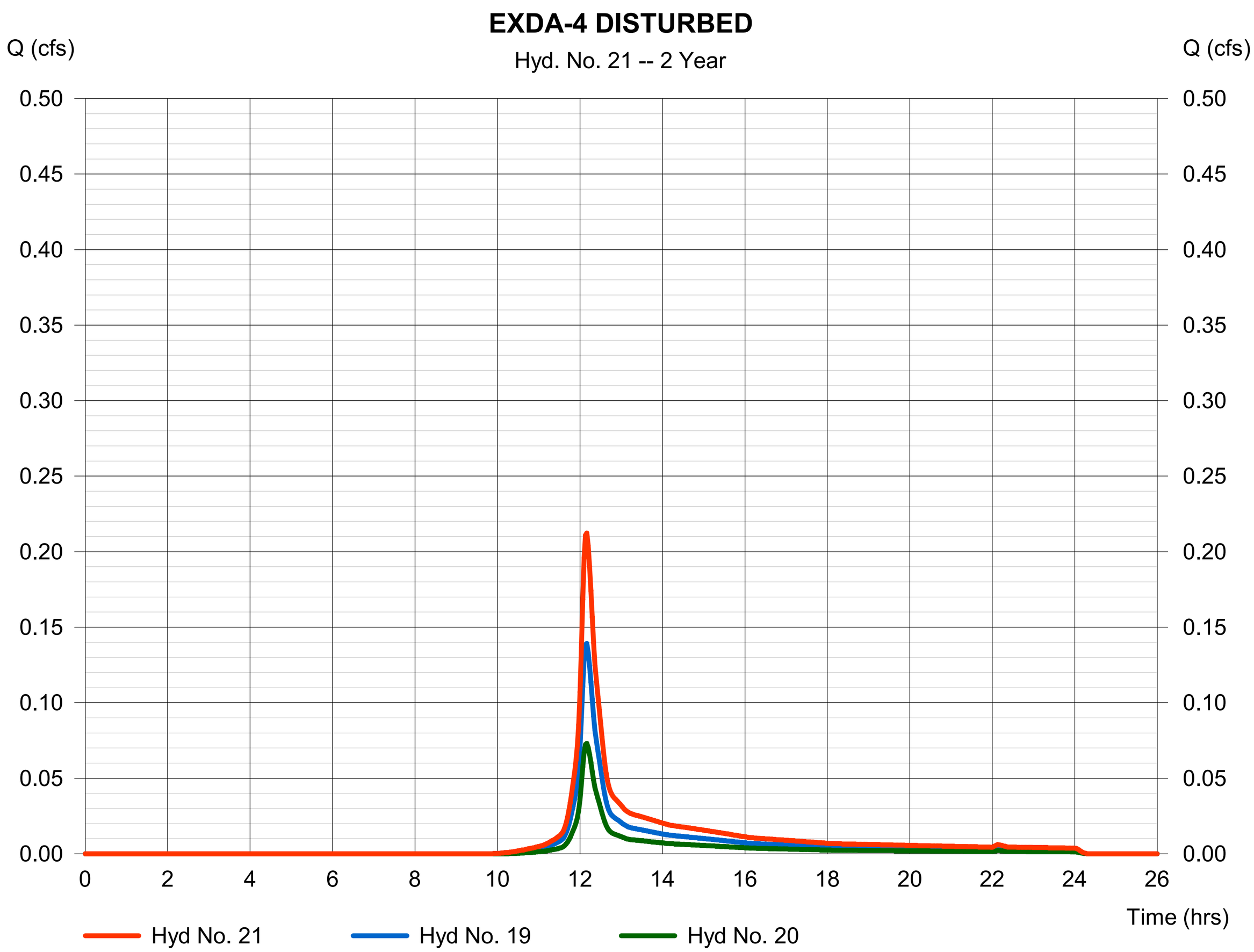
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 21

EXDA-4 DISTURBED

Hydrograph type	= Combine	Peak discharge	= 0.212 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 836 cuft
Inflow hyds.	= 19, 20	Contrib. drain. area	= 0.169 ac



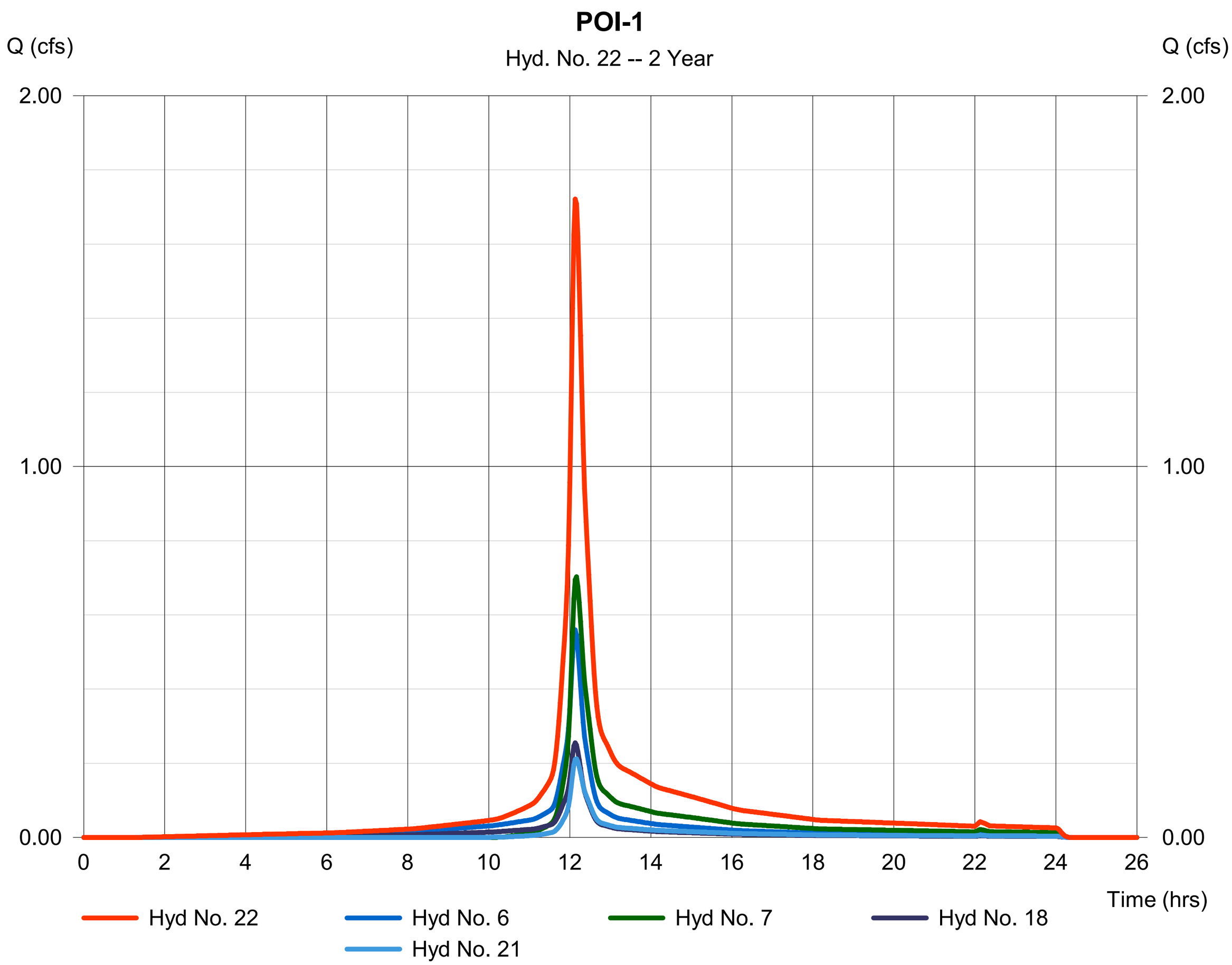
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 22

POI-1

Hydrograph type	= Combine	Peak discharge	= 1.721 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 7,114 cuft
Inflow hyds.	= 6, 7, 18, 21	Contrib. drain. area	= 0.092 ac



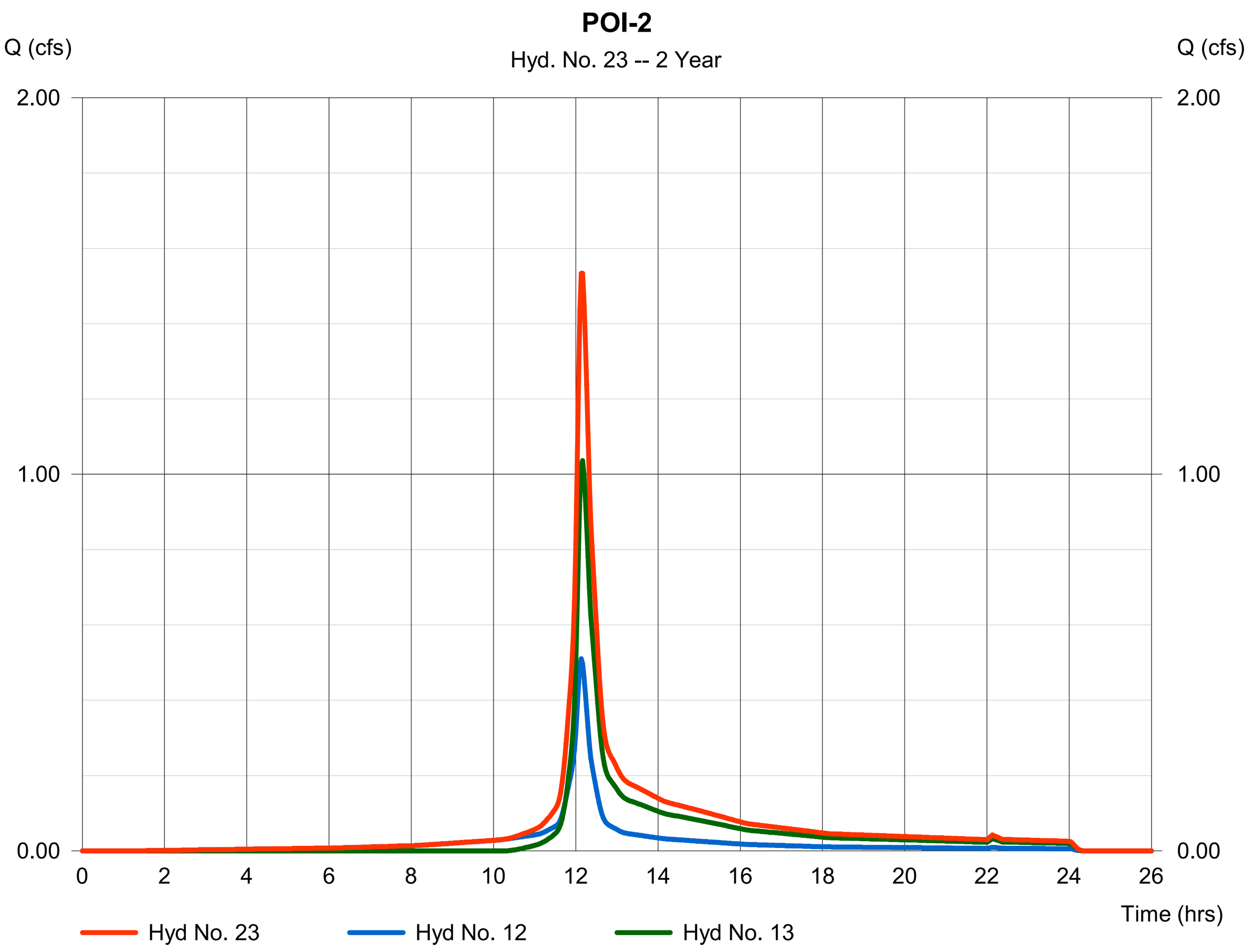
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 23

POI-2

Hydrograph type	= Combine	Peak discharge	= 1.534 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 6,330 cuft
Inflow hyds.	= 12, 13	Contrib. drain. area	= 0.000 ac



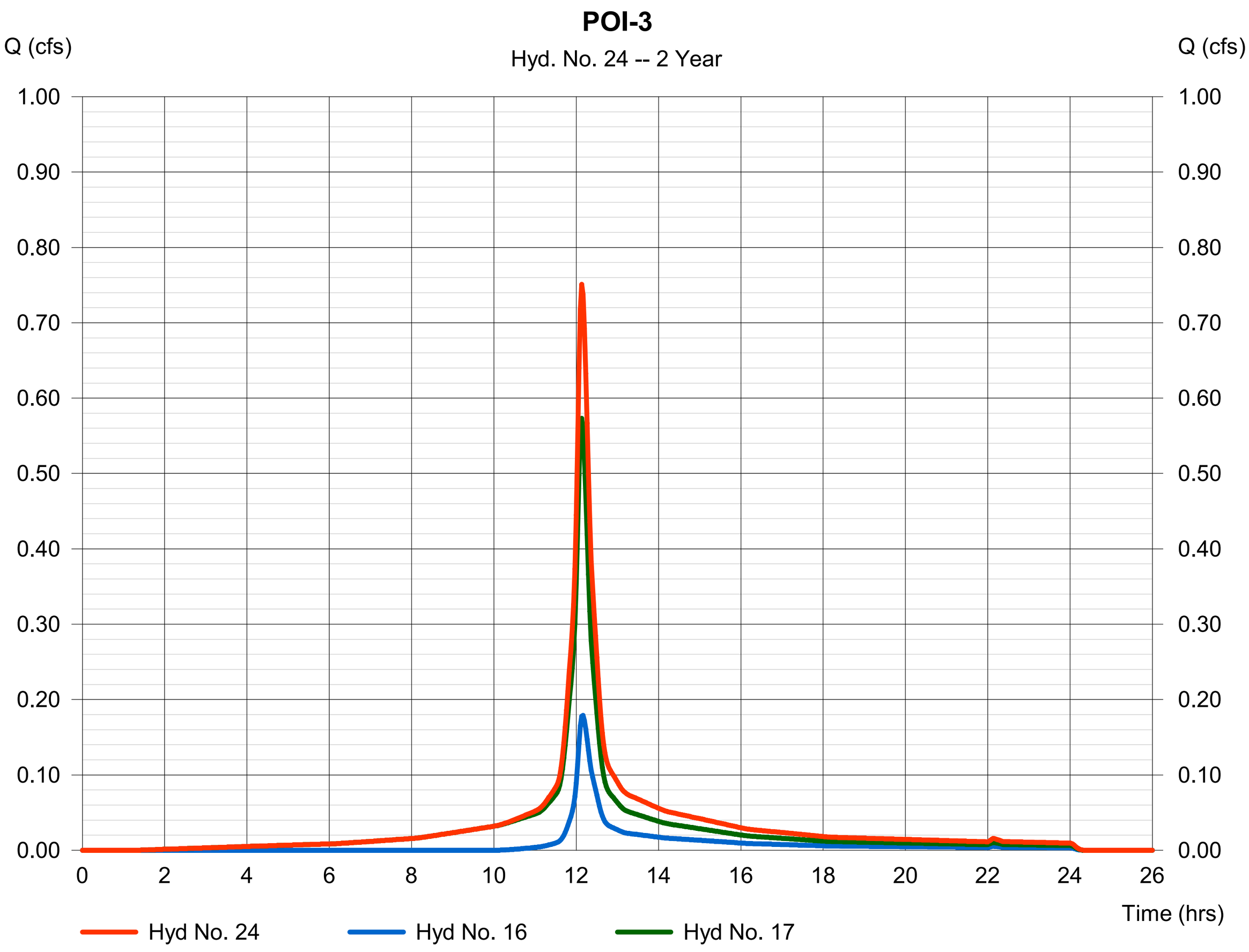
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 24

POI-3

Hydrograph type	= Combine	Peak discharge	= 0.751 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 3,155 cuft
Inflow hyds.	= 16, 17	Contrib. drain. area	= 0.146 ac



10-YEAR 24-HOUR

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.817	2	728	3,548	------	------	------	EXDA-1 IP
2	SCS Runoff	0.008	2	728	36	------	------	------	EXDA-1 IP-D
3	SCS Runoff	0.016	2	728	62	------	------	------	EXDA-1 OS-G
4	SCS Runoff	1.382	2	728	5,327	------	------	------	EXDA-1 OS-G-D
5	SCS Runoff	0.053	2	730	206	------	------	------	EXDA-1 WO-G-D
6	Combine	0.833	2	728	3,610	1, 3,	------	------	EXDA-1 UNDISTURBED
7	Combine	1.442	2	728	5,568	2, 4, 5,	------	------	EXDA-1 DISTURBED
8	SCS Runoff	0.739	2	728	3,210	------	------	------	EXDA-2 IP
9	SCS Runoff	0.023	2	728	89	------	------	------	EXDA-2 OS-G
10	SCS Runoff	1.904	2	728	7,350	------	------	------	EXDA-2 OS-G-D
11	SCS Runoff	0.263	2	730	1,029	------	------	------	EXDA-2 WO-G-D
12	Combine	0.762	2	728	3,298	8, 9,	------	------	EXDA-2 UNDISTURBED
13	Combine	2.166	2	728	8,379	10, 11,	------	------	EXDA-2 DISTURBED
14	SCS Runoff	0.842	2	728	3,655	------	------	------	EXDA-3 IP
15	SCS Runoff	0.009	2	728	35	------	------	------	EXDA-3 OS-G
16	SCS Runoff	0.360	2	728	1,386	------	------	------	EXDA-3 OS-G-D
17	Combine	0.851	2	728	3,691	14, 15,	------	------	EXDA-3 UNDISTURBED
18	SCS Runoff	0.378	2	728	1,640	------	------	------	EXDA-4 IP
19	SCS Runoff	0.275	2	728	1,054	------	------	------	EXDA-4 OS-G-D
20	SCS Runoff	0.149	2	728	574	------	------	------	EXDA-4 WO-G-D
21	Combine	0.424	2	728	1,629	19, 20	------	------	EXDA-4 DISTURBED
22	Combine	3.077	2	728	12,448	6, 7, 18, 21	------	------	POI-1
23	Combine	2.928	2	728	11,677	12, 13,	------	------	POI-2
24	Combine	1.211	2	728	5,076	16, 17,	------	------	POI-3

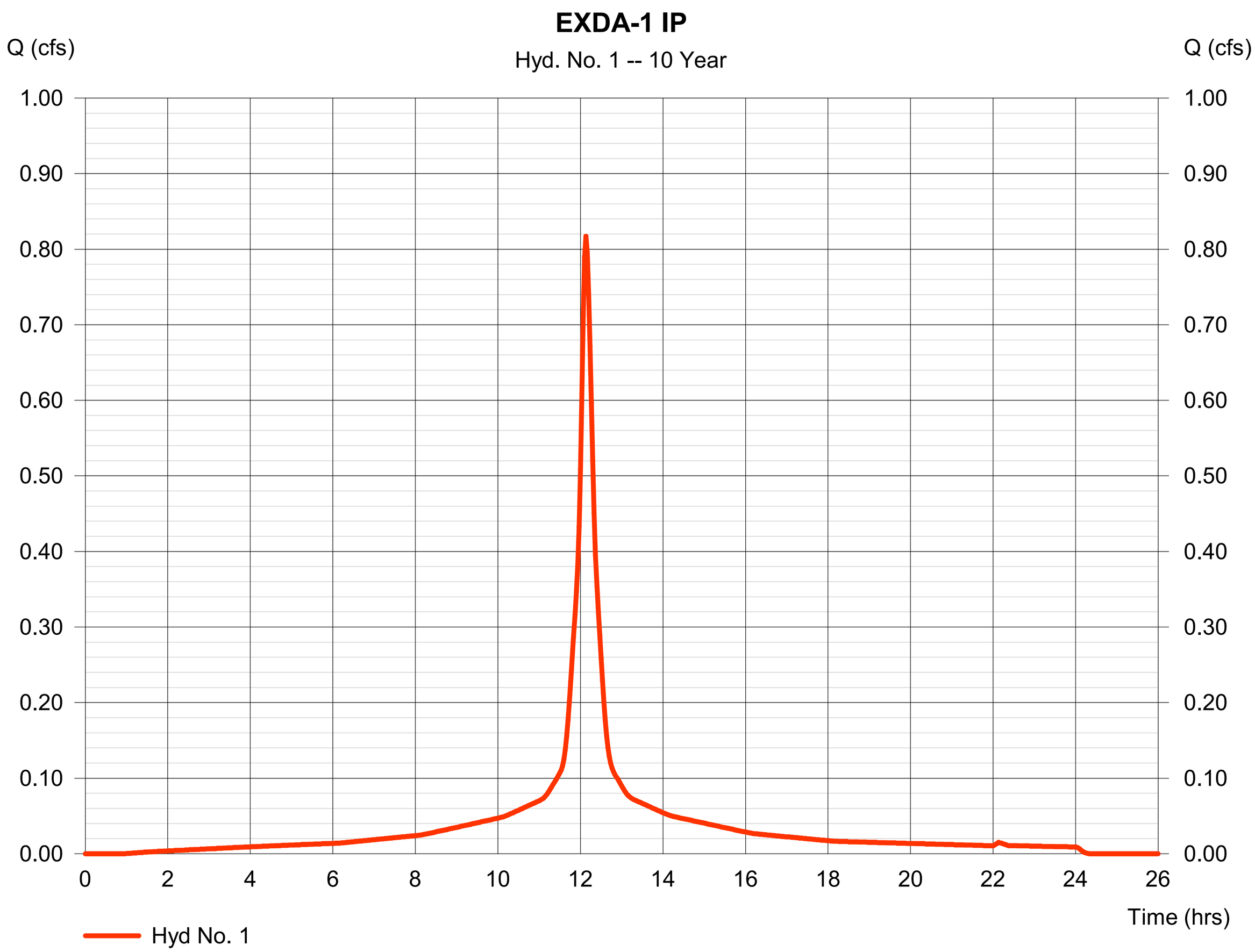
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 1

EXDA-1 IP

Hydrograph type	= SCS Runoff	Peak discharge	= 0.817 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 3,548 cuft
Drainage area	= 0.199 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.10 min
Total precip.	= 5.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



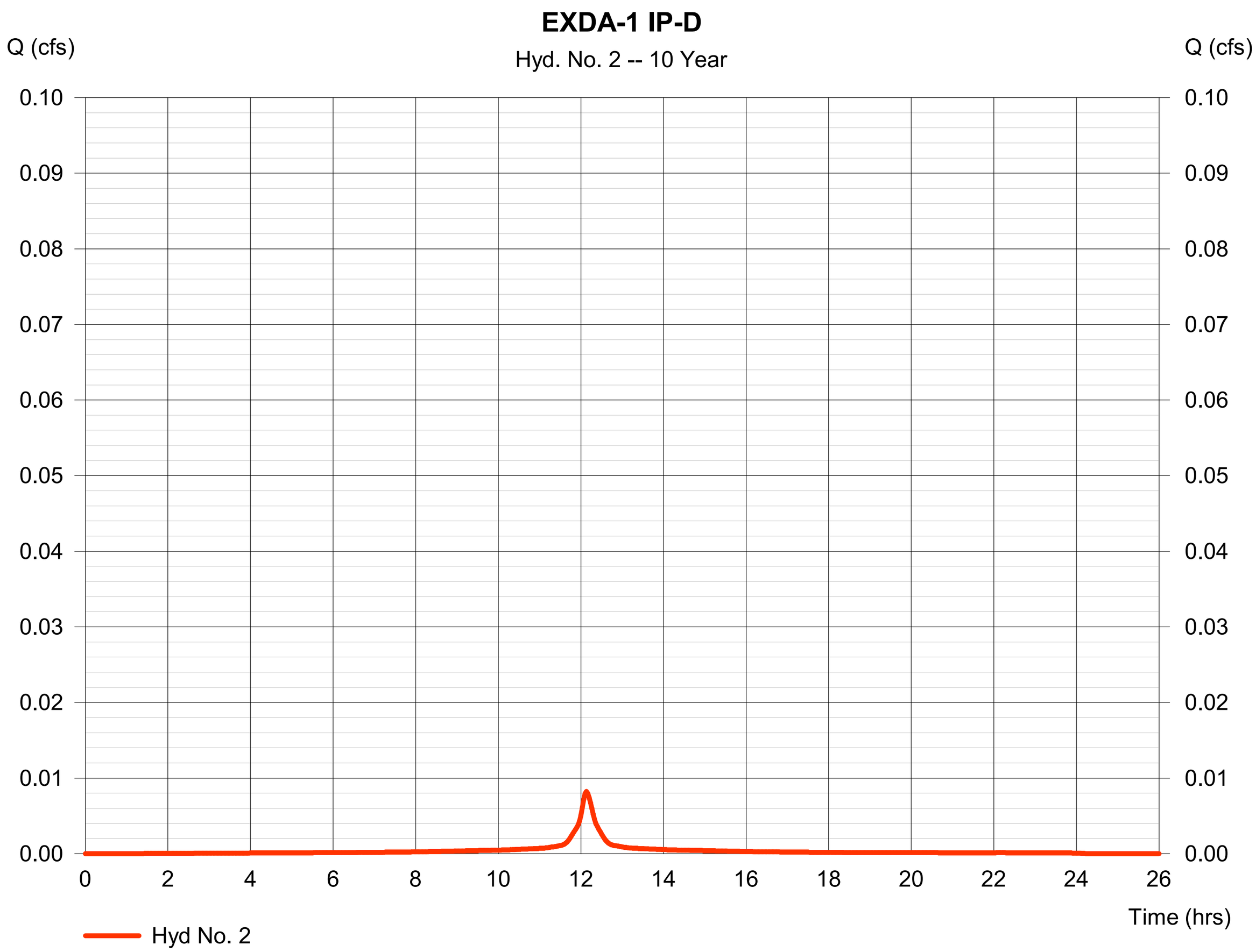
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 2

EXDA-1 IP-D

Hydrograph type	= SCS Runoff	Peak discharge	= 0.008 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 36 cuft
Drainage area	= 0.002 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.15 min
Total precip.	= 5.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



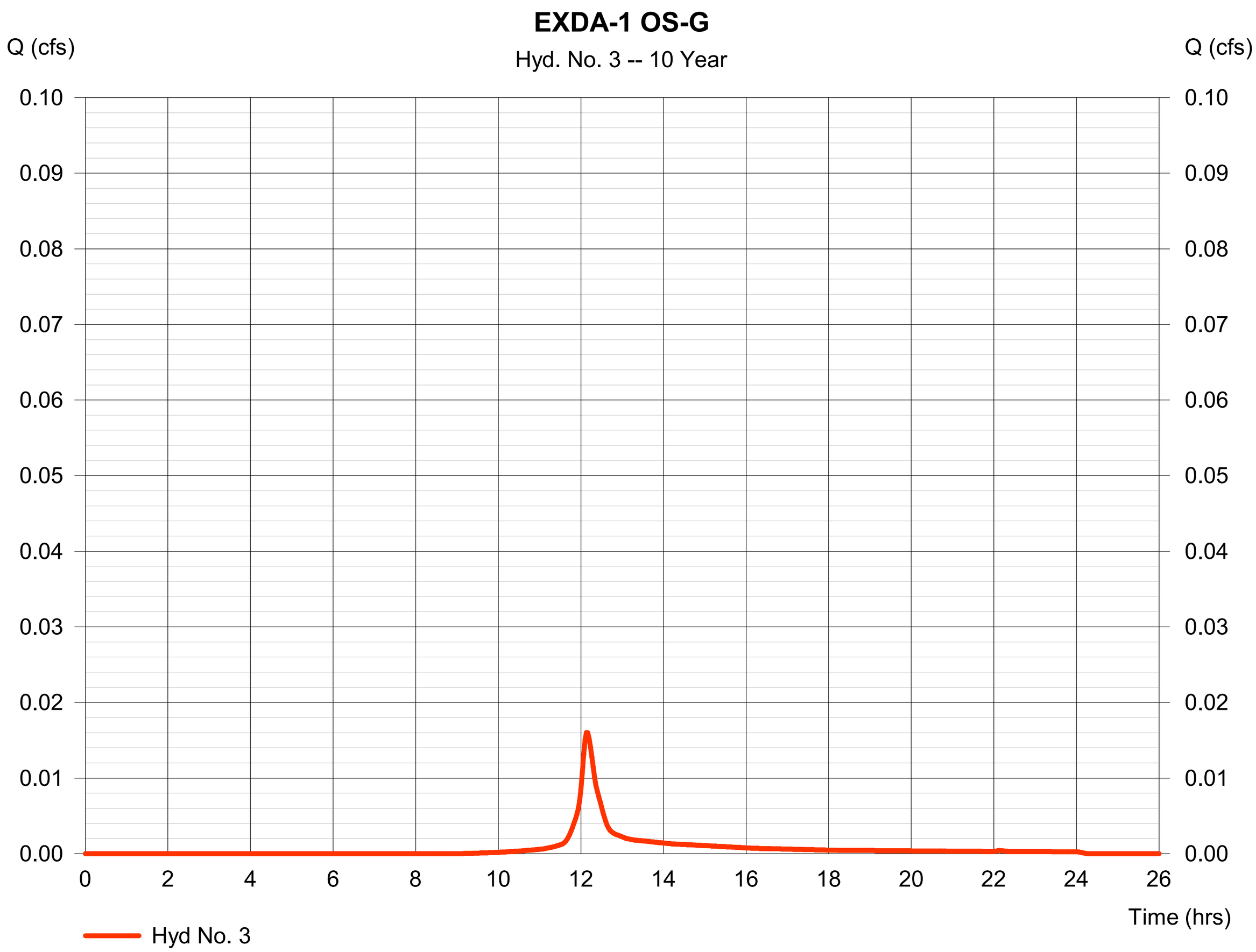
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 3

EXDA-1 OS-G

Hydrograph type	= SCS Runoff	Peak discharge	= 0.016 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 62 cuft
Drainage area	= 0.007 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.10 min
Total precip.	= 5.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



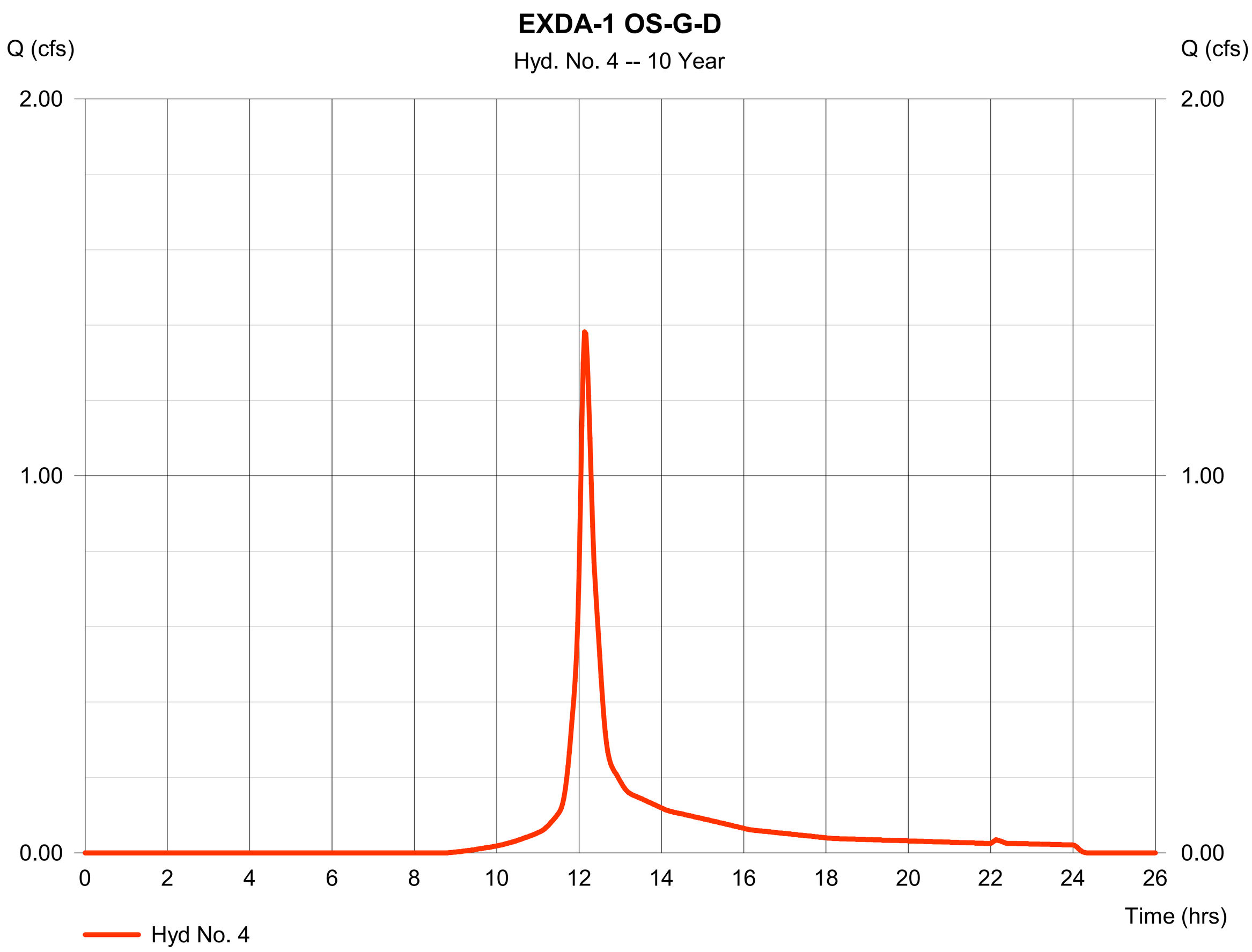
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 4

EXDA-1 OS-G-D

Hydrograph type	= SCS Runoff	Peak discharge	= 1.382 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 5,327 cuft
Drainage area	= 0.581 ac	Curve number	= 75
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.10 min
Total precip.	= 5.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



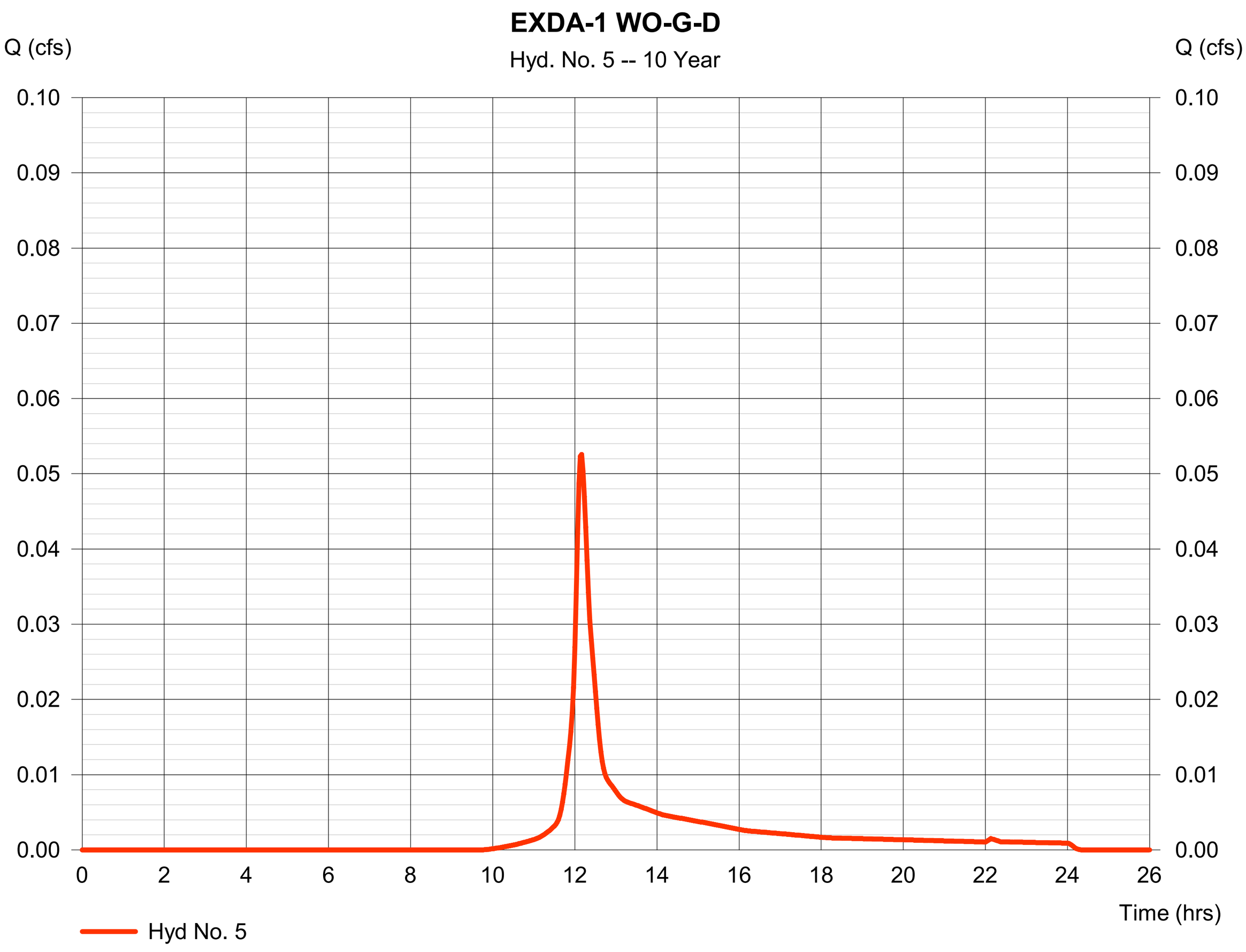
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 5

EXDA-1 WO-G-D

Hydrograph type	= SCS Runoff	Peak discharge	= 0.053 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 206 cuft
Drainage area	= 0.027 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.15 min
Total precip.	= 5.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



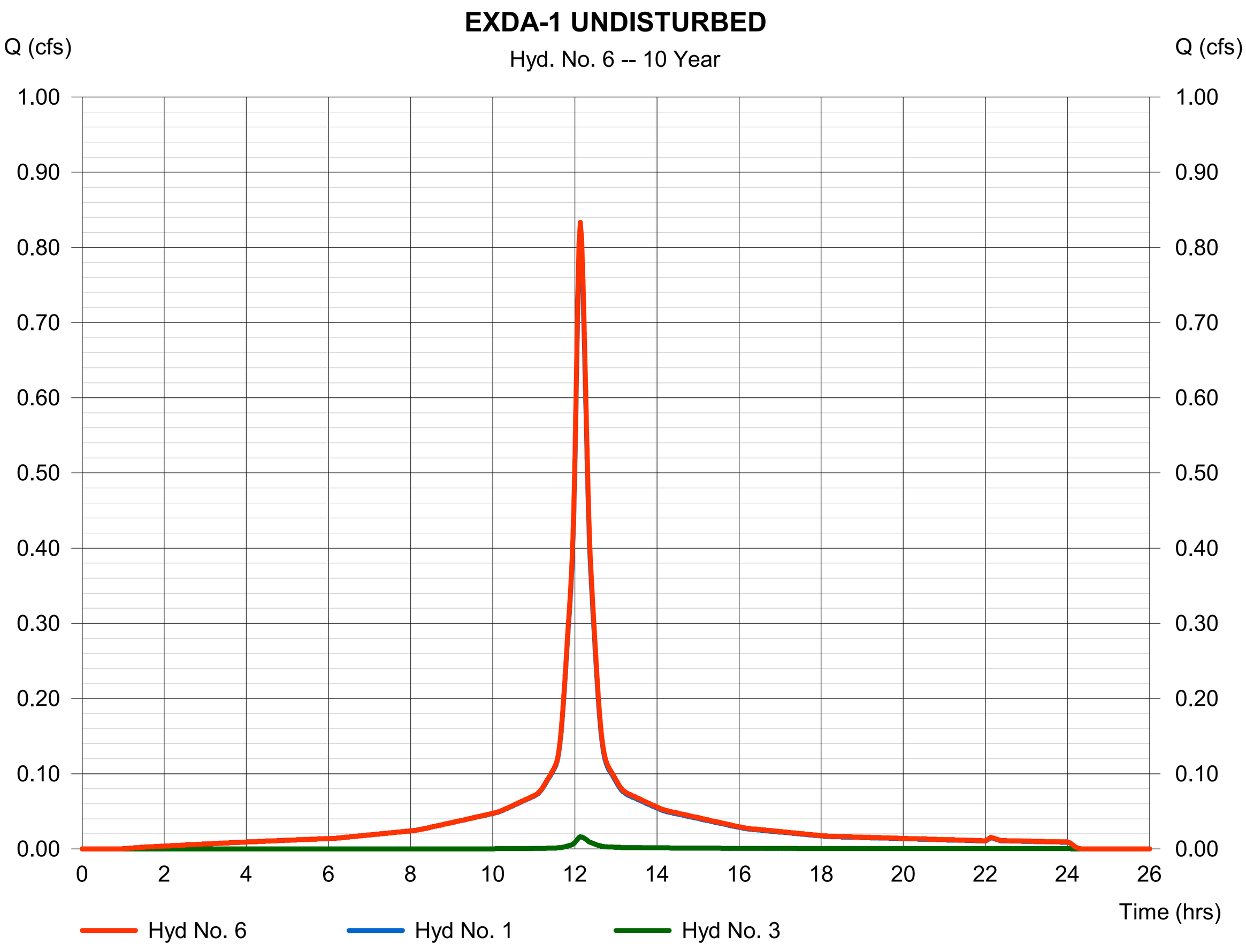
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 6

EXDA-1 UNDISTURBED

Hydrograph type	= Combine	Peak discharge	= 0.833 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 3,610 cuft
Inflow hyds.	= 1, 3	Contrib. drain. area	= 0.206 ac



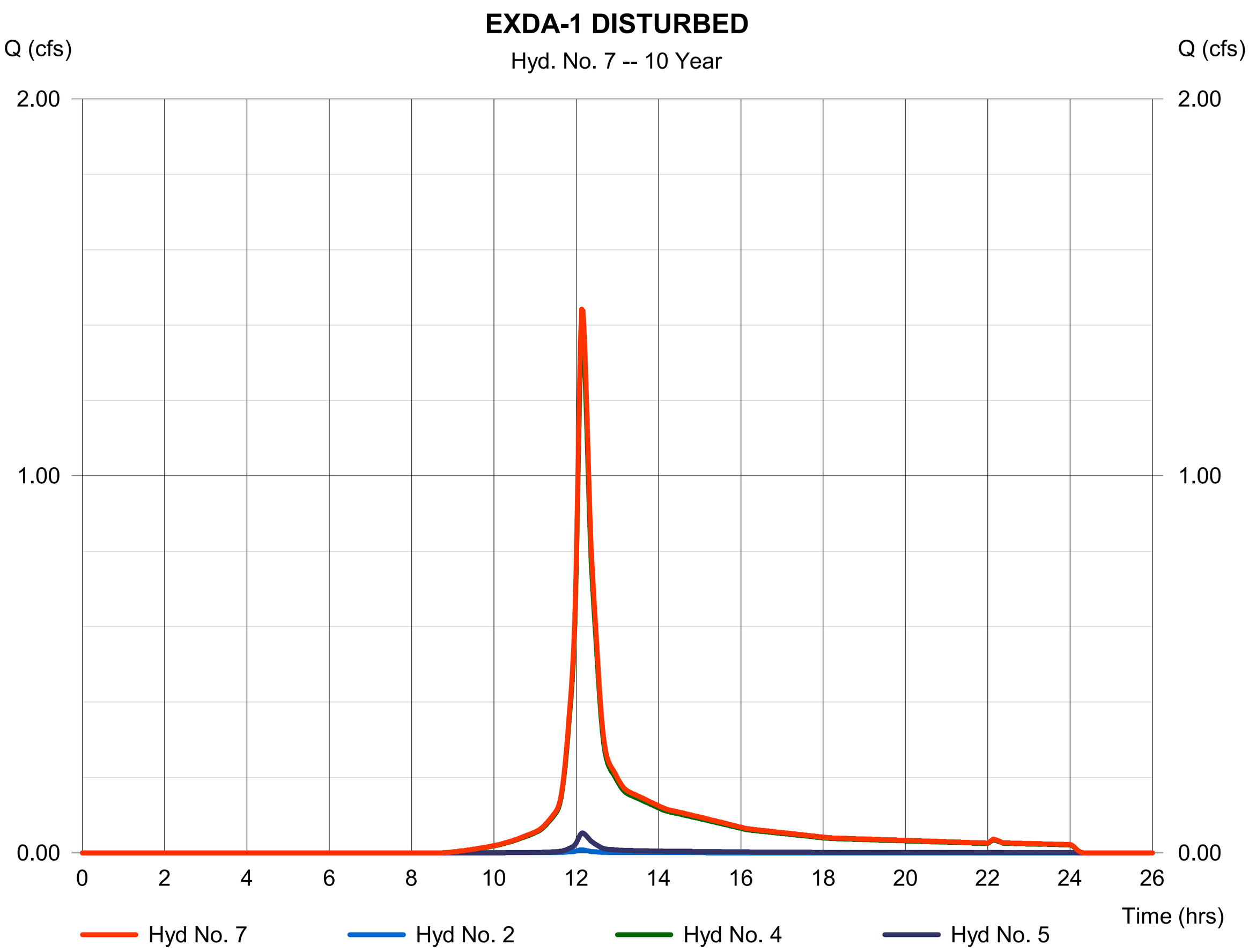
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 7

EXDA-1 DISTURBED

Hydrograph type	= Combine	Peak discharge	= 1.442 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 5,568 cuft
Inflow hyds.	= 2, 4, 5	Contrib. drain. area	= 0.610 ac



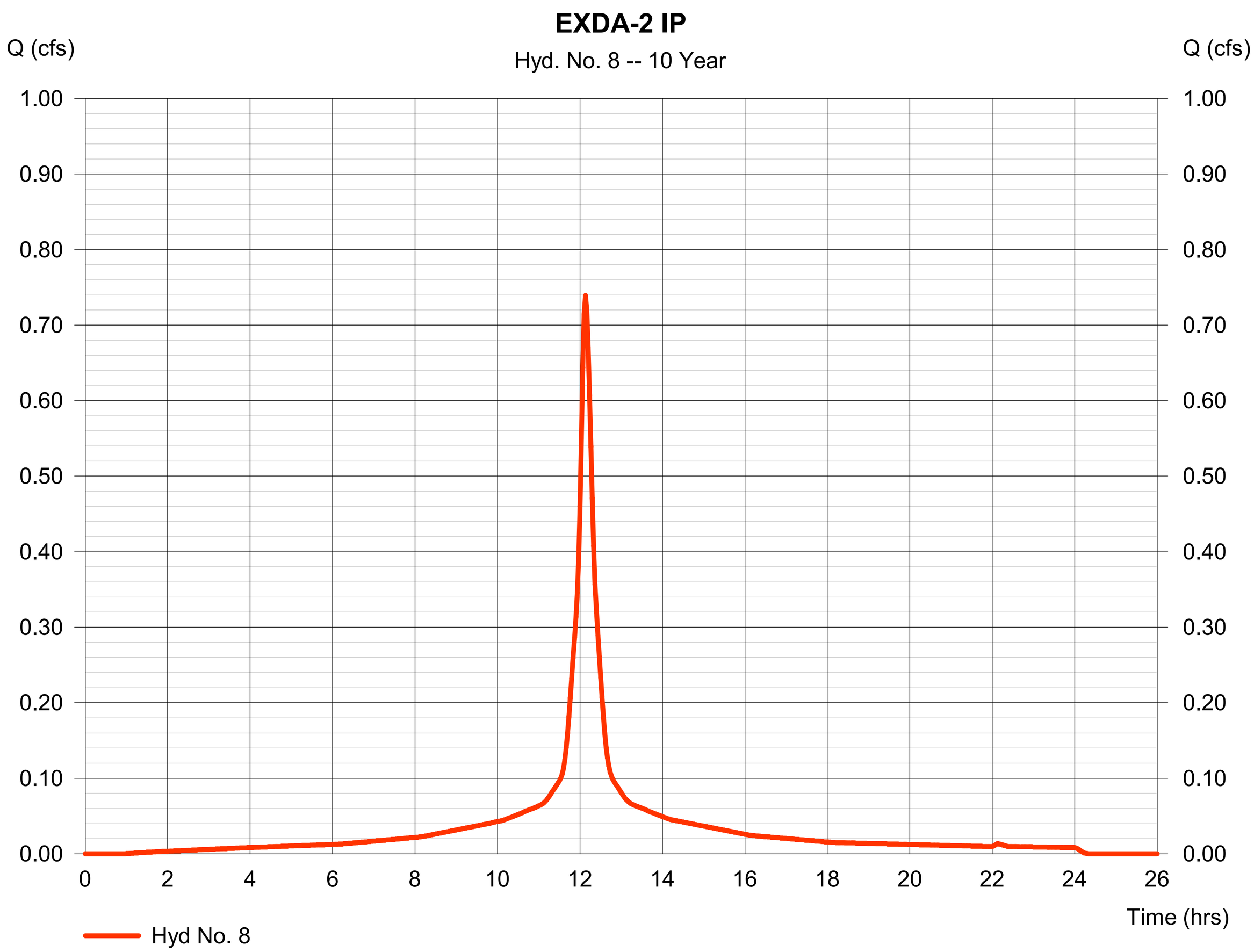
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 8

EXDA-2 IP

Hydrograph type	= SCS Runoff	Peak discharge	= 0.739 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 3,210 cuft
Drainage area	= 0.180 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.80 min
Total precip.	= 5.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



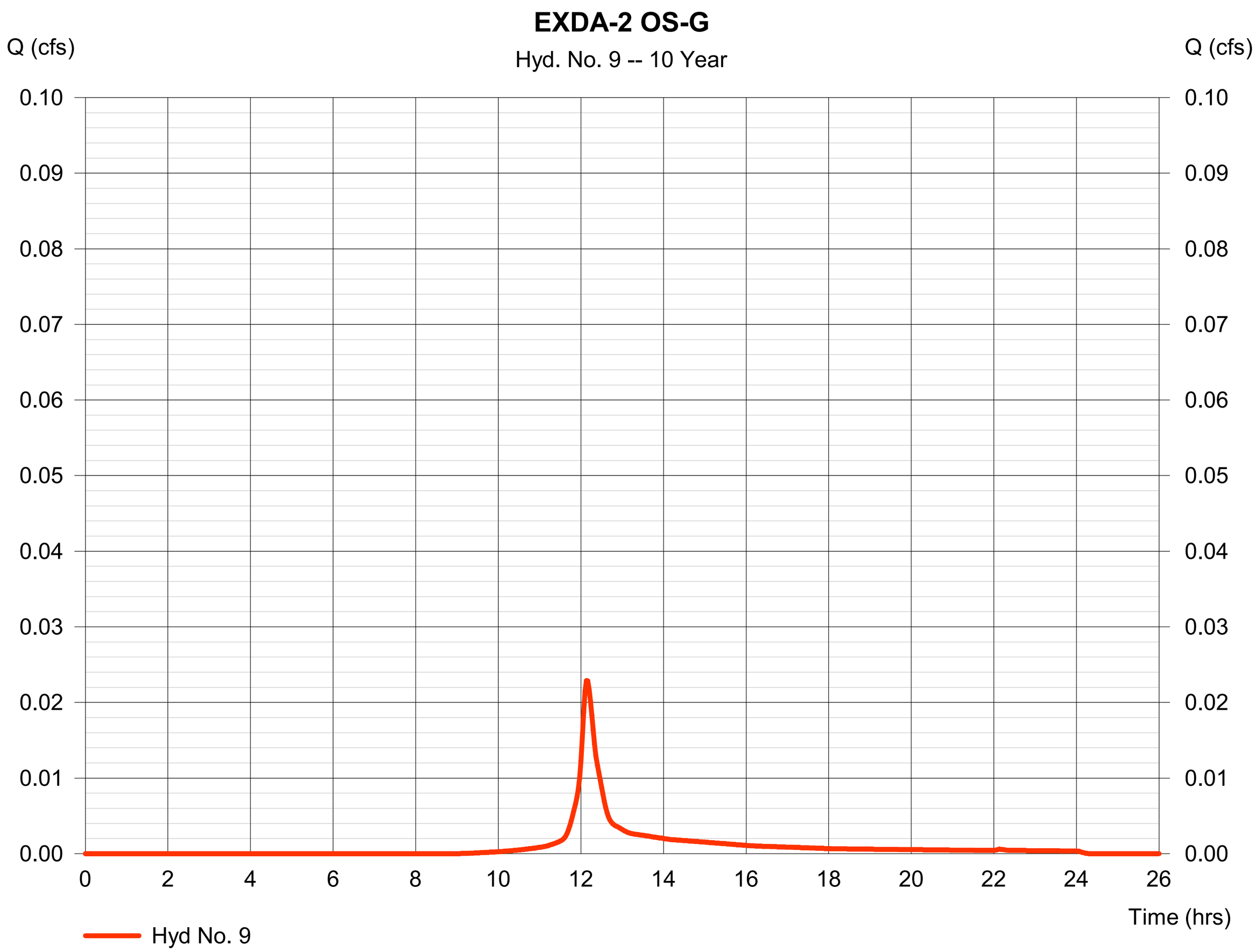
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 9

EXDA-2 OS-G

Hydrograph type	= SCS Runoff	Peak discharge	= 0.023 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 89 cuft
Drainage area	= 0.010 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.80 min
Total precip.	= 5.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



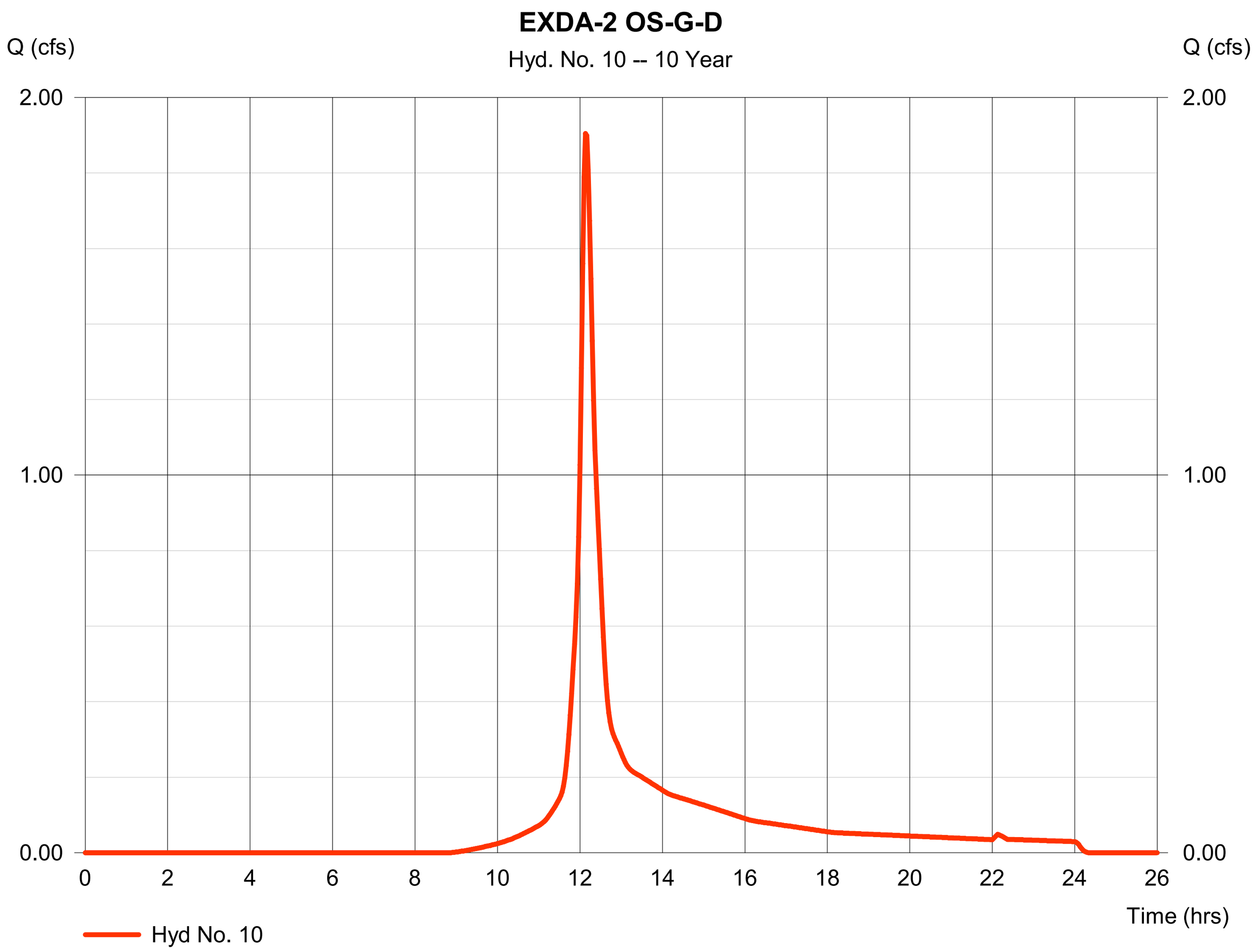
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 10

