



Lake County, Ohio

CENTER PARK ESTATES AREA STORM WATER MANAGEMENT STUDY

PAINESVILLE TOWNSHIP,
LAKE COUNTY, OHIO

July 31, 2013

By:



E N G I N E E R S

**6801 HOPKINS ROAD
MENTOR, OHIO 44060**

PH: 440-205-0484

FAX: 440-205-0846

PROJECT NO. 13048

**CENTER PARK ESTATES AREA
STORM WATER MANAGEMENT STUDY**

PAINESVILLE TOWNSHIP,
LAKE COUNTY, OHIO

July 31, 2013

By: GGC ENGINEERS, INC – NORTH OFFICE
6801 HOPKINS ROAD
MENTOR, OHIO 44060
440-205-0484
440-205-0846 fax

CENTER PARK ESTATES STORMWATER MANAGEMENT STUDY

EXECUTIVE SUMMARY

1. The intersection of Normandy Drive and Coventry Drive periodically floods to the extent that the intersection requires barricades.
2. The areas adjacent to this intersection also flood and includes the parking lot of Personacare of Ohio -Lake Medical Nursing & Rehabilitation.
3. Shallow and undersized storm sewers cannot route flows without flooding.
4. The Topps pond and the Cambridge pond do not serve well as detention basins as they currently exist. Overgrown and silted-in conditions prevent these basins from collecting and detaining flows.
5. The existing storm sewer outlet into the SR 20/Nye Road system is a 30 inch sewer that runs under an existing building at 1717 Mentor Ave., Accurate Auto Body & Frame.
6. The SR 20/Nye Road storm sewer controls the allowable flow to be handled. The SR 20/Nye Road storm sewer system has the ability to carry 35 CFS from the Center Park Estates project.
7. A recommendation has been outlined to lower, expand and re-grade the Topps Pond. This will allow the pond to serve as a detention and holding facility reducing the hydraulic grade line (HGL) which ultimately floods the described areas.
8. A recommendation has been outlined to re-grade the Cambridge pond and re-route flow back to the Topps pond. This will serve to keep Cambridge Pond a wet pond and to an extent serve as a detention and water quality basin.
9. A recommendation has been outlined to construct new detention facility to be sited on the Fairgrounds Road property in order to reduce peak flow rates affecting the downstream Center Park Estates area. Above, below ground or a combination of these alternatives exists for construction type. A Fairgrounds detention site needs to be further discussed in order to understand the day to day needs of the property so that a system maybe integrated within the allowable area.

10. A recommendation has been outlined to lower the proposed Storm sewer outlet to the SR 20/Nye Road. In order to carry the needed capacity and grade back to the Topps Pond, an invert elevation of 667.7 is anticipated and will allow for existing utility clearance.
11. An alternate outlet for the Center Park Estates flow to the SR 20 system would require running through the California Imports driveway into The SR 20 system and upsizing the existing SR 20 storm sewer to a 36 inch diameter pipe at 1.26%.
12. A recommendation has been outlined to raise the existing rim elevations of the Personacare Parking lot catch basins to allow for increased hydraulic grade line elevation.
13. The recommendations outlined allows for an opportunity to collect a portion of the Cherry Hill Storm system into the Fairgrounds Road system in order to reduce peak flows at bottom of the Center Park Estates system. See properties list #14 and #15.
14. Engineer's Preliminary Opinion of Probable Costs results in the below totals :

Complete Entire Project, Segments 1,2,3,4 and 5:	\$2,465,485.00
No-Build Fairgrounds Detention System, Segments 1,2,3,4:	\$ 1,816,606.00
Complete Topps Pond & Cambridge Pond Improvements, Segments 1,2,3:	\$ 1,545,334.00
Complete Entire Project with the alternate route, Segments 2,3,4,5 and alternate route:	\$ 2,437,990.00
No Build Fairgrounds Detention System, Segments 2,3,4, and alternate route:	\$ 1,790,111.00
15. Several private properties are affected by the proposed work. Work and drainage easements must be obtained in order to complete the work. A portion of an existing building must be demolished and rebuilt. An alternate route is suggested to exit through the California Import Drive and tie in to the SR 20 / Nye Road system to limit impact to existing facilities and reduce cost.

GENERAL

A Storm Water Management Study has been prepared in order to effectively design and implement storm water runoff control for the existing Center Park Estates area watershed in order to control local flooding issues currently experienced within the study area.

The flooding that is occurring within the study area includes the Normandy Drive intersection with the Court Yard Village Apartments and the Personacare of Ohio building located north of the Court Yard Village Apartments. Also the surrounding intersection area at Normandy Drive and Coventry Drive has been reported to flood.

EXISTING CONDITIONS

Requests for existing plans from Lake County and Painesville Township have been made but existing drawings were somewhat limited in availability. Field visits along with online existing plans have been used to prepare and analyze this study area. **See Exhibit A.**

The watershed as depicted in **Exhibit B** consists of 5 main areas. The 5 main areas have been divided and studied in order to determine the watershed area in acres, the runoff curve number, soil types and the time of concentration for each design point. The following summarizes the information as determined by acceptable engineering practices:

Area 1: 15.6 acres bounded by the Fairgrounds Road right of way and the rear properties adjacent and on the west side of Fairgrounds Road. The area consists of 2 soil types A and C/D, yielding a RCN of 75.

Area 2: 62.3 acres of watershed that consist of wooded and grassed areas west of Fairgrounds Road residential properties and within property owned and maintained by the Lake County Commissioners. The soil types A and C and a RCN of 61 have been determined.

Area 3: 106 acres bounded by SR84 to the south, Stratford Road/ Cambridge Village Condominiums to the west and the Marcs plaza to the north. This area consists of 1/2 to 1/3 acre lots and Commercial property with paved roads extending down from Cherry Hill Drive, Coventry Drive, Normandy Drive, Pennington Drive and Wilmington Drive. This is known as the Center Park Estates area. This area has type A and C soils and a composite RCN of 76.

Area 4: 37.3 acres of watershed within the Cambridge Village Condominiums and a small portion of residential land located south of Cambridge Village Condominiums. This area has a RCN of 98 within type C soils.

Area 5: 13.7 acres of wooded area located to the west of the Cambridge Village Condominiums. Within this area type C soils and a RCN of 70 is obtained.

Within the above described watershed, storm water routing begins with sheet flow, shallow concentrated flow, storm sewer flow and portions of open channel flow.

Exhibit B represents the overall watershed and the means of conveyance and flow path that has been used in determining the Time of Concentration, (Tc).

Beginning in the southeast corner of the project, shallow concentrated flow is intercepted by shallow swales extending north and then by existing storm sewers within the Fairgrounds Road property. This flow discharges into an open channel located at the rear property line of the Coventry Place Apartments. From here it enters into a 30" diameter storm sewer system which combines with flows from the Center Park Estates area. The Center Park Estates area is comprised of residential properties consisting of sheet flow, to shallow concentrated ditch flow, into storm sewers and finally combines with the Fairgrounds Road Area watershed at / and near the intersection of Normandy Drive with Coventry Drive.

From this intersection a shallow 30 inch storm sewer system currently routes flows to what is known as the Topps pond. The pond was originally designed to be a detention basin located on approximately 2.9 acres of land. Flows from basin are then routed through the Cambridge Village Condominium Pond located to the west. After entering the Cambridge pond, it exits through an open channel system and then into a 30 inch storm sewer located further west. Downstream from here it passes under a building and then enters the SR 20/Nye Road storm sewer system. **See Exhibit B and Exhibit C.**

The SR 20 and Nye Road systems have been recently improved through an ODOT sponsored project. This system is the beginning of control for this project with the capacity of this project being dictated by the capacity of the existing SR 20/Nye Road system. Investigation into the existing design has been made and it has been determined that the SR20/ Nye Road system has a 35 cfs maximum capacity available for the 25 year event.

As discussed above, the Personacare of Ohio Property is north of the Court Yard Village Apartments. Between both properties is the 30 inch storm sewer system that runs east to west. The invert elevations for this system are around 677.0 and the rim/ground grades are around 682.5. It is important to note that the catch basin rims located in the Personacare parking lot are set at 680.0.

PROPOSED CONDITIONS

Under the proposed conditions, the intent is to provide storm water management improvements that will allow for the local flooding events to be mitigated. Coupled with the above defined watershed areas, the overall system and the means to convey outflows in a controlled system is necessary to achieve this goal.

To address the flooding issue the first step is to identify the critical hydraulic grade line elevation for the flood events needs to be determined. Through existing mapping, site surveys and field reviews, the critical elevation within the flooded area is elevation 680.0. This elevation is the current rim elevation of the Personacare parking lot catch basin rims. Outside of this parking lot, the critical elevation is around 682.5. If outflows are controlled such that this elevation is not exceeded, flooding should be mitigated and the design intent would be accomplished. While these elevations are met flows must also stay within the allowable SR20/Nye Road storm sewer capacity of 35 cfs.

STORM WATER MANAGEMENT DESIGN:

The SCS unit hydrograph procedure has been used to analyze and generate reports for the various storm events, more specifically the 10 year through 100 year events. It has been suggested that the target critical storm is a 25 year event. This study reviews events 10 through 100 year in order to determine the overall benefits of the designed system and expected shortcomings during the larger storm events.

This system is to be designed to accommodate the runoff such that the critical HGL elevation is not exceeded and the maximum outflow of 35 cfs is maintained during the 25 year storm event. The optimal design approach is as follows:

Area 1 is proposed to be tied into a detention system sited on the Fairgrounds property.

Area 2 will be controlled and detained such that the total flows from areas 1 & 2 entering the open channel system behind the Coventry Place Apartment complex does not exceed the existing capacity of the open channel and allows for the HGL to be maintained at an elevation near 682.00. Area 2 will be controlled by an above or below ground detention basin sited within the Fairgrounds property. Discussion regarding the size and location of a detention pond would need to occur in order to accommodate the Fairgrounds parking requirements and the detention system requirements.

Area 3 will be contained within the existing open swale and storm sewer system. There exists the opportunity to divert some of the upper Cherry Hill Drive flows to the Fairgrounds system if access through two properties can be obtained at and near the intersection of Pennington Drive @ Coventry Drive. The purpose for this

diversion would be to reduce the peak flows entering downstream system at Coventry Drive & Normandy Drive.

Also anticipated is the upsizing (replacement) or construction of a supplemental line to the 30 inch storm sewer system in order to obtain the total capacity equivalent to a 36"-48" diameter pipe on a 0.13% slope. These flows would be routed to the Topps Pond. Within this entire system, the flows from storm events would be controlled with a re-graded, expanded and lowered Topps pond. Flows would be detained to allow for a maximum 35 cfs outlet capacity and a maximum HGL of 680.0. It is anticipated that a bottom elevation of 673.0, a rim elevation of 682.0 and approximately 20 ac-ft storage capacity would be required. A pond with 4:1 side slopes would fit within this parcel of land.

Also to be considered is the separation of the watershed areas. If the Center Park Estates area can be separated and routed directly to the Topps Pond and separated from the Fairgrounds Watershed, this would reduce the capacity issues within the existing 30 inch storm sewer system.

Areas 4 and 5 will continue to be discharged to the Cambridge Village Condominium Pond. The intent would be to re-grade the Cambridge pond and re-route flows to the Topps pond via a new storm sewer. The Pat Catan's parcel would still flow to the Cambridge Pond.

OUTLET FROM TOPPS POND TO SR 20/ NYE ROAD

From the re-graded Topps pond a new storm sewer system will be re-routed and intercepted within the existing open channel system west of the Cambridge pond and connected to the SR20/Nye Road system at a lowered tie-in elevation. It is noted that the existing 30 inch storm sewer that ties into the SR 20 system runs under an existing building. Consideration to re-routing the outlet from the Topps pond must be given. **See Exhibit D and Exhibit E.**

The below tables represent the calculated flows and elevations as a result of this analysis.

These would be subject to change depending on final design, sewer routes, sizes and grades.

4P, Fairgrounds Pond: Storm Calculations

STORM EVENT	Inflow (cfs)	Outflow (cfs)	Peak Elevation
10	13.5	4.8	682.7
25	20.8	7.1	683.9
50	26.8	8.6	684.9
100	32.0	-	-

(-) denotes flooded conditions, no solution based on information. Requires modified design siting. Location will dictate elevations. Under this analysis, a bottom elevation of 681.0 and a top elevation of 686.0 has been utilized.

2P, Cambridge Pond: Storm Calculations

STORM EVENT	Inflow (cfs)	Outflow (cfs)	Peak Elevation
10	75.3	33.1	680.2
25	94.9	38.9	680.9
50	109.8	38.1	681.8
100	124.0	-	-

(-) denotes flooded conditions, no solution based on information. Requires modified design. Existing water surface elevation 677.0 is maintained under this analysis.

1P, Topps Pond: Storm Calculations

STORM EVENT	Inflow (cfs)	Outflow (cfs)	Peak Elevation
10	125.4	28.1	677.9
25	180.7	31.5	679.6
50	223.3	33.5	680.7
100	267.1	35.6	681.9
***25	200.0	32.8	680.3

***** No-Build Fairgrounds detention system, provide adequate storm sewer pipe capacity to convey flows to Topps pond without HGL exceeding critical elevations.**

The above design approaches can be modified and improved during final design. The important aspect of this design is with the stage-storage and outflow rate of the Topps pond. If the maximum HGL of the pond and upstream pipe can be kept at or below 680.0, the upstream flooding will be contained within the system. Once final survey is obtained and all connected structures are reviewed for the rim elevations, modifications and improvements to the design can be made.

PROPERTIES AFFECTED

The following are the list of properties affected by the proposed work. Also identified is the current occupant of the parcel:

1. 1717 Mentor Ave.- Accurate Auto Body & Frame
2. 1721 Mentor Ave.- FCE, Inc.
3. 1697 Mentor Ave.- California Imports, Mad Hatte
4. Cambridge Village Condominiums

5. 1623 Mentor Ave., - Pat Catan's : Crystal Place Partners, LLC.
6. 1585 Mentor Ave., - Marc's : Georgia Property Group, LLC.
7. 70 Normandy Drive – Lake Medical Nursing & Rehab.: Personacare of Ohio.
8. 100 Normandy Drive- Court Yard Village Apartments
9. 156 Normandy Drive-Lorenzo & Adele Bartolami
10. 162 Normandy Drive-Linda Cutler
11. 21 Coventry Drive- Coventry Place Apartments
12. 77 Normandy Drive- Family Eye Care
13. 1301 Mentor Ave., - Lake County: Fairgrounds
14. 135 Coventry Drive- Kathy Lukehart
15. 151 Coventry Drive-Donald & Deborah Cool

Engineer's Opinion of Preliminary Construction Costs

The following Engineer's Preliminary Opinion of Probable Costs have been developed and itemized in segments for the purpose of identifying associated costs for each phase or segment of work.

Segment 1 is the Right of way work at the SR 20/Nye Road system at the beginning of the project.

Segment 2 is the work required to construct a new storm sewer run back to the Topps pond and to construct the Topps pond improvements.

Segment 3 is the segment of work to complete the Cambridge pond improvements and route the flows back to the Topps pond.

Segment 4 is the work necessary to improve the capacity of the existing storm sewer system from the Topps pond back to the Fairgrounds property.

Segment 5 is the work necessary to construct a detention system on the Fairgrounds property.

Also provided is engineer's preliminary opinion of probable costs for an underground detention system to be used in planning any future work on the Fairgrounds property and an engineer's preliminary opinion of probable costs to complete an alternate outfall route back to the SR 20/ Nye Road system.

Complete Entire Project, Segments 1,2,3,4 and 5:	\$ 2,465,485.00
--	-----------------

No-Build Fairgrounds Detention System, Segments 1,2,3,4:	\$ 1,816,606.00
---	-----------------

Complete Topps Pond & Cambridge Pond Improvements, Segments 1,2,3:	\$ 1,545,334.00
---	-----------------

Complete Entire Project with the alternate route, Segments 2,3,4,5 and alternate route:	\$ 2,437,990.00
--	-----------------

No Build Fairgrounds Detention System, Segments 2,3,4, and alternate route:	\$ 1,790,111.00
--	-----------------

APPENDIX A

ENGINEER'S OPINION OF PRELIMINARY CONSTRUCTION COSTS

**CENTER PARK ESTATES STORM WATER MANAGEMENT STUDY
ENGINEER'S PRELIMINARY OPINION OF CONSTRUCTION COSTS**

	A	B	C	D	E	F	G
1	SEGMENT 1						
2	Open Cut Mentor Ave:						
3	(Work within Right Of Way)						
4		QTY	UNIT	UNIT PRICE	ITEM TOTAL	SEGMENT TOTAL	OVERALL TOTAL
5	Maintenance of Traffic	1	LS	\$ 8,000.00	\$ 8,000.00		
6	Pavement saw Cutting	130	LF	\$ 8.00	\$ 1,040.00		
7	Pavement Removal & Disposal (12'Wx60'L)	80	SY	\$ 10.00	\$ 800.00		
8	Pipe Removed Greater than 24 Inch	65	LF	\$ 10.00	\$ 650.00		
9	Plug Existing Pipe Opening	1	LS	\$ 1,000.00	\$ 1,000.00		
10	Sheeting & Shoring	1	LS	\$ 4,000.00	\$ 4,000.00		
11	33 inch RCP	65	LF	\$ 150.00	\$ 9,750.00		
12	Core Manhole	1	EA	\$ 1,000.00	\$ 1,000.00		
13							
14	Utilities Supported	1	LS	\$ 5,000.00	\$ 5,000.00		
15	Concrete Pavement Replacement	54	SY	\$ 60.00	\$ 3,240.00		
16	Concrete Sidewalk Replacement	26	SY	\$ 40.00	\$ 1,040.00		
17							
18						\$ 35,520.00	

CENTER PARK ESTATES STORM WATER MANAGEMENT STUDY
ENGINEER'S PRELIMINARY OPINION OF CONSTRUCTION COSTS

	A		B	C	D	E	F	G
19	SEGMENT 2							
20	Sewer Run from Mentor Ave Right of Way to Topps Pond:							
21			QTY	UNIT	UNIT PRICE	ITEM TOTAL	SEGMENT TOTAL	OVERALL TOTAL
22	Maintenance of Traffic	1	LS		\$ 3,000.00	\$ 3,000.00		
23	Pavement saw Cutting	500	LF		\$ 3.00	\$ 1,500.00		
24	Pavement Removal & Disposal	400	SY		\$ 7.00	\$ 2,800.00		
25	Building Demo & Shored	1	LS		\$ 15,000.00	\$ 15,000.00		
26	Pipe Removed Greater than 24 Inch	260	LF		\$ 10.00	\$ 2,600.00		
27	Headwalls & Manholes Removed	6	EA		\$ 500.00	\$ 3,000.00		
28	Clearing & Grubbing	3.15	ACRES		\$ 4,000.00	\$ 12,592.29		
29								
30	33 inch RCP	1135	LF		\$ 115.00	\$ 130,525.00		
31	60 inch Diameter Manholes	5	EA		\$ 2,500.00	\$ 12,500.00		
32	Catch basins	4	EA		\$ 1,000.00	\$ 4,000.00		
33	Headwalls	1	EA		\$ 2,500.00	\$ 2,500.00		
34	Rip Rap w/ filter Fabric	20	CY		\$ 85.00	\$ 1,700.00		
35	Outlet Control Structure	1	EA		\$ 3,000.00	\$ 3,000.00		
36								
37	Excavation & Embankment for TOPPS Detention Pond	42000	CY		\$ 7.00	\$ 294,000.00		
38	Export Spoils	42000	CY		\$ 14.00	\$ 588,000.00		
39	Seeding & Mulching Disturbed Areas	3.5	ACRES		\$ 1,900.00	\$ 6,650.00		
40								
41	Miscellaneous Pipe Re-connections	1	LS		\$ 5,000.00	\$ 5,000.00		
42								
43	Building Replaced (BLOCK SHELL 24X32)	1	LS		\$ 76,800.00	\$ 76,800.00		
44	Asphalt Replaced	400	SY		\$ 35.00	\$ 14,000.00		
45							\$ 1,179,167.29	

CENTER PARK ESTATES STORM WATER MANAGEMENT STUDY
ENGINEER'S PRELIMINARY OPINION OF CONSTRUCTION COSTS

	A	B	C	D	E	F	G
46	SEGMENT 3						
47	Cambridge Pond and Storm sewer run to Topps Pond:						
48		QTY	UNIT	UNIT PRICE	ITEM TOTAL	SEGMENT TOTAL	OVERALL TOTAL
49	Maintenance of Traffic	1	LS	\$ 3,000.00	\$ 3,000.00		
50	Pavement saw Cutting	60	LF	\$ 9.00	\$ 540.00		
51	Pavement Removal & Disposal (200x25)	556	SY	\$ 7.00	\$ 3,888.89		
52	Pipe Removed Greater than 24 Inch	200	LF	\$ 10.00	\$ 2,000.00		
53	Headwalls & Manholes Removed (Cambridge rdwy,	6	EA	\$ 500.00	\$ 3,000.00		
54	Pat Catan's parking lot)						
55	Clearing & Grubbing	0.1	ACRES	\$ 4,000.00	\$ 400.00		
56							
57	24 Inch RCP (Cambridge roadway, Patcan's Parking lot)	128	LF	\$ 65.00	\$ 8,320.00		
58	33 inch RCP	140	LF	\$ 115.00	\$ 16,100.00		
59	60 inch Diameter Manholes	3	EA	\$ 2,500.00	\$ 7,500.00		
60	Curb Inlets	2	EA	\$ 1,000.00	\$ 2,000.00		
61	Headwalls	3	EA	\$ 2,500.00	\$ 7,500.00		
62	Rip Rap w/ filter Fabric	44	CY	\$ 85.00	\$ 3,740.00		
63	Outlet Control Structure	1	EA	\$ 5,000.00	\$ 5,000.00		
64							
65	Excavation & Embankment for CAMBRIDGE Dentention Pond	12000	CY	\$ 7.00	\$ 84,000.00		
66	Export Spoils	10000	CY	\$ 14.00	\$ 140,000.00		
67	Seeding & Mulching Disturbed Areas	1	ACRES	\$ 1,900.00	\$ 1,900.00		
68	Miscellaneous Pipe Re-connections	1	LS	\$ 1,900.00	\$ 1,900.00		
69							
70	Asphalt Replaced	145	SY	\$ 45.00	\$ 6,525.00		
71	Concrete Pavement Replacement	556	SY	\$ 60.00	\$ 33,333.33		
72						\$	330,647.22
73							

CENTER PARK ESTATES STORM WATER MANAGEMENT STUDY
ENGINEER'S PRELIMINARY OPINION OF CONSTRUCTION COSTS

	A	B	C	D	E	F	G
74	SEGMENT 4						
75	STORM SEWER RUNS FOR INCREASED PIPE CAPACITY						
76	(TOPPS Pond to Fairgrounds Property)	QTY	UNIT	UNIT PRICE	ITEM TOTAL	SEGMENT TOTAL	OVERALL TOTAL
77							
78	Maintenance of Traffic	1	LS	\$ 5,000.00	\$ 5,000.00		
79	Pavement saw Cutting	700	LF	\$ 3.00	\$ 2,100.00		
80	Pavement Removal & Disposal	466	SY	\$ 7.00	\$ 3,262.00		
81	Clearing & Grubbing	0.25	Acre	\$ 4,000.00	\$ 1,000.00		
82							
83	Headwall	3	EA	\$ 2,500.00	\$ 7,500.00		
84	*36 inch RCP	1650	LF	\$ 125.00	\$ 206,250.00		
85	60 inch Diameter Manholes	5	EA	\$ 3,000.00	\$ 15,000.00		
86	Seeding & Mulching Disturbed Areas	0.1	ACRES	\$ 1,900.00	\$ 190.00		
87	Miscellaneous Pipe Re-connections	1	LS	\$ 5,000.00	\$ 5,000.00		
88	Adjust Parking Lot Basin Grade & Repave	3	EA	\$ 2,000.00	\$ 6,000.00		
89	Asphalt Replaced	466	SY	\$ 45.00	\$ 20,970.00		
90	* Depending on Grades, possible just add adjacent sewer to gain capacity,					\$ 272,272.00	
91	smaller diameter run.						
92							
93							

CENTER PARK ESTATES STORM WATER MANAGEMENT STUDY
ENGINEER'S PRELIMINARY OPINION OF CONSTRUCTION COSTS

		A		B	C	D	E	F	G
		SEGMENT 5							
		FAIRGROUNDS PROPERTY DETENTION SYSTEM		QTY	UNIT	UNIT PRICE	ITEM TOTAL	SEGMENT TOTAL	OVERALL TOTAL
94									
95									
96									
97				300	SY	\$ 7.00	\$ 2,100.00		
98				600	LF	\$ 10.00	\$ 6,000.00		
99				2	Acre	\$ 4,000.00	\$ 8,000.00		
100									
101				2	EA	\$ 2,000.00	\$ 4,000.00		
102				600	LF	\$ 65.00	\$ 39,000.00		
103				3	EA	\$ 2,500.00	\$ 7,500.00		
104				1	EA	\$ 3,000.00	\$ 3,000.00		
105				3	EA	\$ 2,500.00	\$ 7,500.00		
106				15	CY	\$ 85.00	\$ 1,275.00		
107									
108				2	ACRES	\$ 1,900.00	\$ 3,800.00		
109				1	LS	\$ 5,000.00	\$ 5,000.00		
110									
111				13092	CY	\$ 7.00	\$ 91,644.00		
112				13092	CY	\$ 14.00	\$ 183,288.00		
113									
114				300	SY	\$ 45.00	\$ 13,500.00		
115								\$ 647,879.00	
116									\$ 2,465,485.51
117									
118									
119									
120									

CENTER PARK ESTATES STORM WATER MANAGEMENT STUDY
ENGINEER'S PRELIMINARY OPINION OF CONSTRUCTION COSTS

	A	B	C	D	E	F	G
121							
122	(UNDEGROUND SYSTEM)-Green System						
123	200,000 cf (4.5 ac-ft)						
124		QTY	UNIT	UNIT PRICE	ITEM TOTAL	SEGMENT TOTAL	OVERALL TOTAL
125							
126							
127	Chambers 8' w x 5' H x 4.3'L	1197	EA	\$ -	\$ -	\$5.00 TO \$6.00 / CUBIC FT STORAGE	
128	End Caps	50	EA	\$ -	\$ -		
129	INFILL (Recycled Material)	9376	TONS	\$ -	\$ -		
130	Excavation & FAIRGROUNDS Dentention system	13092	CV	\$ -	\$ -		
131	Filter fabric	12394	SV	\$ -	\$ -		
132	Isolator Row 200 lf	200	LF	\$ -	\$ -		
133	Fabric for Isolator Row	550	SV	\$ -	\$ -	\$ 1,000,000.00	
134	(LONGER SYSTEM \$\$ GO DOWN- FEWER END CAPS)						
135							
136	Pavement Removal & Disposal	300	SV	\$ 7.00	\$ 2,100.00		
137	Pipe Removed Greater than 24 Inch	600	LF	\$ 10.00	\$ 6,000.00		
138	Clearing & Grubbing	2	Acres	\$ 4,000.00	\$ 8,000.00		
139	***Haul off spoils	13092	CV	\$ 15.00	\$ 196,380.00		
140	Control Manhole	1	EA	\$ 3,000.00	\$ 3,000.00		
141	Outlet Manhole	1	EA	\$ 3,000.00	\$ 3,000.00		
142	Seeding & Mulching Disturbed Areas	2	ACRES	\$ 1,900.00	\$ 3,800.00		
143	Miscellaneous Pipe Re-connections	1	LS	\$ 5,000.00	\$ 5,000.00		
144	Asphalt Replaced	300	SV	\$ 45.00	\$ 13,500.00		
145							
146							
147						\$ 240,780.00	
148	*** Within Property Hauloff \$\$ could be saved if mounding were allowed					\$	\$ 1,240,780.00
149							
150							

CENTER PARK ESTATES STORM WATER MANAGEMENT STUDY
ENGINEER'S PRELIMINARY OPINION OF CONSTRUCTION COSTS

A		B	C	D	E	F	G
151							
152							
153	Open Cut Mentor Ave: ALTERNATE ROUTE						
154	(Work within Right Of Way)						
		QTY	UNIT	UNIT PRICE	ITEM TOTAL	SEGMENT TOTAL	OVERALL TOTAL
155	Maintenance of Traffic	1	LS	\$ 8,000.00	\$ 8,000.00		
156	Pavement saw Cutting	500	LF	\$ 8.00	\$ 4,000.00		
157	Pavement Removal & Disposal (12'Wx250'L)	333	SY	\$ 10.00	\$ 3,330.00		
158	Pipe Removed Greater than 24 Inch	250	LF	\$ 10.00	\$ 2,500.00		
159	Plug Existing Pipe Opening	1	LS	\$ 1,000.00	\$ 1,000.00		
160	Sheeting & Shoring	1	LS	\$ 4,000.00	\$ 4,000.00		
161	36 inch RCP	250	LF	\$ 165.00	\$ 41,250.00		
162	60 inch Diameter Manholes	1	EA	\$ 3,000.00	\$ 3,000.00		
163	Core Manhole	1	EA	\$ 1,000.00	\$ 1,000.00		
164							
165	Utilities Supported	1	LS	\$ 5,000.00	\$ 5,000.00		
166	Concrete Pavement Replacement	333	SY	\$ 60.00	\$ 19,980.00		
167	Concrete Sidewalk Replacement	26	SY	\$ 40.00	\$ 1,040.00		
168					\$ -		
169						\$ 94,100.00	
170							

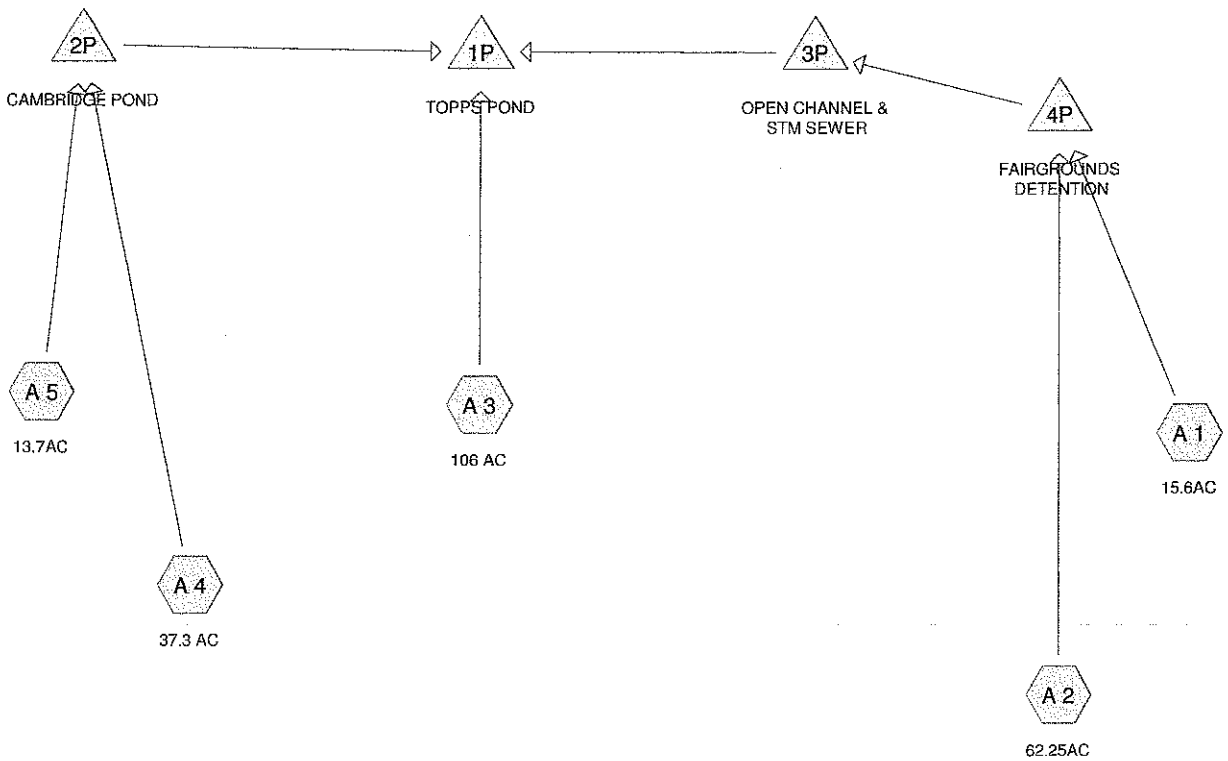
CENTER PARK ESTATES STORM WATER MANAGEMENT STUDY
ENGINEER'S PRELIMINARY OPINION OF CONSTRUCTION COSTS

