

STORMWATER REPORT

Detail Center Town Center Drive & Independence Avenue Lee's Summit, Missouri 64064

Prepared For:

City of Lee's Summit
220 SE Green St
Lee's Summit, MO 64063

Prepared by:

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Project No. 19076



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GENERAL INFORMATION

The proposed commercial development for Lee's Summit Town Center, LLC is located northwest of the intersection of Town Center Drive and Independence Avenue. The total area for the development is this property is approximately 4.02 acres.

The current site soil condition for this property is classified as "Greenton-Urban, 5 to 9 percent Slopes", with a Map Unit Symbol of '2qky4'. The hydrological soil group for this site is Class D. The site lies entirely within 'Zone X', areas determined to be outside the 0.2% annual chance floodplain as depicted on the FEMA Flood Insurance Rate Map (FIRM) no. 29095C0430G, Revision Date: January 20, 2017.



Figure 1 – Location Map (no scale)

METHODOLOGY

KCAPWA IDF curves were used to determine the rainfall intensity for 2, 10, and 100-year storm events. Hydraflow Hydrographs Extension for AutoCAD 2020 was used to determine runoff flow amounts for existing and proposed site conditions. Hydraflow computes the rational method runoff hydrographs by convoluting a rainfall hyetograph through a unit hydrograph. Convolution is known as linear superpositioning where each ordinate of the rainfall hyetograph is multiplied by each ordinate of the unit hydrograph, thus creating a series of hydrographs. These hydrographs are then summed to form the final runoff hydrograph.

EXISTING CONDITIONS

The existing project site location is 4.02 acres, with the entirety of the property being impervious area. Runoff from this site flows from the northwest of the property to east. For analysis the majority of the undeveloped area, encompassed by NE Town Center Boulevard was taken into consideration for runoff volume contribution. The resulting area is approximately 29.35 acres of impervious area. The area for the two existing ponds was added to the overall impervious area contributing to runoff. The total runoff, including the areas for the existing ponds will be taken into account for the detention ponds design.

An existing storm inlet at the east end of the property along NE Independence Avenue allows runoff to be conveyed east toward an existing dedicated drainage area. Refer to Sheet C3.1 “Existing Drainage Map” in Appendix A for the existing drainage patterns for the property.

Table 1 below shows the peak discharges for the 2, 10, and 100-year rainfall events. Refer to Appendix B for Complete Hydraflows Report and results for the existing site conditions.

Table 1 – Existing Site Runoff Hydraflow Results	
Storm Event	Pre-developed Peak Flow (cfs)
2-Yr	35.95
10-Yr	50.20
100-Yr	75.61

PROPOSED CONDITIONS

The existing property will undergo development for a proposed commercial area for Lee's Summit Town Center LLC. The proposed development will increase the impervious area from 0.00 acres to 2.85 acres, with the remaining 29.35 acres as open grass area. Refer to sheet C3.2 "Proposed Drainage Map" in Appendix A for the proposed drainage patterns for the property. The runoff will be collected and conveyed to a detention pond where the existing storm inlet, at the eastern edge of the property, will further convey the runoff towards the existing dedicated drainage area.

Table 2 shows the increase in peak discharge rates for the 2, 10, and 100-year storms rainfall events, due to the increase in impervious area.

Table 2 – Proposed Site Runoff Hydraflow Results without Detention	
Storm Event	Pre-developed Peak Flow (cfs)
2-Yr	41.40
10-Yr	57.80
100-Yr	87.07

In order to mitigate the increase in discharge rates from the site due to the increase in impervious area created by the proposed development, two separate storm networks are proposed to direct runoff to the existing drainage area via the existing storm inlet at the east edge of the property.

Table 3 shows the resulting discharge rates for the 2, 10, and 100-year rainfall events with the proposed storm networks and detention pond.

Table 3 – Proposed Site Runoff Hydraflow Results with Detention	
Storm Event	Post-developed Peak Flow (cfs)
2-Yr	4.49
10-Yr	14.43
100-Yr	32.14

Hydraflow Hydrographs Extension for AutoCAD civil 3D was used to model the post developed site with the proposed storm system. A complete hydrograph can be found in Appendix C.

The above mentioned methodology was used to design the proposed detention pond to effectively capture and discharge the total runoff from the contributing drainage area. The discharge rates are controlled by a proposed storm structure to control peak discharge rates less than the rates yielded by existing conditions. Elevations for different rainfall events were used to set outlet pipe inverts and storm structure openings to effectively discharge the collected runoff while meeting water quality requirements.

For water quality design consideration, a perforated riser is proposed to reach the water quality rainfall event elevation. Perforations within the riser allow for a controlled discharge from the detention pond through the proposed storm network, meeting the minimum forty hour draw down.

Any overflow from the existing pond to the west will be collected and routed via a proposed earthen drainage swale to the north of the proposed development, and then to the detention pond. Outlet pipes convey storm water to existing infrastructure leading to an existing detention area.

A spillway for the proposed detention pond was designed using the 100-yr water surface elevation of 985.19'. Manipulating the design within the Hydraflows program to simulate clogged conditions and zero available storage the spillway crest elevation was set at 985.69' and is 30' in length along the eastern edge of the detention pond. The maximum water elevation under clogged conditions and zero storage is 986'. One foot of freeboard is available as the proposed top of the dam is 987'. The emergency spillway will allow the overflow to drain towards NE Independence Ave, and into the existing storm infrastructure.

SUMMARY

The proposed commercial development for Lee's Summit Town Center, LLC is located northwest of the intersection of Town Center Drive and Independence Avenue increases the amount of impervious area within the property. To account for the increase in runoff, storm networks and a detention basin have been designed to maintain the discharge rates below existing conditions flow rates.

Off-site contributions to runoff have been taken into account for the detention pond design. Outlet pipes and structures control peak discharge rates to less than that of existing conditions, while also meeting water quality requirements for the water quality rainfall event.

Table 4 below provides the discharge rates for the existing and post developed conditions for the 2, 10, and 100-year rainfall events for this site.

Table 4 – Total Runoff Volume Comparison			
Storm Event (yr)	Pre-development Discharge (cfs)	Post-development Discharge (cfs)	Difference (cfs)
2	35.95	4.49	31.46
10	50.20	14.43	35.77
100	75.61	32.14	43.47

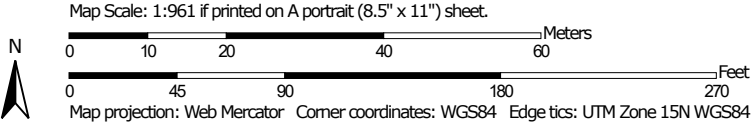
Appendix A

Supporting Data

Soil Map—Jackson County, Missouri



Soil Map may not be valid at this scale.



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

Special Point Features



Blowout



Borrow Pit



Clay Spot



Closed Depression



Gravel Pit



Gravelly Spot



Landfill



Lava Flow



Marsh or swamp



Mine or Quarry



Miscellaneous Water



Perennial Water



Rock Outcrop



Saline Spot



Sandy Spot



Severely Eroded Spot



Sinkhole



Slide or Slip



Sodic Spot



Spoil Area



Stony Spot



Very Stony Spot



Wet Spot



Other



Special Line Features

Water Features



Streams and Canals

Transportation



Rails



Interstate Highways



US Routes



Major Roads



Local Roads

Background



Aerial Photography

MAP INFORMATION

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

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

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

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

Source of Map: Natural Resources Conservation Service

Web Soil Survey URL:

Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Jackson County, Missouri

Survey Area Data: Version 20, Sep 16, 2019

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

Date(s) aerial images were photographed: Sep 6, 2019—Nov 16, 2019

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
10024	Greenton-Urban land complex, 5 to 9 percent slopes	4.0	98.8%
10128	Sharpsburg-Urban land complex, 2 to 5 percent slopes	0.0	1.2%
Totals for Area of Interest		4.0	100.0%

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations (BFEs)** and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Missouri State Plane West Zone (FIPS zone 2403). The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at <http://www.ngs.noaa.gov> or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, NNGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242, or visit its website at <http://www.ngs.noaa.gov>.

Base map information shown on this FIRM was derived from the U.S.D.A. Farm Service National Agriculture Imagery Program (NAIP) dated 2014. Produced at scale of 1:24,000.

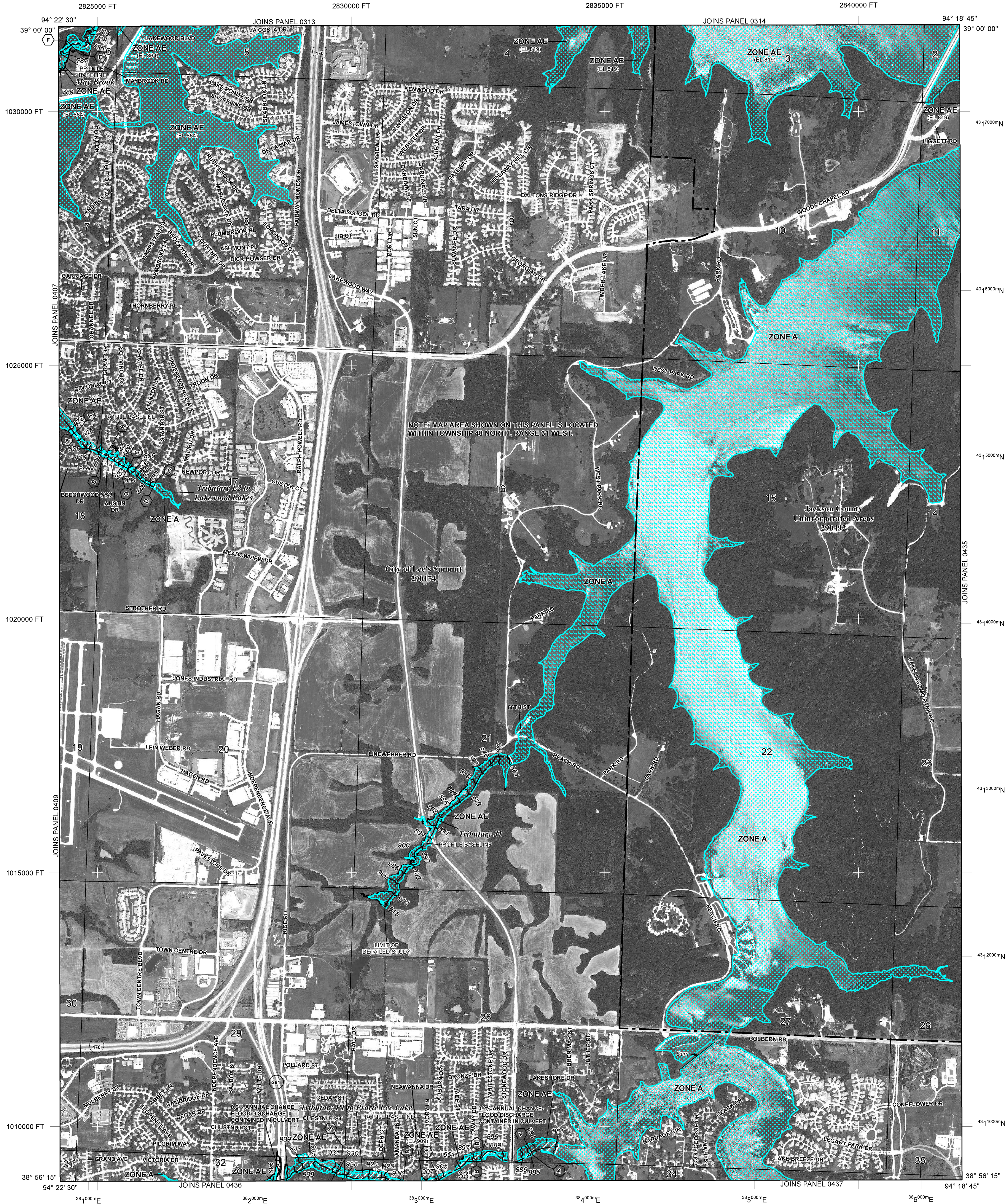
The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Based on updated topographic information, this map reflects more detailed and up-to-date **stream channel configurations** and **floodplain delineations** than those shown on the previous FIRM for this jurisdiction. As a result, the Flood Profiles and Floodway Data tables for multiple streams in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on the map. Also, the road to floodplain relationships for unrevised streams may differ from what is shown on previous maps.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

