(1) BACKGROUND

Horseshoe Farm Dam (State ID Wake-361) is located on an unnamed tributary to the Neuse River in Wake County, NC. The existing dam is a 14 ft wide, 17 ft high earthen impoundment, measured from the crest of the dam to the toe of the slope at the discharge point. At the normal pool elevation of 201.04 it stores 4.0 ac-ft with a maximum storage of 13.04 ac-ft at the top of the dam. An 8 inch PVC riser pipe serves as the principal spillway with a 15" RCP functioning as the emergency spillway. The normal pool elevation is 201.04 with the emergency spillway elevation at 203.31. The principal spillway discharges into a channel that drains into the Neuse River approximately 700 feet below the principal spillway outlet. The emergency spillway passes beneath an existing driveway and discharges onto an adjoining lot. Any flow that is discharged through the emergency spillway eventually crosses back over Horse Shoe Farm Road and continues downstream to the Neuse River.

Currently Horseshoe Farm Road is a single lane gravel road that traverses the entire length of the crest of the dam. It serves as the access road to Horse Shoe Farm Park and it provides driveway access for approximately 8 homes. The City of Raleigh Parks and Recreation Department is proposing to further develop Horseshoe Farm Park. One of the improvements associated with the development of the park is the widening of Horseshoe Farm Road into a two lane wide roadway.

With the development of the park, it is anticipated that the average number of vehicles traveling over the dam will increase past the 25 allowed to remain classified as a low hazard (Class A) dam and move it to the intermediate (Class B) hazard classification. State dam safety laws dictate that the dam shall have a minimum spillway designed to safely pass the 100-year storm event.

(2) DESIGN SUMMARY AND RECOMMENDATIONS

The change to a Class B dam requires the principal spillway be designed with a capacity to pass a flow resulting from the 100 year storm event. Under the current classification the principal spillway and emergency spillway are required to safely pass the 50-year storm event, the criteria for a low hazard dam.

A hydraulic analysis was performed on the existing pond outlet structures. In its present state, the 10 year event is passed safely through the secondary 15" RCP spillway. However, the emergency spillway is activated prior to the 25 year event. The early activation of the emergency spillway substantiates the need for the spillway capacity to be increased.

Two outlet structure configurations were considered in the analysis and the results are presented in this section. The first possible solution includes a principal spillway that is large enough to safely pass the 100 year storm event through it without activating an emergency spillway. The second scenario passes all storm events up to and including the 25 year storm event through a principal spillway but uses an emergency spillway for all other storms.

(a) PRINCIPAL SPILLWAY ALSO SERVING AS EMERGENCY SPILLWAY

A 10' x 10' reinforced concrete structure can be used to replace the existing 8" PVC riser. The existing 15" RCP culvert would be removed as the proposed concrete riser would serve as both principal and emergency spillway. The new riser structure will be designed to control all rainfall events up to and including the 100 year storm event.

To enable the 100 year storm event to pass through the principal spillway, the proposed roadway improvements will include raising the elevation of the low lying area in Horseshoe Farm Road by 0.5 feet to an elevation of 205.45. Raising the elevation of the low lying area will eliminate the use of the driveway pipe as an emergency spillway and eliminate the use of the driveway as a secondary emergency spillway. All runoff can be safely diverted into the proposed spillway and discharged through the embankment.

The upgrade to the primary spillway will limit the use of the emergency spillway to storms greater than the 100 year event. The peak runoff for the 2 year and 10 year storm events will be controlled to the levels that are currently being discharged from the existing PVC riser. All other storms shall be passed through the principal spillway and discharged to the existing stream channel. The results of the proposed 10'x10 outlet structure analysis are shown in Table 2-1.

RETURN PERIOD	DISCHARGE THROUGH PRINCIPAL SPILLWAY (CFS)	DISCHARGE OVER EMERGENCY SPILLWAY (CFS)	TOTAL DISCHARGE (CFS)	WATER SURFACE ELEVATION
2 YR	2.06	0	2.06	203.08
10 YR	7.63	0	7.63	204.66
25 YR	57.49	0	57.49	204.96
50 YR	105.45	0	105.45	205.12
100 YR	149.58	0	149.58	205.25

Table 2-1 10' x 10' Proposed Spillway Hydraulic Data–Discharge & Water Surface Elevation

(b) PRINCIPAL SPILLWAY WITH A SECONDARY EMERGENCY SPILLWAY

A 6' x 6' reinforced concrete structure in conjunction with a 36" ductile iron pipe can also be used to replace the existing 8" PVC riser/barrel. The peak runoff for the 2 year and 10 year storm events will be controlled and released at a rate less than the amount currently being discharged by the 8" PVC riser. The 25 year event will also be passed through the principal spillway and discharged to the existing stream channel. The existing 15" RCP culvert would be removed and any storm in excess of the 25 year event will activate the proposed concrete emergency spillway. The results of the proposed 6' x 6' outlet structure analysis are shown in Table 2-2.

A low lying area in Horse Shoe Farm Road will be utilized as the concrete emergency spillway. To accomplish this, the low lying area in the road will be raised by 0.2 feet. To minimize the depth of water that will cross over Horse Shoe Farm Road, the length of the emergency spillway will be significant. The proposed concrete emergency spillway would be a 50 foot wide trough 0.75 feet in depth. This depth allows for the 100 year event to pass over the emergency spillway while still leaving 0.3 feet of freeboard. Figure 2-3 is a sketch of the proposed structure. The trough will cross the entire width of Horse Shoe Farm Road and extend several feet onto the upstream and downstream embankment. Rip rap will be placed at the downstream end of the spillway and will extend down the side of the embankment to the stream buffer.

	EXISTING DAM SPILLWAY	PROPOSED 10' x 10' DAM SPILLWAY	PROPOSED 6' x 6' DAM SPILLWAY
2 YEAR PEAK FLOW (CFS)	2.066	2.060	
10 YEAR PEAK FLOW (CFS)	7.638	7.626	
10 YEAR WATER SURFACE ELEVATION	204.64	204.66	
25 YEAR WATER SURFACE ELEVATION	205.14	204.96	
50 YEAR WATER SURFACE ELEVATION	205.32	205.12	
100 YEAR WATER SURFACE ELEVATION	205.46	205.25	

Table 2-2: Results comparison for the existing and proposed spillway structures

In both scenarios, the existing PVC conduit will be removed and the new ductile iron pipe will be installed to accommodate the larger design storm. The proposed conduit will terminate at a new headwall at the toe of the widened embankment. Filter diaphragms are proposed to control any seepage along the length of the pipe. In addition a new toe drain system will be installed to safely collect seepage and will also discharge through the proposed headwall.

Watershed Model Schematic

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Legend

Hyd.	Origin	Description
1	SCS Runoff	PROPOSED HORSE SHOE FARM ROAD DAM
2	Reservoir	PROPOSED DAM ROUTED

Project: HORSESHOE FARM ROAD DAM PROPOSED (10x10) 4-12-11.gpw

Monday, Apr 18, 2011

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

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	------	-------	46.89	-------	-------	103.23	139.08	167.78	196.60	PROPOSED HORSE SHOE FARM
2	Reservoir	1	-------	2.060	-------	-------	7.721	43.51	83.42	124.03	PROPOSED DAM ROUTED

Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Monday, Apr 18, 2011

Hyd. No. 1

PROPOSED HORSE SHOE FARM ROAD DAM

Hydrograph type	= SCS Runoff	Peak discharge	= 46.89 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 182,357 cuft
Drainage area	= 43.000 ac	Curve number	= 72
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.20 min
Total precip.	= 3.60 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

Hydrograph Report

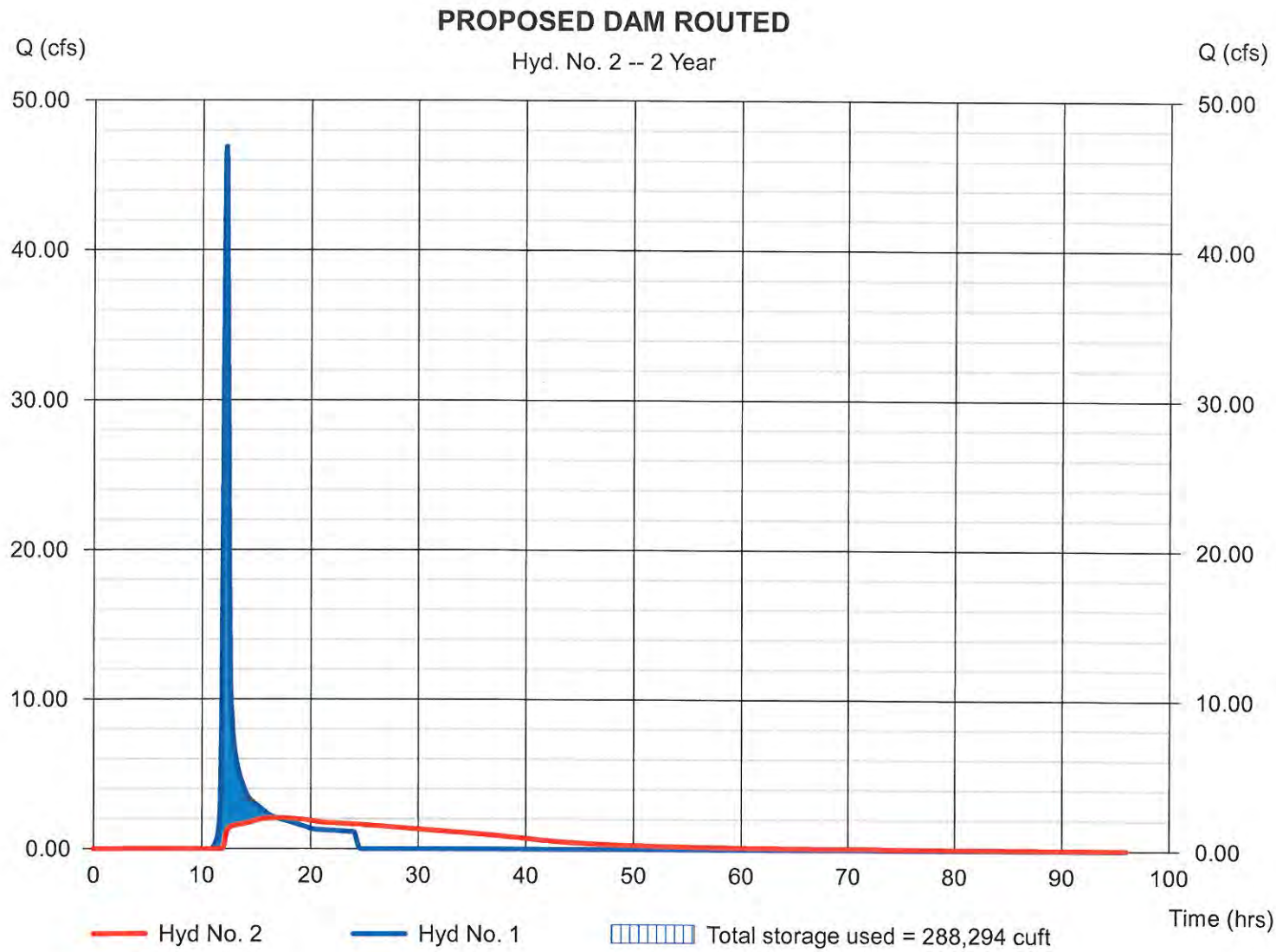
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Monday, Apr 18, 2011

Hyd. No. 2

PROPOSED DAM ROUTED

Hydrograph type	= Reservoir	Peak discharge	= 2.060 cfs
Storm frequency	= 2 yrs	Time to peak	= 16.87 hrs
Time interval	= 2 min	Hyd. volume	= 177,362 cuft
Inflow hyd. No.	= 1 - PROPOSED HORSE SHOE FARM ROAD DAM	Max. Elevation	= 203.08 ft
Reservoir name	= PROPOSED HORSE SHOE FARM POND	Max. Storage	= 288,294 cuft

Storage Indication method used. Wet pond routing start elevation = 201.00 ft.



Hydrograph Report

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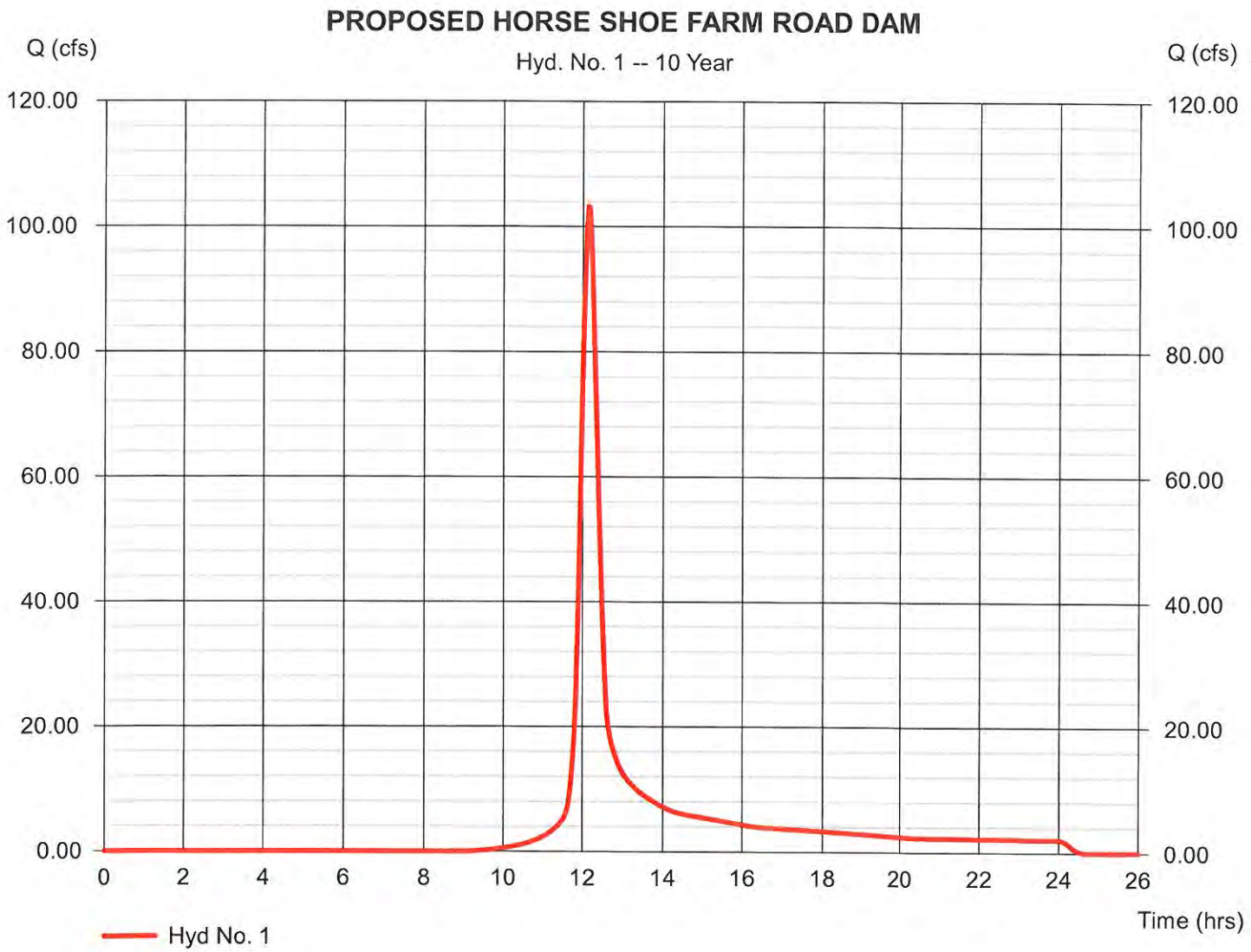
Hyd. No. 1

PROPOSED HORSE SHOE FARM ROAD DAM

Hydrograph type	= SCS Runoff	Peak discharge	= 103.23 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 383,271 cuft
Drainage area	= 43.000 ac	Curve number	= 72
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.20 min
Total precip.	= 5.38 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

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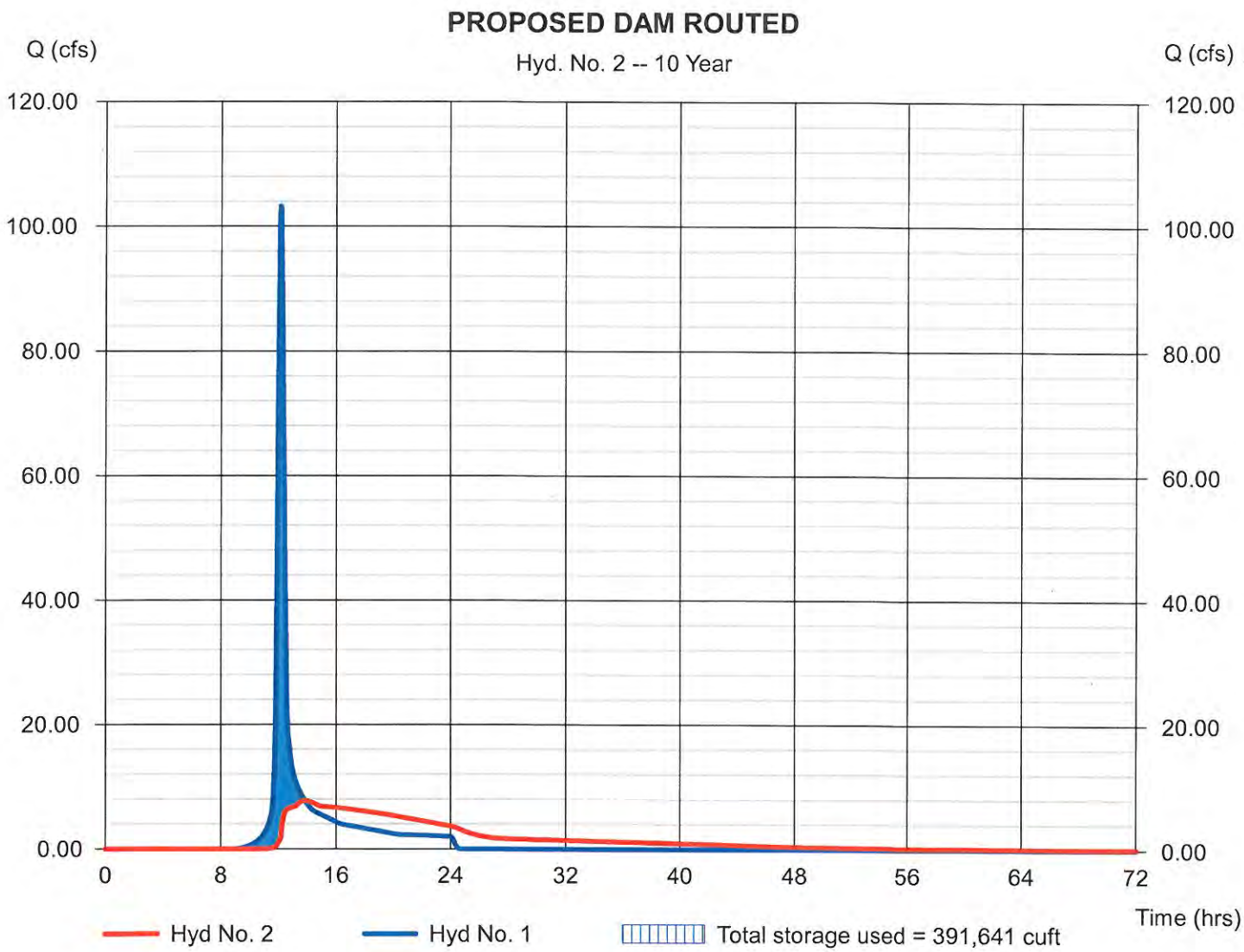
Hyd. No. 2

PROPOSED DAM ROUTED

Hydrograph type	= Reservoir	Peak discharge	= 7.721 cfs
Storm frequency	= 10 yrs	Time to peak	= 13.87 hrs
Time interval	= 2 min	Hyd. volume	= 377,997 cuft
Inflow hyd. No.	= 1 - PROPOSED HORSE SHOE FARM ROAD DAM	Max. Elevation	= 204.65 ft
Reservoir name	= PROPOSED HORSE SHOE FARM POND	Max. Storage	= 391,641 cuft

Storage Indication method used. Wet pond routing start elevation = 201.00 ft.



Hydrograph Report

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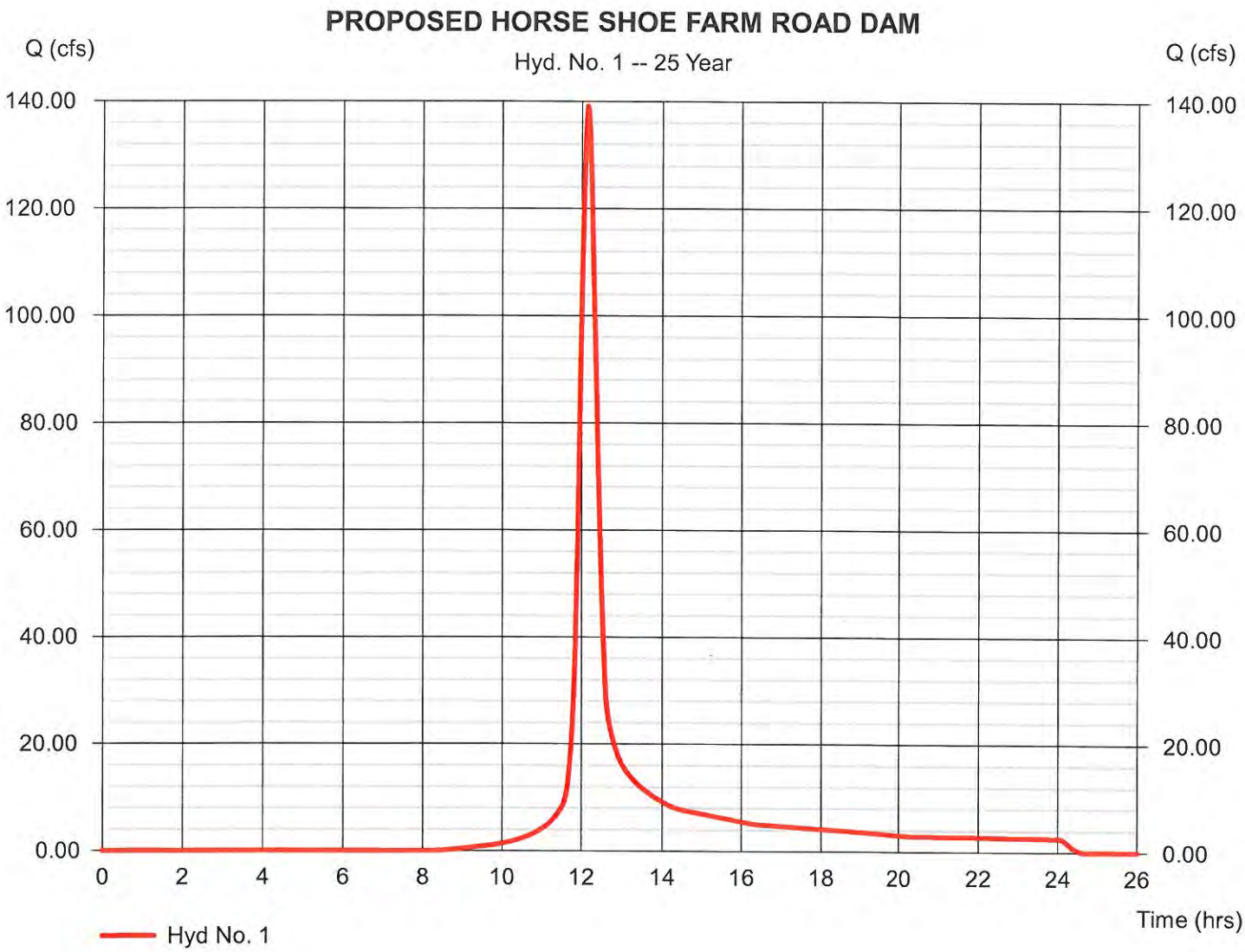
Hyd. No. 1

PROPOSED HORSE SHOE FARM ROAD DAM

Hydrograph type	= SCS Runoff	Peak discharge	= 139.08 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 511,927 cuft
Drainage area	= 43.000 ac	Curve number	= 72
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.20 min
Total precip.	= 6.41 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

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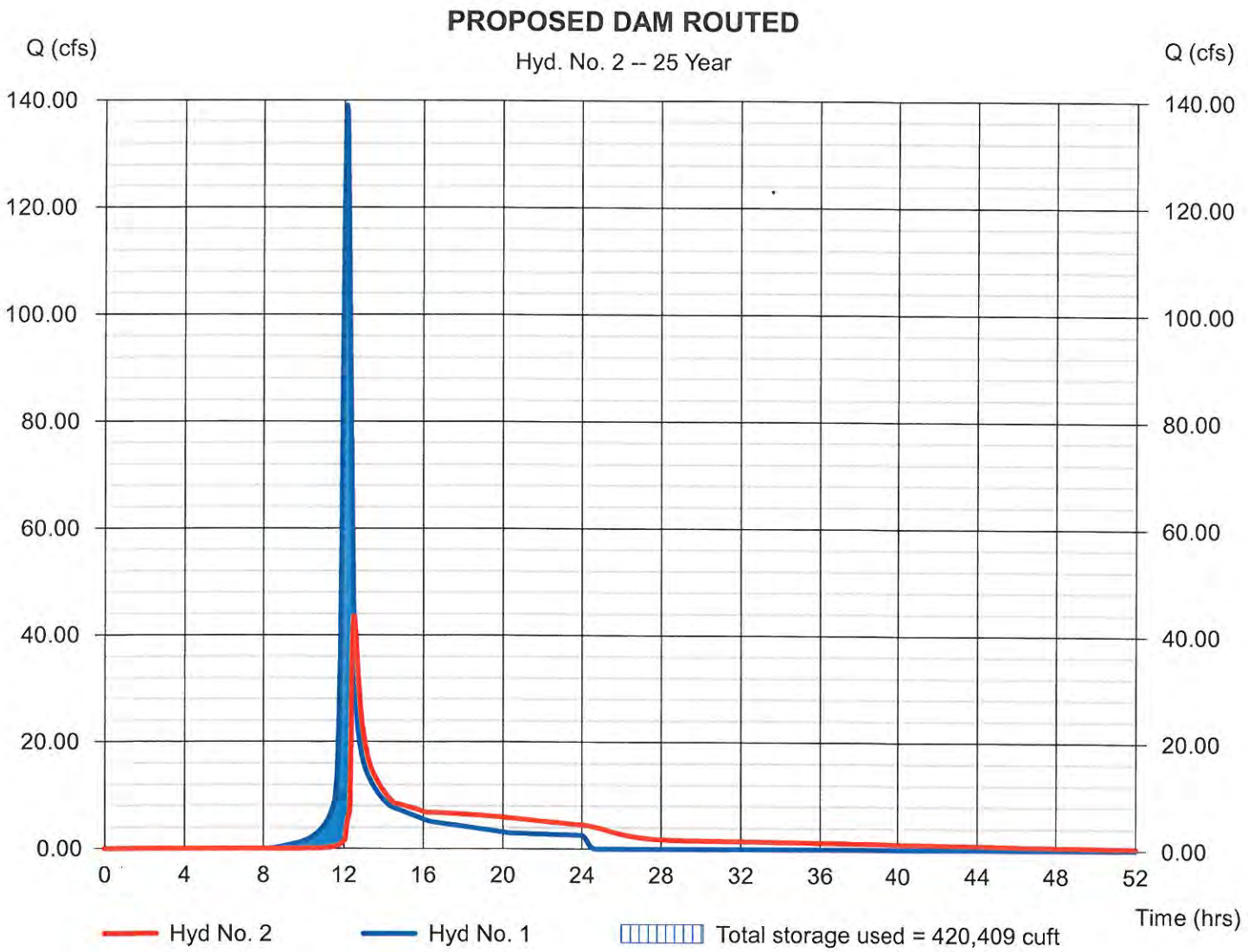
Hyd. No. 2

PROPOSED DAM ROUTED

Hydrograph type	= Reservoir	Peak discharge	= 43.51 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.50 hrs
Time interval	= 2 min	Hyd. volume	= 506,574 cuft
Inflow hyd. No.	= 1 - PROPOSED HORSE SHOE FARM ROAD DAM	Max. Elevation	= 205.07 ft
Reservoir name	= PROPOSED HORSE SHOE FARM POND	Max. Storage	= 420,409 cuft

Storage Indication method used. Wet pond routing start elevation = 201.00 ft.