EXDA-2 OS-G-D

Hydrograph type	= SCS Runoff	Peak discharge	= 1.904 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 7,350 cuft
Drainage area	= 0.813 ac	Curve number	= 74.6
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.80 min
Total precip.	= 5.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



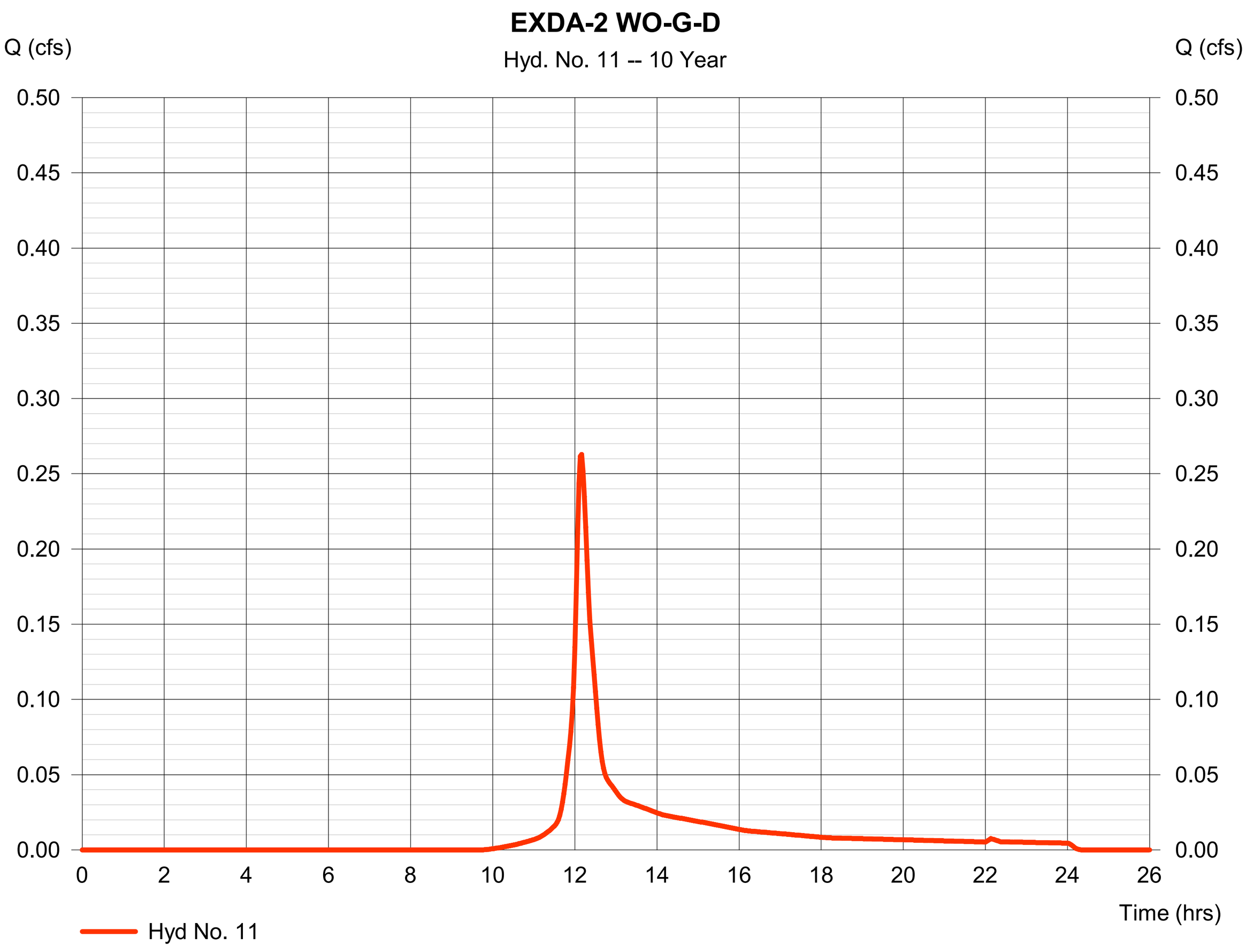
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 11

EXDA-2 WO-G-D

Hydrograph type	= SCS Runoff	Peak discharge	= 0.263 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 1,029 cuft
Drainage area	= 0.135 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.83 min
Total precip.	= 5.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



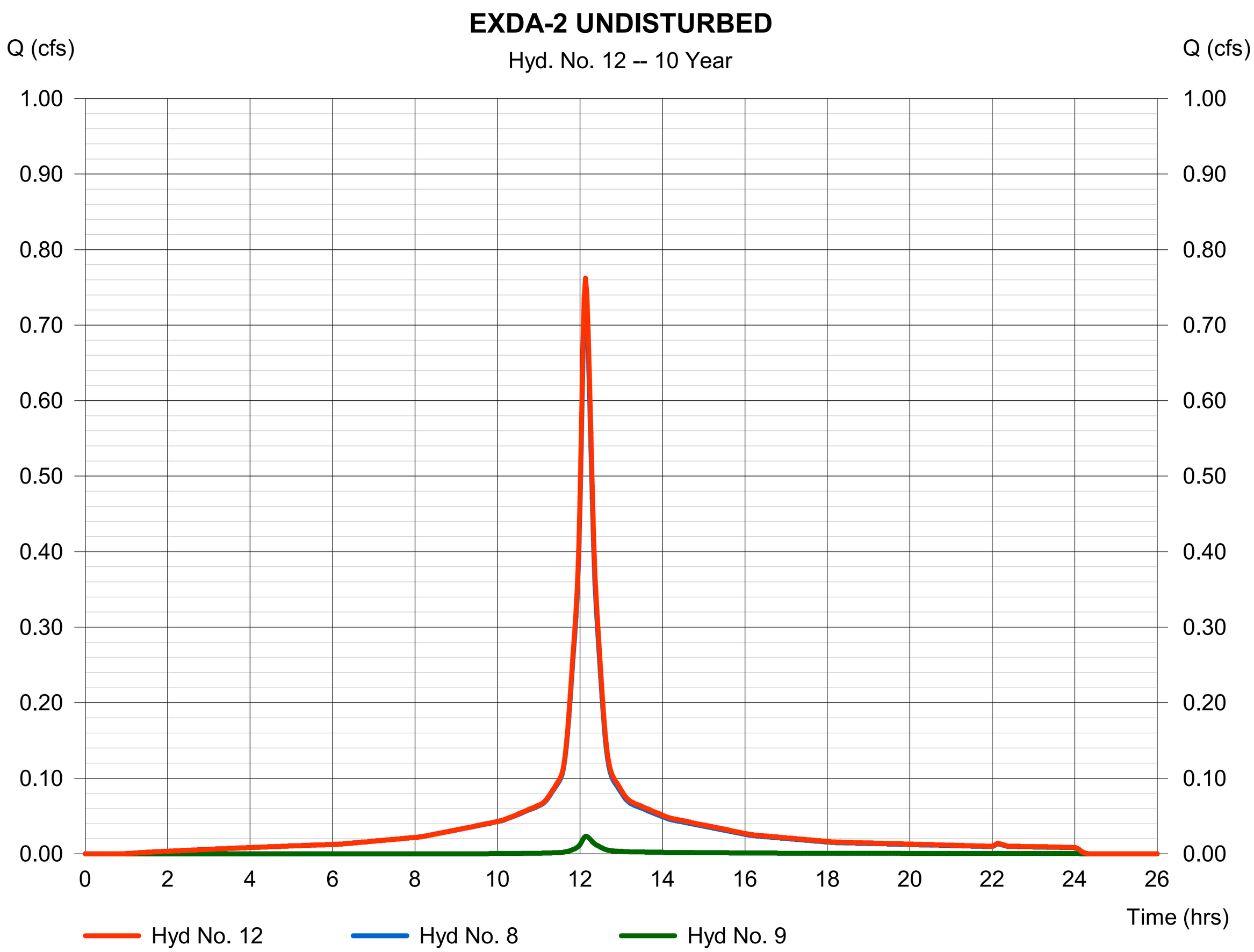
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 12

EXDA-2 UNDISTURBED

Hydrograph type	= Combine	Peak discharge	= 0.762 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 3,298 cuft
Inflow hyds.	= 8, 9	Contrib. drain. area	= 0.190 ac



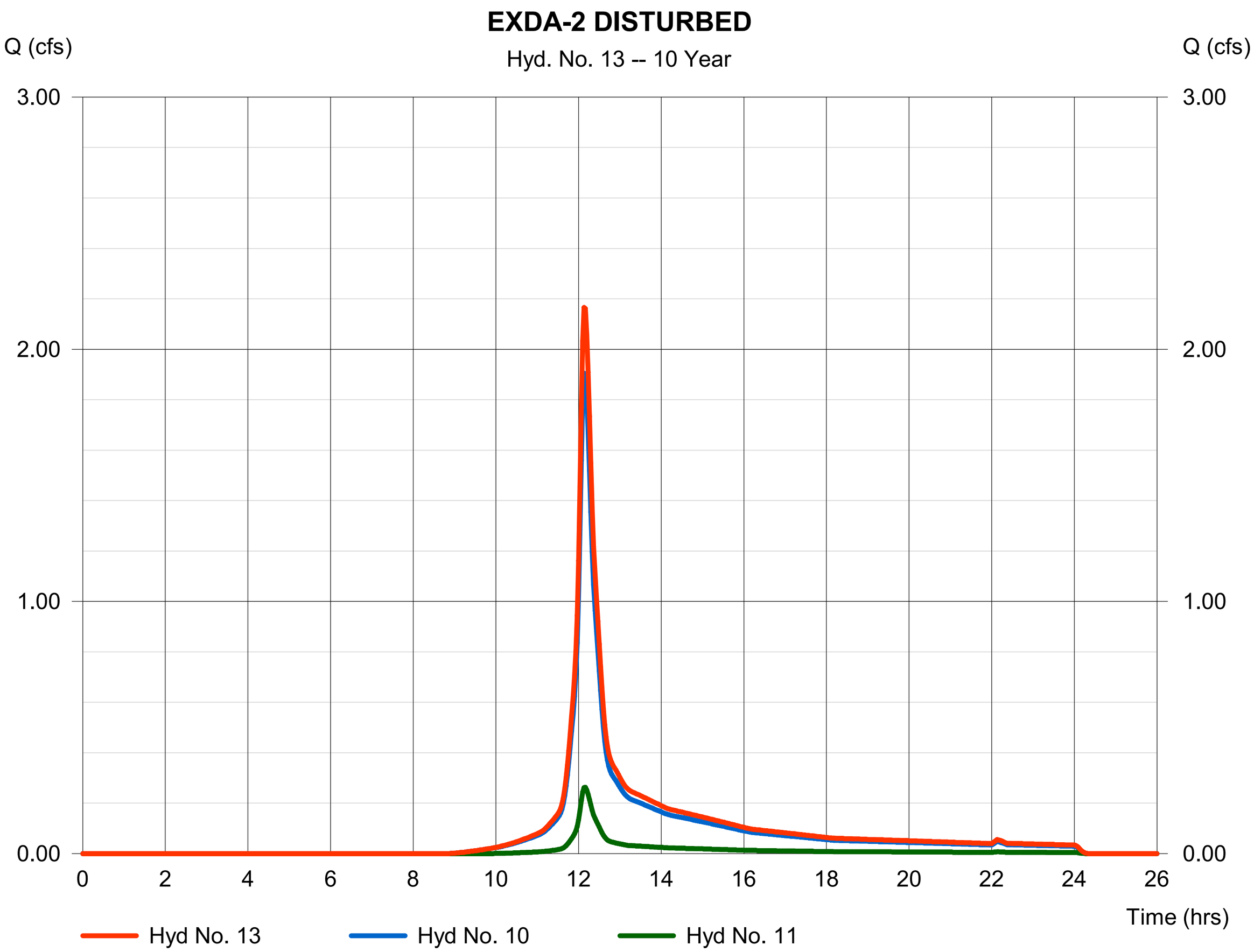
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 13

EXDA-2 DISTURBED

Hydrograph type	= Combine	Peak discharge	= 2.166 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 8,379 cuft
Inflow hyds.	= 10, 11	Contrib. drain. area	= 0.948 ac



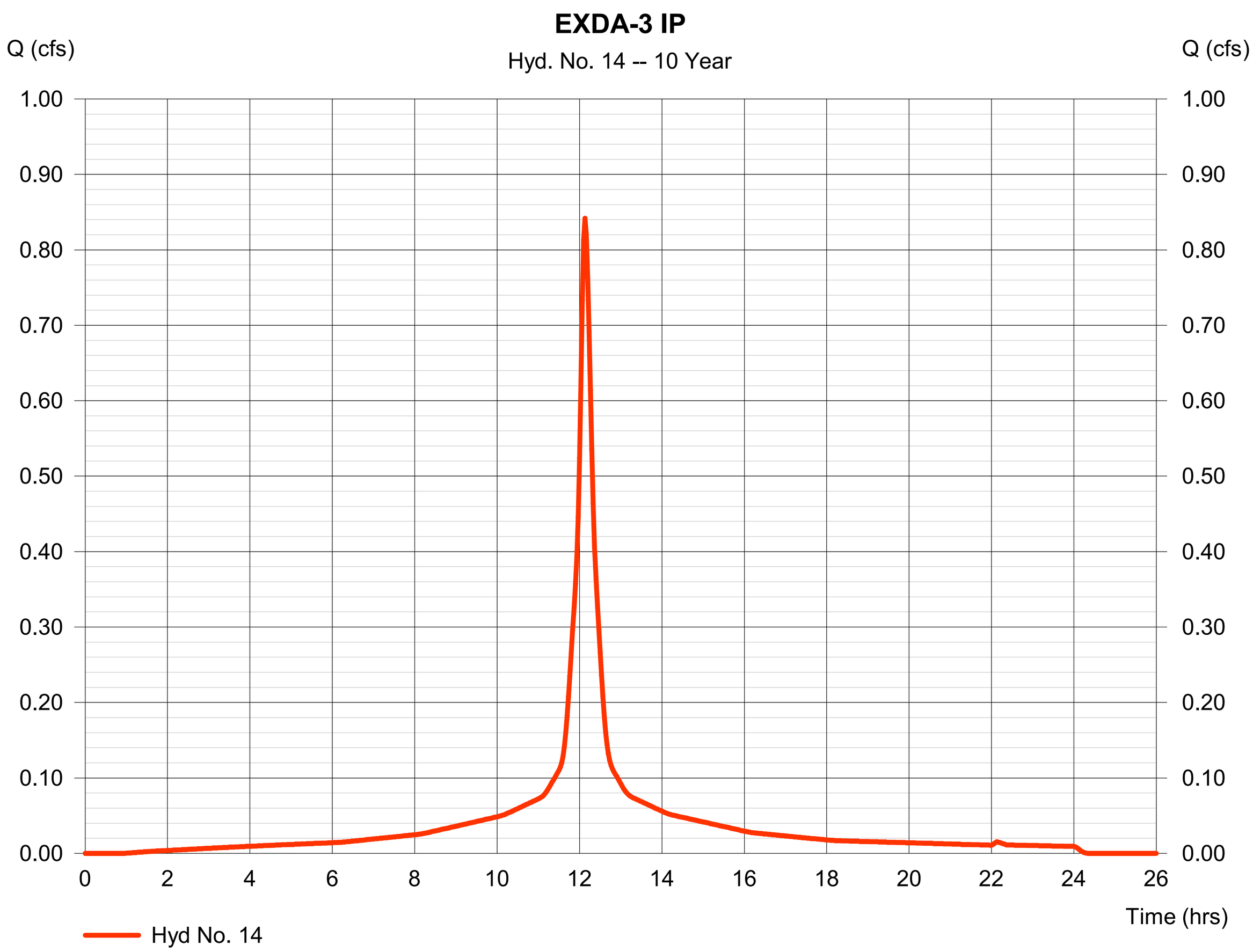
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 14

EXDA-3 IP

Hydrograph type	= SCS Runoff	Peak discharge	= 0.842 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 3,655 cuft
Drainage area	= 0.205 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 5.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



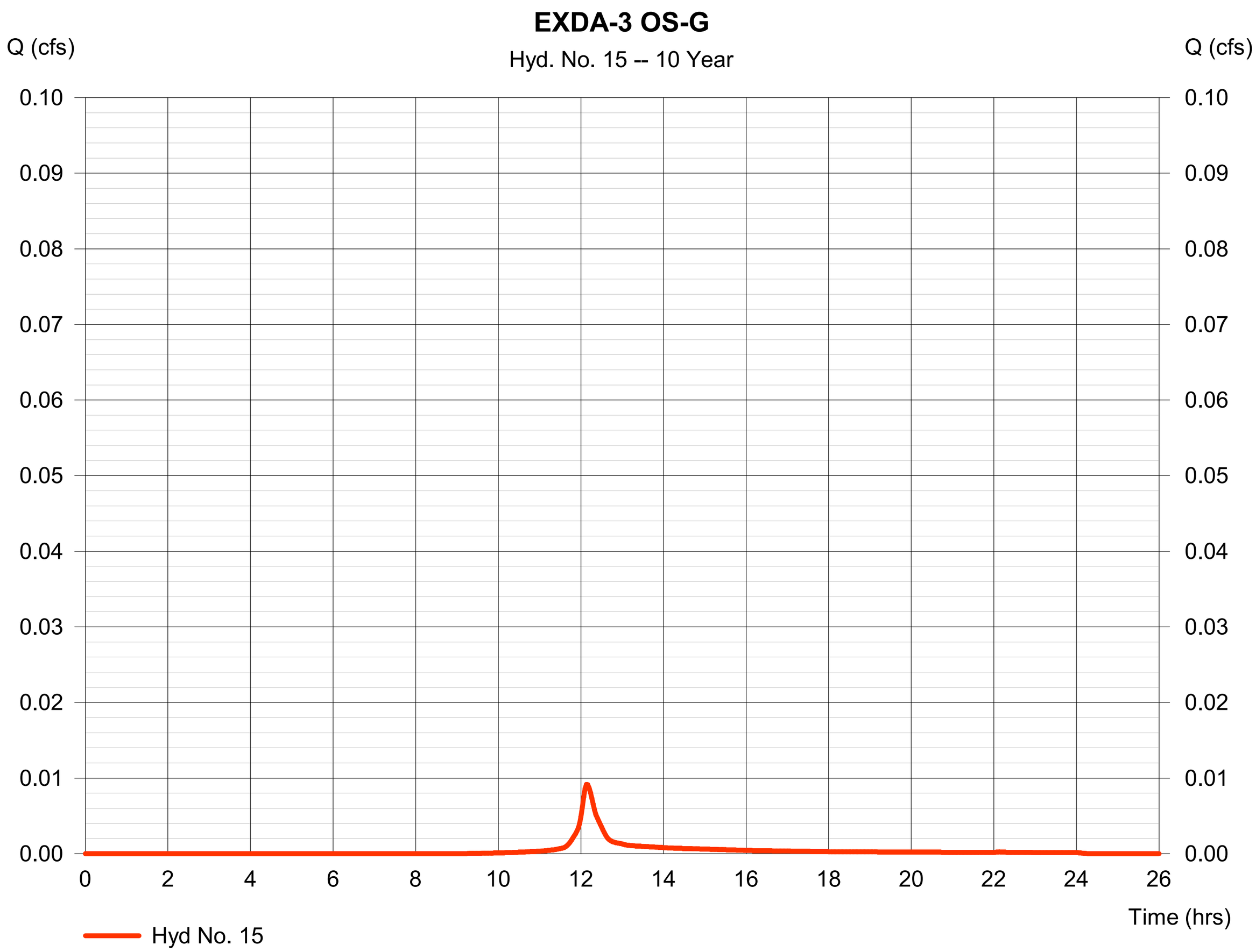
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 15

EXDA-3 OS-G

Hydrograph type	= SCS Runoff	Peak discharge	= 0.009 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 35 cuft
Drainage area	= 0.004 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 5.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



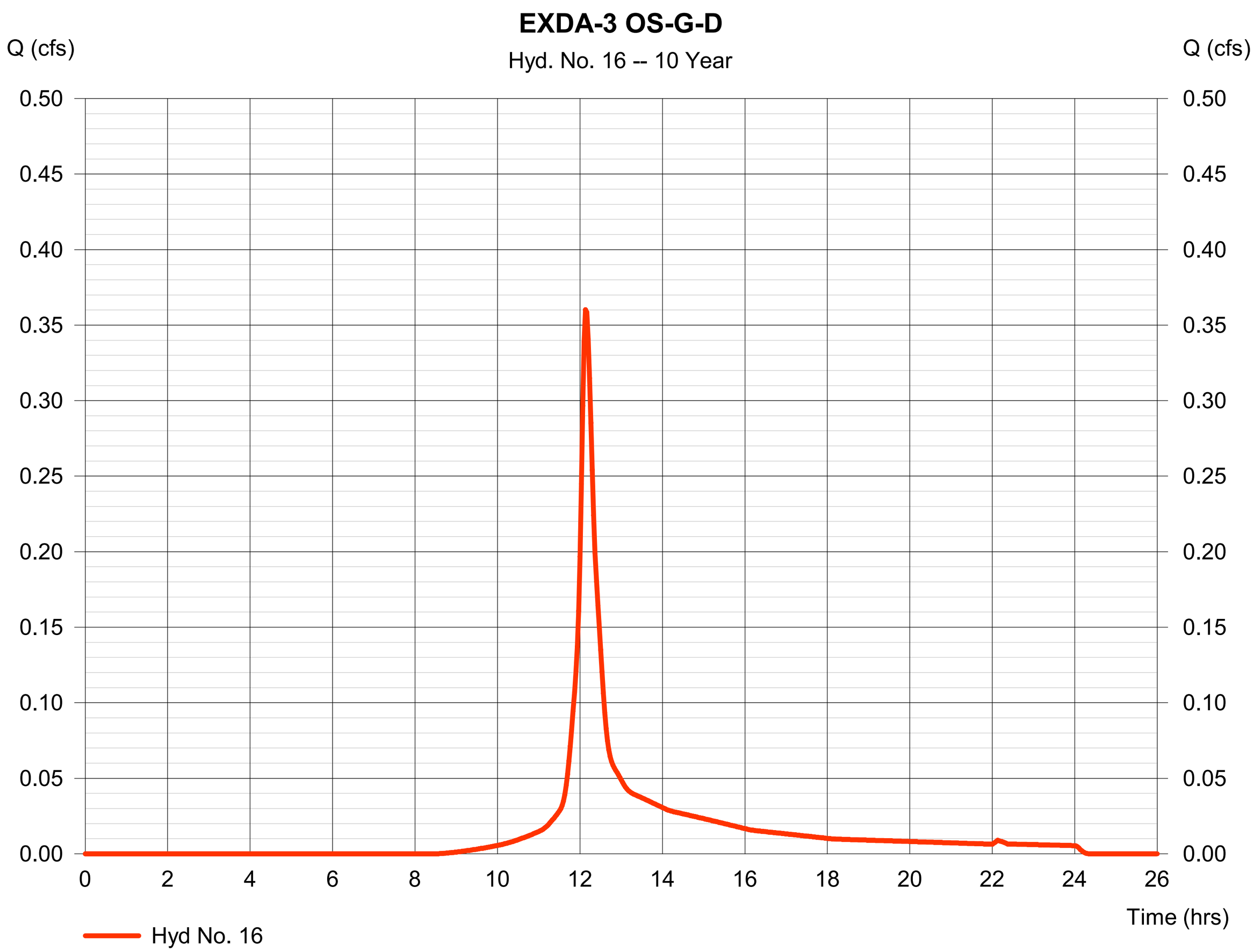
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 16

EXDA-3 OS-G-D

Hydrograph type	= SCS Runoff	Peak discharge	= 0.360 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 1,386 cuft
Drainage area	= 0.146 ac	Curve number	= 76
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 5.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



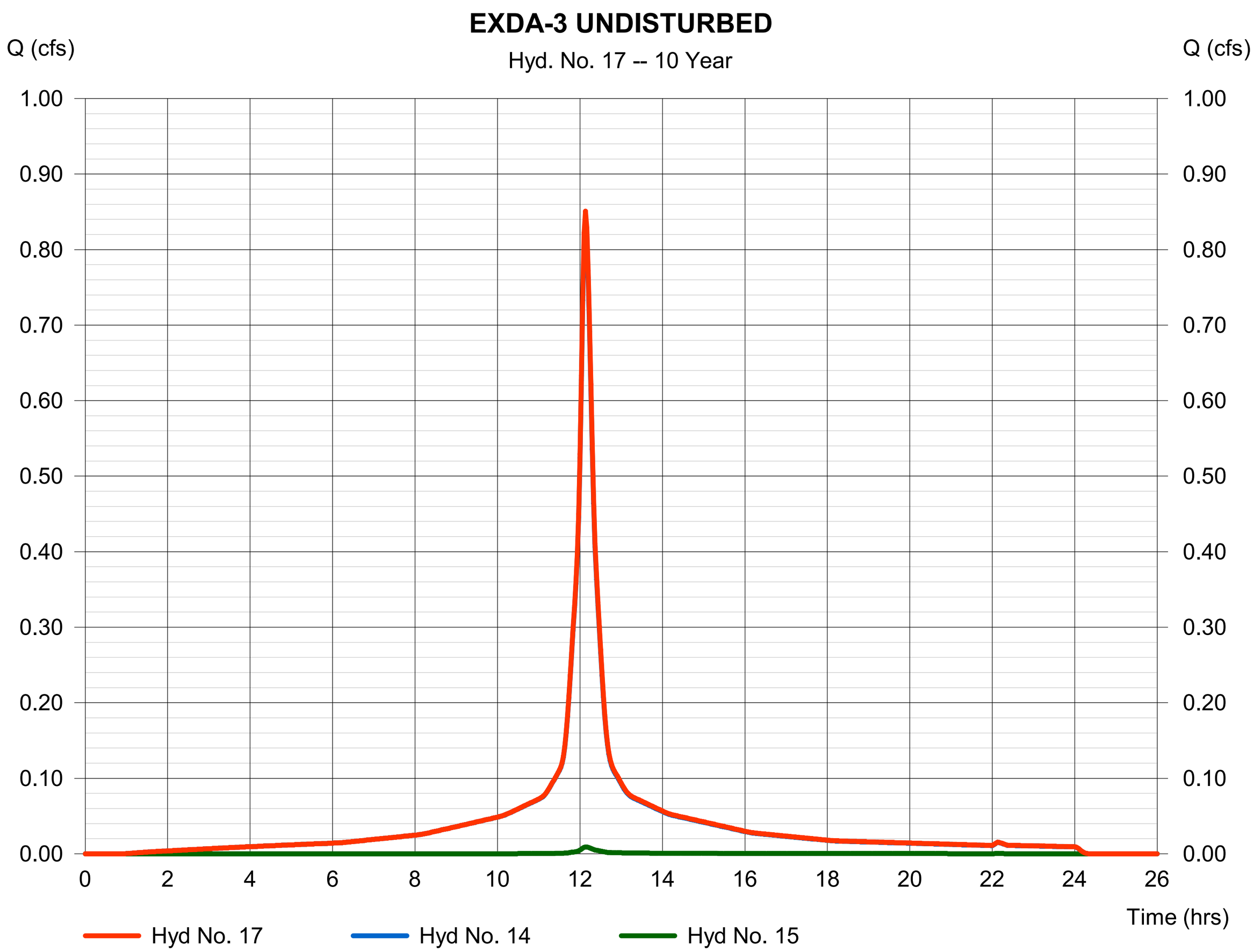
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 17

EXDA-3 UNDISTURBED

Hydrograph type	= Combine	Peak discharge	= 0.851 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 3,691 cuft
Inflow hyds.	= 14, 15	Contrib. drain. area	= 0.209 ac



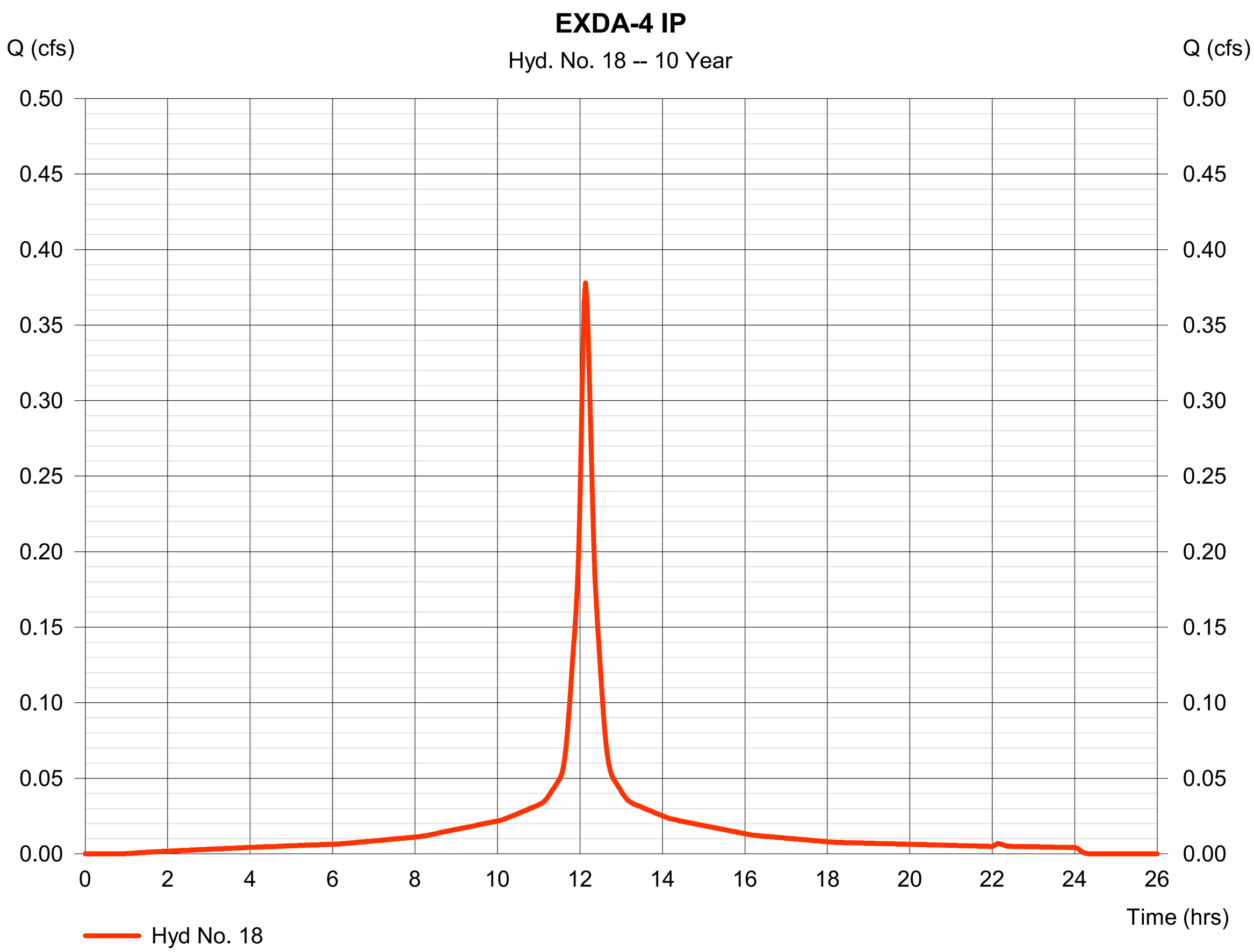
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 18

EXDA-4 IP

Hydrograph type	= SCS Runoff	Peak discharge	= 0.378 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 1,640 cuft
Drainage area	= 0.092 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 5.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



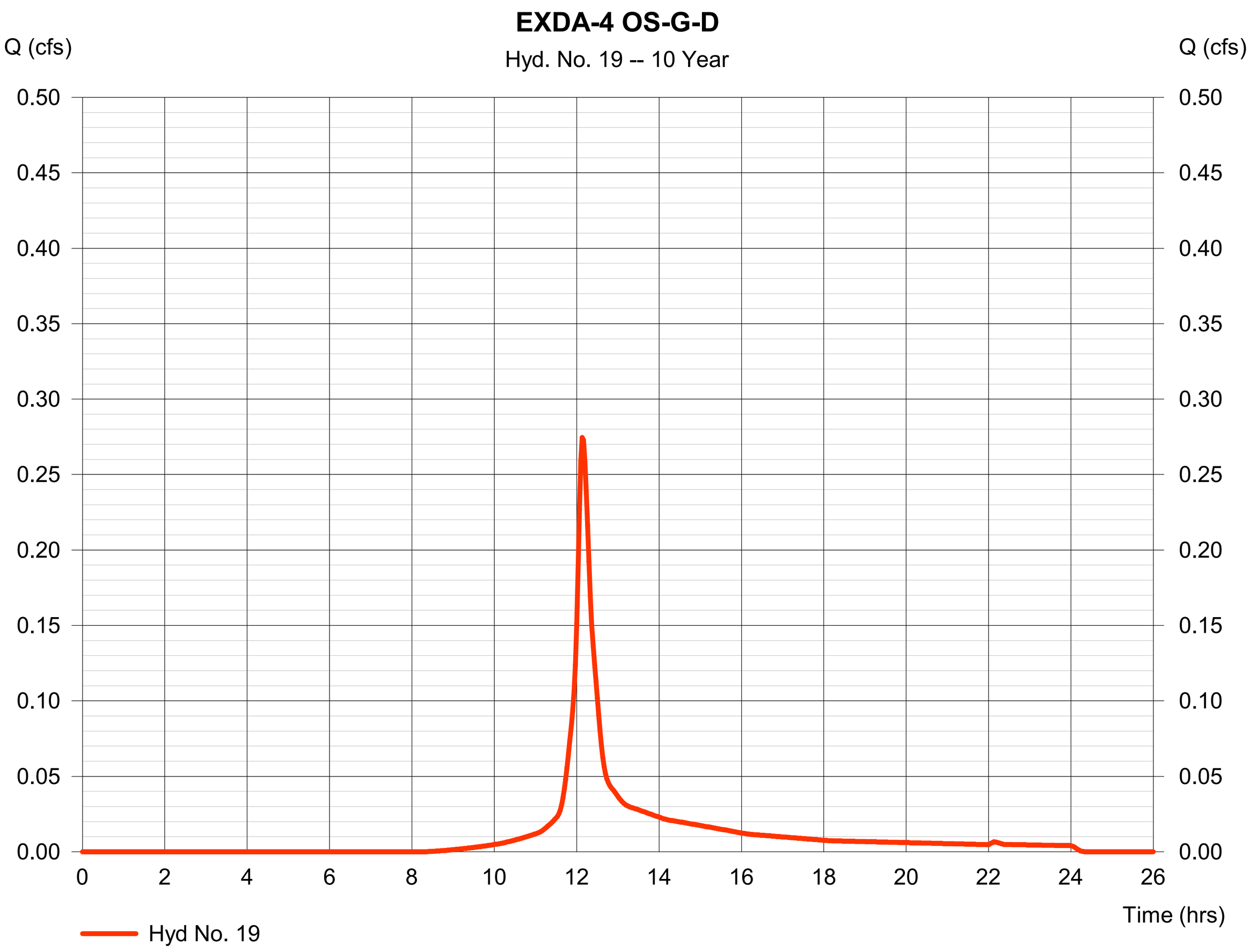
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 19

EXDA-4 OS-G-D

Hydrograph type	= SCS Runoff	Peak discharge	= 0.275 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 1,054 cuft
Drainage area	= 0.107 ac	Curve number	= 77.1
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 5.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



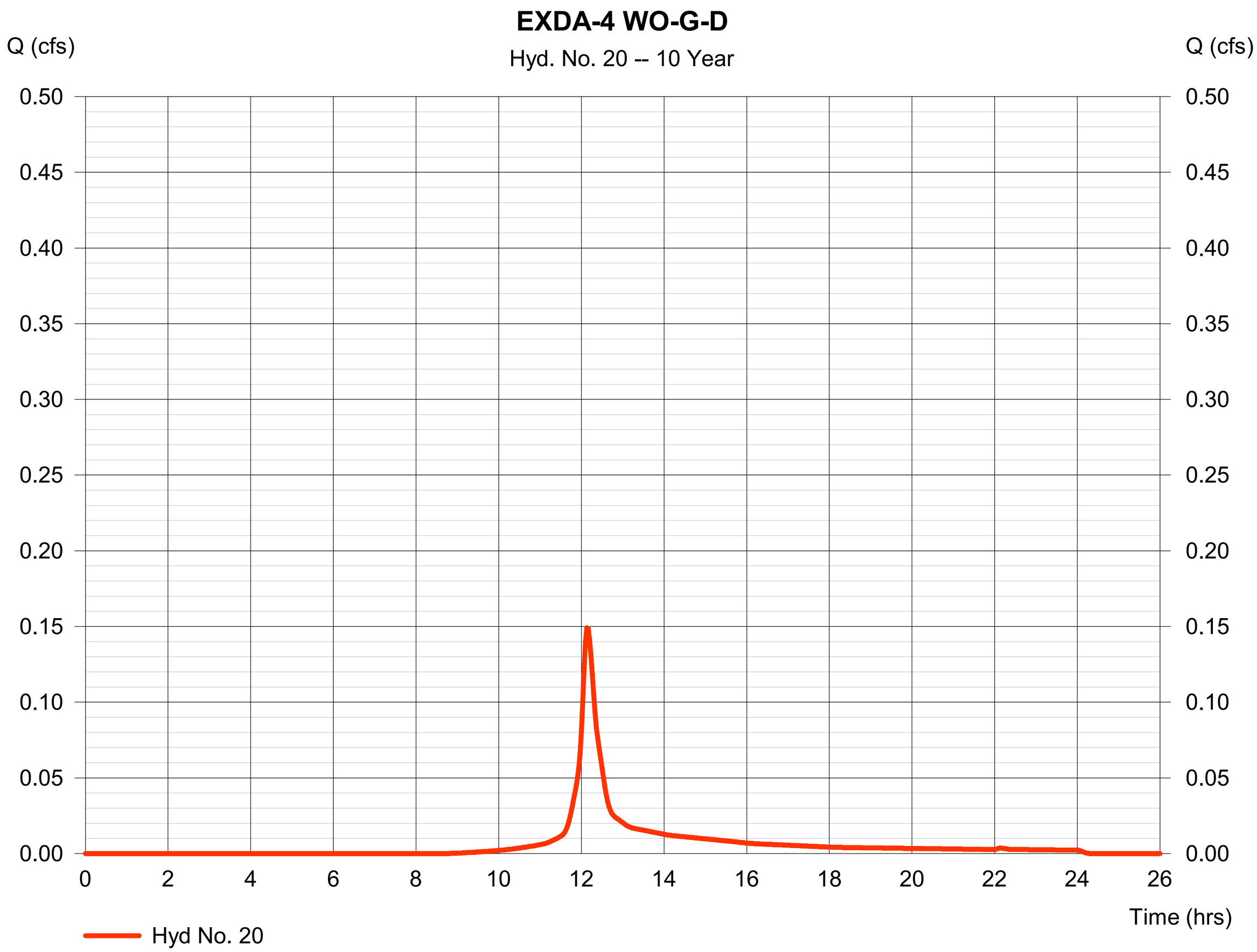
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 20

EXDA-4 WO-G-D

Hydrograph type	= SCS Runoff	Peak discharge	= 0.149 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 574 cuft
Drainage area	= 0.062 ac	Curve number	= 75.3
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 5.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



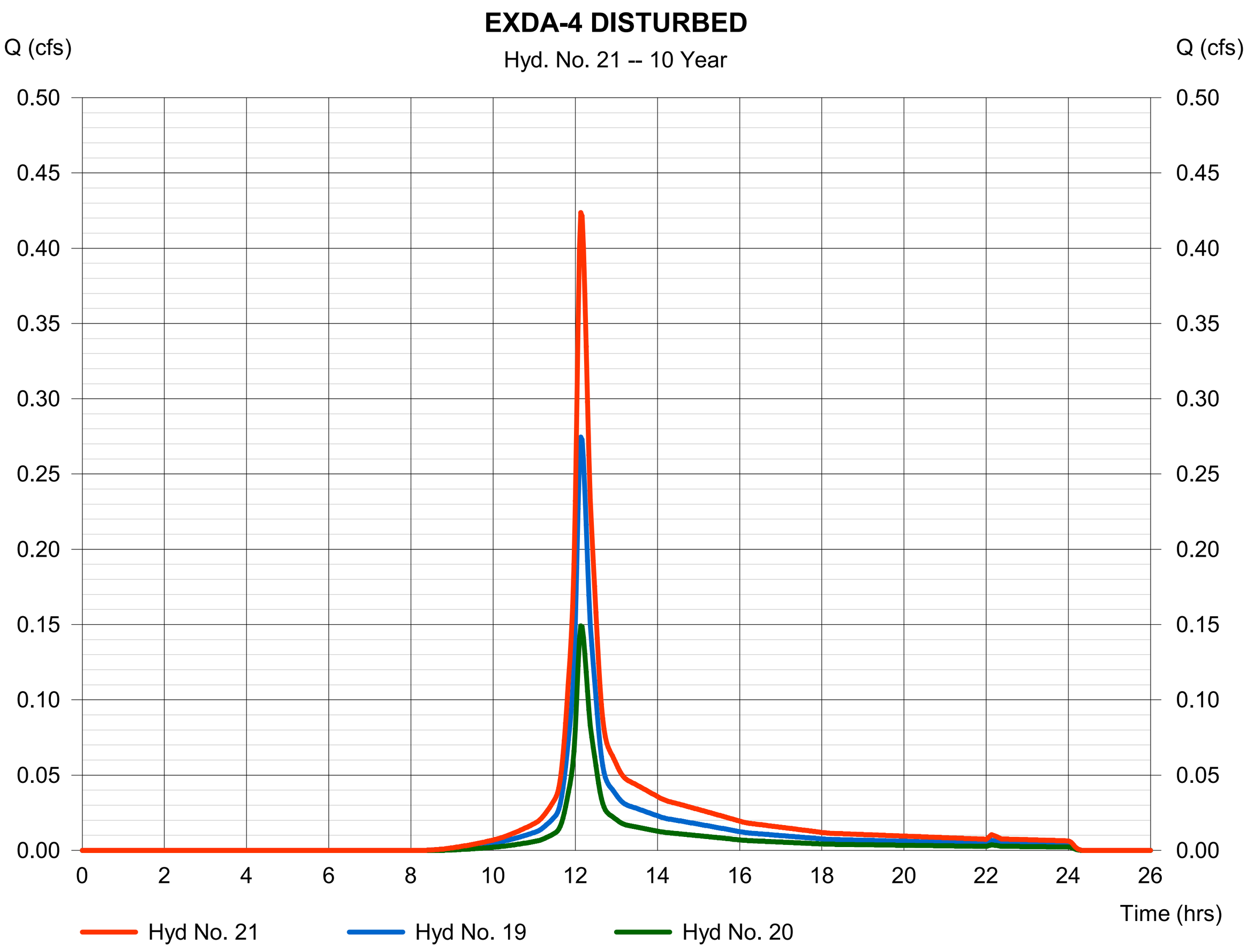
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 21

EXDA-4 DISTURBED

Hydrograph type	= Combine	Peak discharge	= 0.424 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 1,629 cuft
Inflow hyds.	= 19, 20	Contrib. drain. area	= 0.169 ac



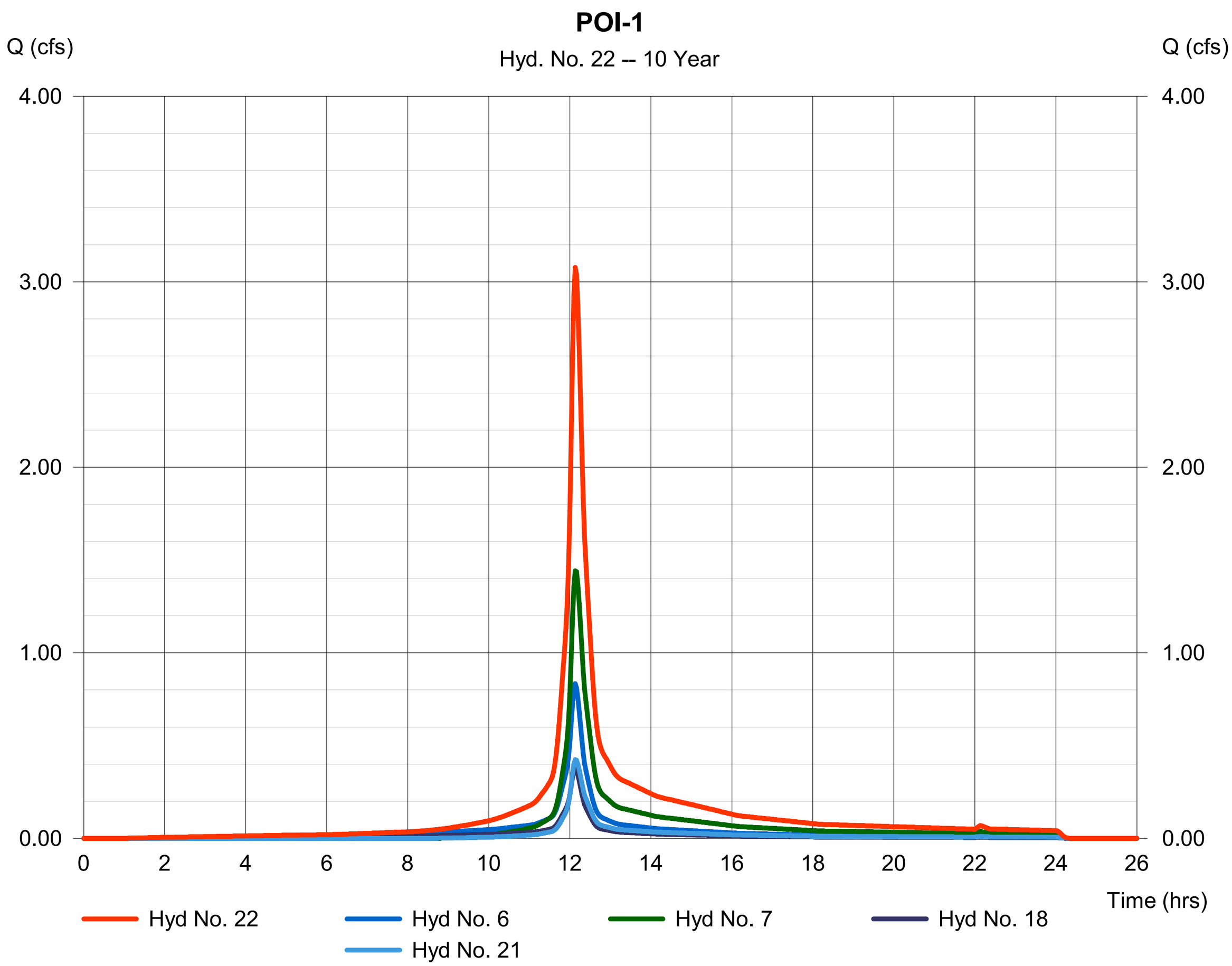
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 22

POI-1

Hydrograph type	= Combine	Peak discharge	= 3.077 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 12,448 cuft
Inflow hyds.	= 6, 7, 18, 21	Contrib. drain. area	= 0.092 ac



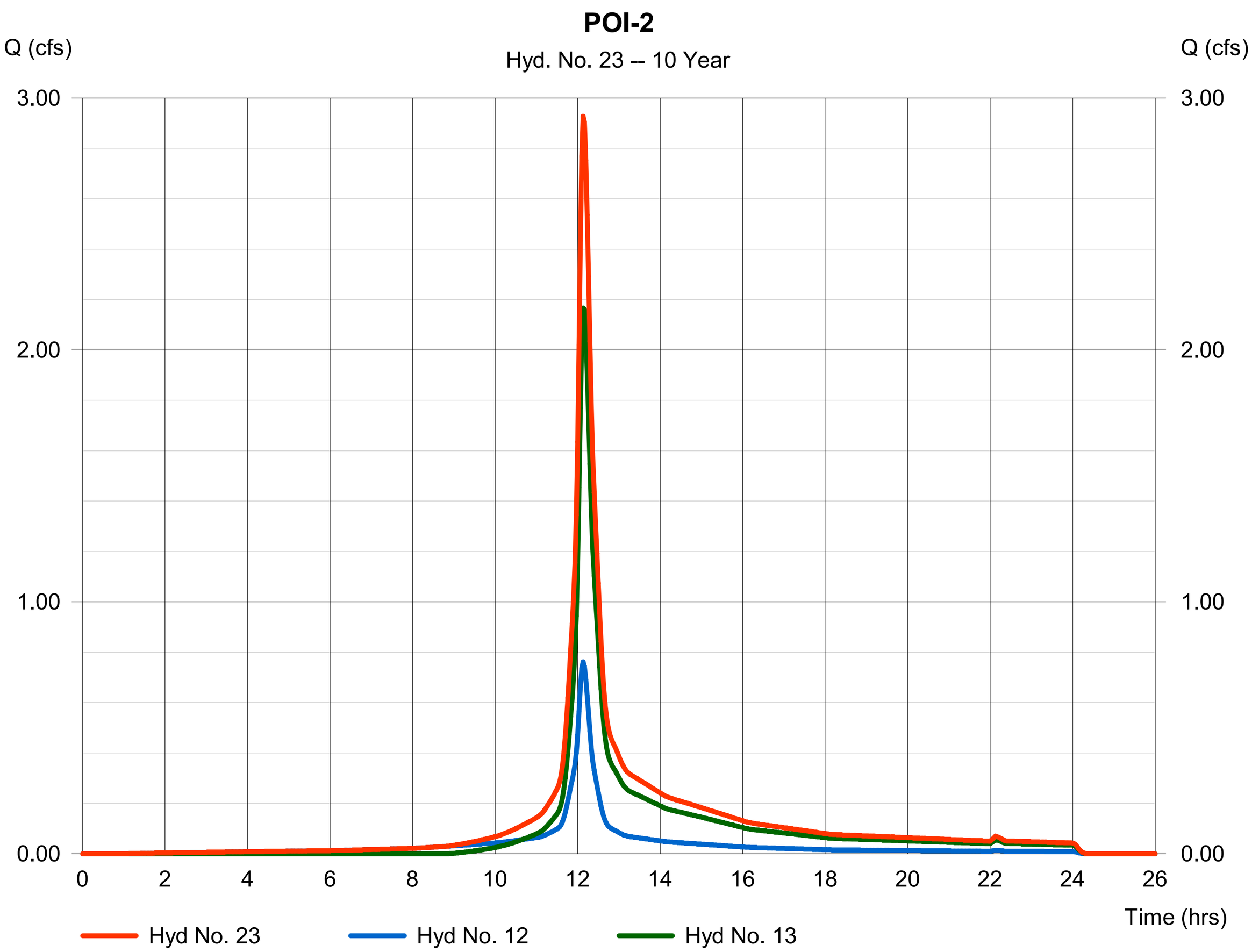
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 23

POI-2

Hydrograph type	= Combine	Peak discharge	= 2.928 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 11,677 cuft
Inflow hyds.	= 12, 13	Contrib. drain. area	= 0.000 ac



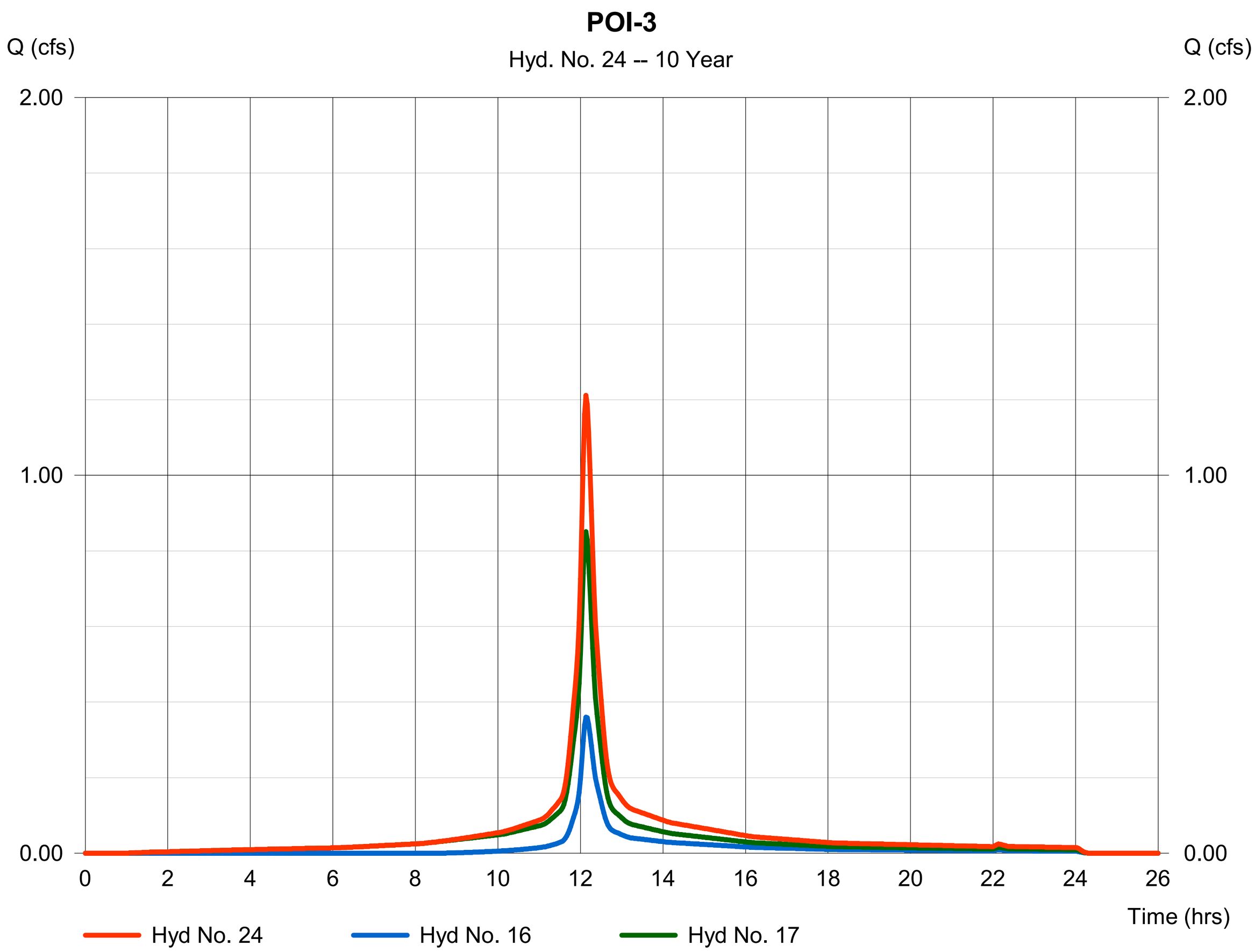
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 24

