PRELIMINARY GRADING AND DRAINAGE ENGINEERING DESIGN REPORT

PREPARED IN ACCORDANCE WITH MDEQ'S CIRCULAR DEQ-8, City of Missoula Subdivision Regulations, and The City of Missoula Public Works Standards and Specifications Manual

for

Carrera Commons Subdivision

Addressed as:
123 South Curtis St
Missoula, Montana 59801

Legally Described as:
The South 110' of Lot 5 of Curtis & Major's Addition, as described in Book 1088, at Page 547, Micro Records of Missoula County, located in the Southwest One-Quarter (SW 1/4) of Section 20, Township 13 North, Range 19 West, Principal Meridian Montana, Missoula County, Montana

March 2024
Revised June 2024

Prepared For:
Homes for Missoula, LLC
P.O. Box 373
Frenchtown, MT 59834

Prepared By:
IMEG Corp.
1817 South Ave W, Suite A
Missoula, MT 59801

1.0 GENERAL

Homes for Missoula, LLC is proposing to develop the property, located at the above-described legal description, as the Carrera Commons Subdivision. This subdivision is comprised of a total of ten (10) residential lots, accessed by a cul-de-sac subdivision road, preliminarily named Pit Lane. The stormwater runoff generated by the proposed roads, curbs, sidewalks, and lot areas on-site is proposed to be stored and infiltrated by three (3) drywell sumps. The curb and gutters of the proposed subdivision road will convey stormwater to the proposed drywell sumps.

This report has been prepared in accordance with MDEQ Circular 8 and City of Missoula Public Works Standards and Specifications Manual, Chapter 6 and is prepared as part of the development's preliminary analysis and design. The design is based on the most current data we have and is prepared in a conservative manner to supplement the Preliminary Plat Review Process.

2.0 DRAINAGE DESIGN CRITERIA AND METHODS USED

As per correspondence with Missoula City Public Works and Mobility, Hydraflow Hydrographs was used to calculate stormwater volumes for this development. Within this program, the TR-55 method was used, based on the principles of the SCS runoff equation, to estimate runoff requirements. The flows from the 2-, 10-, and 100-year, 24-hour storm events were analyzed.

3.0 EXTENT OF STORM DRAINAGE

The following information pertains to on- and off-site flows that may affect the proposed development and conveyance for stormwater flow rates that will be increased due to the development. Detailed information on the proposed drainage patterns is provided in the Drainage Basin Exhibit found in

Appendix A of this report.

3.1 DELINIATION OF DRAINAGE AREAS WITHIN PROJECT SITE

3.1A EXISTING BASIN

All structures on the property have been recently demolished which included a single-family home built in 1935, a single detached garage built in 1965 and another smaller shed towards the back of the property. The existing site is quite flat, with an average slope of 1.35%. As such, there is little concentrated flow in the existing condition, with no single outlet or discharge point. The site is bounded on all sides by residential area except for the side abutting South Curtis Street.

Current ground cover of the site is grasses, weeds, and trees with good coverage.

Well logs show an average static water level of 26.5' below the surface, ranging from 21'-26' below the ground surface. A geotechnical investigation was completed in November 2023, with four (4) exploratory test pits completed at the time of field exploration. Groundwater was not encountered during this investigation. Therefore, depth to groundwater does not pose any significant risk with the drywells proposed onsite.

3.1 B DEVELOPED BASINS

Once developed, the parcel will be comprised by a total of three (3) post-development drainage basins. The table below displays the total and impervious areas of each post-development basin.

Drainage Basin	Total Area (ac)	Impervious Area (ac)
Basin A	0.59	0.11
Basin B	0.23	0.20
Basin C	0.75	0.30

Rainfall that lands anywhere within Basins A – C in the proposed roads' rights-of-way (roadway, boulevards, and sidewalks) or in the vast majority of the residential lot area that drains to the proposed road will be conveyed in the proposed curb and gutter (along Pit Lane) to one of the three (3) proposed sumps. The proposed system has been designed to infiltrate the entirety of the 24-hour, 100-year storm for Basins A-C.

3.2 DELINEATION OF OFF-SITE DRAINAGE BASINS

Overall, the site is quite flat, but the adjacent properties do slope slightly towards the property to be developed. However, as can be seen in the attached preliminary calculations, the proposed sumps in each basin have ample capacity to accept any minor flows from the surrounding properties.

3.3 ~~MODELED OFF-SITE FLOWS~~

3.4 ~~PROVISIONS TO PASS OFF-SITE STORMWATER FLOWS~~

4.0 PROVISIONS TO MITIGATE ON-SITE STORMWATER FLOWS

The calculations in Appendix B, a summary table of which can be seen below, show the peak flows and runoff volumes generated by the proposed right-of-way and lot improvements during the 100-year, 24-hour storm. Please note that, because the site is currently undeveloped and the entirety of the post-development flow is being mitigated, pre-development flows are not being analyzed. See section 4.1F for more information on site variables.

Basin	Post-Development 100-yr Runoff Volume (ft^3)	Post-Development 100-yr Peak Flow (cfs)
A	2898	0.671
B	1371	0.641
C	3891	0.901

4.1 CALCULATIONS & DESIGN

Calculations for this report are based on the SCS Type II Rainfall Distribution and the TR-55 module within the Hydraflow Hydrographs modeling program. Calculations were made using curve numbers, basins, and time of concentration to ensure proper routing and that any proposed infrastructure is not inundated. For any variables, values, equations, or calculations not explicitly shown below in this report, refer to the attached Hydrographs Summary Report in Appendix B. To comply with the Post-Development Runoff Control Requirements, stormwater shall be completely retained and infiltrated on-site for the 100-year storm event. Infiltration capacity calculations are included in Appendix B of this report.

4.1A HYDROLOGIC SOIL GROUP

The NRCS Soil Report (Appendix C) only classifies the onsite soils as "Urban Land" and does not give a Hydrologic Soil Group designation. However, a geotechnical investigation was conducted for the site and there were soils that represent both Group B and Group C. As a result, the more conservative choice of Hydrologic Soil Group C was chosen and used for Curve Number calculations for this report. Although there is some soil variation across the site, Group C, was used as the most conservative soil group for these preliminary calculations.

4.1B CURVE NUMBERS & LAND USE DATA

The existing soils onsite are being classified as Hydrologic Soil Group C for this report (see section 4.1A), and the site's existing groundcover is primarily grass, weeds, and scattered trees in good condition. However, the boulevard and landscaping surrounding the proposed lots will be planted with grass and topsoil. As such, the boulevard/landscaping areas are considered to have a Curve Number (CN) of 74, which corresponds to good condition grass in the TR-55 module. In the post-development condition, all proposed impervious infrastructure (i.e. asphalt, concrete, etc.) corresponded to a Curve Number of 98. In addition, each of the proposed lots is under 1/8 acre, so a Curve Number of 90 was used for all contributing lot areas.

4.1C BASINS AND AREAS

The site was analyzed as three (3) basins. The majority of the site is made up by Basin C followed by Basin A, which are both comprised of a mixture of impervious and pervious surfaces. Basin B is almost entirely comprised of impervious surface.

4.1D TIME OF CONCENTRATION

Time of concentration was determined by the TR-55 module in Hydraflow Hydrographs and is calculated based on the longest flow path and watercourse slope of the post-development conditions for the site and individual basins. Time of concentration calculations are included in the Appendix B Hydrographs Report. It is important to note that, as per Chapter 6 of the Missoula City Public Works Standards and Specifications Manual, if the TR-55 calculated time of concentration was less than 5 minutes, the minimum time of concentration of 5 minutes was used in the calculations for that basin.

4.1E STORM DATA

The SCS Method uses 24-hour storm depths provided by Chapter 6 of the Missoula City Public Works Standards and Specifications Manual as a design recurrence interval. In this case, the 2-year, 10-year, and 100-year storm event were analyzed.

4.1 F SUMMARY OF SITE VARIABLES

A summary of the data developed and/or calculated previously and inputted into the TR-55 module is presented below, further elaboration of which can be found in the Appendix B Hydrographs Report.