Hydrograph Report

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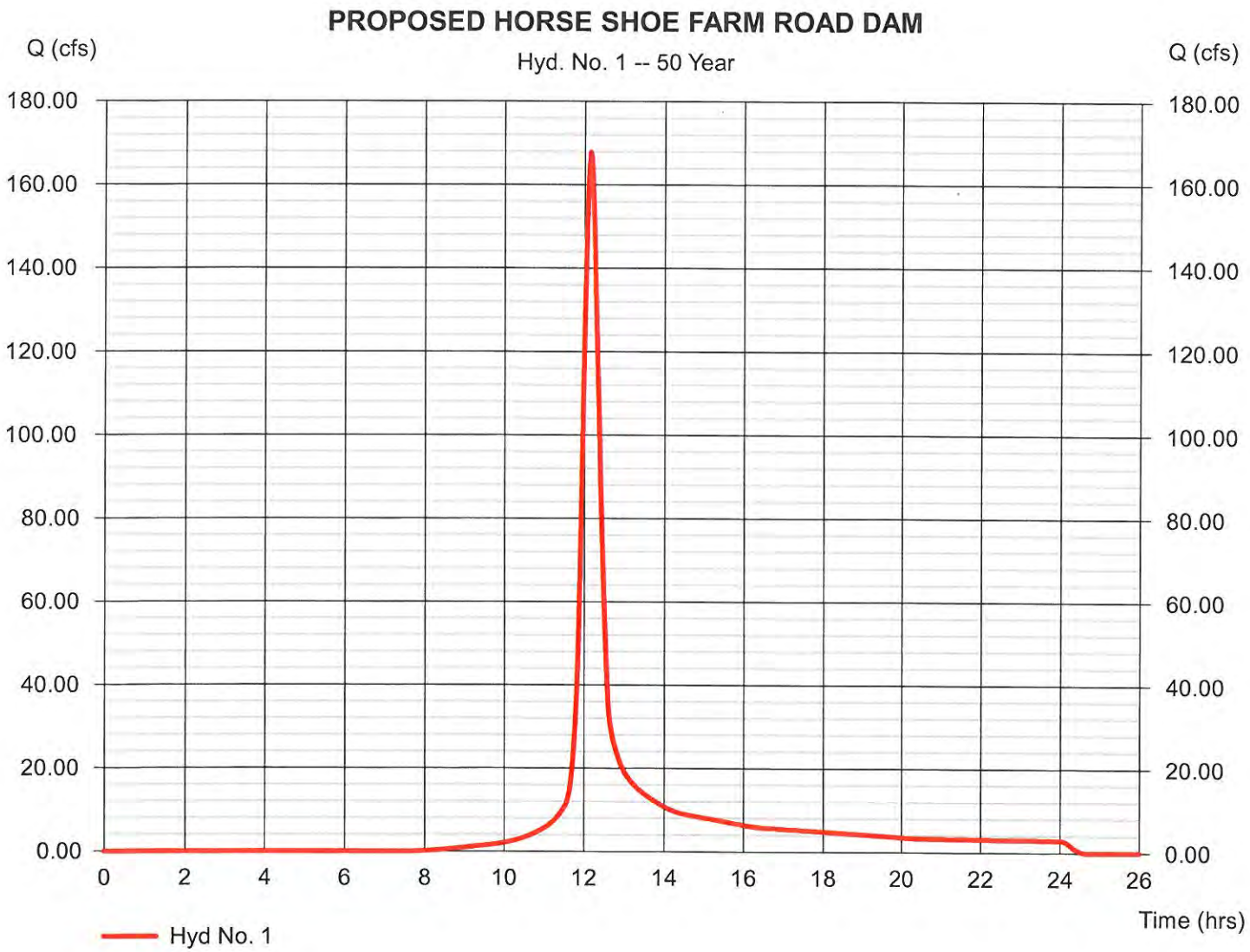
Hyd. No. 1

PROPOSED HORSE SHOE FARM ROAD DAM

Hydrograph type	= SCS Runoff	Peak discharge	= 167.78 cfs
Storm frequency	= 50 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 615,930 cuft
Drainage area	= 43.000 ac	Curve number	= 72
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.20 min
Total precip.	= 7.21 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

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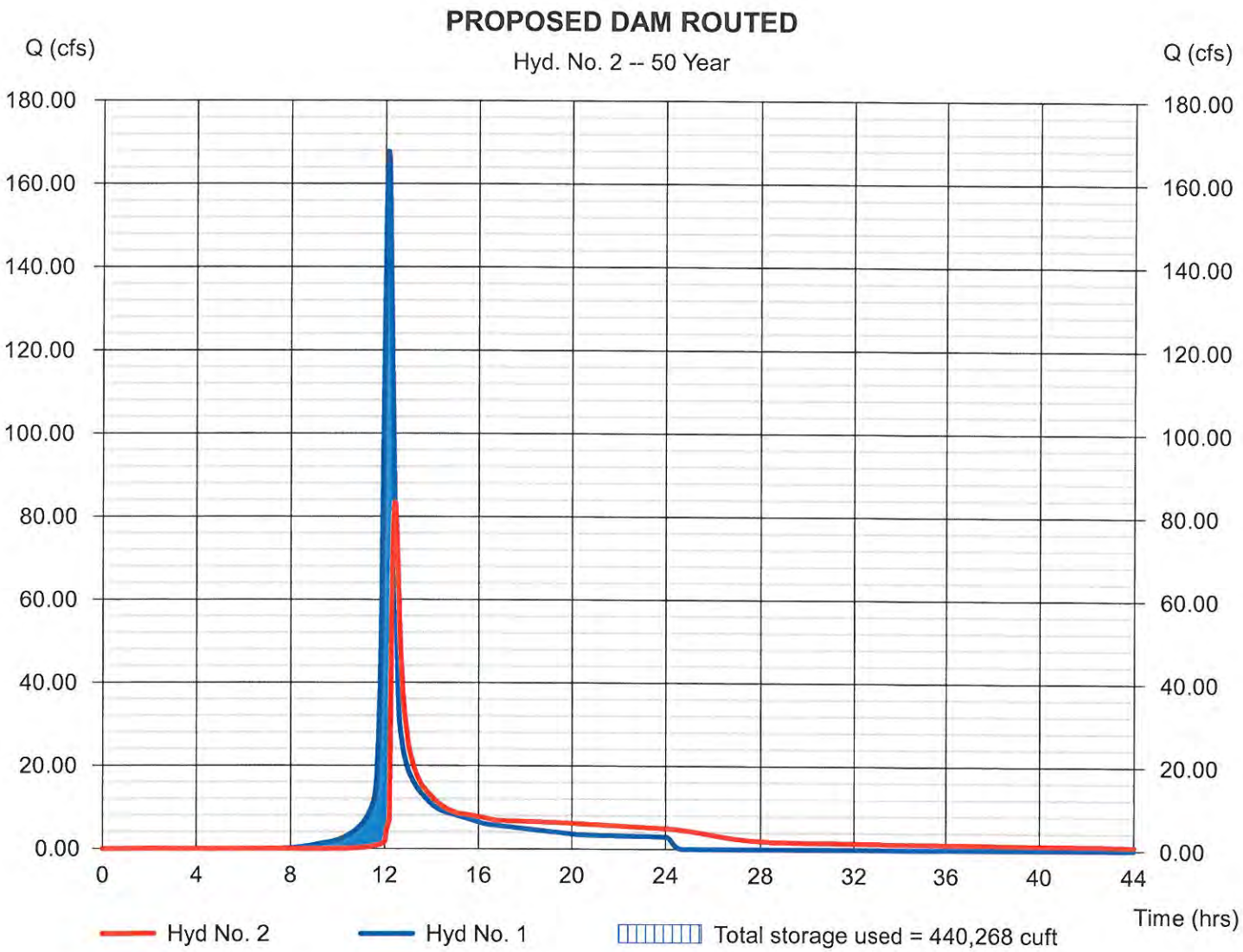
Hyd. No. 2

PROPOSED DAM ROUTED

Hydrograph type	= Reservoir	Peak discharge	= 83.42 cfs
Storm frequency	= 50 yrs	Time to peak	= 12.40 hrs
Time interval	= 2 min	Hyd. volume	= 610,525 cuft
Inflow hyd. No.	= 1 - PROPOSED HORSE SHOE FARM ROAD DAM	Max. Elevation	= 205.34 ft
Reservoir name	= PROPOSED HORSE SHOE FARM POND	Max. Storage	= 440,268 cuft

Storage Indication method used. Wet pond routing start elevation = 201.00 ft.



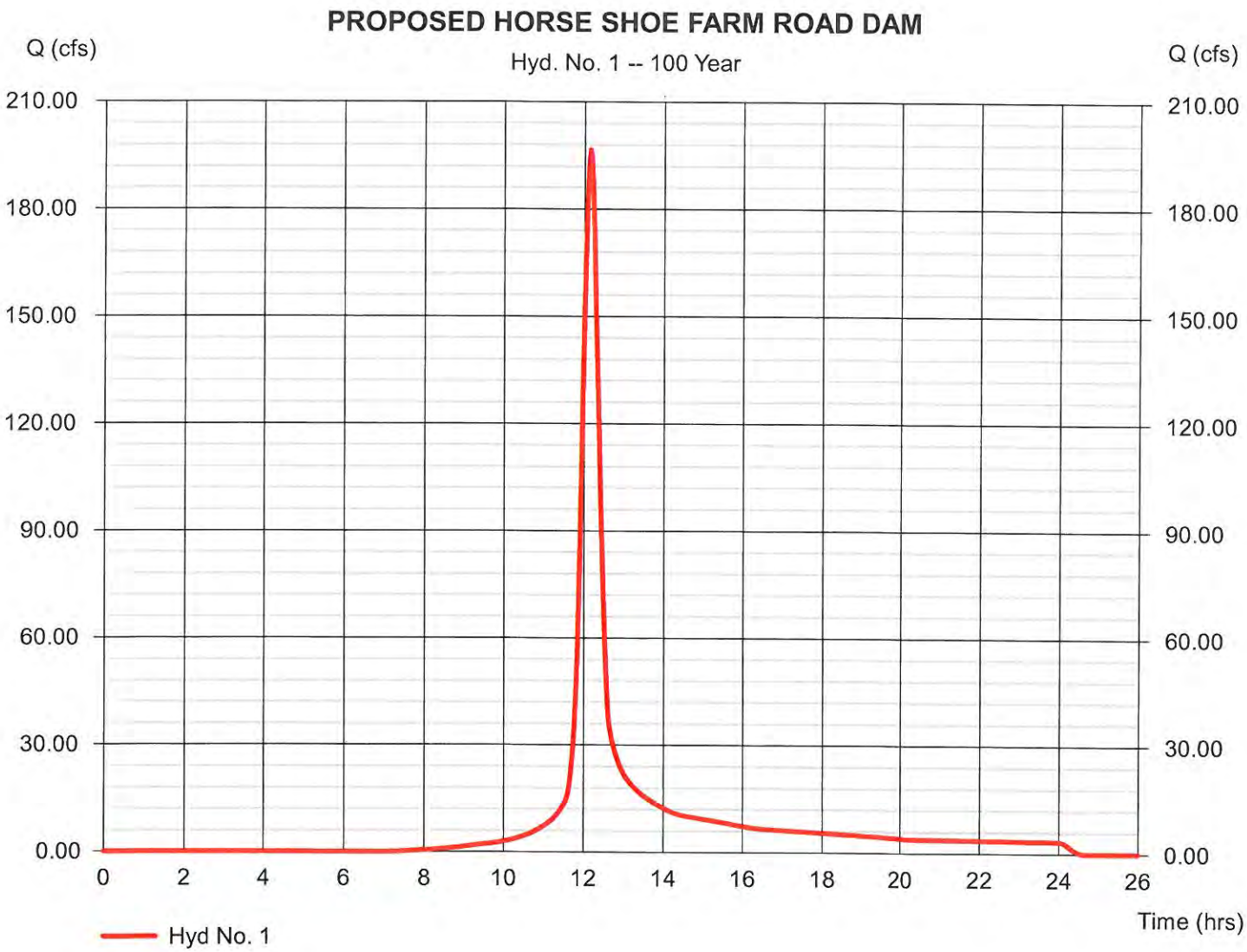
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Monday, Apr 18, 2011

Hyd. No. 1

PROPOSED HORSE SHOE FARM ROAD DAM

Hydrograph type	= SCS Runoff	Peak discharge	= 196.60 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 721,306 cuft
Drainage area	= 43.000 ac	Curve number	= 72
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.20 min
Total precip.	= 8.00 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

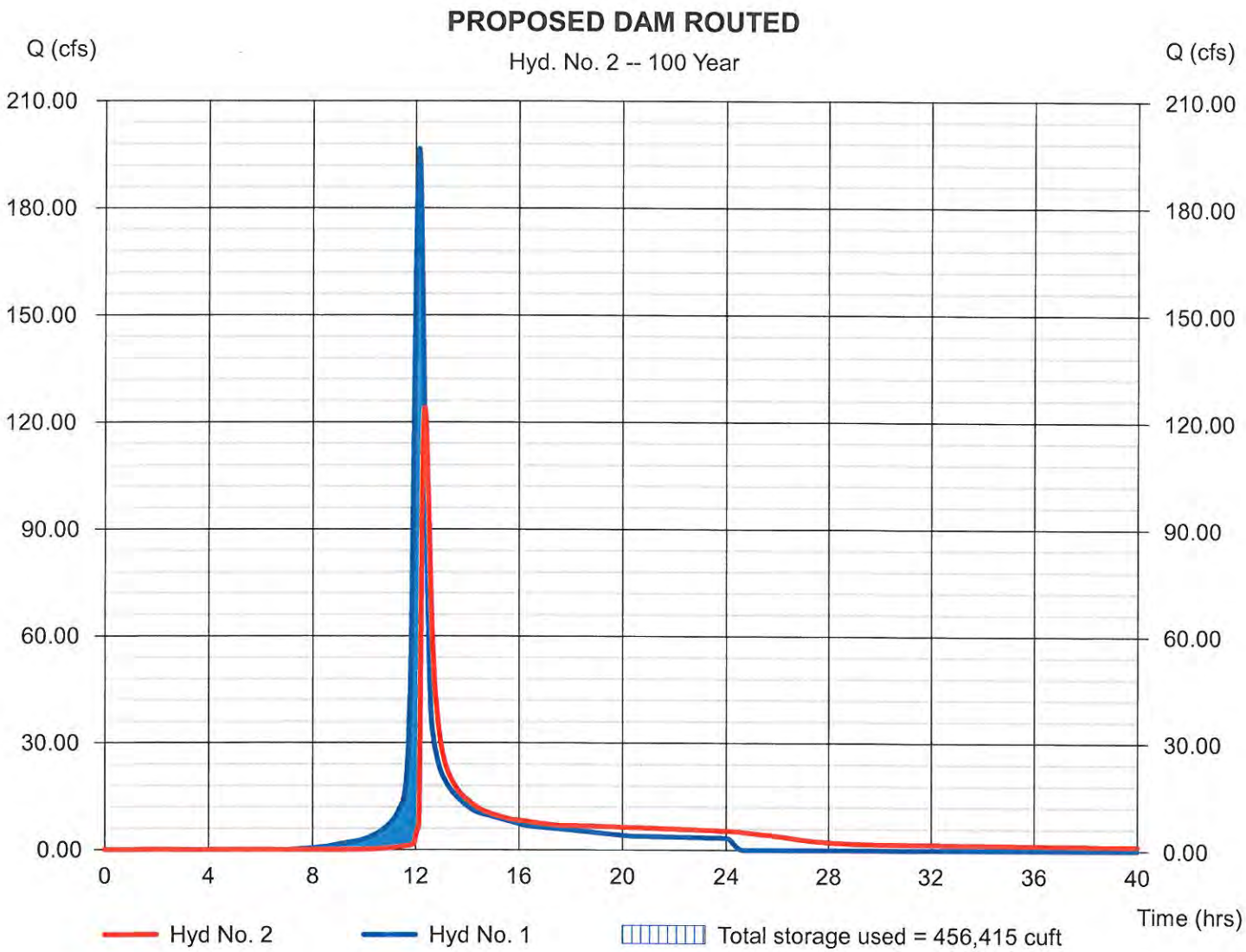
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Monday, Apr 18, 2011

Hyd. No. 2

PROPOSED DAM ROUTED

Hydrograph type	= Reservoir	Peak discharge	= 124.03 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.37 hrs
Time interval	= 2 min	Hyd. volume	= 715,855 cuft
Inflow hyd. No.	= 1 - PROPOSED HORSE SHOE FARM ROAD DAM	Max. Elevation	= 205.56 ft
Reservoir name	= PROPOSED HORSE SHOE FARM POND	Max. Storage	= 456,415 cuft

Storage Indication method used. Wet pond routing start elevation = 201.00 ft.



TR55 Tc Worksheet

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Hyd. No. 1

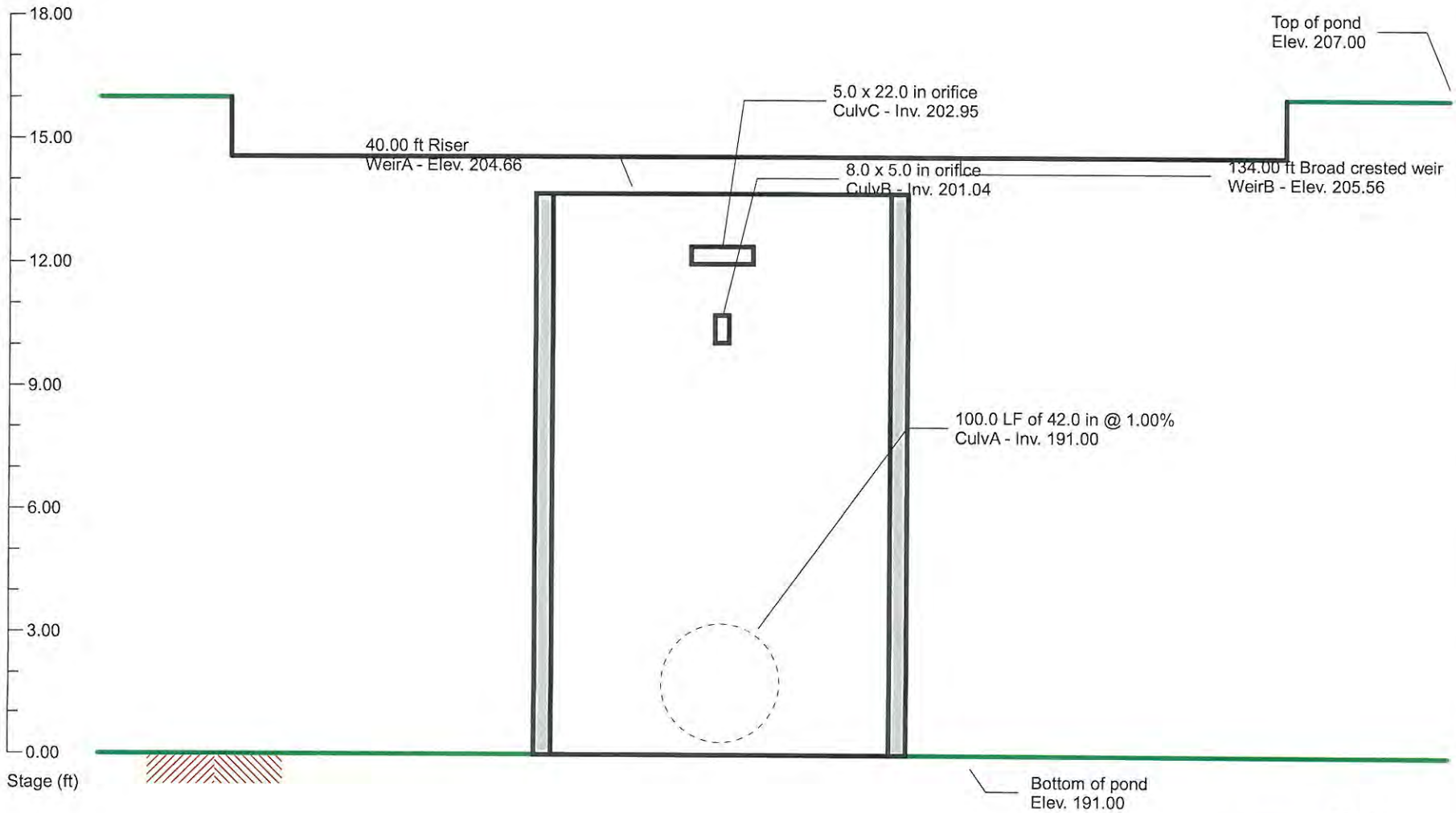
PROPOSED HORSE SHOE FARM ROAD DAM

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.200		0.011		0.011		
Flow length (ft)	=	300.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.60		0.00		0.00		
Land slope (%)	=	4.33		0.00		0.00		
Travel Time (min)	**=**	**20.56**	**+**	**0.00**	**+**	**0.00**	**=**	**20.56**
Shallow Concentrated Flow								
Flow length (ft)	=	934.00		0.00		0.00		
Watercourse slope (%)	=	4.50		0.00		0.00		
Surface description	=	Unpaved		Paved		Paved		
Average velocity (ft/s)	=	3.42		0.00		0.00		
Travel Time (min)	**=**	**4.55**	**+**	**0.00**	**+**	**0.00**	**=**	**4.55**
Channel Flow								
X sectional flow area (sqft)	=	160.00		0.00		0.00		
Wetted perimeter (ft)	=	78.00		0.00		0.00		
Channel slope (%)	=	2.83		0.00		0.00		
Manning's n-value	=	0.026		0.015		0.015		
Velocity (ft/s)	=	15.60		0.00		0.00		
Flow length (ft)	=	1058.0		0.0		0.0		
Travel Time (min)	**=**	**1.13**	**+**	**0.00**	**+**	**0.00**	**=**	**1.13**

Total Travel Time, Tc ..... 26.20 min

Pond No. 2 - PROPOSED HORSE SHOE FARM POND

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066



Front View

NTS - Looking Downstream

Inflow hydrograph = 1. SCS Runoff - PROPOSED HORSE SHOE FARM ROAD DAM

Project: HORSESHOE FARM ROAD DAM PROPOSED (10x10) 4-12-11.gpw	Monday, Apr 18, 2011

Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Monday, Apr 18, 2011

Pond No. 2 - PROPOSED HORSE SHOE FARM POND

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 191.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	191.00	102	0	0
1.00	192.00	1,279	581	581
2.00	193.00	3,235	2,182	2,763
3.00	194.00	6,486	4,767	7,530
4.00	195.00	10,352	8,343	15,873
5.00	196.00	13,742	12,006	27,879
6.00	197.00	17,696	15,676	43,555
7.00	198.00	23,698	20,622	64,177
8.00	199.00	32,818	28,132	92,309
9.00	200.00	41,972	37,298	129,606
10.00	201.00	48,098	44,996	174,602
11.00	202.00	54,110	51,069	225,671
12.00	203.00	60,725	57,380	283,051
13.00	204.00	66,234	63,453	346,504
14.00	205.00	71,891	69,036	415,541
15.00	206.00	76,619	74,235	489,776
16.00	207.00	82,085	79,328	569,104

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 42.00	8.00	5.00	0.00
Span (in)	= 42.00	5.00	22.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 191.00	201.04	202.95	0.00
Length (ft)	= 100.00	0.00	0.00	0.00
Slope (%)	= 1.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	Yes	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 40.00	134.00	0.00	0.00
Crest El. (ft)	= 204.66	205.56	0.00	0.00
Weir Coeff.	= 3.33	3.00	3.33	3.33
Weir Type	= Riser	Broad	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (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).

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	191.00	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
0.10	58	191.10	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
0.20	116	191.20	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
0.30	174	191.30	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
0.40	232	191.40	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
0.50	290	191.50	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
0.60	348	191.60	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
0.70	406	191.70	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
0.80	465	191.80	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
0.90	523	191.90	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
1.00	581	192.00	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
1.10	799	192.10	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
1.20	1,017	192.20	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
1.30	1,235	192.30	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
1.40	1,454	192.40	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
1.50	1,672	192.50	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
1.60	1,890	192.60	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
1.70	2,108	192.70	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
1.80	2,327	192.80	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
1.90	2,545	192.90	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
2.00	2,763	193.00	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
2.10	3,240	193.10	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
2.20	3,717	193.20	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
2.30	4,193	193.30	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
2.40	4,670	193.40	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000

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PROPOSED HORSE SHOE FARM POND

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
2.50	5,147	193.50	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
2.60	5,623	193.60	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
2.70	6,100	193.70	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
2.80	6,577	193.80	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
2.90	7,053	193.90	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
3.00	7,530	194.00	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
3.10	8,364	194.10	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
3.20	9,199	194.20	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
3.30	10,033	194.30	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
3.40	10,867	194.40	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
3.50	11,701	194.50	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
3.60	12,536	194.60	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
3.70	13,370	194.70	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
3.80	14,204	194.80	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
3.90	15,039	194.90	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
4.00	15,873	195.00	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
4.10	17,074	195.10	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
4.20	18,274	195.20	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
4.30	19,475	195.30	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
4.40	20,675	195.40	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
4.50	21,876	195.50	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
4.60	23,077	195.60	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
4.70	24,277	195.70	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
4.80	25,478	195.80	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
4.90	26,678	195.90	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
5.00	27,879	196.00	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
5.10	29,447	196.10	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
5.20	31,014	196.20	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
5.30	32,582	196.30	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
5.40	34,149	196.40	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
5.50	35,717	196.50	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
5.60	37,284	196.60	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
5.70	38,852	196.70	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
5.80	40,420	196.80	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
5.90	41,987	196.90	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
6.00	43,555	197.00	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
6.10	45,617	197.10	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
6.20	47,679	197.20	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
6.30	49,741	197.30	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
6.40	51,804	197.40	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
6.50	53,866	197.50	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
6.60	55,928	197.60	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
6.70	57,990	197.70	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
6.80	60,052	197.80	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
6.90	62,115	197.90	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
7.00	64,177	198.00	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
7.10	66,990	198.10	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
7.20	69,803	198.20	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
7.30	72,616	198.30	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
7.40	75,429	198.40	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
7.50	78,243	198.50	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
7.60	81,056	198.60	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
7.70	83,869	198.70	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
7.80	86,682	198.80	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
7.90	89,495	198.90	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
8.00	92,309	199.00	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
8.10	96,038	199.10	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
8.20	99,768	199.20	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
8.30	103,498	199.30	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
8.40	107,228	199.40	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
8.50	110,957	199.50	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
8.60	114,687	199.60	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
8.70	118,417	199.70	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
8.80	122,147	199.80	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
8.90	125,876	199.90	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
9.00	129,606	200.00	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
9.10	134,106	200.10	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
9.20	138,605	200.20	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
9.30	143,105	200.30	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
9.40	147,604	200.40	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
9.50	152,104	200.50	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000

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PROPOSED HORSE SHOE FARM POND