A									
Sewer Run from Mentor Ave Right of Way to Topps Pond:									
ALTERNATE ROUTE:									
		B	C	D	E	F	G		
		QTY	UNIT	UNIT PRICE	ITEM TOTAL	SEGMENT TOTAL	OVERALL TOTAL		
171	Maintenance of Traffic	1	LS	\$ 3,000.00	\$ 3,000.00				
175	Pavement saw Cutting	500	LF	\$ 3.00	\$ 1,500.00				
176	Pavement Removal & Disposal	400	SY	\$ 7.00	\$ 2,800.00				
177	Building Demo & Shored	1	LS	\$ 15,000.00	\$ 15,000.00				
178	Pipe Removed Greater than 24 Inch	260	LF	\$ 10.00	\$ 2,600.00				
179	Headwalls & Manholes Removed	6	EA	\$ 500.00	\$ 3,000.00				
180	Clearing & Grubbing	3.15	ACRES	\$ 4,000.00	\$ 12,592.29				
181									
182	33 inch RCP	1050	LF	\$ 115.00	\$ 120,750.00				
183	60 inch Diameter Manholes	6	EA	\$ 2,500.00	\$ 15,000.00				
184	Catch basins	2	EA	\$ 1,000.00	\$ 2,000.00				
185	Headwalls	1	EA	\$ 2,500.00	\$ 2,500.00				
186	Rip Rap w/ filter Fabric	20	CY	\$ 85.00	\$ 1,700.00				
187	Outlet Control Structure	1	EA	\$ 3,000.00	\$ 3,000.00				
188									
189	Excavation & Embankment for TOPPS Detention Pond	42000	CY	\$ 7.00	\$ 294,000.00				
190	Export Spoils	42000	CY	\$ 14.00	\$ 588,000.00				
191	Seeding & Mulching Disturbed Areas	3.5	ACRES	\$ 1,900.00	\$ 6,650.00				
192									
193	Miscellaneous Pipe Re-connections	1	LS	\$ 5,000.00	\$ 5,000.00				
194									
195	Asphalt Replaced	400	SY	\$ 35.00	\$ 14,000.00				
196									
					\$ 1,093,092.29	\$	1,187,192.29		

APPENDIX B

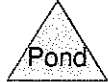
STORM WATER ANALYSIS

10 YEAR-100 YEAR



Subcat

Reach



Link

Routing Diagram for LAKE COUNTY CENTER PARK ESTATES 7-31-13
 Prepared by GGC ENGINEERS-NORTH OFFICE, Printed 7/26/2013
 HydroCAD® 10.00 s/n 02043 © 2013 HydroCAD Software Solutions LLC

LAKE COUNTY CENTER PARK ESTATES 7-31-13

Prepared by GGC ENGINEERS-NORTH OFFICE

Printed 7/26/2013

HydroCAD® 10.00 s/n 02043 © 2013 HydroCAD Software Solutions LLC

Page 2

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
2.000	51	1 acre lots, 20% imp, HSG A (A 1)
13.600	79	1 acre lots, 20% imp, HSG C (A 1)
30.000	54	1/2 acre lots, 25% imp, HSG A (A 3)
57.000	81	1/3 acre lots, 30% imp, HSG C (A 3)
38.050	98	Paved parking, HSG C (A 2, A 4)
19.000	98	Paved roads w/curbs & sewers, HSG C (A 3)
14.500	30	Woods, Good, HSG A (A 2)
60.700	70	Woods, Good, HSG C (A 2, A 5)
234.850	75	TOTAL AREA

LAKE COUNTY CENTER PARK ESTATES 7-31-13

Prepared by GGC ENGINEERS-NORTH OFFICE

Printed 7/26/2013

HydroCAD® 10.00 s/n 02043 © 2013 HydroCAD Software Solutions LLC

Page 3

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
46.500	HSG A	A 1, A 2, A 3
0.000	HSG B	
188.350	HSG C	A 1, A 2, A 3, A 4, A 5
0.000	HSG D	
0.000	Other	
234.850		TOTAL AREA

LAKE COUNTY CENTER PARK ESTATES 7-31-13

Prepared by GGC ENGINEERS-NORTH OFFICE

Printed 7/26/2013

HydroCAD® 10.00 s/n 02043 © 2013 HydroCAD Software Solutions LLC

Page 4

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
2.000	0.000	13.600	0.000	0.000	15.600	1 acre lots, 20% imp	A 1
30.000	0.000	0.000	0.000	0.000	30.000	1/2 acre lots, 25% imp	A 3
0.000	0.000	57.000	0.000	0.000	57.000	1/3 acre lots, 30% imp	A 3
0.000	0.000	38.050	0.000	0.000	38.050	Paved parking	A 2, A 4
0.000	0.000	19.000	0.000	0.000	19.000	Paved roads w/curbs & sewers	A 3
14.500	0.000	60.700	0.000	0.000	75.200	Woods, Good	A 2, A 5
46.500	0.000	188.350	0.000	0.000	234.850	TOTAL AREA	

LAKE COUNTY CENTER PARK ESTATES 7-31-13

Prepared by GGC ENGINEERS-NORTH OFFICE

Printed 7/26/2013

HydroCAD® 10.00 s/n 02043 © 2013 HydroCAD Software Solutions LLC

Page 5

Pipe Listing (selected nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	A 2	0.00	0.00	1,064.0	0.0040	0.015	15.0	0.0	0.0
2	A 3	0.00	0.00	5,491.0	0.0070	0.015	24.0	0.0	0.0
3	A 4	0.00	0.00	1,705.0	0.0050	0.015	24.0	0.0	0.0
4	1P	673.00	667.69	1,210.0	0.0044	0.015	30.0	0.0	0.0
5	3P	679.00	675.50	1,185.0	0.0030	0.015	36.0	0.0	0.0

Summary for Subcatchment A 1: 15.6AC

Runoff = 12.75 cfs @ 12.46 hrs, Volume= 1.692 af, Depth= 1.30"

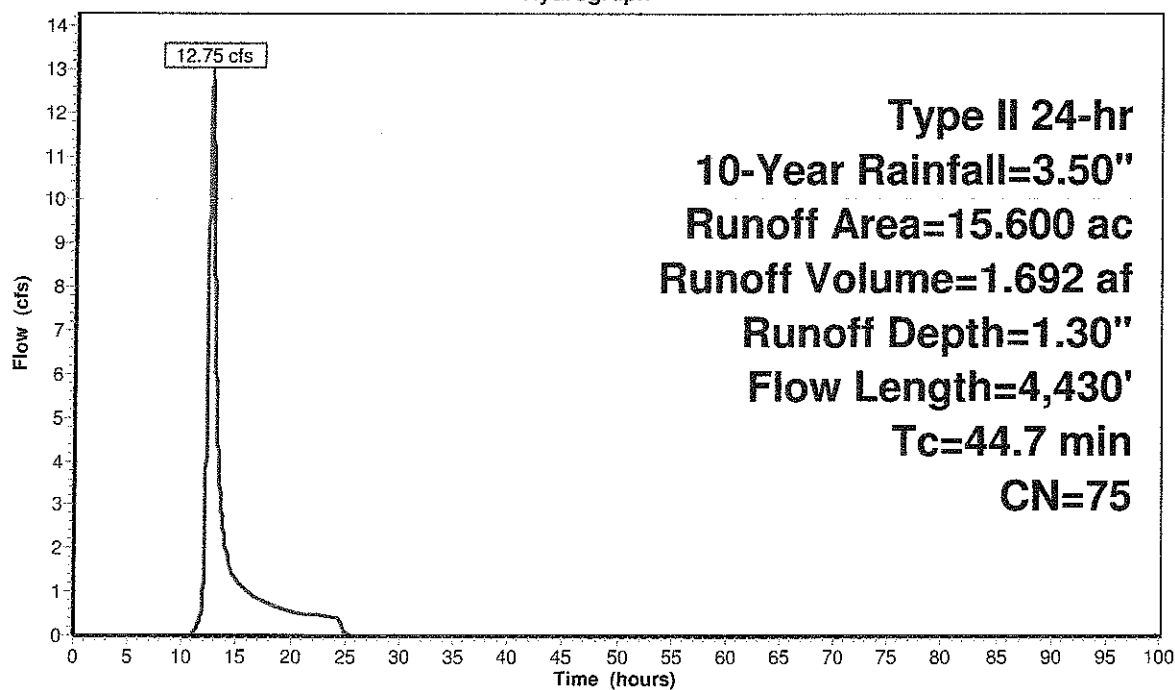
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Year Rainfall=3.50"

Area (ac)	CN	Description
13.600	79	1 acre lots, 20% imp, HSG C
2.000	51	1 acre lots, 20% imp, HSG A
15.600	75	Weighted Average
12.480		80.00% Pervious Area
3.120		20.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	100	0.0100	0.11		Sheet Flow, Grass: Short n= 0.150 P2= 2.40"
29.8	4,330	0.0260	2.42		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
44.7	4,430	Total			

Subcatchment A 1: 15.6AC

Hydrograph



Summary for Subcatchment A 2: 62.25AC

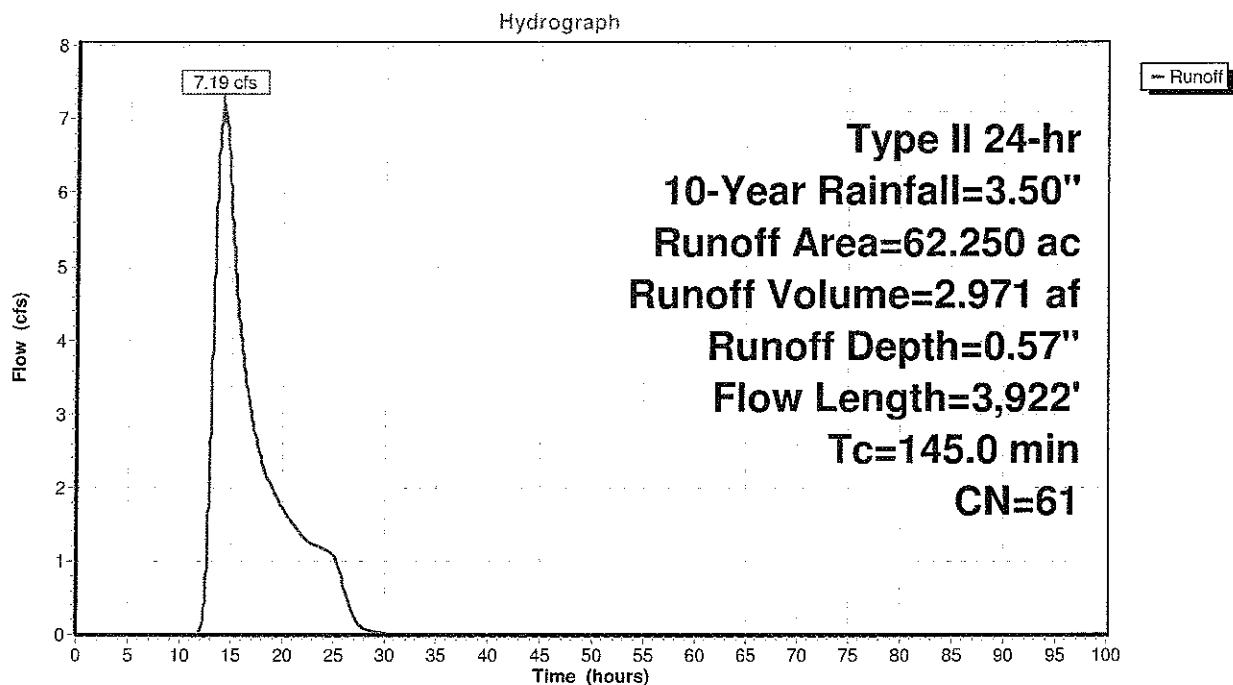
Runoff = 7.19 cfs @ 14.02 hrs, Volume= 2.971 af, Depth= 0.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
 Type II 24-hr 10-Year Rainfall=3.50"

Area (ac)	CN	Description
47.000	70	Woods, Good, HSG C
14.500	30	Woods, Good, HSG A
0.750	98	Paved parking, HSG C
62.250	61	Weighted Average
61.500		98.80% Pervious Area
0.750		1.20% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	100	0.0100	0.11		Sheet Flow, Grass: Short n= 0.150 P2= 2.40"
124.0	2,758	0.0220	0.37		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
6.1	1,064	0.0040	2.89	3.54	Pipe Channel, RCP_Round 15" 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.015 Concrete sewer w/manholes & inlets
145.0	3,922	Total			

Subcatchment A 2: 62.25AC



Summary for Subcatchment A 3: 106 AC

Runoff = 105.64 cfs @ 12.35 hrs, Volume= 12.060 af, Depth= 1.37"

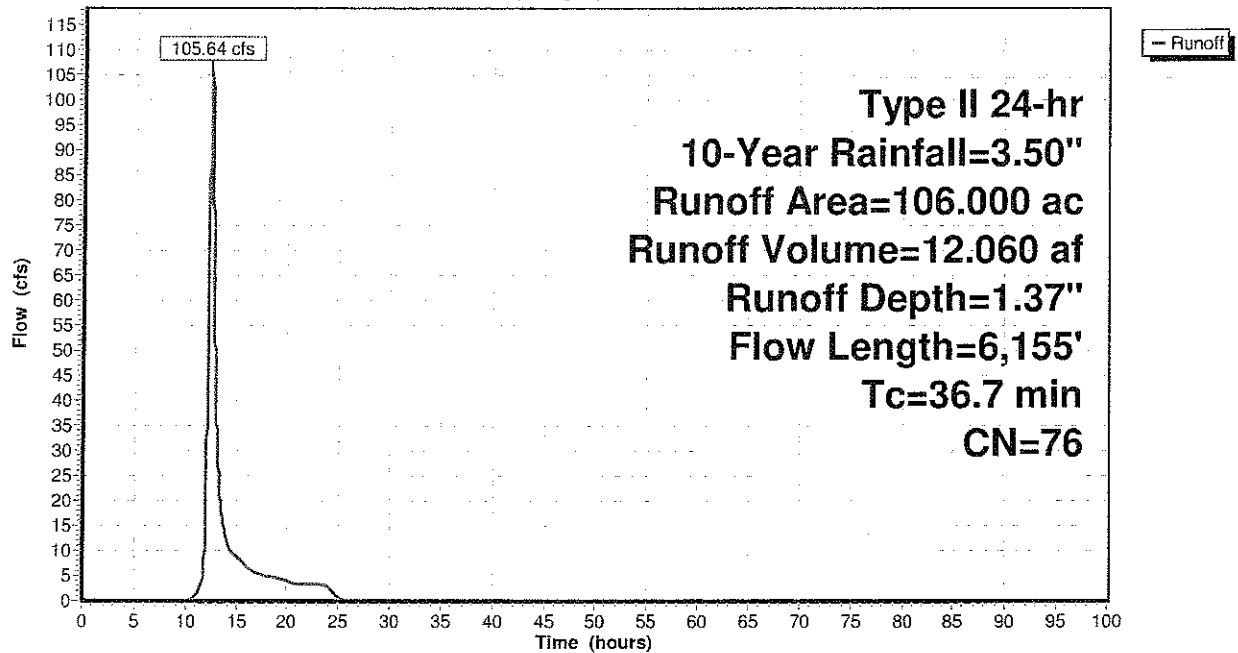
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
 Type II 24-hr 10-Year Rainfall=3.50"

Area (ac)	CN	Description
30.000	54	1/2 acre lots, 25% imp, HSG A
57.000	81	1/3 acre lots, 30% imp, HSG C
19.000	98	Paved roads w/curbs & sewers, HSG C
106.000	76	Weighted Average
62.400		58.87% Pervious Area
43.600		41.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	100	0.0100	0.11		Sheet Flow, Grass: Short n= 0.150 P2= 2.40"
4.3	564	0.0210	2.17		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
17.5	5,491	0.0070	5.22	16.40	Pipe Channel, 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.015 Concrete sewer w/manholes & inlets
36.7	6,155	Total			

Subcatchment A 3: 106 AC

Hydrograph



Summary for Subcatchment A 4: 37.3 AC

Runoff = 71.19 cfs @ 12.43 hrs, Volume= 10.153 af, Depth= 3.27"

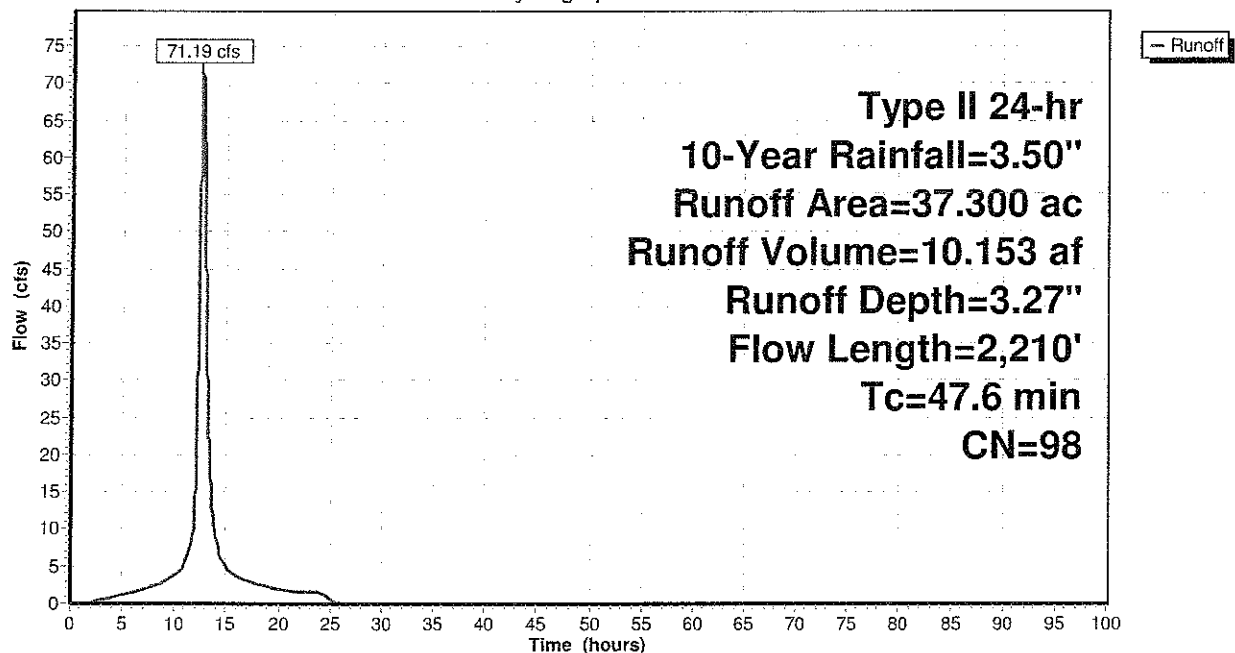
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Year Rainfall=3.50"

Area (ac)	CN	Description
37.300	98	Paved parking, HSG C
37.300		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
37.5	100	0.0010	0.04		Sheet Flow, Grass: Short n= 0.150 P2= 2.40"
3.7	405	0.0150	1.84		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
6.4	1,705	0.0050	4.41	13.86	Pipe Channel, 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.015 Concrete sewer w/manholes & inlets
47.6	2,210	Total			

Subcatchment A 4: 37.3 AC

Hydrograph



LAKE COUNTY CENTER PARK ESTATES 7-31-13

Prepared by GGC ENGINEERS-NORTH OFFICE

HydroCAD® 10.00 s/n 02043 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 10-Year Rainfall=3.50"

Printed 7/26/2013

Page 10

Summary for Subcatchment A 5: 13.7AC

Runoff = 6.07 cfs @ 12.80 hrs, Volume= 1.151 af, Depth= 1.01"

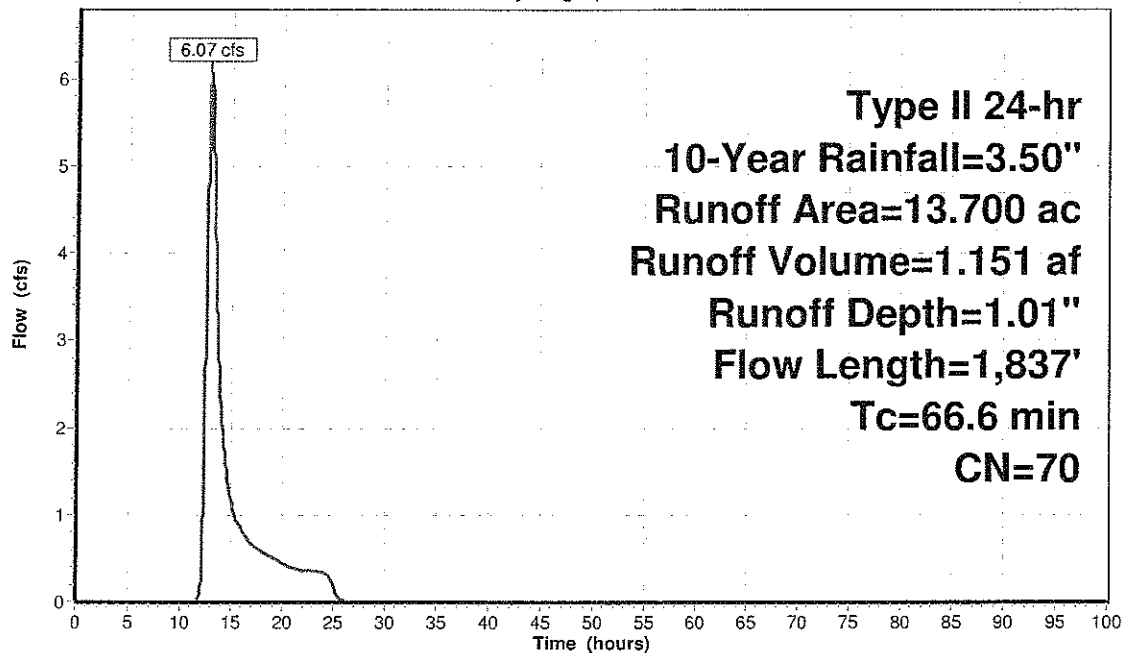
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Year Rainfall=3.50"

Area (ac)	CN	Description
13.700	70	Woods, Good, HSG C
13.700		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.7	100	0.0100	0.05		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 2.40"
10.5	943	0.0100	1.50		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
23.4	794	0.0040	0.57	3.39	Channel Flow, Area= 6.0 sf Perim= 7.0' r= 0.86' n= 0.150 Sheet flow over Short Grass
66.6	1,837	Total			

Subcatchment A 5: 13.7AC

Hydrograph



LAKE COUNTY CENTER PARK ESTATES 7-31-13

Type II 24-hr 10-Year Rainfall=3.50"

Prepared by GGC ENGINEERS-NORTH OFFICE

Printed 7/26/2013

HydroCAD® 10.00 s/n 02043 © 2013 HydroCAD Software Solutions LLC

Page 11

Summary for Pond 1P: TOPPS POND

Inflow Area = 234.850 ac, 36.10% Impervious, Inflow Depth = 1.43" for 10-Year event
 Inflow = 125.37 cfs @ 12.36 hrs, Volume= 27.970 af
 Outflow = 28.16 cfs @ 14.92 hrs, Volume= 27.797 af, Atten= 78%, Lag= 153.2 min
 Primary = 28.16 cfs @ 14.92 hrs, Volume= 27.797 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 677.88' @ 14.92 hrs Surf.Area= 102,451 sf Storage= 440,911 cf

Plug-Flow detention time= 256.4 min calculated for 27.794 af (99% of inflow)
 Center-of-Mass det. time= 240.7 min (1,208.8 - 968.2)

Volume	Invert	Avail.Storage	Storage Description
#1	673.00'	1,407,598 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
673.00	78,916	0	0
674.00	83,494	81,205	81,205
675.00	88,199	85,847	167,052
676.00	93,034	90,617	257,668
677.00	97,995	95,515	353,183
678.00	103,086	100,541	453,723
679.00	108,303	105,695	559,418
680.00	113,648	110,976	670,393
681.00	119,123	116,386	786,779
682.00	124,724	121,924	908,702
686.00	124,724	498,896	1,407,598

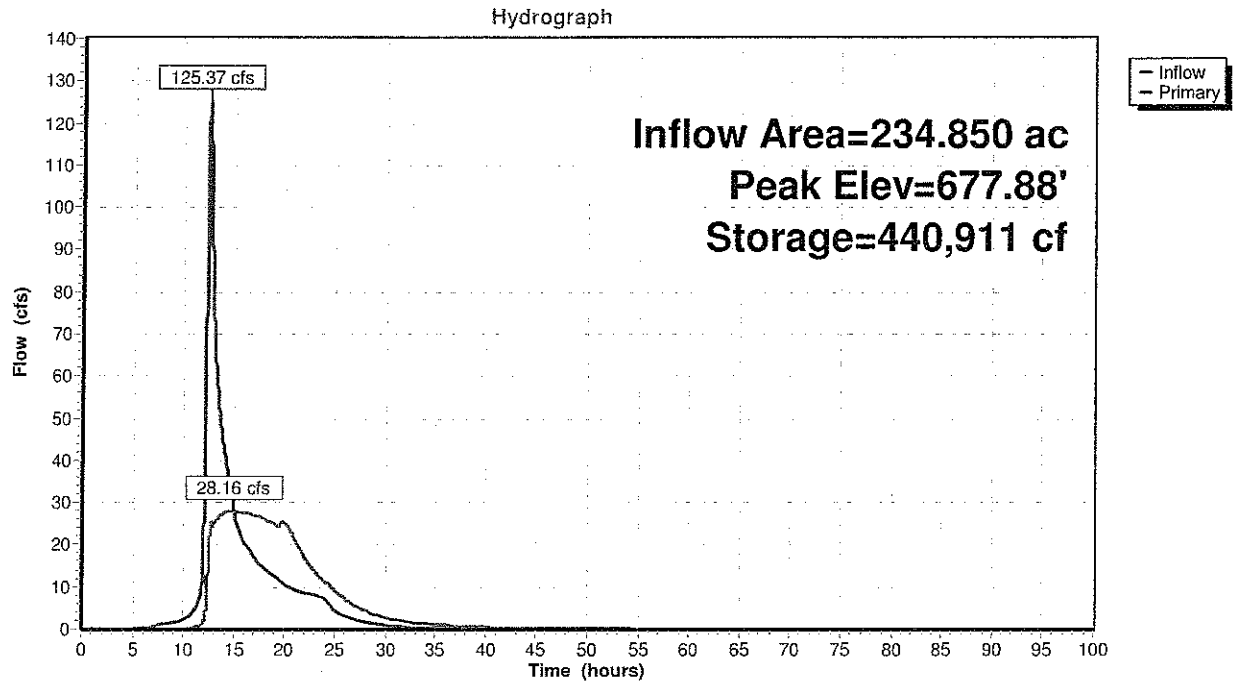
Device	Routing	Invert	Outlet Devices
#1	Primary	673.00'	30.0" Round Culvert L= 1,210.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 673.00' / 667.69' S= 0.0044 ' / Cc= 0.900 n= 0.015, Flow Area= 4.91 sf
#2	Primary	676.00'	6.0" Vert. Orifice/Grate C= 0.600

Primary OutFlow Max=28.16 cfs @ 14.92 hrs HW=677.88' (Free Discharge)

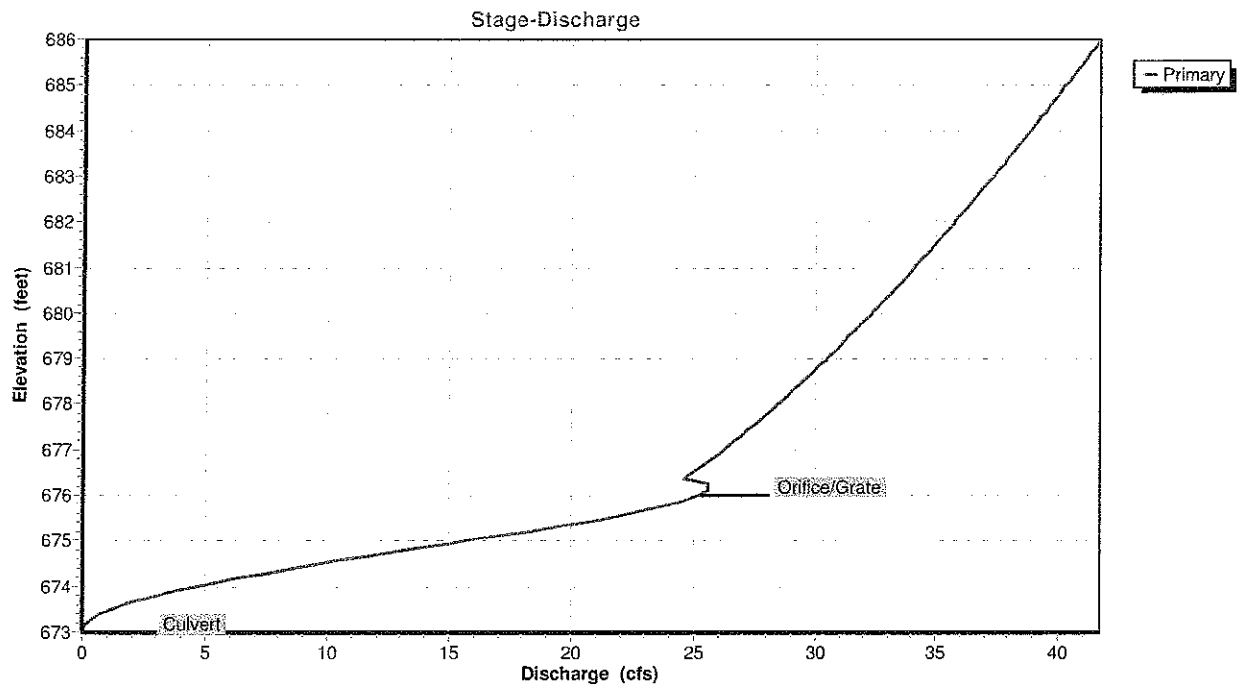
1=Culvert (Barrel Controls 26.96 cfs @ 5.49 fps)

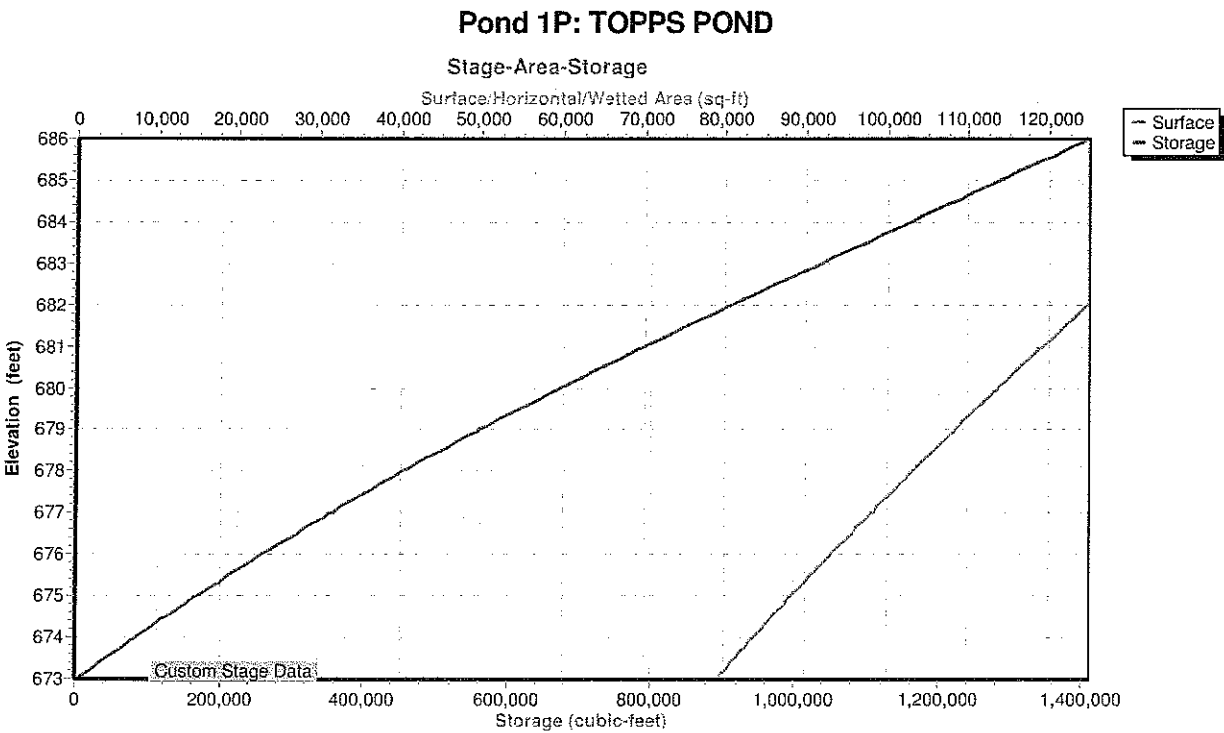
2=Orifice/Grate (Orifice Controls 1.21 cfs @ 6.14 fps)

