

FINAL DRAINAGE REPORT

FOR GEOS NEIGHBORHOOD

Prepared For:

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This report for the final design of GEOS Neighborhood was prepared by me or under my direct supervisions in accordance with the provisions of the City of Arvada Engineering Code of Standards and Specifications. I understand that the City of Arvada and its designated City authority do not and will not assume liability for drainage facilities designed by others.

Travis J Nicholson

Colorado P.E. License No. 35814

Seal and Date

General Location and Description

The GEOS Neighborhood project is located in the northeast quarter of section 1, Township 3 south, Range 70 west of the Sixth Principal Meridian, County of Jefferson, State of Colorado.

The site is bounded by the Croke Canal to the west, 7031 Indiana Street to the north, Cottonwood Park in Ralston Valley to the east and Ralston Creek to the south.

There is a major drainageway facility adjacent to this site. Ralston Creek runs within the site along the entire southern boundary of the site.

The site is bound by one platted subdivision. The Cottonwood Park in Ralston Valley is to the east of the site.

The area of the site being annexed into the City of Arvada is 2.2 acres. The area being developed is 19.44 acres.

The majority of the site is covered in native grasses and weeds. The few trees on-site are next to Ralston Creek and the Croke Canal. There is a small cluster of bushes in the southeast corner of the site. The site is also covered with un-graded piles of fill material.

There are five soils found on site. The Alda loam is 11.3 percent of the site, the Nunn-variant urban land complex is 41.2 percent of the site, the Standley-Nunn gravelly clay loam is 36.3 percent of the site, the Valmont clay loam is 0.6 percent of the site and the Wann fine sandy loam is 10.6 percent of the site. All of the soils on site are hydrologic soil group C.

The proposed use of the site will be a unique mixture of facilities. Part of the site will be live/work units, single-family detached housing and a co-housing facility.

Drainage Basins and Sub-basins

Major Basin Description

The site is within the limits of the Ralston Creek – Leyden Creek Flood Hazard area Delineation report. The site is within the Ralston Creek reach R-5 narrative description. Adjacent to the site Ralston Creek has approximately 5550 cfs of discharge during the 100-year event.

According to FEMA FIRM panel 08059C0183E the southern portion of the site is in the 100-year floodplain. The portion of the site within the 100-year floodplain is not being developed.

The site was platted in 1978 but a drainage report for the previous platting could not be located.

In the existing condition there are two major basins on-site. The first basin is on the north half of the site. The north basin is approximately 13.4 acres and sheet flows in a northeasterly direction. The north basin flows to the north side of the existing Cottonwood Park in Ralston Valley facilities.

The second existing basin is on the south half of the site. The south basin sheet flows in an easterly direction and is directly tributary to Ralston Creek at Joyce Street. The south basin is approximately 11.9 acres.

There are two existing off-site basins to the north of the site. Both basins are not tributary to the site but need to be accounted for due to the access road to the site from Indiana Street. Both off-site basins sheet flow in an easterly direction towards Indiana Street. A culvert will need to be sized to allow the off-site flows to pass underneath the proposed access road and continue in the ditch on the west side of Indiana Street to Ralston Creek.

There are major irrigation facilities adjacent to the site. The Croke Canal runs along the west side of the site. The Croke Canal will remain in place; this project will not have any runoff flows tributary to the Croke Canal.

Drainage Design Criteria

Regulations

The GEOS Neighborhood project is in compliance with the City of Arvada's drainage policy. There will not be any development within a designated 100-year floodplain. The drainage design is in compliance with the Urban Drainage and Flood Control District Criteria Manual (UDFCD).

Development Criteria Reference and Constraints

The site was originally platted in 1978, the original drainage study could not be located for reference. With the many changes in criteria since the original report was written the site would still need to be in compliance with current standards. It is assumed that the original report is now out of compliance with current standards.

Hydrology Criteria

The site design rainfall events will be the 3.5-year initial storm and 100-year major storm per section 105 of the City of Arvada Engineering Code of Standards and Specifications (Code). The duration of the major storm will be 60 minutes.

The Rational Method will be used to determine the site runoff at the individual design points.

The detention pond volume will be determined using the UD&FCD spreadsheet for the modified FAA method.

The detention discharge rate will be from the Drainage Criteria Manual, Volumes 1, 2 and 3, Urban Drainage & Flood Control District (Manual) Table SO-1.

Hydraulic Criteria

The initial storm street capacity will be limited by back of curb overtopping or reaching the crown of the street. The major storm street capacity will be limited by the limits of the right-of-way or reaching the crown of the street.

The outlet structure for each pond will have control for water quality, the 10-year event and 100-year event, except Pond E, which will have water quality and pass the rest of the flows through.

Variance from Criteria

No variances from Criteria are requested at this time.

Drainage Facility Design

General Concept

The goal of the GEOS Neighborhood project is to mimic pre-development conditions and provide for decentralized detention and water quality treatment. To achieve the decentralized detention the GEOS Neighborhood project followed the concept from the Urban Drainage and Flood Control District to minimize directly connected impervious areas. To apply the minimized directly connected impervious areas the Urban Drainage and Flood Control District (UDFCD) grassed waterways facility was chosen. The grassed waterways will be in roadside rain gardens adjacent to the curb flowline and will increase the removal of suspended solids from the runoff. The use of the roadside rain gardens allows for a reduction in the required water quality capture volume for each detention pond.

For water to enter the roadside rain gardens curb openings where sized to allow the 3.5 – year event into the rain gardens. The roadside rain gardens are designed

to capture approximately 20 cubic feet of runoff per each rain garden. The typical roadway basin consists of approximately a third of the basin from the top back of curb to the right-of-way line and the other two-thirds is from the top back of curb to the centerline of the street. Basin D7 was chosen as a representative roadway basin since the area of the basin is the average size of all the roadway basins with 0.12 acres. The 3.5-year flow for the entire basin is 0.2 cfs. The 100-year flow behind the back of curb for the basin is $Q=CiA=0.5 * 6.8 * 0.0325 = 0.11$ cfs. The 100-year flow in the roadway portion of the basin is $Q=CiA=0.96 * 6.8 * 0.0875 = 0.57$ cfs. With a goal of 0.2 cfs allowed in the swale during the 100-year event per basin only 0.10 cfs is allowed to enter the swale from the roadway. On average there will be three openings spaced at 30 feet, per basin. This means that $0.10/3 = 0.03$ cfs per opening is allowed to enter from the roadway to the rain garden during the 100-year event. The opening size is 6 inches every 30 feet, please see the curb opening calculation in the appendix. With the 6-inch openings the larger events will still intercept approximately the 3.5-year flows with the remainder of the flows being collected by type R inlets in the street. Under drains will be placed in the rain gardens behind the back of curb and will tie into the type R inlets. The detention ponds will have under drains at the low points to mitigate wet conditions. The under drain will daylight at the drop just before the outlet structures. The outlet structures are design to fit into the landscape walls and will have 3 stage controls.