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
9.60	156,604	200.60	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
9.70	161,103	200.70	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
9.80	165,603	200.80	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
9.90	170,102	200.90	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
10.00	174,602	201.00	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
10.10	179,709	201.10	0.02 ic	0.02 ic	0.00	---	0.00	0.00	---	---	---	---	0.021
10.20	184,816	201.20	0.10 ic	0.09 ic	0.00	---	0.00	0.00	---	---	---	---	0.091
10.30	189,923	201.30	0.19 ic	0.19 ic	0.00	---	0.00	0.00	---	---	---	---	0.188
10.40	195,030	201.40	0.33 ic	0.31 ic	0.00	---	0.00	0.00	---	---	---	---	0.306
10.50	200,137	201.50	0.48 ic	0.44 ic	0.00	---	0.00	0.00	---	---	---	---	0.443
10.60	205,243	201.60	0.60 ic	0.59 ic	0.00	---	0.00	0.00	---	---	---	---	0.595
10.70	210,350	201.70	0.82 ic	0.76 ic	0.00	---	0.00	0.00	---	---	---	---	0.761
10.80	215,457	201.80	0.90 ic	0.87 ic	0.00	---	0.00	0.00	---	---	---	---	0.874
10.90	220,564	201.90	0.99 ic	0.97 ic	0.00	---	0.00	0.00	---	---	---	---	0.971
11.00	225,671	202.00	1.08 ic	1.06 ic	0.00	---	0.00	0.00	---	---	---	---	1.059
11.10	231,409	202.10	1.18 ic	1.14 ic	0.00	---	0.00	0.00	---	---	---	---	1.140
11.20	237,147	202.20	1.29 ic	1.22 ic	0.00	---	0.00	0.00	---	---	---	---	1.216
11.30	242,885	202.30	1.29 ic	1.29 ic	0.00	---	0.00	0.00	---	---	---	---	1.288
11.40	248,623	202.40	1.41 ic	1.36 ic	0.00	---	0.00	0.00	---	---	---	---	1.355
11.50	254,361	202.50	1.42 ic	1.42 ic	0.00	---	0.00	0.00	---	---	---	---	1.420
11.60	260,099	202.60	1.53 ic	1.48 ic	0.00	---	0.00	0.00	---	---	---	---	1.481
11.70	265,837	202.70	1.54 ic	1.54 ic	0.00	---	0.00	0.00	---	---	---	---	1.541
11.80	271,575	202.80	1.66 ic	1.60 ic	0.00	---	0.00	0.00	---	---	---	---	1.598
11.90	277,313	202.90	1.66 ic	1.65 ic	0.00	---	0.00	0.00	---	---	---	---	1.653
12.00	283,051	203.00	1.79 ic	1.71 ic	0.07 ic	---	0.00	0.00	---	---	---	---	1.776
12.10	289,397	203.10	2.12 ic	1.76 ic	0.36 ic	---	0.00	0.00	---	---	---	---	2.120
12.20	295,742	203.20	2.59 ic	1.81 ic	0.78 ic	---	0.00	0.00	---	---	---	---	2.588
12.30	302,087	203.30	3.17 ic	1.86 ic	1.29 ic	---	0.00	0.00	---	---	---	---	3.149
12.40	308,432	203.40	3.83 ic	1.90 ic	1.81 ic	---	0.00	0.00	---	---	---	---	3.712
12.50	314,778	203.50	4.10 ic	1.95 ic	2.15 ic	---	0.00	0.00	---	---	---	---	4.100
12.60	321,123	203.60	4.58 ic	2.00 ic	2.44 ic	---	0.00	0.00	---	---	---	---	4.440
12.70	327,468	203.70	4.84 ic	2.04 ic	2.71 ic	---	0.00	0.00	---	---	---	---	4.747
12.80	333,814	203.80	5.12 ic	2.08 ic	2.95 ic	---	0.00	0.00	---	---	---	---	5.030
12.90	340,159	203.90	5.41 ic	2.13 ic	3.17 ic	---	0.00	0.00	---	---	---	---	5.294
13.00	346,504	204.00	5.71 ic	2.17 ic	3.37 ic	---	0.00	0.00	---	---	---	---	5.542
13.10	353,408	204.10	5.78 ic	2.21 ic	3.57 ic	---	0.00	0.00	---	---	---	---	5.778
13.20	360,312	204.20	6.01 ic	2.25 ic	3.75 ic	---	0.00	0.00	---	---	---	---	6.003
13.30	367,215	204.30	6.33 ic	2.29 ic	3.93 ic	---	0.00	0.00	---	---	---	---	6.218
13.40	374,119	204.40	6.66 ic	2.33 ic	4.10 ic	---	0.00	0.00	---	---	---	---	6.425
13.50	381,023	204.50	6.66 ic	2.37 ic	4.26 ic	---	0.00	0.00	---	---	---	---	6.625
13.60	387,926	204.60	6.99 ic	2.40 ic	4.42 ic	---	0.00	0.00	---	---	---	---	6.819
13.70	394,830	204.70	8.07 ic	2.44 ic	4.57 ic	---	1.07	0.00	---	---	---	---	8.072
13.80	401,733	204.80	14.25 ic	2.48 ic	4.71 ic	---	6.98	0.00	---	---	---	---	14.17
13.90	408,637	204.90	23.32 ic	2.51 ic	4.85 ic	---	15.67	0.00	---	---	---	---	23.04
14.00	415,541	205.00	34.19 ic	2.55 ic	4.99 ic	---	26.41	0.00	---	---	---	---	33.95
14.10	422,964	205.10	46.84 ic	2.58 ic	5.13 ic	---	38.88	0.00	---	---	---	---	46.58
14.20	430,388	205.20	60.73 oc	2.62 ic	5.26 ic	---	52.86	0.00	---	---	---	---	60.73
14.30	437,811	205.30	76.23 oc	2.65 ic	5.38 ic	---	68.20	0.00	---	---	---	---	76.23
14.40	445,235	205.40	92.98 ic	2.68 ic	5.51 ic	---	84.79	0.00	---	---	---	---	92.98
14.50	452,658	205.50	110.89 ic	2.72 ic	5.63 ic	---	102.55	0.00	---	---	---	---	110.89
14.60	460,082	205.60	129.89 ic	2.75 ic	5.75 ic	---	121.39	3.22	---	---	---	---	133.11
14.70	467,505	205.70	149.28 ic	2.14 ic	5.86 ic	---	141.27	21.06	---	---	---	---	170.33
14.80	474,929	205.80	161.35 ic	1.28 ic	3.52 ic	---	156.55 s	47.27	---	---	---	---	208.61
14.90	482,352	205.90	163.62 ic	1.10 ic	3.02 ic	---	159.50 s	79.73	---	---	---	---	243.35
15.00	489,776	206.00	165.22 ic	0.97 ic	2.67 ic	---	161.57 s	117.33	---	---	---	---	282.54
15.10	497,709	206.10	166.52 ic	0.87 ic	2.40 ic	---	163.23 s	159.52	---	---	---	---	326.04
15.20	505,641	206.20	167.64 ic	0.79 ic	2.18 ic	---	164.66 s	205.82	---	---	---	---	373.46
15.30	513,574	206.30	168.64 ic	0.73 ic	2.00 ic	---	165.89 s	255.90	---	---	---	---	424.52
15.40	521,507	206.40	169.55 ic	0.67 ic	1.84 ic	---	167.04 s	309.49	---	---	---	---	479.03
15.50	529,440	206.50	170.41 ic	0.62 ic	1.71 ic	---	168.07 s	366.37	---	---	---	---	536.76
15.60	537,373	206.60	171.22 ic	0.58 ic	1.59 ic	---	169.04 s	426.36	---	---	---	---	597.57
15.70	545,306	206.70	171.99 ic	0.54 ic	1.48 ic	---	169.94 s	489.31	---	---	---	---	661.27
15.80	553,238	206.80	172.74 ic	0.51 ic	1.39 ic	---	170.82 s	555.09	---	---	---	---	727.80
15.90	561,171	206.90	173.46 ic	0.48 ic	1.31 ic	---	171.64 s	623.64	---	---	---	---	797.06
16.00	569,104	207.00	174.16 ic	0.45 ic	1.23 ic	---	172.43 s	694.66	---	---	---	---	868.77

...End

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Legend

Hyd.	Origin	Description
1	SCS Runoff	PROPOSED HORSE SHOE FARM ROAD DAM
2	Reservoir	PROPOSED DAM ROUTED

Project: HORSESHOE FARM ROAD DAM PROPOSED (6x6) 4-12-11.gpw

Tuesday, Apr 19, 2011

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

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	------	-------	46.89	-------	-------	103.23	139.08	167.78	196.60	PROPOSED HORSE SHOE FARM
2	Reservoir	1	-------	2.060	-------	-------	7.475	36.09	81.48	126.75	PROPOSED DAM ROUTED

Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Tuesday, Apr 19, 2011

Hyd. No. 1

PROPOSED HORSE SHOE FARM ROAD DAM

Hydrograph type	= SCS Runoff	Peak discharge	= 46.89 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 182,357 cuft
Drainage area	= 43.000 ac	Curve number	= 72
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.20 min
Total precip.	= 3.60 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

TR55 Tc Worksheet

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Hyd. No. 1

PROPOSED HORSE SHOE FARM ROAD DAM

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.200		0.011		0.011		
Flow length (ft)	=	300.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.60		0.00		0.00		
Land slope (%)	=	4.33		0.00		0.00		
Travel Time (min)	=	**20.56**	+	**0.00**	+	**0.00**	=	**20.56**
Shallow Concentrated Flow								
Flow length (ft)	=	934.00		0.00		0.00		
Watercourse slope (%)	=	4.50		0.00		0.00		
Surface description	=	Unpaved		Paved		Paved		
Average velocity (ft/s)	=	3.42		0.00		0.00		
Travel Time (min)	=	**4.55**	+	**0.00**	+	**0.00**	=	**4.55**
Channel Flow								
X sectional flow area (sqft)	=	160.00		0.00		0.00		
Wetted perimeter (ft)	=	78.00		0.00		0.00		
Channel slope (%)	=	2.83		0.00		0.00		
Manning's n-value	=	0.026		0.015		0.015		
Velocity (ft/s)	=	15.60		0.00		0.00		
Flow length (ft)	=	1058.0		0.0		0.0		
Travel Time (min)	=	**1.13**	+	**0.00**	+	**0.00**	=	**1.13**

Total Travel Time, Tc ..... 26.20 min

Hydrograph Report

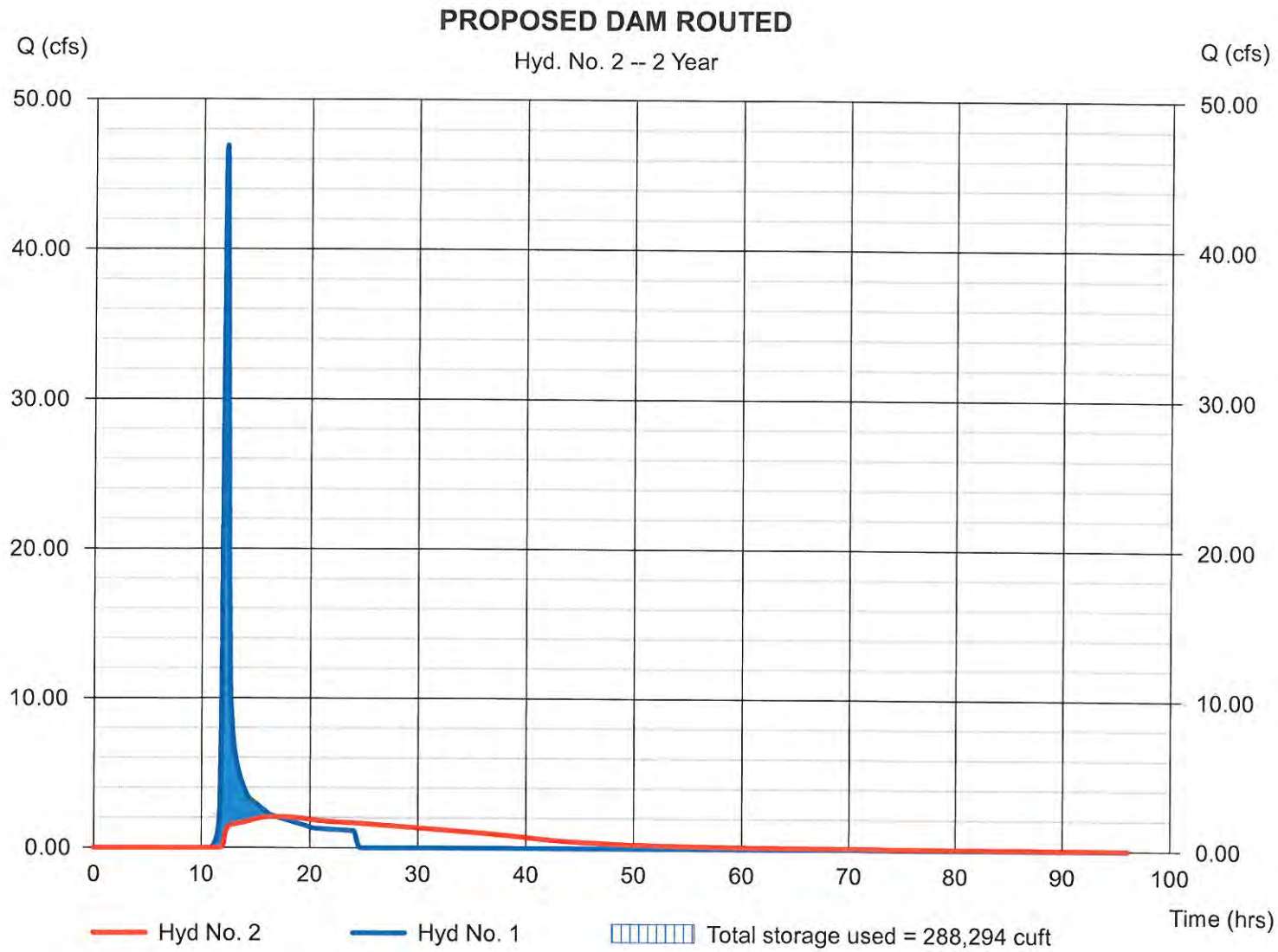
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Tuesday, Apr 19, 2011

Hyd. No. 2

PROPOSED DAM ROUTED

Hydrograph type	= Reservoir	Peak discharge	= 2.060 cfs
Storm frequency	= 2 yrs	Time to peak	= 16.87 hrs
Time interval	= 2 min	Hyd. volume	= 177,362 cuft
Inflow hyd. No.	= 1 - PROPOSED HORSE SHOE FARM ROAD DAM	Max. Elevation	= 203.08 ft
Reservoir name	= PROPOSED HORSE SHOE FARM POND	Max. Storage	= 288,294 cuft

Storage Indication method used. Wet pond routing start elevation = 201.00 ft.



Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Tuesday, Apr 19, 2011

Pond No. 2 - PROPOSED HORSE SHOE FARM POND

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 191.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	191.00	102	0	0
1.00	192.00	1,279	581	581
2.00	193.00	3,235	2,182	2,763
3.00	194.00	6,486	4,767	7,530
4.00	195.00	10,352	8,343	15,873
5.00	196.00	13,742	12,006	27,879
6.00	197.00	17,696	15,676	43,555
7.00	198.00	23,698	20,622	64,177
8.00	199.00	32,818	28,132	92,309
9.00	200.00	41,972	37,298	129,606
10.00	201.00	48,098	44,996	174,602
11.00	202.00	54,110	51,069	225,671
12.00	203.00	60,725	57,380	283,051
13.00	204.00	66,234	63,453	346,504
14.00	205.00	71,891	69,036	415,541
15.00	206.00	76,619	74,235	489,776
16.00	207.00	82,085	79,328	569,104

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 36.00	8.00	5.00	0.00
Span (in)	= 36.00	5.00	22.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 191.00	201.04	202.95	0.00
Length (ft)	= 100.00	0.00	0.00	0.00
Slope (%)	= 1.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	Yes	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 24.00	50.00	0.00	0.00
Crest El. (ft)	= 204.65	205.15	0.00	0.00
Weir Coeff.	= 3.33	3.00	3.33	3.33
Weir Type	= Riser	Broad	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (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).

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	191.00	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
0.10	58	191.10	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
0.20	116	191.20	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
0.30	174	191.30	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
0.40	232	191.40	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
0.50	290	191.50	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
0.60	348	191.60	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
0.70	406	191.70	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
0.80	465	191.80	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
0.90	523	191.90	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
1.00	581	192.00	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
1.10	799	192.10	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
1.20	1,017	192.20	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
1.30	1,235	192.30	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
1.40	1,454	192.40	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
1.50	1,672	192.50	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
1.60	1,890	192.60	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
1.70	2,108	192.70	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
1.80	2,327	192.80	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
1.90	2,545	192.90	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
2.00	2,763	193.00	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
2.10	3,240	193.10	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
2.20	3,717	193.20	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
2.30	4,193	193.30	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
2.40	4,670	193.40	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000

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PROPOSED HORSE SHOE FARM POND

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
2.50	5,147	193.50	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
2.60	5,623	193.60	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
2.70	6,100	193.70	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
2.80	6,577	193.80	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
2.90	7,053	193.90	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
3.00	7,530	194.00	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
3.10	8,364	194.10	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
3.20	9,199	194.20	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
3.30	10,033	194.30	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
3.40	10,867	194.40	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
3.50	11,701	194.50	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
3.60	12,536	194.60	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
3.70	13,370	194.70	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
3.80	14,204	194.80	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
3.90	15,039	194.90	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
4.00	15,873	195.00	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
4.10	17,074	195.10	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
4.20	18,274	195.20	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
4.30	19,475	195.30	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
4.40	20,675	195.40	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
4.50	21,876	195.50	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
4.60	23,077	195.60	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
4.70	24,277	195.70	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
4.80	25,478	195.80	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
4.90	26,678	195.90	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
5.00	27,879	196.00	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
5.10	29,447	196.10	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
5.20	31,014	196.20	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
5.30	32,582	196.30	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
5.40	34,149	196.40	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
5.50	35,717	196.50	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
5.60	37,284	196.60	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
5.70	38,852	196.70	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
5.80	40,420	196.80	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
5.90	41,987	196.90	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
6.00	43,555	197.00	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
6.10	45,617	197.10	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
6.20	47,679	197.20	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
6.30	49,741	197.30	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
6.40	51,804	197.40	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
6.50	53,866	197.50	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
6.60	55,928	197.60	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
6.70	57,990	197.70	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
6.80	60,052	197.80	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
6.90	62,115	197.90	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
7.00	64,177	198.00	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
7.10	66,990	198.10	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
7.20	69,803	198.20	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
7.30	72,616	198.30	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
7.40	75,429	198.40	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
7.50	78,243	198.50	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
7.60	81,056	198.60	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
7.70	83,869	198.70	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
7.80	86,682	198.80	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
7.90	89,495	198.90	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
8.00	92,309	199.00	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
8.10	96,038	199.10	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
8.20	99,768	199.20	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
8.30	103,498	199.30	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
8.40	107,228	199.40	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
8.50	110,957	199.50	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
8.60	114,687	199.60	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
8.70	118,417	199.70	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
8.80	122,147	199.80	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
8.90	125,876	199.90	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
9.00	129,606	200.00	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
9.10	134,106	200.10	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
9.20	138,605	200.20	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
9.30	143,105	200.30	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
9.40	147,604	200.40	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
9.50	152,104	200.50	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000

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PROPOSED HORSE SHOE FARM POND

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
9.60	156,604	200.60	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
9.70	161,103	200.70	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
9.80	165,603	200.80	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
9.90	170,102	200.90	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
10.00	174,602	201.00	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
10.10	179,709	201.10	0.02 ic	0.02 ic	0.00	---	0.00	0.00	---	---	---	---	0.021
10.20	184,816	201.20	0.10 ic	0.09 ic	0.00	---	0.00	0.00	---	---	---	---	0.091
10.30	189,923	201.30	0.20 ic	0.19 ic	0.00	---	0.00	0.00	---	---	---	---	0.188
10.40	195,030	201.40	0.33 ic	0.31 ic	0.00	---	0.00	0.00	---	---	---	---	0.306
10.50	200,137	201.50	0.45 ic	0.44 ic	0.00	---	0.00	0.00	---	---	---	---	0.443
10.60	205,243	201.60	0.61 ic	0.59 ic	0.00	---	0.00	0.00	---	---	---	---	0.595
10.70	210,350	201.70	0.81 ic	0.76 ic	0.00	---	0.00	0.00	---	---	---	---	0.761
10.80	215,457	201.80	0.88 ic	0.87 ic	0.00	---	0.00	0.00	---	---	---	---	0.874
10.90	220,564	201.90	0.97 ic	0.97 ic	0.00	---	0.00	0.00	---	---	---	---	0.971
11.00	225,671	202.00	1.06 ic	1.06 ic	0.00	---	0.00	0.00	---	---	---	---	1.059
11.10	231,409	202.10	1.14 ic	1.14 ic	0.00	---	0.00	0.00	---	---	---	---	1.140
11.20	237,147	202.20	1.22 ic	1.22 ic	0.00	---	0.00	0.00	---	---	---	---	1.216
11.30	242,885	202.30	1.32 ic	1.29 ic	0.00	---	0.00	0.00	---	---	---	---	1.288
11.40	248,623	202.40	1.42 ic	1.36 ic	0.00	---	0.00	0.00	---	---	---	---	1.355
11.50	254,361	202.50	1.42 ic	1.42 ic	0.00	---	0.00	0.00	---	---	---	---	1.420
11.60	260,099	202.60	1.53 ic	1.48 ic	0.00	---	0.00	0.00	---	---	---	---	1.481
11.70	265,837	202.70	1.54 ic	1.54 ic	0.00	---	0.00	0.00	---	---	---	---	1.541
11.80	271,575	202.80	1.64 ic	1.60 ic	0.00	---	0.00	0.00	---	---	---	---	1.598
11.90	277,313	202.90	1.65 ic	1.65 ic	0.00	---	0.00	0.00	---	---	---	---	1.653
12.00	283,051	203.00	1.78 ic	1.71 ic	0.07 ic	---	0.00	0.00	---	---	---	---	1.776
12.10	289,397	203.10	2.16 ic	1.76 ic	0.36 ic	---	0.00	0.00	---	---	---	---	2.120
12.20	295,742	203.20	2.61 ic	1.81 ic	0.78 ic	---	0.00	0.00	---	---	---	---	2.588
12.30	302,087	203.30	3.15 ic	1.86 ic	1.29 ic	---	0.00	0.00	---	---	---	---	3.149
12.40	308,432	203.40	3.71 ic	1.90 ic	1.81 ic	---	0.00	0.00	---	---	---	---	3.712
12.50	314,778	203.50	4.10 ic	1.95 ic	2.15 ic	---	0.00	0.00	---	---	---	---	4.100
12.60	321,123	203.60	4.53 ic	2.00 ic	2.44 ic	---	0.00	0.00	---	---	---	---	4.440
12.70	327,468	203.70	4.76 ic	2.04 ic	2.71 ic	---	0.00	0.00	---	---	---	---	4.747
12.80	333,814	203.80	5.03 ic	2.08 ic	2.95 ic	---	0.00	0.00	---	---	---	---	5.030
12.90	340,159	203.90	5.29 ic	2.13 ic	3.17 ic	---	0.00	0.00	---	---	---	---	5.294
13.00	346,504	204.00	5.54 ic	2.17 ic	3.37 ic	---	0.00	0.00	---	---	---	---	5.542
13.10	353,408	204.10	5.78 ic	2.21 ic	3.57 ic	---	0.00	0.00	---	---	---	---	5.778
13.20	360,312	204.20	6.01 ic	2.25 ic	3.75 ic	---	0.00	0.00	---	---	---	---	6.003
13.30	367,215	204.30	6.28 ic	2.29 ic	3.93 ic	---	0.00	0.00	---	---	---	---	6.218
13.40	374,119	204.40	6.55 ic	2.33 ic	4.10 ic	---	0.00	0.00	---	---	---	---	6.425
13.50	381,023	204.50	6.63 ic	2.37 ic	4.26 ic	---	0.00	0.00	---	---	---	---	6.625
13.60	387,926	204.60	6.84 ic	2.40 ic	4.42 ic	---	0.00	0.00	---	---	---	---	6.819
13.70	394,830	204.70	8.04 ic	2.44 ic	4.57 ic	---	0.89	0.00	---	---	---	---	7.900
13.80	401,733	204.80	11.86 ic	2.48 ic	4.71 ic	---	4.64	0.00	---	---	---	---	11.83
13.90	408,637	204.90	17.57 ic	2.51 ic	4.85 ic	---	10.00	0.00	---	---	---	---	17.36
14.00	415,541	205.00	24.13 ic	2.55 ic	4.99 ic	---	16.55	0.00	---	---	---	---	24.09
14.10	422,964	205.10	31.86 ic	2.58 ic	5.13 ic	---	24.13	0.00	---	---	---	---	31.83
14.20	430,388	205.20	40.47 oc	2.62 ic	5.26 ic	---	32.60	1.68	---	---	---	---	42.15
14.30	437,811	205.30	49.92 oc	2.65 ic	5.38 ic	---	41.88	8.72	---	---	---	---	58.63
14.40	445,235	205.40	60.10 ic	2.68 ic	5.51 ic	---	51.91	18.75	---	---	---	---	78.85
14.50	452,658	205.50	70.98 ic	2.72 ic	5.63 ic	---	62.63	31.06	---	---	---	---	102.04
14.60	460,082	205.60	82.50 ic	2.75 ic	5.75 ic	---	74.00	45.28	---	---	---	---	127.78
14.70	467,505	205.70	94.63 ic	2.78 ic	5.86 ic	---	85.99	61.18	---	---	---	---	155.82
14.80	474,929	205.80	107.01 ic	2.47 ic	5.98 ic	---	98.56	78.61	---	---	---	---	185.62
14.90	482,352	205.90	117.71 ic	1.60 ic	4.41 ic	---	111.71	97.45	---	---	---	---	215.16
15.00	489,776	206.00	120.73 ic	1.28 ic	3.52 ic	---	115.94 s	117.55	---	---	---	---	238.28
15.10	497,709	206.10	122.12 ic	1.14 ic	3.13 ic	---	117.85 s	138.89	---	---	---	---	261.01
15.20	505,641	206.20	123.21 ic	1.03 ic	2.83 ic	---	119.35 s	161.39	---	---	---	---	284.60
15.30	513,574	206.30	124.13 ic	0.94 ic	2.59 ic	---	120.61 s	184.99	---	---	---	---	309.12
15.40	521,507	206.40	124.95 ic	0.87 ic	2.38 ic	---	121.70 s	209.63	---	---	---	---	334.58
15.50	529,440	206.50	125.69 ic	0.80 ic	2.21 ic	---	122.67 s	235.29	---	---	---	---	360.96
15.60	537,373	206.60	126.37 ic	0.75 ic	2.05 ic	---	123.56 s	261.91	---	---	---	---	388.27
15.70	545,306	206.70	127.00 ic	0.70 ic	1.92 ic	---	124.37 s	289.46	---	---	---	---	416.45
15.80	553,238	206.80	127.61 ic	0.65 ic	1.80 ic	---	125.15 s	317.92	---	---	---	---	445.53
15.90	561,171	206.90	128.18 ic	0.62 ic	1.69 ic	---	125.87 s	347.29	---	---	---	---	475.47
16.00	569,104	207.00	128.74 ic	0.58 ic	1.60 ic	---	126.53 s	377.44	---	---	---	---	506.16

...End

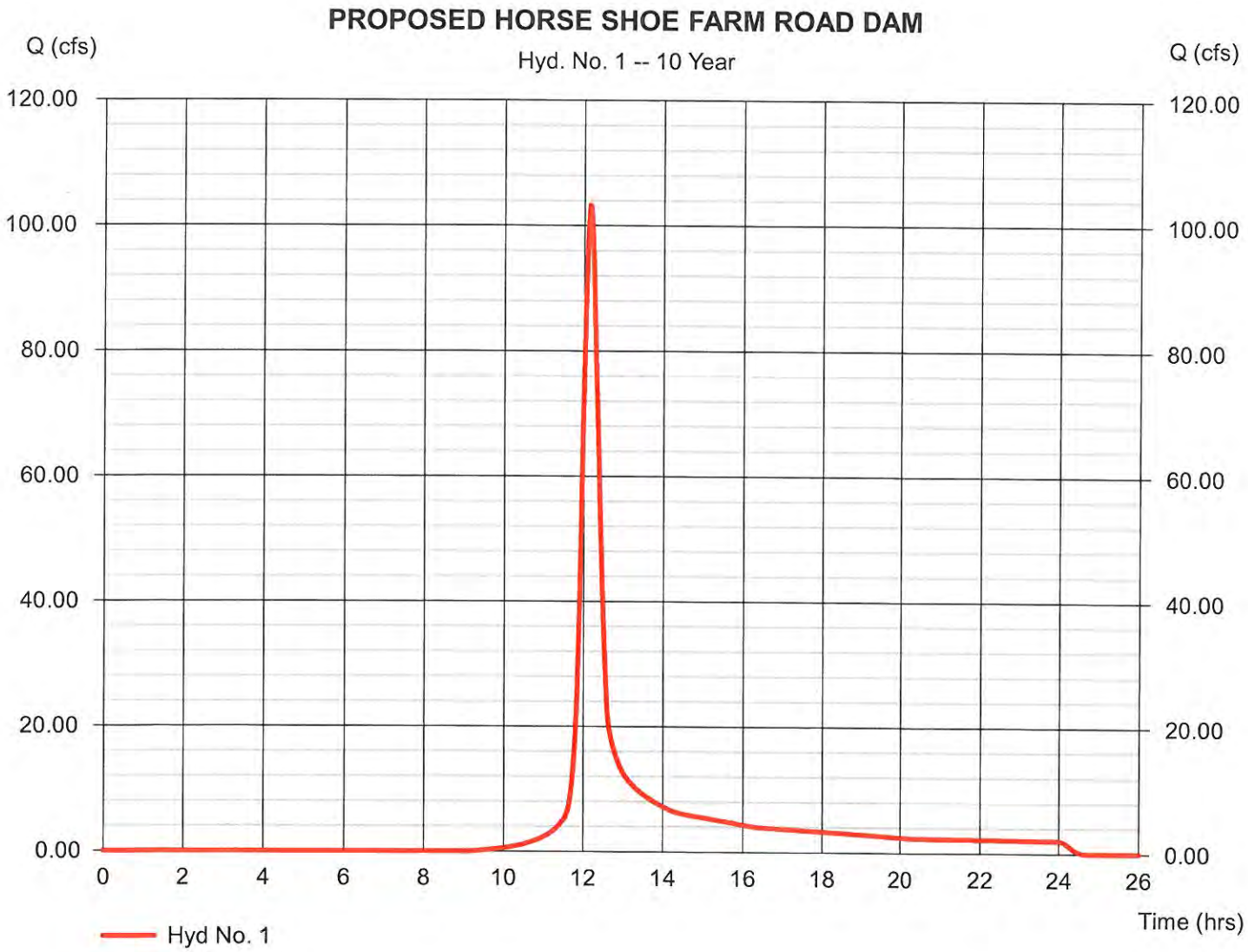
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Tuesday, Apr 19, 2011

