STORM WATER CALCULATIONS
for
WOODBURY PLACE PHASE 1
O'FALLON, MISSOURI

Prepared for

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NUMBER PE-2007002811
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STORM WATER CALCULATIONS
WOODBURY PLACE

The site is in O'Fallon, St. Charles county, Missouri and is described as tracts described by deeds in book 3925 page 1694 and book 4201 page 436 of the St. Charles County records, a part of the NW quarter of Section 29, T47N, R3E. The site consists of approximately 8.39 acres of partially developed land that is bounded to the north by the Liberty Christian Church and a residential home, to the east by Woodlawn Avenue, to the south by a mix of commercial and residential, and to the west by residential. Phase 1 is 4.79 acres and will consist of seven (7) six plex buildings, a community center, an accessory building, and a picnic pavilion. Phase 2 is 3.60 acres and will consist of seven (7) six plex units. The site will be served by an underground detention basin.

Post development flows must be less than or equal to predevelopment flows for the 2, 15, 25, and 100-year storms. The proposed detention basin is designed to receive 5.35 acres of flow that includes 0.82 acres of offsite water from the residential homes to the west. Approximately 0.56 acres of the Phase 1 disturbance bypasses the detention basin. The total Phase 1 disturbance area is larger than 4.79 acres (5.09 acres) because some disturbance takes place on Phase 2.

The Rational method for a 20 minute storm was used to determine pipe. The runoff factors for the 15, 25, and 100-year storms came from city ordinance. The runoff factor for the 2-year storm is based on the IDF curve for MoDOT District 6 (St. Louis). The SCS method for a 24 hour storm was used to design the detention basin and control structures. The 24 hour storm event was calculated from MoDOT District 6 IDF curves for the 2-, 25-, and 100-year storms. The 15-year storm was extrapolated from MSD IDF Curve Figure 4-1. Detention basin inflow and outflow hydrographs were used to determine the size of the basin and to size the control structures.

The detention basin for Phase 1 consists of an Inflow Control Structure (ICS 2), a 30" header pipe, five (5) rows of StormTech MC-3500 chambers, and a Outflow Control Structure (OCS 1). Each row of chambers consists of 265.17 feet of chambers or 37 chambers. The chambers are 3.75 high by 6.42 feet wide. Stormwater enters the detention basin at ICS 2 that is a 5 foot diameter manhole that has a weir that forces the low flow storms into the first row of chambers. The first row of chambers is the isolator row that is designed to have a TSS removal of 84% of an average particle size of 45 microns. OCS 1 is a 5 foot diameter manhole that has a series of weirs that control the flow from the detention basin. The discharge from the detention basin is designed to be less the 2, 15, 25, and 100-year, predevelopment flows for the site.

The basin required sediment storage volume is:

180 cf/yr x 5.35 acres x 2 years = 1926 cf.

The basin has a total storage volume of 34,400 cf., of which 24,000 cf. is used during the 100-year storm. Therefore the basin has adequate sediment storage.

OCS 1 is designed to handle the 100-year flow. The discharge pipe from the control structure is also sized to allow full discharge of the 100-year emergency flow. The roof of the control structure is set at least 1' above the 100-year flow elevation. The detention basin is summarized in the table below:

Detention Basin Flows					
	Predev. Flow (cfs)	**Post Dev. Flow Bypass Detention (cfs)**	**Pond Discharge (cfs)**	**Combined Post Development Discharge (cfs)**	**Elevation in Pond (feet)**
2-year	6.5	0.9	6.0	6.1	585.6
15-year	16.8	2.1	14.8	15.4	586.5
25-year	20.4	2.6	18.5	19.3	586.7
100-year	36.6	4.5	31.7	34.0	587.6

This pond is slightly oversized for Phase 1, however it is being placed under the street pavement between the Community Building and Building 8. For Phase 2 it is expected that another 100 feet of chambers will be added to each row, plus an ICS and header row on the south side of the basin. The OCS is designed to control the flow from both Phase 1 and Phase 2, once the additional chambers are added.

Post construction water quality treatment shall be by the isolator row of the StormTech detention basin. The water quality volume (WQv) for Phase 1 is

WQv = [(1.14")(0.05 + 0.009 * 50.9%)(5.09 Acres)]/12 = 0.25 Ac-ft
WQv = 0.25 Ac-ft * 43,560 cf/Ac = 10,890 cf.

This is equivalent to 2.6 cfs (1,167 gpm) flow to the detention basin. According to the New Jersey Corporation for Advanced Technology report dated August 15, 2007, an isolator row sized at a treatment rate of no more than 2.5 gpm/sf of bottom area, using 2 layers of woven geotextile fabric under the base and one layer of nonwoven fabric wrapped over the system and a mean effluent concentration of 318 mg/L has been shown to have a TSS removal efficiency of 84% for an average particle size of 45 microns. The Phase 1 isolator row is 265.2 feet long less four (4) compartments for the curb inlets and 6.42' wide. The isolator row treatment area is

Treatment area = [265.2 – (7.17 * 4)] * 6.42 = 1,518 sf

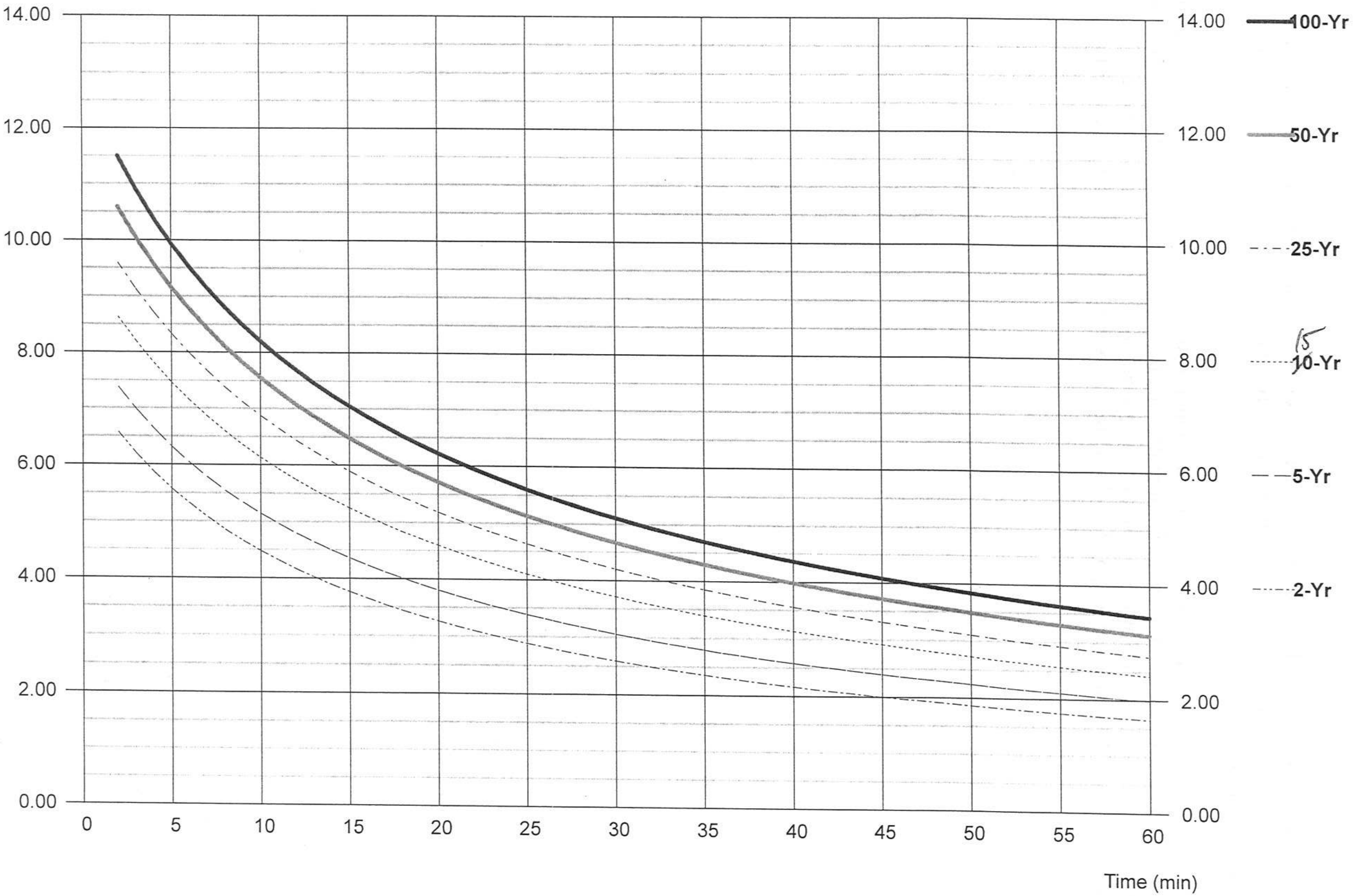
Treatment rate = 1,167 gpm/1,611 sf = 0.8 gpm/sf.

This treatment rate is well below the tested treatment rate which may indicate the Phase 1 isolator row may have a higher removal efficiency rate or may be able to treat higher concentrations of effluent.

The StormTech units may also provide some infiltration into the soils below the detention basin. The units are placed on a minimum of 9" of gravel that have a 40% porosity. The footprint of the detention basin is 9200 sf which provides a good area for infiltration. However, the soils on this site are clay (CH) and silty clay (CL) which are not expected to have very high infiltration rates.

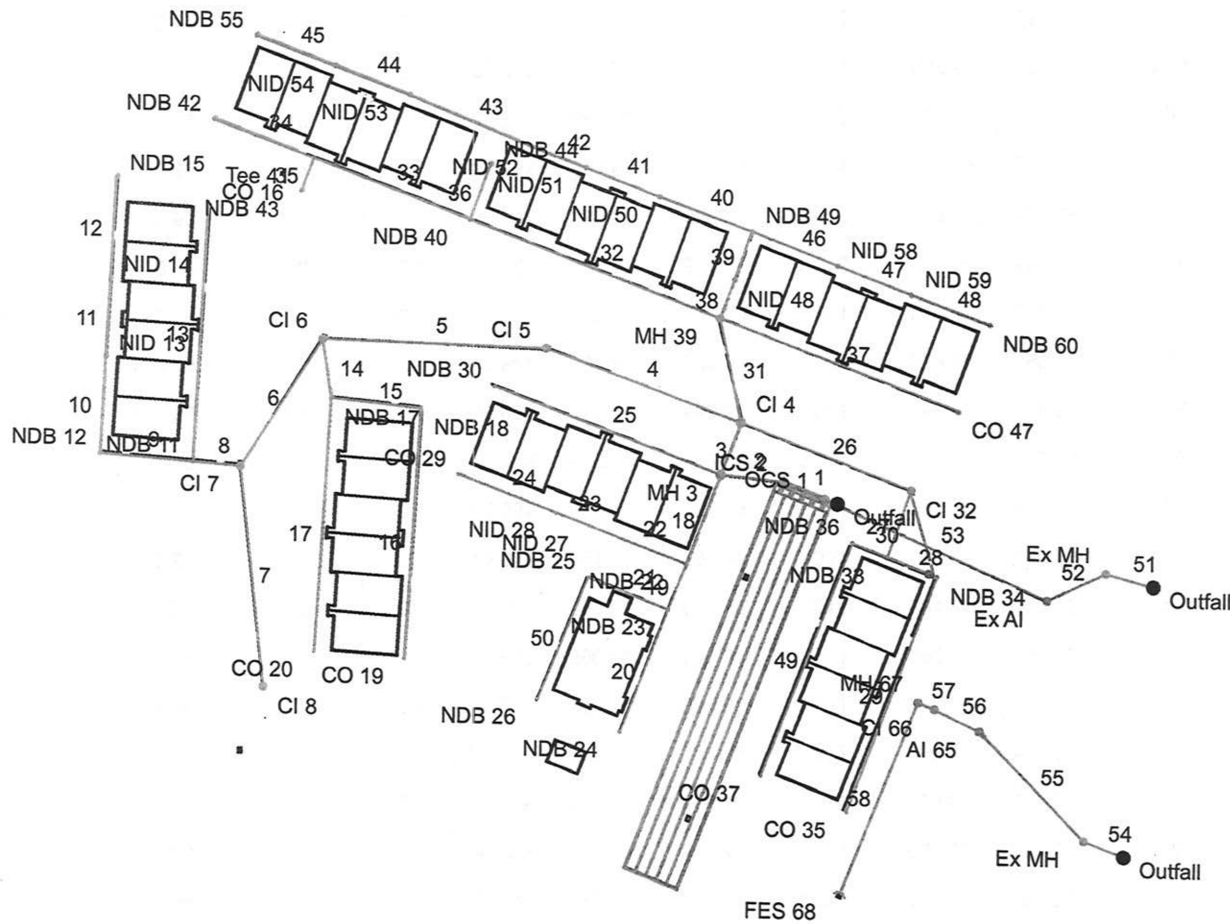
Hydraflow IDF Curves

IDF file: St. Louis 15 yr.IDF



APPENDIX A
STORM PIPE CALCULATIONS
15-YEAR STORM

Hydraflow Storm Sewers Extension for AutoCAD® Civil 3D® 2009 Plan



Project File: Storm.stm	Number of lines: 58	Date: 12-04-2009

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.	Junction Type
1	ICS 2 to Detn	13.66	30	Cir	35.700	584.40	584.50	0.280	586.60	586.62	0.05	586.67	End	Manhole
2	MH 3 to ICS 2	13.66	30	Cir	39.398	584.50	584.80	0.761	586.67	586.66	0.19	586.85	1	Manhole
3	CI 4 to MH 3	11.83	30	Cir	34.971	585.00	585.30	0.858	586.85	586.81	0.68	587.49	2	Combination
4	CI 5 to CI 4	6.96	24	Cir	129.142	585.80	586.80	0.774	587.64	587.73	n/a	587.73 j	3	Combination
5	CI 6 to CI 5	5.49	18	Cir	138.755	587.30	588.40	0.793	588.09	589.29	0.58	589.29	4	Combination
6	CI 7 to CI 6	4.49	18	Cir	94.555	588.60	589.40	0.846	589.58	590.21	n/a	590.21 j	5	Combination
7	CI 8 to CI 7	1.26	15	Cir	137.207	589.60	590.70	0.802	590.52	591.15	n/a	591.15 j	6	Combination
8	NDB 11 to CI 7	1.89	12	Cir	29.648	589.50	589.80	1.012	590.45	590.44	0.19	590.64	6	Manhole
9	NDB 12 to NDB 11	1.59	12	Cir	57.690	590.00	590.60	1.040	590.77	591.13	n/a	591.13 j	8	DropGrate
10	NID 13 to NDB 12	1.20	12	Cir	59.339	590.80	591.42	1.045	591.31	591.88	n/a	591.88 j	9	DropGrate
11	NID 14 to NID 13	0.50	12	Cir	49.035	591.42	591.95	1.081	592.05	592.25	n/a	592.25 j	10	DropGrate
12	NDB 15 to NID 14	0.15	12	Cir	62.081	591.95	592.59	1.031	592.35	592.75	n/a	592.75 j	11	DropGrate
13	CO 16 to NDB 11	0.30	10	Cir	157.866	590.80	592.40	1.014	591.01	592.64	0.08	592.64	8	Manhole
14	NDB 17 to CI 6	0.58	10	Cir	36.950	588.80	589.20	1.083	589.59	589.59	0.08	589.67	5	Manhole
15	NDB 18 to NDB 17	0.28	10	Cir	55.847	589.40	590.00	1.074	589.75	590.24	n/a	590.24 j	14	Manhole
16	CO 19 to NDB 18	0.28	10	Cir	155.417	590.20	591.90	1.094	590.39	592.14	n/a	592.14	15	Manhole
17	CO 20 to NDB 17	0.30	10	Cir	157.586	589.70	591.30	1.015	589.90	591.54	0.08	591.54	14	Manhole
18	NDB 22 to MH 3	1.53	12	Cir	59.638	585.80	586.40	1.006	586.98	587.05	0.19	587.24	2	DropGrate
19	NDB 23 to NDB 22	0.83	12	Cir	30.358	586.60	587.00	1.318	587.34	587.39	n/a	587.39 j	18	DropGrate
20	NDB 24 to NDB 23	0.19	10	Cir	81.312	587.20	588.20	1.230	587.52	588.39	n/a	588.39 j	19	DropGrate
21	NDB 25 to NDB 23	0.60	10	Cir	53.362	587.20	587.80	1.124	587.50	588.14	0.19	588.14	19	DropGrate
22	NID 27 to NDB 22	0.67	10	Cir	64.445	586.60	587.30	1.086	587.34	587.66	n/a	587.66 j	18	DropGrate
23	NID 28 to NID 27	0.32	10	Cir	22.214	587.30	587.60	1.350	587.79	587.85	n/a	587.85 j	22	DropGrate

Project File: Storm.stm | Number of lines: 58 | Run Date: 12-07-2009

NOTES: Return period = 10 Yrs. ; j - Line contains hyd. jump.

Storm Sewer Summary Report

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24	CO 29 to NID 28	0.09	10	Cir	65.070	587.60	588.40	1.230	587.93	588.53	n/a	588.53 j	23	DropGrate
25	NDB 30 to MH 3	0.30	10	Cir	150.615	586.10	587.90	1.195	587.04	588.14	n/a	588.14 j	2	Manhole
26	CI 32 to CI 4	1.08	12	Cir	113.359	586.80	587.60	0.706	587.68	588.04	n/a	588.04 j	3	Combination
27	NDB 33 to CI 32	0.58	12	Cir	44.400	587.80	588.20	0.901	588.20	588.52	n/a	588.52 j	26	Manhole
28	NDB 34 to NDB 33	0.28	12	Cir	33.100	588.40	588.70	0.906	588.63	588.92	n/a	588.92 j	27	Manhole
29	CO 35 to NDB 34	0.28	10	Cir	155.500	588.90	590.45	0.997	589.09	590.69	n/a	590.69	28	Manhole
30	NDB 36 to NDB 33	0.30	10	Cir	23.200	588.60	589.20	2.586	588.76	589.44	0.08	589.44	27	Manhole
31	MH 39 to CI 4	2.82	15	Cir	65.436	586.30	587.00	1.070	587.63	587.68	n/a	587.95 j	3	Manhole
32	NDB 40 to NDB 39	1.20	12	Cir	166.655	587.20	588.90	1.020	588.18	589.36	n/a	589.36 j	31	Manhole
33	Tee 41 to NDB 40	0.80	12	Cir	103.598	589.10	590.20	1.062	589.52	590.58	n/a	590.58 j	32	None
34	NDB 42 to Tee 41	0.53	12	Cir	66.042	590.20	590.90	1.060	590.71	591.21	n/a	591.21 j	33	DropGrate
35	NDB 43 to Tee 41	0.06	10	Cir	22.181	590.20	591.40	5.410	590.71	591.51	n/a	591.51 j	33	DropGrate
36	NDB 44 to NDB 40	0.10	10	Cir	36.239	588.90	589.30	1.104	589.52	589.52	0.01	589.53	32	DropGrate
37	CO 47 to MH 39	0.30	10	Cir	158.171	587.40	589.00	1.012	588.21	589.24	n/a	589.24 j	31	Manhole
38	NID 48 to MH 39	1.32	12	Cir	25.546	587.10	587.41	1.213	588.13	588.14	0.04	588.18	31	DropGrate
39	NDB 49 to NID 48	1.26	12	Cir	31.582	587.41	587.80	1.235	588.21	588.28	n/a	588.28 j	38	DropGrate
40	NID 50 to NDB 49	0.78	10	Cir	61.377	588.00	588.62	1.010	588.43	589.01	n/a	589.01 j	39	DropGrate
41	NID 51 to NID 50	0.57	10	Cir	49.071	588.62	589.11	0.999	589.14	589.45	n/a	589.45 j	40	DropGrate
42	NID 52 to NID 51	0.54	10	Cir	30.562	589.11	589.42	1.014	589.55	589.75	n/a	589.75 j	41	DropGrate
43	NID 53 to NID 52	0.44	10	Cir	87.409	589.42	590.29	0.995	589.85	590.59	n/a	590.59 j	42	DropGrate
44	NID 54 to NID 53	0.32	10	Cir	48.744	590.29	590.78	1.005	590.68	591.03	n/a	591.03 j	43	DropGrate
45	NDB 55 to NID 54	0.21	10	Cir	52.072	590.78	591.30	0.999	591.11	591.50	n/a	591.50 j	44	DropGrate
46	NID 58 to NDB 49	0.38	10	Cir	56.871	588.00	588.36	0.633	588.45	588.63	n/a	588.63 j	39	DropGrate

Project File: Storm.stm

Number of lines: 58

Run Date: 12-07-2009

NOTES: Return period = 10 Yrs. ; j - Line contains hyd. jump.

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.	Junction Type
47	NID 59 to NID 58	0.25	10	Cir	48.912	588.36	588.67	0.634	588.72	588.89	n/a	588.89 j	46	DropGrate
48	NDB 60 to NID 59	0.14	10	Cir	52.105	588.67	589.00	0.633	588.96	589.17	n/a	589.17 j	47	DropGrate
49	CO 37 to NDB 36	0.30	10	Cir	154.700	589.40	591.00	1.034	589.60	591.24	0.08	591.24	30	Manhole
50	NDB 26 to NDB 25	0.44	10	Cir	81.358	588.00	588.90	1.106	588.26	589.20	n/a	589.20	21	DropGrate
51	Ex MH	14.97	30	Cir	30.319	577.30	577.61	1.022	579.68	579.68	0.13	579.81	End	Manhole
52	Ex AI to Ex MH	14.97	30	Cir	40.244	577.83	582.40	11.356	579.85	583.69	n/a	583.69 j	51	DropGrate
53	OCS 1 to Ex AI	14.75	30	Cir	150.581	582.60	583.75	0.764	584.08	585.03	n/a	585.03 j	52	Manhole
54	Ex MH	14.10	15	Cir	26.184	576.20	576.50	1.146	579.62*	580.87*	0.99	581.85	End	Manhole
55	AI 65 to Ex MH	14.10	15	Cir	93.002	576.50	585.30	9.462	581.85	586.53	1.24	586.53	54	DropGrate
56	CI 66 to AI 65	11.90	15	Cir	30.510	585.50	585.70	0.656	587.13*	588.17*	0.73	588.90	55	Curb-Horiz
57	MH 67 to CI 66	11.30	15	Cir	11.044	585.90	586.00	0.905	589.05*	589.38*	1.32	590.70	56	Manhole
58	FES 68 to MH 67	11.30	15	Cir	127.437	586.20	586.90	0.549	590.70*	594.61*	1.32	595.92	57	OpenHeadwall

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NOTES: Return period = 10 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
1	30	13.66	584.40	586.60	2.20	4.58	2.99	0.14	586.74	0.085	35.700	584.50	586.62	2.12	4.44	3.07	0.15	586.77	0.089	0.087	0.031	0.31	0.05
2	30	13.66	584.50	586.67	2.17	4.52	3.02	0.14	586.81	0.087	39.398	584.80	586.66	1.86	3.92	3.48	0.19	586.85	0.115	0.101	0.040	1.00	0.19
3	30	11.83	585.00	586.85	1.85	3.90	3.03	0.14	587.00	0.088	34.971	585.30	586.81	1.51	3.10	3.82	0.23	587.04	0.154	0.121	0.042	2.99	0.68
4	24	6.96	585.80	587.64	1.84	3.02	2.30	0.08	587.72	0.070	129.142	586.80	587.73 j	0.93**	1.44	4.83	0.36	588.10	0.408	0.239	n/a	0.55	n/a
5	18	5.49	587.30	588.09	0.79*	0.94	5.84	0.53	588.62	0.792	138.755	588.40	589.29	0.89**	1.10	5.00	0.39	589.68	0.526	0.659	n/a	1.50	0.58
6	18	4.49	588.60	589.58	0.98	1.23	3.66	0.21	589.79	0.267	94.555	589.40	590.21 j	0.81**	0.97	4.62	0.33	590.54	0.484	0.376	n/a	1.35	n/a
7	15	1.26	589.60	590.52	0.92	0.97	1.30	0.03	590.55	0.040	137.207	590.70	591.15 j	0.45**	0.40	3.18	0.16	591.31	0.425	0.233	n/a	1.00	n/a
8	12	1.89	589.50	590.45	0.95	0.77	2.45	0.09	590.54	0.208	29.648	589.80	590.44	0.64	0.53	3.54	0.19	590.64	0.431	0.319	0.095	1.00	0.19
9	12	1.59	590.00	590.77	0.77	0.65	2.45	0.09	590.86	0.193	57.690	590.60	591.13 j	0.53**	0.43	3.72	0.22	591.35	0.543	0.368	n/a	1.50	n/a
10	12	1.20	590.80	591.31	0.51	0.41	2.95	0.14	591.45	0.354	59.339	591.42	591.88 j	0.46**	0.36	3.36	0.18	592.06	0.498	0.426	n/a	0.50	n/a
11	12	0.50	591.42	592.05	0.63	0.52	0.95	0.01	592.07	0.032	49.035	591.95	592.25 j	0.30**	0.20	2.52	0.10	592.35	0.439	0.235	n/a	0.50	0.05
12	12	0.15	591.95	592.35	0.40	0.29	0.51	0.00	592.35	0.014	62.081	592.59	592.75 j	0.16**	0.08	1.78	0.05	592.80	0.440	0.227	n/a	1.00	n/a
13	10	0.30	590.80	591.01	0.21*	0.11	2.83	0.12	591.13	1.013	157.866	592.40	592.64	0.24**	0.13	2.26	0.08	592.72	0.542	0.777	n/a	1.00	0.08
14	10	0.58	588.80	589.59	0.79	0.53	1.09	0.02	589.61	0.052	36.950	589.20	589.59	0.39	0.25	2.33	0.08	589.67	0.305	0.178	0.066	0.98	0.08
15	10	0.28	589.40	589.75	0.35	0.22	1.28	0.03	589.78	0.102	55.847	590.00	590.24 j	0.24**	0.13	2.21	0.08	590.31	0.460	0.281	n/a	1.00	n/a
16	10	0.28	590.20	590.39	0.19*	0.09	3.01	0.14	590.53	1.093	155.417	591.90	592.14	0.24**	0.13	2.21	0.08	592.21	0.460	0.776	n/a	1.00	n/a
17	10	0.30	589.70	589.90	0.20*	0.10	2.99	0.14	590.04	1.014	157.586	591.30	591.54	0.24**	0.13	2.26	0.08	591.62	0.461	0.737	n/a	1.00	0.08
18	12	1.53	585.80	586.98	1.00	0.79	1.95	0.06	587.04	0.157	59.638	586.40	587.05	0.65	0.54	2.86	0.13	587.17	0.281	0.219	0.131	1.50	0.19
19	12	0.83	586.60	587.34	0.74	0.63	1.32	0.03	587.37	0.057	30.358	587.00	587.39 j	0.39**	0.28	2.96	0.14	587.52	0.463	0.260	n/a	1.50	0.20
20	10	0.19	587.20	587.52	0.32	0.19	0.98	0.01	587.54	0.065	81.312	588.20	588.39 j	0.19**	0.10	1.97	0.06	588.45	0.456	0.260	n/a	1.00	0.06
21	10	0.60	587.20	587.50	0.30	0.18	3.33	0.17	587.68	0.791	53.362	587.80	588.14	0.34**	0.21	2.82	0.12	588.27	0.500	0.645	n/a	1.50	0.19

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Notes: * Normal depth assumed.; ** Critical depth.; j-Line contains hyd. jump. ; c = cir e = ellip b = box

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
22	10	0.67	586.60	587.34	0.74	0.51	1.31	0.03	587.37	0.071	64.445	587.30	587.66 j	0.36**	0.23	2.93	0.13	587.80	0.511	0.291	n/a	0.50	0.07
23	10	0.32	587.30	587.79	0.49	0.33	0.96	0.01	587.81	0.042	22.214	587.60	587.85 j	0.25**	0.14	2.31	0.08	587.93	0.463	0.253	n/a	0.50	0.04
24	10	0.09	587.60	587.93	0.33	0.20	0.44	0.00	587.94	0.015	65.070	588.40	588.53 j	0.13**	0.06	1.60	0.04	588.57	0.547	0.281	n/a	1.00	0.04
25	10	0.30	586.10	587.04	0.83	0.55	0.55	0.00	587.04	0.019	150.615	587.90	588.14 j	0.24**	0.13	2.26	0.08	588.22	0.542	0.280	n/a	1.00	0.08
26	12	1.08	586.80	587.68	0.88	0.73	1.47	0.03	587.72	0.070	113.359	587.60	588.04 j	0.44**	0.33	3.24	0.16	588.20	0.486	0.278	n/a	1.50	n/a
27	12	0.58	587.80	588.20	0.40	0.29	2.01	0.06	588.26	0.208	44.400	588.20	588.52 j	0.32**	0.22	2.64	0.11	588.63	0.444	0.326	n/a	1.00	n/a
28	12	0.28	588.40	588.63	0.23	0.14	2.06	0.07	588.70	0.394	33.100	588.70	588.92 j	0.22**	0.13	2.12	0.07	588.99	0.432	0.413	n/a	1.00	0.07
29	10	0.28	588.90	589.09	0.19*	0.10	2.91	0.13	589.23	0.993	155.500	590.45	590.69	0.24**	0.13	2.21	0.08	590.76	0.460	0.726	n/a	1.00	n/a
30	10	0.30	588.60	588.76	0.16*	0.07	4.17	0.27	589.03	2.582	23.200	589.20	589.44	0.24**	0.13	2.26	0.08	589.52	0.461	1.522	n/a	1.00	0.08
31	15	2.82	586.30	587.63	1.25	1.23	2.30	0.08	587.71	0.163	65.436	587.00	587.68 j	0.68**	0.68	4.17	0.27	587.95	0.502	0.332	0.218	1.00	0.27
32	12	1.20	587.20	588.18	0.98	0.78	1.54	0.04	588.22	0.087	166.655	588.90	589.36 j	0.46**	0.36	3.36	0.18	589.54	0.498	0.293	n/a	1.00	n/a
33	12	0.80	589.10	589.52	0.42	0.32	2.52	0.10	589.62	0.360	103.598	590.20	590.58 j	0.38**	0.27	2.93	0.13	590.71	0.540	0.450	n/a	1.00	n/a
34	12	0.53	590.20	590.71	0.51	0.40	1.33	0.03	590.73	0.085	66.042	590.90	591.21 j	0.31**	0.21	2.57	0.10	591.31	0.517	0.301	n/a	1.00	0.10
35	10	0.06	590.20	590.71	0.51	0.35	0.17	0.00	590.71	0.001	22.181	591.40	591.51 j	0.11**	0.04	1.43	0.03	591.54	0.479	0.240	n/a	1.00	0.03
36	10	0.10	588.90	589.52	0.62	0.43	0.23	0.00	589.52	0.002	36.239	589.30	589.52	0.22	0.12	0.85	0.01	589.53	0.073	0.037	0.014	1.00	0.01
37	10	0.30	587.40	588.21	0.81	0.54	0.55	0.00	588.22	0.014	158.171	589.00	589.24 j	0.24**	0.13	2.26	0.08	589.32	0.461	0.238	n/a	1.00	0.08
38	12	1.32	587.10	588.13	1.00	0.79	1.68	0.04	588.18	0.117	25.546	587.41	588.14	0.73	0.61	2.15	0.07	588.21	0.150	0.133	0.034	0.50	0.04
39	12	1.26	587.41	588.21	0.80	0.67	1.87	0.05	588.26	0.132	31.582	587.80	588.28 j	0.48**	0.37	3.42	0.18	588.46	0.592	0.362	n/a	2.25	n/a
40	10	0.78	588.00	588.43	0.43	0.28	2.78	0.12	588.55	0.402	61.377	588.62	589.01 j	0.39**	0.25	3.09	0.15	589.16	0.530	0.466	n/a	0.50	0.07
41	10	0.57	588.62	589.14	0.52	0.36	1.58	0.04	589.18	0.111	49.071	589.11	589.45 j	0.34**	0.21	2.77	0.12	589.57	0.495	0.303	n/a	0.50	0.06
42	10	0.54	589.11	589.55	0.44	0.29	1.85	0.05	589.60	0.173	30.562	589.42	589.75 j	0.33**	0.20	2.72	0.12	589.86	0.491	0.332	n/a	0.50	n/a

Project File: Storm.stm | Number of lines: 58 | Run Date: 12-07-2009

Notes: * Normal depth assumed.; ** Critical depth.; j-Line contains hyd. jump. ; c = cir e = ellip b = box

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
43	10	0.44	589.42	589.85	0.43	0.29	1.54	0.04	589.89	0.122	87.409	590.29	590.59 j	0.29**	0.17	2.55	0.10	590.69	0.477	0.299	n/a	0.50	n/a
44	10	0.32	590.29	590.68	0.39	0.25	1.28	0.03	590.71	0.091	48.744	590.78	591.03 j	0.25**	0.14	2.31	0.08	591.11	0.463	0.277	n/a	0.50	0.04
45	10	0.21	590.78	591.11	0.33	0.20	1.04	0.02	591.13	0.070	52.072	591.30	591.50 j	0.20**	0.10	2.03	0.06	591.57	0.456	0.263	n/a	1.00	0.06
46	10	0.38	588.00	588.45	0.45	0.30	1.26	0.02	588.47	0.079	56.871	588.36	588.63 j	0.27**	0.16	2.43	0.09	588.73	0.470	0.274	n/a	0.50	n/a
47	10	0.25	588.36	588.72	0.36	0.23	1.10	0.02	588.74	0.072	48.912	588.67	588.89 j	0.22**	0.12	2.14	0.07	588.96	0.458	0.265	n/a	0.50	n/a
48	10	0.14	588.67	588.96	0.29	0.17	0.82	0.01	588.97	0.050	52.105	589.00	589.17 j	0.17**	0.08	1.81	0.05	589.22	0.457	0.254	n/a	1.00	n/a
49	10	0.30	589.40	589.60	0.20*	0.10	3.01	0.14	589.74	1.031	154.700	591.00	591.24	0.24**	0.13	2.26	0.08	591.32	0.461	0.746	n/a	1.00	0.08
50	10	0.44	588.00	588.26	0.26	0.14	3.06	0.15	588.40	0.796	81.358	588.90	589.20	0.29**	0.17	2.55	0.10	589.30	0.477	0.636	n/a	1.00	n/a
51	30	14.97	577.30	579.68	2.38	4.82	3.10	0.15	579.83	0.115	30.319	577.61	579.68	2.07	4.35	3.44	0.18	579.87	0.130	0.123	0.037	0.69	0.13
52	30	14.97	577.83	579.85	2.02	4.25	3.52	0.19	580.04	0.137	40.244	582.40	583.69 j	1.29**	2.56	5.84	0.53	584.22	0.475	0.306	n/a	1.20	n/a
53	30	14.75	582.60	584.08	1.48	3.03	4.86	0.37	584.45	0.297	150.581	583.75	585.03 j	1.28**	2.54	5.81	0.52	585.56	0.473	0.385	n/a	1.00	n/a
54	15	14.10	576.20	579.62	1.25	1.23	11.49	2.05	581.67	4.770	26.184	576.50	580.87	1.25	1.23	11.49	2.05	582.92	4.768	4.769	1.249	0.48	0.99
55	15	14.10	576.50	581.85	1.25	1.22	11.49	2.05	583.91	4.770	93.002	585.30	586.53	1.23**	1.22	11.52	2.06	588.60	4.335	4.553	n/a	0.60	1.24
56	15	11.90	585.50	587.13	1.25	1.23	9.70	1.46	588.60	3.397	30.510	585.70	588.17	1.25	1.23	9.70	1.46	589.63	3.396	3.397	1.036	0.50	0.73
57	15	11.30	585.90	589.05	1.25	1.23	9.21	1.32	590.36	3.064	11.044	586.00	589.38	1.25	1.23	9.21	1.32	590.70	3.062	3.063	0.338	1.00	1.32
58	15	11.30	586.20	590.70	1.25	1.23	9.21	1.32	592.02	3.064	127.437	586.90	594.61	1.25	1.23	9.21	1.32	595.92	3.062	3.063	3.903	1.00	1.32

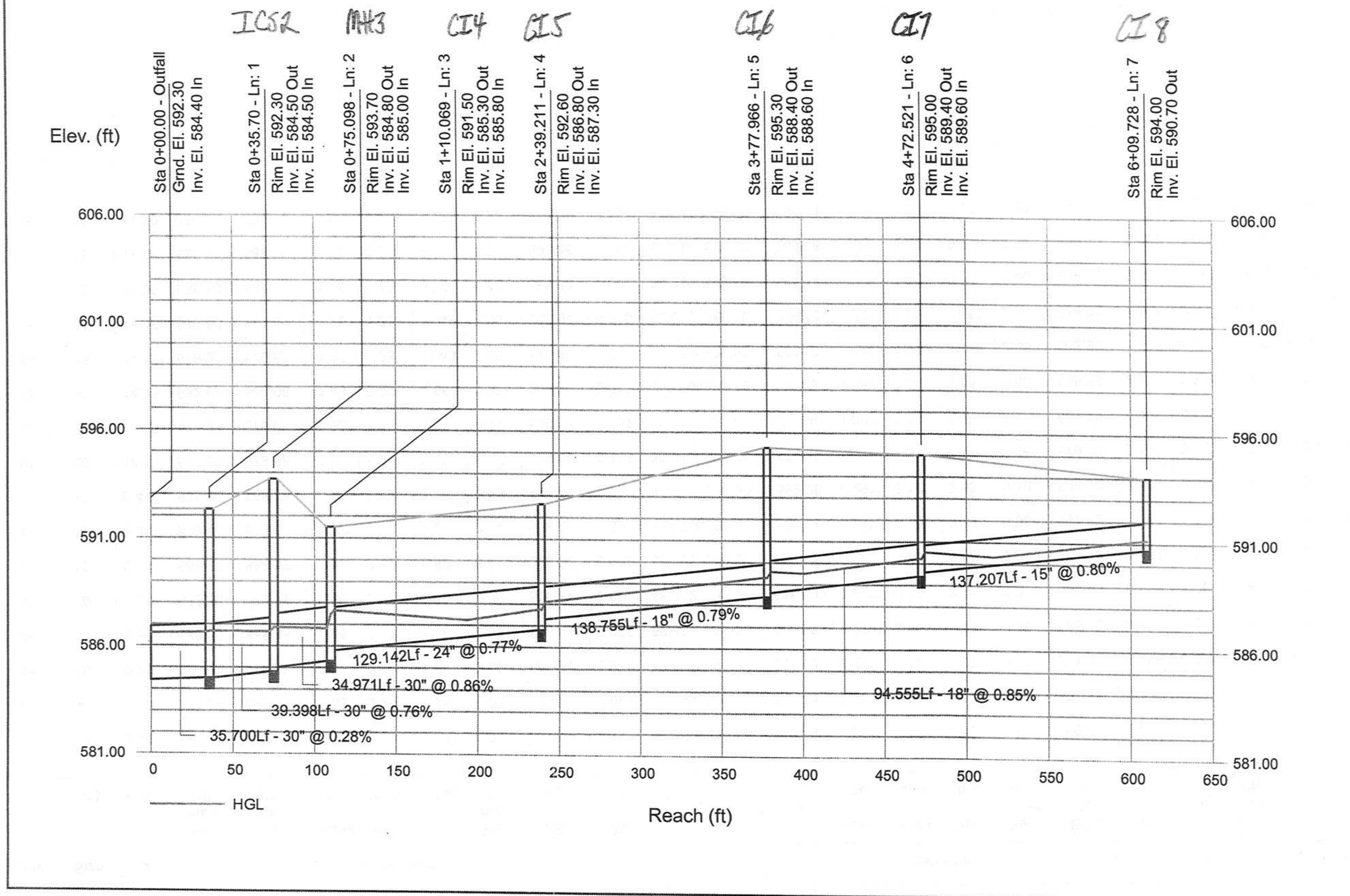
Project File: Storm.stm

Number of lines: 58

Run Date: 12-07-2009

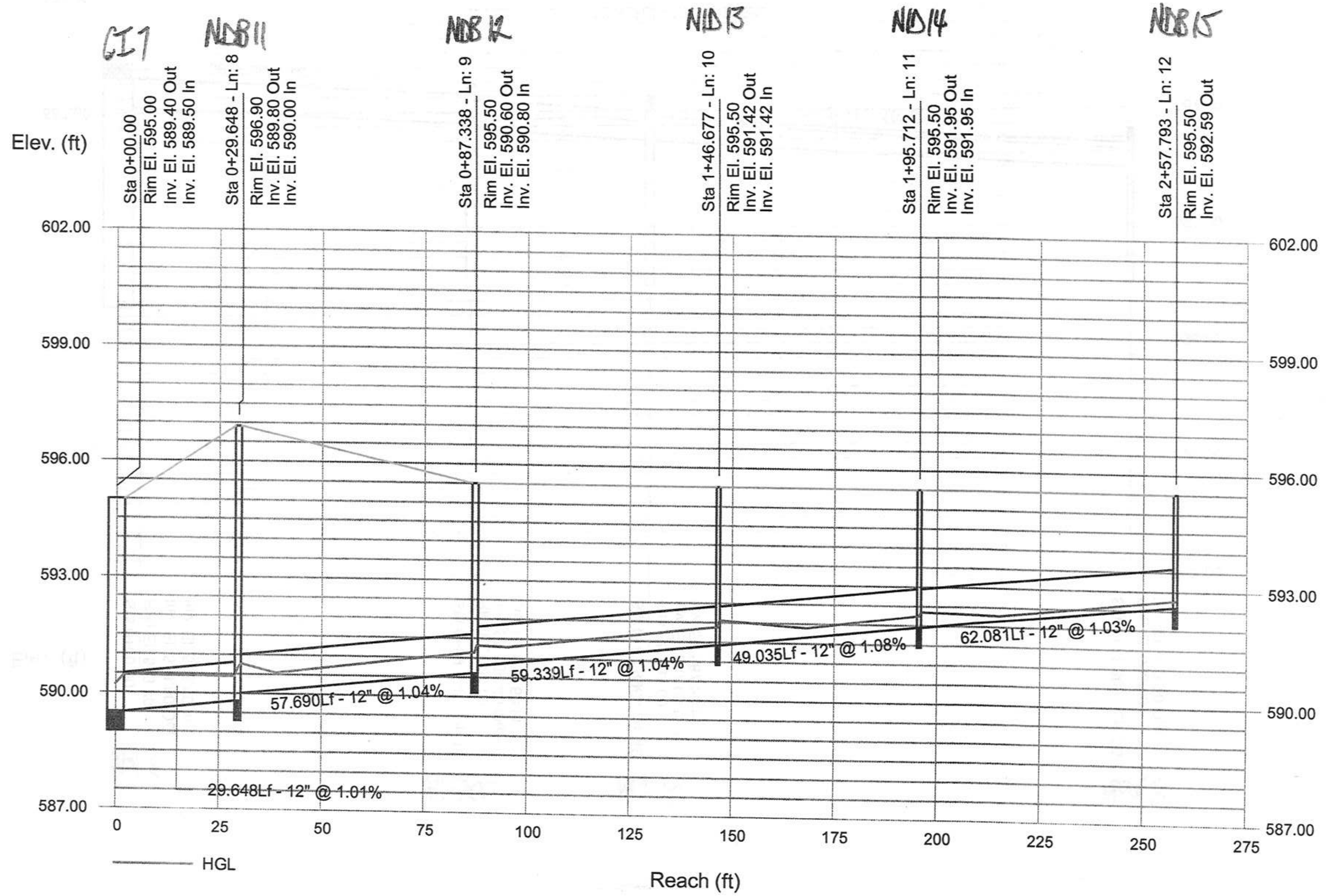
Notes: * Normal depth assumed.; ** Critical depth.; j-Line contains hyd. jump. ; c = cir e = ellip b = box

Storm Sewer Profile



Storm Sewer Profile

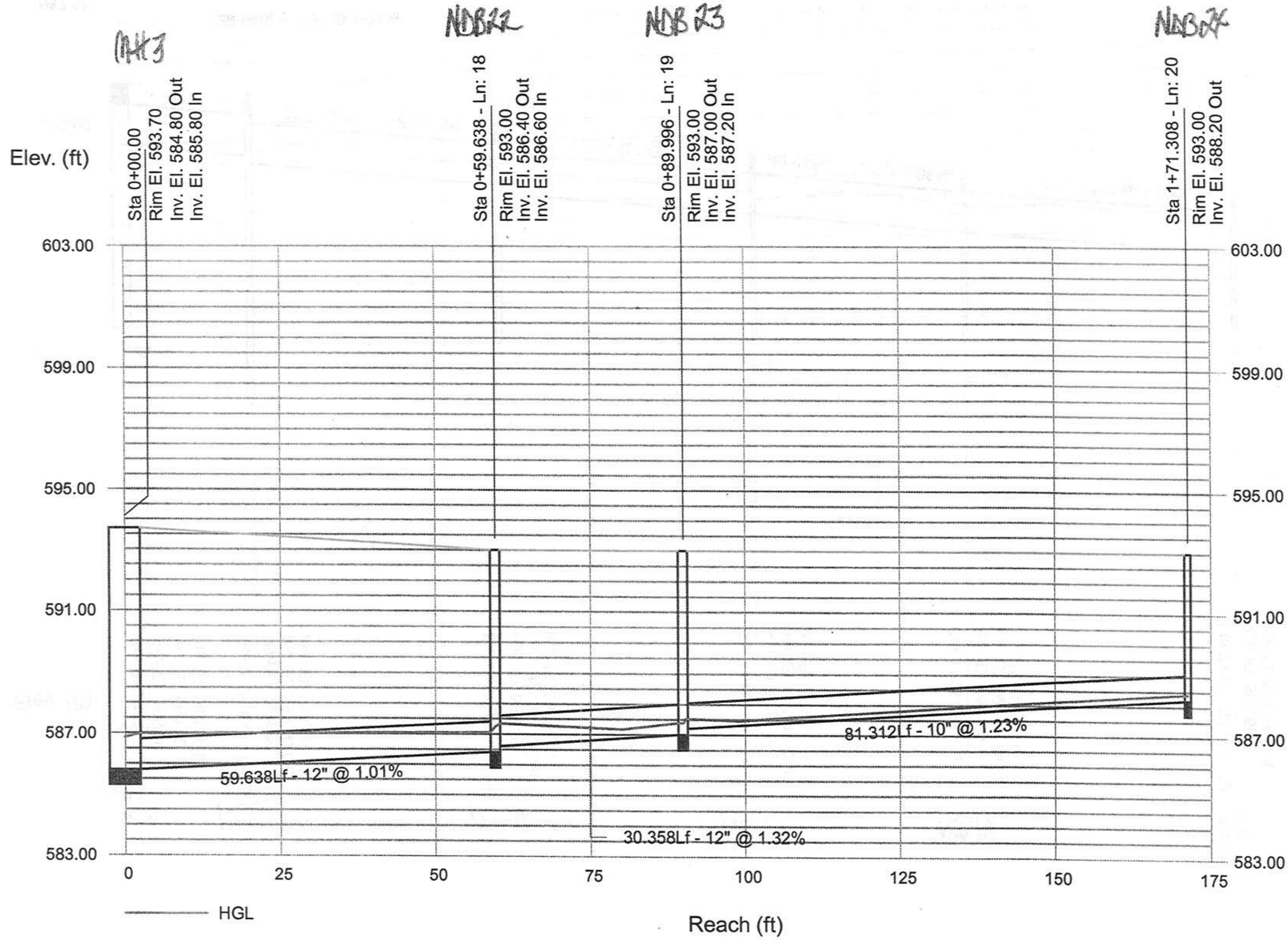
Proj. file: Storm.stm



Hydraflow Storm Sewers Extension

Storm Sewer Profile

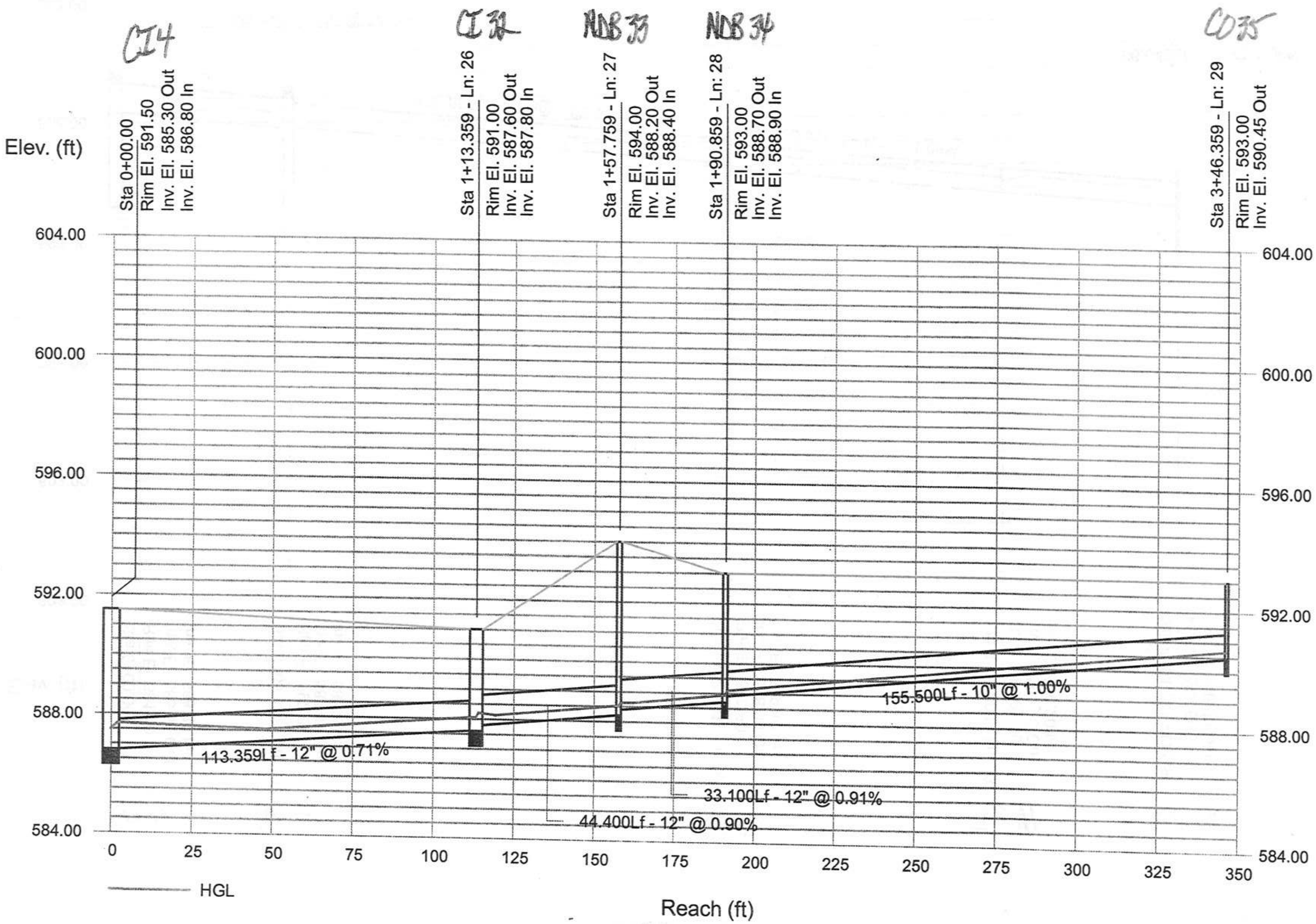
Proj. file: Storm.stm



Hydraflow Storm Sewers Extension

Storm Sewer Profile

Proj. file: Storm.stm



Storm Sewer Profile

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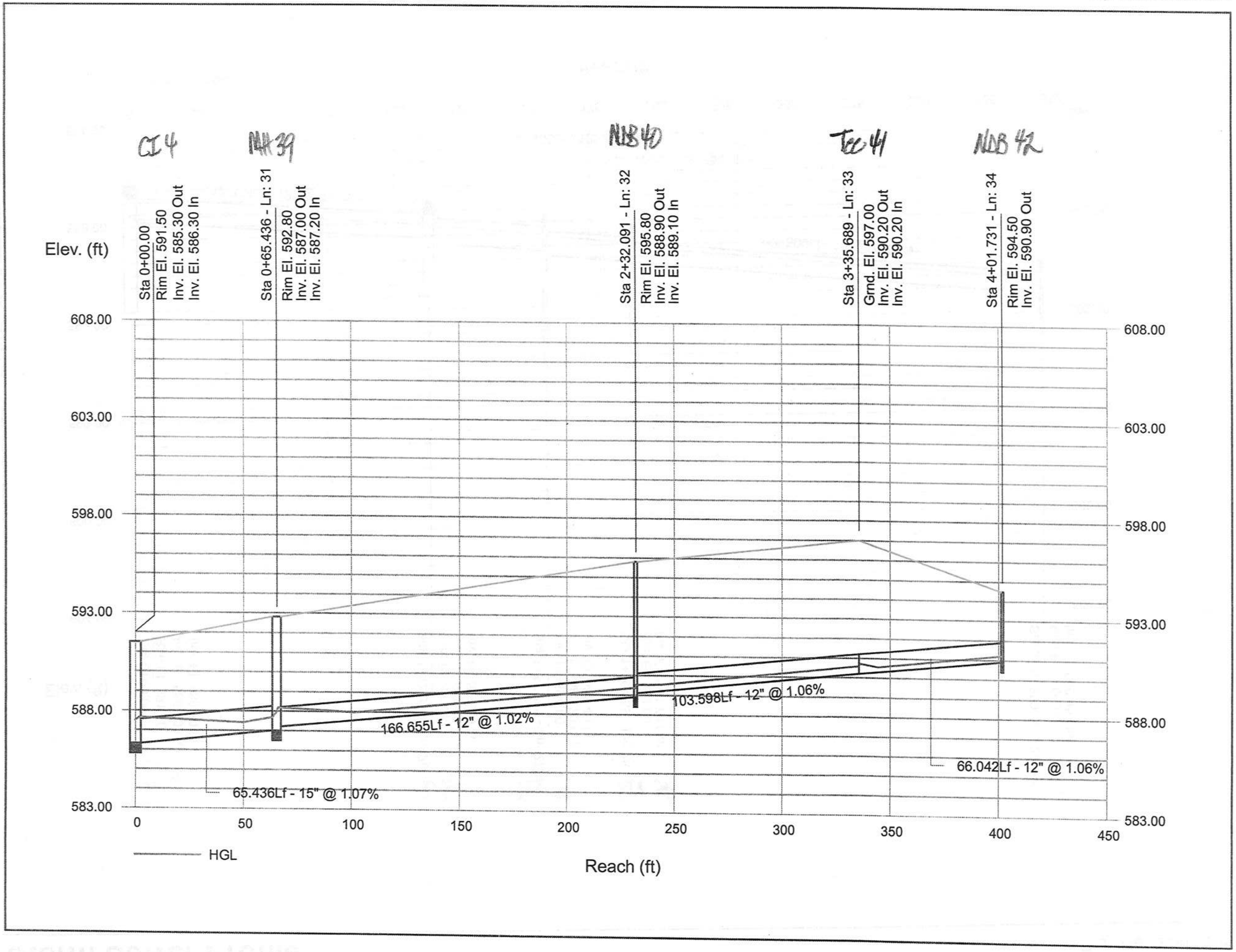

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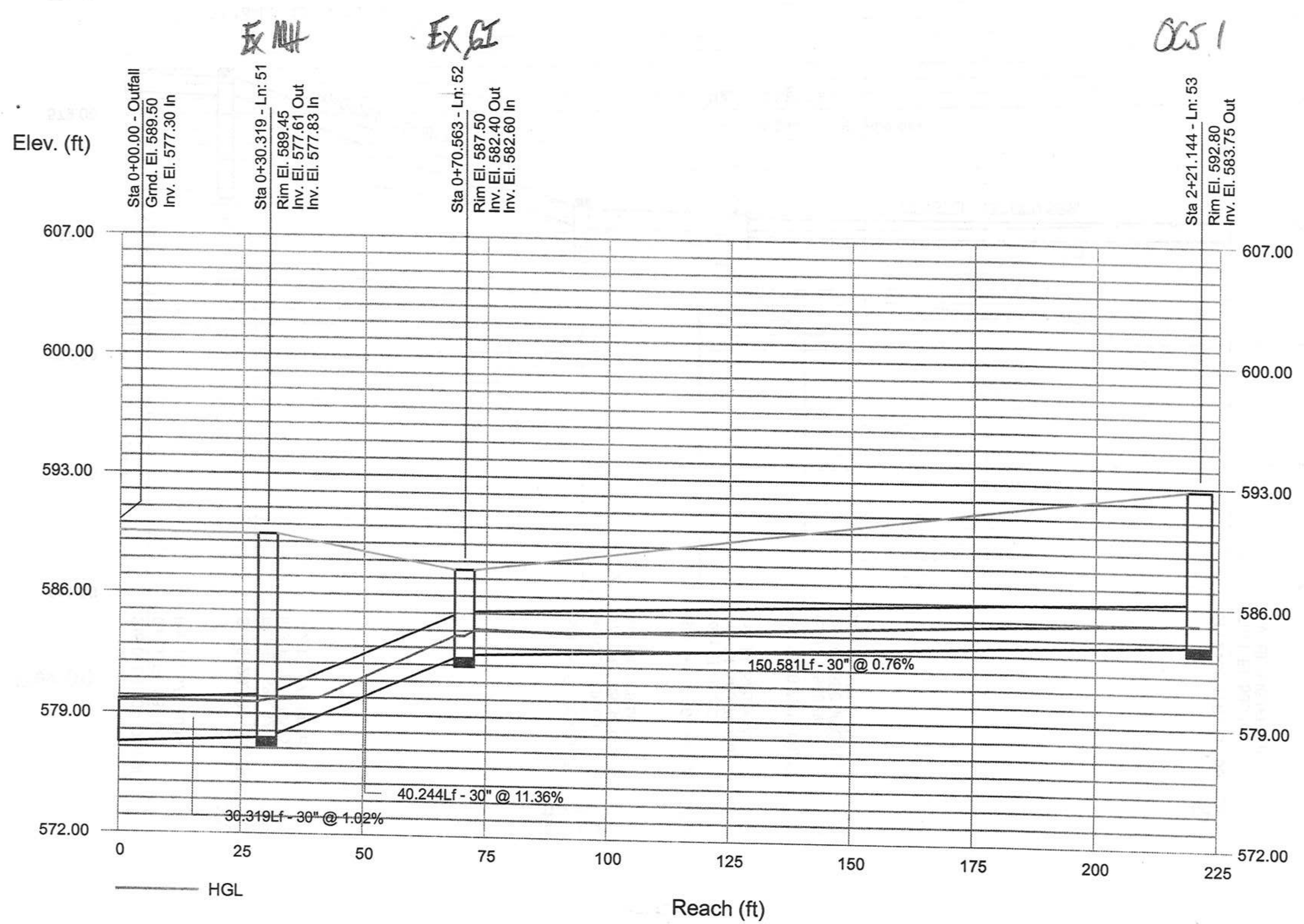

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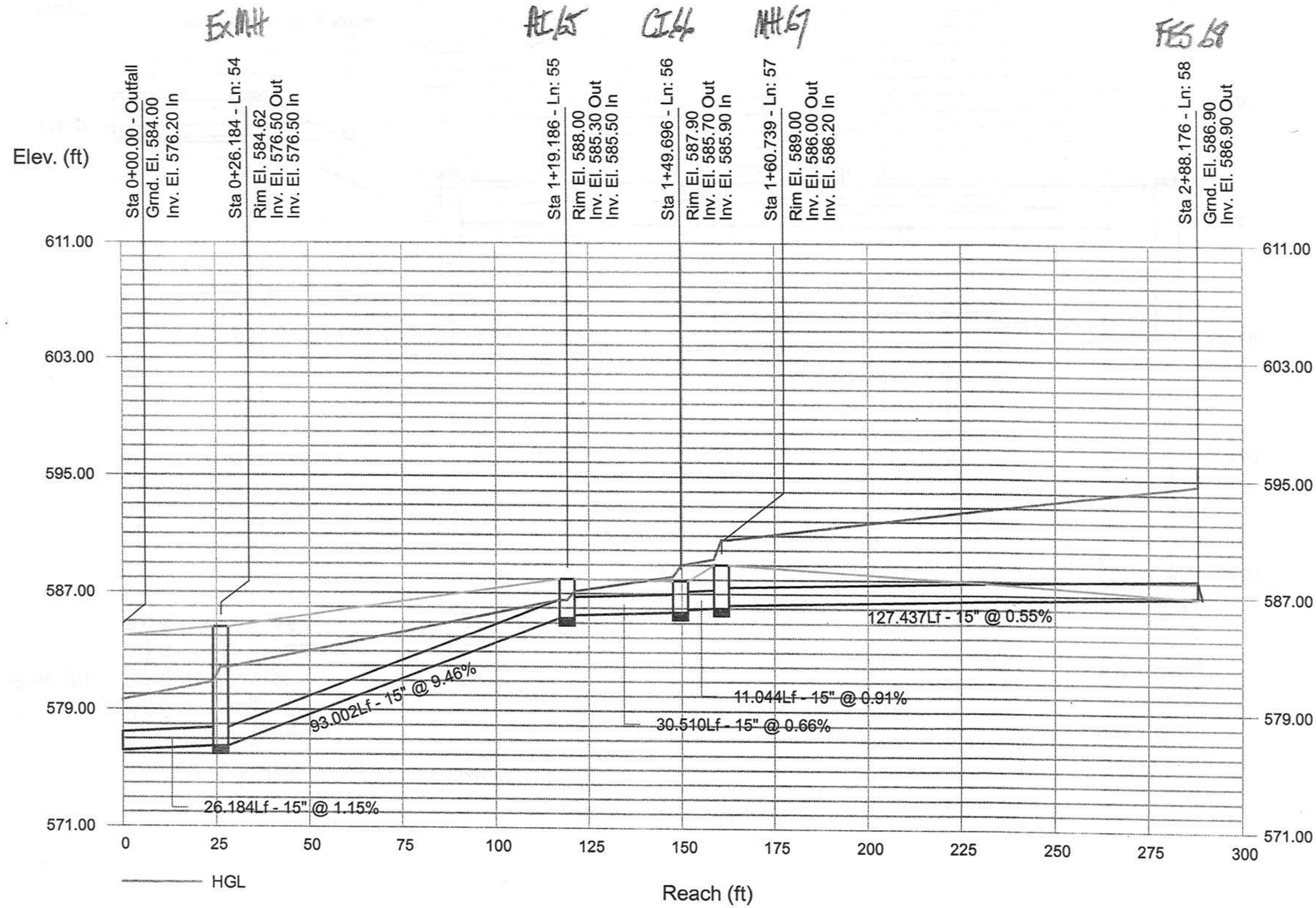
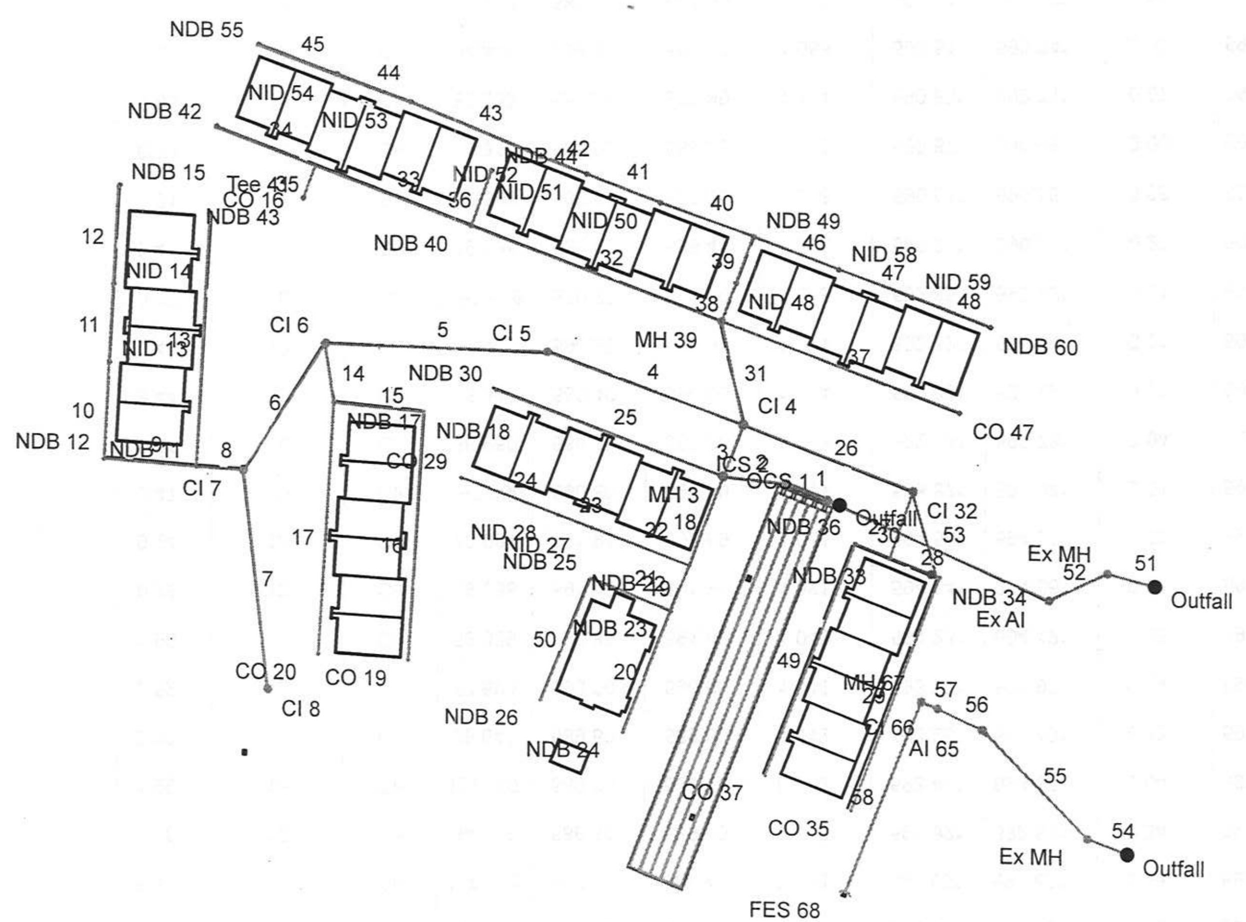


APPENDIX B
STORM PIPE CALCULATIONS
100-YEAR STORM

Hydraflow Storm Sewers Extension for AutoCAD® Civil 3D® 2009 Plan



Starting HGL based on Phase 1 & 2 detention basin (1150)

Project File: Storm 100.stm	Number of lines: 58	Date: 12-04-2009

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.	Junction Type
1	ICS 2 to Detn	21.55	30	Cir	35.700	584.40	584.50	0.280	589.25*	589.33*	0.09	589.43	End	Manhole
2	MH 3 to ICS 2	21.55	30	Cir	39.398	584.50	584.80	0.761	589.43*	589.52*	0.30	589.82	1	Manhole
3	CI 4 to MH 3	18.67	30	Cir	34.971	585.00	585.30	0.858	589.89*	589.96*	0.67	590.63	2	Combination
4	CI 5 to CI 4	10.99	24	Cir	129.142	585.80	586.80	0.774	590.66*	590.92*	0.10	591.03	3	Combination
5	CI 6 to CI 5	8.67	18	Cir	138.755	587.30	588.40	0.793	591.03*	591.83*	0.56	592.40	4	Combination
6	CI 7 to CI 6	7.10	18	Cir	94.555	588.60	589.40	0.846	592.52*	592.89*	0.34	593.23	5	Combination
7	CI 8 to CI 7	1.99	15	Cir	137.207	589.60	590.70	0.802	593.44*	593.55*	0.04	593.59	6	Combination
8	NDB 11 to CI 7	2.99	12	Cir	29.648	589.50	589.80	1.012	593.25*	593.43*	0.23	593.65	6	Manhole
9	NDB 12 to NDB 11	2.52	12	Cir	57.690	590.00	590.60	1.040	593.72*	593.97*	0.24	594.21	8	DropGrate
10	NID 13 to NDB 12	1.90	12	Cir	59.339	590.80	591.42	1.045	594.28*	594.42*	0.05	594.47	9	DropGrate
11	NID 14 to NID 13	0.79	12	Cir	49.035	591.42	591.95	1.081	594.54*	594.56*	0.01	594.57	10	DropGrate
12	NDB 15 to NID 14	0.24	12	Cir	62.081	591.95	592.59	1.031	594.58*	594.59*	0.00	594.59	11	DropGrate
13	CO 16 to NDB 11	0.47	10	Cir	157.866	590.80	592.40	1.014	593.87*	593.94*	0.01	593.95	8	Manhole
14	NDB 17 to CI 6	0.91	10	Cir	36.950	588.80	589.20	1.083	592.73*	592.78*	0.04	592.82	5	Manhole
15	NDB 18 to NDB 17	0.44	10	Cir	55.847	589.40	590.00	1.074	592.86*	592.88*	0.01	592.89	14	Manhole
16	CO 19 to NDB 18	0.44	10	Cir	155.417	590.20	591.90	1.094	592.89*	592.94*	0.01	592.95	15	Manhole
17	CO 20 to NDB 17	0.47	10	Cir	157.586	589.70	591.30	1.015	592.85*	592.92*	0.01	592.93	14	Manhole
18	NDB 22 to MH 3	2.41	12	Cir	59.638	585.80	586.40	1.006	589.97*	590.21*	0.22	590.43	2	DropGrate
19	NDB 23 to NDB 22	1.31	12	Cir	30.358	586.60	587.00	1.318	590.53*	590.56*	0.06	590.63	18	DropGrate
20	NDB 24 to NDB 23	0.30	10	Cir	81.312	587.20	588.20	1.230	590.67*	590.68*	0.00	590.68	19	DropGrate
21	NDB 25 to NDB 23	0.95	10	Cir	53.362	587.20	587.80	1.124	590.63*	590.71*	0.07	590.78	19	DropGrate
22	NID 27 to NDB 22	1.05	10	Cir	64.445	586.60	587.30	1.086	590.51*	590.64*	0.03	590.67	18	DropGrate
23	NID 28 to NID 27	0.50	10	Cir	22.214	587.30	587.60	1.350	590.71*	590.72*	0.01	590.73	22	DropGrate

Project File: Storm 100.stm | Number of lines: 58 | Run Date: 12-04-2009

NOTES: Return period = 100 Yrs. ; *Surcharged (HGL above crown).