POI-3

Hydrograph type	= Combine	Peak discharge	= 1.211 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 5,076 cuft
Inflow hyds.	= 16, 17	Contrib. drain. area	= 0.146 ac



100-YEAR 24-HOUR

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	1.312	2	728	5,781	------	------	------	EXDA-1 IP
2	SCS Runoff	0.013	2	728	58	------	------	------	EXDA-1 IP-D
3	SCS Runoff	0.034	2	728	129	------	------	------	EXDA-1 OS-G
4	SCS Runoff	2.855	2	728	10,965	------	------	------	EXDA-1 OS-G-D
5	SCS Runoff	0.118	2	728	451	------	------	------	EXDA-1 WO-G-D
6	Combine	1.346	2	728	5,910	1, 3,	------	------	EXDA-1 UNDISTURBED
7	Combine	2.986	2	728	11,475	2, 4, 5,	------	------	EXDA-1 DISTURBED
8	SCS Runoff	1.187	2	728	5,229	------	------	------	EXDA-2 IP
9	SCS Runoff	0.048	2	728	184	------	------	------	EXDA-2 OS-G
10	SCS Runoff	3.960	2	728	15,203	------	------	------	EXDA-2 OS-G-D
11	SCS Runoff	0.589	2	728	2,256	------	------	------	EXDA-2 WO-G-D
12	Combine	1.235	2	728	5,413	8, 9,	------	------	EXDA-2 UNDISTURBED
13	Combine	4.548	2	728	17,459	10, 11,	------	------	EXDA-2 DISTURBED
14	SCS Runoff	1.352	2	728	5,955	------	------	------	EXDA-3 IP
15	SCS Runoff	0.019	2	728	74	------	------	------	EXDA-3 OS-G
16	SCS Runoff	0.733	2	728	2,819	------	------	------	EXDA-3 OS-G-D
17	Combine	1.371	2	728	6,029	14, 15,	------	------	EXDA-3 UNDISTURBED
18	SCS Runoff	0.607	2	728	2,673	------	------	------	EXDA-4 IP
19	SCS Runoff	0.549	2	728	2,117	------	------	------	EXDA-4 OS-G-D
20	SCS Runoff	0.307	2	728	1,178	------	------	------	EXDA-4 WO-G-D
21	Combine	0.856	2	728	3,296	19, 20	------	------	EXDA-4 DISTURBED
22	Combine	5.795	2	728	23,353	6, 7, 18, 21	------	------	POI-1
23	Combine	5.784	2	728	22,872	12, 13,	------	------	POI-2
24	Combine	2.104	2	728	8,848	16, 17,	------	------	POI-3

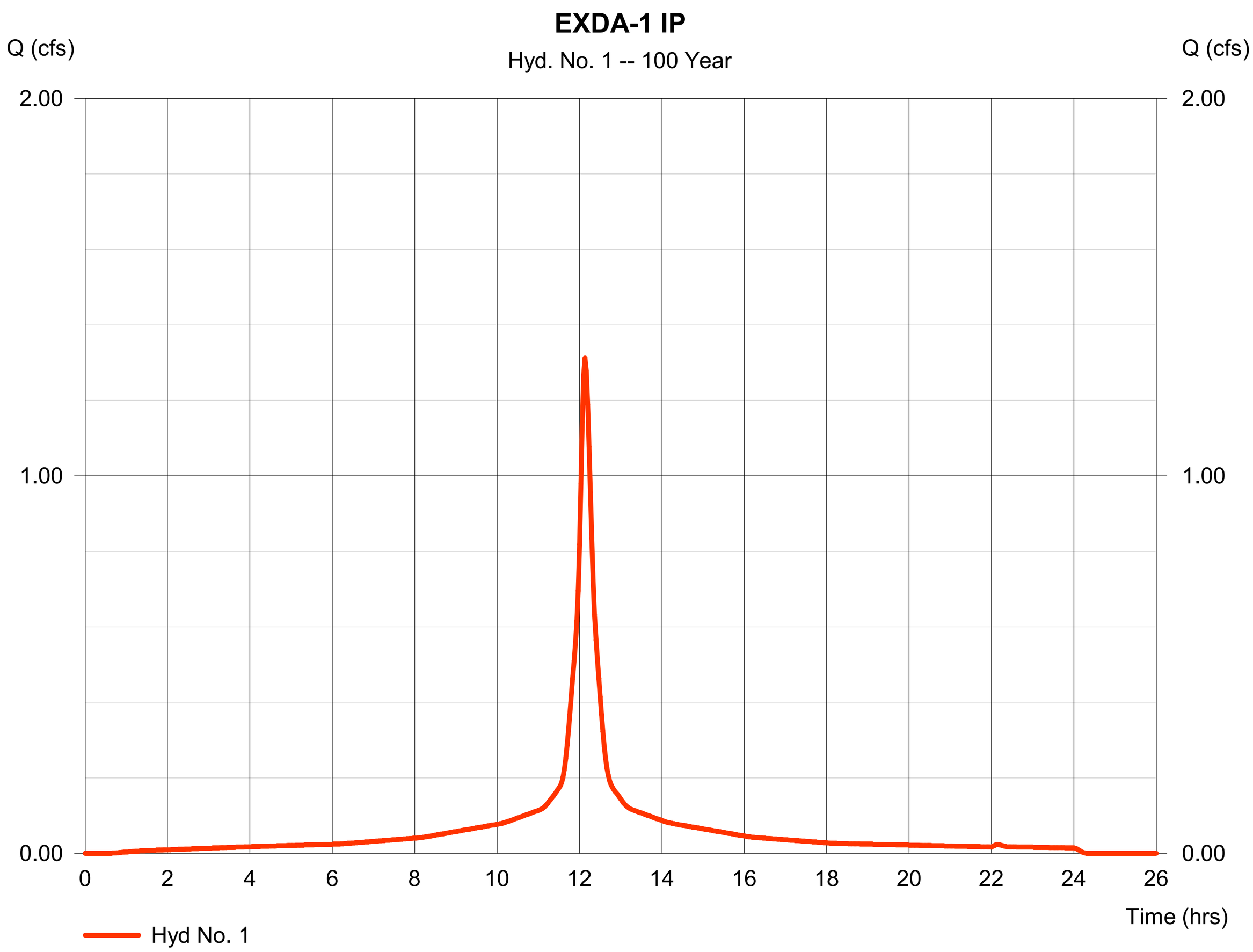
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 1

EXDA-1 IP

Hydrograph type	= SCS Runoff	Peak discharge	= 1.312 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 5,781 cuft
Drainage area	= 0.199 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.10 min
Total precip.	= 8.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



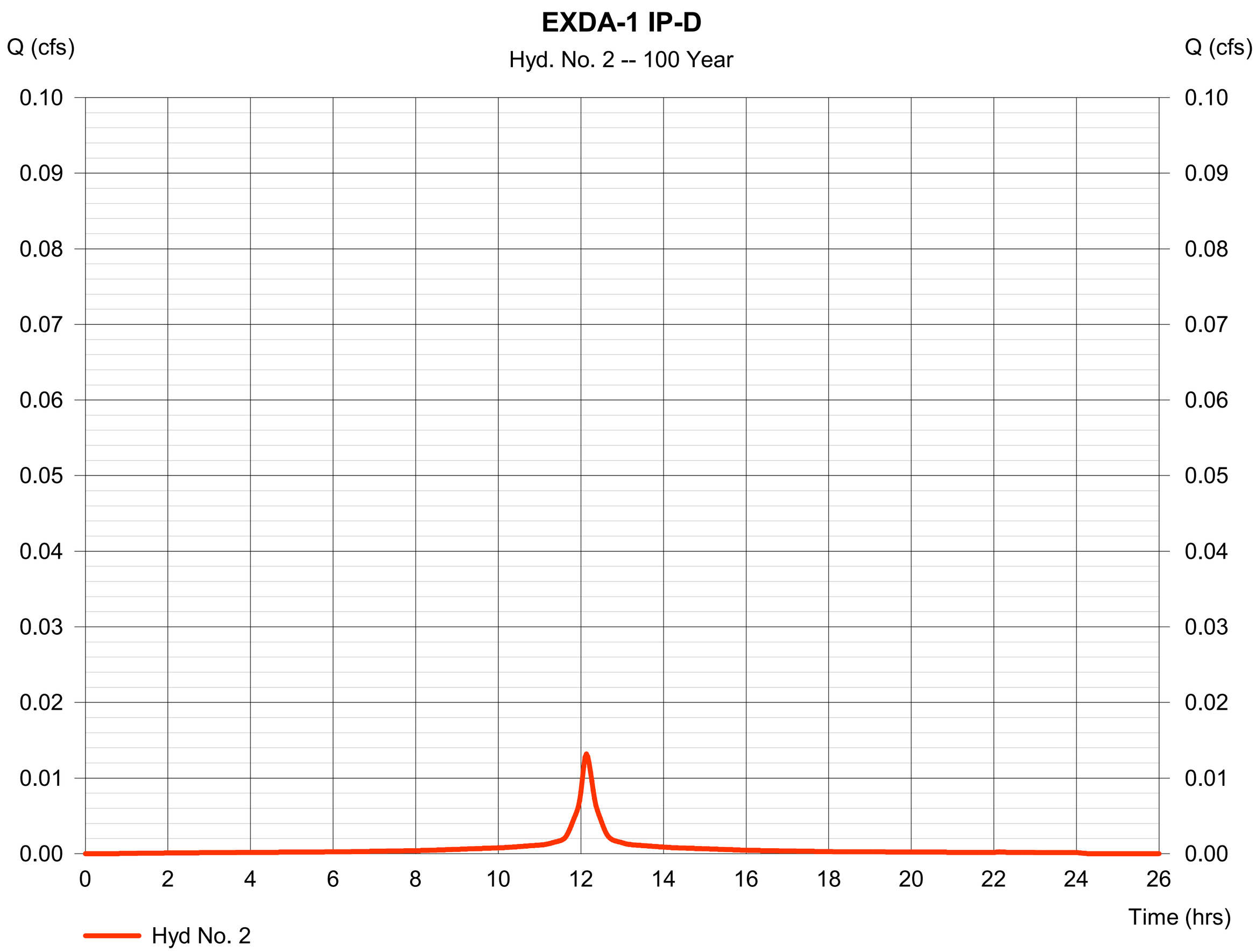
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 2

EXDA-1 IP-D

Hydrograph type	= SCS Runoff	Peak discharge	= 0.013 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 58 cuft
Drainage area	= 0.002 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.15 min
Total precip.	= 8.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



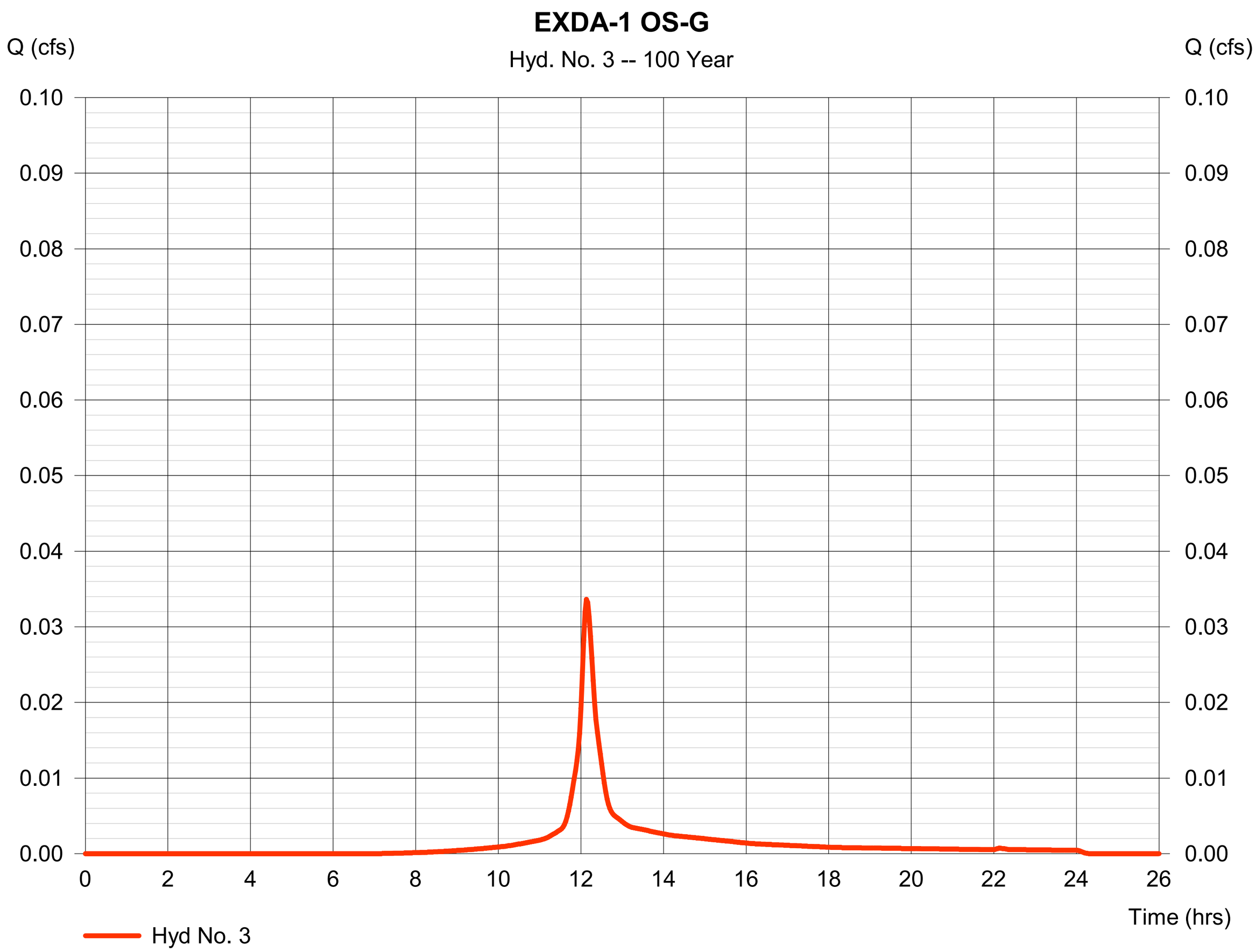
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 3

EXDA-1 OS-G

Hydrograph type	= SCS Runoff	Peak discharge	= 0.034 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 129 cuft
Drainage area	= 0.007 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.10 min
Total precip.	= 8.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



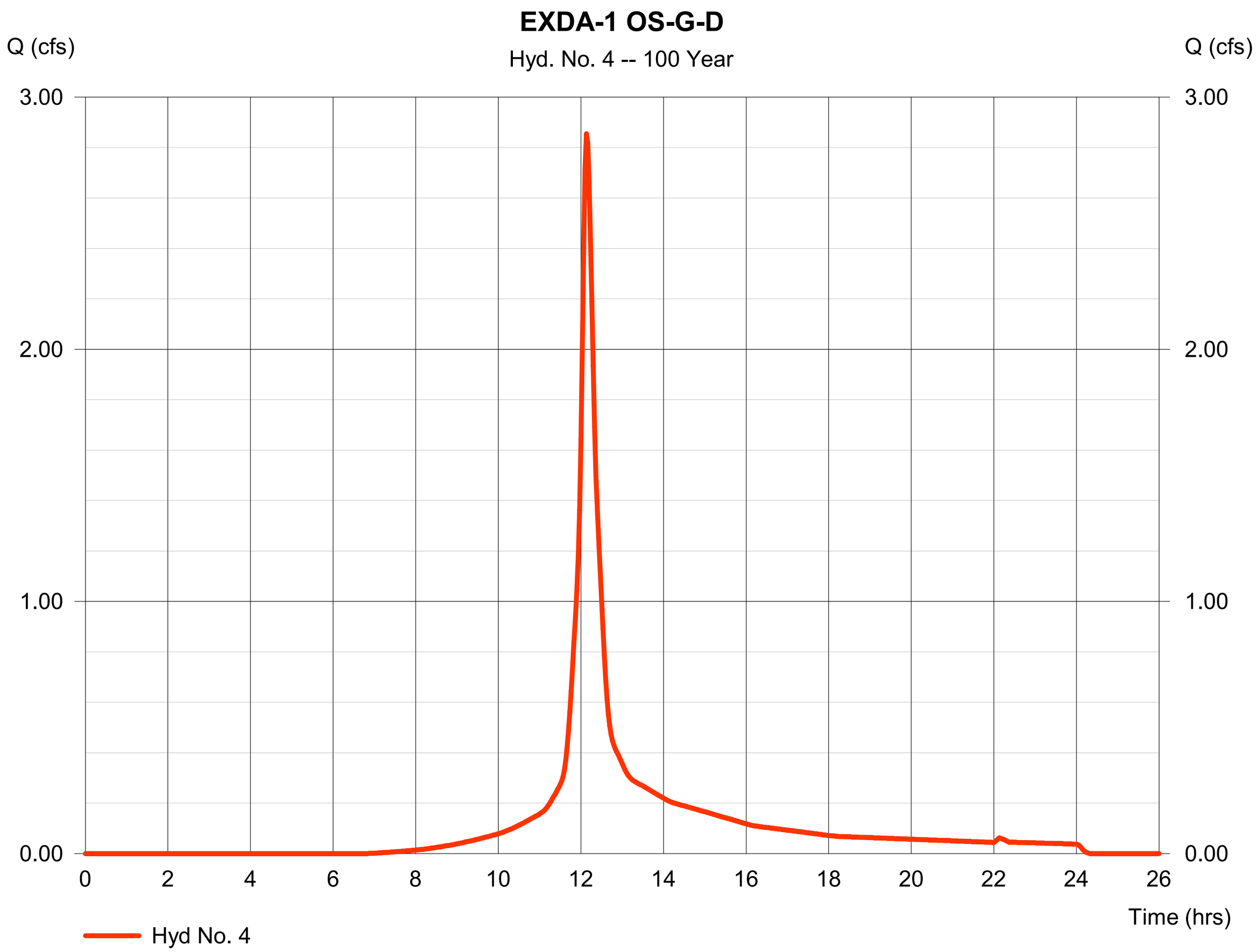
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 4

EXDA-1 OS-G-D

Hydrograph type	= SCS Runoff	Peak discharge	= 2.855 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 10,965 cuft
Drainage area	= 0.581 ac	Curve number	= 75
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.10 min
Total precip.	= 8.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



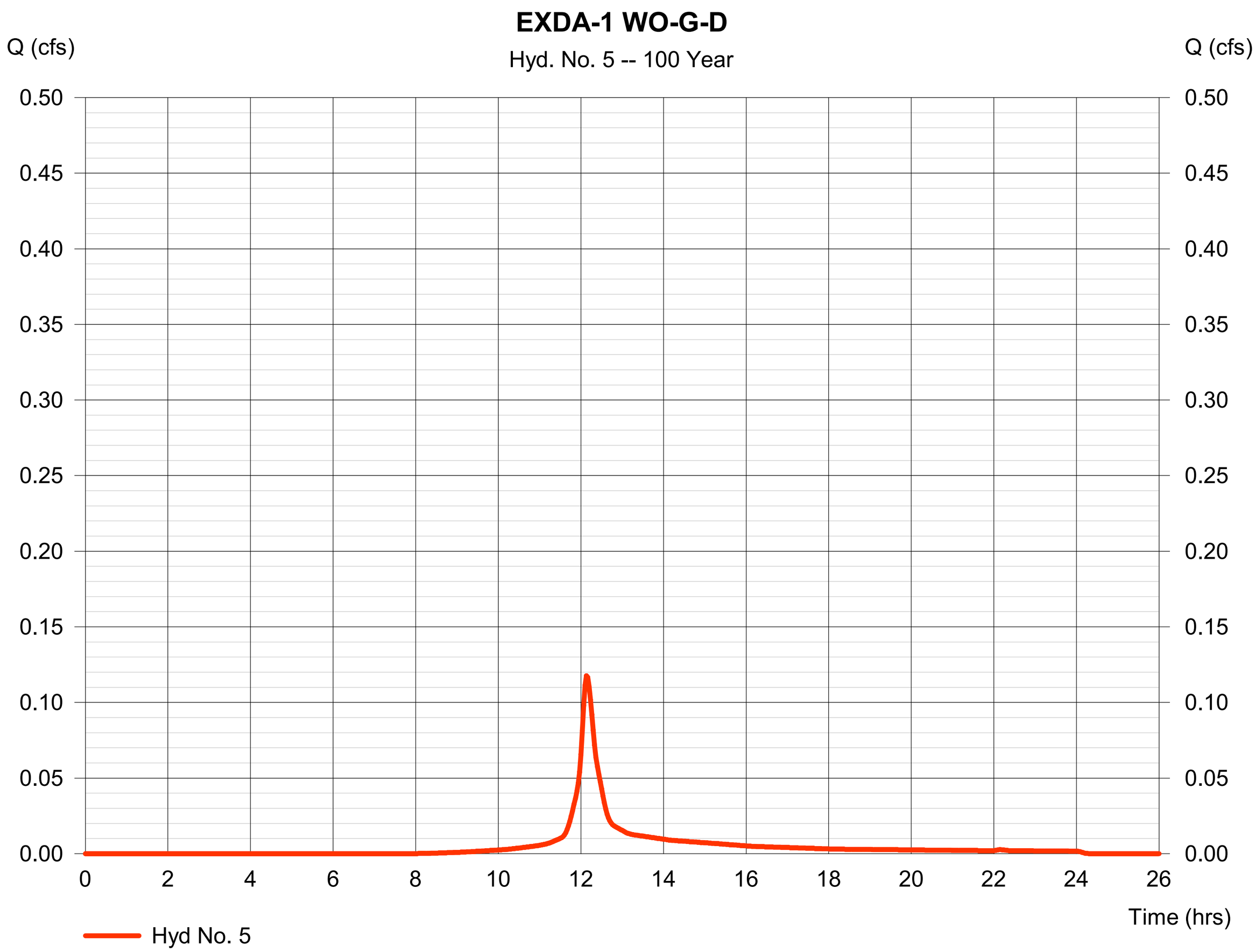
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 5

EXDA-1 WO-G-D

Hydrograph type	= SCS Runoff	Peak discharge	= 0.118 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 451 cuft
Drainage area	= 0.027 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.15 min
Total precip.	= 8.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



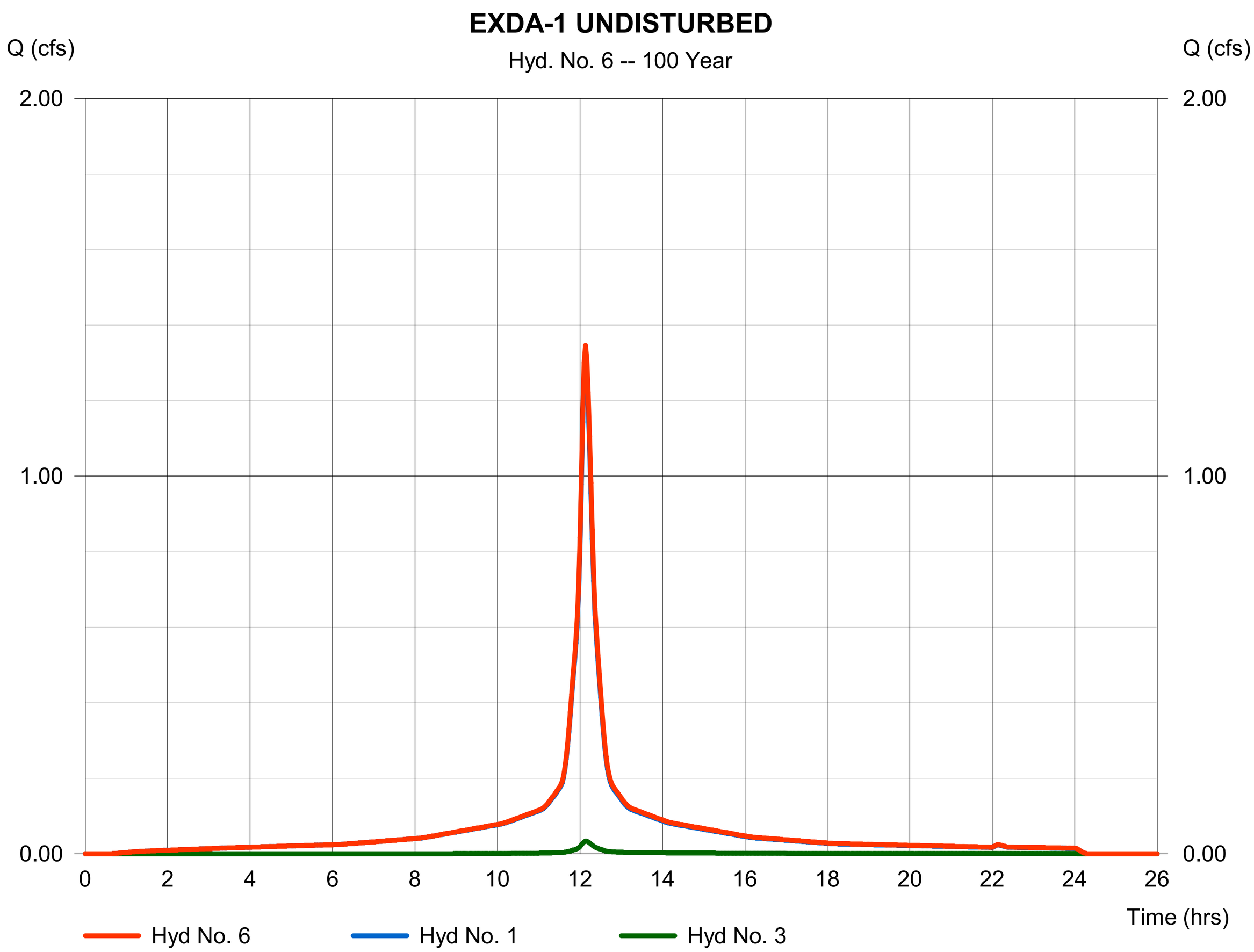
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 6

EXDA-1 UNDISTURBED

Hydrograph type	= Combine	Peak discharge	= 1.346 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 5,910 cuft
Inflow hyds.	= 1, 3	Contrib. drain. area	= 0.206 ac



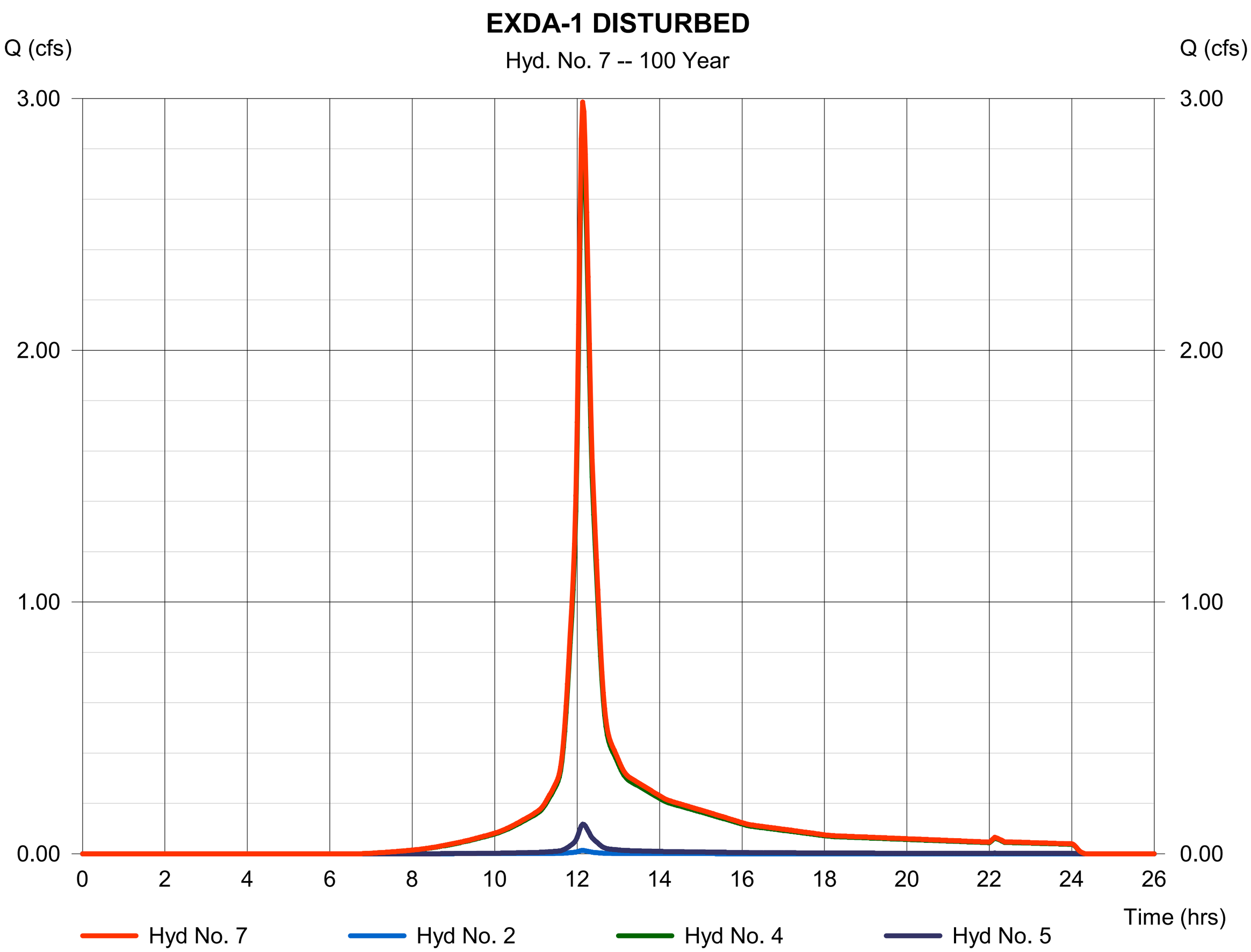
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 7

EXDA-1 DISTURBED

Hydrograph type	= Combine	Peak discharge	= 2.986 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 11,475 cuft
Inflow hyds.	= 2, 4, 5	Contrib. drain. area	= 0.610 ac



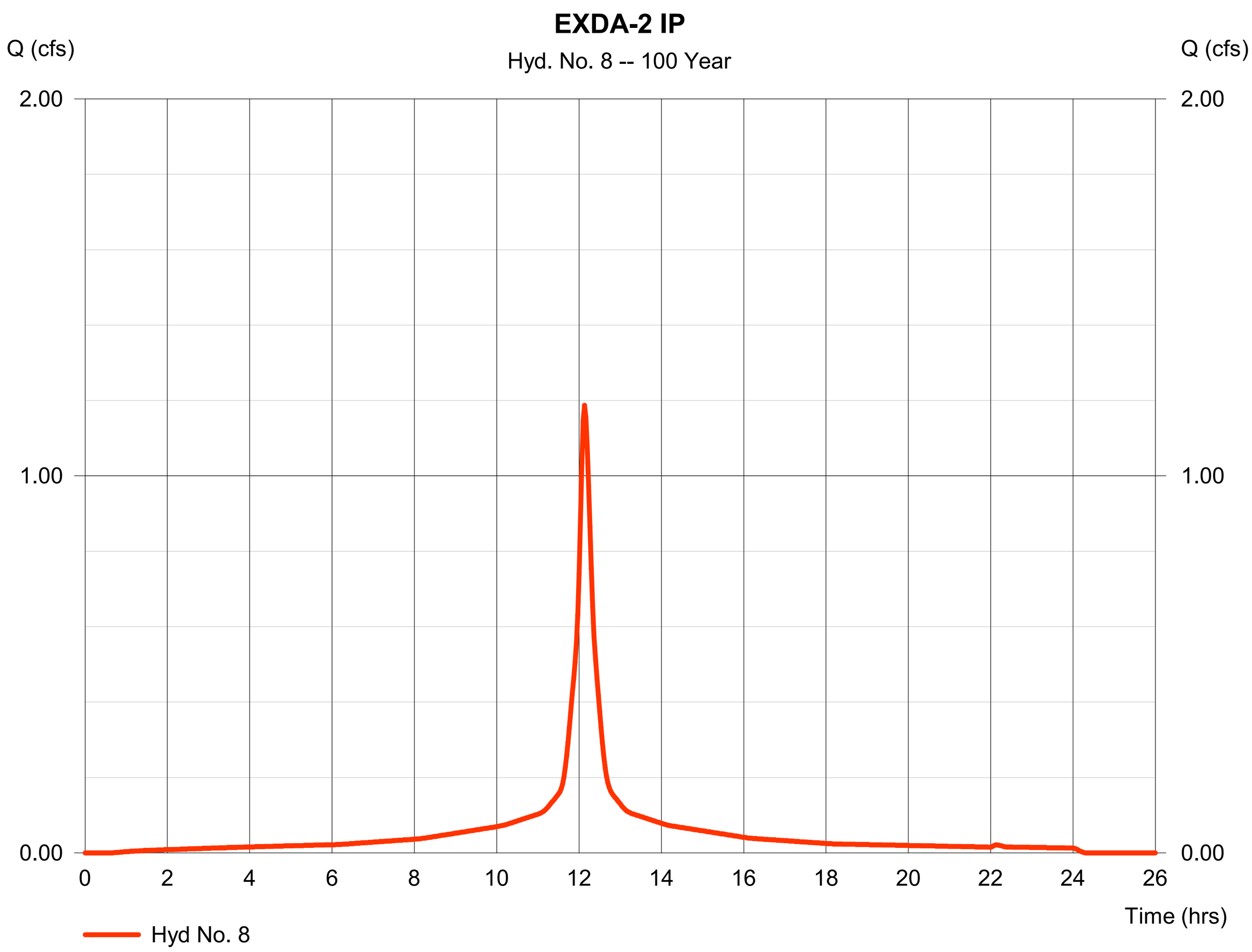
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 8

EXDA-2 IP

Hydrograph type	= SCS Runoff	Peak discharge	= 1.187 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 5,229 cuft
Drainage area	= 0.180 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.80 min
Total precip.	= 8.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



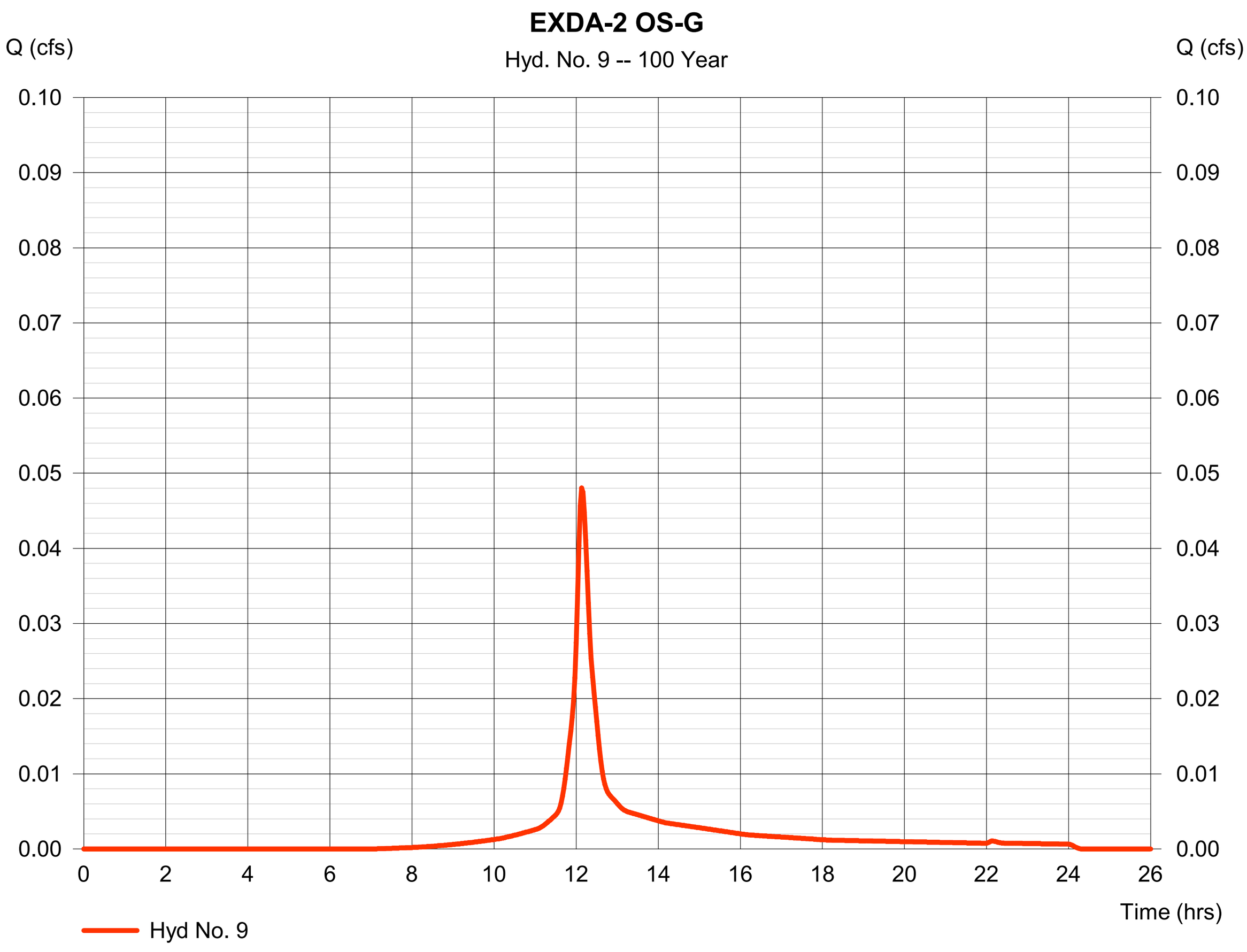
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 9

EXDA-2 OS-G

Hydrograph type	= SCS Runoff	Peak discharge	= 0.048 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 184 cuft
Drainage area	= 0.010 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.80 min
Total precip.	= 8.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



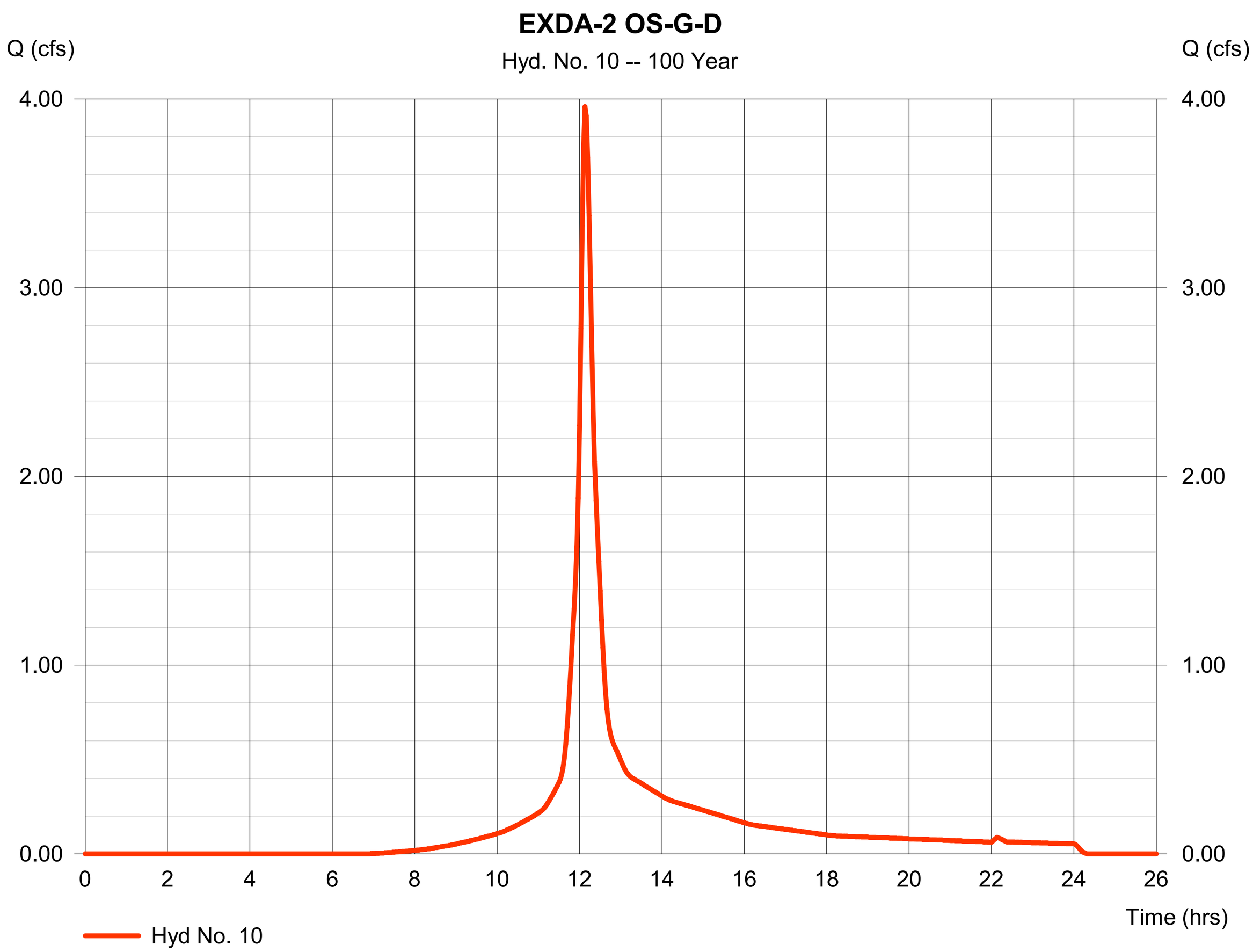
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 10

EXDA-2 OS-G-D

Hydrograph type	= SCS Runoff	Peak discharge	= 3.960 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 15,203 cuft
Drainage area	= 0.813 ac	Curve number	= 74.6
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.80 min
Total precip.	= 8.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



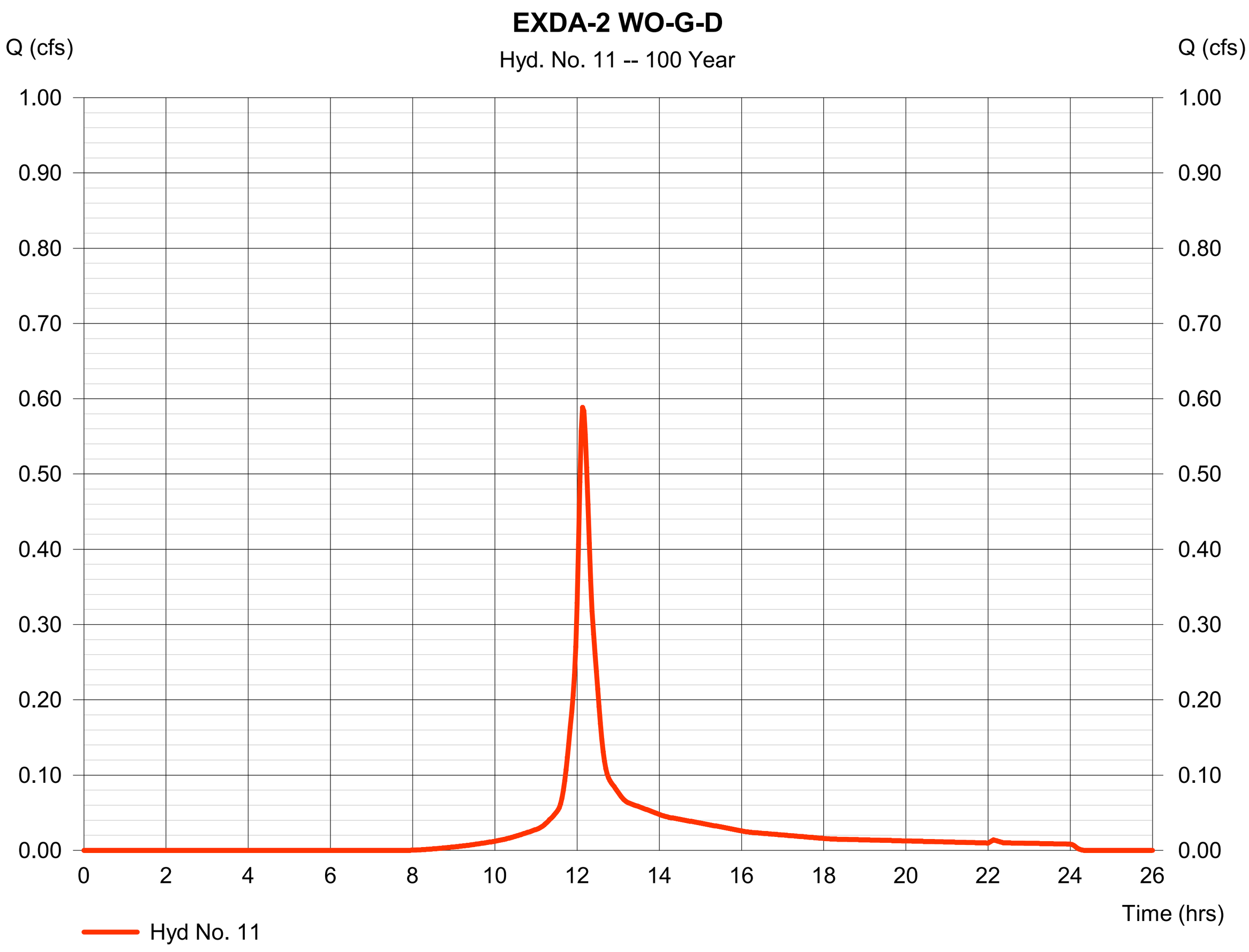
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 11

EXDA-2 WO-G-D

Hydrograph type	= SCS Runoff	Peak discharge	= 0.589 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 2,256 cuft
Drainage area	= 0.135 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.83 min
Total precip.	= 8.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



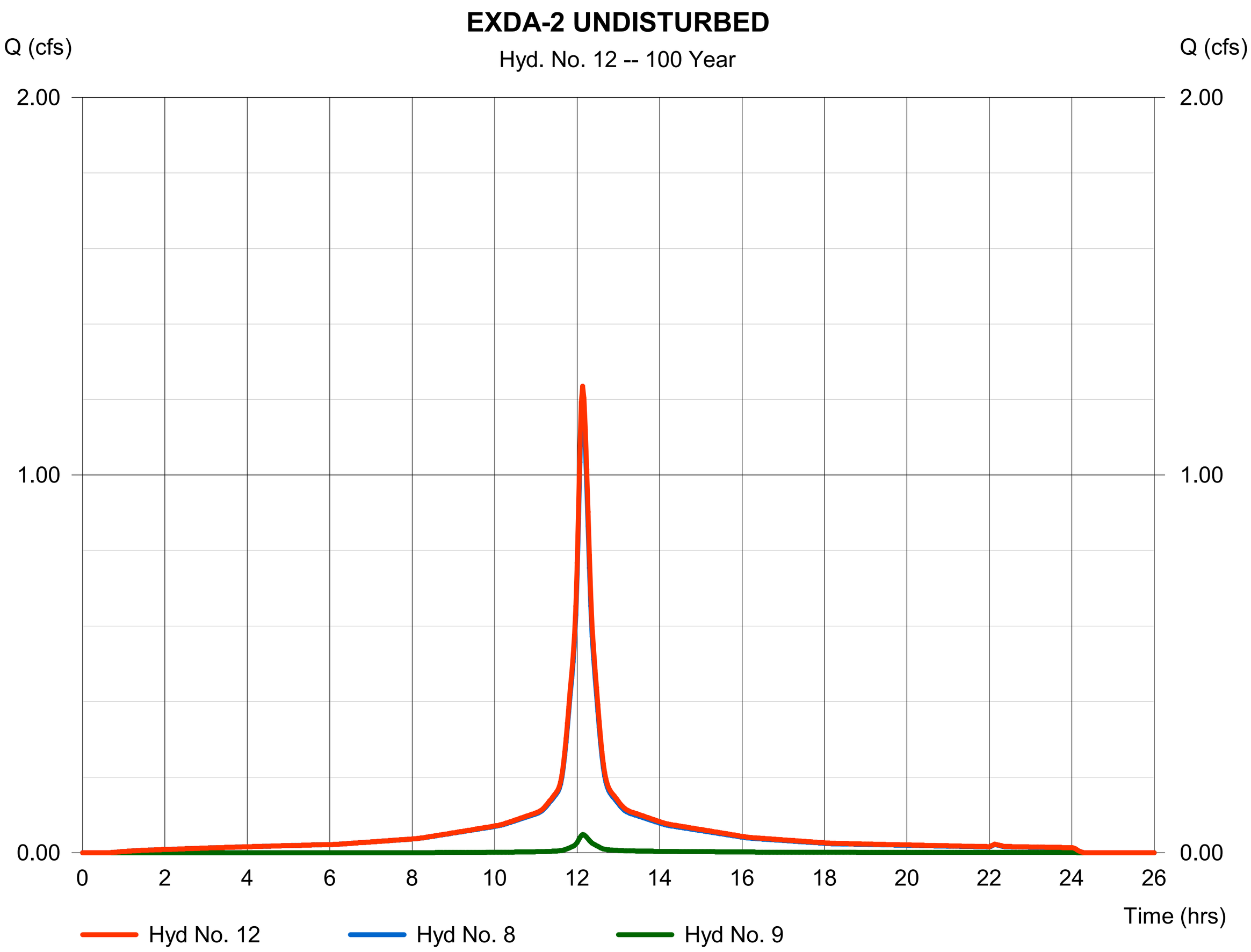
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 12

EXDA-2 UNDISTURBED

Hydrograph type	= Combine	Peak discharge	= 1.235 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 5,413 cuft
Inflow hyds.	= 8, 9	Contrib. drain. area	= 0.190 ac



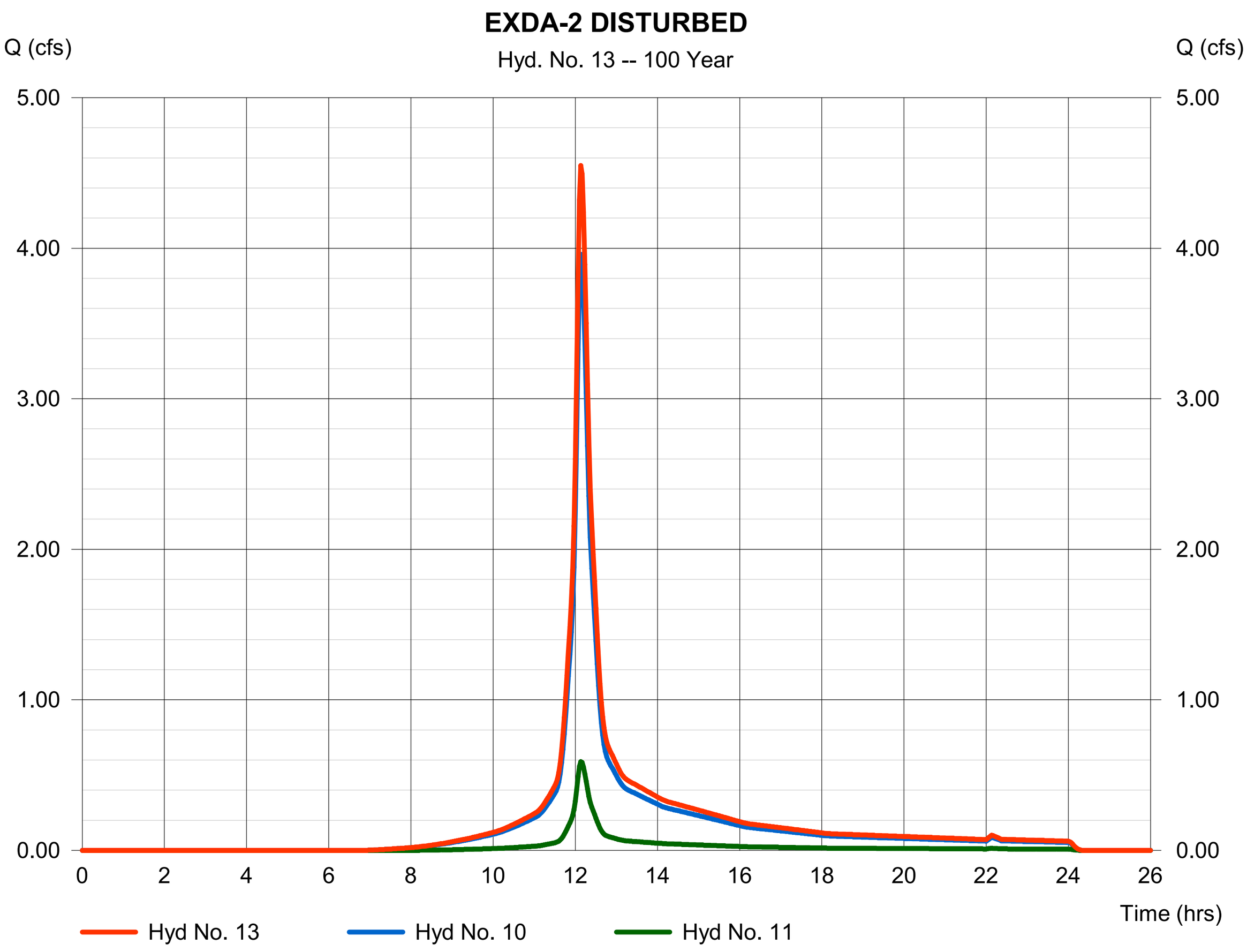
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 13

EXDA-2 DISTURBED

Hydrograph type	= Combine	Peak discharge	= 4.548 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 17,459 cuft
Inflow hyds.	= 10, 11	Contrib. drain. area	= 0.948 ac