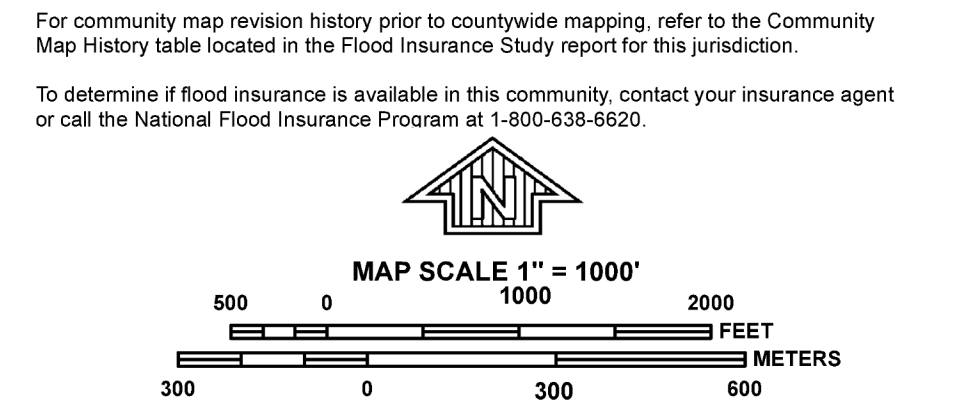
Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels, community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at <http://msc.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.



LEGEND

- SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD**
- The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.
- ZONE A** No Base Flood Elevations determined.
- ZONE AE** Base Flood Elevations determined.
- ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- ZONE AR** Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- ZONE A99** Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- ZONE V** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.
- FLOODWAY AREAS IN ZONE AE**
- The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.
- OTHER FLOOD AREAS**
- ZONE X** Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.
- OTHER AREAS**
- ZONE X** Areas determined to be outside the 0.2% annual chance floodplain.
- ZONE D** Areas in which flood hazards are undetermined, but possible.
- COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS**
- OTHERWISE PROTECTED AREAS (OPAs)**
- CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.
- 1% Annual Chance Floodplain Boundary
- 0.2% Annual Chance Floodplain Boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
- Base Flood Elevation line and value; elevation in feet*
- Base Flood Elevation value where uniform within zone; elevation in feet*
- *Referenced to the North American Vertical Datum of 1988
- Cross section line**
- Transect line**
- Culvert**
- Bridge**
- Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
- 5000-foot ticks: Missouri State Plane West Zone (FIPS Zone 2403), Transverse Mercator projection
- Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 River Mile
- MAP REPOSITORIES**
- Refer to Map Repositories list on Map Index
- EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP**
- September 29, 2006
- EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL**
- January 20, 2017 - to change Special Flood Hazard Areas



NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0430G

FIRM

FLOOD INSURANCE RATE MAP

JACKSON COUNTY, MISSOURI AND INCORPORATED AREAS

PANEL 430 OF 625

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
JACKSON COUNTY	290462	0430	G
LEE'S SUMMIT, CITY OF	290174	0430	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
29095C0430G

MAP REVISED
JANUARY 20, 2017

Federal Emergency Management Agency



Automotive Detail Center
2150 NE Independence Ave
Lee's Summit, Missouri 64064

Drawn by
 SLM
 Checked by
 PAM
 Revisions 

03.24.2020 1

Sheet number
C3.1
Drawing type
Preliminary
Project number

Existing Drainage Area Map

1"=80'

0 40 80 160

Pre-Construction Impervious Area Calculations

Area 1-1
A=9.38 ac
C=0.31

Area 1-2
A=4.49 ac
C=0.30

Area 1-3
A=15.48 ac
C=0.31

Approximate location of transition from sheet flow to concentrated flow

Existing pond to be remain

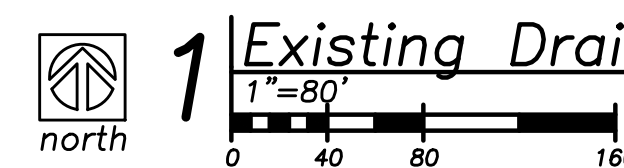
Existing pond to be removed

Existing sanitary sewer line

Existing water line

1/1/2010

 1 Existing Drainage Area Map



		<u>Square Feet</u>	<u>Acres</u>
Area of Site		1,278,486	29.35
Impervious Area		0	0.00
Pervious Area		1,278,486	29.35

Q:	10 year	50.20 cfs
	100 year	75.61 cfs



Local Benchmarks: BM-#

BM-1: Storm Structure, Manhole Cover
Elevation: 982.05'
N: 1013823.1378
E: 2827361.8656

BM-2: Storm Structure, Manhole Cover
Elevation: 1001.21'
N: 1013384.7454
E: 2827199.0101

Floodplain Note:

The site lies entirely within 'Zone X', areas determined to be outside the 0.2% annual chance floodplain as depicted on the FEMA Flood Insurance Rate Map (FIRM) no. 29095C04306, Revision Date: January 20, 2017.

Drainage Legend

- drainage area
- existing flow direction
- proposed flow direction

Property Legend

- right of way
- property lines
- easements
- setbacks

Grading Legend

- existing minor contour
- existing major contour
- proposed minor contour
- proposed major contour

Utility Legend

- existing
- proposed

Symbol Legend

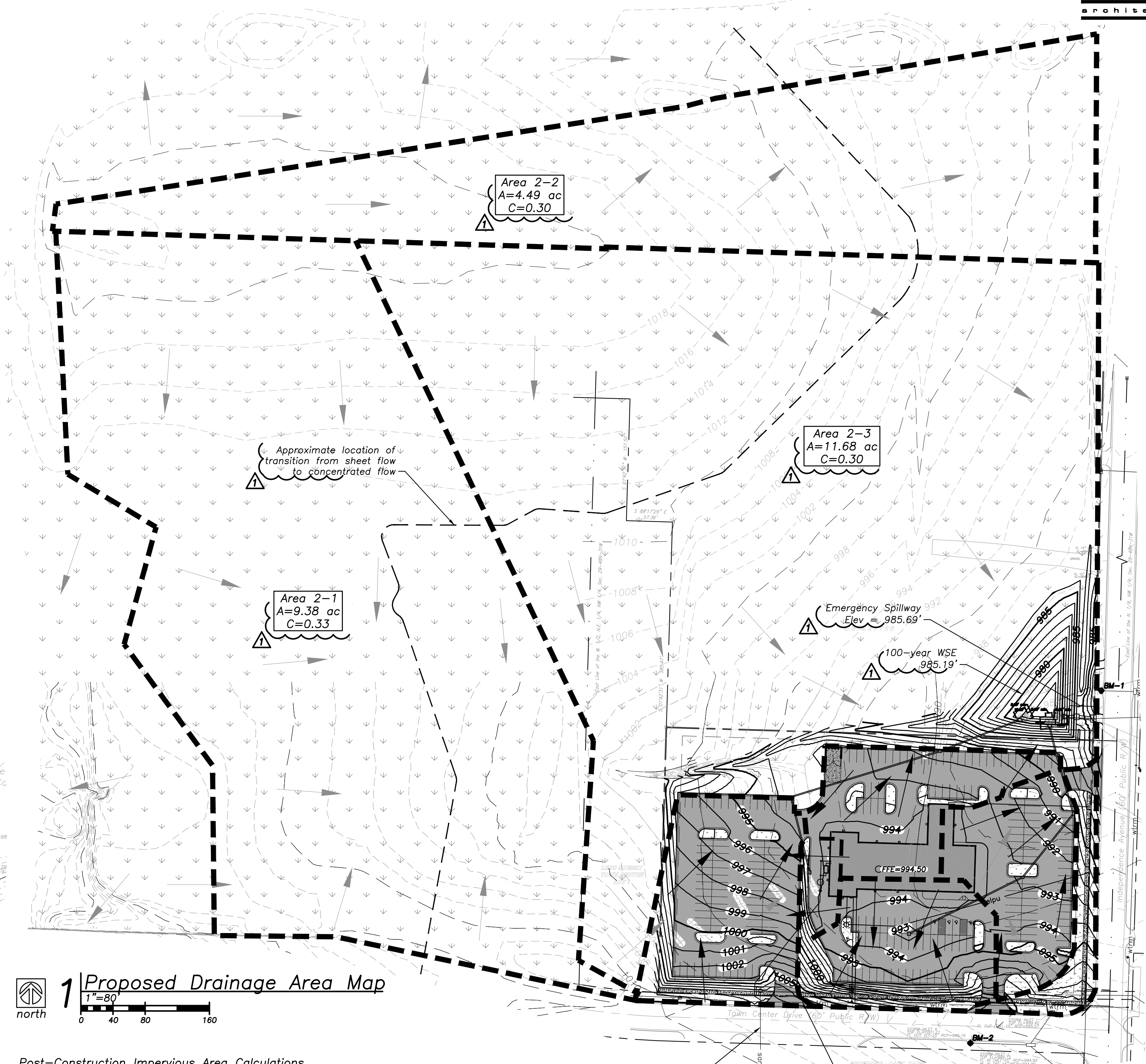
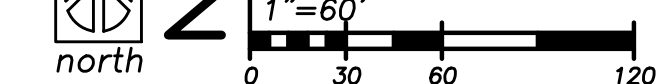
- | | | | |
|------|--------------------------|---|---------------------------------|
| ⊙ | sanitary manhole | T | service transformer (pad mount) |
| ⊙co | service cleanout | S | primary switch gear |
| ⊙fmv | force main release valve | ⊙ | light pole |
| □ | rectangular structure | C | cable/phone/data junction box |
| ○ | circular structure | ⊙ | street light |
| ⊕ | fire hydrant | ⊙ | pedestrian street light |
| ⊙wv | water valve | ⊙ | electric pole |
| M | water meter | → | guy wire |
| BFP | backflow preventer | ▷ | end section |
| ⊙g | natural gas meter | | |

