APS Doney Park Renewable Energy Site

Drainage Report Addendum

June 8, 2011

EXPIRES 9/30/11

Prepared by:
EN3 Professionals, LLC
125 E. Elm Ave., Suite 101
Flagstaff, AZ 86001

STATEMENT OF RESPONSIBLE CHARGE

This drainage study addendum for the APS Doney Park Renewable Energy Facility was prepared by me (with vital assistance from Mark Daniels, M.S.), in accordance with the "Drainage Planning Submittal Requirements" of Coconino County and other regulations of the Coconino County Flood Control District. I understand that Coconino County does not, and will not, assume liability for drainage facilities designed by others.

Charles M. Schlinger, P.E.
Arizona Professional Engineer (Civil) No. 30615

In a May 6, 2011, email from Ted Smith to Charlie Schlinger, Ted requested that EN3 Professionals, LLC, address the following items that pertain to the April 22, 2011 *APS Doney Park Renewable Energy Site Drainage Report*:

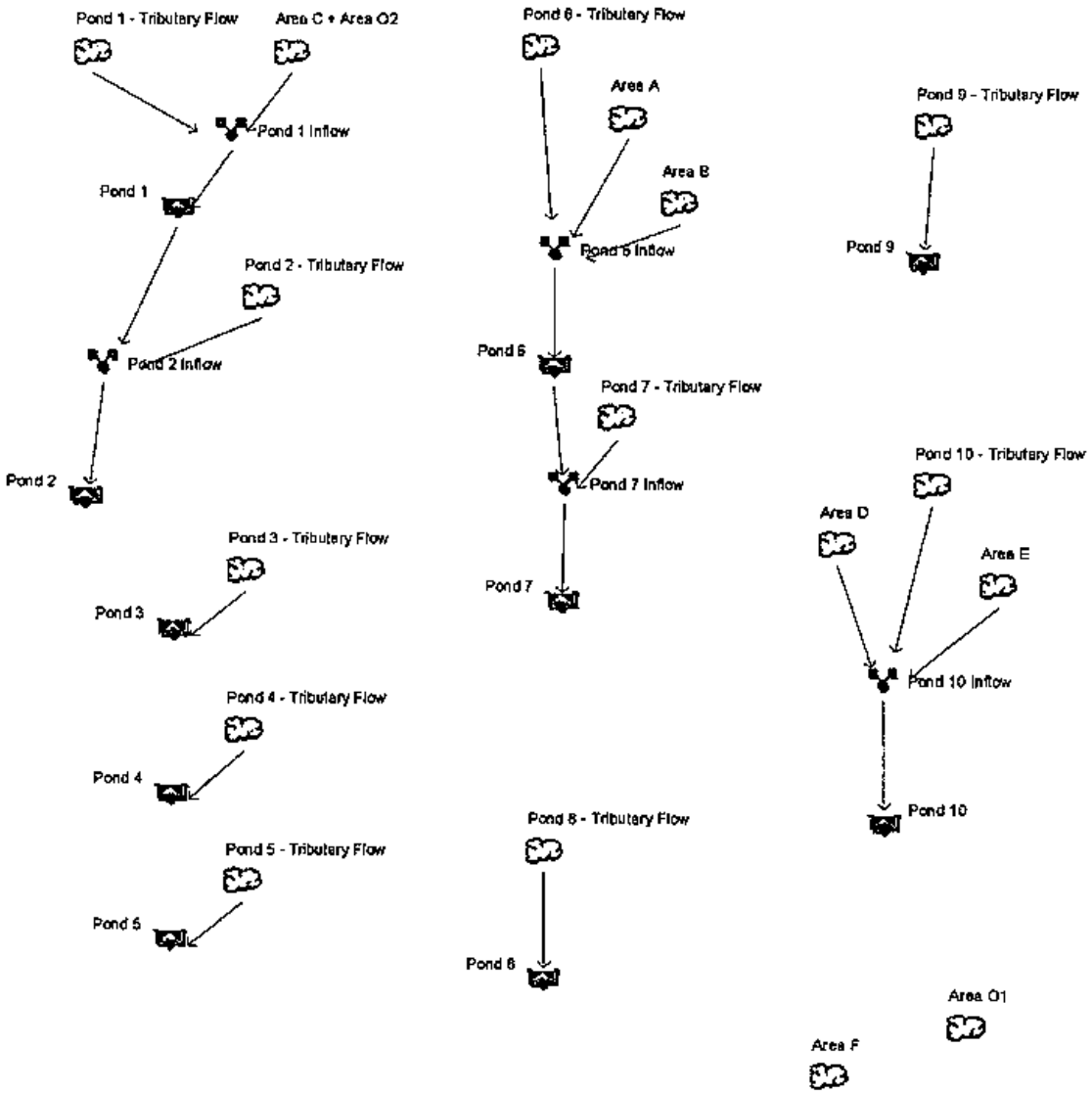
1) The peak weir flows at ponds 1 and 6 for the 100-yr flow condition.
2) Confirmation that the riprapping of the weir bottom and sides will not take away from the flow cross sectional area of the weir and that the riprap will be brushed with concrete or cement to improve the roughness and long-term durability of the weirs.
3) As the on-site infiltration tests weren't run in April, the results of the tests may necessitate some drainage report reanalysis if there is measurably lower infiltration capacity determined from the tests. I would like to receive the results of the infiltration tests as soon as they are available.
4) Please forward a tabular summary of the infiltration losses versus time for those sites where the graphs were truncated at 14 hrs.
5) Please forward water surface elevation versus time graphs for ponds, especially for ponds 1, 2, 6, 7 and 10.
6) Please forward a paragraph of text further clarifying the naming and numbering schemes for the ponds, channels and subareas as shown on the hydrograph report printouts and the schematic for the site.
7) I am requesting that inspections of the berms between the ponds be done on an annual basis rather than every three years and inspection results forwarded to this office.
8) Please forward some narrative on how the curve number values were selected and from what sources.
9) A SWPPP and an NOI will have to be developed prior to any construction work on the site. The SWPPP must be submitted to this office for review and approval and then kept on site along with a copy of the NOI during the construction phase.

In this Addendum, we sequentially address each of the above items.

With respect to Item 3), above, infiltration testing at the site was conducted in May, 2011, and the results of the test are reported and discussed herein.

1) The peak weir flows at ponds 1 and 6 for the 100-yr flow condition.

In addressing this question, we discovered a mistake in the model, and fixed the error, which consisted of no interconnection between Ponds 1 & 2. Please see the following model schematic, which illustrates the correct arrangement and relationships amongst all model elements, including the hydrographs, hydrograph additions, and ponds for Ponds 1 & 2.



With respect to Ponds 1 & 6, the peak weir flows for the 100-yr event are:

0.72 cfs for Pond 1;
2.71 cfs for Pond 6.

Please see the following hydrograph summary report for the 100-yr storm, and the pond hydrographs (inflow, outflow and exfiltration together on one graph) for Ponds 1 & 6 for the 100-yr event. The report and hydrographs provide tabular and graphical program output that serve as the basis for the above statement regarding peak weir flows.

Note that the hydrograph numbers (left-most column in the summary report, below) are used only for internal tracking by the software. Generally, the hydrograph numbers do not correspond to pond number or hydrograph descriptions (given in the preceding illustration and in the right-most column of the summary report).

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	3.065	1	715	6,857	---	---	---	Pond 6 - Tributary Flow
2	SCS Runoff	3.860	1	716	7,486	---	---	---	Area A
3	SCS Runoff	7.050	1	715	12,768	---	---	---	Area B
4	Combine	13.87	1	716	27,111	1, 2, 3	---	---	Pond 6 Inflow
5	Reservoir	2.706	1	722	6,938	4	6725.12	11,868	Pond 6
6	SCS Runoff	3.065	1	715	6,857	---	---	---	Pond 7 - Tributary Flow
7	SCS Runoff	0.560	1	715	1,015	---	---	---	Area E
8	Combine	3.803	1	718	13,795	5, 6,	---	---	Pond 7 Inflow
9	Reservoir	0.000	1	717	0	8	6723.59	8,163	Pond 7
10	SCS Runoff	3.065	1	715	6,857	---	---	---	Pond 8 - Tributary Flow
11	Reservoir	0.000	1	724	0	10	6722.19	2,883	Pond 8
12	SCS Runoff	3.065	1	715	6,857	---	---	---	Pond 9 - Tributary Flow
13	Reservoir	0.000	1	724	0	12	6720.39	2,883	Pond 9
14	SCS Runoff	2.820	1	715	6,309	---	---	---	Pond 10 - Tributary Flow
15	SCS Runoff	4.622	1	715	8,371	---	---	---	Area C + Area O2
16	SCS Runoff	1.226	1	715	2,743	---	---	---	Pond 1 - Tributary Flow
17	Combine	5.848	1	715	11,114	15, 16	---	---	Pond 1 Inflow
18	Reservoir	0.720	1	723	2,091	17	6731.43	4,976	Pond 1
19	SCS Runoff	1.226	1	715	2,743	---	---	---	Pond 2 - Tributary Flow
20	Combine	1.242	1	716	4,834	18, 19	---	---	Pond 2 Inflow
21	Reservoir	0.000	1	715	0	20	6729.98	2,705	Pond 2
22	SCS Runoff	1.226	1	715	2,743	---	---	---	Pond 3 - Tributary Flow
23	SCS Runoff	1.226	1	715	2,743	---	---	---	Pond 4 - Tributary Flow
24	SCS Runoff	1.226	1	715	2,743	---	---	---	Pond 5 - Tributary Flow
25	Reservoir	0.000	1	715	0	22	6728.28	1,150	Pond 3
26	Reservoir	0.000	1	715	0	23	6726.88	1,150	Pond 4
27	Reservoir	0.000	1	715	0	24	6725.78	1,150	Pond 5
28	SCS Runoff	3.175	1	715	5,750	---	---	---	Area D
29	Combine	6.555	1	715	13,073	7, 14, 28	---	---	Pond 10 Inflow
30	Reservoir	0.000	1	736	0	29	6718.94	6,558	Pond 10
31	SCS Runoff	2.614	1	715	4,735	---	---	---	Area F
32	SCS Runoff	1.621	1	715	3,298	---	---	---	Area O1