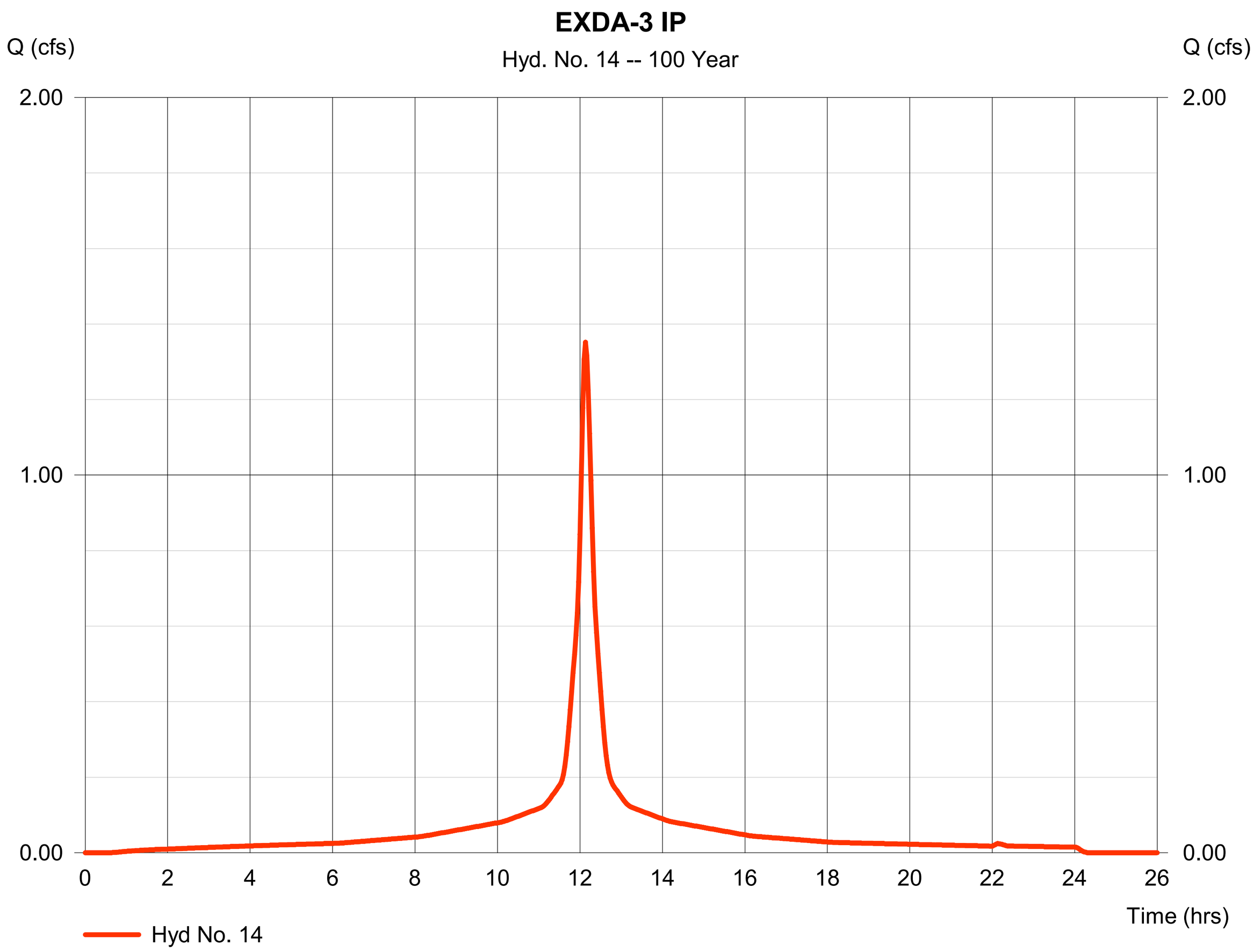
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 14

EXDA-3 IP

Hydrograph type	= SCS Runoff	Peak discharge	= 1.352 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 5,955 cuft
Drainage area	= 0.205 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 8.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



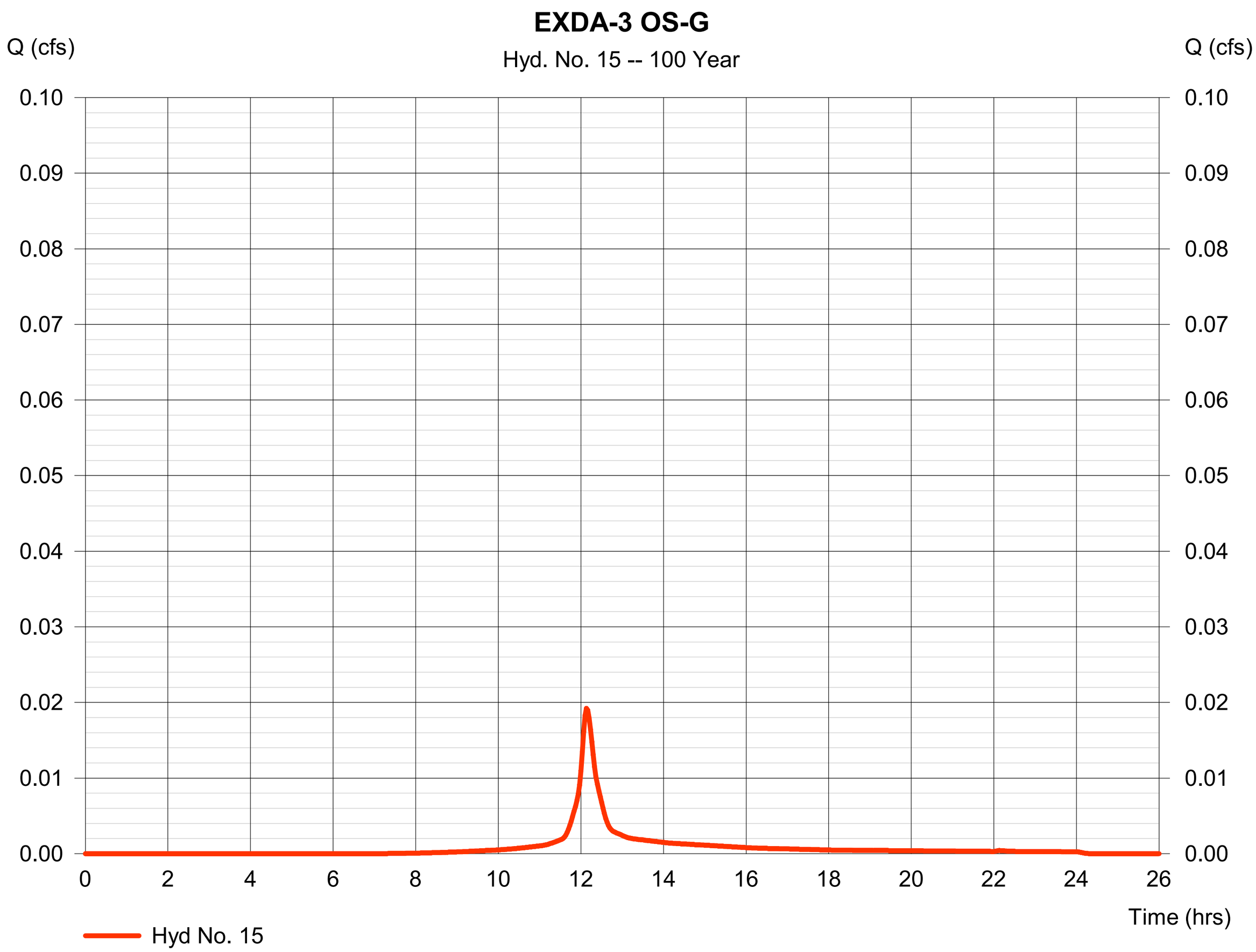
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 15

EXDA-3 OS-G

Hydrograph type	= SCS Runoff	Peak discharge	= 0.019 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 74 cuft
Drainage area	= 0.004 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 8.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



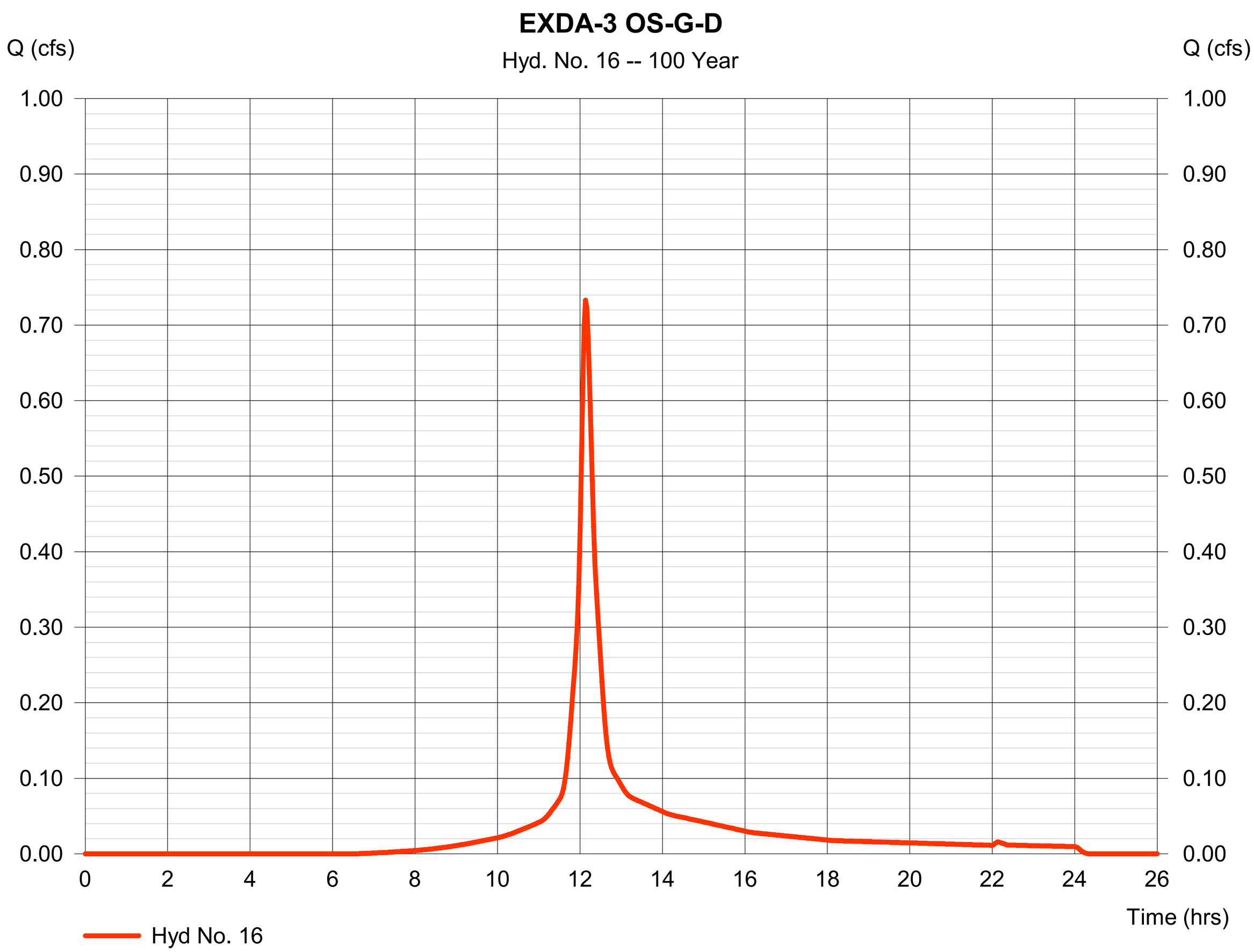
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 16

EXDA-3 OS-G-D

Hydrograph type	= SCS Runoff	Peak discharge	= 0.733 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 2,819 cuft
Drainage area	= 0.146 ac	Curve number	= 76
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 8.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



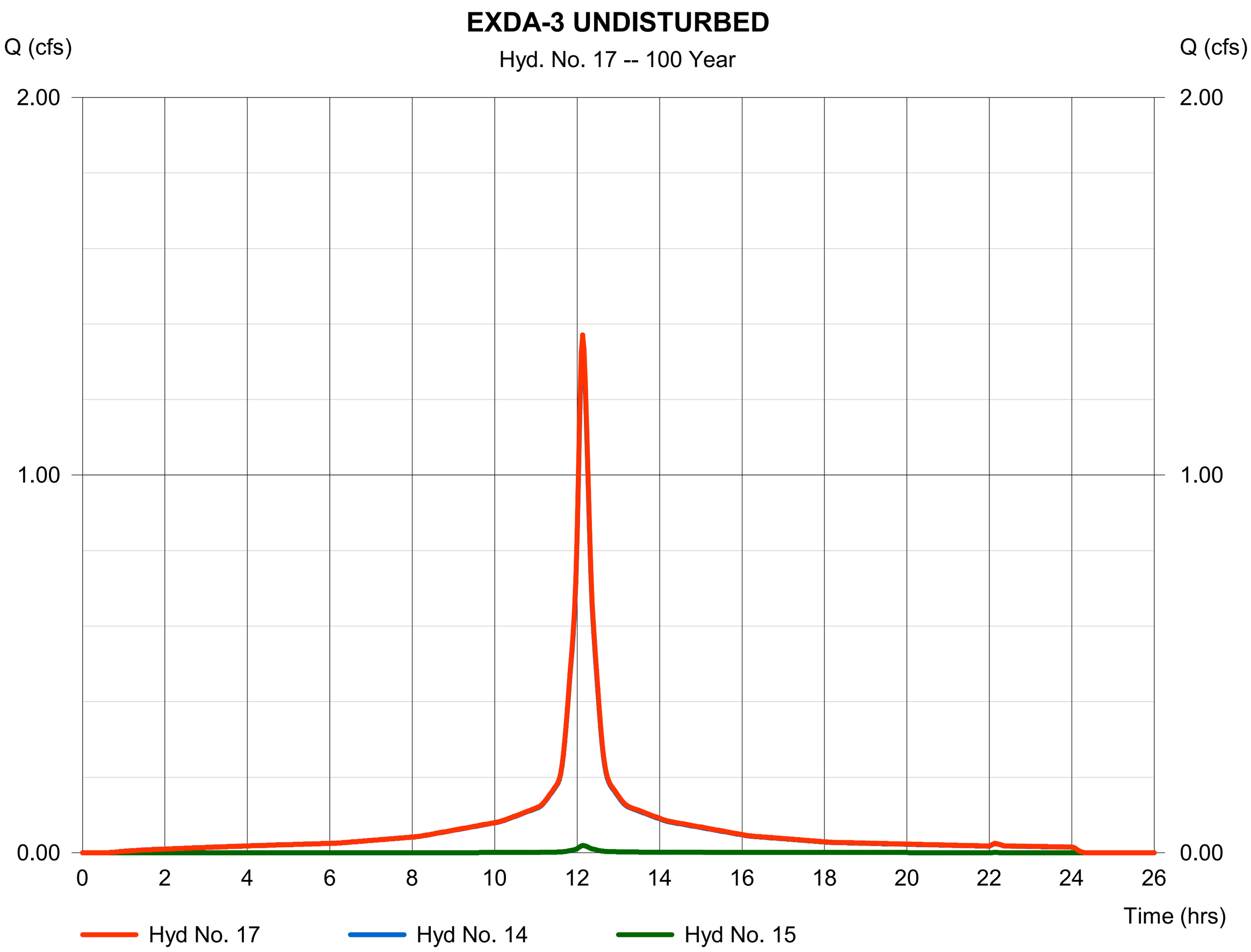
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 17

EXDA-3 UNDISTURBED

Hydrograph type	= Combine	Peak discharge	= 1.371 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 6,029 cuft
Inflow hyds.	= 14, 15	Contrib. drain. area	= 0.209 ac



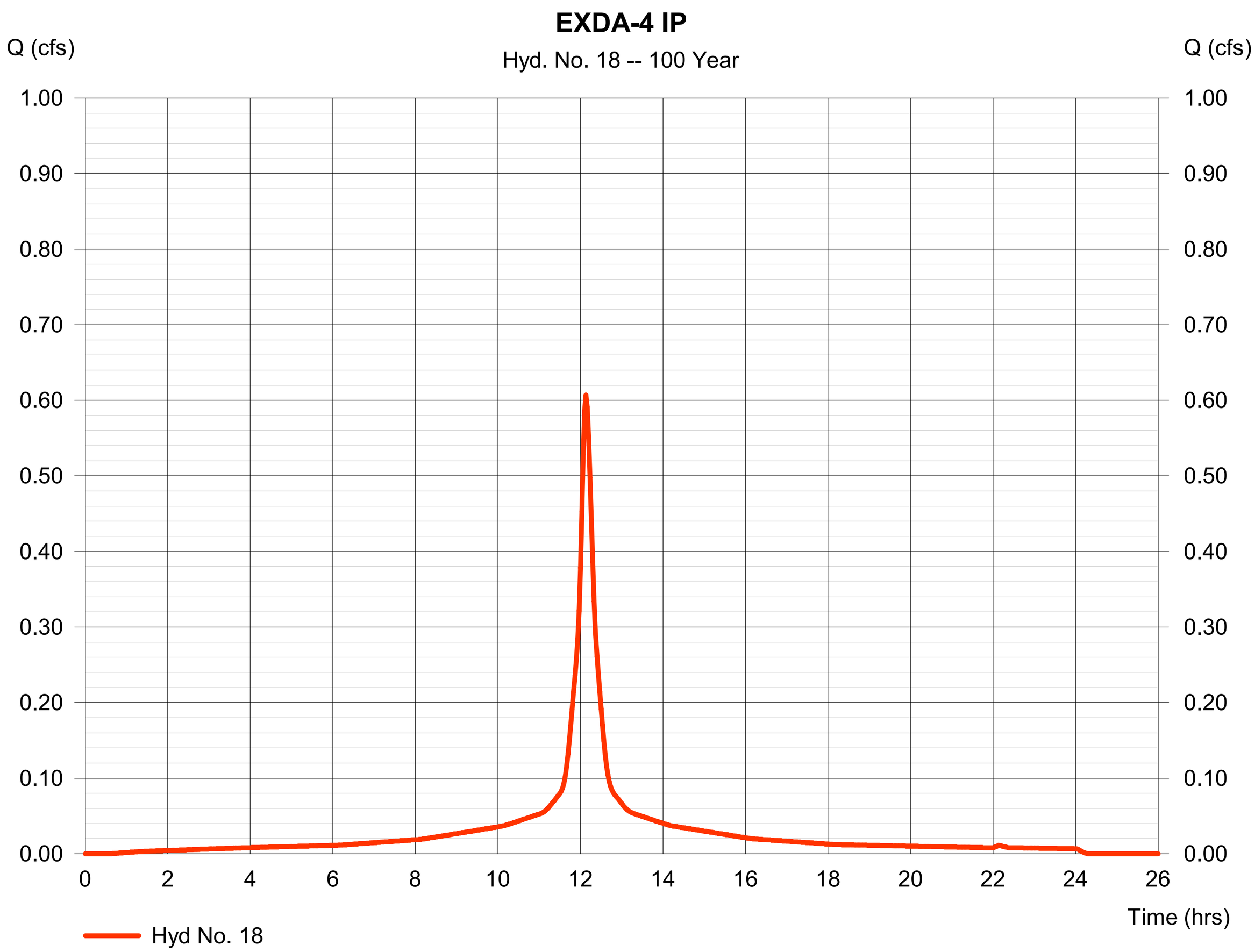
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 18

EXDA-4 IP

Hydrograph type	= SCS Runoff	Peak discharge	= 0.607 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 2,673 cuft
Drainage area	= 0.092 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 8.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



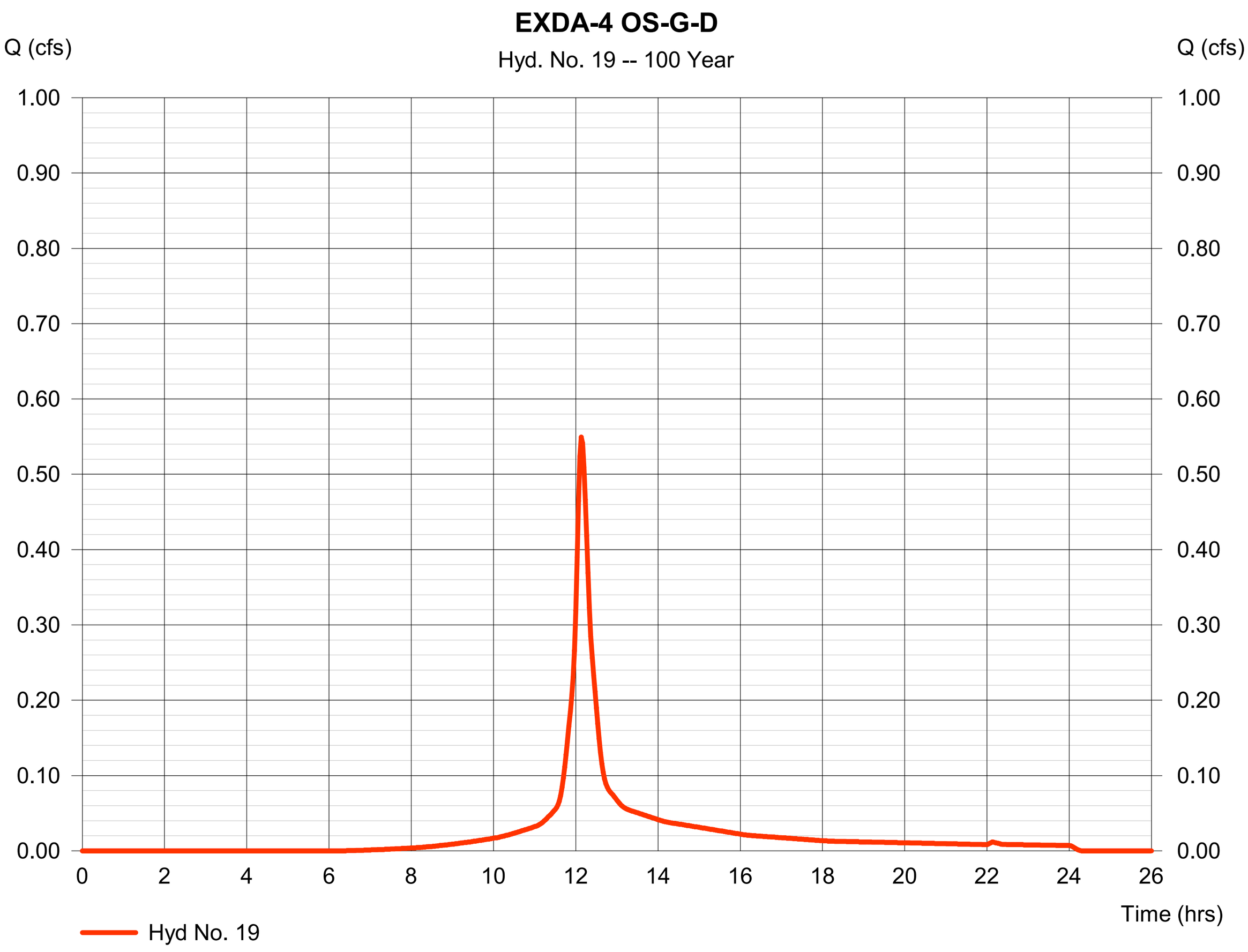
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 19

EXDA-4 OS-G-D

Hydrograph type	= SCS Runoff	Peak discharge	= 0.549 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 2,117 cuft
Drainage area	= 0.107 ac	Curve number	= 77.1
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 8.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



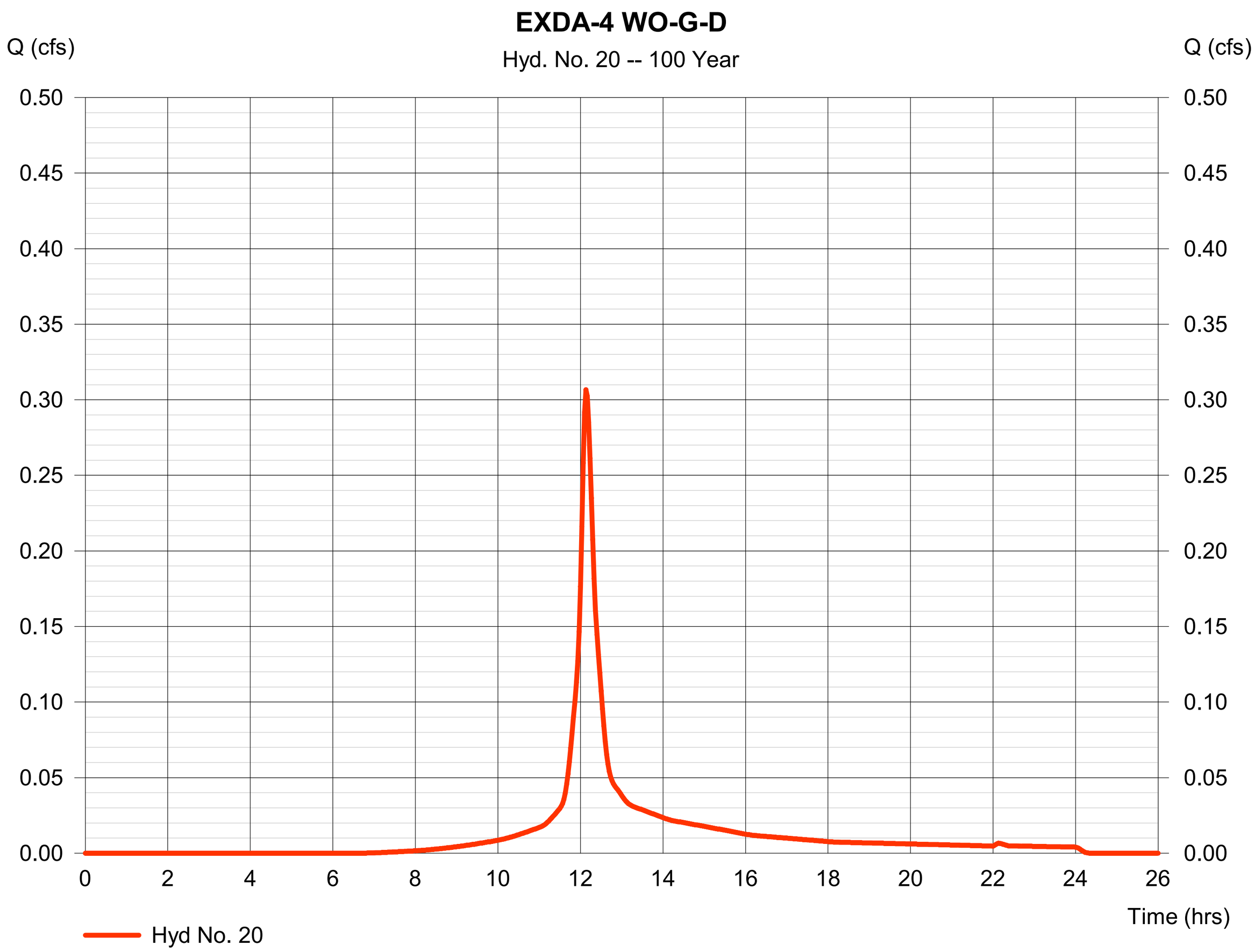
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 20

EXDA-4 WO-G-D

Hydrograph type	= SCS Runoff	Peak discharge	= 0.307 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 1,178 cuft
Drainage area	= 0.062 ac	Curve number	= 75.3
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 8.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



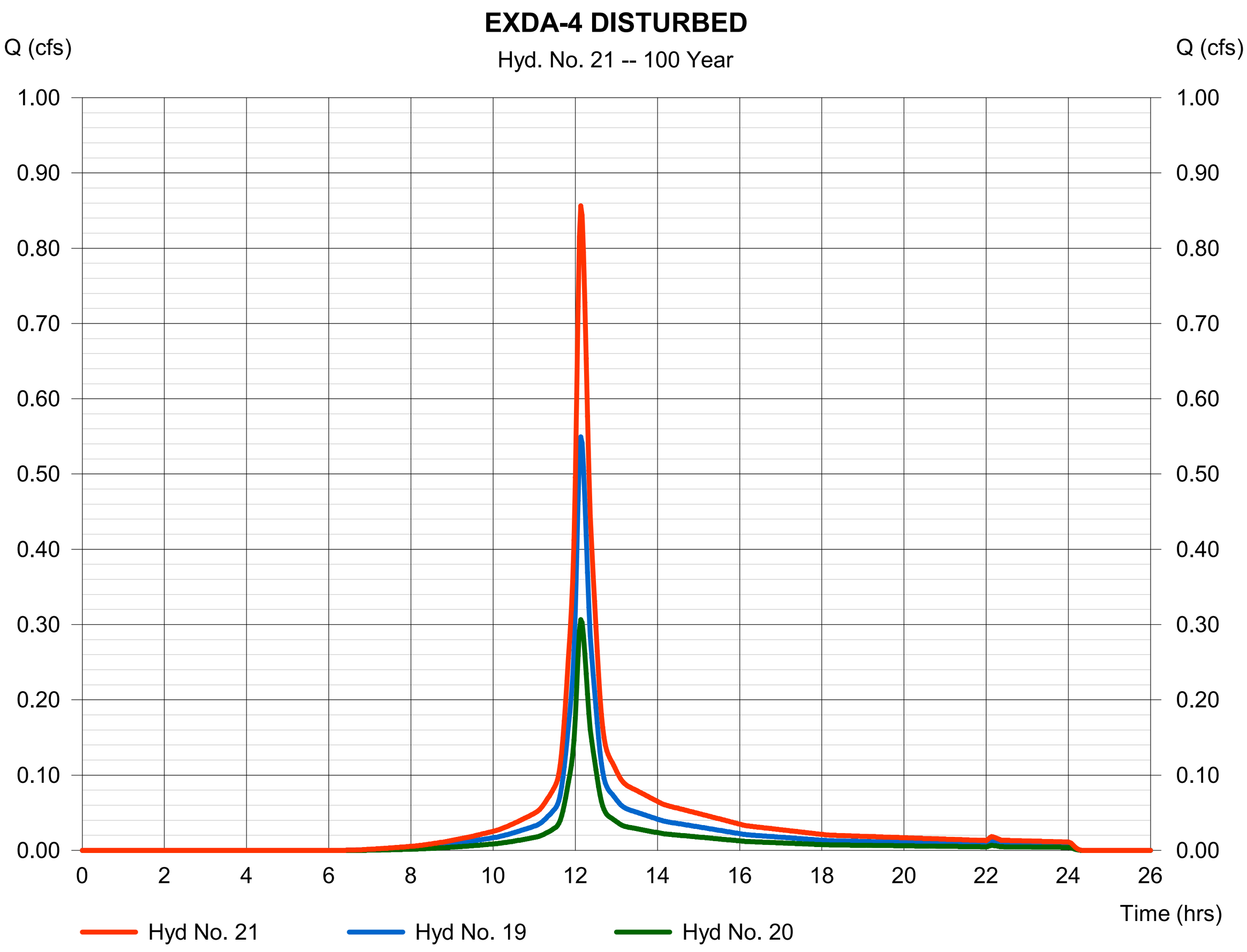
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 21

EXDA-4 DISTURBED

Hydrograph type	= Combine	Peak discharge	= 0.856 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 3,296 cuft
Inflow hyds.	= 19, 20	Contrib. drain. area	= 0.169 ac



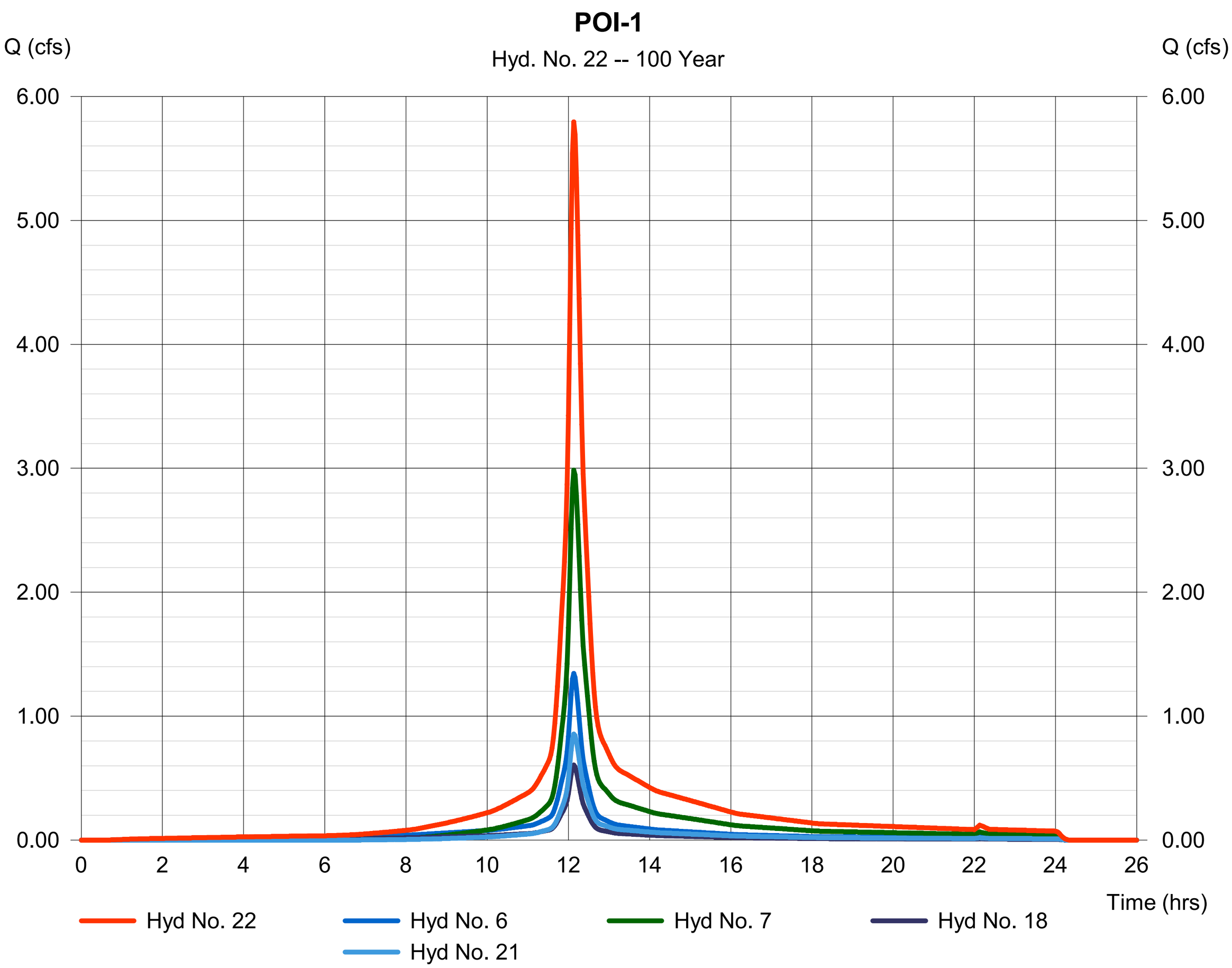
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 22

POI-1

Hydrograph type	= Combine	Peak discharge	= 5.795 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 23,353 cuft
Inflow hyds.	= 6, 7, 18, 21	Contrib. drain. area	= 0.092 ac



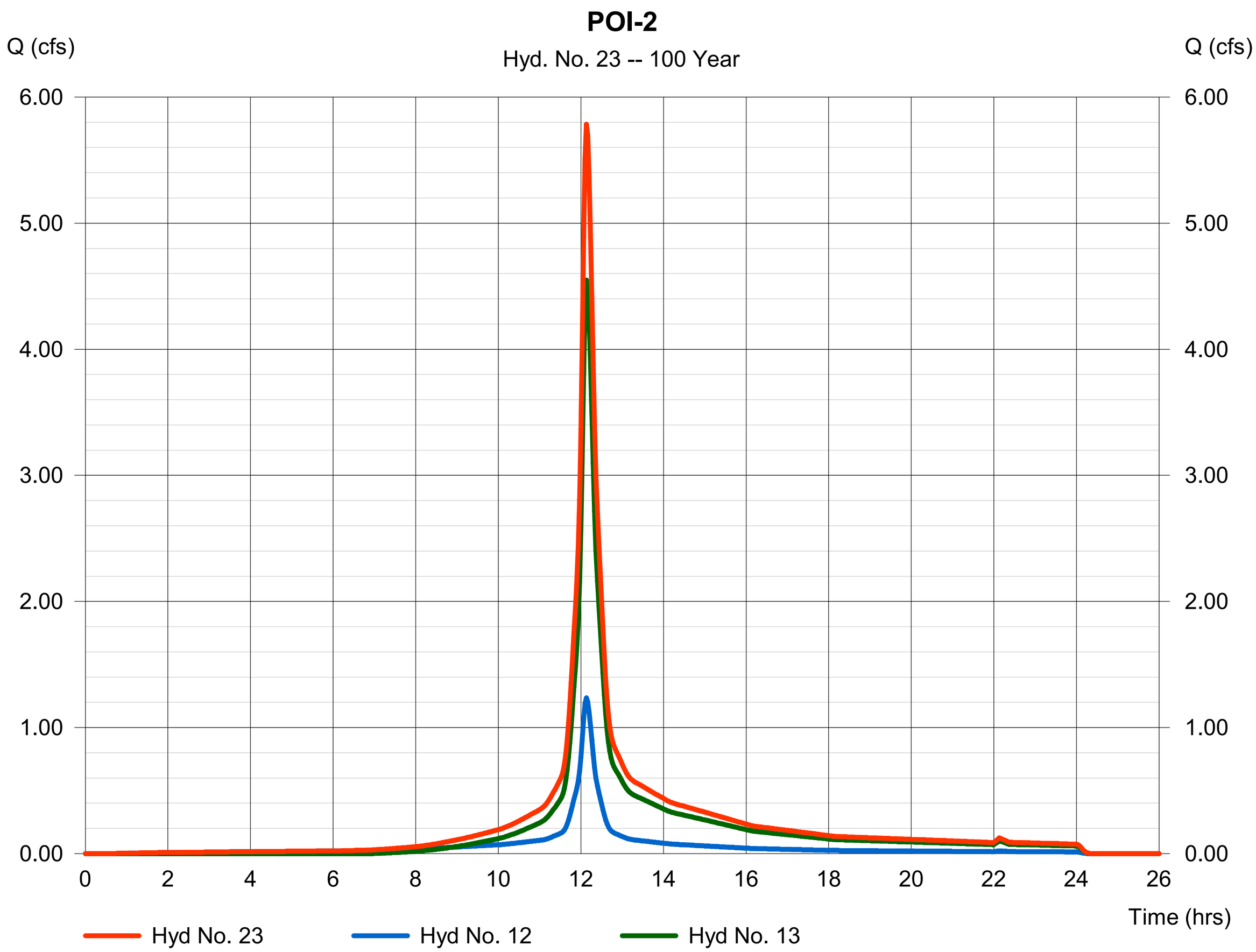
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 23

POI-2

Hydrograph type	= Combine	Peak discharge	= 5.784 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 22,872 cuft
Inflow hyds.	= 12, 13	Contrib. drain. area	= 0.000 ac



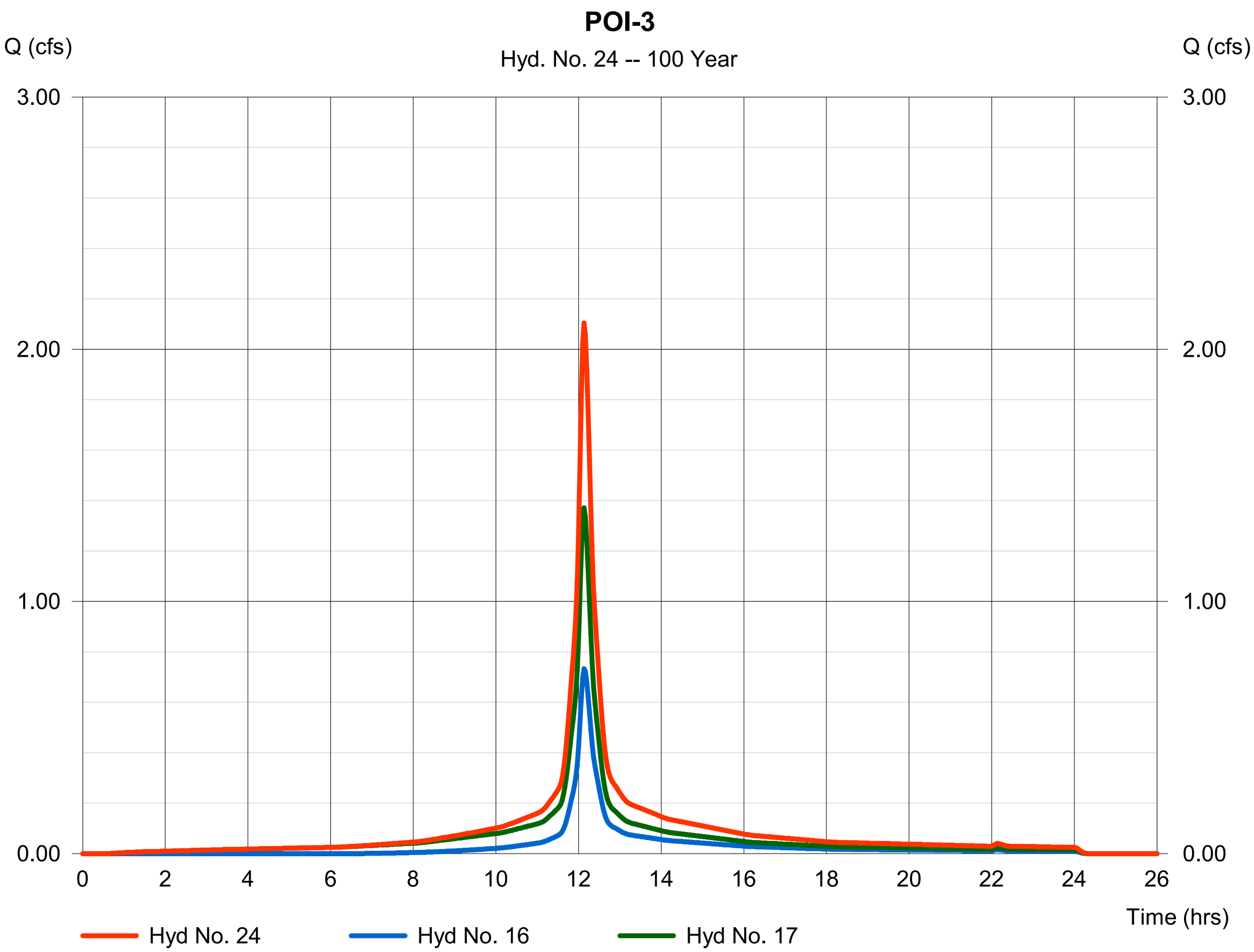
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 06 / 24 / 2019

Hyd. No. 24

POI-3

Hydrograph type	= Combine	Peak discharge	= 2.104 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 8,848 cuft
Inflow hyds.	= 16, 17	Contrib. drain. area	= 0.146 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	36.9738	16.1000	0.7641	--------
2	94.4784	24.8001	0.9391	--------
3	0.0000	0.0000	0.0000	--------
5	176.2795	30.1001	1.0248	--------
10	317.8354	35.8000	1.1154	--------
25	309.7854	36.4000	1.0685	--------
50	1324.7950	53.7998	1.3207	--------
100	68.0213	20.7000	0.7186	--------

File name: Irvington.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	3.60	3.06	2.67	2.39	2.16	1.98	1.83	1.70	1.60	1.50	1.42	1.35
2	3.90	3.37	2.97	2.66	2.41	2.20	2.03	1.88	1.75	1.64	1.55	1.46
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	4.60	4.01	3.56	3.19	2.90	2.65	2.44	2.26	2.11	1.97	1.86	1.75
10	5.08	4.46	3.98	3.58	3.25	2.98	2.75	2.54	2.37	2.22	2.08	1.96
25	5.80	5.13	4.60	4.17	3.81	3.50	3.24	3.01	2.82	2.64	2.49	2.35
50	6.10	5.48	4.96	4.52	4.14	3.82	3.54	3.29	3.07	2.88	2.71	2.55
100	6.60	5.81	5.21	4.74	4.36	4.05	3.79	3.56	3.36	3.19	3.04	2.90

Tc = time in minutes. Values may exceed 60.

Precip. file name: P:\353754 PennEast\Stormwater\Site 2 - Springville\SW Model\Site2.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	2.64	3.40	0.00	3.94	5.00	6.20	6.73	8.00
SCS 6-Hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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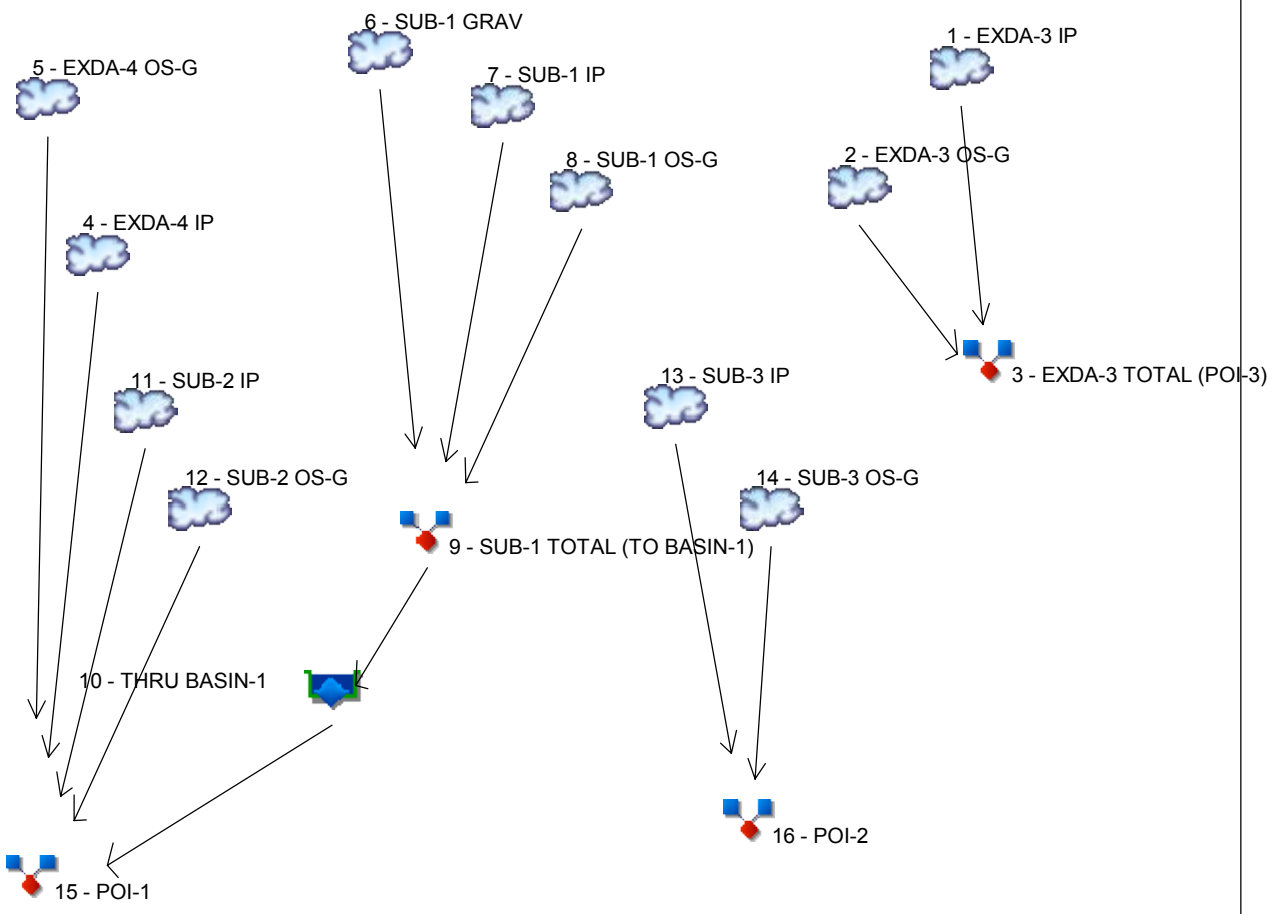
IDF Report..... 78

PROPOSED CONDITIONS

Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020



Legend

Hyd.	Origin	Description
1	SCS Runoff	EXDA-3 IP
2	SCS Runoff	EXDA-3 OS-G
3	Combine	EXDA-3 TOTAL (POI-3)
4	SCS Runoff	EXDA-4 IP
5	SCS Runoff	EXDA-4 OS-G
6	SCS Runoff	SUB-1 GRAV
7	SCS Runoff	SUB-1 IP
8	SCS Runoff	SUB-1 OS-G
9	Combine	SUB-1 TOTAL (TO BASIN-1)
10	Reservoir	THRU BASIN-1
11	SCS Runoff	SUB-2 IP
12	SCS Runoff	SUB-2 OS-G
13	SCS Runoff	SUB-3 IP
14	SCS Runoff	SUB-3 OS-G
15	Combine	POI-1
16	Combine	POI-2

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)								Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	------	-------	0.569	-------	-------	0.842	-------	-------	1.352	EXDA-3 IP
2	SCS Runoff	------	-------	0.183	-------	-------	0.369	-------	-------	0.751	EXDA-3 OS-G
3	Combine	1, 2	-------	0.750	-------	-------	1.211	-------	-------	2.103	EXDA-3 TOTAL (POI-3)
4	SCS Runoff	------	-------	0.255	-------	-------	0.378	-------	-------	0.607	EXDA-4 IP
5	SCS Runoff	------	-------	0.226	-------	-------	0.441	-------	-------	0.877	EXDA-4 OS-G
6	SCS Runoff	------	-------	1.617	-------	-------	2.641	-------	-------	4.541	SUB-1 GRAV
7	SCS Runoff	------	-------	0.014	-------	-------	0.021	-------	-------	0.033	SUB-1 IP
8	SCS Runoff	------	-------	0.300	-------	-------	0.608	-------	-------	1.242	SUB-1 OS-G
9	Combine	6, 7, 8	-------	1.929	-------	-------	3.269	-------	-------	5.816	SUB-1 TOTAL (TO BASIN-1)
10	Reservoir	9	-------	0.250	-------	-------	0.711	-------	-------	1.752	THRU BASIN-1
11	SCS Runoff	------	-------	0.544	-------	-------	0.805	-------	-------	1.293	SUB-2 IP
12	SCS Runoff	------	-------	0.205	-------	-------	0.422	-------	-------	0.873	SUB-2 OS-G
13	SCS Runoff	------	-------	0.499	-------	-------	0.739	-------	-------	1.187	SUB-3 IP
14	SCS Runoff	------	-------	0.475	-------	-------	0.976	-------	-------	2.020	SUB-3 OS-G
15	Combine	4, 5, 10, 11, 12,	-------	1.256	-------	-------	2.421	-------	-------	4.792	POI-1
16	Combine	13, 14,	-------	0.970	-------	-------	1.715	-------	-------	3.207	POI-2

2-YEAR 24-HOUR

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.569	2	728	2,430	------	------	------	EXDA-3 IP
2	SCS Runoff	0.183	2	730	723	------	------	------	EXDA-3 OS-G
3	Combine	0.750	2	728	3,153	1, 2	------	------	EXDA-3 TOTAL (POI-3)
4	SCS Runoff	0.255	2	728	1,091	------	------	------	EXDA-4 IP
5	SCS Runoff	0.226	2	730	883	------	------	------	EXDA-4 OS-G
6	SCS Runoff	1.617	2	728	6,239	------	------	------	SUB-1 GRAV
7	SCS Runoff	0.014	2	728	59	------	------	------	SUB-1 IP
8	SCS Runoff	0.300	2	730	1,188	------	------	------	SUB-1 OS-G
9	Combine	1.929	2	728	7,486	6, 7, 8	------	------	SUB-1 TOTAL (TO BASIN-1)
10	Reservoir	0.250	2	778	7,372	9	234.24	4,120	THRU BASIN-1
11	SCS Runoff	0.544	2	728	2,324	------	------	------	SUB-2 IP
12	SCS Runoff	0.205	2	730	817	------	------	------	SUB-2 OS-G
13	SCS Runoff	0.499	2	728	2,134	------	------	------	SUB-3 IP
14	SCS Runoff	0.475	2	730	1,890	------	------	------	SUB-3 OS-G
15	Combine	1.256	2	728	12,485	4, 5, 10, 11, 12,	------	------	POI-1
16	Combine	0.970	2	728	4,024	13, 14,	------	------	POI-2

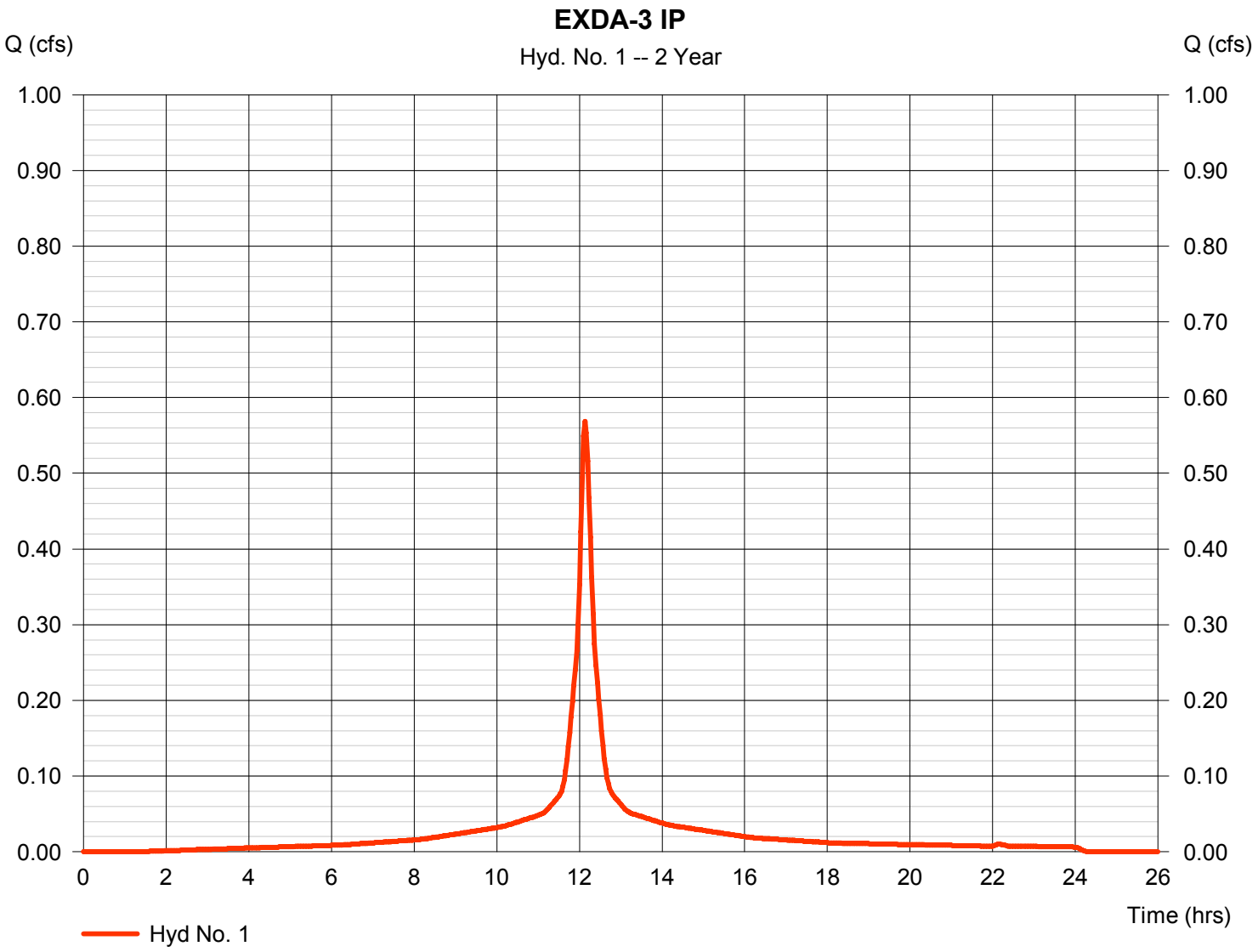
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 1

EXDA-3 IP

Hydrograph type	= SCS Runoff	Peak discharge	= 0.569 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 2,430 cuft
Drainage area	= 0.205 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 3.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