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.	Junction Type
24	CO 29 to NID 28	0.14	10	Cir	65.070	587.60	588.40	1.230	590.74*	590.74*	0.00	590.75	23	DropGrate
25	NDB 30 to MH 3	0.47	10	Cir	150.615	586.10	587.90	1.195	590.11*	590.18*	0.01	590.19	2	Manhole
26	CI 32 to CI 4	1.70	12	Cir	113.359	586.80	587.60	0.706	590.78*	591.00*	0.11	591.11	3	Combination
27	NDB 33 to CI 32	0.91	12	Cir	44.400	587.80	588.20	0.901	591.16*	591.19*	0.02	591.21	26	Manhole
28	NDB 34 to NDB 33	0.44	12	Cir	33.100	588.40	588.70	0.906	591.22*	591.23*	0.00	591.23	27	Manhole
29	CO 35 to NDB 34	0.44	10	Cir	155.500	588.90	590.45	0.997	591.23	591.28	0.01	591.29	28	Manhole
30	NDB 36 to NDB 33	0.47	10	Cir	23.200	588.60	589.20	2.586	591.22*	591.23*	0.01	591.24	27	Manhole
31	MH 39 to CI 4	4.45	15	Cir	65.436	586.30	587.00	1.070	590.65*	590.91*	0.20	591.12	3	Manhole
32	NDB 40 to NDB 39	1.89	12	Cir	166.655	587.20	588.90	1.020	591.23*	591.63*	0.09	591.72	31	Manhole
33	Tee 41 to NDB 40	1.26	12	Cir	103.598	589.10	590.20	1.062	591.77*	591.90*	0.04	591.94	32	None
34	NDB 42 to Tee 41	0.84	12	Cir	66.042	590.20	590.90	1.060	591.96*	592.00*	0.02	592.02	33	DropGrate
35	NDB 43 to Tee 41	0.09	10	Cir	22.181	590.20	591.40	5.410	591.98	591.98	0.00	591.98	33	DropGrate
36	NDB 44 to NDB 40	0.16	10	Cir	36.239	588.90	589.30	1.104	591.81*	591.81*	0.00	591.81	32	DropGrate
37	CO 47 to MH 39	0.47	10	Cir	158.171	587.40	589.00	1.012	591.31*	591.37*	0.01	591.38	31	Manhole
38	NID 48 to MH 39	2.09	12	Cir	25.546	587.10	587.41	1.213	591.21*	591.29*	0.06	591.34	31	DropGrate
39	NDB 49 to NID 48	2.00	12	Cir	31.582	587.41	587.80	1.235	591.35*	591.45*	0.23	591.68	38	DropGrate
40	NID 50 to NDB 49	1.23	10	Cir	61.377	588.00	588.62	1.010	591.70*	591.87*	0.04	591.90	39	DropGrate
41	NID 51 to NID 50	0.90	10	Cir	49.071	588.62	589.11	0.999	591.94*	592.01*	0.02	592.03	40	DropGrate
42	NID 52 to NID 51	0.85	10	Cir	30.562	589.11	589.42	1.014	592.04*	592.08*	0.02	592.10	41	DropGrate
43	NID 53 to NID 52	0.69	10	Cir	87.409	589.42	590.29	0.995	592.11*	592.18*	0.01	592.20	42	DropGrate
44	NID 54 to NID 53	0.50	10	Cir	48.744	590.29	590.78	1.005	592.21*	592.23*	0.01	592.24	43	DropGrate
45	NDB 55 to NID 54	0.33	10	Cir	52.072	590.78	591.30	0.999	592.24*	592.25*	0.01	592.26	44	DropGrate
46	NID 58 to NDB 49	0.60	10	Cir	56.871	588.00	588.36	0.633	591.76*	591.80*	0.01	591.81	39	DropGrate

Project File: Storm 100.stm | Number of lines: 58 | Run Date: 12-04-2009

NOTES: Return period = 100 Yrs. ; *Surcharged (HGL above crown).

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.	Junction Type
47	NID 59 to NID 58	0.39	10	Cir	48.912	588.36	588.67	0.634	591.82*	591.83*	0.00	591.83	46	DropGrate
48	NDB 60 to NID 59	0.22	10	Cir	52.105	588.67	589.00	0.633	591.84*	591.84*	0.00	591.85	47	DropGrate
49	CO 37 to NDB 36	0.47	10	Cir	154.700	589.40	591.00	1.034	591.24	591.38	0.06	591.44	30	Manhole
50	NDB 26 to NDB 25	0.70	10	Cir	81.358	588.00	588.90	1.106	590.81*	590.88*	0.03	590.90	21	DropGrate
51	Ex MH	45.55	30	Cir	30.319	577.30	577.61	1.022	579.68	580.03	0.94	580.97	End	Manhole
52	Ex AI to Ex MH	45.55	30	Cir	40.244	577.83	582.40	11.356	581.00	584.64	1.80	584.64	51	DropGrate
53	OCS 1 to Ex AI	45.20	30	Cir	150.581	582.60	583.75	0.764	585.10*	586.93*	1.32	588.25	52	Manhole
54	Ex MH	22.33	15	Cir	26.184	576.20	576.50	1.146	579.62*	582.75*	2.47	585.22	End	Manhole
55	AI 65 to Ex MH	22.33	15	Cir	93.002	576.50	585.30	9.462	585.22*	596.35*	3.09	599.44	54	DropGrate
56	CI 66 to AI 65	18.85	15	Cir	30.510	585.50	585.70	0.656	600.92*	603.52*	1.83	605.35	55	Curb-Horiz
57	MH 67 to CI 66	17.90	15	Cir	11.044	585.90	586.00	0.905	605.71*	606.56*	3.31	609.87	56	Manhole
58	FES 68 to MH 67	17.90	15	Cir	127.437	586.20	586.90	0.549	609.87*	619.67*	3.31	622.97	57	OpenHeadwall

Project File: Storm 100.stm | Number of lines: 58 | Run Date: 12-04-2009

NOTES: Return period = 100 Yrs. ; *Surcharged (HGL above crown).

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
1	30	21.55	584.40	589.25	2.50	4.91	4.39	0.30	589.55	0.235	35.700	584.50	589.33	2.50	4.91	4.39	0.30	589.63	0.235	0.235	0.084	0.31	0.09
2	30	21.55	584.50	589.43	2.50	4.91	4.39	0.30	589.73	0.235	39.398	584.80	589.52	2.50	4.91	4.39	0.30	589.82	0.235	0.235	0.093	1.00	0.30
3	30	18.67	585.00	589.89	2.50	4.91	3.80	0.22	590.12	0.177	34.971	585.30	589.96	2.50	4.91	3.80	0.22	590.18	0.177	0.177	0.062	2.99	0.67
4	24	10.99	585.80	590.66	2.00	3.14	3.50	0.19	590.85	0.201	129.142	586.80	590.92	2.00	3.14	3.50	0.19	591.11	0.201	0.201	0.260	0.55	0.10
5	18	8.67	587.30	591.03	1.50	1.77	4.91	0.37	591.40	0.581	138.755	588.40	591.83	1.50	1.77	4.91	0.37	592.21	0.581	0.581	0.806	1.50	0.56
6	18	7.10	588.60	592.52	1.50	1.77	4.02	0.25	592.77	0.390	94.555	589.40	592.89	1.50	1.77	4.02	0.25	593.14	0.390	0.390	0.368	1.35	0.34
7	15	1.99	589.60	593.44	1.25	1.23	1.62	0.04	593.48	0.081	137.207	590.70	593.55	1.25	1.23	1.62	0.04	593.59	0.081	0.081	0.111	1.00	0.04
8	12	2.99	589.50	593.25	1.00	0.79	3.81	0.23	593.48	0.601	29.648	589.80	593.43	1.00	0.79	3.81	0.23	593.65	0.601	0.601	0.178	1.00	0.23
9	12	2.52	590.00	593.72	1.00	0.79	3.21	0.16	593.88	0.427	57.690	590.60	593.97	1.00	0.79	3.21	0.16	594.13	0.427	0.427	0.246	1.50	0.24
10	12	1.90	590.80	594.28	1.00	0.79	2.42	0.09	594.37	0.243	59.339	591.42	594.42	1.00	0.79	2.42	0.09	594.51	0.243	0.243	0.144	0.50	0.05
11	12	0.79	591.42	594.54	1.00	0.79	1.01	0.02	594.56	0.042	49.035	591.95	594.56	1.00	0.79	1.01	0.02	594.58	0.042	0.042	0.021	0.50	0.01
12	12	0.24	591.95	594.58	1.00	0.79	0.31	0.00	594.58	0.004	62.081	592.59	594.59	1.00	0.79	0.31	0.00	594.59	0.004	0.004	0.002	1.00	0.00
13	10	0.47	590.80	593.87	0.83	0.55	0.86	0.01	593.88	0.046	157.866	592.40	593.94	0.83	0.55	0.86	0.01	593.95	0.046	0.046	0.073	1.00	0.01
14	10	0.91	588.80	592.73	0.83	0.55	1.67	0.04	592.77	0.147	36.950	589.20	592.78	0.83	0.55	1.67	0.04	592.82	0.147	0.147	0.054	0.98	0.04
15	10	0.44	589.40	592.86	0.83	0.55	0.81	0.01	592.87	0.034	55.847	590.00	592.88	0.83	0.55	0.81	0.01	592.89	0.034	0.034	0.019	1.00	0.01
16	10	0.44	590.20	592.89	0.83	0.55	0.81	0.01	592.90	0.034	155.417	591.90	592.94	0.83	0.55	0.81	0.01	592.95	0.034	0.034	0.053	1.00	0.01
17	10	0.47	589.70	592.85	0.83	0.55	0.86	0.01	592.87	0.039	157.586	591.30	592.92	0.83	0.55	0.86	0.01	592.93	0.039	0.039	0.062	1.00	0.01
18	12	2.41	585.80	589.97	1.00	0.79	3.07	0.15	590.12	0.390	59.638	586.40	590.21	1.00	0.79	3.07	0.15	590.35	0.390	0.390	0.233	1.50	0.22
19	12	1.31	586.60	590.53	1.00	0.79	1.67	0.04	590.57	0.115	30.358	587.00	590.56	1.00	0.79	1.67	0.04	590.61	0.115	0.115	0.035	1.50	0.06
20	10	0.30	587.20	590.67	0.83	0.55	0.55	0.00	590.67	0.016	81.312	588.20	590.68	0.83	0.55	0.55	0.00	590.68	0.016	0.016	0.013	1.00	0.00
21	10	0.95	587.20	590.63	0.83	0.55	1.74	0.05	590.68	0.160	53.362	587.80	590.71	0.83	0.55	1.74	0.05	590.76	0.160	0.160	0.086	1.50	0.07

Project File: Storm 100.stm

Number of lines: 58

Run Date: 12-04-2009

; c = cir e = ellip b = box

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
22	10	1.05	586.60	590.51	0.83	0.55	1.93	0.06	590.57	0.196	64.445	587.30	590.64	0.83	0.55	1.93	0.06	590.70	0.196	0.196	0.126	0.50	0.03
23	10	0.50	587.30	590.71	0.83	0.55	0.92	0.01	590.73	0.044	22.214	587.60	590.72	0.83	0.55	0.92	0.01	590.74	0.044	0.044	0.010	0.50	0.01
24	10	0.14	587.60	590.74	0.83	0.55	0.26	0.00	590.74	0.004	65.070	588.40	590.74	0.83	0.55	0.26	0.00	590.75	0.004	0.004	0.003	1.00	0.00
25	10	0.47	586.10	590.11	0.83	0.55	0.86	0.01	590.12	0.046	150.615	587.90	590.18	0.83	0.55	0.86	0.01	590.19	0.046	0.046	0.069	1.00	0.01
26	12	1.70	586.80	590.78	1.00	0.79	2.16	0.07	590.85	0.194	113.359	587.60	591.00	1.00	0.79	2.16	0.07	591.07	0.194	0.194	0.220	1.50	0.11
27	12	0.91	587.80	591.16	1.00	0.79	1.16	0.02	591.18	0.056	44.400	588.20	591.19	1.00	0.79	1.16	0.02	591.21	0.056	0.056	0.025	1.00	0.02
28	12	0.44	588.40	591.22	1.00	0.79	0.56	0.00	591.23	0.013	33.100	588.70	591.23	1.00	0.79	0.56	0.00	591.23	0.013	0.013	0.004	1.00	0.00
29	10	0.44	588.90	591.23	0.83	0.55	0.81	0.01	591.24	0.034	155.500	590.45	591.28	0.83	0.55	0.81	0.01	591.29	0.034	0.034	0.053	1.00	0.01
30	10	0.47	588.60	591.22	0.83	0.55	0.86	0.01	591.23	0.039	23.200	589.20	591.23	0.83	0.55	0.86	0.01	591.24	0.039	0.039	0.009	1.00	0.01
31	15	4.45	586.30	590.65	1.25	1.23	3.63	0.20	590.85	0.405	65.436	587.00	590.91	1.25	1.23	3.63	0.20	591.12	0.405	0.405	0.265	1.00	0.20
32	12	1.89	587.20	591.23	1.00	0.79	2.41	0.09	591.32	0.240	166.655	588.90	591.63	1.00	0.79	2.41	0.09	591.72	0.240	0.240	0.400	1.00	0.09
33	12	1.26	589.10	591.77	1.00	0.79	1.60	0.04	591.81	0.125	103.598	590.20	591.90	1.00	0.79	1.60	0.04	591.94	0.125	0.125	0.130	1.00	0.04
34	12	0.84	590.20	591.96	1.00	0.79	1.07	0.02	591.98	0.056	66.042	590.90	592.00	1.00	0.79	1.07	0.02	592.02	0.056	0.056	0.037	1.00	0.02
35	10	0.09	590.20	591.98	0.83	0.55	0.17	0.00	591.98	0.001	22.181	591.40	591.98	0.58	0.41	0.22	0.00	591.98	0.002	0.002	0.000	1.00	0.00
36	10	0.16	588.90	591.81	0.83	0.55	0.29	0.00	591.81	0.005	36.239	589.30	591.81	0.83	0.55	0.29	0.00	591.81	0.005	0.005	0.002	1.00	0.00
37	10	0.47	587.40	591.31	0.83	0.55	0.86	0.01	591.32	0.039	158.171	589.00	591.37	0.83	0.55	0.86	0.01	591.38	0.039	0.039	0.062	1.00	0.01
38	12	2.09	587.10	591.21	1.00	0.79	2.66	0.11	591.32	0.294	25.546	587.41	591.29	1.00	0.79	2.66	0.11	591.40	0.293	0.294	0.075	0.50	0.06
39	12	2.00	587.41	591.35	1.00	0.79	2.55	0.10	591.45	0.316	31.582	587.80	591.45	1.00	0.79	2.55	0.10	591.55	0.315	0.315	0.100	2.25	0.23
40	10	1.23	588.00	591.70	0.83	0.55	2.26	0.08	591.78	0.269	61.377	588.62	591.87	0.83	0.55	2.26	0.08	591.94	0.269	0.269	0.165	0.50	0.04
41	10	0.90	588.62	591.94	0.83	0.55	1.65	0.04	591.98	0.144	49.071	589.11	592.01	0.83	0.55	1.65	0.04	592.05	0.144	0.144	0.071	0.50	0.02
42	10	0.85	589.11	592.04	0.83	0.55	1.56	0.04	592.08	0.128	30.562	589.42	592.08	0.83	0.55	1.56	0.04	592.11	0.128	0.128	0.039	0.50	0.02

Project File: Storm 100.stm | Number of lines: 58 | Run Date: 12-04-2009

; c = cir e = ellip b = box

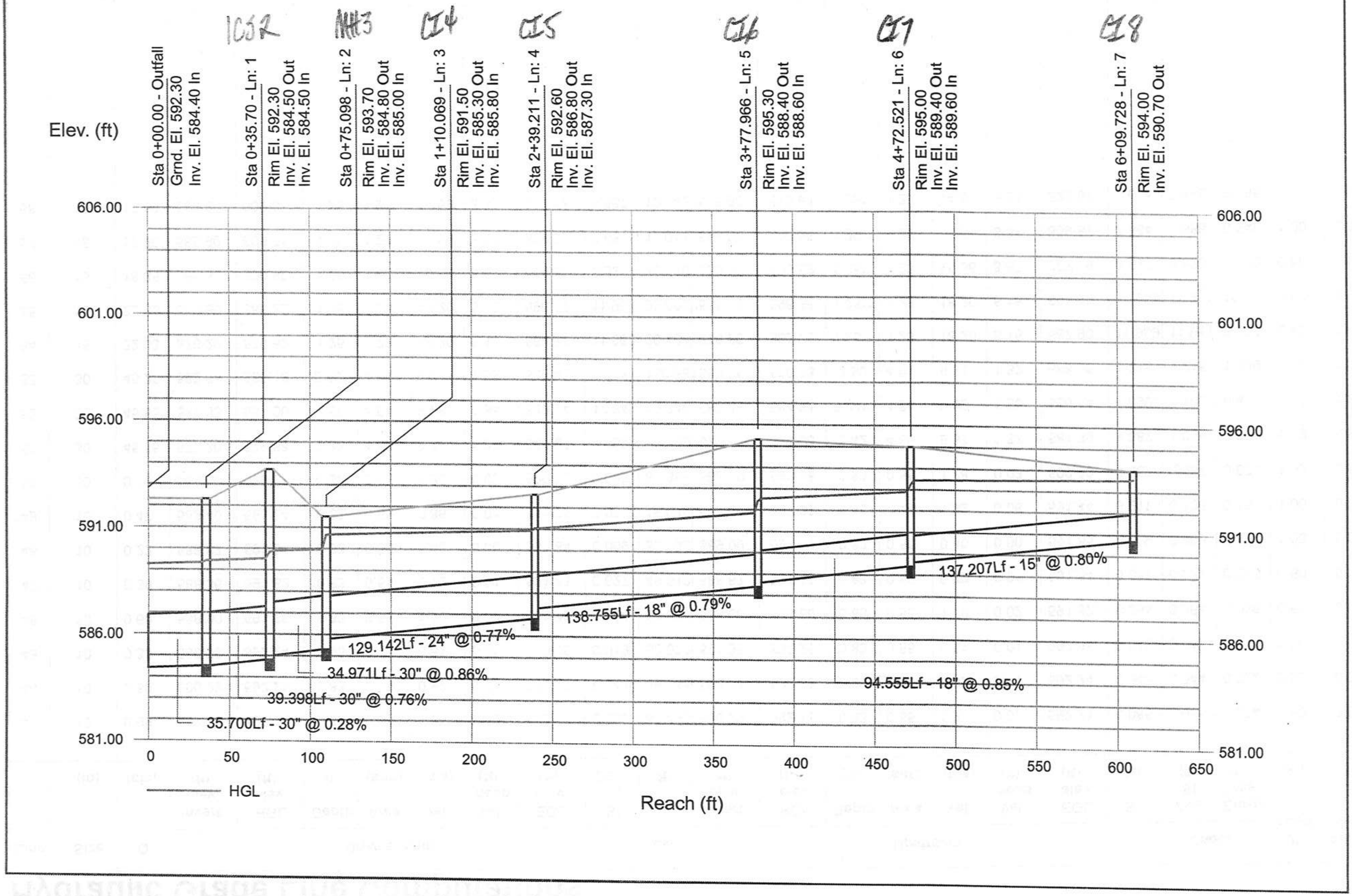
Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
43	10	0.69	589.42	592.11	0.83	0.55	1.27	0.02	592.13	0.085	87.409	590.29	592.18	0.83	0.55	1.27	0.02	592.21	0.085	0.085	0.074	0.50	0.01
44	10	0.50	590.29	592.21	0.83	0.55	0.92	0.01	592.22	0.044	48.744	590.78	592.23	0.83	0.55	0.92	0.01	592.24	0.044	0.044	0.022	0.50	0.01
45	10	0.33	590.78	592.24	0.83	0.55	0.61	0.01	592.25	0.019	52.072	591.30	592.25	0.83	0.55	0.61	0.01	592.26	0.019	0.019	0.010	1.00	0.01
46	10	0.60	588.00	591.76	0.83	0.55	1.10	0.02	591.78	0.064	56.871	588.36	591.80	0.83	0.55	1.10	0.02	591.82	0.064	0.064	0.036	0.50	0.01
47	10	0.39	588.36	591.82	0.83	0.55	0.72	0.01	591.83	0.027	48.912	588.67	591.83	0.83	0.55	0.72	0.01	591.84	0.027	0.027	0.013	0.50	0.00
48	10	0.22	588.67	591.84	0.83	0.55	0.40	0.00	591.84	0.009	52.105	589.00	591.84	0.83	0.55	0.40	0.00	591.85	0.009	0.009	0.004	1.00	0.00
49	10	0.47	589.40	591.24	0.83	0.55	0.86	0.01	591.25	0.039	154.700	591.00	591.38	0.38	0.24	1.92	0.06	591.44	0.211	0.125	0.193	1.00	0.06
50	10	0.70	588.00	590.81	0.83	0.55	1.28	0.03	590.83	0.087	81.358	588.90	590.88	0.83	0.55	1.28	0.03	590.90	0.087	0.087	0.071	1.00	0.03
51	30	45.55	577.30	579.68	2.38	4.82	9.45	1.39	581.07	1.069	30.319	577.61	580.03	2.42	4.86	9.37	1.37	581.39	1.082	1.075	0.326	0.69	0.94
52	30	45.55	577.83	581.00	2.50	4.64	9.28	1.34	582.34	1.234	40.244	582.40	584.64	2.24**	4.64	9.82	1.50	586.14	1.090	1.162	n/a	1.20	1.80
53	30	45.20	582.60	585.10	2.50*	4.91	9.21	1.32	586.42	1.215	150.581	583.75	586.93	2.50	4.91	9.21	1.32	588.25	1.215	1.215	1.830	1.00	1.32
54	15	22.33	576.20	579.62	1.25	1.23	18.20	5.15	584.77	11.963	26.184	576.50	582.75	1.25**	1.23	18.20	5.15	587.90	11.959	11.961	3.132	0.48	2.47
55	15	22.33	576.50	585.22	1.25	1.23	18.20	5.15	590.37	11.963	93.002	585.30	596.35	1.25**	1.23	18.20	5.15	601.50	11.959	11.961	11.12	0.60	3.09
56	15	18.85	585.50	600.92	1.25	1.23	15.36	3.67	604.59	8.525	30.510	585.70	603.52	1.25**	1.23	15.36	3.67	607.19	8.522	8.523	2.600	0.50	1.83
57	15	17.90	585.90	605.71	1.25	1.23	14.59	3.31	609.02	7.687	11.044	586.00	606.56	1.25**	1.23	14.59	3.31	609.87	7.684	7.686	0.849	1.00	3.31
58	15	17.90	586.20	609.87	1.25	1.23	14.59	3.31	613.18	7.687	127.437	586.90	619.67	1.25**	1.23	14.59	3.31	622.97	7.684	7.686	9.795	1.00	3.31

Project File: Storm 100.stm | Number of lines: 58 | Run Date: 12-04-2009

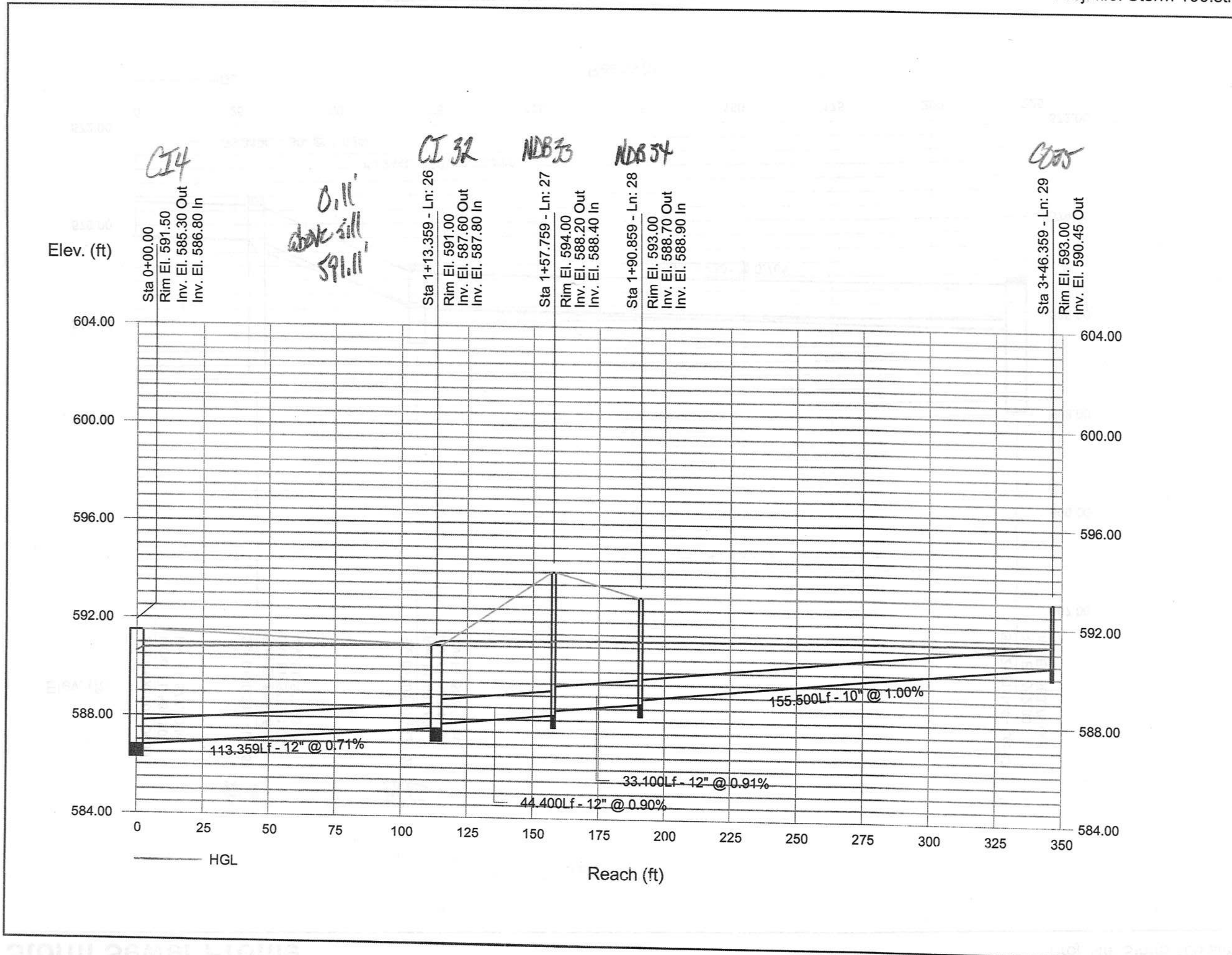
Notes: * Normal depth assumed.; ** Critical depth. ; c = cir e = ellip b = box

Storm Sewer Profile

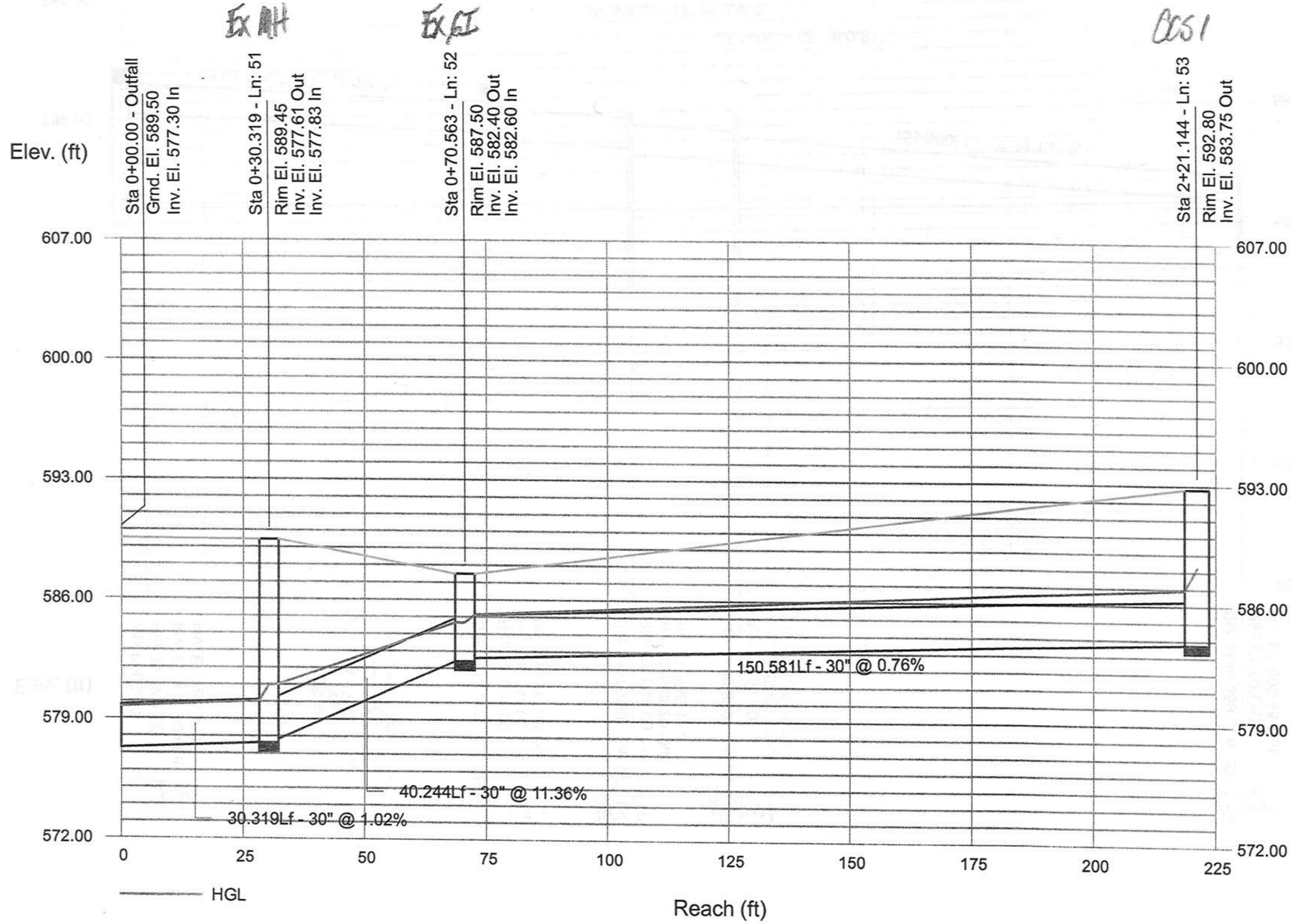


Storm Sewer Profile

Proj. file: Storm 100.stm

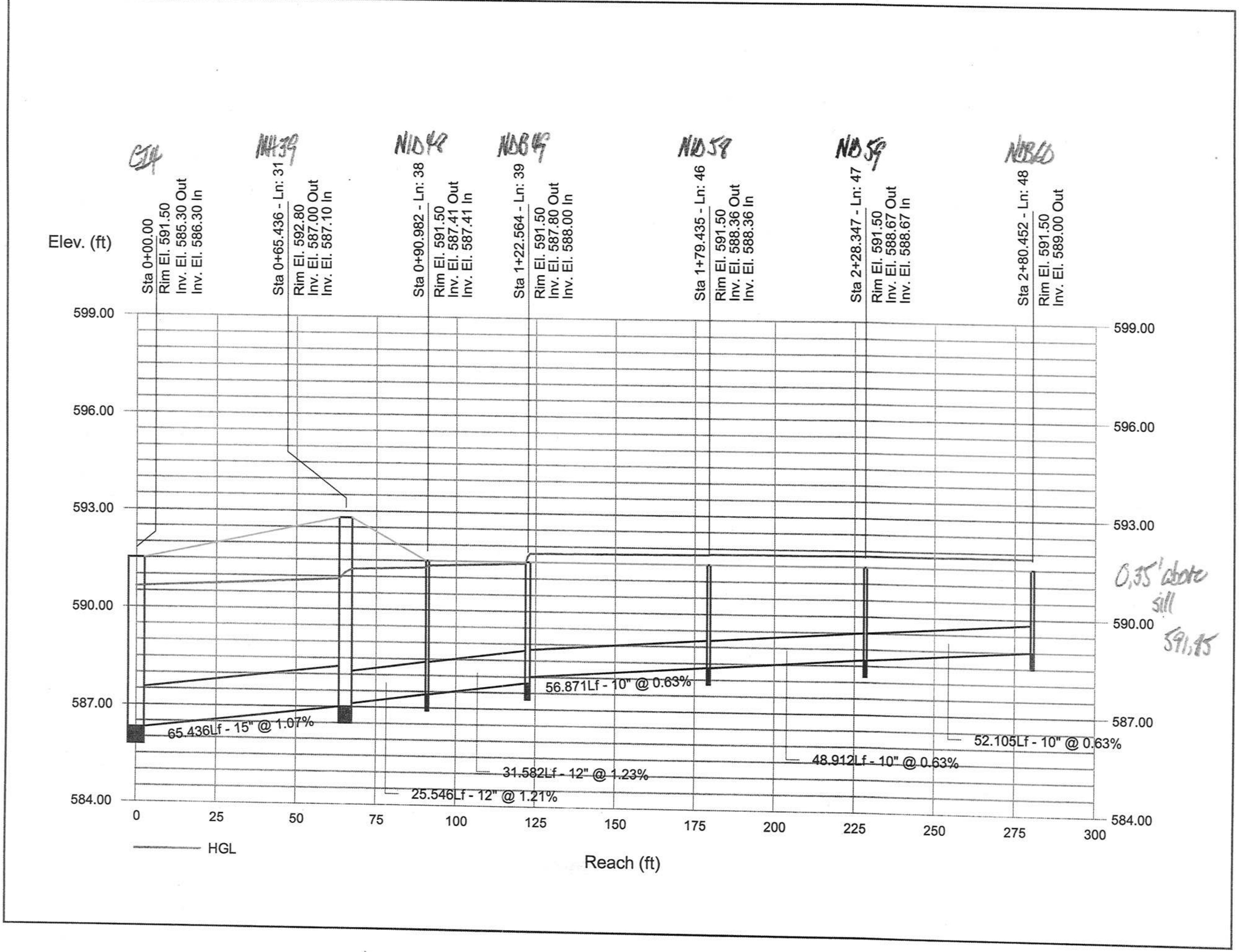


Storm Sewer Profile



Storm Sewer Profile

Proj. file: Storm 100.stm

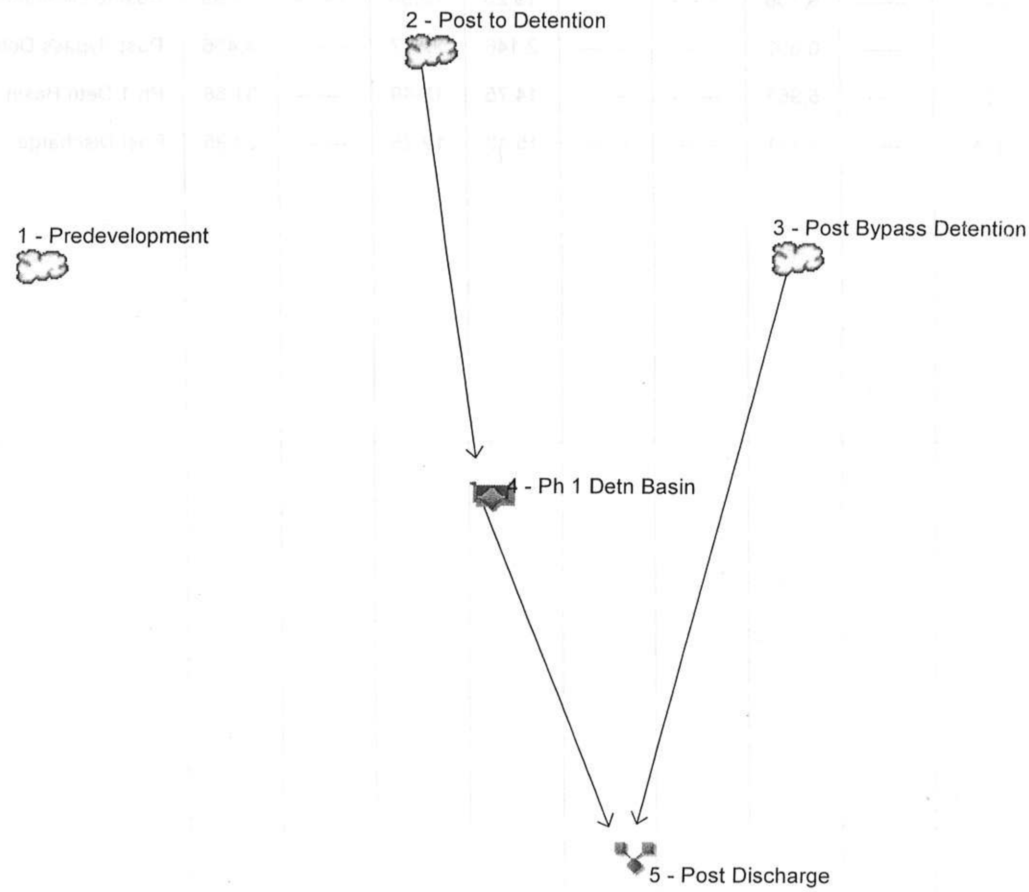


APPENDIX C
DETENTION POND CALCULATIONS
PHASE 1

Hydraflow Table of Contents

Watershed Model Schematic

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



Legend

Hyd.	Origin	Description
1	SCS Runoff	Predevelopment
2	SCS Runoff	Post to Detention
3	SCS Runoff	Post Bypass Detention
4	Reservoir	Ph 1 Detn Basin
5	Combine	Post Discharge

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 15	25-Yr	50-Yr	100-Yr	
1	SCS Runoff	------	-------	6.471	-------	-------	16.77	20.42	-------	36.58	Predevelopment
2	SCS Runoff	------	-------	9.136	-------	-------	19.23	22.59	-------	37.09	Post to Detention
3	SCS Runoff	------	-------	0.892	-------	-------	2.146	2.577	-------	4.456	Post Bypass Detention
4	Reservoir	2	-------	5.962	-------	-------	14.75	18.49	-------	31.68	Ph 1 Detn Basin
5	Combine	3, 4	-------	6.131	-------	-------	15.40	19.25	-------	33.95	Post Discharge

Hydrograph Summary Report

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

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	6.471	6	732	26,978	------	------	------	Predevelopment
2	SCS Runoff	9.136	6	726	37,071	------	------	------	Post to Detention
3	SCS Runoff	0.892	6	720	2,772	------	------	------	Post Bypass Detention
4	Reservoir	5.962	6	744	36,963	2	585.55	8,657	Ph 1 Detn Basin
5	Combine	6.131	6	744	39,735	3, 4	------	------	Post Discharge

Hydrograph Report

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

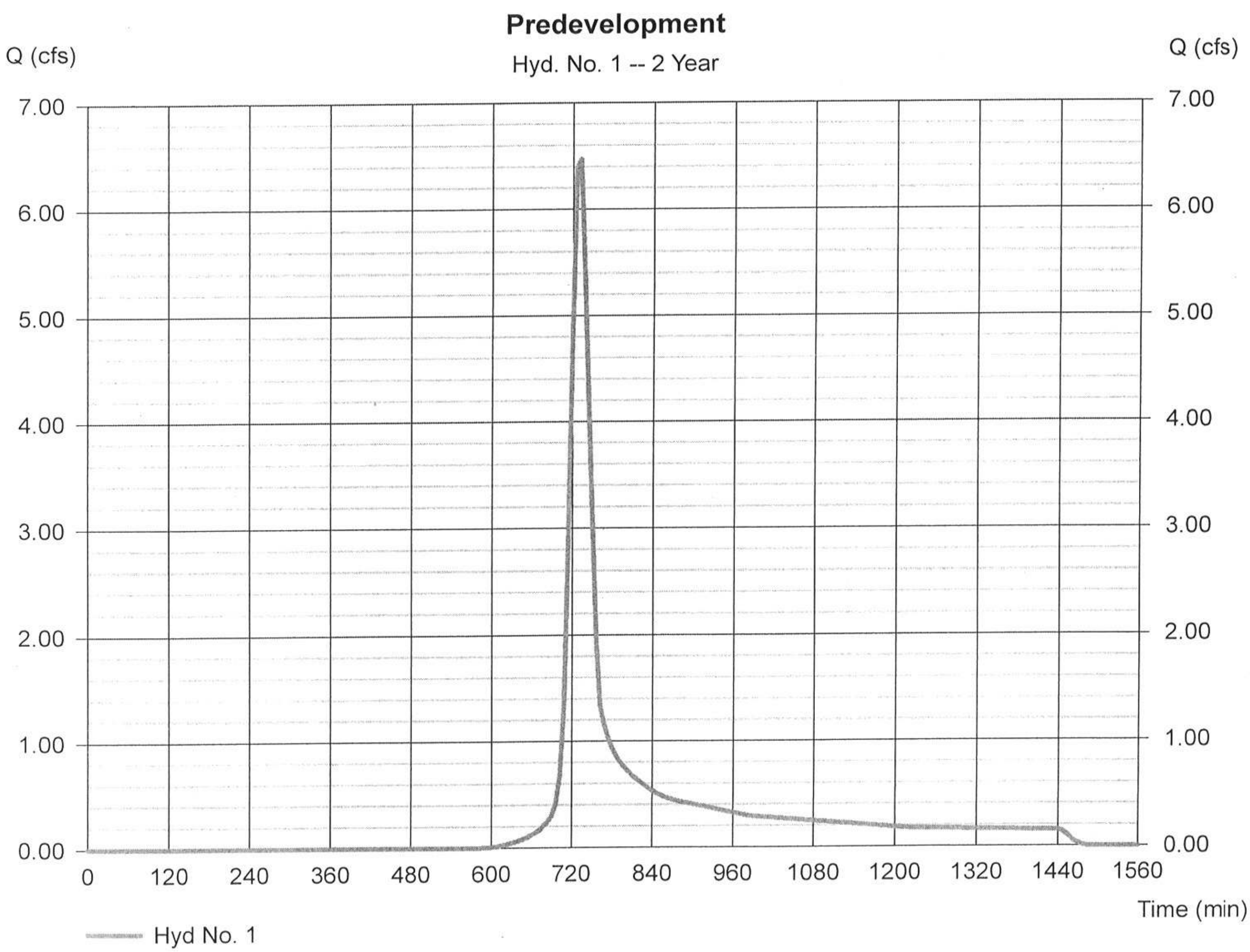
Friday, Dec 4, 2009

Hyd. No. 1

Predevelopment

Hydrograph type	= SCS Runoff	Peak discharge	= 6.471 cfs
Storm frequency	= 2 yrs	Time to peak	= 732 min
Time interval	= 6 min	Hyd. volume	= 26,978 cuft
Drainage area	= 5.910 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.80 min
Total precip.	= 3.01 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(4.880 x 80) + (0.160 x 98) + (0.660 x 80) + (0.210 x 79)] / 5.910



TR55 Tc Worksheet

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

Hyd. No. 1

Predevelopment

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.240		0.011		0.011		
Flow length (ft)	=	136.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.00		0.00		0.00		
Land slope (%)	=	1.80		0.00		0.00		
Travel Time (min)	**=**	**19.66**	**+**	**0.00**	**+**	**0.00**	**=**	**19.66**
Shallow Concentrated Flow								
Flow length (ft)	=	570.00		0.00		0.00		
Watercourse slope (%)	=	2.00		0.00		0.00		
Surface description	=	Unpaved		Paved		Paved		
Average velocity (ft/s)	=	2.28		0.00		0.00		
Travel Time (min)	**=**	**4.16**	**+**	**0.00**	**+**	**0.00**	**=**	**4.16**
Channel Flow								
X sectional flow area (sqft)	=	0.00		0.00		0.00		
Wetted perimeter (ft)	=	0.00		0.00		0.00		
Channel slope (%)	=	0.00		0.00		0.00		
Manning's n-value	=	0.015		0.015		0.015		
Velocity (ft/s)	=	0.00		0.00		0.00		
Flow length (ft)	=	0.0		0.0		0.0		
Travel Time (min)	**=**	**0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc .... 23.80 min

Hydrograph Report

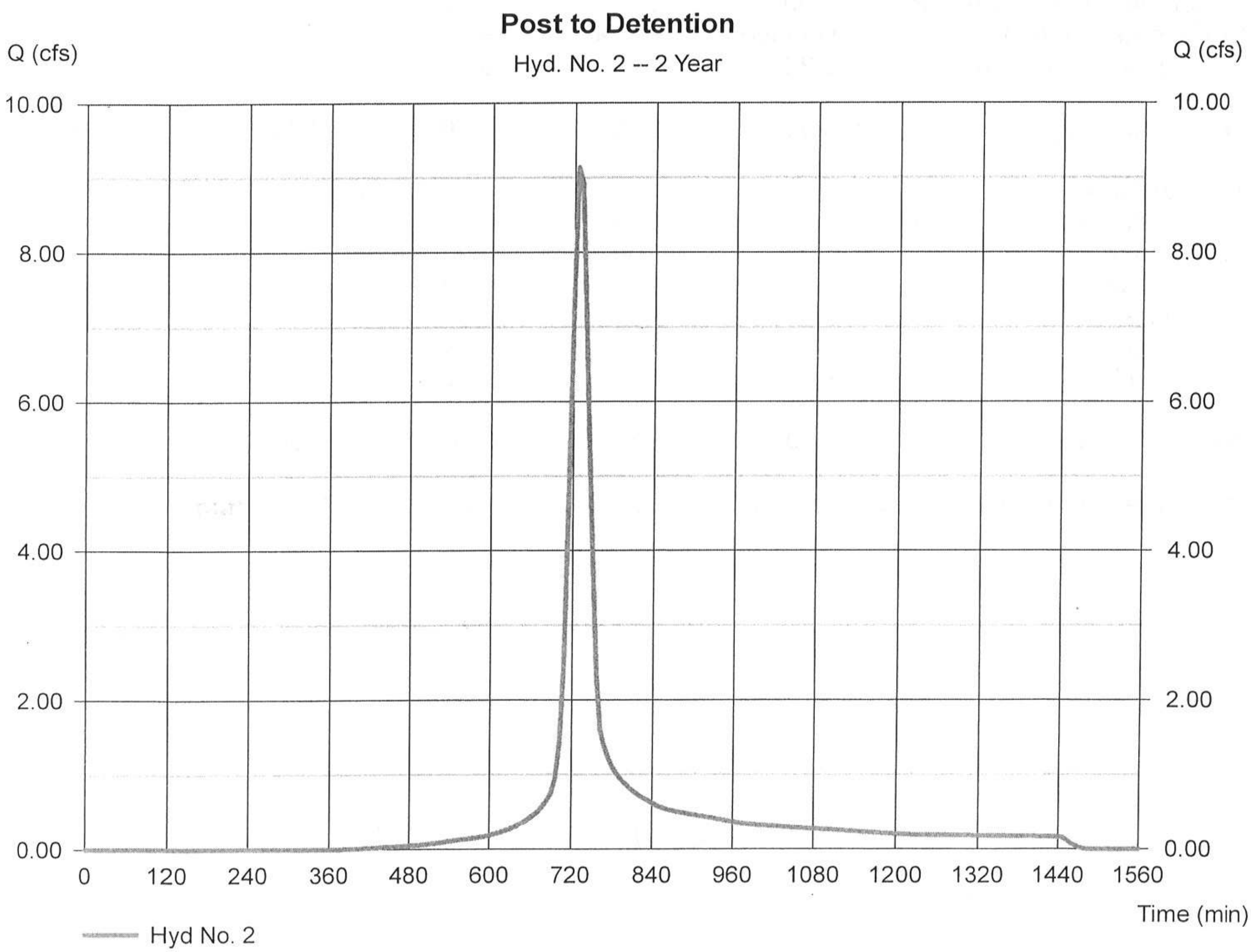
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 | Friday, Dec 4, 2009

Hyd. No. 2

Post to Detention

Hydrograph type	= SCS Runoff	Peak discharge	= 9.136 cfs
Storm frequency	= 2 yrs	Time to peak	= 726 min
Time interval	= 6 min	Hyd. volume	= 37,071 cuft
Drainage area	= 5.350 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 21.20 min
Total precip.	= 3.01 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.510 x 98) + (2.020 x 80) + (0.160 x 98) + (0.660 x 80)] / 5.350



TR55 Tc Worksheet

Hyd. No. 2

Post to Detention

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.240		0.011		0.011		
Flow length (ft)	=	136.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.01		0.00		0.00		
Land slope (%)	=	1.80		0.00		0.00		
Travel Time (min)	=	**19.63**	+	**0.00**	+	**0.00**	=	**19.63**
Shallow Concentrated Flow								
Flow length (ft)	=	0.00		0.00		0.00		
Watercourse slope (%)	=	0.00		0.00		0.00		
Surface description	=	Paved		Paved		Paved		
Average velocity (ft/s)	=	0.00		0.00		0.00		
Travel Time (min)	=	**0.00**	+	**0.00**	+	**0.00**	=	**0.00**
Channel Flow								
X sectional flow area (sqft)	=	1.77		0.00		0.00		
Wetted perimeter (ft)	=	4.70		0.00		0.00		
Channel slope (%)	=	1.00		0.00		0.00		
Manning's n-value	=	0.013		0.015		0.015		
Velocity (ft/s)	=	5.96		0.00		0.00		
Flow length (ft)	=	550.0		0.0		0.0		
Travel Time (min)	=	**1.54**	+	**0.00**	+	**0.00**	=	**1.54**

Total Travel Time, Tc .... 21.20 min

Hydrograph Report

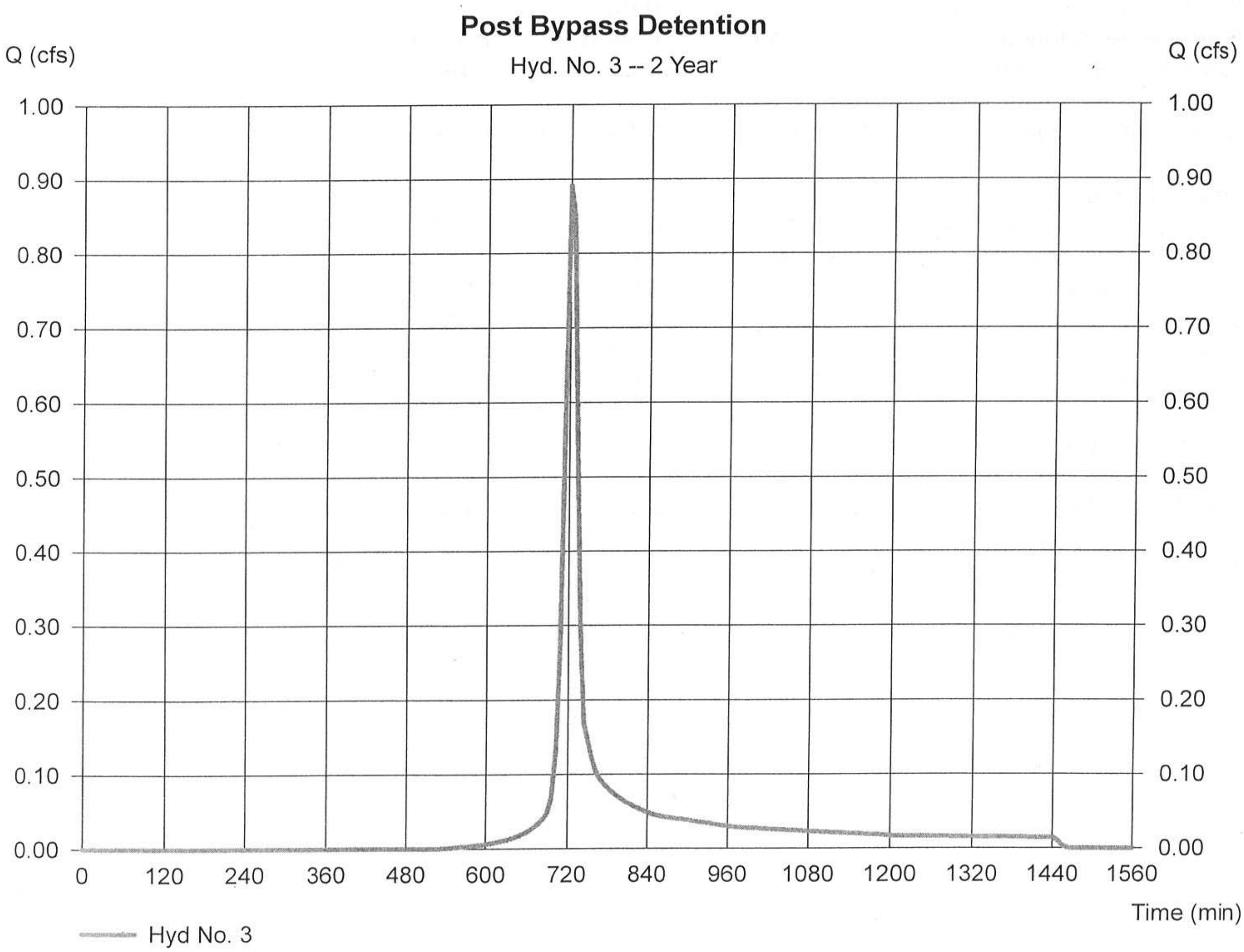
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 — Friday, Dec 4, 2009

Hyd. No. 3

Post Bypass Detention

Hydrograph type	= SCS Runoff
Storm frequency	= 2 yrs
Time interval	= 6 min
Drainage area	= 0.560 ac
Basin Slope	= 0.0 %
Tc method	= TR55
Total precip.	= 3.01 in
Storm duration	= 24 hrs
Peak discharge	= 0.892 cfs
Time to peak	= 720 min
Hyd. volume	= 2,772 cuft
Curve number	= 83*
Hydraulic length	= 0 ft
Time of conc. (Tc)	= 11.70 min
Distribution	= Type II
Shape factor	= 484

* Composite (Area/CN) = [(0.080 x 98) + (0.480 x 80)] / 0.560



TR55 Tc Worksheet

Hyd. No. 3

Post Bypass Detention

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.240		0.011		0.011		
Flow length (ft)	=	90.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.01		0.00		0.00		
Land slope (%)	=	4.00		0.00		0.00		
Travel Time (min)	**=**	**10.25**	**+**	**0.00**	**+**	**0.00**	**=**	**10.25**
Shallow Concentrated Flow								
Flow length (ft)	=	90.00		0.00		0.00		
Watercourse slope (%)	=	0.25		0.00		0.00		
Surface description	=	Paved		Paved		Paved		
Average velocity (ft/s)	=	1.02		0.00		0.00		
Travel Time (min)	**=**	**1.48**	**+**	**0.00**	**+**	**0.00**	**=**	**1.48**
Channel Flow								
X sectional flow area (sqft)	=	0.00		0.00		0.00		
Wetted perimeter (ft)	=	0.00		0.00		0.00		
Channel slope (%)	=	0.00		0.00		0.00		
Manning's n-value	=	0.015		0.015		0.015		
Velocity (ft/s)	=	0.00		0.00		0.00		
Flow length (ft)	=	0.0		0.0		0.0		
Travel Time (min)	**=**	**0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc .... 11.70 min

Hydrograph Report

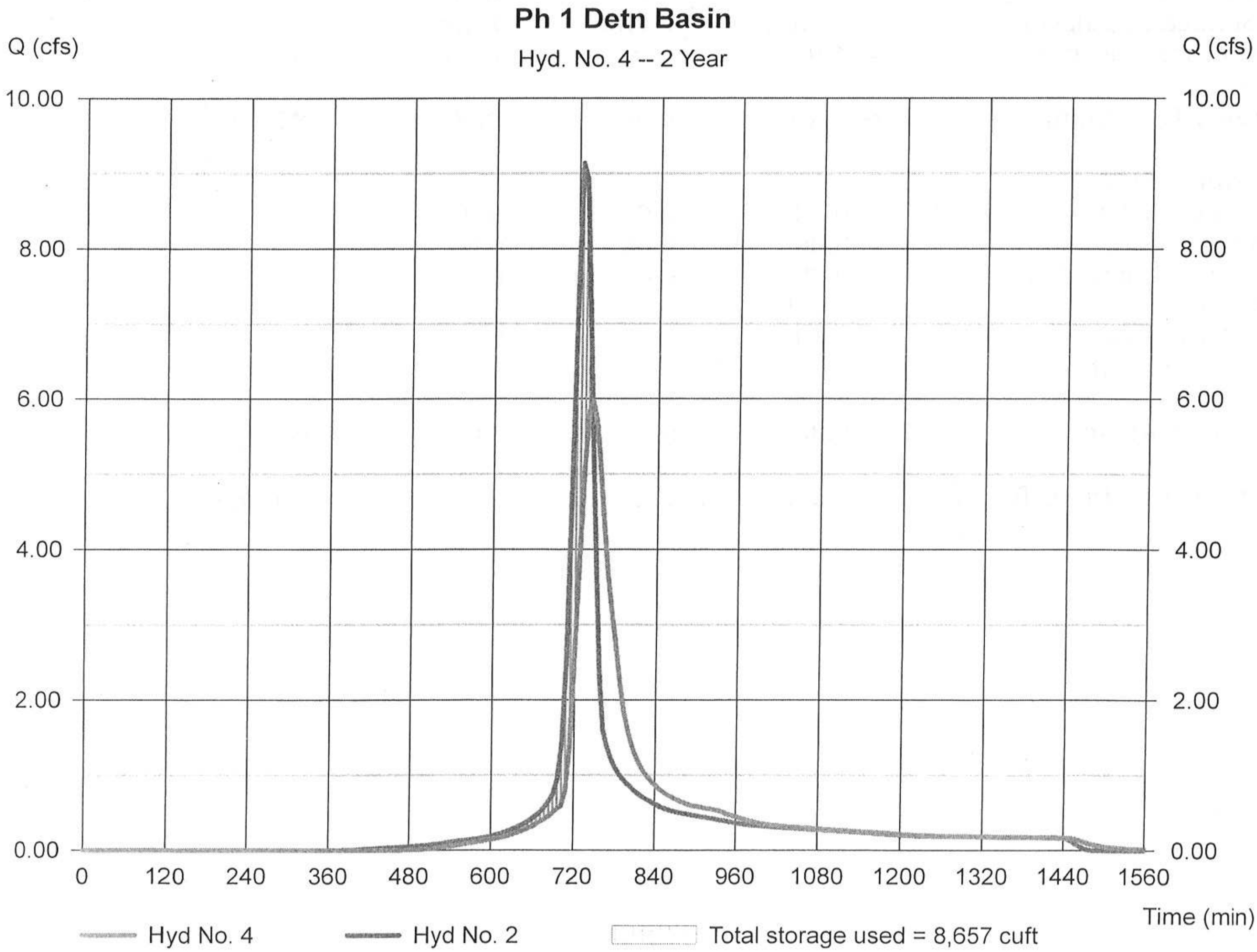
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 | Friday, Dec 4, 2009

Hyd. No. 4

Ph 1 Detn Basin

Hydrograph type	= Reservoir	Peak discharge	= 5.962 cfs
Storm frequency	= 2 yrs	Time to peak	= 744 min
Time interval	= 6 min	Hyd. volume	= 36,963 cuft
Inflow hyd. No.	= 2 - Post to Detention	Max. Elevation	= 585.55 ft
Reservoir name	= StormTech MC-3500	Max. Storage	= 8,657 cuft

Storage Indication method used.



Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Friday, Dec 4, 2009

Pond No. 1 - StormTech MC-3500

Pond Data

UG Chambers - Invert elev. = 584.50 ft, Rise x Span = 3.75 x 6.42 ft, Barrel Len = 250.83 ft, No. Barrels = 5, Slope = 0.25%, Headers = No
Encasement - Invert elev. = 583.75 ft, Width = 6.92 ft, Height = 5.50 ft, Voids = 40.00%
Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 590.25 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	583.75	n/a	0	0
0.61	584.36	n/a	1,047	1,047
1.23	584.98	n/a	3,022	4,069
1.84	585.59	n/a	4,936	9,005
2.45	586.20	n/a	4,955	13,960
3.06	586.81	n/a	4,759	18,719
3.68	587.43	n/a	4,448	23,167
4.29	588.04	n/a	3,956	27,123
4.90	588.65	n/a	2,997	30,120
5.51	589.26	n/a	2,169	32,290
6.13	589.88	n/a	2,127	34,417
6.50	590.25	25	3	34,420
7.00	590.75	25	13	34,433
7.25	591.00	01	3	34,435

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 30.00	6.00	0.00	0.00
Span (in)	= 30.00	6.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 583.75	583.80	0.00	0.00
Length (ft)	= 146.00	0.00	0.00	0.00
Slope (%)	= 0.79	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	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 1.33	3.67	Inactive	0.00
Crest El. (ft)	= 584.40	586.20	585.70	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	Rect	Rect	---
Multi-Stage	= Yes	Yes	Yes	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	583.75	0.00	0.00	---	---	0.00	0.00	0.00	---	---	---	0.000
0.06	105	583.81	0.00 ic	0.00 ic	---	---	0.00	0.00	0.00	---	---	---	0.000
0.12	209	583.87	0.02 ic	0.02 ic	---	---	0.00	0.00	0.00	---	---	---	0.016
0.18	314	583.93	0.05 ic	0.05 ic	---	---	0.00	0.00	0.00	---	---	---	0.054
0.25	419	584.00	0.11 ic	0.11 ic	---	---	0.00	0.00	0.00	---	---	---	0.107
0.31	524	584.06	0.18 ic	0.18 ic	---	---	0.00	0.00	0.00	---	---	---	0.176
0.37	628	584.12	0.26 ic	0.25 ic	---	---	0.00	0.00	0.00	---	---	---	0.254
0.43	733	584.18	0.35 ic	0.34 ic	---	---	0.00	0.00	0.00	---	---	---	0.336
0.49	838	584.24	0.43 ic	0.42 ic	---	---	0.00	0.00	0.00	---	---	---	0.415
0.55	942	584.30	0.47 ic	0.47 ic	---	---	0.00	0.00	0.00	---	---	---	0.474
0.61	1,047	584.36	0.56 ic	0.53 ic	---	---	0.00	0.00	0.00	---	---	---	0.529
0.67	1,349	584.42	0.61 ic	0.58 ic	---	---	0.02	0.00	0.00	---	---	---	0.595
0.74	1,652	584.49	0.72 ic	0.61 ic	---	---	0.11	0.00	0.00	---	---	---	0.721
0.80	1,954	584.55	0.90 ic	0.63 ic	---	---	0.25	0.00	0.00	---	---	---	0.878
0.86	2,256	584.61	1.12 ic	0.64 ic	---	---	0.42	0.00	0.00	---	---	---	1.063
0.92	2,558	584.67	1.28 ic	0.66 ic	---	---	0.62	0.00	0.00	---	---	---	1.283
0.98	2,860	584.73	1.55 ic	0.68 ic	---	---	0.84	0.00	0.00	---	---	---	1.517
1.04	3,163	584.79	1.77 ic	0.69 ic	---	---	1.09	0.00	0.00	---	---	---	1.775
1.10	3,465	584.85	2.09 ic	0.70 ic	---	---	1.35	0.00	0.00	---	---	---	2.055
1.16	3,767	584.91	2.35 ic	0.72 ic	---	---	1.63	0.00	0.00	---	---	---	2.350
1.23	4,069	584.98	2.73 ic	0.73 ic	---	---	1.93	0.00	0.00	---	---	---	2.662
1.29	4,563	585.04	3.02 ic	0.75 ic	---	---	2.25 s	0.00	0.00	---	---	---	2.992
1.35	5,056	585.10	3.32 ic	0.76 ic	---	---	2.56 s	0.00	0.00	---	---	---	3.323
1.41	5,550	585.16	3.65 ic	0.77 ic	---	---	2.88 s	0.00	0.00	---	---	---	3.654
1.47	6,044	585.22	4.00 ic	0.79 ic	---	---	3.21 s	0.00	0.00	---	---	---	3.998
1.53	6,537	585.28	4.35 ic	0.80 ic	---	---	3.55 s	0.00	0.00	---	---	---	4.351

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StormTech MC-3500

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
1.59	7,031	585.34	4.72 ic	0.82 ic	---	---	3.90 s	0.00	0.00	---	---	---	4.717
1.65	7,524	585.40	5.10 ic	0.83 ic	---	---	4.26 s	0.00	0.00	---	---	---	5.091
1.72	8,018	585.47	5.50 ic	0.84 ic	---	---	4.62 s	0.00	0.00	---	---	---	5.465
1.78	8,512	585.53	5.93 ic	0.86 ic	---	---	4.99 s	0.00	0.00	---	---	---	5.848
1.84	9,005	585.59	6.36 ic	0.87 ic	---	---	5.37 s	0.00	0.00	---	---	---	6.236
1.90	9,501	585.65	6.64 ic	0.88 ic	---	---	5.76 s	0.00	0.00	---	---	---	6.640
1.96	9,996	585.71	7.07 ic	0.90 ic	---	---	6.17 s	0.00	0.00	---	---	---	7.067
2.02	10,492	585.77	7.52 ic	0.91 ic	---	---	6.58 s	0.00	0.00	---	---	---	7.493
2.08	10,987	585.83	8.01 ic	0.92 ic	---	---	6.99 s	0.00	0.00	---	---	---	7.912
2.14	11,482	585.89	8.50 ic	0.93 ic	---	---	7.40 s	0.00	0.00	---	---	---	8.336
2.21	11,978	585.96	8.79 ic	0.95 ic	---	---	7.85 s	0.00	0.00	---	---	---	8.793
2.27	12,473	586.02	9.27 ic	0.96 ic	---	---	8.30 s	0.00	0.00	---	---	---	9.259
2.33	12,969	586.08	9.79 ic	0.97 ic	---	---	8.73 s	0.00	0.00	---	---	---	9.706
2.39	13,464	586.14	10.32 ic	0.98 ic	---	---	9.17 s	0.00	0.00	---	---	---	10.16
2.45	13,960	586.20	10.64 ic	1.00 ic	---	---	9.64 s	0.00	0.00	---	---	---	10.64
2.51	14,436	586.26	11.41 ic	1.00 ic	---	---	10.08 s	0.19	0.00	---	---	---	11.27
2.57	14,912	586.32	12.03 ic	1.01 ic	---	---	10.49 s	0.53	0.00	---	---	---	12.03
2.63	15,388	586.38	13.07 ic	1.01 ic	---	---	10.90 s	0.97	0.00	---	---	---	12.87
2.70	15,863	586.45	13.91 ic	1.01 ic	---	---	11.32 s	1.49	0.00	---	---	---	13.81
2.76	16,339	586.51	14.79 ic	1.00 ic	---	---	11.70 s	2.08	0.00	---	---	---	14.79
2.82	16,815	586.57	15.85 ic	1.00 ic	---	---	12.10 s	2.73	0.00	---	---	---	15.84
2.88	17,291	586.63	16.93 ic	1.00 ic	---	---	12.47 s	3.44	0.00	---	---	---	16.91
2.94	17,767	586.69	18.01 ic	0.99 ic	---	---	12.82 s	4.20	0.00	---	---	---	18.01
3.00	18,243	586.75	19.25 ic	0.98 ic	---	---	13.15 s	5.02	0.00	---	---	---	19.15
3.06	18,719	586.81	20.43 ic	0.97 ic	---	---	13.48 s	5.87	0.00	---	---	---	20.32
3.12	19,164	586.87	21.54 ic	0.97 ic	---	---	13.80 s	6.77	0.00	---	---	---	21.54
3.19	19,609	586.94	22.74 ic	0.95 ic	---	---	14.07 s	7.72	0.00	---	---	---	22.74
3.25	20,053	587.00	23.99 ic	0.94 ic	---	---	14.32 s	8.70	0.00	---	---	---	23.96
3.31	20,498	587.06	25.15 ic	0.92 ic	---	---	14.50 s	9.72	0.00	---	---	---	25.15
3.37	20,943	587.12	25.66 oc	0.86 ic	---	---	14.17 s	10.63 s	0.00	---	---	---	25.66
3.43	21,388	587.18	26.64 oc	0.84 ic	---	---	14.34 s	11.46 s	0.00	---	---	---	26.64
3.49	21,833	587.24	27.57 oc	0.82 ic	---	---	14.49 s	12.25 s	0.00	---	---	---	27.57
3.55	22,277	587.30	28.45 oc	0.81 ic	---	---	14.64 s	13.01 s	0.00	---	---	---	28.45
3.61	22,722	587.37	29.30 oc	0.79 ic	---	---	14.78 s	13.73 s	0.00	---	---	---	29.30
3.68	23,167	587.43	30.12 oc	0.77 ic	---	---	14.91 s	14.43 s	0.00	---	---	---	30.12
3.74	23,562	587.49	30.90 oc	0.76 ic	---	---	15.04 s	15.10 s	0.00	---	---	---	30.90
3.80	23,958	587.55	31.66 oc	0.74 ic	---	---	15.16 s	15.75 s	0.00	---	---	---	31.65
3.86	24,354	587.61	32.39 oc	0.73 ic	---	---	15.27 s	16.38 s	0.00	---	---	---	32.38
3.92	24,749	587.67	33.09 oc	0.72 ic	---	---	15.38 s	16.99 s	0.00	---	---	---	33.09
3.98	25,145	587.73	33.77 oc	0.70 ic	---	---	15.49 s	17.58 s	0.00	---	---	---	33.77
4.04	25,541	587.79	34.43 oc	0.69 ic	---	---	15.59 s	18.15 s	0.00	---	---	---	34.43
4.11	25,936	587.86	35.07 oc	0.67 ic	---	---	15.68 s	18.71 s	0.00	---	---	---	35.06
4.17	26,332	587.92	35.69 oc	0.66 ic	---	---	15.77 s	19.25 s	0.00	---	---	---	35.69
4.23	26,728	587.98	36.29 oc	0.65 ic	---	---	15.86 s	19.78 s	0.00	---	---	---	36.29
4.29	27,123	588.04	36.87 oc	0.64 ic	---	---	15.95 s	20.29 s	0.00	---	---	---	36.87
4.35	27,423	588.10	37.45 oc	0.63 ic	---	---	16.03 s	20.79 s	0.00	---	---	---	37.45
4.41	27,723	588.16	38.00 oc	0.62 ic	---	---	16.11 s	21.27 s	0.00	---	---	---	38.00
4.47	28,022	588.22	38.55 oc	0.60 ic	---	---	16.19 s	21.75 s	0.00	---	---	---	38.54
4.53	28,322	588.28	39.08 oc	0.59 ic	---	---	16.27 s	22.21 s	0.00	---	---	---	39.08
4.60	28,622	588.35	39.60 oc	0.58 ic	---	---	16.34 s	22.67 s	0.00	---	---	---	39.59
4.66	28,922	588.41	40.11 oc	0.57 ic	---	---	16.42 s	23.11 s	0.00	---	---	---	40.10
4.72	29,221	588.47	40.60 oc	0.56 ic	---	---	16.49 s	23.55 s	0.00	---	---	---	40.60
4.78	29,521	588.53	41.09 oc	0.55 ic	---	---	16.56 s	23.97 s	0.00	---	---	---	41.09
4.84	29,821	588.59	41.57 oc	0.55 ic	---	---	16.63 s	24.39 s	0.00	---	---	---	41.57
4.90	30,120	588.65	42.04 oc	0.54 ic	---	---	16.70 s	24.80 s	0.00	---	---	---	42.03
4.96	30,337	588.71	42.50 oc	0.53 ic	---	---	16.77 s	25.20 s	0.00	---	---	---	42.50
5.02	30,554	588.77	42.95 oc	0.52 ic	---	---	16.84 s	25.60 s	0.00	---	---	---	42.95
5.09	30,771	588.84	43.40 oc	0.51 ic	---	---	16.90 s	25.98 s	0.00	---	---	---	43.40
5.15	30,988	588.90	43.84 oc	0.50 ic	---	---	16.97 s	26.36 s	0.00	---	---	---	43.84
5.21	31,205	588.96	44.27 oc	0.50 ic	---	---	17.03 s	26.74 s	0.00	---	---	---	44.27
5.27	31,422	589.02	44.70 oc	0.49 ic	---	---	17.10 s	27.10 s	0.00	---	---	---	44.69
5.33	31,639	589.08	45.12 oc	0.48 ic	---	---	17.16 s	27.47 s	0.00	---	---	---	45.12
5.39	31,856	589.14	45.53 oc	0.48 ic	---	---	17.23 s	27.82 s	0.00	---	---	---	45.53
5.45	32,073	589.20	45.94 oc	0.47 ic	---	---	17.29 s	28.18 s	0.00	---	---	---	45.94
5.51	32,290	589.26	46.34 oc	0.46 ic	---	---	17.35 s	28.52 s	0.00	---	---	---	46.34
5.58	32,502	589.33	46.74 oc	0.46 ic	---	---	17.42 s	28.86 s	0.00	---	---	---	46.74
5.64	32,715	589.39	47.13 oc	0.45 ic	---	---	17.48 s	29.20 s	0.00	---	---	---	47.13
5.70	32,928	589.45	47.52 oc	0.44 ic	---	---	17.54 s	29.53 s	0.00	---	---	---	47.52
5.76	33,140	589.51	47.91 oc	0.44 ic	---	---	17.60 s	29.86 s	0.00	---	---	---	47.90
5.82	33,353	589.57	48.29 oc	0.43 ic	---	---	17.67 s	30.19 s	0.00	---	---	---	48.28
5.88	33,566	589.63	48.66 oc	0.43 ic	---	---	17.73 s	30.51 s	0.00	---	---	---	48.66

Continues on next page...

StormTech MC-3500

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
5.94	33,779	589.69	49.03 oc	0.42 ic	---	---	17.79 s	30.82 s	0.00	---	---	---	49.03
6.00	33,991	589.75	49.40 oc	0.42 ic	---	---	17.85 s	31.13 s	0.00	---	---	---	49.40
6.07	34,204	589.82	49.77 oc	0.41 ic	---	---	17.91 s	31.44 s	0.00	---	---	---	49.76
6.13	34,417	589.88	50.12 oc	0.41 ic	---	---	17.97 s	31.75 s	0.00	---	---	---	50.12
6.16	34,417	589.91	50.34 oc	0.40 ic	---	---	18.00 s	31.93 s	0.00	---	---	---	50.33
6.20	34,418	589.95	50.56 oc	0.40 ic	---	---	18.04 s	32.11 s	0.00	---	---	---	50.55
6.24	34,418	589.99	50.77 oc	0.40 ic	---	---	18.08 s	32.29 s	0.00	---	---	---	50.77
6.28	34,418	590.03	50.99 oc	0.40 ic	---	---	18.11 s	32.47 s	0.00	---	---	---	50.98
6.31	34,418	590.06	51.20 oc	0.39 ic	---	---	18.15 s	32.65 s	0.00	---	---	---	51.20
6.35	34,419	590.10	51.41 oc	0.39 ic	---	---	18.19 s	32.83 s	0.00	---	---	---	51.41
6.39	34,419	590.14	51.62 oc	0.39 ic	---	---	18.22 s	33.00 s	0.00	---	---	---	51.61
6.43	34,419	590.18	51.83 oc	0.38 ic	---	---	18.26 s	33.18 s	0.00	---	---	---	51.83
6.46	34,420	590.21	52.04 oc	0.38 ic	---	---	18.30 s	33.36 s	0.00	---	---	---	52.03
6.50	34,420	590.25	52.25 oc	0.38 ic	---	---	18.33 s	33.53 s	0.00	---	---	---	52.24
6.55	34,421	590.30	52.52 oc	0.38 ic	---	---	18.38 s	33.76 s	0.00	---	---	---	52.51
6.60	34,423	590.35	52.80 oc	0.37 ic	---	---	18.43 s	33.99 s	0.00	---	---	---	52.79
6.65	34,424	590.40	53.07 oc	0.37 ic	---	---	18.48 s	34.22 s	0.00	---	---	---	53.06
6.70	34,425	590.45	53.34 oc	0.37 ic	---	---	18.52 s	34.44 s	0.00	---	---	---	53.33
6.75	34,426	590.50	53.61 oc	0.36 ic	---	---	18.57 s	34.66 s	0.00	---	---	---	53.60
6.80	34,428	590.55	53.88 oc	0.36 ic	---	---	18.62 s	34.89 s	0.00	---	---	---	53.87
6.85	34,429	590.60	54.14 oc	0.36 ic	---	---	18.67 s	35.11 s	0.00	---	---	---	54.13
6.90	34,430	590.65	54.40 oc	0.35 ic	---	---	18.72 s	35.33 s	0.00	---	---	---	54.40
6.95	34,431	590.70	54.67 oc	0.35 ic	---	---	18.76 s	35.54 s	0.00	---	---	---	54.65
7.00	34,433	590.75	54.93 oc	0.35 ic	---	---	18.81 s	35.76 s	0.00	---	---	---	54.92
7.03	34,433	590.78	55.06 oc	0.35 ic	---	---	18.83 s	35.87 s	0.00	---	---	---	55.04
7.05	34,433	590.80	55.19 oc	0.35 ic	---	---	18.86 s	35.98 s	0.00	---	---	---	55.18
7.08	34,433	590.83	55.32 oc	0.34 ic	---	---	18.88 s	36.08 s	0.00	---	---	---	55.30
7.10	34,434	590.85	55.45 oc	0.34 ic	---	---	18.90 s	36.19 s	0.00	---	---	---	55.43
7.13	34,434	590.88	55.57 oc	0.34 ic	---	---	18.93 s	36.30 s	0.00	---	---	---	55.57
7.15	34,434	590.90	55.70 oc	0.34 ic	---	---	18.95 s	36.41 s	0.00	---	---	---	55.70
7.18	34,434	590.93	55.83 oc	0.34 ic	---	---	18.98 s	36.51 s	0.00	---	---	---	55.83
7.20	34,435	590.95	55.96 oc	0.34 ic	---	---	19.00 s	36.62 s	0.00	---	---	---	55.96
7.23	34,435	590.98	56.08 oc	0.34 ic	---	---	19.02 s	36.71 s	0.00	---	---	---	56.07
7.25	34,435	591.00	56.21 oc	0.33 ic	---	---	19.05 s	36.82 s	0.00	---	---	---	56.20

...End

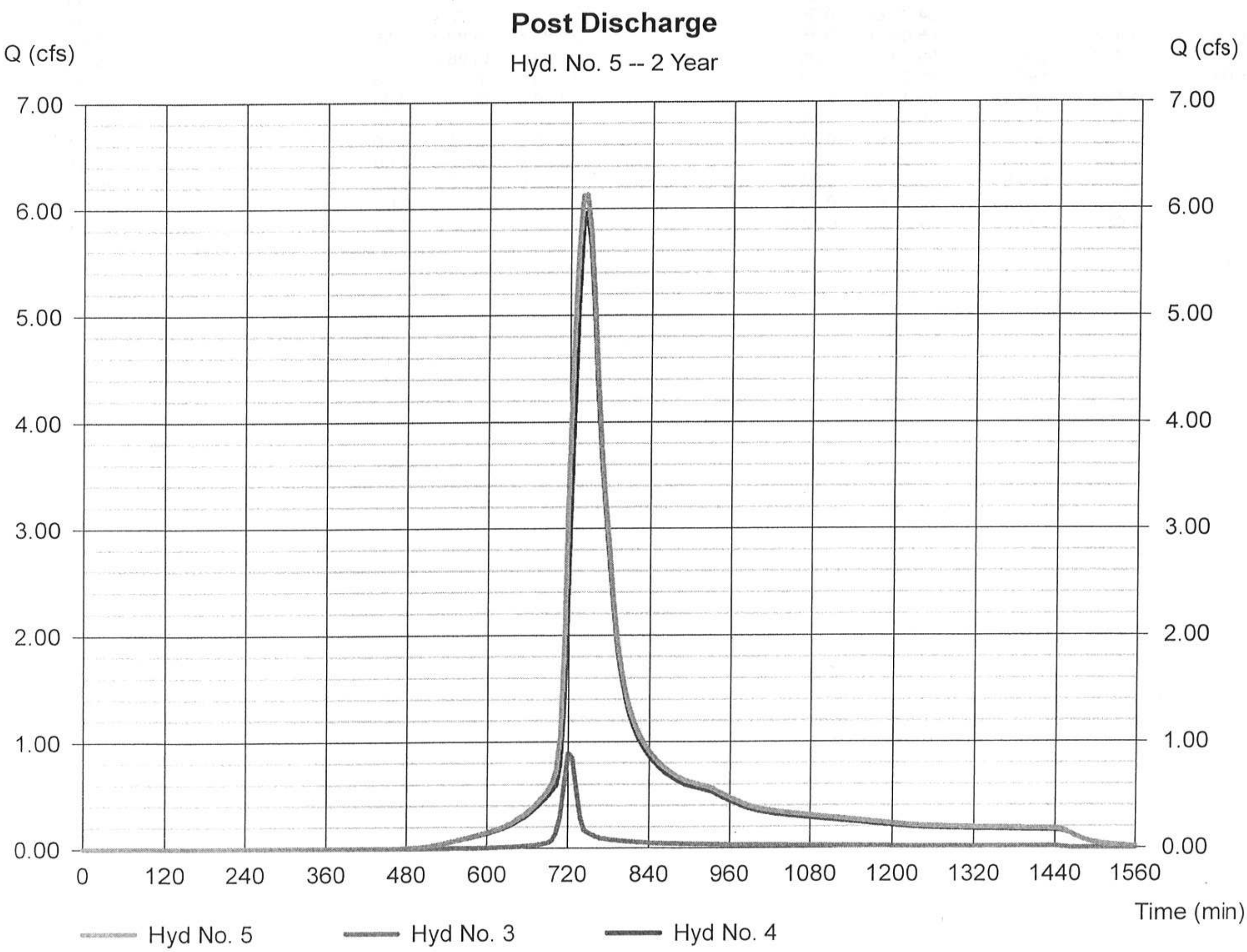
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 | Friday, Dec 4, 2009

Hyd. No. 5

Post Discharge

Hydrograph type	= Combine	Peak discharge	= 6.131 cfs
Storm frequency	= 2 yrs	Time to peak	= 744 min
Time interval	= 6 min	Hyd. volume	= 39,735 cuft
Inflow hyds.	= 3, 4	Contrib. drain. area	= 0.560 ac



Hydrograph Summary Report

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

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	16.77	6	726	68,089	------	------	------	Predevelopment
2	SCS Runoff	19.23	6	726	79,216	------	------	------	Post to Detention
3	SCS Runoff	2.146	6	720	6,603	------	------	------	Post Bypass Detention
4	Reservoir	14.75	6	738	79,108	2	586.51	16,322	Ph 1 Detn Basin
5	Combine	15.40	6	738	85,711	3, 4	------	------	Post Discharge

Woodbury Phase 1.gpw	Return Period: ~~10~~ 15 Year	Friday, Dec 4, 2009

Hydrograph Report

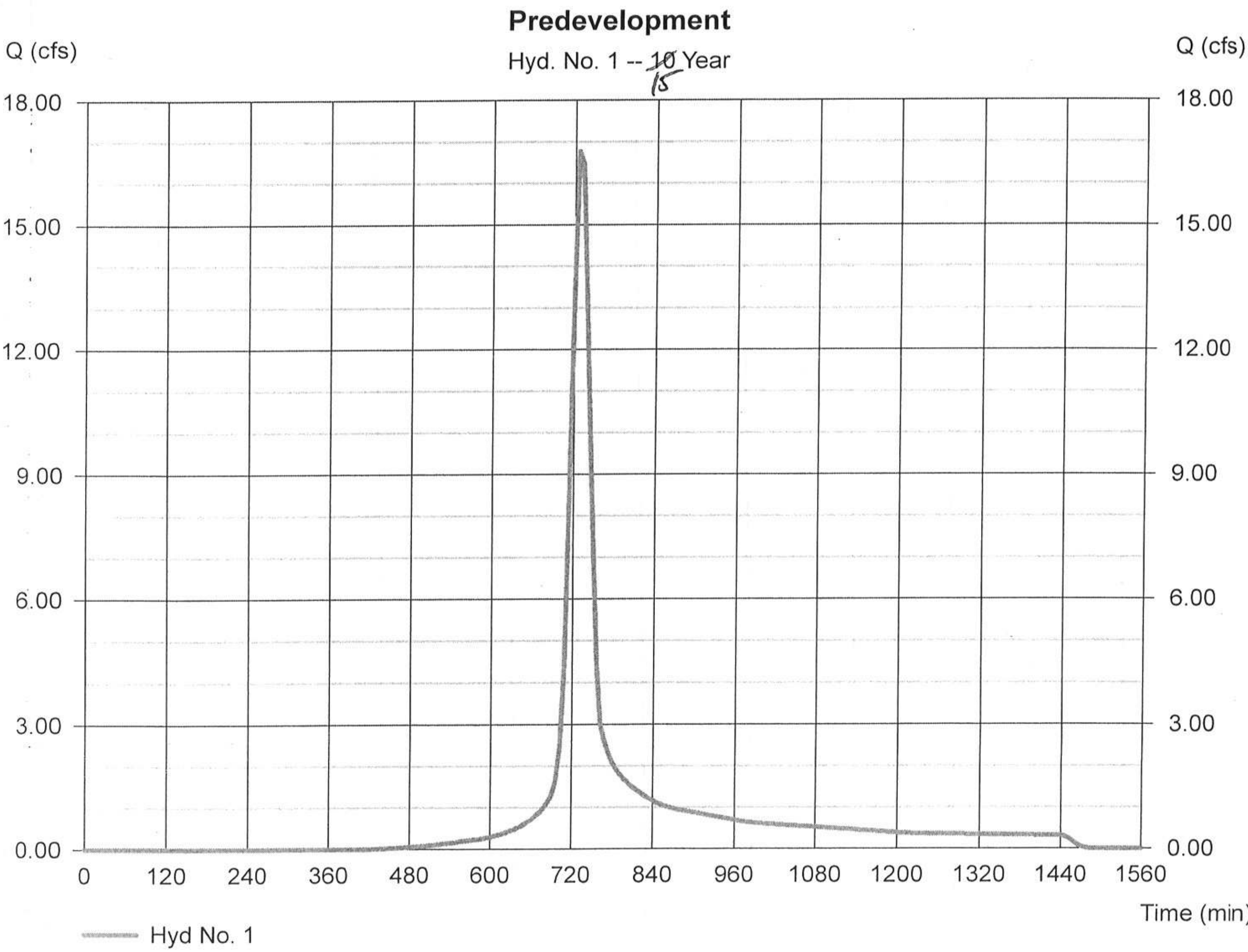
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Friday, Dec 4, 2009

Hyd. No. 1

Predevelopment

Hydrograph type	= SCS Runoff	Peak discharge	= 16.77 cfs
Storm frequency	= ~~10~~ yrs 15	Time to peak	= 726 min
Time interval	= 6 min	Hyd. volume	= 68,089 cuft
Drainage area	= 5.910 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.80 min
Total precip.	= 5.32 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(4.880 x 80) + (0.160 x 98) + (0.660 x 80) + (0.210 x 79)] / 5.910



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 — Friday, Dec 4, 2009

Hyd. No. 2

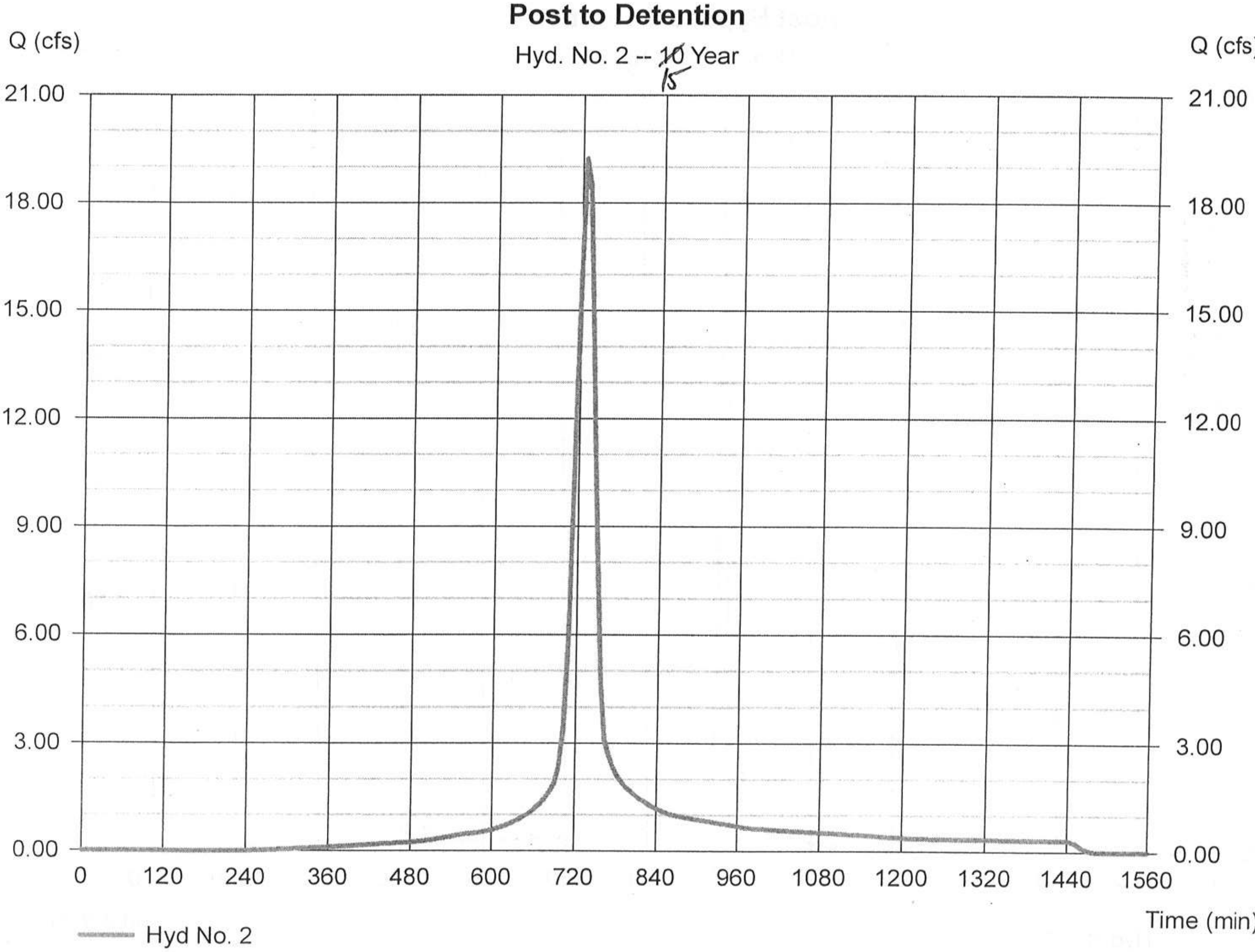
Post to Detention

Hydrograph type	= SCS Runoff	Peak discharge	= 19.23 cfs
Storm frequency	= ~~10~~ yrs 15	Time to peak	= 726 min
Time interval	= 6 min	Hyd. volume	= 79,216 cuft
Drainage area	= 5.350 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 21.20 min
Total precip.	= 5.32 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.510 x 98) + (2.020 x 80) + (0.160 x 98) + (0.660 x 80)] / 5.350

Post to Detention

Hyd. No. 2 -- ~~10~~ 15 Year



Hydrograph Report

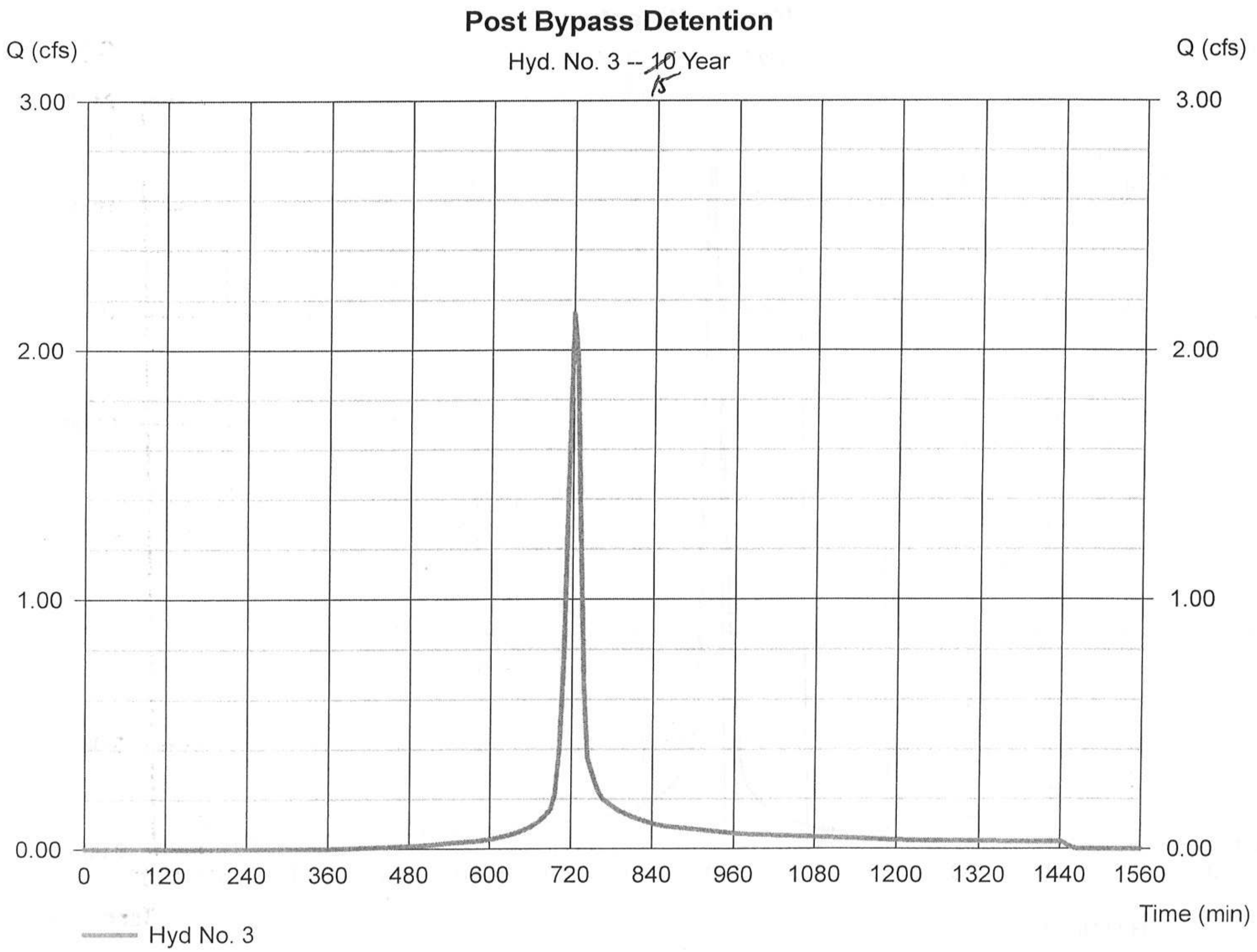
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 | Friday, Dec 4, 2009

Hyd. No. 3

Post Bypass Detention

Hydrograph type	= SCS Runoff	Peak discharge	= 2.146 cfs
Storm frequency	= ~~10~~ yrs 15	Time to peak	= 720 min
Time interval	= 6 min	Hyd. volume	= 6,603 cuft
Drainage area	= 0.560 ac	Curve number	= 83*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.70 min
Total precip.	= 5.32 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.080 x 98) + (0.480 x 80)] / 0.560



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 — Friday, Dec 4, 2009

Hyd. No. 4

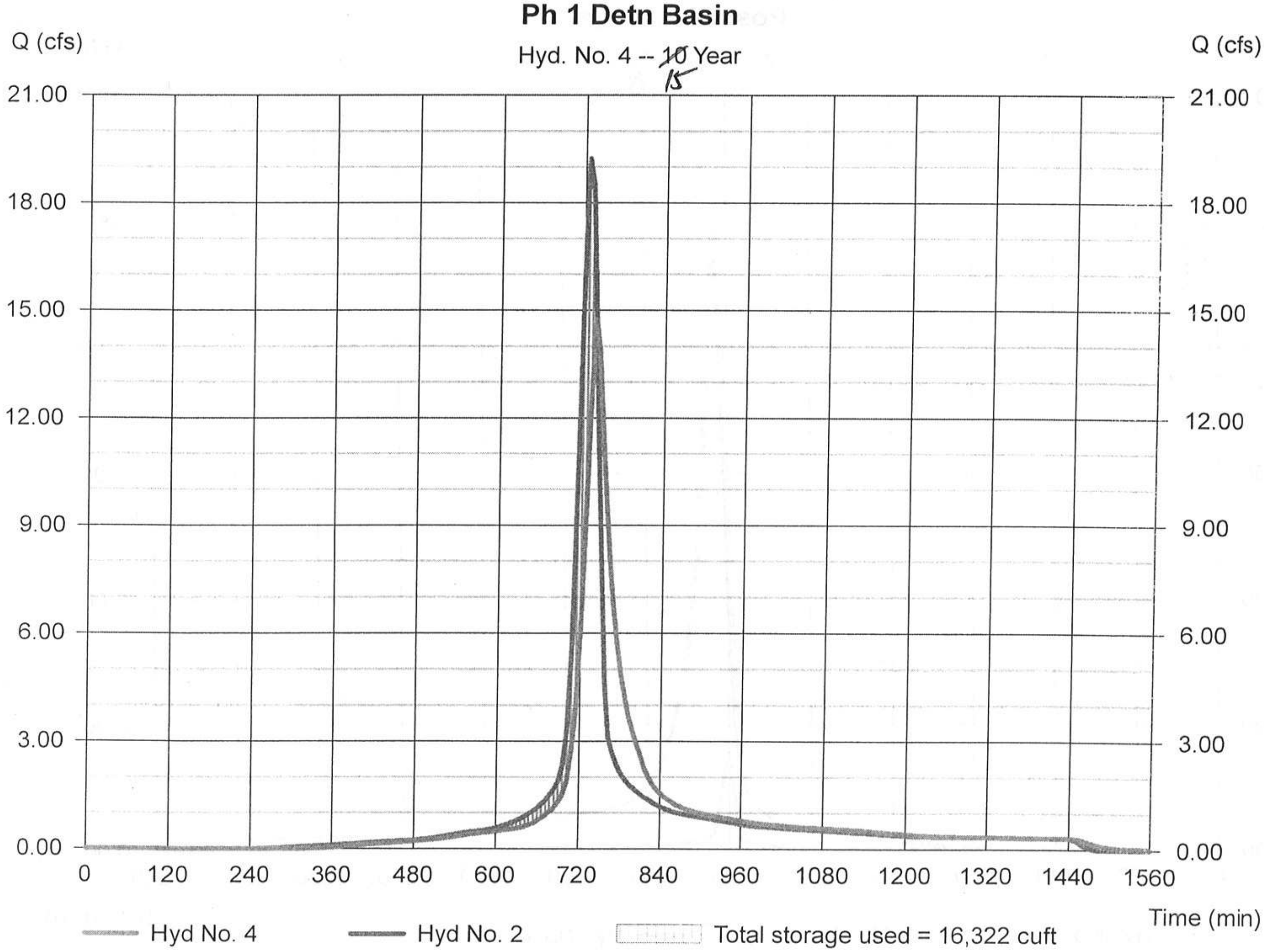
Ph 1 Detn Basin

Hydrograph type	= Reservoir	Peak discharge	= 14.75 cfs
Storm frequency	= ~~10~~ yrs 15	Time to peak	= 738 min
Time interval	= 6 min	Hyd. volume	= 79,108 cuft
Inflow hyd. No.	= 2 - Post to Detention	Max. Elevation	= 586.51 ft
Reservoir name	= StormTech MC-3500	Max. Storage	= 16,322 cuft

Storage Indication method used.

Ph 1 Detn Basin

Hyd. No. 4 -- ~~10~~ 15 Year



Hydrograph Report

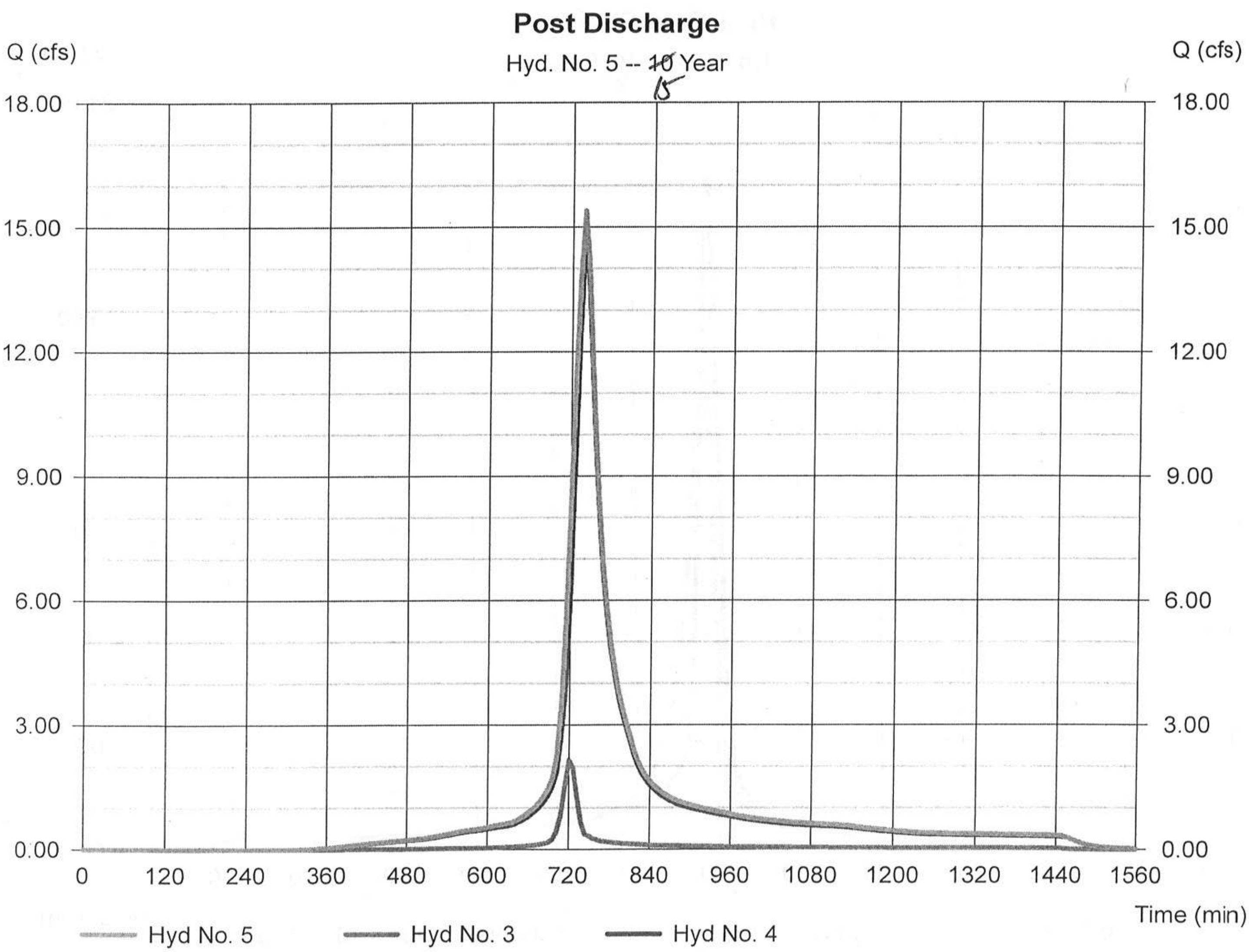
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Friday, Dec 4, 2009

Hyd. No. 5

Post Discharge

Hydrograph type	= Combine	Peak discharge	= 15.40 cfs
Storm frequency	= ~~10~~ yrs 15	Time to peak	= 738 min
Time interval	= 6 min	Hyd. volume	= 85,711 cuft
Inflow hyds.	= 3, 4	Contrib. drain. area	= 0.560 ac



Hydrograph Summary Report

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

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	20.42	6	726	82,865	------	------	------	Predevelopment
2	SCS Runoff	22.59	6	726	93,658	------	------	------	Post to Detention
3	SCS Runoff	2.577	6	720	7,956	------	------	------	Post Bypass Detention
4	Reservoir	18.49	6	738	93,550	2	586.74	17,965	Ph 1 Detn Basin
5	Combine	19.25	6	738	101,506	3, 4	------	------	Post Discharge

Hydrograph Report

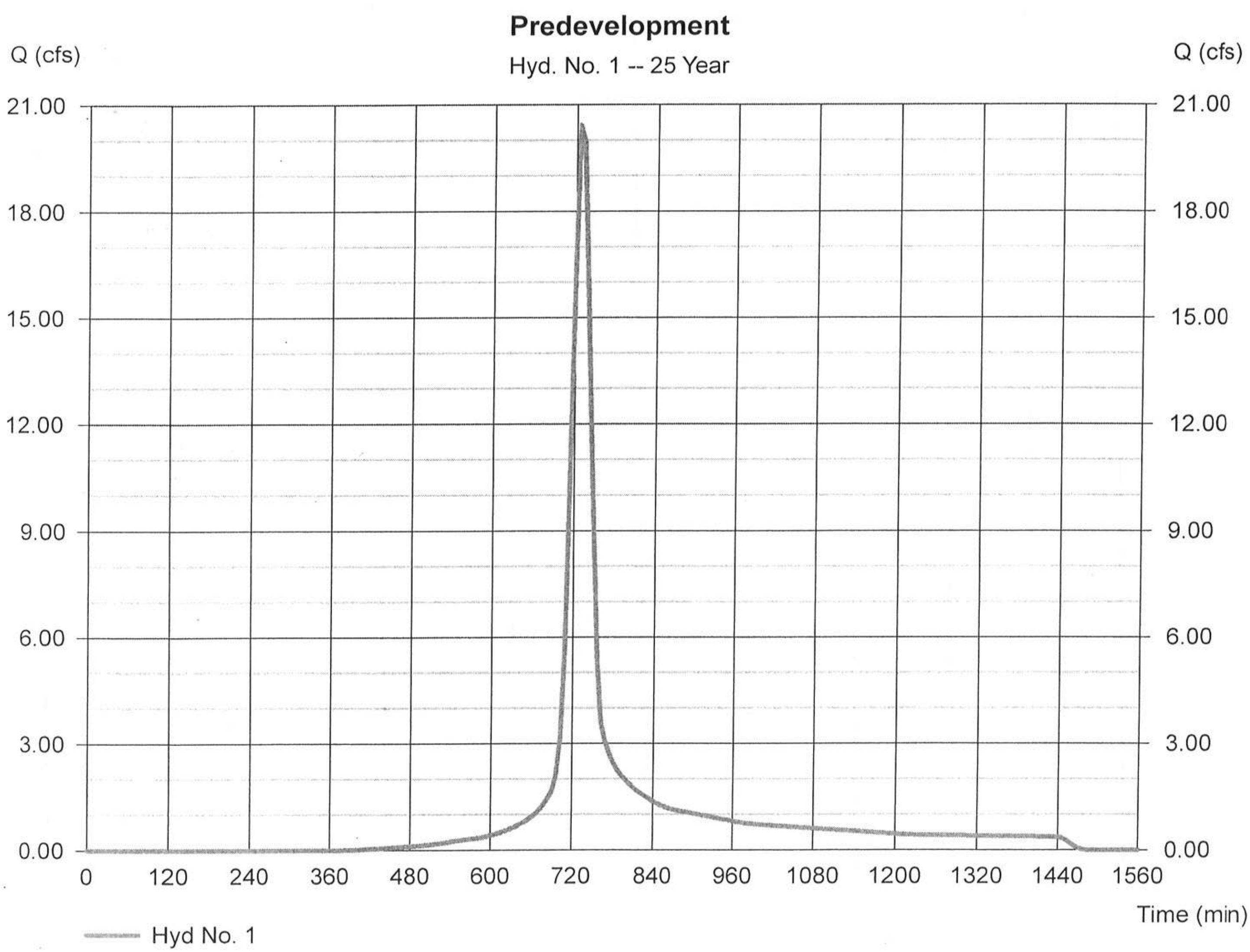
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 — Friday, Dec 4, 2009

Hyd. No. 1

Predevelopment

Hydrograph type	= SCS Runoff	Peak discharge	= 20.42 cfs
Storm frequency	= 25 yrs	Time to peak	= 726 min
Time interval	= 6 min	Hyd. volume	= 82,865 cuft
Drainage area	= 5.910 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.80 min
Total precip.	= 6.09 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(4.880 x 80) + (0.160 x 98) + (0.660 x 80) + (0.210 x 79)] / 5.910



Hydrograph Report

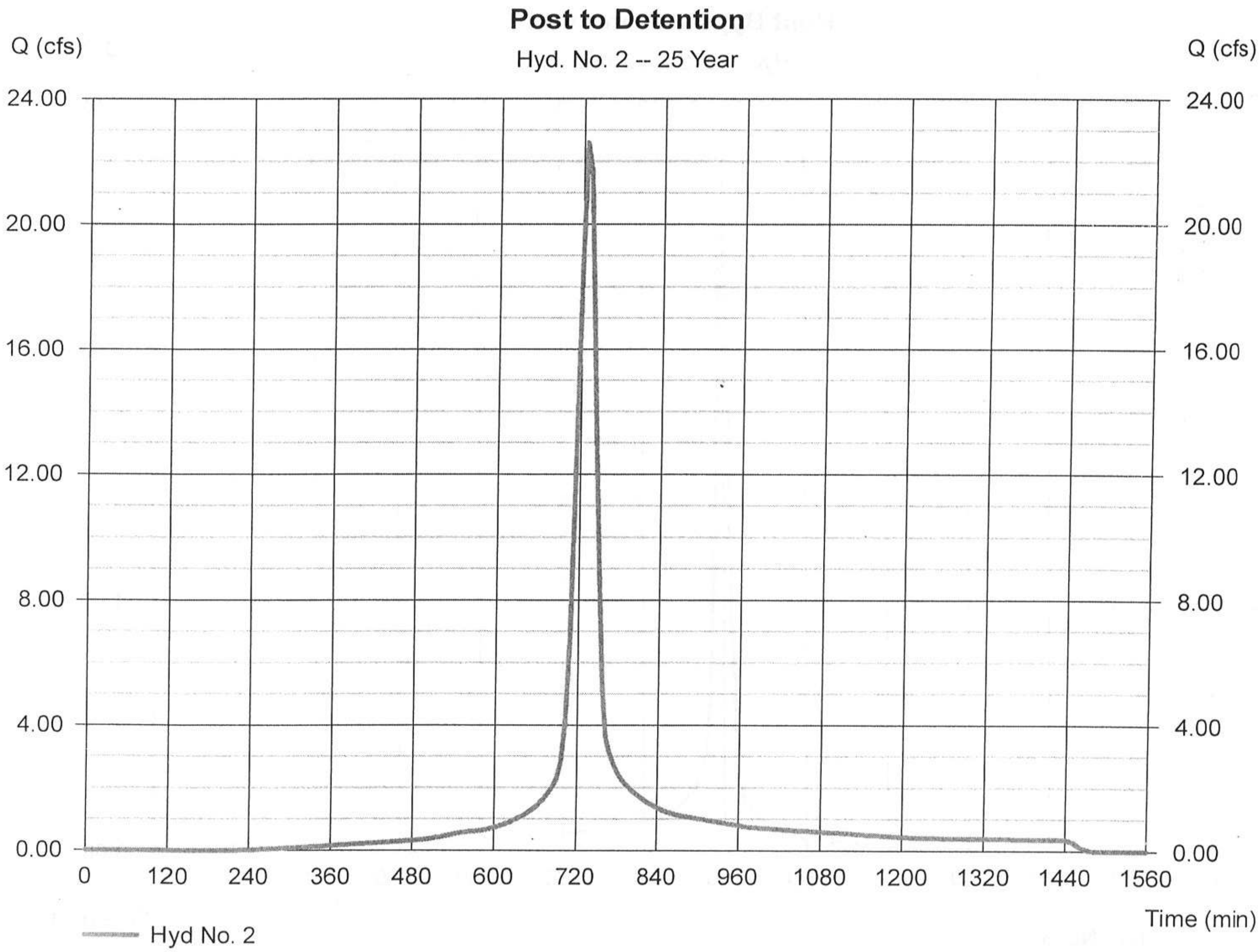
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 | Friday, Dec 4, 2009

Hyd. No. 2

Post to Detention

Hydrograph type	= SCS Runoff	Peak discharge	= 22.59 cfs
Storm frequency	= 25 yrs	Time to peak	= 726 min
Time interval	= 6 min	Hyd. volume	= 93,658 cuft
Drainage area	= 5.350 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 21.20 min
Total precip.	= 6.09 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.510 x 98) + (2.020 x 80) + (0.160 x 98) + (0.660 x 80)] / 5.350



Hydrograph Report

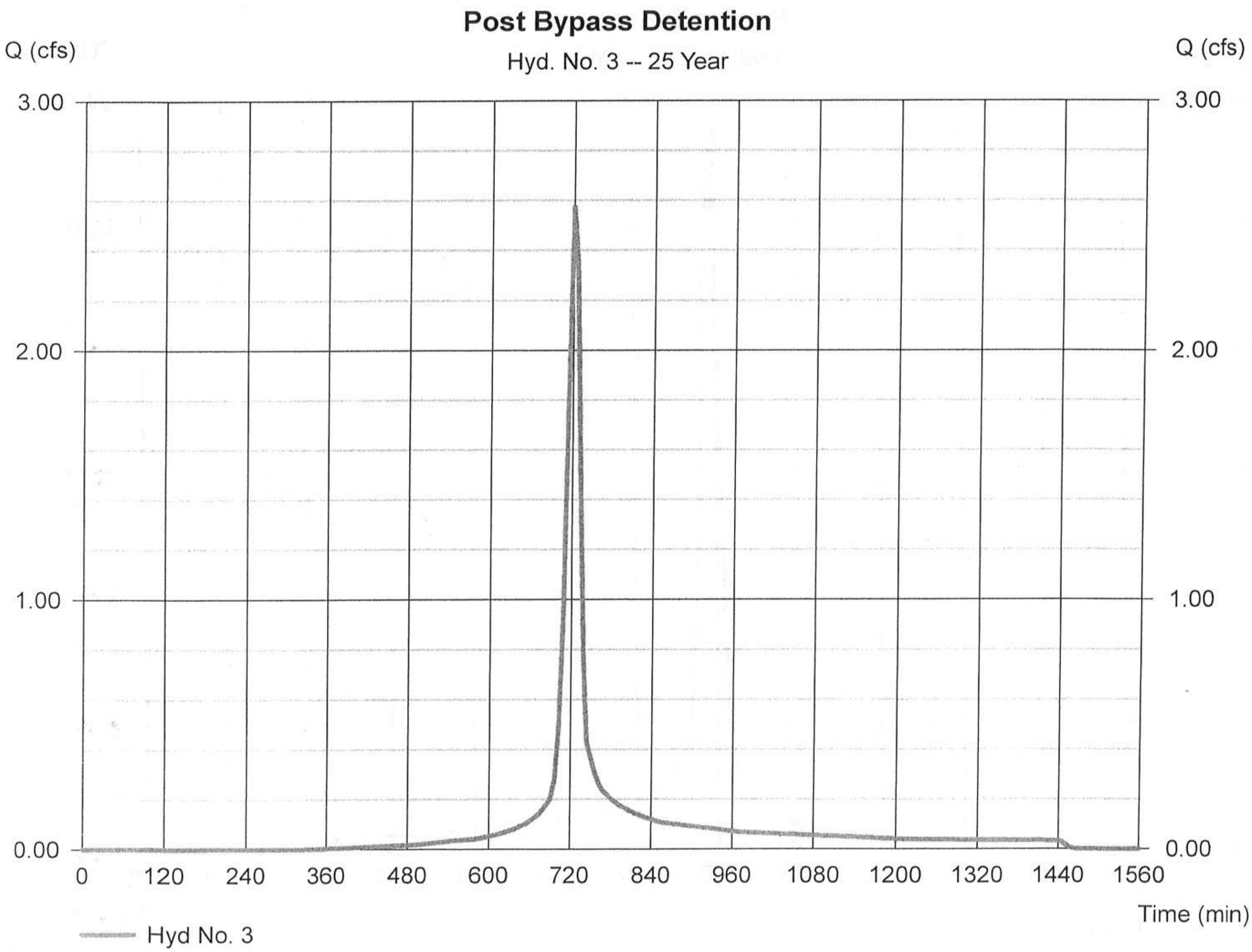
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 — Friday, Dec 4, 2009

Hyd. No. 3

Post Bypass Detention

Hydrograph type	= SCS Runoff	Peak discharge	= 2.577 cfs
Storm frequency	= 25 yrs	Time to peak	= 720 min
Time interval	= 6 min	Hyd. volume	= 7,956 cuft
Drainage area	= 0.560 ac	Curve number	= 83*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.70 min
Total precip.	= 6.09 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.080 x 98) + (0.480 x 80)] / 0.560



Hydrograph Report

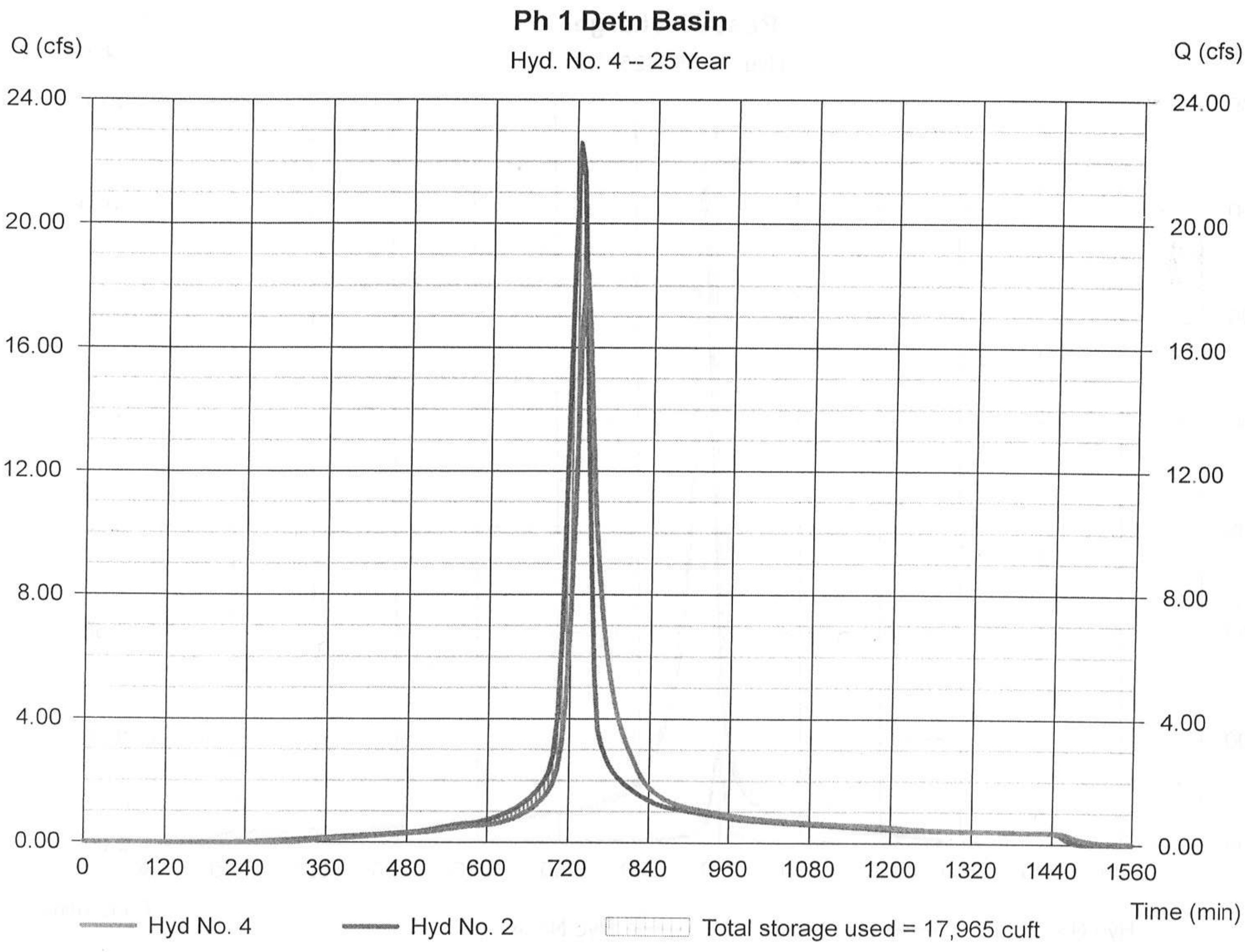
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 — Friday, Dec 4, 2009

Hyd. No. 4

Ph 1 Detn Basin

Hydrograph type	= Reservoir	Peak discharge	= 18.49 cfs
Storm frequency	= 25 yrs	Time to peak	= 738 min
Time interval	= 6 min	Hyd. volume	= 93,550 cuft
Inflow hyd. No.	= 2 - Post to Detention	Max. Elevation	= 586.74 ft
Reservoir name	= StormTech MC-3500	Max. Storage	= 17,965 cuft

Storage Indication method used.