A steel plate bolted to the outlet will control the water quality capture volume. A weir set at the water quality capture volume water surface elevation and ends at the 10-year water surface elevation will control the 10-year flow. The top of the box is set at the 10-year water surface elevation to allow weir flow of the 100-year storm into the box. The 100-yr control is by an orifice plat bolted to the outlet pipe with the head set by the 100-year water surface elevation.

The SF-2 and SF-3 forms were used to determine the time of concentration and runoff rates for each design point for both the historic basins and the developed basins.

Table RO-11 from the Manual was used to determine the Runoff Coefficients.

Weighted C values were calculated for the site and have been included in appendix A.

Figure RO-1 from the Manual was used to determine the velocity of flow in the street for the time of concentration calculation.

The soil survey sheets were used to determine the type of soil on site and the hydrologic group of the soil, see appendix A.

The FEMA FIRM panel was used to determine if the site is within the limits of the 100-year floodplain, see appendix A.

The UD&FCD Detention Volume by Modified FAA Method spreadsheet was used to determine the required volume for both the 10-year and 100-year event.

The UD&FCD Extended Detention Basin spreadsheet was used to determine the size of the water quality storage needed for the detention pond.

The Allowable Release Rate spreadsheet was used to determine the allowable release rate from each detention pond.

The Detention pond WQCV spreadsheet was used to determine the design volume of the detention pond and determine the water quality opening sizing.

Table SO-1 from the Manual was used to determine the allowable release rate factor for the soil type.

To determine the final pipe size Hydroflow Storm Sewers 2008® was used to determine the pipe size based on the Manning's equation at each design point.

The historic drainage map shows the historic basins and routing.

The final drainage map shows the developed basins and routing.

Specific Details

Basin A also has detention pond A. Major Basin A has been divided into 12 sub-basins to determine flows. At the north and south end of the detention pond runoff will be conveyed from the street to the detention pond. A type R inlet will collect runoff at the street flowline and is sized to collect 100% basin runoff.

Basin B also has detention pond B. Major Basin B has been divided into 8 sub-basins to determine flows. There are 2 street flowline collection points that will be conveyed into pond B by a type R inlet connected to storm sewer piping.

Major Basin C does not have any detention facilities due to the restraints of developable land. Detention pond F has been sized to overdetain the runoff from basin F to compensate for the undetained flows from basin C.

Basin D also has detention pond D. Major Basin D has been divided into 8 sub-basins to determine flows. At the north and south end of the detention pond runoff will be conveyed from the street to the detention pond. A type R inlet will collect any runoff at the street flowline and is sized to collect 100% of the basin runoff.

Basin E also has detention pond E. Major Basin E has been divided into 7 sub-basins to determine flows. There are 2 street flowline collection points that will be conveyed into pond E by a type R inlet connected to storm sewer piping. Pond E does not meet the volume requirements of the major basin so the outlet structure

will be sized to pass the full 100-year runoff rates. Detention pond F has been sized to overdetain the runoff from basin F to compensate for the undetained flows from basin E.

Basin F also has detention pond F. Major Basin F has been divided into 2 sub-basins to determine flows. At the north end of the detention pond runoff will be conveyed from the street to the detention pond. A type R inlet will collect runoff at the street flowline and is sized to collect 100% of the basin runoff. Detention pond F has been oversized to compensate for basin C and E releasing undetained flows.

Basin G also has detention pond G. Major Basin G has been divided into 3 sub-basins to determine flows. At the north end of the detention pond runoff will be conveyed from the street to the detention pond. A type R inlet will collect runoff at the street flowline and is sized to collect 100% of the basin runoff.

Basin H also has detention pond H. Major Basin H has been divided into 5 sub-basins to determine flows. At the north end of the detention pond runoff will be conveyed from the street to the detention pond. A type R inlet will also collect runoff at the street flowline and is sized to collect 100% of the basin runoff.

Basin I also has detention pond I. The water will enter the pond from the surface only. The runoff west and north of the pond will sheet flow into the pond. The block developer will complete the detail design of this pond.

Basin J also has detention pond J. The water will enter the pond from the surface only. The runoff west and north of the pond will sheet flow into the pond. The runoff from the pond will be routed to Ralston Creek. The block developer will complete the detail design of this pond.

Basin L is the portion of West 69th Place east of the Geos Neighborhood and the Indiana Court connection. This basin consists of the mostly the roadway and a small portion of flows adjacent to the street. The runoff from this basin will be conveyed along the roadway and into an open channel sized to convey the 100-year flow to the roadside swale in Indiana Street.

Conclusions

Compliance with Standards

This drainage report is in compliance with all applicable criteria.

Drainage Concept

The drainage plan for this site effectively controls the minor and major event storm water runoff. The maintenance of the storm sewer system and detention ponds will be by the GEOS Neighborhood Home Owners Association. The erosion control plan effectively mitigates the erosion of sediment to acceptable standards.

References

1. City of Arvada Engineering Code of Standards and Specifications, January 2007 edition.
2. Drainage Criteria Manual, Volumes 1 & 2 and 3, Urban Drainage & Flood Control District.
3. Flood Insurance Rate Map, Jefferson County, Colorado and Incorporated Areas, Map Number 08059C0183 E, Effective Date June 17, 2003.
4. FlowMaster v5.11 by Haestad Methods, Inc.
5. Hydraflow Storm Sewers version 11.0.0.0 by Intelisolve

Appendix

A. Hydrology

- SF-2 Form Time of Concentration - Historic
- SF-3 Form 3.5-year Rational Method- Historic
- SF-3 Form 100-year Rational Method - Historic
- SF-2 Form Time of Concentration – Developed
- SF-3 Form 3.5-year Rational Method- Developed
- SF-3 Form 100-year Rational Method - Developed
- Weighted Percent Imperviousness Calculation
- Weighted 3.5-year Runoff Coefficients
- Weighted 5-year Runoff Coefficients
- Weighted 10-year Runoff Coefficients
- Weighted 100-year Runoff Coefficients
- Table RO-3
- Table RO-5
- Figure RO-1
- FEMA FIRM Panel
- Hydrologic Group
- Hydrologic Group Map Information
- Hydrologic Group Description
- Soil Survey Map
- Soil Survey Map Information
- Soil Survey Map Legend