DP Retention Analysis - May 24 2011.gpw	Return Period: 100 Year	Wednesday, May 25, 2011

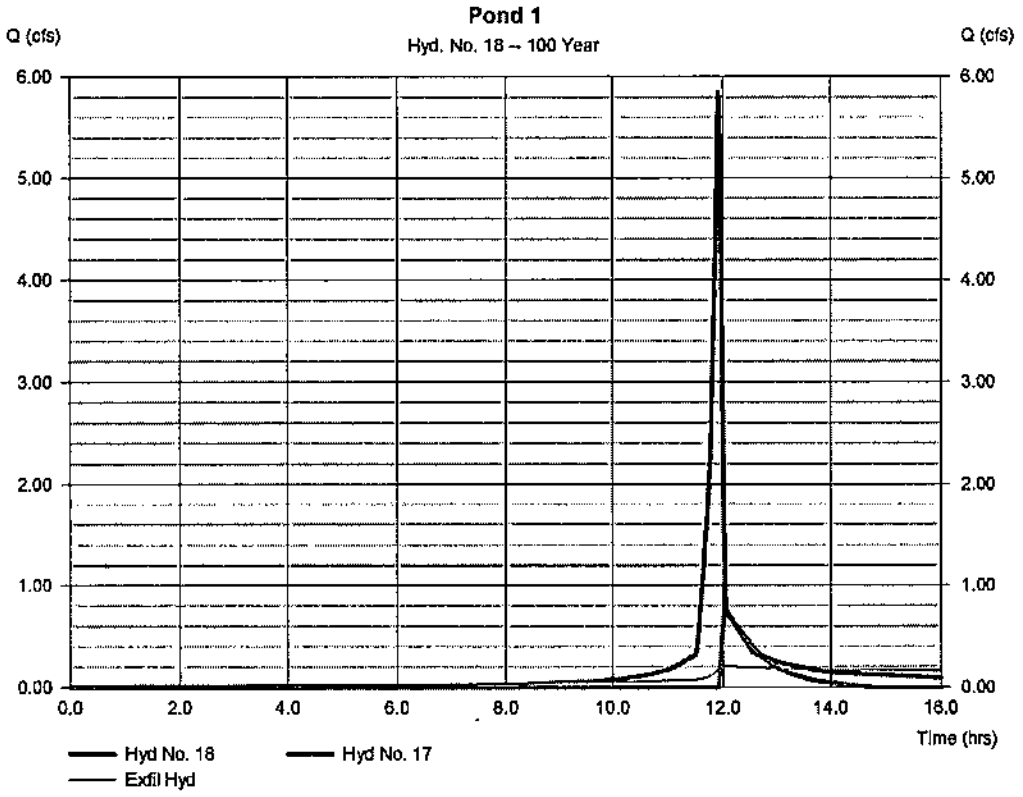
Hydrograph Report

Hyd. No. 18

Pond 1

Hydrograph type	= Reservoir	Peak discharge	= 0.720 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.05 hrs
Time interval	= 1 min	Hyd. volume	= 2,091 cuft
Inflow hyd. No.	= 17 - Pond 1 Inflow	Max. Elevation	= 6731.43 ft
Reservoir name	= Pond 1	Max. Storage	= 4,976 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



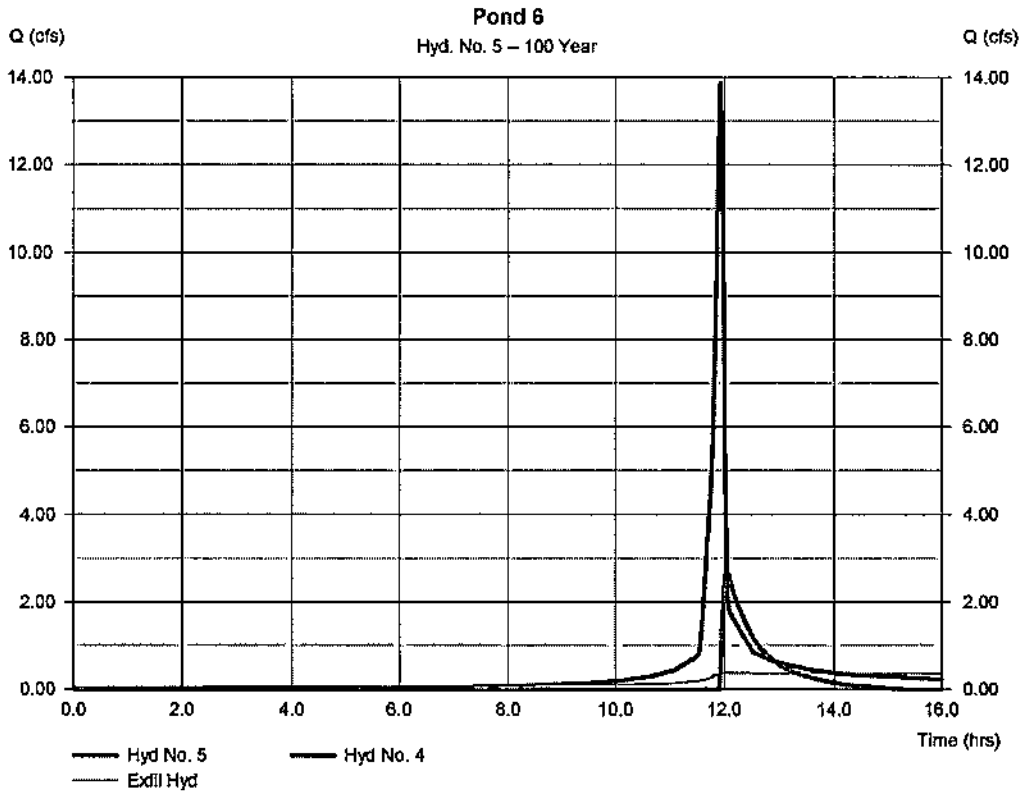
Hydrograph Report

Hyd. No. 5

Pond 6

Hydrograph type	= Reservoir	Peak discharge	= 2.706 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.03 hrs
Time interval	= 1 min	Hyd. volume	= 6,938 cuft
Inflow hyd. No.	= 4 - Pond 6 Inflow	Max. Elevation	= 6725.12 ft
Reservoir name	= Pond 6	Max. Storage	= 11,868 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



2) **Confirmation that the riprapping of the weir bottom and sides will not take away from the flow cross sectional area of the weir and that the riprap will be brushed with concrete or cement to improve the roughness and long-term durability of the weirs.**

Riprap will be grouted and small-diameter rock or cobbles will be used.

assume area for rock riprap is accounted for by extra excavating the sides and bottom for this amount

3) **As the on-site infiltration tests weren't run in April, the results of the tests may necessitate some drainage report reanalysis if there is measurably lower infiltration capacity determined from the tests. I would like to receive the results of the infiltration tests as soon as they are available.**

On-site infiltration testing was recently completed and the May 19, 2011, Alpha Geotechnical & Materials, Inc. report follows.

The main outcome of the testing is that on-the-ground infiltration rate is 1 in/hr, which is less than the value of 3 in/hr that was used for the April 22, 2011, drainage study. Therefore, in preparing this addendum, we revised our simulation using the value of 1 in/hr.

Alpha
Geotechnical & Materials, Inc.

May 19, 2011
Alpha Project #11-G-1983

RITOCH-POWELL & Associates
3838 N. Central Ave, Suite 1250
Phoenix, AZ 85012

Attention: Mr. Ryan Nichols, P.E.

Re: **Double Ring Infiltration Testing**
Doney Park Renewable Energy Site
Flagstaff, Arizona

In accordance with your request and authorization, Alpha Geotechnical & Materials, Inc. (Alpha) performed double ring infiltration testing at the Doney Park Renewable Energy site located near Flagstaff, Arizona. The purpose of this letter is to provide a summary of our field investigation and present the results of our field tests. The scope of service presented within this letter is in general accordance with our proposal 11-G-1983 dated February 17, 2011.

Project Understanding

The project is a 10-acre parcel located east of State Route 89 and north of Swede Lane in the Doney Park Community of Flagstaff, Arizona. The site development will include a substation located near the northwestern portion of the site and a Renewable Energy site will encompass the remaining 8 acres. It is understood that surface retention basins will be constructed within the Renewable Energy portion of the site by building small perimeter berms. Double Ring Testing of the surface soils is required to develop information relative to the infiltration rate of the surface soils.

Field Testing

Alpha visited the subject site on May 18, 2011 and performed two surface double ring infiltration tests. The double ring infiltration tests were performed in general accordance with the American Society for Testing and Materials (ASTM) D 3385 test method. The purpose of this test was to develop information relative to the site surface soil infiltration rate. The infiltrometer test was performed at the locations identified on the attached sample location plan. The results of the infiltration tests are tabulated below.