Impervious Area CN	98
Pervious Area CN	74
Lot Area CN	90
24-hr, 2-yr Rainfall (in)	1.17
24-hr, 10-yr Rainfall (in)	1.66
24-hr, 100-yr Rainfall (in)	2.28

4.2 RUNOFF STORAGE

Calculations were completed for the three (3) on-site basins to analyze the runoff volume and peak flow rate. Each runoff basin has a respective drywell sump for stormwater runoff storage and infiltration.

4.2A RUNOFF RATES

The peak flow for the post-development 24-hour, 100-year storm was analyzed for this report. The site will be graded so that there will be three (3) drainage basins on-site. The entirety of the 100-year storm will be captured within Basins A – C. Each of the three (3) proposed drywell sumps are at points along the curb and gutter line with Drywell Sump C being at the road's lowest point in the proposed cul-de-sac. Any backup during large events will just pond in the cul-de-sac until the system is able to catch up with the runoff peak flow. However, given the high infiltration rates and the capacity demonstrated by the modeled sumps onsite, this is unlikely. Additionally, the road is graded such that, if drywell sumps A or B were to fail, stormwater runoff would overflow to Drywell Sump C before leaving the right-of-way and threatening to inundate any buildings. The peak flow rates for each post-development basin, can be seen in the summary table in Section 4.0.

4.2B RUNOFF VOLUME AND STORAGE

The entirety of the 100- year storm for each of the three (3) proposed basins will be stored and infiltrated in each respective proposed drywell sump without being discharged off-site. The post-development volume of stormwater for each basin's 100-year storm can be found in the summary table in Section 4.0. This has been calculated using the Hydraflow Hydrographs program.

4.2C INFILTRATION

Infiltration rates for the project site have been measured and are contained in the geotechnical investigation. The more conservative of the two measured infiltration rate of **2,220 inches/hour** was used for the entirety of the site for these preliminary calculations. A factor of safety of 3 was used, resulting in a design infiltration rate of 740 inches/hour.

In Hydraflow Hydrographs, the assumed infiltration rate was used in conjunction with the site's proposed slopes, impervious areas, and other characteristics to determine the runoff volume and peak flow for each basin. It was determined that the proposed drywell sumps system will be able to store and infiltrate the entirety of the 100-year storm runoff from Basins A - C without overtopping. In the table below, one can see that, with the proposed drywell sumps and the assumed infiltration rate, there is still over 9' of freeboard in each drywell sump during the 100-year storm.

Basin	100-year Peak Runoff Rate (cfs)	100-year Peak Infiltration Rate (cfs)	100-year Runoff Volume (ft^3)	Storage/Infiltrative Capacity (ft^3)	Max height of sump storage (cuft)
A	0.671	0.670	2,998	2,898	10.7
B	0.641	0.633	1,371	1,371	10.1
C	0.901	0.899	3,891	3,891	14.4

The storage capacity of each drywell sump is 169 cubic feet.

4.2 D INUNDATION

All stormwater runoff during the 100-year event is proposed to be infiltrated by the sumps within the site. As such, during the 100-year event, no buildings or roads will be inundated.

4.3 STORMWATER QUALITY CONTROL

Stormwater quality will be addressed using the proposed drywell sumps system. The drywell sumps system will infiltrate the entirety of the initial 0.5-in of rainfall, meeting the requirements of Section 6.2.6 of the Missoula City Public Works Standards and Specifications Manual.

4.4 GROUNDWATER

Well logs in the existing section, township, and range were examined to estimate the depth of groundwater. From the well log shown in Appendix B, the static water level ranged from 21'-26' below the surface. As discussed above in Section 3.1A, a geotechnical investigation – including soil profiles – was completed for the site in Nov. 2023. No evidence of groundwater was encountered during this investigation.

4.5 DOWN-GRADIENT ANALYSIS

A down-gradient analysis is not applicable for this drainage report as all stormwater will infiltrate in the proposed drywell sumps on site.

5.0 EROSION CONTROL

A Stormwater Pollution Prevention Plan (SWPPP) will be required through the Montana Department of Environmental Quality (MDEQ), it will be the responsibility of the Contractor (or owner if previously agreed upon) to prepare, obtain, and administrate a SWPPP and any other erosion control permits required by City of Missoula. Erosion and sediment control in the form of BMP's or stabilized surface throughout the project area will minimize the potential for pollutants to leave the site.

6.0 CONCLUSIONS

This drainage report has been prepared in accordance with Chapter 6 of the Missoula City Public Works Standards and Specifications Manual. The proposed drywell sumps will ensure that the road is not inundated during the 10-year storm and no neighboring buildings will be inundated during the 100-year storm. Other existing drainage patterns in non-disturbed or off-site areas will be maintained. All construction will be in accordance with the Construction Plans, Montana Public Works Standard Specifications (MPWSS), and City of Missoula requirements.

Prepared by:
IMEG Corp.

Jason Brandes, Civil Designer

Reviewed by:
IMEG Corp.

Cory Davis, P.E

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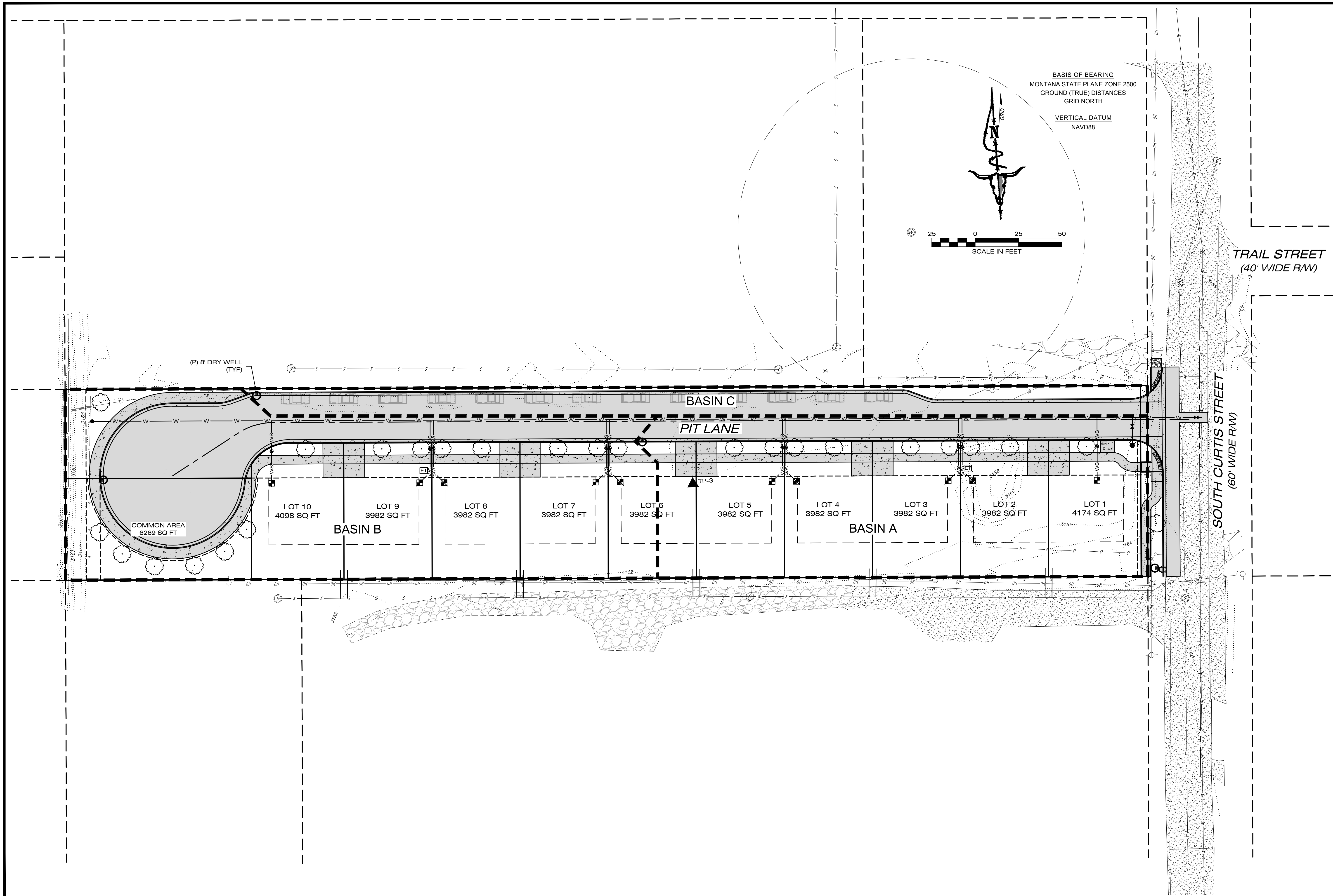
Appendix A:

Drainage Exhibit



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PLOT DATE: 6/20/2024 2:07 PM

REVISIONS	DATE

DESIGNED: DO
DRAFTED: BRB
CHECKED: DO/TR
DATE: APR., 2024

LOCATION: LOT 5 OF CURTIS AND MAJOR'S ADDITION SECTION 20, T.13N., R.19W., MISSOULA COUNTY

PREPARED FOR: HOMES FOR MISSOULA LLC

PROJECT NAME: CARRERA COMMONS SUBDIVISION

SHEET TITLE: DRAINAGE BASIN EXHIBIT

PROJECT NO. 23002731

SHEET: 1 OF 1

DWG LOCATION: G:\2023\23002731.00\DESIGN\CIVIL\C3D\EXHIBIT\CONCEPT\DRAINAGE BASIN-23002731.DWG

Appendix B:

Hydraflow Hydrographs Summary Report w/ Infiltration System Modeling

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

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	0.671	2	732	2,898	------	------	------	Basin A
2	Reservoir	0.670	2	734	2,898	1	100.63	10.7	Basin A
3	SCS Runoff	0.641	2	716	1,371	------	------	------	Basin B
4	Reservoir	0.633	2	716	1,371	3	100.60	10.1	Basin B
5	SCS Runoff	0.901	2	732	3,891	------	------	------	Basin C
6	Reservoir	0.899	2	732	3,891	5	100.85	14.4	Basin C

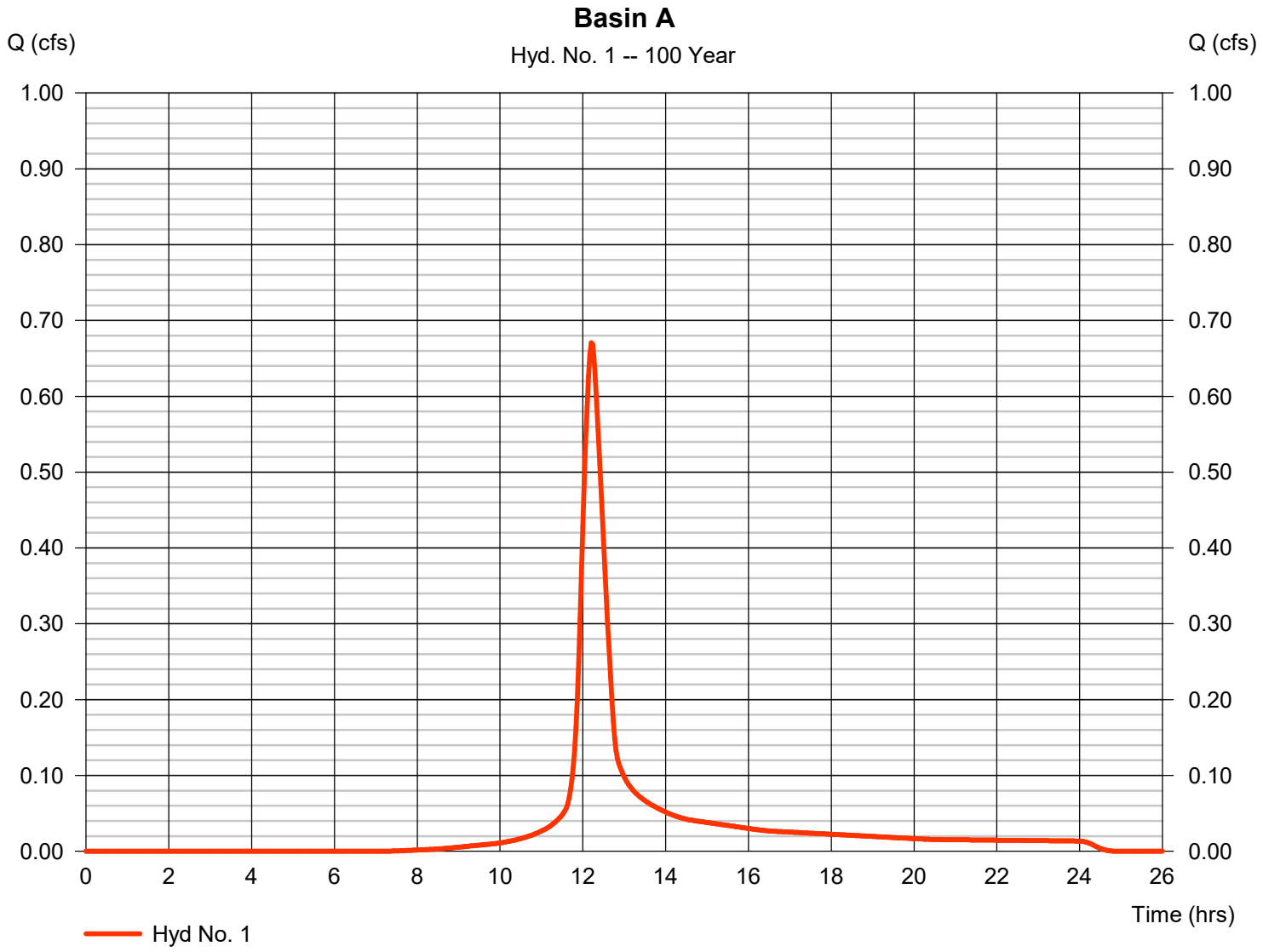
Hydrograph Report

Hyd. No. 1

Basin A

Hydrograph type	= SCS Runoff	Peak discharge	= 0.671 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.20 hrs
Time interval	= 2 min	Hyd. volume	= 2,898 cuft
Drainage area	= 0.590 ac	Curve number	= 90*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 30.40 min
Total precip.	= 2.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.111 x 98) + (0.045 x 74) + (0.430 x 90)] / 0.590



TR55 Tc Worksheet

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Hyd. No. 1

Basin A

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.400		0.011		0.011		
Flow length (ft)	= 74.0		5.0		0.0		
Two-year 24-hr precip. (in)	= 1.17		1.17		0.00		
Land slope (%)	= 2.00		2.00		0.00		
Travel Time (min)	**= 27.91**	**+**	**0.18**	**+**	**0.00**	**=**	**28.09**
Shallow Concentrated Flow							
Flow length (ft)	= 278.00		0.00		0.00		
Watercourse slope (%)	= 1.00		0.00		0.00		
Surface description	= Paved		Paved		Paved		
Average velocity (ft/s)	=2.03		0.00		0.00		
Travel Time (min)	**= 2.28**	**+**	**0.00**	**+**	**0.00**	**=**	**2.28**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 30.40 min