B. Hydraulics

- Required Detention Pond Volume Summary
- Minor Detention Volume – Pond A
- Major Detention Volume – Pond A
- Water Quality Capture Volume – Pond A
- Minor Detention Volume – Pond B
- Major Detention Volume – Pond B
- Water Quality Capture Volume – Pond B
- Minor Detention Volume – Pond C
- Major Detention Volume – Pond C
- Water Quality Capture Volume – Pond C
- Minor Detention Volume – Pond D
- Major Detention Volume – Pond D
- Water Quality Capture Volume – Pond D
- Minor Detention Volume – Pond E
- Major Detention Volume – Pond E
- Water Quality Capture Volume – Pond E
- Minor Detention Volume – Pond F
- Major Detention Volume – Pond F
- Water Quality Capture Volume – Pond F

Minor Detention Volume – Pond G
Major Detention Volume – Pond G
Water Quality Capture Volume – Pond G
Minor Detention Volume – Pond H
Major Detention Volume – Pond H
Water Quality Capture Volume – Pond H
Minor Detention Volume – Pond I
Major Detention Volume – Pond I
Water Quality Capture Volume – Pond I
Minor Detention Volume – Pond J
Major Detention Volume – Pond J
Water Quality Capture Volume – Pond J
Figure RO-8
Provided Detention Pond Volume Summaries
Allowable Release Rates
Sizing Outlet Structures
Inlet Calculations for Type R inlets
Curb Opening Sizing
Emergency Overflow Calculation
Culvert Sizing for OS-1
Hydroflow Storm Sewer ® Calculations

C. Drainage Map

Historic Map 1 of 4
Developed Map 2 of 4
Developed Map 3 of 4
Usage Map 4 of 4

Appendix A

Hydrology

SF-2 Form Time of Concentration - Historic
SF-3 Form 3.5-year Rational Method- Historic
SF-3 Form 100-year Rational Method - Historic
SF-2 Form Time of Concentration – Developed
SF-3 Form 3.5-year Rational Method- Developed
SF-3 Form 100-year Rational Method - Developed
Weighted Percent Imperviousness Calculation
Weighted 3.5-year Runoff Coefficients
Weighted 5-year Runoff Coefficients
Weighted 10-year Runoff Coefficients
Weighted 100-year Runoff Coefficients
Table RO-3
Table RO-5
Figure RO-1
FEMA FIRM Panel
Hydrologic Group
Hydrologic Group Map Information
Hydrologic Group Description
Soil Survey Map
Soil Survey Map Information
Soil Survey Map Legend

**STANDARD FORM SF-2
TIME OF CONCENTRATION**

SUBDIVISION GEOS-Historic Condition
CALCULATED BY NRW DATE 6/6/2006

SUB-BASIN DATA			INITIAL/OVERLAND TIME (Ti)			TRAVEL TIME (Tt)				Tc CHECK (URBANIZED BASINS)			FINAL Tc	REMARKS
DESIG:	AREA Ac (2)	C5 (3)	LENGTH Ft (4)	SLOPE % (5)	Ti Min (6)	LENGTH Ft (7)	SLOPE % (8)	VEL. FPS (9)	Tt Min (10)	COMP. Tc (11)	TOTAL LENGTH (ft) (12)	Tc Min (13)	Min (14)	
1	24.92	0.13	300	1.0	30.2	1921	1.0	1.0	32.0	62.3	2221	22.3	22.3	Basin OS-1
2	1.65	0.13	193	1.3	22.5	917	1.2	1.1	13.9	36.4	1110	16.2	16.2	Basin OS-2
3	14.47	0.13	300	4.0	19.2	980	1.4	0.8	20.4	39.6	1280	17.1	17.1	Basin E-1
4	4.67	0.13	300	1.8	25.0	675	1.4	0.8	14.1	39.0	975	15.4	15.4	Basin E-2
5	6.99	0.13	294	5.0	17.6	2455	0.6	1.2	34.1	51.7	2749	25.3	25.3	Basin OS-3

CALCULATED BY NRW
 DATE 6/6/2006
 CHECKED BY _____

STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

JOB NO. 05-056-01
 PROJECT GEOS
 DESIGN STORM 3.5 year- Existing

STREET		DESIGN POINT	DIRECT RUNOFF								TOTAL RUNOFF				STREET		PIPE		TRAVEL TIME			REMARKS
			AREA DESIGN	AREA (AC)	RUNOFF COEFF	Tc (MIN)	C'A (AC)	I (IN/HR)	Q (CFS)	Tc (MIN)	SUM C'A (AC)	I (IN/HR)	Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE	LENGTH (FT)	VELOCIT Y (FPS)	TL (MIN)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	
		3	Basin E-1	14.47	0.13	17.1	1.88	3.0	5.6												TO DP 2	
		2	Basin OS-2	1.65	0.13	16.2	0.21	3.1	0.7	17.1	2.10	3.0	6.2			6.2			263	3	1.5	TO DP 1
		1	Basin OS-1	24.92	0.13	22.3	3.24	2.5	8.0	22.3	5.34	2.5	13.2			13.2						To Rasilton Creek (Indiana)
		4	Basin E-2	4.67	0.13	15.4	0.61	3.2	1.9							1.9			130	3.3	0.7	TO DP 4
		5	Basin OS-3	6.99	0.13	25.3	0.91	2.3	2.1	25.3	1.52	2.3	3.5									To Rasilton Creek (Joyce)

CALCULATED BY NRW
 DATE 6/6/2006
 CHECKED BY _____

STANDARD FORM SF-3
 STORM DRAINAGE SYSTEM DESIGN
 (RATIONAL METHOD PROCEDURE)

JOB NO. 05-056-01
 PROJECT GEOS
 DESIGN STORM 100 year- Existing

STREET	DESIGN POINT	AREA DESIGN	DIRECT RUNOFF					TOTAL RUNOFF					STREET		PIPE			TRAVEL TIME			REMARKS
			AREA (AC)	RUNOFF COEFF	T _c (MIN)	C*A (AC)	I (IN/HR)	Q (CFS)	T _c (MIN)	SUM C*A (AC)	I (IN/HR)	Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE	LENGTH (FT)	VELOCITY (FPS)	TI (MIN)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	
	3	Basin E-1	14.47	0.52	17.1	7.52	5.2	39.1							43.6			263	3.7	1.2	TO DP 2
	2	Basin OS-2	1.65	0.52	16.2	0.86	5.4	4.7	17.1	8.38	5.2	43.6									TO DP 1
	1	Basin OS-1	24.92	0.52	22.3	12.96	4.3	56.0	22.3	21.34	4.3	92.3									To Rasilton Creek (Indiana)
	4	Basin E-2	4.67	0.52	15.4	2.43	5.6	13.6							13.6			130	5.3	0.4	TO DP 4
	5	Basin OS-3	6.99	0.52	25.3	3.63	4.1	14.8	25.3	6.06	4.1	24.7									To Rasilton Creek (Joyce)