Test Location	Infiltration Rate (in/hr)
DR-1	1.07
DR-2	1.23

2504 W. Southern Avenue | Tempe, Arizona 85282 | O 602.453.3265 | F 602.453.3267

We appreciate the opportunity of providing our services for this project. If you have questions regarding this report or if we may be of further assistance, please contact the undersigned.

Sincerely,

ALPHA GEOTECHNICAL & MATERIALS, INC.

Expires 9/30/2011

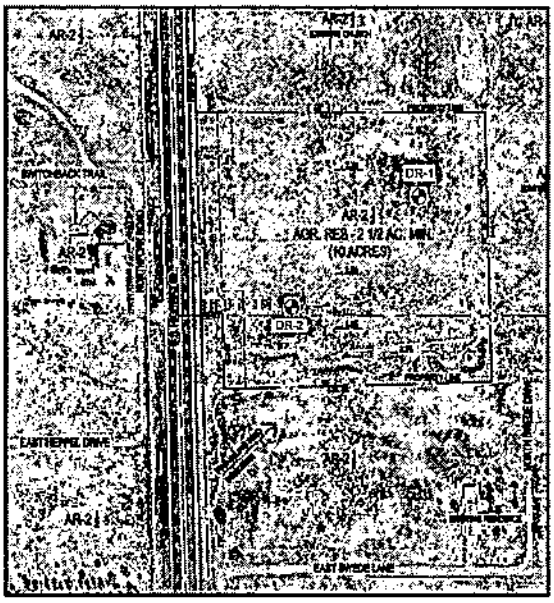
James P Floyd, P.E.
Project Manager

Expires 12/31/2013

James E Weaver, P.E.
President

Attached – Site Plan
Results of the Double Ring Infiltration Tests

Alpha
Engineering | Testing | Solutions



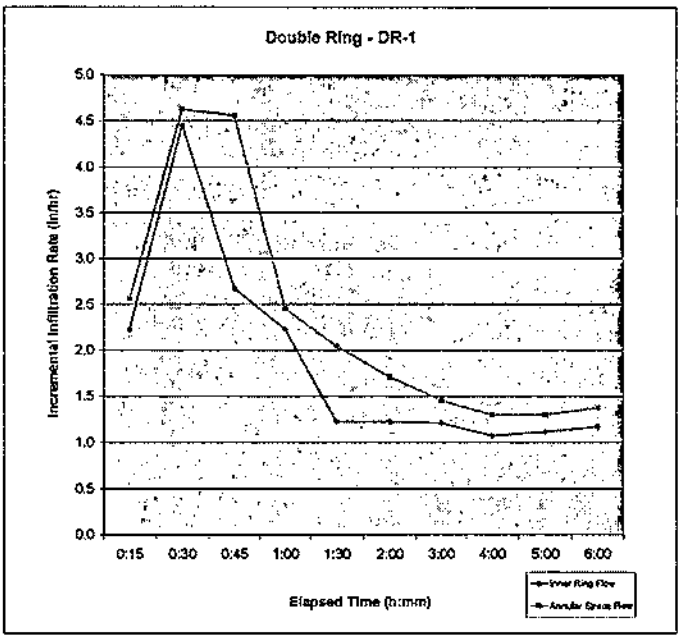
N
(NOT TO SCALE)

LEGEND
Double Ring Test Location

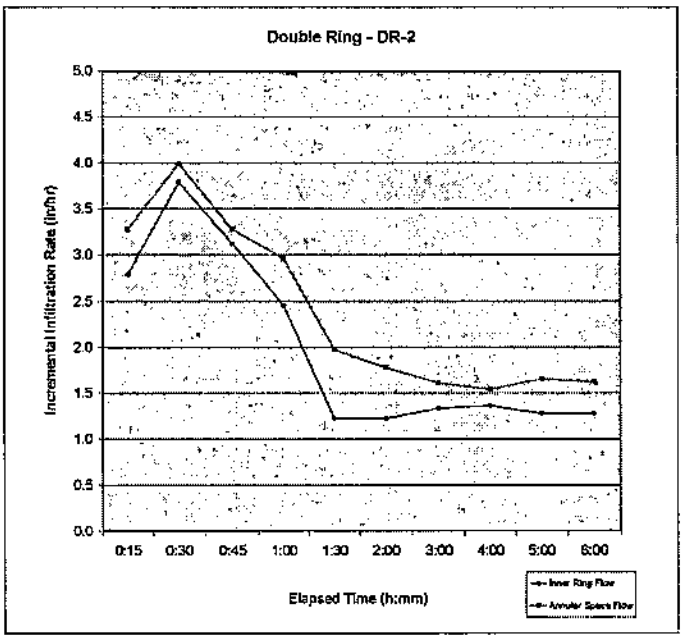
ALPHA
Geotechnical and Materials, Inc.
2504 W. Southern Avenue
Tempe, AZ 85282

Double Ring Location Plan

Project: Doney Park Renewable Energy-Infiltration Testing, 11-G-1963
Location: Flagstaff, Arizona
Date: 05/19/11 | Drawn By: J Floyd



Start Time	Finish Time	Elapsed Time			Inner Ring			Outer Ring			Flow Rate (cm/hr)		Flow Rate (in/hr)	
		Cum hours	Delta T	Incr. Duration	T	Initial Reading	Final Reading	Initial Reading	Final Reading		Inner Ring Flow	Annular Space Flow	Inner Ring Flow	Annular Space Flow
10:05:00 AM	10:20:00 AM	0:15	0:15	0:15	0:15	0	1000	0	3400		9.84	9.81	3.73	3.86
10:20:00 AM	10:35:00 AM	0:15	0:15	0:30	0:30	1000	5000	3400	10100		11.76	11.78	4.46	4.63
10:35:00 AM	10:50:00 AM	0:15	0:15	0:45	0:45	5000	6200	10100	13500		4.78	11.87	2.01	4.56
10:50:00 AM	11:05:00 AM	0:15	0:15	1:00	1:00	6200	7400	13500	16950		3.94	9.24	2.25	3.49
11:05:00 AM	11:35:00 AM	0:30	0:30	1:30	1:30	7400	8900	16950	25700		3.55	8.30	1.35	2.05
11:35:00 AM	12:05:00 PM	0:30	0:30	2:00	2:00	8900	7400	25700	30500		3.11	4.24	1.23	1.72
12:05:00 PM	1:05:00 PM	1:00	1:00	3:00	3:00	7400	9300	30500	34150		3.04	3.84	1.24	1.43
1:05:00 PM	2:05:00 PM	1:00	1:00	4:00	4:00	9675	11000	34950	43950		2.72	3.30	1.03	1.30
2:05:00 PM	3:05:00 PM	1:00	1:00	5:00	5:00	11000	12500	43950	52750		2.85	3.30	1.13	1.32
3:05:00 PM	4:05:00 PM	1:00	1:00	6:00	6:00	12500	13950	52750	60900		2.87	3.48	1.17	1.38



Start Time	Finish Time	Duration	Delta T	Incr. Duration	T	Inner Ring		Outer Ring		Flow Rate (cm/hr)		Flow Rate (in/hr)	
						Initial Reading	Final Reading	Initial Reading	Final Reading	Inner Ring Flow	Annular Space Flow	Inner Ring Flow	Annular Space Flow
7:42:00 AM	7:57:00 AM	0:15	0:15	0:15	0:15	0	1250	0	4800	7.07	9.32	2.78	3.67
7:57:00 AM	8:17:00 AM	0:15	0:20	0:30	0:30	1250	2950	4800	10000	9.62	10.13	3.79	3.99
8:12:00 AM	8:27:00 AM	0:15	0:25	0:45	0:45	2950	4350	10000	14800	7.92	9.34	3.12	3.68
8:27:00 AM	8:42:00 AM	0:15	0:15	1:00	1:00	4750	5450	14800	18650	8.22	7.55	3.45	2.95
8:42:00 AM	9:12:00 AM	0:30	0:30	1:30	1:30	5450	8650	18650	24500	3.11	5.02	1.23	1.98
8:57:00 AM	9:42:00 AM	0:30	0:30	2:00	2:00	6550	7450	21500	28500	3.11	4.52	1.23	1.78
9:42:00 AM	10:42:00 AM	1:00	1:00	3:00	3:00	7450	10000	28500	38560	3.40	4.04	1.34	1.61
10:42:00 AM	11:42:00 AM	1:00	1:00	4:00	4:00	10000	12500	38560	47200	3.47	3.91	1.36	1.54
11:42:00 AM	12:42:00 PM	1:00	1:00	5:00	5:00	12500	14850	47200	55500	3.25	3.20	1.28	1.26
12:42:00 PM	1:42:00 PM	1:00	1:00	6:00	6:00	14850	17100	55500	63650	3.25	3.11	1.28	1.22

4) Please forward a tabular summary of the infiltration losses versus time for those sites where the graphs were truncated at 14 hrs.

Regrettably, due to a software flaw, whenever a pond has an outflow hydrograph, the display of exfiltration (infiltration) is truncated as soon as the outflow drops to zero, in this case at a time of around 16 hours, for Ponds 1 & 6. However, a worst case scenario is available by disabling the weir outflow for those ponds, which creates a somewhat greater water depth in the pond, but does obtain an acceptable idea as to how exfiltration (infiltration) varies over a 24-hr time period. Please see the following hydrographs (inflow + exfiltration versus time) in addition to graphs of elevation versus time for Ponds 1 & 6 for the condition when no weir is present.