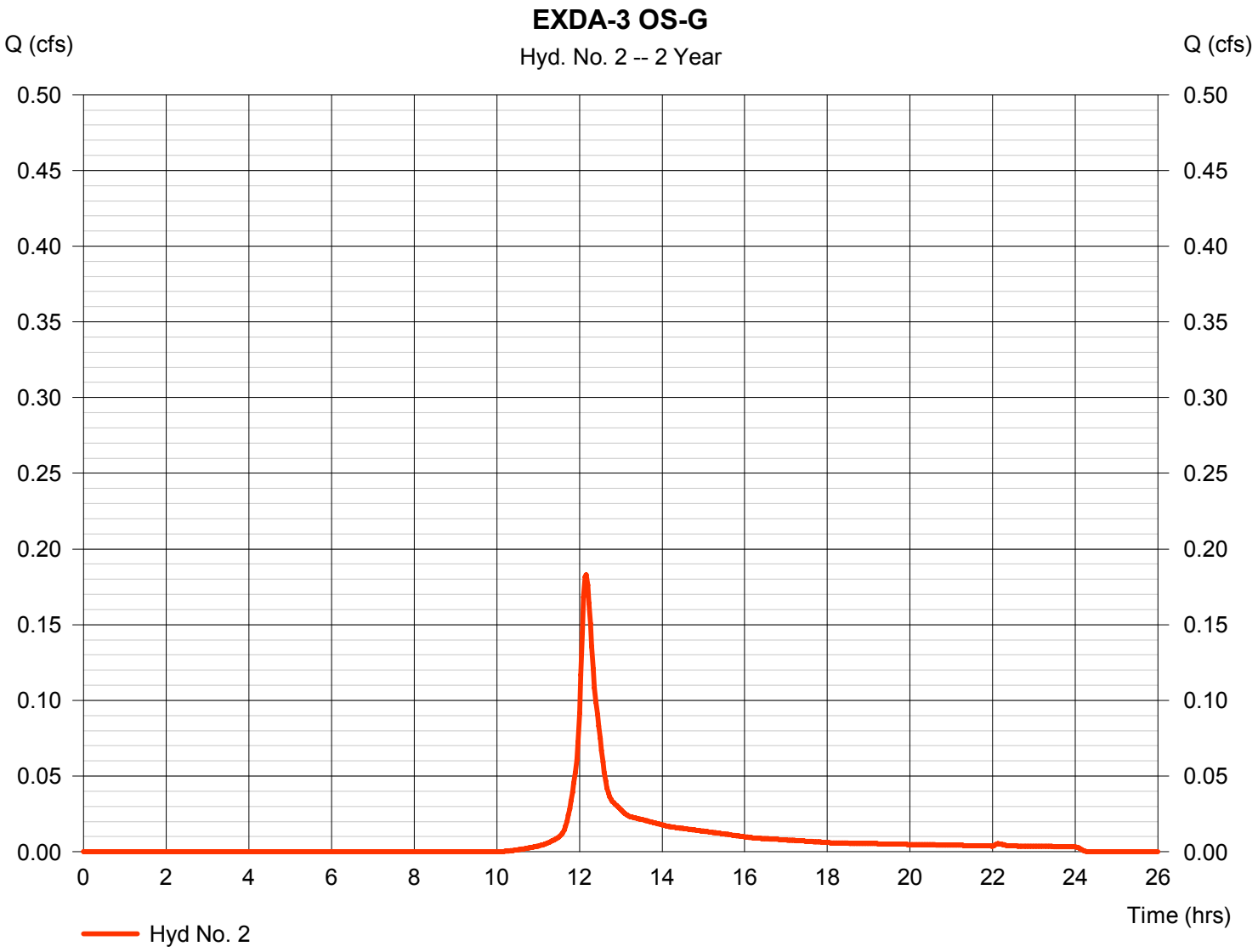
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 2

EXDA-3 OS-G

Hydrograph type	= SCS Runoff	Peak discharge	= 0.183 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 723 cuft
Drainage area	= 0.150 ac	Curve number	= 75.9
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 3.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



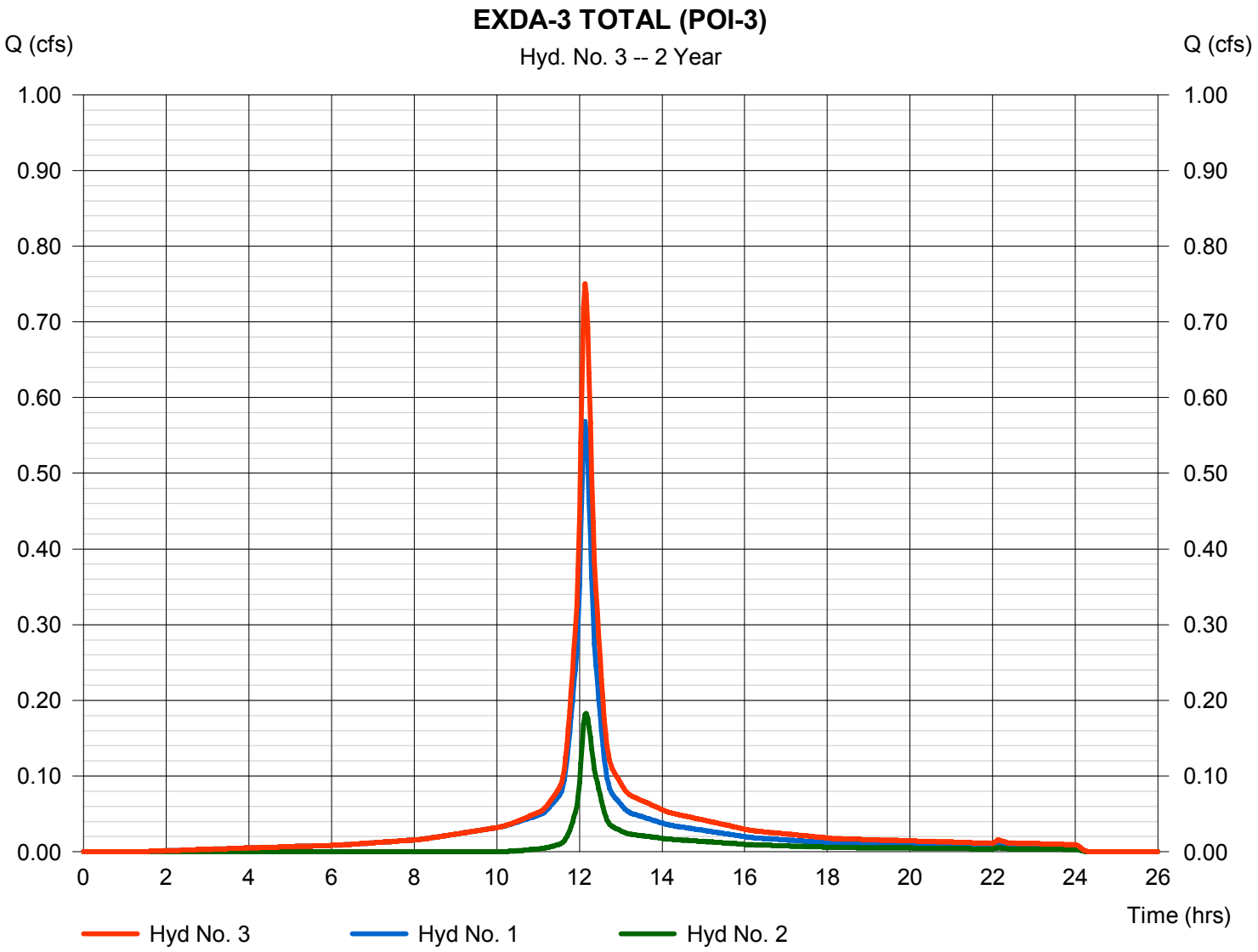
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 3

EXDA-3 TOTAL (POI-3)

Hydrograph type	= Combine	Peak discharge	= 0.750 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 3,153 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 0.355 ac



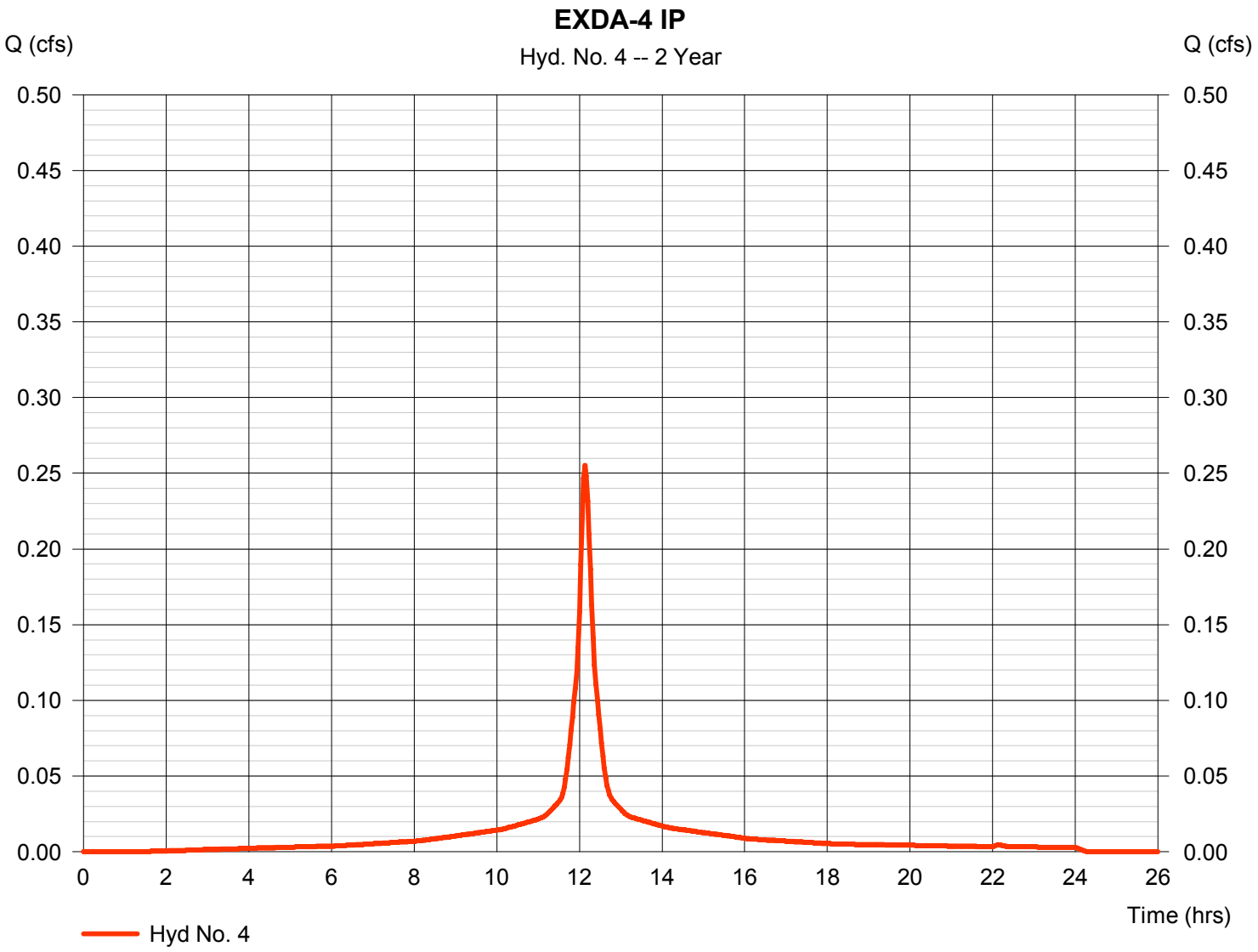
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 4

EXDA-4 IP

Hydrograph type	= SCS Runoff	Peak discharge	= 0.255 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 1,091 cuft
Drainage area	= 0.092 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 3.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



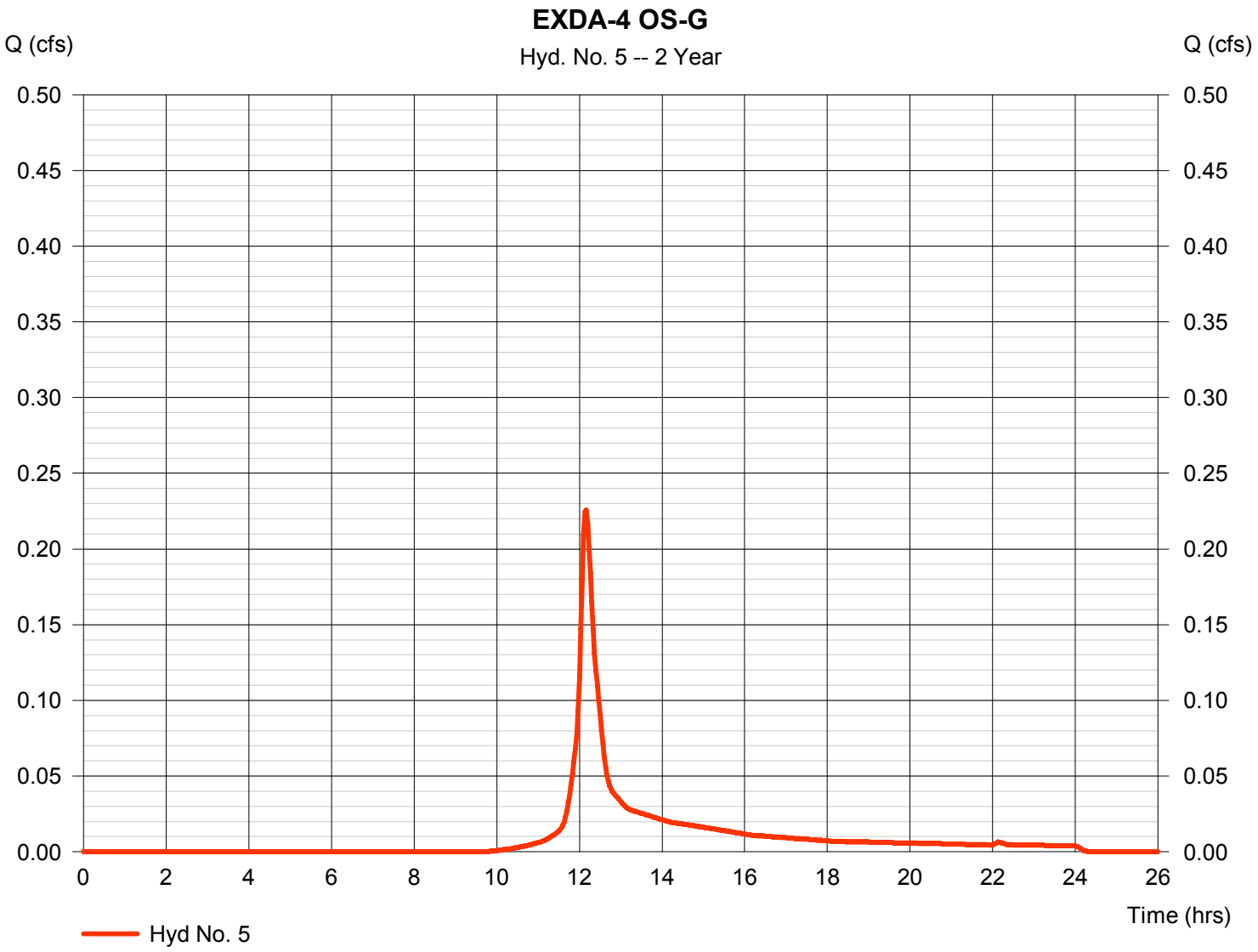
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 5

EXDA-4 OS-G

Hydrograph type	= SCS Runoff	Peak discharge	= 0.226 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 883 cuft
Drainage area	= 0.169 ac	Curve number	= 77.6
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 3.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



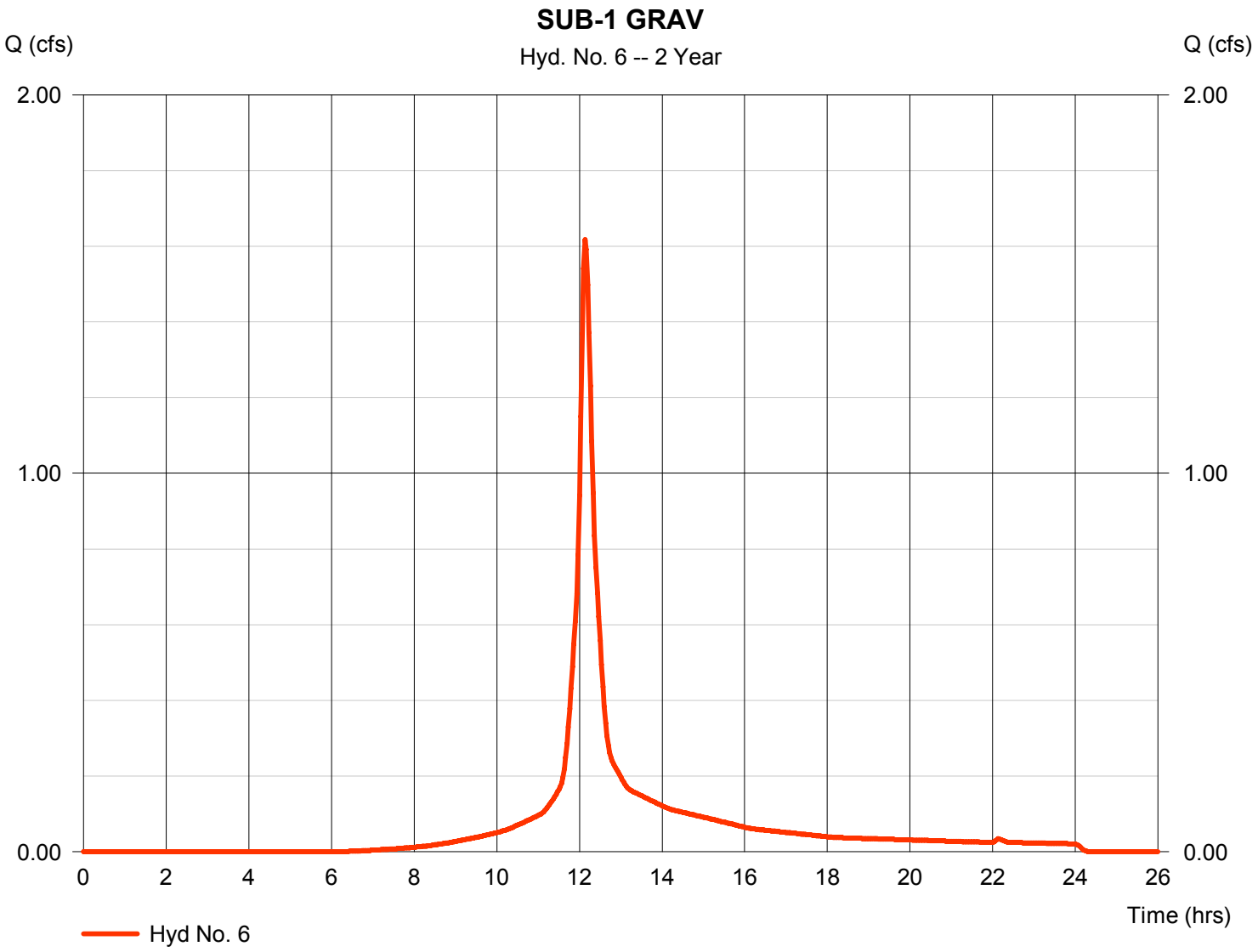
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 6

SUB-1 GRAV

Hydrograph type	= SCS Runoff	Peak discharge	= 1.617 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 6,239 cuft
Drainage area	= 0.733 ac	Curve number	= 89.1
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.46 min
Total precip.	= 3.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



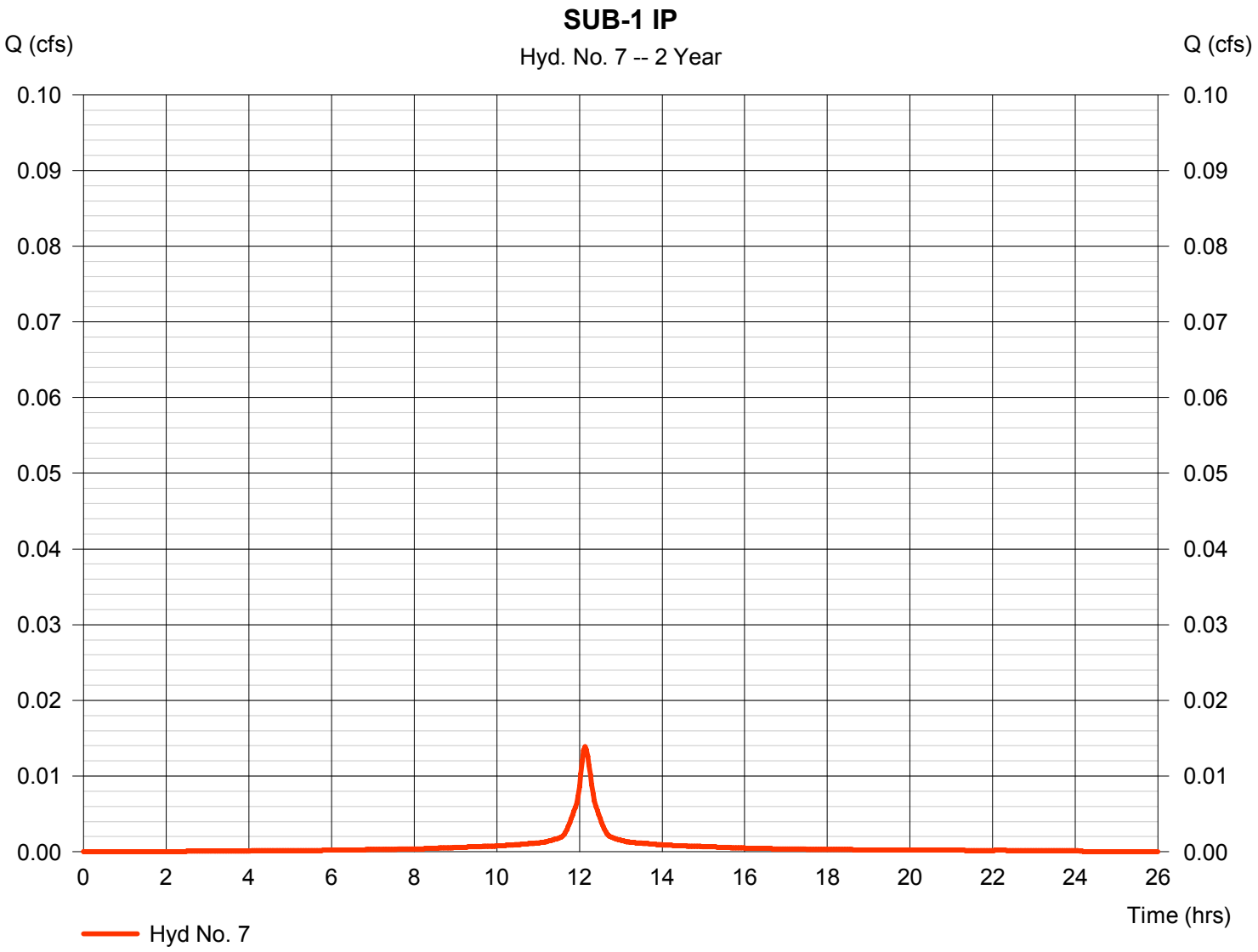
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 7

SUB-1 IP

Hydrograph type	= SCS Runoff	Peak discharge	= 0.014 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 59 cuft
Drainage area	= 0.005 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.46 min
Total precip.	= 3.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



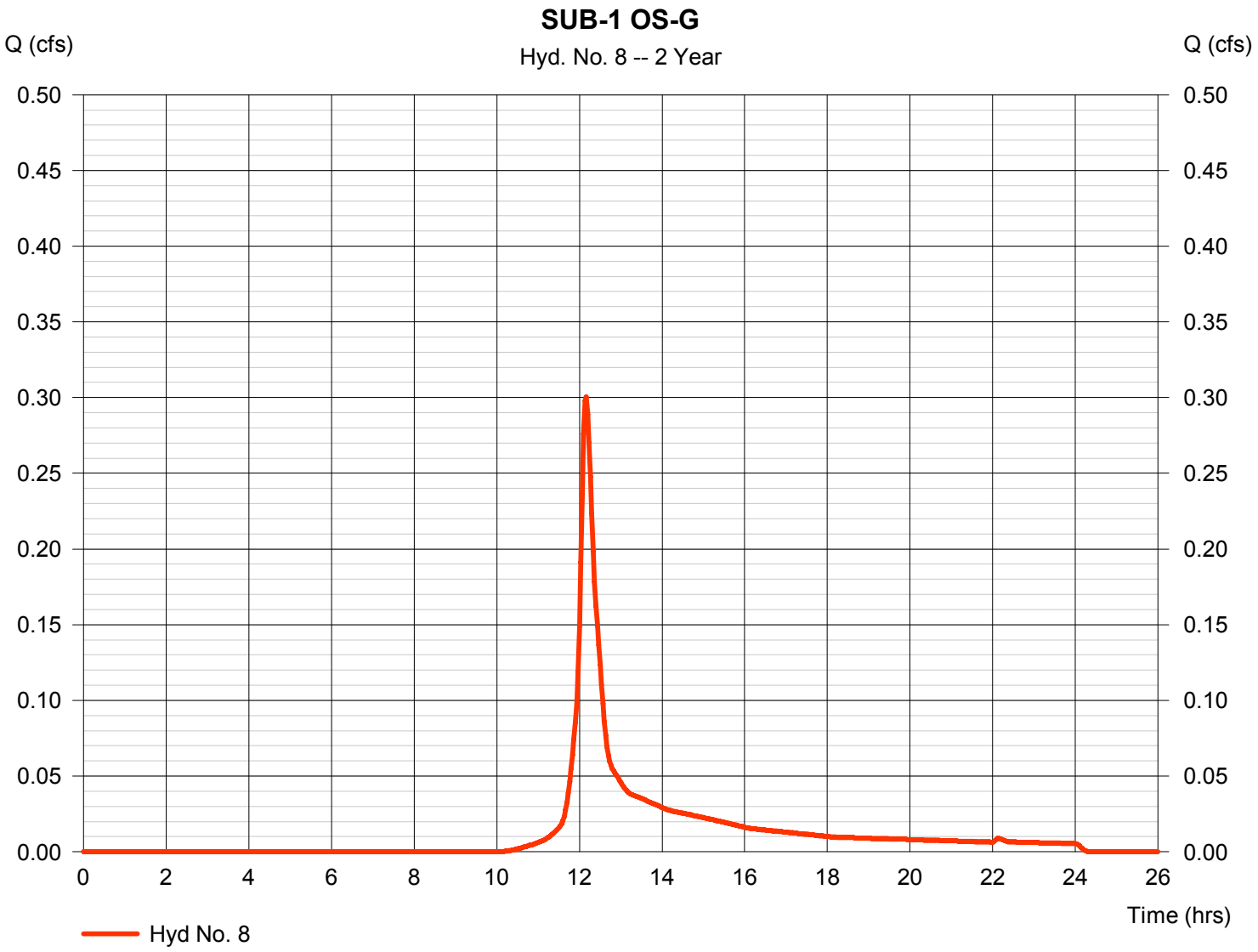
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 8

SUB-1 OS-G

Hydrograph type	= SCS Runoff	Peak discharge	= 0.300 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 1,188 cuft
Drainage area	= 0.249 ac	Curve number	= 75.7
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.46 min
Total precip.	= 3.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



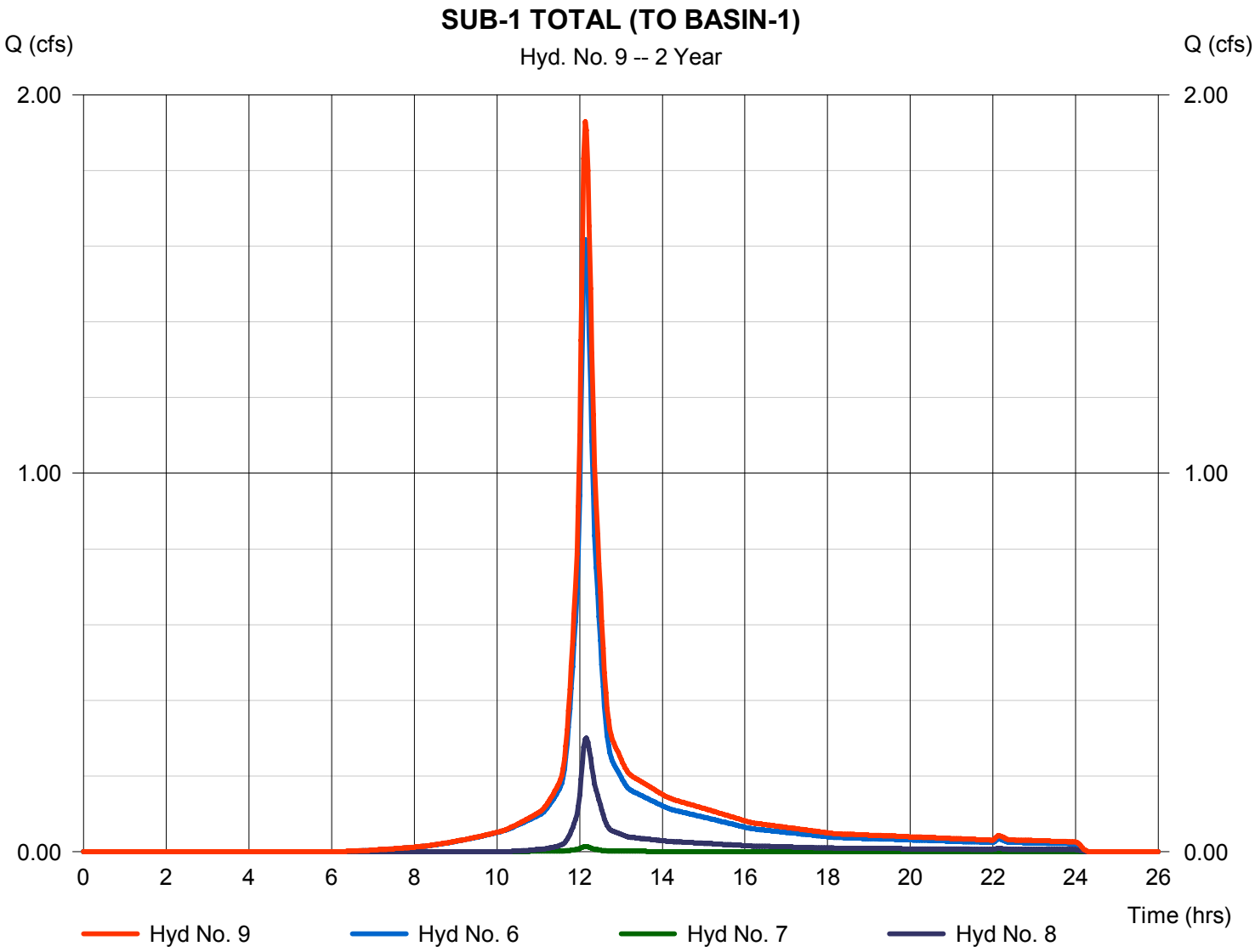
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 9

SUB-1 TOTAL (TO BASIN-1)

Hydrograph type	= Combine	Peak discharge	= 1.929 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 7,486 cuft
Inflow hyds.	= 6, 7, 8	Contrib. drain. area	= 0.987 ac



Hydrograph Report

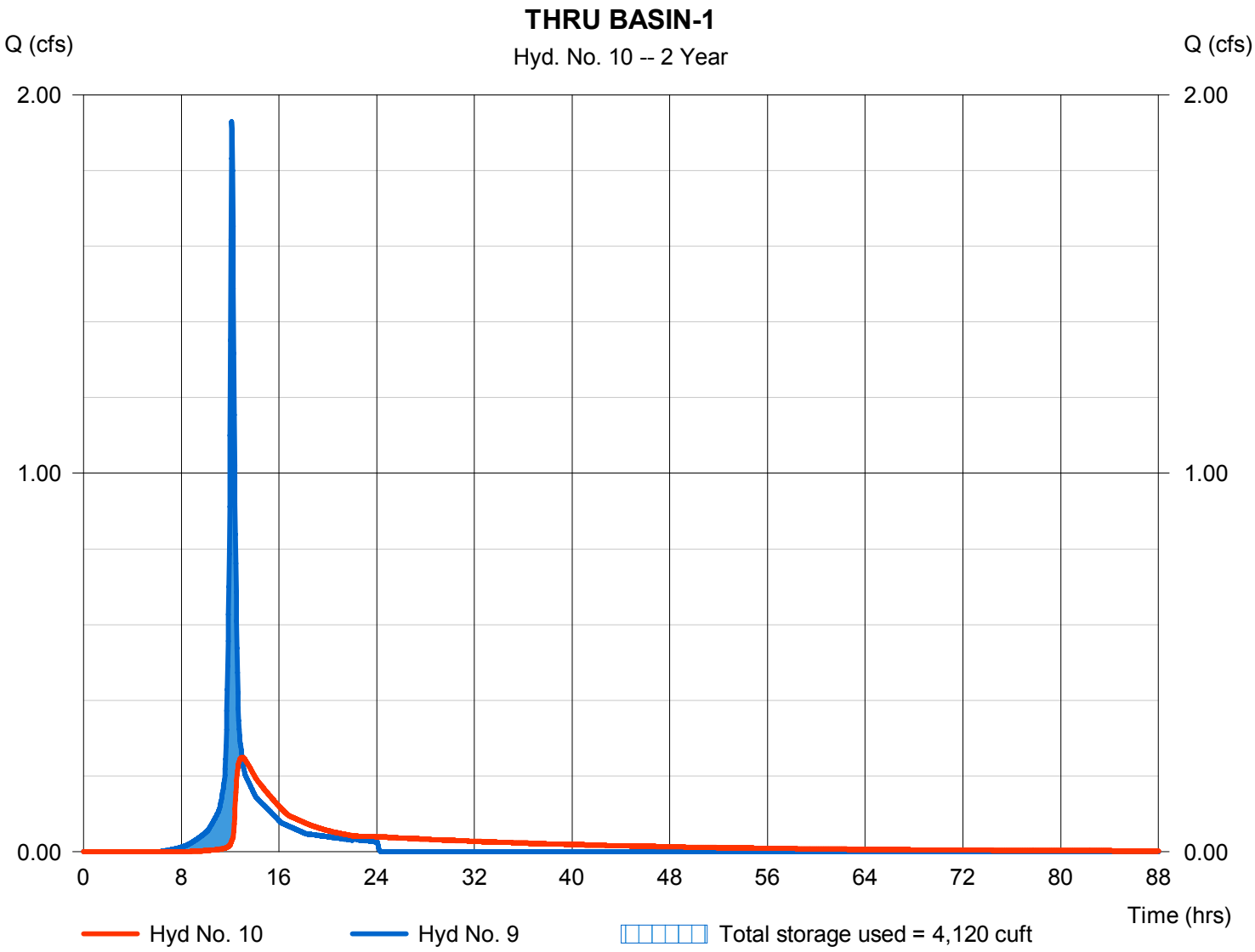
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 10

THRU BASIN-1

Hydrograph type	= Reservoir	Peak discharge	= 0.250 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.97 hrs
Time interval	= 2 min	Hyd. volume	= 7,372 cuft
Inflow hyd. No.	= 9 - SUB-1 TOTAL (TO BASIN-1)	Max. Elevation	= 234.24 ft
Reservoir name	= BASIN-1	Max. Storage	= 4,120 cuft

Storage Indication method used. Outflow includes exfiltration.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Pond No. 1 - BASIN-1

Pond Data

Contours -User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 233.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	233.00	2,855	0	0
1.00	234.00	3,507	3,181	3,181
2.00	235.00	4,219	3,863	7,044
3.00	236.00	4,995	4,607	11,651
4.00	237.00	5,883	5,439	17,090

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 15.00	4.00	5.00	Inactive
Span (in)	= 15.00	6.00	5.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 231.50	234.00	234.85	0.00
Length (ft)	= 21.00	0.00	0.00	0.00
Slope (%)	= 2.25	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	Yes	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 16.00	15.00	Inactive	Inactive
Crest El. (ft)	= 235.85	236.35	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	Rect	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.500 (by Contour)

TW Elev. (ft) = 0.00

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

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	233.00	0.00	0.00	0.00	---	0.00	0.00	---	---	0.000	---	0.000
0.10	318	233.10	5.53 ic	0.00	0.00	---	0.00	0.00	---	---	0.004	---	0.004
0.20	636	233.20	5.53 ic	0.00	0.00	---	0.00	0.00	---	---	0.008	---	0.008
0.30	954	233.30	5.53 ic	0.00	0.00	---	0.00	0.00	---	---	0.012	---	0.012
0.40	1,272	233.40	5.53 ic	0.00	0.00	---	0.00	0.00	---	---	0.016	---	0.016
0.50	1,591	233.50	5.53 ic	0.00	0.00	---	0.00	0.00	---	---	0.020	---	0.020
0.60	1,909	233.60	5.53 ic	0.00	0.00	---	0.00	0.00	---	---	0.024	---	0.024
0.70	2,227	233.70	5.53 ic	0.00	0.00	---	0.00	0.00	---	---	0.028	---	0.028
0.80	2,545	233.80	5.53 ic	0.00	0.00	---	0.00	0.00	---	---	0.032	---	0.032
0.90	2,863	233.90	5.53 ic	0.00	0.00	---	0.00	0.00	---	---	0.037	---	0.037
1.00	3,181	234.00	5.53 ic	0.00	0.00	---	0.00	0.00	---	---	0.041	---	0.041
1.10	3,567	234.10	5.53 ic	0.05 ic	0.00	---	0.00	0.00	---	---	0.041	---	0.095
1.20	3,954	234.20	5.53 ic	0.15 ic	0.00	---	0.00	0.00	---	---	0.042	---	0.194
1.30	4,340	234.30	5.53 ic	0.28 ic	0.00	---	0.00	0.00	---	---	0.043	---	0.323
1.40	4,726	234.40	5.53 ic	0.39 ic	0.00	---	0.00	0.00	---	---	0.044	---	0.432
1.50	5,112	234.50	5.53 ic	0.46 ic	0.00	---	0.00	0.00	---	---	0.045	---	0.508
1.60	5,499	234.60	5.53 ic	0.53 ic	0.00	---	0.00	0.00	---	---	0.046	---	0.574
1.70	5,885	234.70	5.53 ic	0.59 ic	0.00	---	0.00	0.00	---	---	0.046	---	0.632
1.80	6,271	234.80	5.53 ic	0.64 ic	0.00	---	0.00	0.00	---	---	0.047	---	0.686
1.90	6,658	234.90	5.53 ic	0.69 ic	0.01 ic	---	0.00	0.00	---	---	0.048	---	0.743
2.00	7,044	235.00	5.53 ic	0.73 ic	0.06 ic	---	0.00	0.00	---	---	0.049	---	0.840
2.10	7,505	235.10	5.53 ic	0.78 ic	0.15 ic	---	0.00	0.00	---	---	0.050	---	0.971
2.20	7,965	235.20	5.53 ic	0.82 ic	0.25 ic	---	0.00	0.00	---	---	0.051	---	1.113
2.30	8,426	235.30	5.53 ic	0.85 ic	0.32 ic	---	0.00	0.00	---	---	0.052	---	1.229
2.40	8,887	235.40	5.53 ic	0.89 ic	0.38 ic	---	0.00	0.00	---	---	0.052	---	1.327
2.50	9,347	235.50	5.53 ic	0.93 ic	0.44 ic	---	0.00	0.00	---	---	0.053	---	1.416
2.60	9,808	235.60	5.53 ic	0.96 ic	0.48 ic	---	0.00	0.00	---	---	0.054	---	1.498
2.70	10,269	235.70	5.53 ic	0.99 ic	0.53 ic	---	0.00	0.00	---	---	0.055	---	1.575
2.80	10,730	235.80	5.53 ic	1.03 ic	0.57 ic	---	0.00	0.00	---	---	0.056	---	1.647
2.90	11,190	235.90	5.53 ic	1.06 ic	0.60 ic	---	0.60	0.00	---	---	0.057	---	2.313
3.00	11,651	236.00	5.53 ic	1.09 ic	0.64 ic	---	3.10	0.00	---	---	0.058	---	4.877
3.10	12,195	236.10	8.45 ic	1.12 ic	0.67 ic	---	6.66	0.00	---	---	0.059	---	8.504
3.20	12,739	236.20	11.50 ic	0.43 ic	0.35 ic	---	10.71 s	0.00	---	---	0.060	---	11.56
3.30	13,283	236.30	11.88 ic	0.29 ic	0.24 ic	---	11.35 s	0.00	---	---	0.061	---	11.94
3.40	13,827	236.40	12.11 ic	0.22 ic	0.18 ic	---	11.70 s	0.56	---	---	0.062	---	12.72
3.50	14,370	236.50	12.29 ic	0.18 ic	0.15 ic	---	11.96 s	2.90	---	---	0.063	---	15.25
3.60	14,914	236.60	12.45 ic	0.15 ic	0.12 ic	---	12.18 s	6.24	---	---	0.064	---	18.76
3.70	15,458	236.70	12.60 ic	0.12 ic	0.10 ic	---	12.36 s	10.34	---	---	0.065	---	23.00

Continues on next page...

BASIN-1

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
3.80	16,002	236.80	12.75 ic	0.11 ic	0.09 ic	---	12.55 s	15.08	---	---	0.066	---	27.89
3.90	16,546	236.90	12.89 ic	0.09 ic	0.08 ic	---	12.69 s	20.38	---	---	0.067	---	33.31
4.00	17,090	237.00	13.03 ic	0.08 ic	0.07 ic	---	12.84 s	26.18	---	---	0.068	---	39.24

...End

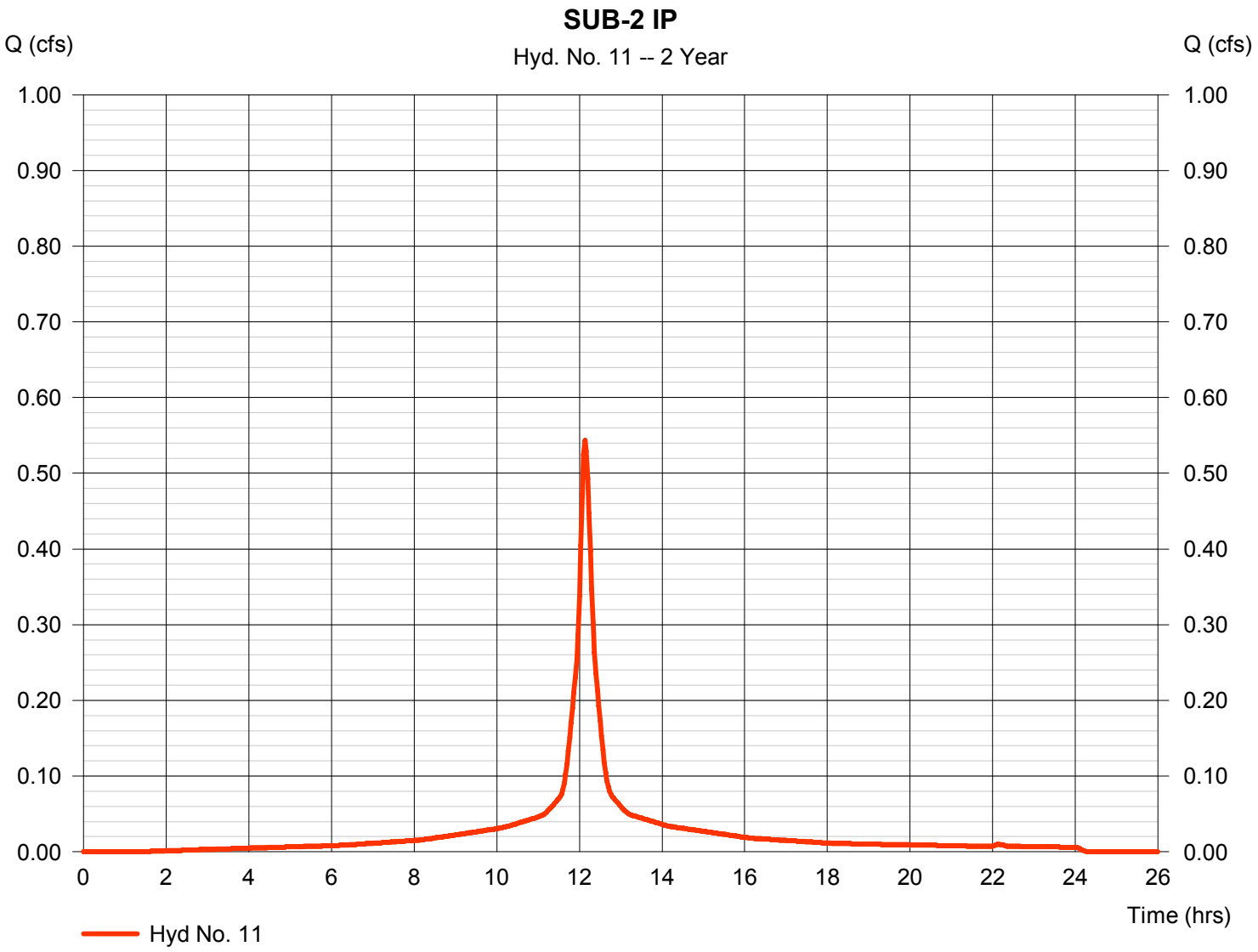
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 11

SUB-2 IP

Hydrograph type	= SCS Runoff	Peak discharge	= 0.544 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 2,324 cuft
Drainage area	= 0.196 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 3.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



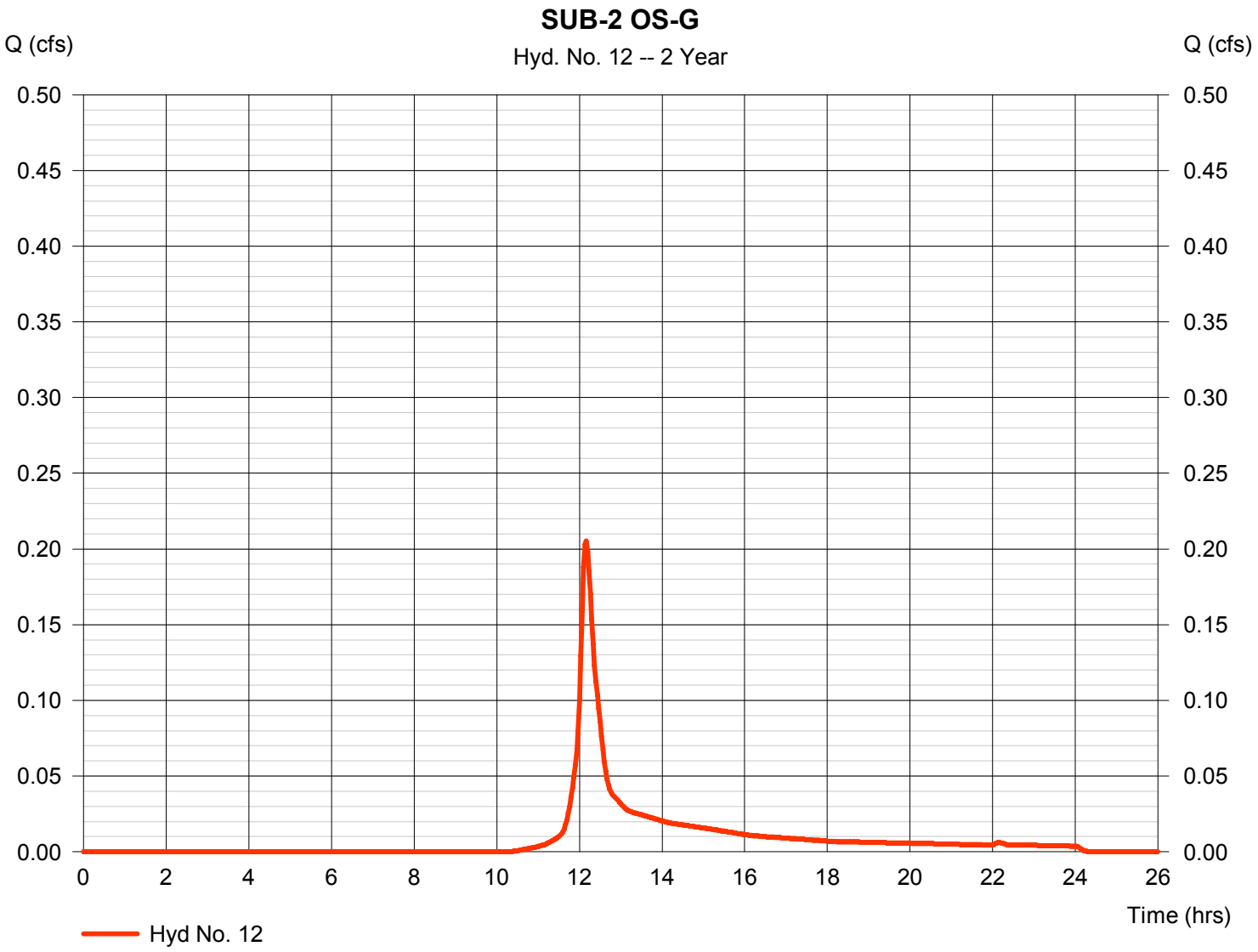
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 12

SUB-2 OS-G

Hydrograph type	= SCS Runoff	Peak discharge	= 0.205 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 817 cuft
Drainage area	= 0.178 ac	Curve number	= 74.9
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 3.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



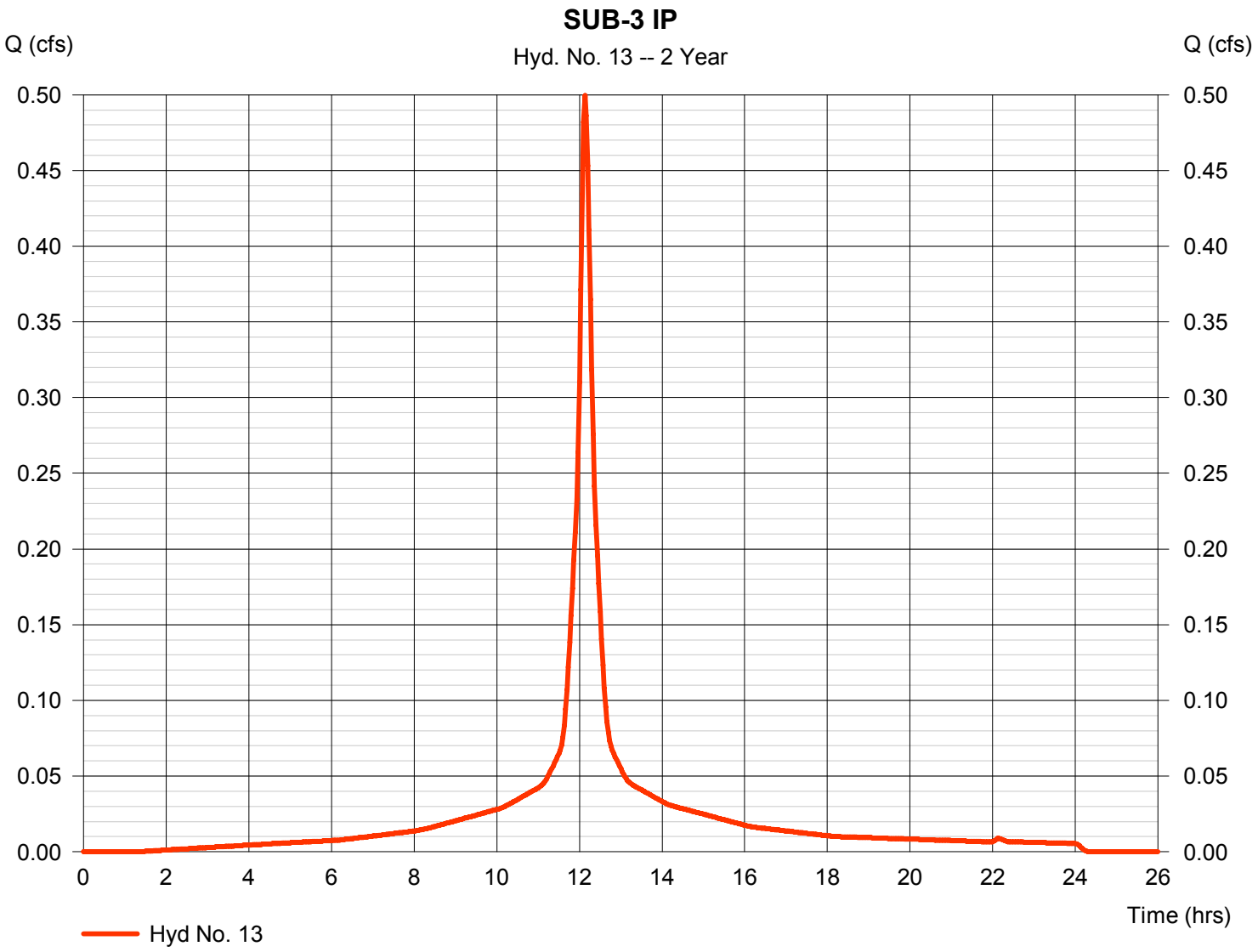
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 13

SUB-3 IP

Hydrograph type	= SCS Runoff	Peak discharge	= 0.499 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 2,134 cuft
Drainage area	= 0.180 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.80 min
Total precip.	= 3.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



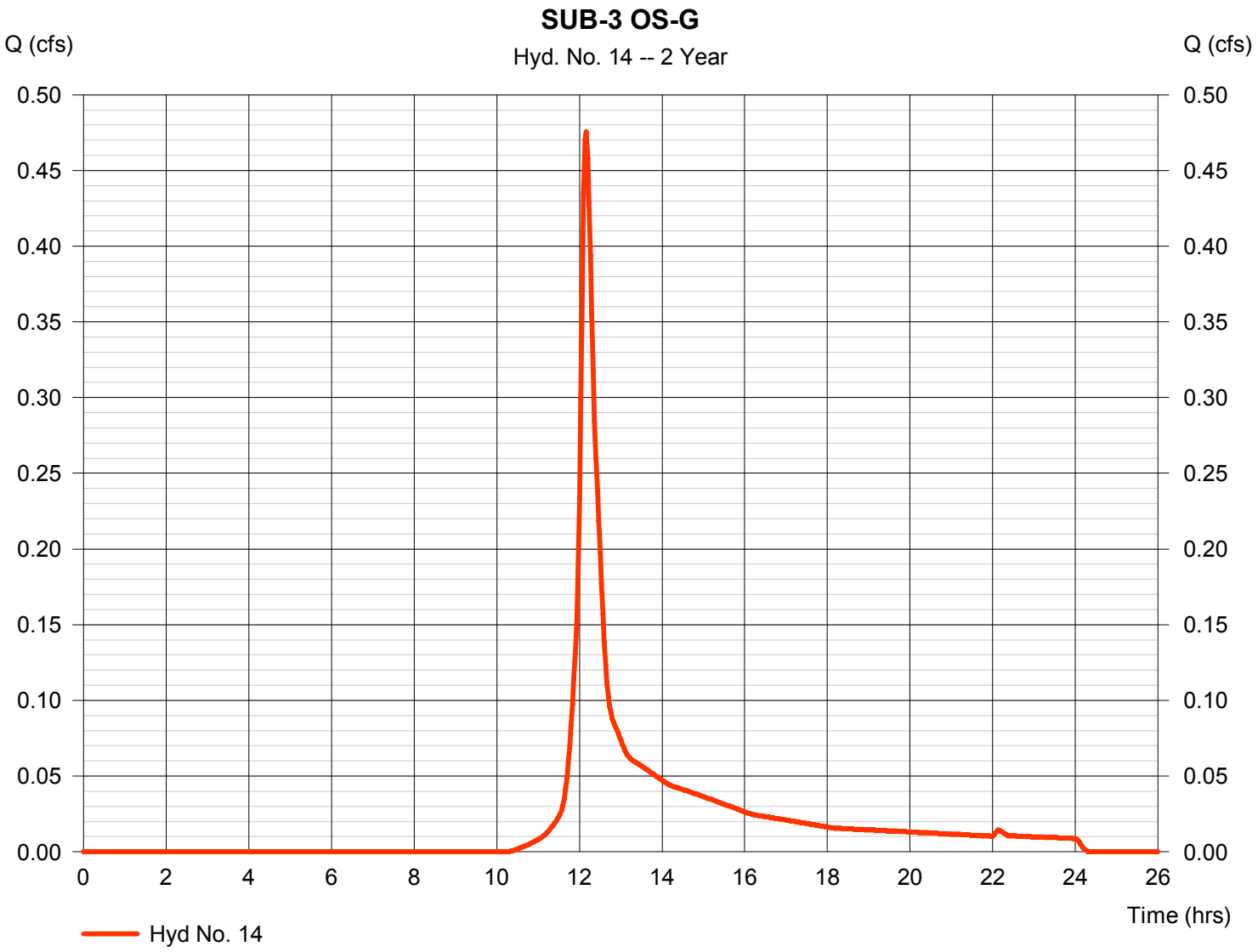
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 14