Pond 1P: TOPPS POND



Pond 1P: TOPPS POND





LAKE COUNTY CENTER PARK ESTATES 7-31-13

Type II 24-hr 10-Year Rainfall=3.50"

Prepared by GGC ENGINEERS-NORTH OFFICE

Printed 7/26/2013

HydroCAD® 10.00 s/n 02043 © 2013 HydroCAD Software Solutions LLC

Page 14

Summary for Pond 2P: CAMBRIDGE POND

Inflow Area = 51.000 ac, 73.14% Impervious, Inflow Depth = 2.66" for 10-Year event
 Inflow = 75.33 cfs @ 12.43 hrs, Volume= 11.304 af
 Outflow = 33.07 cfs @ 13.04 hrs, Volume= 11.278 af, Atten= 56%, Lag= 36.1 min
 Primary = 33.07 cfs @ 13.04 hrs, Volume= 11.278 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 680.21' @ 13.04 hrs Surf.Area= 58,932 sf Storage= 170,908 cf

Plug-Flow detention time= 138.9 min calculated for 11.277 af (100% of inflow)
 Center-of-Mass det. time= 137.7 min (940.4 - 802.7)

Volume	Invert	Avail.Storage	Storage Description
#1	677.00'	282,457 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
677.00	47,789	0	0
678.00	51,142	49,466	49,466
679.00	54,602	52,872	102,338
680.00	58,168	56,385	158,723
681.00	61,841	60,005	218,727
682.00	65,619	63,730	282,457

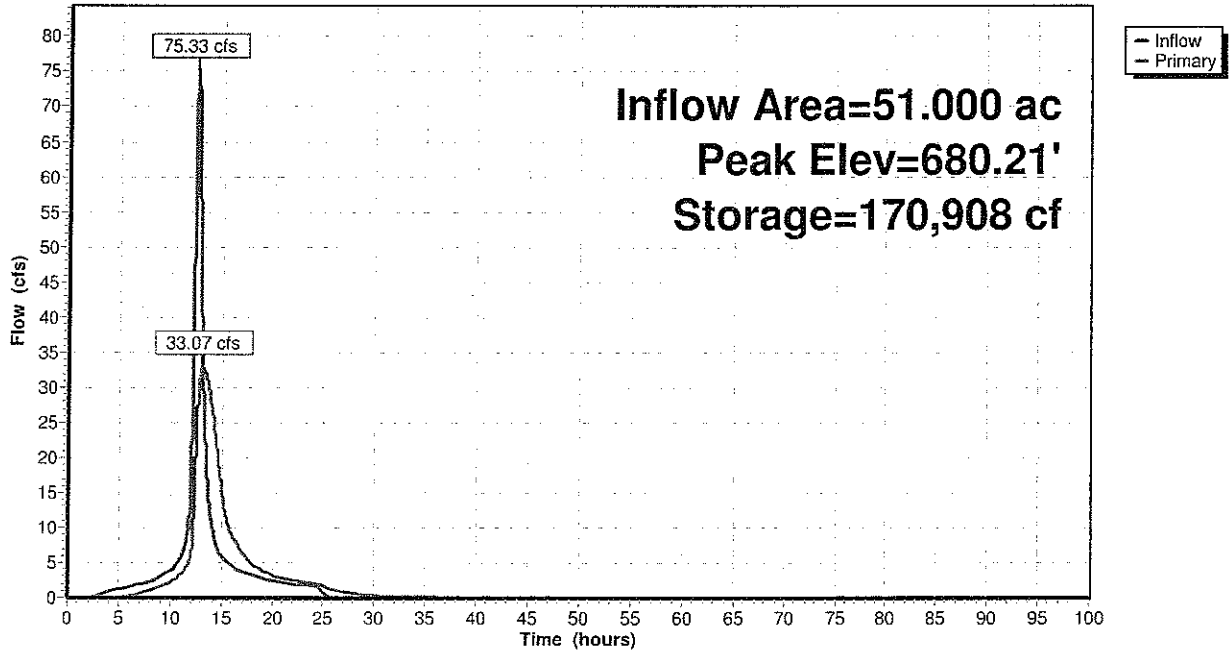
Device	Routing	Invert	Outlet Devices
#1	Primary	677.00'	30.0" Vert. Orifice/Grate C= 0.600

Primary OutFlow Max=33.07 cfs @ 13.04 hrs HW=680.21' TW=676.81' (Dynamic Tailwater)

↑ **1=Orifice/Grate** (Orifice Controls 33.07 cfs @ 6.74 fps)

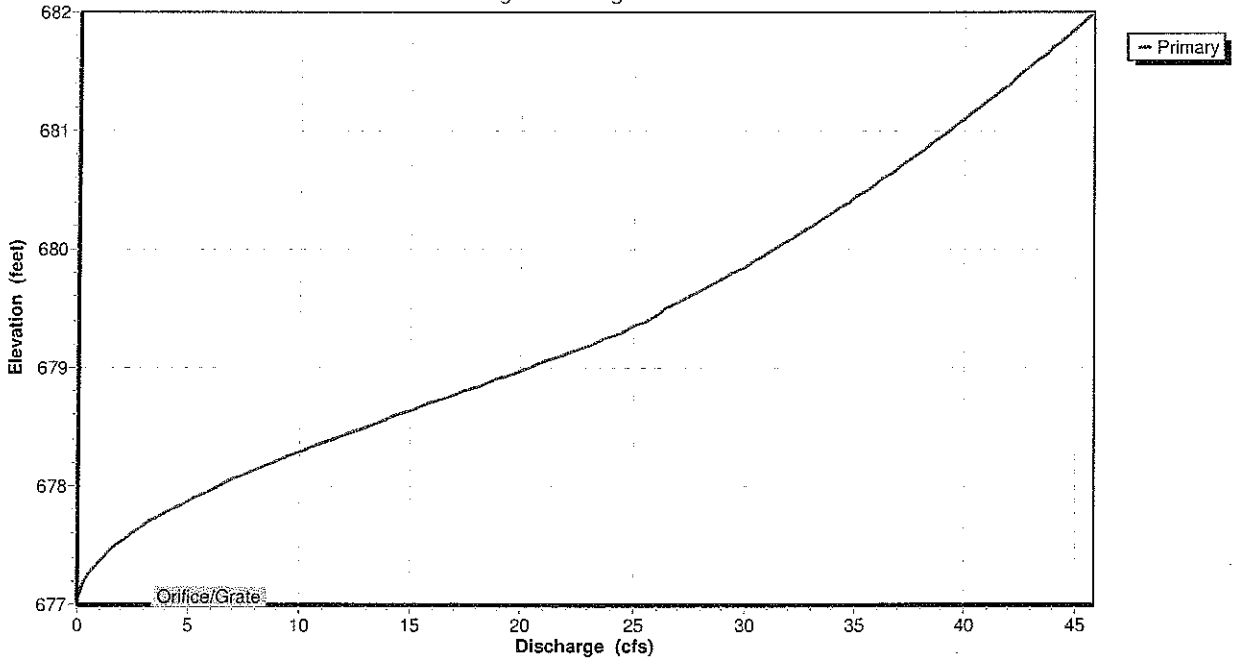
Pond 2P: CAMBRIDGE POND

Hydrograph

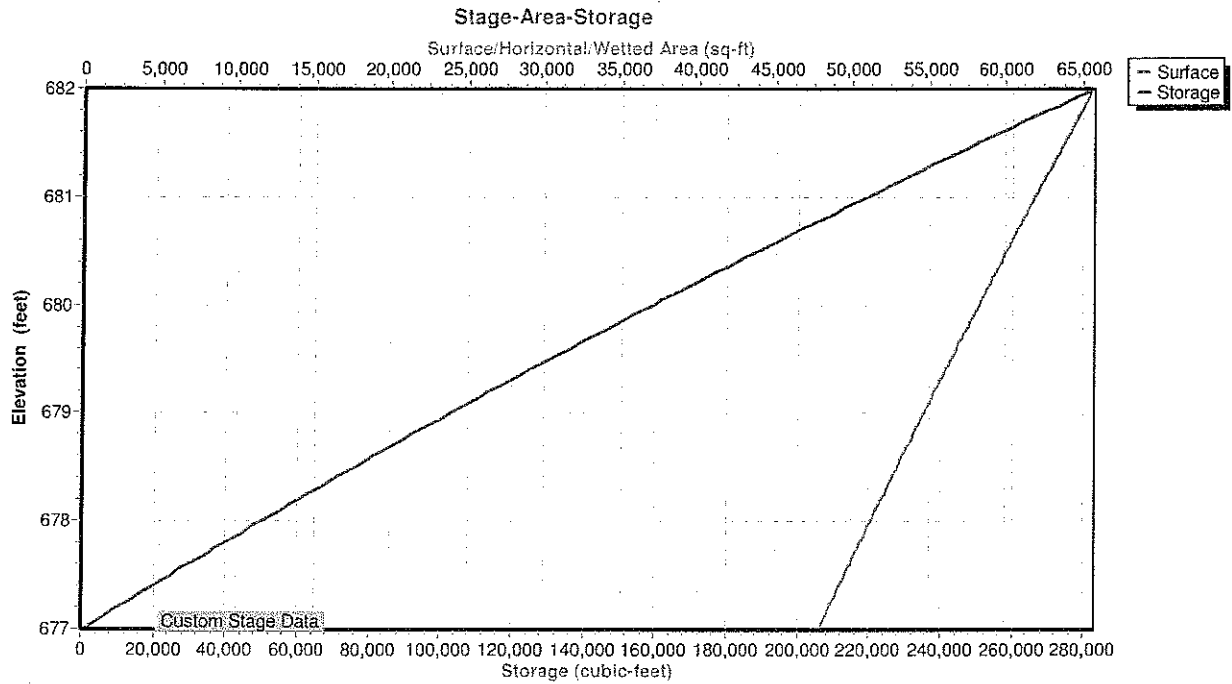


Pond 2P: CAMBRIDGE POND

Stage-Discharge



Pond 2P: CAMBRIDGE POND



Summary for Pond 3P: OPEN CHANNEL & STM SEWER

Inflow Area = 77.850 ac, 4.97% Impervious, Inflow Depth > 0.71" for 10-Year event
 Inflow = 4.83 cfs @ 16.00 hrs, Volume= 4.633 af
 Outflow = 4.85 cfs @ 16.15 hrs, Volume= 4.632 af, Atten= 0%, Lag= 9.2 min
 Primary = 4.85 cfs @ 16.15 hrs, Volume= 4.632 af

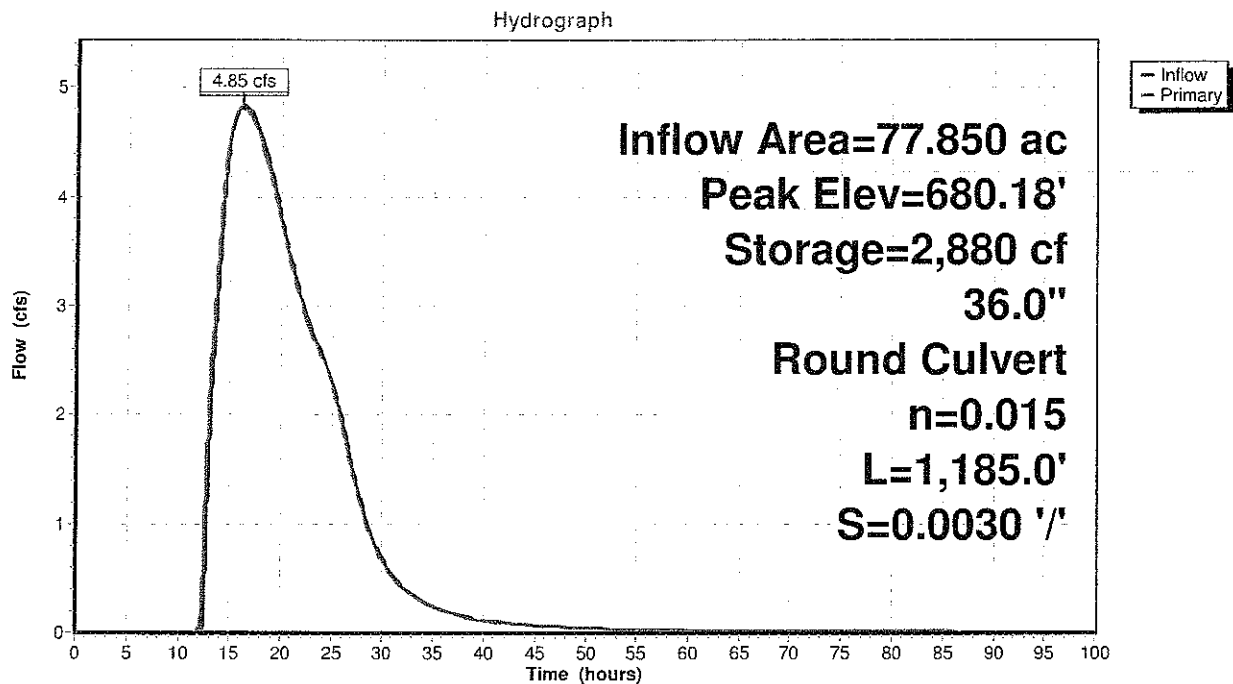
Routing by Dyn-Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 680.18' @ 15.59 hrs Surf.Area= 3,519 sf Storage= 2,880 cf

Plug-Flow detention time= 12.7 min calculated for 4.632 af (100% of inflow)
 Center-of-Mass det. time= 11.3 min (1,276.9 - 1,265.6)

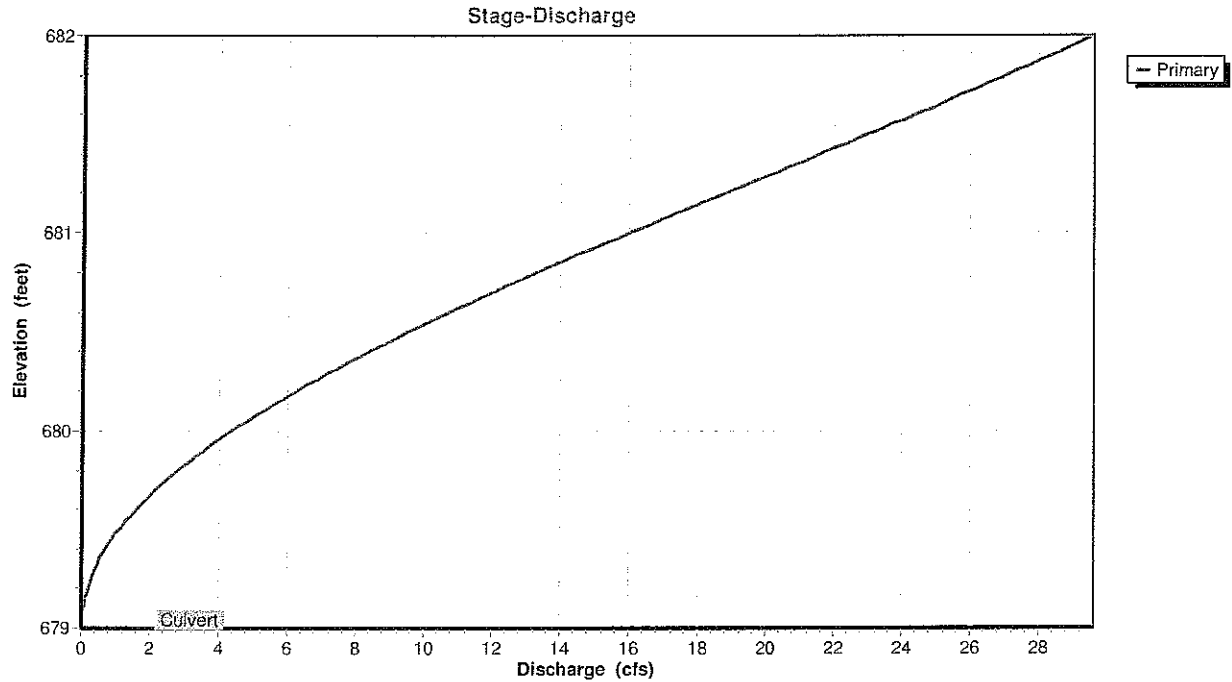
Volume	Invert	Avail.Storage	Storage Description
#1	679.00'	12,348 cf	3.00'W x 450.00'L x 3.00'H Prismatoid Z=2.0

Device	Routing	Invert	Outlet Devices
#1	Primary	679.00'	36.0" Round Culvert L= 1,185.0' Ke= 0.200 Inlet / Outlet Invert= 679.00' / 675.50' S= 0.0030 '/' Cc= 0.900 n= 0.015 Concrete sewer w/manholes & inlets, Flow Area= 7.07 sf

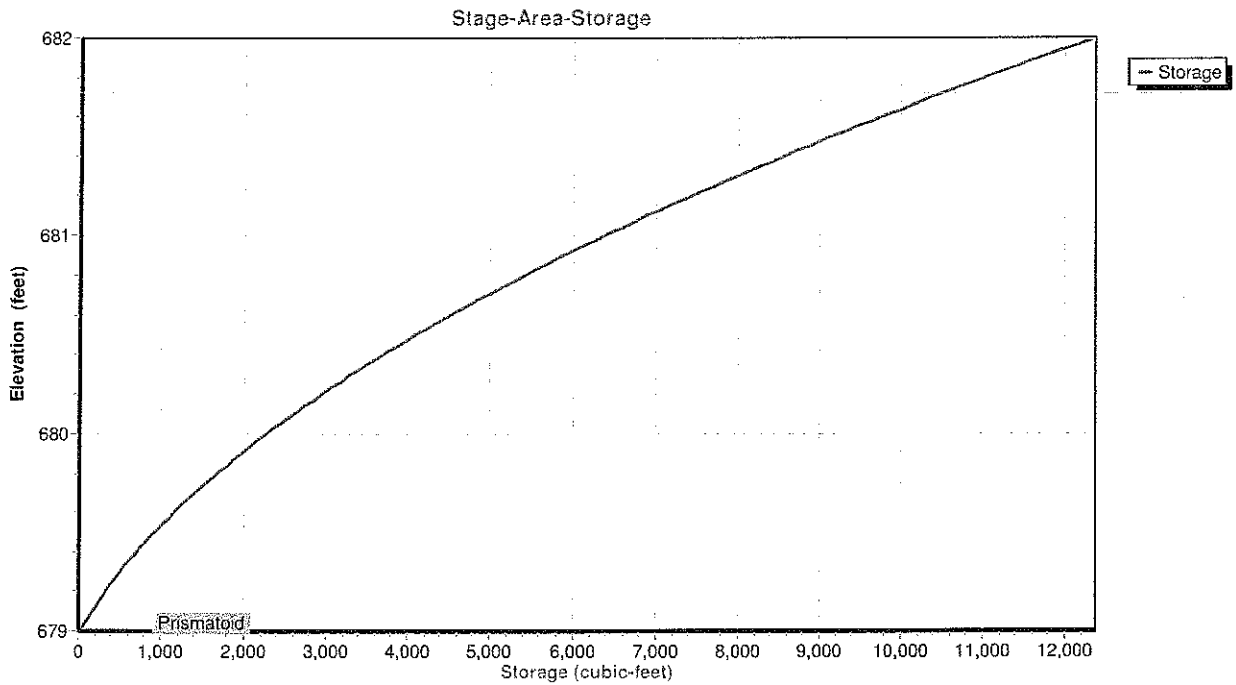
Primary OutFlow Max=4.85 cfs @ 16.15 hrs HW=680.18' TW=677.66' (Dynamic Tailwater)
 ←1=Culvert (Outlet Controls 4.85 cfs @ 2.80 fps)

Pond 3P: OPEN CHANNEL & STM SEWER

Pond 3P: OPEN CHANNEL & STM SEWER



Pond 3P: OPEN CHANNEL & STM SEWER



Summary for Pond 4P: FAIRGROUNDS DETENTION

Inflow Area = 77.850 ac, 4.97% Impervious, Inflow Depth = 0.72" for 10-Year event
 Inflow = 13.56 cfs @ 12.47 hrs, Volume= 4.664 af
 Outflow = 4.83 cfs @ 16.00 hrs, Volume= 4.633 af, Atten= 64%, Lag= 211.9 min
 Primary = 4.83 cfs @ 16.00 hrs, Volume= 4.633 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 682.72' @ 16.00 hrs Surf.Area= 1.049 ac Storage= 1.691 af

Plug-Flow detention time= 291.8 min calculated for 4.633 af (99% of inflow)
 Center-of-Mass det. time= 287.4 min (1,265.6 - 978.1)

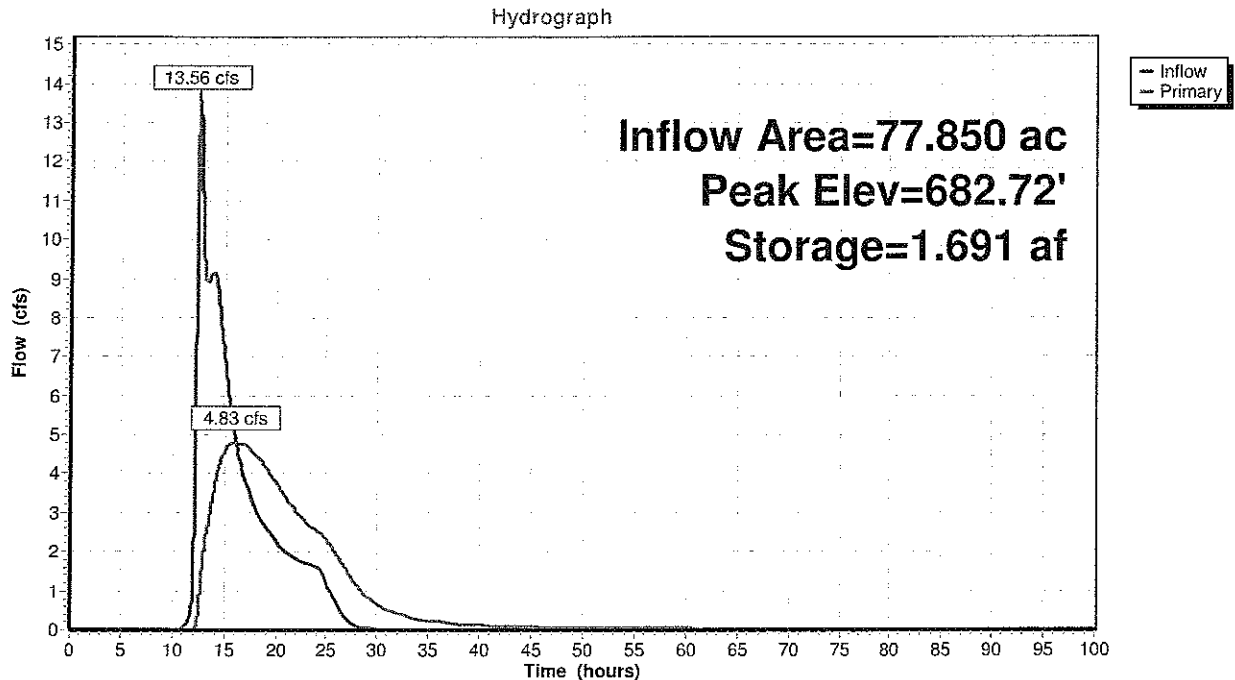
Volume	Invert	Avail.Storage	Storage Description
#1	681.00'	5.571 af	200.00'W x 200.00'L x 5.00'H Prismatic Z=4.0

Device	Routing	Invert	Outlet Devices
#1	Primary	681.00'	12.0" Vert. Orifice/Grate C= 0.600
#2	Primary	682.00'	6.0" Vert. Orifice/Grate C= 0.600

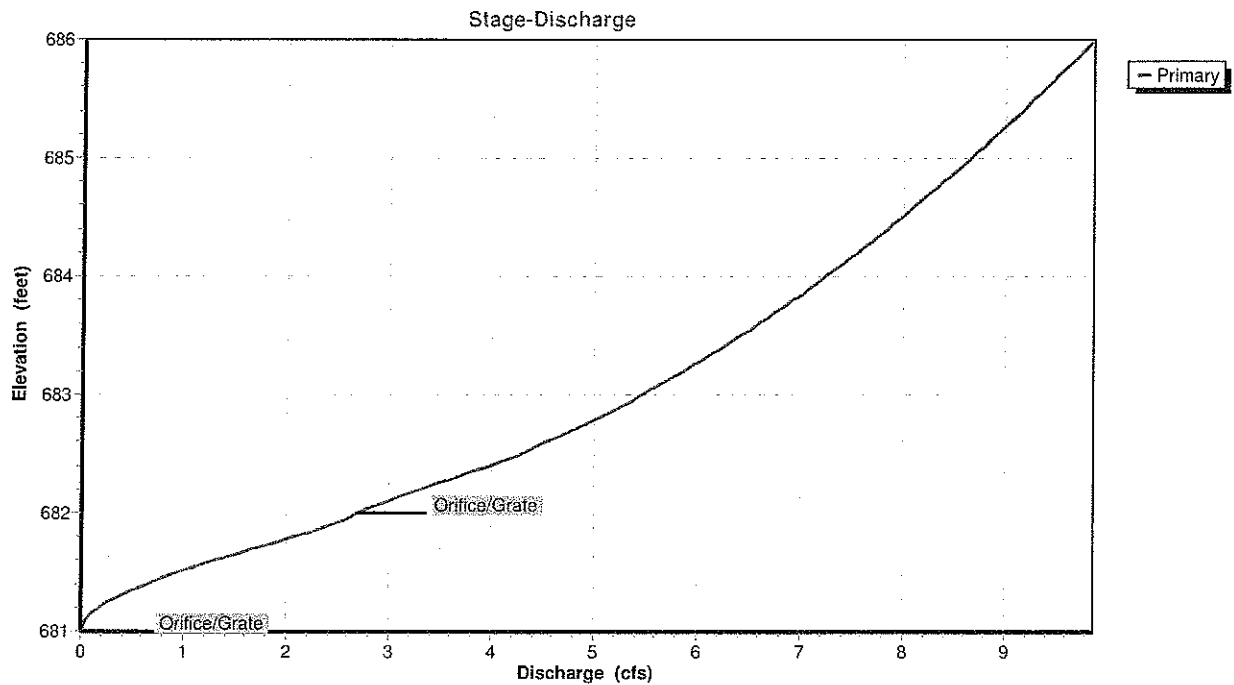
Primary OutFlow Max=4.83 cfs @ 16.00 hrs HW=682.72' TW=680.18' (Dynamic Tailwater)

1=Orifice/Grate (Orifice Controls 4.18 cfs @ 5.32 fps)
 2=Orifice/Grate (Orifice Controls 0.65 cfs @ 3.30 fps)

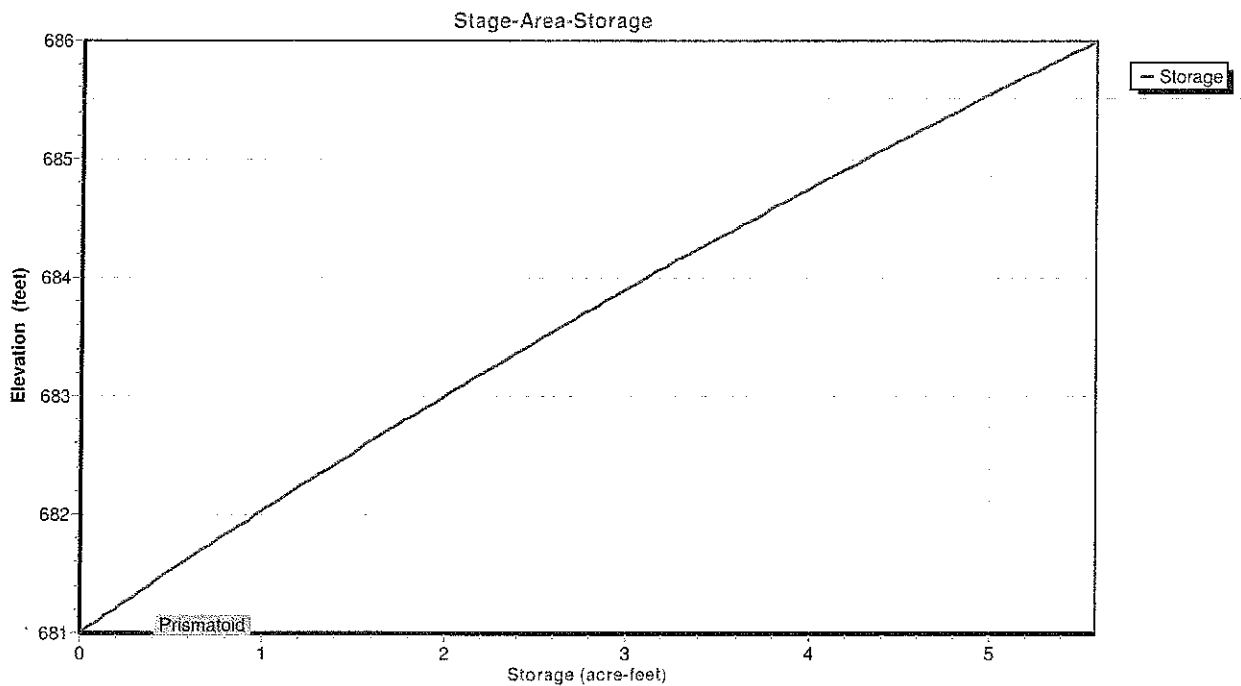
Pond 4P: FAIRGROUNDS DETENTION



Pond 4P: FAIRGROUNDS DETENTION



Pond 4P: FAIRGROUNDS DETENTION



LAKE COUNTY CENTER PARK ESTATES 7-31-13

Type II 24-hr 25-Year Rainfall=4.30"

Prepared by GGC ENGINEERS-NORTH OFFICE

Printed 7/26/2013

HydroCAD® 10.00 s/n 02043 © 2013 HydroCAD Software Solutions LLC

Page 21

Summary for Subcatchment A 1: 15.6AC

Runoff = 19.06 cfs @ 12.46 hrs, Volume= 2.463 af, Depth= 1.89"

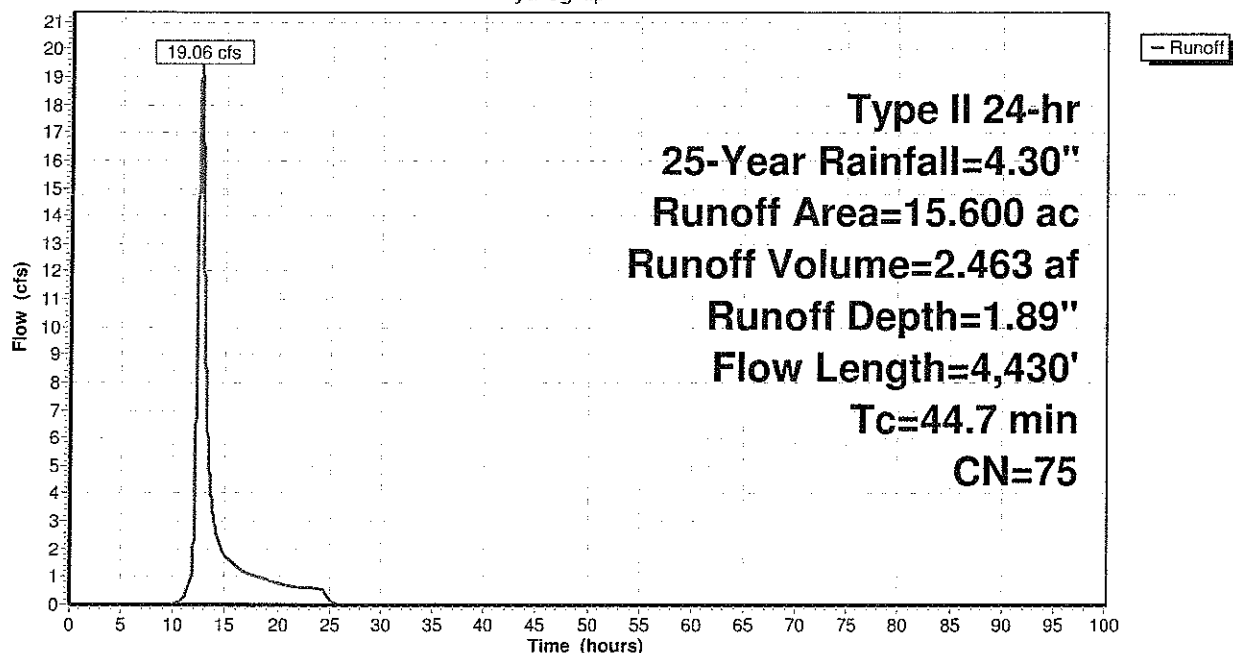
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.30"