Hydrograph Report

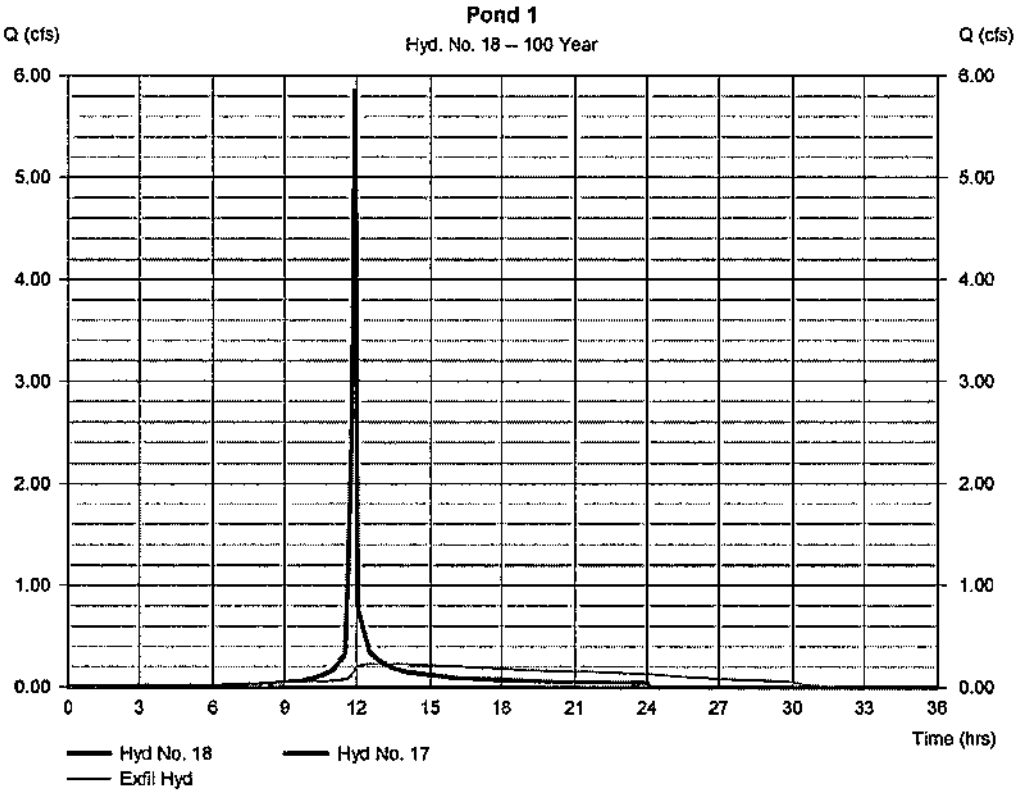
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Wednesday, May 25, 2011

Hyd. No. 18

Pond 1

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.03 hrs
Time interval	= 1 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 17 - Pond 1 Inflow	Max. Elevation	= 6731.53 ft
Reservoir name	= Pond 1	Max. Storage	= 5,869 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

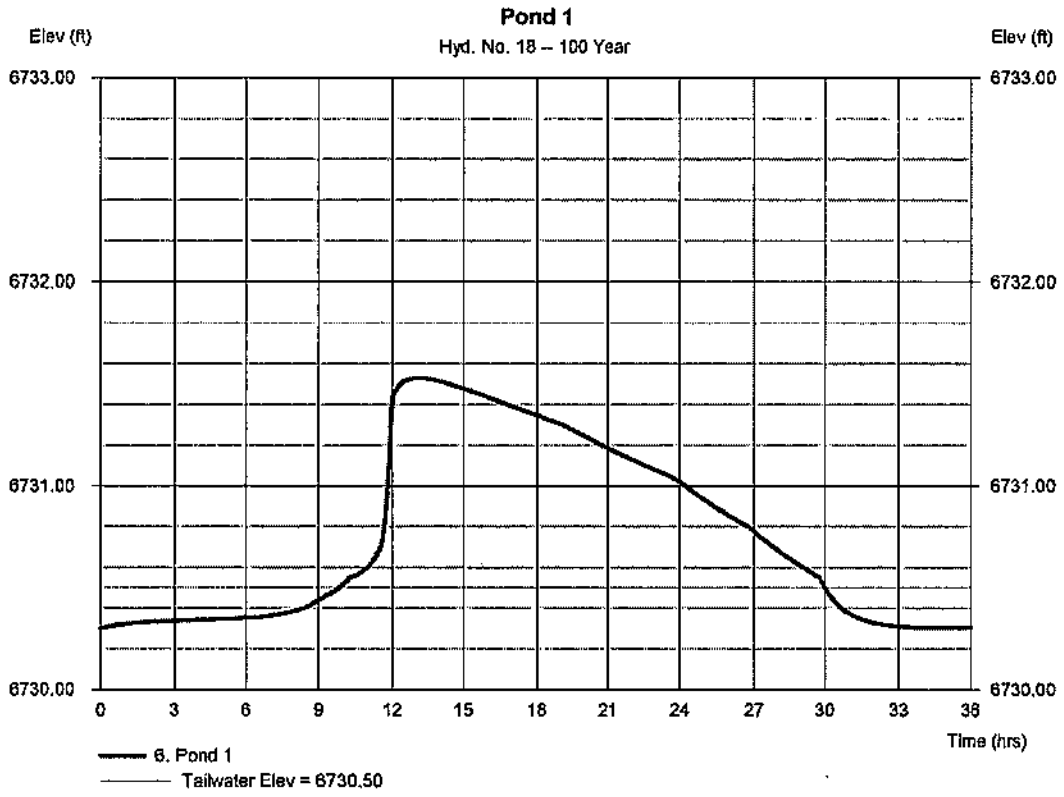
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Wednesday, May 25, 2011

Hyd. No. 18

Pond 1

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.03 hrs
Time interval	= 1 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 17 - Pond 1 Inflow	Max. Elevation	= 6731.53 ft
Reservoir name	= Pond 1	Max. Storage	= 5,869 cuft

Storage indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

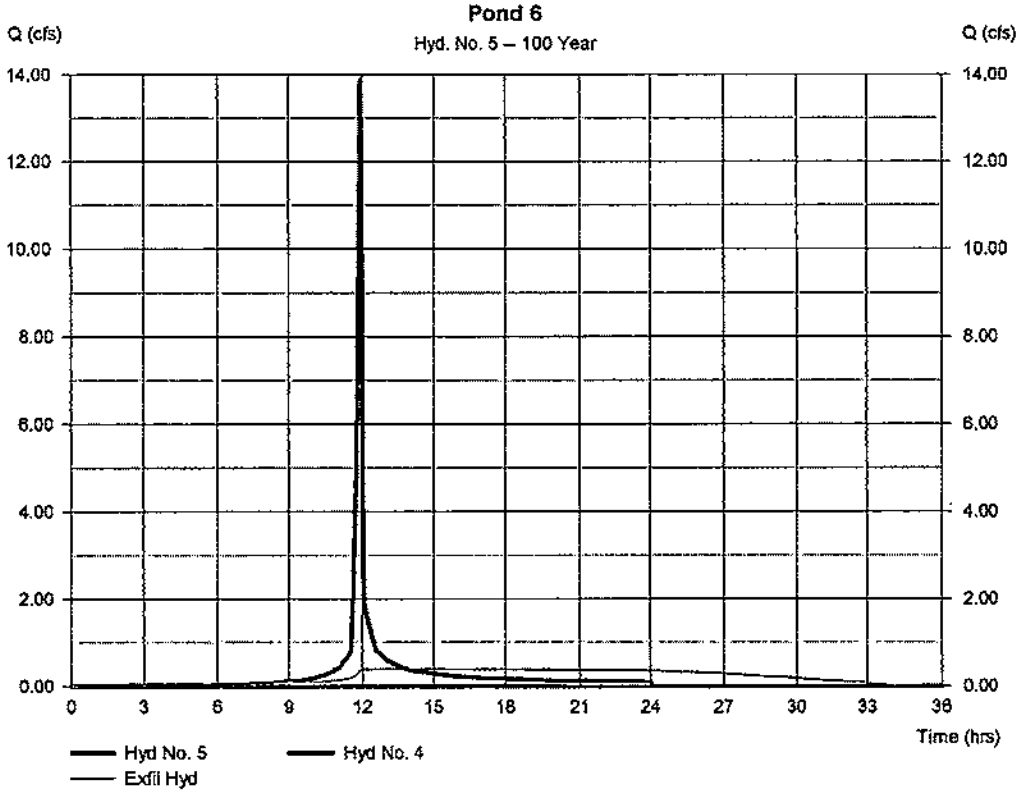
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Wednesday, May 25, 2011

Hyd. No. 5

Pond 6

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.63 hrs
Time interval	= 1 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 4 - Pond 6 Inflow	Max. Elevation	= 6725.32 ft
Reservoir name	= Pond 6	Max. Storage	= 15,244 cuft