Hyd. No. 1

PROPOSED HORSE SHOE FARM ROAD DAM

Hydrograph type	= SCS Runoff	Peak discharge	= 103.23 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 383,271 cuft
Drainage area	= 43.000 ac	Curve number	= 72
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.20 min
Total precip.	= 5.38 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

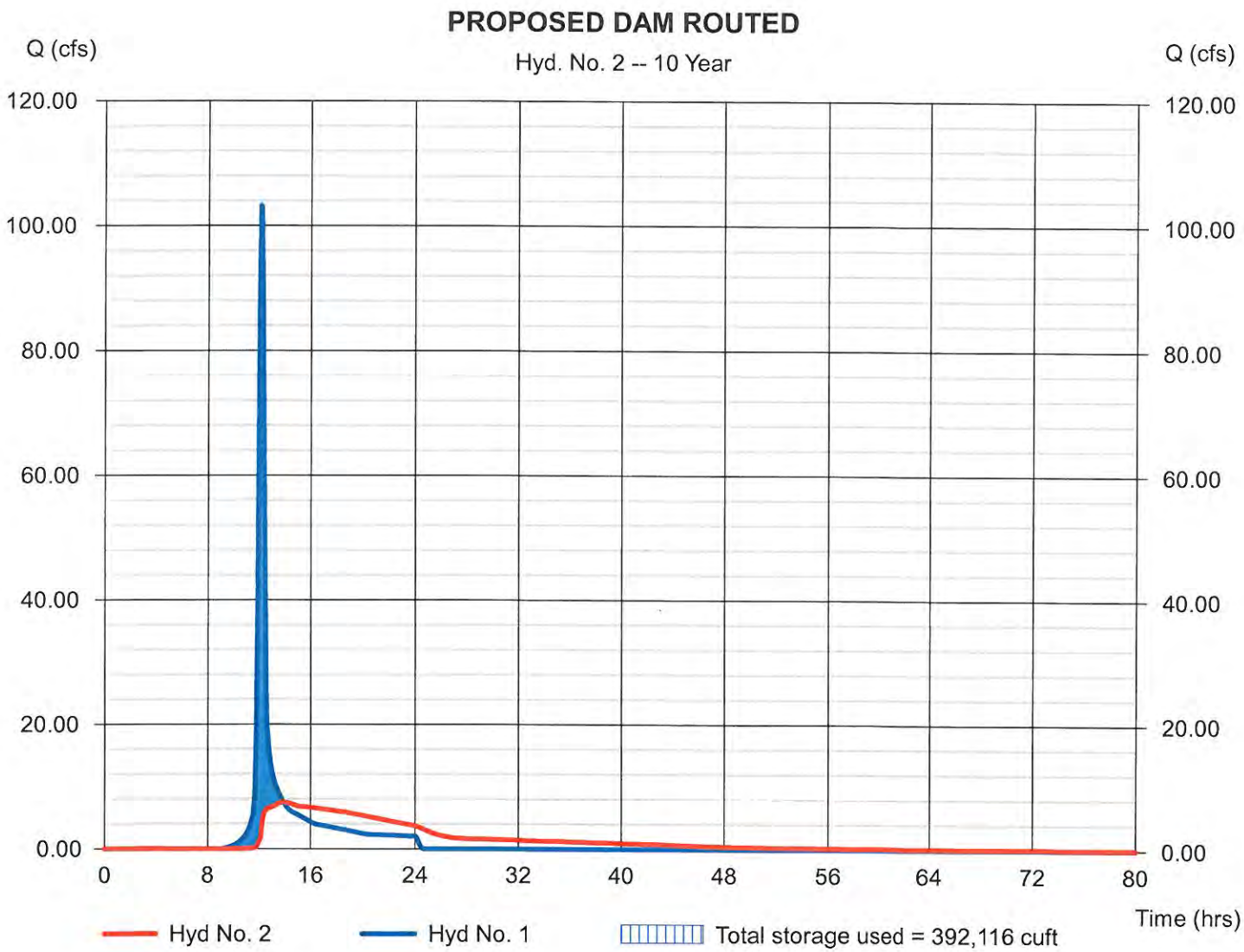
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Tuesday, Apr 19, 2011

Hyd. No. 2

PROPOSED DAM ROUTED

Hydrograph type	= Reservoir	Peak discharge	= 7.475 cfs
Storm frequency	= 10 yrs	Time to peak	= 13.93 hrs
Time interval	= 2 min	Hyd. volume	= 377,996 cuft
Inflow hyd. No.	= 1 - PROPOSED HORSE SHOE FARM ROAD DAM	Max. Elevation	= 204.66 ft
Reservoir name	= PROPOSED HORSE SHOE FARM POND	Max. Storage	= 392,116 cuft

Storage Indication method used. Wet pond routing start elevation = 201.00 ft.



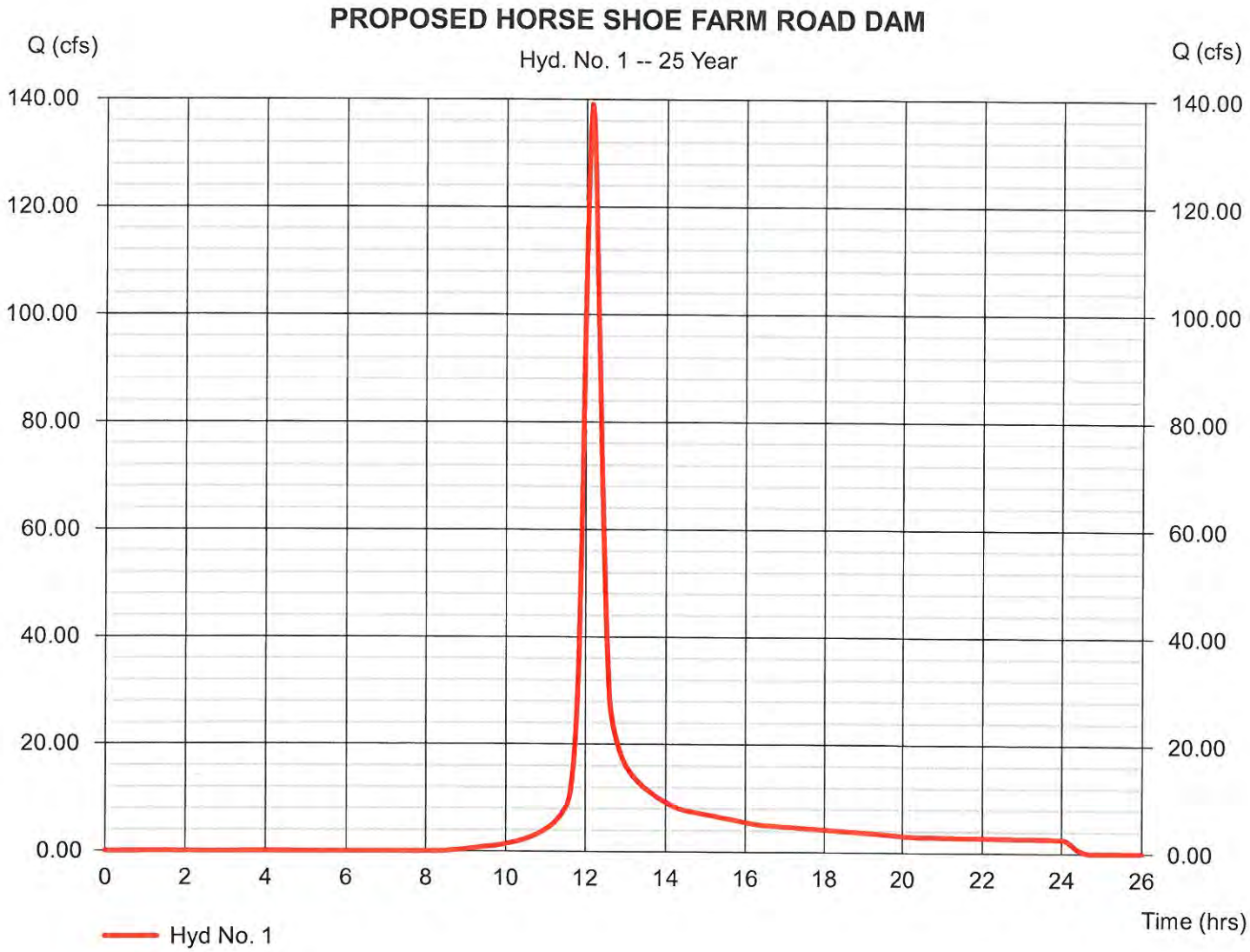
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Tuesday, Apr 19, 2011

Hyd. No. 1

PROPOSED HORSE SHOE FARM ROAD DAM

Hydrograph type	= SCS Runoff	Peak discharge	= 139.08 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 511,927 cuft
Drainage area	= 43.000 ac	Curve number	= 72
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.20 min
Total precip.	= 6.41 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

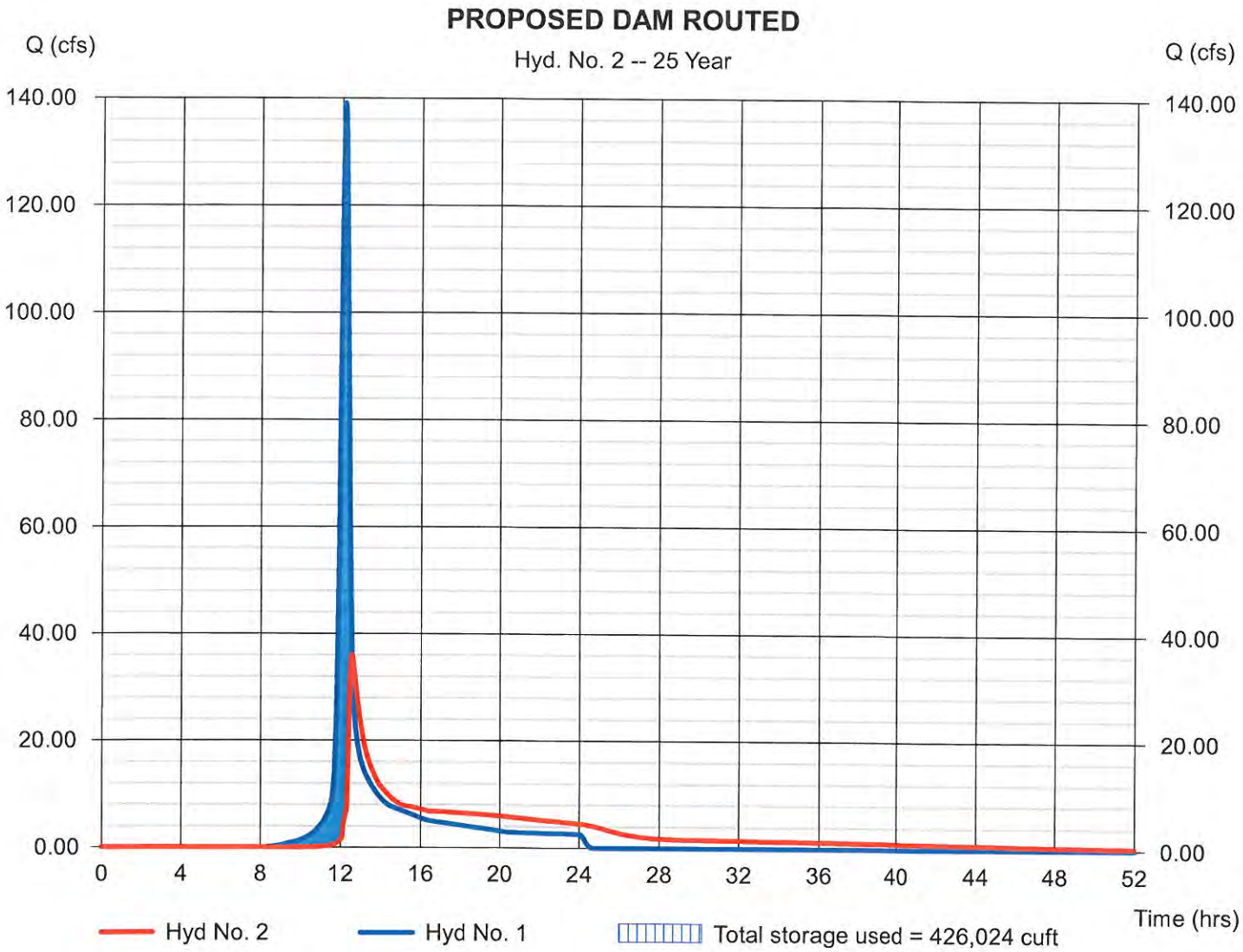
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Tuesday, Apr 19, 2011

Hyd. No. 2

PROPOSED DAM ROUTED

Hydrograph type	= Reservoir	Peak discharge	= 36.09 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.57 hrs
Time interval	= 2 min	Hyd. volume	= 506,571 cuft
Inflow hyd. No.	= 1 - PROPOSED HORSE SHOE FARM ROAD DAM	Max. Elevation	= 205.14 ft
Reservoir name	= PROPOSED HORSE SHOE FARM POND	Max. Storage	= 426,024 cuft

Storage Indication method used. Wet pond routing start elevation = 201.00 ft.



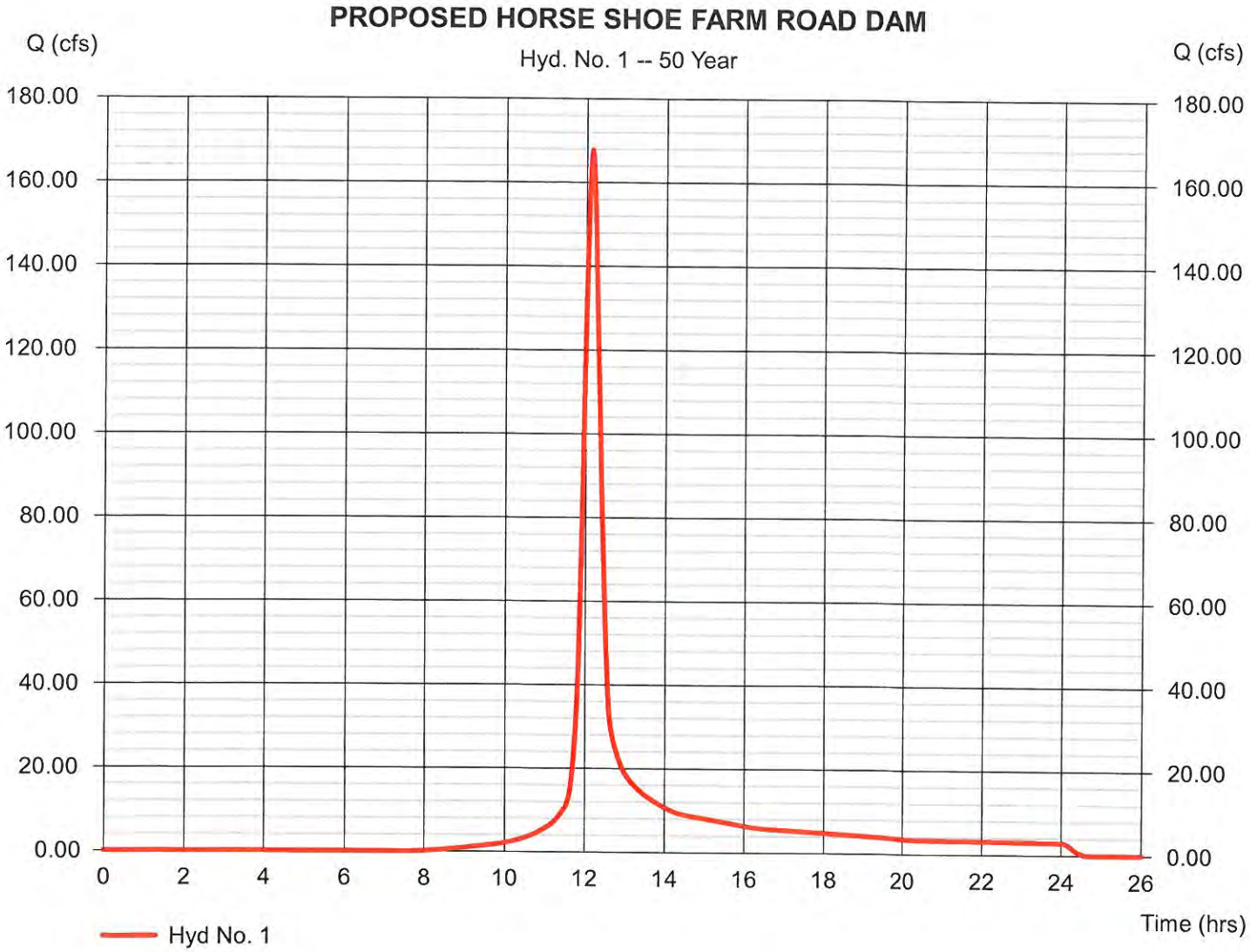
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Tuesday, Apr 19, 2011

Hyd. No. 1

PROPOSED HORSE SHOE FARM ROAD DAM

Hydrograph type	= SCS Runoff	Peak discharge	= 167.78 cfs
Storm frequency	= 50 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 615,930 cuft
Drainage area	= 43.000 ac	Curve number	= 72
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.20 min
Total precip.	= 7.21 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

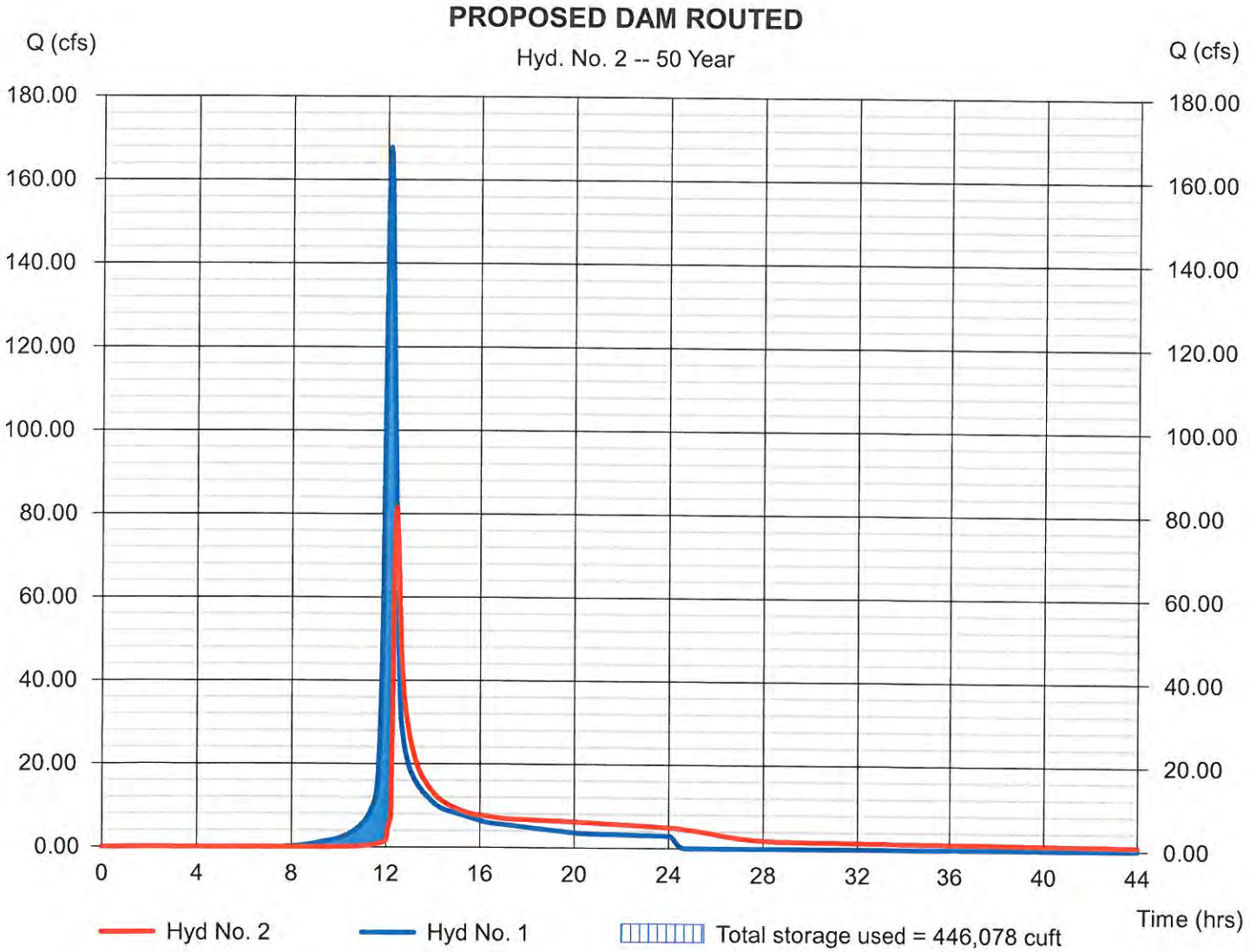
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Tuesday, Apr 19, 2011

Hyd. No. 2

PROPOSED DAM ROUTED

Hydrograph type	= Reservoir	Peak discharge	= 81.48 cfs
Storm frequency	= 50 yrs	Time to peak	= 12.43 hrs
Time interval	= 2 min	Hyd. volume	= 610,521 cuft
Inflow hyd. No.	= 1 - PROPOSED HORSE SHOE FARM ROAD DAM	Max. Elevation	= 205.41 ft
Reservoir name	= PROPOSED HORSE SHOE FARM POND	Max. Storage	= 446,078 cuft

Storage Indication method used. Wet pond routing start elevation = 201.00 ft.



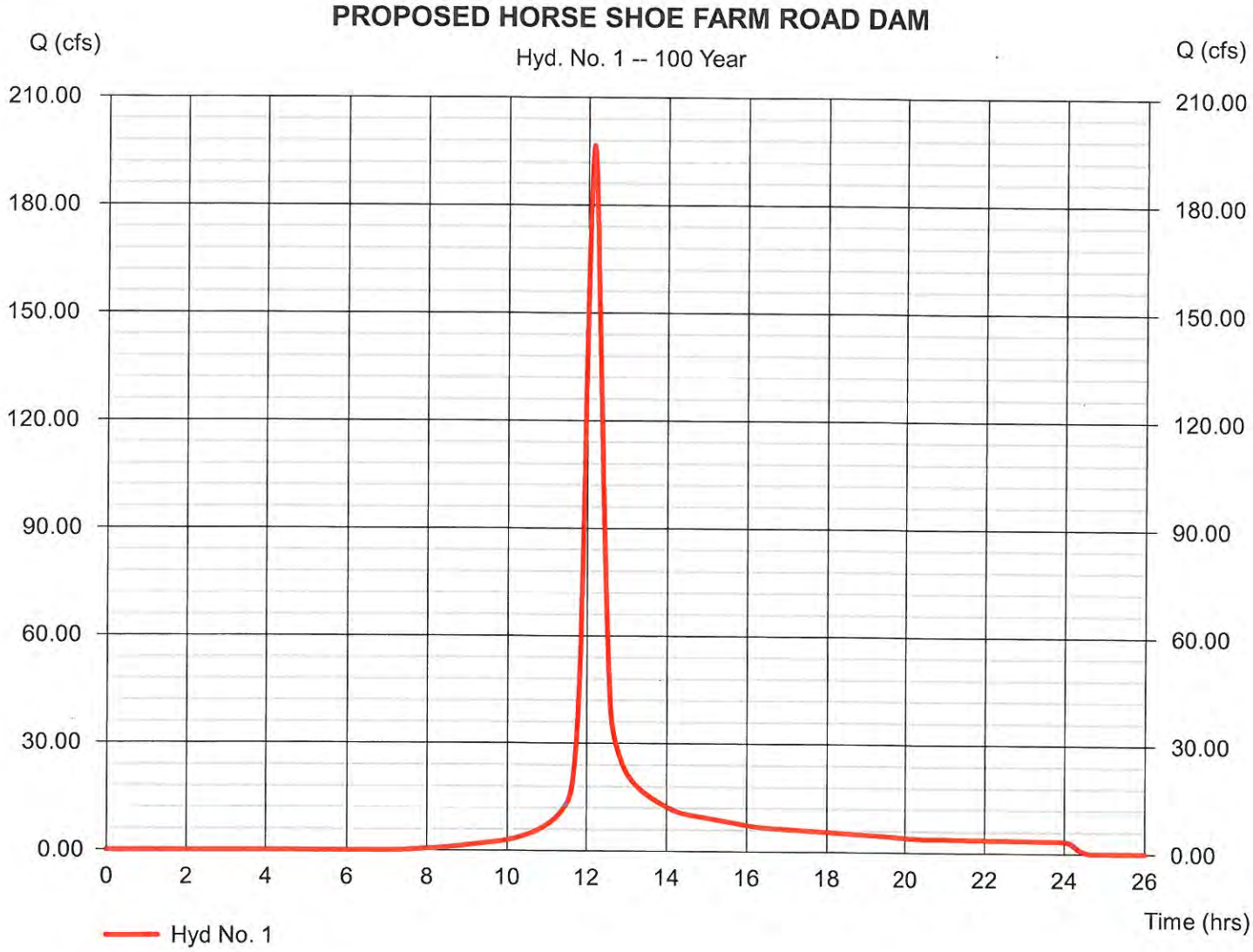
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Tuesday, Apr 19, 2011

Hyd. No. 1

PROPOSED HORSE SHOE FARM ROAD DAM

Hydrograph type	= SCS Runoff	Peak discharge	= 196.60 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 721,306 cuft
Drainage area	= 43.000 ac	Curve number	= 72
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.20 min
Total precip.	= 8.00 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

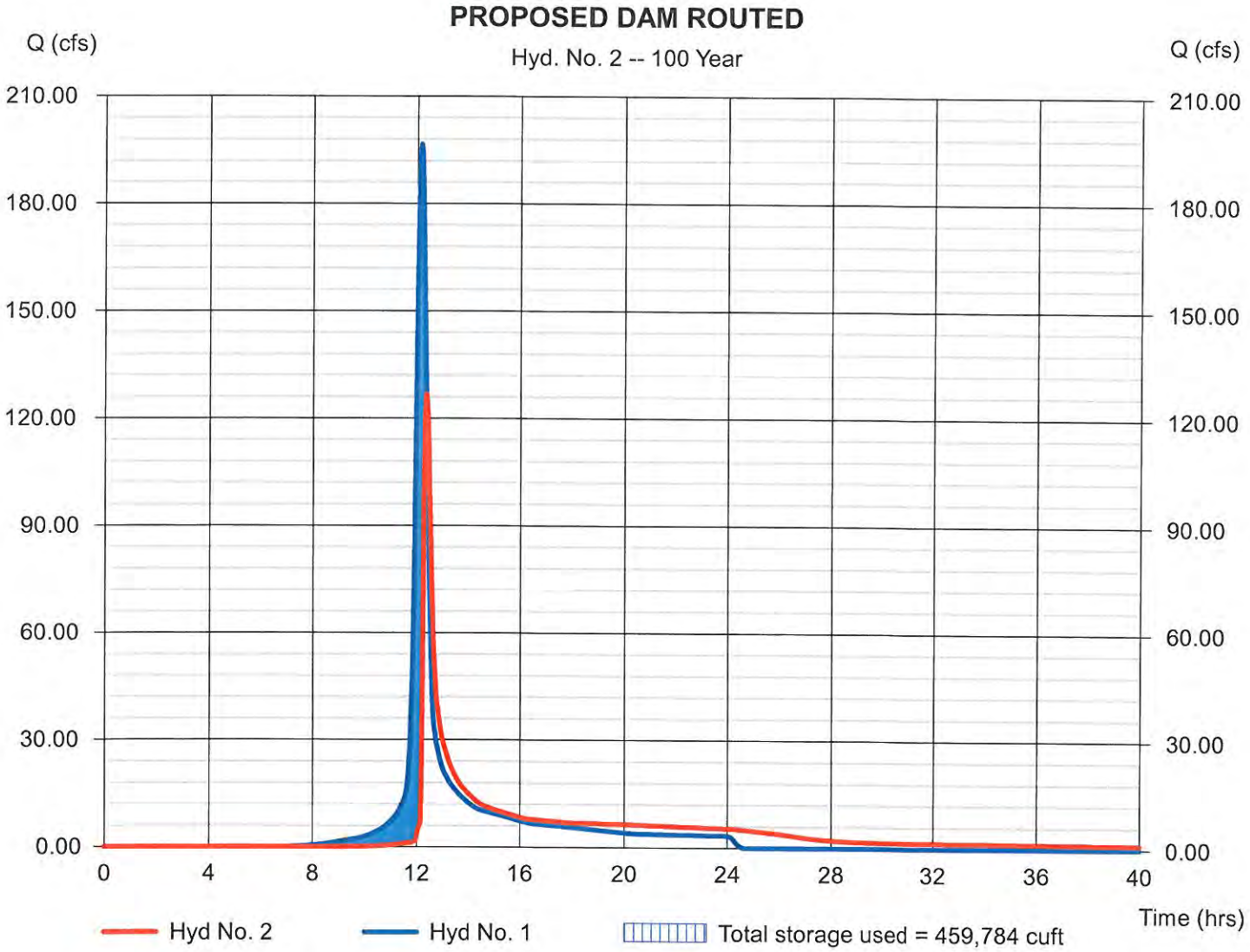
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Tuesday, Apr 19, 2011

Hyd. No. 2

PROPOSED DAM ROUTED

Hydrograph type	= Reservoir	Peak discharge	= 126.75 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.33 hrs
Time interval	= 2 min	Hyd. volume	= 715,851 cuft
Inflow hyd. No.	= 1 - PROPOSED HORSE SHOE FARM ROAD DAM	Max. Elevation	= 205.60 ft
Reservoir name	= PROPOSED HORSE SHOE FARM POND	Max. Storage	= 459,784 cuft

Storage Indication method used. Wet pond routing start elevation = 201.00 ft.