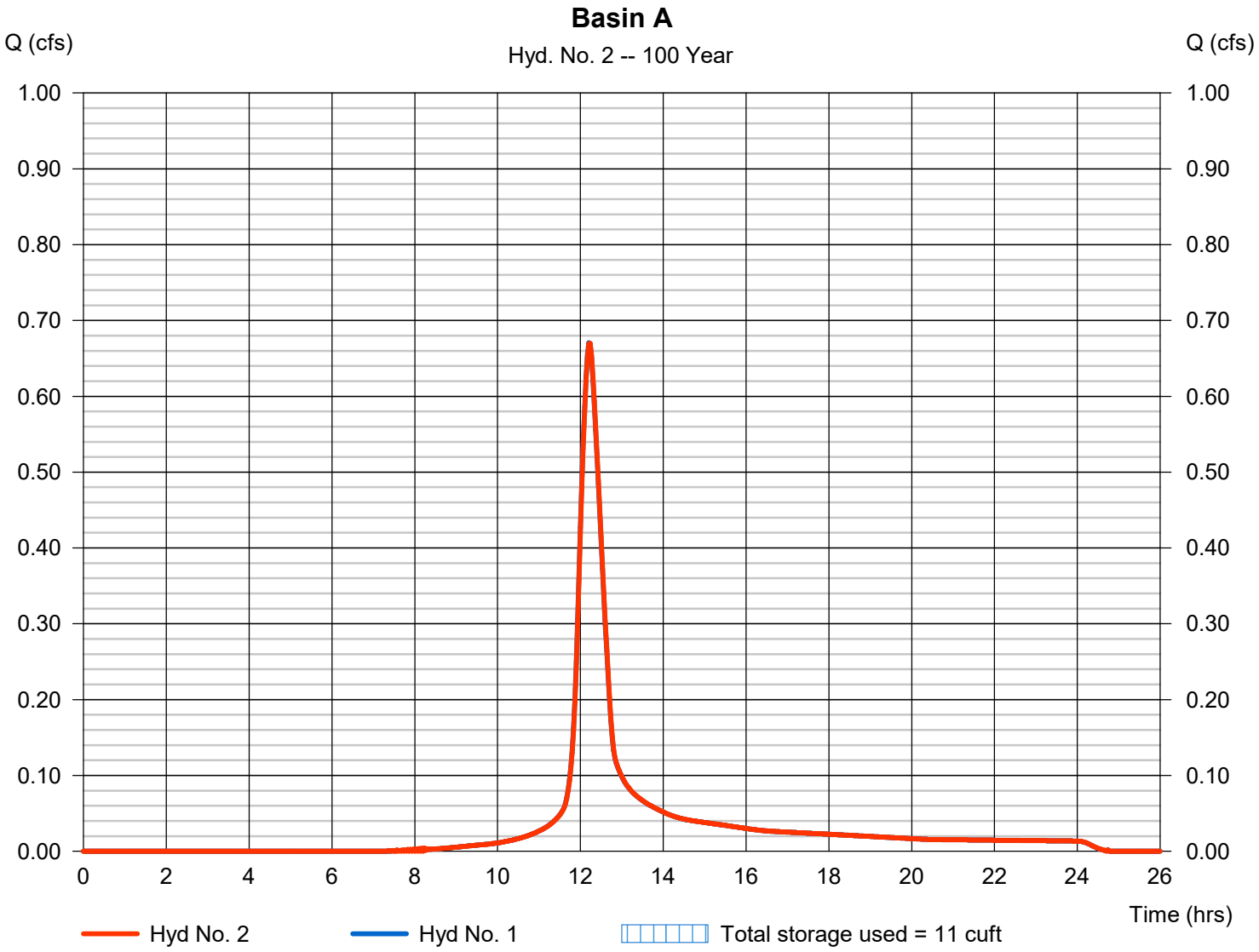
Hydrograph Report

Hyd. No. 2

Basin A

Hydrograph type	=	Reservoir	Peak discharge	=	0.670 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.23 hrs
Time interval	=	2 min	Hyd. volume	=	2,898 cuft
Inflow hyd. No.	=	1 - Basin A	Max. Elevation	=	100.63 ft
Reservoir name	=	Basin A Sump	Max. Storage	=	11 cuft

Storage Indication method used. Outflow includes exfiltration.



Pond Report

Pond No. 1 - Basin A Sump

Pond Data

Trapezoid -Bottom L x W = 7.7 x 8.0 ft, Side slope = 0.00:1, Bottom elev. = 100.00 ft, Depth = 10.00 ft, Voids = 27.40%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	100.00	62	0	0
1.00	101.00	62	17	17
2.00	102.00	62	17	34
3.00	103.00	62	17	51
4.00	104.00	62	17	68
5.00	105.00	62	17	84
6.00	106.00	62	17	101
7.00	107.00	62	17	118
8.00	108.00	62	17	135
9.00	109.00	62	17	152
10.00	110.00	62	17	169

Culvert / Orifice Structures

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

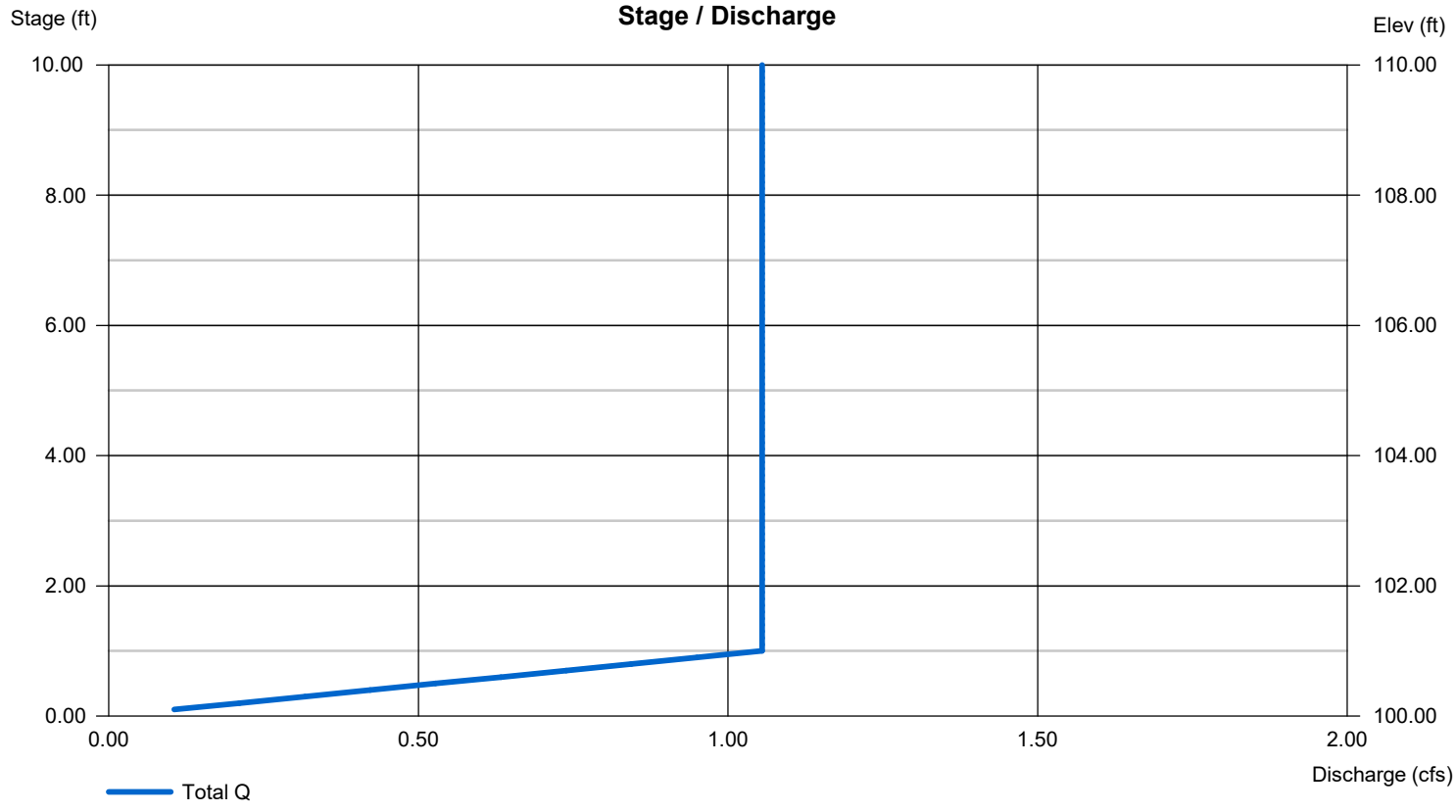
Weir Structures

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

Exfil.(in/hr) = 740.000 (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).