Area (ac)	CN	Description
13.600	79	1 acre lots, 20% imp, HSG C
2.000	51	1 acre lots, 20% imp, HSG A
15.600	75	Weighted Average
12.480		80.00% Pervious Area
3.120		20.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	100	0.0100	0.11		Sheet Flow, Grass: Short n= 0.150 P2= 2.40"
29.8	4,330	0.0260	2.42		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
44.7	4,430	Total			

Subcatchment A 1: 15.6AC

Hydrograph



LAKE COUNTY CENTER PARK ESTATES 7-31-13

Prepared by GGC ENGINEERS-NORTH OFFICE

HydroCAD® 10.00 s/n 02043 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 25-Year Rainfall=4.30"

Printed 7/26/2013

Page 22

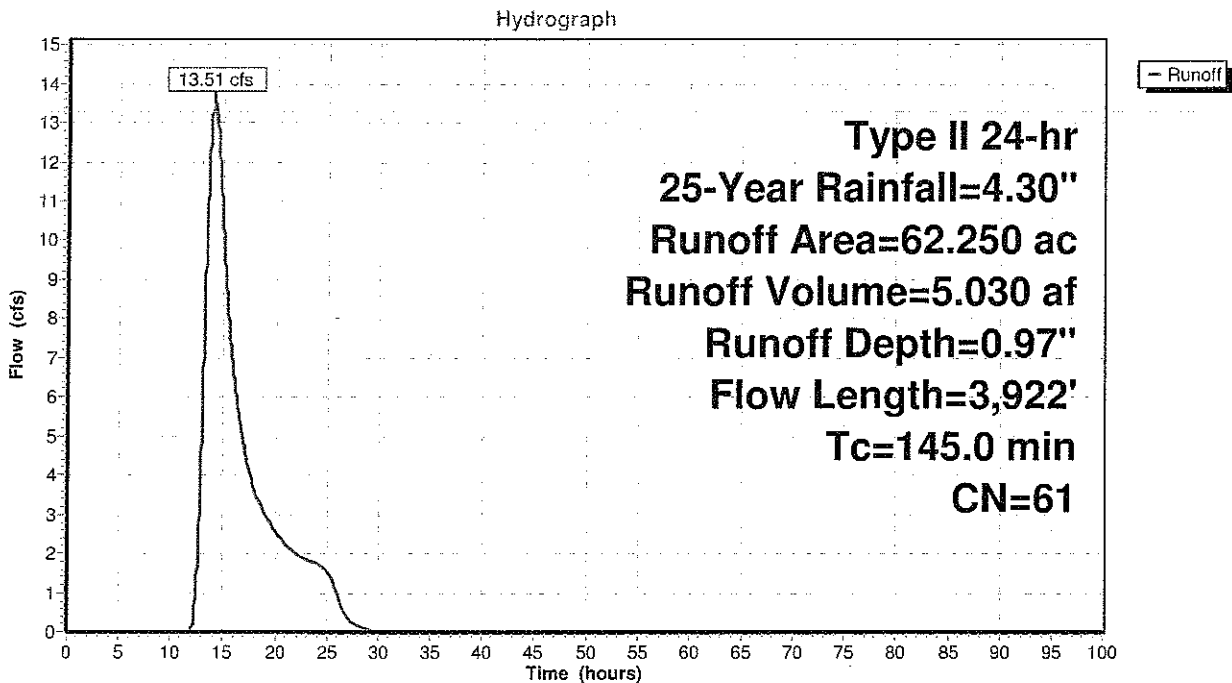
Summary for Subcatchment A 2: 62.25AC

Runoff = 13.51 cfs @ 14.01 hrs, Volume= 5.030 af, Depth= 0.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.30"

Area (ac)	CN	Description
47.000	70	Woods, Good, HSG C
14.500	30	Woods, Good, HSG A
0.750	98	Paved parking, HSG C
62.250	61	Weighted Average
61.500		98.80% Pervious Area
0.750		1.20% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	100	0.0100	0.11		Sheet Flow, Grass: Short n= 0.150 P2= 2.40"
124.0	2,758	0.0220	0.37		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
6.1	1,064	0.0040	2.89	3.54	Pipe Channel, RCP_Round 15" 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.015 Concrete sewer w/manholes & inlets
145.0	3,922	Total			

Subcatchment A 2: 62.25AC

LAKE COUNTY CENTER PARK ESTATES 7-31-13

Prepared by GGC ENGINEERS-NORTH OFFICE

HydroCAD® 10.00 s/n 02043 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 25-Year Rainfall=4.30"

Printed 7/26/2013

Page 23

Summary for Subcatchment A 3: 106 AC

Runoff = 155.90 cfs @ 12.35 hrs, Volume= 17.414 af, Depth= 1.97"

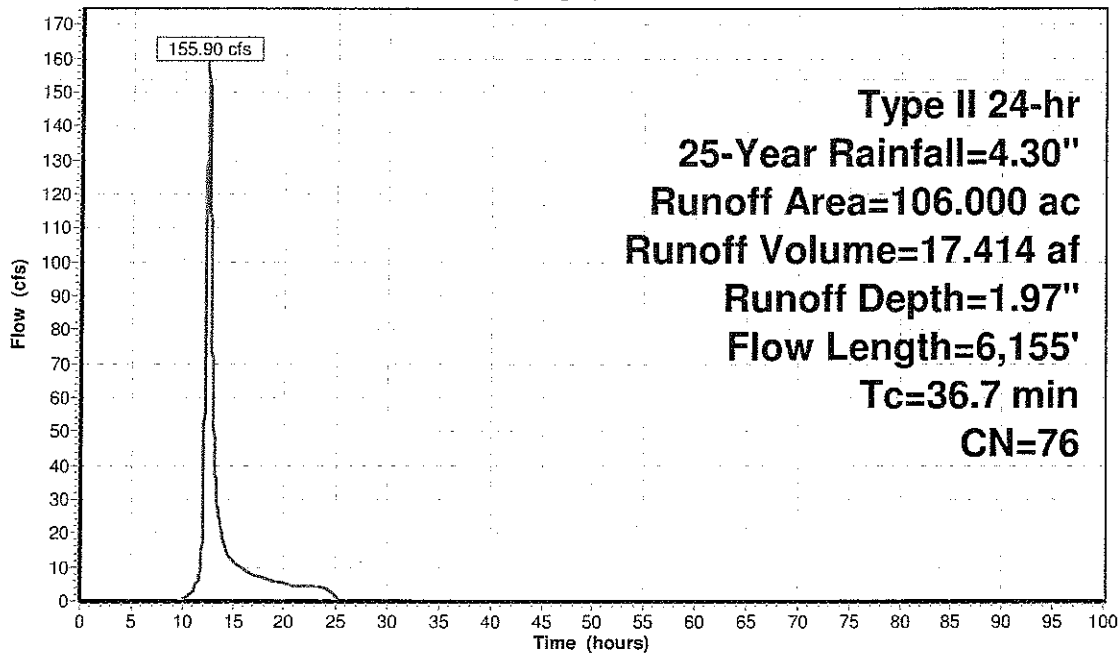
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.30"

Area (ac)	CN	Description
30.000	54	1/2 acre lots, 25% imp, HSG A
57.000	81	1/3 acre lots, 30% imp, HSG C
19.000	98	Paved roads w/curbs & sewers, HSG C
106.000	76	Weighted Average
62.400		58.87% Pervious Area
43.600		41.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	100	0.0100	0.11		Sheet Flow, Grass: Short n= 0.150 P2= 2.40"
4.3	564	0.0210	2.17		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
17.5	5,491	0.0070	5.22	16.40	Pipe Channel, 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.015 Concrete sewer w/manholes & inlets
36.7	6,155	Total			

Subcatchment A 3: 106 AC

Hydrograph



Summary for Subcatchment A 4: 37.3 AC

Runoff = 87.85 cfs @ 12.43 hrs, Volume= 12.634 af, Depth= 4.06"

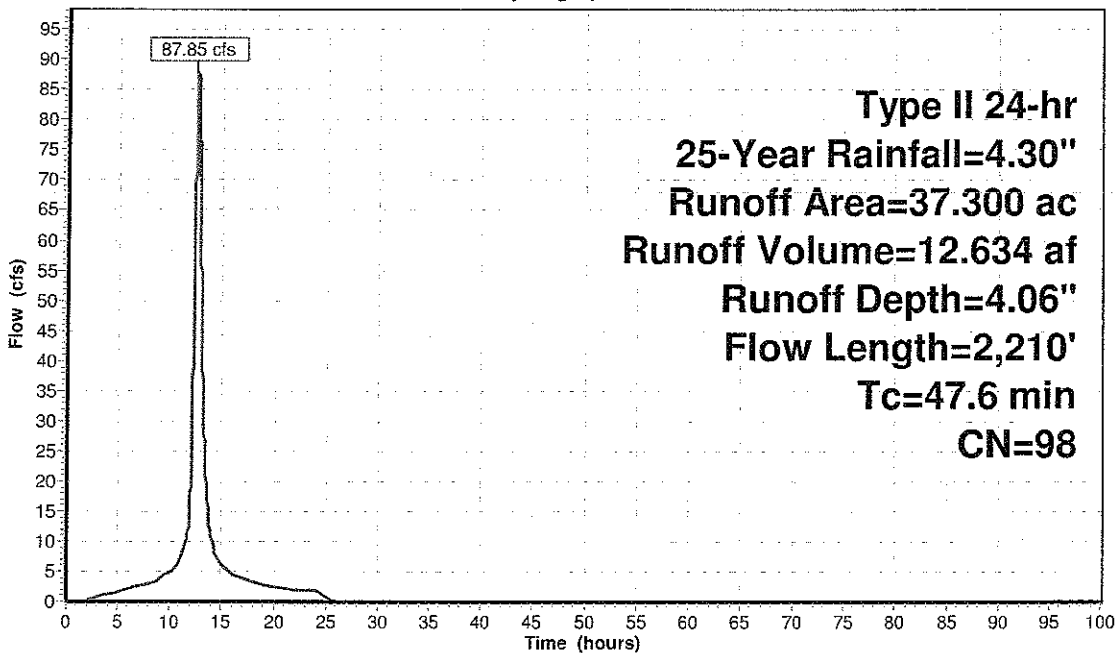
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.30"

Area (ac)	CN	Description
37.300	98	Paved parking, HSG C
37.300		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
37.5	100	0.0010	0.04		Sheet Flow, Grass: Short n= 0.150 P2= 2.40"
3.7	405	0.0150	1.84		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
6.4	1,705	0.0050	4.41	13.86	Pipe Channel, 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.015 Concrete sewer w/manholes & inlets
47.6	2,210	Total			

Subcatchment A 4: 37.3 AC

Hydrograph



Summary for Subcatchment A 5: 13.7AC

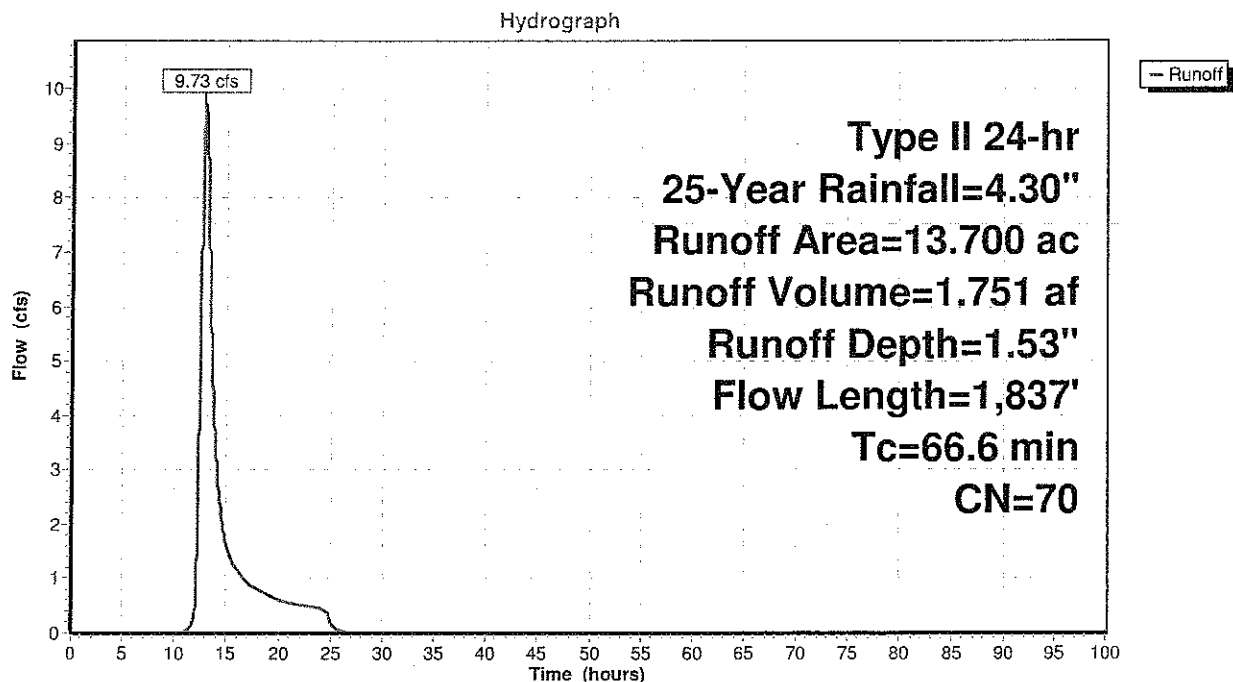
Runoff = 9.73 cfs @ 12.79 hrs, Volume= 1.751 af, Depth= 1.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
 Type II 24-hr 25-Year Rainfall=4.30"

Area (ac)	CN	Description
13.700	70	Woods, Good, HSG C
13.700		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.7	100	0.0100	0.05		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 2.40"
10.5	943	0.0100	1.50		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
23.4	794	0.0040	0.57	3.39	Channel Flow, Area= 6.0 sf Perim= 7.0' r= 0.86' n= 0.150 Sheet flow over Short Grass
66.6	1,837	Total			

Subcatchment A 5: 13.7AC



LAKE COUNTY CENTER PARK ESTATES 7-31-13

Type II 24-hr 25-Year Rainfall=4.30"

Prepared by GGC ENGINEERS-NORTH OFFICE

Printed 7/26/2013

HydroCAD® 10.00 s/n 02043 © 2013 HydroCAD Software Solutions LLC

Page 26

Summary for Pond 1P: TOPPS POND

Inflow Area = 234.850 ac, 36.10% Impervious, Inflow Depth = 2.00" for 25-Year event
 Inflow = 180.72 cfs @ 12.36 hrs, Volume= 39.232 af
 Outflow = 31.52 cfs @ 15.02 hrs, Volume= 39.056 af, Atten= 83%, Lag= 159.6 min
 Primary = 31.52 cfs @ 15.02 hrs, Volume= 39.056 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 679.58' @ 15.02 hrs Surf.Area= 111,389 sf Storage= 622,832 cf

Plug-Flow detention time= 289.6 min calculated for 39.056 af (100% of inflow)
 Center-of-Mass det. time= 277.8 min (1,258.2 - 980.4)

Volume	Invert	Avail.Storage	Storage Description
#1	673.00'	1,407,598 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
673.00	78,916	0	0
674.00	83,494	81,205	81,205
675.00	88,199	85,847	167,052
676.00	93,034	90,617	257,668
677.00	97,995	95,515	353,183
678.00	103,086	100,541	453,723
679.00	108,303	105,695	559,418
680.00	113,648	110,976	670,393
681.00	119,123	116,386	786,779
682.00	124,724	121,924	908,702
686.00	124,724	498,896	1,407,598

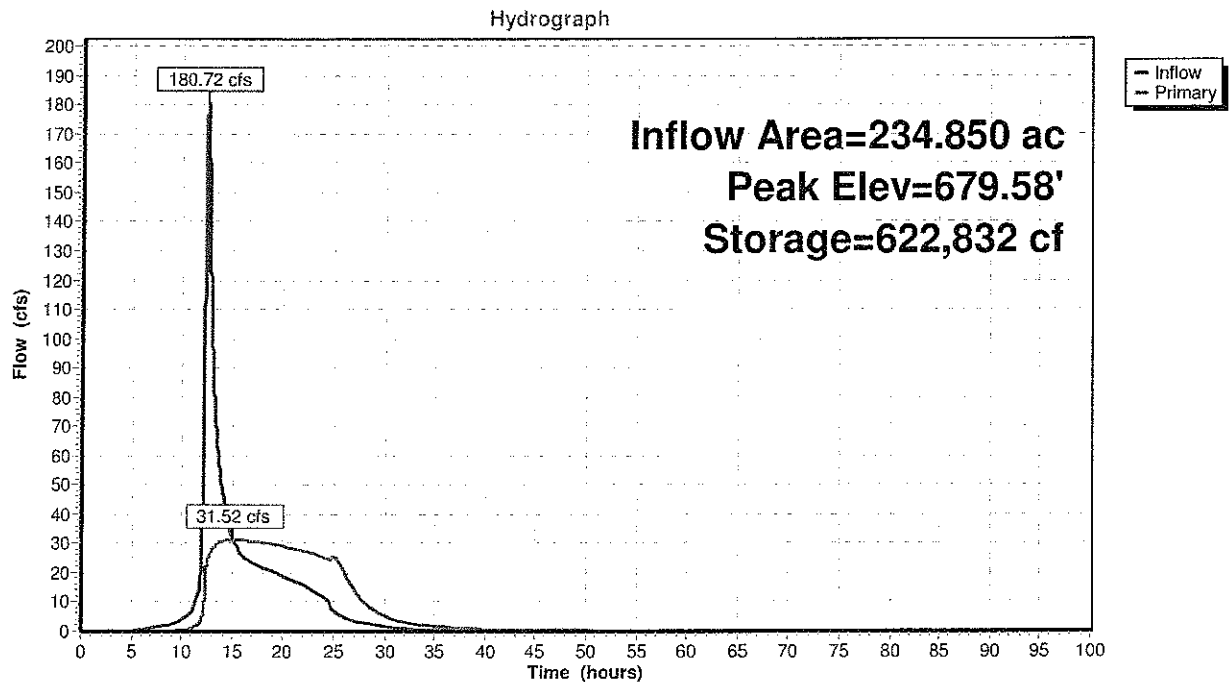
Device	Routing	Invert	Outlet Devices
#1	Primary	673.00'	30.0" Round Culvert L= 1,210.0' GPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 673.00' / 667.69' S= 0.0044 ' / Cc= 0.900 n= 0.015, Flow Area= 4.91 sf
#2	Primary	676.00'	6.0" Vert. Orifice/Grate C= 0.600

Primary OutFlow Max=31.52 cfs @ 15.02 hrs HW=679.58' (Free Discharge)

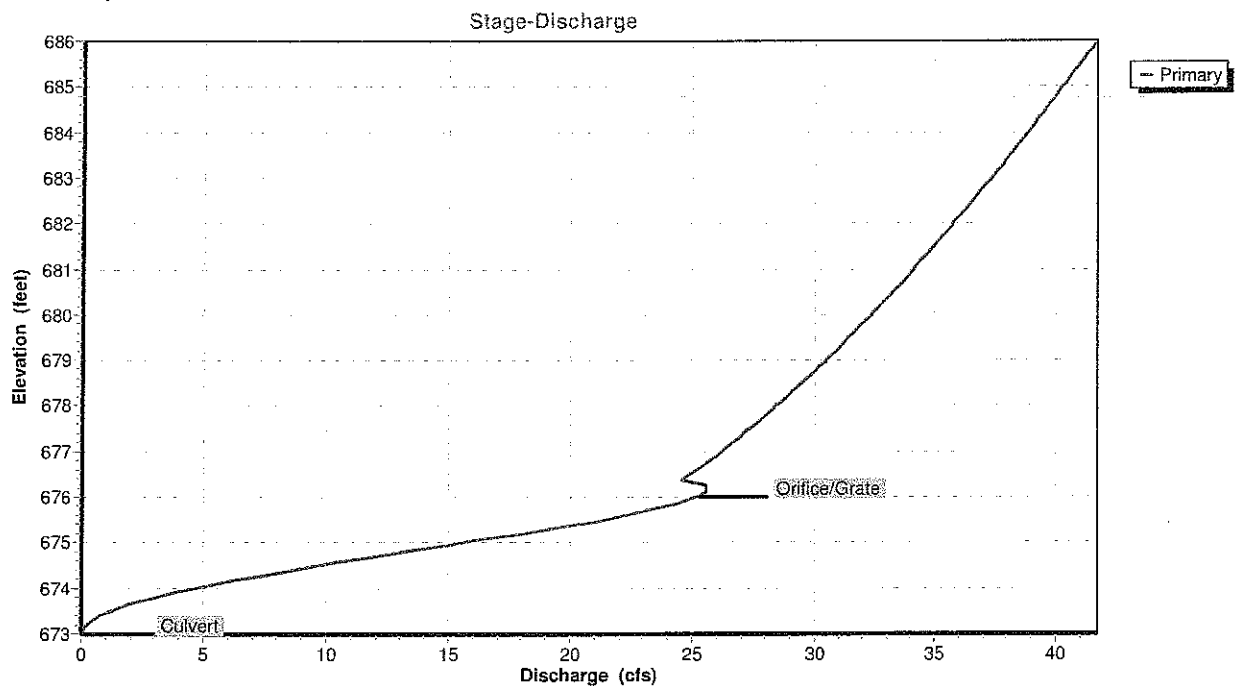
1=Culvert (Barrel Controls 29.79 cfs @ 6.07 fps)

2=Orifice/Grate (Orifice Controls 1.72 cfs @ 8.78 fps)

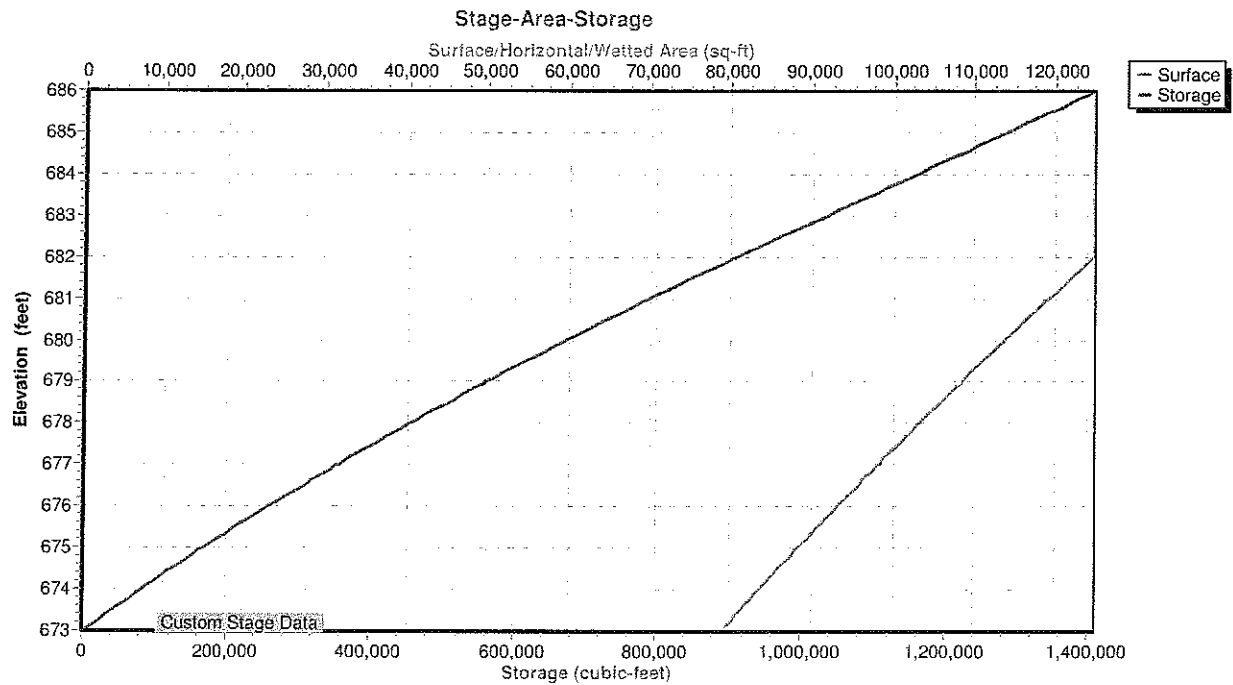
Pond 1P: TOPPS POND



Pond 1P: TOPPS POND



Pond 1P: TOPPS POND



LAKE COUNTY CENTER PARK ESTATES 7-31-13

Prepared by GGC ENGINEERS-NORTH OFFICE

HydroCAD® 10.00 s/n 02043 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 25-Year Rainfall=4.30"

Printed 7/26/2013

Page 29

Summary for Pond 2P: CAMBRIDGE POND

Inflow Area = 51.000 ac, 73.14% Impervious, Inflow Depth = 3.38" for 25-Year event

Inflow = 94.92 cfs @ 12.43 hrs, Volume= 14.385 af

Outflow = 38.87 cfs @ 12.98 hrs, Volume= 14.358 af, Atten= 59%, Lag= 32.7 min

Primary = 38.87 cfs @ 12.98 hrs, Volume= 14.358 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs / 2

Peak Elev= 680.98' @ 13.11 hrs Surf.Area= 61,780 sf Storage= 217,702 cf

Plug-Flow detention time= 169.7 min calculated for 14.357 af (100% of inflow)

Center-of-Mass det. time= 168.8 min (969.0 - 800.2)

Volume	Invert	Avail.Storage	Storage Description
#1	677.00'	282,457 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

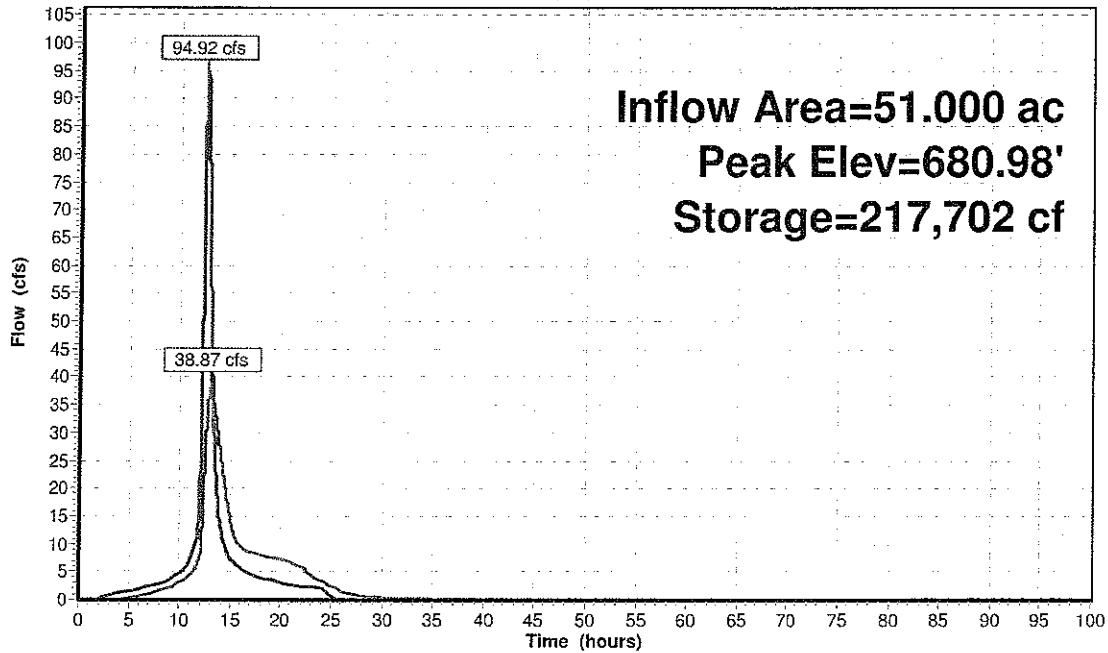
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
677.00	47,789	0	0
678.00	51,142	49,466	49,466
679.00	54,602	52,872	102,338
680.00	58,168	56,385	158,723
681.00	61,841	60,005	218,727
682.00	65,619	63,730	282,457

Device	Routing	Invert	Outlet Devices
#1	Primary	677.00'	30.0" Vert. Orifice/Grate C= 0.600

Primary OutFlow Max=38.87 cfs @ 12.98 hrs HW=680.95' TW=678.24' (Dynamic Tailwater)↑ **1=Orifice/Grate** (Orifice Controls 38.87 cfs @ 7.92 fps)

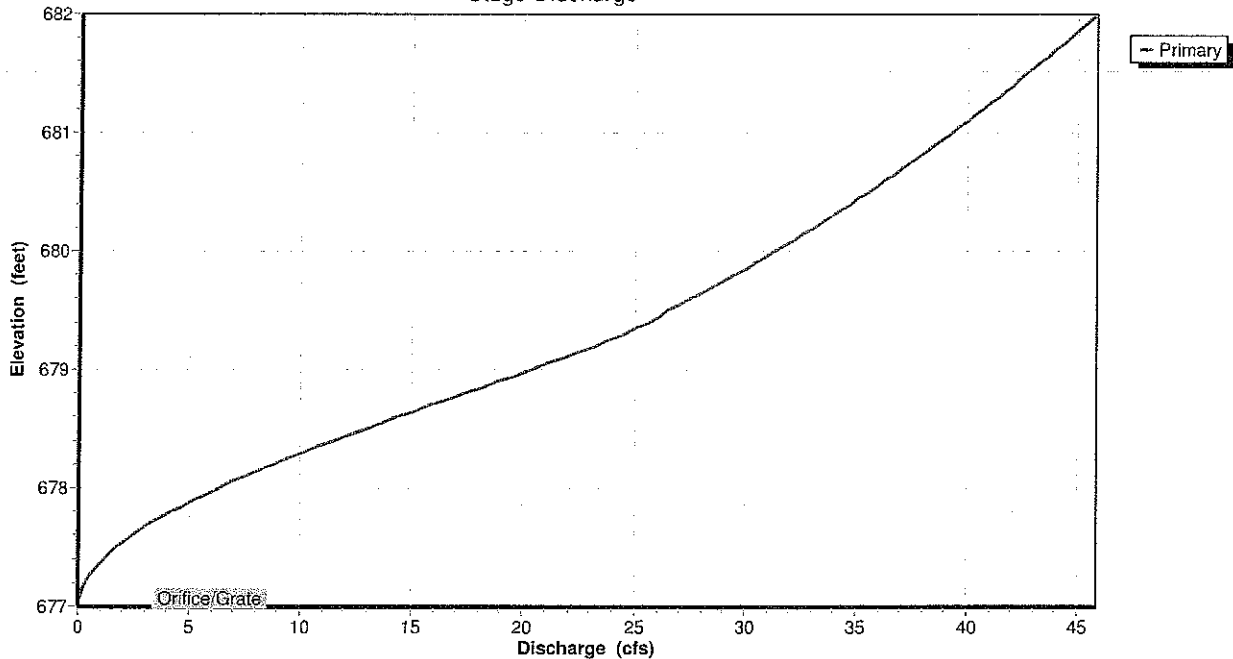
Pond 2P: CAMBRIDGE POND

Hydrograph

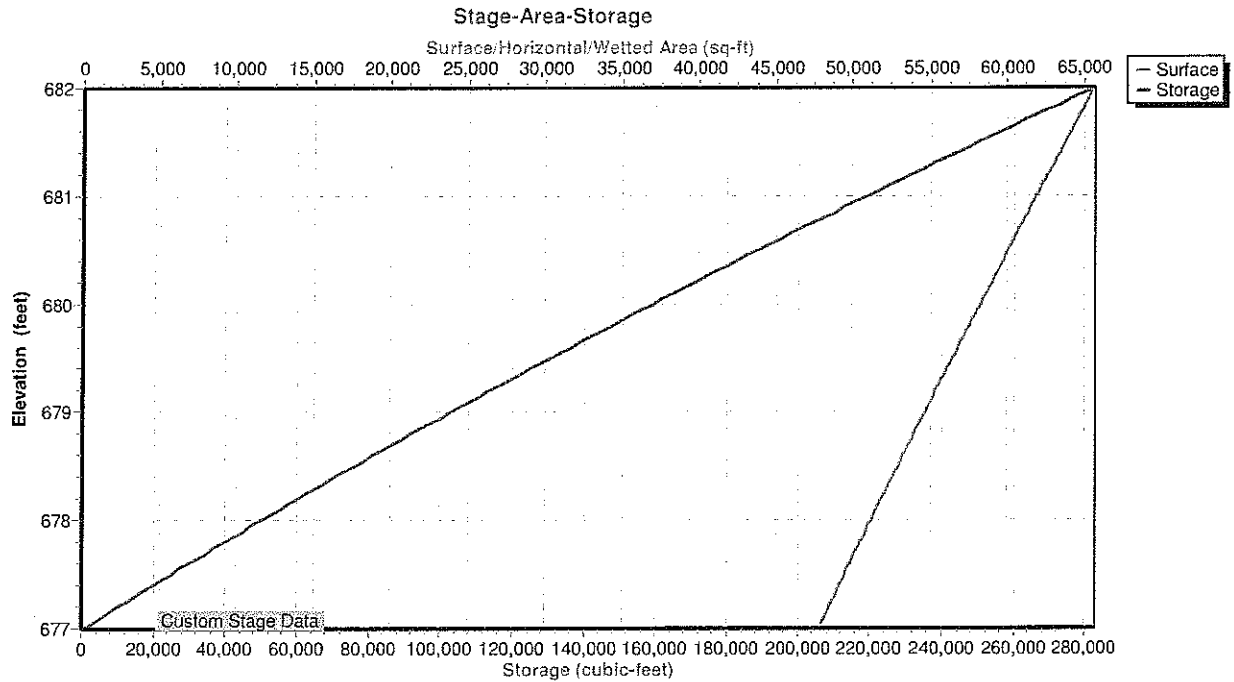


Pond 2P: CAMBRIDGE POND

Stage-Discharge



Pond 2P: CAMBRIDGE POND



LAKE COUNTY CENTER PARK ESTATES 7-31-13

Prepared by GGC ENGINEERS-NORTH OFFICE

HydroCAD® 10.00 s/n 02043 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 25-Year Rainfall=4.30"