STANDARD FORM SF-2
TIME OF CONCENTRATION

SUBDIVISION GEOS-Minimizing Directly Connected Impervious Areas
CALCULATED BY TJN DATE 2/7/2008

DESIGN POINT	SUB-BASIN DATA			INITIAL/OVERLAND TIME (Ti)		TRAVEL TIME (Tt)				Tc CHECK With addition of 6A (URBANIZED BASINS)				FINAL Tc	REMARKS
	BASIN ID (1)	AREA Ac (2)	C5 (3)	LENGTH Ft (4)	SLOPE % (5)	Ti Min (6)	LENGTH Ft (7)	SLOPE % (8)	VEL. FPS (9)	Tt Min (10)	COMP. Tc (11)	TOTAL LENGTH (ft) (12)	Tc Min (13)	Min (14)	
1	A1	0.18	0.50	190	1.9	12.0					12.0	190	11.1	11.1	
2	A2	0.12	0.50	170	1.9	11.3					11.3	170	10.9	10.9	
3	A3	0.64	0.50	155	1.8	11.1	175	0.8	1.3	2.2	13.3	330	11.8	11.8	
4	A4	0.31	0.50	135	1.5	10.9	70	0.8	1.3	0.9	11.8	205	11.1	11.1	
5	A5	0.15	0.50	16	2.0	3.4	200	0.8	1.3	2.6	6.0	216	11.2	10.0	
6	A6	0.09	0.50	50	2.0	6.0	60	1.4	1.8	0.6	6.6	110	10.6	10.0	
7	A7	0.81	0.50	120	2.2	9.1	370	0.6	1.6	3.9	12.9	490	12.7	12.7	
8	A8	0.08	0.50	40	2.0	5.4	80	2.0	2.0	0.7	6.1	120	10.7	10.0	
9	A9	0.09	0.50	30	2.0	4.7	100	2.3	2.2	0.8	5.4	130	10.7	10.0	
10	A10	0.03	0.50	25	2.0	4.3					4.3	25	10.1	10.0	
11	A11	0.83	0.50	45	6.0	4.0	165	1.0	1.5	1.8	5.8	210	11.2	10.0	
12	A12	0.26	0.50	78	2.0	7.5	185	1.2	1.6	1.9	9.5	263	11.5	10.0	
13	B1	0.08	0.51	20	2.0	3.8	105	0.8	1.3	1.3	5.1	125	10.7	10.0	
14	B2	0.10	0.51	20	2.0	3.8	120	0.8	1.3	1.5	5.3	140	10.8	10.0	
15	B3	0.19	0.51	20	2.0	3.8	175	1.9	2.0	1.5	5.2	195	11.1	10.0	
16	B4	0.09	0.51	15	2.0	3.3	125	2.9	2.3	0.9	4.2	140	10.8	10.0	
17	B5	0.09	0.51	15	2	3.3	125	2.9	2.3	0.9	4.2	140	10.8	10.0	
18	B6	0.79	0.51	120	1.5	10.2	350	1.1	1.5	3.9	14.1	470	12.6	12.6	
19	B7	0.76	0.51	140	1.7	10.5	128	1.0	1.5	1.4	12.0	268	11.5	11.5	
20	B8	0.25	0.51	16	2	3.4	350	1.9	2.6	2.2	5.6	366	12.0	10.0	
21	C1	1.04	0.59	110	3.2	6.6	270	1.7	2.4	1.9	8.4	380	12.1	10.0	
22	C2	1.03	0.59	175	3.3	8.2					8.2	175	11.0	10.0	
23	D1	0.47	0.48	190	2	12.2	106	0.8	1.3	1.4	13.6	296	11.6	11.6	
24	D2	0.08	0.48	16	2	3.6	75	0.8	1.3	1.0	4.5	91	10.5	10.0	
25	D3	0.08	0.48	40	2	5.6	75	2.0	2.0	0.6	6.2	115	10.6	10.0	
26	D4	0.90	0.48	105	1.2	10.8	370	2.2	2.2	2.8	13.6	475	12.6	12.6	
27	D5	0.13	0.48	16	2	3.6	160	1.2	1.6	1.7	5.2	176	11.0	10.0	
28	D6	0.05	0.48	20	70	1.2	70	1.2	1.6	0.7	2.0	90	10.5	10.0	
29	D7	0.12	0.48	18	2	3.8	100	1.3	1.6	1.0	4.8	118	10.7	10.0	
30	D8	0.92	0.48	135	5.5	7.4	150	1.0	1.5	1.7	9.1	285	11.6	10.0	
31	E1	0.21	0.49	65	1	8.9	90	2.0	2.0	0.8	9.6	155	10.9	10.0	
32	E2	0.17	0.49	65	1	8.9	90	1.8	2.0	0.8	9.6	155	10.9	10.0	
33	E3														Removed
34	E4	0.1	0.49	16	2	3.5	75	0.8	1.3	1.0	4.5	91	10.5	10.0	
35	E5	0.08	0.49	25	2	4.4	105	0.8	1.3	1.3	5.7	130	10.7	10.0	
36	E6	0.56	0.49	115	1	11.8	280	1.6	2.4	1.9	13.7	395	12.2	12.2	
37	E7	0.58	0.49	120	2.7	8.7	150	1.0	1.5	1.7	10.3	270	11.5	10.3	
38	F1	0.87	0.44	190	2	13.0	500	1.0	1.5	5.6	18.6	690	13.8	13.8	
39	F2	0.99	0.44	430	1.5	21.5	150	1.0	1.5	1.7	23.2	580	13.2	13.2	
40	G1	0.08	0.54	16	2	3.2	110	2.0	2.0	0.9	4.1	126	10.7	10.0	
41	G2	0.14	0.54	20	2	3.6	150	1.4	1.6	1.6	5.1	170	10.9	10.0	
42	G3	1.06	0.54	265	2.3	12.5	95	1.0	1.5	1.1	13.5	360	12.0	12.0	
43	H1	0.17	0.70	30	2	3.1	80	1.6	1.8	0.7	3.9	110	10.6	10.0	
44	H2	0.17	0.70	22	2	2.7	195	1.7	1.8	1.8	4.5	217	11.2	10.0	
45	H3	0.07	0.70	16	2	2.3	95	1.3	1.6	1.0	3.3	111	10.6	10.0	
46	H4	0.17	0.70	22	2	2.7	195	1.7	1.8	1.8	4.5	217	11.2	10.0	
47	H5	0.43	0.70	180	2.9	6.8	25	1.0	1.5	0.3	7.1	205	11.1	10.0	
48	I	0.84	0.35	112	2.7	10.3	260	1.0	1.5	2.9	13.2	372	12.1	12.1	
49	J	1.4	0.47	300	1	19.6	105	1.0	1.5	1.2	20.8	405	12.3	12.3	
50	K	6.89	0.15	115	15	7.5	1220	1.6	1.8	11.3	18.8	1335	17.4	17.4	
51	L	1.82	0.9	25	2	1.4	1205	1.0	1.5	13.4	14.8	1230	16.8	14.8	