Storage indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

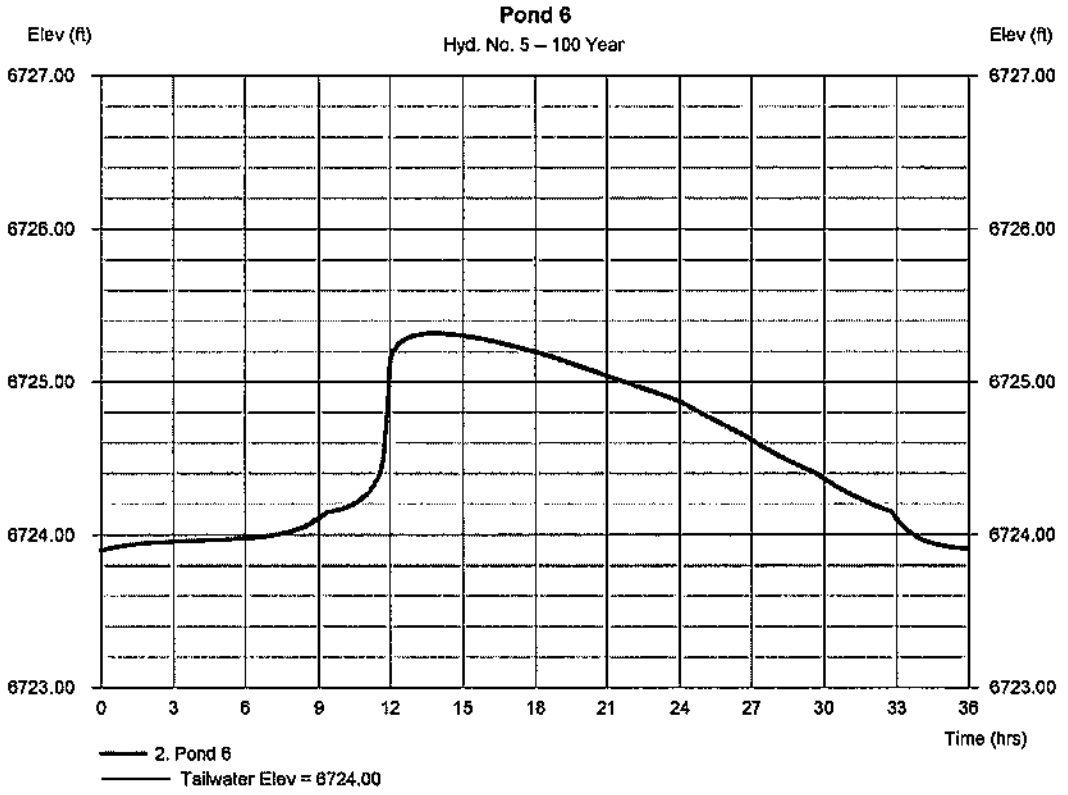
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Wednesday, May 25, 2011

Hyd. No. 5

Pond 6

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.63 hrs
Time interval	= 1 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 4 - Pond 6 Inflow	Max. Elevation	= 6725.32 ft
Reservoir name	= Pond 6	Max. Storage	= 15,244 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



5) Please forward water surface elevation versus time graphs for ponds, especially for ponds 1, 2, 6, 7 and 10.

Graphs of water surface elevation versus time for all ponds 1-10 follow. As discussed above, due to a software flaw, the graphs for ponds 1 & 6 are truncated, as these ponds overflow.

Hydrograph Report

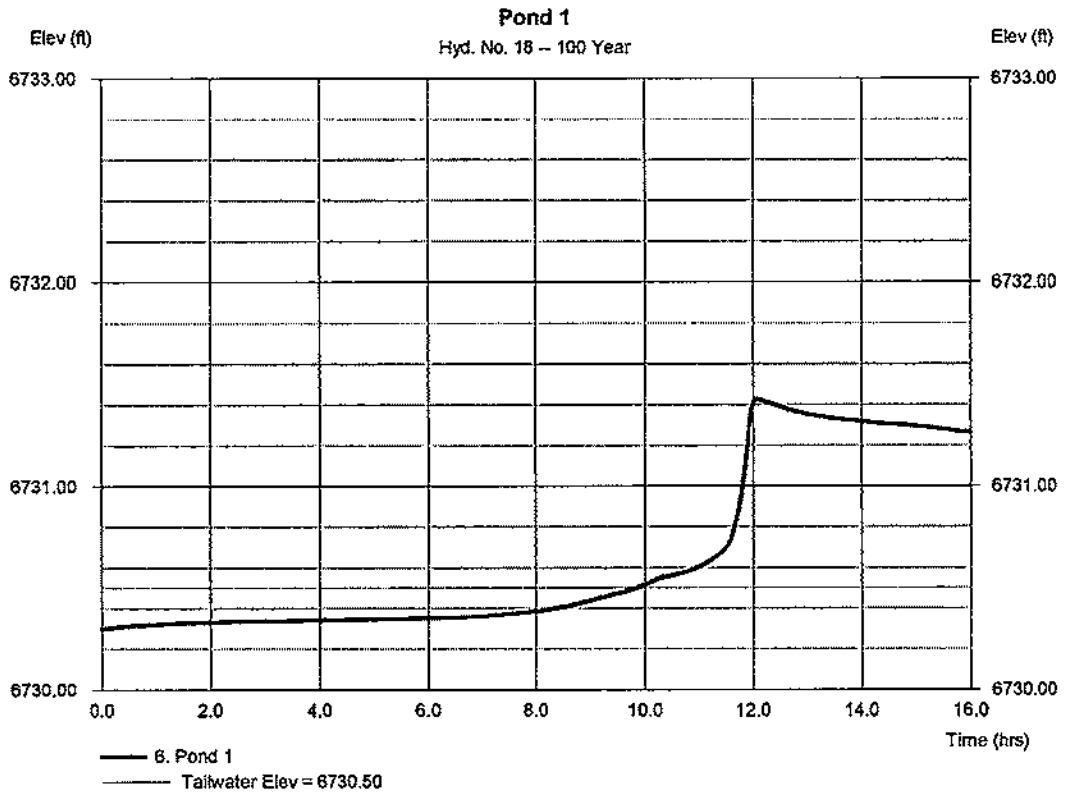
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc, v8 — Wednesday, May 25, 2011

Hyd. No. 18

Pond 1

Hydrograph type	= Reservoir	Peak discharge	= 0.720 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.05 hrs
Time interval	= 1 min	Hyd. volume	= 2,091 cuft
Inflow hyd. No.	= 17 - Pond 1 Inflow	Max. Elevation	= 6731.43 ft
Reservoir name	= Pond 1	Max. Storage	= 4,976 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

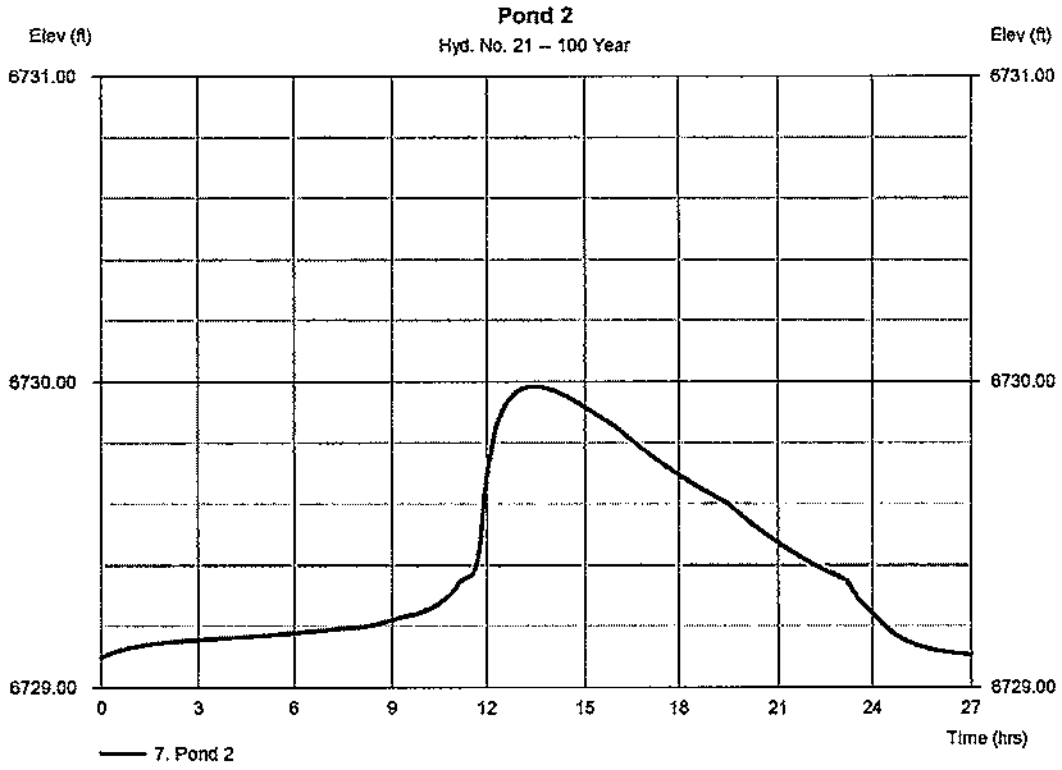
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Wednesday, May 25, 2011

Hyd. No. 21

Pond 2

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.92 hrs
Time interval	= 1 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 20 - Pond 2 Inflow	Max. Elevation	= 6729.98 ft
Reservoir name	= Pond 2	Max. Storage	= 2,705 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