SUB-3 OS-G

Hydrograph type	= SCS Runoff	Peak discharge	= 0.475 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 1,890 cuft
Drainage area	= 0.412 ac	Curve number	= 74.9
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.80 min
Total precip.	= 3.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



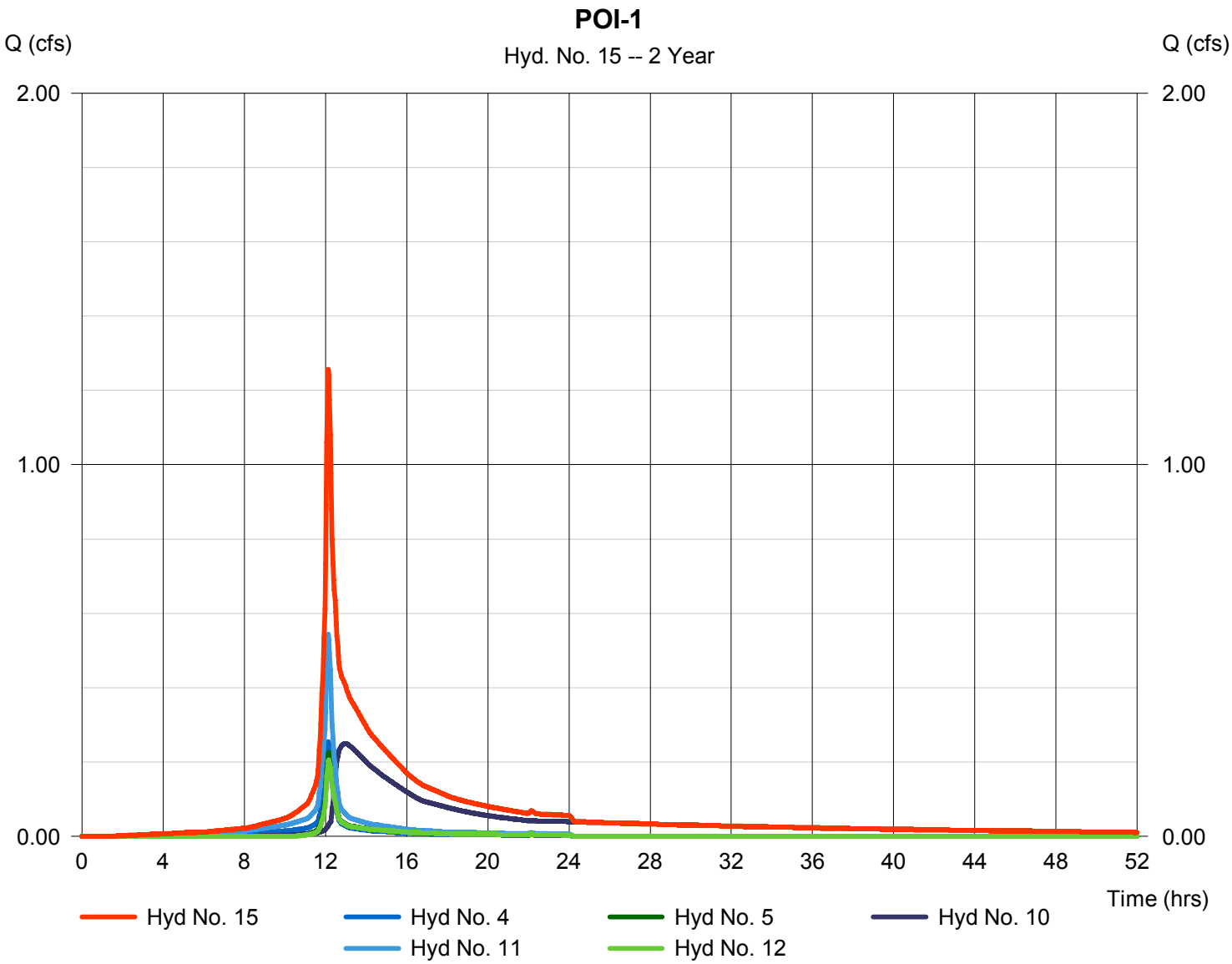
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 15

POI-1

Hydrograph type	= Combine	Peak discharge	= 1.256 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 12,485 cuft
Inflow hyds.	= 4, 5, 10, 11, 12	Contrib. drain. area	= 0.635 ac



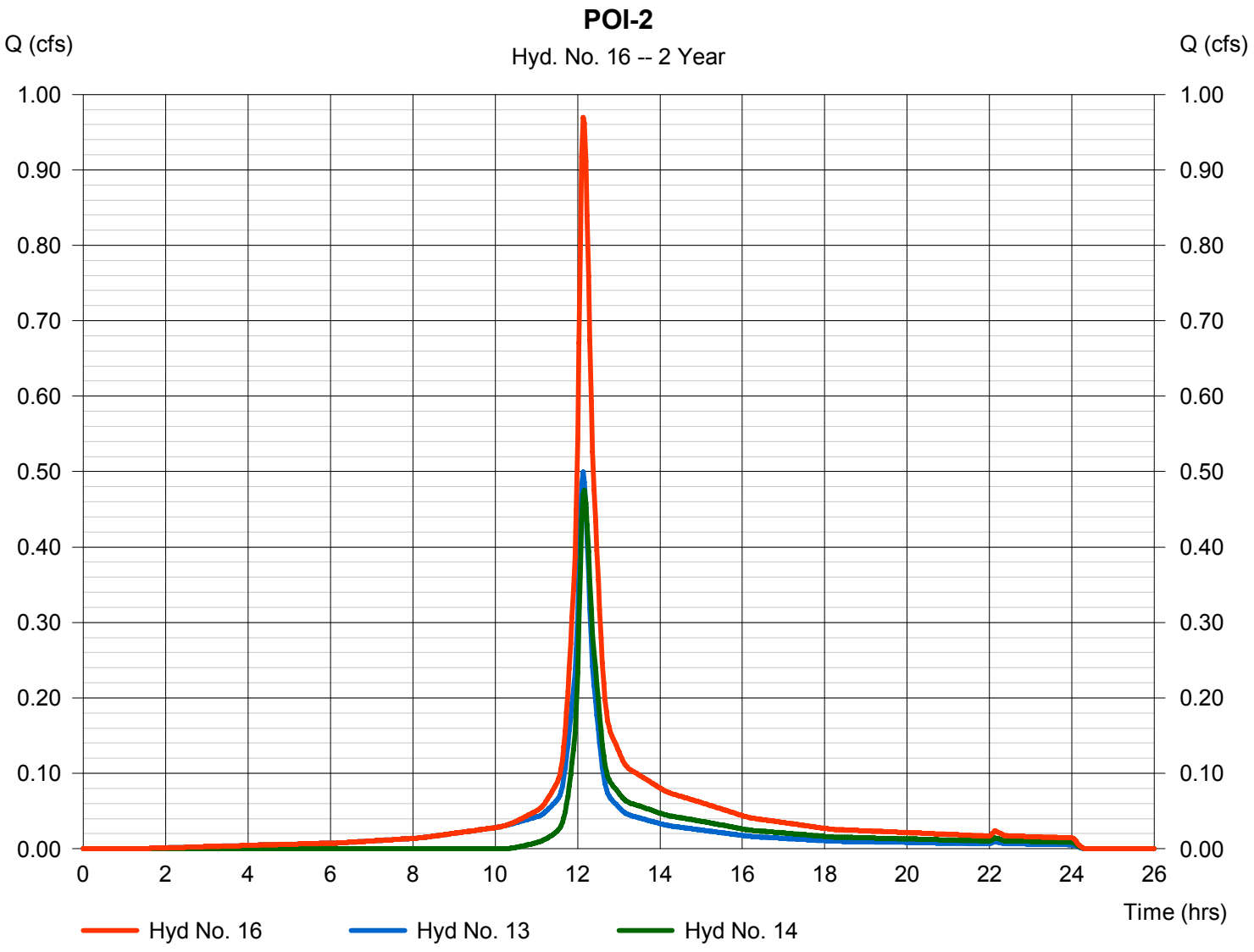
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 16

POI-2

Hydrograph type	= Combine	Peak discharge	= 0.970 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 4,024 cuft
Inflow hyds.	= 13, 14	Contrib. drain. area	= 0.592 ac



10-YEAR 24-HOUR

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.842	2	728	3,655	------	------	------	EXDA-3 IP
2	SCS Runoff	0.369	2	728	1,419	------	------	------	EXDA-3 OS-G
3	Combine	1.211	2	728	5,074	1, 2	------	------	EXDA-3 TOTAL (POI-3)
4	SCS Runoff	0.378	2	728	1,640	------	------	------	EXDA-4 IP
5	SCS Runoff	0.441	2	728	1,693	------	------	------	EXDA-4 OS-G
6	SCS Runoff	2.641	2	728	10,378	------	------	------	SUB-1 GRAV
7	SCS Runoff	0.021	2	728	89	------	------	------	SUB-1 IP
8	SCS Runoff	0.608	2	728	2,339	------	------	------	SUB-1 OS-G
9	Combine	3.269	2	728	12,807	6, 7, 8	------	------	SUB-1 TOTAL (TO BASIN-1)
10	Reservoir	0.711	2	758	12,687	9	234.84	6,442	THRU BASIN-1
11	SCS Runoff	0.805	2	728	3,495	------	------	------	SUB-2 IP
12	SCS Runoff	0.422	2	728	1,626	------	------	------	SUB-2 OS-G
13	SCS Runoff	0.739	2	728	3,210	------	------	------	SUB-3 IP
14	SCS Runoff	0.976	2	728	3,764	------	------	------	SUB-3 OS-G
15	Combine	2.421	2	730	21,141	4, 5, 10, 11, 12,	------	------	POI-1
16	Combine	1.715	2	728	6,974	13, 14,	------	------	POI-2

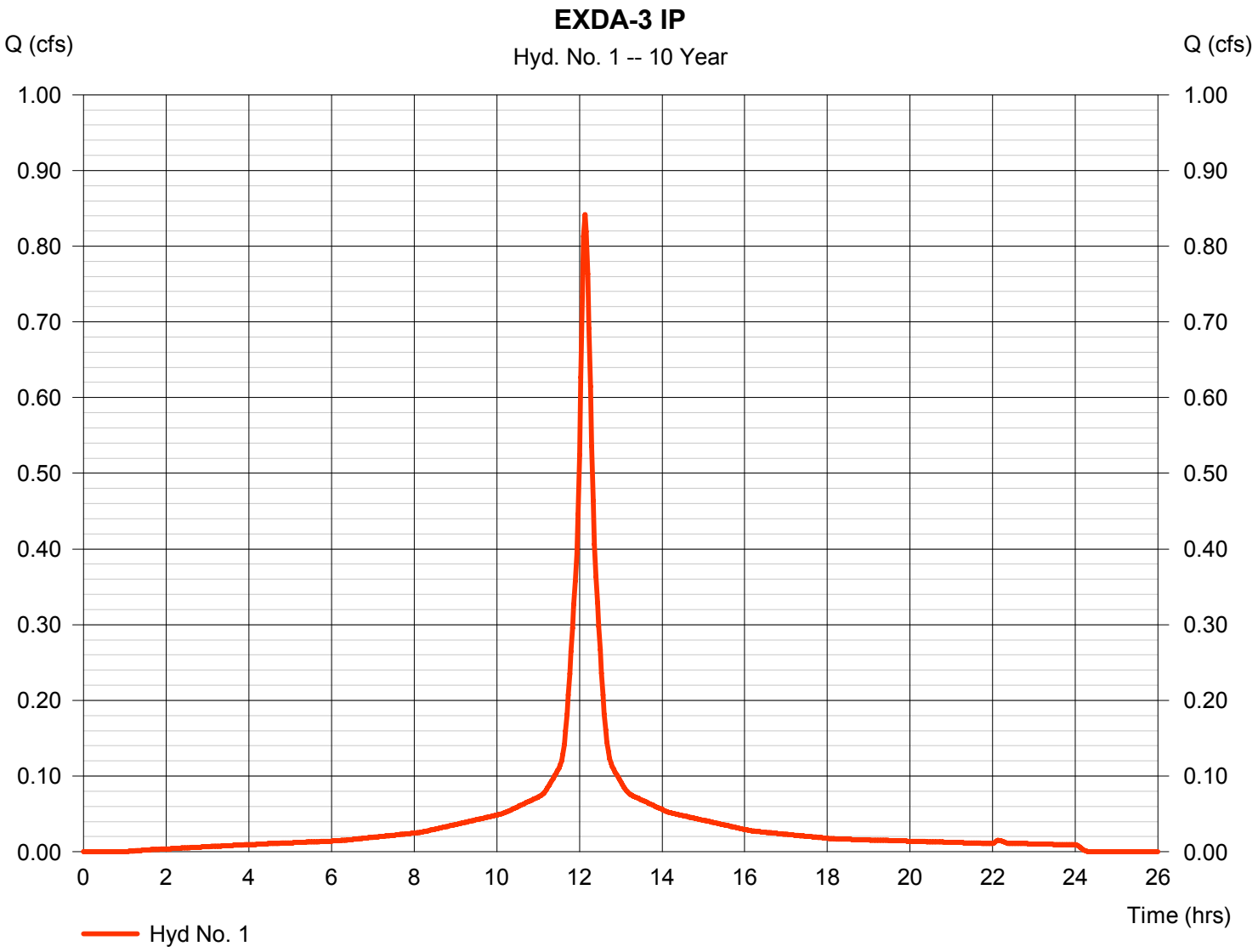
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 1

EXDA-3 IP

Hydrograph type	= SCS Runoff	Peak discharge	= 0.842 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 3,655 cuft
Drainage area	= 0.205 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 5.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



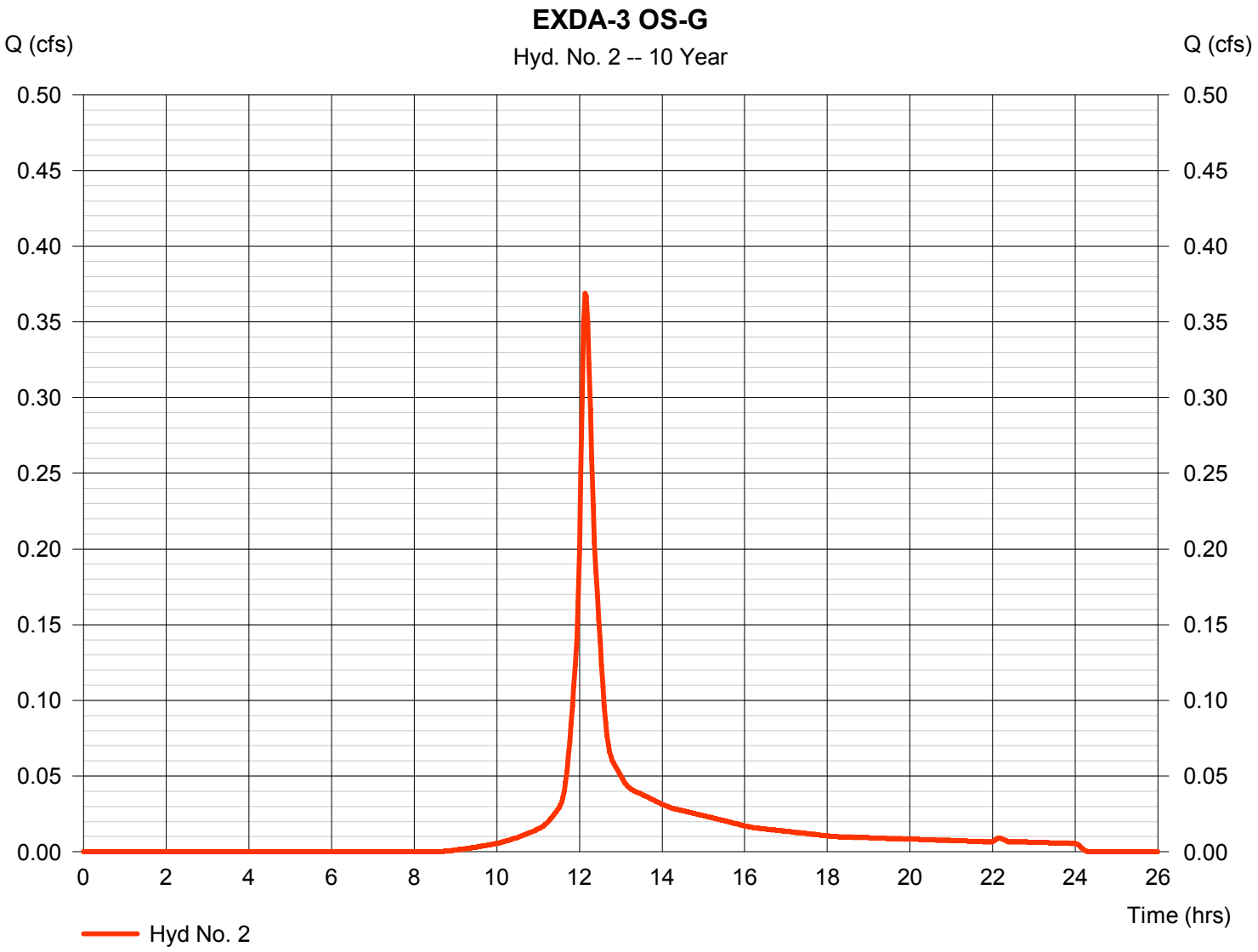
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 2

EXDA-3 OS-G

Hydrograph type	= SCS Runoff	Peak discharge	= 0.369 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 1,419 cuft
Drainage area	= 0.150 ac	Curve number	= 75.9
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 5.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



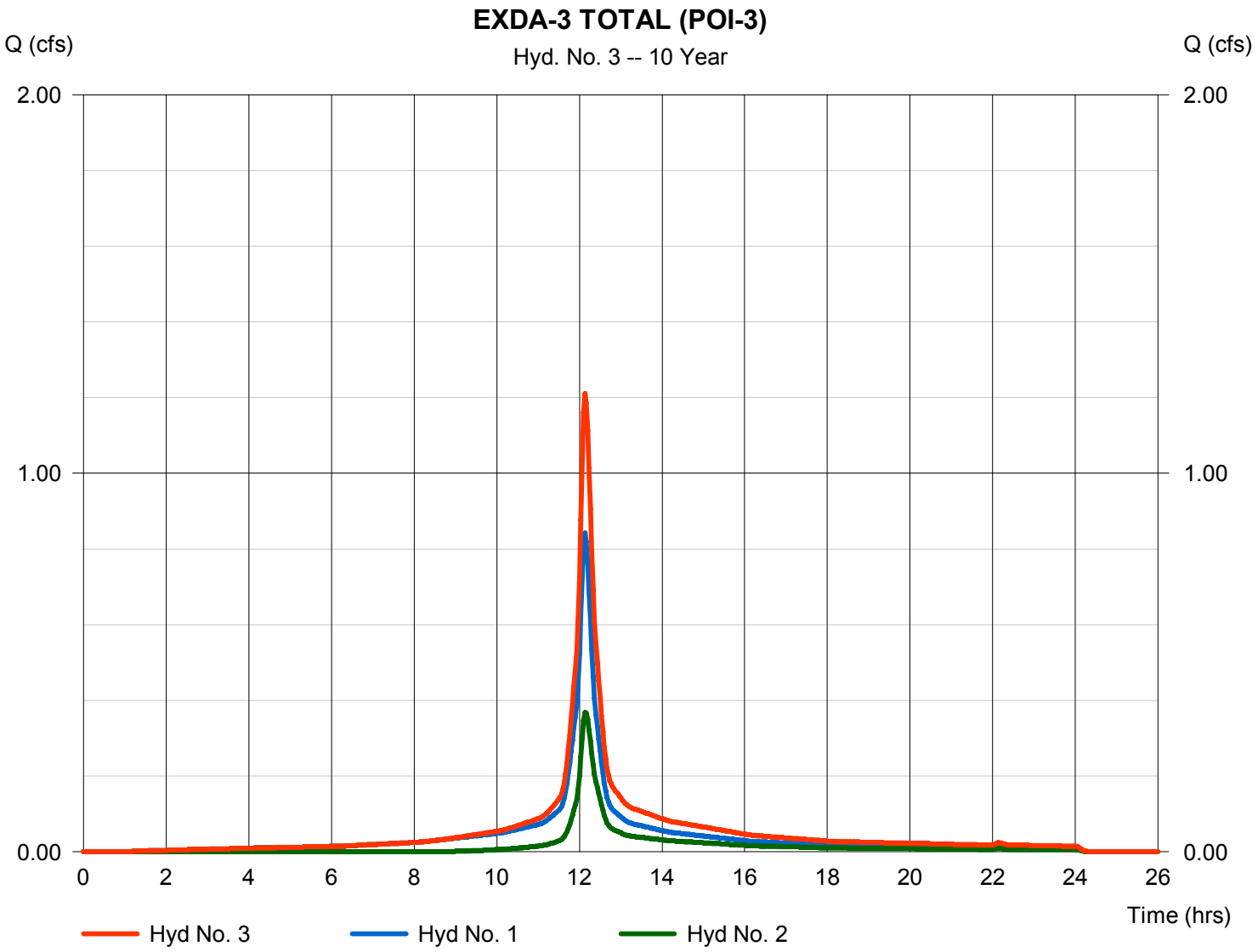
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 3

EXDA-3 TOTAL (POI-3)

Hydrograph type	= Combine	Peak discharge	= 1.211 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 5,074 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 0.355 ac



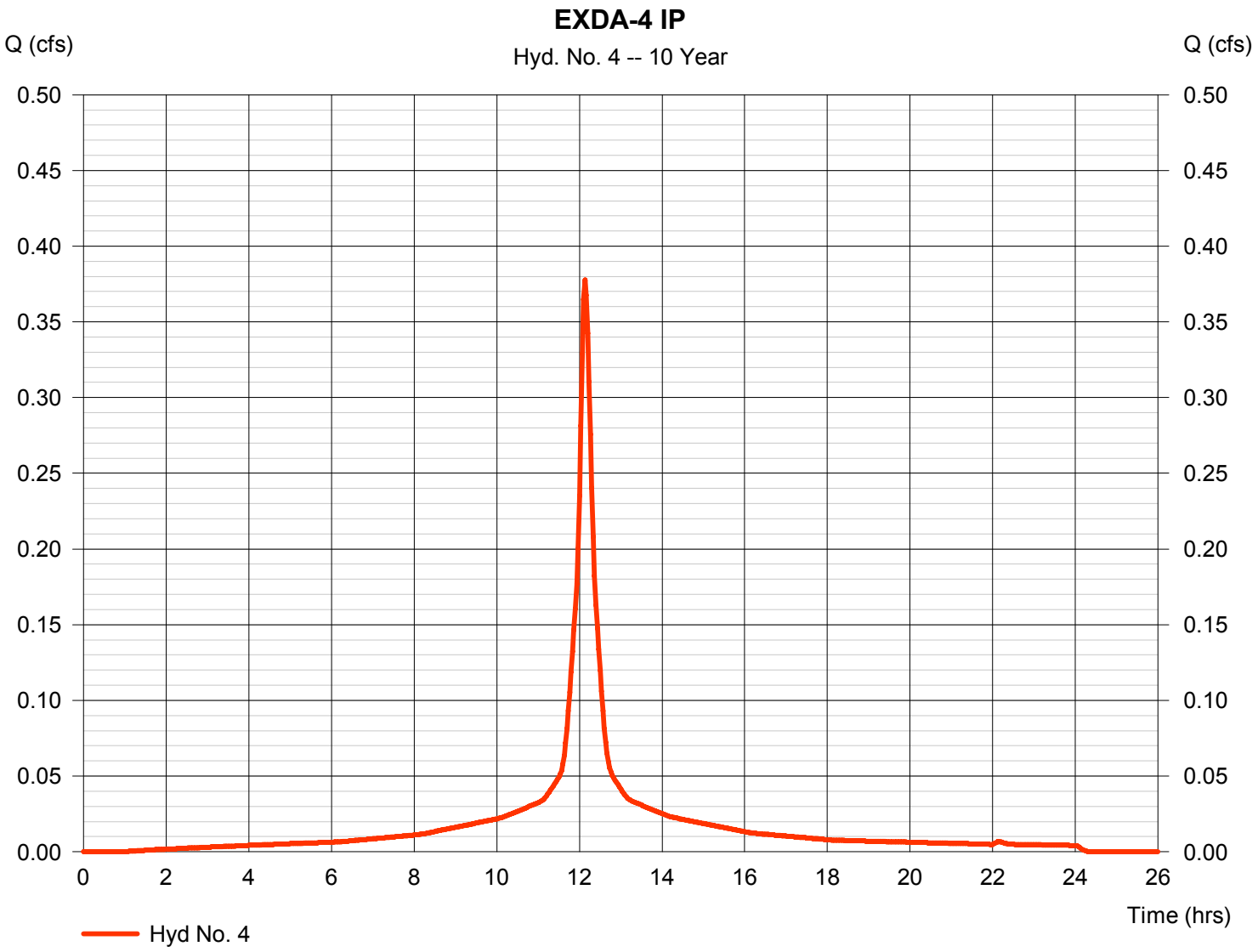
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 4

EXDA-4 IP

Hydrograph type	= SCS Runoff	Peak discharge	= 0.378 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 1,640 cuft
Drainage area	= 0.092 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 5.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



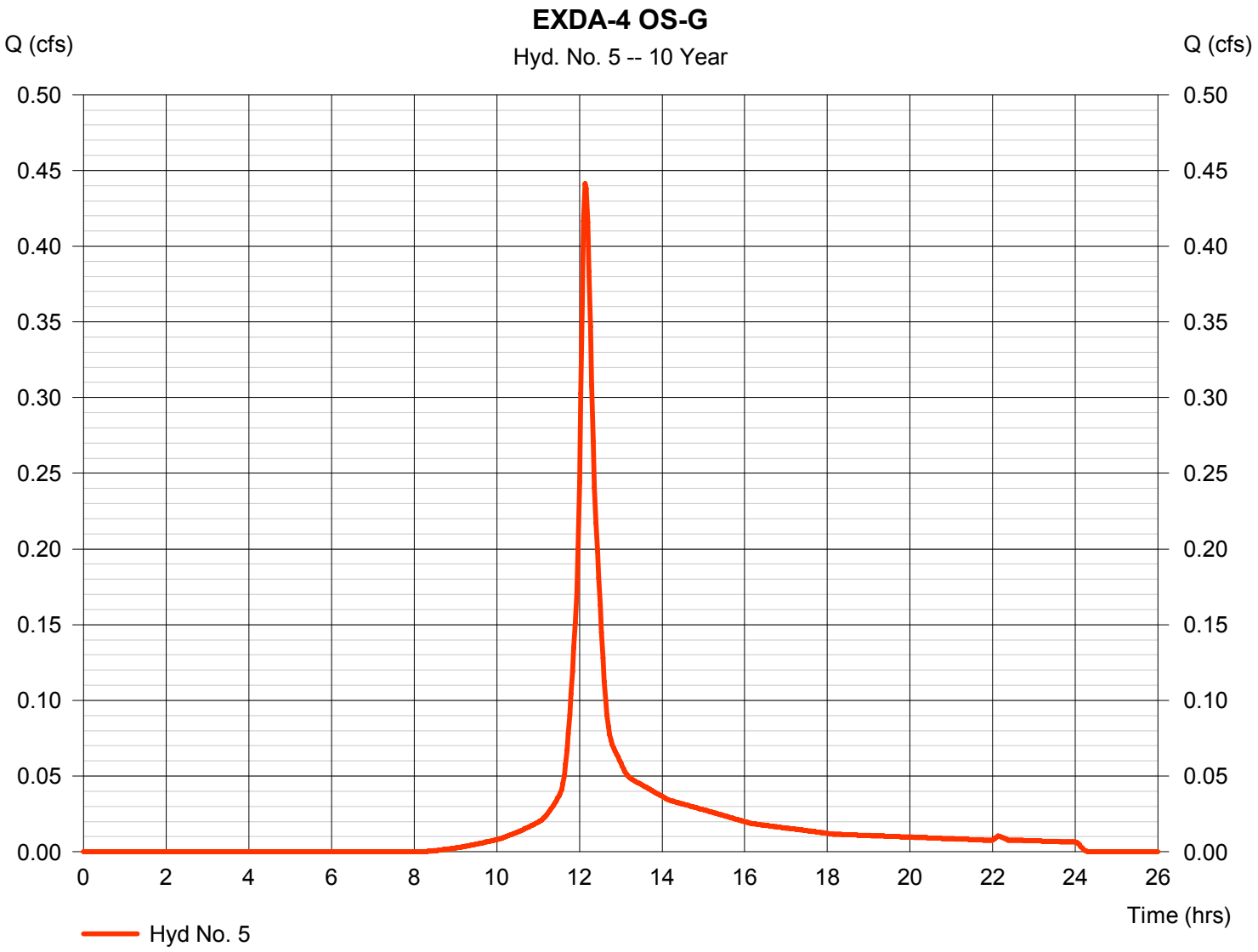
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 5

EXDA-4 OS-G

Hydrograph type	= SCS Runoff	Peak discharge	= 0.441 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 1,693 cuft
Drainage area	= 0.169 ac	Curve number	= 77.6
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 5.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



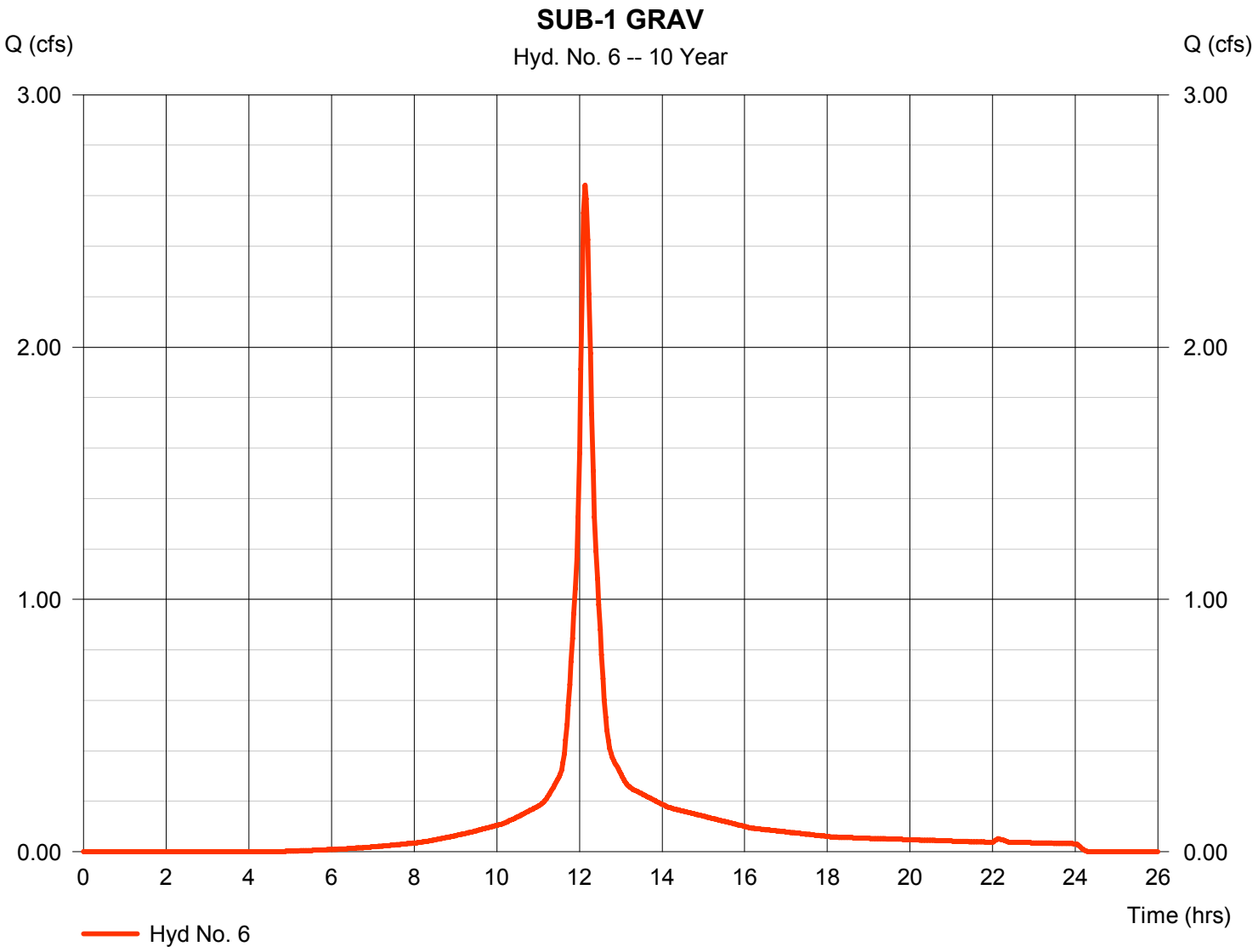
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 6

SUB-1 GRAV

Hydrograph type	= SCS Runoff	Peak discharge	= 2.641 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 10,378 cuft
Drainage area	= 0.733 ac	Curve number	= 89.1
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.46 min
Total precip.	= 5.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



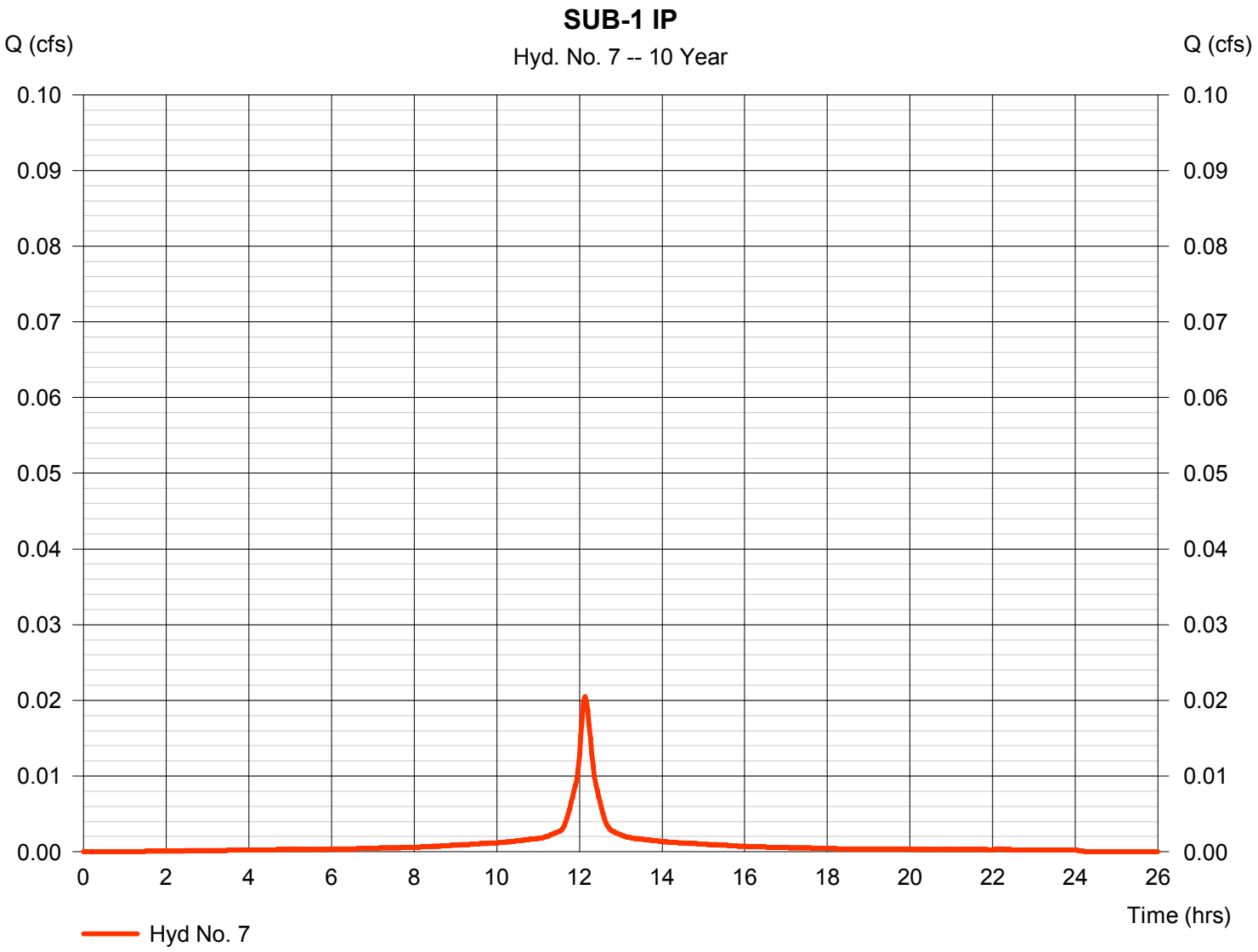
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 7

SUB-1 IP

Hydrograph type	= SCS Runoff	Peak discharge	= 0.021 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 89 cuft
Drainage area	= 0.005 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.46 min
Total precip.	= 5.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



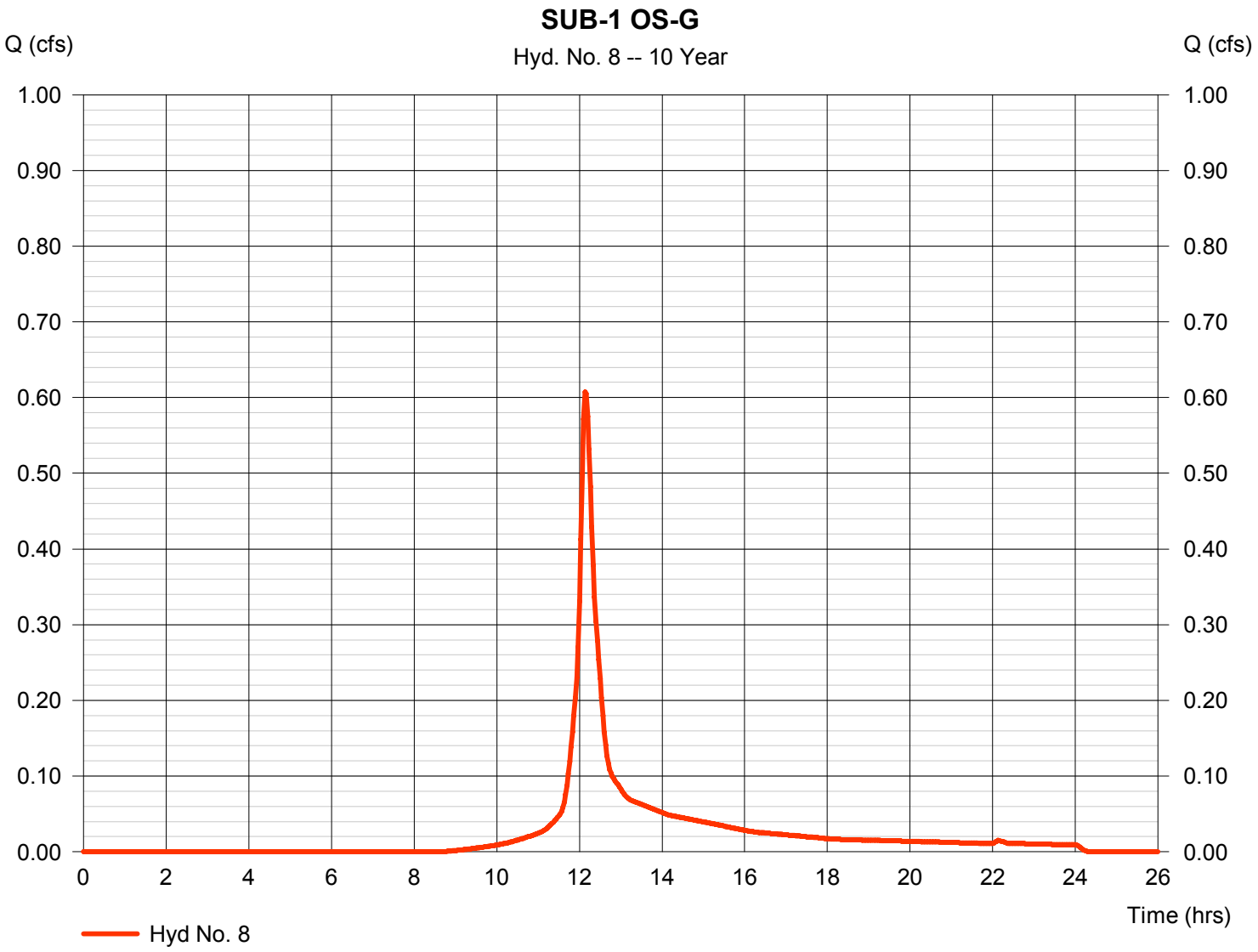
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 8

SUB-1 OS-G

Hydrograph type	= SCS Runoff	Peak discharge	= 0.608 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 2,339 cuft
Drainage area	= 0.249 ac	Curve number	= 75.7
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.46 min
Total precip.	= 5.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



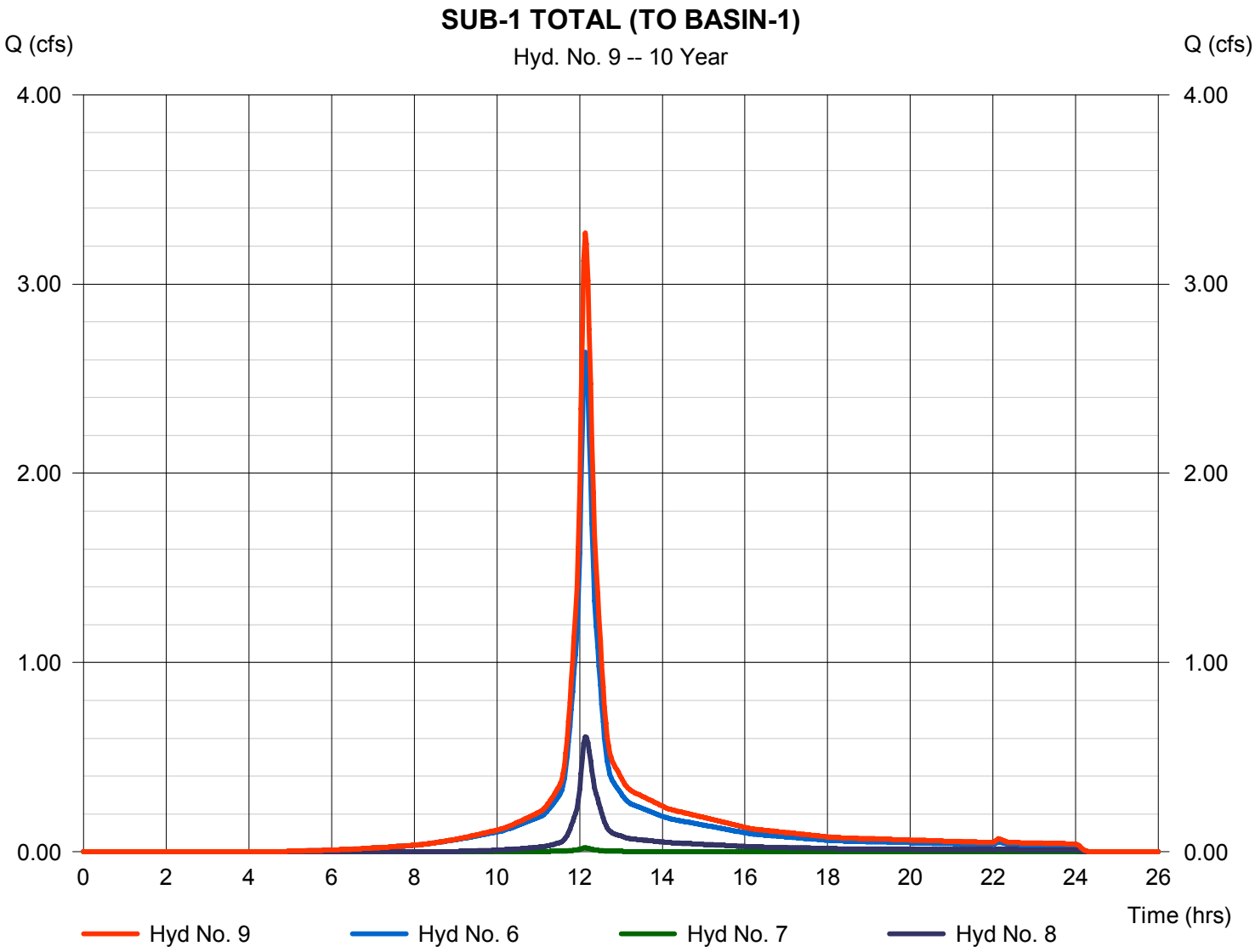
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 9

SUB-1 TOTAL (TO BASIN-1)

Hydrograph type	= Combine	Peak discharge	= 3.269 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 12,807 cuft
Inflow hyds.	= 6, 7, 8	Contrib. drain. area	= 0.987 ac



Hydrograph Report

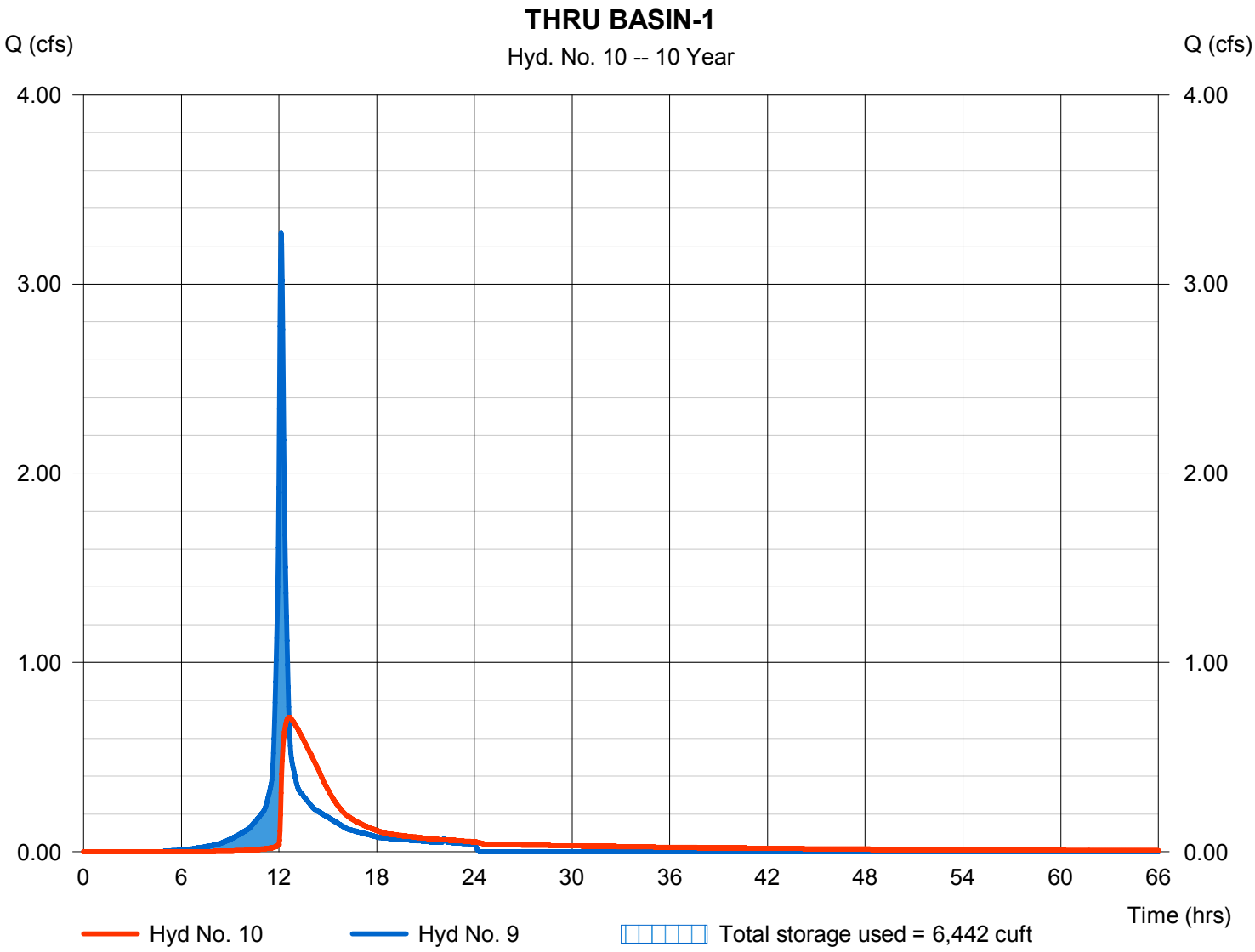
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 10

THRU BASIN-1

Hydrograph type	= Reservoir	Peak discharge	= 0.711 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.63 hrs
Time interval	= 2 min	Hyd. volume	= 12,687 cuft
Inflow hyd. No.	= 9 - SUB-1 TOTAL (TO BASIN-1)	Max. Elevation	= 234.84 ft
Reservoir name	= BASIN-1	Max. Storage	= 6,442 cuft

Storage Indication method used. Outflow includes exfiltration.