CALCULATED BY TJN
DATE 2/7/2008
CHECKED BY

STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

JOB NO. 05-056-01
PROJECT GEOS
DESIGN STORM 3.5 year- Developed

STREET		DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE				TRAVEL TIME			REMARKS
			AREA DESIGN	AREA (AC)	RUNOFF COEFF	Tc (MIN)	C*A (AC)	I (IN/HR)	Q (CFS)	Tc (MIN)	SUM C*A (AC)	I (IN/HR)	Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE	LENGTH (FT)	VELOCIT Y (FPS)	Tt (MIN)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)		
		1	A1	0.18	0.48	11.1	0.09	3.7	0.3							0.3	0.50	8	18	2.79	0.1	TO DP 2	
		2	A2	0.12	0.48	10.9	0.06	3.7	0.2	11.2	0.14	3.7	0.5			0.5	0.50	8	175	7.82	0.4	TO DP 3	
		3	A3	0.64	0.48	11.8	0.31	3.6	1.1	11.8	0.45	3.6	1.6			1.6	0.50	15	70	4.23	0.3	TO DP 4	
		4	A4	0.31	0.48	11.1	0.15	3.7	0.6	12.1	0.60	3.6	2.1			2.1	0.80	15	75	5.38	0.2	TO DP 6	
		5	A5	0.15	0.48	10.0	0.07	3.8	0.3							0.3	0.50	8	60	2.74	0.4	TO DP 6	
		6	A6	0.09	0.48	10.0	0.04	3.8	0.2	12.3	0.72	3.6	2.5			2.5	1.10	15	75	6.31	0.2	TO DP 7	
		7	A7	0.81	0.48	12.7	0.39	3.5	1.4	12.7	1.10	3.5	3.9			3.9	0.50	24	75	5.38	0.2	TO Pond A	
		8	A8	0.08	0.48	10.0	0.04	3.8	0.1							0.1	0.50	8	60	2.35	0.4	TO DP 9	
		9	A9	0.09	0.48	10.0	0.04	3.8	0.2	10.4	0.08	3.8	0.3			0.3	0.50	8	60	2.79	0.4	TO Pond A	
		10	A10	0.03	0.48	10.0	0.01	3.8	0.1	10.8	0.10	3.8	0.4			0.4	0.60	8	50	3.06	0.3	TO Pond A	
		11	A11	0.83	0.48	10.0	0.40	3.8	1.5	12.9	1.60	3.5	5.6			3.3	0.50	12	50	2.64	0.3	TO DP 19A	
		12	A12	0.26	0.48	10.0	0.12	3.8	0.5														
		13	B1	0.08	0.48	10.0	0.04	3.8	0.1							0.1	0.50	8	60	2.41	0.4	TO DP 14	
		14	B2	0.10	0.48	10.0	0.05	3.8	0.2	10.4	0.09	3.8	0.3			0.3	0.50	12	60	2.94	0.3	TO DP 16	
		15	B3	0.19	0.48	10.0	0.09	3.8	0.4							0.4	0.50	12	60	2.94	0.3	TO DP 16	
		16	B4	0.09	0.48	10.0	0.04	3.8	0.2	10.8	0.2	3.8	0.8			0.8	0.50	12	42	3.62	0.2	TO POND B	
		17	B5	0.09	0.48	10.0	0.04	3.8	0.2							0.2	0.50	8	60	2.41	0.4	TO DP 18	
		18	B6	0.79	0.48	12.6	0.38	3.5	1.3	12.6	0.42	3.5	1.5			1.5	1.20	12	17	5.68	0.0	TO POND B	
		19	B7	0.76	0.48	11.5	0.36	3.7	1.3	12.6	1.01	3.5	3.5			2.1	0.70	12	17	3.60	0.1	TO DP 19A	
		19A														5.4	0.70	15	1600	5.03	5.3	To Indiana	
		20	B8	0.25	0.48	10.0	0.12	3.8	0.5														
		21	C1	1.04	0.57	10.0	0.59	3.8	2.3													Undetained	
		22	C2	1.03	0.57	10.0	0.59	3.8	2.3													Undetained	
		23	D1	0.47	0.46	11.6	0.22	3.6	0.8							0.8	0.50	12	75	3.60	0.3	TO DP 25	
		24	D2	0.08	0.46	10.0	0.04	3.8	0.1							0.1	0.50	8	50	2.41	0.3	TO DP 25	
		25	D3	0.08	0.46	10.0	0.04	3.8	0.1	12.0	0.29	3.6	1.0			1.0	0.65	12	60	4.18	0.2	TO DP 26	
		26	D4	0.90	0.46	12.6	0.41	3.5	1.5	12.6	0.70	3.5	2.5			2.5	0.50	18	40	4.76	0.1	TO Pond D	
		27	D5	0.13	0.46	10.0	0.06	3.8	0.2							0.2	0.50	8	60	2.66	0.4	TO DP 28	
		28	D6	0.05	0.46	10.0	0.02	3.8	0.1	10.4	0.08	3.8	0.3			0.3	0.50	8	60	2.79	0.4	TO DP 28	
		29	D7	0.12	0.46	10.0	0.06	3.8	0.2	10.7	0.14	3.8	0.5			0.5	0.50	12	60	3.30	0.3	TO Pond D	
		30	D8	0.92	0.46	10.0	0.42	3.8	1.6	12.8	1.27	3.5	4.4			2.8	0.70	12	360	4.33	1.4	TO DP 37A	
		31	E1	0.21	0.47	10.0	0.10	3.8	0.4							0.4	0.55	12	60	3.84	0.3	TO DP 32	
		32	E2	0.17	0.47	10.0	0.08	3.8	0.3	10.3	0.18	3.8	0.7			0.7	0.50	15	70	10.88	0.1	TO Pond E	
		34	E4	0.10	0.47	10.0	0.05	3.8	0.2	10.0	0.05	3.8	0.2			0.2	0.75	12	14	4.49	0.1	TO Pond E	
		35	E5	0.08	0.47	10.0	0.04	3.8	0.1							0.1	0.50	8	40	2.24	0.3	TO DP 36	
		36	E6	0.56	0.47	12.2	0.26	3.6	0.9	12.2	0.30	3.6	1.1			2.8	0.65	12	20	4.18	0.1	TO Pond E	
		37	E7	0.58	0.47	10.3	0.27	3.8	1.0	12.3	0.80	3.6	2.9			3.0	0.80	12	37	4.63	0.1	TO DP 37A	
		38	F1	0.87	0.41	13.8	0.36	3.4	1.2							1.2	1.00	12	45	5.18	0.1	TO DP 38	
		39	F2	0.99	0.41	13.2	0.41	3.4	1.4	13.9	0.76	3.4	2.6			1.9	0.50	12	60	3.53	0.3	TO Ralston	
		40	G1	0.08	0.51	10.0	0.04	3.8	0.2							0.2	0.50	8	40	2.41	0.3	TO DP 41	
		41	G2	0.14	0.51	10.0	0.07	3.8	0.3	10.3	0.11	3.8	0.4			0.4	0.50	12	45	3.10	0.2	TO Pond G	
		42	G3	1.06	0.51	12.0	0.54	3.6	1.9	12.0	0.65	3.6	2.3			1.3	0.50	12	50	3.24	0.3	TO Ralston	
		43	H1	0.17	0.69	10.0	0.12	3.8	0.5							0.5	0.50	8	40	2.41	0.3	TO DP 44	
		44	H2	0.17	0.69	10.0	0.12	3.8	0.5	10.3	0.23	3.8	0.9			0.9	0.50	12	40	3.24	0.2	TO DP 46	
		45	H3	0.07	0.69	10.0	0.05	3.8	0.2							0.2	0.50	8	40	2.41	0.3	TO DP 46	
		46	H4	0.17	0.69	10.0	0.12	3.8	0.5	10.3	0.40	3.8	1.5			1.5	0.55	12	75	3.84	0.3	TO DP 47	
		47	H5	0.43	0.69	10.0	0.30	3.8	1.1	10.6	0.70	3.8	2.6			0.9	0.50	12	50	2.95	0.3	TO Ralston	
		48	I	0.84	0.31	12.1	0.26	3.6	0.9							0.8	0.50	8	30	2.79	0.2	TO Ralston	
		49	J	1.40	0.44	12.3	0.62	3.6	2.2							4.1	0.50	15	22	4.22	0.1	TO Ralston	
		50	K	6.89	0.10	17.4	0.69	2.9	2.0							2.0	0.50	12	50	2.95	0.3	TO Ralston	
		51	L	1.82	0.88	14.8	1.60	3.2	5.2														