Printed 7/26/2013

Page 32

Summary for Pond 3P: OPEN CHANNEL & STM SEWER

Inflow Area = 77.850 ac, 4.97% Impervious, Inflow Depth > 1.15" for 25-Year event
Inflow = 7.11 cfs @ 16.22 hrs, Volume= 7.462 af
Outflow = 7.18 cfs @ 16.42 hrs, Volume= 7.460 af, Atten= 0%, Lag= 12.1 min
Primary = 7.18 cfs @ 16.42 hrs, Volume= 7.460 af

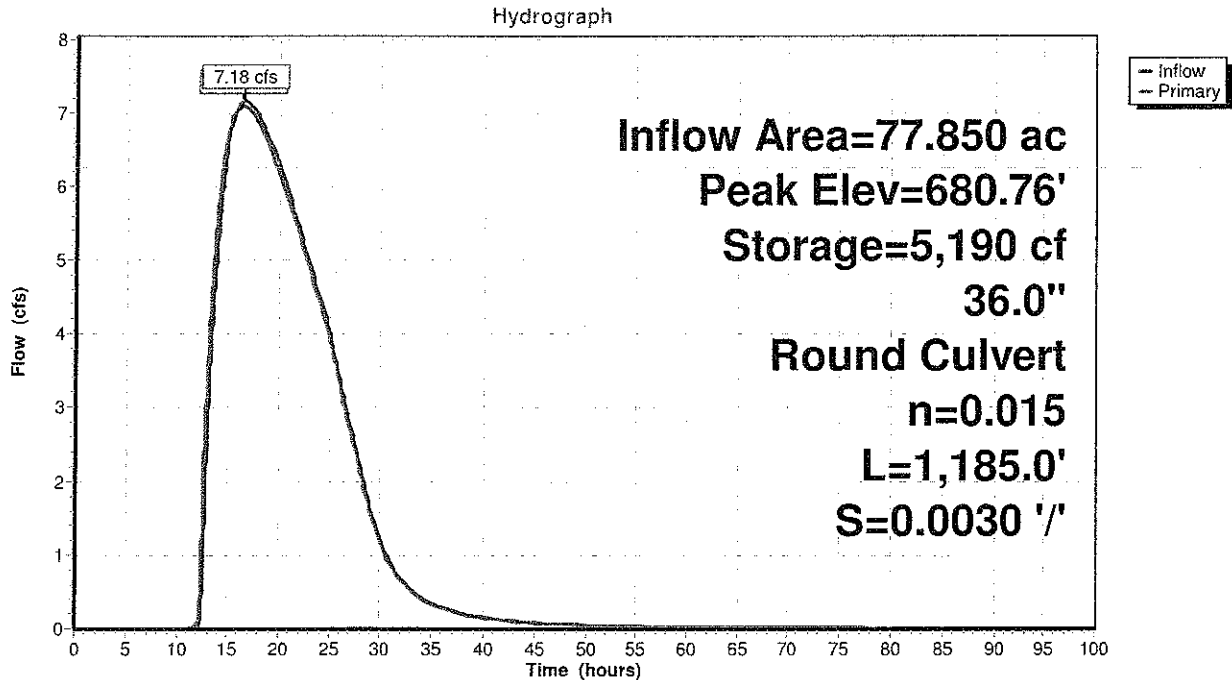
Routing by Dyn-Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 680.76' @ 15.55 hrs Surf.Area= 4,580 sf Storage= 5,190 cf

Plug-Flow detention time= 12.3 min calculated for 7.459 af (100% of inflow)
Center-of-Mass det. time= 11.4 min (1,272.1 - 1,260.7)

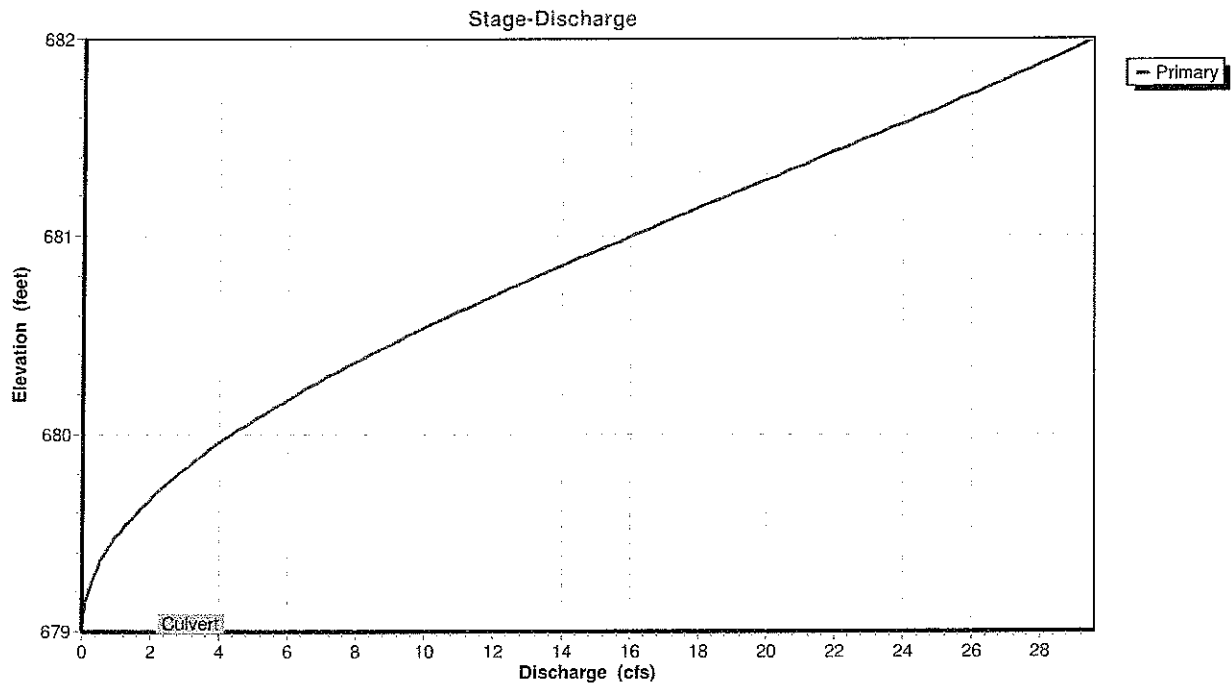
Volume	Invert	Avail.Storage	Storage Description
#1	679.00'	12,348 cf	3.00'W x 450.00'L x 3.00'H Prismatoid Z=2.0

Device	Routing	Invert	Outlet Devices
#1	Primary	679.00'	36.0" Round Culvert L= 1,185.0' Ke= 0.200 Inlet / Outlet Invert= 679.00' / 675.50' S= 0.0030 '/' Cc= 0.900 n= 0.015 Concrete sewer w/manholes & inlets, Flow Area= 7.07 sf

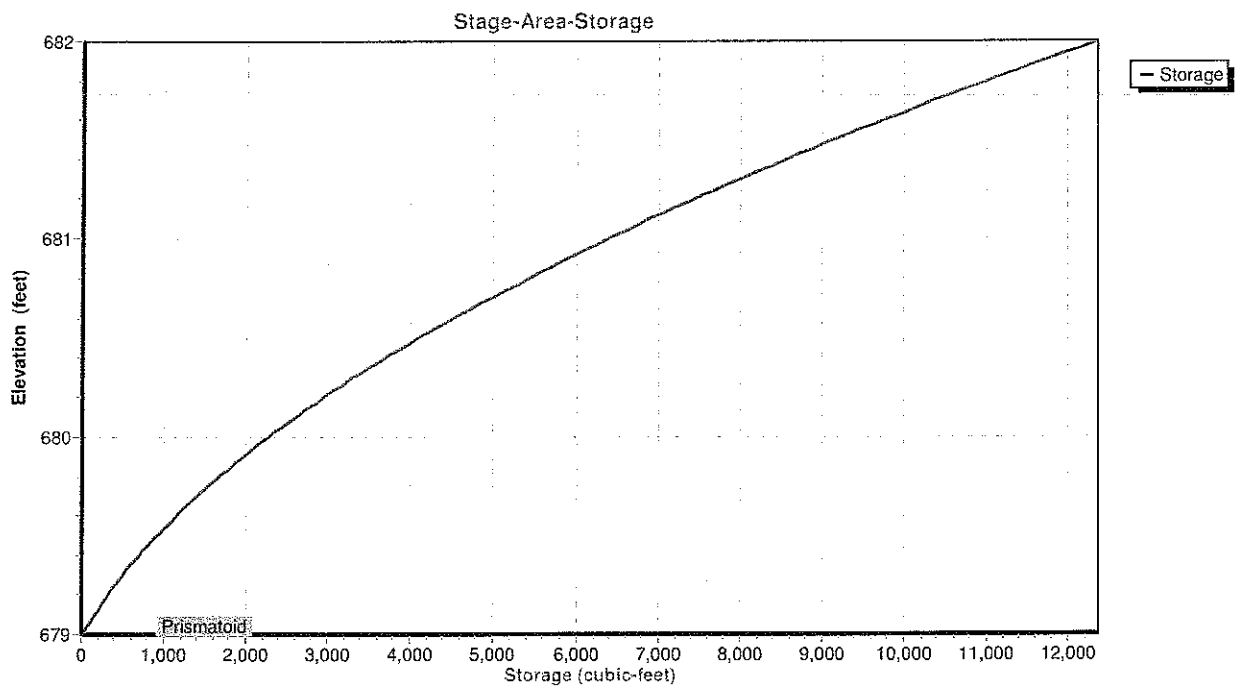
Primary OutFlow Max=7.18 cfs @ 16.42 hrs HW=680.73' TW=679.39' (Dynamic Tailwater)
↑1=Culvert (Outlet Controls 7.18 cfs @ 2.46 fps)

Pond 3P: OPEN CHANNEL & STM SEWER

Pond 3P: OPEN CHANNEL & STM SEWER



Pond 3P: OPEN CHANNEL & STM SEWER



Summary for Pond 4P: FAIRGROUNDS DETENTION

Inflow Area = 77.850 ac, 4.97% Impervious, Inflow Depth = 1.15" for 25-Year event
 Inflow = 20.84 cfs @ 12.47 hrs, Volume= 7.493 af
 Outflow = 7.11 cfs @ 16.22 hrs, Volume= 7.462 af, Atten= 66%, Lag= 225.0 min
 Primary = 7.11 cfs @ 16.22 hrs, Volume= 7.462 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 683.92' @ 16.22 hrs Surf.Area= 1.145 ac Storage= 3.008 af

Plug-Flow detention time= 297.8 min calculated for 7.461 af (100% of inflow)
 Center-of-Mass det. time= 295.3 min (1,260.7 - 965.4)

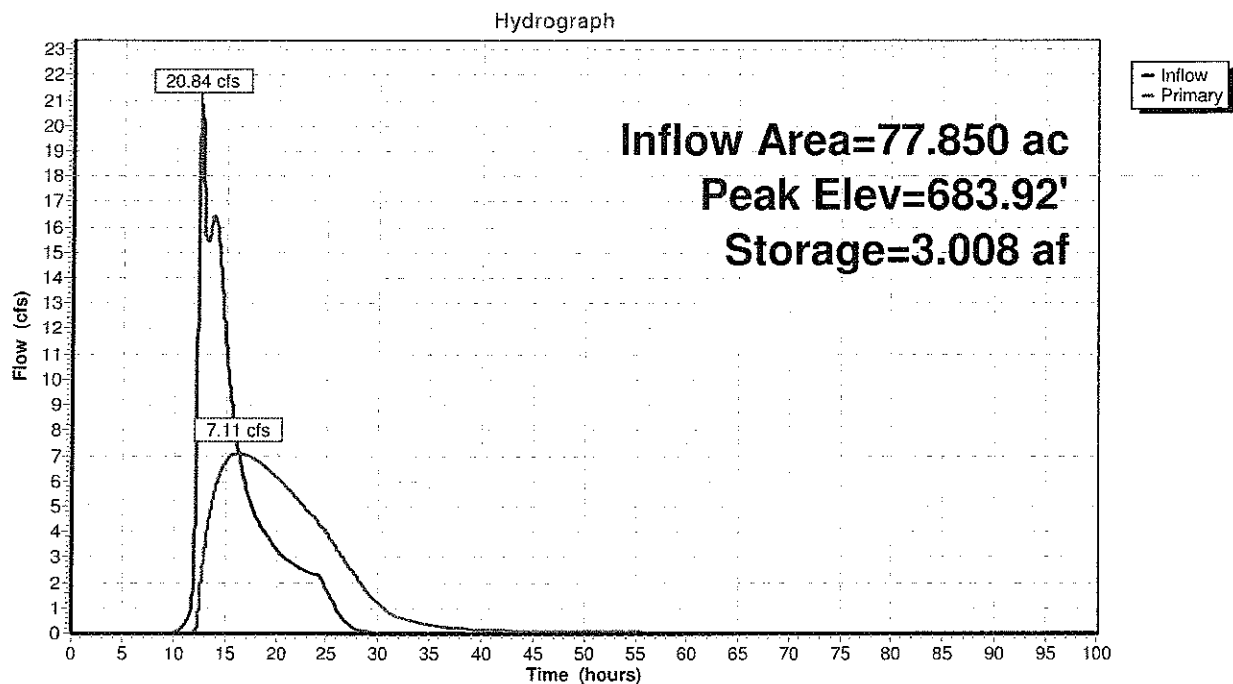
Volume	Invert	Avail.Storage	Storage Description
#1	681.00'	5.571 af	200.00'W x 200.00'L x 5.00'H Prismatic Z=4.0

Device	Routing	Invert	Outlet Devices
#1	Primary	681.00'	12.0" Vert. Orifice/Grate C= 0.600
#2	Primary	682.00'	6.0" Vert. Orifice/Grate C= 0.600

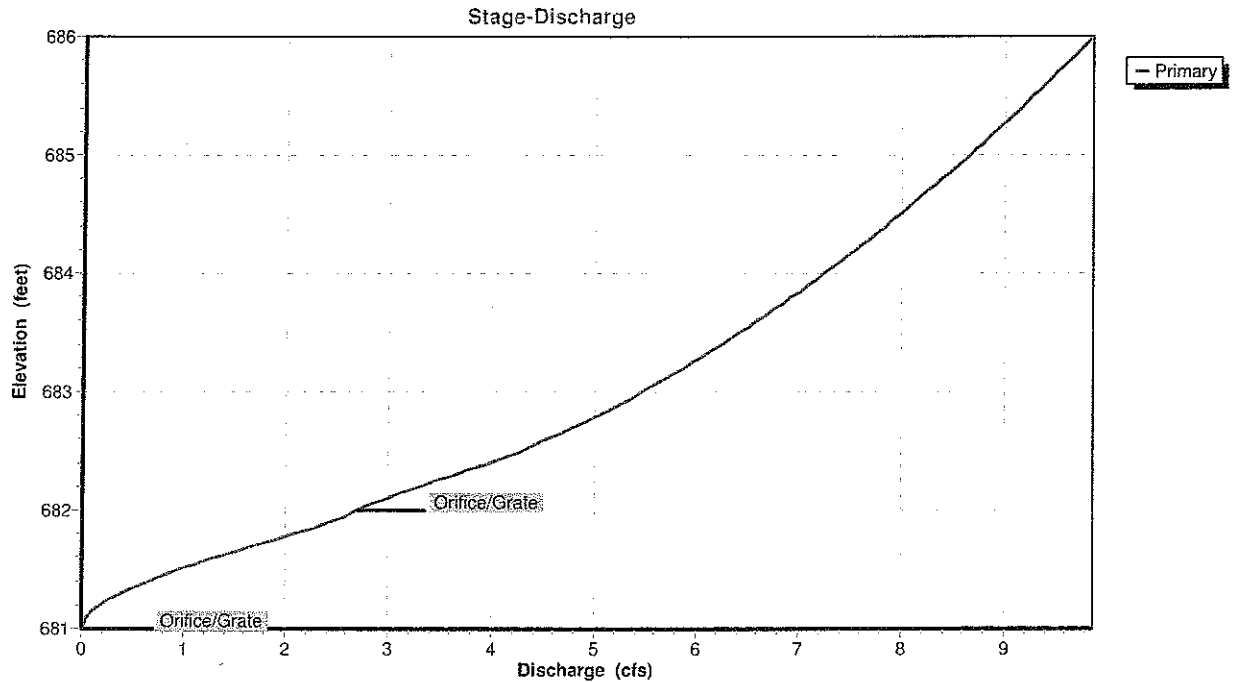
Primary OutFlow Max=7.11 cfs @ 16.22 hrs HW=683.92' TW=680.74' (Dynamic Tailwater)

1=Orifice/Grate (Orifice Controls 5.88 cfs @ 7.49 fps)

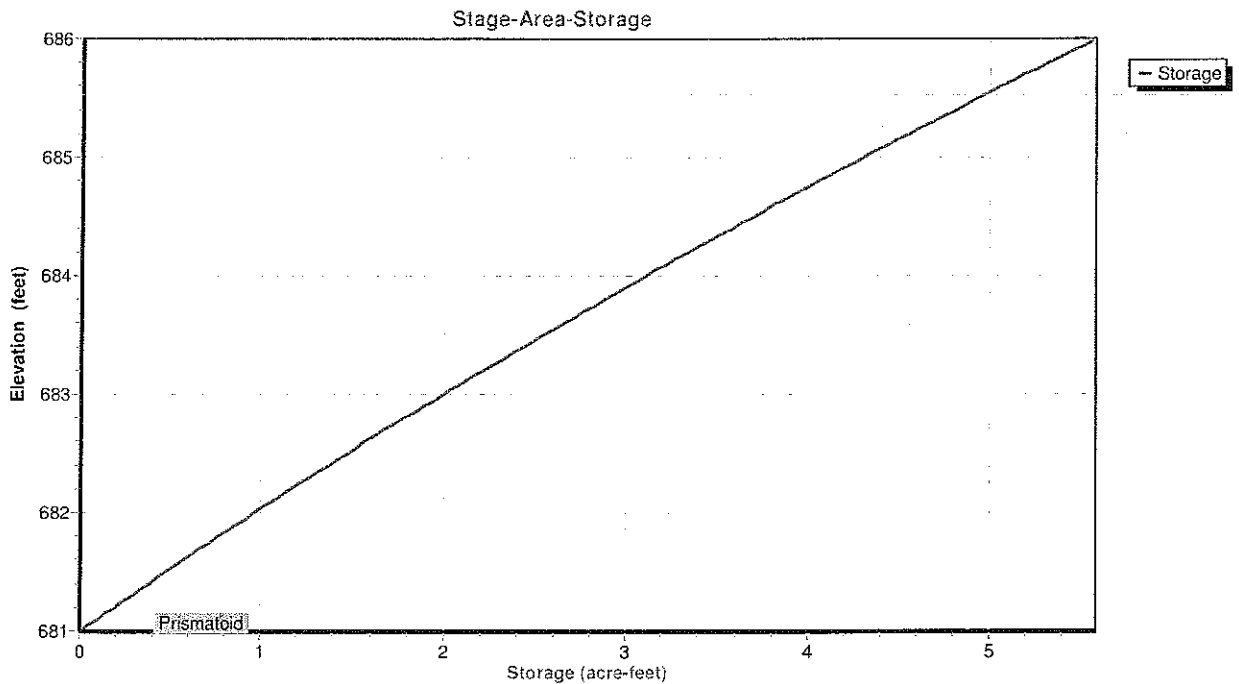
2=Orifice/Grate (Orifice Controls 1.22 cfs @ 6.22 fps)

Pond 4P: FAIRGROUNDS DETENTION

Pond 4P: FAIRGROUNDS DETENTION



Pond 4P: FAIRGROUNDS DETENTION



Summary for Subcatchment A 1: 15.6AC

Runoff = 24.06 cfs @ 12.46 hrs, Volume= 3.079 af, Depth= 2.37"

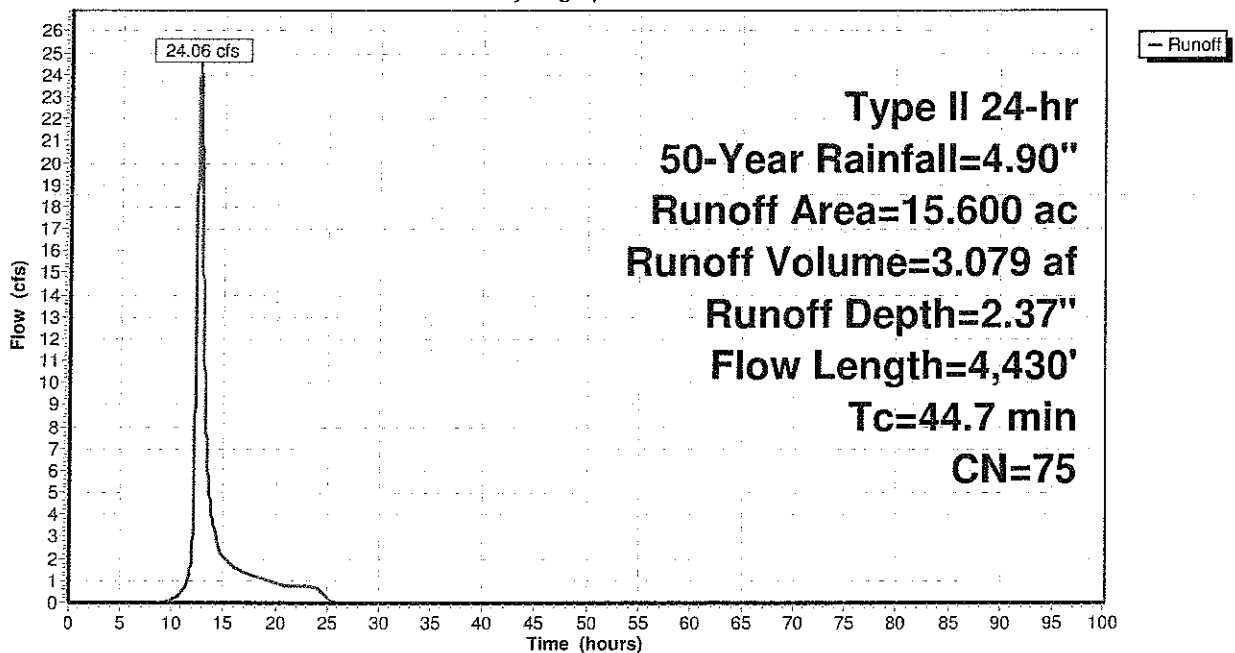
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
 Type II 24-hr 50-Year Rainfall=4.90"

Area (ac)	CN	Description
13.600	79	1 acre lots, 20% imp, HSG C
2.000	51	1 acre lots, 20% imp, HSG A
15.600	75	Weighted Average
12.480		80.00% Pervious Area
3.120		20.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	100	0.0100	0.11		Sheet Flow, Grass: Short n= 0.150 P2= 2.40"
29.8	4,330	0.0260	2.42		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
44.7	4,430	Total			

Subcatchment A 1: 15.6AC

Hydrograph



Summary for Subcatchment A 2: 62.25AC

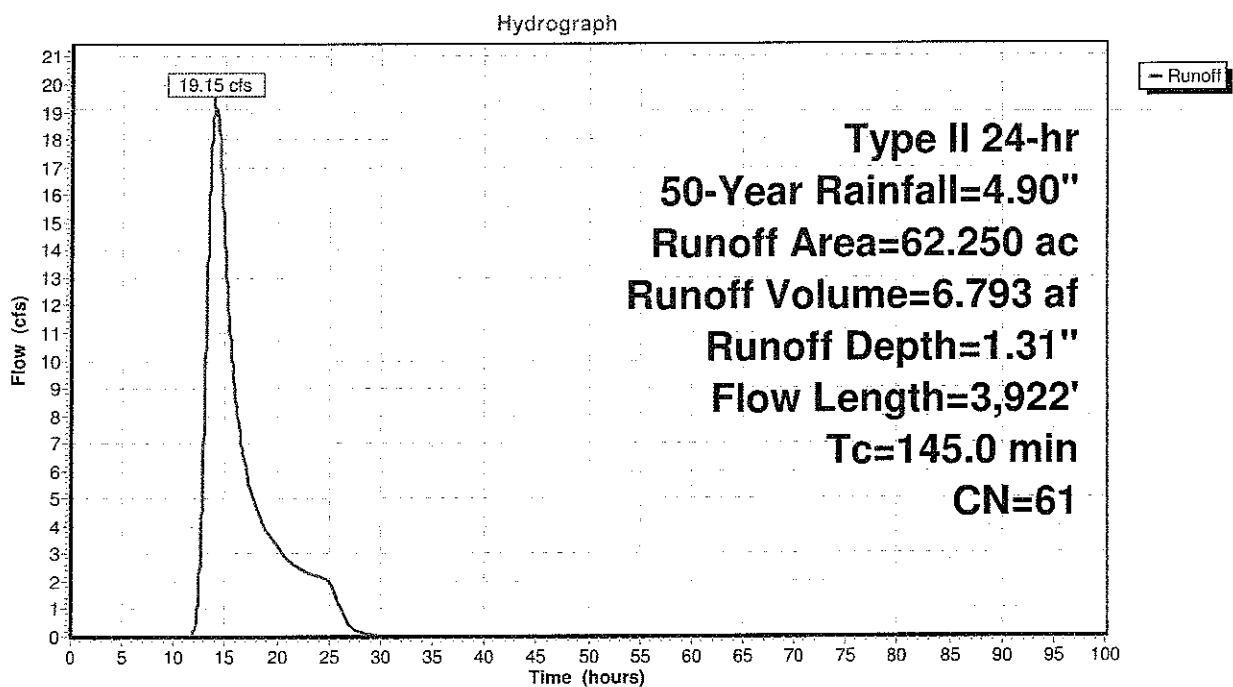
Runoff = 19.15 cfs @ 13.86 hrs, Volume= 6.793 af, Depth= 1.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
 Type II 24-hr 50-Year Rainfall=4.90"

Area (ac)	CN	Description
47.000	70	Woods, Good, HSG C
14.500	30	Woods, Good, HSG A
0.750	98	Paved parking, HSG C
62.250	61	Weighted Average
61.500		98.80% Pervious Area
0.750		1.20% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	100	0.0100	0.11		Sheet Flow, Grass: Short n= 0.150 P2= 2.40"
124.0	2,758	0.0220	0.37		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
6.1	1,064	0.0040	2.89	3.54	Pipe Channel, RCP_Round 15" 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.015 Concrete sewer w/manholes & inlets
145.0	3,922	Total			

Subcatchment A 2: 62.25AC



Summary for Subcatchment A 3: 106 AC

Runoff = 195.48 cfs @ 12.32 hrs, Volume= 21.671 af, Depth= 2.45"

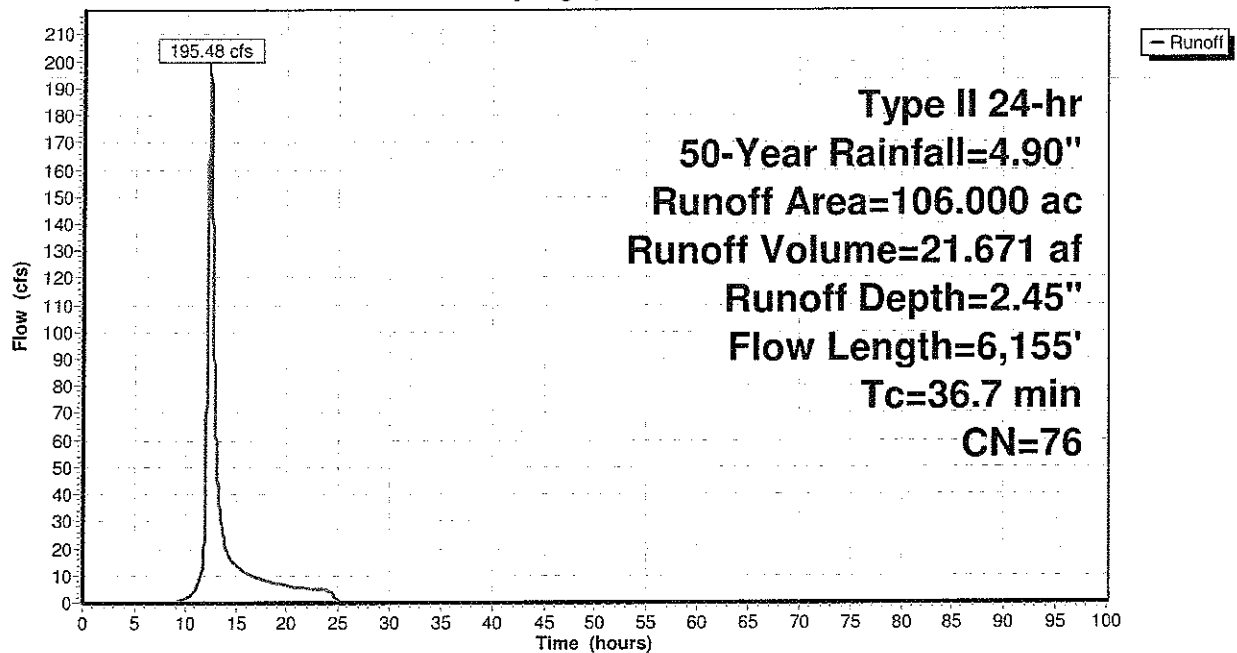
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
 Type II 24-hr 50-Year Rainfall=4.90"

Area (ac)	CN	Description
30.000	54	1/2 acre lots, 25% imp, HSG A
57.000	81	1/3 acre lots, 30% imp, HSG C
19.000	98	Paved roads w/curbs & sewers, HSG C
106.000	76	Weighted Average
62.400		58.87% Pervious Area
43.600		41.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	100	0.0100	0.11		Sheet Flow, Grass: Short n= 0.150 P2= 2.40"
4.3	564	0.0210	2.17		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
17.5	5,491	0.0070	5.22	16.40	Pipe Channel, 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.015 Concrete sewer w/manholes & inlets
36.7	6,155	Total			

Subcatchment A 3: 106 AC

Hydrograph



Summary for Subcatchment A 4: 37.3 AC

Runoff = 100.33 cfs @ 12.43 hrs, Volume= 14.495 af, Depth= 4.66"

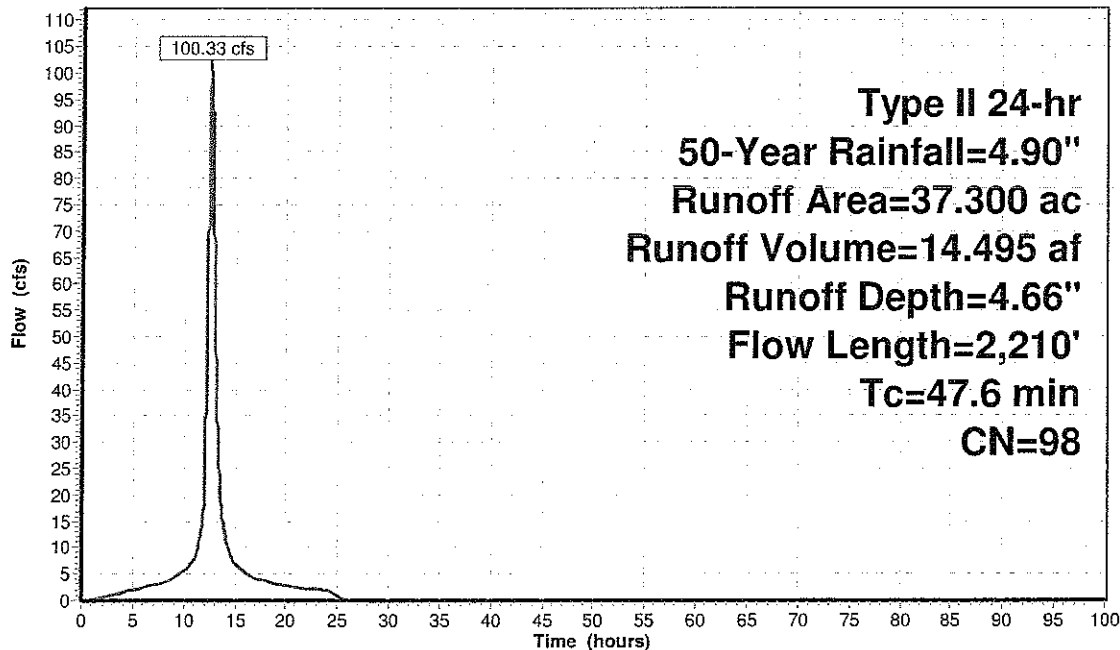
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 50-Year Rainfall=4.90"