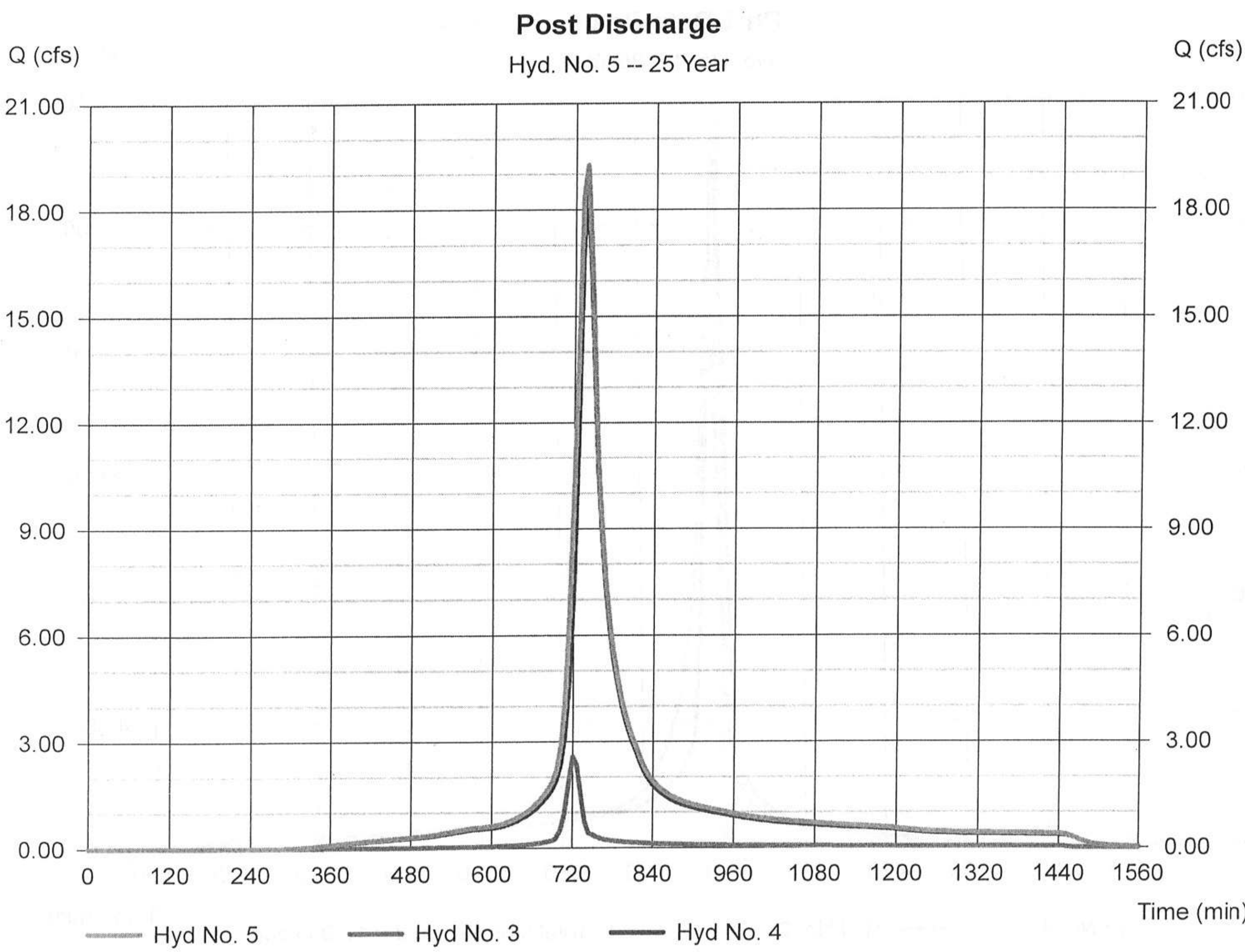
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 | Friday, Dec 4, 2009

Hyd. No. 5

Post Discharge

Hydrograph type	= Combine	Peak discharge	= 19.25 cfs
Storm frequency	= 25 yrs	Time to peak	= 738 min
Time interval	= 6 min	Hyd. volume	= 101,506 cuft
Inflow hyds.	= 3, 4	Contrib. drain. area	= 0.560 ac



Hydrograph Summary Report

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

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	36.58	6	726	149,880	------	------	------	Predevelopment
2	SCS Runoff	37.09	6	726	157,370	------	------	------	Post to Detention
3	SCS Runoff	4.456	6	720	14,028	------	------	------	Post Bypass Detention
4	Reservoir	31.68	6	738	157,262	2	587.64	23,973	Ph 1 Detn Basin
5	Combine	33.95	6	732	171,290	3, 4	------	------	Post Discharge

Hydrograph Report

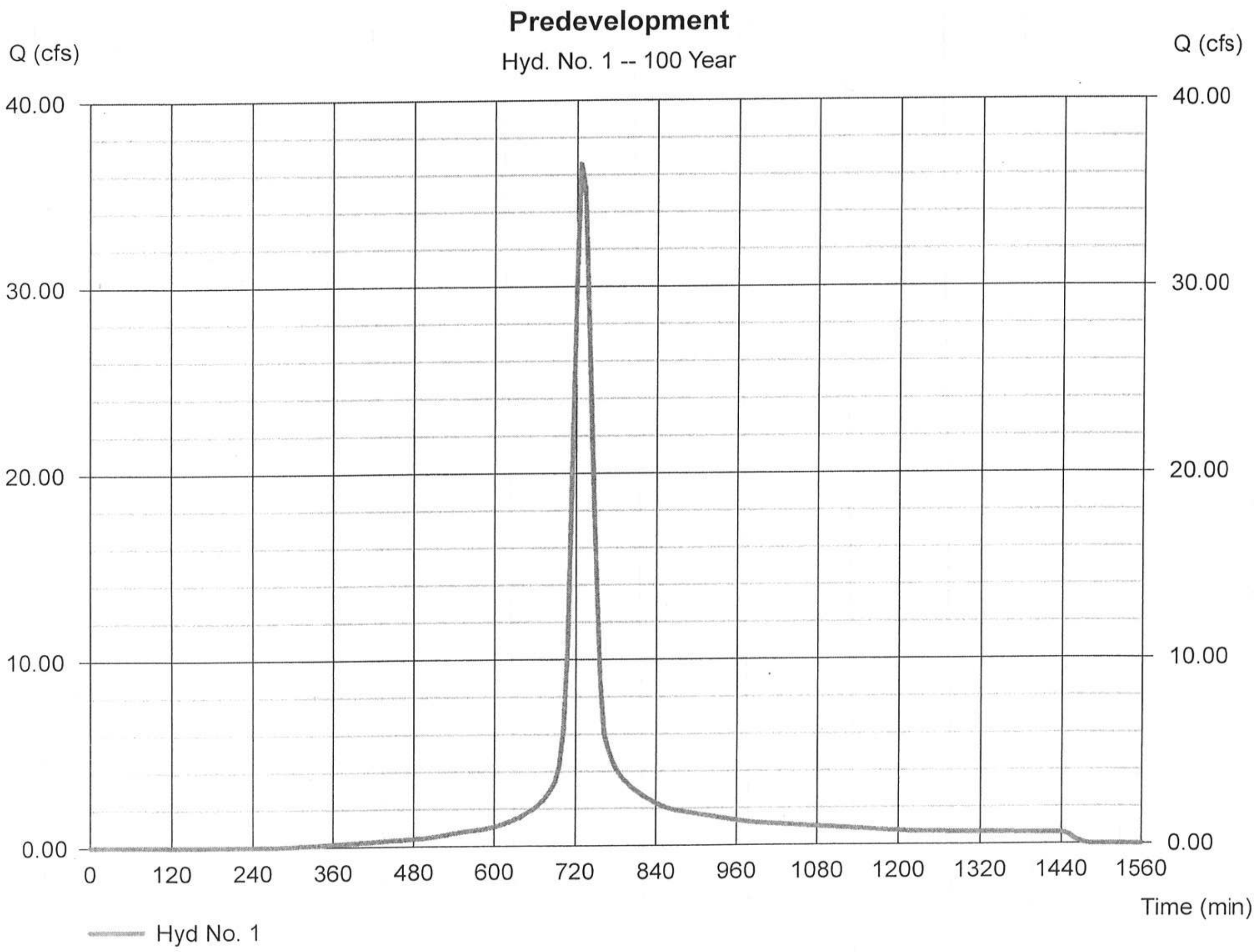
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Friday, Dec 4, 2009

Hyd. No. 1

Predevelopment

Hydrograph type	= SCS Runoff	Peak discharge	= 36.58 cfs
Storm frequency	= 100 yrs	Time to peak	= 726 min
Time interval	= 6 min	Hyd. volume	= 149,880 cuft
Drainage area	= 5.910 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.80 min
Total precip.	= 9.44 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(4.880 x 80) + (0.160 x 98) + (0.660 x 80) + (0.210 x 79)] / 5.910



Hydrograph Report

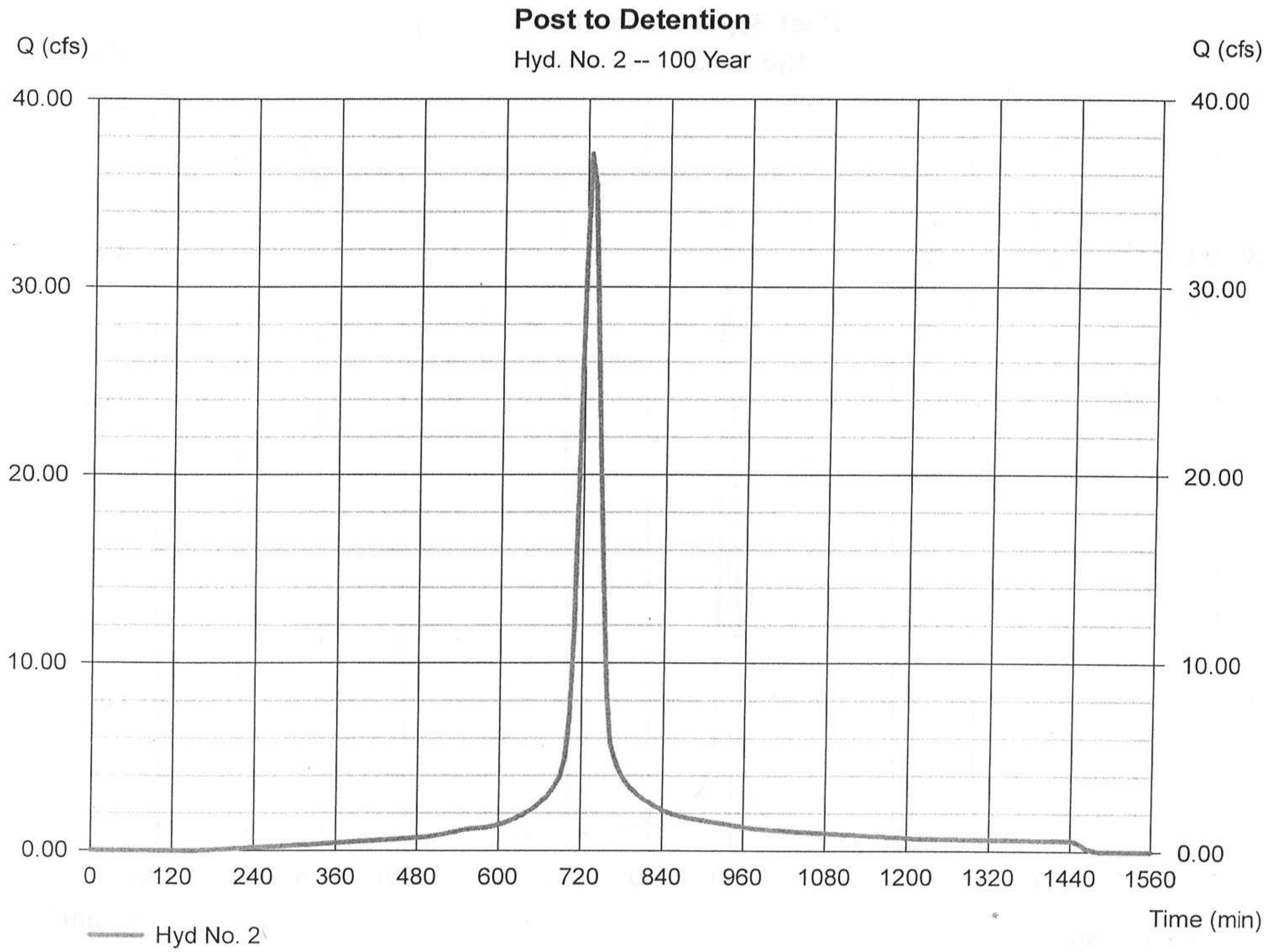
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Friday, Dec 4, 2009

Hyd. No. 2

Post to Detention

Hydrograph type	= SCS Runoff	Peak discharge	= 37.09 cfs
Storm frequency	= 100 yrs	Time to peak	= 726 min
Time interval	= 6 min	Hyd. volume	= 157,370 cuft
Drainage area	= 5.350 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 21.20 min
Total precip.	= 9.44 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.510 x 98) + (2.020 x 80) + (0.160 x 98) + (0.660 x 80)] / 5.350



Hydrograph Report

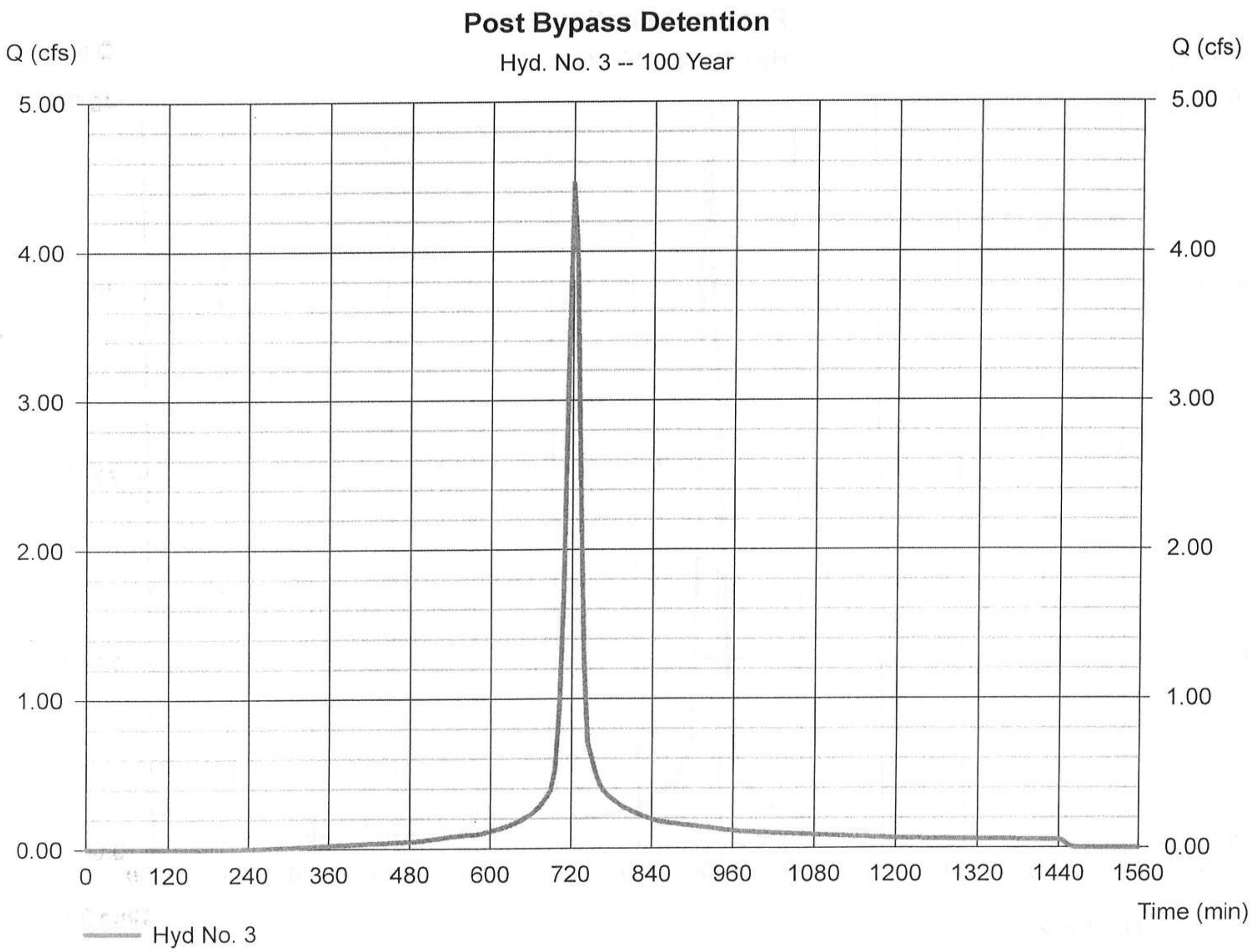
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 — Friday, Dec 4, 2009

Hyd. No. 3

Post Bypass Detention

Hydrograph type	= SCS Runoff	Peak discharge	= 4.456 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 6 min	Hyd. volume	= 14,028 cuft
Drainage area	= 0.560 ac	Curve number	= 83*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.70 min
Total precip.	= 9.44 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.080 x 98) + (0.480 x 80)] / 0.560



Hydrograph Report

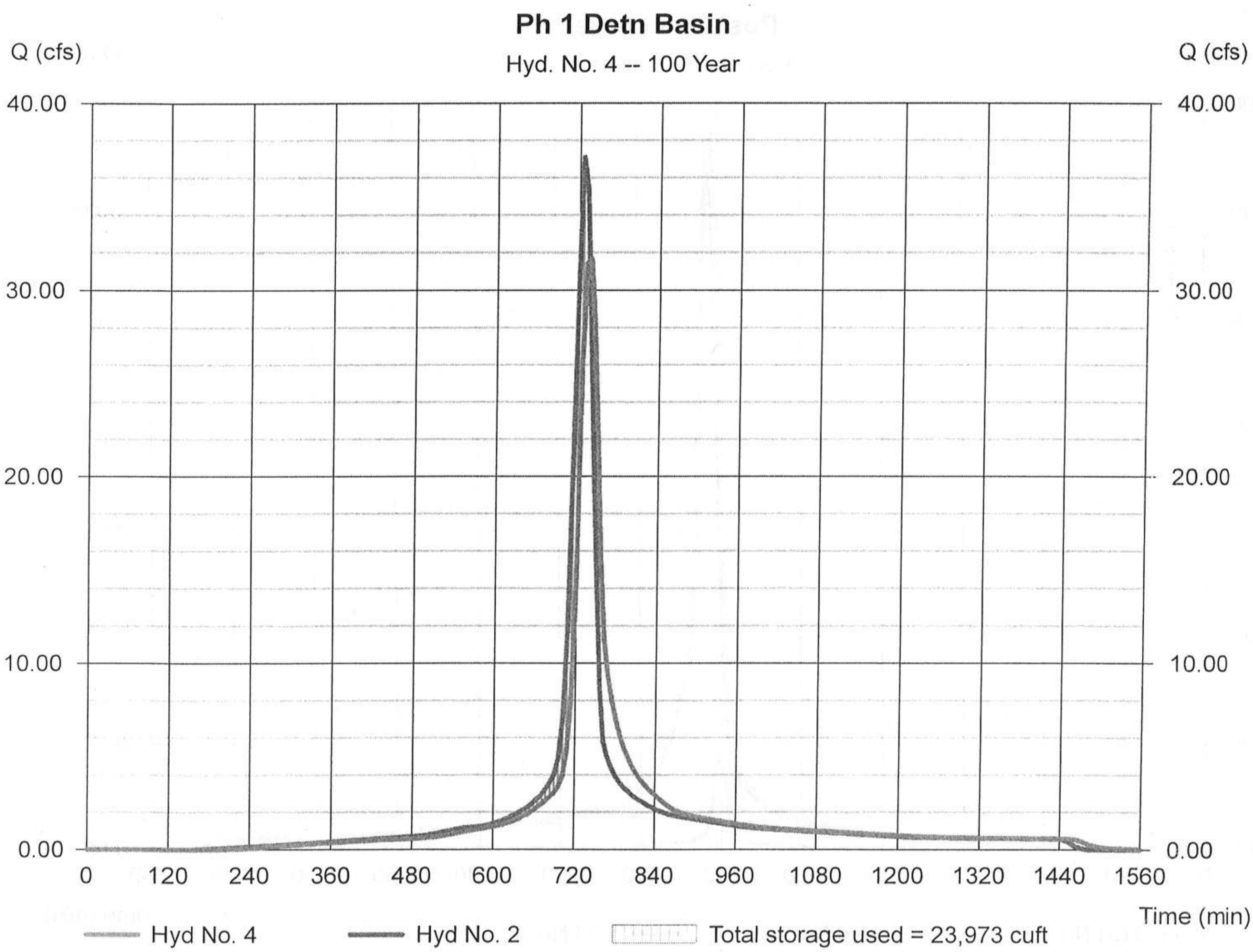
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Friday, Dec 4, 2009

Hyd. No. 4

Ph 1 Detn Basin

Hydrograph type	= Reservoir	Peak discharge	= 31.68 cfs
Storm frequency	= 100 yrs	Time to peak	= 738 min
Time interval	= 6 min	Hyd. volume	= 157,262 cuft
Inflow hyd. No.	= 2 - Post to Detention	Max. Elevation	= 587.64 ft
Reservoir name	= StormTech MC-3500	Max. Storage	= 23,973 cuft

Storage Indication method used.



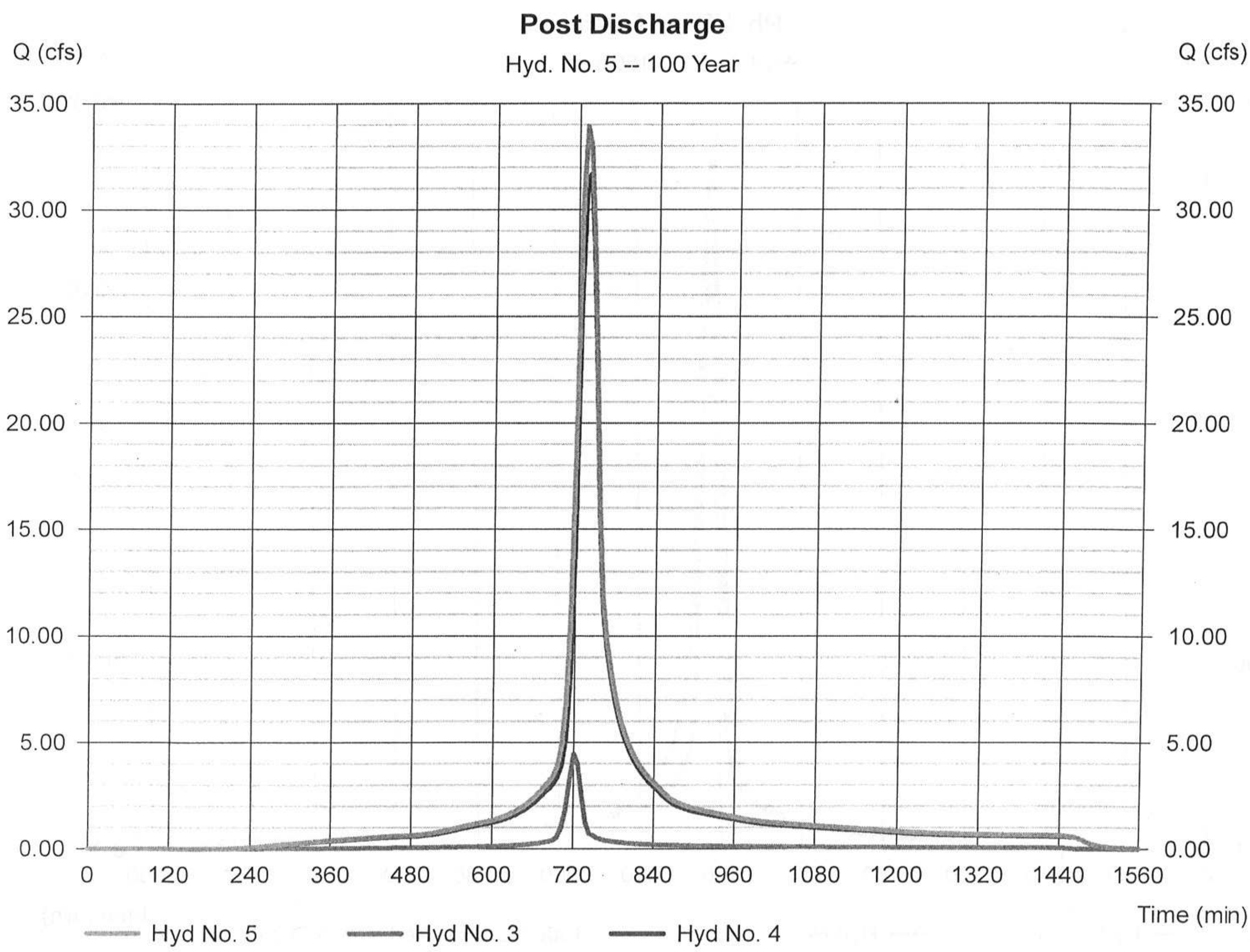
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Friday, Dec 4, 2009

Hyd. No. 5

Post Discharge

Hydrograph type	= Combine	Peak discharge	= 33.95 cfs
Storm frequency	= 100 yrs	Time to peak	= 732 min
Time interval	= 6 min	Hyd. volume	= 171,290 cuft
Inflow hyds.	= 3, 4	Contrib. drain. area	= 0.560 ac

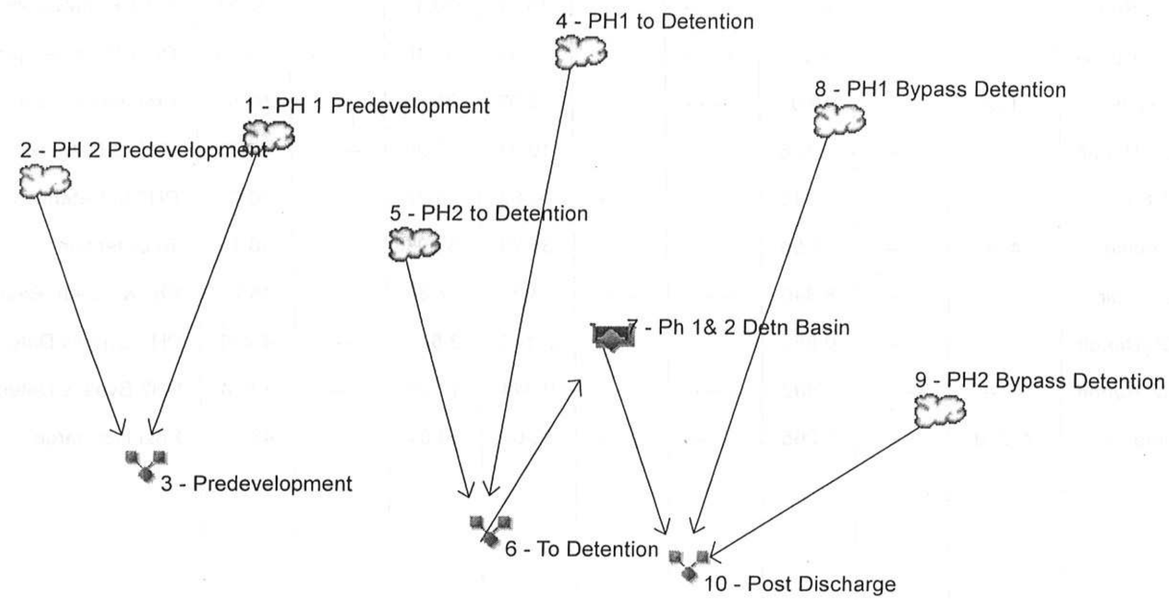


APPENDIX D
DETENTION POND CALCULATIONS
PHASE 1 & 2

Hydraflow Table of Contents

Watershed Model Schematic

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



Legend

Hyd.	Origin	Description
1	SCS Runoff	PH 1 Predevelopment
2	SCS Runoff	PH 2 Predevelopment
3	Combine	Predevelopment
4	SCS Runoff	PH1 to Detention
5	SCS Runoff	PH2 to Detention
6	Combine	To Detention
7	Reservoir	Ph 1& 2 Detn Basin
8	SCS Runoff	PH1 Bypass Detention
9	SCS Runoff	PH2 Bypass Detention
10	Combine	Post Discharge

Project: Woodbury Phase 1 & 2.gpw

Friday, Dec 4, 2009

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 15	25-Yr	50-Yr	100-Yr	
1	SCS Runoff	------	-------	6.471	-------	-------	16.77	20.42	-------	36.58	PH 1 Predevelopment
2	SCS Runoff	------	-------	3.537	-------	-------	9.164	11.16	-------	19.99	PH 2 Predevelopment
3	Combine	1, 2	-------	10.01	-------	-------	25.93	31.58	-------	56.58	Predevelopment
4	SCS Runoff	------	-------	9.136	-------	-------	19.23	22.59	-------	37.09	PH1 to Detention
5	SCS Runoff	------	-------	7.113	-------	-------	14.00	16.27	-------	26.05	PH2 to Detention
6	Combine	4, 5	-------	15.58	-------	-------	31.73	37.08	-------	60.16	To Detention
7	Reservoir	6	-------	8.840	-------	-------	23.25	27.88	-------	45.21	Ph 1& 2 Detn Basin
8	SCS Runoff	------	-------	0.892	-------	-------	2.146	2.577	-------	4.456	PH1 Bypass Detention
9	SCS Runoff	------	-------	0.402	-------	-------	0.944	1.129	-------	1.934	PH2 Bypass Detention
10	Combine	7, 8, 9	-------	9.265	-------	-------	25.04	30.01	-------	48.79	Post Discharge

Hydrograph Summary Report

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

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	6.471	6	732	26,978	------	------	------	PH 1 Predevelopment
2	SCS Runoff	3.537	6	732	14,744	------	------	------	PH 2 Predevelopment
3	Combine	10.01	6	732	41,722	1, 2	------	------	Predevelopment
4	SCS Runoff	9.136	6	726	37,071	------	------	------	PH1 to Detention
5	SCS Runoff	7.113	6	720	22,086	------	------	------	PH2 to Detention
6	Combine	15.58	6	726	59,157	4, 5	------	------	To Detention
7	Reservoir	8.840	6	738	59,039	6	585.93	14,940	Ph 1& 2 Detn Basin
8	SCS Runoff	0.892	6	720	2,772	------	------	------	PH1 Bypass Detention
9	SCS Runoff	0.402	6	720	1,245	------	------	------	PH2 Bypass Detention
10	Combine	9.265	6	738	63,057	7, 8, 9	------	------	Post Discharge

Hydrograph Report

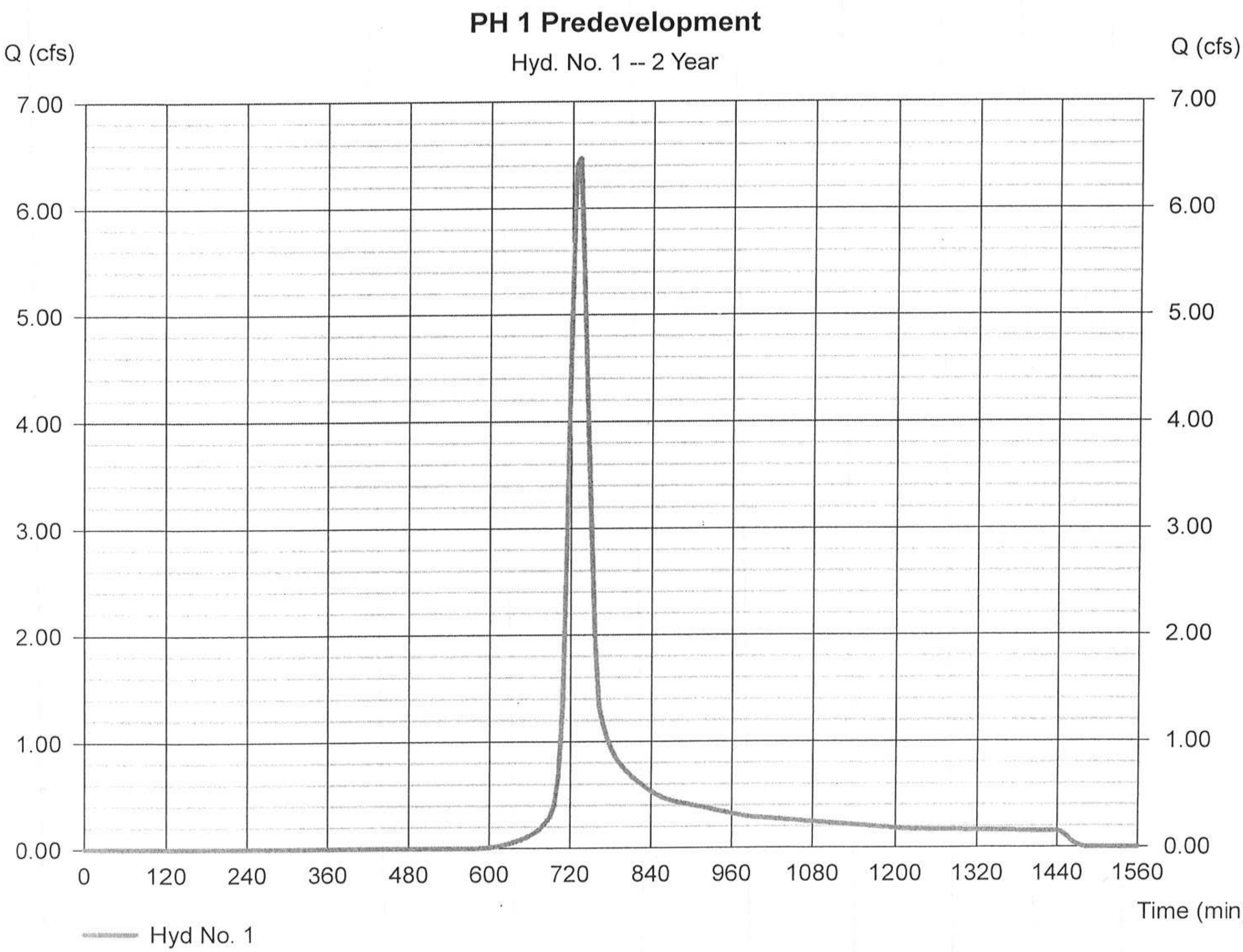
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 — Friday, Dec 4, 2009

Hyd. No. 1

PH 1 Predevelopment

Hydrograph type	= SCS Runoff	Peak discharge	= 6.471 cfs
Storm frequency	= 2 yrs	Time to peak	= 732 min
Time interval	= 6 min	Hyd. volume	= 26,978 cuft
Drainage area	= 5.910 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.80 min
Total precip.	= 3.01 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(4.880 x 80) + (0.160 x 98) + (0.660 x 80) + (0.210 x 79)] / 5.910



TR55 Tc Worksheet

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

Hyd. No. 1

PH 1 Predevelopment

Description	A	B	C	Totals
Sheet Flow				
Manning's n-value	= 0.240	0.011	0.011	
Flow length (ft)	= 136.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 3.00	0.00	0.00	
Land slope (%)	= 1.80	0.00	0.00	
Travel Time (min)	**= 19.66**	**+ 0.00**	**+ 0.00**	**= 19.66**
Shallow Concentrated Flow				
Flow length (ft)	= 570.00	0.00	0.00	
Watercourse slope (%)	= 2.00	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	= 2.28	0.00	0.00	
Travel Time (min)	**= 4.16**	**+ 0.00**	**+ 0.00**	**= 4.16**
Channel Flow				
X sectional flow area (sqft)	= 0.00	0.00	0.00	
Wetted perimeter (ft)	= 0.00	0.00	0.00	
Channel slope (%)	= 0.00	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	= 0.00	0.00	0.00	
Flow length (ft)	= 0.0	0.0	0.0	
Travel Time (min)	**= 0.00**	**+ 0.00**	**+ 0.00**	**= 0.00**

Total Travel Time, Tc .... 23.80 min

Hydrograph Report

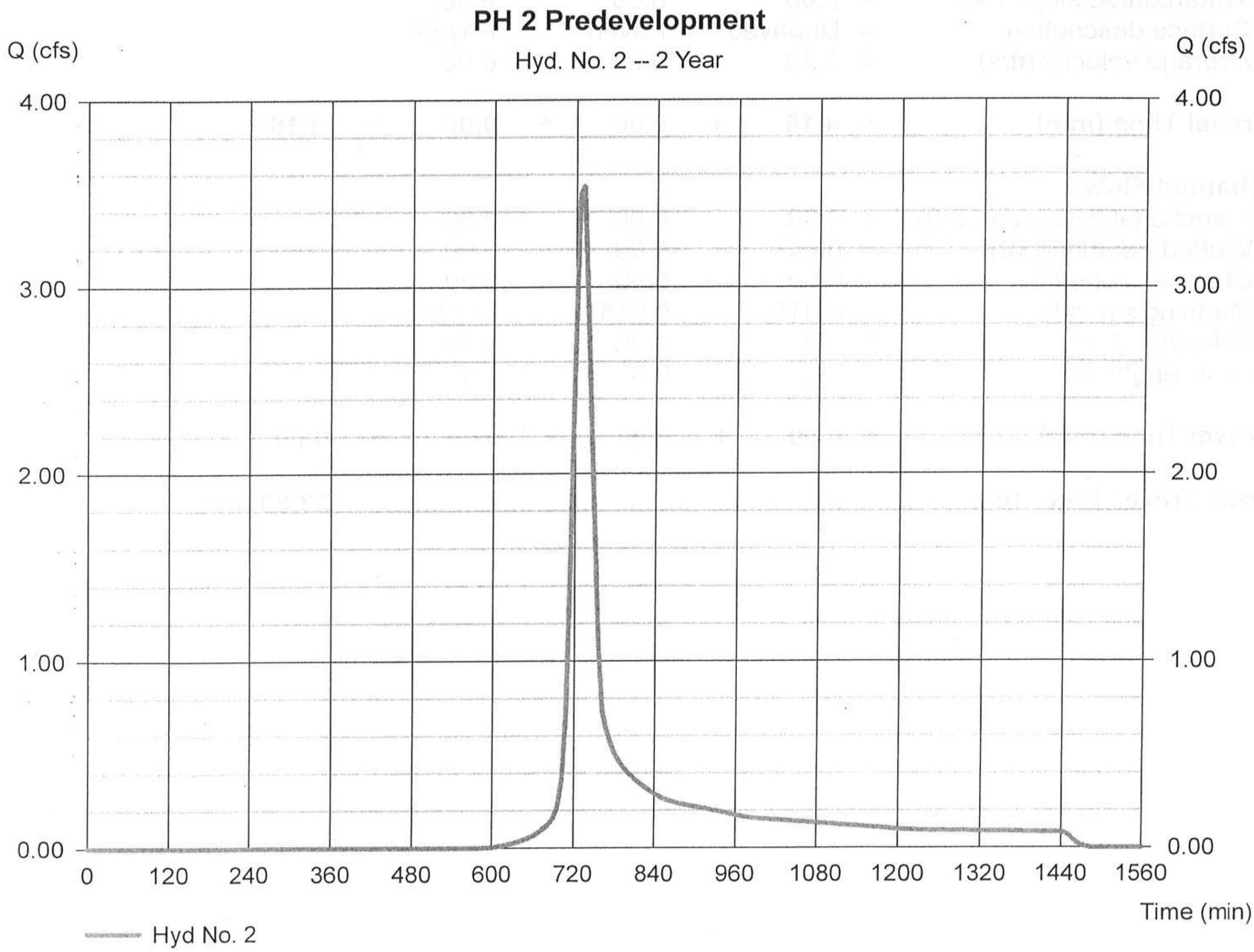
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Friday, Dec 4, 2009

Hyd. No. 2

PH 2 Predevelopment

Hydrograph type	= SCS Runoff	Peak discharge	= 3.537 cfs
Storm frequency	= 2 yrs	Time to peak	= 732 min
Time interval	= 6 min	Hyd. volume	= 14,744 cuft
Drainage area	= 3.230 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.70 min
Total precip.	= 3.01 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.960 x 80) + (0.270 x 79)] / 3.230



TR55 Tc Worksheet

Hyd. No. 2

PH 2 Predevelopment

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.240		0.011		0.011		
Flow length (ft)	=	100.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.00		0.00		0.00		
Land slope (%)	=	1.80		0.00		0.00		
Travel Time (min)	=	**15.37**	+	**0.00**	+	**0.00**	=	**15.37**
Shallow Concentrated Flow								
Flow length (ft)	=	400.00		0.00		0.00		
Watercourse slope (%)	=	2.00		0.00		0.00		
Surface description	=	Unpaved		Paved		Paved		
Average velocity (ft/s)	=	2.28		0.00		0.00		
Travel Time (min)	=	**2.92**	+	**0.00**	+	**0.00**	=	**2.92**
Channel Flow								
X sectional flow area (sqft)	=	5.00		0.00		0.00		
Wetted perimeter (ft)	=	4.00		0.00		0.00		
Channel slope (%)	=	0.50		0.00		0.00		
Manning's n-value	=	0.200		0.015		0.015		
Velocity (ft/s)	=	0.61		0.00		0.00		
Flow length (ft)	=	200.0		0.0		0.0		
Travel Time (min)	=	**5.45**	+	**0.00**	+	**0.00**	=	**5.45**

Total Travel Time, Tc .... 23.70 min

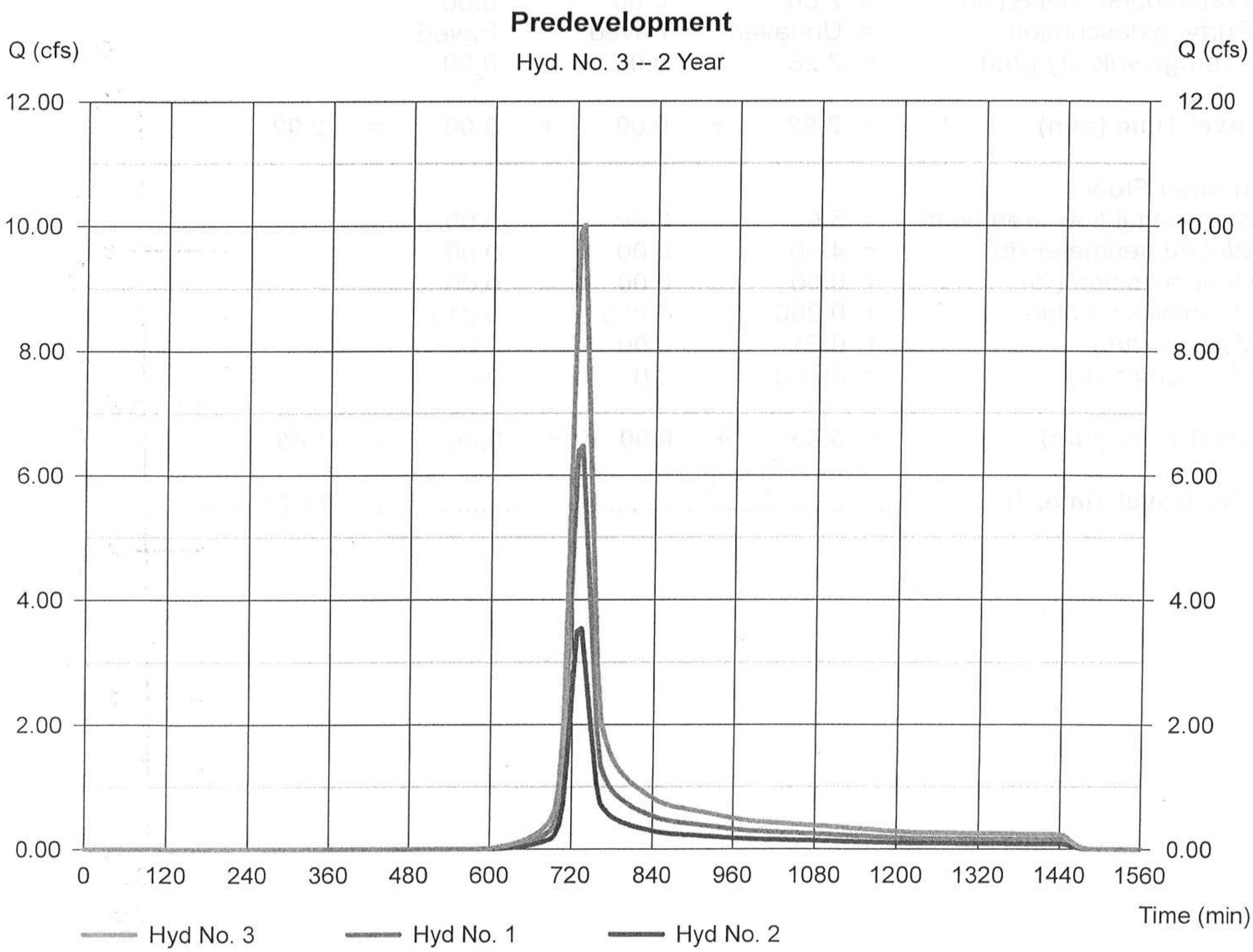
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 | Friday, Dec 4, 2009

Hyd. No. 3

Predevelopment

Hydrograph type	= Combine	Peak discharge	= 10.01 cfs
Storm frequency	= 2 yrs	Time to peak	= 732 min
Time interval	= 6 min	Hyd. volume	= 41,722 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 9.140 ac



Hydrograph Report

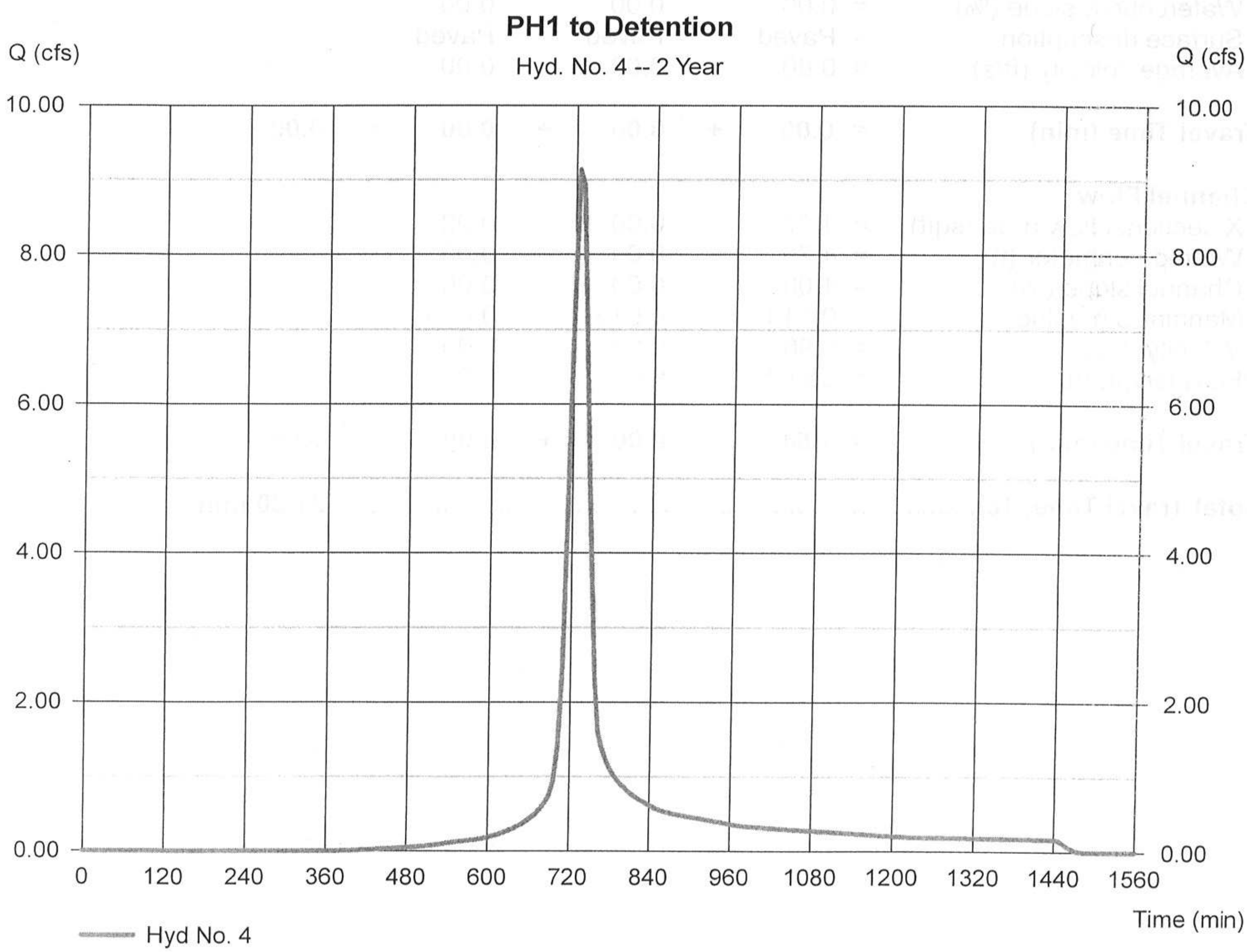
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Friday, Dec 4, 2009

Hyd. No. 4

PH1 to Detention

Hydrograph type	= SCS Runoff	Peak discharge	= 9.136 cfs
Storm frequency	= 2 yrs	Time to peak	= 726 min
Time interval	= 6 min	Hyd. volume	= 37,071 cuft
Drainage area	= 5.350 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 21.20 min
Total precip.	= 3.01 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.510 x 98) + (2.020 x 80) + (0.160 x 98) + (0.660 x 80)] / 5.350



TR55 Tc Worksheet

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

Hyd. No. 4

PH1 to Detention

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.240		0.011		0.011		
Flow length (ft)	=	136.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.01		0.00		0.00		
Land slope (%)	=	1.80		0.00		0.00		
Travel Time (min)	=	**19.63**	+	**0.00**	+	**0.00**	=	**19.63**
Shallow Concentrated Flow								
Flow length (ft)	=	0.00		0.00		0.00		
Watercourse slope (%)	=	0.00		0.00		0.00		
Surface description	=	Paved		Paved		Paved		
Average velocity (ft/s)	=	0.00		0.00		0.00		
Travel Time (min)	=	**0.00**	+	**0.00**	+	**0.00**	=	**0.00**
Channel Flow								
X sectional flow area (sqft)	=	1.77		0.00		0.00		
Wetted perimeter (ft)	=	4.70		0.00		0.00		
Channel slope (%)	=	1.00		0.00		0.00		
Manning's n-value	=	0.013		0.015		0.015		
Velocity (ft/s)	=	5.96		0.00		0.00		
Flow length (ft)	=	550.0		0.0		0.0		
Travel Time (min)	=	**1.54**	+	**0.00**	+	**0.00**	=	**1.54**

Total Travel Time, Tc .... 21.20 min

Hydrograph Report

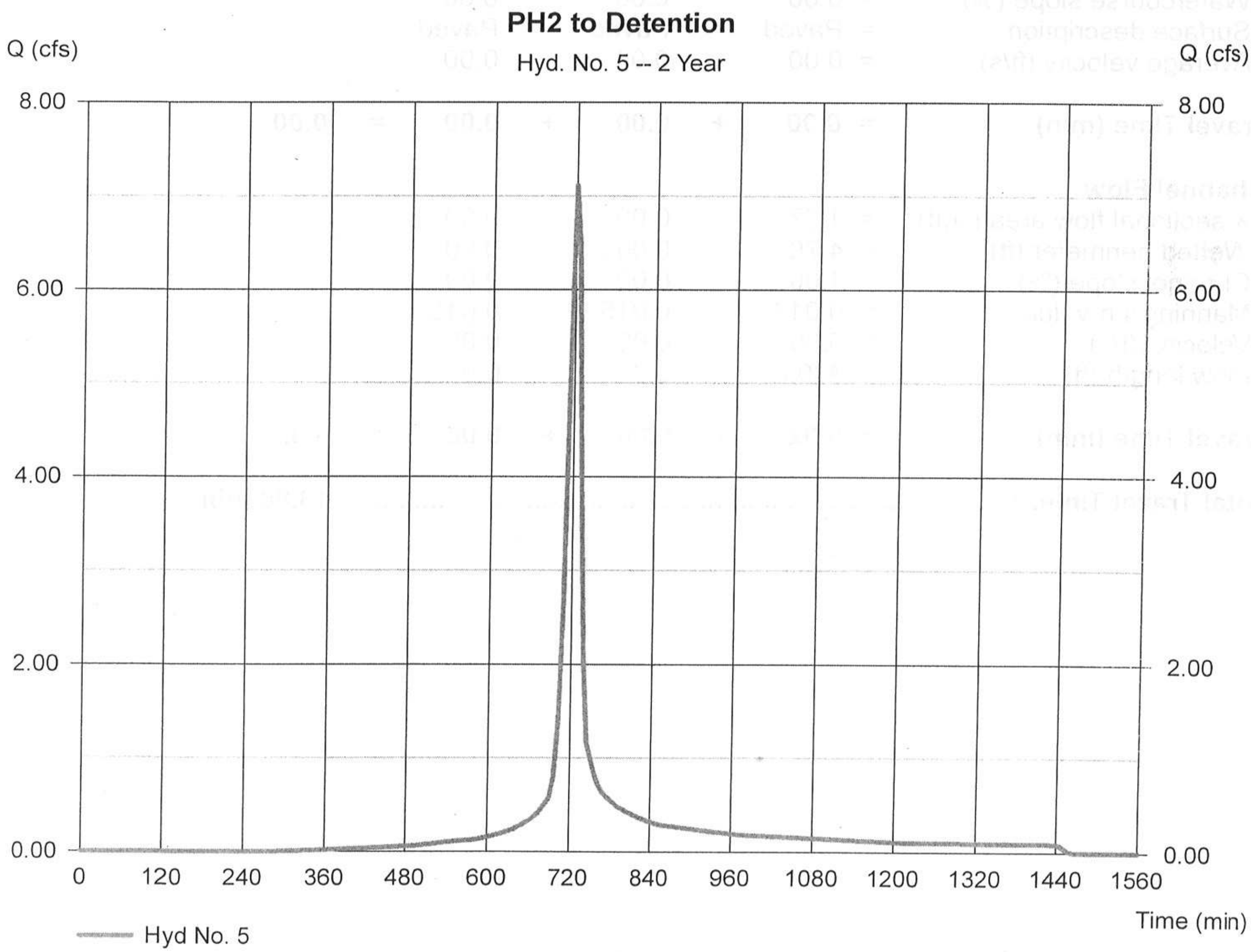
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Friday, Dec 4, 2009

Hyd. No. 5

PH2 to Detention

Hydrograph type	= SCS Runoff	Peak discharge	= 7.113 cfs
Storm frequency	= 2 yrs	Time to peak	= 720 min
Time interval	= 6 min	Hyd. volume	= 22,086 cuft
Drainage area	= 2.990 ac	Curve number	= 92*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 13.80 min
Total precip.	= 3.01 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.000 x 98) + (0.990 x 80)] / 2.990



TR55 Tc Worksheet

Hyd. No. 5

PH2 to Detention

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.240		0.011		0.011		
Flow length (ft)	=	80.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.01		0.00		0.00		
Land slope (%)	=	1.80		0.00		0.00		
Travel Time (min)	=	**12.84**	+	**0.00**	+	**0.00**	=	**12.84**
Shallow Concentrated Flow								
Flow length (ft)	=	0.00		0.00		0.00		
Watercourse slope (%)	=	0.00		0.00		0.00		
Surface description	=	Paved		Paved		Paved		
Average velocity (ft/s)	=	0.00		0.00		0.00		
Travel Time (min)	=	**0.00**	+	**0.00**	+	**0.00**	=	**0.00**
Channel Flow								
X sectional flow area (sqft)	=	1.77		0.00		0.00		
Wetted perimeter (ft)	=	4.70		0.00		0.00		
Channel slope (%)	=	1.00		0.00		0.00		
Manning's n-value	=	0.013		0.015		0.015		
Velocity (ft/s)	=	5.96		0.00		0.00		
Flow length (ft)	=	330.0		0.0		0.0		
Travel Time (min)	=	**0.92**	+	**0.00**	+	**0.00**	=	**0.92**

Total Travel Time, Tc .... 13.80 min

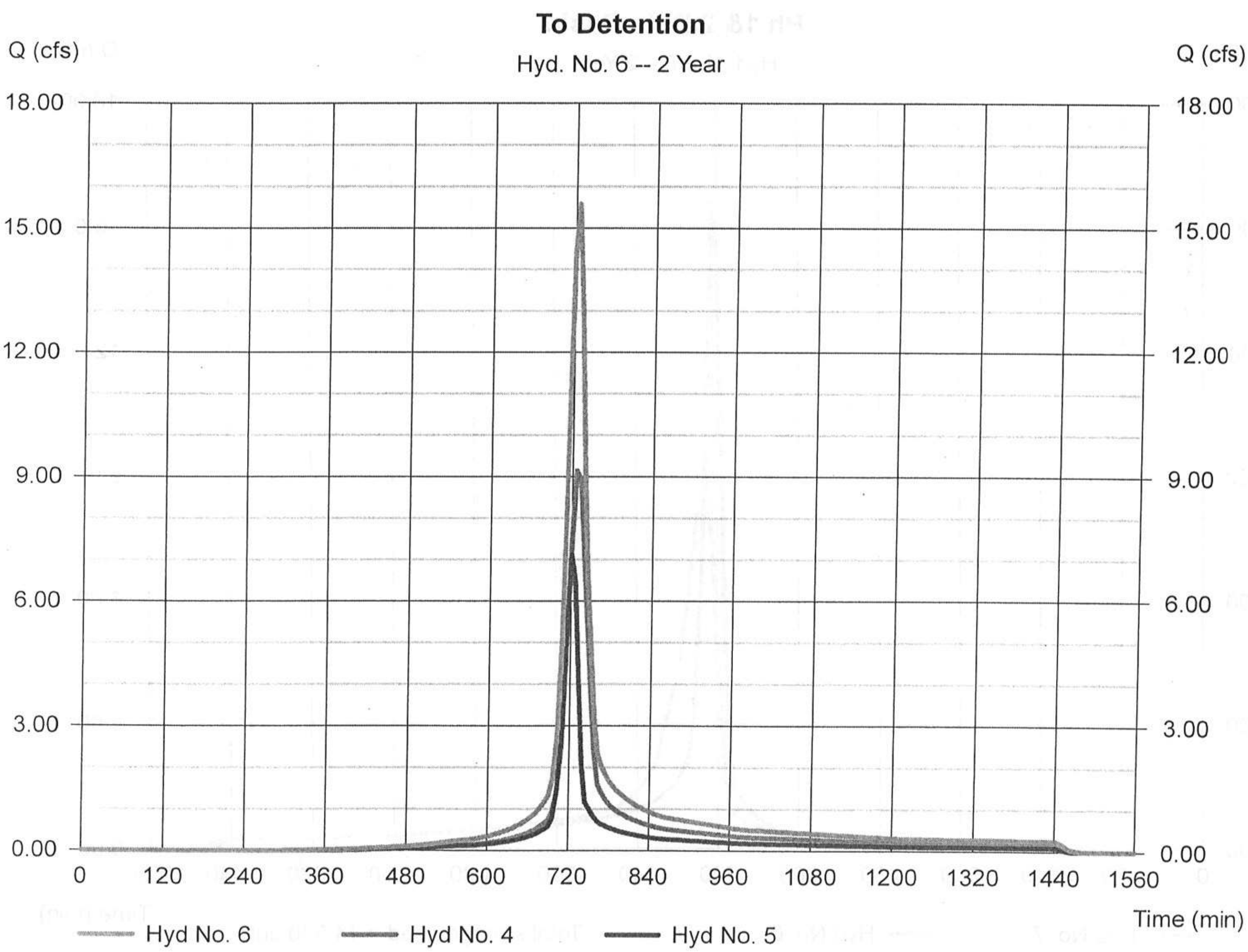
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Friday, Dec 4, 2009