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STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

JOB NO. 05-056-01
PROJECT GEOS
DESIGN STORM 100 year- Developed

STREET		DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
			AREA DESIGN	AREA (AC)	RUNOFF COEFF	Tc (MIN)	C*A (AC)	I (IN/HR)	Q (CFS)	Tc (MIN)	SUM C*A (AC)	I (IN/HR)	Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE	LENGTH (FT)	VELOCITY (FPS)	Tt (MIN)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)		
	1	A1	0.18	0.70	11.1	0.13	6.6	0.8							0.8	0.50	8	18	2.79	0.1	TO DP 2	
	2	A2	0.12	0.70	10.9	0.08	6.6	0.6	11.2	0.21	6.6	1.4			1.4	0.50	8	175	7.82	0.4	TO DP 3	
	3	A3	0.64	0.70	11.8	0.45	6.4	2.9	11.8	0.66	6.4	4.2			4.2	0.50	15	70	4.23	0.3	TO DP 4	
	4	A4	0.31	0.70	11.1	0.22	6.6	1.4	12.1	0.88	6.4	5.6			5.6	0.80	15	75	5.38	0.2	TO DP 6	
	5	A5	0.15	0.70	10.0	0.11	6.8	0.7							0.7	0.50	8	60	2.74	0.4	TO DP 6	
	6	A6	0.09	0.70	10.0	0.06	6.8	0.4	12.3	1.04	6.3	6.6			6.6	1.10	15	75	6.31	0.2	TO DP 7	
	7	A7	0.81	0.70	12.7	0.57	6.2	3.5	12.7	1.61	6.2	10.0			10.0	0.50	3-12"	75	5.38	0.2	TO Pond A	
	8	A8	0.08	0.70	10.0	0.06	6.8	0.4							0.4	0.50	8	60	2.35	0.4	TO DP 9	
	9	A9	0.09	0.70	10.0	0.06	6.8	0.4	10.4	0.12	6.7	0.8			0.8	0.50	8	60	2.79	0.4	TO Pond A	
	10	A10	0.03	0.70	10.0	0.02	6.8	0.1	10.8	0.14	6.7	0.9			0.9	0.60	8	50	3.06	0.3	TO Pond A	
	11	A11	0.83	0.70	10.0	0.58	6.8	4.0	12.9	2.33	6.2	14.4			3.3	0.50	12	50	2.64	0.3	TO DP 19A	
	12	A12	0.26	0.70	10.0	0.18	6.8	1.2														
	13	B1	0.08	0.71	10.0	0.06	6.8	0.4							0.4	0.50	8	60	2.41	0.4	TO DP 14	
	14	B2	0.10	0.71	10.0	0.07	6.8	0.5	10.4	0.13	6.7	0.9			0.9	0.50	12	60	2.94	0.3	TO DP 16	
	15	B3	0.19	0.71	10.0	0.13	6.8	0.9							0.9	0.50	12	60	2.94	0.3	TO DP 16	
	16	B4	0.09	0.71	10.0	0.06	6.8	0.4	10.8	0.3	6.7	2.2			2.2	0.50	12	42	3.62	0.2	TO POND B	
	17	B5	0.09	0.71	10.0	0.06	6.8	0.4							0.4	0.50	8	60	2.41	0.4	TO DP 18	
	18	B6	0.79	0.71	12.6	0.56	6.2	3.5	12.6	0.62	6.2	3.9			3.9	1.20	12	17	5.68	0.0	TO POND B	
	19	B7	0.76	0.71	11.5	0.54	6.5	3.5	12.6	1.49	6.2	9.3			2.1	0.70	12	17	3.60	0.1	TO DP 19A	
	19A														5.4	0.70	15	1600	5.03	5.3	To 37B	
	20	B8	0.25	0.71	10.0	0.18	6.8	1.2														
	21	C1	1.04	0.75	10.0	0.78	6.8	5.3													Undetained	
	22	C2	1.03	0.72	10.0	0.74	6.8	5.1													Undetained	
	23	D1	0.47	0.69	11.6	0.32	6.5	2.1							2.1	0.50	12	75	3.60	0.3	TO DP 25	
	24	D2	0.08	0.69	10.0	0.06	6.8	0.4							0.4	0.50	8	50	2.41	0.3	TO DP 25	
	25	D3	0.08	0.69	10.0	0.06	6.8	0.4	12.0	0.43	6.4	2.8			2.8	0.65	12	60	4.18	0.2	TO DP 26	
	26	D4	0.90	0.69	12.6	0.62	6.2	3.9	12.6	1.06	6.2	6.6			6.6	0.50	2-12"	40	4.76	0.1	TO Pond D	
	27	D5	0.13	0.69	10.0	0.09	6.8	0.6							0.6	0.50	8	60	2.66	0.4	TO DP 28	
	28	D6	0.05	0.69	10.0	0.03	6.8	0.2	10.4	0.12	6.8	0.8			0.8	0.50	8	60	2.79	0.4	TO DP 28	
	29	D7	0.12	0.69	10.0	0.08	6.8	0.6	10.7	0.21	6.7	1.4			1.4	0.50	12	60	3.30	0.3	TO Pond D	
	30	D8	0.92	0.69	10.0	0.63	6.8	4.3	12.8	1.90	6.2	11.8			2.8	0.70	12	360	4.33	1.4	TO DP 37A	
	31	E1	0.21	0.69	10.0	0.14	6.8	1.0							1.0	0.55	12	60	3.84	0.3	TO DP 32	
	32	E2	0.17	0.69	10.0	0.12	6.8	0.8	10.3	0.26	6.8	1.8			1.8	0.50	2-12"	70	10.88	0.1	TO Pond E	