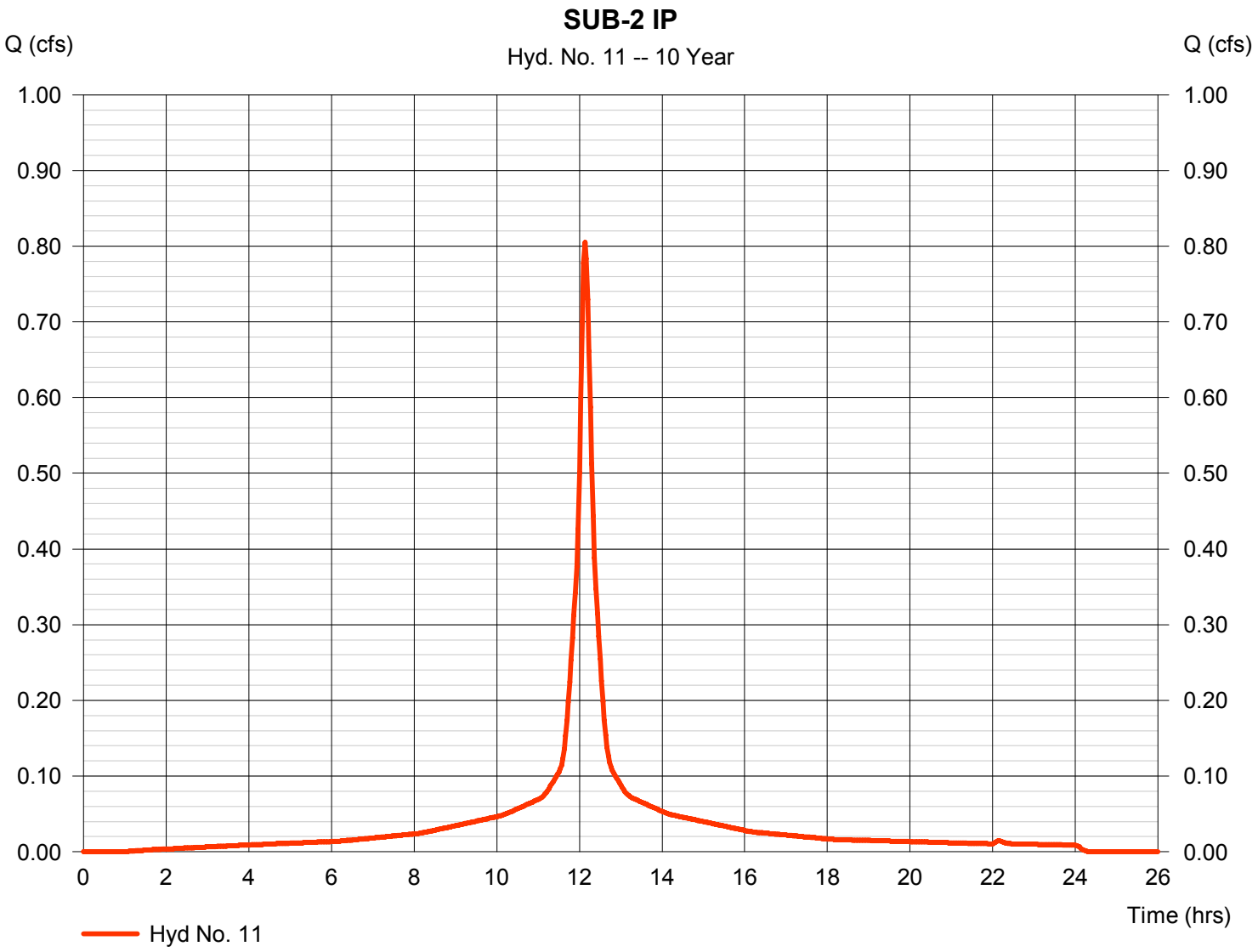
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 11

SUB-2 IP

Hydrograph type	= SCS Runoff	Peak discharge	= 0.805 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 3,495 cuft
Drainage area	= 0.196 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 5.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



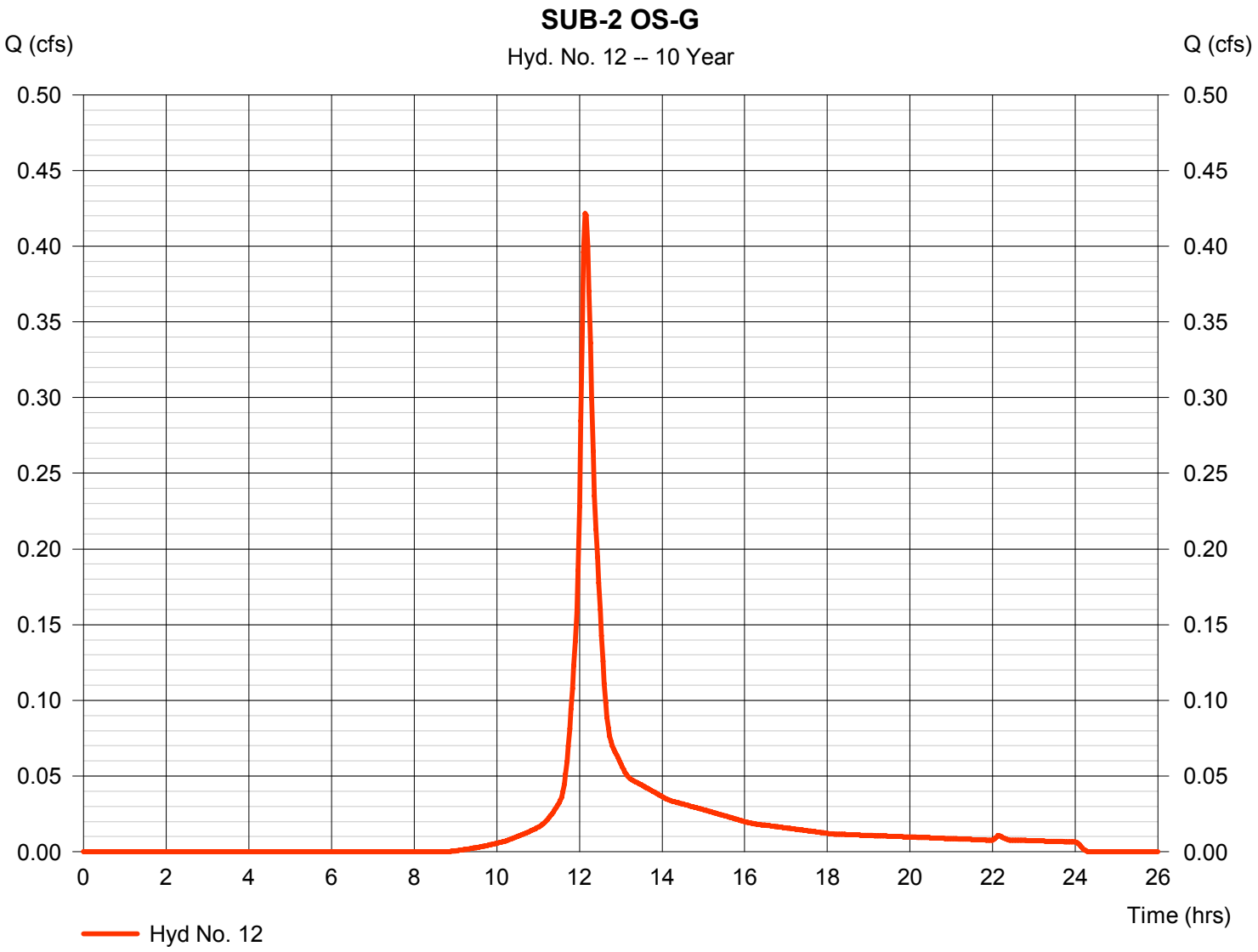
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 12

SUB-2 OS-G

Hydrograph type	= SCS Runoff	Peak discharge	= 0.422 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 1,626 cuft
Drainage area	= 0.178 ac	Curve number	= 74.9
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 5.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



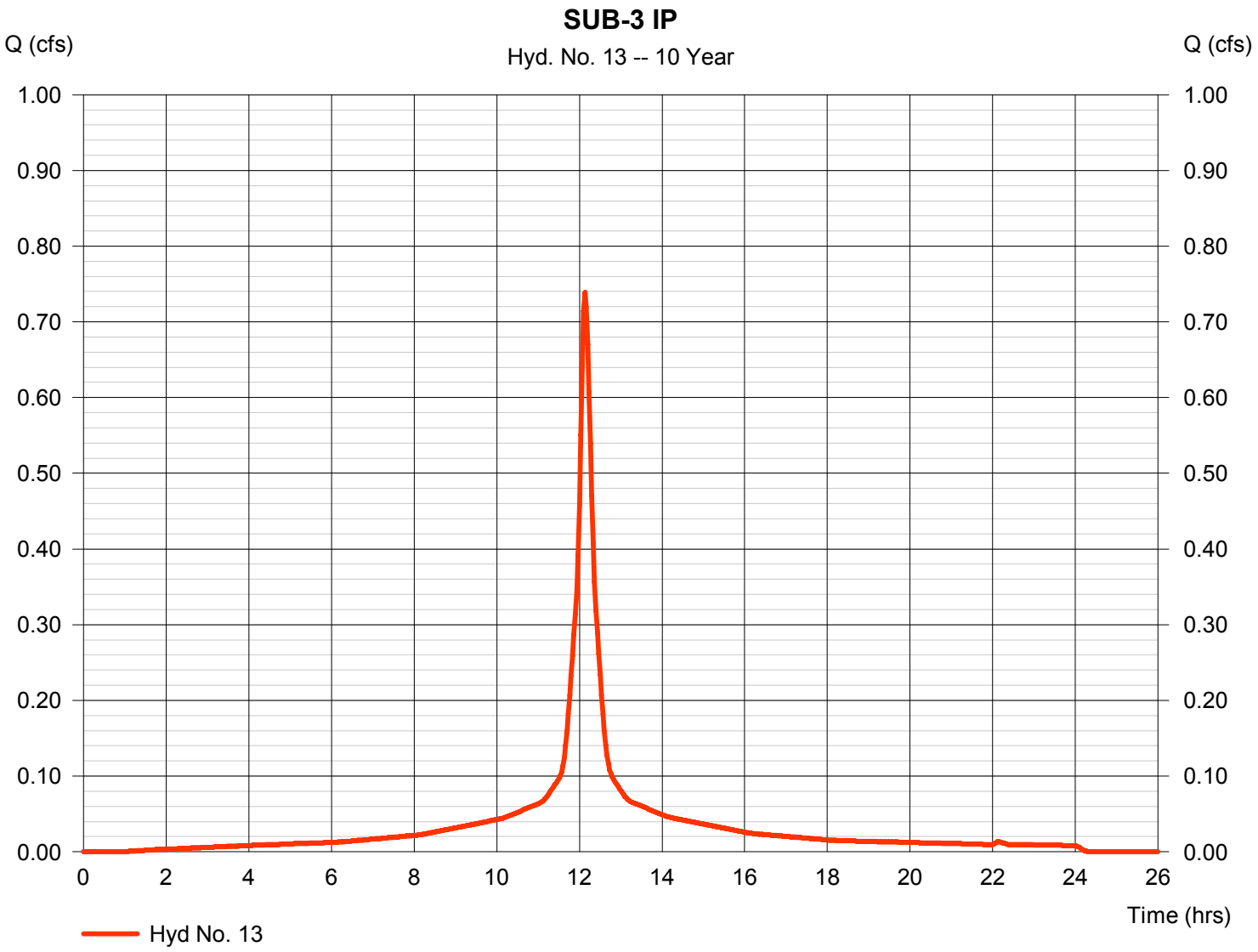
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 13

SUB-3 IP

Hydrograph type	= SCS Runoff	Peak discharge	= 0.739 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 3,210 cuft
Drainage area	= 0.180 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.80 min
Total precip.	= 5.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



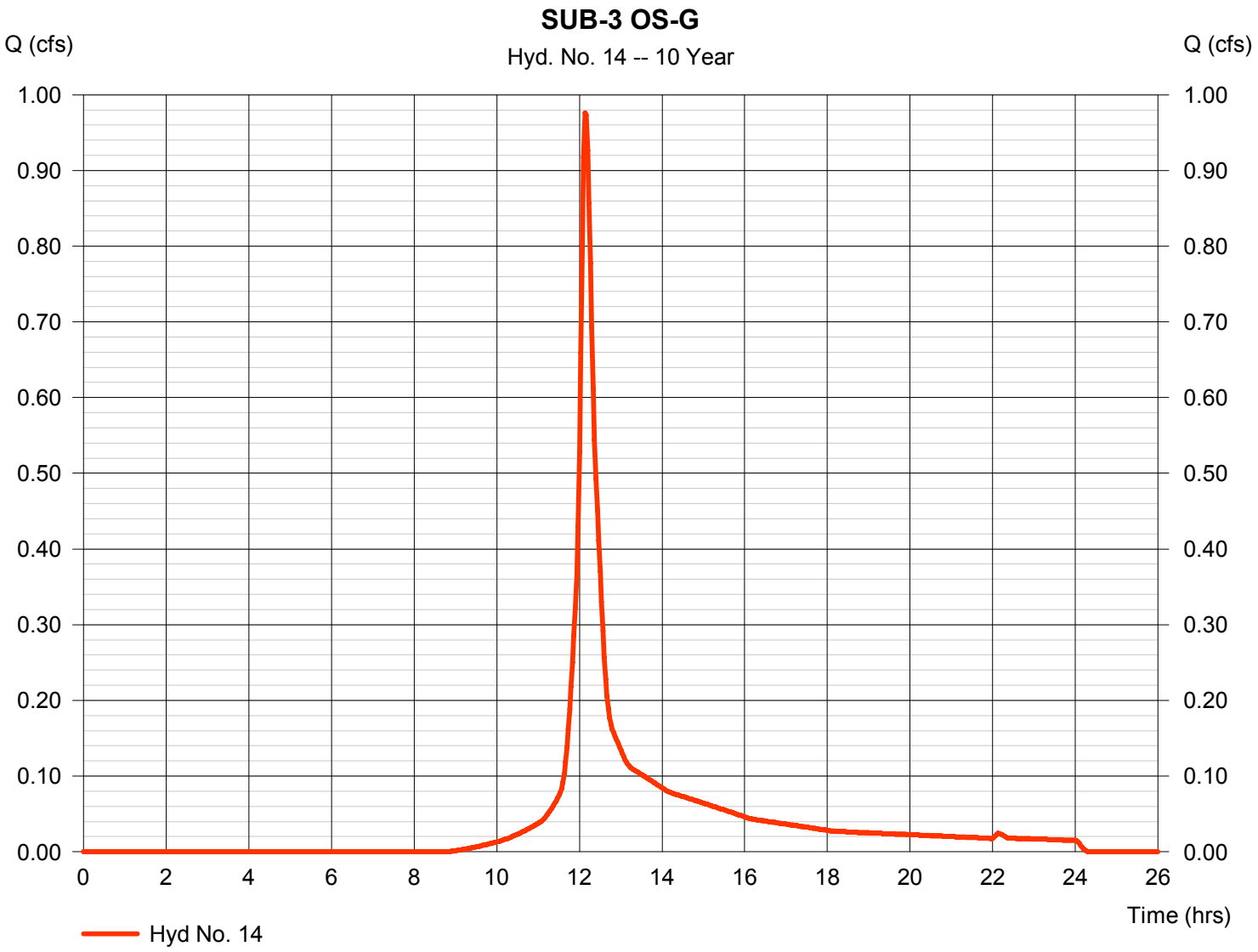
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 14

SUB-3 OS-G

Hydrograph type	= SCS Runoff	Peak discharge	= 0.976 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 3,764 cuft
Drainage area	= 0.412 ac	Curve number	= 74.9
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.80 min
Total precip.	= 5.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



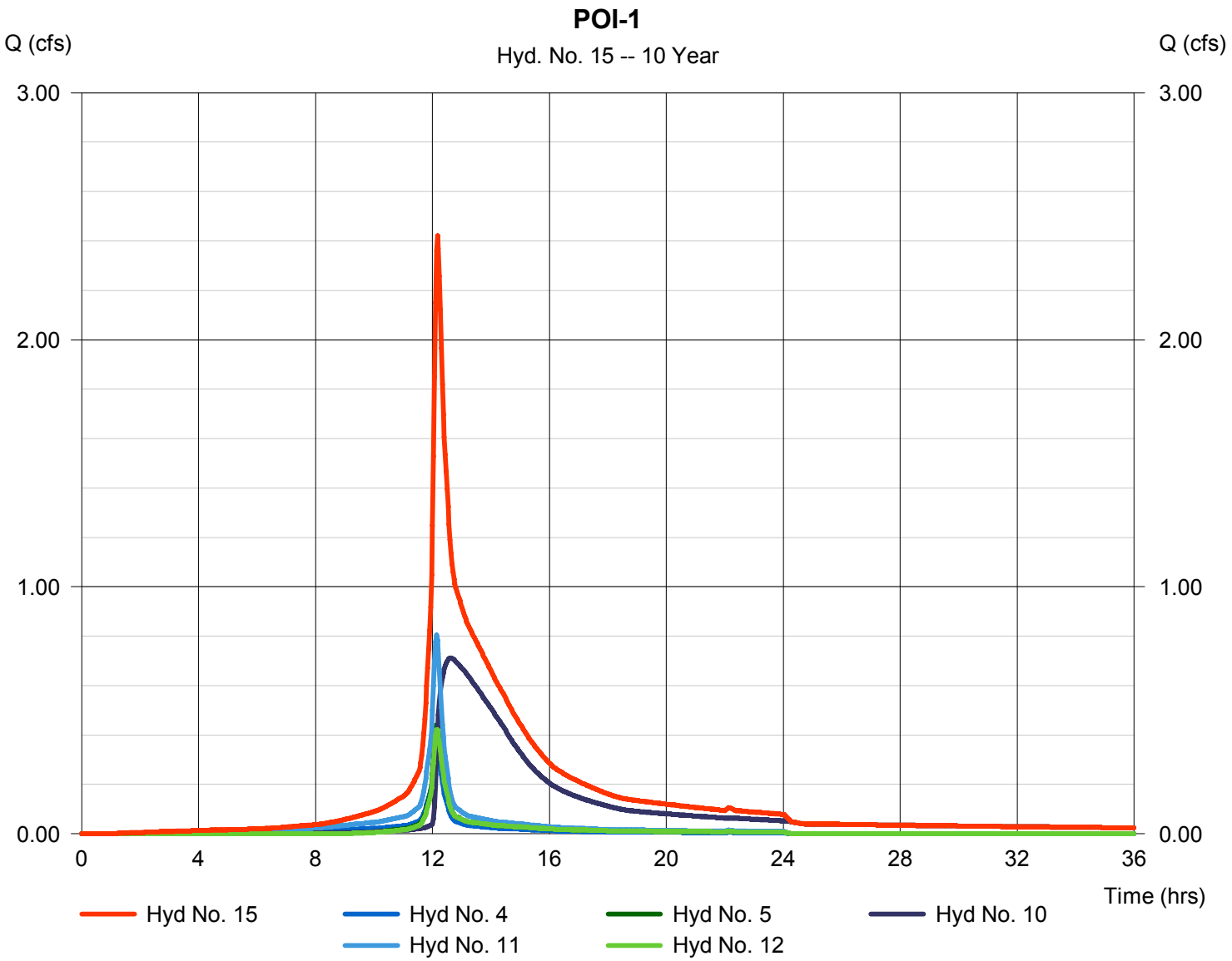
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 15

POI-1

Hydrograph type	= Combine	Peak discharge	= 2.421 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 21,141 cuft
Inflow hyds.	= 4, 5, 10, 11, 12	Contrib. drain. area	= 0.635 ac



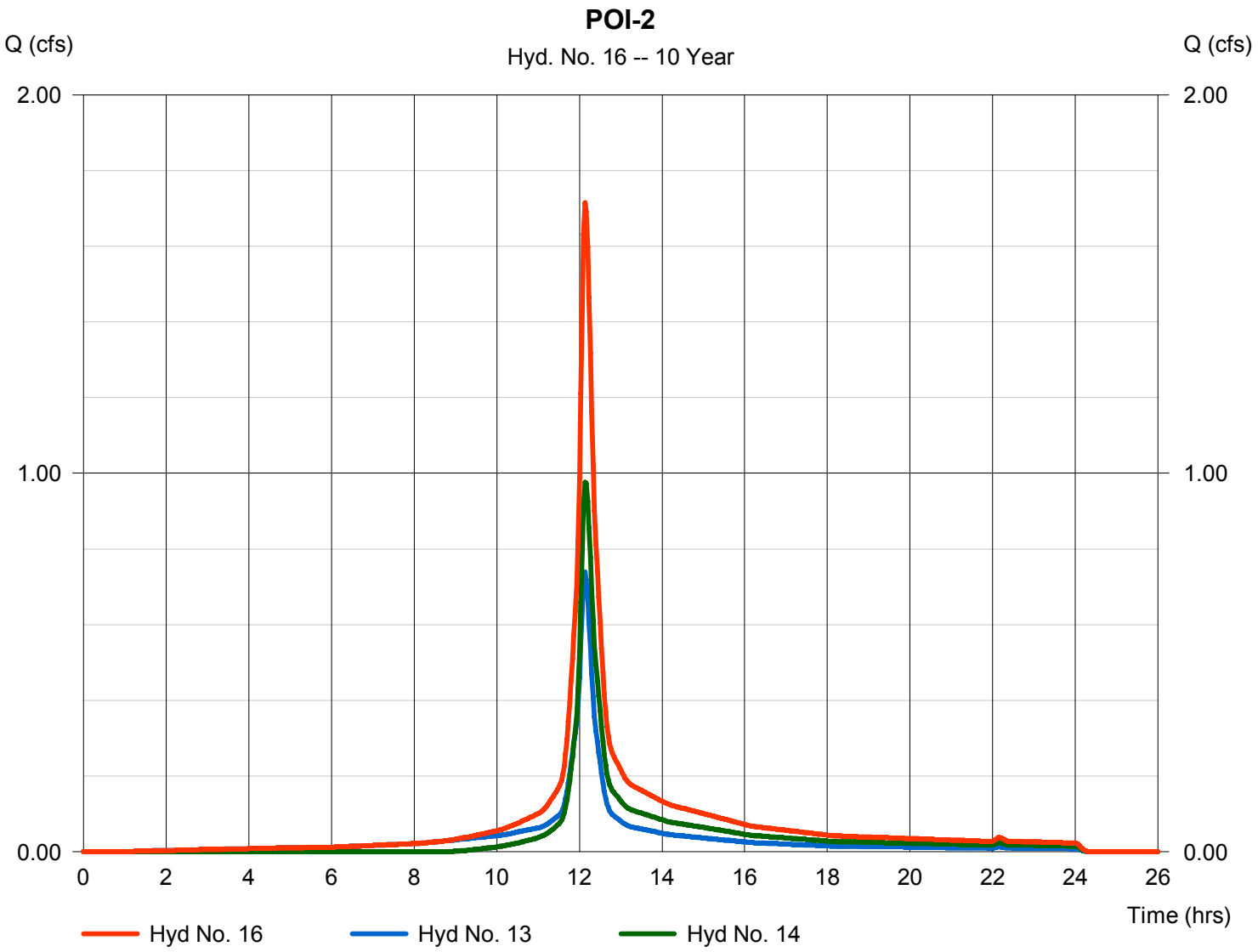
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 16

POI-2

Hydrograph type	= Combine	Peak discharge	= 1.715 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 6,974 cuft
Inflow hyds.	= 13, 14	Contrib. drain. area	= 0.592 ac



100-YEAR 24-HOUR

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	1.352	2	728	5,955	------	------	------	EXDA-3 IP
2	SCS Runoff	0.751	2	728	2,890	------	------	------	EXDA-3 OS-G
3	Combine	2.103	2	728	8,845	1, 2	------	------	EXDA-3 TOTAL (POI-3)
4	SCS Runoff	0.607	2	728	2,673	------	------	------	EXDA-4 IP
5	SCS Runoff	0.877	2	728	3,381	------	------	------	EXDA-4 OS-G
6	SCS Runoff	4.541	2	728	18,381	------	------	------	SUB-1 GRAV
7	SCS Runoff	0.033	2	728	145	------	------	------	SUB-1 IP
8	SCS Runoff	1.242	2	728	4,775	------	------	------	SUB-1 OS-G
9	Combine	5.816	2	728	23,301	6, 7, 8	------	------	SUB-1 TOTAL (TO BASIN-1)
10	Reservoir	1.752	2	752	23,176	9	235.82	10,802	THRU BASIN-1
11	SCS Runoff	1.293	2	728	5,694	------	------	------	SUB-2 IP
12	SCS Runoff	0.873	2	728	3,352	------	------	------	SUB-2 OS-G
13	SCS Runoff	1.187	2	728	5,229	------	------	------	SUB-3 IP
14	SCS Runoff	2.020	2	728	7,758	------	------	------	SUB-3 OS-G
15	Combine	4.792	2	730	38,275	4, 5, 10, 11, 12,	------	------	POI-1
16	Combine	3.207	2	728	12,987	13, 14,	------	------	POI-2

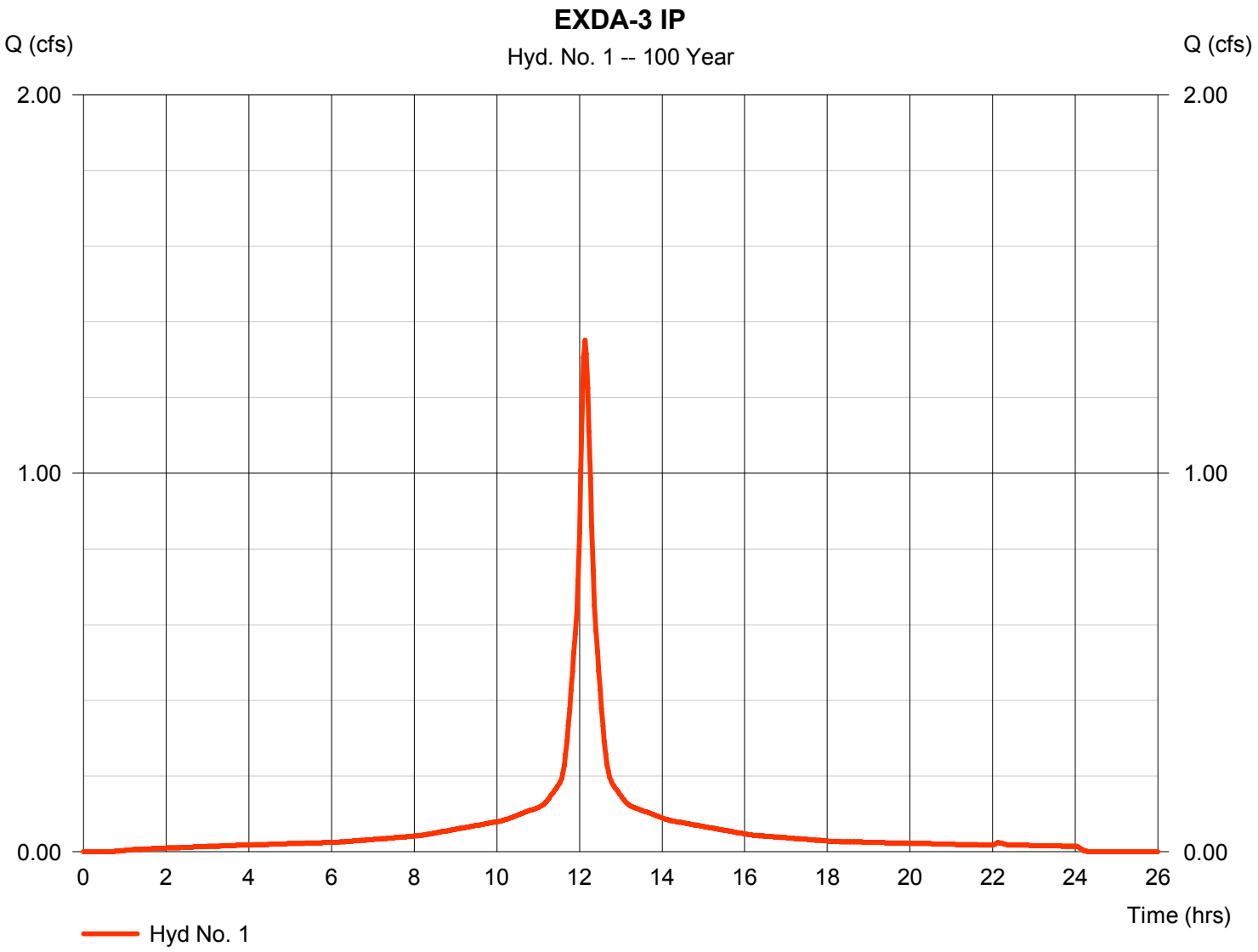
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 1

EXDA-3 IP

Hydrograph type	= SCS Runoff	Peak discharge	= 1.352 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 5,955 cuft
Drainage area	= 0.205 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 8.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



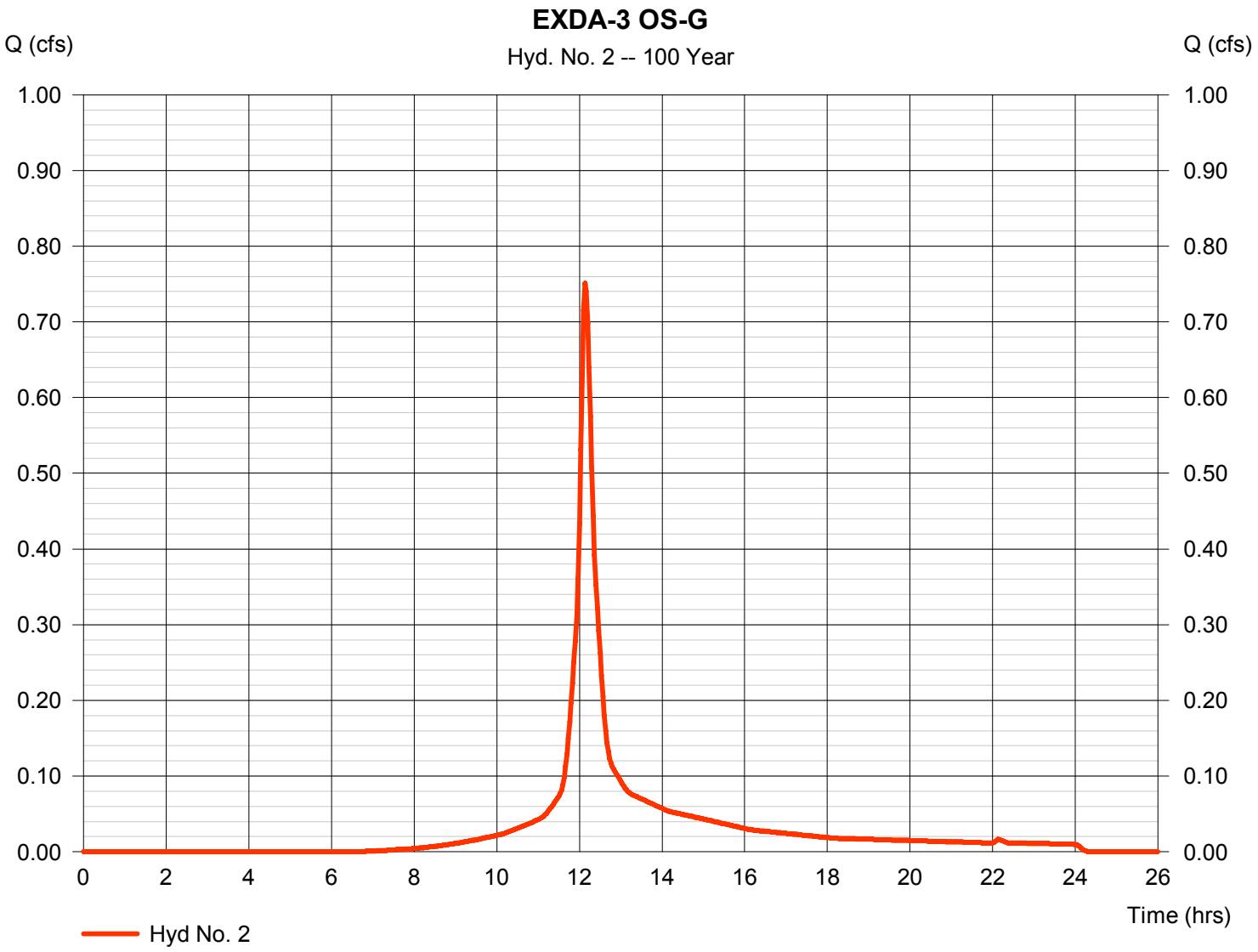
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 2

EXDA-3 OS-G

Hydrograph type	= SCS Runoff	Peak discharge	= 0.751 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 2,890 cuft
Drainage area	= 0.150 ac	Curve number	= 75.9
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 8.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



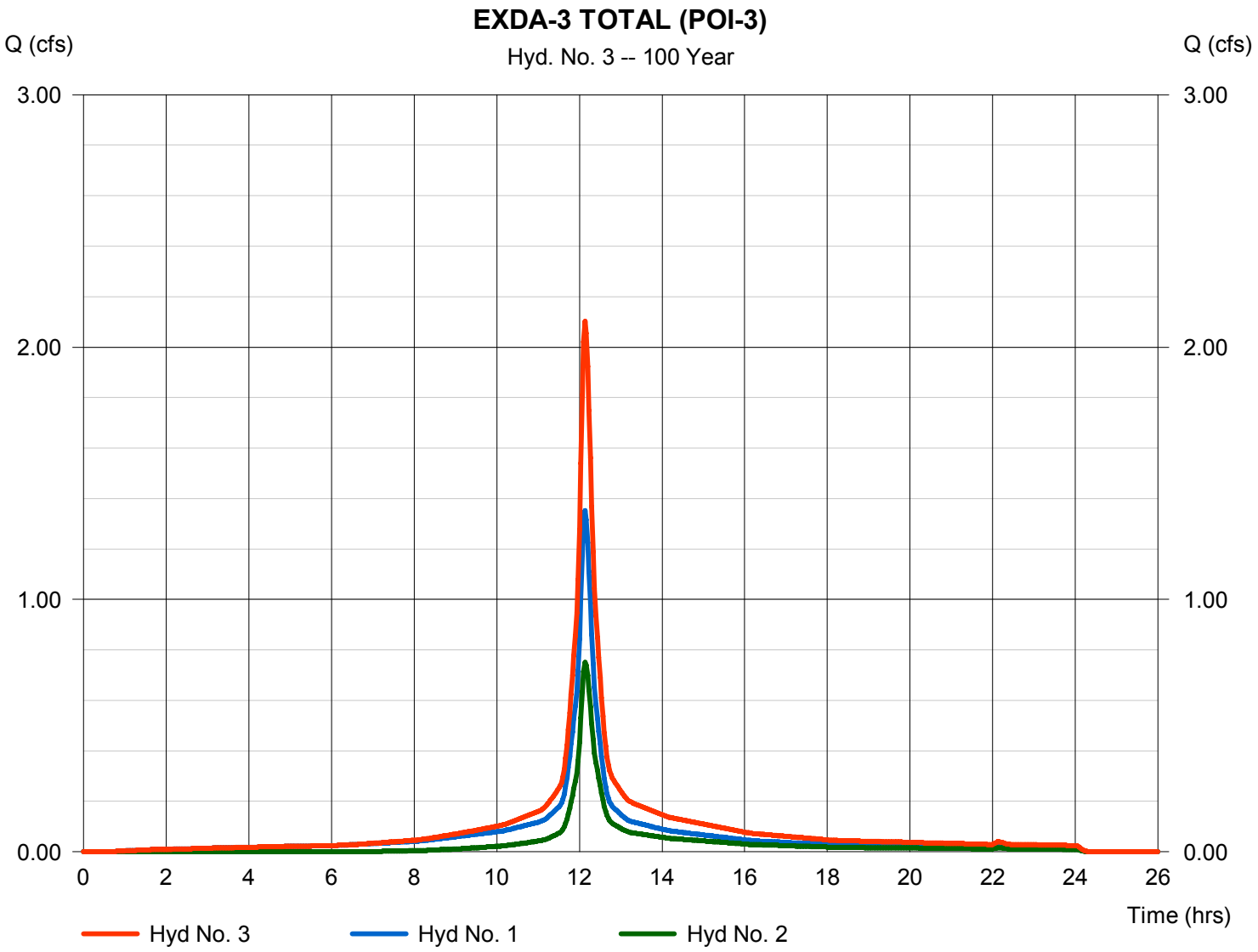
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 3

EXDA-3 TOTAL (POI-3)

Hydrograph type	= Combine	Peak discharge	= 2.103 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 8,845 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 0.355 ac



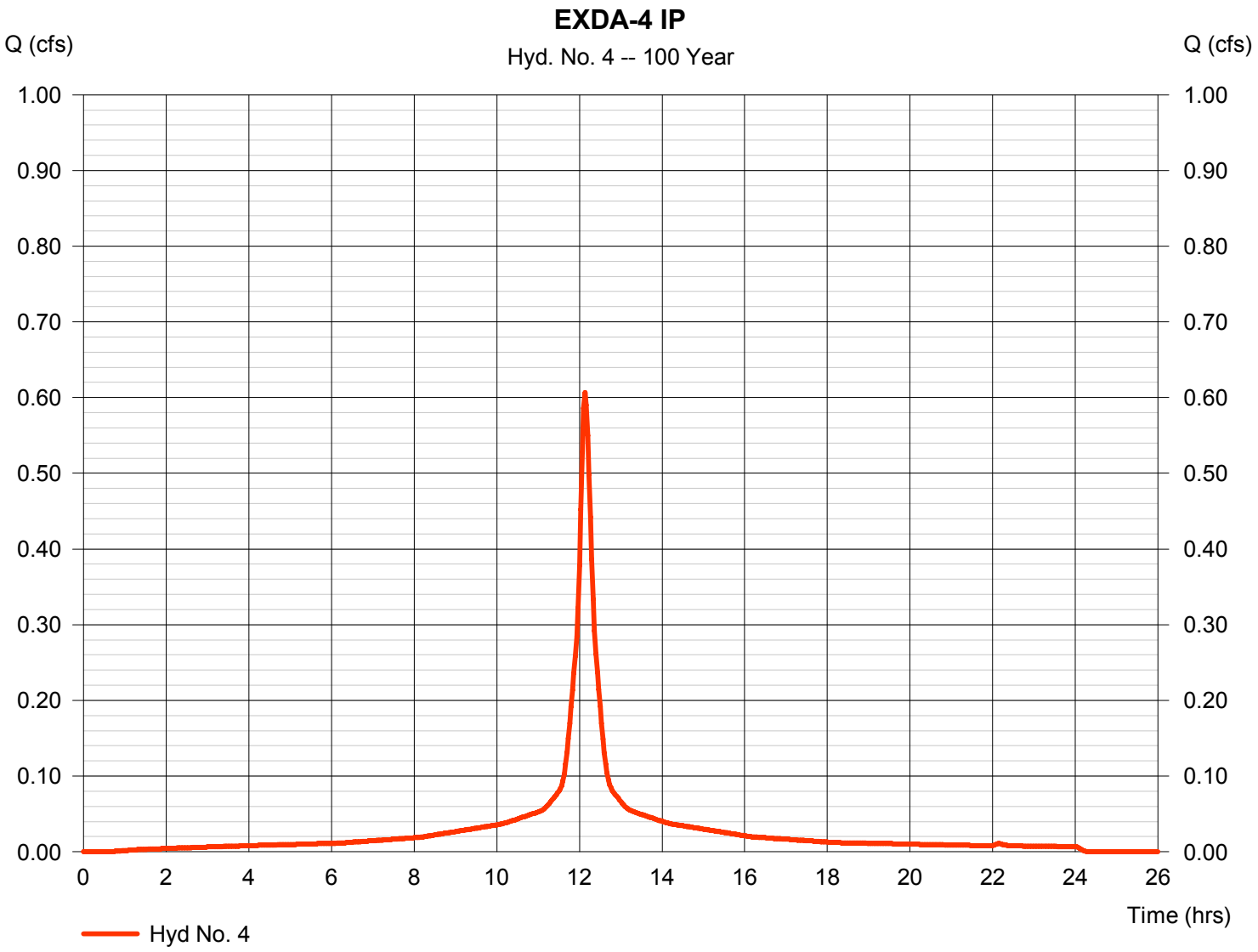
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 4

EXDA-4 IP

Hydrograph type	= SCS Runoff	Peak discharge	= 0.607 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 2,673 cuft
Drainage area	= 0.092 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 8.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



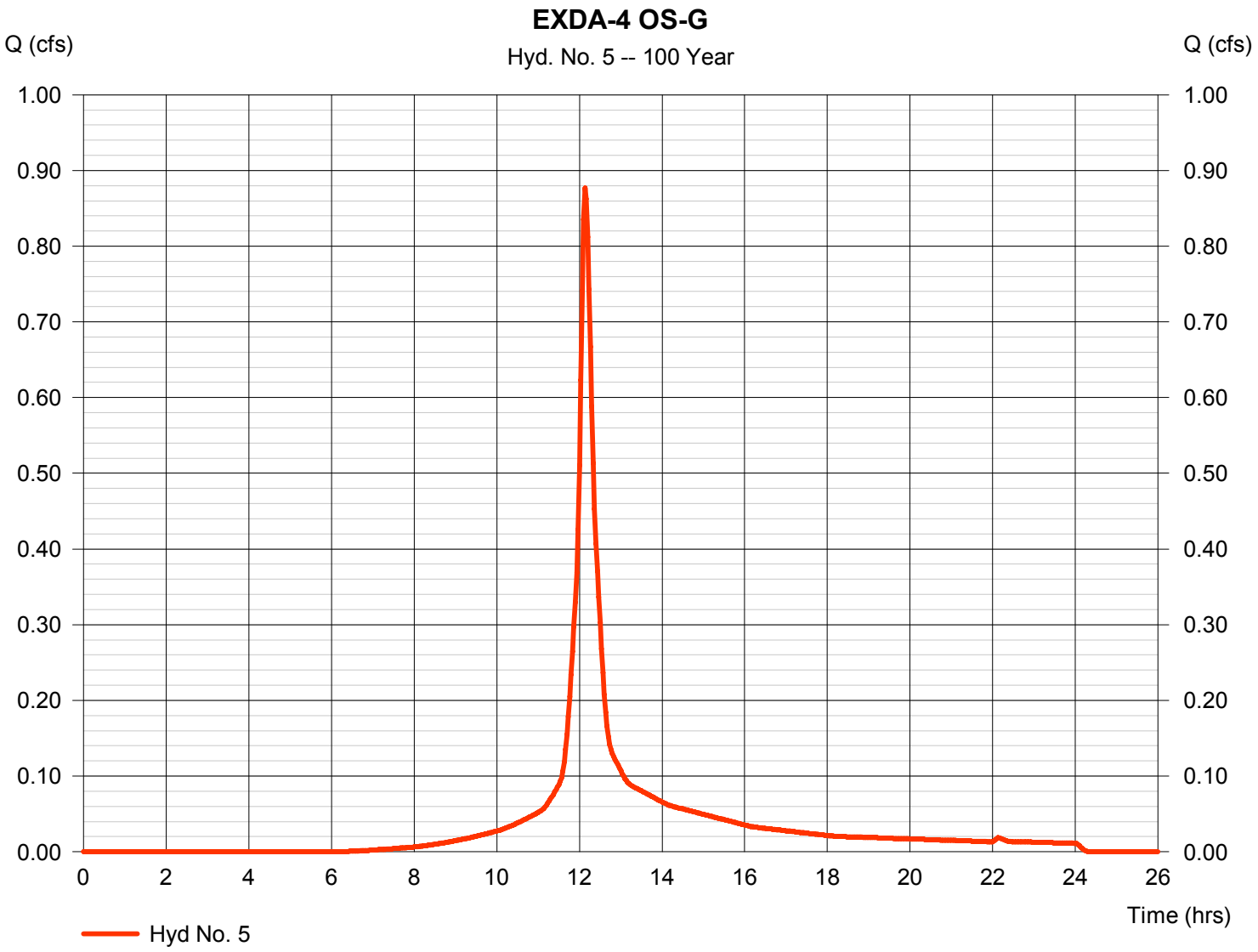
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 5

EXDA-4 OS-G

Hydrograph type	= SCS Runoff	Peak discharge	= 0.877 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 3,381 cuft
Drainage area	= 0.169 ac	Curve number	= 77.6
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 8.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



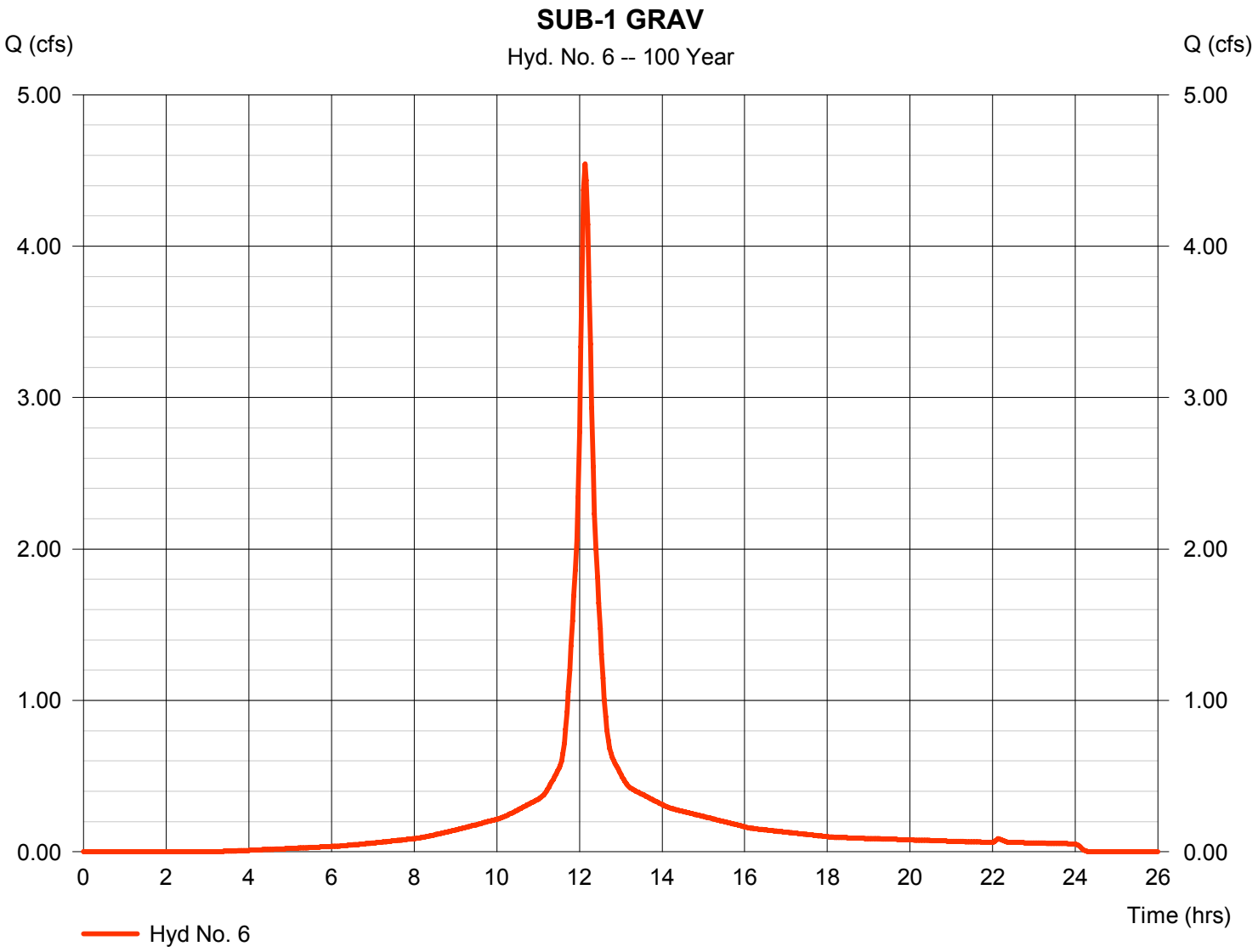
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 6

SUB-1 GRAV

Hydrograph type	= SCS Runoff	Peak discharge	= 4.541 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 18,381 cuft
Drainage area	= 0.733 ac	Curve number	= 89.1
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.46 min
Total precip.	= 8.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



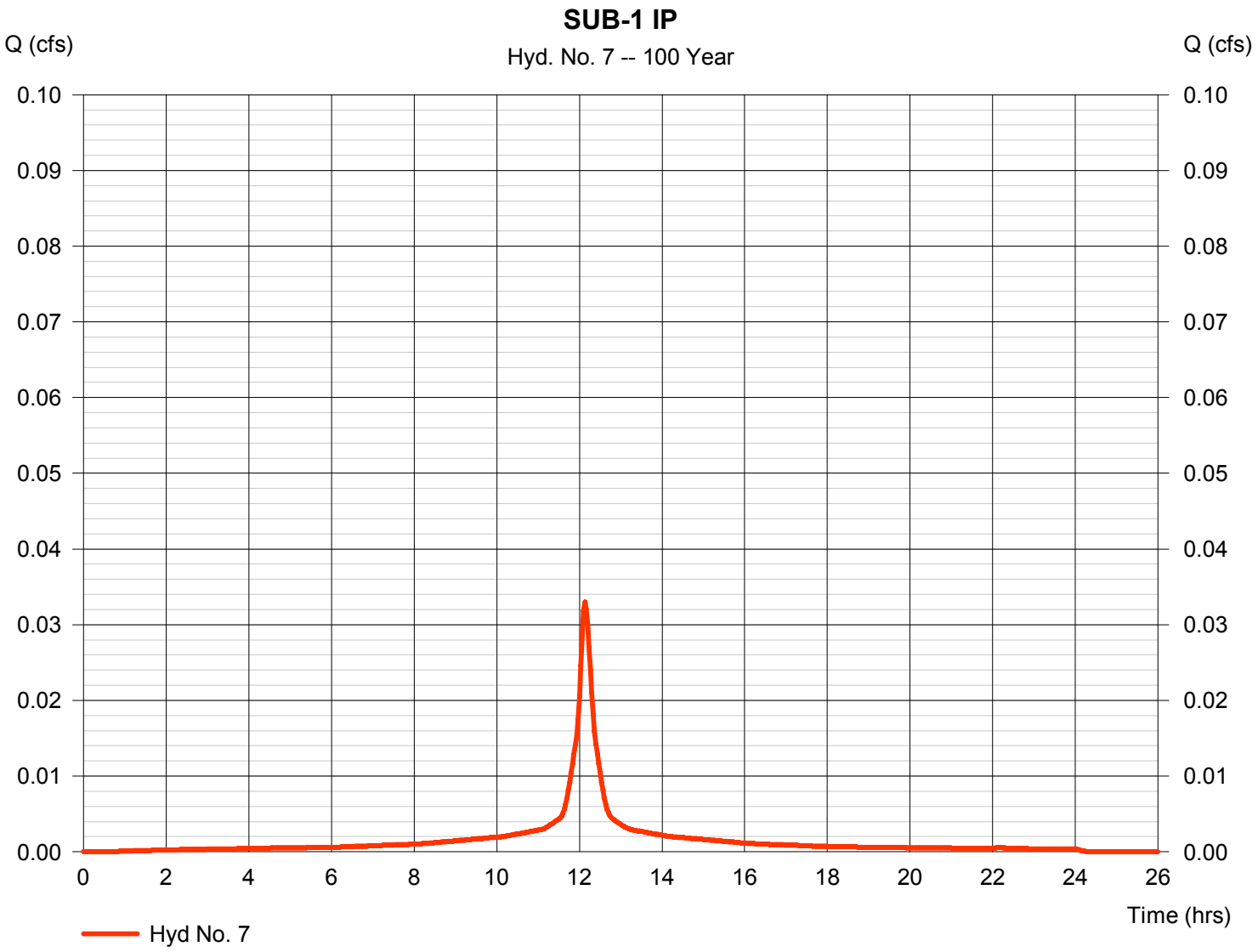
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 7

SUB-1 IP

Hydrograph type	= SCS Runoff	Peak discharge	= 0.033 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 145 cuft
Drainage area	= 0.005 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.46 min
Total precip.	= 8.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



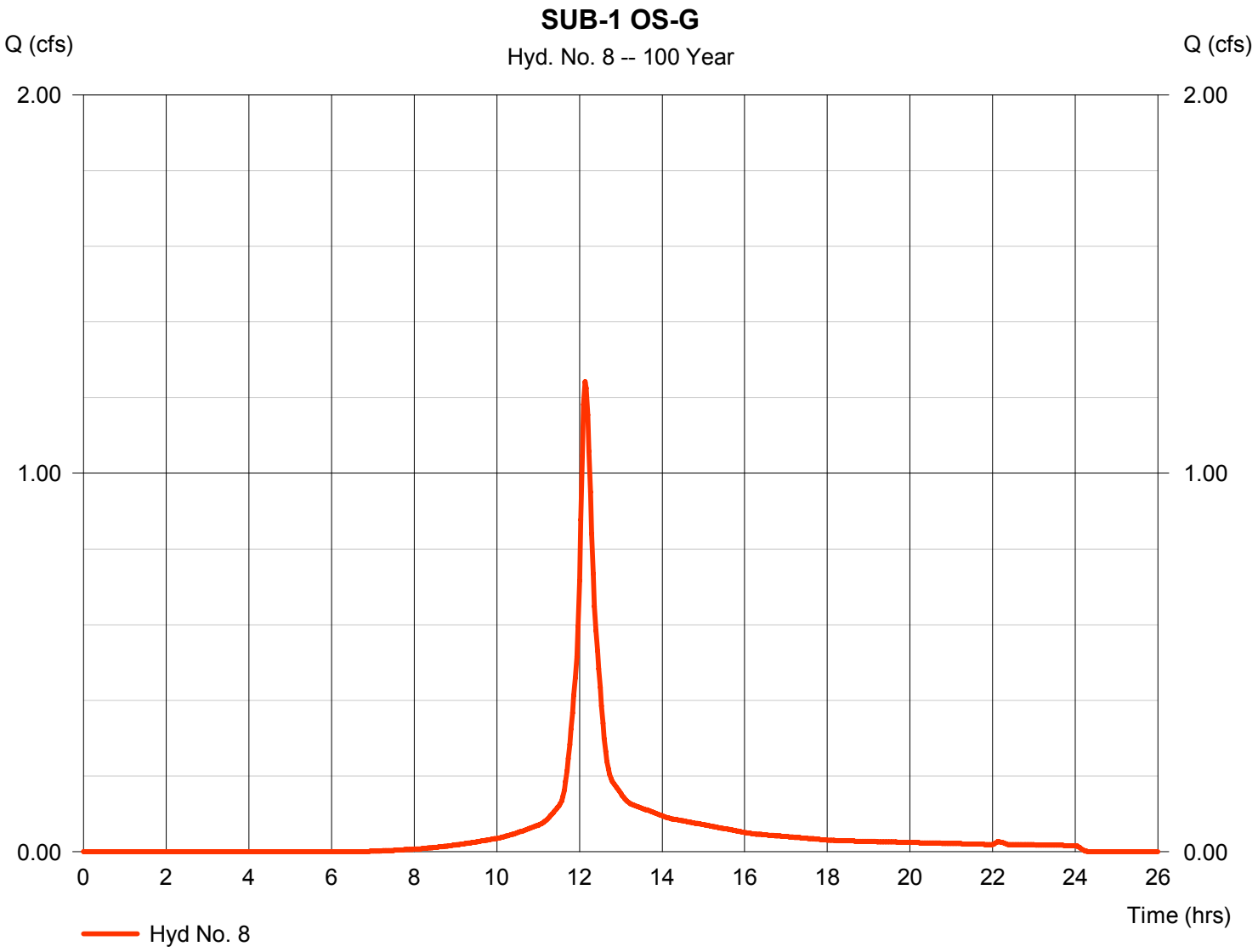
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 8

SUB-1 OS-G

Hydrograph type	= SCS Runoff	Peak discharge	= 1.242 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 4,775 cuft
Drainage area	= 0.249 ac	Curve number	= 75.7
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.46 min
Total precip.	= 8.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



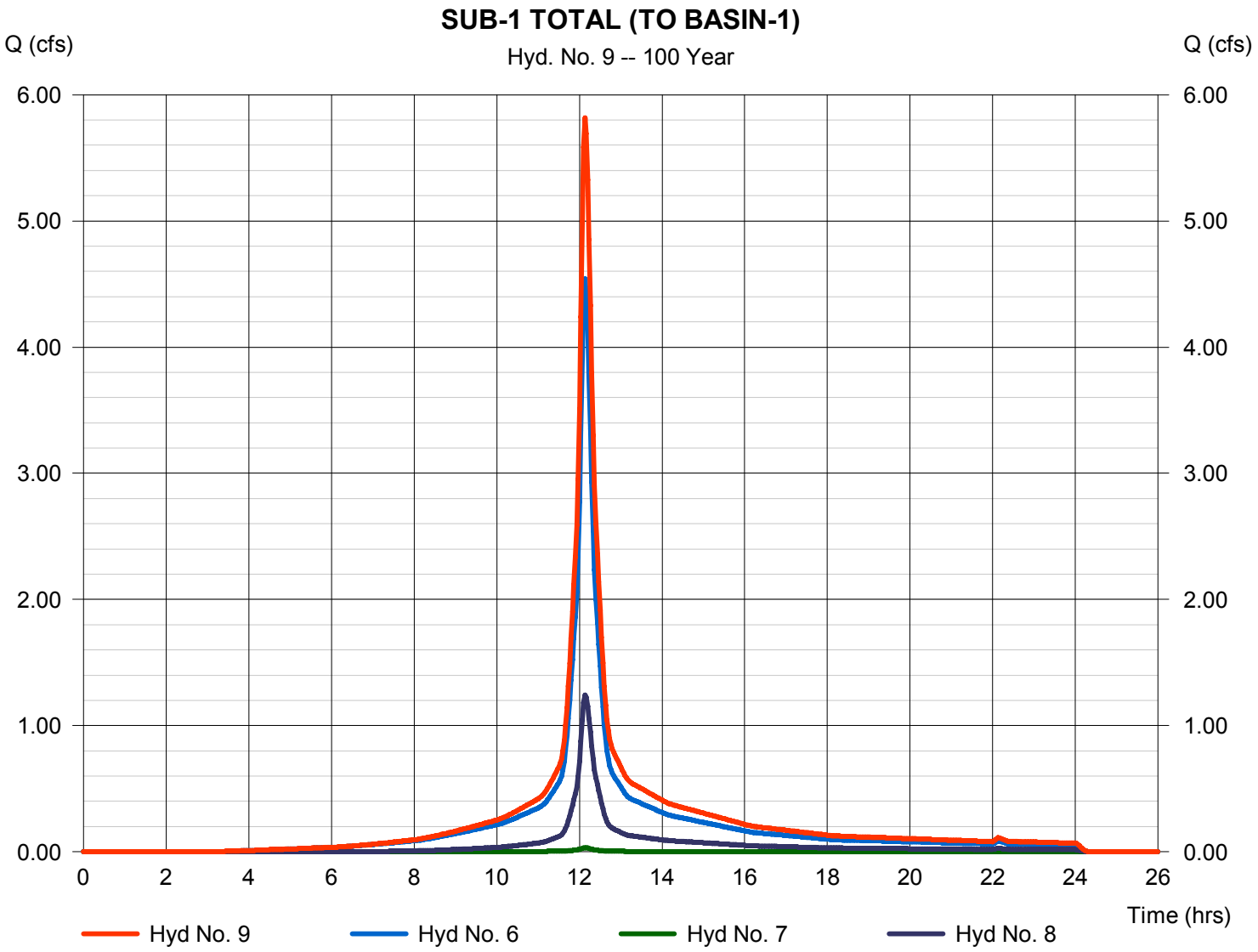
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 9

SUB-1 TOTAL (TO BASIN-1)

Hydrograph type	= Combine	Peak discharge	= 5.816 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 23,301 cuft
Inflow hyds.	= 6, 7, 8	Contrib. drain. area	= 0.987 ac



Hydrograph Report

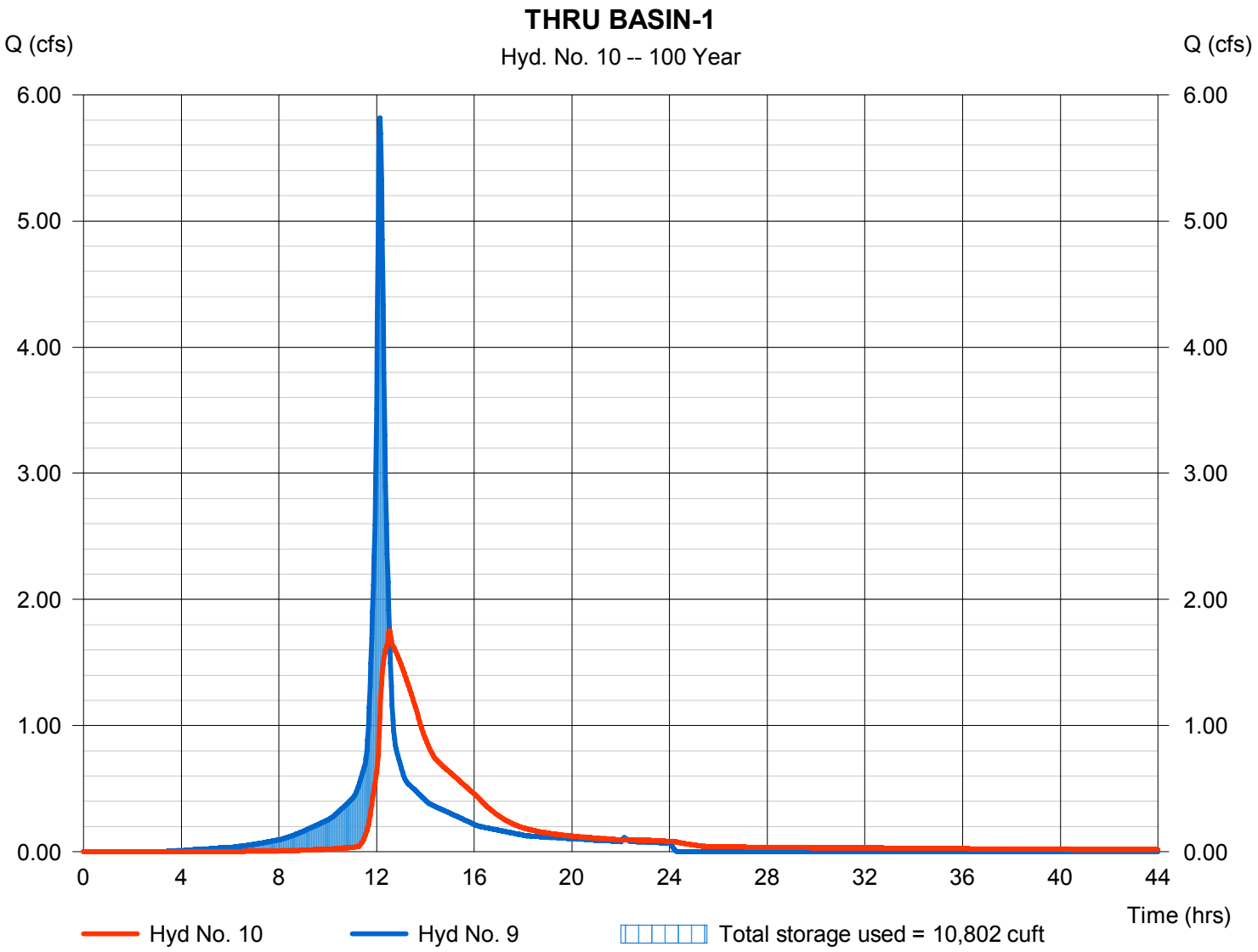
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 10

THRU BASIN-1

Hydrograph type	= Reservoir	Peak discharge	= 1.752 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.53 hrs
Time interval	= 2 min	Hyd. volume	= 23,176 cuft
Inflow hyd. No.	= 9 - SUB-1 TOTAL (TO BASIN-1)	Max. Elevation	= 235.82 ft
Reservoir name	= BASIN-1	Max. Storage	= 10,802 cuft

Storage Indication method used. Outflow includes exfiltration.