(3) DESCRIPTION OF THE PROPERTIES LOCATED BELOW THE DAM

Immediately downstream of the dam is a tract of land owned by the City of Raleigh that is zoned as R-4, thereby limiting it to residential use with ¼ acre lots. There are no existing buildings, roads or railroads downstream of the existing dam. In the event of dam failure, loss of life is not likely. Future development of the area downstream of the dam is unlikely, due to the existence of a "blue line" stream which extends to the Neuse River. The required 100-foot Neuse River Riparian buffer would prevent development along the outfall of the dam. Figure 3-1 is an aerial image taken from Wake County IMAPS that shows the existing pond and dam with the undeveloped downstream area. Figure 3-2 shows the blue line stream that would prohibit development below the outfall of the dam.

Figure 3-1: Aerial photo of the area downstream of Horseshoe Farm Dam

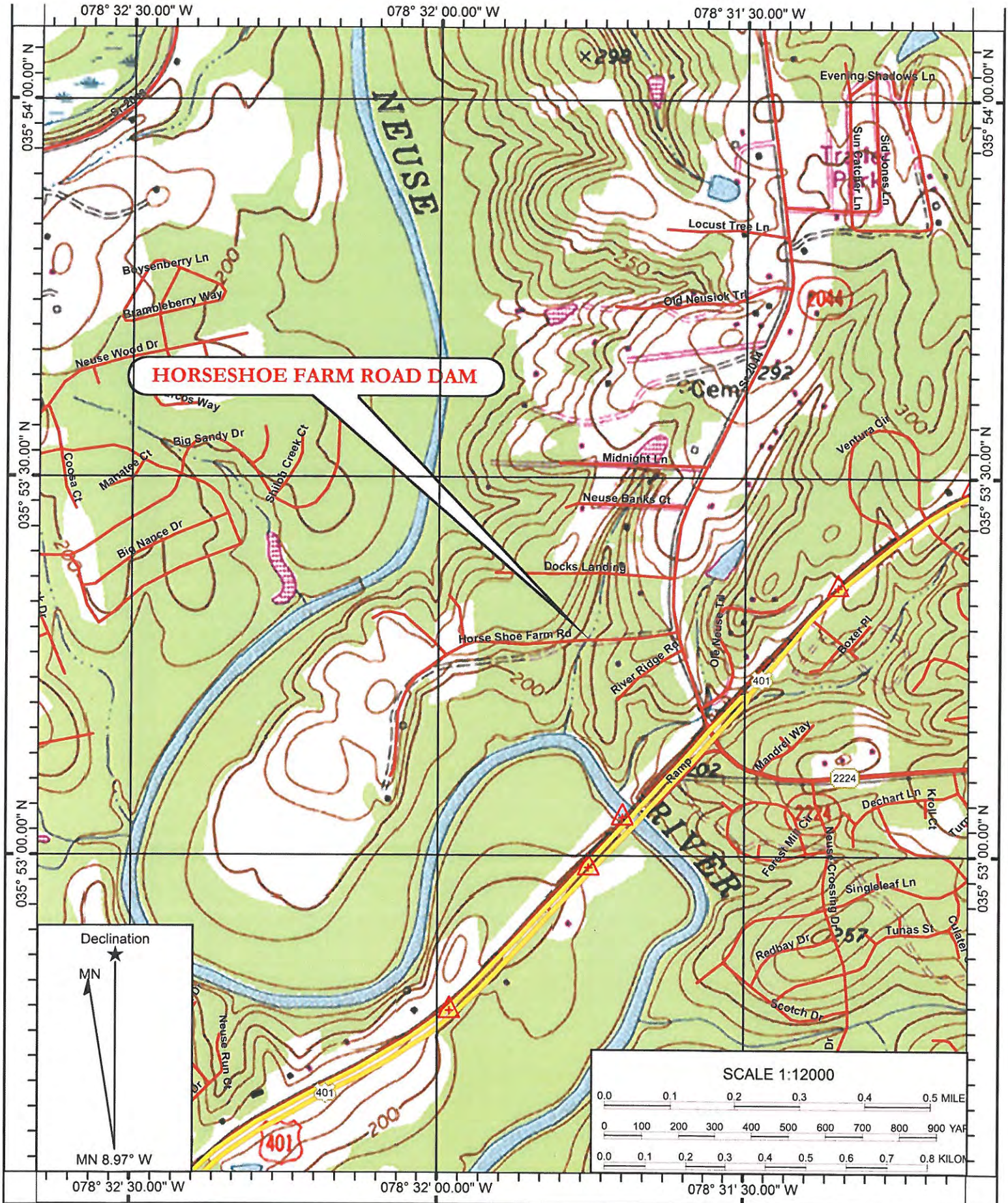


Figure 3-2: Wake Forest Quadrangle Map showing blue line stream downstream of Horseshoe Farm Dam outfall

(4) MAPS SHOWING THE LOCATION OF THE PROPOSED STRUCTURE

Horseshoe Farm Road serves as the only public entrance to a community park owned by the City of Raleigh, Horseshoe Farm Park. Horse Shoe Farm Road intersects with Ligon Mill Rd (SR-2224) approximately 0.2 miles north of Louisburg Road (US-401). The dam is located on Horse Shoe Farm Road, approximately 400 feet west of the intersection with Ligon Mill Road. The dam is shown on the Wake Forest quadrangle at 35 53' 15.08" N and 78 31' 54.61" W.

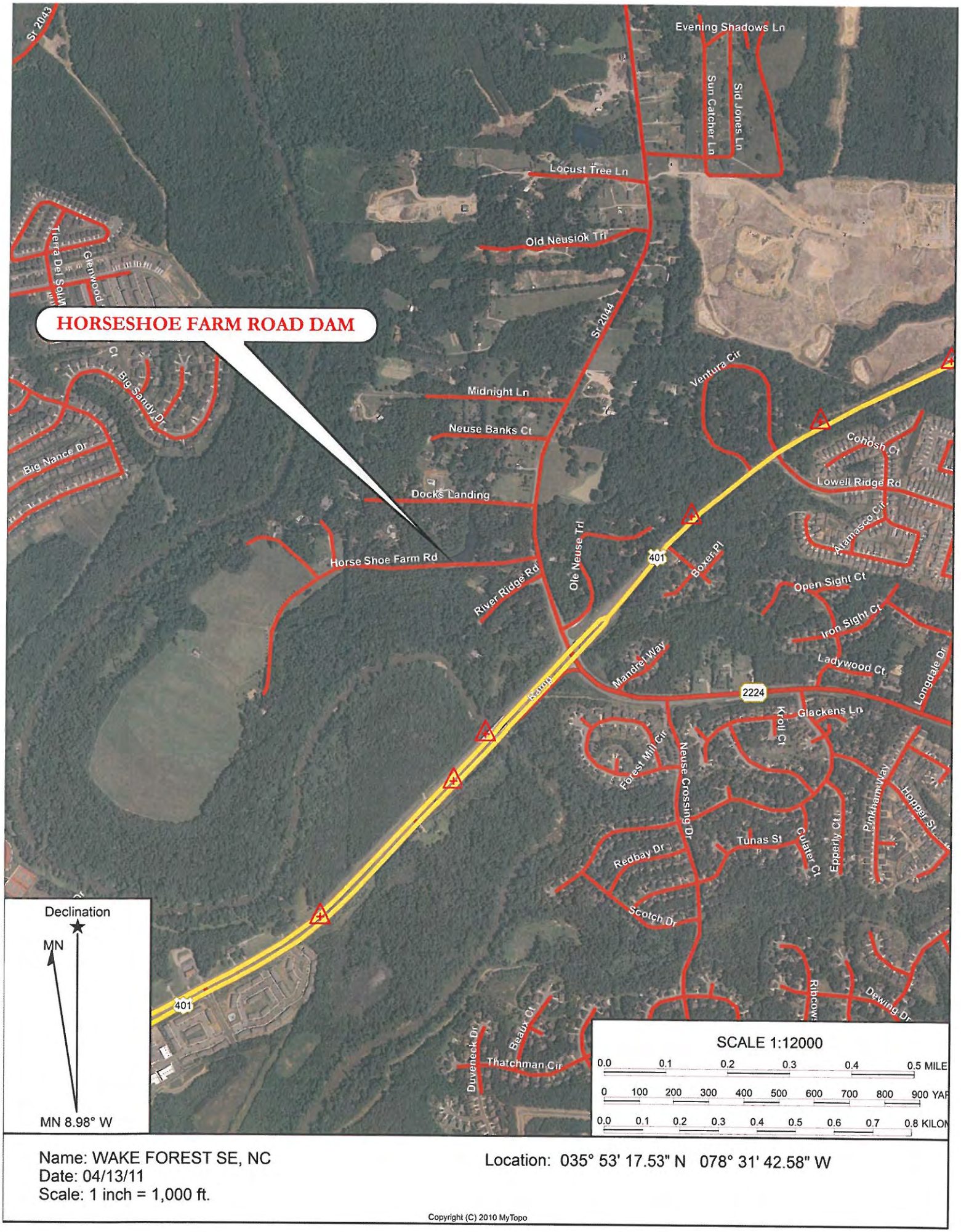
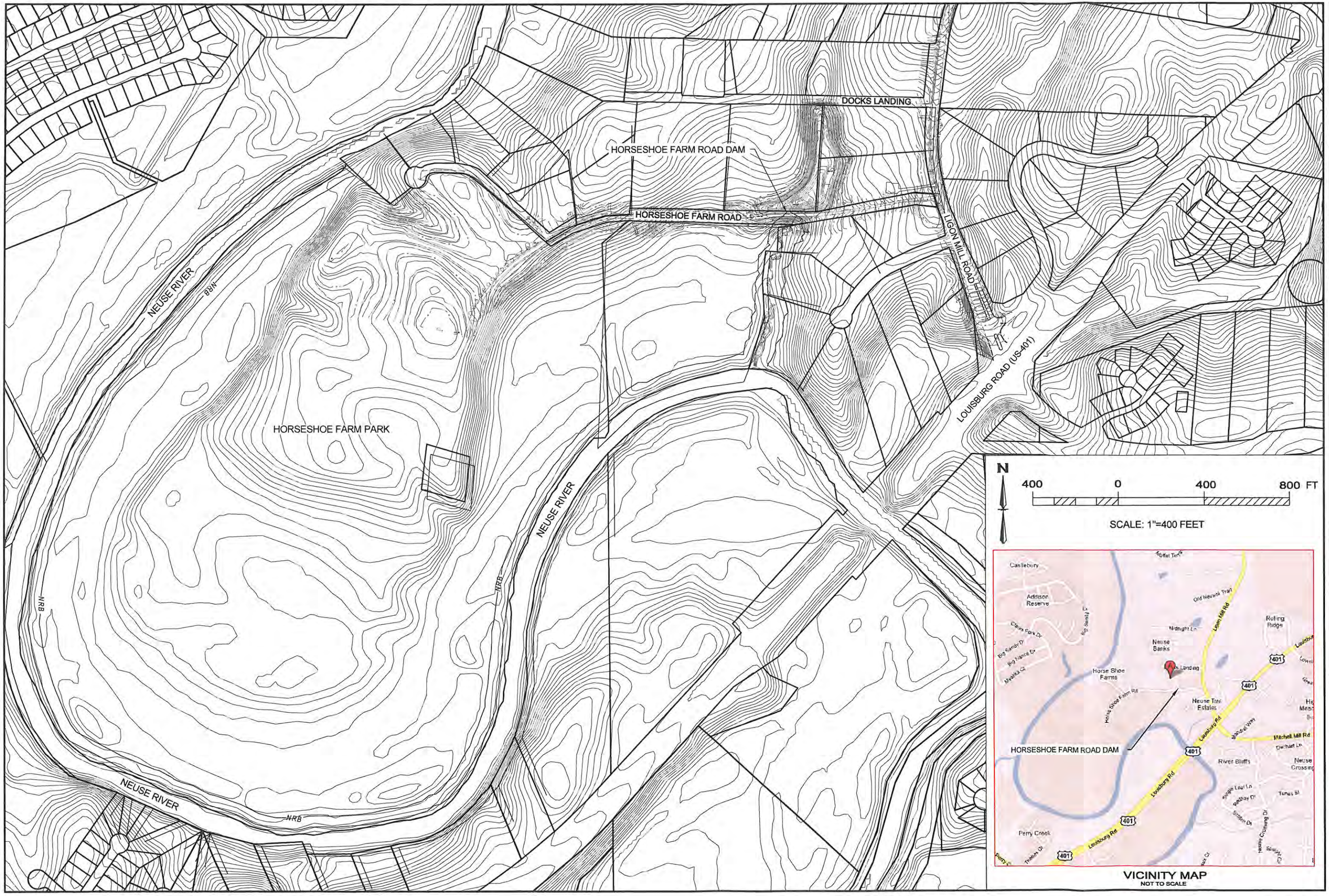


Figure 4-1: Wake Forest Quadrangle Map with aerial photo showing the location of Horseshoe Farm Road Dam.



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ENGINEERS & CONSULTANTS
PO Box 33127
RALEIGH, N.C. 27636-3127
(919) 851-1912
(919) 851-1918 (FAX)
WWW.MULKEYINC.COM

DATE: 4-11-2011	
DRAWN BY:	
DWG. CHECKED BY:	
DESIGNED BY:	
DGN. CHECKED BY:	
SCALE:	
PROJECT NO. 20100015.00	

REMARKS

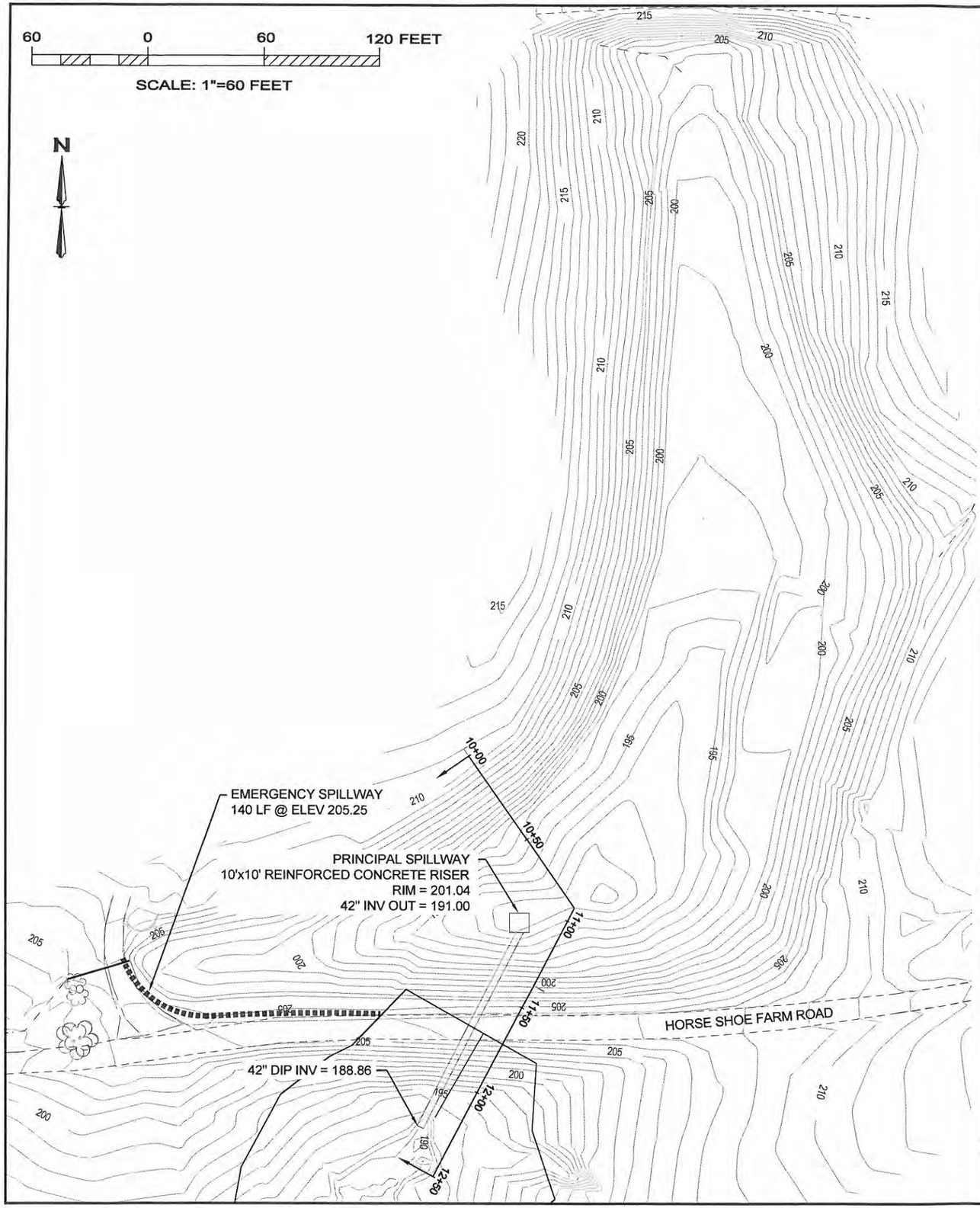
HORSESHOE FARM DAM

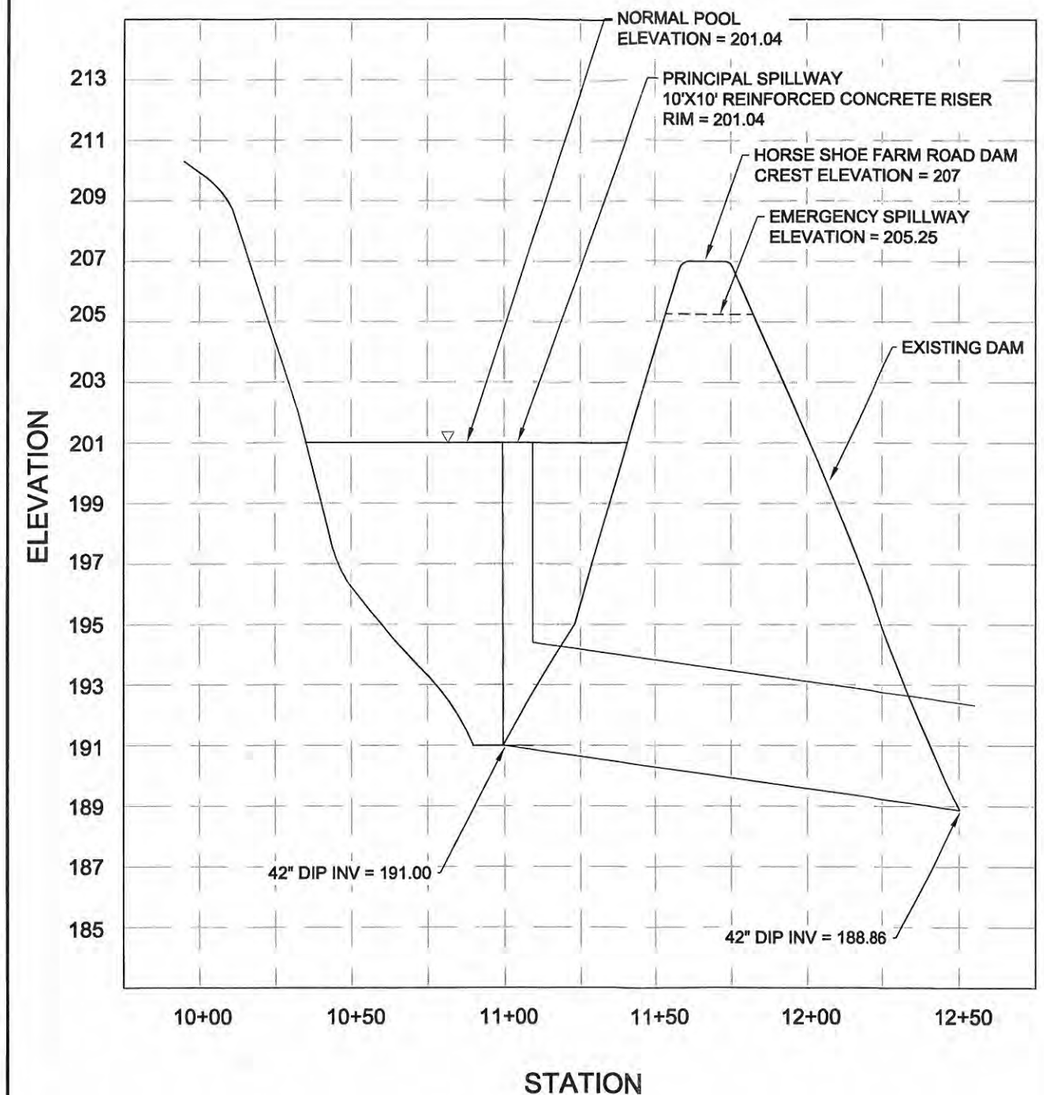
WAKE FOREST, NORTH CAROLINA

DAM LOCATION MAP

Figure 4-2

(5) PRELIMINARY DRAWINGS OR SKETCHES





50 0 50 100 FEET

HORIZONTAL SCALE: 1"=50 FEET
VERTICAL SCALE: 1"= 5 FEET

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RALEIGH, N.C. 27636-3127
(919) 851-1912
(919) 851-1918 (FAX)
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REMARKS

HORSE SHOE FARM DAM
WAKE FOREST, NORTH CAROLINA

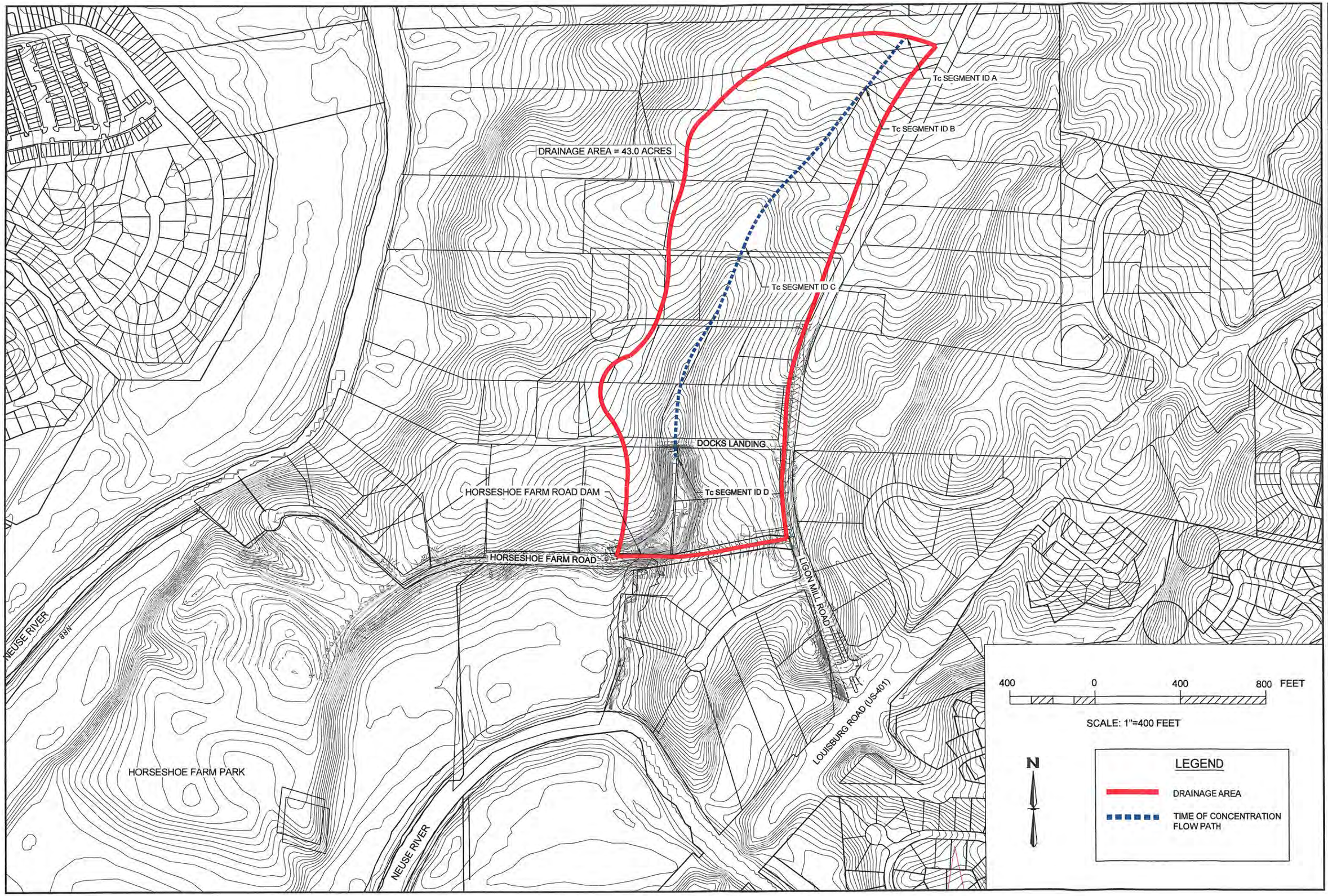
PROPOSED DAM
CROSS SECTION

(6) PRELIMINARY DESIGN CRITERIA

The drainage basin for the dam is approximately 43 acres. The USGS classifies the soils for the contributing drainage basin as Class B, with Wedowee and Vance being the predominant soil types. With the exception of one parcel, all of the upstream area draining into the pond is zoned as R-30. All of the properties zoned as R-30 fall under Wake County's zoning guidelines. The lot that is zoned as R-4 is subject to the City of Raleigh's zoning guidelines. According to the Wake County's zoning manual, R-30 has a minimum lot size of 30,000 SF and a maximum allowable impervious cover of 30%. The lot that is zoned R-4 has a minimum lot size of 10,890 SF according to the City of Raleigh's zoning manual. All of the area that is zoned as R-30 was assigned a Curve Number of 70, the value typically used for residential land use with an average lot size of ½ acre. For the tract zoned as R-4, a CN of 75 was used, the value normally used for ¼ acre lot residential land use. A composite CN of 72 was used for the entire drainage basin that is draining into the pond. Table 6-1 shows the breakdown of the land use types draining to Horseshoe Farm Pond and their corresponding CN values. The drainage area for the pond is delineated in Figure 6-1. The drainage area map also shows the time of concentration flow path that was used to perform the hydrologic analysis.