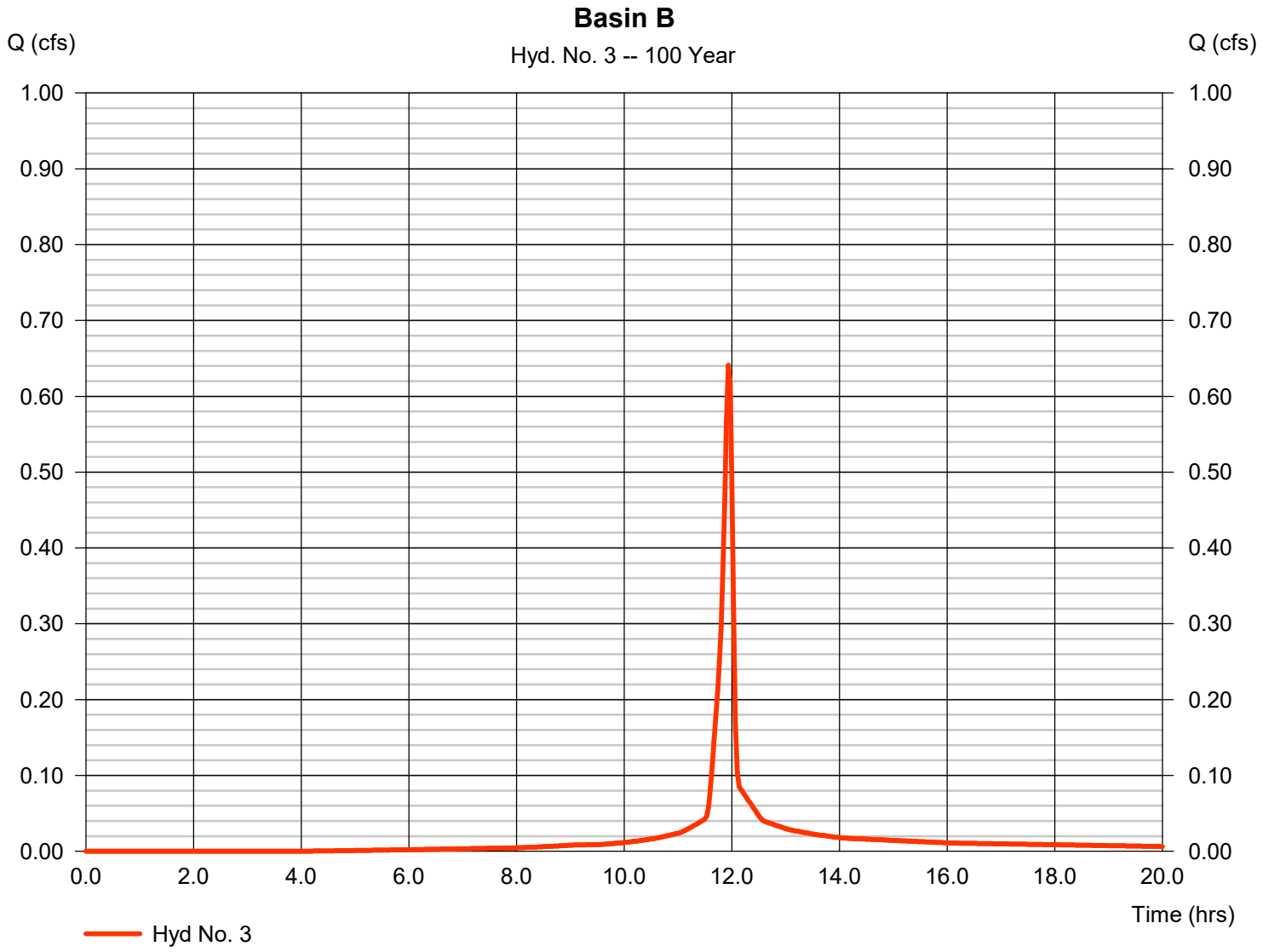
Hydrograph Report

Hyd. No. 3

Basin B

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.641 cfs
Storm frequency	=	100 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	1,371 cuft
Drainage area	=	0.230 ac	Curve number	=	95*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	2.28 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.200 x 98) + (0.030 x 74)] / 0.230



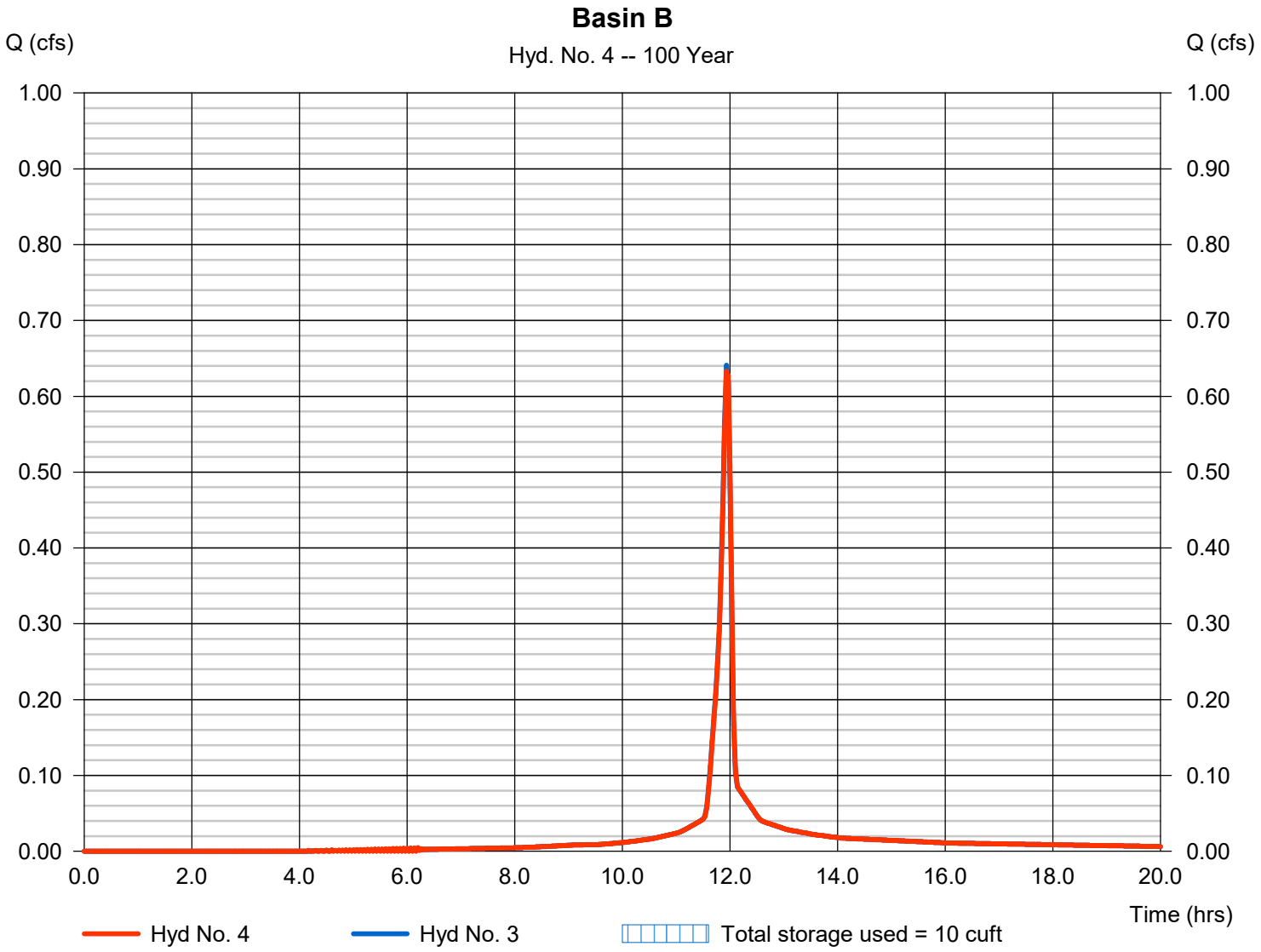
Hydrograph Report

Hyd. No. 4

Basin B

Hydrograph type	=	Reservoir	Peak discharge	=	0.633 cfs
Storm frequency	=	100 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	1,371 cuft
Inflow hyd. No.	=	3 - Basin B	Max. Elevation	=	100.60 ft
Reservoir name	=	Basin B Sump	Max. Storage	=	10 cuft

Storage Indication method used. Outflow includes exfiltration.