Area (ac)	CN	Description
37.300	98	Paved parking, HSG C
37.300		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
37.5	100	0.0010	0.04		Sheet Flow, Grass: Short n= 0.150 P2= 2.40"
3.7	405	0.0150	1.84		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
6.4	1,705	0.0050	4.41	13.86	Pipe Channel, 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.015 Concrete sewer w/manholes & inlets
47.6	2,210	Total			

Subcatchment A 4: 37.3 AC

Hydrograph



Summary for Subcatchment A 5: 13.7AC

Runoff = 12.75 cfs @ 12.73 hrs, Volume= 2.241 af, Depth= 1.96"

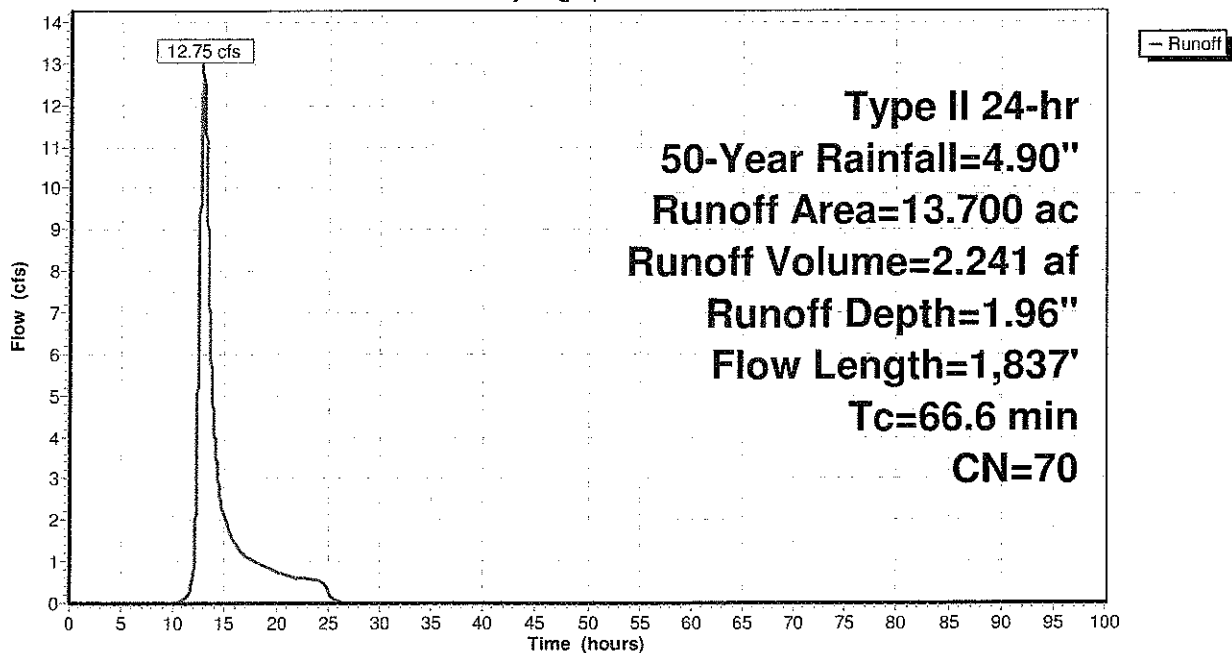
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 50-Year Rainfall=4.90"

Area (ac)	CN	Description
13.700	70	Woods, Good, HSG C
13.700		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.7	100	0.0100	0.05		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 2.40"
10.5	943	0.0100	1.50		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
23.4	794	0.0040	0.57	3.39	Channel Flow, Area= 6.0 sf Perim= 7.0' r= 0.86' n= 0.150 Sheet flow over Short Grass
66.6	1,837				Total

Subcatchment A 5: 13.7AC

Hydrograph



LAKE COUNTY CENTER PARK ESTATES 7-31-13

Type II 24-hr 50-Year Rainfall=4.90"

Prepared by GGC ENGINEERS-NORTH OFFICE

Printed 7/26/2013

HydroCAD® 10.00 s/n 02043 © 2013 HydroCAD Software Solutions LLC

Page 41

Summary for Pond 1P: TOPPS POND

Inflow Area = 234.850 ac, 36.10% Impervious, Inflow Depth = 2.46" for 50-Year event
 Inflow = 223.32 cfs @ 12.35 hrs, Volume= 48.218 af
 Outflow = 33.57 cfs @ 15.24 hrs, Volume= 48.037 af, Atten= 85%, Lag= 173.2 min
 Primary = 33.57 cfs @ 15.24 hrs, Volume= 48.037 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 680.73' @ 15.24 hrs Surf.Area= 117,657 sf Storage= 755,079 cf

Plug-Flow detention time= 317.8 min calculated for 48.037 af (100% of inflow)
 Center-of-Mass det. time= 307.9 min (1,310.6 - 1,002.7)

Volume	Invert	Avail.Storage	Storage Description
#1	673.00'	1,407,598 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
673.00	78,916	0	0
674.00	83,494	81,205	81,205
675.00	88,199	85,847	167,052
676.00	93,034	90,617	257,668
677.00	97,995	95,515	353,183
678.00	103,086	100,541	453,723
679.00	108,303	105,695	559,418
680.00	113,648	110,976	670,393
681.00	119,123	116,386	786,779
682.00	124,724	121,924	908,702
686.00	124,724	498,896	1,407,598

Device	Routing	Invert	Outlet Devices
#1	Primary	673.00'	30.0" Round Culvert L= 1,210.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 673.00' / 667.69' S= 0.0044 ' / ' Cc= 0.900 n= 0.015, Flow Area= 4.91 sf
#2	Primary	676.00'	6.0" Vert. Orifice/Grate C= 0.600

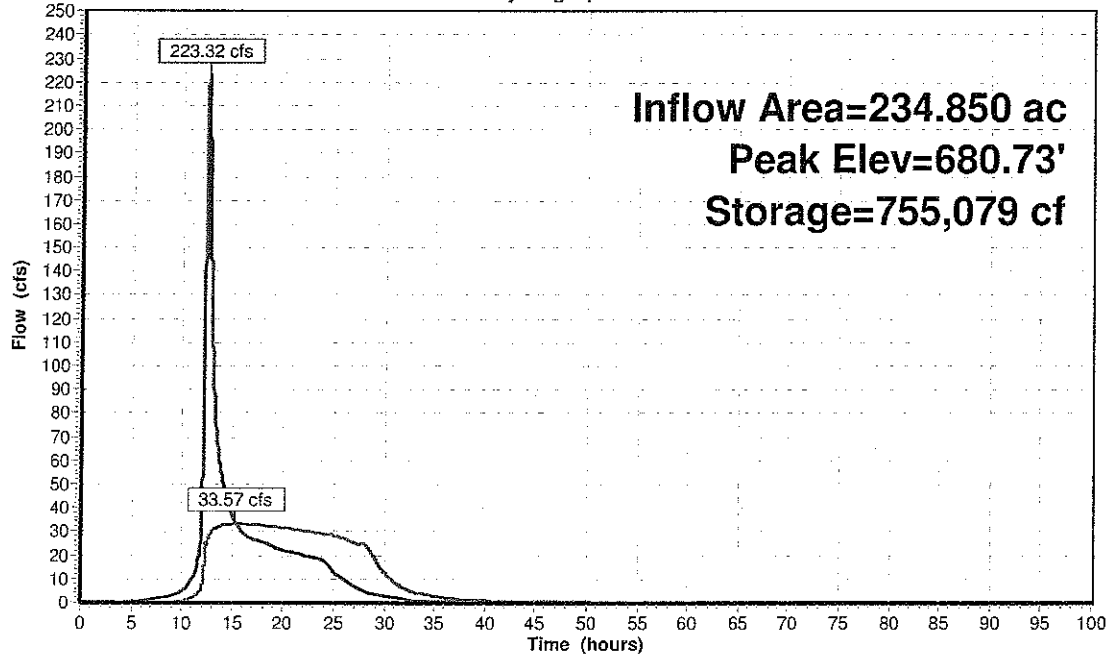
Primary OutFlow Max=33.57 cfs @ 15.24 hrs HW=680.73' (Free Discharge)

1=Culvert (Barrel Controls 31.57 cfs @ 6.43 fps)

2=Orifice/Grate (Orifice Controls 2.00 cfs @ 10.19 fps)

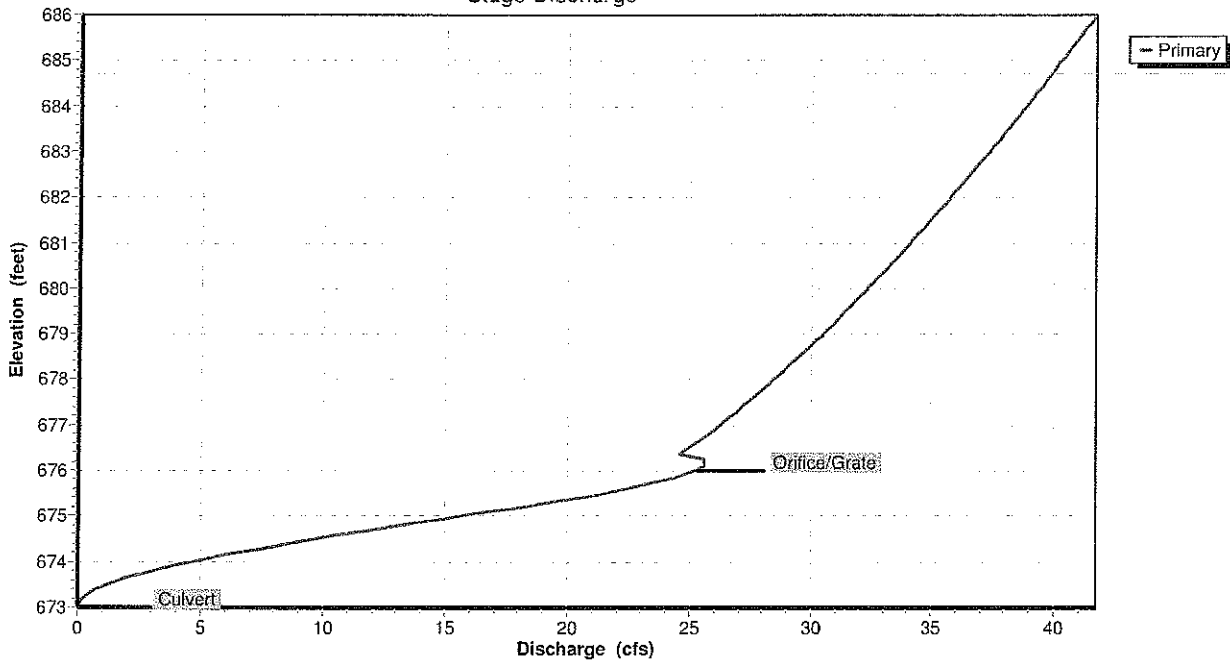
Pond 1P: TOPPS POND

Hydrograph

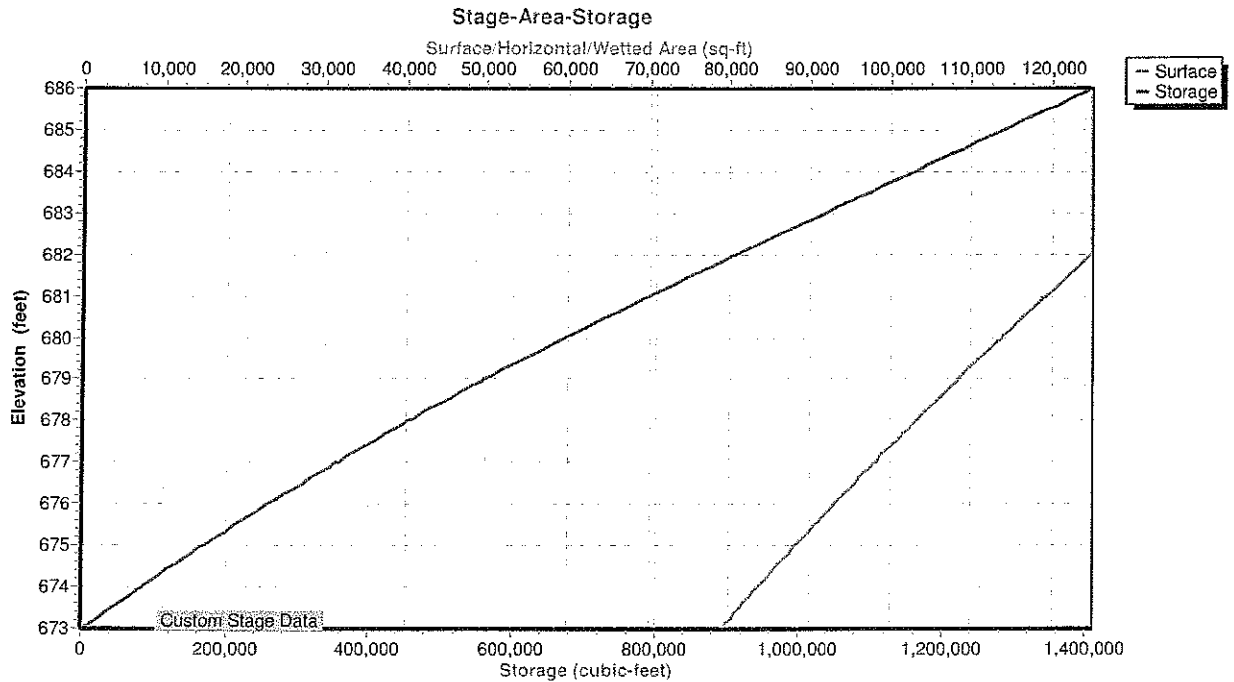


Pond 1P: TOPPS POND

Stage-Discharge



Pond 1P: TOPPS POND



LAKE COUNTY CENTER PARK ESTATES 7-31-13

Type II 24-hr 50-Year Rainfall=4.90"

Prepared by GGC ENGINEERS-NORTH OFFICE

Printed 7/26/2013

HydroCAD® 10.00 s/n 02043 © 2013 HydroCAD Software Solutions LLC

Page 44

Summary for Pond 2P: CAMBRIDGE POND

Inflow Area = 51.000 ac, 73.14% Impervious, Inflow Depth = 3.94" for 50-Year event
 Inflow = 109.81 cfs @ 12.43 hrs, Volume= 16.736 af
 Outflow = 38.04 cfs @ 12.63 hrs, Volume= 16.709 af, Atten= 65%, Lag= 12.0 min
 Primary = 38.04 cfs @ 12.63 hrs, Volume= 16.709 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 681.75' @ 13.30 hrs Surf.Area= 64,685 sf Storage= 266,358 cf

Plug-Flow detention time= 221.2 min calculated for 16.709 af (100% of inflow)
 Center-of-Mass det. time= 220.1 min (1,018.8 - 798.7)

Volume	Invert	Avail.Storage	Storage Description
#1	677.00'	282,457 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

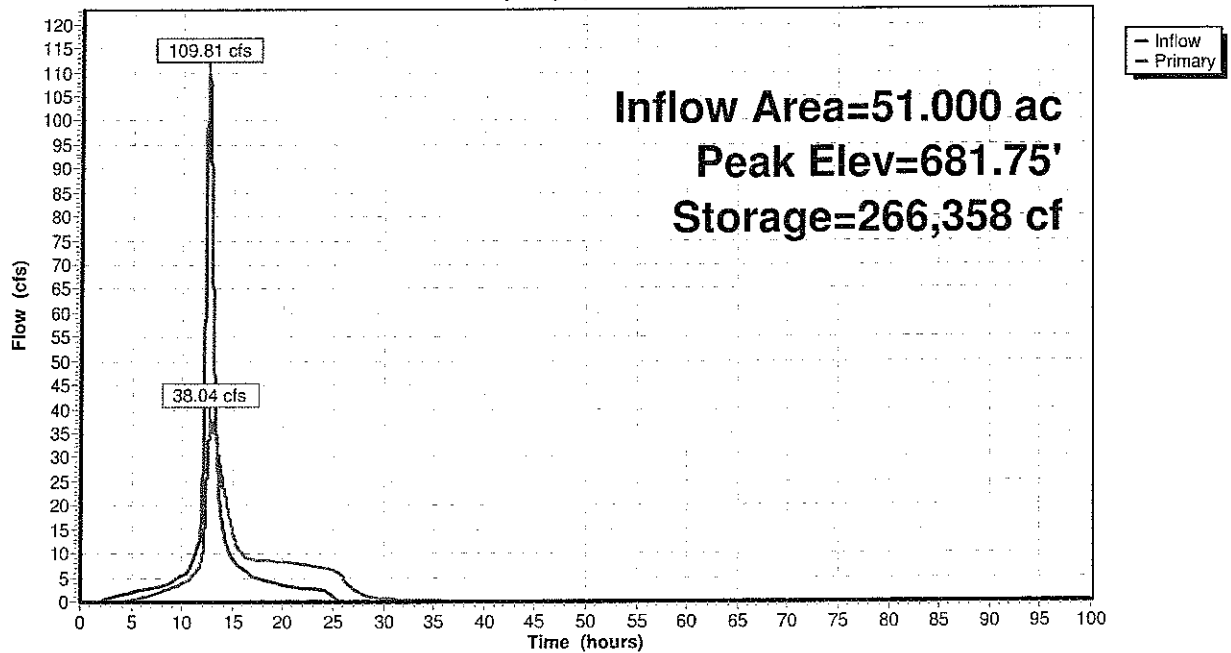
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
677.00	47,789	0	0
678.00	51,142	49,466	49,466
679.00	54,602	52,872	102,338
680.00	58,168	56,385	158,723
681.00	61,841	60,005	218,727
682.00	65,619	63,730	282,457

Device	Routing	Invert	Outlet Devices
#1	Primary	677.00'	30.0" Vert. Orifice/Grate C= 0.600

Primary OutFlow Max=38.03 cfs @ 12.63 hrs HW=680.85' TW=678.26' (Dynamic Tailwater)
 ↑=Orifice/Grate (Orifice Controls 38.03 cfs @ 7.75 fps)

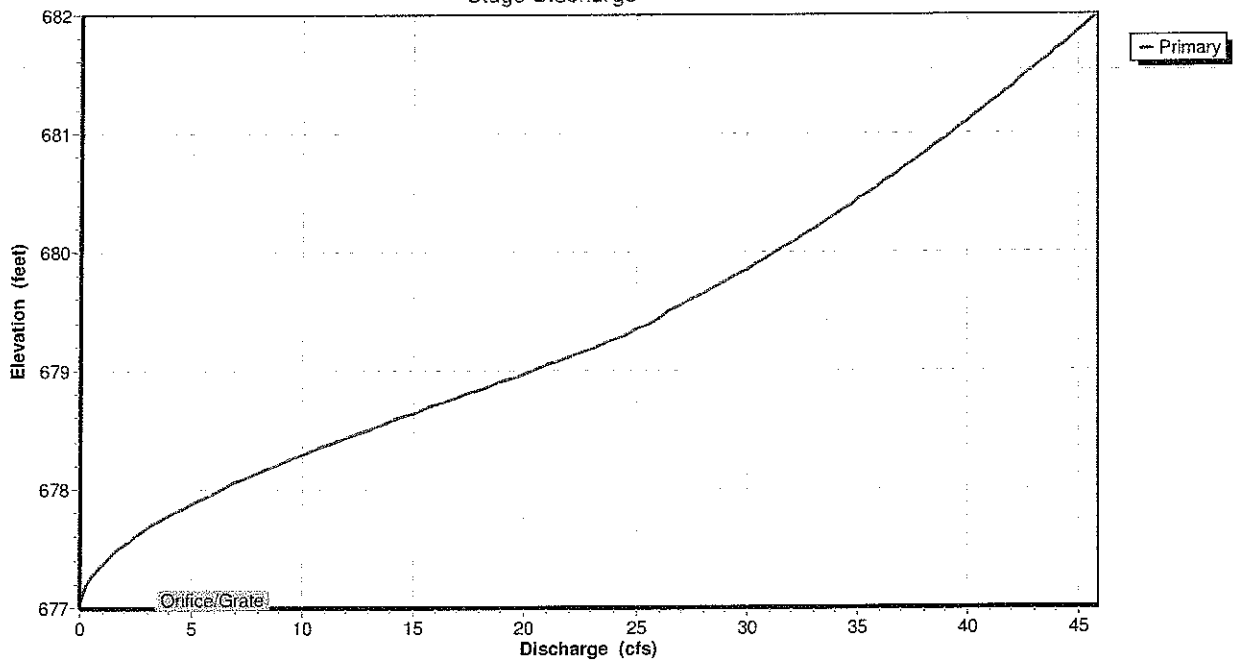
Pond 2P: CAMBRIDGE POND

Hydrograph

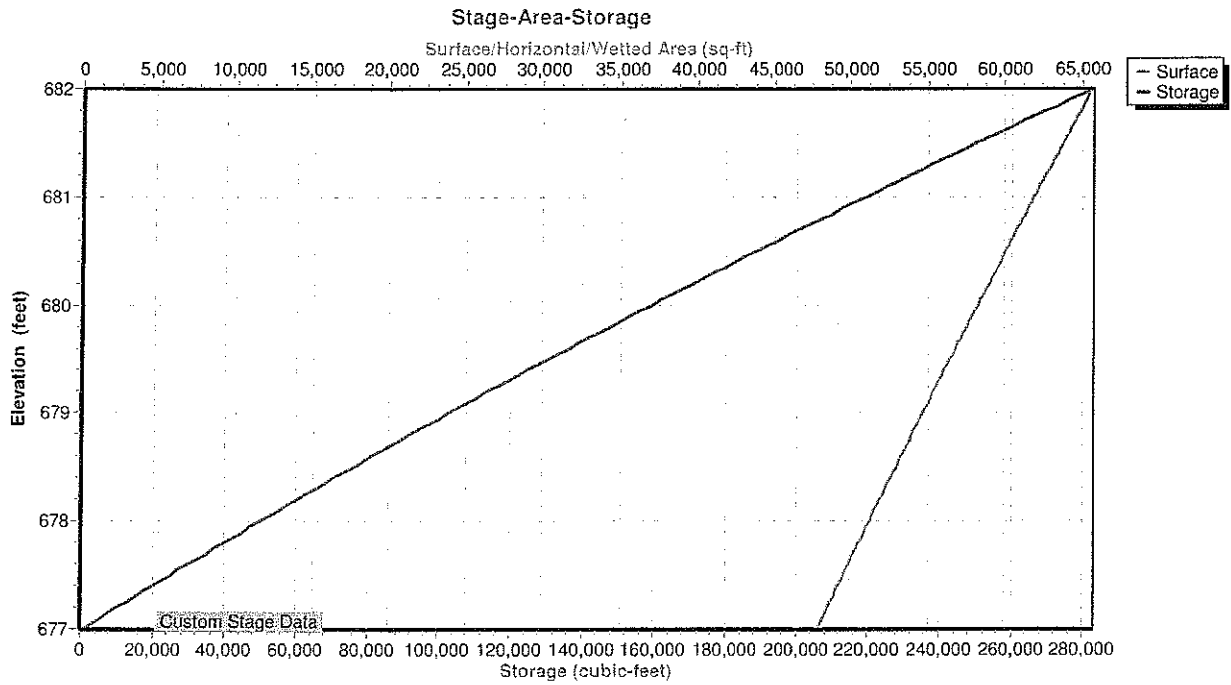


Pond 2P: CAMBRIDGE POND

Stage-Discharge



Pond 2P: CAMBRIDGE POND



Summary for Pond 3P: OPEN CHANNEL & STM SEWER

Inflow Area = 77.850 ac, 4.97% Impervious, Inflow Depth > 1.52" for 50-Year event
 Inflow = 8.62 cfs @ 16.42 hrs, Volume= 9.840 af
 Outflow = 8.76 cfs @ 16.71 hrs, Volume= 9.838 af, Atten= 0%, Lag= 17.6 min
 Primary = 8.76 cfs @ 16.71 hrs, Volume= 9.838 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 681.38' @ 15.63 hrs Surf.Area= 5,749 sf Storage= 8,404 cf

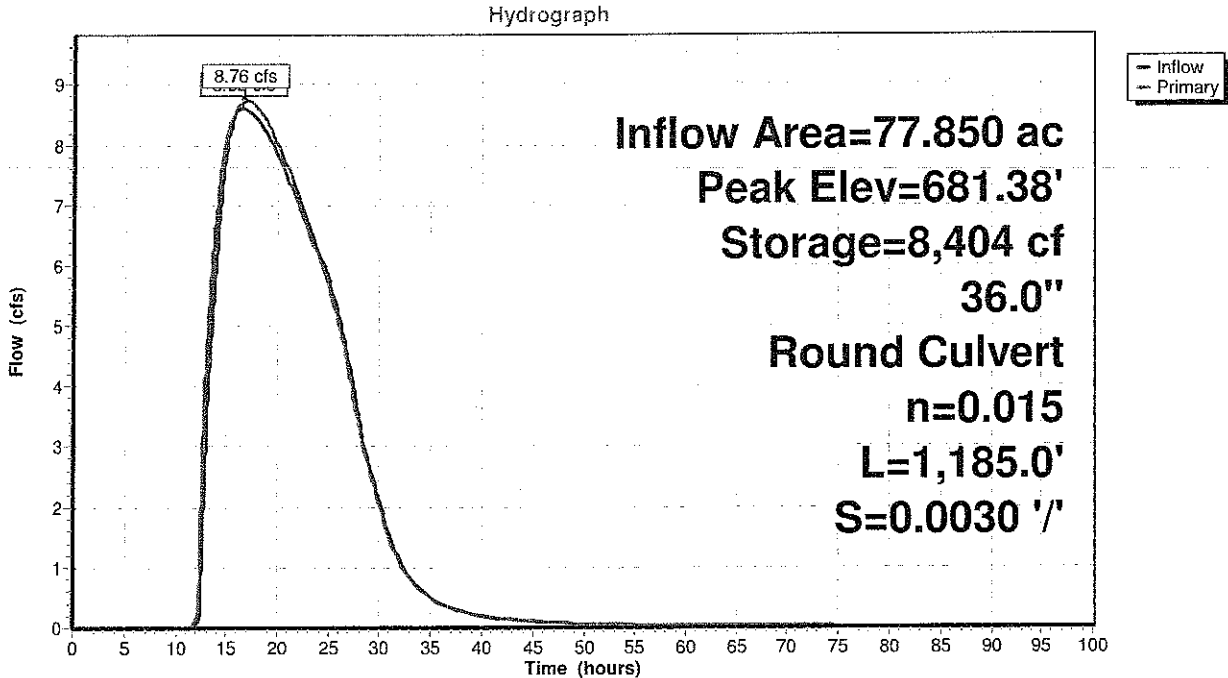
Plug-Flow detention time= 13.9 min calculated for 9.838 af (100% of inflow)
 Center-of-Mass det. time= 13.2 min (1,293.1 - 1,279.9)

Volume	Invert	Avail.Storage	Storage Description
#1	679.00'	12,348 cf	3.00'W x 450.00'L x 3.00'H Prismatic Z=2.0

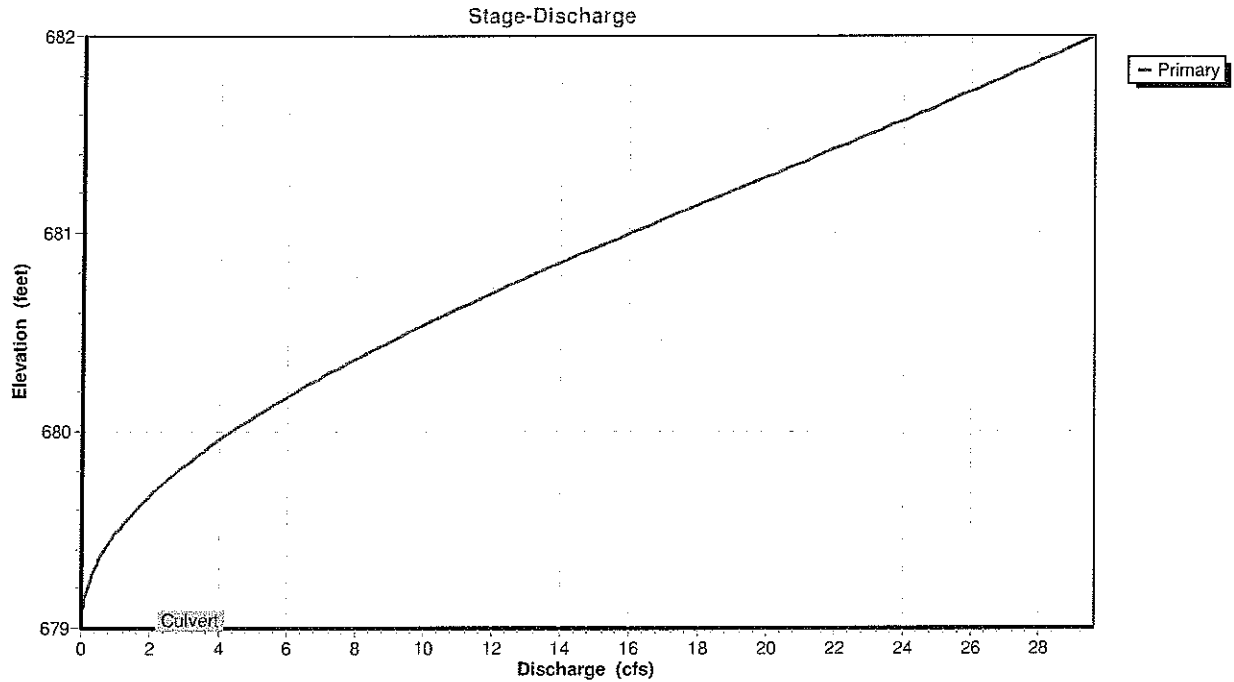
Device	Routing	Invert	Outlet Devices
#1	Primary	679.00'	36.0" Round Culvert L= 1,185.0' Ke= 0.200 Inlet / Outlet Invert= 679.00' / 675.50' S= 0.0030 '/' Cc= 0.900 n= 0.015 Concrete sewer w/manholes & inlets, Flow Area= 7.07 sf

Primary OutFlow Max=8.76 cfs @ 16.71 hrs HW=681.32' TW=680.56' (Dynamic Tailwater)
 ↑1=Culvert (Outlet Controls 8.76 cfs @ 2.06 fps)