	LAND USE	AREA (FT^2)	AREA (ACRE)	CN
	R-4	117612	2.70	75
	R-30	1660725	38.1	70
	IMPERVIOUS	95956	2.2	98
TOTAL		1874293	43.0	72

Table 6-1: Drainage Basin Land Use and CN Determination



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PO BOX 33127
RALEIGH, NC 27636-3127
(919) 851-1912
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PROJECT NO. 2010015.00	

REMARKS

HORSESHOE FARM DAM
WAKE FOREST, NORTH CAROLINA

DRAINAGEA AREA MAP

Figure 6-1

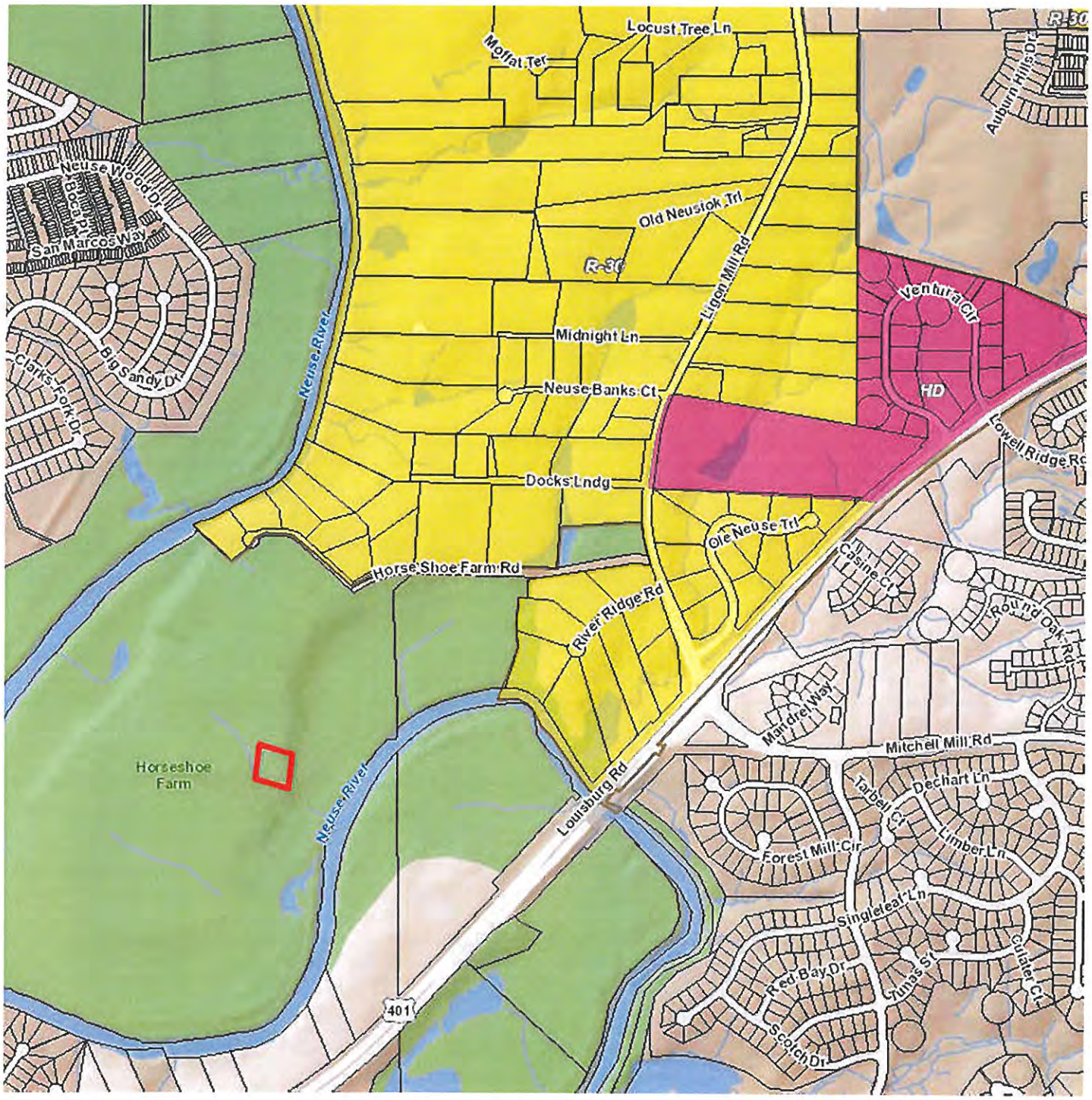


Figure 6-2: Wake County Zoning Map for Horseshoe Farm Pond drainage basin

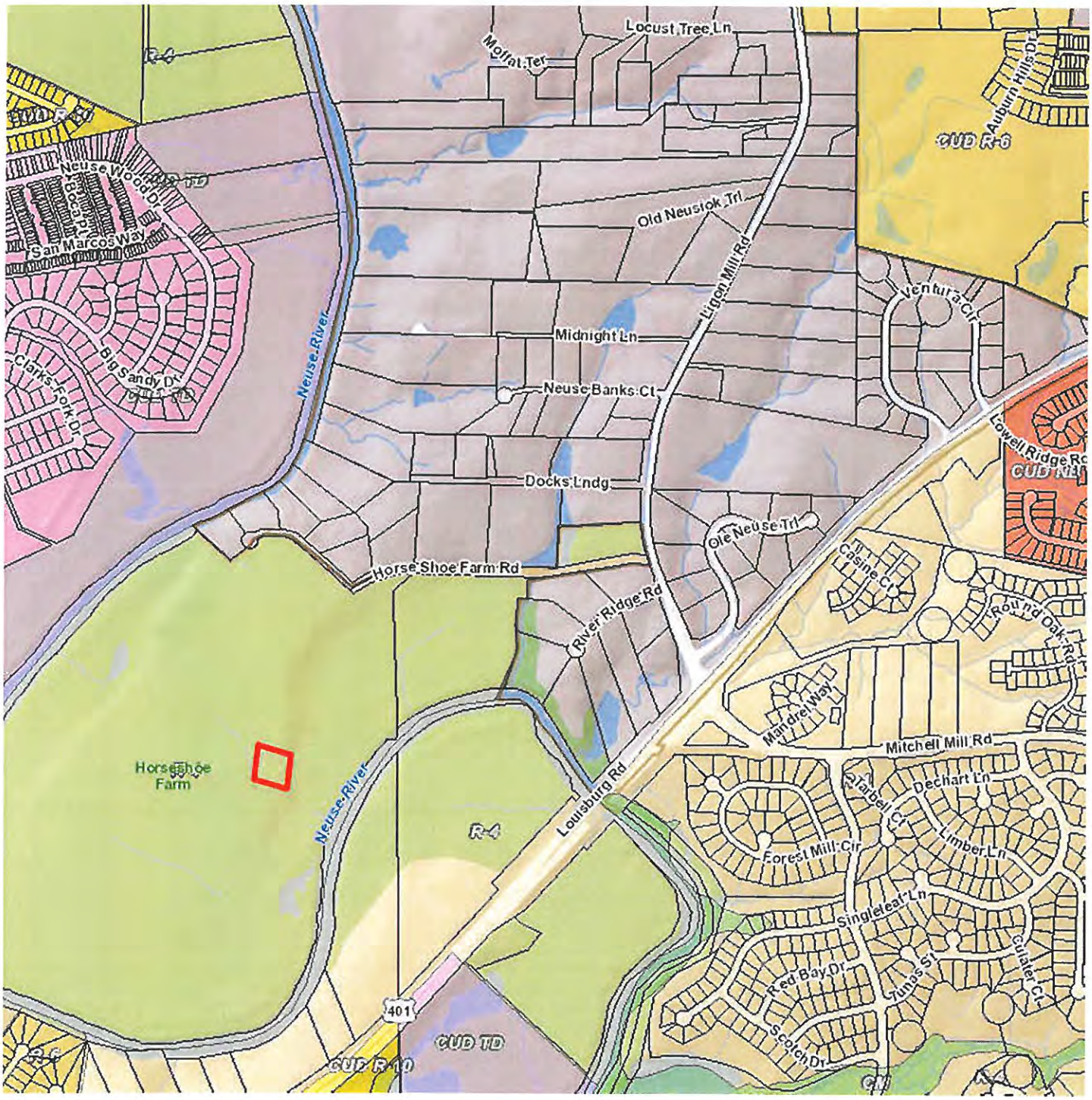


Figure 6-3: City of Raleigh Zoning Map for Horseshoe Farm Pond drainage basin

Map Scale: 1:4,470 if printed on B size (11" x 17") sheet.

N

Meters: 0 30 60 120 180

Feet: 0 100 200 400 600

Map Unit Legend

Wake County, North Carolina (NC183)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
AfB	Altavista fine sandy loam, 0 to 6 percent slopes, rarely flooded	6.3	3.0%
CmA	Chewacla sandy loam, 0 to 2 percent slopes, frequently flooded	5.4	2.6%
CoA	Congaree fine sandy loam, 0 to 2 percent slopes, frequently flooded	9.4	4.6%
DuC	Durham loamy sand, 6 to 10 percent slopes	0.2	0.1%
LwC2	Louisburg-Wedowee complex, 6 to 10 percent slopes, moderately eroded	5.2	2.5%
PgF	Pacolet-Gullied land complex, 4 to 25 percent slopes	0.0	0.0%
VaB2	Vance sandy loam, 2 to 6 percent slopes, moderately eroded	10.8	5.2%
VaC2	Vance sandy loam, 6 to 10 percent slopes, moderately eroded	6.3	3.1%
W	Water	2.4	1.2%
WkE	Wake-Wateree complex, 10 to 25 percent slopes, very rocky	28.0	13.5%
WmB	Wedowee sandy loam, 2 to 6 percent slopes	6.2	3.0%
WmB2	Wedowee sandy loam, 2 to 6 percent slopes, moderately eroded	30.1	14.5%
WmC	Wedowee sandy loam, 6 to 10 percent slopes	5.0	2.4%
WmC2	Wedowee sandy loam, 6 to 10 percent slopes, moderately eroded	49.6	24.0%
WmD2	Wedowee sandy loam, 10 to 15 percent slopes, moderately eroded	25.6	12.3%
WmE	Wedowee sandy loam, 15 to 25 percent slopes	10.8	5.2%
WoA	Wehadkee and Bibb soils, 0 to 2 percent slopes, frequently flooded	3.1	1.5%
WyA	Worsham sandy loam, 0 to 3 percent slopes	2.7	1.3%
Totals for Area of Interest		**207.1**	**100.0%**

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

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

- Gully
- Short Steep Slope
- Other

Political Features

- Cities

Water Features

- Oceans
- Streams and Canals

Transportation

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

MAP INFORMATION

Map Scale: 1:4,470 if printed on B size (11" × 17") sheet.

The soil surveys that comprise your AOI were mapped at 1:15,840.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 17N NAD83

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

Soil Survey Area: Wake County, North Carolina
Survey Area Data: Version 9, Mar 20, 2007

Date(s) aerial images were photographed: 6/18/2006

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.

(7) EXISTING CONDITIONS, HYDROLOGIC ANALYSIS

Currently, the dam is classified as a Class A, "Low Hazard". The existing dam impounds 13.04 ac-ft at its crest elevation of 207. The stage-storage data for the pond is shown below in Table 7-1.

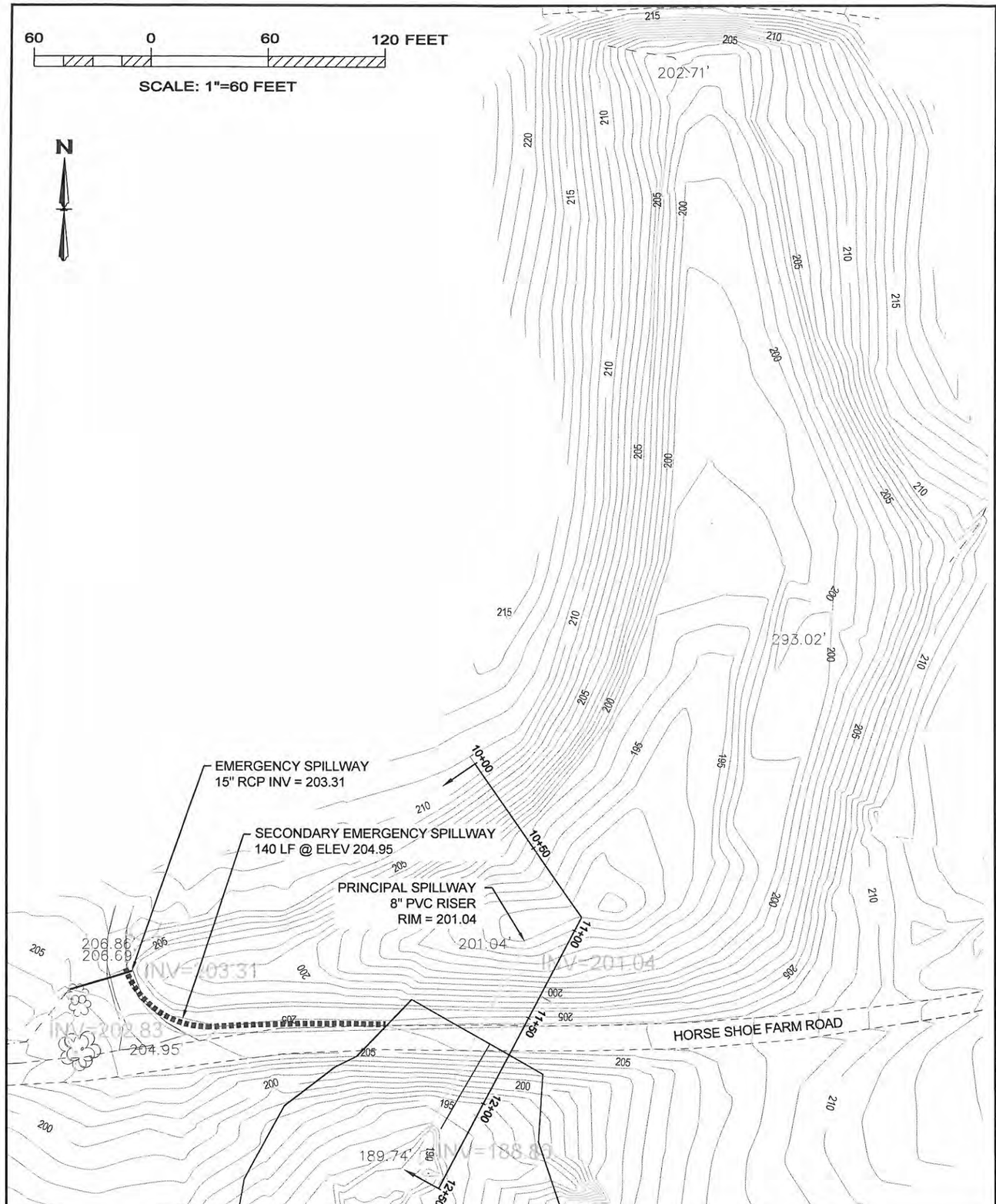
STAGE	ELEVATION	CONTOUR AREA (FT^2)	INCREMENTAL STORAGE (FT^3)	TOTAL STORAGE (FT^3)	TOTAL STORAGE (AC*FT)
0	191.00	102	0	0	0
1	192.00	1279	581	581	0.013
2	193.00	3235	2182	2763	0.063
3	194.00	6486	4767	7530	0.173
4	195.00	10352	8343	15873	0.364
5	196.00	13742	12006	27879	0.640
6	197.00	17696	15676	43555	1.000
7	198.00	23698	20622	64177	2.162
8	199.00	32818	28132	92309	2.119
9	200.00	41972	37298	129606	2.975
10	201.00	48098	44996	174602	4.008
11	202.00	54110	51069	225671	5.181
12	203.00	60725	57380	283051	6.498
13	204.00	65734	63207	346258	7.949
14	205.00	71291	68487	414745	9.521
15	206.00	76619	73932	488676	11.218
16	207.00	82085	79328	568005	13.040

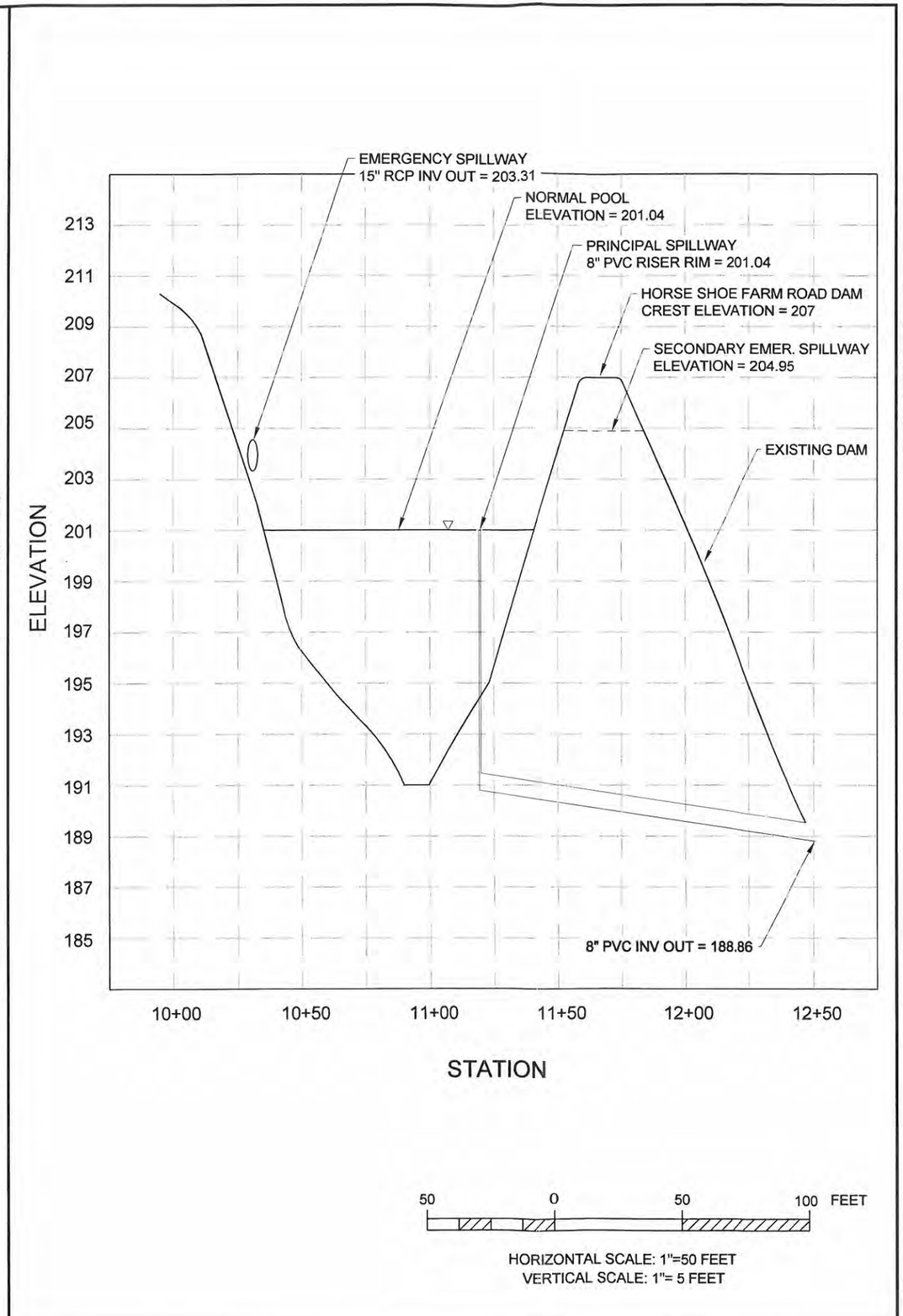
Table 7-1: Stage – Storage Data for Horseshoe Farm Road Pond

The minimum spillway design storm for a low hazard dam is the 50 year event. A hydrologic analysis was performed for the dam in its existing state. Based on the information available and an analysis of the hydrology the spillway capacity is insufficient to meet current guidelines due to the small nature of the spillway relative to the drainage area that it serves. A low area on Horse Shoe Farm Road adjacent to a driveway serves as a secondary "emergency spillway". Once water inundates the 15" RCP spillway, it will begin to flow over Horse Shoe Farm Road at the southwest corner of the pond, where the crest falls to an elevation of 204.95. Water will continue to flow over the secondary emergency spillway and across Horse Shoe Farm Road. As this spillway is unarmored, it is not advisable to allow water to flow over the road and down the back of the dam, which could lead to rills, gullies, and ultimately failure, if not maintained. Table 7-2 displays the results of the hydraulic analysis of the existing spillway structure. The secondary emergency spillway is activated before the 25 year storm event can safely pass through either the principal or emergency spillways. Although activation of the emergency spillway is acceptable for events greater than the 25 year storm it does pose the potential for erosion problems if not properly maintained.

RETURN PERIOD	DISCHARGE THROUGH PRINICPAL SPILLWAY (CFS)	DISCHARGE THROUGH EMERGENCY SPILLWAY (CFS)	DISCHARGE OVER SECONDARY EMERGENCY SPILLWAY (CFS)	TOTAL DISCHARGE (CFS)	WATER SURFACE ELEVATION
2 YR	2.07	0	0	2.07	203.02
10 YR	2.78	4.83	0	7.61	204.63
25 YR	2.97	6.46	32.83	41.88	205.13
50 YR	3.03	6.90	86.97	94.43	205.30
100 YR	3.08	7.22	135.33	144.03	205.42

Table 7-2 Existing Horseshoe Farm Pond Hydraulic Data– Discharge & Water Surface Elevation





MULKEY
ENGINEERS & CONSULTANTS
PO Box 33127
RALEIGH, NC 27636-3127
(919) 851-1912
(919) 851-1918 (FAX)
WWW.MULKEYINC.COM

DATE: 4-11-2011	
DRAWN BY:	
DWG. CHECKED BY:	
DESIGNED BY:	
DGN. CHECKED BY:	
SCALE:	
PROJECT NO. 2010015.00	

REMARKS

HORSE SHOE FARM DAM
WAKE FOREST, NORTH CAROLINA

EXISTING DAM
CROSS SECTION

(7) EXISTING CONDITIONS, HYDROLOGIC ANALYSIS

Currently, the dam is classified as a Class A, "Low Hazard". The existing dam impounds 13.04 ac-ft at its crest elevation of 207. The stage-storage data for the pond is shown below in Table 7-1.

STAGE	ELEVATION	CONTOUR AREA (FT^2)	INCREMENTAL STORAGE (FT^3)	TOTAL STORAGE (FT^3)	TOTAL STORAGE (AC*FT)
0	191.00	102	0	0	0
1	192.00	1279	581	581	0.013
2	193.00	3235	2182	2763	0.063
3	194.00	6486	4767	7530	0.173
4	195.00	10352	8343	15873	0.364
5	196.00	13742	12006	27879	0.640
6	197.00	17696	15676	43555	1.000
7	198.00	23698	20622	64177	2.162
8	199.00	32818	28132	92309	2.119
9	200.00	41972	37298	129606	2.975
10	201.00	48098	44996	174602	4.008
11	202.00	54110	51069	225671	5.181
12	203.00	60725	57380	283051	6.498
13	204.00	65734	63207	346258	7.949
14	205.00	71291	68487	414745	9.521
15	206.00	76619	73932	488676	11.218
16	207.00	82085	79328	568005	13.040

Table 7-1: Stage – Storage Data for Horseshoe Farm Road Pond

The minimum spillway design storm for a low hazard dam is the 50 year event. A hydrologic analysis was performed for the dam in its existing state. Based on the information available and an analysis of the hydrology the spillway capacity is insufficient to meet current guidelines due to the small nature of the spillway relative to the drainage area that it serves. A low area on Horse Shoe Farm Road adjacent to a driveway serves as a secondary "emergency spillway". Once water inundates the 15" RCP spillway, it will begin to flow over Horse Shoe Farm Road at the southwest corner of the pond, where the crest falls to an elevation of 204.95. Water will continue to flow over the secondary emergency spillway and across Horse Shoe Farm Road. As this spillway is unarmored, it is not advisable to allow water to flow over the road and down the back of the dam, which could lead to rills, gullies, and ultimately failure, if not maintained. Table 7-2 displays the results of the hydraulic analysis of the existing spillway structure. The secondary emergency spillway is activated before the 25 year storm event can safely pass through either the principal or emergency spillways. Although activation of the emergency spillway is acceptable for events greater than the 25 year storm it does pose the potential for erosion problems if not properly maintained.

RETURN PERIOD	DISCHARGE THROUGH PRINICPAL SPILLWAY (CFS)	DISCHARGE THROUGH EMERGENCY SPILLWAY (CFS)	DISCHARGE OVER SECONDARY EMERGENCY SPILLWAY (CFS)	TOTAL DISCHARGE (CFS)	WATER SURFACE ELEVATION
2 YR	2.07	0	0	2.07	203.02
10 YR	2.78	4.83	0	7.61	204.63
25 YR	2.97	6.46	32.83	41.88	205.13
50 YR	3.03	6.90	86.97	94.43	205.30
100 YR	3.08	7.22	135.33	144.03	205.42

Table 7-2 Existing Horseshoe Farm Pond Hydraulic Data– Discharge & Water Surface Elevation

TR55 Tc Worksheet

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Hyd. No. 1

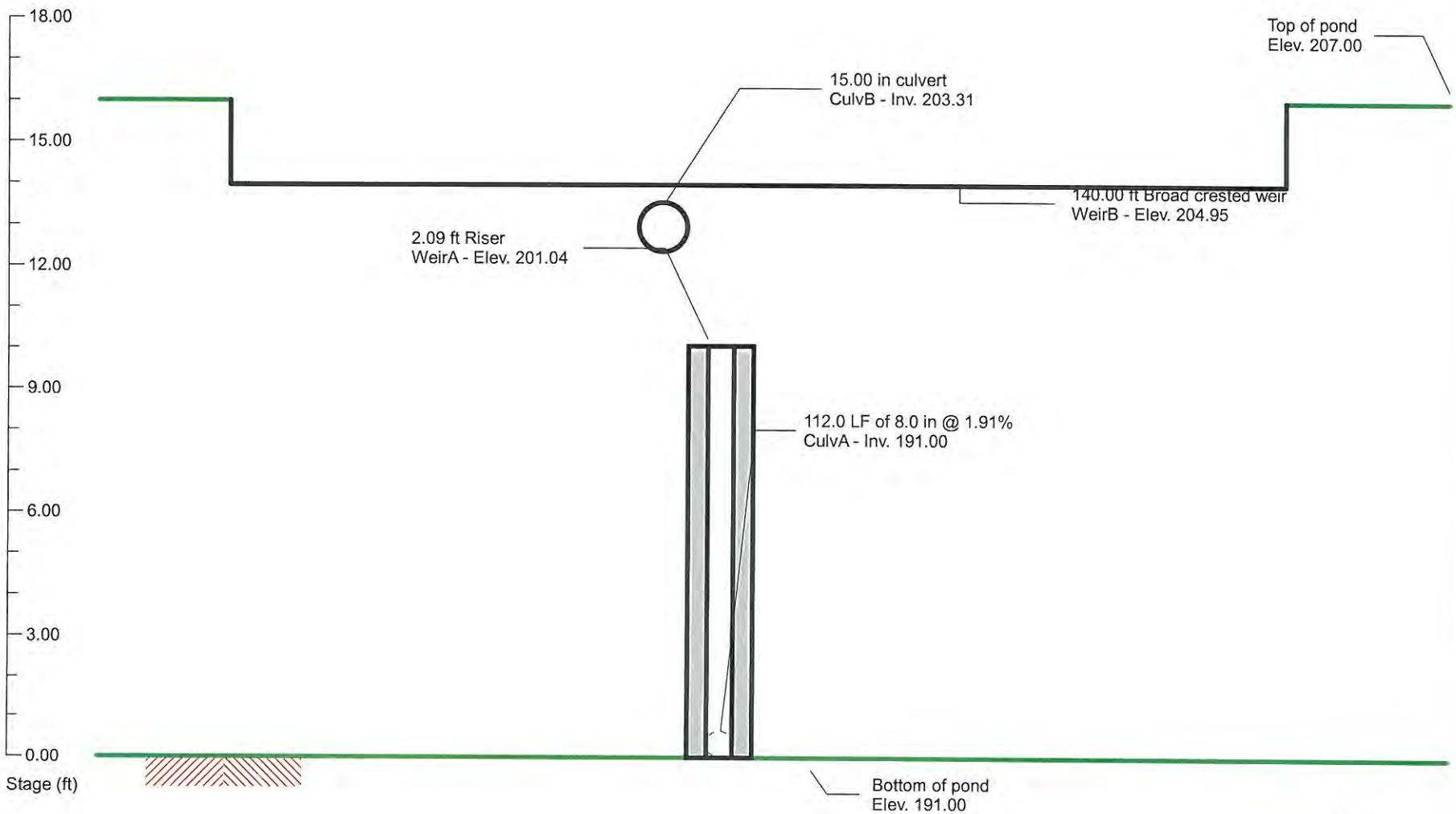
EXIST HORSESHOE FARM ROAD DAM

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.200		0.011		0.011		
Flow length (ft)	=	300.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.60		0.00		0.00		
Land slope (%)	=	4.33		0.00		0.00		
Travel Time (min)	**=**	**20.56**	**+**	**0.00**	**+**	**0.00**	**=**	**20.56**
Shallow Concentrated Flow								
Flow length (ft)	=	934.00		0.00		0.00		
Watercourse slope (%)	=	4.50		0.00		0.00		
Surface description	=	Unpaved		Paved		Paved		
Average velocity (ft/s)	=	3.42		0.00		0.00		
Travel Time (min)	**=**	**4.55**	**+**	**0.00**	**+**	**0.00**	**=**	**4.55**
Channel Flow								
X sectional flow area (sqft)	=	160.00		0.00		0.00		
Wetted perimeter (ft)	=	78.00		0.00		0.00		
Channel slope (%)	=	2.83		0.00		0.00		
Manning's n-value	=	0.026		0.015		0.015		
Velocity (ft/s)	=	15.60		0.00		0.00		
Flow length (ft)	=	1058.0		0.0		0.0		
Travel Time (min)	**=**	**1.13**	**+**	**0.00**	**+**	**0.00**	**=**	**1.13**

Total Travel Time, Tc ..... 26.20 min

Pond No. 1 - EXISTING HORSE SHOE FARM POND

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066



Front View

NTS - Looking Downstream

50-yr
25-yr
10-yr
100-yr
2-yr

Inflow hydrograph = 1. SCS Runoff - EXIST HORSESHOE FARM ROAD DAM

Project: HORSESHOE FARM ROAD DAM EXISTING 4-12-11.gpw

Wednesday, Apr 13, 2011

Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Wednesday, Apr 13, 2011

Pond No. 1 - EXISTING HORSE SHOE FARM POND

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 191.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	191.00	102	0	0
1.00	192.00	1,279	581	581
2.00	193.00	3,235	2,182	2,763
3.00	194.00	6,486	4,767	7,530
4.00	195.00	10,352	8,343	15,873
5.00	196.00	13,742	12,006	27,879
6.00	197.00	17,696	15,676	43,555
7.00	198.00	23,698	20,622	64,177
8.00	199.00	32,818	28,132	92,309
9.00	200.00	41,972	37,298	129,606
10.00	201.00	48,098	44,996	174,602
11.00	202.00	54,110	51,069	225,671
12.00	203.00	60,725	57,380	283,051
13.00	204.00	66,234	63,453	346,504
14.00	205.00	71,891	69,036	415,541
15.00	206.00	76,619	74,235	489,776
16.00	207.00	82,085	79,328	569,104

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 8.00	15.00	0.00	0.00
Span (in)	= 8.00	15.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 191.00	203.31	0.00	0.00
Length (ft)	= 112.00	34.00	0.00	0.00
Slope (%)	= 1.91	1.41	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)	= 2.09	140.00	0.00	0.00
Crest El. (ft)	= 201.04	204.95	0.00	0.00
Weir Coeff.	= 3.33	3.00	3.33	3.33
Weir Type	= Riser	Broad	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (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).