Linetypes

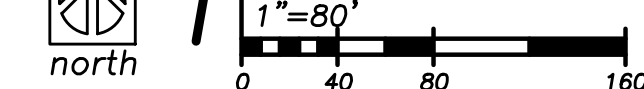
- | | |
|-----------|--------------------------------------|
| --- sanm | sanitary main |
| --- sans | sanitary service |
| --- stnm | storm sewer (existing) |
| --- stns | storm sewer (solid wall, proposed) |
| --- stpm | storm sewer (solid wall, proposed) |
| --- stpr | storm sewer (perforated, proposed) |
| --- wtrm | water main |
| --- wtrf | water service (fire) |
| --- wtrd | water service (domestic) |
| --- wtri | water service (irrigation) |
| --- gasm | natural gas main |
| --- gass | natural gas service schematic |
| --- elpu | underground primary electric |
| --- elsu | underground secondary electric |
| --- elpo | overhead electric |
| --- datu | underground cable/phone/data |
| --- datau | underground cable/phone/data service |
| --- a | fence-chainlink |
| --- b | fence-wood |
| --- c | fence-barbed wire |
| --- d | treeline |



2 Proposed Drainage Area Map Detail



1 Proposed Drainage Area Map



Post-Construction Impervious Area Calculations

	Square Feet	Acres
Area of Site	1,278,486	29.35
Impervious Area	125,453	2.88
Pervious Area	1,153,033	26.47

Q: 10 year 11.67 cfs
100 year 28.34 cfs

4301 Indian Creek Parkway
Overland Park, KS 66207
phone: 913.451.9390
fax: 913.451.9391
www.davidsonae.com



Commercial Preliminary Development Plan for Automotive Detail Center

2150 NE Independence Ave
Lee's Summit, Missouri 64064

date

drawn by
SLM
checked by
PAM
revisions

03.24.2020 1

sheet number

C3.2

drawing type
Preliminary
project number



Local Benchmarks: BM-#

BM-1: Storm Structure, Manhole Cover
Elevation: 982.05'
N: 1013823.1378
E: 2827361.8656

BM-2: Storm Structure, Manhole Cover
Elevation: 1001.21'
N: 1013384.7454
E: 2827199.0101

Property Legend

— right of way
--- property lines
--- easements
--- setbacks

Grading Legend

--- existing minor contour
--- existing major contour
--- proposed minor contour
--- proposed major contour

Utility Legend

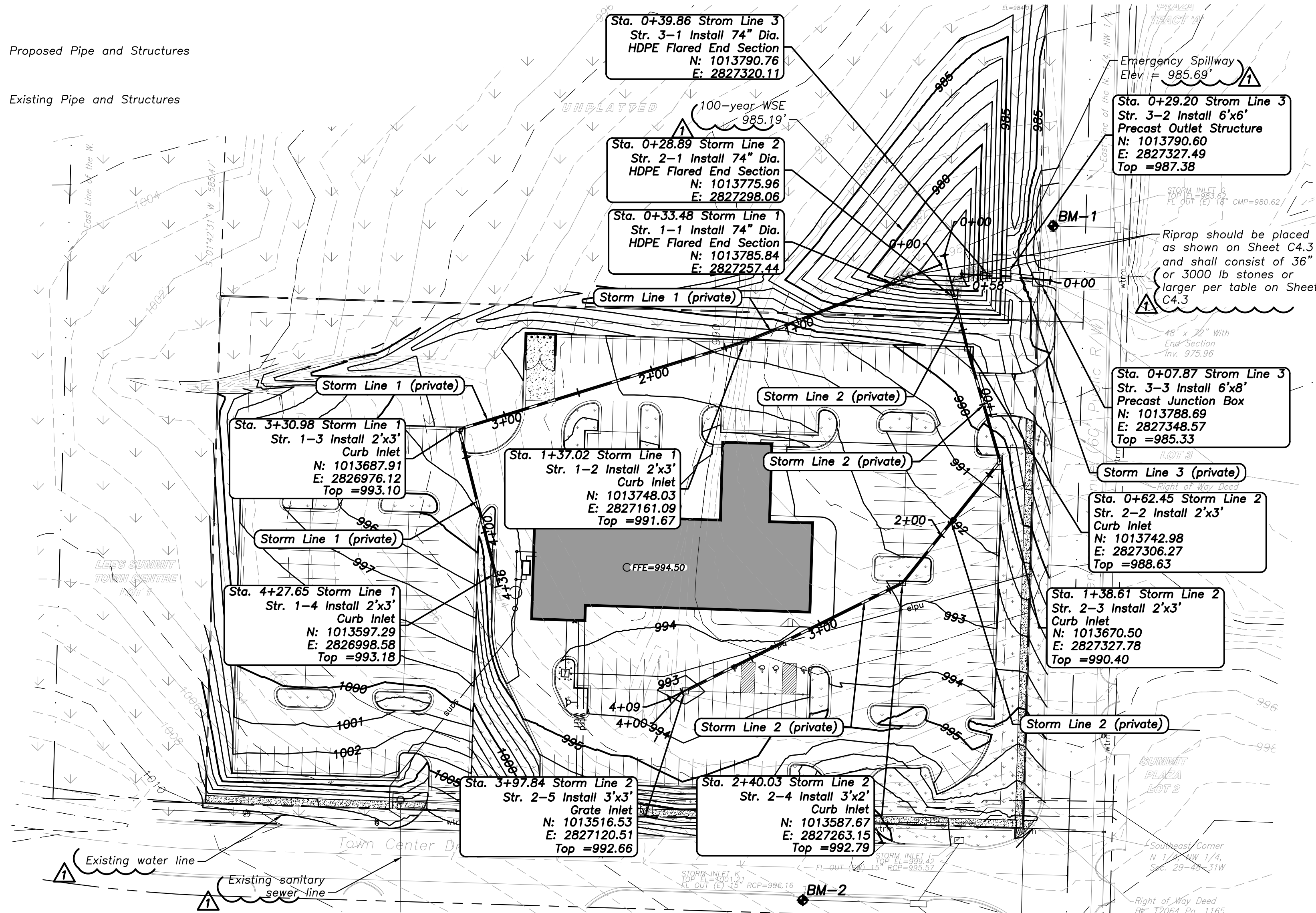
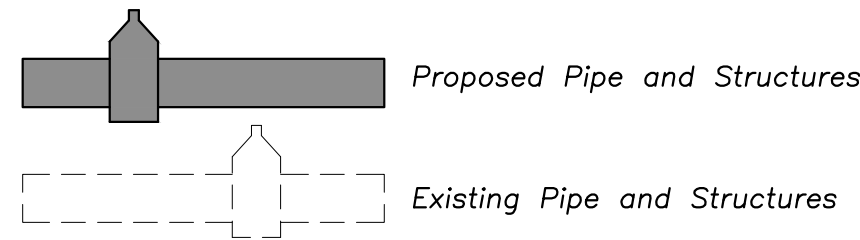
--- existing
--- proposed

Linetypes

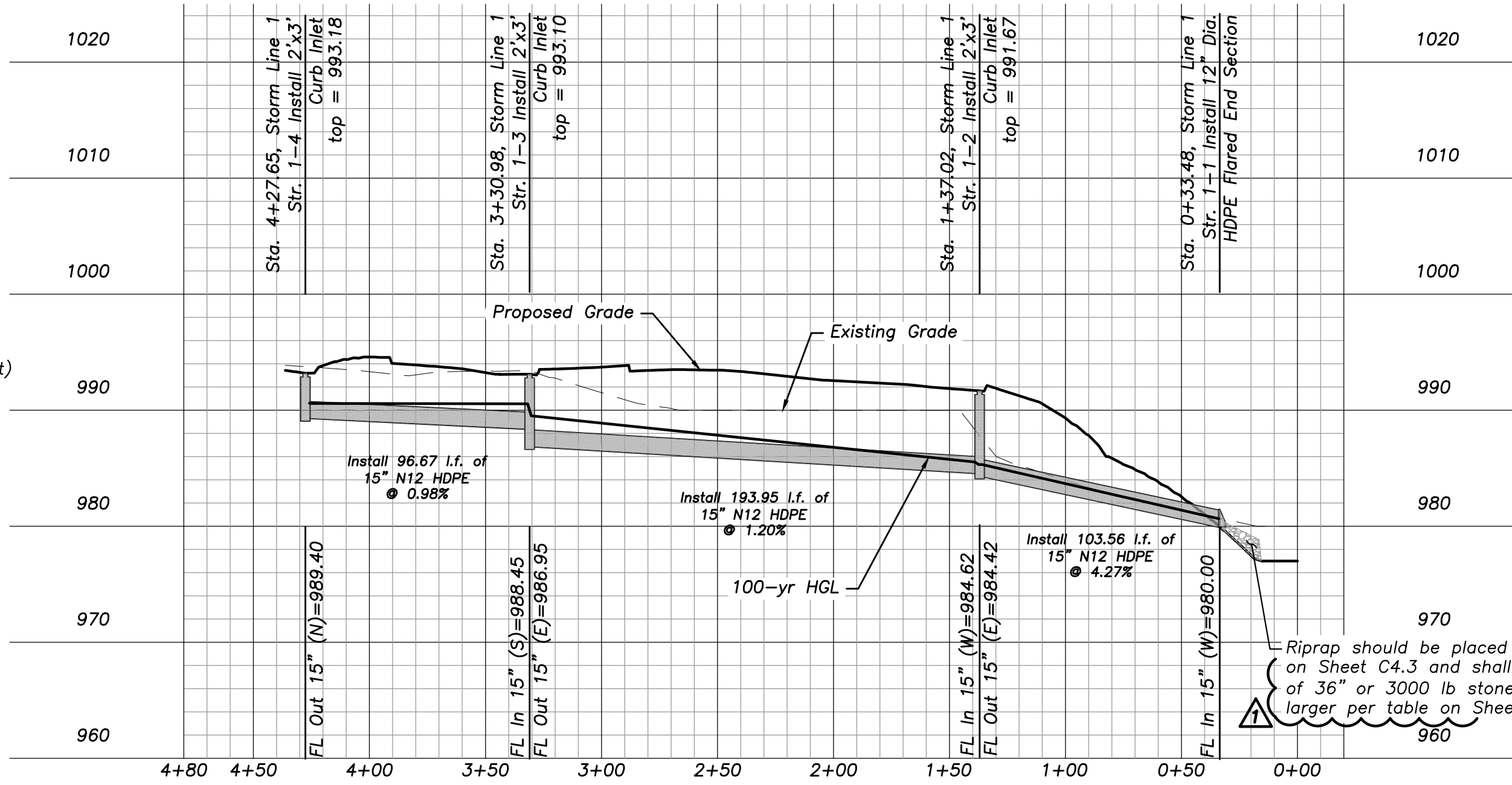
sanm sanitary main
sans sanitary service
ssm storm sewer (existing)
stwm storm sewer (solid wall, proposed)
stwm storm sewer (solid wall, proposed)
stwm storm sewer (perforated, proposed)
wtrm water main
wtrf water service (fire)
wtrd water service (domestic)
wtri water service (irrigation)
gasm natural gas main
gass natural gas service schematic
elpu underground primary electric
alsu underground secondary electric
alpo overhead electric
datu underground cable/phone/data
datsu underground cable/phone/data service
fence-chainlink
fence-wood
fence-barbed wire
treeline