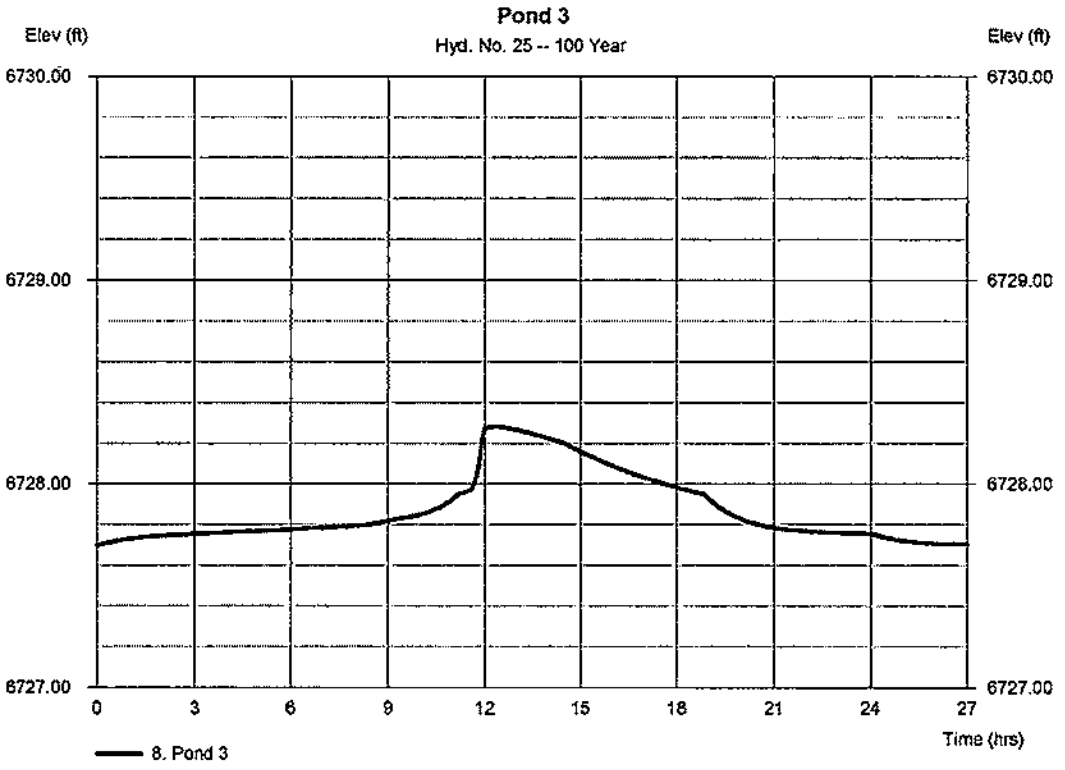
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Wednesday, May 25, 2011

Hyd. No. 25

Pond 3

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.92 hrs
Time interval	= 1 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 22 - Pond 3 - Tributary Flow	Max. Elevation	= 6728.28 ft
Reservoir name	= Pond 3	Max. Storage	= 1,150 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

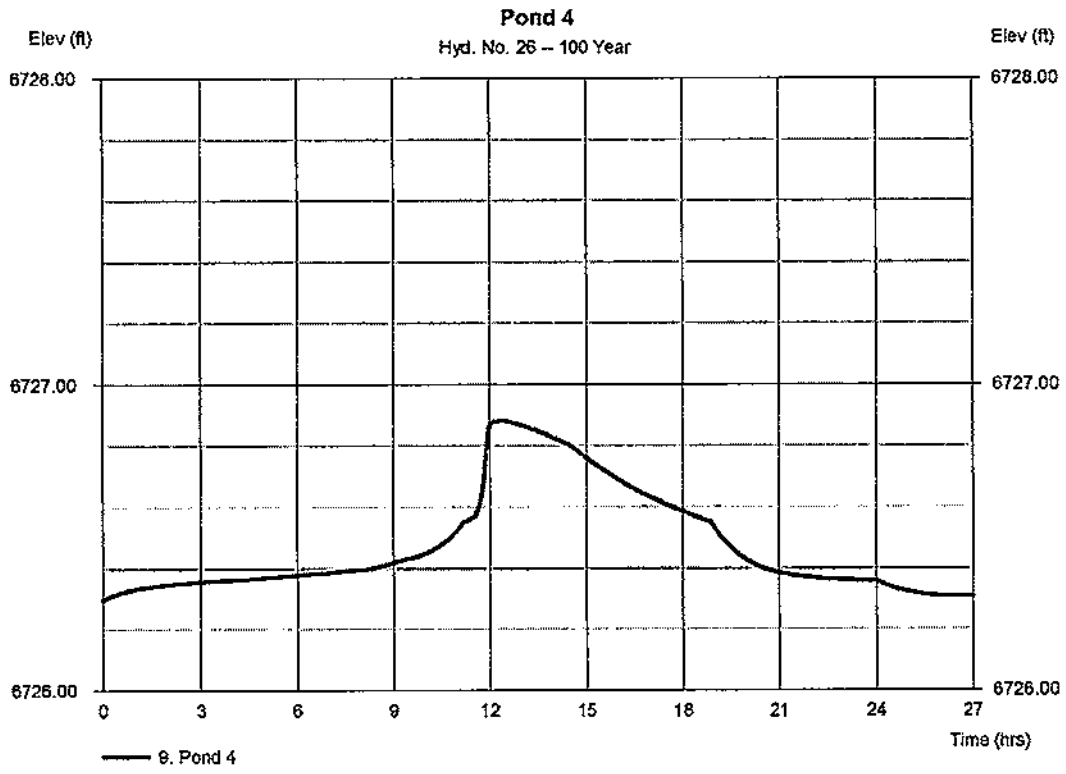
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Wednesday, May 25, 2011

Hyd. No. 26

Pond 4

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.92 hrs
Time interval	= 1 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 23 - Pond 4 - Tributary Flow	Max. Elevation	= 6726.88 ft
Reservoir name	= Pond 4	Max. Storage	= 1,150 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

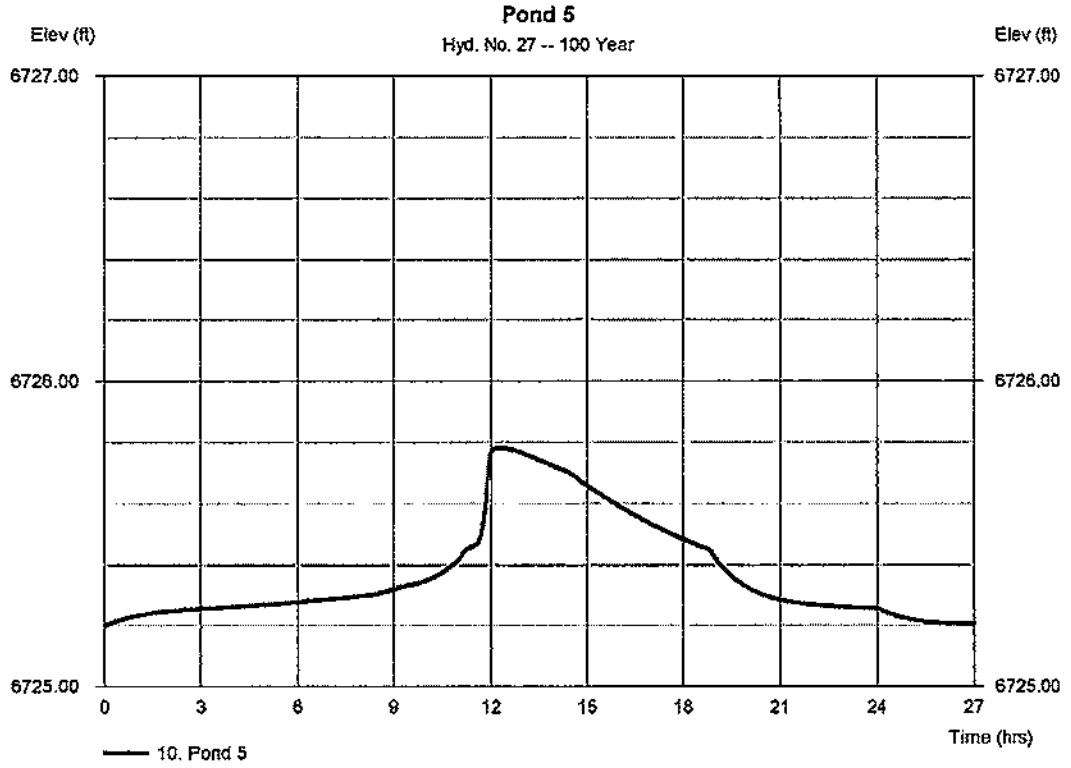
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Wednesday, May 25, 2011

Hyd. No. 27

Pond 5

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.92 hrs
Time interval	= 1 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 24 - Pond 5 - Tributary Flow	Max. Elevation	= 6725.78 ft
Reservoir name	= Pond 5	Max. Storage	= 1,150 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