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	191.00	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
0.10	58	191.10	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
0.20	116	191.20	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
0.30	174	191.30	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
0.40	232	191.40	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
0.50	290	191.50	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
0.60	348	191.60	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
0.70	406	191.70	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
0.80	465	191.80	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
0.90	523	191.90	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
1.00	581	192.00	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
1.10	799	192.10	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
1.20	1,017	192.20	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
1.30	1,235	192.30	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
1.40	1,454	192.40	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
1.50	1,672	192.50	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
1.60	1,890	192.60	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
1.70	2,108	192.70	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
1.80	2,327	192.80	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
1.90	2,545	192.90	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
2.00	2,763	193.00	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
2.10	3,240	193.10	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
2.20	3,717	193.20	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
2.30	4,193	193.30	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
2.40	4,670	193.40	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000

Continues on next page...

EXISTING HORSE SHOE FARM POND

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
2.50	5,147	193.50	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
2.60	5,623	193.60	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
2.70	6,100	193.70	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
2.80	6,577	193.80	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
2.90	7,053	193.90	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
3.00	7,530	194.00	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
3.10	8,364	194.10	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
3.20	9,199	194.20	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
3.30	10,033	194.30	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
3.40	10,867	194.40	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
3.50	11,701	194.50	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
3.60	12,536	194.60	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
3.70	13,370	194.70	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
3.80	14,204	194.80	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
3.90	15,039	194.90	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
4.00	15,873	195.00	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
4.10	17,074	195.10	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
4.20	18,274	195.20	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
4.30	19,475	195.30	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
4.40	20,675	195.40	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
4.50	21,876	195.50	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
4.60	23,077	195.60	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
4.70	24,277	195.70	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
4.80	25,478	195.80	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
4.90	26,678	195.90	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
5.00	27,879	196.00	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
5.10	29,447	196.10	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
5.20	31,014	196.20	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
5.30	32,582	196.30	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
5.40	34,149	196.40	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
5.50	35,717	196.50	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
5.60	37,284	196.60	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
5.70	38,852	196.70	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
5.80	40,420	196.80	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
5.90	41,987	196.90	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
6.00	43,555	197.00	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
6.10	45,617	197.10	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
6.20	47,679	197.20	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
6.30	49,741	197.30	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
6.40	51,804	197.40	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
6.50	53,866	197.50	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
6.60	55,928	197.60	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
6.70	57,990	197.70	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
6.80	60,052	197.80	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
6.90	62,115	197.90	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
7.00	64,177	198.00	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
7.10	66,990	198.10	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
7.20	69,803	198.20	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
7.30	72,616	198.30	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
7.40	75,429	198.40	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
7.50	78,243	198.50	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
7.60	81,056	198.60	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
7.70	83,869	198.70	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
7.80	86,682	198.80	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
7.90	89,495	198.90	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
8.00	92,309	199.00	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
8.10	96,038	199.10	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
8.20	99,768	199.20	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
8.30	103,498	199.30	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
8.40	107,228	199.40	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
8.50	110,957	199.50	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
8.60	114,687	199.60	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
8.70	118,417	199.70	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
8.80	122,147	199.80	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
8.90	125,876	199.90	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
9.00	129,606	200.00	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
9.10	134,106	200.10	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
9.20	138,605	200.20	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
9.30	143,105	200.30	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
9.40	147,604	200.40	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
9.50	152,104	200.50	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000

Continues on next page....

EXISTING HORSE SHOE FARM POND

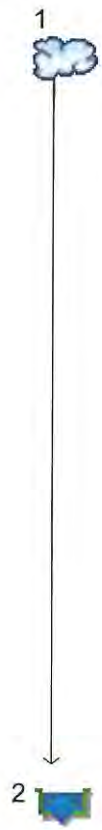
Stage / Storage / Discharge Table

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
9.60	156,604	200.60	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
9.70	161,103	200.70	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
9.80	165,603	200.80	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
9.90	170,102	200.90	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
10.00	174,602	201.00	0.00	0.00	---	---	0.00	0.00	---	---	---	---	0.000
10.10	179,709	201.10	0.11 ic	0.00	---	---	0.10	0.00	---	---	---	---	0.102
10.20	184,816	201.20	0.45 ic	0.00	---	---	0.45	0.00	---	---	---	---	0.445
10.30	189,923	201.30	0.92 ic	0.00	---	---	0.92	0.00	---	---	---	---	0.923
10.40	195,030	201.40	0.91 ic	0.00	---	---	0.88 ic	0.00	---	---	---	---	0.881
10.50	200,137	201.50	1.00 ic	0.00	---	---	1.00 ic	0.00	---	---	---	---	0.996
10.60	205,243	201.60	1.10 ic	0.00	---	---	1.10 ic	0.00	---	---	---	---	1.099
10.70	210,350	201.70	1.19 ic	0.00	---	---	1.19 ic	0.00	---	---	---	---	1.193
10.80	215,457	201.80	1.28 ic	0.00	---	---	1.28 ic	0.00	---	---	---	---	1.280
10.90	220,564	201.90	1.36 ic	0.00	---	---	1.36 ic	0.00	---	---	---	---	1.361
11.00	225,671	202.00	1.44 ic	0.00	---	---	1.44 ic	0.00	---	---	---	---	1.438
11.10	231,409	202.10	1.51 ic	0.00	---	---	1.51 ic	0.00	---	---	---	---	1.511
11.20	237,147	202.20	1.58 ic	0.00	---	---	1.58 ic	0.00	---	---	---	---	1.581
11.30	242,885	202.30	1.65 ic	0.00	---	---	1.65 ic	0.00	---	---	---	---	1.648
11.40	248,623	202.40	1.71 ic	0.00	---	---	1.71 ic	0.00	---	---	---	---	1.712
11.50	254,361	202.50	1.77 oc	0.00	---	---	1.77 ic	0.00	---	---	---	---	1.774
11.60	260,099	202.60	1.83 oc	0.00	---	---	1.83 ic	0.00	---	---	---	---	1.833
11.70	265,837	202.70	1.89 oc	0.00	---	---	1.89 ic	0.00	---	---	---	---	1.891
11.80	271,575	202.80	1.95 oc	0.00	---	---	1.95 ic	0.00	---	---	---	---	1.947
11.90	277,313	202.90	2.00 oc	0.00	---	---	2.00 ic	0.00	---	---	---	---	2.002
12.00	283,051	203.00	2.06 oc	0.00	---	---	2.06 ic	0.00	---	---	---	---	2.055
12.10	289,397	203.10	2.11 oc	0.00	---	---	2.11 ic	0.00	---	---	---	---	2.107
12.20	295,742	203.20	2.16 oc	0.00	---	---	2.16 ic	0.00	---	---	---	---	2.157
12.30	302,087	203.30	2.21 oc	0.00	---	---	2.21 ic	0.00	---	---	---	---	2.207
12.40	308,432	203.40	2.26 oc	0.04 ic	---	---	2.26 ic	0.00	---	---	---	---	2.295
12.50	314,778	203.50	2.30 oc	0.17 ic	---	---	2.30 ic	0.00	---	---	---	---	2.477
12.60	321,123	203.60	2.35 oc	0.40 ic	---	---	2.35 ic	0.00	---	---	---	---	2.745
12.70	327,468	203.70	2.39 oc	0.70 ic	---	---	2.39 ic	0.00	---	---	---	---	3.090
12.80	333,814	203.80	2.44 oc	1.07 ic	---	---	2.44 ic	0.00	---	---	---	---	3.504
12.90	340,159	203.90	2.48 oc	1.49 ic	---	---	2.48 ic	0.00	---	---	---	---	3.975
13.00	346,504	204.00	2.53 oc	1.97 ic	---	---	2.53 ic	0.00	---	---	---	---	4.492
13.10	353,408	204.10	2.57 oc	2.48 ic	---	---	2.57 ic	0.00	---	---	---	---	5.045
13.20	360,312	204.20	2.61 oc	3.00 ic	---	---	2.61 ic	0.00	---	---	---	---	5.612
13.30	367,215	204.30	2.65 oc	3.53 ic	---	---	2.65 ic	0.00	---	---	---	---	6.184
13.40	374,119	204.40	2.69 oc	4.04 ic	---	---	2.69 ic	0.00	---	---	---	---	6.729
13.50	381,023	204.50	2.73 oc	4.48 ic	---	---	2.73 ic	0.00	---	---	---	---	7.208
13.60	387,926	204.60	2.77 oc	4.70 oc	---	---	2.77 ic	0.00	---	---	---	---	7.467
13.70	394,830	204.70	2.81 oc	5.13 oc	---	---	2.81 ic	0.00	---	---	---	---	7.938
13.80	401,733	204.80	2.85 oc	5.50 ic	---	---	2.85 ic	0.00	---	---	---	---	8.341
13.90	408,637	204.90	2.88 oc	5.80 ic	---	---	2.88 ic	0.00	---	---	---	---	8.688
14.00	415,541	205.00	2.92 oc	6.10 ic	---	---	2.92 ic	4.70	---	---	---	---	13.71
14.10	422,964	205.10	2.96 oc	6.38 ic	---	---	2.96 ic	24.40	---	---	---	---	33.74
14.20	430,388	205.20	2.99 oc	6.65 ic	---	---	2.99 ic	52.50	---	---	---	---	62.14
14.30	437,811	205.30	3.03 oc	6.90 ic	---	---	3.03 ic	86.97	---	---	---	---	96.91
14.40	445,235	205.40	3.07 oc	7.15 ic	---	---	3.07 ic	126.80	---	---	---	---	137.01
14.50	452,658	205.50	3.10 oc	7.39 ic	---	---	3.10 ic	171.33	---	---	---	---	181.82
14.60	460,082	205.60	3.13 oc	7.62 ic	---	---	3.13 ic	220.12	---	---	---	---	230.88
14.70	467,505	205.70	3.17 oc	7.85 ic	---	---	3.17 ic	272.82	---	---	---	---	283.84
14.80	474,929	205.80	3.20 oc	8.07 ic	---	---	3.20 ic	329.17	---	---	---	---	340.44
14.90	482,352	205.90	3.24 oc	8.28 ic	---	---	3.24 ic	388.93	---	---	---	---	400.45
15.00	489,776	206.00	3.27 oc	8.49 ic	---	---	3.27 ic	451.89	---	---	---	---	463.65
15.10	497,709	206.10	3.30 oc	8.69 ic	---	---	3.30 ic	517.97	---	---	---	---	529.96
15.20	505,641	206.20	3.33 oc	8.89 ic	---	---	3.33 ic	586.98	---	---	---	---	599.20
15.30	513,574	206.30	3.37 oc	9.09 ic	---	---	3.37 ic	658.81	---	---	---	---	671.26
15.40	521,507	206.40	3.40 oc	9.28 ic	---	---	3.40 ic	733.35	---	---	---	---	746.03
15.50	529,440	206.50	3.43 oc	9.46 ic	---	---	3.43 ic	810.51	---	---	---	---	823.41
15.60	537,373	206.60	3.46 oc	9.64 ic	---	---	3.46 ic	890.21	---	---	---	---	903.31
15.70	545,306	206.70	4.25 oc	9.82 ic	---	---	4.12 s	972.35	---	---	---	---	986.30
15.80	553,238	206.80	4.26 oc	10.00 ic	---	---	4.20 s	1056.88	---	---	---	---	1071.08
15.90	561,171	206.90	4.28 oc	10.17 ic	---	---	4.13 s	1143.72	---	---	---	---	1158.03
16.00	569,104	207.00	4.29 oc	10.34 ic	---	---	4.27 s	1232.77	---	---	---	---	1247.39

...End

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066



Legend

Hyd.	Origin	Description
1	SCS Runoff	EXIST HORSESHOE FARM ROAD DAM
2	Reservoir	HORSESHOE POND ROUTED

Project: HORSESHOE FARM ROAD DAM EXISTING 4-12-11.gpw

Wednesday, Apr 13, 2011

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

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	------	-------	46.89	-------	-------	103.23	139.08	167.78	196.60	EXIST HORSESHOE FARM ROAD
2	Reservoir	1	-------	2.066	-------	-------	7.607	41.88	94.43	144.03	HORSESHOE POND ROUTED

Proj. file: HORSESHOE FARM ROAD DAM EXISTING 4-12-11.gpw | Wednesday, Apr 13, 2011

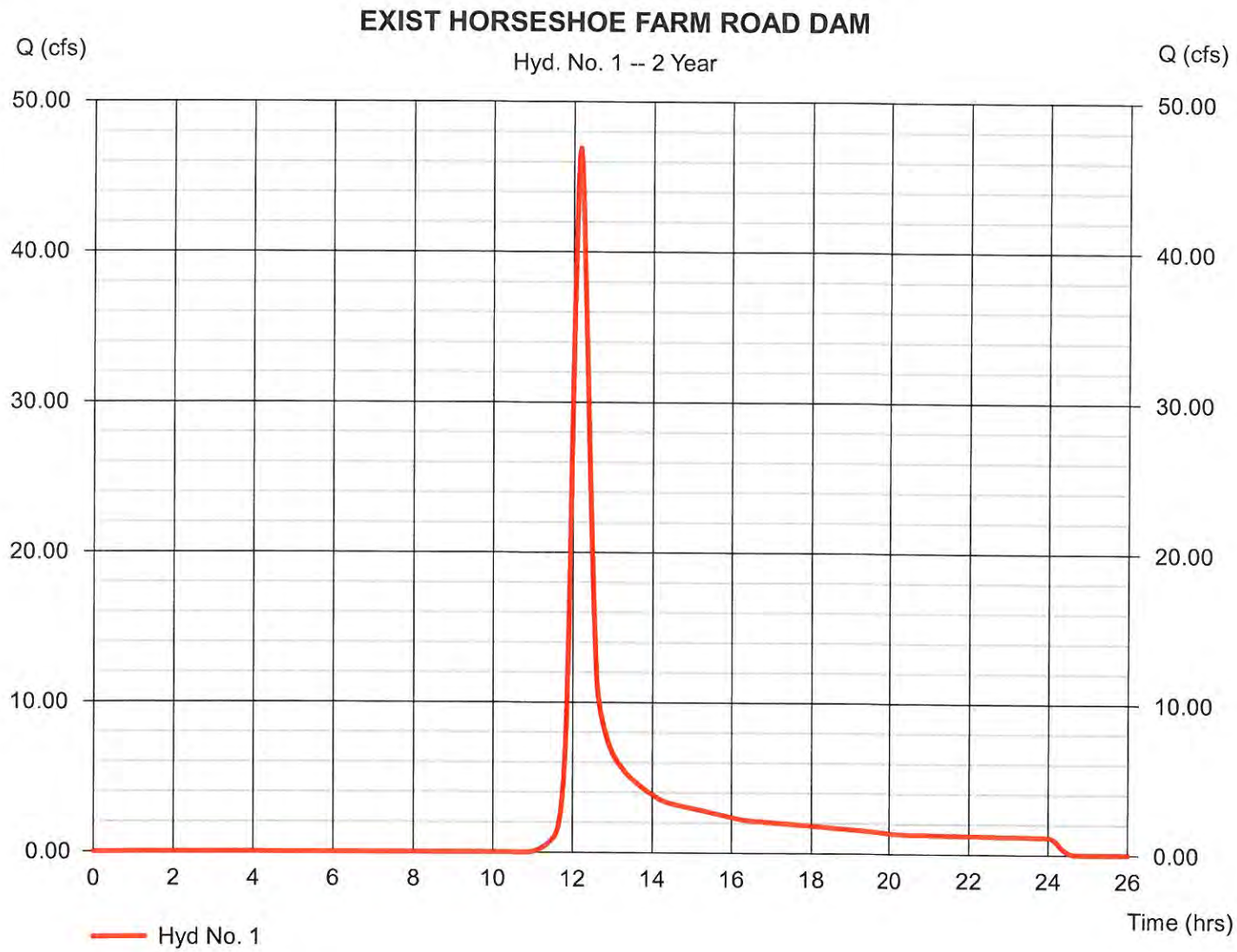
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Wednesday, Apr 13, 2011

Hyd. No. 1

EXIST HORSESHOE FARM ROAD DAM

Hydrograph type	= SCS Runoff	Peak discharge	= 46.89 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 182,357 cuft
Drainage area	= 43.000 ac	Curve number	= 72
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.20 min
Total precip.	= 3.60 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

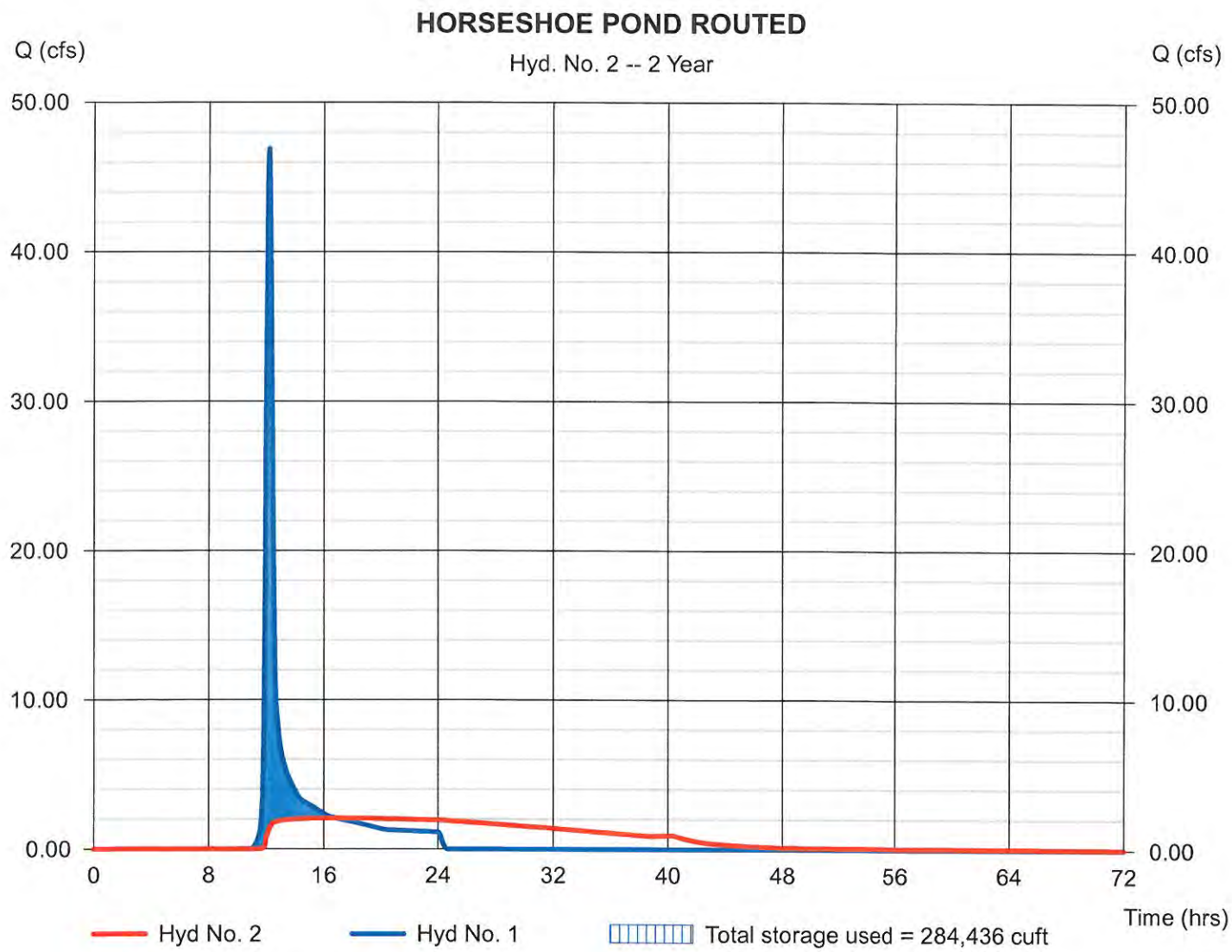
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Wednesday, Apr 13, 2011

Hyd. No. 2

HORSESHOE POND ROUTED

Hydrograph type	= Reservoir	Peak discharge	= 2.066 cfs
Storm frequency	= 2 yrs	Time to peak	= 16.87 hrs
Time interval	= 2 min	Hyd. volume	= 182,190 cuft
Inflow hyd. No.	= 1 - EXIST HORSESHOE FARM ROAD DAM	Max. Elevation	= 203.02 ft
Reservoir name	= EXISTING HORSE SHOE FARM POND	Max. Storage	= 284,436 cuft

Storage Indication method used. Wet pond routing start elevation = 201.00 ft.



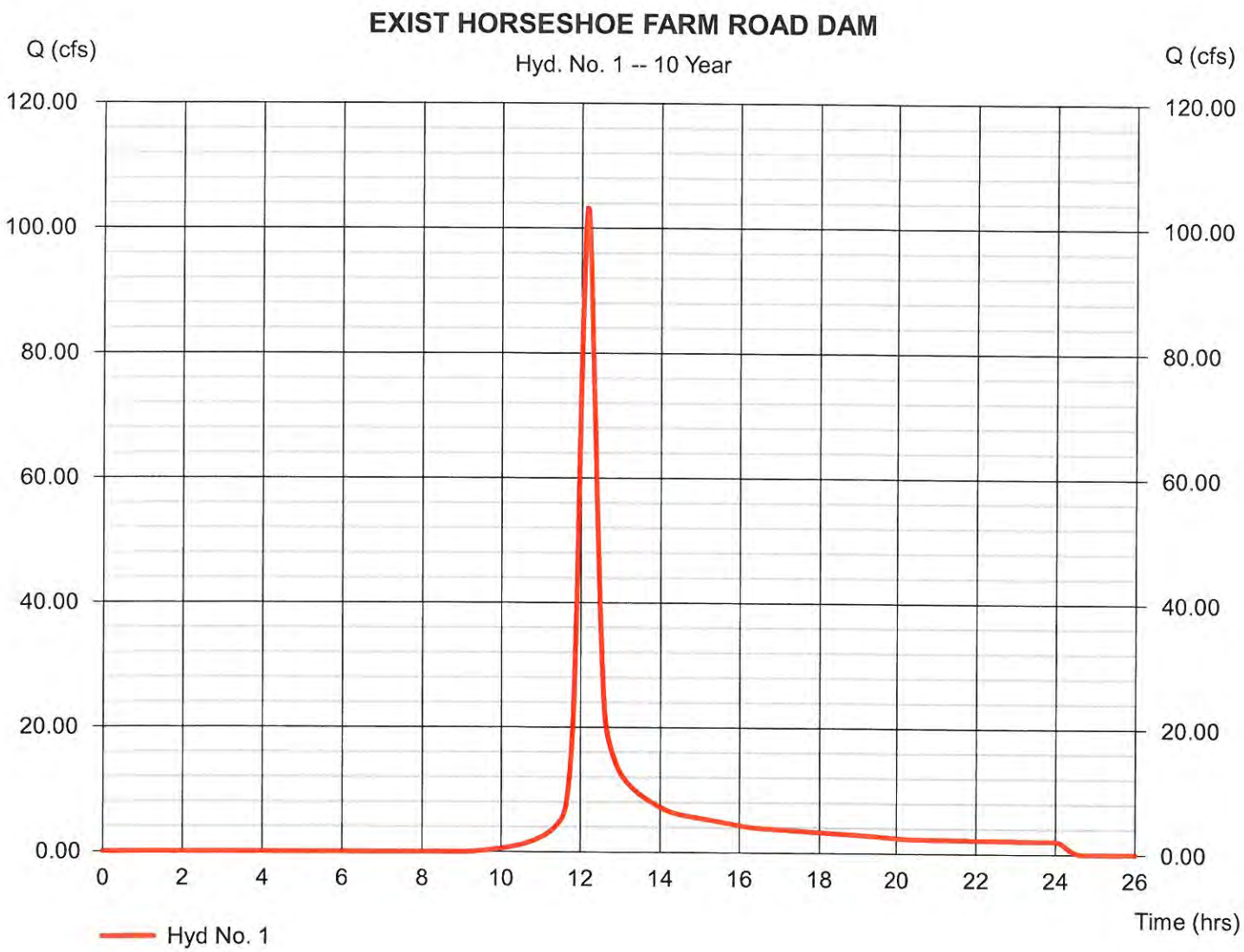
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Wednesday, Apr 13, 2011

Hyd. No. 1

EXIST HORSESHOE FARM ROAD DAM

Hydrograph type	= SCS Runoff	Peak discharge	= 103.23 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 383,271 cuft
Drainage area	= 43.000 ac	Curve number	= 72
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.20 min
Total precip.	= 5.38 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

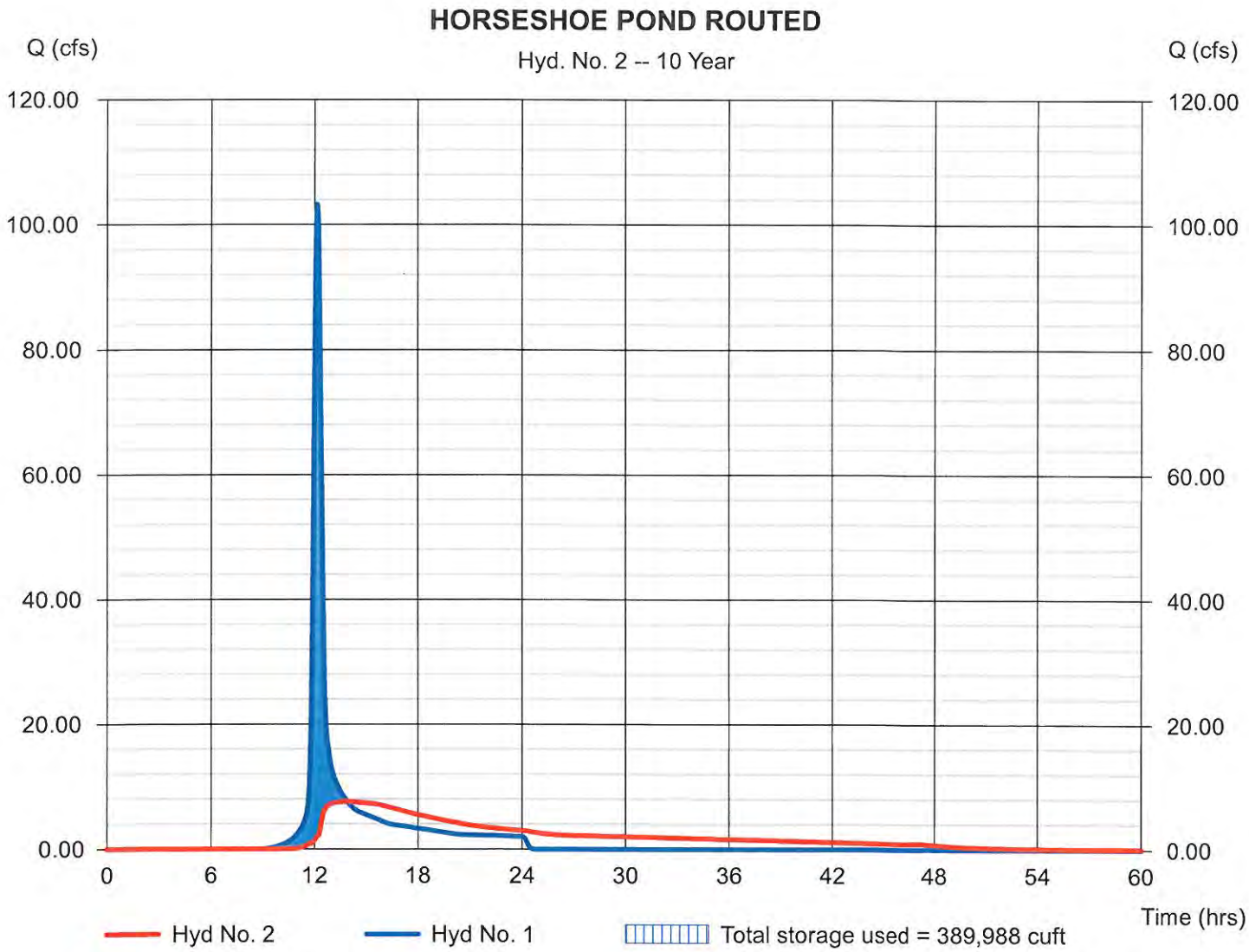
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Wednesday, Apr 13, 2011

Hyd. No. 2

HORSESHOE POND ROUTED

Hydrograph type	= Reservoir	Peak discharge	= 7.607 cfs
Storm frequency	= 10 yrs	Time to peak	= 13.90 hrs
Time interval	= 2 min	Hyd. volume	= 382,995 cuft
Inflow hyd. No.	= 1 - EXIST HORSESHOE FARM ROAD DAM	Max. Elevation	= 204.63 ft
Reservoir name	= EXISTING HORSE SHOE FARM POND	Max. Storage	= 389,988 cuft

Storage Indication method used. Wet pond routing start elevation = 201.00 ft.