Symbols

sanitary manhole
service cleanout
force main release valve
rectangular structure
circular structure
fire hydrant
water valve
water meter
backflow preventer
natural gas meter
service transformer (pad mount)
primary switch gear
light pole
cable/phone/data junction box
street light
pedestrian street light
electric pole
guy wire
end section



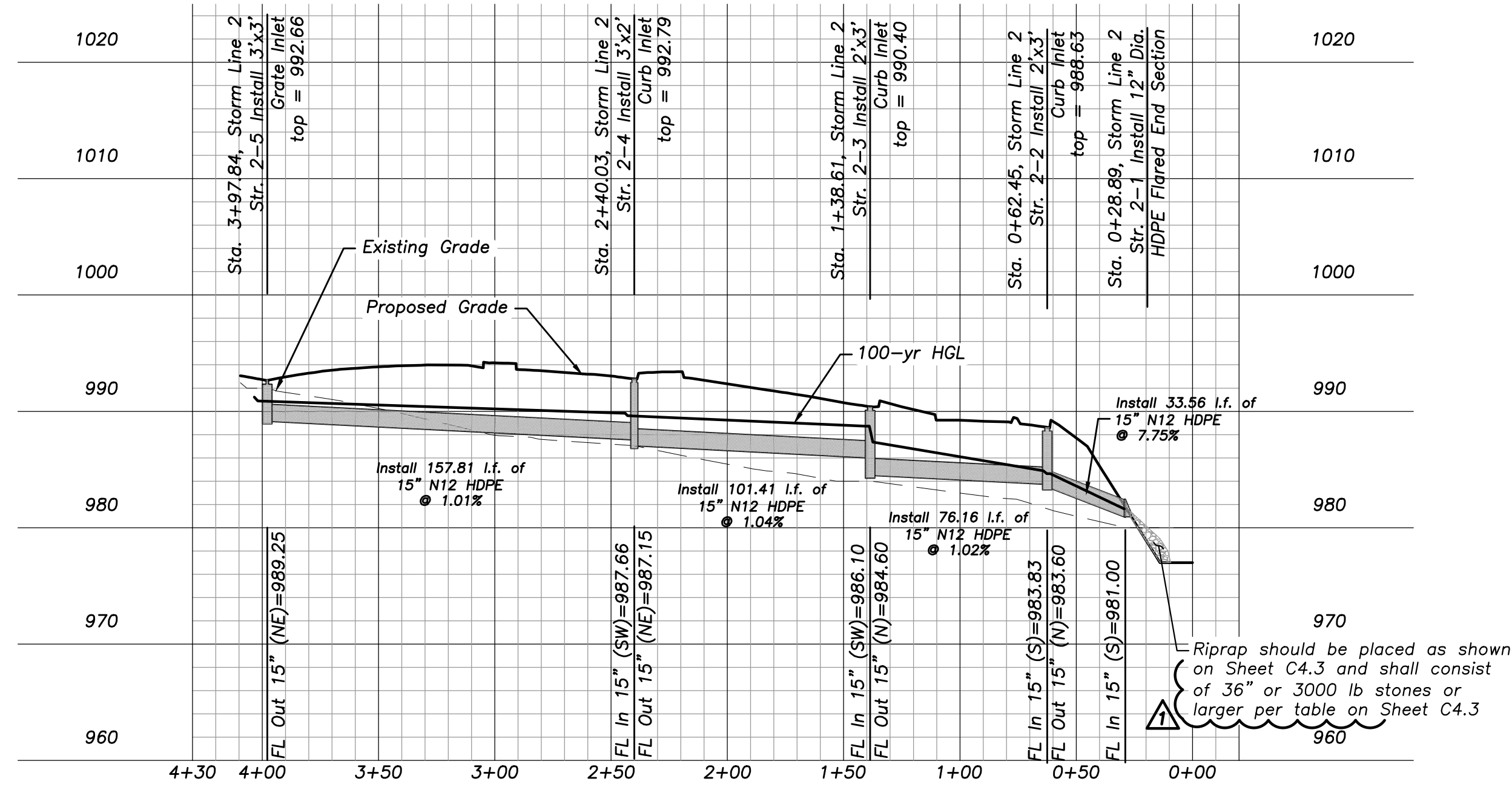
Storm Line 1



Station

Pipe Segment	DrainageArea (ac)	RunoffCoeff (C)	InletTime (min)	IncrQ (cfs)	TotalCxA	iSys (in/hr)	TotalRunoff (cfs)	LineSize (in)	LineSlope (%)	n-valuePipe	CapacityFull (cfs)	DepthDn (ft)	DepthUp (ft)	HGLDn (ft)	HGLUp (ft)	VelAve (ft/s)	EGLDn (ft)	EGLUp (ft)	EnergyLoss	LineLength (ft)	PipeTravel (min)	Rim-Hw (ft)
1-1 to 1-2	0.50	0.86	5.0	4.23	1.5	9.23	13.80	15	4.27	0.012	14.40	0.98	1.23**	980.98	985.65	12.36	982.97	987.64	0.000	103.559	0.14	6.02
1-2 to 1-3	1.12	0.83	5.0	9.14	1.07	9.35	9.97	15	1.20	0.012	7.63	1.25	1.25	985.87	989.84	8.14	986.90	990.88	3.975	194.370	0.40	2.22
1-3 to 1-4	0.16	0.85	5.0	1.34	0.14	9.83	1.34	15	1.01	0.012	7.01	1.25	1.25	990.88	990.91	1.09	990.89	990.93	0.035	94.027	1.43	2.24
2-1 to 2-2	0.19	0.88	5.0	1.64	1.48	9.48	14.06	15	7.80	0.012	19.47	0.79	1.23**	981.79	984.83	14.42	983.85	986.90	0.000	33.341	0.04	3.77
2-2 to 2-3	0.73	0.89	5.0	6.39	1.32	9.52	12.53	15	1.01	0.012	7.00	1.25	1.25	985.08	987.54	10.24	986.71	989.17	2.466	76.266	0.12	1.48
2-3 to 2-4	0.10	0.89	5.0	0.88	0.67	9.64	6.42	15	1.00	0.012	6.97	1.25	1.25	988.91	989.80	5.25	989.34	990.23	0.891	105.005	0.33	2.77
2-4 to 2-5	0.78	0.74	5.0	5.68	0.58	9.83	5.68	15	1.00	0.012	6.96	1.25	1.25	990.02	991.08	4.64	990.35	991.41	1.057	159.472	0.57	1.25

Storm Line 2



Station



Commercial Preliminary Development Plan for
Automotive Detail Center
2150 NE Independence Ave
Lee's Summit, Missouri 64064

date 02.02.2020
drawn by SLM
checked by PAM
revisions

03.24.2020 1

sheet number

C3.3

drawing type
preliminary
project number
19076

Appendix B

Existing Conditions Hydraflow Hydrograph Output Data



Watershed Model Schematic

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

1



Legend

<u>Hyd.</u>	<u>Origin</u>	<u>Description</u>
1	Rational	Existing Conditions

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 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	Rational	-----	28.28	35.95	-----	-----	50.20	-----	64.86	75.61	Existing Conditions
Proj. file: 19076.ExistingConditions.02.11.2020.gpw										Monday, 03 / 23 / 2020	

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 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	Rational	28.28	1	15	25,453	-----	-----	-----	Existing Conditions
19076.ExistingConditions.02.11.2020.gpw					Return Period: 1 Year			Monday, 03 / 23 / 2020	

Hydrograph Report

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

Monday, 03 / 23 / 2020

Hyd. No. 1

Existing Conditions

Hydrograph type	= Rational	Peak discharge	= 28.28 cfs
Storm frequency	= 1 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 25,453 cuft
Drainage area	= 29.350 ac	Runoff coeff.	= 0.33
Intensity	= 2.920 in/hr	Tc by User	= 15.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 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	Rational	35.95	1	15	32,356	-----	-----	-----	Existing Conditions
19076.ExistingConditions.02.11.2020.gpw					Return Period: 2 Year			Monday, 03 / 23 / 2020	