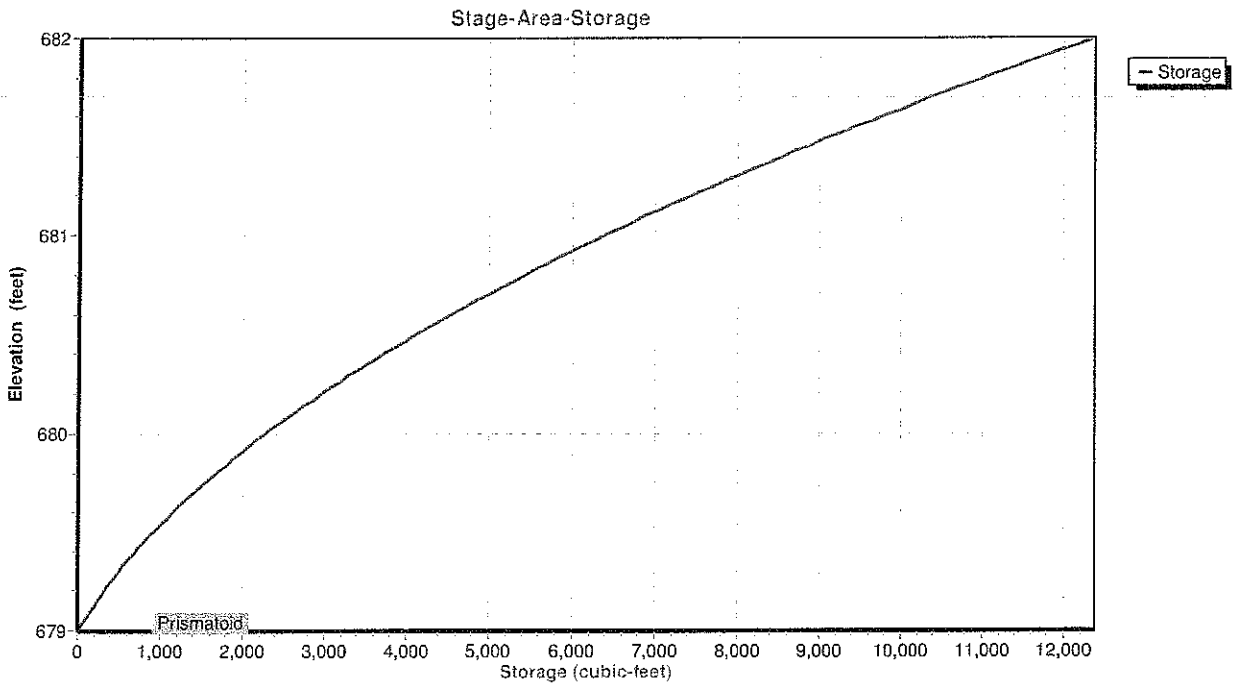
Pond 3P: OPEN CHANNEL & STM SEWER



Pond 3P: OPEN CHANNEL & STM SEWER



Pond 3P: OPEN CHANNEL & STM SEWER



Summary for Pond 4P: FAIRGROUNDS DETENTION

Inflow Area = 77.850 ac, 4.97% Impervious, Inflow Depth = 1.52" for 50-Year event
 Inflow = 26.83 cfs @ 12.47 hrs, Volume= 9.872 af
 Outflow = 8.62 cfs @ 16.42 hrs, Volume= 9.840 af, Atten= 68%, Lag= 236.8 min
 Primary = 8.62 cfs @ 16.42 hrs, Volume= 9.840 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 684.98' @ 16.42 hrs Surf.Area= 1.234 ac Storage= 4.273 af

Plug-Flow detention time= 323.5 min calculated for 9.839 af (100% of inflow)
 Center-of-Mass det. time= 321.6 min (1,279.9 - 958.3)

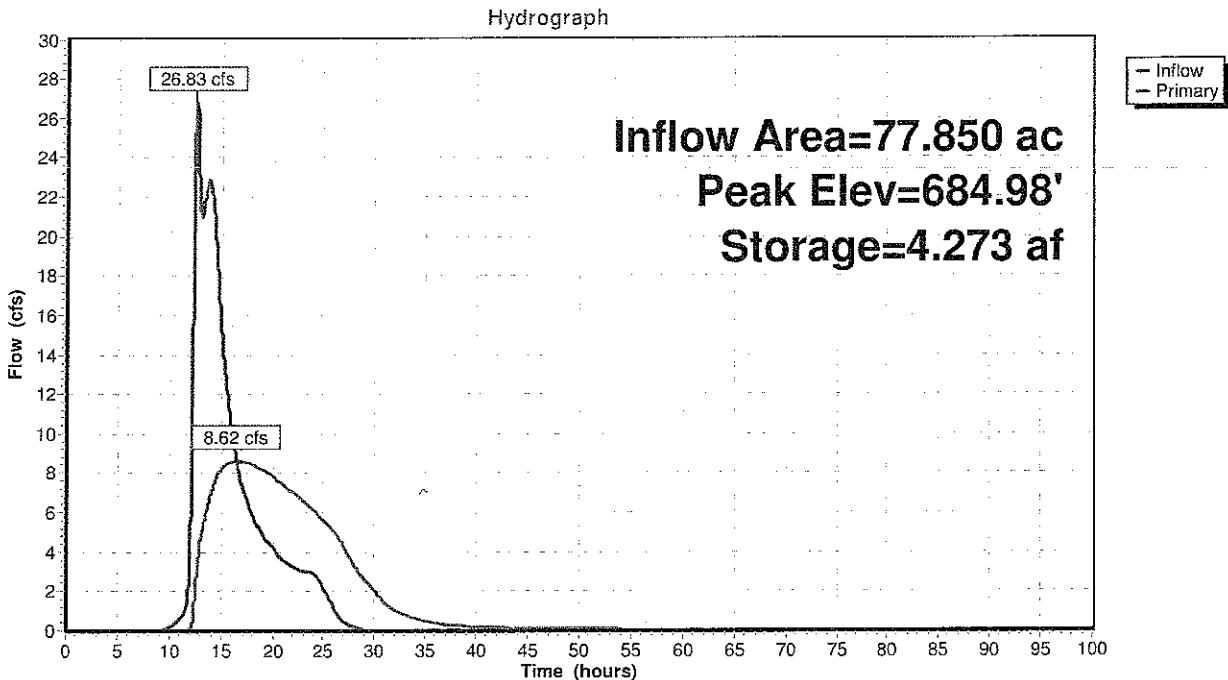
Volume	Invert	Avail.Storage	Storage Description
#1	681.00'	5.571 af	200.00'W x 200.00'L x 5.00'H Prismaoid Z=4.0

Device	Routing	Invert	Outlet Devices
#1	Primary	681.00'	12.0" Vert. Orifice/Grate C= 0.600
#2	Primary	682.00'	6.0" Vert. Orifice/Grate C= 0.600

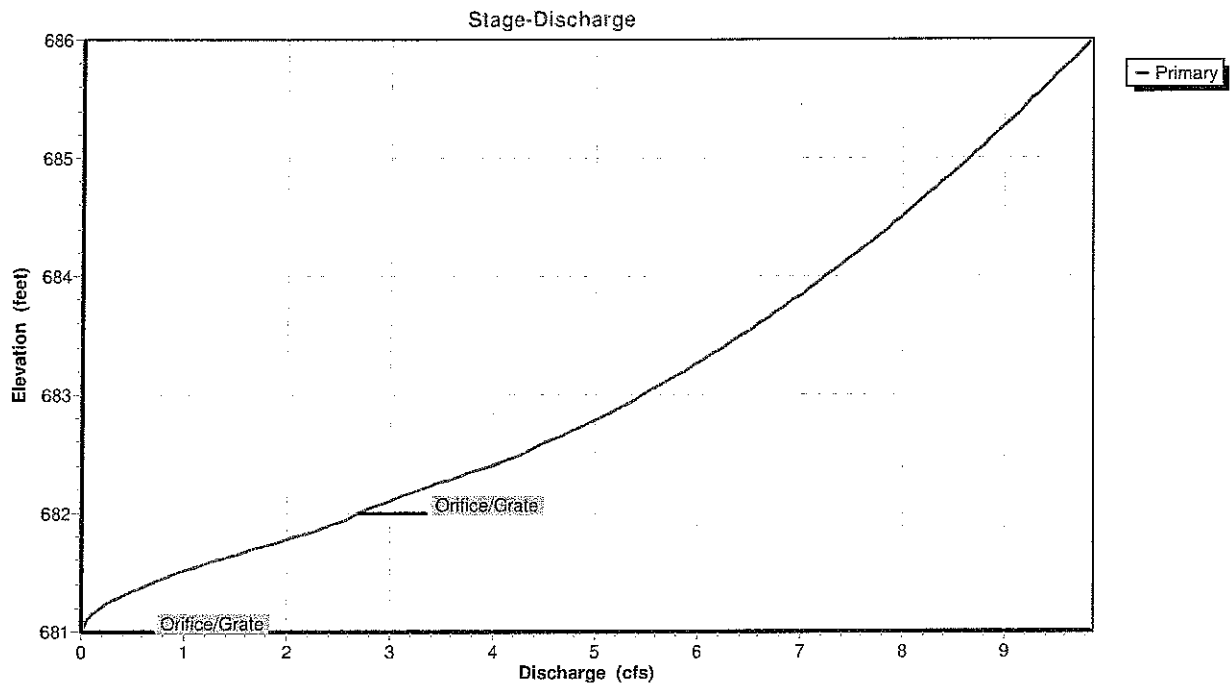
Primary OutFlow Max=8.62 cfs @ 16.42 hrs HW=684.98' TW=681.34' (Dynamic Tailwater)

1=Orifice/Grate (Orifice Controls 7.06 cfs @ 8.99 fps)
 2=Orifice/Grate (Orifice Controls 1.56 cfs @ 7.96 fps)

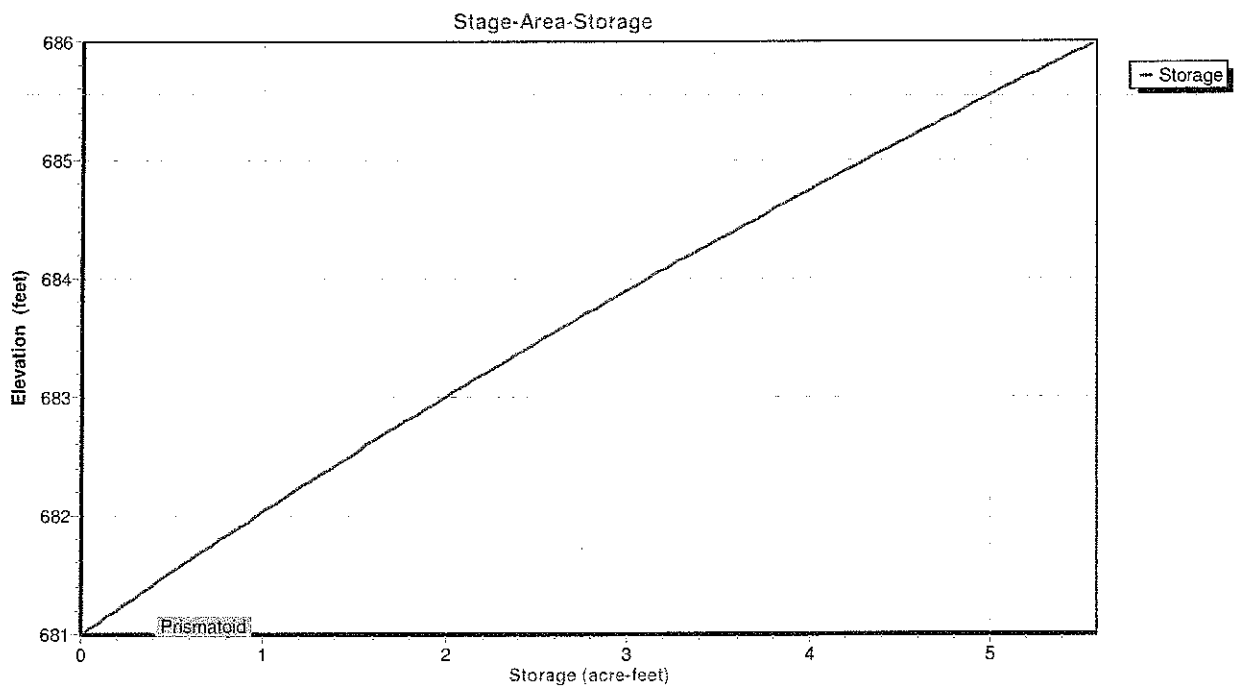
Pond 4P: FAIRGROUNDS DETENTION



Pond 4P: FAIRGROUNDS DETENTION



Pond 4P: FAIRGROUNDS DETENTION



LAKE COUNTY CENTER PARK ESTATES 7-31-13

Prepared by GGC ENGINEERS-NORTH OFFICE

HydroCAD® 10.00 s/n 02043 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 100-Year Rainfall=5.50"

Printed 7/26/2013

Page 51

Summary for Subcatchment A 1: 15.6AC

Runoff = 29.26 cfs @ 12.42 hrs, Volume= 3.719 af, Depth= 2.86"

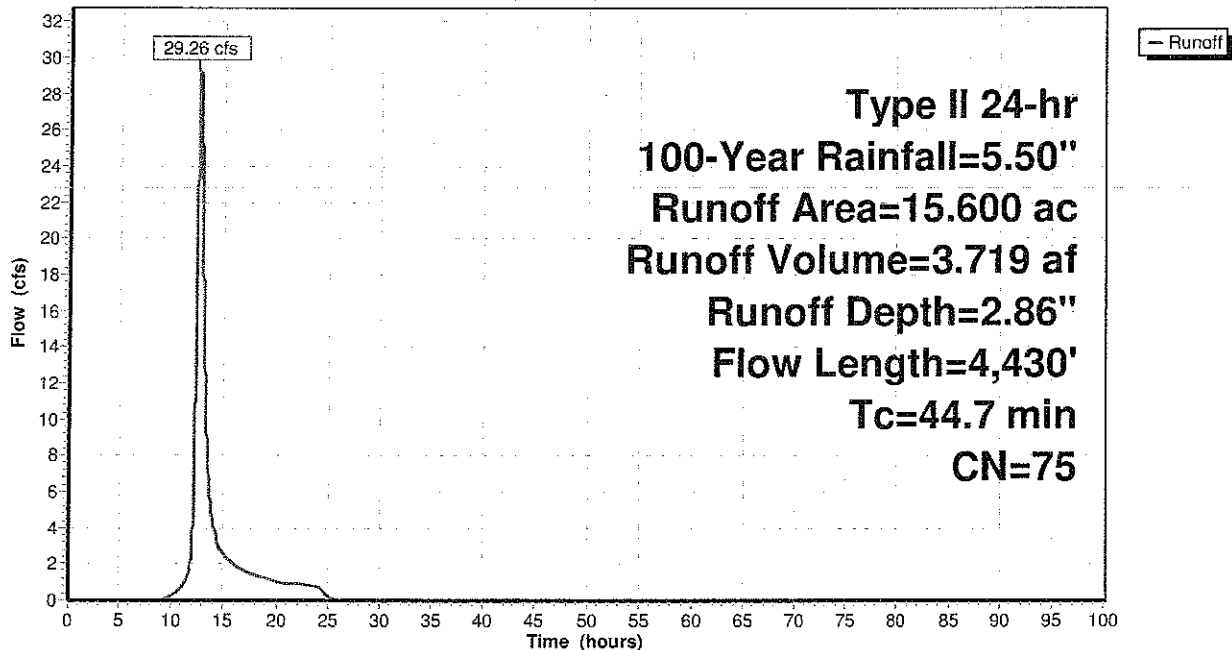
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Year Rainfall=5.50"

Area (ac)	CN	Description
13.600	79	1 acre lots, 20% imp, HSG C
2.000	51	1 acre lots, 20% imp, HSG A
15.600	75	Weighted Average
12.480		80.00% Pervious Area
3.120		20.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	100	0.0100	0.11		Sheet Flow, Grass: Short n= 0.150 P2= 2.40"
29.8	4,330	0.0260	2.42		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
44.7	4,430	Total			

Subcatchment A 1: 15.6AC

Hydrograph



LAKE COUNTY CENTER PARK ESTATES 7-31-13

Prepared by GGC ENGINEERS-NORTH OFFICE

HydroCAD® 10.00 s/n 02043 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 100-Year Rainfall=5.50"

Printed 7/26/2013

Page 52

Summary for Subcatchment A 2: 62.25AC

Runoff = 25.48 cfs @ 13.86 hrs, Volume= 8.708 af, Depth= 1.68"

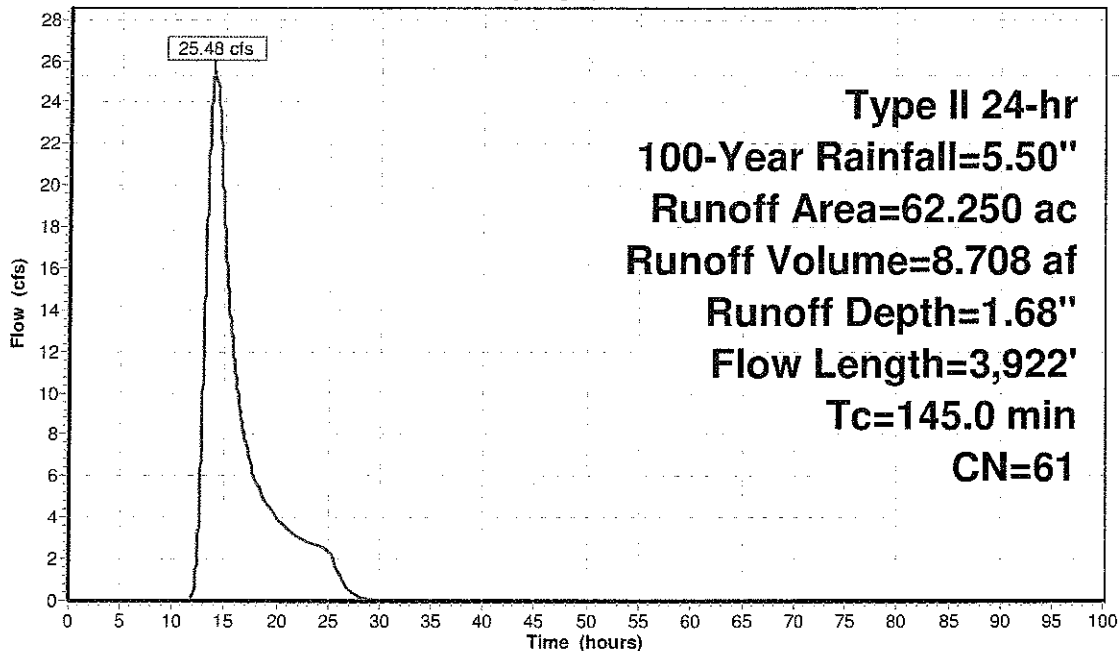
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Year Rainfall=5.50"

Area (ac)	CN	Description
47.000	70	Woods, Good, HSG C
14.500	30	Woods, Good, HSG A
0.750	98	Paved parking, HSG C
62.250	61	Weighted Average
61.500		98.80% Pervious Area
0.750		1.20% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	100	0.0100	0.11		Sheet Flow, Grass: Short n= 0.150 P2= 2.40"
124.0	2,758	0.0220	0.37		Shallow Concentrated Flow, Forest w/Heavy Litter Kv= 2.5 fps
6.1	1,064	0.0040	2.89	3.54	Pipe Channel, RCP_Round 15" 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.015 Concrete sewer w/manholes & inlets
145.0	3,922	Total			

Subcatchment A 2: 62.25AC

Hydrograph



LAKE COUNTY CENTER PARK ESTATES 7-31-13

Prepared by GGC ENGINEERS-NORTH OFFICE

HydroCAD® 10.00 s/n 02043 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 100-Year Rainfall=5.50"

Printed 7/26/2013

Page 53

Summary for Subcatchment A 3: 106 AC

Runoff = 236.57 cfs @ 12.32 hrs, Volume= 26.085 af, Depth= 2.95"

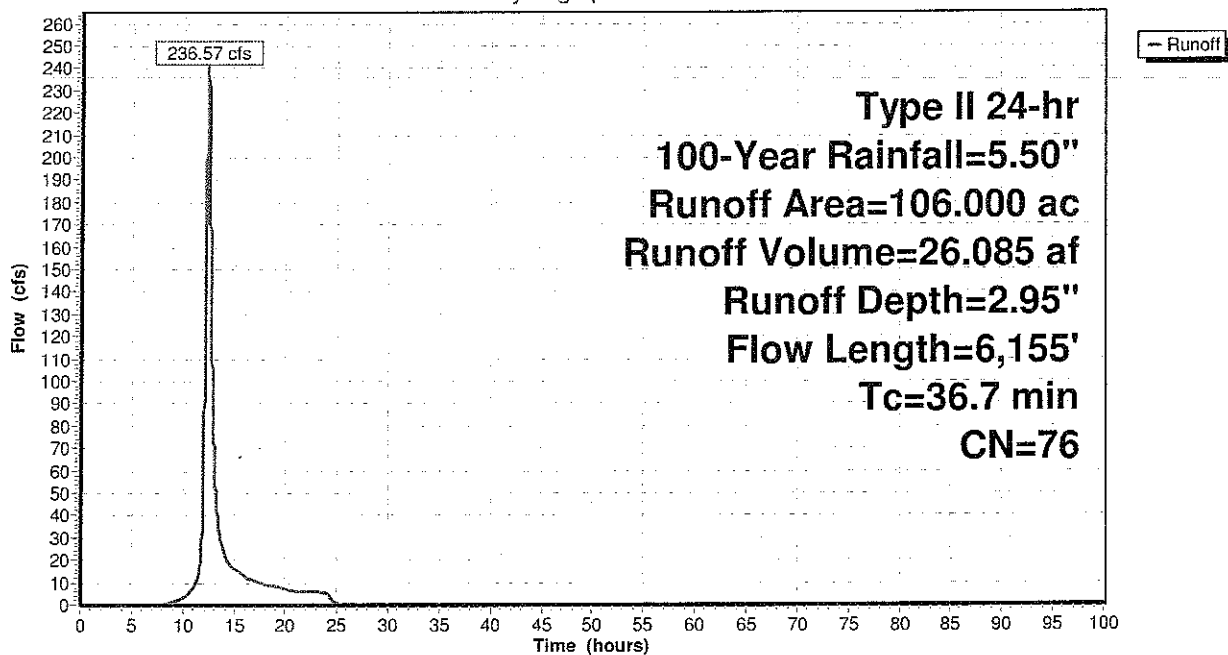
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Year Rainfall=5.50"

Area (ac)	CN	Description
30.000	54	1/2 acre lots, 25% imp, HSG A
57.000	81	1/3 acre lots, 30% imp, HSG C
19.000	98	Paved roads w/curbs & sewers, HSG C
106.000	76	Weighted Average
62.400		58.87% Pervious Area
43.600		41.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	100	0.0100	0.11		Sheet Flow, Grass: Short n= 0.150 P2= 2.40"
4.3	564	0.0210	2.17		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
17.5	5,491	0.0070	5.22	16.40	Pipe Channel, 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.015 Concrete sewer w/manholes & inlets
36.7	6,155	Total			

Subcatchment A 3: 106 AC

Hydrograph



Summary for Subcatchment A 4: 37.3 AC

Runoff = 112.78 cfs @ 12.43 hrs, Volume= 16.357 af, Depth= 5.26"

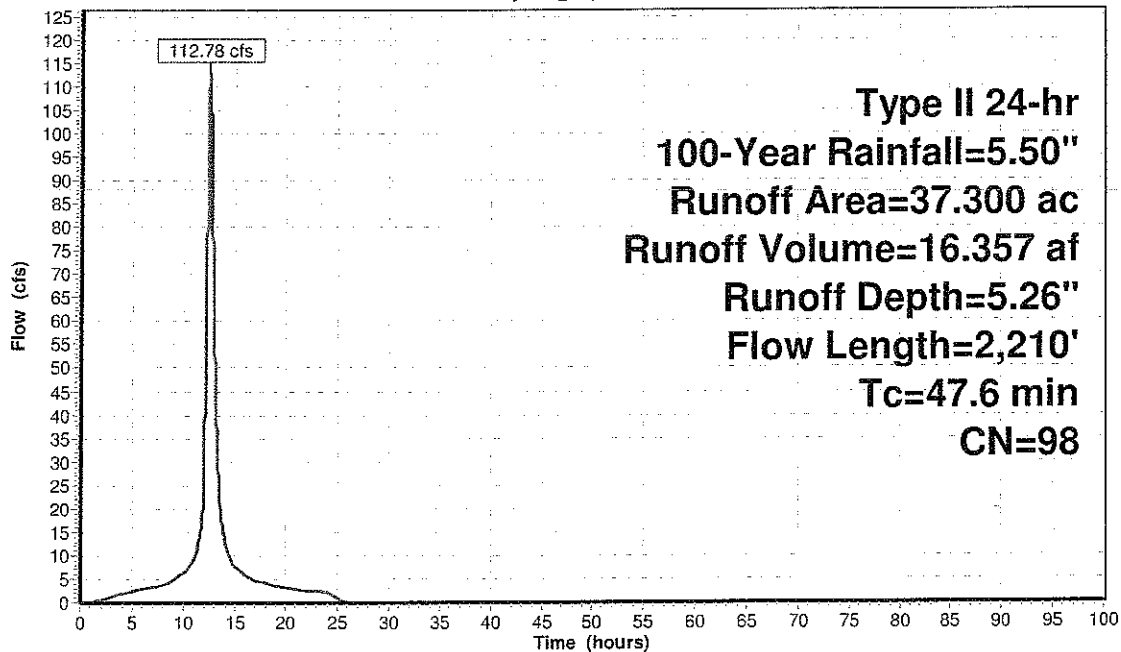
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
 Type II 24-hr 100-Year Rainfall=5.50"

Area (ac)	CN	Description
37.300	98	Paved parking, HSG C
37.300		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
37.5	100	0.0010	0.04		Sheet Flow, Grass: Short n= 0.150 P2= 2.40"
3.7	405	0.0150	1.84		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
6.4	1,705	0.0050	4.41	13.86	Pipe Channel, 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.015 Concrete sewer w/manholes & inlets
47.6	2,210	Total			

Subcatchment A 4: 37.3 AC

Hydrograph



LAKE COUNTY CENTER PARK ESTATES 7-31-13

Prepared by GGC ENGINEERS-NORTH OFFICE

HydroCAD® 10.00 s/n 02043 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 100-Year Rainfall=5.50"

Printed 7/26/2013

Page 55

Summary for Subcatchment A 5: 13.7AC

Runoff = 15.92 cfs @ 12.73 hrs, Volume= 2.756 af, Depth= 2.41"

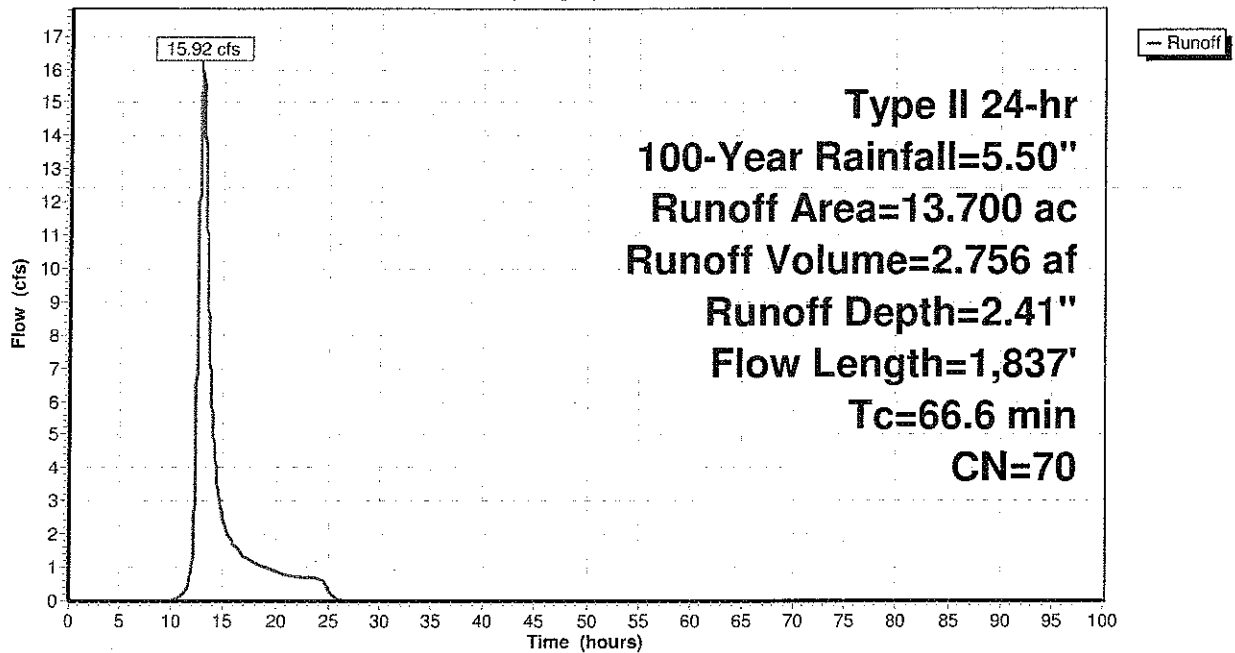
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Year Rainfall=5.50"

Area (ac)	CN	Description
13.700	70	Woods, Good, HSG C
13.700		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.7	100	0.0100	0.05		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 2.40"
10.5	943	0.0100	1.50		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
23.4	794	0.0040	0.57	3.39	Channel Flow, Area= 6.0 sf Perim= 7.0' r= 0.86' n= 0.150 Sheet flow over Short Grass
66.6	1,837	Total			

Subcatchment A 5: 13.7AC

Hydrograph



LAKE COUNTY CENTER PARK ESTATES 7-31-13

Type II 24-hr 100-Year Rainfall=5.50"

Prepared by GGC ENGINEERS-NORTH OFFICE

Printed 7/26/2013

HydroCAD® 10.00 s/n 02043 © 2013 HydroCAD Software Solutions LLC

Page 56

Summary for Pond 1P: TOPPS POND

Inflow Area = 234.850 ac, 36.10% Impervious, Inflow Depth = 2.94" for 100-Year event
 Inflow = 267.10 cfs @ 12.35 hrs, Volume= 57.563 af
 Outflow = 35.51 cfs @ 14.88 hrs, Volume= 57.377 af, Atten= 87%, Lag= 152.0 min
 Primary = 35.51 cfs @ 14.88 hrs, Volume= 57.377 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 681.89' @ 14.88 hrs Surf.Area= 124,129 sf Storage= 895,478 cf

Plug-Flow detention time= 346.7 min calculated for 57.371 af (100% of inflow)
 Center-of-Mass det. time= 338.2 min (1,365.4 - 1,027.2)

Volume	Invert	Avail.Storage	Storage Description
#1	673.00'	1,407,598 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
673.00	78,916	0	0
674.00	83,494	81,205	81,205
675.00	88,199	85,847	167,052
676.00	93,034	90,617	257,668
677.00	97,995	95,515	353,183
678.00	103,086	100,541	453,723
679.00	108,303	105,695	559,418
680.00	113,648	110,976	670,393
681.00	119,123	116,386	786,779
682.00	124,724	121,924	908,702
686.00	124,724	498,896	1,407,598

Device	Routing	Invert	Outlet Devices
#1	Primary	673.00'	30.0" Round Culvert L= 1,210.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 673.00' / 667.69' S= 0.0044 ' S= 0.0044 ' Cc= 0.900 n= 0.015, Flow Area= 4.91 sf
#2	Primary	676.00'	6.0" Vert. Orifice/Grate C= 0.600

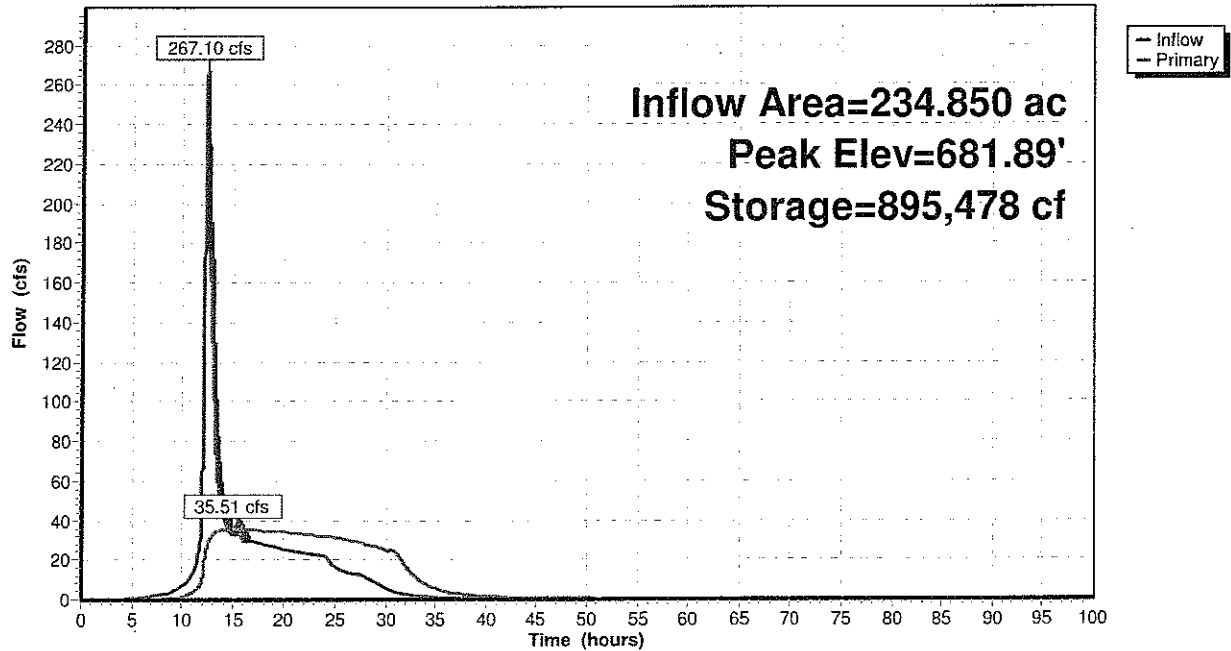
Primary OutFlow Max=35.51 cfs @ 14.88 hrs HW=681.89' (Free Discharge)