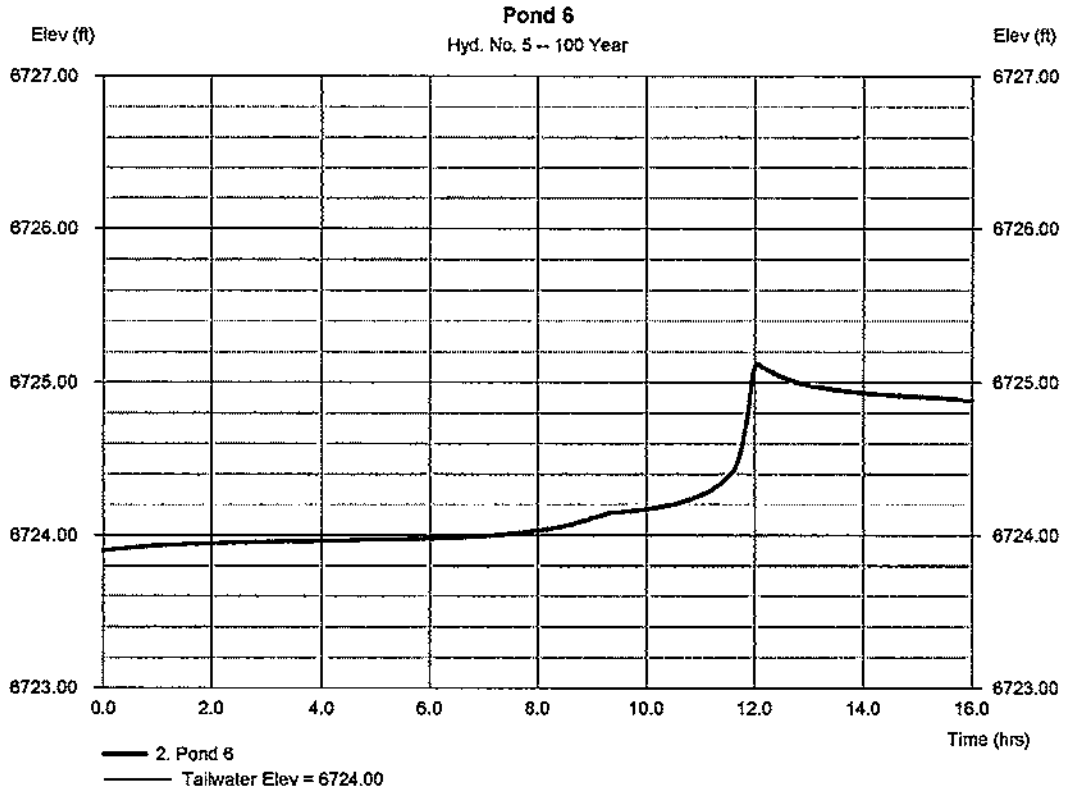
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Wednesday, May 25, 2011

Hyd. No. 5

Pond 6

Hydrograph type	= Reservoir	Peak discharge	= 2.706 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.03 hrs
Time interval	= 1 min	Hyd. volume	= 6,938 cuft
Inflow hyd. No.	= 4 - Pond 6 Inflow	Max. Elevation	= 6725.12 ft
Reservoir name	= Pond 6	Max. Storage	= 11,868 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

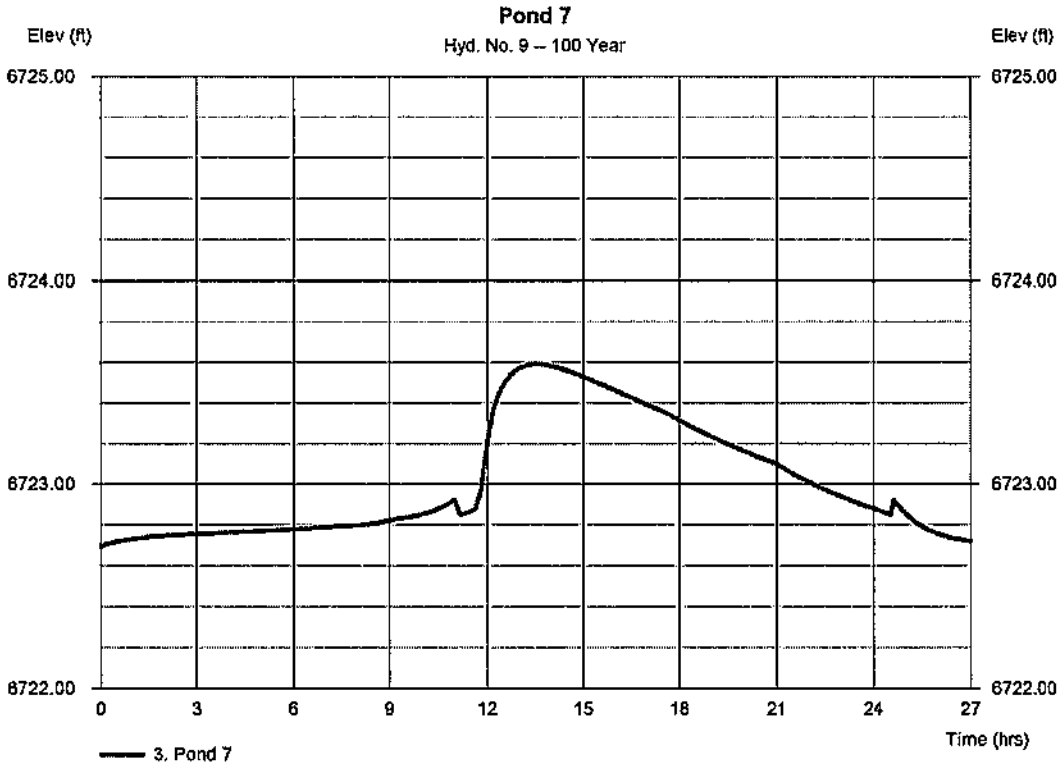
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc, v8 — Wednesday, May 25, 2011

Hyd. No. 9

Pond 7

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.95 hrs
Time interval	= 1 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 8 - Pond 7 Inflow	Max. Elevation	= 6723.59 ft
Reservoir name	= Pond 7	Max. Storage	= 8,163 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

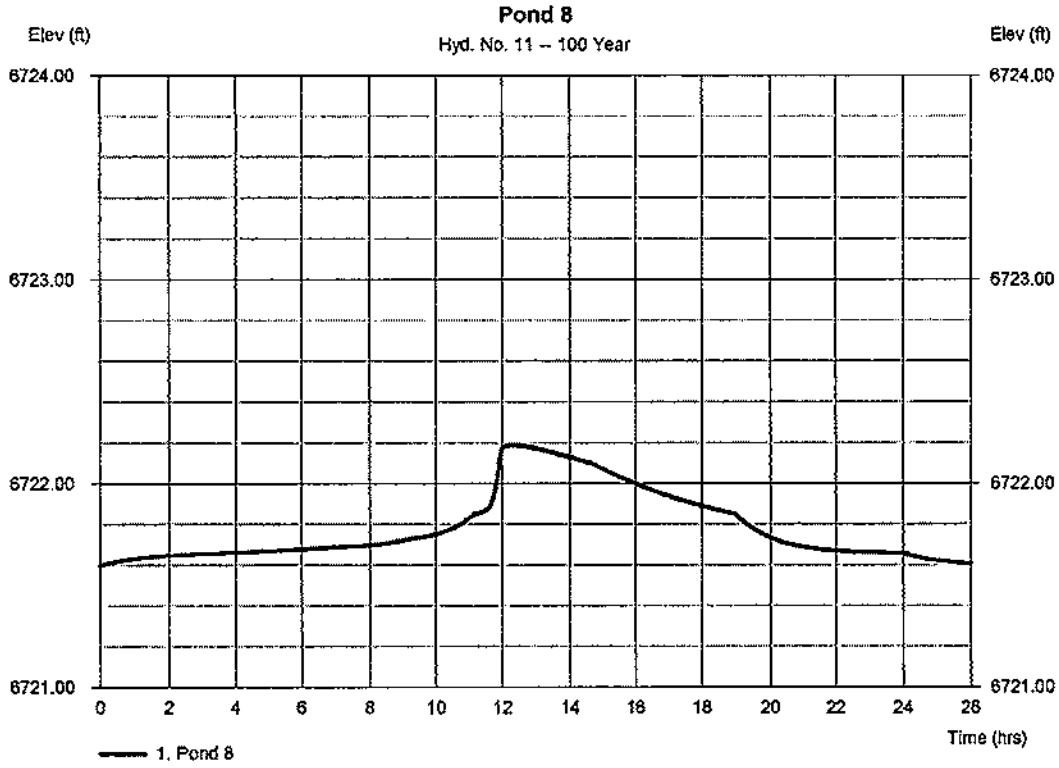
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Wednesday, May 25, 2011

Hyd. No. 11

Pond 8

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 1 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 10 - Pond 8 - Tributary Flow	Max. Elevation	= 6722.19 ft
Reservoir name	= Pond 8	Max. Storage	= 2,883 cuft