Pond Report

Pond No. 2 - Basin B Sump

Pond Data

Trapezoid -Bottom L x W = 7.7 x 8.0 ft, Side slope = 0.00:1, Bottom elev. = 100.00 ft, Depth = 10.00 ft, Voids = 27.40%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	100.00	62	0	0
1.00	101.00	62	17	17
2.00	102.00	62	17	34
3.00	103.00	62	17	51
4.00	104.00	62	17	68
5.00	105.00	62	17	84
6.00	106.00	62	17	101
7.00	107.00	62	17	118
8.00	108.00	62	17	135
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10.00	110.00	62	17	169

Culvert / Orifice Structures

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

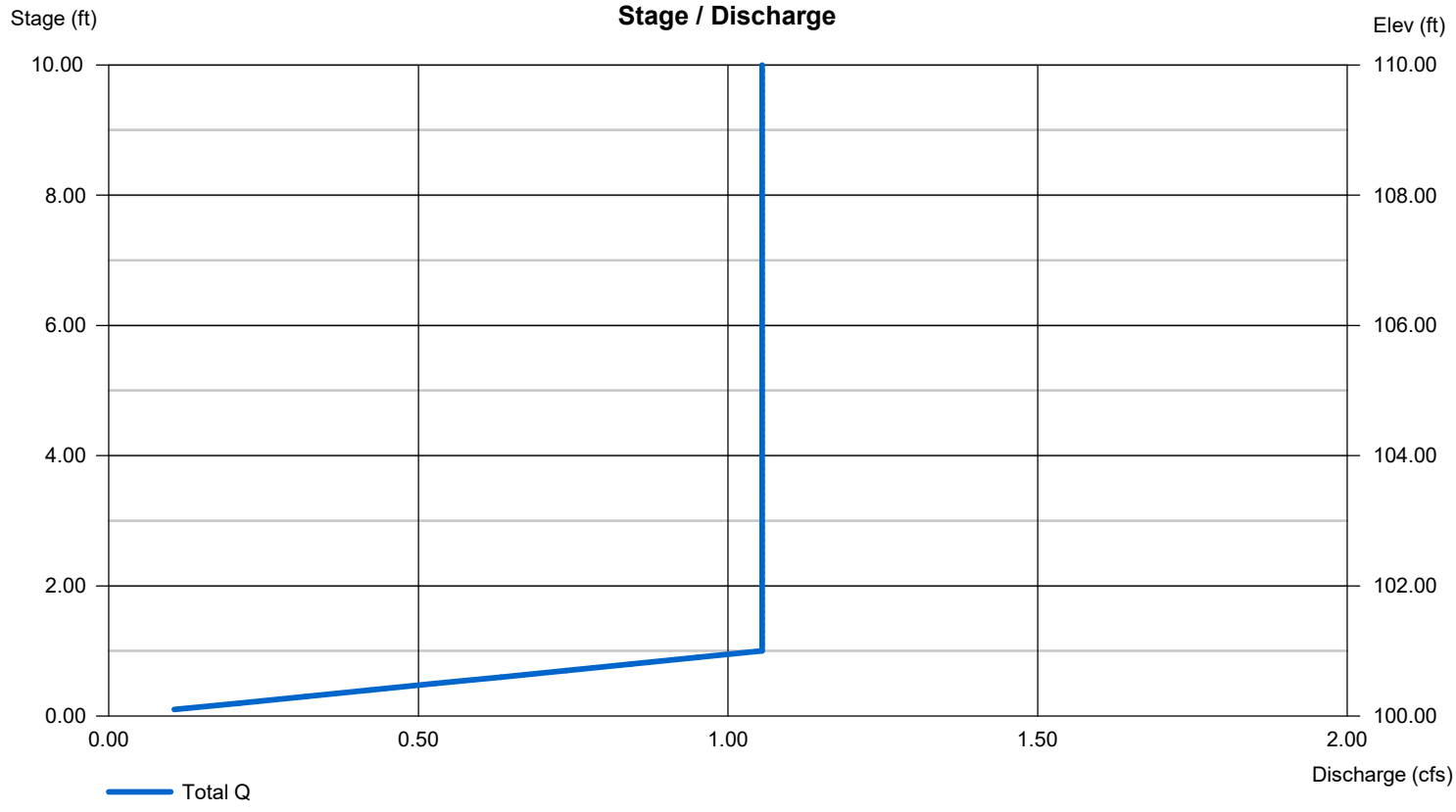
Weir Structures

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

Exfil.(in/hr) = 740.000 (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).



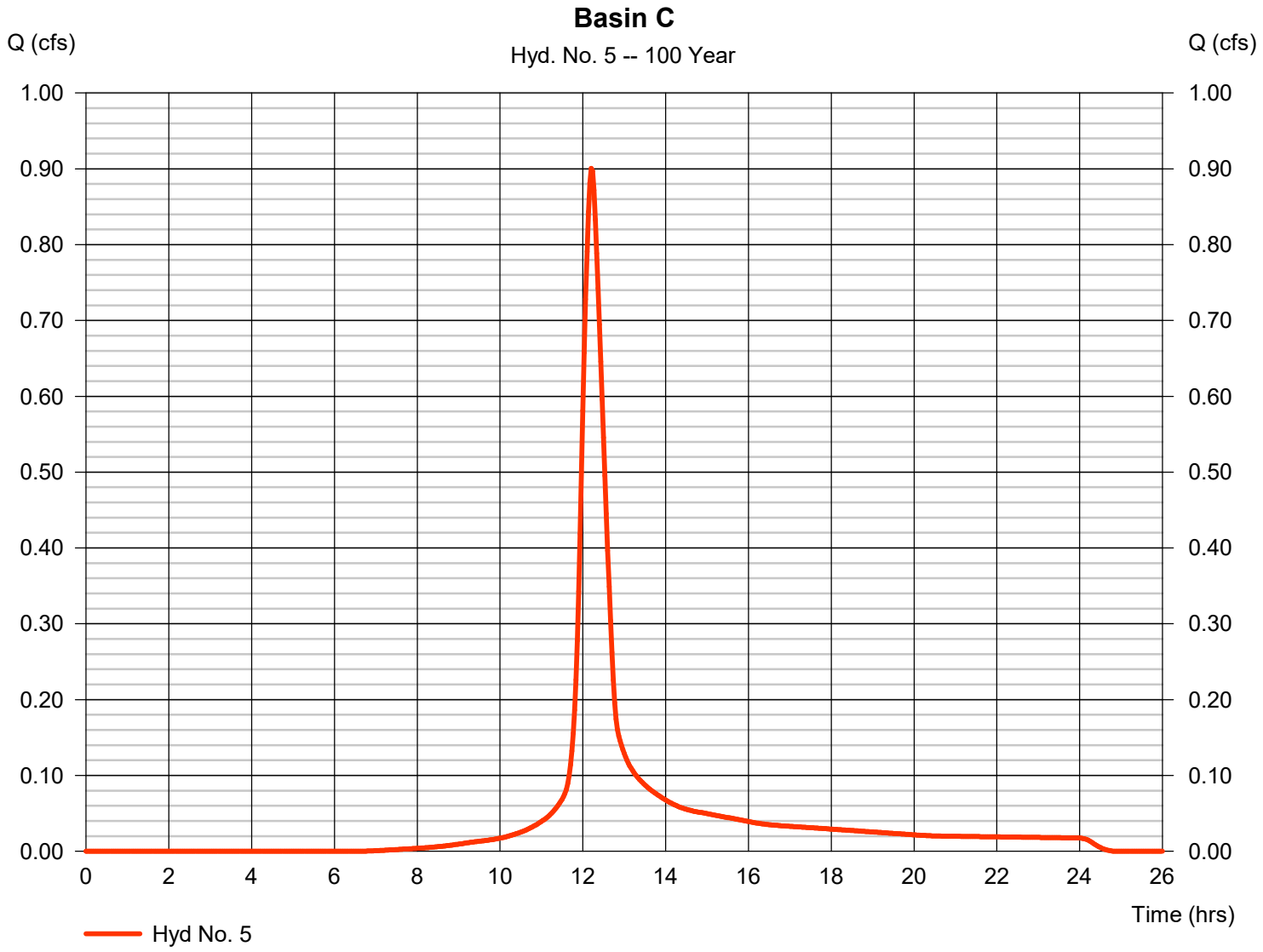
Hydrograph Report

Hyd. No. 5

Basin C

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.901 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.20 hrs
Time interval	=	2 min	Hyd. volume	=	3,891 cuft
Drainage area	=	0.750 ac	Curve number	=	91*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	31.70 min
Total precip.	=	2.28 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.300 x 98) + (0.350 x 90) + (0.100 x 74)] / 0.750



TR55 Tc Worksheet

Hyd. No. 5

Basin C

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.400		0.011		0.011		
Flow length (ft)	= 74.0		5.0		0.0		
Two-year 24-hr precip. (in)	= 1.17		1.17		0.00		
Land slope (%)	= 2.00		2.00		0.00		
Travel Time (min)	**= 27.91**	**+**	**0.18**	**+**	**0.00**	**=**	**28.09**
Shallow Concentrated Flow							
Flow length (ft)	= 445.00		0.00		0.00		
Watercourse slope (%)	= 1.00		0.00		0.00		
Surface description	= Paved		Paved		Paved		
Average velocity (ft/s)	=2.03		0.00		0.00		
Travel Time (min)	**= 3.65**	**+**	**0.00**	**+**	**0.00**	**=**	**3.65**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00		0.00		0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 31.70 min