Hyd. No. 6

To Detention

Hydrograph type	= Combine	Peak discharge	= 15.58 cfs
Storm frequency	= 2 yrs	Time to peak	= 726 min
Time interval	= 6 min	Hyd. volume	= 59,157 cuft
Inflow hyds.	= 4, 5	Contrib. drain. area	= 8.340 ac



Hydrograph Report

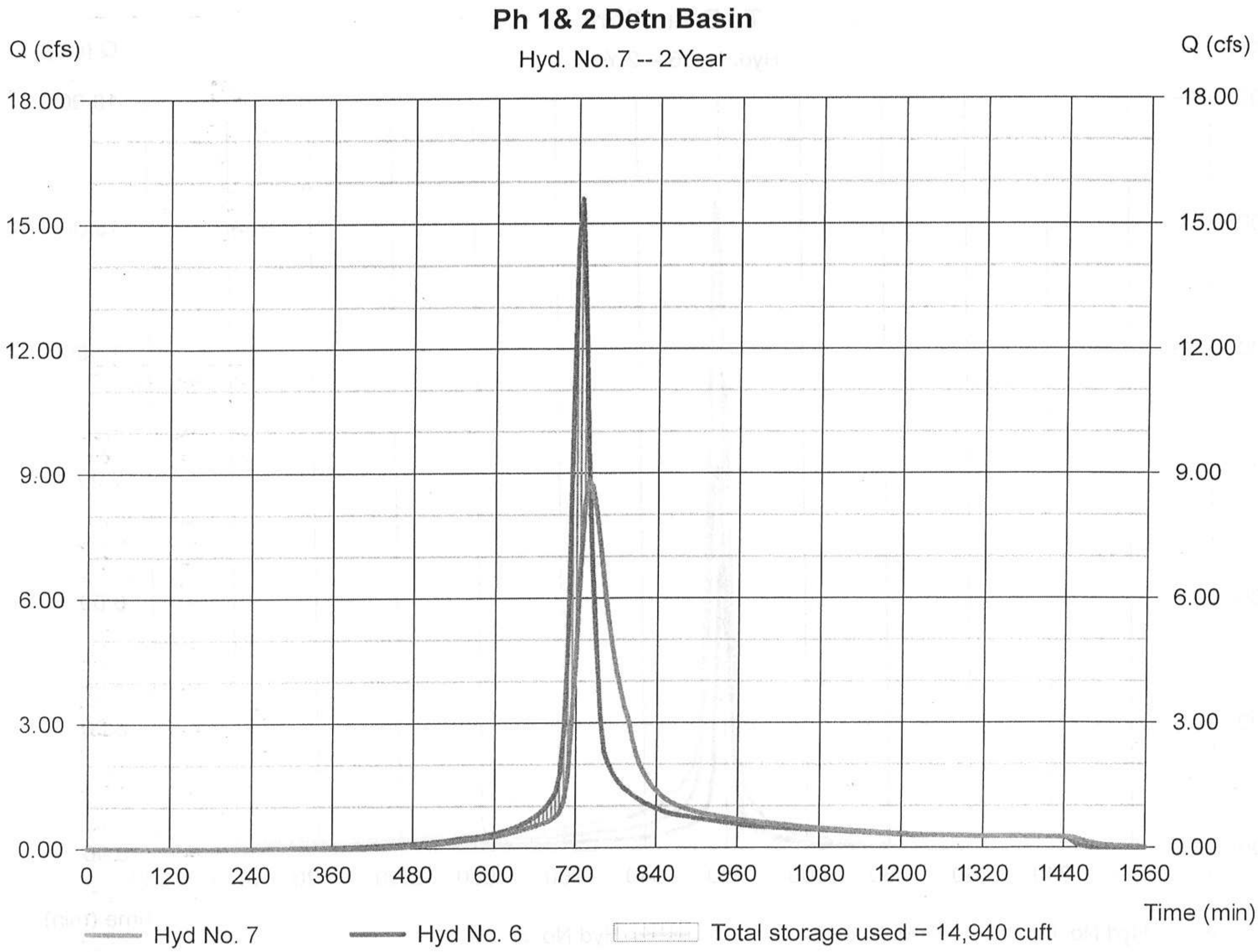
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 | Friday, Dec 4, 2009

Hyd. No. 7

Ph 1& 2 Detn Basin

Hydrograph type	= Reservoir	Peak discharge	= 8.840 cfs
Storm frequency	= 2 yrs	Time to peak	= 738 min
Time interval	= 6 min	Hyd. volume	= 59,039 cuft
Inflow hyd. No.	= 6 - To Detention	Max. Elevation	= 585.93 ft
Reservoir name	= StormTech MC-3500	Max. Storage	= 14,940 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 — Friday, Dec 4, 2009

Pond No. 1 - StormTech MC-3500

Pond Data

UG Chambers - Invert elev. = 584.50 ft, Rise x Span = 3.75 x 6.42 ft, Barrel Len = 351.20 ft, No. Barrels = 5, Slope = 0.25%, Headers = No
Encasement - Invert elev. = 583.75 ft, Width = 6.92 ft, Height = 5.50 ft, Voids = 40.00%
Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 590.75 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	583.75	n/a	0	0
0.64	584.39	n/a	1,161	1,161
1.28	585.03	n/a	3,887	5,048
1.91	585.66	n/a	6,978	12,027
2.55	586.30	n/a	7,228	19,255
3.19	586.94	n/a	6,936	26,191
3.83	587.58	n/a	6,460	32,651
4.46	588.21	n/a	5,677	38,328
5.10	588.85	n/a	4,191	42,519
5.74	589.49	n/a	3,179	45,698
6.38	590.13	n/a	3,101	48,799
7.00	590.75	25	5	48,804
7.25	591.00	01	3	48,807
7.75	591.50	01	1	48,807
8.25	592.00	01	1	48,808

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 30.00	6.00	0.00	0.00
Span (in)	= 30.00	6.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 583.75	583.80	0.00	0.00
Length (ft)	= 146.00	0.00	0.00	0.00
Slope (%)	= 0.79	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	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 1.33	3.67	Inactive	0.00
Crest El. (ft)	= 584.40	586.20	585.70	0.00
Weir Coeff.	= 3.50	3.33	3.33	3.33
Weir Type	= Rect	Rect	Rect	---
Multi-Stage	= Yes	Yes	Yes	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	583.75	0.00	0.00	---	---	0.00	0.00	0.00	---	---	---	0.000
0.06	116	583.81	0.00 ic	0.00 ic	---	---	0.00	0.00	0.00	---	---	---	0.001
0.13	232	583.88	0.02 ic	0.02 ic	---	---	0.00	0.00	0.00	---	---	---	0.019
0.19	348	583.94	0.06 ic	0.06 ic	---	---	0.00	0.00	0.00	---	---	---	0.060
0.26	464	584.01	0.13 ic	0.12 ic	---	---	0.00	0.00	0.00	---	---	---	0.118
0.32	581	584.07	0.21 ic	0.19 ic	---	---	0.00	0.00	0.00	---	---	---	0.191
0.38	697	584.13	0.29 ic	0.27 ic	---	---	0.00	0.00	0.00	---	---	---	0.274
0.45	813	584.20	0.36 ic	0.36 ic	---	---	0.00	0.00	0.00	---	---	---	0.358
0.51	929	584.26	0.47 ic	0.44 ic	---	---	0.00	0.00	0.00	---	---	---	0.437
0.57	1,045	584.32	0.51 ic	0.49 ic	---	---	0.00	0.00	0.00	---	---	---	0.495
0.64	1,161	584.39	0.56 ic	0.55 ic	---	---	0.00	0.00	0.00	---	---	---	0.549
0.70	1,550	584.45	0.66 ic	0.60 ic	---	---	0.05	0.00	0.00	---	---	---	0.654
0.77	1,939	584.52	0.84 ic	0.62 ic	---	---	0.18	0.00	0.00	---	---	---	0.800
0.83	2,327	584.58	0.99 ic	0.63 ic	---	---	0.35	0.00	0.00	---	---	---	0.987
0.89	2,716	584.64	1.21 ic	0.65 ic	---	---	0.56	0.00	0.00	---	---	---	1.209
0.96	3,105	584.71	1.46 ic	0.67 ic	---	---	0.79	0.00	0.00	---	---	---	1.461
1.02	3,494	584.77	1.76 ic	0.68 ic	---	---	1.05	0.00	0.00	---	---	---	1.732
1.08	3,882	584.83	2.09 ic	0.69 ic	---	---	1.33	0.00	0.00	---	---	---	2.025
1.15	4,271	584.90	2.34 ic	0.71 ic	---	---	1.64	0.00	0.00	---	---	---	2.345
1.21	4,660	584.96	2.73 ic	0.72 ic	---	---	1.96	0.00	0.00	---	---	---	2.681
1.28	5,048	585.03	3.03 ic	0.73 ic	---	---	2.30 s	0.00	0.00	---	---	---	3.031
1.34	5,746	585.09	3.48 ic	0.75 ic	---	---	2.63 s	0.00	0.00	---	---	---	3.378
1.40	6,444	585.15	3.81 ic	0.76 ic	---	---	2.98 s	0.00	0.00	---	---	---	3.743
1.47	7,142	585.22	4.16 ic	0.78 ic	---	---	3.34 s	0.00	0.00	---	---	---	4.119
1.53	7,840	585.28	4.52 ic	0.79 ic	---	---	3.71 s	0.00	0.00	---	---	---	4.503

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StormTech MC-3500

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
1.59	8,538	585.34	4.90 ic	0.81 ic	---	---	4.09 s	0.00	0.00	---	---	---	4.897
1.66	9,235	585.41	5.30 ic	0.82 ic	---	---	4.48 s	0.00	0.00	---	---	---	5.300
1.72	9,933	585.47	5.71 ic	0.84 ic	---	---	4.87 s	0.00	0.00	---	---	---	5.711
1.79	10,631	585.54	6.14 ic	0.85 ic	---	---	5.28 s	0.00	0.00	---	---	---	6.131
1.85	11,329	585.60	6.59 ic	0.86 ic	---	---	5.70 s	0.00	0.00	---	---	---	6.560
1.91	12,027	585.66	7.05 ic	0.88 ic	---	---	6.12 s	0.00	0.00	---	---	---	6.997
1.98	12,750	585.73	7.52 ic	0.89 ic	---	---	6.55 s	0.00	0.00	---	---	---	7.442
2.04	13,472	585.79	8.01 ic	0.90 ic	---	---	6.99 s	0.00	0.00	---	---	---	7.895
2.10	14,195	585.85	8.50 ic	0.91 ic	---	---	7.44 s	0.00	0.00	---	---	---	8.355
2.17	14,918	585.92	8.83 ic	0.93 ic	---	---	7.90 s	0.00	0.00	---	---	---	8.825
2.23	15,641	585.98	9.32 ic	0.94 ic	---	---	8.38 s	0.00	0.00	---	---	---	9.319
2.30	16,364	586.05	9.82 ic	0.95 ic	---	---	8.87 s	0.00	0.00	---	---	---	9.821
2.36	17,086	586.11	10.33 ic	0.97 ic	---	---	9.36 s	0.00	0.00	---	---	---	10.33
2.42	17,809	586.17	10.86 ic	0.98 ic	---	---	9.86 s	0.00	0.00	---	---	---	10.84
2.49	18,532	586.24	11.42 ic	0.99 ic	---	---	10.35 s	0.09	0.00	---	---	---	11.42
2.55	19,255	586.30	12.24 ic	0.99 ic	---	---	10.81 s	0.39	0.00	---	---	---	12.19
2.61	19,949	586.37	13.07 ic	1.00 ic	---	---	11.26 s	0.82	0.00	---	---	---	13.07
2.68	20,642	586.43	13.99 ic	0.99 ic	---	---	11.66 s	1.34	0.00	---	---	---	13.99
2.74	21,336	586.49	15.04 ic	0.99 ic	---	---	12.11 s	1.93	0.00	---	---	---	15.04
2.81	22,030	586.56	16.12 ic	0.99 ic	---	---	12.53 s	2.60	0.00	---	---	---	16.11
2.87	22,723	586.62	17.22 ic	0.98 ic	---	---	12.91 s	3.33	0.00	---	---	---	17.22
2.93	23,417	586.68	18.50 ic	0.98 ic	---	---	13.28 s	4.11	0.00	---	---	---	18.37
3.00	24,110	586.75	19.56 ic	0.97 ic	---	---	13.64 s	4.95	0.00	---	---	---	19.56
3.06	24,804	586.81	20.88 ic	0.96 ic	---	---	14.01 s	5.84	0.00	---	---	---	20.81
3.13	25,498	586.88	22.12 ic	0.95 ic	---	---	14.32 s	6.78	0.00	---	---	---	22.05
3.19	26,191	586.94	23.38 ic	0.93 ic	---	---	14.61 s	7.76	0.00	---	---	---	23.31
3.25	26,837	587.00	24.56 ic	0.92 ic	---	---	14.85 s	8.79	0.00	---	---	---	24.56
3.32	27,483	587.07	25.72 oc	0.89 ic	---	---	14.97 s	9.86	0.00	---	---	---	25.72
3.38	28,129	587.13	26.21 oc	0.83 ic	---	---	14.69 s	10.68 s	0.00	---	---	---	26.21
3.44	28,775	587.19	27.19 oc	0.82 ic	---	---	14.86 s	11.51 s	0.00	---	---	---	27.19
3.51	29,421	587.26	28.12 oc	0.80 ic	---	---	15.03 s	12.29 s	0.00	---	---	---	28.12
3.57	30,067	587.32	29.01 oc	0.78 ic	---	---	15.18 s	13.05 s	0.00	---	---	---	29.01
3.64	30,713	587.39	29.87 oc	0.77 ic	---	---	15.33 s	13.77 s	0.00	---	---	---	29.86
3.70	31,359	587.45	30.69 oc	0.75 ic	---	---	15.46 s	14.47 s	0.00	---	---	---	30.68
3.76	32,005	587.51	31.47 oc	0.74 ic	---	---	15.59 s	15.14 s	0.00	---	---	---	31.47
3.83	32,651	587.58	32.23 oc	0.72 ic	---	---	15.72 s	15.79 s	0.00	---	---	---	32.23
3.89	33,219	587.64	32.96 oc	0.71 ic	---	---	15.83 s	16.42 s	0.00	---	---	---	32.96
3.95	33,786	587.70	33.67 oc	0.69 ic	---	---	15.95 s	17.03 s	0.00	---	---	---	33.67
4.02	34,354	587.77	34.35 oc	0.68 ic	---	---	16.05 s	17.62 s	0.00	---	---	---	34.35
4.08	34,922	587.83	35.02 oc	0.66 ic	---	---	16.16 s	18.19 s	0.00	---	---	---	35.01
4.15	35,490	587.90	35.66 oc	0.65 ic	---	---	16.26 s	18.75 s	0.00	---	---	---	35.66
4.21	36,057	587.96	36.28 oc	0.64 ic	---	---	16.35 s	19.29 s	0.00	---	---	---	36.28
4.27	36,625	588.02	36.89 oc	0.63 ic	---	---	16.44 s	19.82 s	0.00	---	---	---	36.89
4.34	37,193	588.09	37.48 oc	0.61 ic	---	---	16.53 s	20.33 s	0.00	---	---	---	37.47
4.40	37,760	588.15	38.05 oc	0.60 ic	---	---	16.62 s	20.83 s	0.00	---	---	---	38.05
4.46	38,328	588.21	38.61 oc	0.59 ic	---	---	16.70 s	21.31 s	0.00	---	---	---	38.61
4.53	38,747	588.28	39.16 oc	0.58 ic	---	---	16.79 s	21.79 s	0.00	---	---	---	39.16
4.59	39,166	588.34	39.69 oc	0.57 ic	---	---	16.87 s	22.25 s	0.00	---	---	---	39.69
4.66	39,585	588.41	40.22 oc	0.56 ic	---	---	16.95 s	22.71 s	0.00	---	---	---	40.22
4.72	40,004	588.47	40.73 oc	0.55 ic	---	---	17.02 s	23.15 s	0.00	---	---	---	40.73
4.78	40,423	588.53	41.23 oc	0.54 ic	---	---	17.10 s	23.59 s	0.00	---	---	---	41.23
4.85	40,843	588.60	41.72 oc	0.53 ic	---	---	17.18 s	24.01 s	0.00	---	---	---	41.72
4.91	41,262	588.66	42.21 oc	0.52 ic	---	---	17.25 s	24.43 s	0.00	---	---	---	42.20
4.97	41,681	588.72	42.68 oc	0.51 ic	---	---	17.33 s	24.84 s	0.00	---	---	---	42.68
5.04	42,100	588.79	43.15 oc	0.51 ic	---	---	17.40 s	25.24 s	0.00	---	---	---	43.15
5.10	42,519	588.85	43.61 oc	0.50 ic	---	---	17.47 s	25.63 s	0.00	---	---	---	43.60
5.17	42,837	588.92	44.06 oc	0.49 ic	---	---	17.54 s	26.02 s	0.00	---	---	---	44.06
5.23	43,155	588.98	44.50 oc	0.48 ic	---	---	17.61 s	26.40 s	0.00	---	---	---	44.50
5.29	43,473	589.04	44.94 oc	0.48 ic	---	---	17.68 s	26.78 s	0.00	---	---	---	44.94
5.36	43,791	589.11	45.37 oc	0.47 ic	---	---	17.75 s	27.14 s	0.00	---	---	---	45.37
5.42	44,109	589.17	45.80 oc	0.46 ic	---	---	17.82 s	27.51 s	0.00	---	---	---	45.79
5.49	44,426	589.24	46.22 oc	0.46 ic	---	---	17.89 s	27.87 s	0.00	---	---	---	46.21
5.55	44,744	589.30	46.63 oc	0.45 ic	---	---	17.96 s	28.22 s	0.00	---	---	---	46.63
5.61	45,062	589.36	47.04 oc	0.44 ic	---	---	18.03 s	28.56 s	0.00	---	---	---	47.03
5.68	45,380	589.43	47.44 oc	0.44 ic	---	---	18.09 s	28.91 s	0.00	---	---	---	47.44
5.74	45,698	589.49	47.84 oc	0.43 ic	---	---	18.16 s	29.25 s	0.00	---	---	---	47.84
5.80	46,008	589.55	48.24 oc	0.42 ic	---	---	18.23 s	29.58 s	0.00	---	---	---	48.23
5.87	46,318	589.62	48.63 oc	0.42 ic	---	---	18.29 s	29.91 s	0.00	---	---	---	48.62
5.93	46,628	589.68	49.01 oc	0.41 ic	---	---	18.36 s	30.23 s	0.00	---	---	---	49.00
6.00	46,938	589.75	49.39 oc	0.41 ic	---	---	18.43 s	30.56 s	0.00	---	---	---	49.39
6.06	47,249	589.81	49.77 oc	0.40 ic	---	---	18.49 s	30.87 s	0.00	---	---	---	49.76

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StormTech MC-3500

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
6.12	47,559	589.87	50.15 oc	0.40 ic	---	---	18.56 s	31.18 s	0.00	---	---	---	50.14
6.19	47,869	589.94	50.51 oc	0.39 ic	---	---	18.62 s	31.49 s	0.00	---	---	---	50.51
6.25	48,179	590.00	50.88 oc	0.39 ic	---	---	18.69 s	31.80 s	0.00	---	---	---	50.88
6.31	48,489	590.06	51.24 oc	0.38 ic	---	---	18.75 s	32.10 s	0.00	---	---	---	51.23
6.38	48,799	590.13	51.60 oc	0.38 ic	---	---	18.82 s	32.40 s	0.00	---	---	---	51.60
6.44	48,799	590.19	51.95 oc	0.38 ic	---	---	18.88 s	32.69 s	0.00	---	---	---	51.95
6.50	48,800	590.25	52.30 oc	0.37 ic	---	---	18.94 s	32.97 s	0.00	---	---	---	52.29
6.56	48,800	590.31	52.64 oc	0.37 ic	---	---	19.01 s	33.26 s	0.00	---	---	---	52.63
6.63	48,801	590.38	52.98 oc	0.36 ic	---	---	19.07 s	33.53 s	0.00	---	---	---	52.96
6.69	48,801	590.44	53.31 oc	0.36 ic	---	---	19.13 s	33.82 s	0.00	---	---	---	53.31
6.75	48,802	590.50	53.65 oc	0.36 ic	---	---	19.19 s	34.09 s	0.00	---	---	---	53.63
6.81	48,803	590.56	53.98 oc	0.35 ic	---	---	19.26 s	34.36 s	0.00	---	---	---	53.97
6.88	48,803	590.63	54.31 oc	0.35 ic	---	---	19.32 s	34.64 s	0.00	---	---	---	54.30
6.94	48,804	590.69	54.63 oc	0.34 ic	---	---	19.38 s	34.90 s	0.00	---	---	---	54.62
7.00	48,804	590.75	54.96 oc	0.34 ic	---	---	19.44 s	35.17 s	0.00	---	---	---	54.95
7.03	48,804	590.78	55.09 oc	0.34 ic	---	---	19.46 s	35.27 s	0.00	---	---	---	55.07
7.05	48,805	590.80	55.22 oc	0.34 ic	---	---	19.49 s	35.38 s	0.00	---	---	---	55.20
7.08	48,805	590.83	55.34 oc	0.34 ic	---	---	19.51 s	35.48 s	0.00	---	---	---	55.33
7.10	48,805	590.85	55.47 oc	0.34 ic	---	---	19.54 s	35.59 s	0.00	---	---	---	55.47
7.13	48,805	590.88	55.60 oc	0.33 ic	---	---	19.56 s	35.69 s	0.00	---	---	---	55.58
7.15	48,806	590.90	55.73 oc	0.33 ic	---	---	19.59 s	35.80 s	0.00	---	---	---	55.72
7.18	48,806	590.93	55.86 oc	0.33 ic	---	---	19.61 s	35.90 s	0.00	---	---	---	55.84
7.20	48,806	590.95	55.98 oc	0.33 ic	---	---	19.63 s	36.00 s	0.00	---	---	---	55.97
7.23	48,806	590.98	56.11 oc	0.33 ic	---	---	19.66 s	36.11 s	0.00	---	---	---	56.11
7.25	48,807	591.00	56.24 oc	0.33 ic	---	---	19.69 s	36.22 s	0.00	---	---	---	56.23
7.30	48,807	591.05	56.49 oc	0.32 ic	---	---	19.73 s	36.41 s	0.00	---	---	---	56.47
7.35	48,807	591.10	56.74 oc	0.32 ic	---	---	19.78 s	36.62 s	0.00	---	---	---	56.73
7.40	48,807	591.15	56.99 oc	0.32 ic	---	---	19.83 s	36.82 s	0.00	---	---	---	56.98
7.45	48,807	591.20	57.23 oc	0.32 ic	---	---	19.88 s	37.03 s	0.00	---	---	---	57.23
7.50	48,807	591.25	57.48 oc	0.32 ic	---	---	19.93 s	37.23 s	0.00	---	---	---	57.48
7.55	48,807	591.30	57.72 oc	0.31 ic	---	---	19.98 s	37.42 s	0.00	---	---	---	57.71
7.60	48,807	591.35	57.97 oc	0.31 ic	---	---	20.02 s	37.61 s	0.00	---	---	---	57.95
7.65	48,807	591.40	58.21 oc	0.31 ic	---	---	20.08 s	37.82 s	0.00	---	---	---	58.21
7.70	48,807	591.45	58.45 oc	0.31 ic	---	---	20.12 s	38.01 s	0.00	---	---	---	58.43
7.75	48,807	591.50	58.69 oc	0.30 ic	---	---	20.17 s	38.20 s	0.00	---	---	---	58.67
7.80	48,807	591.55	58.93 oc	0.30 ic	---	---	20.22 s	38.41 s	0.00	---	---	---	58.93
7.85	48,807	591.60	59.17 oc	0.30 ic	---	---	20.27 s	38.59 s	0.00	---	---	---	59.16
7.90	48,807	591.65	59.41 oc	0.30 ic	---	---	20.32 s	38.79 s	0.00	---	---	---	59.40
7.95	48,807	591.70	59.64 oc	0.30 ic	---	---	20.37 s	38.98 s	0.00	---	---	---	59.64
8.00	48,807	591.75	59.88 oc	0.29 ic	---	---	20.41 s	39.15 s	0.00	---	---	---	59.85
8.05	48,807	591.80	60.11 oc	0.29 ic	---	---	20.46 s	39.35 s	0.00	---	---	---	60.10
8.10	48,807	591.85	60.34 oc	0.29 ic	---	---	20.51 s	39.54 s	0.00	---	---	---	60.33
8.15	48,808	591.90	60.58 oc	0.29 ic	---	---	20.55 s	39.72 s	0.00	---	---	---	60.56
8.20	48,808	591.95	60.81 oc	0.29 ic	---	---	20.60 s	39.90 s	0.00	---	---	---	60.79
8.25	48,808	592.00	61.04 oc	0.28 ic	---	---	20.65 s	40.10 s	0.00	---	---	---	61.03

...End

Hydrograph Report

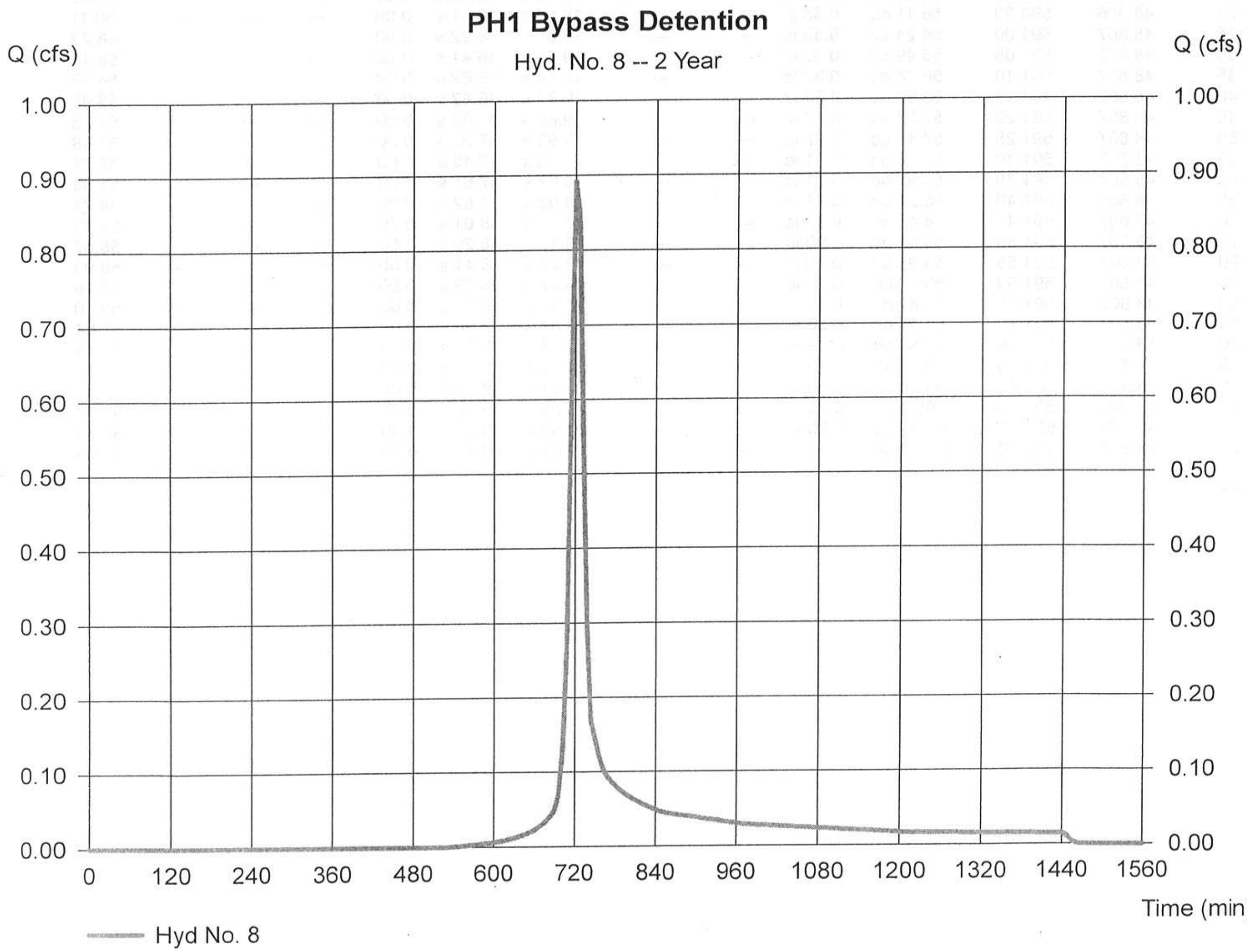
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 | Friday, Dec 4, 2009

Hyd. No. 8

PH1 Bypass Detention

Hydrograph type	= SCS Runoff	Peak discharge	= 0.892 cfs
Storm frequency	= 2 yrs	Time to peak	= 720 min
Time interval	= 6 min	Hyd. volume	= 2,772 cuft
Drainage area	= 0.560 ac	Curve number	= 83*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.70 min
Total precip.	= 3.01 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.080 x 98) + (0.480 x 80)] / 0.560



TR55 Tc Worksheet

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

Hyd. No. 8

PH1 Bypass Detention

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.240		0.011		0.011		
Flow length (ft)	=	90.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.01		0.00		0.00		
Land slope (%)	=	4.00		0.00		0.00		
Travel Time (min)	=	**10.25**	+	**0.00**	+	**0.00**	=	**10.25**
Shallow Concentrated Flow								
Flow length (ft)	=	90.00		0.00		0.00		
Watercourse slope (%)	=	0.25		0.00		0.00		
Surface description	=	Paved		Paved		Paved		
Average velocity (ft/s)	=	1.02		0.00		0.00		
Travel Time (min)	=	**1.48**	+	**0.00**	+	**0.00**	=	**1.48**
Channel Flow								
X sectional flow area (sqft)	=	0.00		0.00		0.00		
Wetted perimeter (ft)	=	0.00		0.00		0.00		
Channel slope (%)	=	0.00		0.00		0.00		
Manning's n-value	=	0.015		0.015		0.015		
Velocity (ft/s)	=	0.00		0.00		0.00		
Flow length (ft)	=	0.0		0.0		0.0		
Travel Time (min)	=	**0.00**	+	**0.00**	+	**0.00**	=	**0.00**

Total Travel Time, Tc .... 11.70 min

Hydrograph Report

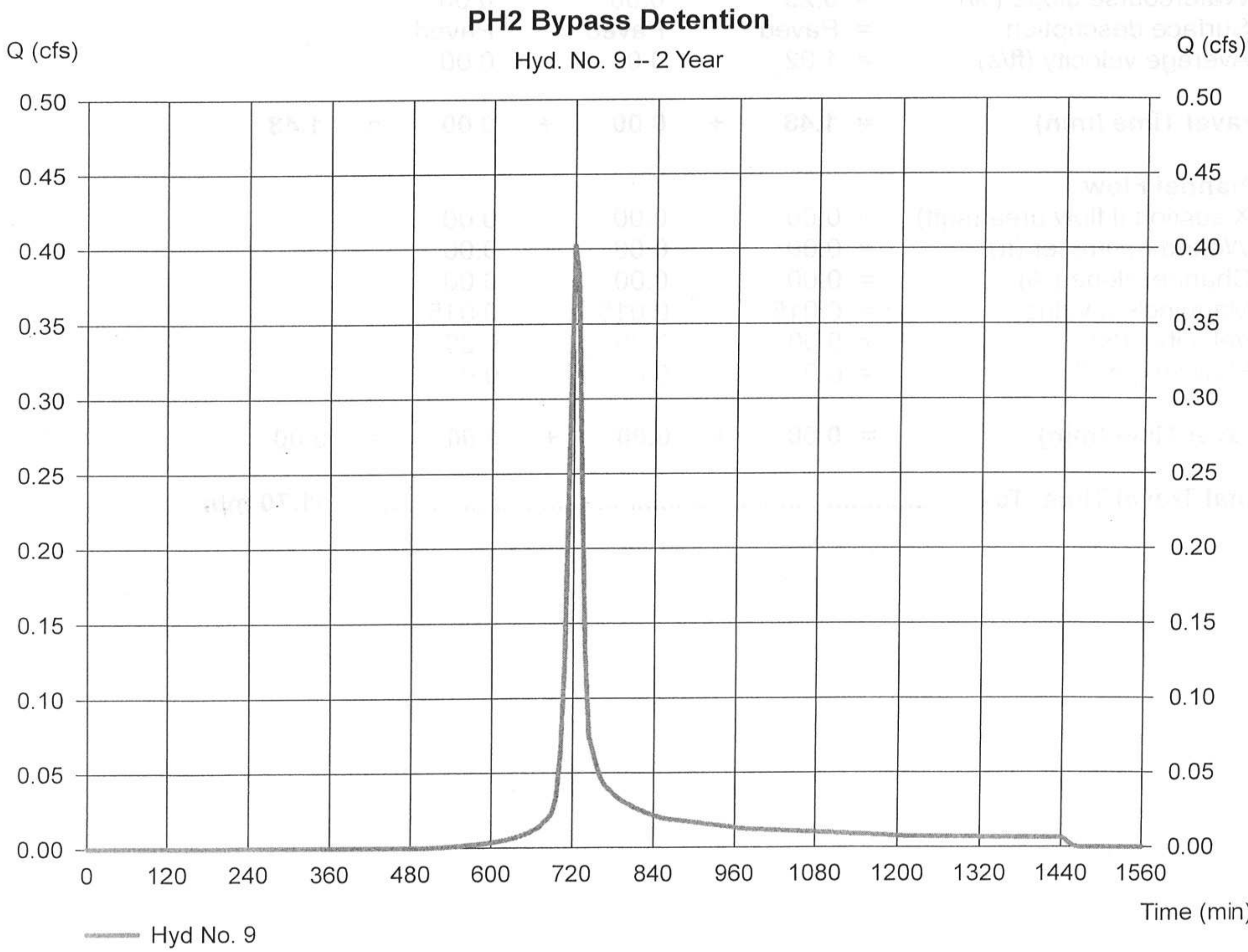
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 — Friday, Dec 4, 2009

Hyd. No. 9

PH2 Bypass Detention

Hydrograph type	= SCS Runoff	Peak discharge	= 0.402 cfs
Storm frequency	= 2 yrs	Time to peak	= 720 min
Time interval	= 6 min	Hyd. volume	= 1,245 cuft
Drainage area	= 0.240 ac	Curve number	= 84*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.70 min
Total precip.	= 3.01 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.050 x 98) + (0.190 x 80)] / 0.240



TR55 Tc Worksheet

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

Hyd. No. 9

PH2 Bypass Detention

Description	A	B	C	Totals
Sheet Flow				
Manning's n-value	= 0.240	0.011	0.011	
Flow length (ft)	= 90.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 3.01	0.00	0.00	
Land slope (%)	= 4.00	0.00	0.00	
Travel Time (min)	**= 10.25**	**+ 0.00**	**+ 0.00**	**= 10.25**
Shallow Concentrated Flow				
Flow length (ft)	= 90.00	0.00	0.00	
Watercourse slope (%)	= 0.25	0.00	0.00	
Surface description	= Paved	Paved	Paved	
Average velocity (ft/s)	= 1.02	0.00	0.00	
Travel Time (min)	**= 1.48**	**+ 0.00**	**+ 0.00**	**= 1.48**
Channel Flow				
X sectional flow area (sqft)	= 0.00	0.00	0.00	
Wetted perimeter (ft)	= 0.00	0.00	0.00	
Channel slope (%)	= 0.00	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	= 0.00	0.00	0.00	
Flow length (ft)	= 0.0	0.0	0.0	
Travel Time (min)	**= 0.00**	**+ 0.00**	**+ 0.00**	**= 0.00**

Total Travel Time, Tc .... 11.70 min

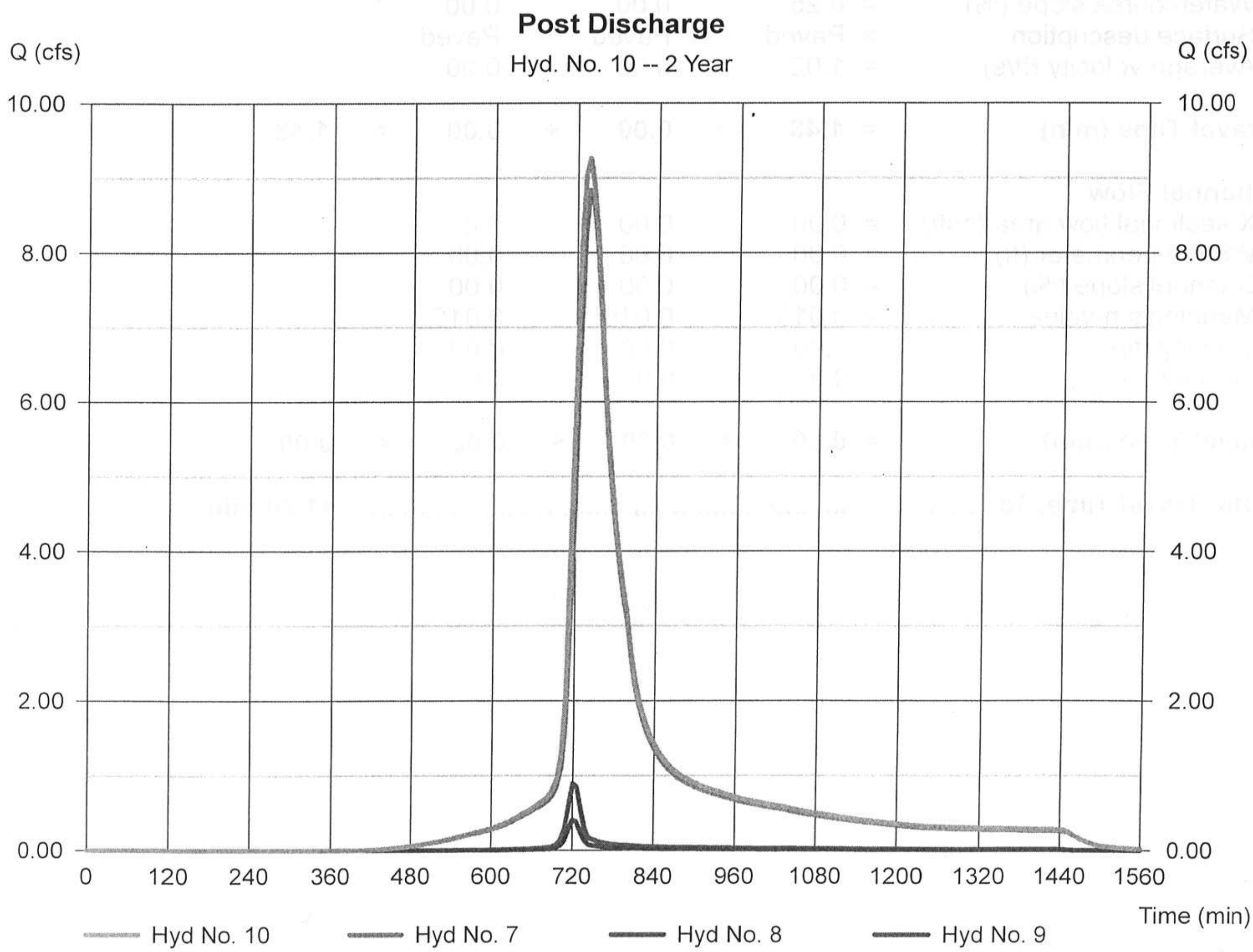
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 | Friday, Dec 4, 2009

Hyd. No. 10

Post Discharge

Hydrograph type	= Combine	Peak discharge	= 9.265 cfs
Storm frequency	= 2 yrs	Time to peak	= 738 min
Time interval	= 6 min	Hyd. volume	= 63,057 cuft
Inflow hyds.	= 7, 8, 9	Contrib. drain. area	= 0.800 ac



Hydrograph Summary Report

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

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	16.77	6	726	68,089	------	------	------	PH 1 Predevelopment
2	SCS Runoff	9.164	6	726	37,213	------	------	------	PH 2 Predevelopment
3	Combine	25.93	6	726	105,302	1, 2	------	------	Predevelopment
4	SCS Runoff	19.23	6	726	79,216	------	------	------	PH1 to Detention
5	SCS Runoff	14.00	6	720	44,794	------	------	------	PH2 to Detention
6	Combine	31.73	6	726	124,010	4, 5	------	------	To Detention
7	Reservoir	23.25	6	732	123,892	6	586.99	26,160	Ph 1& 2 Detn Basin
8	SCS Runoff	2.146	6	720	6,603	------	------	------	PH1 Bypass Detention
9	SCS Runoff	0.944	6	720	2,911	------	------	------	PH2 Bypass Detention
10	Combine	25.04	6	732	133,406	7, 8, 9	------	------	Post Discharge

Woodbury Phase 1 & 2.gpw	Return Period: ~~10~~ 15 Year	Friday, Dec 4, 2009

Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 — Friday, Dec 4, 2009

Hyd. No. 1

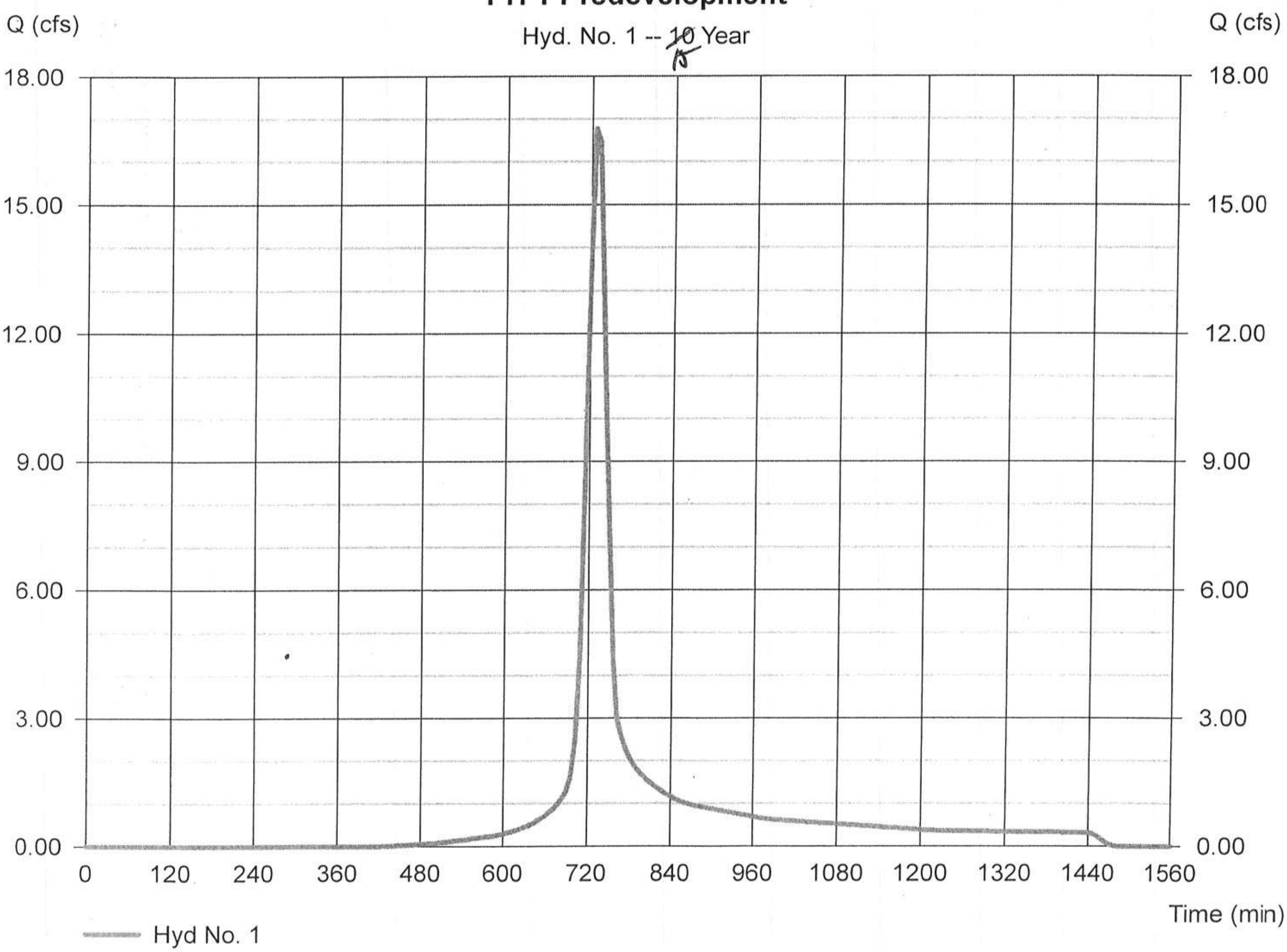
PH 1 Predevelopment

Hydrograph type	= SCS Runoff	Peak discharge	= 16.77 cfs
Storm frequency	= ~~10~~ yrs 15	Time to peak	= 726 min
Time interval	= 6 min	Hyd. volume	= 68,089 cuft
Drainage area	= 5.910 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.80 min
Total precip.	= 5.32 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(4.880 x 80) + (0.160 x 98) + (0.660 x 80) + (0.210 x 79)] / 5.910

PH 1 Predevelopment

Hyd. No. 1 -- ~~10~~ 15 Year



Hydrograph Report

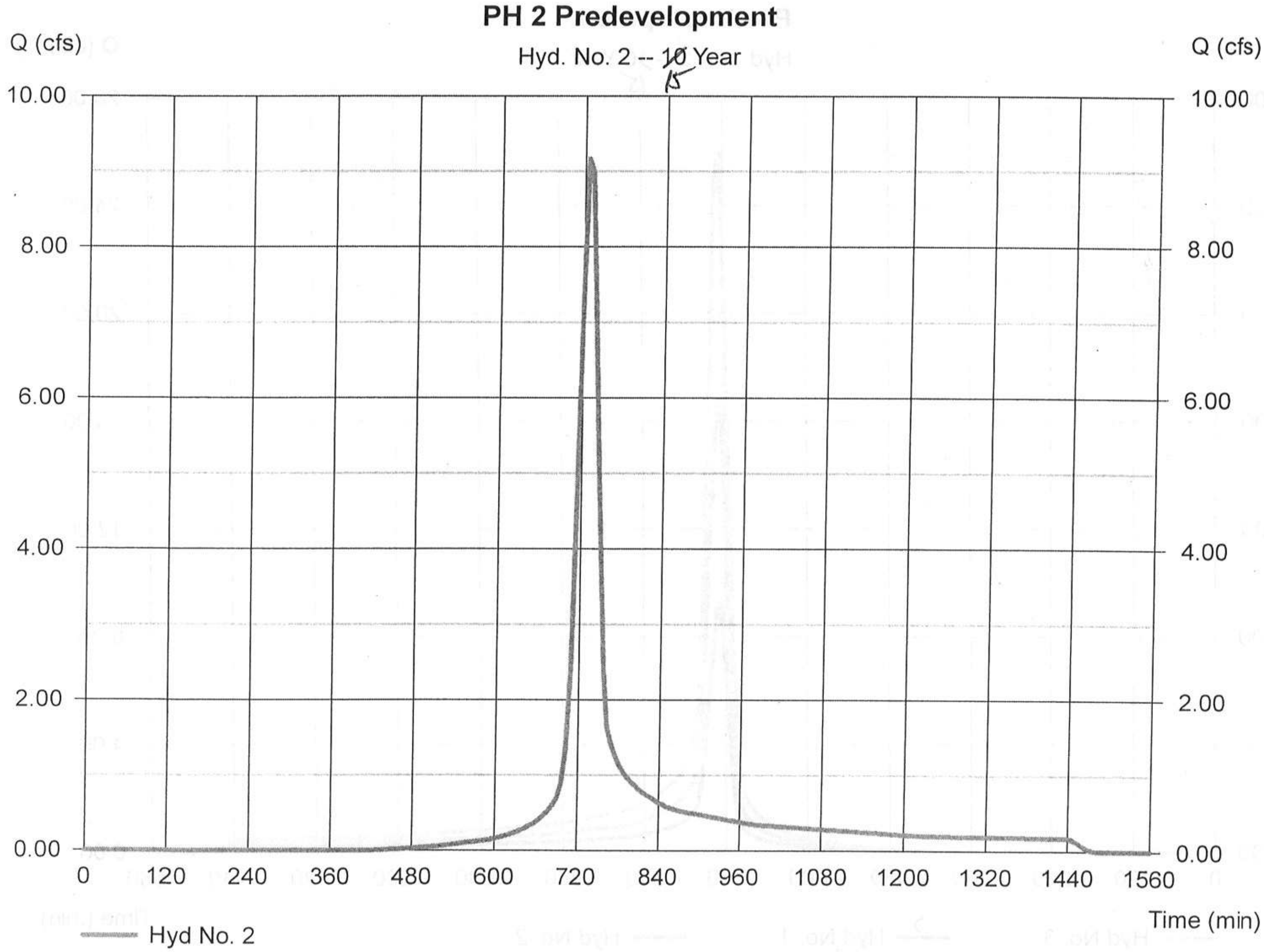
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Friday, Dec 4, 2009

Hyd. No. 2

PH 2 Predevelopment

Hydrograph type	= SCS Runoff	Peak discharge	= 9.164 cfs
Storm frequency	= ~~10~~ 15 yrs	Time to peak	= 726 min
Time interval	= 6 min	Hyd. volume	= 37,213 cuft
Drainage area	= 3.230 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.70 min
Total precip.	= 5.32 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.960 x 80) + (0.270 x 79)] / 3.230



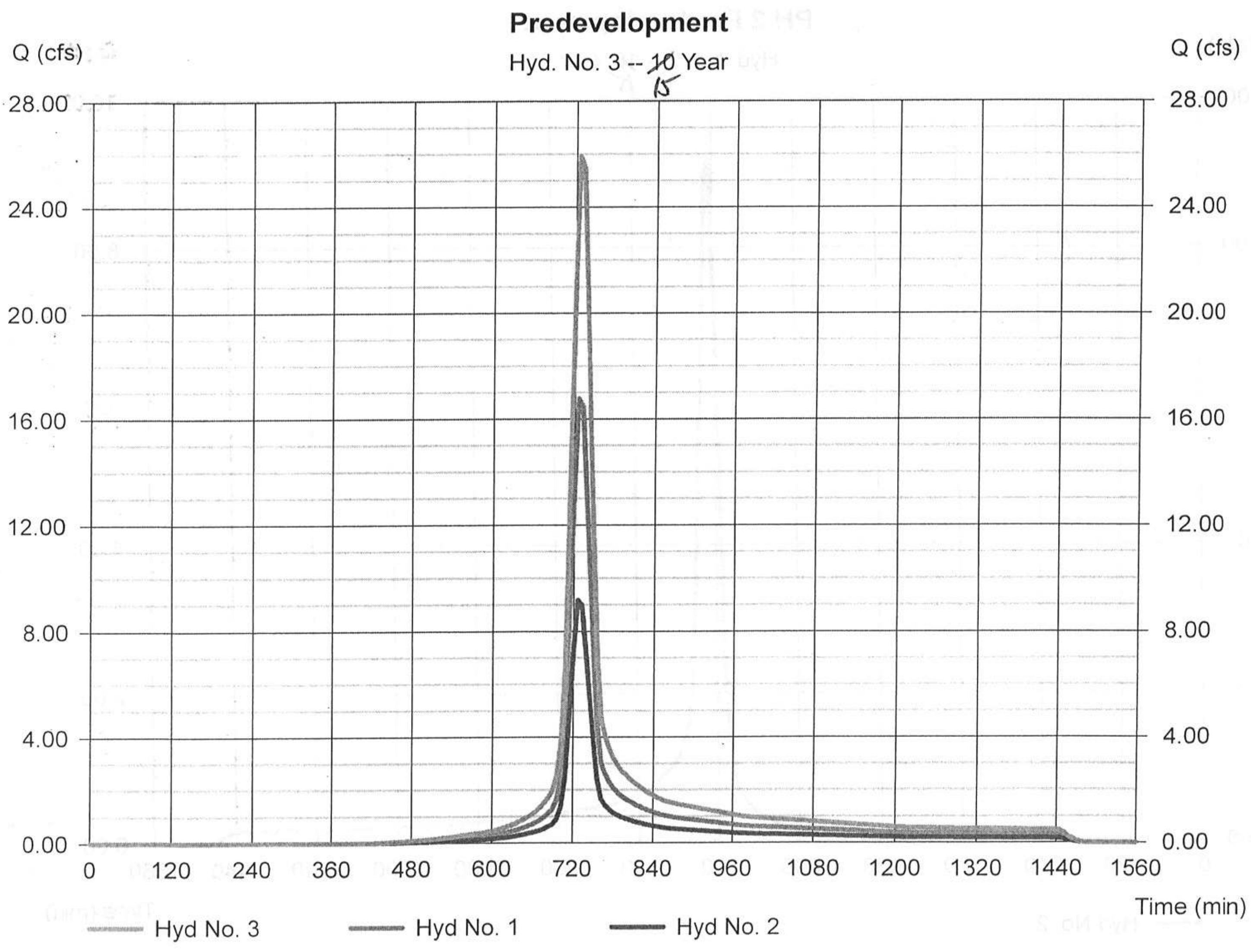
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 — Friday, Dec 4, 2009

Hyd. No. 3

Predevelopment

Hydrograph type	= Combine	Peak discharge	= 25.93 cfs
Storm frequency	= ~~10~~ 15 yrs	Time to peak	= 726 min
Time interval	= 6 min	Hyd. volume	= 105,302 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 9.140 ac



Hydrograph Report

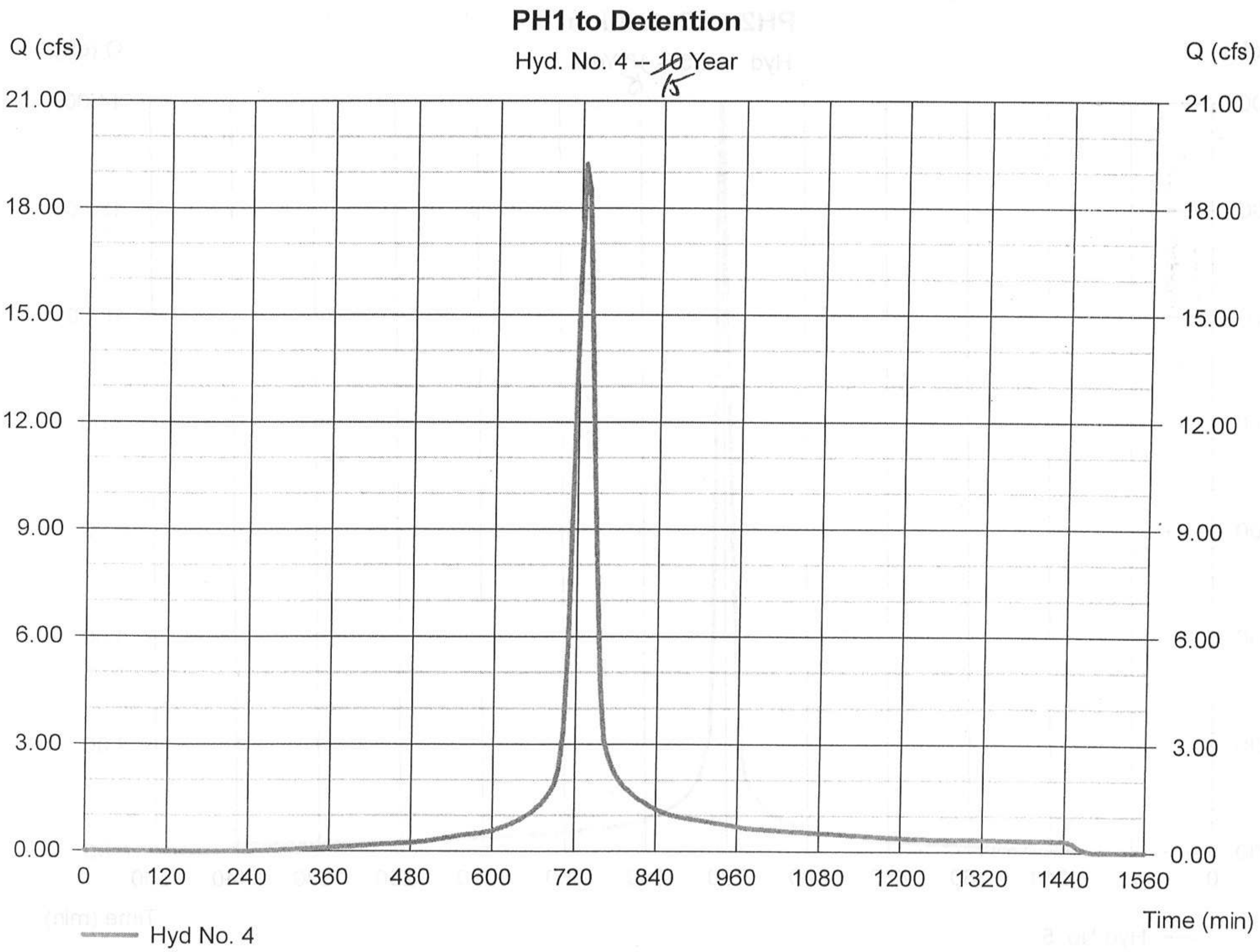
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Friday, Dec 4, 2009

Hyd. No. 4

PH1 to Detention

Hydrograph type	= SCS Runoff	Peak discharge	= 19.23 cfs
Storm frequency	= ~~10~~ yrs 15	Time to peak	= 726 min
Time interval	= 6 min	Hyd. volume	= 79,216 cuft
Drainage area	= 5.350 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 21.20 min
Total precip.	= 5.32 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.510 x 98) + (2.020 x 80) + (0.160 x 98) + (0.660 x 80)] / 5.350



Hydrograph Report

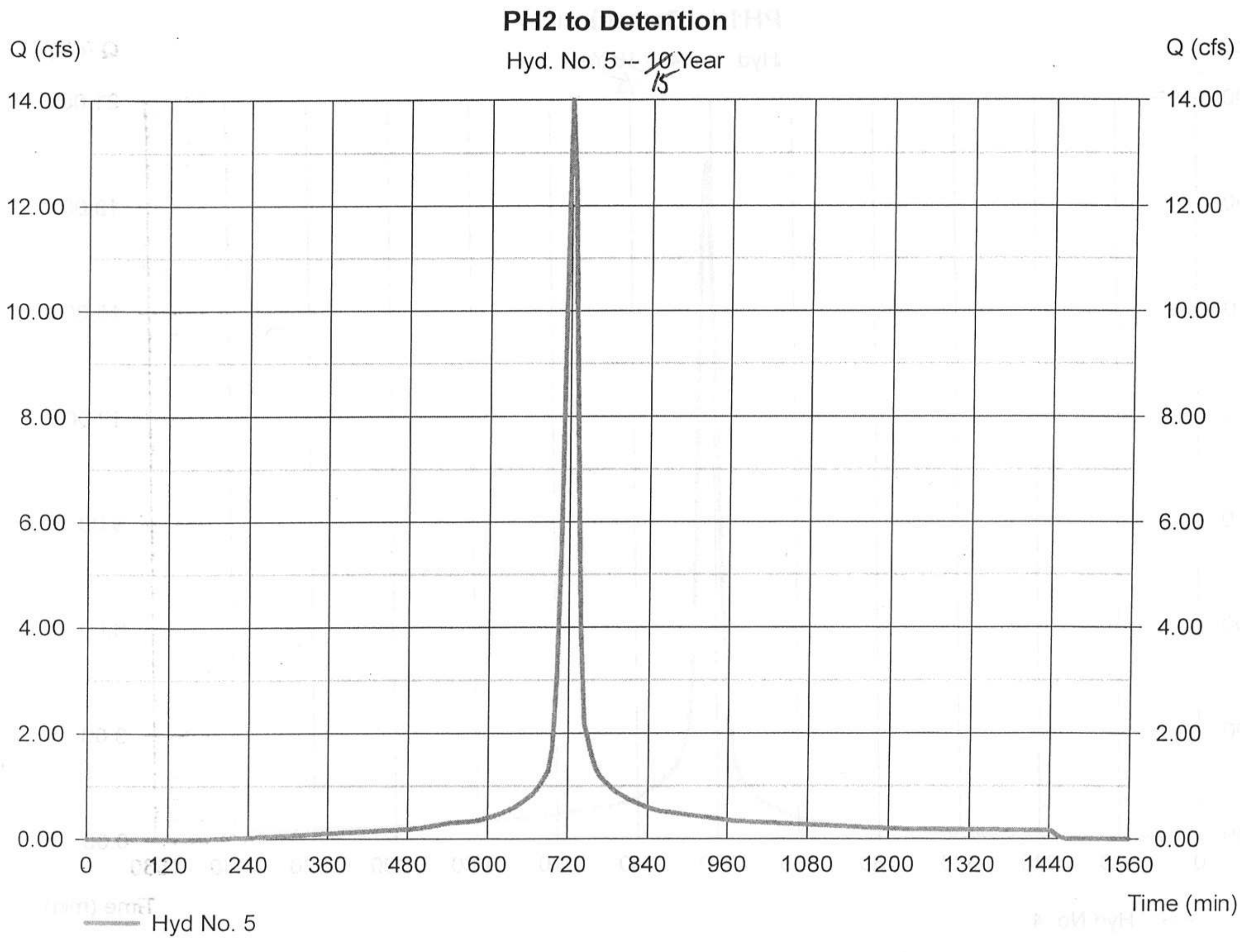
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Friday, Dec 4, 2009

Hyd. No. 5

PH2 to Detention

Hydrograph type	= SCS Runoff	Peak discharge	= 14.00 cfs
Storm frequency	= ~~10~~ yrs 15	Time to peak	= 720 min
Time interval	= 6 min	Hyd. volume	= 44,794 cuft
Drainage area	= 2.990 ac	Curve number	= 92*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 13.80 min
Total precip.	= 5.32 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.000 x 98) + (0.990 x 80)] / 2.990



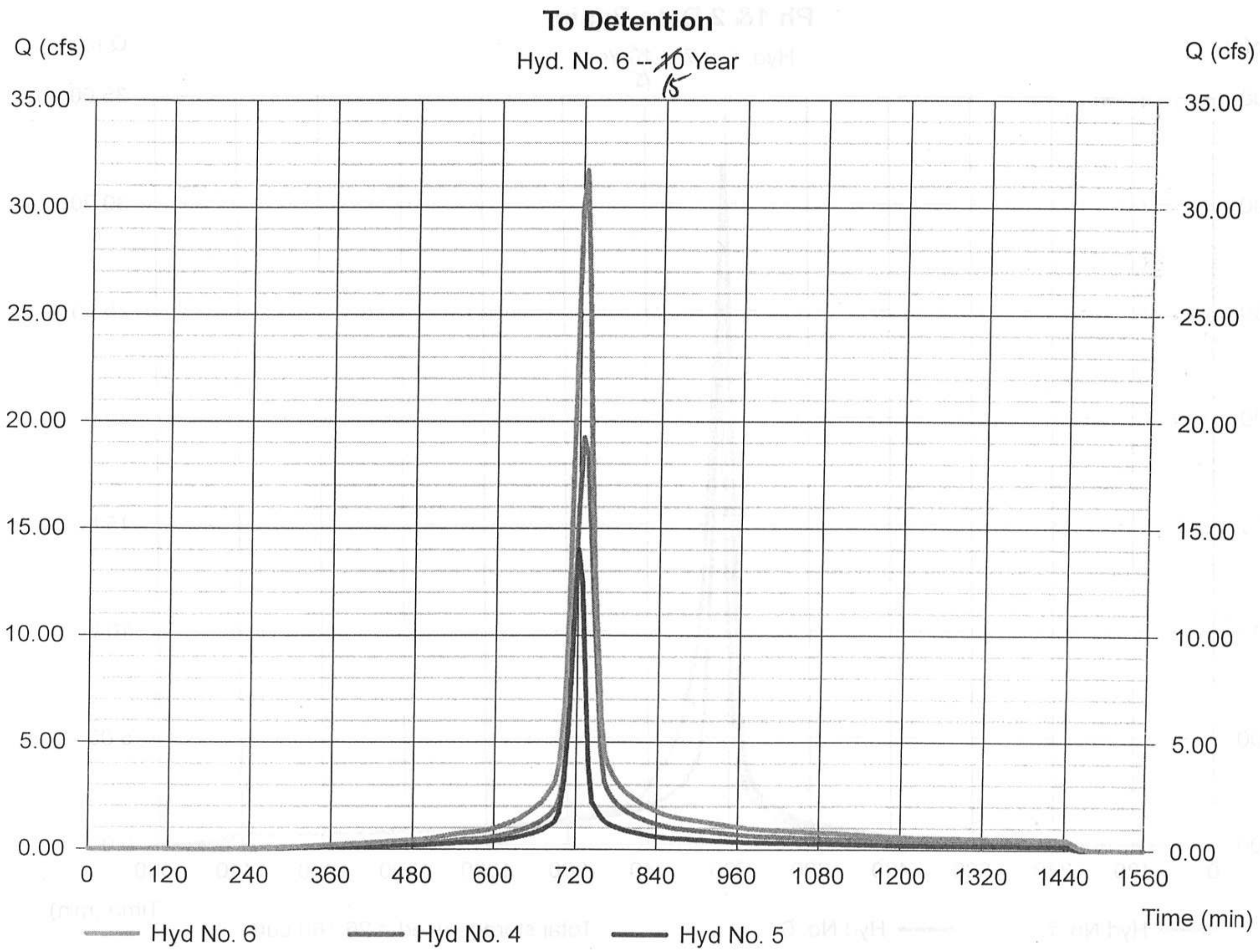
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Friday, Dec 4, 2009

Hyd. No. 6

To Detention

Hydrograph type	= Combine	Peak discharge	= 31.73 cfs
Storm frequency	= ~~10~~ 15 yrs	Time to peak	= 726 min
Time interval	= 6 min	Hyd. volume	= 124,010 cuft
Inflow hyds.	= 4, 5	Contrib. drain. area	= 8.340 ac



Hydrograph Report

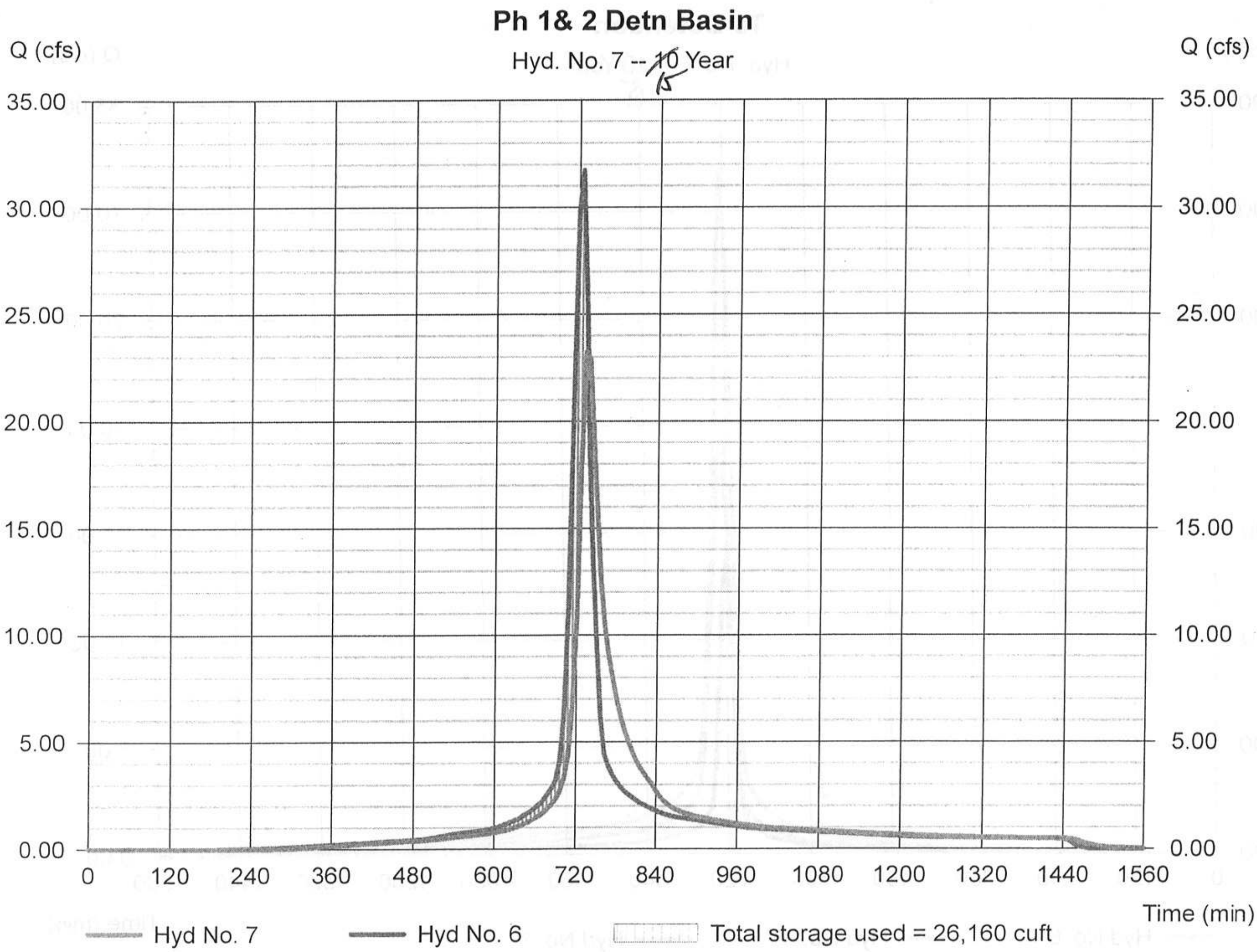
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 — Friday, Dec 4, 2009

Hyd. No. 7

Ph 1& 2 Detn Basin

Hydrograph type	= Reservoir	Peak discharge	= 23.25 cfs
Storm frequency	= ~~10~~ 15 yrs	Time to peak	= 732 min
Time interval	= 6 min	Hyd. volume	= 123,892 cuft
Inflow hyd. No.	= 6 - To Detention	Max. Elevation	= 586.99 ft
Reservoir name	= StormTech MC-3500	Max. Storage	= 26,160 cuft

Storage Indication method used.