	34	E4	0.10	0.69	10.0	0.07	6.8	0.5	10.0	0.07	6.8	0.5			0.5	0.75	12	14	4.49	0.1	TO Pond E	
	35	E5	0.08	0.69	10.0	0.06	6.8	0.4							0.4	0.50	8	40	2.24	0.3	TO DP 36	
	36	E6	0.56	0.69	12.2	0.39	6.4	2.5	12.2	0.44	6.4	2.8			2.8	0.65	12	20	4.18	0.1	TO Pond E	
	37	E7	0.58	0.69	10.3	0.40	6.8	2.7	12.3	1.17	6.3	7.4			7.4	0.80	12	37	4.63	0.1	TO DP 37A	
	37A														10.2	1.57	18	450	5.47	1.4	TO DP 37B	
	37B														15.6	0.65	24	1095	5.00	3.7	TO DP 37C	
	37C														40.6	0.83	36	430	6.00	1.2	To outfall	
	38	F1	0.87	0.66	13.8	0.57	6.0	3.4							3.4	1.00	12	45	5.18	0.1	TO DP 38	
	39	F2	0.99	0.66	13.2	0.65	6.1	4.0	13.9	1.23	5.9	7.3			1.9	0.50	12	60	3.53	0.3	TO Ralston	
	40	G1	0.08	0.72	10.0	0.06	6.8	0.4							0.4	0.50	8	40	2.41	0.3	TO DP 41	
	41	G2	0.14	0.72	10.0	0.10	6.8	0.7	10.3	0.16	6.8	1.1			1.1	0.50	12	45	3.10	0.2	TO Pond G	
	42	G3	1.06	0.72	12.0	0.76	6.4	4.9	12.0	0.92	6.4	5.9			1.3	0.50	12	50	3.24	0.3	TO Ralston	
	43	H1	0.17	0.81	10.0	0.14	6.8	0.9							0.9	0.50	8	40	2.41	0.3	TO DP 44	
	44	H2	0.17	0.81	10.0	0.14	6.8	0.9	10.3	0.28	6.8	1.9			1.9	0.50	12	40	3.24	0.2	TO DP 46	
	45	H3	0.07	0.81	10.0	0.06	6.8	0.4							0.4	0.50	8	40	2.41	0.3	TO DP 46	
	46	H4	0.17	0.81	10.0	0.14	6.8	0.9	10.3	0.47	6.8	3.2			3.2	0.55	12	75	3.84	0.3	TO DP 47	
	47	H5	0.43	0.81	10.0	0.35	6.8	2.4	10.6	0.82	6.7	5.5			0.9	0.50	12	50	2.95	0.3	TO Ralston	
	48	I	0.84	0.61	12.1	0.51	6.4	3.3							0.8	0.50	8	30	2.79	0.2	TO Ralston	
	49	J	1.40	0.68	12.3	0.95	6.3	6.0							4.1	0.50	15	22	4.22	0.1	TO Ralston	
	50	K	6.96	0.50	17.4	3.48	5.1	17.9													TO Ralston	
	51	L	1.82	0.88	14.8	1.60	5.7	9.2														

1.0 CFS
/ACRE
FOR PIPE
OUT OF
PONDS

Weighted Percent Imperviousness Calculations

GEOS Neighborhood

Date 7/18/2007

By TJN

															by ROW												
Basin ID	Lawn Area, sf	Lawn % imper.	Roof Area, sf	Roof % imper.	Concrete Walk in ROW Area, sf	Concrete Walk in ROW % imper.	Street in ROW Area, sf	Street in ROW % imper.	Porous Concrete Alley or Parking Area, sf	Porous Concrete Alley or Parking % imper.	Porous Paver Walk Area, sf	Porous Paver Walk % imper.	Total Area, sf	Weighted % imper.													
A	65743	*	0	+	35482	*	90	+	8348	*	90	+	24839	*	100	+	13569	*	55	+	4047	*	40	/	152028	=	48
B	47307	*	0	+	19364	*	90	+	7549	*	90	+	23959	*	100	+	6042	*	55	+	1148	*	40	/	105369	=	49
C	28094	*	0	+	32650	*	90	+	8450	*	90	+	5871	*	100	+	25871	*	55	+	0	*	40	/	100936	=	57
D	54298	*	0	+	28378	*	90	+	3840	*	90	+	16934	*	100	+	11293	*	55	+	4095	*	40	/	118838	=	45
E	22550	*	0	+	14405	*	90	+	2090	*	90	+	5843	*	100	+	4212	*	55	+	0	*	40	/	49100	=	47
F	45065	*	0	+	20548	*	90	+	3025	*	90	+	10700	*	100	+	4243	*	55	+	6084	*	40	/	89665	=	41
G	31470	*	0	+	25882	*	90	+	4491	*	90	+	13584	*	100	+	5975	*	55	+	2969	*	40	/	84371	=	54
H	2780	*	0	+	6558	*	90	+	4408	*	90	+	5772	*	100	+	5142	*	55	+	1168	*	40	/	25828	=	73
I	22986	*	0	+	6300	*	90	+	4862	*	90	+	0	*	100	+	0	*	55	+	2500	*	40	/	36648	=	30
J	28314	*	0	+	19426	*	90	+	0	*	90	+	0	*	100	+	12968	*	55	+	478	*	40	/	61186	=	41
K	303196	*	0	+	0	*	90	+	0	*	90	+	0	*	100	+	0	*	55	+	0	*	40	/	303196	=	0
													1127165														