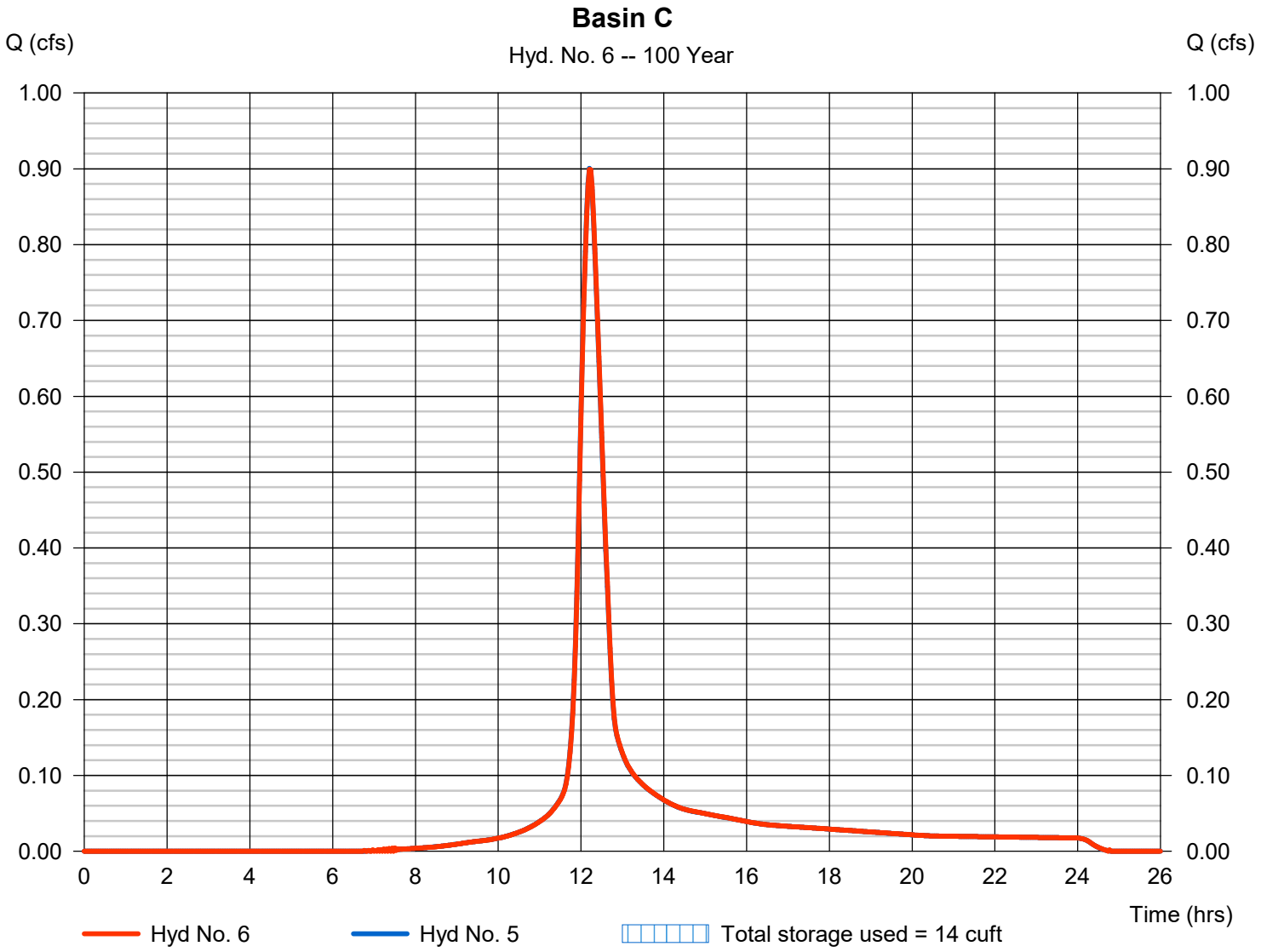
Hydrograph Report

Hyd. No. 6

Basin C

Hydrograph type	=	Reservoir	Peak discharge	=	0.899 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.20 hrs
Time interval	=	2 min	Hyd. volume	=	3,891 cuft
Inflow hyd. No.	=	5 - Basin C	Max. Elevation	=	100.85 ft
Reservoir name	=	Basin C Sump	Max. Storage	=	14 cuft

Storage Indication method used. Outflow includes exfiltration.



Pond Report

Pond No. 4 - Basin C Sump

Pond Data

Trapezoid -Bottom L x W = 7.7 x 8.0 ft, Side slope = 0.00:1, Bottom elev. = 100.00 ft, Depth = 10.00 ft, Voids = 27.40%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	100.00	62	0	0
1.00	101.00	62	17	17
2.00	102.00	62	17	34
3.00	103.00	62	17	51
4.00	104.00	62	17	68
5.00	105.00	62	17	84
6.00	106.00	62	17	101
7.00	107.00	62	17	118
8.00	108.00	62	17	135
9.00	109.00	62	17	152
10.00	110.00	62	17	169

Culvert / Orifice Structures

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

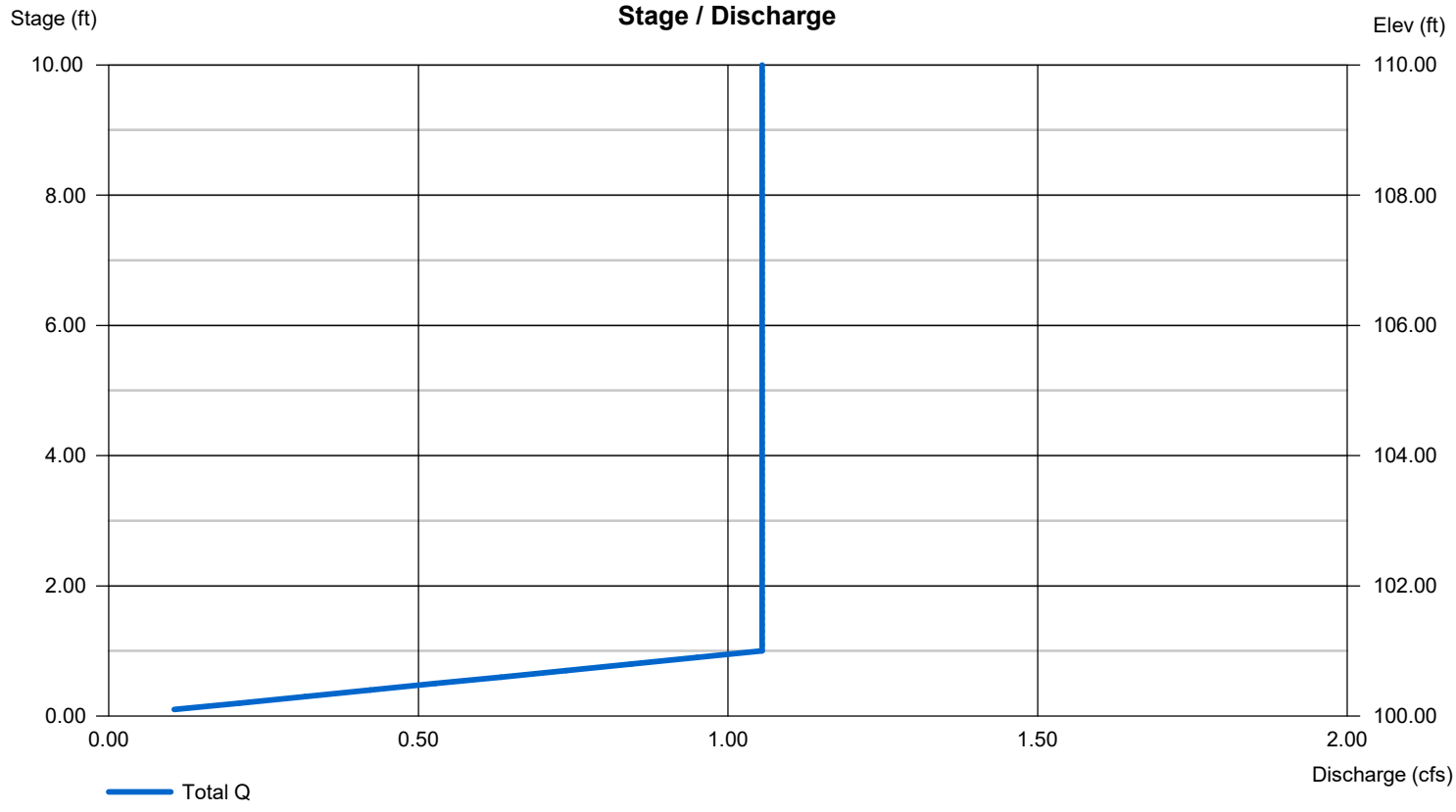
Weir Structures

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

Exfil.(in/hr) = 740.000 (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).