Hydrograph Report

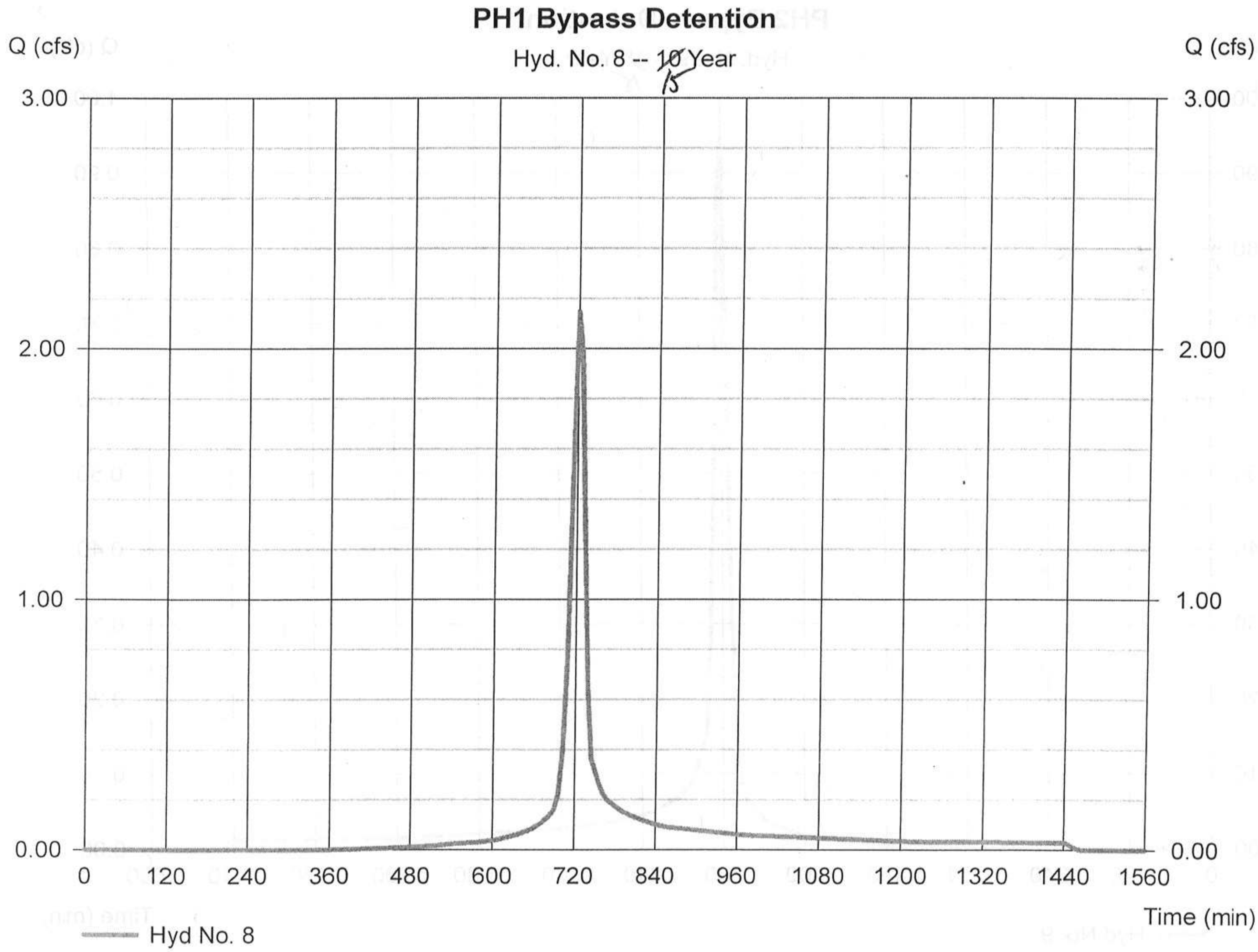
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Friday, Dec 4, 2009

Hyd. No. 8

PH1 Bypass Detention

Hydrograph type	= SCS Runoff	Peak discharge	= 2.146 cfs
Storm frequency	= ~~10~~ yrs 15	Time to peak	= 720 min
Time interval	= 6 min	Hyd. volume	= 6,603 cuft
Drainage area	= 0.560 ac	Curve number	= 83*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.70 min
Total precip.	= 5.32 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.080 x 98) + (0.480 x 80)] / 0.560



Hydrograph Report

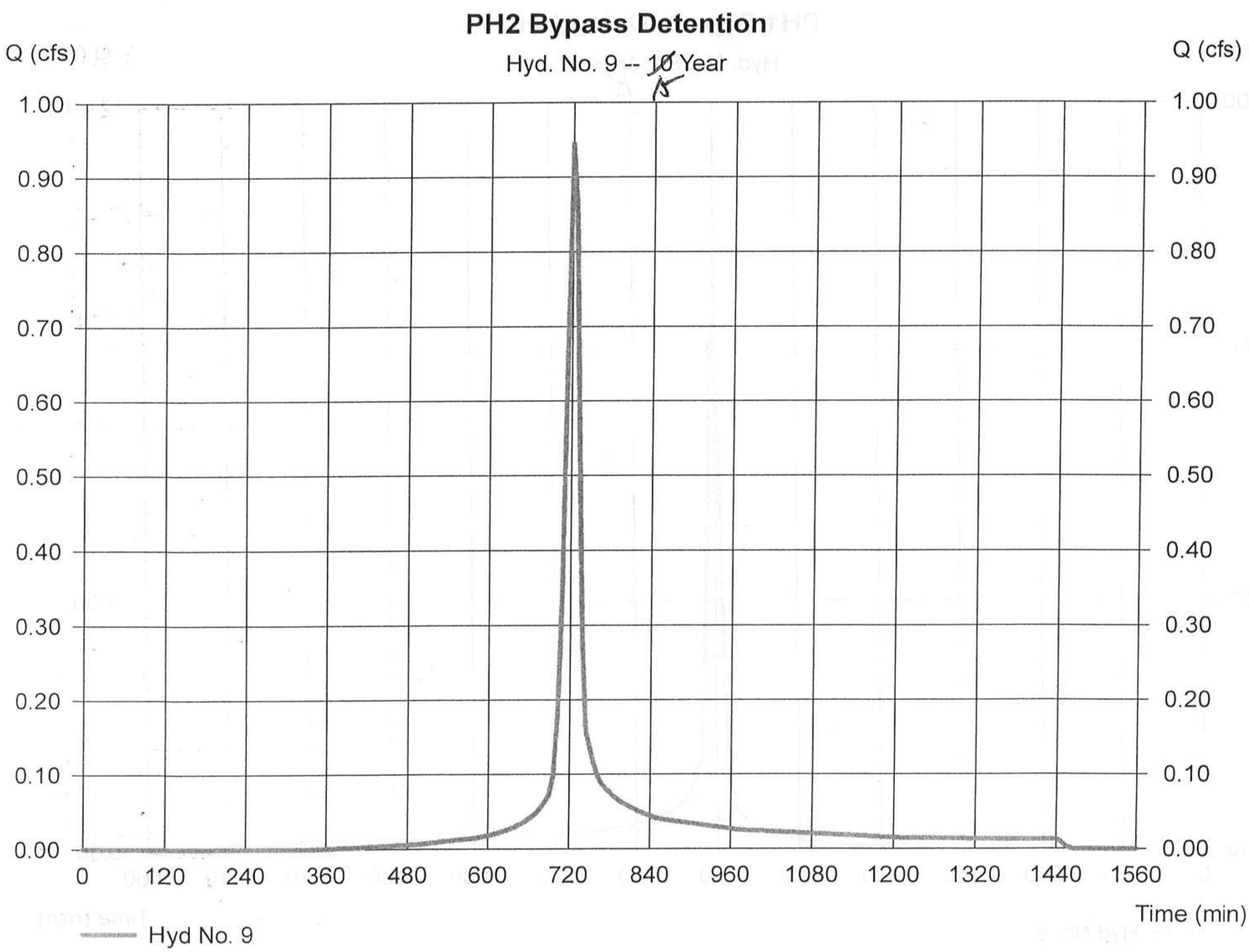
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Friday, Dec 4, 2009

Hyd. No. 9

PH2 Bypass Detention

Hydrograph type	= SCS Runoff	Peak discharge	= 0.944 cfs
Storm frequency	= ~~10~~ yrs 15	Time to peak	= 720 min
Time interval	= 6 min	Hyd. volume	= 2,911 cuft
Drainage area	= 0.240 ac	Curve number	= 84*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.70 min
Total precip.	= 5.32 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.050 x 98) + (0.190 x 80)] / 0.240



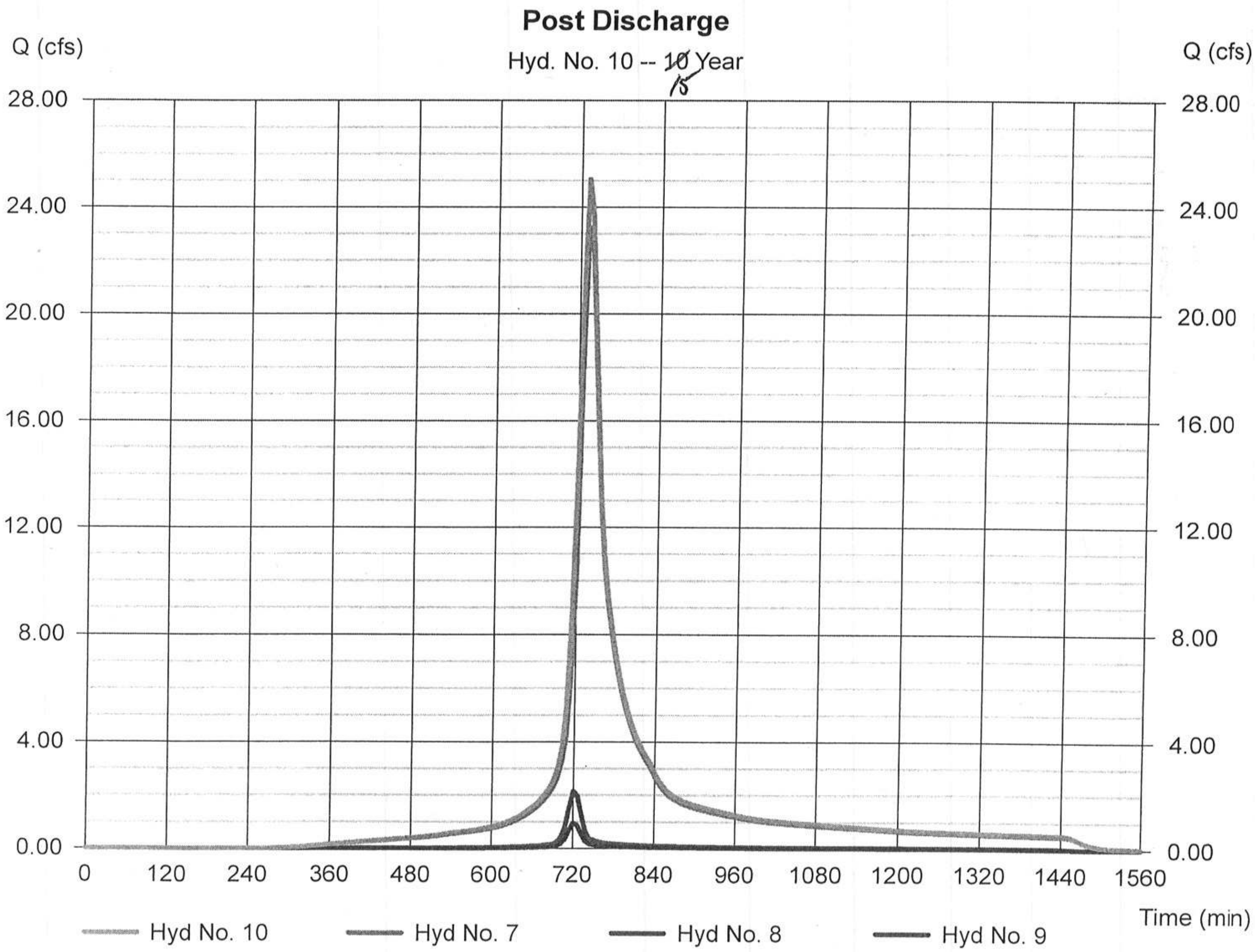
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 — Friday, Dec 4, 2009

Hyd. No. 10

Post Discharge

Hydrograph type	= Combine	Peak discharge	= 25.04 cfs
Storm frequency	= ~~10~~ yrs 15	Time to peak	= 732 min
Time interval	= 6 min	Hyd. volume	= 133,406 cuft
Inflow hyds.	= 7, 8, 9	Contrib. drain. area	= 0.800 ac



Hydrograph Summary Report

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

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	20.42	6	726	82,865	------	------	------	PH 1 Predevelopment
2	SCS Runoff	11.16	6	726	45,288	------	------	------	PH 2 Predevelopment
3	Combine	31.58	6	726	128,153	1, 2	------	------	Predevelopment
4	SCS Runoff	22.59	6	726	93,658	------	------	------	PH1 to Detention
5	SCS Runoff	16.27	6	720	52,484	------	------	------	PH2 to Detention
6	Combine	37.08	6	726	146,142	4, 5	------	------	To Detention
7	Reservoir	27.88	6	732	146,024	6	587.29	29,254	Ph 1& 2 Detn Basin
8	SCS Runoff	2.577	6	720	7,956	------	------	------	PH1 Bypass Detention
9	SCS Runoff	1.129	6	720	3,496	------	------	------	PH2 Bypass Detention
10	Combine	30.01	6	732	157,477	7, 8, 9	------	------	Post Discharge

Hydrograph Report

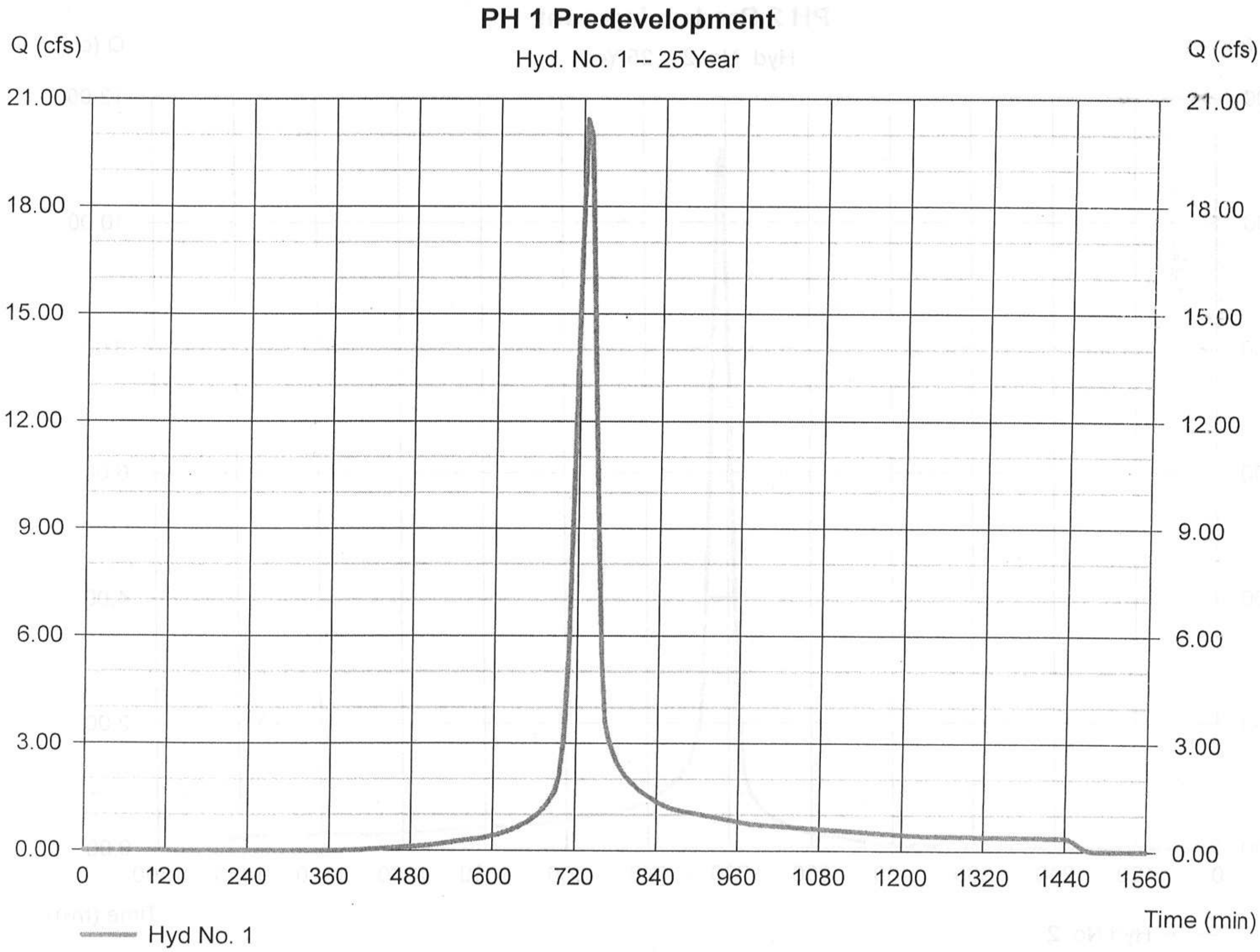
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Friday, Dec 4, 2009

Hyd. No. 1

PH 1 Predevelopment

Hydrograph type	= SCS Runoff	Peak discharge	= 20.42 cfs
Storm frequency	= 25 yrs	Time to peak	= 726 min
Time interval	= 6 min	Hyd. volume	= 82,865 cuft
Drainage area	= 5.910 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.80 min
Total precip.	= 6.09 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(4.880 x 80) + (0.160 x 98) + (0.660 x 80) + (0.210 x 79)] / 5.910



Hydrograph Report

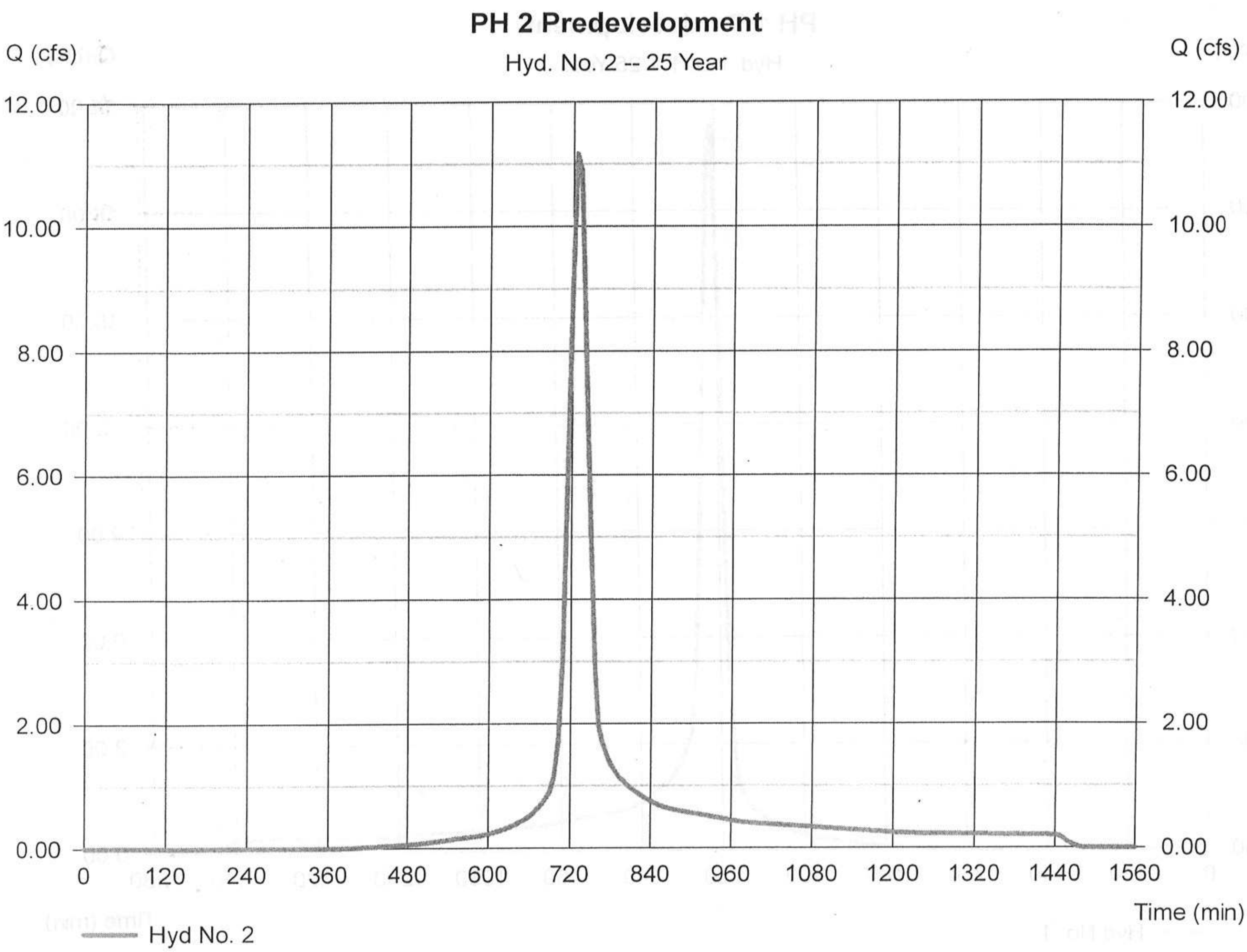
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Friday, Dec 4, 2009

Hyd. No. 2

PH 2 Predevelopment

Hydrograph type	= SCS Runoff	Peak discharge	= 11.16 cfs
Storm frequency	= 25 yrs	Time to peak	= 726 min
Time interval	= 6 min	Hyd. volume	= 45,288 cuft
Drainage area	= 3.230 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.70 min
Total precip.	= 6.09 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.960 x 80) + (0.270 x 79)] / 3.230



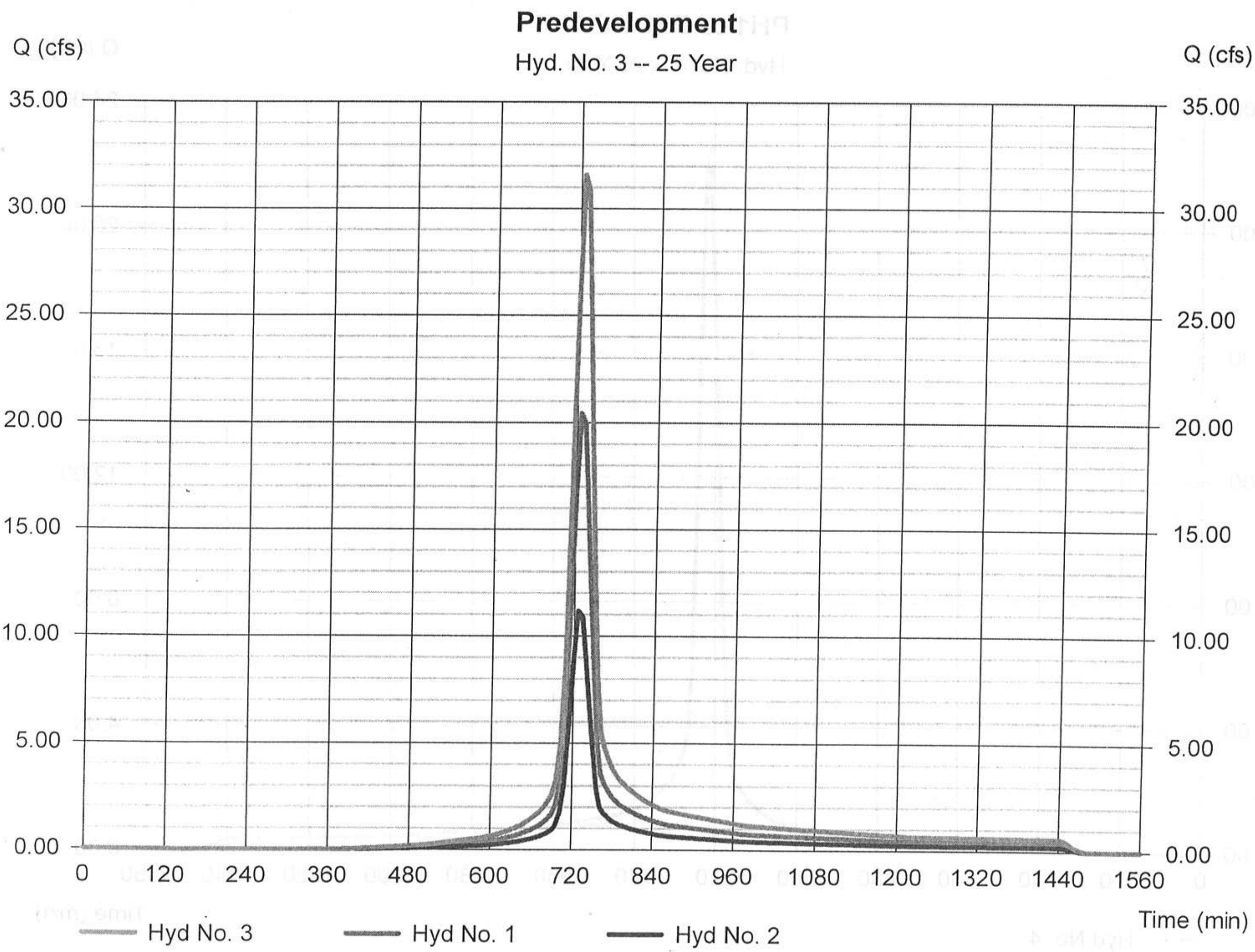
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 — Friday, Dec 4, 2009

Hyd. No. 3

Predevelopment

Hydrograph type	= Combine	Peak discharge	= 31.58 cfs
Storm frequency	= 25 yrs	Time to peak	= 726 min
Time interval	= 6 min	Hyd. volume	= 128,153 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 9.140 ac



Hydrograph Report

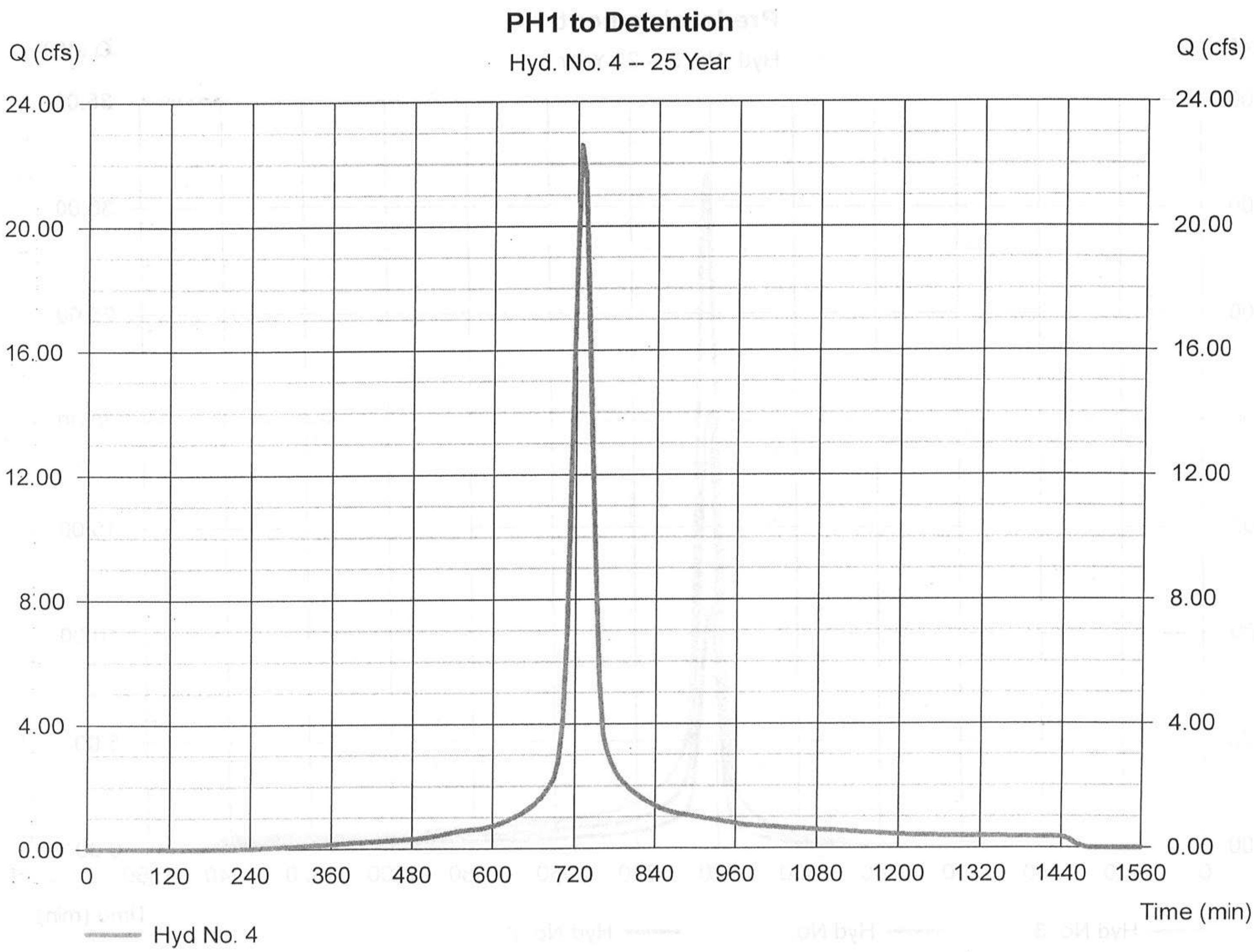
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 | Friday, Dec 4, 2009

Hyd. No. 4

PH1 to Detention

Hydrograph type	= SCS Runoff	Peak discharge	= 22.59 cfs
Storm frequency	= 25 yrs	Time to peak	= 726 min
Time interval	= 6 min	Hyd. volume	= 93,658 cuft
Drainage area	= 5.350 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 21.20 min
Total precip.	= 6.09 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.510 x 98) + (2.020 x 80) + (0.160 x 98) + (0.660 x 80)] / 5.350



Hydrograph Report

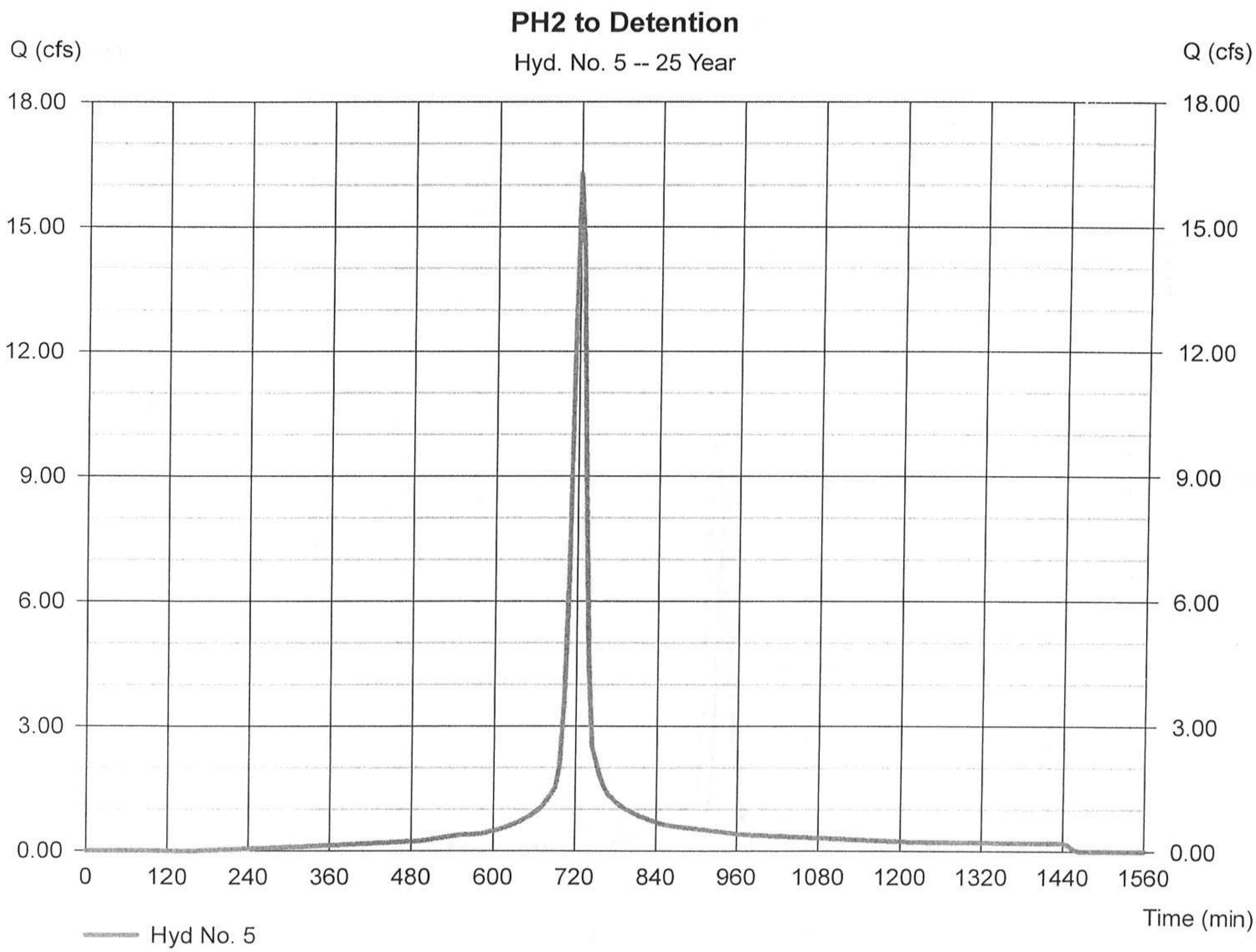
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 — Friday, Dec 4, 2009

Hyd. No. 5

PH2 to Detention

Hydrograph type	= SCS Runoff	Peak discharge	= 16.27 cfs
Storm frequency	= 25 yrs	Time to peak	= 720 min
Time interval	= 6 min	Hyd. volume	= 52,484 cuft
Drainage area	= 2.990 ac	Curve number	= 92*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 13.80 min
Total precip.	= 6.09 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.000 x 98) + (0.990 x 80)] / 2.990



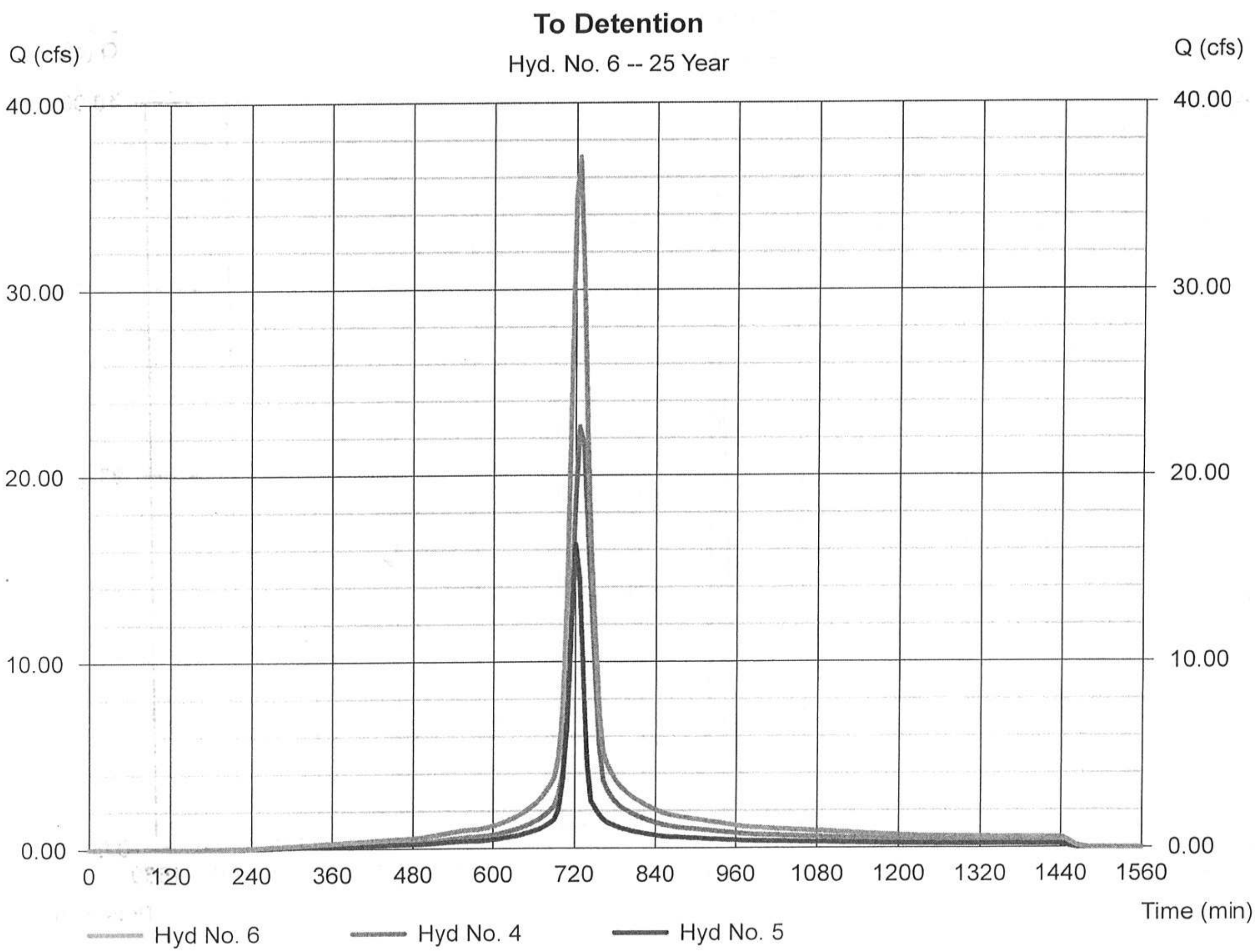
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Friday, Dec 4, 2009

Hyd. No. 6

To Detention

Hydrograph type	= Combine	Peak discharge	= 37.08 cfs
Storm frequency	= 25 yrs	Time to peak	= 726 min
Time interval	= 6 min	Hyd. volume	= 146,142 cuft
Inflow hyds.	= 4, 5	Contrib. drain. area	= 8.340 ac



Hydrograph Report

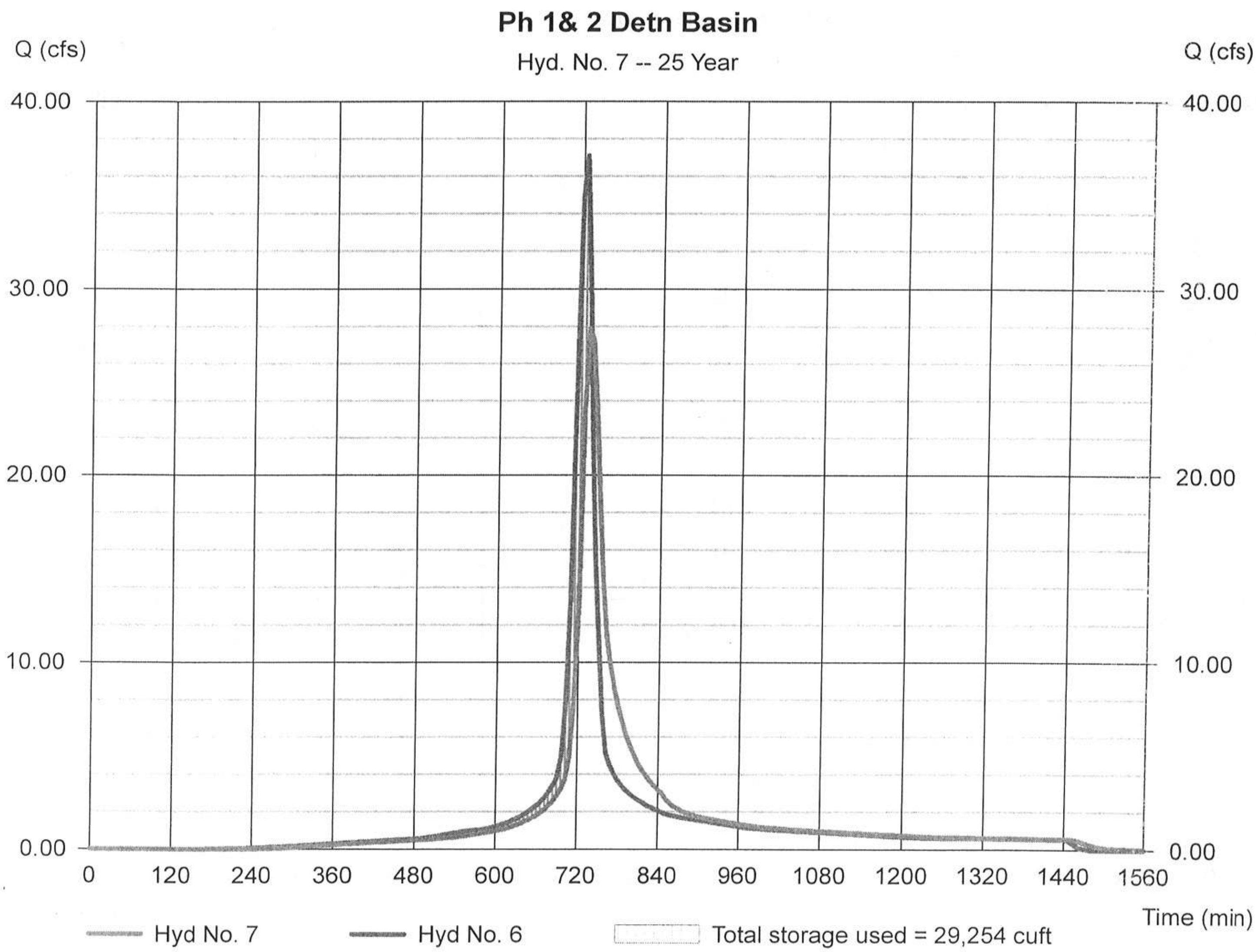
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Friday, Dec 4, 2009

Hyd. No. 7

Ph 1& 2 Detn Basin

Hydrograph type	= Reservoir	Peak discharge	= 27.88 cfs
Storm frequency	= 25 yrs	Time to peak	= 732 min
Time interval	= 6 min	Hyd. volume	= 146,024 cuft
Inflow hyd. No.	= 6 - To Detention	Max. Elevation	= 587.29 ft
Reservoir name	= StormTech MC-3500	Max. Storage	= 29,254 cuft

Storage Indication method used.



Hydrograph Report

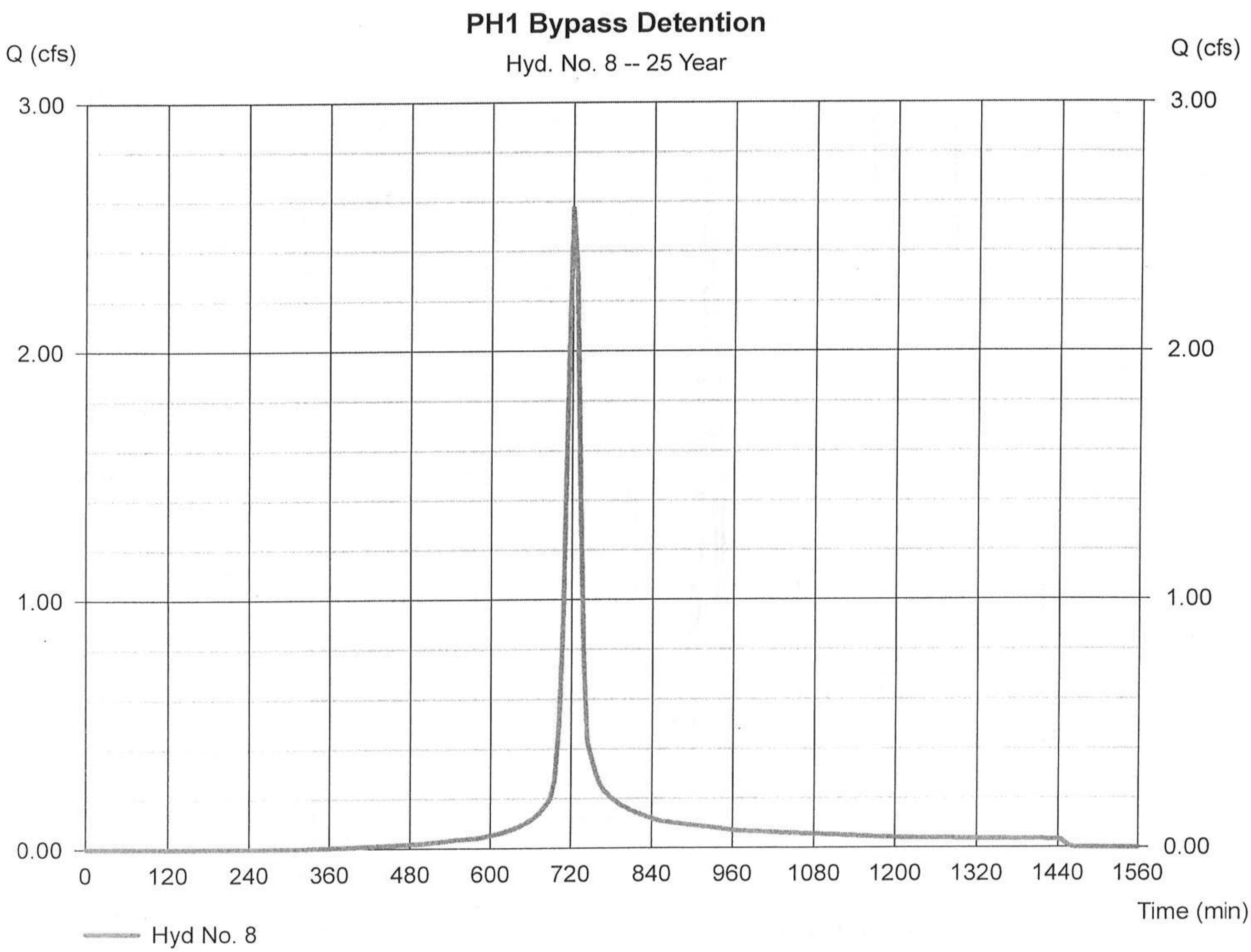
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 — Friday, Dec 4, 2009

Hyd. No. 8

PH1 Bypass Detention

Hydrograph type	= SCS Runoff	Peak discharge	= 2.577 cfs
Storm frequency	= 25 yrs	Time to peak	= 720 min
Time interval	= 6 min	Hyd. volume	= 7,956 cuft
Drainage area	= 0.560 ac	Curve number	= 83*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.70 min
Total precip.	= 6.09 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.080 x 98) + (0.480 x 80)] / 0.560



Hydrograph Report

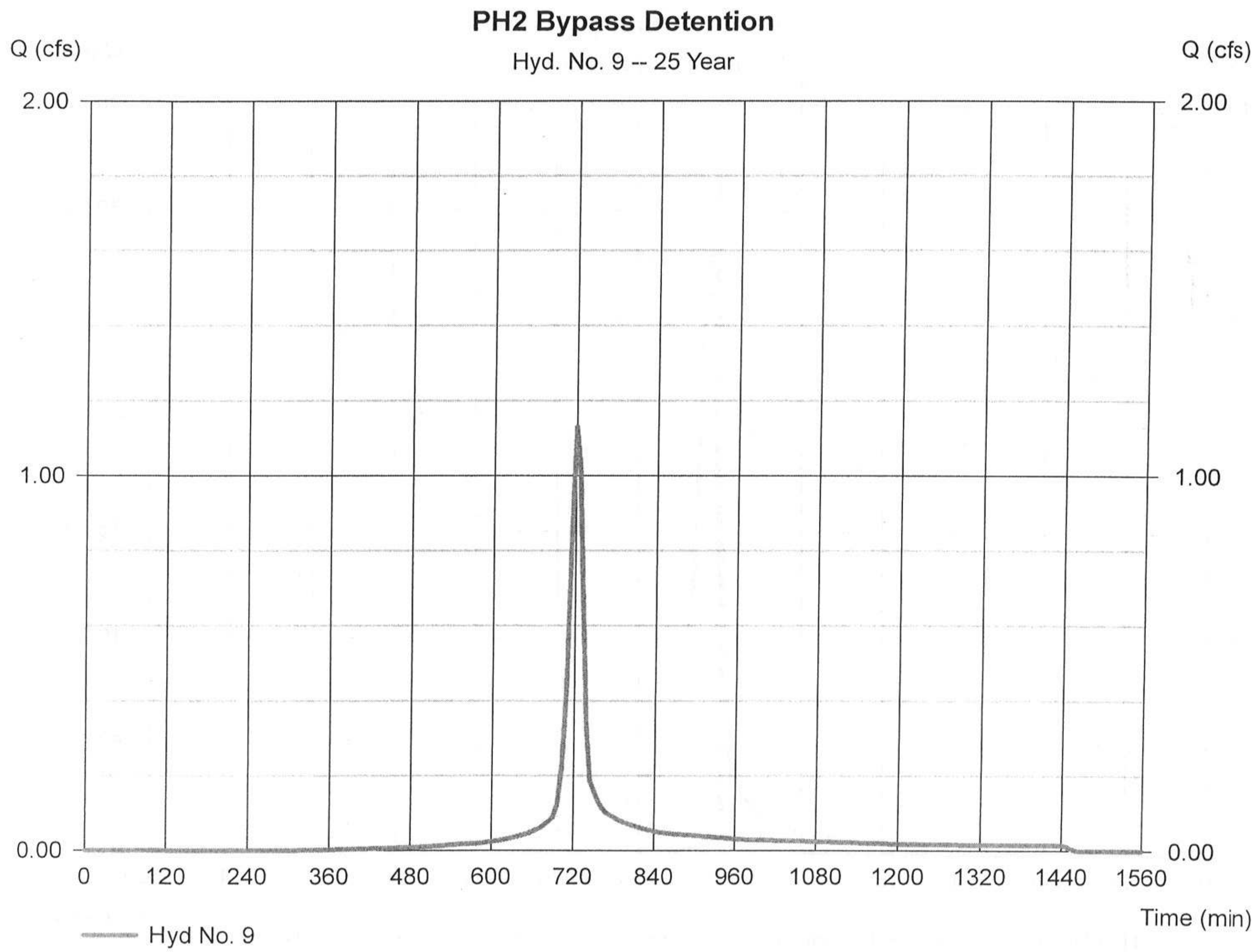
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 — Friday, Dec 4, 2009

Hyd. No. 9

PH2 Bypass Detention

Hydrograph type	= SCS Runoff	Peak discharge	= 1.129 cfs
Storm frequency	= 25 yrs	Time to peak	= 720 min
Time interval	= 6 min	Hyd. volume	= 3,496 cuft
Drainage area	= 0.240 ac	Curve number	= 84*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.70 min
Total precip.	= 6.09 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.050 x 98) + (0.190 x 80)] / 0.240



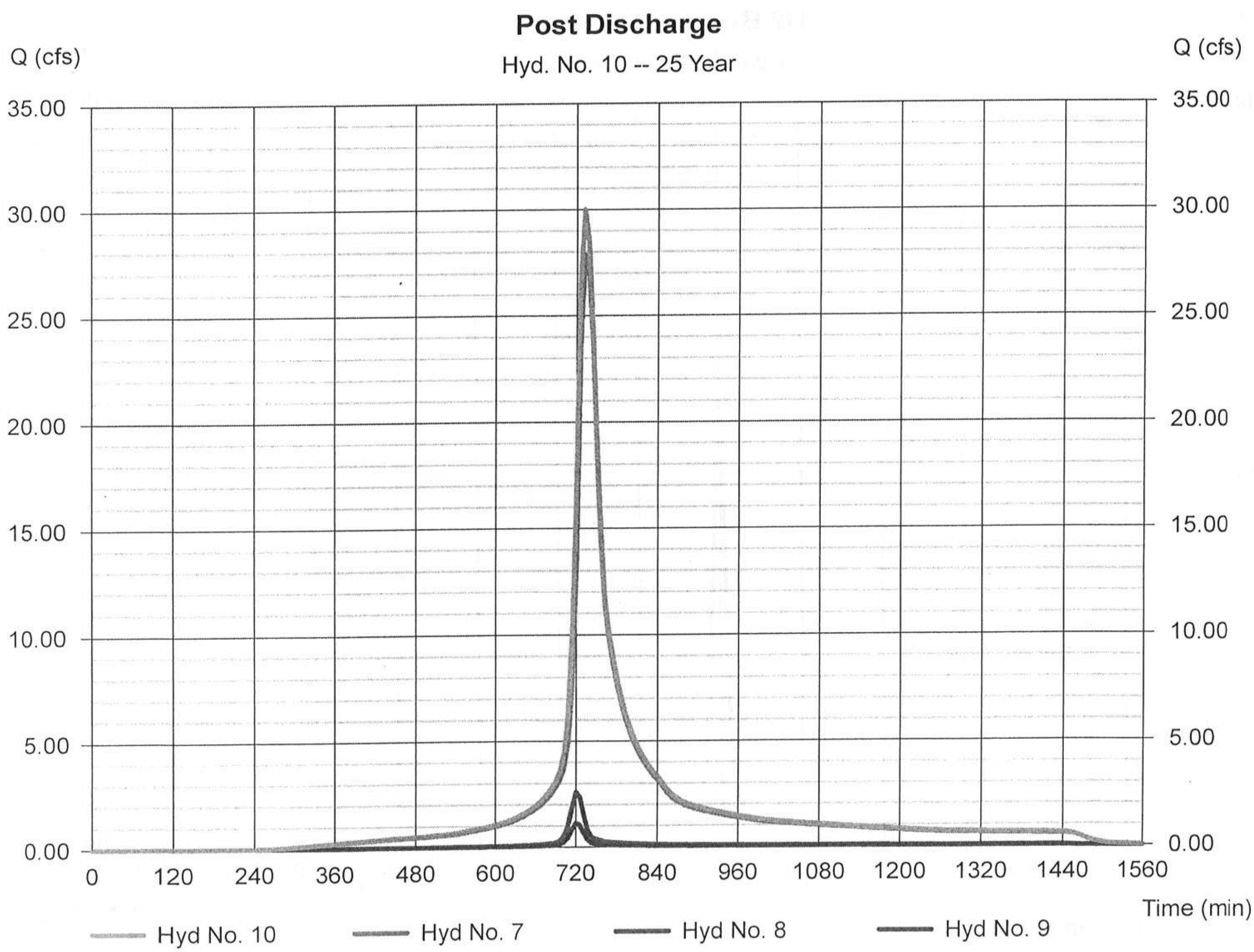
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 | Friday, Dec 4, 2009