1=Culvert (Barrel Controls 33.27 cfs @ 6.78 fps)

2=Orifice/Grate (Orifice Controls 2.25 cfs @ 11.44 fps)

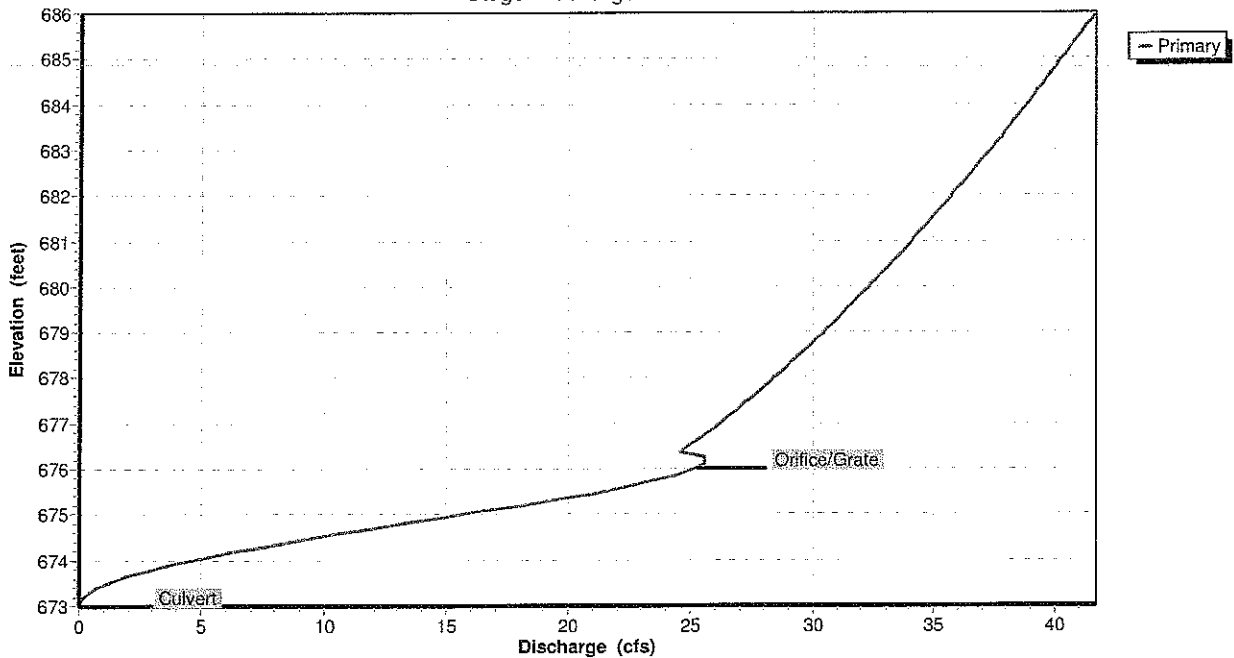
Pond 1P: TOPPS POND

Hydrograph

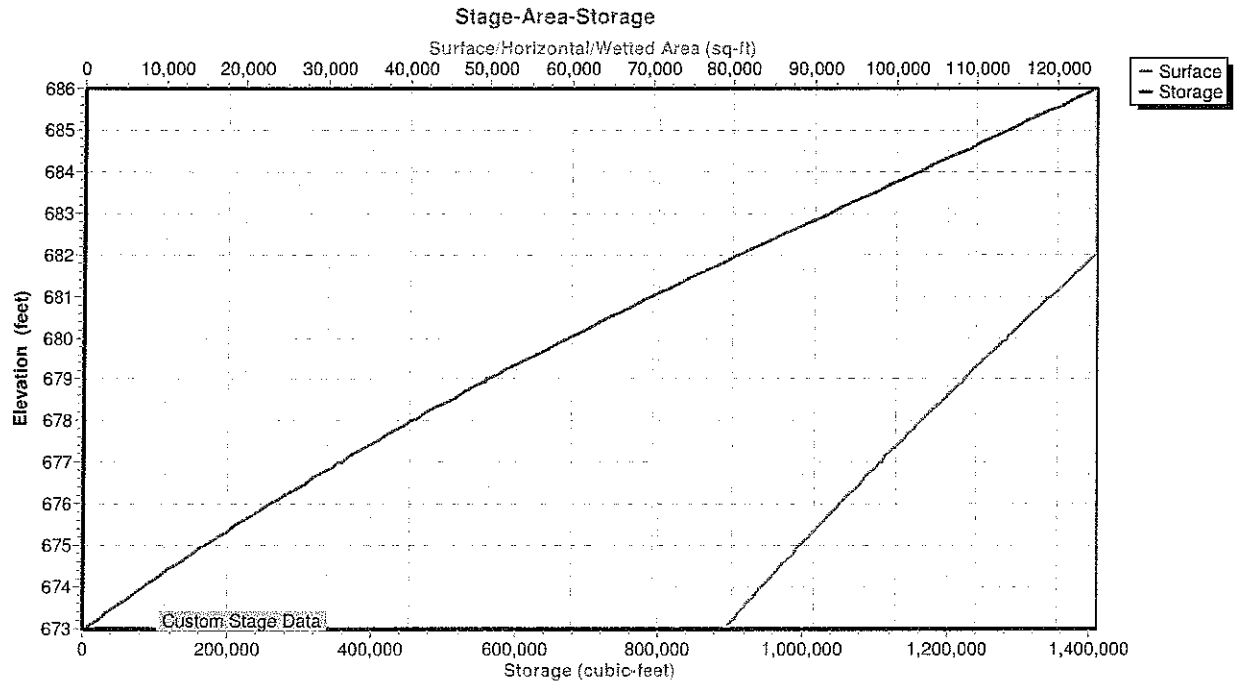


Pond 1P: TOPPS POND

Stage-Discharge



Pond 1P: TOPPS POND



LAKE COUNTY CENTER PARK ESTATES 7-31-13

Type II 24-hr 100-Year Rainfall=5.50"

Prepared by GGC ENGINEERS-NORTH OFFICE

Printed 7/26/2013

HydroCAD® 10.00 s/n 02043 © 2013 HydroCAD Software Solutions LLC

Page 59

Summary for Pond 2P: CAMBRIDGE POND

Inflow Area = 51.000 ac, 73.14% Impervious, Inflow Depth = 4.50" for 100-Year event
 Inflow = 124.84 cfs @ 12.43 hrs, Volume= 19.114 af
 Outflow = 96.41 cfs @ 12.83 hrs, Volume= 19.086 af, Atten= 23%, Lag= 23.7 min
 Primary = 96.41 cfs @ 12.83 hrs, Volume= 19.086 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 696.78' @ 12.83 hrs Surf.Area= 65,619 sf Storage= 282,457 cf

Plug-Flow detention time= 276.7 min calculated for 19.084 af (100% of inflow)
 Center-of-Mass det. time= 276.1 min (1,073.5 - 797.5)

Volume	Invert	Avail.Storage	Storage Description
#1	677.00'	282,457 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

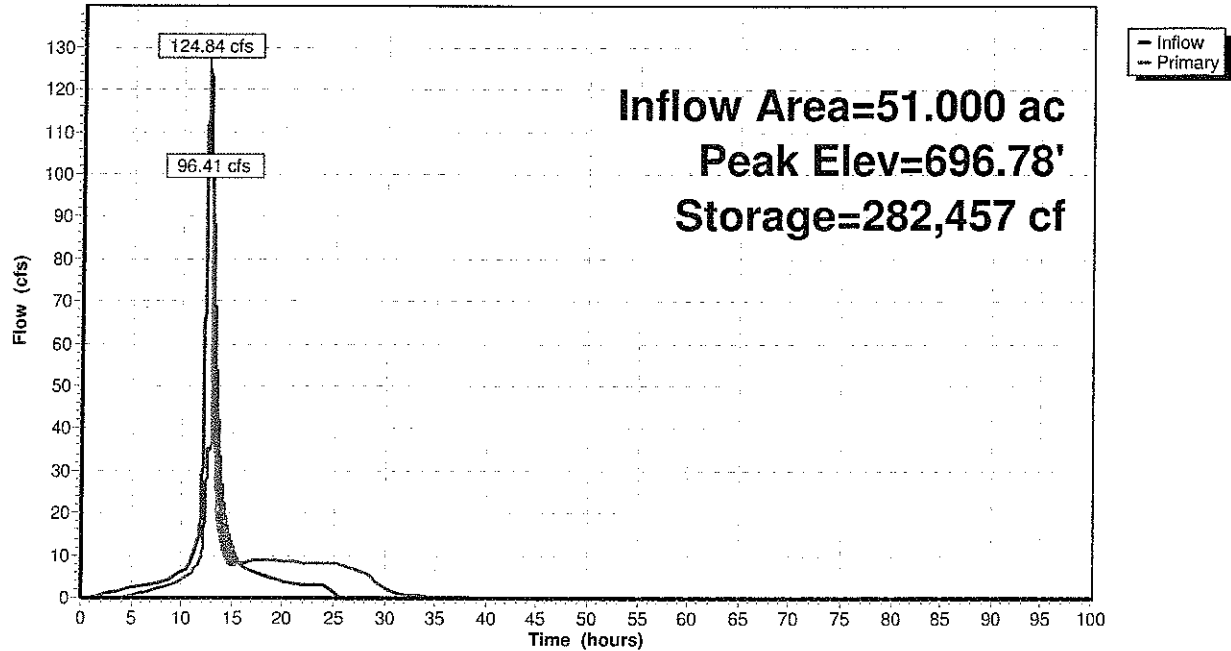
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
677.00	47,789	0	0
678.00	51,142	49,466	49,466
679.00	54,602	52,872	102,338
680.00	58,168	56,385	158,723
681.00	61,841	60,005	218,727
682.00	65,619	63,730	282,457

Device	Routing	Invert	Outlet Devices
#1	Primary	677.00'	30.0" Vert. Orifice/Grate C= 0.600

Primary OutFlow Max=96.41 cfs @ 12.83 hrs HW=696.62' TW=679.98' (Dynamic Tailwater)
 ↑ **1=Orifice/Grate** (Orifice Controls 96.41 cfs @ 19.64 fps)

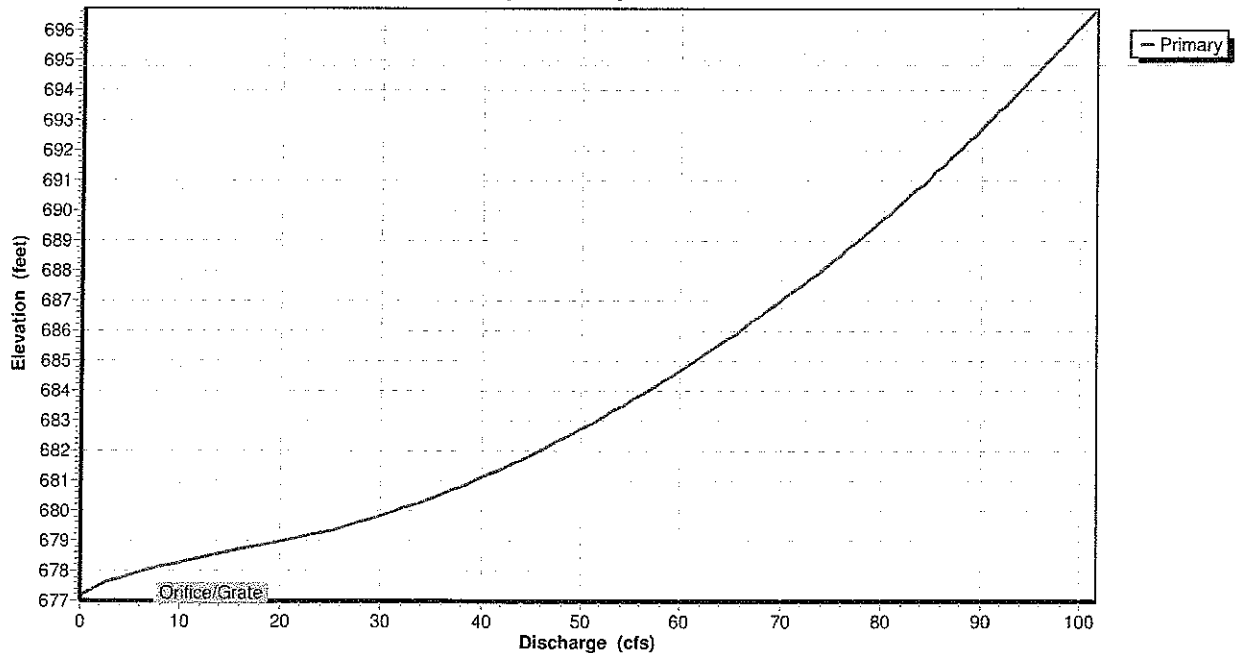
Pond 2P: CAMBRIDGE POND

Hydrograph

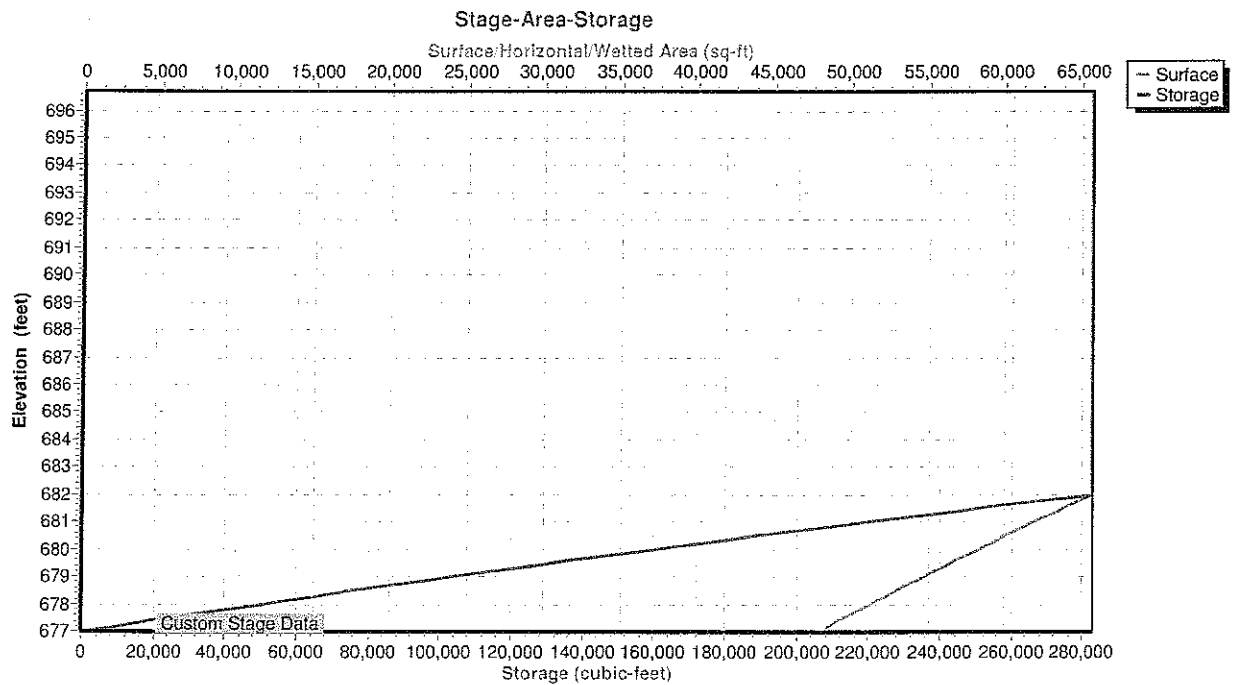


Pond 2P: CAMBRIDGE POND

Stage-Discharge



Pond 2P: CAMBRIDGE POND



LAKE COUNTY CENTER PARK ESTATES 7-31-13

Type II 24-hr 100-Year Rainfall=5.50"

Prepared by GGC ENGINEERS-NORTH OFFICE

Printed 7/26/2013

HydroCAD® 10.00 s/n 02043 © 2013 HydroCAD Software Solutions LLC

Page 62

Summary for Pond 3P: OPEN CHANNEL & STM SEWER

Inflow Area = 77.850 ac, 4.97% Impervious, Inflow Depth > 1.91" for 100-Year event
 Inflow = 19.11 cfs @ 15.42 hrs, Volume= 12.394 af
 Outflow = 19.22 cfs @ 15.42 hrs, Volume= 12.393 af, Atten= 0%, Lag= 0.0 min
 Primary = 19.22 cfs @ 15.42 hrs, Volume= 12.393 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 683.33' @ 15.42 hrs Surf.Area= 6,930 sf Storage= 12,348 cf

Plug-Flow detention time= 17.2 min calculated for 12.391 af (100% of inflow)
 Center-of-Mass det. time= 16.7 min (1,321.9 - 1,305.1)

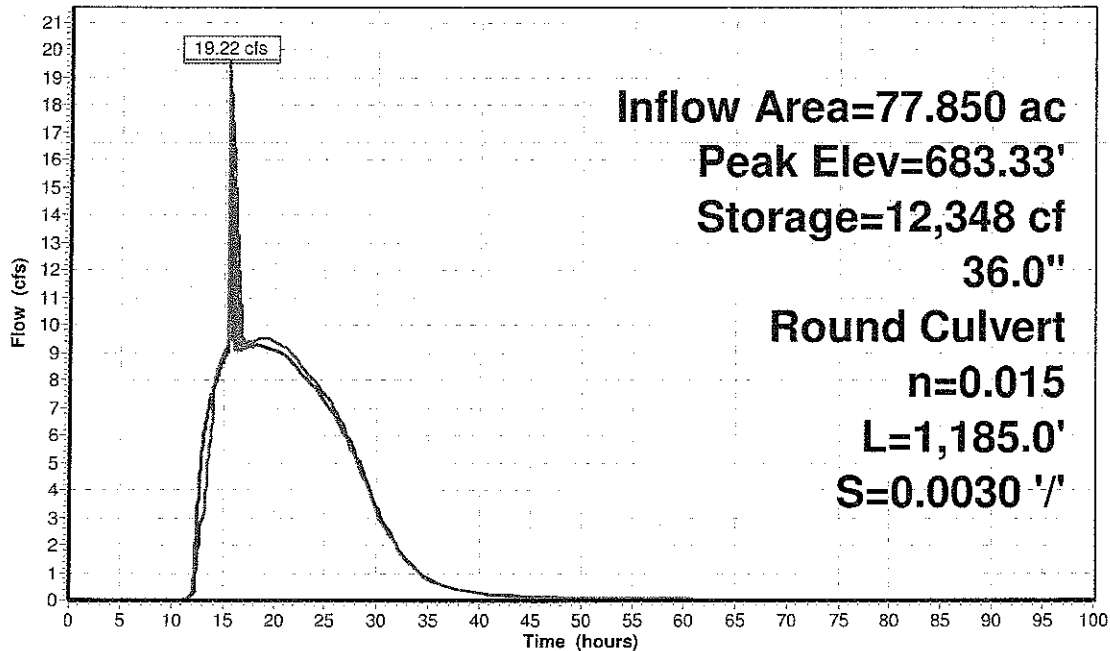
Volume	Invert	Avail.Storage	Storage Description
#1	679.00'	12,348 cf	3.00'W x 450.00'L x 3.00'H Prismatoid Z=2.0

Device	Routing	Invert	Outlet Devices
#1	Primary	679.00'	36.0" Round Culvert L= 1,185.0' Ke= 0.200 Inlet / Outlet Invert= 679.00' / 675.50' S= 0.0030 '/' Cc= 0.900 n= 0.015 Concrete sewer w/manholes & inlets, Flow Area= 7.07 sf

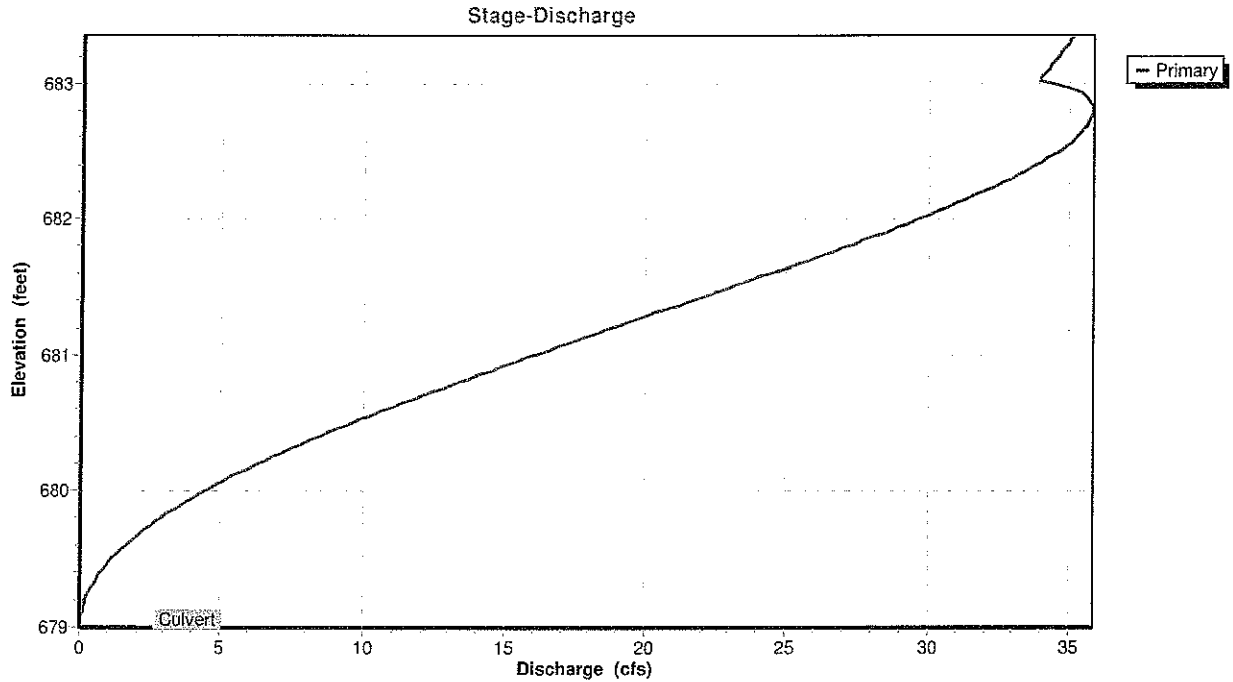
Primary OutFlow Max=19.22 cfs @ 15.42 hrs HW=683.33' TW=681.87' (Dynamic Tailwater)
 ↑ **1=Culvert** (Outlet Controls 19.22 cfs @ 2.72 fps)

Pond 3P: OPEN CHANNEL & STM SEWER

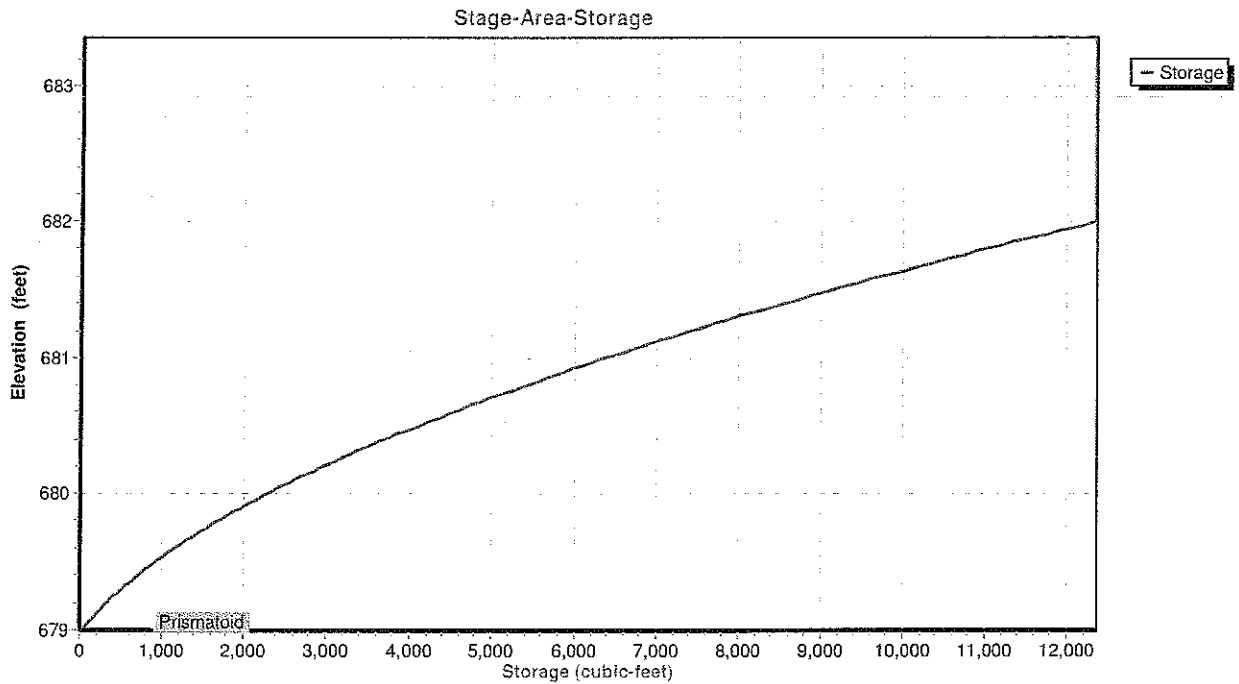
Hydrograph



Pond 3P: OPEN CHANNEL & STM SEWER



Pond 3P: OPEN CHANNEL & STM SEWER



LAKE COUNTY CENTER PARK ESTATES 7-31-13

Prepared by GGC ENGINEERS-NORTH OFFICE

HydroCAD® 10.00 s/n 02043 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 100-Year Rainfall=5.50"

Printed 7/26/2013

Page 64

Summary for Pond 4P: FAIRGROUNDS DETENTION

Inflow Area = 77.850 ac, 4.97% Impervious, Inflow Depth = 1.92" for 100-Year event
Inflow = 33.24 cfs @ 12.47 hrs, Volume= 12.427 af
Outflow = 19.11 cfs @ 15.42 hrs, Volume= 12.394 af, Atten= 43%, Lag= 177.0 min
Primary = 19.11 cfs @ 15.42 hrs, Volume= 12.394 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 699.66' @ 15.42 hrs Surf.Area= 1.322 ac Storage= 5.571 af

Plug-Flow detention time= 354.0 min calculated for 12.393 af (100% of inflow)
Center-of-Mass det. time= 352.5 min (1,305.1 - 952.6)

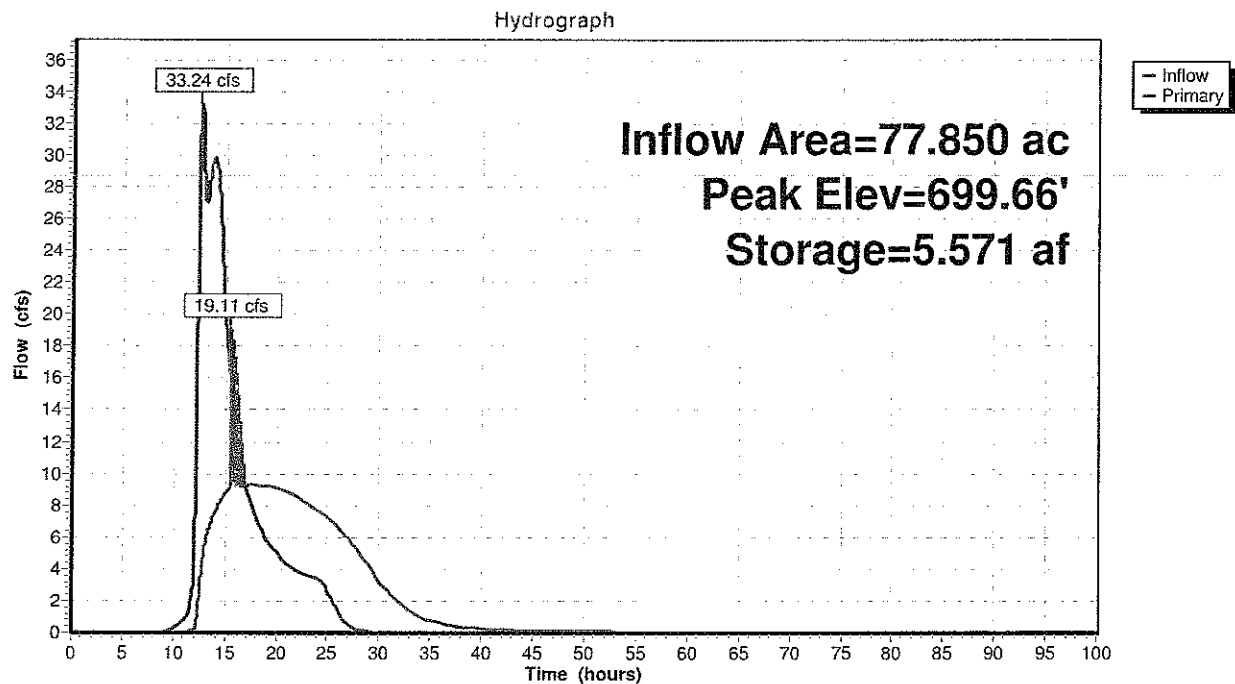
Volume	Invert	Avail.Storage	Storage Description
#1	681.00'	5.571 af	200.00'W x 200.00'L x 5.00'H Prismatic Z=4.0

Device	Routing	Invert	Outlet Devices
#1	Primary	681.00'	12.0" Vert. Orifice/Grate C= 0.600
#2	Primary	682.00'	6.0" Vert. Orifice/Grate C= 0.600

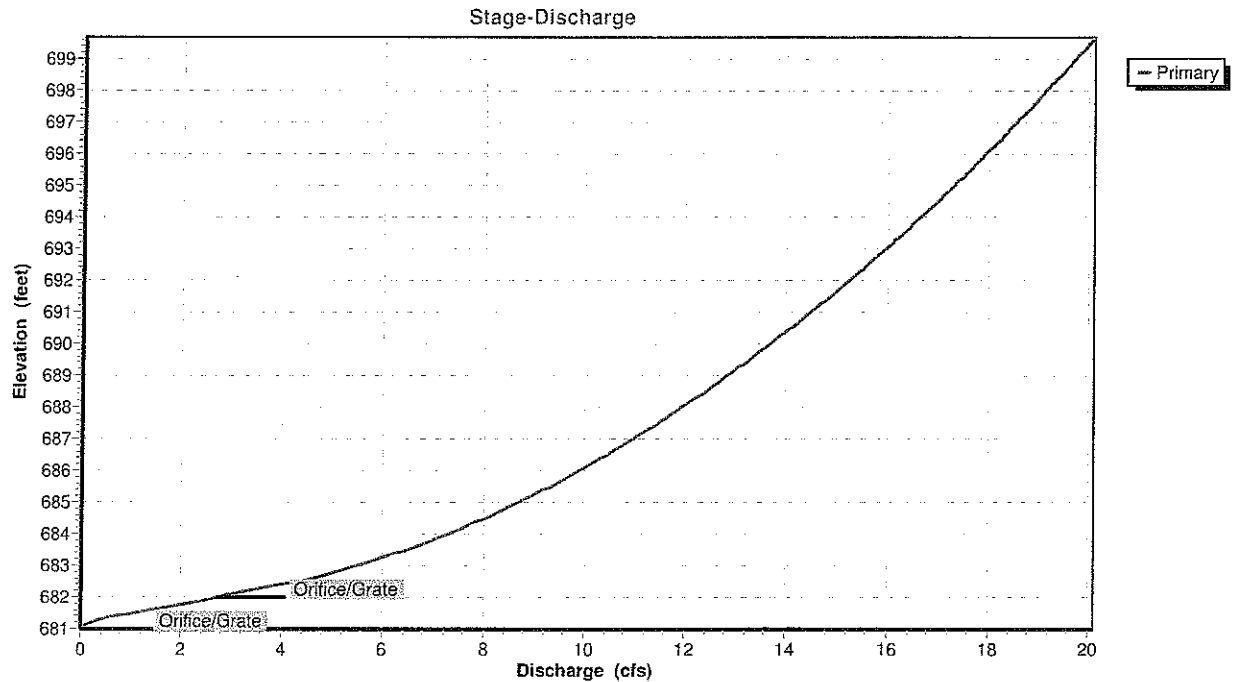
Primary OutFlow Max=19.11 cfs @ 15.42 hrs HW=699.66' TW=683.33' (Dynamic Tailwater)

1=Orifice/Grate (Orifice Controls 15.29 cfs @ 19.46 fps)

2=Orifice/Grate (Orifice Controls 3.82 cfs @ 19.46 fps)

Pond 4P: FAIRGROUNDS DETENTION

Pond 4P: FAIRGROUNDS DETENTION



Pond 4P: FAIRGROUNDS DETENTION