Hydrograph Report

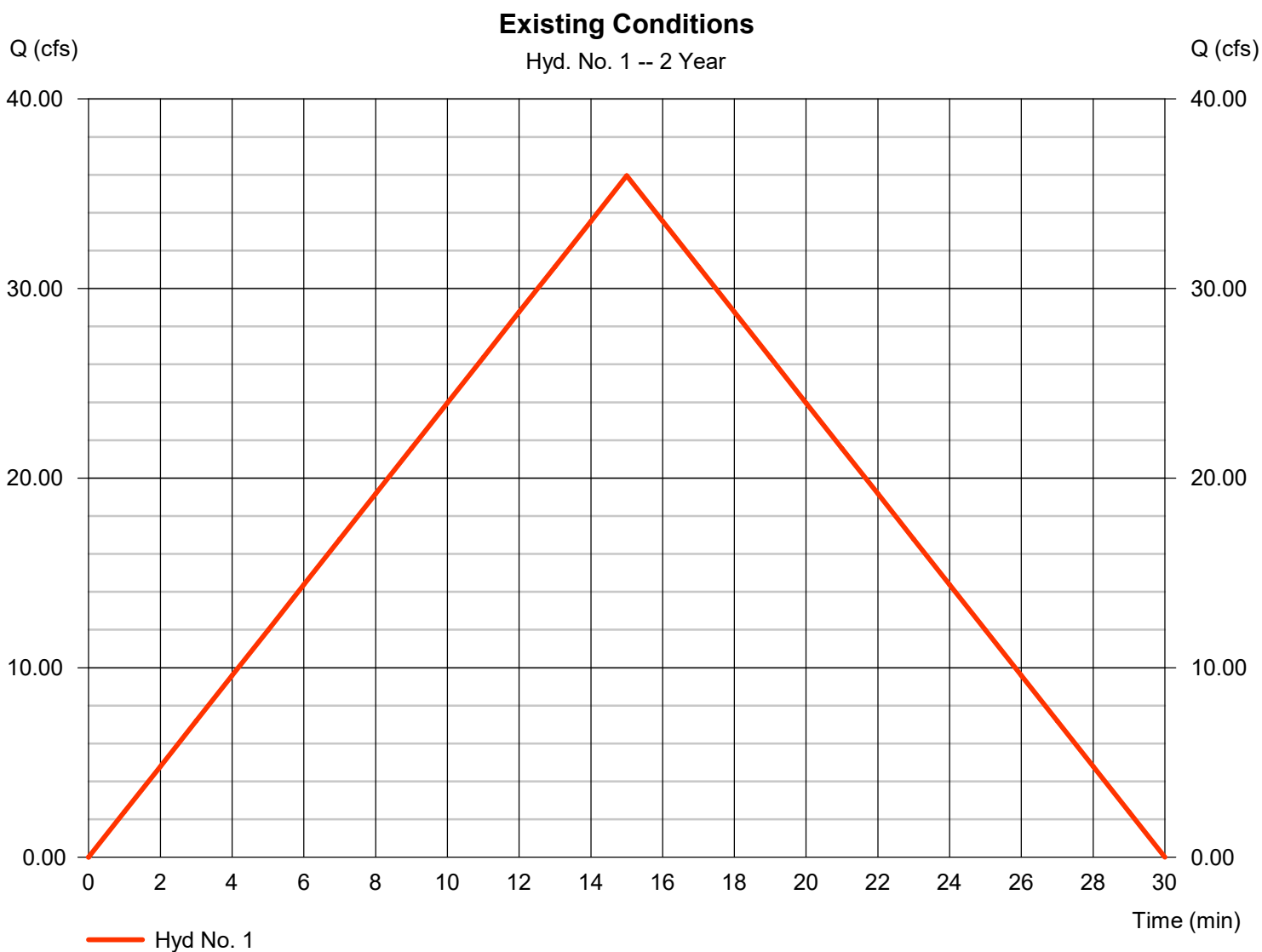
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

Monday, 03 / 23 / 2020

Hyd. No. 1

Existing Conditions

Hydrograph type	= Rational	Peak discharge	= 35.95 cfs
Storm frequency	= 2 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 32,356 cuft
Drainage area	= 29.350 ac	Runoff coeff.	= 0.33
Intensity	= 3.712 in/hr	Tc by User	= 15.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 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	Rational	50.20	1	15	45,176	-----	-----	-----	Existing Conditions
19076.ExistingConditions.02.11.2020.gpw					Return Period: 10 Year			Monday, 03 / 23 / 2020	

Hydrograph Report

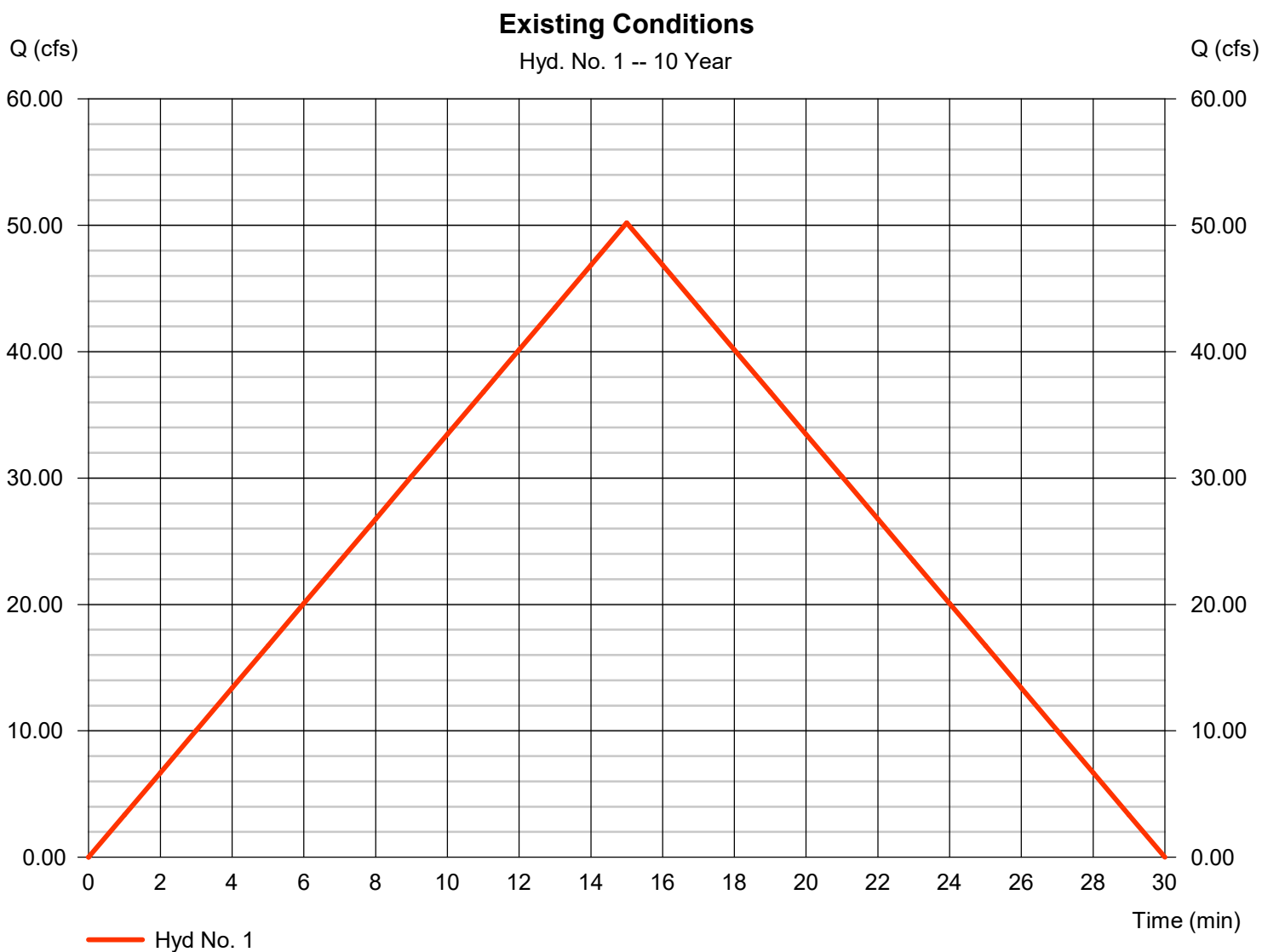
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

Monday, 03 / 23 / 2020

Hyd. No. 1

Existing Conditions

Hydrograph type	= Rational	Peak discharge	= 50.20 cfs
Storm frequency	= 10 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 45,176 cuft
Drainage area	= 29.350 ac	Runoff coeff.	= 0.33
Intensity	= 5.183 in/hr	Tc by User	= 15.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 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	Rational	75.61	1	15	68,053	-----	-----	-----	Existing Conditions
19076.ExistingConditions.02.11.2020.gpw					Return Period: 100 Year			Monday, 03 / 23 / 2020	

Hydrograph Report

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

Monday, 03 / 23 / 2020

Hyd. No. 1

Existing Conditions

Hydrograph type	= Rational	Peak discharge	= 75.61 cfs
Storm frequency	= 100 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 68,053 cuft
Drainage area	= 29.350 ac	Runoff coeff.	= 0.33
Intensity	= 7.807 in/hr	Tc by User	= 15.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1



Hydraflow Rainfall Report

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

Monday, 03 / 23 / 2020

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	2.9200	0.1000	0.0000	-----
2	110.7137	16.5000	0.9842	-----
3	0.0000	0.0000	0.0000	-----
5	168.3971	19.5000	1.0189	-----
10	183.3473	19.2000	1.0096	-----
25	103.5313	15.9000	0.8218	-----
50	235.4014	19.9000	1.0020	-----
100	83.7894	6.1000	0.7783	-----

File name: KCAPWA.IDF

$$\text{Intensity} = B / (T_c + D)^E$$

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92
2	5.41	4.40	3.71	3.21	2.83	2.53	2.29	2.09	1.92	1.78	1.66	1.55
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	6.47	5.35	4.56	3.98	3.52	3.16	2.86	2.62	2.41	2.24	2.08	1.95
10	7.35	6.08	5.18	4.52	4.00	3.59	3.26	2.98	2.74	2.54	2.37	2.22
25	8.51	7.14	6.17	5.46	4.90	4.46	4.10	3.79	3.54	3.31	3.12	2.95
50	9.39	7.82	6.70	5.86	5.20	4.68	4.25	3.90	3.60	3.34	3.12	2.92
100	12.87	9.64	7.81	6.62	5.77	5.14	4.65	4.25	3.92	3.65	3.41	3.21

T_c = time in minutes. Values may exceed 60.

Precip. file name: P:\DAE Civil\Hydraflow Storm Sewer\SCS Custom Water Quality.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	1.37	3.50	0.00	4.50	5.30	6.10	6.90	7.50
SCS 6-Hr	0.00	1.80	0.00	0.00	2.60	2.90	0.00	4.00
Huff-1st	0.00	1.55	0.00	2.75	4.00	5.38	6.50	8.00
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	1.75	0.00	2.80	3.90	5.25	6.00	7.10