Hyd. No. 10

Post Discharge

Hydrograph type	= Combine	Peak discharge	= 30.01 cfs
Storm frequency	= 25 yrs	Time to peak	= 732 min
Time interval	= 6 min	Hyd. volume	= 157,477 cuft
Inflow hyds.	= 7, 8, 9	Contrib. drain. area	= 0.800 ac



Hydrograph Summary Report

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

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	36.58	6	726	149,880	------	------	------	PH 1 Predevelopment
2	SCS Runoff	19.99	6	726	81,914	------	------	------	PH 2 Predevelopment
3	Combine	56.58	6	726	231,793	1, 2	------	------	Predevelopment
4	SCS Runoff	37.09	6	726	157,370	------	------	------	PH1 to Detention
5	SCS Runoff	26.05	6	720	86,197	------	------	------	PH2 to Detention
6	Combine	60.16	6	726	243,567	4, 5	------	------	To Detention
7	Reservoir	45.21	6	732	243,449	6	589.25	43,676	Ph 1& 2 Detn Basin
8	SCS Runoff	4.456	6	720	14,028	------	------	------	PH1 Bypass Detention
9	SCS Runoff	1.934	6	720	6,114	------	------	------	PH2 Bypass Detention
10	Combine	48.79	6	732	263,590	7, 8, 9	------	------	Post Discharge

Hydrograph Report

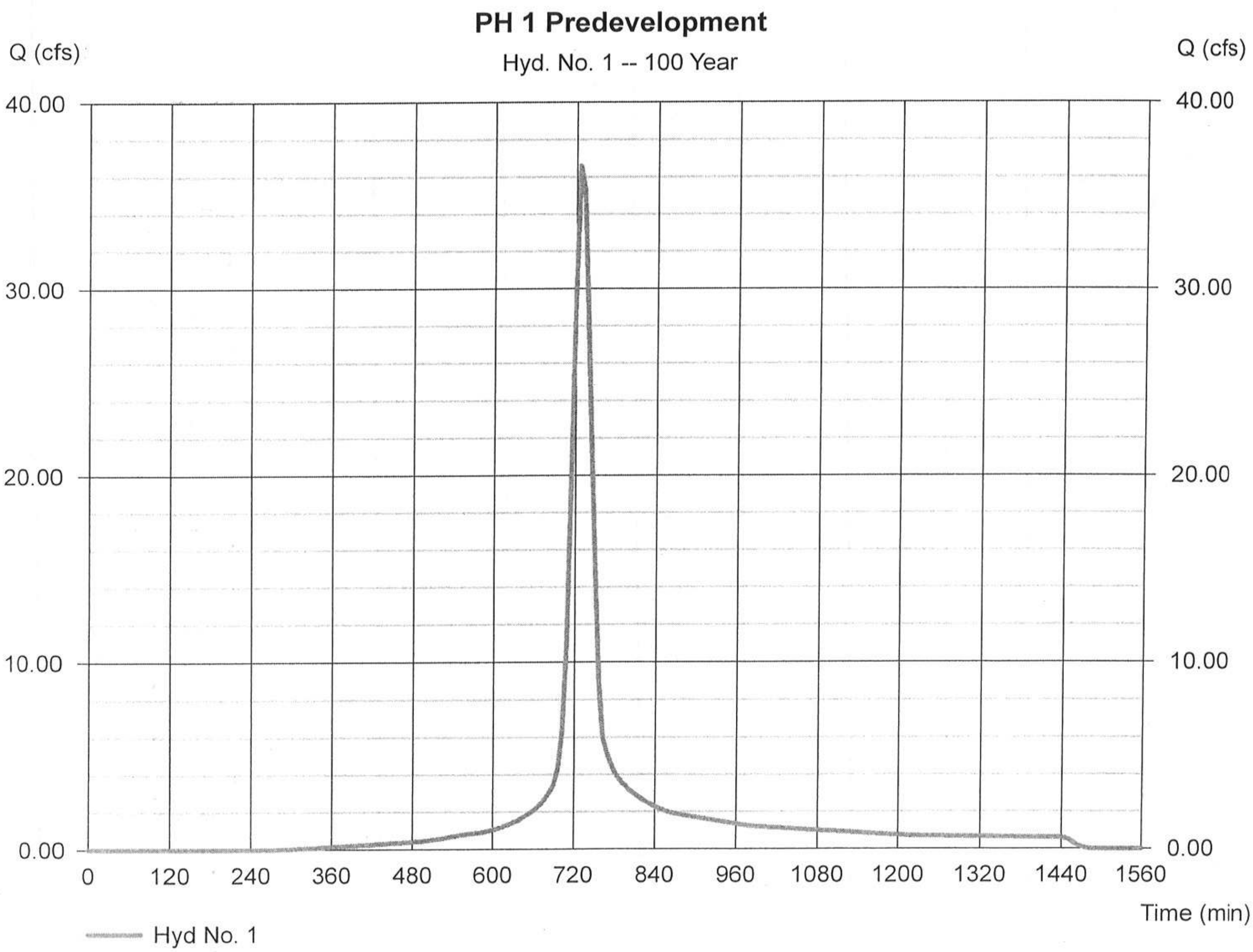
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 — Friday, Dec 4, 2009

Hyd. No. 1

PH 1 Predevelopment

Hydrograph type	= SCS Runoff	Peak discharge	= 36.58 cfs
Storm frequency	= 100 yrs	Time to peak	= 726 min
Time interval	= 6 min	Hyd. volume	= 149,880 cuft
Drainage area	= 5.910 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.80 min
Total precip.	= 9.44 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(4.880 x 80) + (0.160 x 98) + (0.660 x 80) + (0.210 x 79)] / 5.910



Hydrograph Report

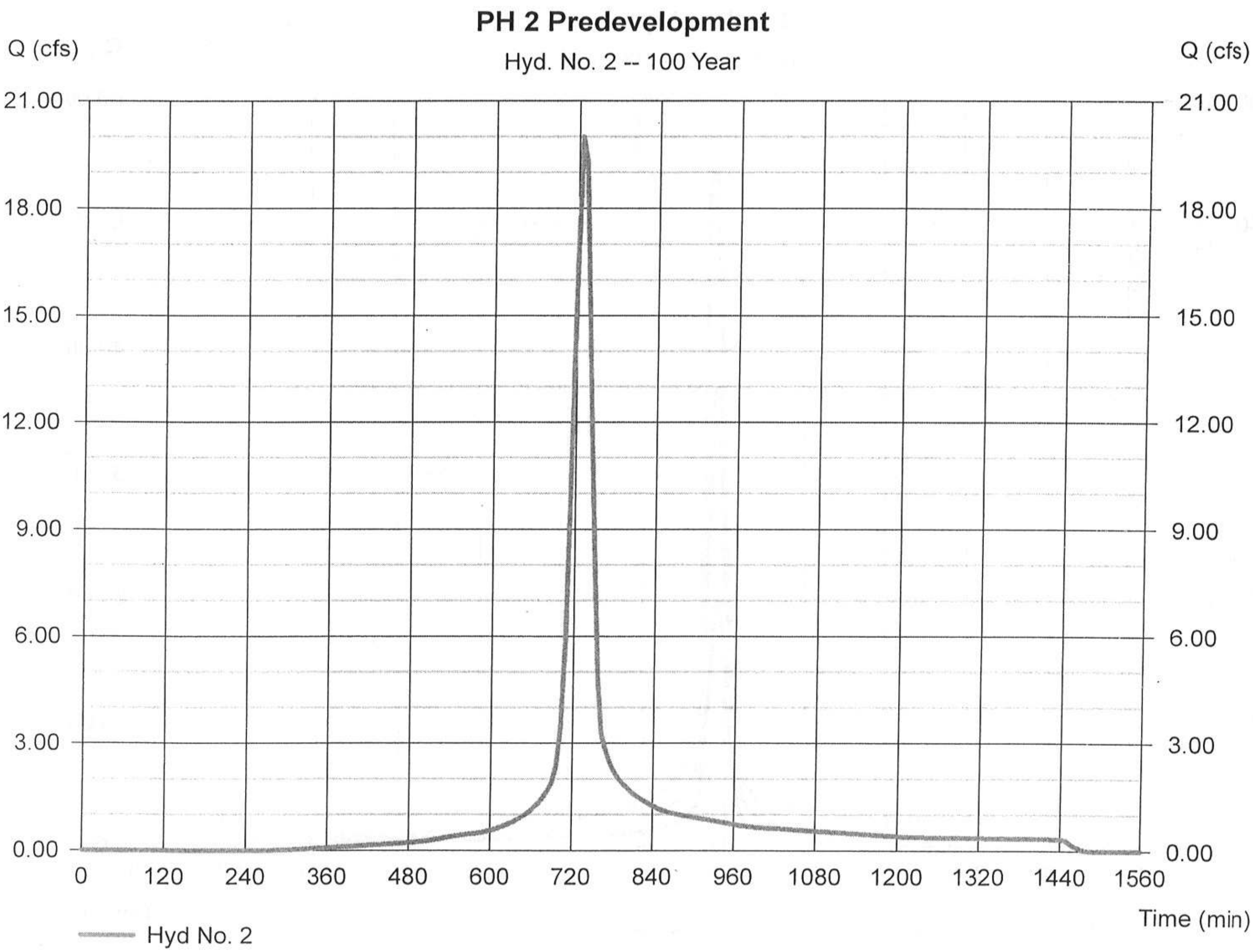
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Friday, Dec 4, 2009

Hyd. No. 2

PH 2 Predevelopment

Hydrograph type	= SCS Runoff	Peak discharge	= 19.99 cfs
Storm frequency	= 100 yrs	Time to peak	= 726 min
Time interval	= 6 min	Hyd. volume	= 81,914 cuft
Drainage area	= 3.230 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.70 min
Total precip.	= 9.44 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.960 x 80) + (0.270 x 79)] / 3.230



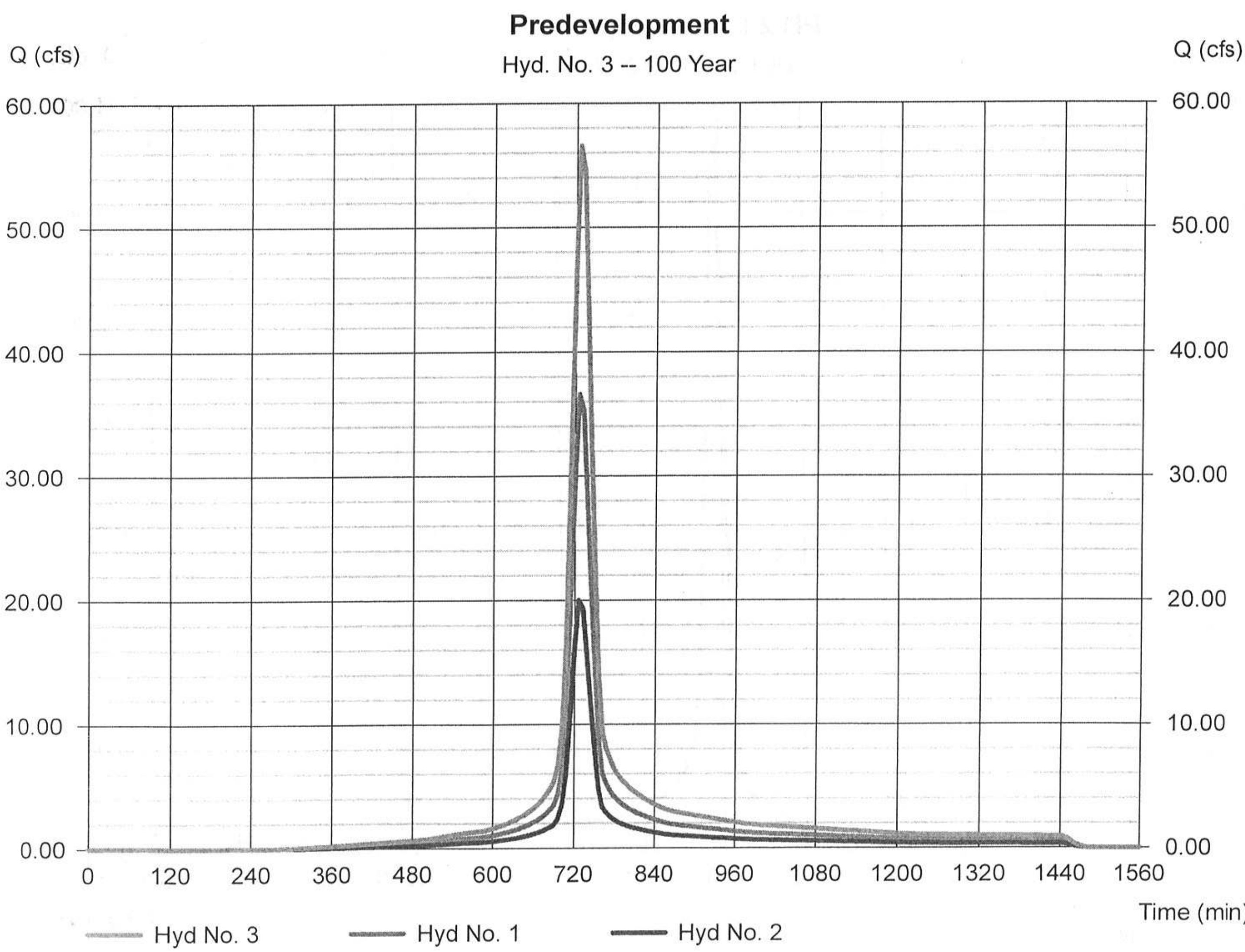
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 | Friday, Dec 4, 2009

Hyd. No. 3

Predevelopment

Hydrograph type	= Combine	Peak discharge	= 56.58 cfs
Storm frequency	= 100 yrs	Time to peak	= 726 min
Time interval	= 6 min	Hyd. volume	= 231,793 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 9.140 ac



Hydrograph Report

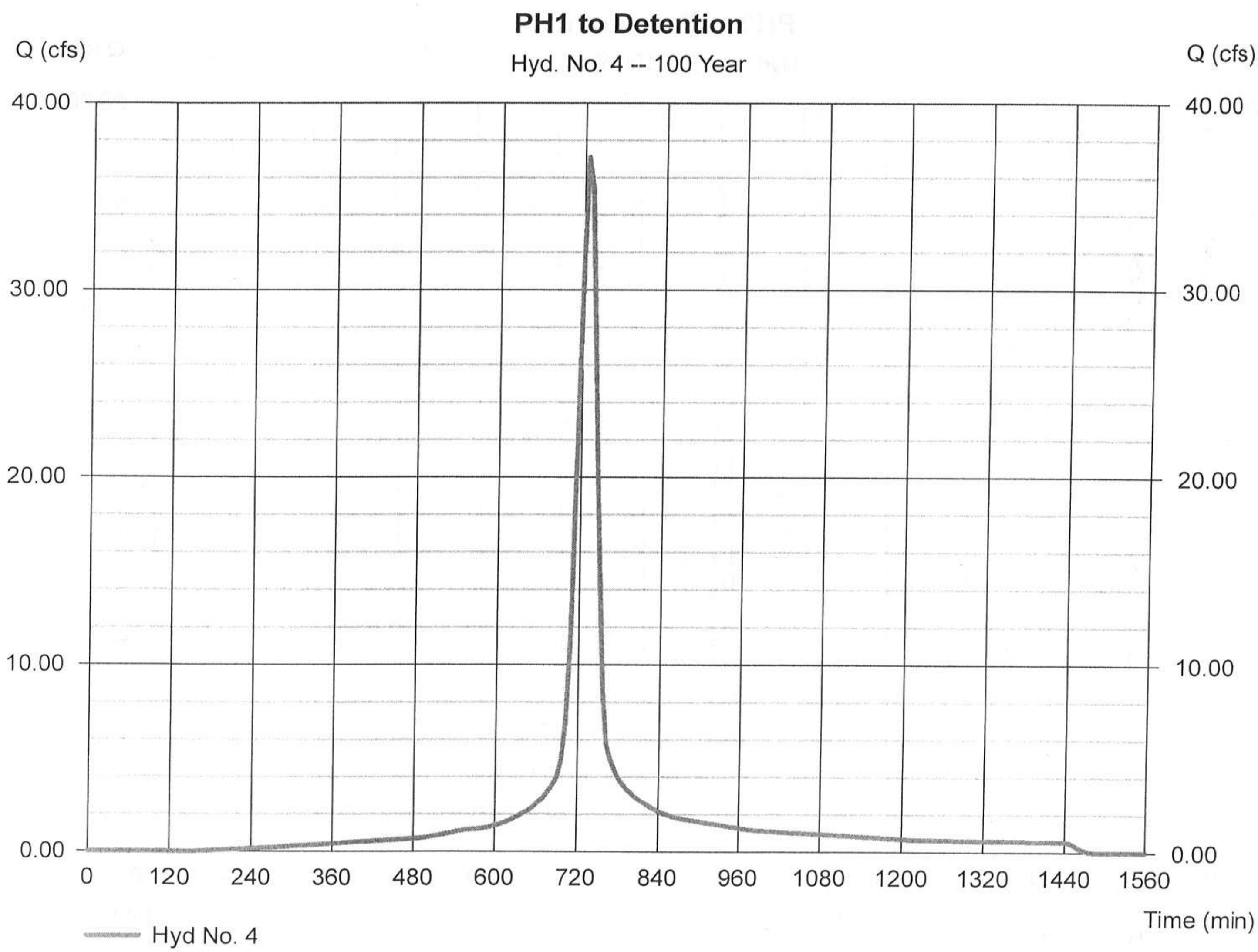
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Friday, Dec 4, 2009

Hyd. No. 4

PH1 to Detention

Hydrograph type	= SCS Runoff	Peak discharge	= 37.09 cfs
Storm frequency	= 100 yrs	Time to peak	= 726 min
Time interval	= 6 min	Hyd. volume	= 157,370 cuft
Drainage area	= 5.350 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 21.20 min
Total precip.	= 9.44 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.510 x 98) + (2.020 x 80) + (0.160 x 98) + (0.660 x 80)] / 5.350



Hydrograph Report

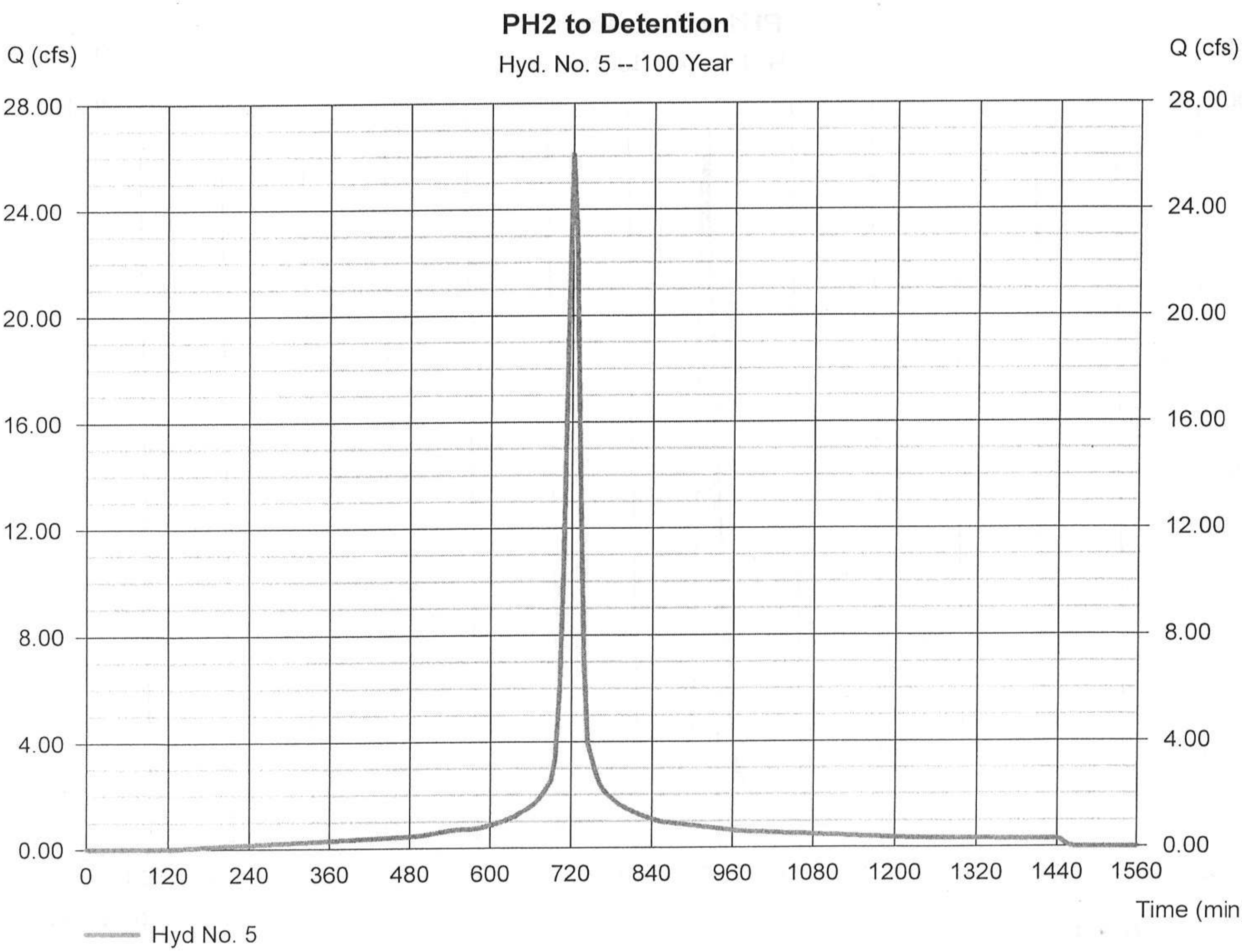
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Friday, Dec 4, 2009

Hyd. No. 5

PH2 to Detention

Hydrograph type	= SCS Runoff	Peak discharge	= 26.05 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 6 min	Hyd. volume	= 86,197 cuft
Drainage area	= 2.990 ac	Curve number	= 92*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 13.80 min
Total precip.	= 9.44 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.000 x 98) + (0.990 x 80)] / 2.990



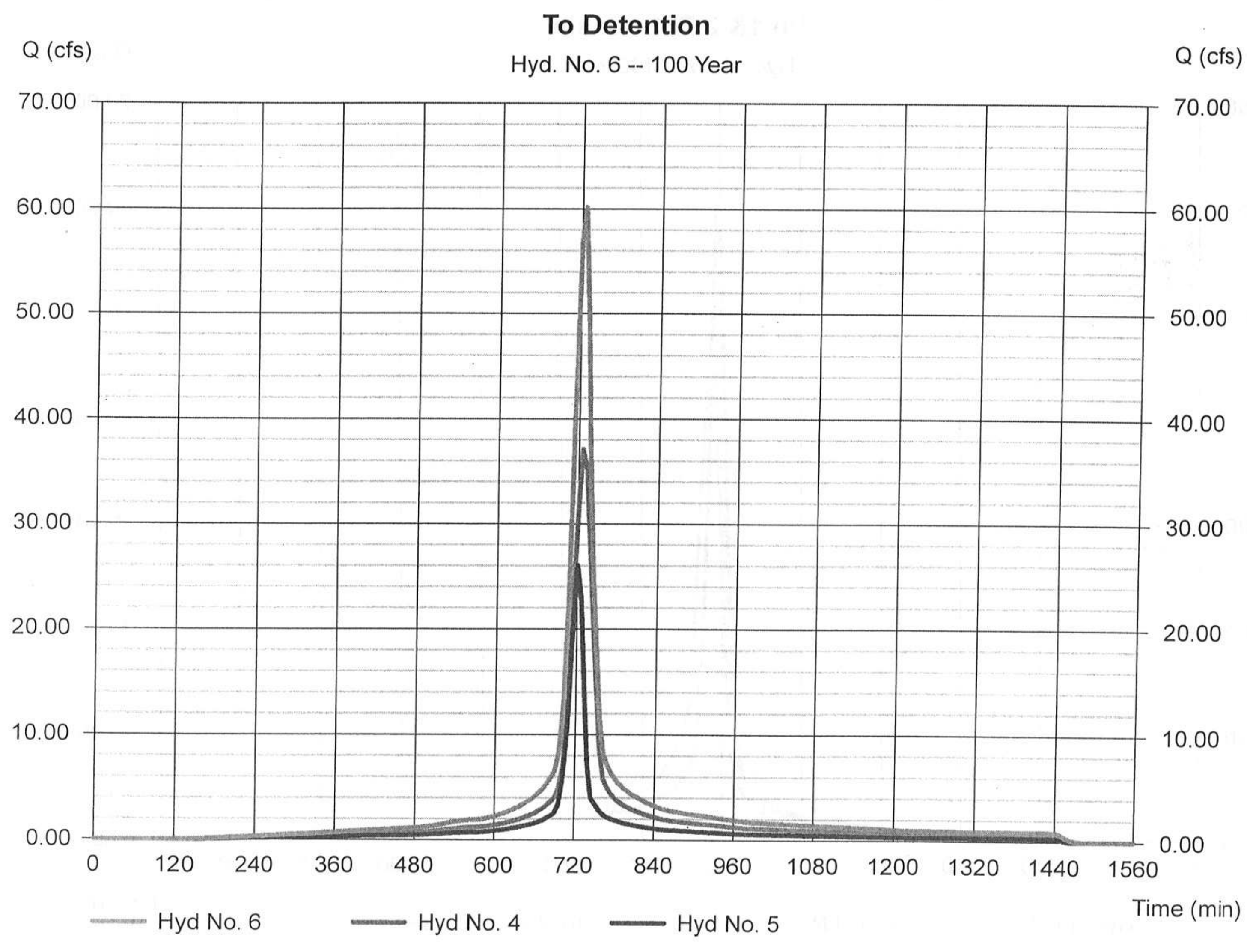
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 — Friday, Dec 4, 2009

Hyd. No. 6

To Detention

Hydrograph type	= Combine	Peak discharge	= 60.16 cfs
Storm frequency	= 100 yrs	Time to peak	= 726 min
Time interval	= 6 min	Hyd. volume	= 243,567 cuft
Inflow hyds.	= 4, 5	Contrib. drain. area	= 8.340 ac



Hydrograph Report

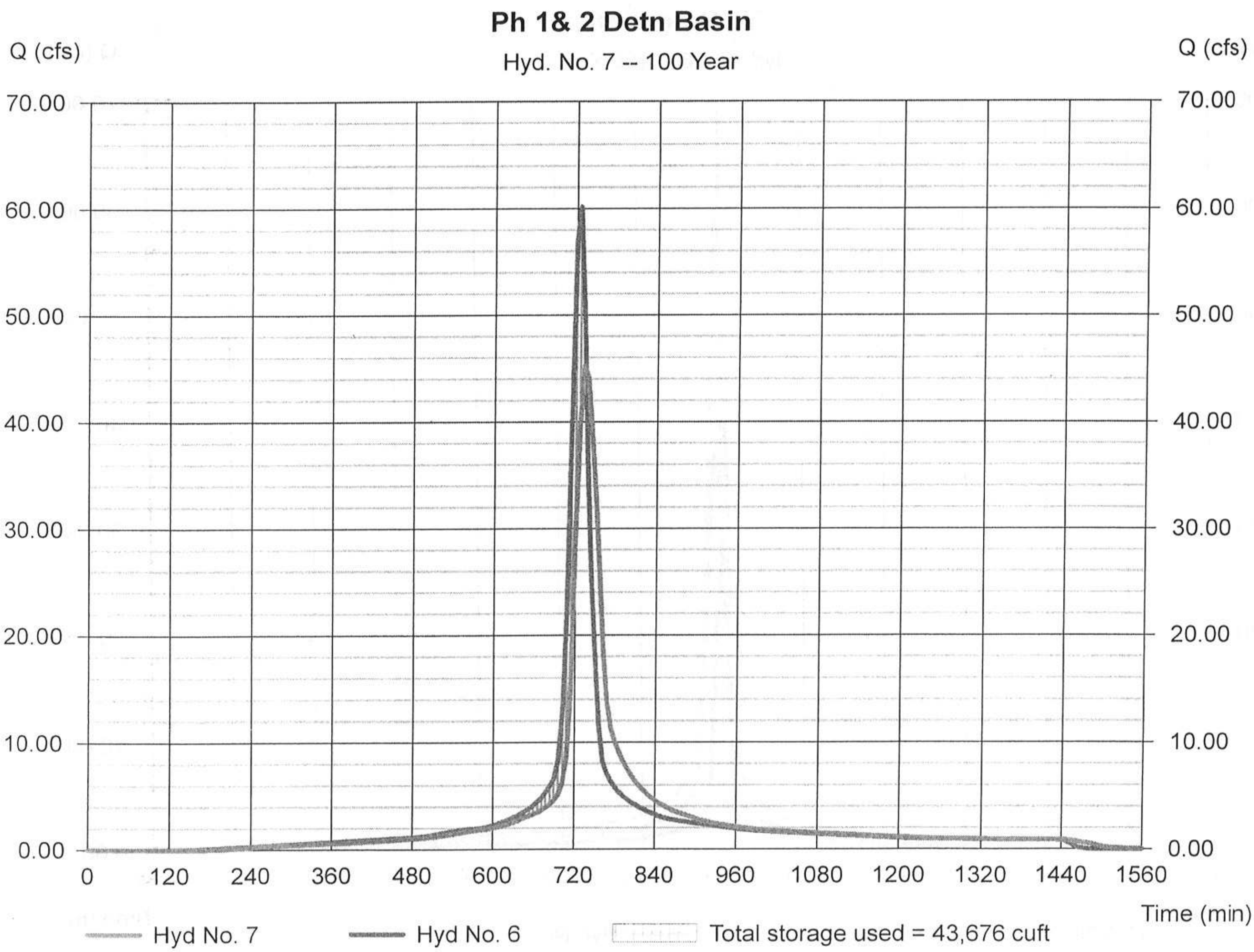
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Friday, Dec 4, 2009

Hyd. No. 7

Ph 1& 2 Detn Basin

Hydrograph type	= Reservoir	Peak discharge	= 45.21 cfs
Storm frequency	= 100 yrs	Time to peak	= 732 min
Time interval	= 6 min	Hyd. volume	= 243,449 cuft
Inflow hyd. No.	= 6 - To Detention	Max. Elevation	= 589.25 ft
Reservoir name	= StormTech MC-3500	Max. Storage	= 43,676 cuft

Storage Indication method used.



Hydrograph Report

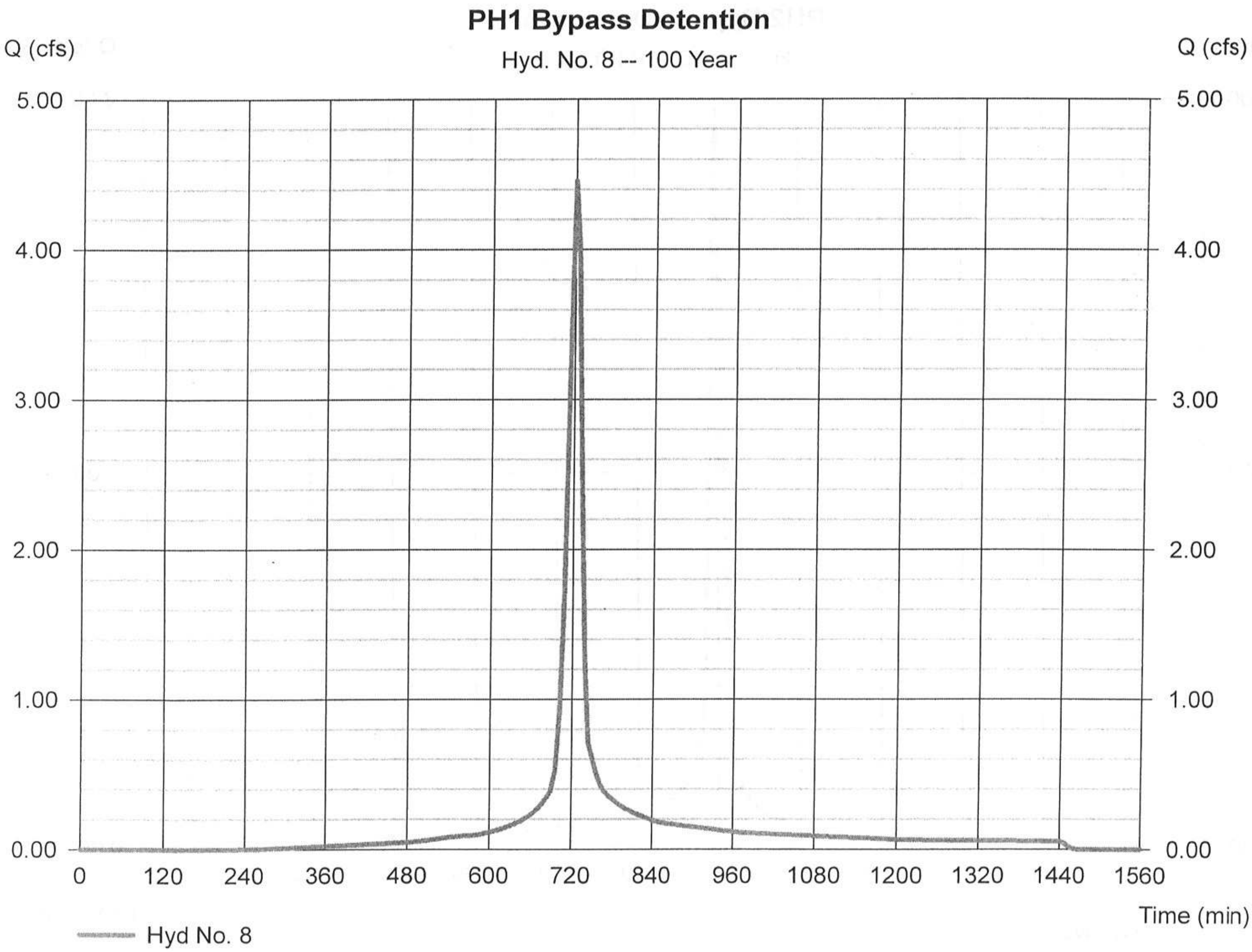
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 — Friday, Dec 4, 2009

Hyd. No. 8

PH1 Bypass Detention

Hydrograph type	= SCS Runoff	Peak discharge	= 4.456 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 6 min	Hyd. volume	= 14,028 cuft
Drainage area	= 0.560 ac	Curve number	= 83*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.70 min
Total precip.	= 9.44 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.080 x 98) + (0.480 x 80)] / 0.560



Hydrograph Report

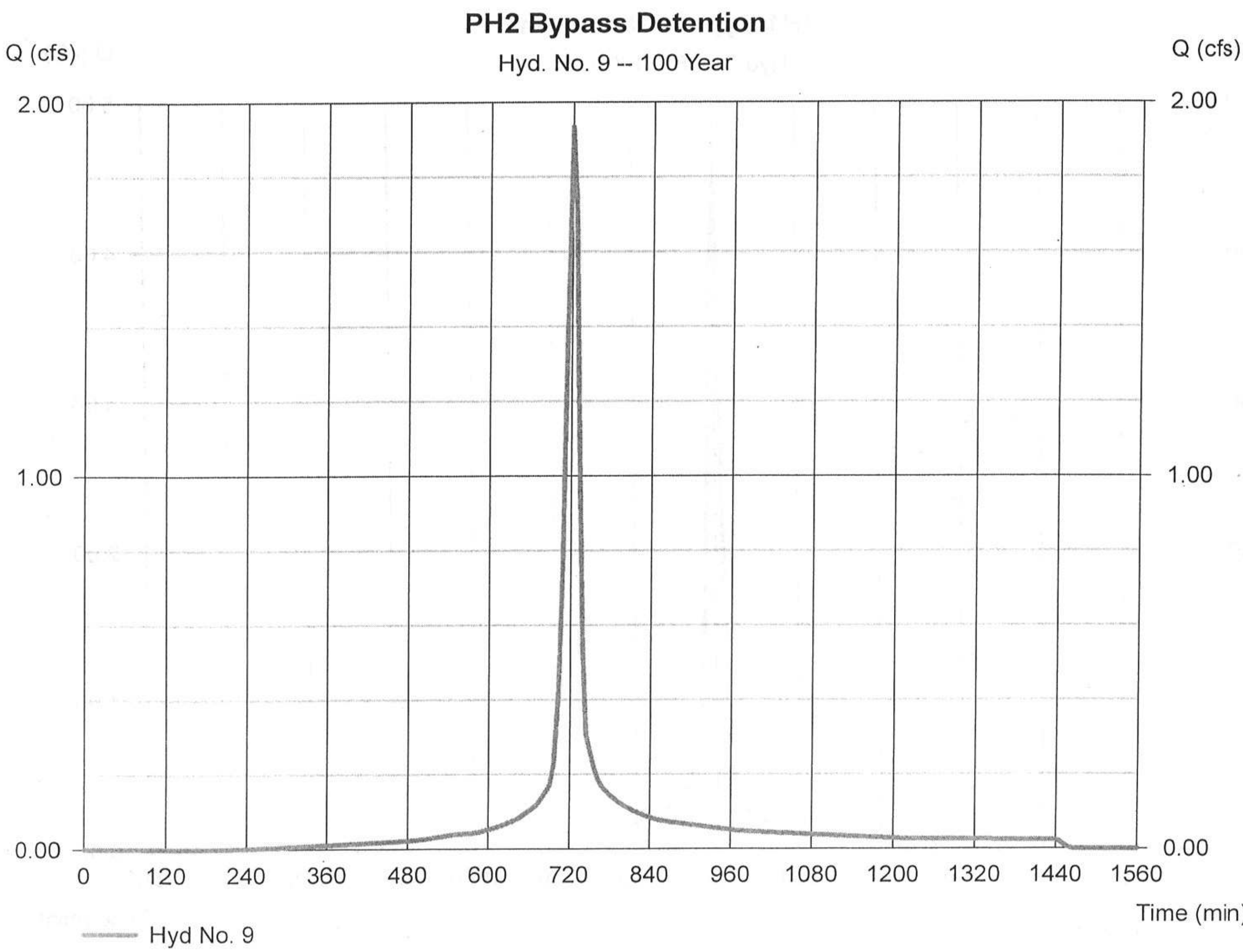
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 | Friday, Dec 4, 2009

Hyd. No. 9

PH2 Bypass Detention

Hydrograph type	= SCS Runoff	Peak discharge	= 1.934 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 6 min	Hyd. volume	= 6,114 cuft
Drainage area	= 0.240 ac	Curve number	= 84*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.70 min
Total precip.	= 9.44 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.050 x 98) + (0.190 x 80)] / 0.240



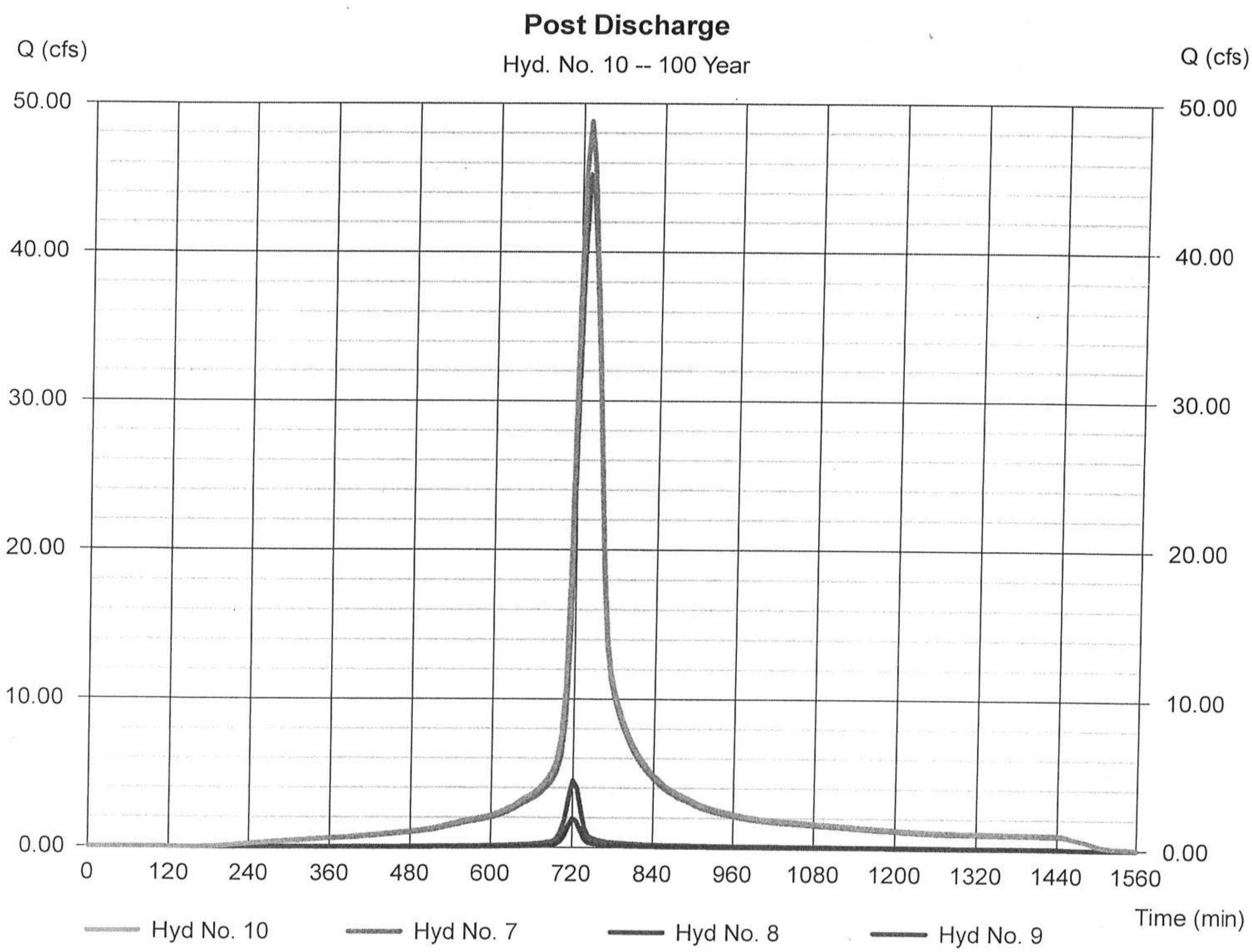
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 — Friday, Dec 4, 2009

Hyd. No. 10

Post Discharge

Hydrograph type	= Combine	Peak discharge	= 48.79 cfs
Storm frequency	= 100 yrs	Time to peak	= 732 min
Time interval	= 6 min	Hyd. volume	= 263,590 cuft
Inflow hyds.	= 7, 8, 9	Contrib. drain. area	= 0.800 ac



APPENDIX E
NJCAT REPORT ON STORMTECH UNITS

VERIFICATION

To: Ron Vitarelli, President
Dan Hurdis, Zone Manager
David J. Mailhot, PE, Engineering Manager
StormTech, LLC
20 Beaver Road
Wethersfield, CT 06109
860-257-2150

Re: Identification of Technology:
StormTech® SC-740 Isolator™ Row

Identification of Claims:
Technical Performance Claims

Claim 1: A StormTech® SC-740 Isolator™ Row, sized at a treatment rate of no more than 2.5 gpm/ft^2 of bottom area, using two layers of woven geotextile fabric under the base of the system and one layer of non-woven fabric wrapped over the top of the system and a mean event influent concentration of 270 mg/L (range of 139 – 361 mg/L) has been shown to have a TSS removal efficiency (measured as SSC) of at least 60% for SIL-CO-SIL 106, a manufactured silica product with an average particle size of 22 microns, in laboratory studies using simulated stormwater.

Claim 2: A StormTech® SC-740 Isolator™ Row, sized at a treatment rate of no more than 2.5 gpm/ft^2 of bottom area, using two layers of woven geotextile fabric under the base of the system and one layer of non-woven fabric wrapped over the top of the system and a mean event influent concentration of 318 mg/L (range of 129 – 441 mg/L) has been shown to have a TSS removal efficiency (measured as SSC) of 84% for SIL-CO-SIL 250, a manufactured silica product with an average particle size of 45 microns, in laboratory studies using simulated stormwater.

Claim 3: A StormTech® SC-740 Isolator™ Row, sized at a treatment rate of no more than 6.5 gpm/ft^2 of bottom area, using a single layer of woven geotextile fabric under the base of the system and one layer of non-woven fabric wrapped over the top of the system and a mean event influent concentration of 371 mg/L (range of 116 – 614 mg/L) has been shown to have a TSS removal efficiency (measured as SSC) of greater than 95% for OK-110, a manufactured silica product with an average particle size of 110 microns, in laboratory studies using simulated stormwater.

This will confirm that NJCAT has concluded the evaluation of the above captioned claims for the above captioned technology, pursuant to your application and our mutually agreed plan of evaluation. NJCAT is pleased to provide a copy of the final report, "NJCAT Technology Verification – **StormTech® SC-740 Isolator™ Row**" detailing the review procedures conducted to evaluate the claims.

The verification differs from typical NJCAT verifications in that final verification of the **StormTech® SC-740 Isolator™ Row** technology awaits completed field testing that meets the full requirements of the Technology Acceptance and Reciprocity Partnership (TARP) - Stormwater Best Management Practice Tier II Protocol for Interstate Reciprocity for stormwater treatment technology. This verification reflects an evaluation of **StormTech® SC-740 Isolator™ Row** initial performance claims for the technology based primarily on carefully conducted laboratory studies. These claims are expected to be modified and expanded following completion of the TARP required field testing.

NJCAT is pleased to confirm that the above captioned claim have been verified by our review procedures and that **StormTech** may use the notation *"NJCAT Verified"* and the Verification Mark in its literature describing the claim in accordance with this Verification Agreement.

Verified

Corporation for Advanced Technology

VERIFIED

StormTech® agrees that the notation "NJCAT Verified" and the Verification Mark will only be used in connection with the above-captioned claims, and the above-captioned technology. Breach by StormTech® of these conditions of use may result in the withdrawal of this verification and the right to use the notation "NJCAT Verified" and the Verification Mark. StormTech® agrees to provide NJCAT, upon request, with sample copies of any literature in which the notation "NJCAT Verified" or the Verification Mark are used. Any third party, who submits a written inquiry to NJCAT concerning this Verification, may be provided with a copy of this Verification Agreement, the final report, and any subsequent correspondence and/or revocation of StormTech® rights hereunder, upon terms and conditions established by NJCAT.

In consideration for participation in the NJCAT Technology Verification Program, the undersigned hereby releases and holds harmless NJCAT, its officers, directors, trustees, employees, members and subcontractors from any and all damages, claims

and liabilities arising out of participation by StormTech® in the NJCAT Technology Verification Program.

Please confirm your acceptance of this Verification Agreement by executing the enclosed copy of this Verification Agreement and returning the same to NJCAT.

New Jersey Corporation for Advanced Technology	**StormTech®**
By: ______________________	**Accepted:** ______________________
RHEA WEINBERG BREKKE **Executive Director**	**Dan Hurdis**
Date: **August 15, 2007**	**Date:** ______________________

NJCAT TECHNOLOGY VERIFICATION

StormTech® Isolator™ Row

August 2007

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1. Introduction

1.1 New Jersey Corporation for Advanced Technology (NJCAT) Program

NJCAT is a not-for-profit corporation to promote in New Jersey the retention and growth of technology-based businesses in emerging fields such as environmental and energy technologies. NJCAT provides innovators with the regulatory, commercial, technological and financial assistance required to bring their ideas to market successfully. Specifically, NJCAT functions to:

- Advance policy strategies and regulatory mechanisms to promote technology commercialization;
- Identify, evaluate, and recommend specific technologies for which the regulatory and commercialization process should be facilitated;
- Facilitate funding and commercial relationships/alliances to bring new technologies to market and new business to the state; and
- Assist in the identification of markets and applications for commercialized technologies.

The technology verification program specifically encourages collaboration between vendors and users of technology. Through this program, teams of academic and business professionals are formed to implement a comprehensive evaluation of vendor specific performance claims. Thus, suppliers have the competitive edge of an independent third party confirmation of claims.

Pursuant to N.J.S.A. 13:1D-134 et seq. (Energy and Environmental Technology Verification Program), the New Jersey Department of Environmental Protection (NJDEP) and NJCAT have established a Performance Partnership Agreement (PPA) whereby NJCAT performs the technology verification review and NJDEP certifies that the technology meets the regulatory intent and that there is a net beneficial environmental effect by using the technology. In addition, NJDEP/NJCAT work in conjunction to develop expedited or more efficient timeframes for review and decision-making of permits or approvals associated with the verified/certified technology.

The PPA also requires that:

- The NJDEP shall enter into reciprocal environmental technology agreements concerning the evaluation and verification protocols with the United States Environmental Protection Agency (USEPA), other local or national environmental agencies, entities or groups in other states and New Jersey for the purpose of encouraging and permitting the reciprocal acceptance of technology data and information concerning the evaluation and verification of energy and environmental technologies; and

- The NJDEP shall work closely with the State Treasurer to include in State bid specifications, as deemed appropriate by the State Treasurer, any technology verified under the Energy and Environment Technology Verification Program.

1.2 Technology Verification Report

In December 2006 StormTech®, LLC (20 Beaver Road, Suite 104, Wethersfield, Connecticut, 06109) submitted a formal request for participation in the NJCAT Technology Verification Program. The technology proposed, the StormTech® Isolator™ Row, filters sand, and silt sized particles from stormwater runoff from developed sites. It is considered a post-development BMP (best management practice) that is potentially an additional tool to meet the State's stormwater quality objectives.

The request (after pre-screening by NJCAT staff personnel in accordance with the technology assessment guidelines) was accepted into the verification program. This verification report covers the evaluation based upon the performance claims of the vendor, StormTech® (see Section 4). This verification report is intended to evaluate StormTech®'s initial performance claims for the technology based primarily on laboratory studies. This project included the evaluation of company manuals and laboratory testing reports to verify that the StormTech® Isolator™ Row meets the performance claims of StormTech®.

1.3 Technology Description

1.3.1 Technology Status

In 1990 Congress established deadlines and priorities for USEPA to require permits for discharges of stormwater that are not mixed or contaminated with household or industrial wastewater. Phase I regulations established that a NPDES (National Pollutant Discharge Elimination System) permit is required for stormwater discharge from municipalities with a separate storm sewer system that serves a population greater than 100,000 and certain defined industrial activities. To receive a NPDES permit, the municipality or specific industry has to develop a stormwater management plan and identify best management practices for stormwater treatment and discharge. Best management practices (BMPs) are measures, systems, processes or controls that reduce pollutants at the source to prevent the pollution of stormwater runoff discharge from the site. Phase II stormwater discharges include all discharges composed entirely of stormwater, except those specifically classified as Phase I discharge.

The StormTech® subsurface chamber system for stormwater management provides underground detention, retention, and storage of stormwater. This subsurface chamber system eliminates the need for surface detention ponds and optimizes space. The StormTech® chamber system for stormwater management can be used in commercial, residential, recreational, agricultural, and highway drainage applications. The StormTech® chamber system is accompanied by the StormTech® Isolator™ Row, which enhances total suspended solids (TSS) removal, as well as provides for inspection and maintenance of the chamber system.

The Isolator™ Row is a row of StormTech® chambers that is surrounded with filter fabric and connected to a manhole. The chambers allow for settling and filtration of sediment as stormwater rises within the Isolator™ Row and passes through the filter fabric. The open bottom chambers and the perforated sidewalls allow stormwater to flow in both a vertical and horizontal direction out of the chambers. Sediments are then captured in the Isolator™ Row, thereby protecting the storage areas of the adjacent stone and chambers from sediment accumulation.

1.3.2 Specific Applicability

The Isolator™ Row can be designed on a volume basis or flow rate basis depending on regulatory requirements. An upstream manhole can typically include a high flow weir such that stormwater flow rates or volumes that exceed the capacity of the Isolator™ Row overtop the overflow weir and discharge through a manifold to the other chambers.

1.4 Project Description

This project included the evaluation of company manuals and laboratory testing reports to verify that the StormTech® Isolator™ Row meets the performance claims of StormTech®.

1.5 Key Contacts

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Dan Hurdis, Zone Manager
David J. Mailhot, PE, Engineering Manager
StormTech, LLC
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Wethersfield, CT 06109
860-257-2150
dmailhot@stormtech.com

2. Evaluation of the Applicant *(As provided by David J. Mailhot, P.E. on 1/19/07)*

2.1 Corporate History

StormTech® was founded in the late 1990s by Jim Nichols to provide subsurface chamber systems exclusively for stormwater applications. Mr. Nichols, a mechanical engineer and entrepreneur, is known for successfully developing a plastic chamber system for on-site sanitary sewage applications and for ultimately creating the market for chambers.

Since a primary motivation for engineers and developers locating stormwater storage under ground is often to create more parking spaces, subsurface chamber applications are typically under parking lots and roadways. In these demanding applications, structural integrity is vital. StormTech® recognized the need for a structurally robust chamber and began a product development program to turn this vision into a reality.

StormTech®'s product development program spanned more than four years at a cost of over $7 million. Early chambers were thermoformed from sheets of polyethylene and installed in sixteen locations around the country for observation. Although the early chambers performed well, it became apparent that maintaining uniform wall thickness in the product was an important structural concern that could not be controlled using the thermoforming process. So StormTech® moved on, investing more money and time developing the means to injection mold chambers.

At about the same time as StormTech®'s move to injection molding, Dr. Timothy McGrath, P.E. of Simpson, Gumpertz & Heger was developing new design specifications for buried pipe under the National Cooperative Highway Research Program (NCHRP). After years of research and collaboration with others conducting state of the art work for flexible pipe design, Dr. McGrath framed the design requirements for flexible structures based on strain limits for long term loads and a time-dependent material modulus. Dr. McGrath's NCHRP work was adopted by the American Association of State Highway and Transportation Officials (AASHTO) and incorporated into the AASHTO LRFD Bridge Design Specifications. This design method is now the standard for structures buried under vehicle travel ways.

StormTech® seized an opportunity to hire Dr. McGrath as a consultant for their chamber development program. From that point forward, the chamber development would be evaluated under a higher standard, AASHTO. Dr. McGrath oversaw extensive field testing of the buried chambers using state-of-the-art instrumentation. The testing included several shallow cover tests under AASHTO H20 design vehicle loads for various structural aggregate gradations as well as deep cover tests that spanned months in duration. Test results were used to validate finite element analysis models and to verify structural safety factors.

The result of the product development program was a chamber that was designed in accordance with the same AASHTO specifications that structural engineers use in the design of highway structures. The product was unique since it was the only chamber produced from virgin, impact modified polypropylene, the only injection molded chamber and, at approximately 75 pounds, was the largest injection-molded, one-piece thermoplastic structure produced anywhere.

In 2002, with Jim Nichols as President and David Click as Vice President and General Manager, StormTech®, Inc. began manufacturing and distributing two models of yellow chambers called the StormTech® SC-740 and the StormTech® SC-310. However, StormTech®'s resources were limited to a small force of six outside sales personnel. Although the chamber system was proving to be a more cost effective alternative for underground stormwater storage than competing systems such as polyethylene pipe, it was clear that sales and distribution would need to be ramped up fast to realize the business potential of this product line.

In 2003 Jim Nichols and David Click found the perfect partner and StormTech®, Inc. became StormTech®, LLC as the result of a joint venture agreement between two corporate owners. The new joint venture partner was Advanced Drainage Systems (ADS). ADS brought access to an outside sales force of over 200 personnel, field engineers, an established distribution system and a fleet of trucks to move the product. Ronald Vitarelli was appointed President and General Manager and StormTech®, LLC was positioned as an independently operated, privately owned business.

Under Mr. Vitarelli, StormTech® is committed to a safe, conservative design philosophy. This is accomplished by strict adherence to national standards. StormTech® chamber systems are not only designed to AASHTO specifications, but the chamber itself is produced to ASTM standards. StormTech® played a key role in driving the development of ASTM F2418 "Standard Specification for Polypropylene (PP) Corrugated Wall Stormwater Collection Chambers." This standard ensures that each chamber produced meets minimum standards for raw materials, dimensional consistency and overall product quality. The robust design and adherence to national standards separates StormTech® chambers from various other flexible structures and positions StormTech® with classes of established buried structures like reinforced concrete and high density polyethylene pipe.

With the creation of StormTech®, LLC, the outside sales group immediately transitioned into a team of Regional Product Managers who provide technical support and management to the ADS sales team.

Shortly after the inception of StormTech®, LLC, Mr. Vitarelli brought David J. Mailhot, P.E. to StormTech® to establish a technical department and the small inside sales team was replaced with a technical team comprised of engineers and technicians. David Mailhot brings many years of engineering experience from the flexible pipe industry including work with researchers to apply soil-structure interaction principles to flexible drainage structure design and also includes work with water quality systems for stormwater treatment. The technical team includes engineering for product development and the Technical Services Department which provides CAD services and specifications to the consulting engineers who specify StormTech® chambers and to the contractors who install StormTech® chambers.

Also in 2003, StormTech® introduced an innovative yet simple system to capture and remove sediments from stormwater called the Isolator™ Row. Removing the sediments from the incoming stormwater prevents sediments from accumulating in the chambers and in the surrounding aggregate. Since the chamber system utilizes the storage volume in the stone porosity, as well as the volume within the chambers, it is important to prevent any loss of void space. The Isolator™ Row intercepts sediments before they reach the surrounding stone voids and provides a means to inspect and conduct maintenance.

The Isolator™ Row is a row or rows of chambers that are completely wrapped by geotextile fabrics. Stormwater is directed into the Isolator™ Row so that flow must pass through the fabric before reaching the surrounding stone. Sediments are filtered out onto the fabric where they can later be jetted out and vactored from the access manhole upstream.

Since 2003, StormTech® chambers have gained wide acceptance as a stormwater detention method. The Isolator™ Row is a recent extension of this technology to address water quality.

In the spring of 2004, StormTech®, LLC received an award from The Society of the Plastics Industry, Inc. Structural Plastics Division for the "Stormwater Chamber & End Caps Model 740." This award was recognition for the sophistication and technology of the mold design for the production of what may be the largest injection molded structural part.

2005 was an important year for StormTech® and for the chamber industry. In early 2005, StormTech®'s significant investment in materials research paid dividends as StormTech® validated a short term materials test for creep modulus determination. This new testing technique enables StormTech® the ability to ensure that raw materials not only meet the initial properties that are commonly measured by resin suppliers, but also the 50-year creep modulus property that is an essential component of long-term design requirement in the AASHTO design specification. StormTech®'s materials research remains an important leg of the Company's leadership position in the Industry.

In the fall of 2005, ASTM F 2418 "Standard Specification for Polypropylene (PP) Corrugated Wall Stormwater Collection Chambers" was passed by ASTM and became the standard for polypropylene chambers and the model specification for the chamber industry. StormTech® chambers are marked with the "ASTM F 2418" designation and with the ASTM F 4101 materials designation "PP0330B99945" as required by the ASTM standard.

Also in 2005, Tennessee Technological University completed the first series of laboratory tests for the Isolator™ Row and reported total suspended solids (TSS) removal efficiencies of over 95% for the manufactured silica product, US Silica OK-110. This testing resulted in an approval of the Isolator™ Row as a water quality BMP in the state of Maine. However, currently applications are more limited since the new Maine standards require other BMP techniques. The Ontario (Canada) Ministry of the Environment also has reviewed the Isolator™ Row testing by Tennessee Tech University and has issued a Certificate of Technology Assessment.

Currently StormTech® has 26 employees. Approximately 500,000 chambers are installed around the word in over 2,600 projects. Only a small percentage (less than 10%) of chambers nationwide are being used for water quality purposes. The large percentage of chambers is used for retention or detention applications. The Isolator™ Row concept with one-layer of geotextile fabric is used on approximately 90% of StormTech® projects. However, historically the primary application has been as a maintenance feature where sediments and debris are captured and prevented from entering the stone voids. In these applications, the objectives are to prevent accumulation of sediment in the stone voids in detention systems and to minimize occlusion at infiltration surfaces in retention systems.

2.2 Organization and Management

The Company is headquartered in Wethersfield, Connecticut with ten regional sales offices in the United States. StormTech® is also represented in Europe, Australia and the Middle East.

Ronald Vitarelli is the President and General Manager of StormTech®, LLC and reports to a Board of Directors consisting of executives from each of two corporate owners. Other members of the management team include: David J. Mailhot, P.E., Engineering Manager, Susan McNamee, Operations Manager, David K. Click, Director of International Sales & Southern Zone Manager, Daniel Hurdis, Northeastern Zone Manager and Mark Moeller, P.E., Western Zone Manager.

2.3 Technical Resources, Staff and Capital Equipment

StormTech® benefits from several technical resources. StormTech® has five registered professional Civil Engineers on staff, three non-registered degreed Civil Engineers, a geologist, a polymer scientist and a construction engineer. Several of the engineers have advanced degrees. StormTech® engineers bring with them decades of experience in buried structures from the drainage pipe industry and decades of experience from the water quality industry. Water quality experience includes design and sales of vortex separators, gravity grit separators, gravity filters and various media filters.

The corporate owners lead their respective industries in pipe extrusion and injection molding technologies. StormTech® owns multiple molds for injection molding chambers and end caps. Together with their corporate owners and outside consultants, StormTech® uses state-of-the-art molding techniques and has advanced the industry with their developmental work of materials test methods for the determination of long-term thermoplastic mechanical properties.

StormTech® retains Simpson, Gumpertz & Heger, Inc. (SGH) for structural analysis relative to applications and product design. SGH is uniquely qualified in areas of buried pipe design and soil-structure interaction systems including buried flexible structure behavior. StormTech® contracts with Dr. Vincent Neary, P.E., from Tennessee Technological University for water quality testing of the Isolator™ Row.

2.4 Patents

In January of 2006, the United States Patent Office issued a patent for the Isolator™ Row, Patent No: US 6,991,734 B1 entitled "Solids Retention in Stormwater System."

3. Treatment System Description

StormTech®, LLC is the owner and producer of two brand names of subsurface chambers that are designed for use under paved and unpaved surfaces for stormwater applications. The brand names are StormTech® and LandSaver. Respective chambers are identical in every way but are branded by name and color. LandSaver chambers are blue and StormTech® chambers are yellow. Identical chamber models are listed below.

- StormTech® SC-740 is the same as LandSaver LS-3051
- StormTech® SC-310 is the same as LandSaver LS-1633

The StormTech® SC-740 is 85.4" x 51.0" x 30.0" (L x W x H) and has a chamber storage of 45.9 ft^3. The StormTech® SC-310 is 85.4" x 34.0" x 16.0" (L x W x H) and has a chamber storage of 14.7 ft^3.