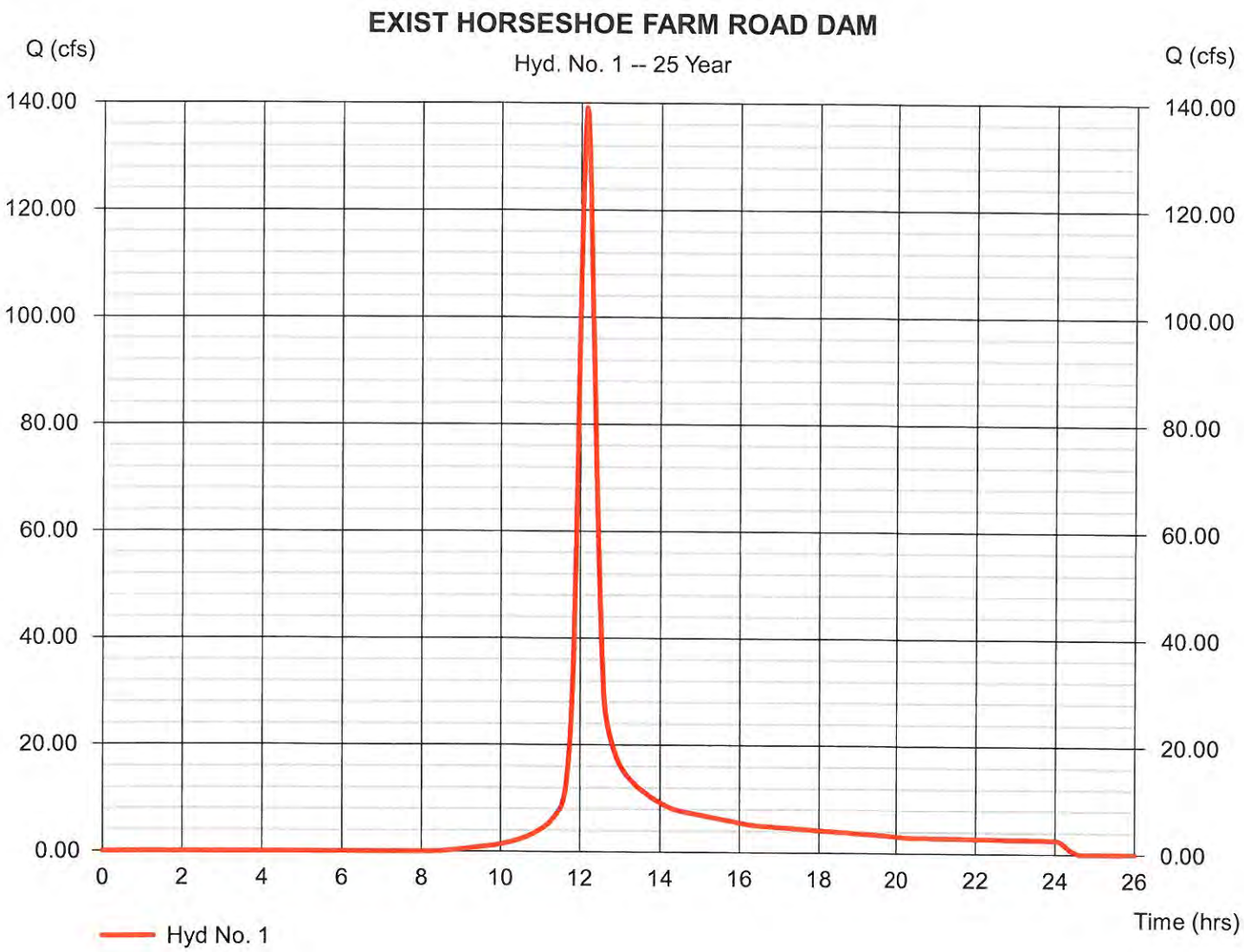
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Wednesday, Apr 13, 2011

Hyd. No. 1

EXIST HORSESHOE FARM ROAD DAM

Hydrograph type	= SCS Runoff	Peak discharge	= 139.08 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 511,927 cuft
Drainage area	= 43.000 ac	Curve number	= 72
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.20 min
Total precip.	= 6.41 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

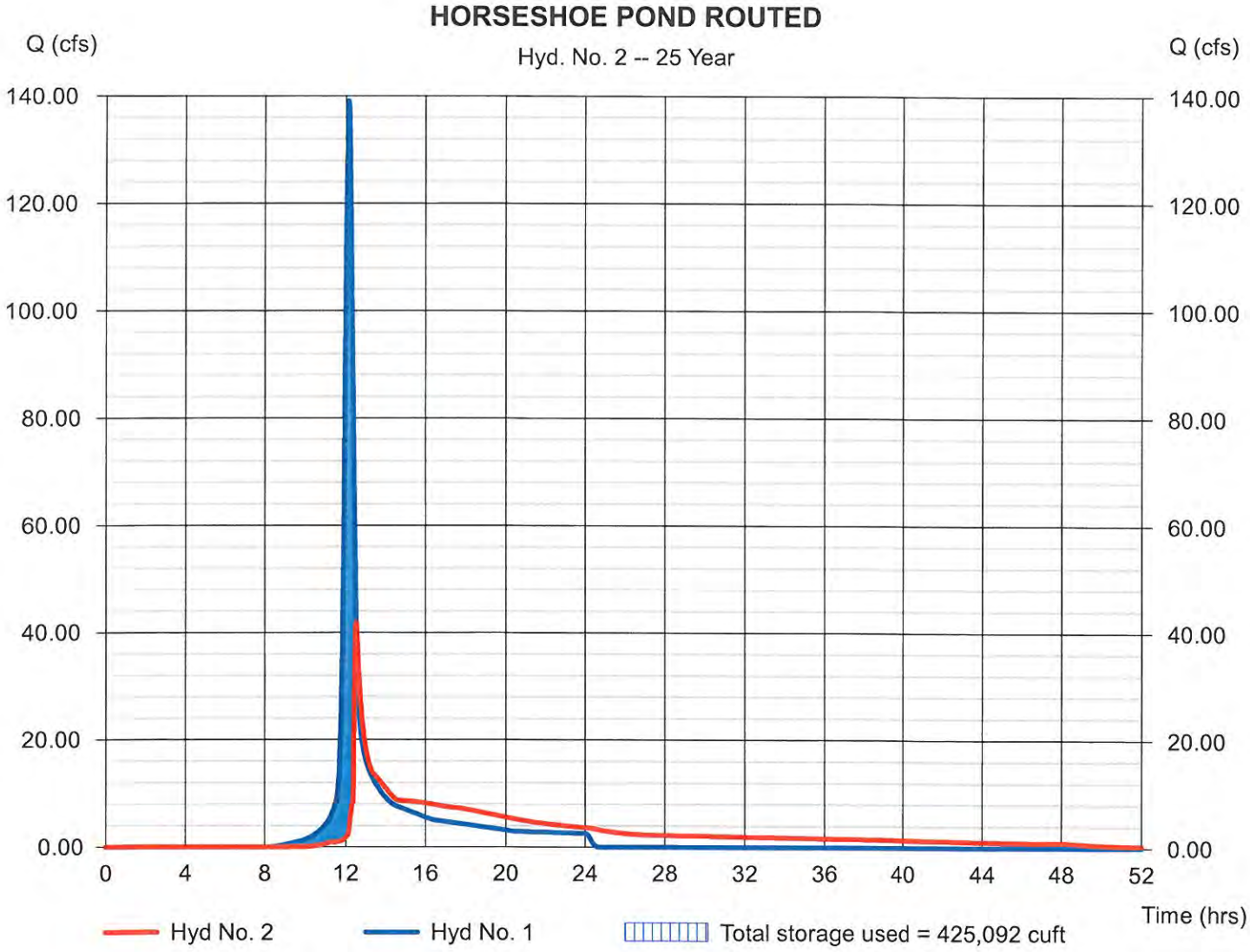
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Wednesday, Apr 13, 2011

Hyd. No. 2

HORSESHOE POND ROUTED

Hydrograph type	= Reservoir	Peak discharge	= 41.88 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.53 hrs
Time interval	= 2 min	Hyd. volume	= 511,632 cuft
Inflow hyd. No.	= 1 - EXIST HORSESHOE FARM ROAD DAM	Max. Elevation	= 205.13 ft
Reservoir name	= EXISTING HORSE SHOE FARM POND	Max. Storage	= 425,092 cuft

Storage Indication method used. Wet pond routing start elevation = 201.00 ft.



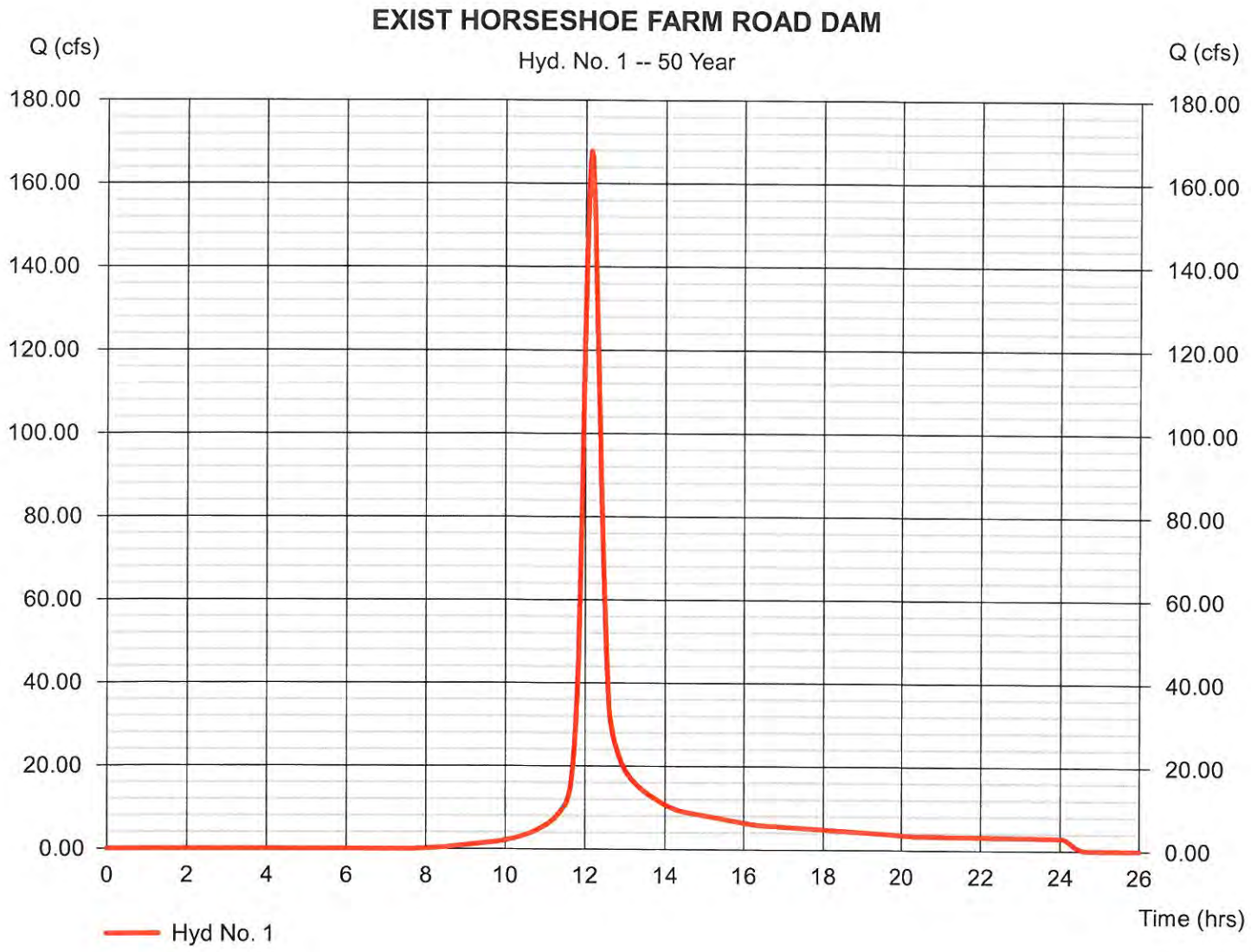
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Wednesday, Apr 13, 2011

Hyd. No. 1

EXIST HORSESHOE FARM ROAD DAM

Hydrograph type	= SCS Runoff	Peak discharge	= 167.78 cfs
Storm frequency	= 50 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 615,930 cuft
Drainage area	= 43.000 ac	Curve number	= 72
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.20 min
Total precip.	= 7.21 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

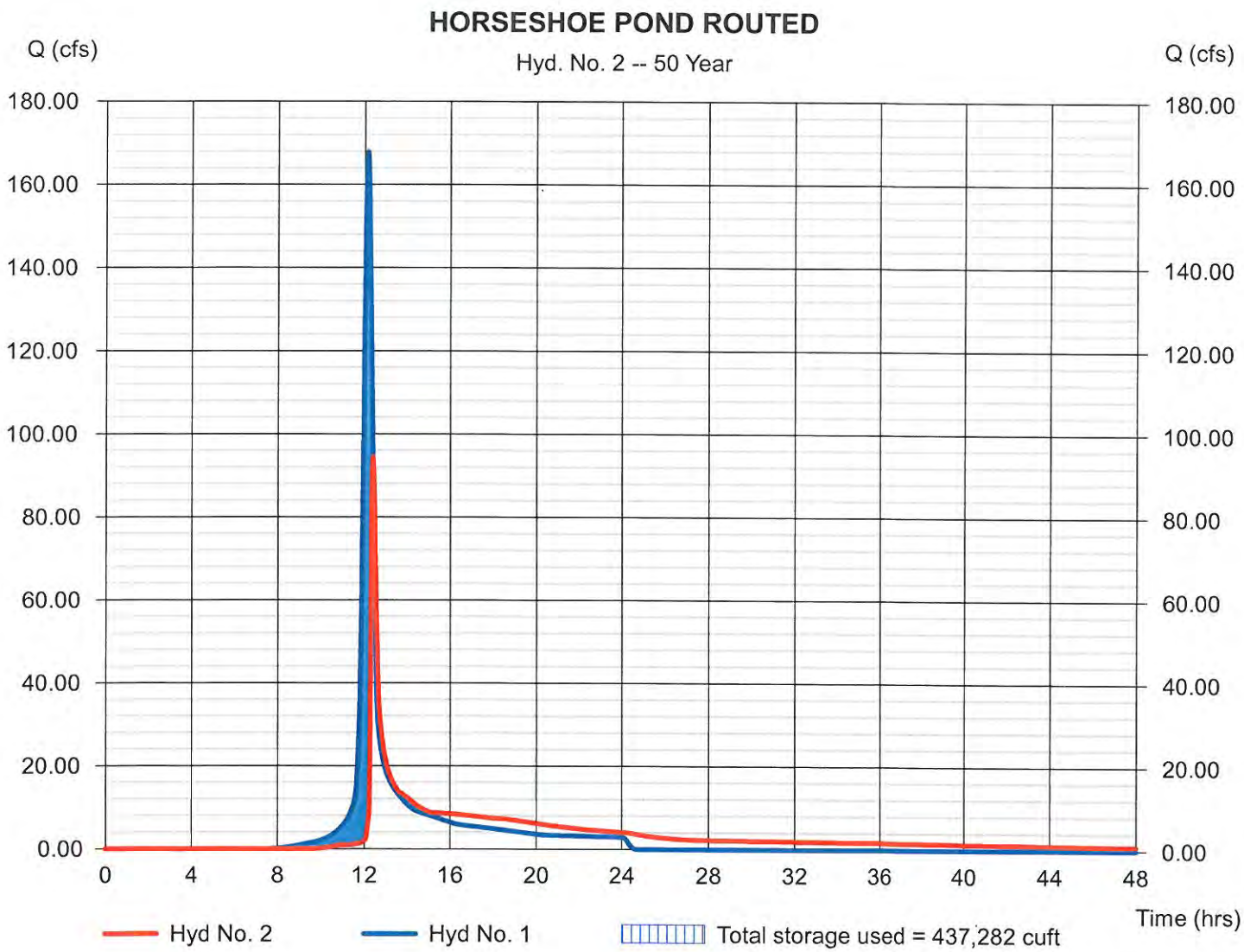
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Wednesday, Apr 13, 2011

Hyd. No. 2

HORSESHOE POND ROUTED

Hydrograph type	= Reservoir	Peak discharge	= 94.43 cfs
Storm frequency	= 50 yrs	Time to peak	= 12.40 hrs
Time interval	= 2 min	Hyd. volume	= 615,626 cuft
Inflow hyd. No.	= 1 - EXIST HORSESHOE FARM ROAD DAM	Max. Elevation	= 205.30 ft
Reservoir name	= EXISTING HORSE SHOE FARM POND	Max. Storage	= 437,282 cuft

Storage Indication method used. Wet pond routing start elevation = 201.00 ft.



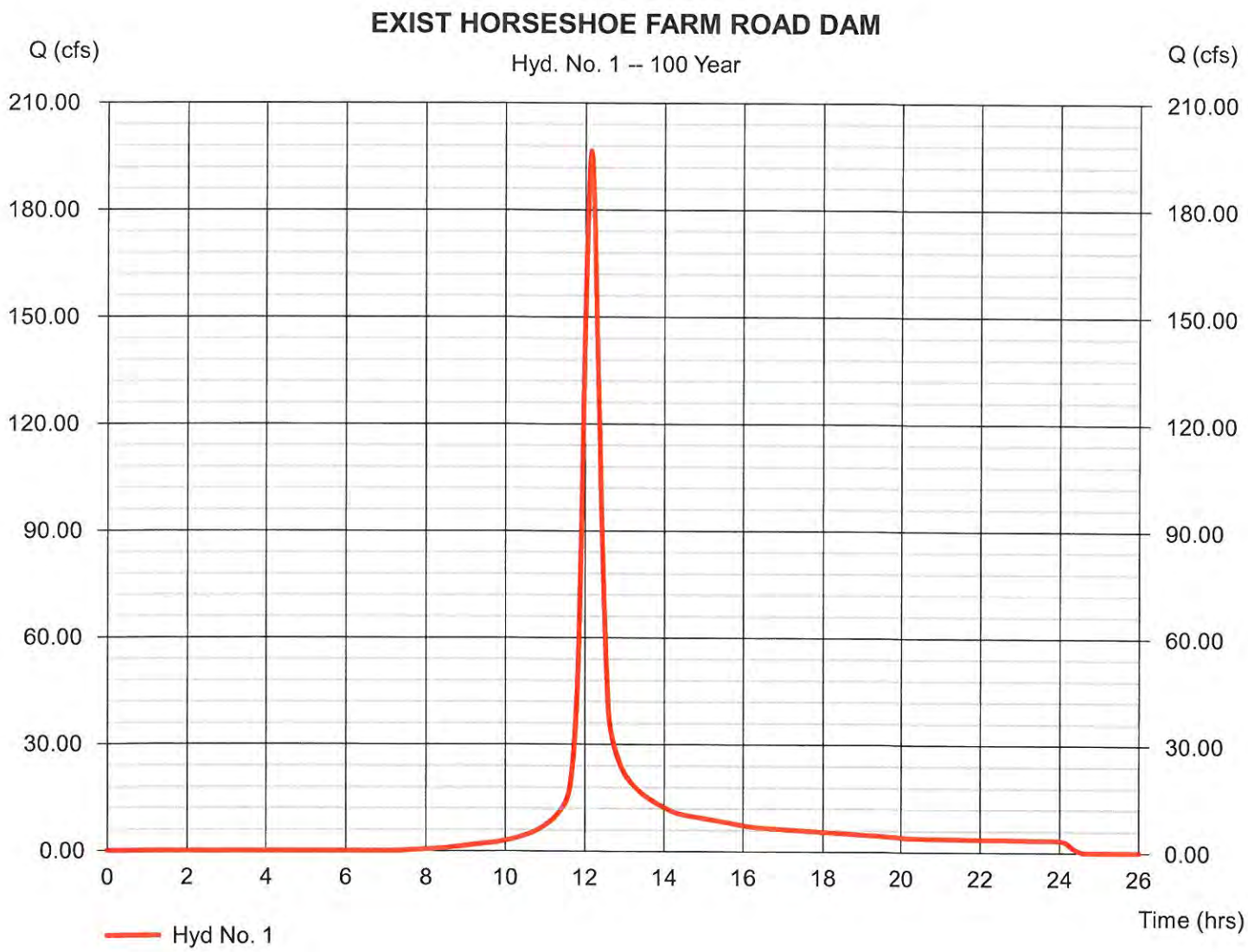
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Wednesday, Apr 13, 2011

Hyd. No. 1

EXIST HORSESHOE FARM ROAD DAM

Hydrograph type	= SCS Runoff	Peak discharge	= 196.60 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 721,306 cuft
Drainage area	= 43.000 ac	Curve number	= 72
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.20 min
Total precip.	= 8.00 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

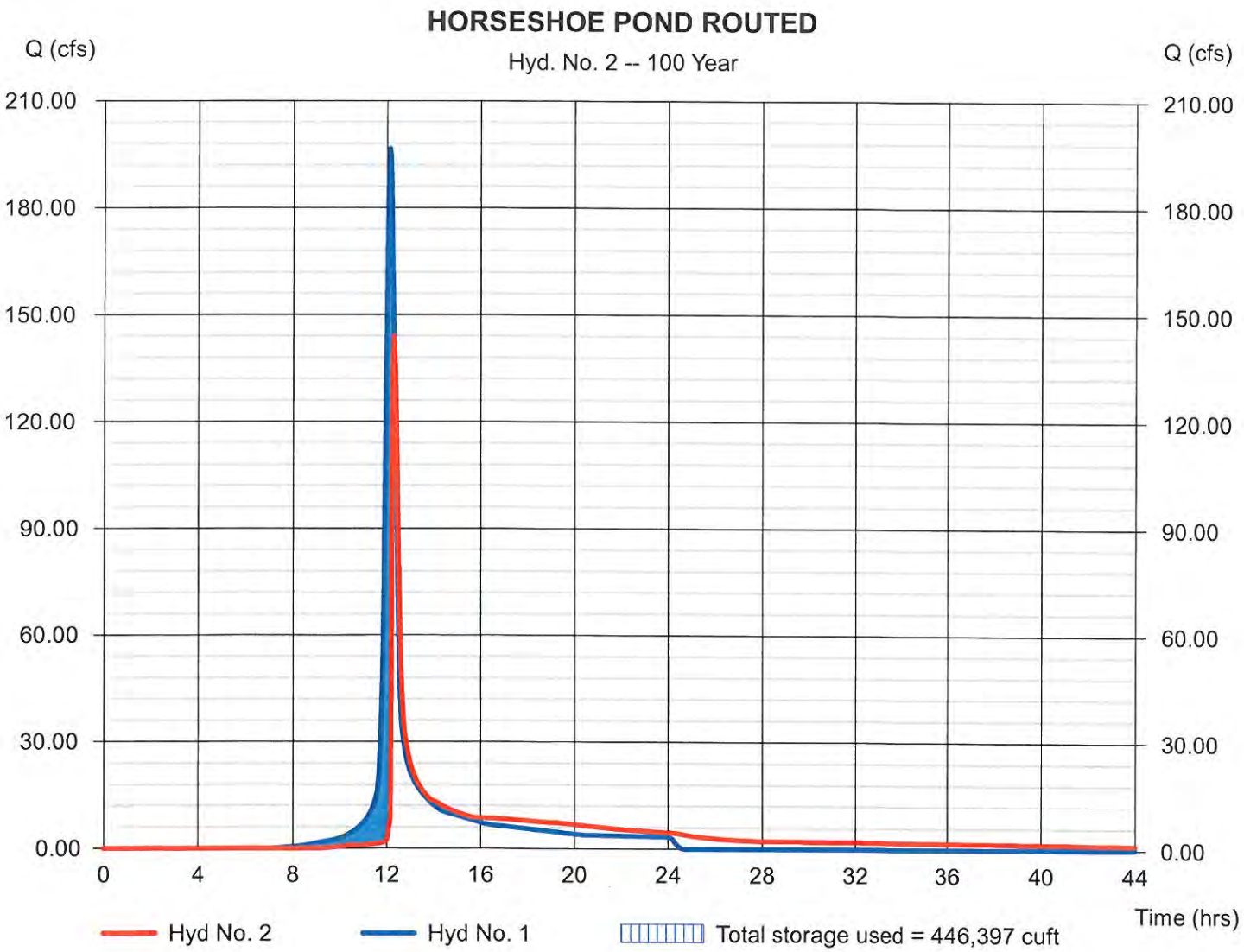


Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Wednesday, Apr 13, 2011

Hyd. No. 2

HORSESHOE POND ROUTED

Hydrograph type	= Reservoir	Peak discharge	= 144.03 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.30 hrs
Time interval	= 2 min	Hyd. volume	= 720,995 cuft
Inflow hyd. No.	= 1 - EXIST HORSESHOE FARM ROAD DAM	Max. Elevation	= 205.42 ft
Reservoir name	= EXISTING HORSE SHOE FARM POND	Max. Storage	= 446,397 cuft

Storage Indication method used. Wet pond routing start elevation = 201.00 ft.