Watershed Model Schematic..... 1

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1 - Year

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2 - Year

Summary Report..... 5

Hydrograph Reports..... 6

 Hydrograph No. 1, Rational, Existing Conditions..... 6

10 - Year

Summary Report..... 7

Hydrograph Reports..... 8

 Hydrograph No. 1, Rational, Existing Conditions..... 8

100 - Year

Summary Report..... 9

Hydrograph Reports..... 10

 Hydrograph No. 1, Rational, Existing Conditions..... 10

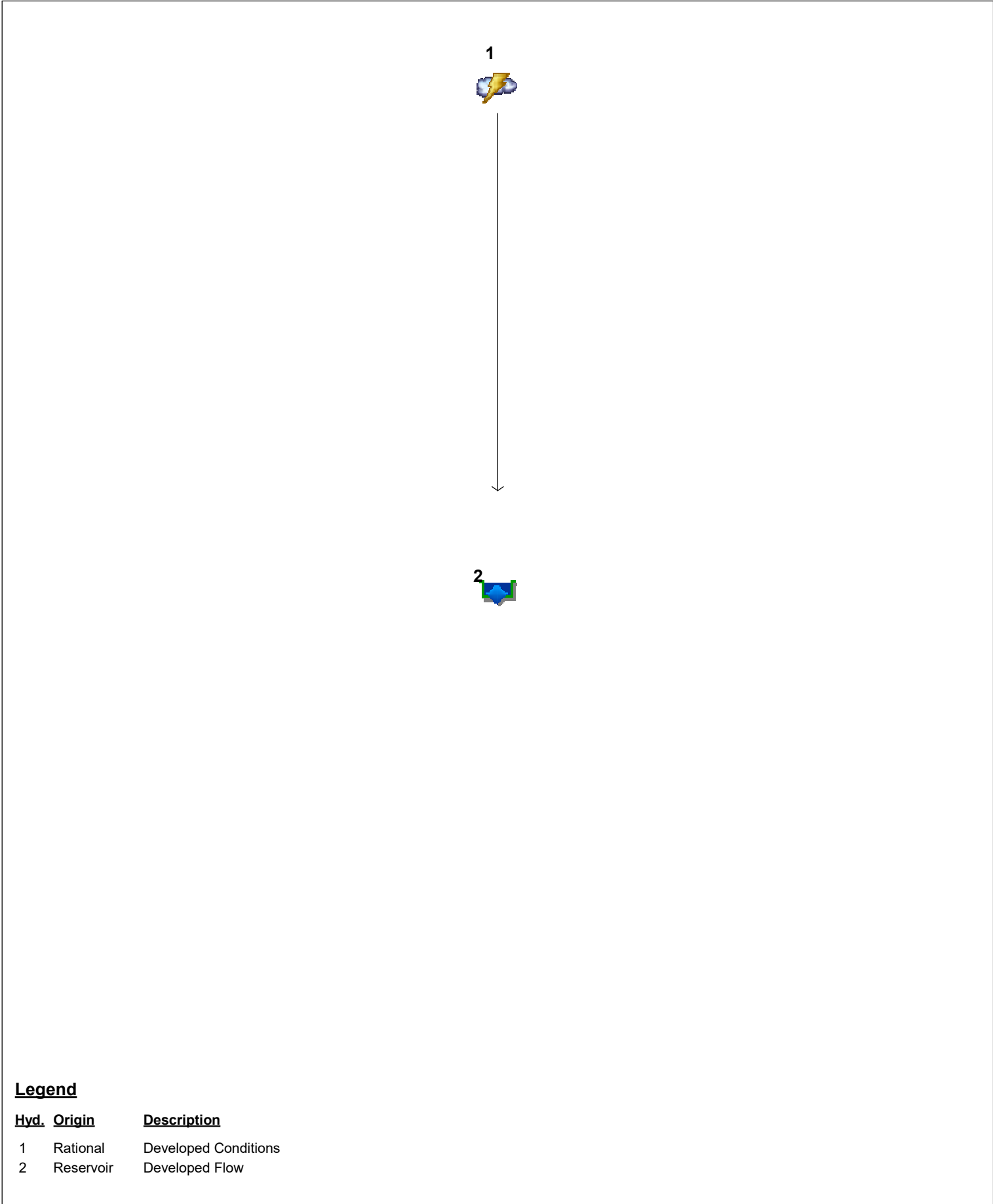
IDF Report..... 11

Appendix C

Proposed Conditions Hydraflow Output Data

Watershed Model Schematic

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



Legend

Hyd.	Origin	Description
1	Rational	Developed Conditions
2	Reservoir	Developed Flow

Hydrograph Summary Report

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

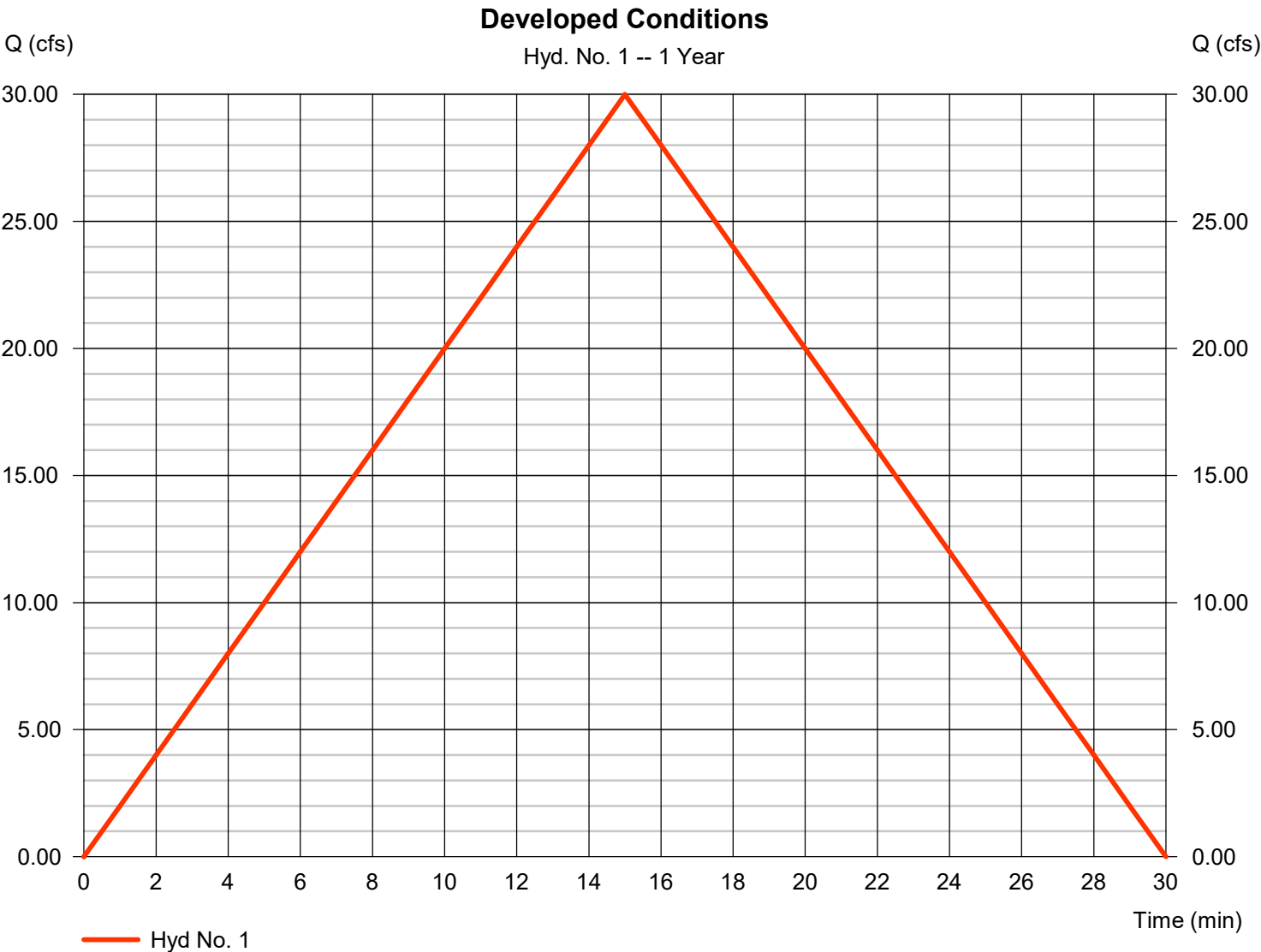
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	30.00	1	15	26,996	-----	-----	-----	Developed Conditions
2	Reservoir	0.000	1	n/a	0	1	983.01	26,996	Developed Flow
</									

Hydrograph Report

Hyd. No. 1

Developed Conditions

Hydrograph type	= Rational	Peak discharge	= 30.00 cfs
Storm frequency	= 1 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 26,996 cuft
Drainage area	= 29.350 ac	Runoff coeff.	= 0.35
Intensity	= 2.920 in/hr	Tc by User	= 15.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1



Hydrograph Report

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

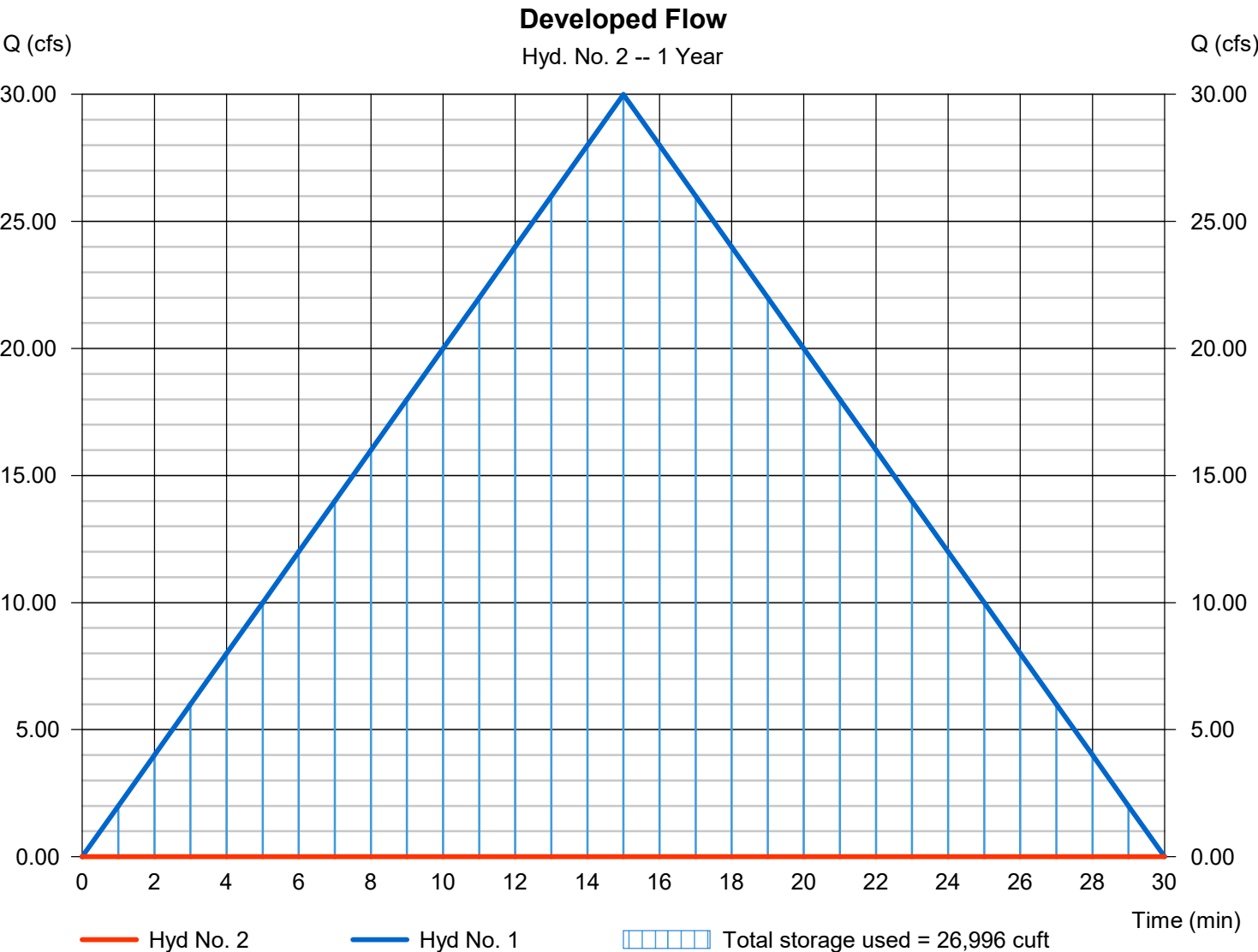
Monday, 03 / 23 / 2020

Hyd. No. 2

Developed Flow

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 1 yrs	Time to peak	= n/a
Time interval	= 1 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 1 - Developed Conditions	Max. Elevation	= 983.01 ft
Reservoir name	= Detention	Max. Storage	= 26,996 cuft

Storage Indication method used.