The Isolator™ Row is a row of StormTech® chambers (either SC-740 or SC-310 models) that is surrounded with filter fabric and connected to a manhole. The chambers allow for settling and filtration of sediment as stormwater rises within the Isolator™ Row and passes through the filter fabric. The open bottom chambers and the perforated sidewalls allow stormwater to flow in both a vertical and horizontal direction out of the chambers. Sediments are then captured in the Isolator™ Row, thereby protecting the storage areas of the adjacent stone and chambers from sediment accumulation (See Figure 1).

Typically, some level of pre-treatment of the stormwater is required prior to entry into the system. Pre-treatment devices differ greatly in complexity, design and effectiveness. Options include a simple deep sumped manhole with a 90° bend on its outlet, baffle boxes, swirl concentrators, sophisticated filtration devices and devices that combine these processes. Some of the most effective pre-treatment options combine engineering site grading with vegetation such as bio-swales or grass filter strips.

The Isolator™ Row is designed to capture the "first flush," and it can be sized on a volume basis or flow rate basis. The Isolator™ Row is designed with a manhole with an overflow weir at its upstream end (See Figure 1). The manhole is connected to the Isolator™ Row with a short 12" to 24" diameter pipe set near the bottom of the end cap. The diversion manhole provides access to the Isolator™ Row for inspection and maintenance. The overflow weir with its crest set even with the top of the chamber allows stormwater in excess of the Isolator™ Row's storage/conveyance capacity to bypass the chamber system through the downstream eccentric header/manifold system (See Figure 2). This diversion manhole is the only mechanism used to control flow into the system.

The Isolator™ Row typically rests on a 6-18 inch foundation of No. 3 gravel overlaid with a woven geotextile filter fabric (GEOTEX® 315 ST – see Appendix for product data sheet). A double-layer of fabric was introduced to address the need for removal of finer sediments in accordance with NJDEP requirements. StormTech® implemented the double layer approach to enhance protection of infiltration surfaces by targeting finer particles for removal. The individual slit films are woven together in such a manner as to provide dimensional stability relative to each other. This geotextile fabric provides a media for stormwater filtration and also provides a durable surface for maintenance operations. In addition, this geotextile fabric is designed to prevent scour of the underlying stone and is designed to remain intact during high pressure jetting. A non-woven fabric is also used for the Isolator™ Row (GEOTEX® 601 – see Appendix for product data sheet). GEOTEX® 601 is a polypropylene, staple fiber, needle-punched, non-woven geotextile. The fibers are needled to form a stable network that retains dimensional stability relative to each other. The non-woven fabric is placed over the chambers to provide a filter media for flows passing through the perforations in the sidewall of the chamber. The chamber has two rows of perforations along the side with the lowest row 2 ¾ inches above the base woven geotextile fabric. As head increases in the chamber, water is discharged through these perforations as it continues to be discharged through the underlying stone bed. The non-woven geotextile fabric provides some filtering capacity for the water exiting the system through the side perforations.

Since the majority of the StormTech® installations are detention systems, they are designed to have some type of outlet structure. These systems are installed on angular stone that has a porosity of 40% and the systems are designed to discharge stormwater through this stone bed. The water in the stone bed can either be allowed to percolate into the underlying soil or perforated piping can be embedded within the stone to collect and discharge the treated stormwater.

4. Technical Performance Claims

Claim 1: A StormTech® SC-740 Isolator™ Row, sized at a treatment rate of no more than 2.5 gpm/ft^2 of bottom area, using two layers of woven geotextile fabric under the base of the system and one layer of non-woven fabric wrapped over the top of the system and a mean event influent concentration of 270 mg/L (range of 139 – 361 mg/L) has been shown to have a TSS removal efficiency (measured as SSC) of at least 60% for SIL-CO-SIL 106, a manufactured silica product with an average particle size of 22 microns, in laboratory studies using simulated stormwater.

Claim 2: A StormTech® SC-740 Isolator™ Row, sized at a treatment rate of no more than 2.5 gpm/ft^2 of bottom area, using two layers of woven geotextile fabric under the base of the system and one layer of non-woven fabric wrapped over the top of the system and a mean event influent concentration of 318 mg/L (range of 129 – 441 mg/L) has been shown to have a TSS removal efficiency (measured as SSC) of 84% for SIL-CO-SIL 250, a manufactured silica product with an average particle size of 45 microns, in laboratory studies using simulated stormwater.

Claim 3: A StormTech® SC-740 Isolator™ Row, sized at a treatment rate of no more than 6.5 gpm/ft^2 of bottom area, using a single layer of woven geotextile fabric under the base of the system and one layer of non-woven fabric wrapped over the top of the system and a mean event influent concentration of 371 mg/L (range of 116 – 614 mg/L) has been shown to have a TSS removal efficiency (measured as SSC) of greater than 95% for OK-110, a manufactured silica product with an average particle size of 110 microns, in laboratory studies using simulated stormwater.

5. Technical System Performance

A StormTech® SC-740 Isolator™ Row was tested in a full-scale laboratory study by the Department of Civil and Environmental Engineering at Tennessee Technological University, Cookeville, TN. Three different silica-water slurry influent streams were used in the experiment. The first consisted of SIL-CO-SIL 106 with a median particle size of approximately 22 microns. The second consisted of SIL-CO-SIL 250 with a median particle size of approximately 45 microns. For both silica-water slurries, the system was tested at a hydraulic loading rate of 3.2 gpm/ft^2 of filter area. The SIL-CO-SIL 250 was also tested at a hydraulic loading rate of 1.7

gpm/ft^2 of filter area. Finally, a third silica-water slurry using US Silica OK-110 with a median particle size of 110 microns was tested in the laboratory at a range of hydraulic loading rates with maximum rates of 4.8 gpm/ft^2 and 8.1 gpm/ft^2. The removal efficiencies measured in these laboratory experiments were then used to calculate SSC removal efficiency to verify the claims presented above (See Section 4).

5.1 Test System Description

The main components of the laboratory set-up are shown in the design drawings (See Figure 3). Two (2) SC-740 chambers were secured to a wooden frame and laid over a 12-in. bed of No. 3 angular stone (AASHTO M43 #3) with a porosity of 40% contained in a wooden flume with interior W x L x H dimensions, 6.25-ft x 16.22-ft x 3-ft.

The chambers were covered with GEOTEX® 601 non-woven geotextile fabric with a thickness of 60 mils and an apparent opening size of 0.212 mm (see attached product data sheet). Two layers of GEOTEX® 315 ST woven geotextile fabric, each layer with a thickness of 20 mils and an apparent opening size of 0.212 mm (see Appendix for product data sheet), were placed at the bottom of the chamber to stabilize the stone foundation and to prevent scouring of the stone base. Both the nonwoven fabric covering the chamber and the woven fabric placed at the bottom provided filtration media for the Isolator™ Row. During testing, the water depth varied upstream to downstream from 3.5 inches to 4.75 inches, with an average depth of 4 inches. Variations in depth of ±20% were due to the roughness and non-uniformity of the gravel substrate underneath the geotextile fabric.

An 8-inch pipe fed the silica-water mixture through an expansion into the 12-inch inlet pipe of the Isolator™ Row. The target SSC influent concentration was set to 200 mg/L. A 1.5 lb/gal silica-water slurry was introduced to the 8-inch pipe from a 35-gallon mixing tank using a Watson-Marlow 323S/RL (220 rpm) pump. The silica–water slurry enters a 3/8″ feed tap located 10 inches upstream of a butterfly valve, which introduces turbulence and promotes uniform mixing of the influent stream. The Isolator™ Row resides in the recirculating flume, which collects and drains water discharged by the chamber to the stone substrate through an 8-inch drain that discharges to the laboratory trench and sump. The water was recirculated with a 25 horsepower Allis Chalmers (model AC7V) variable speed pump. A 1-micron filter, designed for flows up to 1.5 cfs, was placed at the end of the outlet, which was intended to trap all sediment that was not removed by the chambers.

For the OK-110 testing, the chambers were covered with Mirafli 160N non-woven geotextile fabric, meeting AASHTO M288 Class 2 standards. The Mirafli 160N geotextile has an apparent opening size of 0.212 mm. Mirafli 600X woven geotextile fabric, which meets ASSHTO's M288 Class 1 requirements, was placed at the bottom of the chamber to stabilize the stone foundation and to prevent scouring of the stone base. The Miralfi 600X fabric has an apparent opening size of 0.425 mm (see Appendix for product data sheet).

Flow rates were measured with a Thermo Electron Corporation Polysonic DCT 7088 portable digital correlation transit time flow meter placed on the 8″ aluminum water line. The DCT 7088 was factory calibrated by the manufacturer and was guaranteed accurate to ±0.5%.

The removal efficiency, η, for the Isolator™ Row was calculated as:

$$\eta = \frac{SSC_{Influent} - SSC_{Effluent}}{SSC_{Influent}} x100$$

where SSC is the suspended sediment concentration of the influent and the effluent grab samples, which were staggered by one detention time.

5.2 Procedure

Test runs for both SIL-CO-SIL 106 and SIL-CO-SIL 250 were completed at a treatment flow rate of 180 gpm (0.4 cfs), which corresponds to a hydraulic loading rate of 3.2 gpm/ft^2. Five (5) test runs were completed with SIL-CO-SIL 106 silica slurry. One (1) test run was completed with a SIL-CO-SIL 250 silica-water slurry. Additionally one (1) test run was completed with a SIL-CO-SIL 250 silica-water slurry at a treatment flow rate of 94 gpm (0.21 cfs), which corresponds to a hydraulic loading rate of 1.7 gpm/ft^2. All tests lasted fifteen detention times with sampling beginning after three detention times. Flow rates were regulated by an inlet valve.

Test runs for the OK-110 were completed at a range of treatment flows from 44.9 to 539 gpm (0.1 to 1.2 cfs), which corresponds to hydraulic loading rates of 0.4 to 4.8 gpm/ft^2. This experiment used four of the StormTech® Isolator™ Chambers. The experiment was then modified using two chambers with a maximum design hydraulic loading rate of 8.1 gpm/ft^2. Since the system was half the size (two chambers instead of four), the experiment could be run at higher flows.

Table 1 includes the results for the SIL-CO-SIL 106 test runs. The influent concentrations were generally above the target concentration of 200 mg/L, which suggests that the one-micron filter sock at the outlet was only partially effective at trapping the finer SIL-CO-SIL 106 particles. This was supported by visual observations, which noted that the trench went from clear to cloudy in less than one detention time. The average influent concentration was 270±59 mg/L, with a minimum value of 139 mg/L and a maximum value of 361 mg/L. The average effluent concentration was 109±35 mg/L, with a minimum value of 66 mg/L and a maximum value of 182 mg/L.

Table 2 shows how the average removal efficiency decreased on average with detention time during each test run as a result of recirculation. The removal efficiencies were calculated by averaging all influent and effluent samples with the same sample number, respectively (e.g., all influent samples with sample No. 1 and all effluent samples with sample No. 2). The results indicate that at the beginning of the test recirculation did not significantly increase influent concentrations above the target level of 200 mg/L. The average influent concentration for sample No. 1 was 219 mg/L. In addition, as discussed below, one can speculate that the recirculation of predominantly fine particles has not reduced the particle size distribution of the influent significantly. Under these conditions, the average removal efficiency (based solely on the first samples of each test run) is 66%. However, as the test progresses and recirculation of fines increases, the removal efficiency is reduced.

During the SIL-CO-SIL 106 tests, grab samples of the effluent were collected and sent to the laboratory for grain size analysis. These analyses indicated that the effluent sediments consisted mainly of very fine particles, 84% of which were 10 microns or smaller.

The observed variability in the influent and effluent concentrations was mainly due to the recirculation of fine grained particles not trapped by the filter sock. It was apparent starting with the first test (9-July) that the filter sock was not effective at trapping the fine effluent sediments and preventing their recirculation. As a result, there is a trend of increasing influent and effluent SSC concentrations with increasing detention time during each test run. Additionally, sediments occluded within the woven fabric and trapped in the gravel cannot be removed between each test run. As a result, the initial condition cannot be reestablished once testing has begun, and the sediments trapped in previous test runs may washout, raising effluent and influent SSC concentrations at latter test runs. One potential benefit of sediment occlusion and deposition over time may be increased removal efficiency as the geotextile fabric clogs and a filter cake develops on the Isolator™ Row bottom. (Note: The depth of accumulated sediment varies along the bottom of the Isolator™ Row.) Eventually, however, the cake will begin to reduce the flow through the bottom fabric and direct more flow through the chamber sides.

Note that removal efficiencies were calculated using the "indirect method" only, which relies on influent and effluent concentrations. The material trapped in the isolator row was intentionally not removed to allow the filter cake to develop with time. A rough estimate can be made by determining the total amount of sediment influent and effluent mass over the testing period. The difference is the amount trapped on the surface of the geotextile fabric, occluded in the fabric, and within the gravel substrate. A rough estimate indicates that about 50% of the total sediment trapped was on the surface of the fabric, with the remaining 50% occluded and within the gravel substrate.

Furthermore, the above "50%-50%" estimate is in fact an estimate for only the fine particle test runs since the testing was by indirect method and the sediment captured on the fabric is based on a rough measurement of the depth observed on the fabric at the conclusion of testing. The depth varied across the bottom of the test system. Earlier testing of the OK-110 by direct testing demonstrated 80% removal on the fabric. This is significant since the frequency of maintenance is driven very much by the accumulation of larger particles on the fabric based on the measured 80% capture.

In the SIL-CO-SIL 106 tests, the water depth varied from upstream to downstream from 3.5 inches to 4.75 inches, with an average depth of 4 inches. Variations in depth of ±20% were due to the roughness and nonuniformity of the gravel substrate underneath the geotextile fabric.

Results for the one SIL-CO-SIL 250 test are summarized in Tables 3 and 4. Recirculation of fine sediments was observed and would have reduced the particle size distribution of the influent concentrations below the mean particle size of D_{50}=45 microns. However, particle size analyses of influent sediments were not obtained as was done for the SIL-CO-SIL 106 experiment. The average removal efficiency was 71±14%, with a minimum value of 47% and a maximum value of 82% at 3.2 gpm/ft^2 and 88±1% at 1.7 gpm/ft^2. Compared to the results for the SIL-CO-SIL

106, these values appear reasonable since one would expect higher removal efficiencies when the particle size distribution is greater.

The results for the OK-110 tests at a range of hydraulic loading rates ranging from 0.1 to 1.2 cfs (0.4 to 4.8 gpm/ft^2) are summarized in Table 5. The scaled experiment is also presented in Table 5 for the hydraulic loading rate of 8.1 gpm/ft^2. Two types of influent sampling were conducted during the experiment: discrete sampling and grab sampling. These influent samples are greatly different in concentration. The removal rates exceed 95% for all samples.

5.3 Verification Procedures for All Claims

All the data provided to NJCAT were reviewed to fully understand the capabilities of the StormTech® Isolator™ Row. To verify the StormTech® claim for the Isolator™ Row, the laboratory data were reviewed and compared to the NJDEP TSS laboratory testing procedure.

5.3.1 NJDEP Recommended TSS Laboratory Testing Procedure

The NJDEP has prepared a TSS laboratory testing procedure, primarily designed for hydrodynamic devices, to help guide vendors as they prepare to test their stormwater treatment systems prior to applying for NJCAT verification. The testing procedure has three components:

1. Particle size distribution
2. Full scale laboratory testing requirements
3. Measuring treatment efficiency

1. <u>Particle size distribution:</u>

The following particle size distribution will be utilized to evaluate a manufactured treatment system (See Table 6) using a natural/commercial soil representing the USDA definition of a sandy loam material. This hypothetical distribution was selected as it represents the various particles that would be associated with typical stormwater runoff from a post construction site. NJDEP now requires that filter based BMPs be tested with SIL-CO-SIL 106.

2. <u>Full Scale lab test requirements:</u>
   - A. At a minimum, complete a total of 15 test runs including three (3) tests each at a constant flow rate of 25, 50, 75, 100, and 125 percent of the treatment flow rate. These tests should be operated with initial sediment loading of 50% of the unit's capture capacity.
   - B. The three tests for each treatment flow rate will be conducted for influent concentrations of 100, 200, and 300 mg/L.
   - C. For an online system, complete two tests at the maximum hydraulic operating rate. Utilizing clean water, the tests will be operated with initial sediment loading at 50% and 100% of the unit's capture capacity. These tests will be utilized to check the potential for TSS re-suspension and washout.
   - D. The test runs should be conducted at a temperature between 73-79 degrees Fahrenheit (°F) or colder.

3. <u>Measuring treatment efficiency:</u>
   - A. Calculate the individual removal efficiency for the 15 test runs.

B. Average the three test runs for each operating rate.
C. The average percent removal efficiency will then be multiplied by a specified weight factor (See Table 7) for that particular operating rate.
D. The results of the five numbers will then be summed to obtain the theoretical annual TSS load removal efficiency of the system.

5.3.2 Laboratory Testing for the StormTech® Isolator™ Row

The results of the laboratory testing that were performed by Tennessee Tech are presented later in Tables 1, 2, 3, 4 and 5. Testing was performed for two different silica-water slurry influent streams at a target SSC influent concentration of 200 mg/L. The tests using the SIL-CO-SIL 106 slurry were performed at 3.2 gpm/ft^2, which was set to be 125% of the treatment operating rate. The tests using the SIL-CO-SIL 250 slurry were performed at 1.7 gpm/ft^2 and 3.2 gpm/ft^2, which were assumed to be 62.5% and 125% of the treatment operating rate, respectively. The tests using the OK-110 slurry were performed for a range of hydraulic loading rates (0.4 to 8.1 gpm/ft^2).

For the SIL-CO-SIL 106, laboratory testing shows a 60% removal efficiency at 3.2 gpm/ft^2 for an average SSC influent concentration of 270 mg/L. Since only one operating rate was tested, the 3.2 gpm/ft^2 was set to be 125% of the treatment operating rate. Since other verifications of pre-manufactured systems have indicated that as the operating rate increases, removal efficiency decreases, the 60% removal efficiency at 3.2 gpm/ft^2 was assumed as the minimum removal of this system at this operating rate. Therefore, the NJDEP weighting system can be used to determine an overall removal efficiency of the system by assuming that removal efficiency observed at the 125% treatment operating rates would also be applicable for the lower operating rates. Since the 3.2 gpm/ft^2 is set to be 125% of the treatment operating rate, the SSC removal efficiency for the system would be based upon 2.56 gpm/ft^2, which would be 100% of the treatment operating rate (see Table 8 and Figure 4).

For the SIL-CO-SIL 250, laboratory testing demonstrates a 71% removal efficiency at 3.2 gpm/ft^2 for an average SSC influent concentration of 211 mg/L and an 88% removal efficiency at 1.7 gpm/ft^2 for an average SSC influent concentration of 424 mg/L. Once again, the 3.2 gpm/ft^2 was set to be 125% of the treatment operating rate, and 1.7 gpm/ft^2 was set to be 62.5% of the treatment operating rate. These removal efficiencies, which were input into the NJDEP weighting system, can be used to determine an overall removal efficiency of the system. Since the 3.2 gpm/ft^2 is set to be 125% of the treatment operating rate, the SSC removal efficiency for the system would be based upon 2.56 gpm/ft^2, which would be 100% of the treatment operating rate (see Table 9 and Figure 5).

For the OK-110, laboratory testing data that are presented in Table 5 were used with the NJDEP protocol to develop an NJDEP weighted removal efficiency for the hydraulic loading rates of 4.8 and 8.1 gpm/ft^2 (see Tables 10 and 11). These loading rates were set to be 125% of the treatment operating rate. Removal efficiencies for 25, 50, 75, and 100% of the treatment operating rate were interpolated from the data presented in Table 5. The NJDEP weighted removal efficiencies were determined to be 98.8 and 98.4% for the hydraulic loading rates of 3.87 and 6.48 gpm/ft^2, respectively.

5.4 Inspection and Maintenance

The StormTech® Isolator™ Row requires minimal routine inspection and maintenance. However, it is important that the system be inspected at regular intervals and cleaned when necessary to ensure optimum performance. Initially, the StormTech® Isolator™ Row should be inspected every six months until information can be gathered to develop an inspection and maintenance routine for the particular site. The rate at which the system collects pollutants will depend more on site activities than on the size of the unit (i.e., heavy winter sanding will cause the lower chamber to fill more quickly, but regular sweeping will slow accumulation). The JetVac process can be used to clean the system. However, the JetVac process, as per StormTech® should only be performed on StormTech® Isolator™ Rows that have AASHTO class 1 woven geotextile over their angular base stone. When the average depth of sediment exceeds three inches, clean-out should be conducted.

The frequency of cleanout is related to the number of chambers in the Isolator™ Row. StormTech®'s cleanout experience includes systems receiving flows from paved areas that were cleaned in advance of actual need and systems that received construction sediments and were cleaned after a sedimentation event.

StormTech® does not recommend that the Isolator™ be used for construction sediments. Where erosion of disturbed sites is possible which could cause sedimentation of the subsurface system, StormTech® recommends plugging inlet pipes to both the Isolator™ Row and high flow manifolds until the site is stabilized and the post development conditions established.

A 20-chamber Isolator™ Row in Portland, Maine was cleaned after one year in service. Approximately 1/8" to 1/4" of sediment had accumulated and StormTech® cleaned the system as a maintenance demonstration. Four passes of a jet nozzle cleaned the Isolator™ Row to bare fabric. The nozzle pressure reached approximately 2200 psi. The fabric was not impacted by the jetting.

Other experience, for all Isolator™ Rows receiving flows from paved areas, indicates that a 1-year maintenance interval is too frequent. Only Isolator™ Rows that 1) have received construction sediments or 2) received sediments from gravel parking areas required maintenance within the first year.

In each cleaning event observed, solids were successfully moved from the fabric bottom to the access manhole and vactored. The solids movement includes both clumps of solids and slurry. Since murky water is produced, it is reasonable to assume that some amount of the clay size particles that go into suspension may be lost through the fabric during the cleanout process. Actual sediment removal is expected to include the larger particle sizes targeted during performance tests and some percentage of finer particles that are moved in the solid cake clumps and slurry that is vactored from the manhole.

5.4.1 Solids Disposal

Solids recovered from the StormTech® Isolator™ Row can typically be land filled or disposed of at a waste water treatment plant.

5.4.2 Damage Due to Lack of Maintenance

It is unlikely that the StormTech® Isolator™ Row will become damaged due to lack of maintenance since there are no fragile internal parts. However, adhering to a regular maintenance plan ensures optimal performance of the system, since filter cake build-up will eventually reduce treatment flow rate through the double layer bottom fabrics.

StormTech® has no reported clogged infiltration systems. The typical StormTech® design includes Isolator™ Rows downstream of all inlets with high flow bypasses to the balance of the chamber system. Therefore the infiltration surface is preserved while the Isolator™ Row collects sediments. Flow through the Isolator™ Row bottom material is expected to decrease over several years. As the bottom occludes and head builds, flow increases through perforations and joints which are covered with a single layer of filter fabric.

6. Technical Evaluation Analysis

6.1 Verification of Performance Claims

Claim 1: A StormTech® SC-740 Isolator™ Row, sized at a treatment rate of no more than 2.5 gpm/ft^2 of bottom area, using two layers of woven geotextile fabric under the base of the system and one layer of non-woven fabric wrapped over the top of the system and a mean event influent concentration of 270 mg/L (range of 139 – 361 mg/L) has been shown to have a TSS removal efficiency (measured as SSC) of 60% for SIL-CO-SIL 106, a manufactured silica product with an average particle size of 22 microns, in laboratory studies using simulated stormwater.

- *Since the claim laboratory test was performed at 3.2 gpm/ft^2 and this was set to be 125% of the treatment operating rate, the treatment operating rate in Claim 1 should be adjusted to reflect the true operation rate (100% value or 2.56 gpm/ft^2). Claim 1 is verified.*

Claim 2: A StormTech® SC-740 Isolator™ Row, sized at a treatment rate of no more than 2.5 gpm/ft^2 of bottom area, using two layers of woven geotextile fabric under the base of the system and one layer of non-woven fabric wrapped over the top of the system and a mean event influent concentration of 318 mg/L (range of 129 – 441 mg/L) has been shown to have a TSS removal efficiency (measured as SSC) of 84% for SIL-CO-SIL 250, a manufactured silica product with an average particle size of 45 microns, in laboratory studies using simulated stormwater.

- *For a treatment operating rate of 2.56 gpm/ft^2 and a mean event influent concentration of 318 mg/L (measured as SSC) the data at 3.20 gpm/ft^2 and 1.7 gpm/ft^2 were used to conservatively determine a TSS removal efficiency of 84% for SIL-CO-SIL 250, verifying Claim 2. The average influent concentration of 318 mg/L is simply the average concentration of the two sets of experiments that were run using the SIL-CO-SIL 250.*

Claim 3: A StormTech® SC-740 Isolator™ Row, sized at a treatment rate of no more than 6.5 gpm/ft^2 of bottom area, using a single layer of woven geotextile fabric and a mean event influent concentration of 371 mg/L (range of 116 – 614 mg/L) has been shown to have a TSS removal efficiency (measured as SSC) of greater than 95% for OK-110, a manufactured silica product with an average particle size of 110 microns, in laboratory studies using simulated stormwater.

- *Since the experiment was run at 8.1 gpm/ft^2, which was set at 125% of the treatment operating rate, Claim 3 is valid with 100% of the treatment operating rate of 6.5 gpm/ft^2. The weighted removal efficiency at rates of 8.1 gpm/ft^2 and 4.8 gpm/ft^2 exceeded 98% so a removal efficiency greater than 95% is valid.*

6.2 Limitations

6.2.1 Factors Causing Under-Performance

If the StormTech® Isolator™ Row is designed and installed correctly, there is minimal possibility of failure. There are no moving parts to bind or break, nor are there parts that are particularly susceptible to wear or corrosion. Lack of maintenance may cause the system to operate at a reduced efficiency, and it is possible that eventually the system will become totally filled with sediment.

6.2.2 Pollutant Transformation and Release

The StormTech® Isolator™ Row should not increase the net pollutant load to the downstream environment. However, pollutants may be transformed within the unit. For example, organic matter may decompose and release nitrogen in the form of nitrogen gas or nitrate. These processes are similar to those in wetlands but probably occur at slower rates in the StormTech® Isolator™ Row due to the absence of light and mixing by wind, thermal inputs, and biological activity. Accumulated sediment should not be lost from the system at or under the design flow rate.

6.2.3 Sensitivity to Heavy Sediment Loading

Heavy loads of sediment will increase the needed maintenance frequency.

6.2.4 Mosquitoes

Although the StormTech® Isolator™ Row normally drain completely, designs may include standing water in a sump in the diversion manhole, which can be a breeding site for mosquitoes. StormTech® advises that the sump is not a necessity for proper Isolator™ Row operation and maintenance. The sump can be eliminated or designed with drain holes where the intent is to preclude mosquito breeding sites. In addition, StormTech® advises that the stone is designed to drain so as to not leave standing water. Small amounts of water that may not drain due to depressions in the otherwise flat bottom would infiltrate.

7. Net Environmental Benefit

Once the StormTech® Isolator™ Row has been verified and granted interim approval use within the State of New Jersey, StormTech® will then proceed to install and monitor systems in the field for the purpose of achieving goals set by the Tier II Protocol and final certification. At that time a net environmental benefit evaluation will be completed. However, it should be noted that the StormTech® technology requires no input of raw material, has no moving parts, and therefore, uses no water or energy.

8. References

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FIGURES

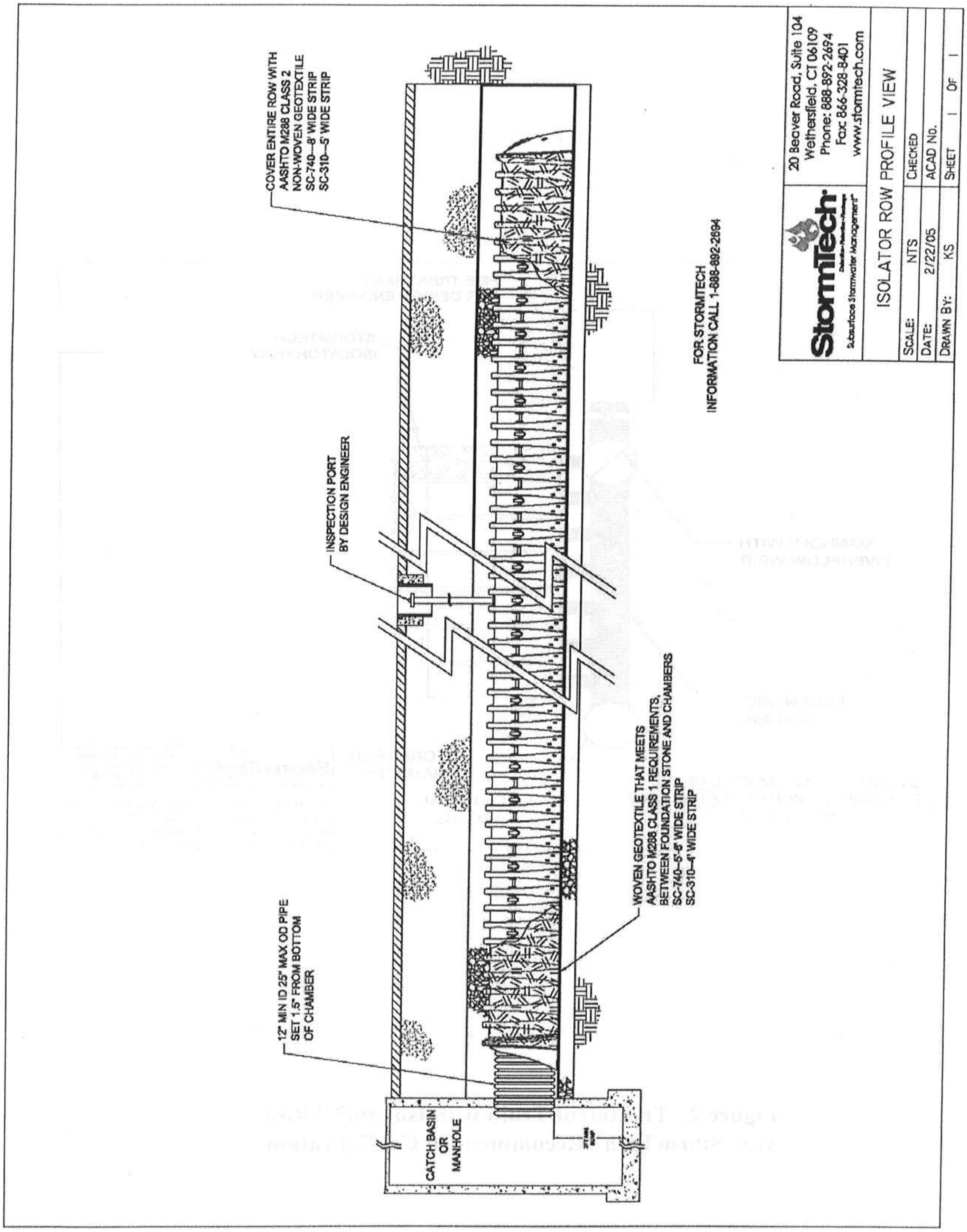

Figure 1. Isolator™ Row Profile View

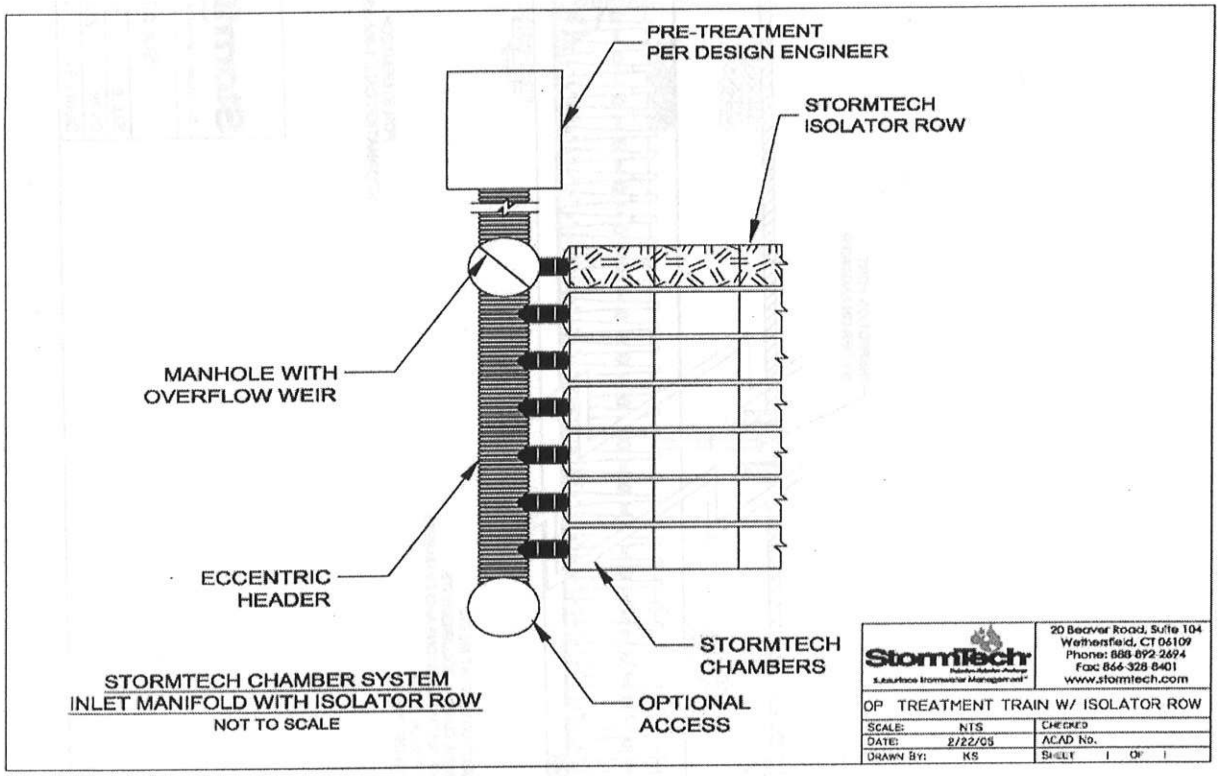

Figure 2. Treatment Train with Isolator™ Row
One StormTech® Recommended Configuration

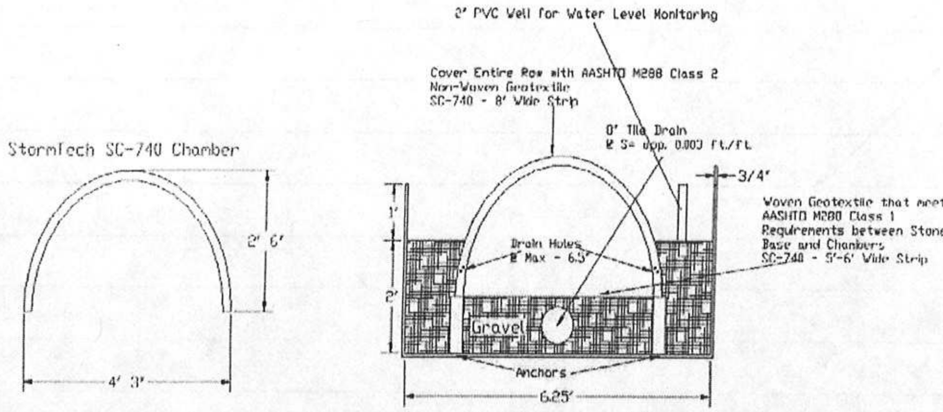

Figure 1.1: Section View of StormTech® Isolator™ Row as Installed in Lab

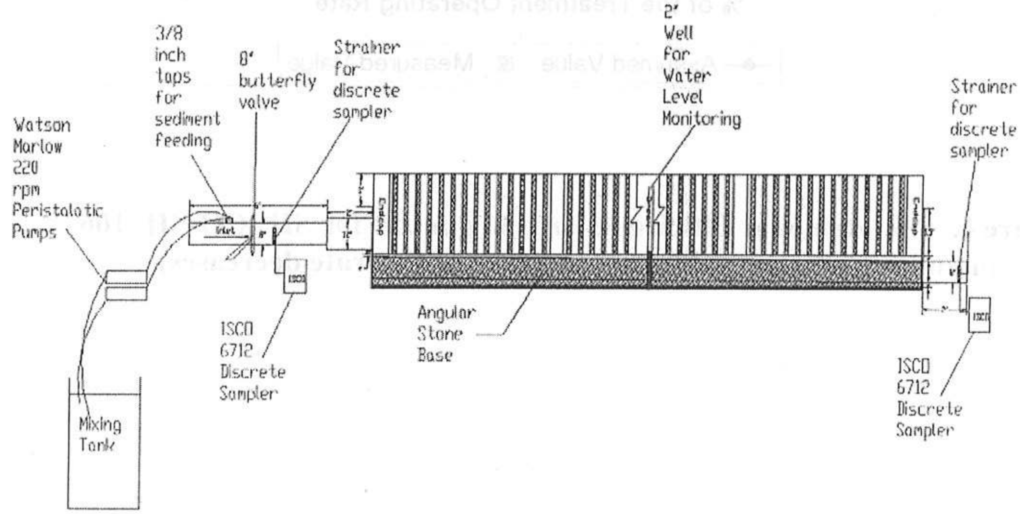

Figure 1. 2: Profile View of StormTech® Isolator™ Row as Installed in Lab.
Flow left to right.

Figure 3. Section and Profile Views of StormTech®Isolator™ Row as Installed in the Laboratory

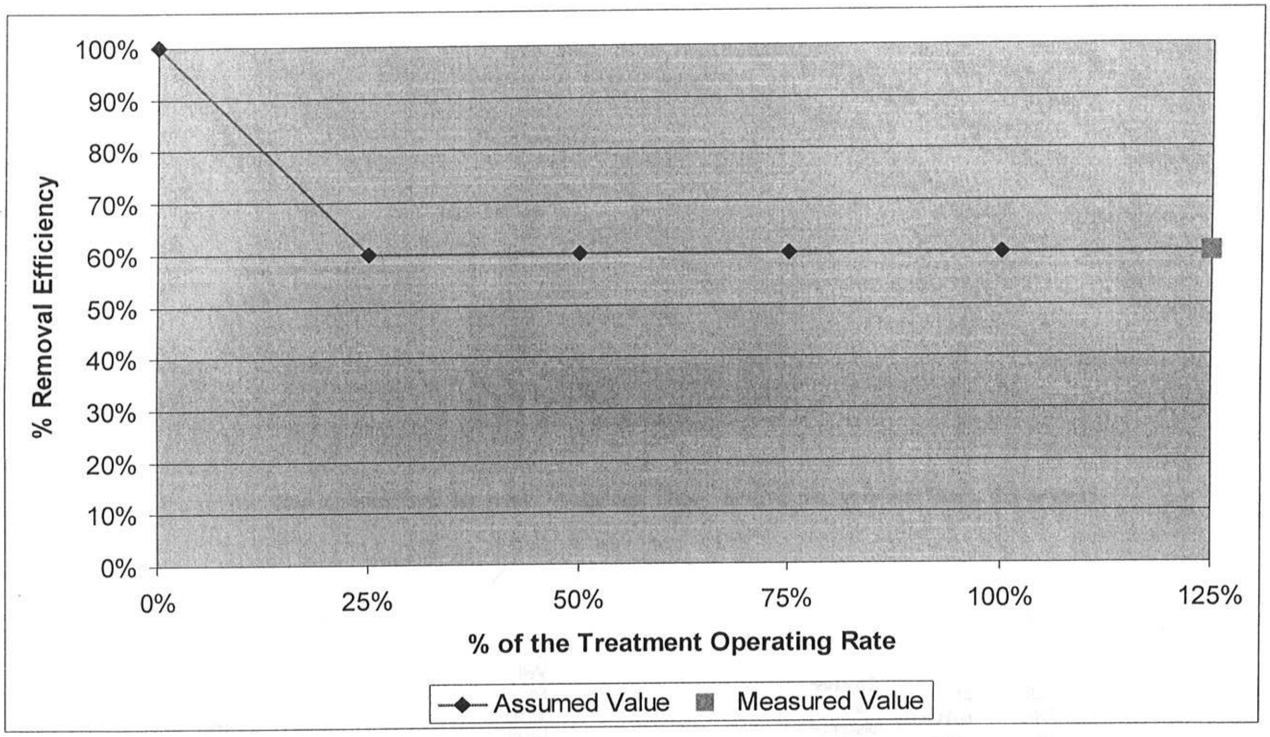

Figure 4. SSC Removal Efficiency for 2.56 gpm/ft² for SIL-CO-SIL 106 (assuming efficiency does not increase as flowrate decreases)

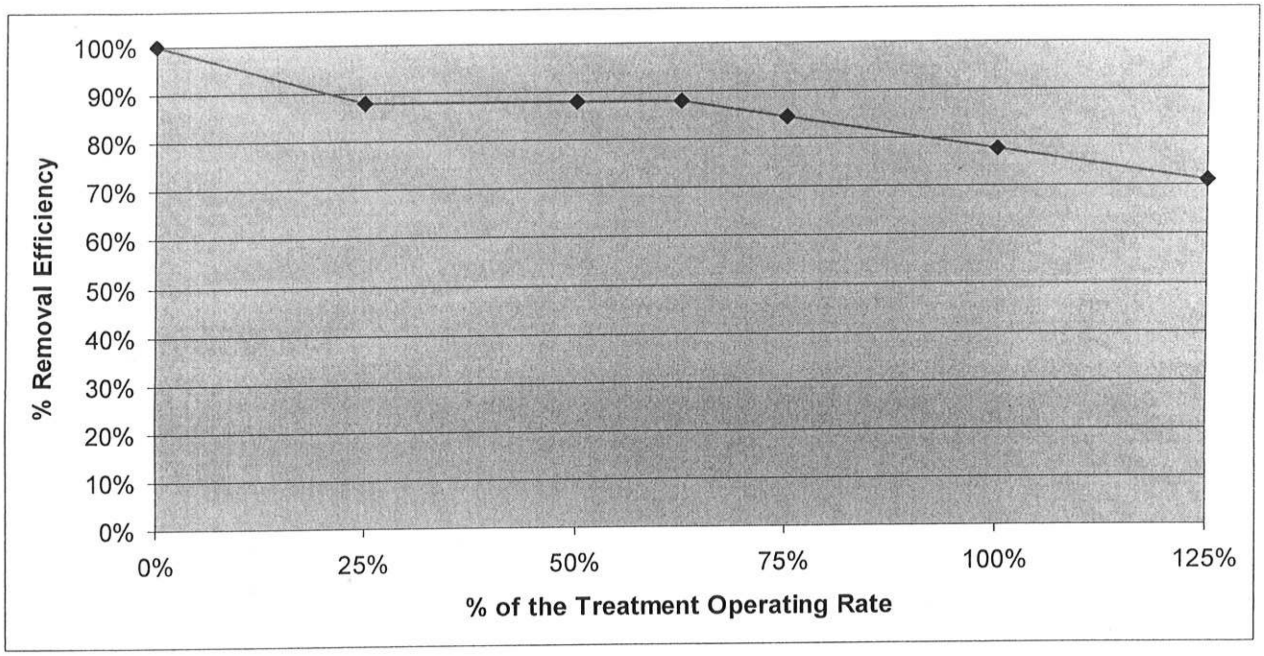

Figure 5. SSC Removal Efficiency for 2.56 gpm/ft^2 for SIL-CO-SIL 250

TABLES

Table 1. Results: SIL-CO-SIL 106 Tests

Date	Influent SSC (mg/L)	Effluent SSC (mg/L)	% Removal
9-Jul	180	81	55
9-Jul	177	100	44
9-Jul	292	122	58
9-Jul	315	147	53
9-Jul	318	162	49
17-Jul	212	72	66
17-Jul	266	95	64
17-Jul	278	135	51
25-Jul	236	77	67
25-Jul	229	66	71
25-Jul	139	74	47
25-Jul	293	87	70
1-Aug	240	70	71
1-Aug	290	124	57
1-Aug	294	144	51
1-Aug	341	146	57
1-Aug	361	132	63
28-Aug	227	74	67
28-Aug	266	67	75
28-Aug	328	137	58
28-Aug	308	100	68
28-Aug	353	182	48
Average:	**270**	**109**	**60**
Std. Deviation:	**59**	**35**	**9**
Minimum:	**139**	**66**	**44**
Maximum:	**361**	**182**	**75**

Table 2. Reduction of Removal Efficiency with Detention Time

Sample No.	No. of Detention Times	Influent SSC (mg/L)	Effluent SSC (mg/L)	% Removal
1	3	219	75	66
2	6	246	90	63
3	9	305	134	56
4	12	311	132	57
5	15	331	141	58

Table 3. Results: SIL-CO-SIL 250 Tests at 3.2 gpm/ft^2 (July 19, 2006)

Sample No.	Influent SSC (mg/L)	Effluent SSC (mg/L)	% Removal
1	226	40	82
2	169	47	72
3	244	53	78
4	288	67	77
5	129	68	47
Average:	**211**	**55**	**71**
Std. Deviation:	**63**	**12**	**14**
Minimum:	**129**	**40**	**47**
Maximum:	**288**	**68**	**82**

Table 4. Results: SIL-CO-SIL 250 Tests at 1.7 gpm/ft^2 (July 19, 2006)

Sample	Influent SSC (mg/L)	Effluent SSC (mg/L)	% Removal
1	416	27	89
2	407	44	88
3	441	48	87
4	417	56	89
5	441	61	87
Average:	**424**	**47**	**88**
Std. Deviation:	**16**	**13**	**1**
Minimum:	**407**	**27**	**87**
Maximum:	**441**	**61**	**89**

Table 5. Results: OK-110 Tests

Flow (cfs)	Hydraulic Loading Rate (gpm/ft^2)	Influent - Discrete SSC (mg/L)	Influent – Grab SSC (mg/L)	Effluent - Discrete SSC (mg/L)	% Removal - Discrete	% Removal - Grab
0.1	0.4	613.8	86.2	1.08	99.82%	98.75%
0.2	0.81	324.4	192.0	2.56	99.21%	98.67%
0.4	1.61	514.6	207.7	3.14	99.39%	98.49%
0.6	2.42	411.8	175.0	3.34	99.19%	98.09%
0.8	3.23	325.4	193.0	2.80	99.14%	98.55%
1.0	4.04	525.6	137.2	1.96	99.63%	98.57%
1.2	4.84	116.4	178.6	3.18	97.27%	98.22%
0.2	0.81	398.2	108.8	1.78	99.55%	98.37%
0.4	1.61	358.8	85.7	1.96	99.45%	97.71%
0.6	2.42	329.5	200.0	3.41	98.97%	98.30%
1.2	4.84	227.5	164.4	2.00	99.12%	98.79%
1.0 (scaled)	8.1	302.0	241.8	11.00	96.36%	95.45%
Average:		**370.7**	**164.2**	**3.18**	**99.14%**	**98.06%**
Minimum:		**116.4**	**85.7**	**1.08**	**96.36%**	**95.45%**
Maximum:		**613.8**	**241.8**	**11.0**	**99.82%**	**98.79%**

Table 6. Particle Size Distribution

Particle Size (microns)	Sandy loam (percent by mass)
500-1,000 (coarse sand)	5.0
250-500 (medium sand)	5.0
100-250 (fine sand)	30.0
50-100 (very fine sand)	15.0
2-50 (silt)	(8-50 μm, 25%) (2-8 μm, 15%)*
1-2 (clay)	5.0

Notes:
Recommended density of particles ≤2.65 g/cm^3
*The 8 μm diameter is the boundary between very fine silt and fine silt according to the definition of American Geophysical Union. The reference for this division/classification is: Lane, E. W., et al. (1947). "Report of the Subcommittee on Sediment Terminology," Transactions of the American Geophysical Union, Vol. 28, No. 6, pp. 936-938.

Table 7. Weight Factors for Different Treatment Operating Rates

Treatment operating rate	Weight factor
25%	0.25
50%	0.30
75%	0.20
100%	0.15
125%	0.10

Notes:
Weight factors were based upon the average annual distribution of runoff volumes in New Jersey and the assumed similarity with the distribution of runoff peaks. This runoff volume distribution was based upon accepted computation methods for small storm hydrology and a statistical analysis of 52 years of daily rainfall data at 92 rainfall gages.

Table 8. NJDEP Weighted Removal Efficiency for 2.56 gpm/ft^2 for SIL-CO-SIL 106 (assuming efficiency does not increase as flowrate decreases)

Treatment Operating Rate	NJDEP Weight Factor	Loading Rate (gpm/ft^2)	% SSC Removal	NJDEP Weighted % Removal
25%	0.25	0.64	60	15
50%	0.30	1.28	60	18
75%	0.20	1.92	60	12
100%	0.15	2.56	60	9
125%	0.10	3.20	60	6
Total:				**60**

Table 9. NJDEP Weighted Removal Efficiency for 2.56 gpm/ft^2 for SIL-CO-SIL 250

Treatment Operating Rate	NJDEP Weight Factor	Loading Rate (gpm/ft^2)	% SSC Removal	NJDEP Weighted % Removal
25%	0.25	0.64	0.88	0.22
50%	0.30	1.28	0.88	0.264
62.5		1.70	0.88	
75%	0.20	1.92	0.846	0.1692
100%	0.15	2.56	0.778	0.1167
125%	0.10	3.20	0.71	0.071
Total:				**84**

Table 10. NJDEP Weighted Removal Efficiency for 4.8 gpm/ft² for OK-110

Treatment Operating Rate	NJDEP Weight Factor	Loading Rate (gpm/ft²)	% SSC Removal	NJDEP Weighted % Removal
25%	0.25	0.97	98.9	24.7
50%	0.30	1.94	98.7	29.6
75%	0.20	2.90	98.7	19.7
100%	0.15	3.87	98.9	14.8
125%	0.10	4.84	98.4	9.8
Total:				**98.8**

Table 11. NJDEP Weighted Removal Efficiency for 8.1 gpm/ft² for OK-110

Treatment Operating Rate	NJDEP Weight Factor	Loading Rate (gpm/ft²)	% SSC Removal	NJDEP Weighted % Removal
25%	0.25	1.62	98.8	24.7
50%	0.30	3.24	98.8	29.7
75%	0.20	4.86	98.3	19.7
100%	0.15	6.48	98.3	14.8
125%	0.10	8.10	95.9	9.6
Total:				**98.4**

SI® Geosolutions

Product Data Sheet

GEOTEX® 315 ST

GEOTEX 315ST is a woven slit film geotextile manufactured at one of SI Corporations' facilities. The individual slit films are woven together in such a manner as to provide dimensional stability relative to each other. The construction of the geotextile makes **GEOTEX 315ST** ideal for soil separation and stabilization. The geotextile is resistant to ultraviolet degradation and to biological and chemical environments for normally found in soils. **GEOTEX 315ST** conforms to the property values listed below[1] which have been derived from quality control testing perfomed by one of SI Corporations' GAI-LAP accredited laboratories:

PROPERTY	TEST METHOD	MARV[2] ENGLISH	METRIC
Physical			
Mass/Unit Area	ASTM D5261	6.5 oz/yd^2	220 g/m^2
Thickness	ASTM D5199	20 mils	.5 mm
Mechanical			
Tensile Strength (Grab)	ASTM D4632	315 x 315 lbs	1,400 x 1,400 N
Elongation	ASTM D4632	15 x 15%	15 x 15%
Wide Width Tensile	ASTM D4595	175 x 200 lbs/in	30.6 x 35.0 kN/m
Wide Width Elongation	ASTM D4595	10 x 8%	10 x 8%
Puncture	ASTM D4833	125 lbs	555 N
Mullen Burst	ASTM D3786	650 psi	4475 kPa
Trapezoidal Tear	ASTM D4533	120 x 120 lbs	530 x 530 N
CBR Burst	GRI-GS1	1075 lbs	4780 N
Endurance			
UV Resistance	ASTM D4355	90%	90%
Hydraulic			
Apparent Opening Size (AOS)	ASTM D4751	70 US Std. Sieve	0.212 mm
Permittivity	ASTM D4491	0.05 sec^{-1}	0.05 sec^{-1}
Permeability	ASTM D4491	.003 cm/sec	.003 cm/sec
Water Flow Rate	ASTM D4491	4 gpm/ft^2	161 l/min/m^2
Roll Sizes		12.5 ft x 360 ft 15.0 ft x 300 ft 17.5 ft x 258 ft	3.81 m x 109.73 m 4.57 m x 91.44 m 5.33 m x 78.64 m

NOTES:
1. **The property values listed above are effective 03/24/2006 and are subject to change without notice.**
2. Values for machine (warp) and cross-machine (fill), respectively, under dry or saturated conditions. Minimum average roll values (MARV) are calculated as the typical minus two standard deviations. Statistically, it yields a 97.7% degree of confidence that any samples taken from quality assurance testing will exceed the value reported.

6025 Lee Highway, Suite 435 • Chattanooga, Tennessee USA • (423) 899-0444 or (800) 621-0444 • FAX (423) 485-9068 • www.fixsoil.com

SI® Geosolutions

Product Data Sheet

GEOTEX® 601

GEOTEX 601 is a polypropylene, staple fiber, needlepunched nonwoven geotextile manufactured at one of SI Geosolutions' facilities that has achieved ISO-9002 certification for its systematic approach to quality. The fibers are needled to form a stable network that retains dimensional stability relative to each other. The geotextile is resistant to ultraviolet degradation and to biological and chemical environments normally found in soils. GEOTEX 601 conforms to the property values listed below[1] which have been derived from quality control testing performed by one of SI Geosolutions' GAI-LAP accredited laboratories:

		MARV[2]	
PROPERTY	TEST METHOD	ENGLISH	METRIC
Physical			
Mass/Unit Area	ASTM D5261	5.0 oz/yd²	170 g/m²
Thickness	ASTM D5199	60 mils	1.5 mm
Mechanical			
Grab Tensile Strength	ASTM D4632	160 lbs	712 N
Grab Elongation	ASTM D4632	50%	50%
Puncture Strength	ASTM D4833	85 lbs	378 N
Mullen Burst	ASTM D3786	280 psi	1930 kPa
Trapezoidal Tear	ASTM D4533	60 lbs	267 N
Wide Width Tensile	ASTM D4595	720 lbs/ft	10.5 kN/m
Endurance			
UV Resistance @ 500 hrs	ASTM D4355	70%	70%
Hydraulic			
Apparent Opening Size (AOS)[3]	ASTM D4751	70 US Std. Sieve	0.212 mm
Permittivity	ASTM D4491	1.30 sec^{-1}	1.30 sec^{-1}
Permeability	ASTM D4491	0.24 cm/sec	0.24 cm/sec
Water Flow Rate	ASTM D4491	110 gpm/ft²	4480 l/min/m²
Typical Roll Sizes		150 in x 100 yds 180 in x 100 yds	3.81 m x 91.5 m 4.57 m x 91.5 m

NOTES:

1 The property values listed below are effective 12/2003 are subject to change without notice.

2 Values shown are in weaker principal direction. Minimum average roll values are calculated as the typical minus two standard deviations. Statistically, it yields a 97.7% degree of confidence that any samples taken from quality assurance testing will exceed the value reported.

3 Maximum average roll value. Statistically, it yields a 97.7% degree of confidence that samples taken from quality assurance testing will be below the value reported.

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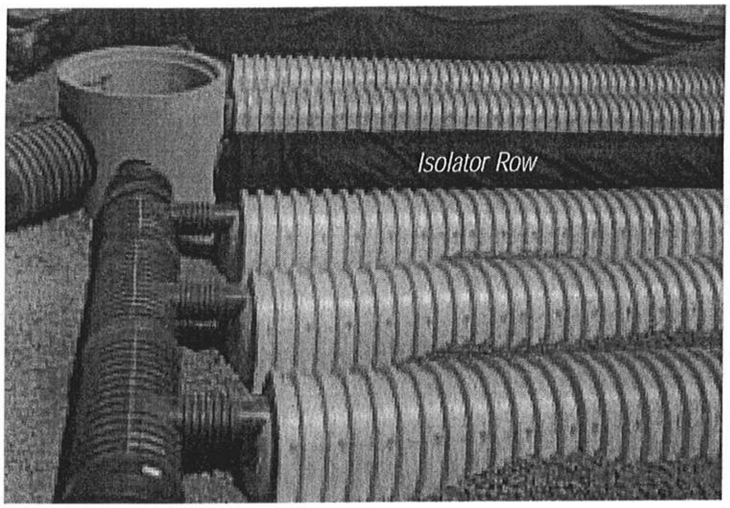
StormTech®

Detention • Retention • Recharge

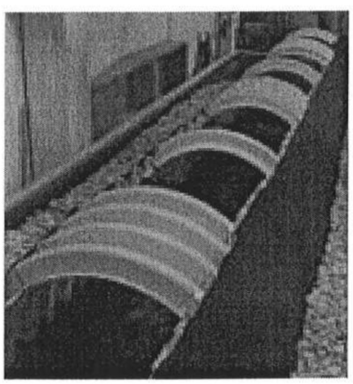
Subsurface Stormwater Management℠

Isolator Row™ Performance Test Results

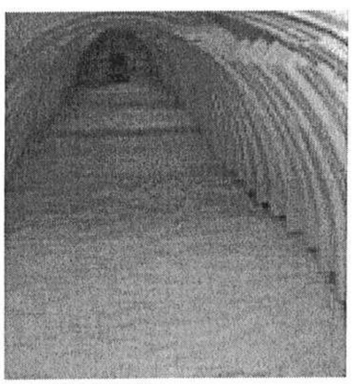
as reported by Tennessee Technological University



StormTech chambers are the only chambers that meet stringent AASHTO safety factors for traffic load and deep burial applications.



Four SC-740 chambers in test apparatus at Tennessee Tech.



Uniform sediment distribution (US Silica OK-110 SG=2.65).

The Isolator Row is an innovative yet simple system that inexpensively removes total suspended solids (TSS) from storm water and provides easy access for inspection and maintenance. In the Isolator Row, StormTech chambers are completely enclosed by geotextile fabrics. Sediment is captured in the Isolator Row as storm water passes through the fabric to the stone and adjacent chambers.

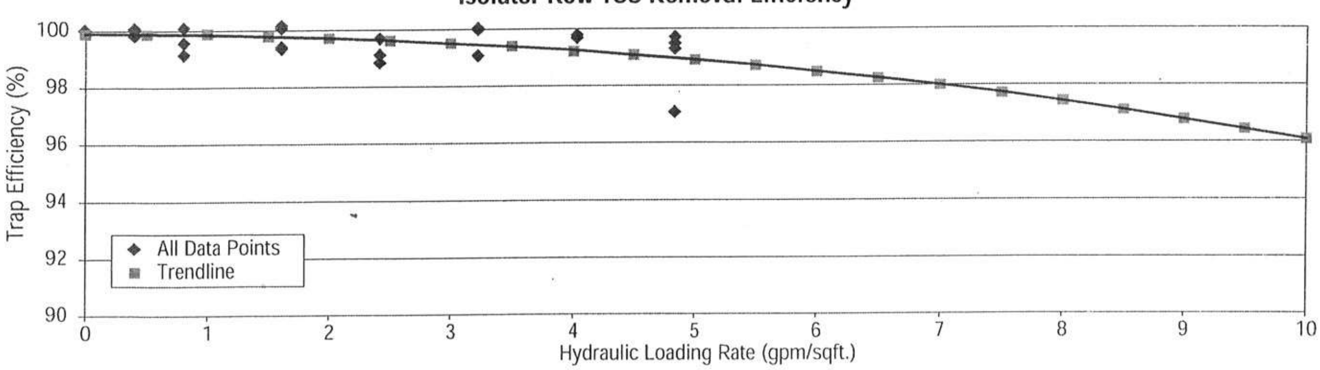
The recent completion of TSS removal testing at Tennessee Tech provides design engineers and regulators solid data that can be used to estimate the maintenance free interval and establishes the Isolator Row as a best management practice (BMP) for TSS removal.

For additional information on the Isolator Row (patent pending), contact StormTech at (888) 892-2694.

Performance Summary:

- 97% Overall TSS Removal
- 80% TSS Captured in the Isolator Row
- Estimated Maintenance Interval – 3 years

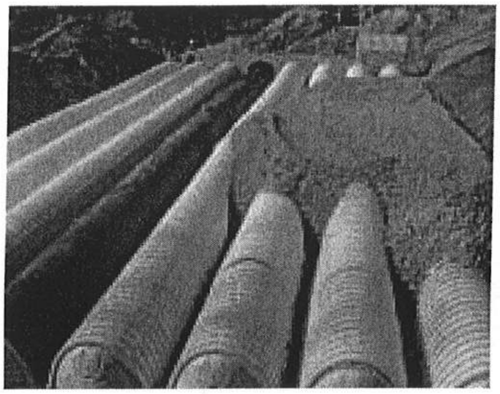
Isolator Row TSS Removal Efficiency

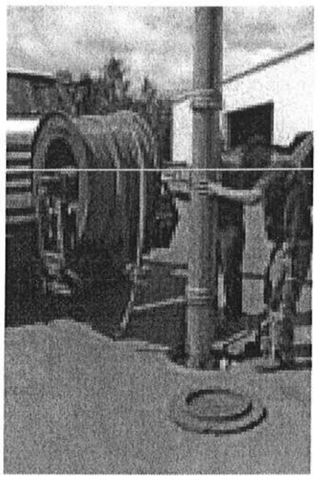


Another Success Story for the Isolator Row

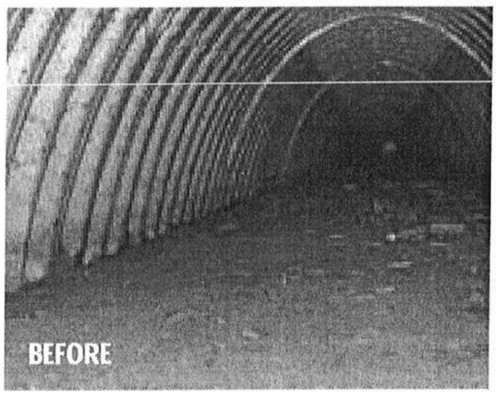
After One Year of Operation, Harvey Industries Inspected and Cleaned Their Isolator Row in Portland, Maine

150 StormTech SC-740 chambers were installed in April, 2003. On July 7, 2004, after one year in service, StormTech inspected the Isolator Row and observed maintenance procedures.





Vactor trucks are typically equipped with both jetting and vacuum equipment.



During maintenance, the jetting nozzle propels itself down the Isolator Row scouring up sediment and washing it down to the access manhole where it is vacuumed into the truck.

After four passes of the jetting nozzle at pressures up to 1900 psi, the bottom fabric was scoured clean.

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StormTech products are covered by one or more of the following patents: U.S. Patents: 5,401,459; 5,511,903; 5,716,163; 5,588,778; 5,839,844; Canadian Patents: 2,158,418 Other U.S. and Foreign Patents Pending

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