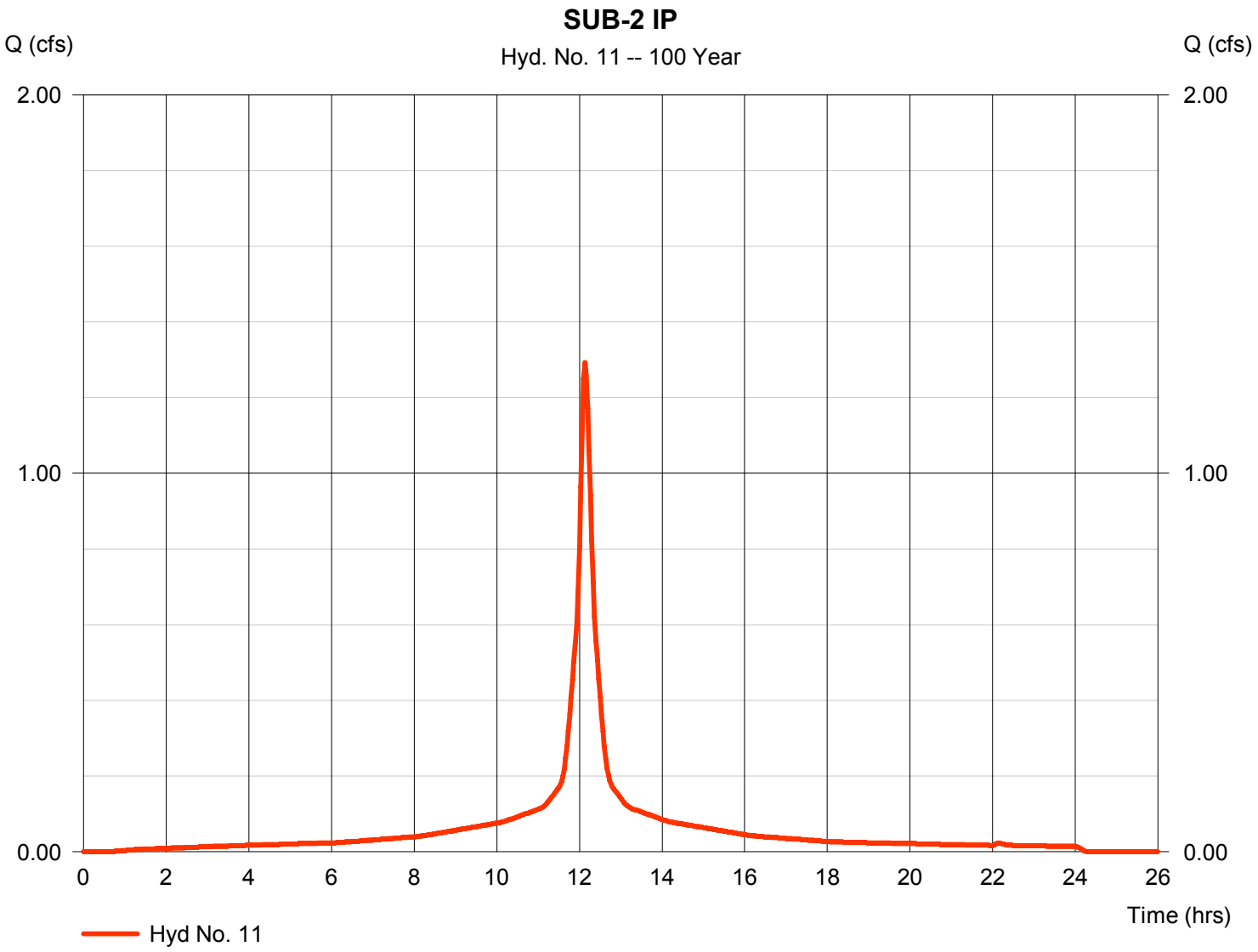
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 11

SUB-2 IP

Hydrograph type	= SCS Runoff	Peak discharge	= 1.293 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 5,694 cuft
Drainage area	= 0.196 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 8.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



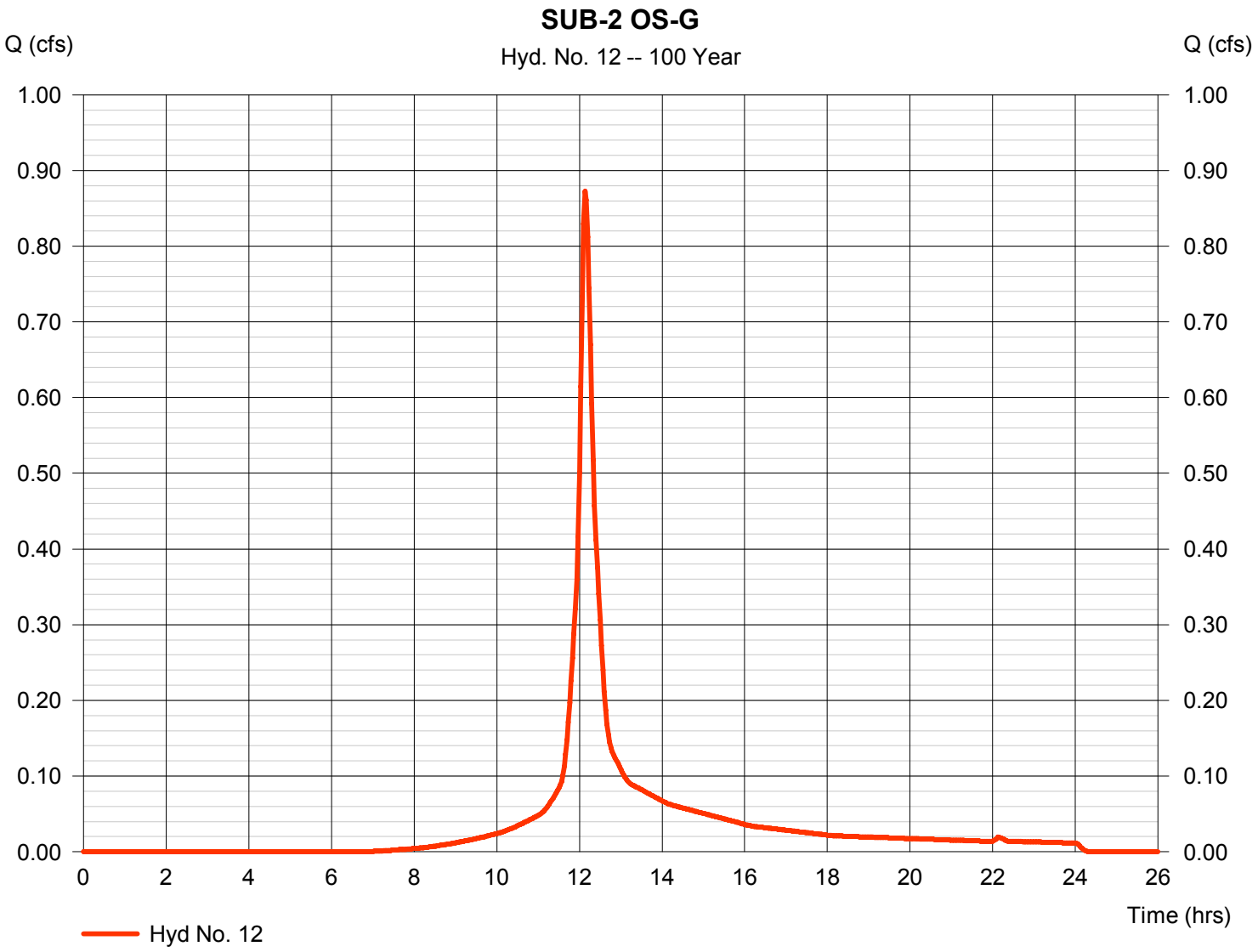
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 12

SUB-2 OS-G

Hydrograph type	= SCS Runoff	Peak discharge	= 0.873 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 3,352 cuft
Drainage area	= 0.178 ac	Curve number	= 74.9
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 8.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



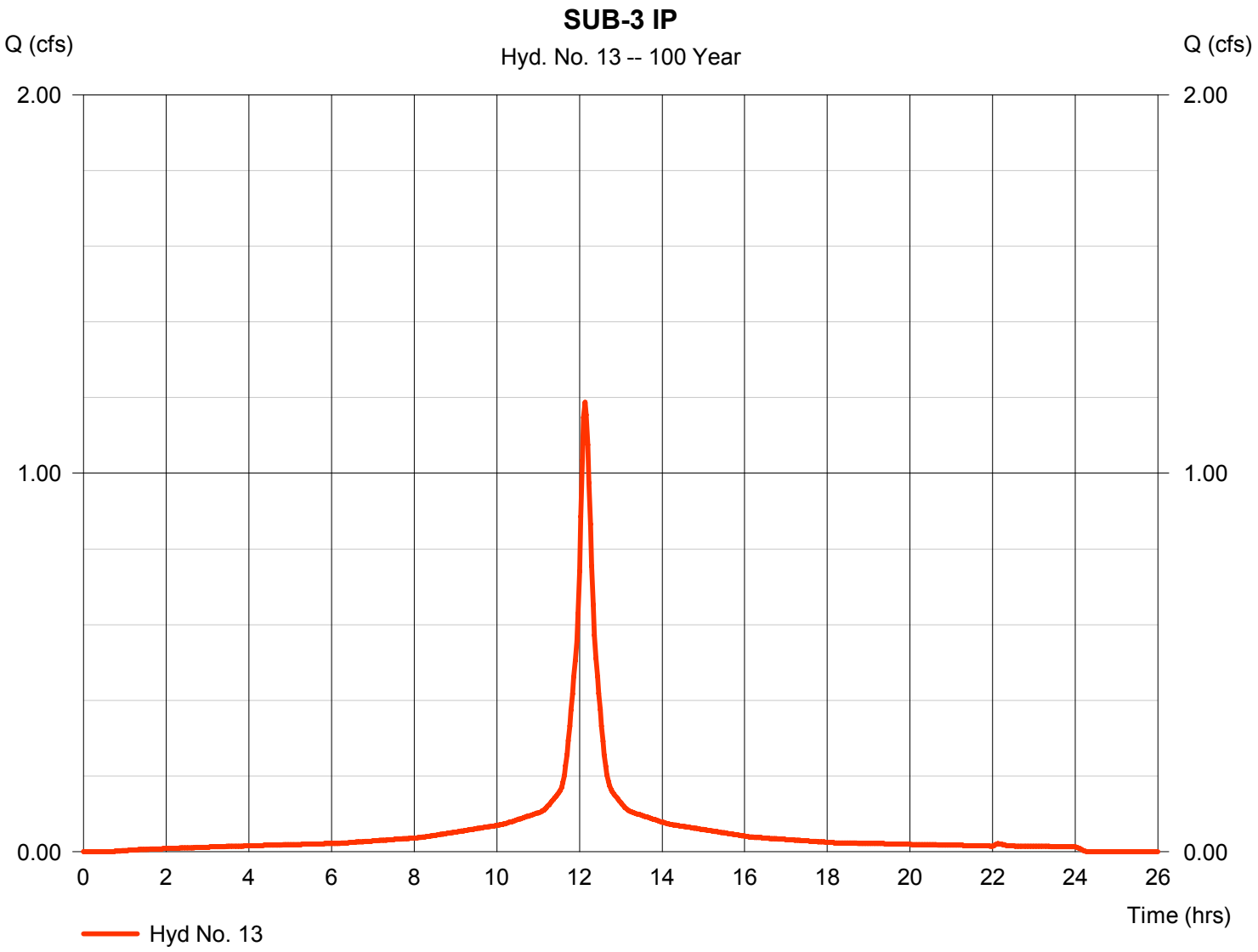
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 13

SUB-3 IP

Hydrograph type	= SCS Runoff	Peak discharge	= 1.187 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 5,229 cuft
Drainage area	= 0.180 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.80 min
Total precip.	= 8.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



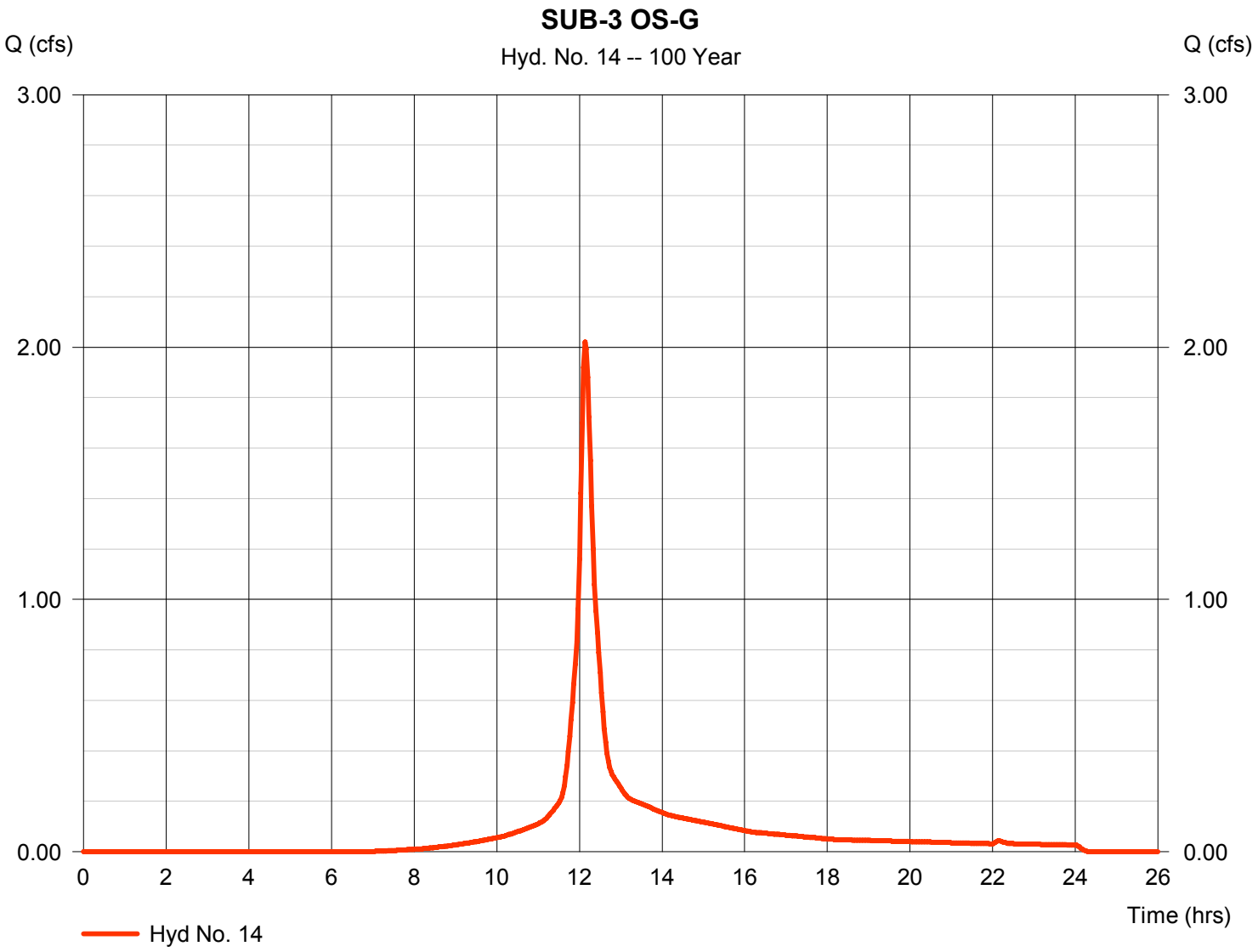
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 14

SUB-3 OS-G

Hydrograph type	= SCS Runoff	Peak discharge	= 2.020 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 7,758 cuft
Drainage area	= 0.412 ac	Curve number	= 74.9
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.80 min
Total precip.	= 8.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



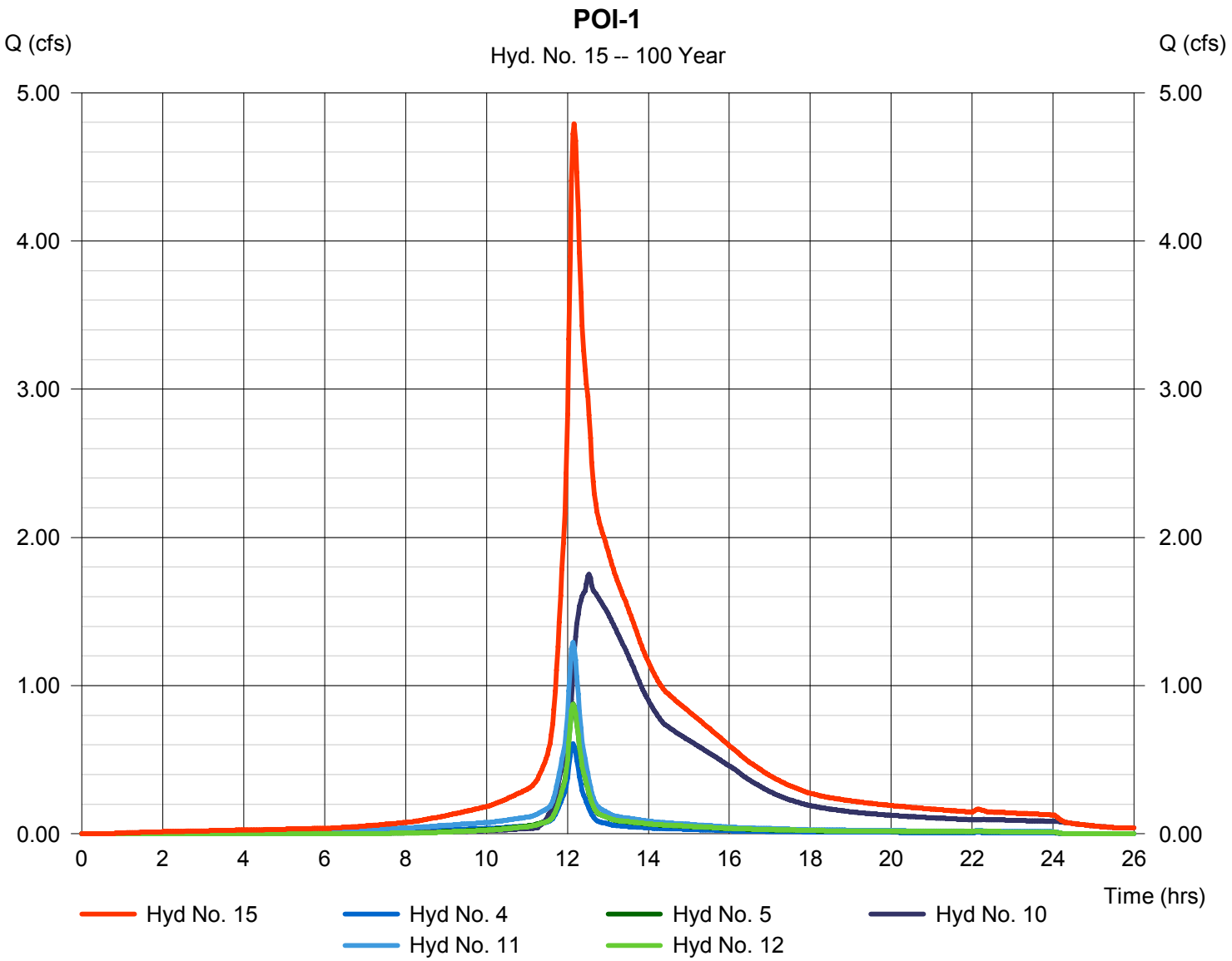
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 15

POI-1

Hydrograph type	= Combine	Peak discharge	= 4.792 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 38,275 cuft
Inflow hyds.	= 4, 5, 10, 11, 12	Contrib. drain. area	= 0.635 ac



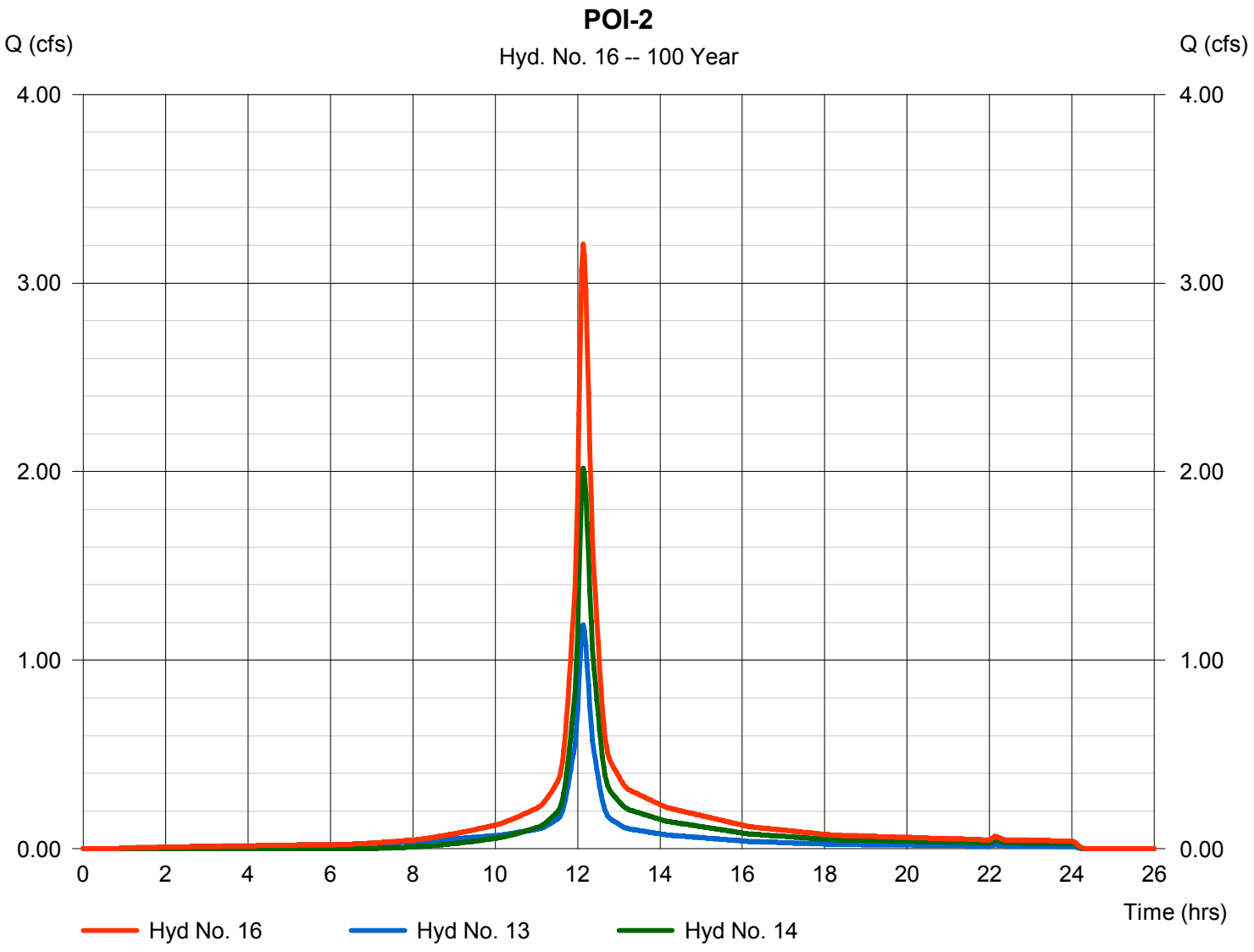
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Hyd. No. 16

POI-2

Hydrograph type	= Combine	Peak discharge	= 3.207 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 12,987 cuft
Inflow hyds.	= 13, 14	Contrib. drain. area	= 0.592 ac



Hydraflow Rainfall Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 07 / 2 / 2019

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	36.9738	16.1000	0.7641	--------
2	94.4784	24.8001	0.9391	--------
3	0.0000	0.0000	0.0000	--------
5	176.2795	30.1001	1.0248	--------
10	317.8354	35.8000	1.1154	--------
25	309.7854	36.4000	1.0685	--------
50	1324.7950	53.7998	1.3207	--------
100	68.0213	20.7000	0.7186	--------

File name: Irvington.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	3.60	3.06	2.67	2.39	2.16	1.98	1.83	1.70	1.60	1.50	1.42	1.35
2	3.90	3.37	2.97	2.66	2.41	2.20	2.03	1.88	1.75	1.64	1.55	1.46
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	4.60	4.01	3.56	3.19	2.90	2.65	2.44	2.26	2.11	1.97	1.86	1.75
10	5.08	4.46	3.98	3.58	3.25	2.98	2.75	2.54	2.37	2.22	2.08	1.96
25	5.80	5.13	4.60	4.17	3.81	3.50	3.24	3.01	2.82	2.64	2.49	2.35
50	6.10	5.48	4.96	4.52	4.14	3.82	3.54	3.29	3.07	2.88	2.71	2.55
100	6.60	5.81	5.21	4.74	4.36	4.05	3.79	3.56	3.36	3.19	3.04	2.90

Tc = time in minutes. Values may exceed 60.

Precip. file name: P:\353754 PennEast\Stormwater\Site 2 - Springville\SW Model\Site2.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	2.64	3.40	0.00	3.94	5.00	6.20	6.73	8.00
SCS 6-Hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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PR-SWM.gpw

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I. Soil Erosion and Sediment Control Calculations

The proposed infiltration basin will be used as a sediment basin during construction (less 6 inches of depth at the bottom, starting at elevation 233.5'). The following calculations were performed per Standards for Soil Erosion and Sediment Control in New Jersey, Section 24-1 (Standard for Sediment Basin).

Design Criteria

Requirement

The basin configuration shall be such that the effective flow length is equal to at least two times the effective flow width.

Minimum basin width shall be:

$$W = 10 \times (Q_5)^{1/2}$$

where: W = the width in ft.

Q_5 = peak discharge from a 5-year frequency storm in cfs.

(2.679 cfs using Watershed Model Schematic in Hydraflow Hydrographs Extension)

$$W = 10 \times 2.377^{1/2}$$

$$W = 15.4 \text{ ft.}$$

Proposed Sediment Basin

Proposed Sediment Basin width = 60 ft.

Proposed Sediment Basin effective flow length with baffle = 120 ft.

Effective flow length = 120 ft. $\geq$ Wx2 = 120 ft. required OK

W = 60 ft. design $\geq$ 15.4 ft. required OK

Sediment Basin Sizing

Requirement

The volume in the sediment basin below the crest elevation emergency spillway (10,139 cubic ft. at elevation 236.0') shall be the larger of:

1. The volume necessary to obtain 70% trap efficiency at the start of the basin's useful life, or
2. The volume necessary to provide sediment storage capacity and provide for temporary stormwater runoff storage from a 2-year frequency, 24-hour duration, Type III storm.

1. Trap Efficiency

C = total capacity of the sediment basin up to the crest elevation of the emergency spillway in acre feet

I = average annual surface runoff from Figure 24-1 converted to units of acre feet

For a normally dry sediment basin, the actual trap efficiency is reduced 10% where the incoming sediment is predominately silt, clay, or fine grained. Entering Curve 24-1 with 80% trap efficiency, ratio of capacity to annual inflow (C/I) = 0.06.

Using Figure 24-1, average annual surface runoff at site location in Hunterdon County = 18 inches

I = 18 inches x drainage area (acres) x 1ft/12in

I = 18 inches x 0.986 acres x 1ft/12in

I = 1.5 acre ft

C/I = 0.06

C/1.5 acre feet = 0.06

C = 0.09 acre feet = 3,920 cubic ft.

2. Sediment Storage Capacity plus 2 Year Storm Runoff Volume

$$V = (DA)(A)(DR)(TE)(1/\gamma_a)(2{,}000 \text{ lbs/ton})(1/43{,}560 \text{ sq. ft./acre})$$

where: V = the volume of sediment trapped in Ac. ft./year

DA = the total drainage area in acres = 0.986 acres

A = the average annual erosion in tons per acre per year based on land use

DR = the delivery ratio determined from Curve 24-2

TE = the trap efficiency as determined = 80% (determined above)

γ_a = the aerated density in a normally dry sediment pool

Using table Land Use type = construction areas in table "Average Annual Erosion by Land Use Type" on page 24-4, average annual erosion (A) = 50 ton/ac/yr.

Using Curve sediment type Silty and drainage area 0.986 acres (0.002 square miles) in Curve 24-2, delivery ratio (DR) = 85%.

Using soil texture Clay-silt-sand mixtures (equal parts) in Table 24-1, the aerated soil density (γ_a) = 90 (average taken).

V = (0.986 acres)(50 ton/ac/yr)(0.85)(0.80)(1/90 cu. ft./lbs)

x (2,000 lbs/ton)(1/43,560 sq. ft./Ac.)

V = 0.017 Ac. ft./yr.

Based on Sequence of Construction on Drawing 025-03-05-001 (SESC General Notes), total estimated time of construction is 160 days. This is used in the following calculation as a conservative value.

Sediment Storage Capacity = (0.017 Ac. ft./yr)(160 days)

x (1/365 yr/days)(43,560 sq. ft./acre)

Sediment Storage Capacity = 325 cubic ft.

The NRCS Type III 2-year Storm Runoff Volume draining to the sediment basin is 7,250 cubic ft.

C = 7,250 cubic ft. + 325 cubic ft.

C = 7,575 cubic ft.

Proposed Sediment Basin

Total capacity of sediment basin = 10,139 cubic ft. design > 7,575 cubic ft. required OK

Sediment Basin Outlets

Requirement

If the sediment basin is de-watered by using a hole in the riser:

> The elevation of the hole shall be the elevation that results in 50% actual trap efficiency in the basin. The value for C used to determine the 50% actual trap efficiency is the capacity of the basin between the bottom of the basin and the invert of the dewatering hole. The riser shall be completely watertight except for the inlet at the top and one hole 4 inches or less in diameter to de-water the basin.

Proposed Sediment Basin

For a normally dry sediment basin, the actual trap efficiency is reduced 10% where the incoming sediment is predominately silt, clay, or fine grained. Entering Curve 24-1 with 60% trap efficiency, ratio of capacity to annual inflow (C/I) = 0.02.

C/I = 0.02

C/1.5 acre feet = 0.02

C = 0.03 acre feet = 1,307 cubic ft.

Basin surface area = 80 ft. length x 60 ft. width = 4,800 sq. ft.

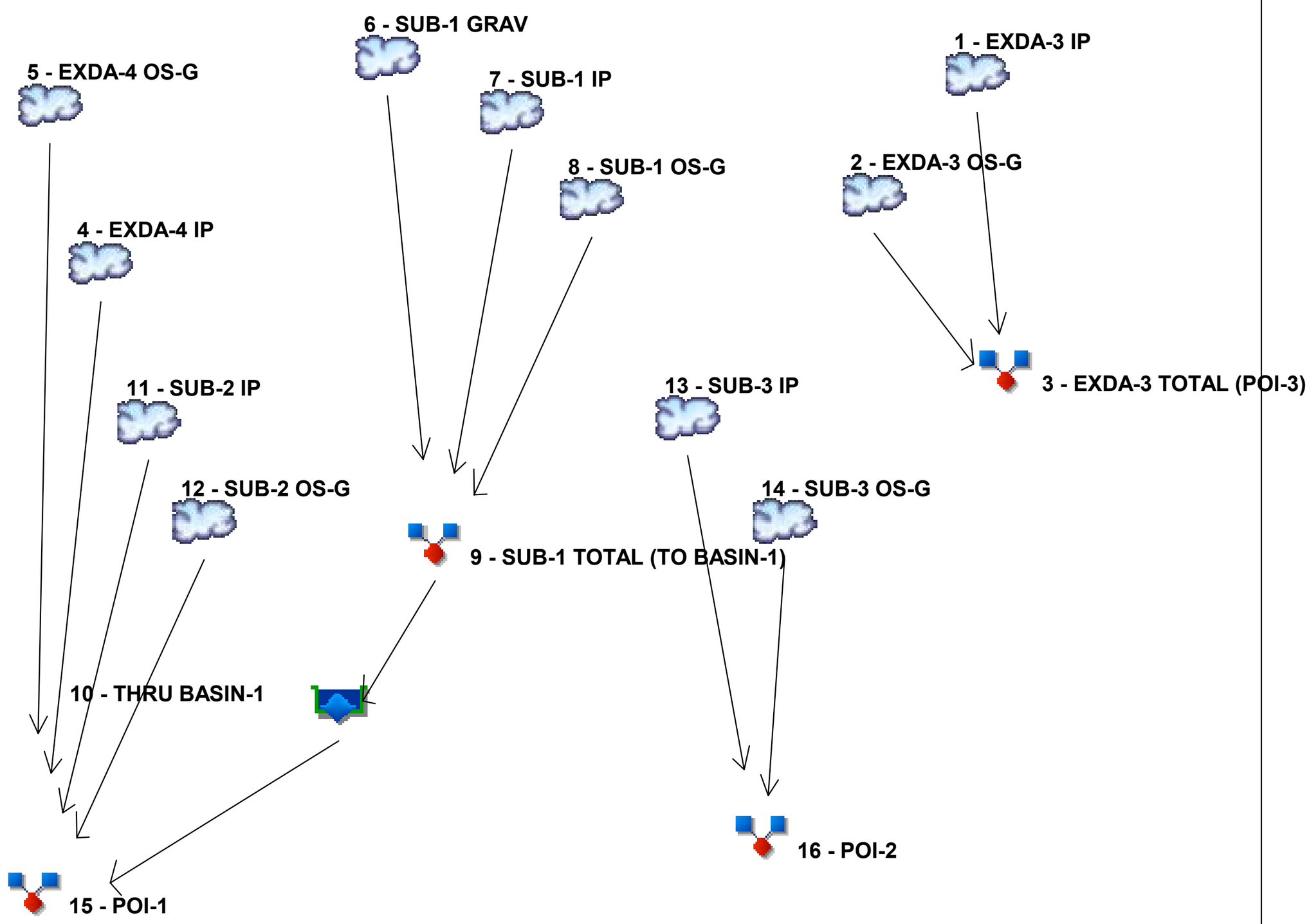
Depth between basin bottom and invert of dewatering hole = 1,307 cubic ft. / 4,800 sq. ft.

Depth between basin bottom and invert of dewatering hole = 0.27 ft.

The proposed permanent outlet structure's 6"Wx4"H orifice will be used to dewater the sediment basin during construction. The 6"Wx4"H orifice is at elevation 234.0', which provides 0.5 ft. of depth between the basin bottom and invert of the dewatering hole. This will provide excess depth for sediment storage and water infiltration.

Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020



Legend

Hyd.	Origin	Description
1	SCS Runoff	EXDA-3 IP
2	SCS Runoff	EXDA-3 OS-G
3	Combine	EXDA-3 TOTAL (POI-3)
4	SCS Runoff	EXDA-4 IP
5	SCS Runoff	EXDA-4 OS-G
6	SCS Runoff	SUB-1 GRAV
7	SCS Runoff	SUB-1 IP
8	SCS Runoff	SUB-1 OS-G
9	Combine	SUB-1 TOTAL (TO BASIN-1)
10	Reservoir	THRU BASIN-1
11	SCS Runoff	SUB-2 IP
12	SCS Runoff	SUB-2 OS-G
13	SCS Runoff	SUB-3 IP
14	SCS Runoff	SUB-3 OS-G
15	Combine	POI-1
16	Combine	POI-2

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)								Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	------	-------	-------	-------	0.661	-------	-------	-------	-------	EXDA-3 IP
2	SCS Runoff	------	-------	-------	-------	0.243	-------	-------	-------	-------	EXDA-3 OS-G
3	Combine	1, 2	-------	-------	-------	0.903	-------	-------	-------	-------	EXDA-3 TOTAL (POI-3)
4	SCS Runoff	------	-------	-------	-------	0.297	-------	-------	-------	-------	EXDA-4 IP
5	SCS Runoff	------	-------	-------	-------	0.295	-------	-------	-------	-------	EXDA-4 OS-G
6	SCS Runoff	------	-------	-------	-------	1.963	-------	-------	-------	-------	SUB-1 GRAV
7	SCS Runoff	------	-------	-------	-------	0.016	-------	-------	-------	-------	SUB-1 IP
8	SCS Runoff	------	-------	-------	-------	0.399	-------	-------	-------	-------	SUB-1 OS-G
9	Combine	6, 7, 8	-------	-------	-------	2.377	-------	-------	-------	-------	SUB-1 TOTAL (TO BASIN-1)
10	Reservoir	9	-------	-------	-------	0.430	-------	-------	-------	-------	THRU BASIN-1
11	SCS Runoff	------	-------	-------	-------	0.632	-------	-------	-------	-------	SUB-2 IP
12	SCS Runoff	------	-------	-------	-------	0.275	-------	-------	-------	-------	SUB-2 OS-G
13	SCS Runoff	------	-------	-------	-------	0.580	-------	-------	-------	-------	SUB-3 IP
14	SCS Runoff	------	-------	-------	-------	0.636	-------	-------	-------	-------	SUB-3 OS-G
15	Combine	4, 5, 10,	-------	-------	-------	1.498	-------	-------	-------	-------	POI-1
16	Combine	11, 12, 13, 14,	-------	-------	-------	1.214	-------	-------	-------	-------	POI-2

J. Basin Summary Forms & Dewatering Calculations

New Jersey Department of Agriculture

Hydrologic Modeling Database – Data Entry Form

Project Site Details

Chpt. 251 Application Number:

Start Date (if known):

Street Address:

County: Hunterdon

Municipality: Holland Township

Block: 26

Lot: 11

NJDEP Anderson Landuse Code (4 digits): 1700

Landuse description: Other Urban or Built-Up Land

Site Centroid Location (NJ State Plane Feet): [1]

Northing: 633384.66 Easting: 307506.33

Project Contact Details

Applicant: PennEast Pipeline Company, LLC

Address: One Meridian Boulevard, Suite 201, Wyomissing PA 19610

Phone: 610-373-7999

Email:

Post Construction Operation & Maintenance:[2]

Party Name: PennEast Pipeline Company, LLC

Address: One Meridian Boulevard, Suite 201, Wyomissing PA 19610

Phone: 610-373-7999

Email:

Party type (HOA, government, private, etc): private

New Jersey Department of Agriculture

Hydrologic Modeling Database – Data Entry Form

Basin Details:[3]

Basin Centroid (NJ State Plane Feet):[4]

Northing: 633281.29 Easting: 307551.40

Basin Type: detention

Construction: excavated

Status phase:[5] Design ☒ As-built ☐

Dam Height (ft) 3 top width (ft) 10

Dam Classification: choose an item

Drainage Area(s) to Basin [note- include any bypass areas][6]

Drainage Area Name	Drainage Area (acres)	Post-Development CN#	Percent Impervious	Time of Concentration (min)
SEE APP C				

Basin Outlet Structure(s)[7]

ID: OS-1

End of Pipe Location:[8] Northing: 633287.73 Easting: 307382.90

Discharge Type[9] (weir, orifice, etc)	Dimensions (diameter, length)	Elevation (USGS)	Discharge [10]Coefficient	Equation Used[11]
ORIFICE	4"H x 6"L	234.00	0.6	RECTANGULAR ORIFICE
ORIFICE	5"	234.75	0.6	CIRCULAR ORIFICE
WEIR	16'	235.85	3.33	WEIR
WEIR	15	236	3.33	WEIR

New Jersey Department of Agriculture

Hydrologic Modeling Database – Data Entry Form

Basin Outlet Structure(s)

ID:

End of Pipe Location: Northing: Easting:

Discharge Type (weir, orifice, etc)	Dimensions (diameter, length)	Elevation (USGS)	Discharge Coefficient	Equation Used

Basin Stage-Discharge Rating Table[12]

Elevation (USGS Feet)	Storage (Acre-Ft)	Total Outlet Structure Discharge (cfs)
SEE APP H		

NJDEP BMP Water Quality Structures[13]

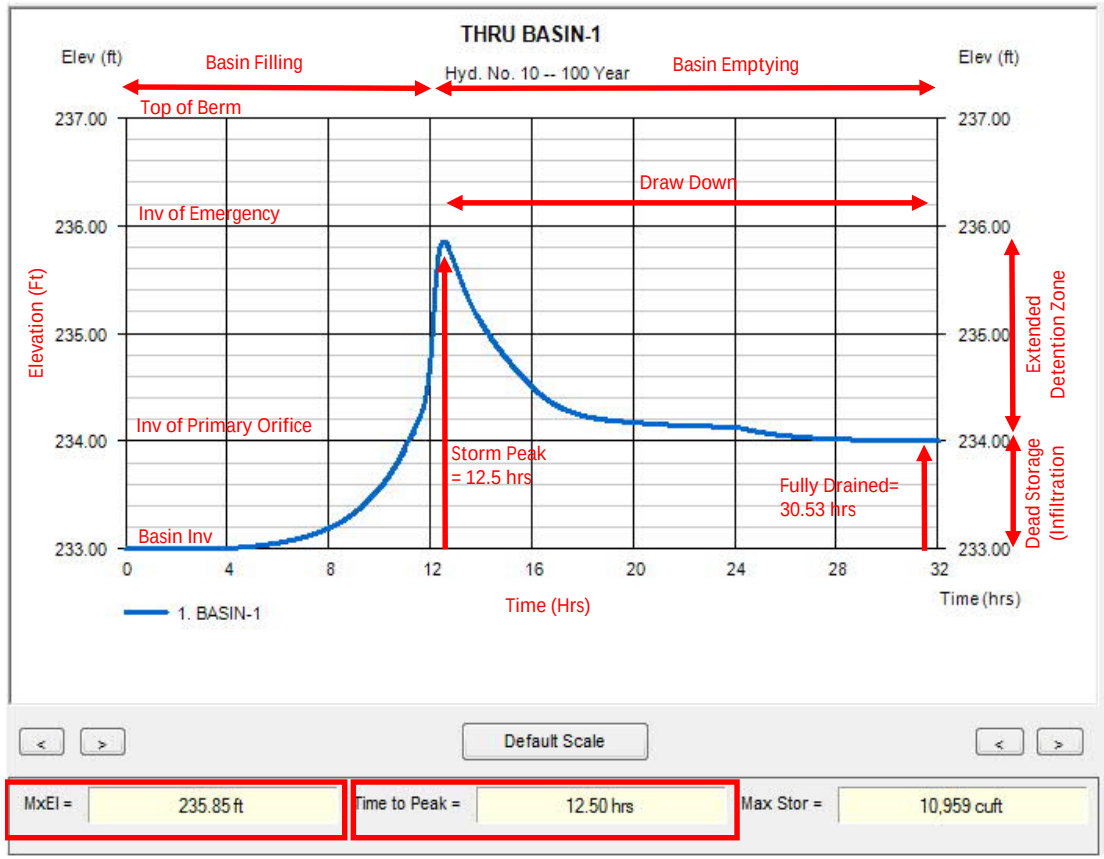
Type (rain garden, green roof, seepage pit etc)	Size	Size Units (cu ft, sq ft etc)	Northing (SPF)	Easting (SPF)
choose an item	NOT APPLICABLE			
choose an item				
choose an item				
choose an item				
choose an item				

Explanatory Notes-

[1] Approximate location of center of site, coordinates in state plane feet
[2] Indicate who will be responsible for permanent operation and maintenance
[3] Additional Basin Detail Pages can be used for more than one basin in a project.
[4] Approximate location of center of basin, coordinates in state plane feet
[5] Indicate "design" for basins not yet constructed
[6] Drainage areas which are modified by construction, but not directed to the basin should still be listed and described
[7] "Outlet structure" means the control box, outlet headwall, FES etc. This does not refer to an individual control on the structure such as a weir or orifice. There are two tables for more than one outlet structure
[8] Approximate location of terminal discharge end of basin outfall, coordinates instate plane feet
[9] Indicate the type of outlet – weir, orifice, hydro brake, etc.
[10] Discharge Coefficient specific to the type of outlet control i.e., 0.6 for circular orifice
[11] List the discharge equation for each outlet (weir, orifice etc) used
[12] For basins with dead storage below the primary outlet, indicate 0 cfs discharge until the lowest outlet is reached. Routing table should begin at the lowest basin elevation.
[13] Describe NJDEP BMP Manual water quality devices such as seepage pits, rain gardens etc. Size is appropriate for device – cubic feet, square feet or linear feet. Location of device using state plane feet coordinates.

BASIN DEWATERING TIME CALCULATIONS

BASIN NAME	BASIN-1	
GLTP-2, IN/HR	0.5	
GLTP-3, IN/HR	0.5	
AVERAGE, IN/HR	0.50	
FOS	1.00	*BASIN FLOOD TEST HAS SAFETY FACTOR BUILT IN
DESIGN RATE, IN/HR	0.50	
INFILTRATION OF STORAGE VOLUME BELOW PRIMARY ORIFICE		
BASIN INV. EL., FT	233.00	
TOP OF DEAD STORAGE EL., FT	234.00	
DELTA 2 DEPTH, IN	12	
DRAIN TIME (1)	24.00	DRAIN TIME FOR DEAD STORAGE BELOW PRIMARY ORIFICE
INFILTRATION OF STORAGE VOLUME ABOVE PRIMARY ORIFICE (THROUGH OUTLET STR)		



Time (hrs)	Elev (ft)
30.40	234.01
30.43	234.01
30.47	234.01
30.50	234.01
30.53	234.00
30.57	234.00
30.60	234.00
30.63	234.00
30.67	234.00
30.70	234.00
30.73	234.00
30.77	234.00
30.80	234.00
30.83	234.00
30.87	234.00
30.90	234.00
30.93	234.00
30.97	234.00
31.00	234.00
31.03	234.00
31.07	234.00
31.10	234.00
31.13	234.00
31.17	234.00
31.20	234.00

DRAIN TIME (2)	18.03	DRAIN TIME FROM 100-YEAR STORM PEAK TO DEAD STORAGE ELEVATION
TOTAL DRAIN TIME (1+2)	42.03	OK

K. Operation and Maintenance of Stormwater Management Facilities

Etown and Gilbert Interconnect Operations and Maintenance Manual for Stormwater Facilities

PennEast Pipeline Project

Date July 28, 2017

PennEast Pipeline Project
353754- Rev0

Mott MacDonald
111 Wood Avenue South
Iselin, NJ 08830-4112
973-379-3400

PennEast Pipeline Company, LLC.
835 Knitting Mills Way
Wyomissing, PA 19610
610-373-7999

Etown and Gilbert Interconnect Operations and Maintenance Manual for Stormwater Facilities

PennEast Pipeline Project

Date July 28, 2017

PennEast Pipeline Project
353754- Rev0

Issue and revision record

Revision	Date	Originator	Checkout	Approver	Descriptor
A	07/28/2017	M. Machalaba	J. Dening	J. Dening	Initial Draft

Information class: **Standard**

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1 Introduction and Project Description

1.1 Need for Stormwater BMPs and Maintenance

Stormwater Best Management Practices (BMPs) are facilities used to reduce the pollution of stormwater runoff, thereby protecting area waterways. These practices also handle and convey stormwater runoff from an area in a safe manner, thereby reducing hazard from flooding and increasing safety. These BMPs require regular maintenance to be able to perform as designed. If the performance of a BMP is compromised due to lack of maintenance, this can lead to flooding in the immediate vicinity as well as downstream locations. A regular maintenance program is the best way to verify that a BMP will consistently perform its intended functions. In addition, regular inspection, maintenance, and corrective actions (as required) of stormwater BMPs will save time and money in the long term.

1.2 Transfer of Responsibilities

In the event the operator responsibilities are transferred to another entity, the current operator shall, within thirty (30) days prior to transfer, notify the Township and NJDEP of such transfer.

Contact Information of Current Operator:

Name – PennEast Pipeline Company, LLC

Address – 835 Knitting Mills Way, Wyomissing PA 19610

Phone Number – 610-373-7999

2 Summary of Proposed Stormwater Management Facilities

2.1 Proposed Facilities on Site

Under proposed conditions, an infiltration basin is proposed to attenuate peak stormwater runoff and provide water quality for this project site. The site is graded to gently slope towards the basin. Offsite runoff will sheet flow into the proposed facility. Proposed stormwater management features are summarized below.

Summary

- **Total number of stormwater management basins = 1**
- **Total number of swales = 0**
- **Total linear feet of swales = 0**
- **Total linear feet of drainage piping = 145**
- **Total number of drainage structures (manholes, inlets, headwalls etc.) = 2**

Details of Proposed Surface Stormwater Features on Site:

- **Infiltration Basin**

All proposed stormwater management features listed above are labeled and identified on the site plans.

3 Summary of Maintenance Required

3.1 Extended Detention Basin and Groundwater Recharge Area

Monthly Inspection:

- Perform a visual inspection of the infiltration basins to check for accumulated trash or sediment deposition on the basin floor.
- Check for standing water on basin floor.
- Check the control structure orifice, weir, and emergency spillways for accumulated trash.
- Perform a visual inspection to confirm the fence around the basin is in good condition, and that there are no damages that will allow undesirable entry.

Quarterly Inspection:

- Check for erosion and bare spots along the embankment. And formation of rills or gullies.
- Inspect the basin after a rainfall event to make sure that runoff drains down within 72 hours.

Preventive Maintenance:

- Infiltration basin shall be inspected for clogging and excessive debris and sediment accumulation at least four times annually, and after every storm exceeding 1 inch of rainfall. Sediment removal shall take place when the basin is thoroughly dry. Disposal of debris, trash, sediment, and other waste material shall be done at suitable disposal/recycling sites and in compliance with all applicable local, state, and federal waste regulations. Inspections shall also address any erosion or scour.
- Basin permeability rates shall be tested periodically. If water fails to infiltrate within 72 hours after the end of a storm, corrective measures shall be taken. Annual tilling by light equipment can assist in maintaining infiltration capacity and break up clogged surfaces. If a drain time exceeds 72 hours after tilling and/or sediment/debris removal has been performed, replacement of the 6” sand layer (or deeper) may be required.
- When establishing or restoring vegetation, biweekly inspections of vegetation health should be performed during the first growing season or until the vegetation is established. Once established, inspections of vegetation health, density, and diversity shall be performed at least twice annually during both the growing and non-growing season (total of 4 inspections annually). If vegetation has greater than 50 percent damage, the area should be reestablished in accordance with the original specifications and the above inspection requirements.
- Grass shall be trimmed at least once per month during the growing season. Unwanted tree growth shall be removed with minimal disruption to the remaining vegetation and subsoil.
- Inlets shall be inspected annually for signs of structural failure and accumulated debris.

3.2 Drainage structures and piping

Monthly Inspection:

- Perform a visual inspection to check accumulated trash or debris in the drainage structures.

Quarterly Inspection:

- Check for settlement near drainage structures.

Preventive Maintenance:

- Remove any trash, leaves, or debris from inlet grates.

Corrective Maintenance:

- If any settlement is observed near drainage structures, the structure and connecting pipes shall be TV inspected promptly to identify any buried structure damage. If buried structure damage is observed, the structure and/ or connecting pipes shall be replaced as necessary.

This plan shall be evaluated annually for effectiveness and updated as needed. A Quarterly Inspection Log, Maintenance Log and Annual Plan Review Log are included with this Stormwater Maintenance Plan and shall be filled out and updated by PennEast in accordance with this plan.

3.3 Cost Estimate for Operation and Maintenance

Maintenance of stormwater facilities detailed herein will be performed by PennEast Pipeline Company, LLC. Maintenance activities will primarily be performed with equipment belonging to PennEast Pipeline Company, LLC.

Quarterly inspection costs – One man hour four times a year.

Inspection costs after rainfall exceeds 1 inch – One man hour eight times a year.

Monthly inspection costs – Two man hours twelve times a year.

Tilling of infiltration basin sand – Four man hours once every five years. Tiller rental @ $200.00 for half a day.

Monthly grass trimming – Two man hours eight times a year.

Etown and Gilbert Interconnects

Township of Holland, Hunterdon County, New Jersey

Infiltration Basin Maintenance Log

Date	Post Rainfall Inspection (Y/N)	Grass Trimming (Y/N)	Notes and Additional Corrective Actions Taken

Retain Original and make additional copies of this form as required. Retain completed log sheets with maintenance plan.

Etown and Gilbert Interconnects

Township of Holland, Hunterdon County, New Jersey

Annual Plan Review Log

Review Date	Plan updates and changes
8 / 2017	Initial Plan

Retain Original and make additional copies of this form as required. Retain completed log sheets with maintenance plan.