Pond No. 1 - Detention

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 977.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	977.00	665	0	0
1.00	978.00	1,468	1,040	1,040
2.00	979.00	2,585	2,000	3,040
3.00	980.00	4,022	3,277	6,317
4.00	981.00	5,772	4,870	11,187
5.00	982.00	7,822	6,770	17,958
6.00	983.00	10,100	8,936	26,894
7.00	984.00	12,577	11,315	38,208
8.00	985.00	15,256	13,894	52,102
9.00	986.00	18,139	16,675	68,777
10.00	987.00	23,085	20,560	89,337

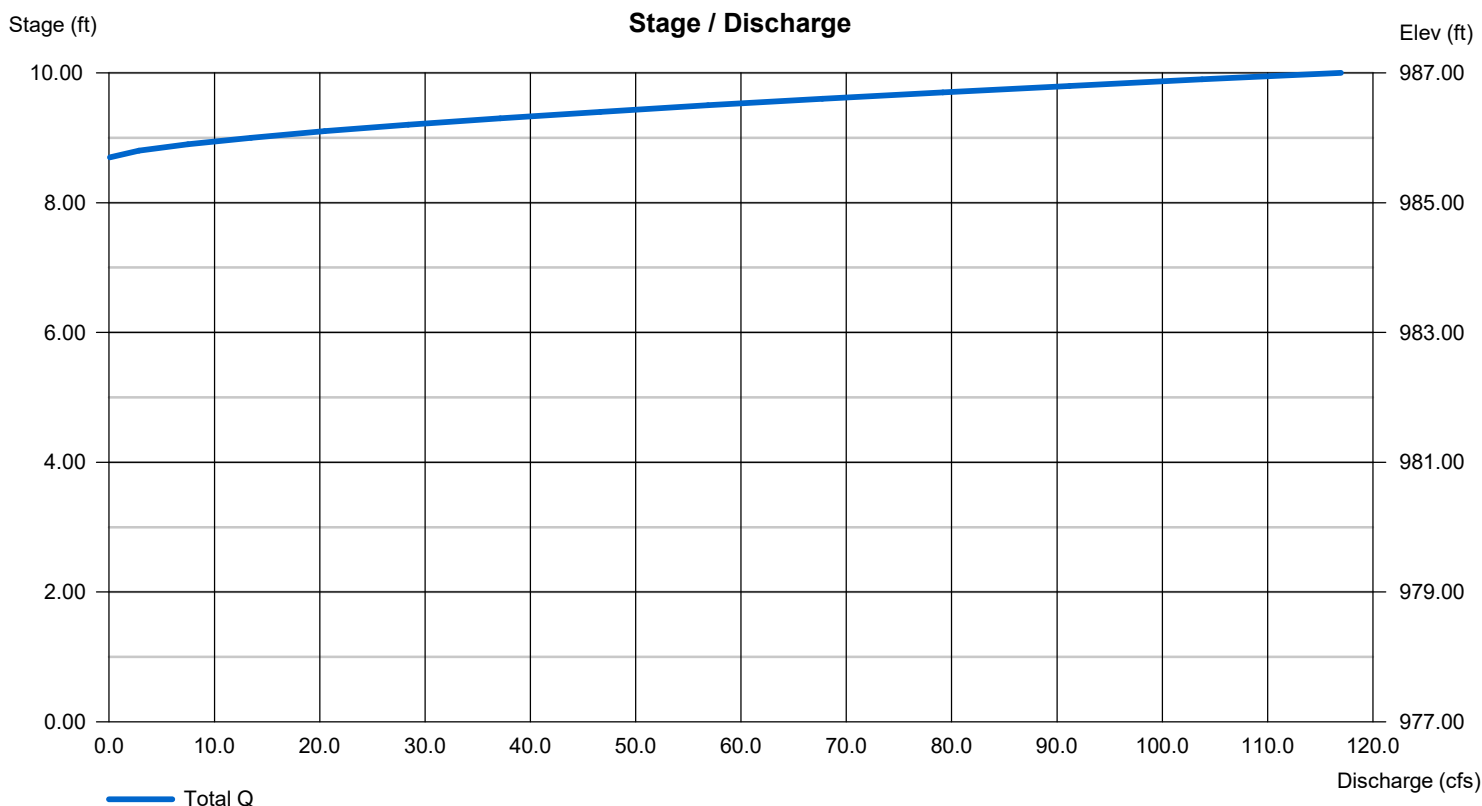
Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	Inactive	Inactive	Inactive	Inactive
Span (in)	= 42.00	36.00	0.00	1.50
No. Barrels	= 1	1	0	6
Invert El. (ft)	= 977.00	983.01	0.00	977.00
Length (ft)	= 48.00	6.00	0.00	6.01
Slope (%)	= 2.00	2.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	No	Yes

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 30.00	0.00	0.00	0.00
Crest El. (ft)	= 985.69	0.00	0.00	0.00
Weir Coeff.	= 2.60	3.33	3.33	3.33
Weir Type	= Broad	---	---	---
Multi-Stage	= No	No	No	No
Exfil.(in/hr)	= 0.000 (by Wet area)			
TW Elev. (ft)	= 0.00			

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



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 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	Rational	38.13	1	15	34,317	-----	-----	-----	Developed Conditions
2	Reservoir	0.000	1	n/a	0	1	983.66	34,317	Developed Flow

Hydrograph Report

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

Monday, 03 / 23 / 2020

Hyd. No. 1

Developed Conditions

Hydrograph type	= Rational	Peak discharge	= 38.13 cfs
Storm frequency	= 2 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 34,317 cuft
Drainage area	= 29.350 ac	Runoff coeff.	= 0.35
Intensity	= 3.712 in/hr	Tc by User	= 15.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1



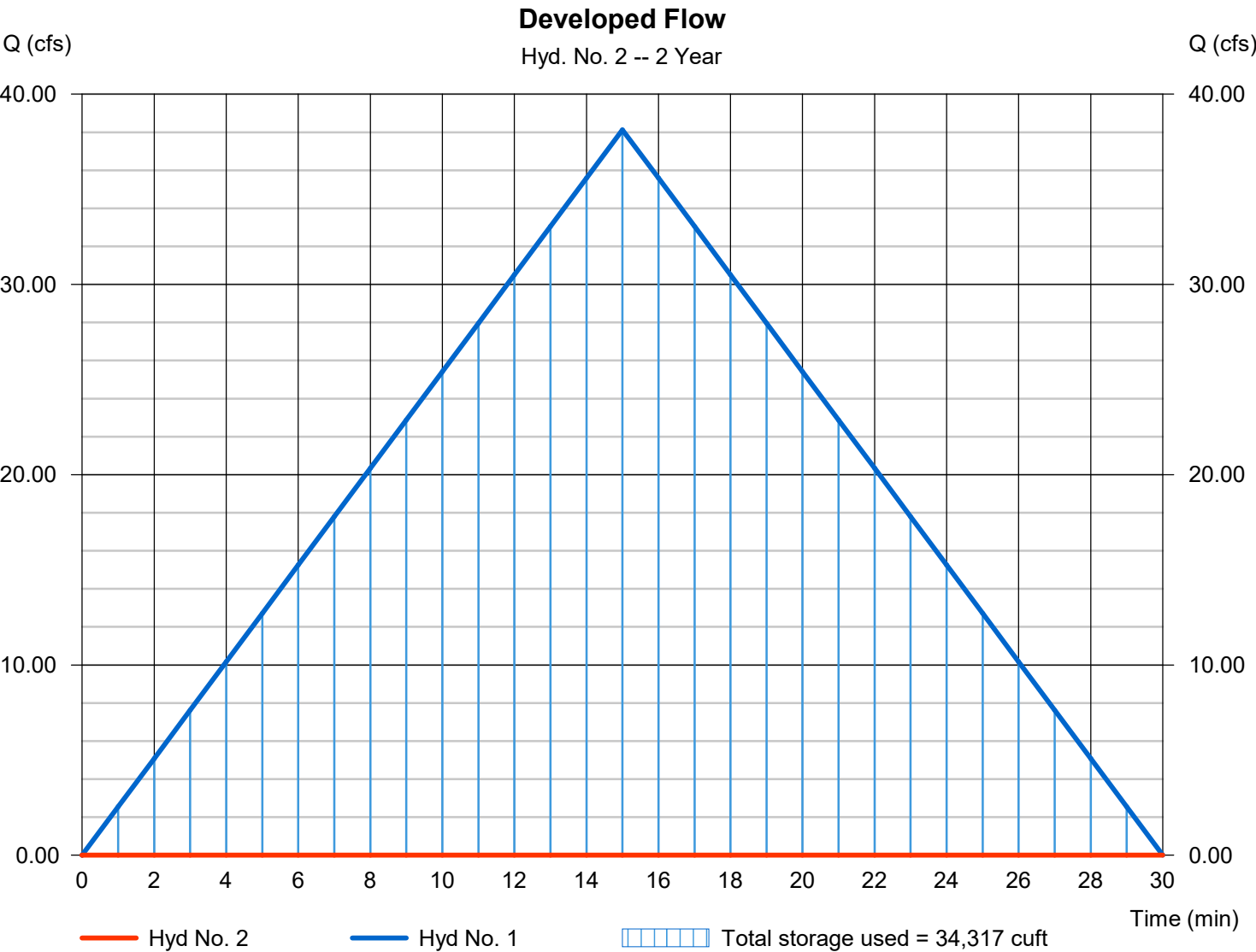
Hydrograph Report

Hyd. No. 2

Developed Flow

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 2 yrs	Time to peak	= n/a
Time interval	= 1 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 1 - Developed Conditions	Max. Elevation	= 983.66 ft
Reservoir name	= Detention	Max. Storage	= 34,317 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 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	Rational	53.24	1	15	47,914	-----	-----	-----	Developed Conditions
2	Reservoir	0.000	1	n/a	0	1	984.70	47,914	Developed Flow

Hydrograph Report

Hyd. No. 1

Developed Conditions

Hydrograph type	= Rational	Peak discharge	= 53.24 cfs
Storm frequency	= 10 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 47,914 cuft
Drainage area	= 29.350 ac	Runoff coeff.	= 0.35
Intensity	= 5.183 in/hr	Tc by User	= 15.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1