Appendix C:

NRCS Soils Report
Well Logs

Map Scale: 1:1,360 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 20 40 80 120

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

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

Special Point Features

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Missoula County Area, Montana
Survey Area Data: Version 21, Aug 29, 2023

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

Date(s) aerial images were photographed: Aug 15, 2022—Sep 17, 2022

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
114	Urban land	7.9	100.0%
Totals for Area of Interest		**7.9**	**100.0%**

Missoula County Area, Montana

114—Urban land

Map Unit Setting

National map unit symbol: 4w9f
Elevation: 2,600 to 5,500 feet
Mean annual precipitation: 11 to 19 inches
Mean annual air temperature: 41 to 45 degrees F
Frost-free period: 90 to 120 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Minor Components

Orthents

Percent of map unit: 3 percent
Hydric soil rating: No

Argiborolls

Percent of map unit: 3 percent
Hydric soil rating: No

Bigarm

Percent of map unit: 3 percent
Landform: Stream terraces
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R044AB032MT - Loamy (Lo) LRU 44A-B
Hydric soil rating: No

Grassvalley

Percent of map unit: 2 percent
Landform: Lake plains
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R044AA032MT - Loamy (Lo) LRU 44A-A
Hydric soil rating: No

Desmet

Percent of map unit: 2 percent
Landform: Stream terraces
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R044AA032MT - Loamy (Lo) LRU 44A-A
Hydric soil rating: No

Grantsdale

Percent of map unit: 2 percent
Landform: Stream terraces
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R044AB032MT - Loamy (Lo) LRU 44A-B
Hydric soil rating: No

Data Source Information

Soil Survey Area: Missoula County Area, Montana
Survey Area Data: Version 21, Aug 29, 2023

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

Go to GWIC website
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (2/9/2024 1:43:24 PM)

NOTICE >> **This well has been marked as ABANDONED in the GWIC database.** **<< NOTICE**

Site Name: HOMES FOR MISSOULA LLC/ GOODEN CONSTRUCTION
GWIC Id: 329990

Section 1: Well Owner(s)

1) HOMES FOR MISSOULA LLC (MAIL)
P.O. BOX 373
FRENCHTOWN MT 59834 [12/08/2023]
2) HOMES FOR MISSOULA LLC (WELL)
123 SOUTH CURTIS STREET
MISSOULA MT 59801 [12/08/2023]
3) GOODEN CONSTRUCTION (MAIL)
PO BOX 373
FRENCHTOWN MT 59834-0374 [12/08/2023]
4) GOODEN CONSTRUCTION (WELL)
123 SOUTH CURTIS STREET
MISSOULA MT 59801 [12/08/2023]

Section 2: Location

Township	Range	Section	Quarter Sections
13N	19W	20	

County	Geocode
MISSOULA	04-2200-0-3-26-09-0000

Latitude	Longitude	Geomethod	Datum
46.8706654419	-114.029518274	TRS-SEC	NAD83

Ground Surface Altitude	Ground Surface Method	Datum	Date

Addition	Block	Lot
CURTIS AND MAJOR ADDITION		

Section 3: Proposed Use of Water

UNKNOWN (1)

Section 4: Type of Work

Drilling Method: ROTARY
Status: ABANDONED

Section 5: Well Completion Date

Date well completed: Friday, December 8, 2023

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	35	6

There are no casing strings assigned to this well.
There are no completion records assigned to this well.

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	25	BENTONITE SURFACE SEAL	Y

Section 7: Well Test Data

Total Depth: 35
Static Water Level: 21
Water Temperature:

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log

Geologic Source

Unassigned

From	To	Description
0	35	ABANDONED WITH BENTONITE

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name: DANIELLE NORCROSS
Company: CAMP WELL DRILLING AND PUMP SERVICE
License No: WWC-795
Date Completed: 12/8/2023

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

Go to GWIC website
Plot this site in State Library Digital Atlas
Plot this site in Google Maps

Site Name: LEFLER JOAN
GWIC Id: 189526

Section 1: Well Owner(s)

1) LEFLER, JOAN (MAIL)
115 SOUTH CURTIS
MISSOULA MT 59801 [04/13/2001]

Section 2: Location

Township	Range	Section	Quarter Sections
13N	19W	20	NW¼ NE¼ SW¼

County

MISSOULA

Latitude	Longitude	Geomethod	Datum
46.869711	-114.033448	TRS-SEC	NAD83

Ground Surface Altitude **Ground Surface Method** **Datum** **Date**

Addition **Block** **Lot**

Section 3: Proposed Use of Water

DOMESTIC (1)

Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

Section 5: Well Completion Date

Date well completed: Friday, April 13, 2001

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	60	6

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-2	58	6	0.250			STEEL

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
58	60	6			OPEN HOLE

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	0	BENTONITE	

Section 7: Well Test Data

Total Depth: 58
Static Water Level: 32.75
Water Temperature:

Air Test *

60 gpm with drill stem set at 48 feet for 1.2 hours.
Time of recovery 0.25 hours.
Recovery water level 32.75 feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log

Geologic Source

111ALVM - ALLUVIUM (HOLOCENE)

From	To	Description
0	0.7	TOP SOIL
0.7	18	GRAVEL AND COBBLES
18	32	GRAVEL AND COBBLES/ SILTY
32	41	GRAVEL AND SANDY
41	49	GRAVEL AND COBBLES/ SILT AND SAND/ DAMP
49	60	GRAVEL COBBLES/ SILT AND SAND/ WATER BEARING

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name:
Company: BLACKFOOT WELL DRILLING & PUMP SERVICE INC
License No: WWC-578
Date Completed: 4/13/2001

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

Go to GWIC website
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View scanned well log (4/3/2009 1:19:10 PM)

Site Name: BROWN MIKE
GWIC Id: 134718
DNRC Water Right: 86758

Section 1: Well Owner(s)

1) BROWN, MIKIE (MAIL)
2401 WYOMING ST
MISSOULA MT N/A [05/07/1993]

Section 2: Location

Township	Range	Section	Quarter Sections
13N	19W	20	SE¼ SW¼ NW¼

County
MISSOULA

Geocode

Latitude	Longitude	Geomethod	Datum
46.87162	-114.036068	TRS-SEC	NAD83

Ground Surface Altitude **Ground Surface Method** **Datum** **Date**

Addition	Block	Lot
MART ADDITION		1

Section 3: Proposed Use of Water

DOMESTIC (1)

Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

Section 5: Well Completion Date

Date well completed: Friday, May 7, 1993

Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-2	55	6				STEEL

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
55	55	6			OPEN BOTTOM *

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	20	BENTONITE	

Section 7: Well Test Data

Total Depth: 55
Static Water Level: 26
Water Temperature:

Air Test *

40 gpm with drill stem set at _ feet for 1 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 41 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log

Geologic Source

111ALVM - ALLUVIUM (HOLOCENE)

From	To	Description
0	2	SOIL
2	26	SAND GRAVEL COBBLES
26	55	SAND GRAVEL

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name:
Company: JEROMES DRILLING CO
License No: WWC-249
Date Completed: 5/7/1993

Grading and Drainage Plans (attached separately)

INCLUDED BY REFERENCE

Montana Public Works and Specifications *(latest edition)*
Missoula City Public Works Standards & Specifications Manual (*2024 Edition*)
Montana Department of Environmental Quality Circular 8 *(2018 Edition)*