Storage indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

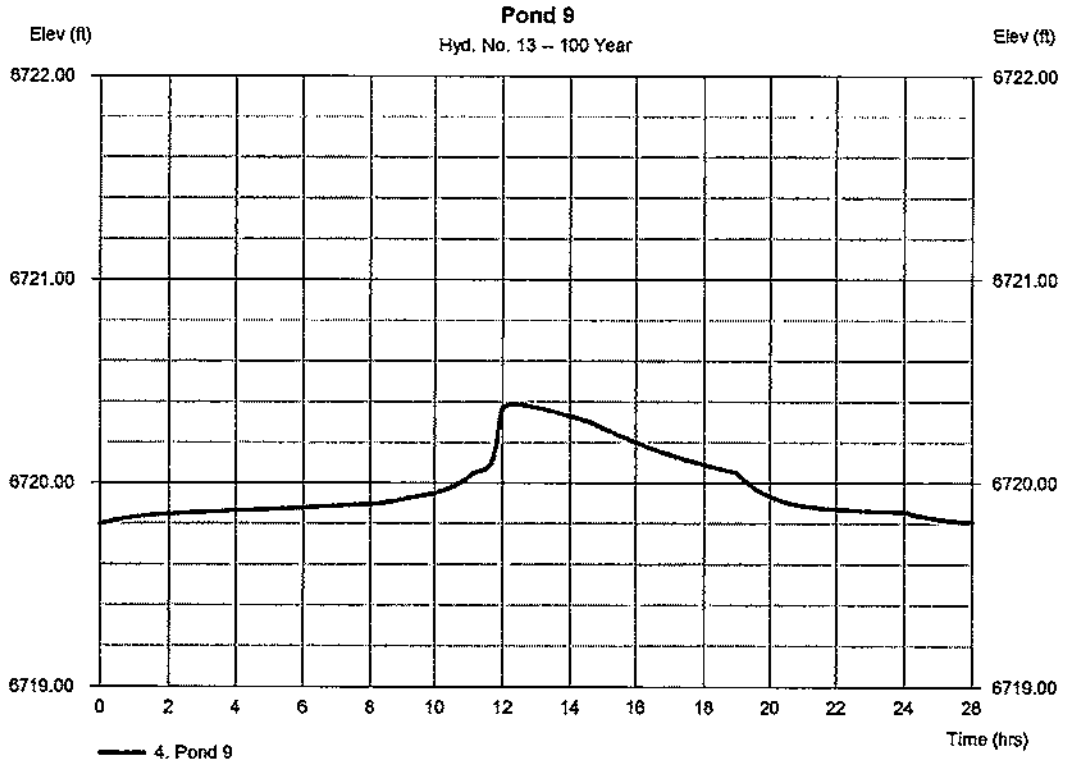
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Wednesday, May 25, 2011

Hyd. No. 13

Pond 9

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 1 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 12 - Pond 9 - Tributary Flow	Max. Elevation	= 6720.39 ft
Reservoir name	= Pond 9	Max. Storage	= 2,883 cuft

Storage indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

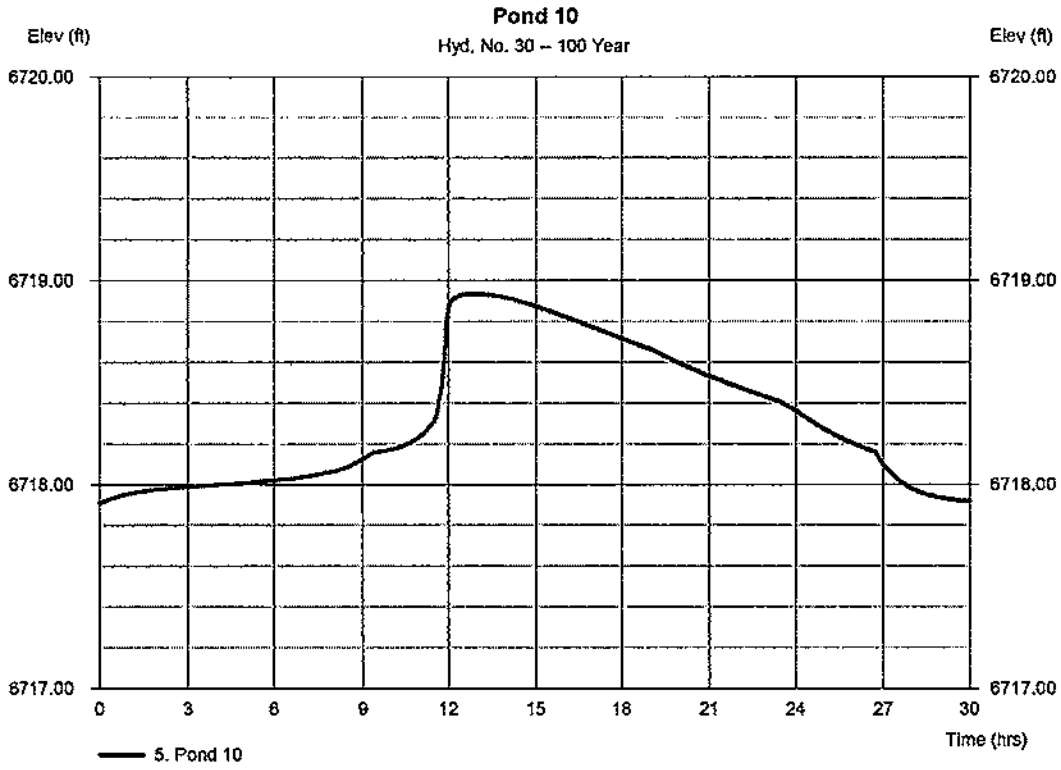
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Wednesday, May 25, 2011

Hyd. No. 30

Pond 10

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.27 hrs
Time interval	= 1 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 29 - Pond 10 Inflow	Max. Elevation	= 6718.94 ft
Reservoir name	= Pond 10	Max. Storage	= 6,558 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



6) **Please forward a paragraph of text further clarifying the naming and numbering schemes for the ponds, channels and subareas as shown on the hydrograph report printouts and the schematic for the site.**

Please see item 1, above.

7) I am requesting that inspections of the berms between the ponds be done on an annual basis rather than every three years and inspection results forwarded to this office.

APS will have a department for handling O&M for all of its solar facilities, including this one. APS will annually observe the berms for breaching or other degradation due to runoff, vehicular traffic, etc., and will forward inspection results to the Coconino County Stormwater Coordinator.

8) Please forward some narrative on how the curve number values were selected and from what sources.

For our drainage analysis we followed the Coconino County Drainage Design Criteria (2001 edition) and utilized methods described in the SCS TR-55 manual (Urban Hydrology for Small Watersheds, 1986). Curve numbers for estimation of runoff were chosen from the tables in chapter 2 of the TR-55 manual, primarily Table 2-2a, which deals with developed and developing urban areas. The portion of Highway 89 and the adjacent right-of-way area that drain onto the site (areas O1-O2) included several different substrates ranging from pavement + gravel shoulder, vegetated strip in the right of way, and paved driveway. For these areas we chose individual curve numbers for each substrate and, with the acreage of each, calculated a composite curve number. For each individual retention basin we used a curve number of 100, as the water falling on these areas will not travel anywhere and instead will immediately contribute to basin inflow and infiltration. For the rest of the site, which will be graded, unvegetated earth, we used a curve number of 85.

	Acreage	CN	
Existing condition	8.5	58	← seems low but makes for a more conservative detention
Proposed condition (no detention/retention facilities)			
Road & shoulder/slope	1.5	85	
Interior areas	4.4	85	
Impervious (driveway, batteries, transformers)	0.1	95	
Substation	1.5	87	
Periphery	1	77	
Composite	8.5	85	✓
Offsite (road & ROW)			
Pavement/shoulder	0.47	95	
Vegetation off shoulder	0.56	60	
Composite	1.03	76	✓
Proposed condition (w/retention facilities)			
Ponds 1-10	3.46	100	
Areas A,B,D,E,F	3.7	85	
Area O1			
Pavement	0.2	98	
Unpaved shoulder & vegetation	0.19	71	
Composite	0.39	85	✓

Areas O2 & C		
Pavement	0.24	98
Unpaved shoulder & vegetation	0.24	71
Paved driveway	0.05	98
Unpaved interior area	0.46	85
Composite	0.99	85

9) **A SWPPP and an NOI will have to be developed prior to any construction work on the site. The SWPPP must be submitted to this office for review and approval and then kept on site along with a copy of the NOI during the construction phase.**

The contractor hired for this project will provide the SWPPP and NOI prior to the commencement of construction.

5/6/11

Charlie:

Thanks for taking the time out of your busy schedule to meet with me this morning to discuss the questions I had regarding the drainage report. Based on our discussion, this email serves as my formal approval of the drainage report. I am giving my approval with the understanding that you will submit me the following items either before or around the first part of June.

1. The peak weir flows at ponds 1 and 6 for the 100-yr flow condition.
2. Confirmation that the riprapping of the weir bottom and sides will not take away from the flow cross sectional area of the weir and that the riprap will be brushed with concrete or cement to improve the roughness and long-term durability of the weirs.
3. As the on-site infiltration tests weren't run in April, the results of the tests may necessitate some drainage report reanalysis if there is measurably lower infiltration capacity determined from the tests. I would like to receive the results of the infiltration tests as soon as they are available.
4. Please forward a tabular summary of the infiltration losses versus time for those sites where the graphs were truncated at 14 hrs.
5. Please forward water surface elevation versus time graphs for ponds, especially for ponds 1, 2, 6, 7 and 10.
6. Please forward a paragraph of text further clarifying the naming and numbering schemes for the ponds, channels and subareas as shown on the hydrograph report printouts and the schematic for the site.
7. I am requesting that inspections of the berms between the ponds be done on an annual basis rather than every three years and inspection results forwarded to this office.
8. Please forward some narrative on how the curve number values were selected and from what sources.
9. A SWPPP and an NOI will have to be developed prior to any construction work on the site. The SWPPP must be submitted to this office for review and approval and then kept on site along with a copy of the NOI during the construction phase.

Thanks for a good job on the drainage report. With the number of ponds and just a different than normal approach for dealing with excess runoff rates and volumes, I know that it require a lot more involved hydrologic and hydraulic modeling.

Ted Smith