Hydrograph Report

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

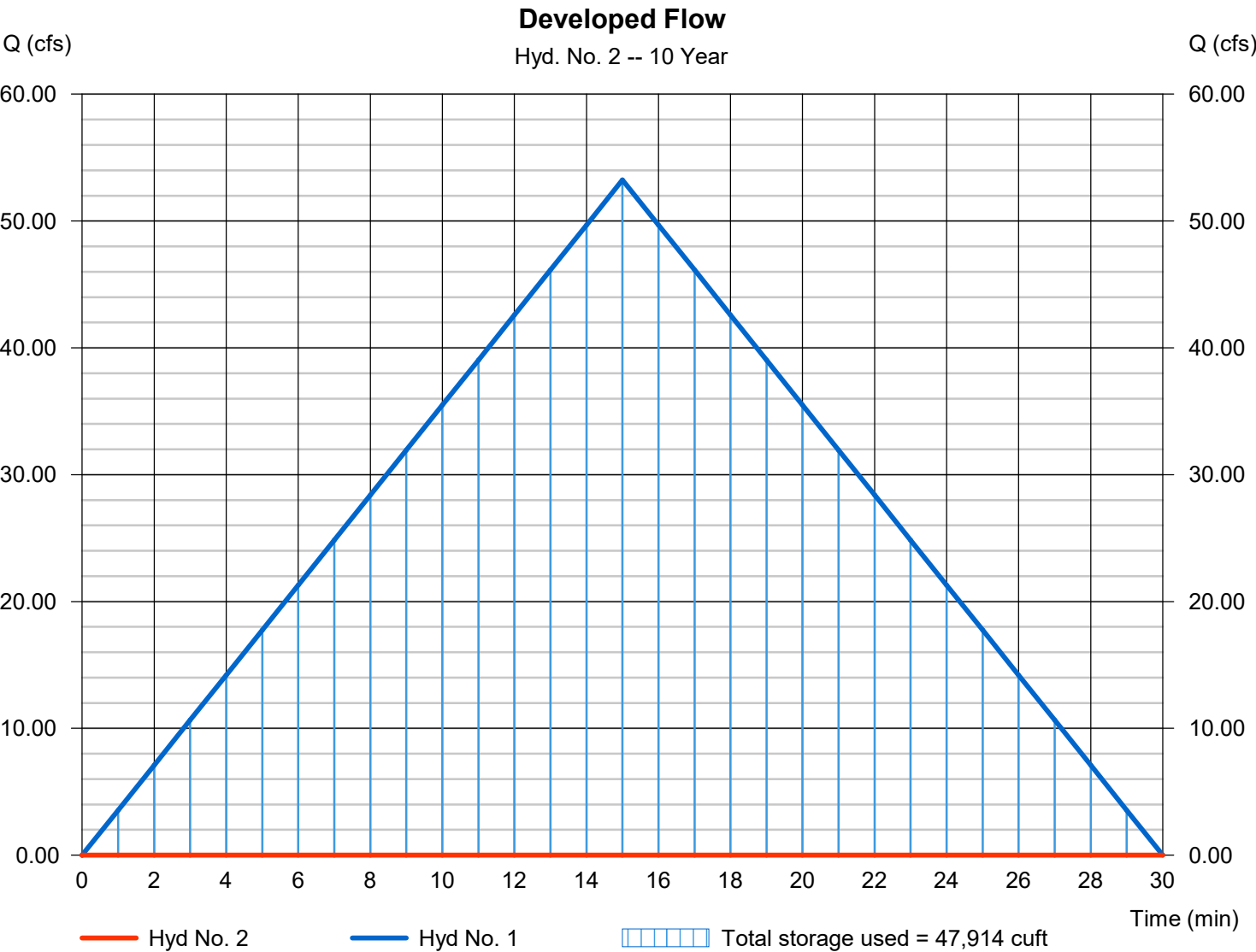
Monday, 03 / 23 / 2020

Hyd. No. 2

Developed Flow

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 10 yrs	Time to peak	= n/a
Time interval	= 1 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 1 - Developed Conditions	Max. Elevation	= 984.70 ft
Reservoir name	= Detention	Max. Storage	= 47,914 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 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	Rational	80.20	1	15	72,178	-----	-----	-----	Developed Conditions
2	Reservoir	13.29	1	28	10,049	1	986.00	68,728	Developed Flow

Hydrograph Report

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

Monday, 03 / 23 / 2020

Hyd. No. 1

Developed Conditions

Hydrograph type	= Rational	Peak discharge	= 80.20 cfs
Storm frequency	= 100 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 72,178 cuft
Drainage area	= 29.350 ac	Runoff coeff.	= 0.35
Intensity	= 7.807 in/hr	Tc by User	= 15.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1



Hydrograph Report

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

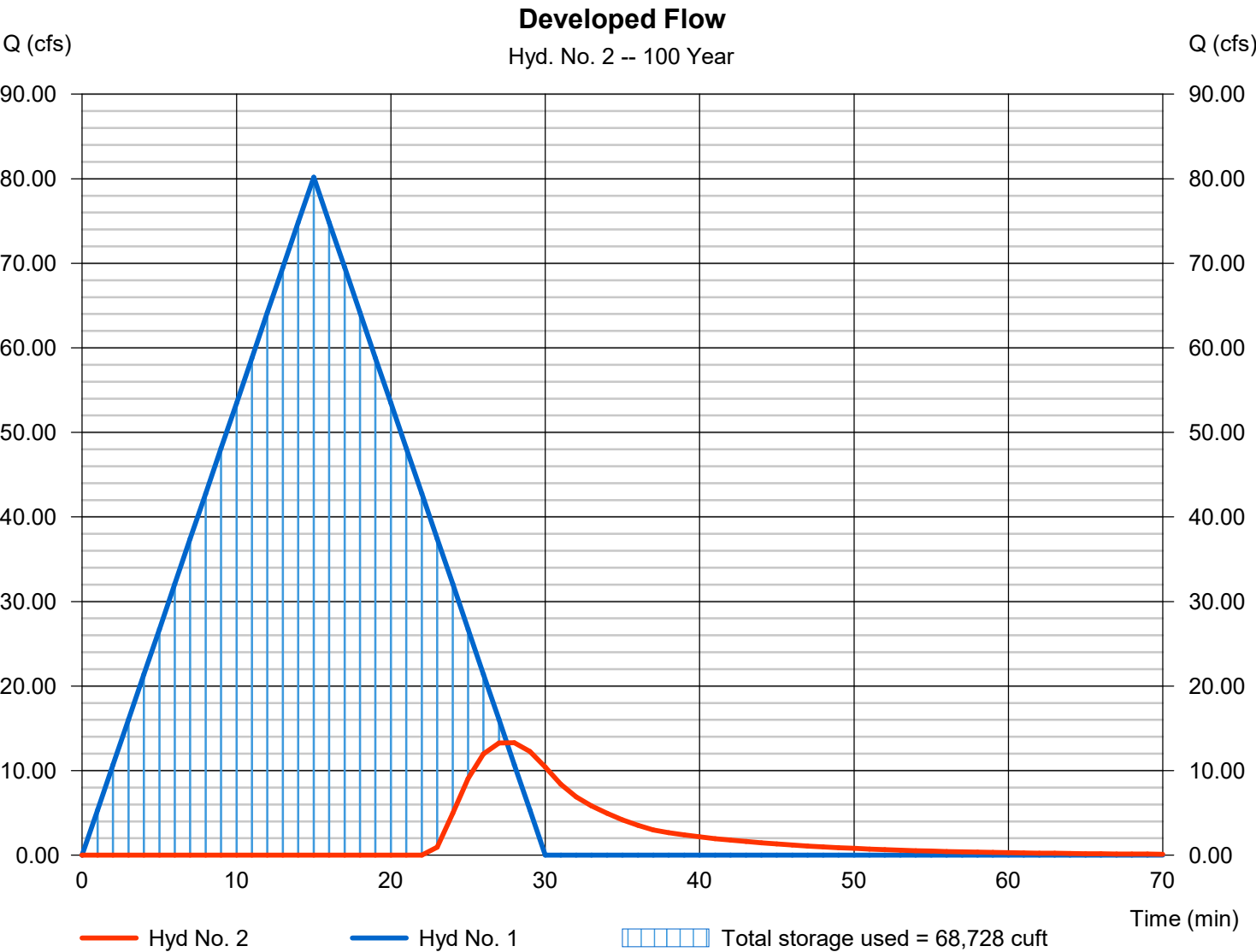
Monday, 03 / 23 / 2020

Hyd. No. 2

Developed Flow

Hydrograph type	= Reservoir	Peak discharge	= 13.29 cfs
Storm frequency	= 100 yrs	Time to peak	= 28 min
Time interval	= 1 min	Hyd. volume	= 10,049 cuft
Inflow hyd. No.	= 1 - Developed Conditions	Max. Elevation	= 986.00 ft
Reservoir name	= Detention	Max. Storage	= 68,728 cuft

Storage Indication method used.



Hydraflow Rainfall Report

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

Monday, 03 / 23 / 2020

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	2.9200	0.1000	0.0000	-----
2	110.7137	16.5000	0.9842	-----
3	0.0000	0.0000	0.0000	-----
5	168.3971	19.5000	1.0189	-----
10	183.3473	19.2000	1.0096	-----
25	103.5313	15.9000	0.8218	-----
50	235.4014	19.9000	1.0020	-----
100	83.7894	6.1000	0.7783	-----

File name: KCAPWA.IDF

$$\text{Intensity} = B / (T_c + D)^E$$

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92
2	5.41	4.40	3.71	3.21	2.83	2.53	2.29	2.09	1.92	1.78	1.66	1.55
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	6.47	5.35	4.56	3.98	3.52	3.16	2.86	2.62	2.41	2.24	2.08	1.95
10	7.35	6.08	5.18	4.52	4.00	3.59	3.26	2.98	2.74	2.54	2.37	2.22
25	8.51	7.14	6.17	5.46	4.90	4.46	4.10	3.79	3.54	3.31	3.12	2.95
50	9.39	7.82	6.70	5.86	5.20	4.68	4.25	3.90	3.60	3.34	3.12	2.92
100	12.87	9.64	7.81	6.62	5.77	5.14	4.65	4.25	3.92	3.65	3.41	3.21

Tc = time in minutes. Values may exceed 60.

Precip. file name: P:\DAE Civil\Hydraflow Storm Sewer\SCS Custom Water Quality.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	1.37	3.50	0.00	4.50	5.30	6.10	6.90	7.50
SCS 6-Hr	0.00	1.80	0.00	0.00	2.60	2.90	0.00	4.00
Huff-1st	0.00	1.55	0.00	2.75	4.00	5.38	6.50	8.00
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	1.75	0.00	2.80	3.90	5.25	6.00	7.10

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