Weighted Percent Imperviousness Calculations, Impervious areas adjusted by UDFCD figure PP-1
Limited to no more than two units of impervious area tributary credit for each unit of Porous Pavement area.

Basin ID	Roof area - (2 x Porous Concrete area)										Porous Concrete area + (2 x Tributary Roof Area)										Total Area, sf	Weighted % imper.					
	Unadjusted Lawn		Tributary area to PP removed	Concrete		Concrete Walk in ROW	Street		Porous Concrete Alley or Parking Effective Area, sf	Porous Concrete Alley or Parking Effective % imper.	Porous Paver Walk Area, sf	Porous Paver Walk % imper.															
	Area, sf	% imper.		Roof Area, sf	Roof % imper.		in ROW Area, sf	in ROW % imper.					in ROW Area, sf	in ROW % imper.													
A	65743	*	0	+	8344	*	90	+	8348	*	90	+	24839	*	100	+	40707	*	70	+	4047	*	40	/	152028	=	46
B	47307	*	0	+	7280	*	90	+	7549	*	90	+	23959	*	100	+	18126	*	70	+	1148	*	40	/	105369	=	48
C	28094	*	0	+	0	*	90	+	8450	*	90	+	5871	*	100	+	58521	*	45	+	0	*	40	/	100936	=	39
D	54298	*	0	+	5792	*	90	+	3840	*	90	+	16934	*	100	+	33879	*	70	+	4095	*	40	/	118838	=	43
E	22550	*	0	+	5981	*	90	+	2090	*	90	+	5843	*	100	+	12636	*	70	+	0	*	40	/	49100	=	45
F	45065	*	0	+	12062	*	90	+	3025	*	90	+	10700	*	100	+	12729	*	70	+	6084	*	40	/	89665	=	40
G	31470	*	0	+	13932	*	90	+	4491	*	90	+	13584	*	100	+	17925	*	70	+	2969	*	40	/	84371	=	52
H	2780	*	0	+	0	*	90	+	4408	*	90	+	5772	*	100	+	11700	*	40	+	1168	*	40	/	25828	=	58
I	22986	*	0	+	6300	*	90	+	4862	*	90	+	0	*	100	+	0	*	70	+	2500	*	40	/	36648	=	30
J	28314	*	0	+	0	*	90	+	0	*	90	+	0	*	100	+	32394	*	48	+	478	*	40	/	61186	=	26
K	303196	*	0	+	0	*	90	+	0	*	90	+	0	*	100	+	0	*	70	+	0	*	40	/	303196	=	0
																							1127165				

A 152028
B 105369
C 100936
D 118838
E 49100
F 89665
G 84371
H 25828
I 36648
J 61186
K 303196
Tot 1127165

Weighted 3.5-year Runoff Coefficients, from UDFCD Table RO-5 for type C soils, averaged between 2-yr and 5-yr values.

GEOS

Date 7/18/2007

By TJN

Basin ID	Lawn Area, sf	Lawn 3.5-yr C	Roof Area, sf	Roof 3.5-yr C	Concrete Walk Area, sf	Concrete Walk 3.5-yr C	Street Area, sf	Street 3.5-yr C	Alley Area, sf	Alley 3.5-yr C	Gravel Walk Area, sf	Gravel Walk 3.5-yr C	Total Area, sf	Weighted 3.5-yr C							
A	65743	* 0.10	+	35482	* 0.74	+	8348	* 0.74	+	24839	* 0.90	+	13569	* 0.74	+	4047	* 0.32	/	152028	=	0.48
B	47307	* 0.10	+	19364	* 0.74	+	7549	* 0.74	+	23959	* 0.90	+	6042	* 0.74	+	1148	* 0.32	/	105369	=	0.48
C	28094	* 0.10	+	32650	* 0.74	+	8450	* 0.74	+	5871	* 0.90	+	25871	* 0.74	+	0	* 0.32	/	100936	=	0.57
D	54298	* 0.10	+	28378	* 0.74	+	3840	* 0.74	+	16934	* 0.90	+	11293	* 0.74	+	4095	* 0.32	/	118838	=	0.46
E	22550	* 0.10	+	14405	* 0.74	+	2090	* 0.74	+	5843	* 0.90	+	4212	* 0.74	+	0	* 0.32	/	49100	=	0.47
F	45065	* 0.10	+	20548	* 0.74	+	3025	* 0.74	+	10700	* 0.90	+	4243	* 0.74	+	6084	* 0.32	/	89665	=	0.41
G	31470	* 0.10	+	25882	* 0.74	+	4491	* 0.74	+	13584	* 0.90	+	5975	* 0.74	+	2969	* 0.32	/	84371	=	0.51
H	2780	* 0.10	+	6558	* 0.74	+	4408	* 0.74	+	5772	* 0.90	+	5142	* 0.74	+	1168	* 0.32	/	25828	=	0.69
I	22986	* 0.10	+	6300	* 0.74	+	4862	* 0.74	+	0	* 0.90	+	0	* 0.74	+	2500	* 0.32	/	36648	=	0.31
J	28314	* 0.10	+	19426	* 0.74	+	0	* 0.74	+	0	* 0.90	+	12968	* 0.74	+	478	* 0.32	/	61186	=	0.44
K	303196	* 0.10	+	0	* 0.74	+	0	* 0.74	+	0	* 0.90	+	0	* 0.74	+	0	* 0.32	/	303196	=	0.10

Weighted 5-year Runoff Coefficients, from UDFCD Table RO-5 for type C soils.

GEOS

Date 7/18/2007

By TJN

Basin ID	Lawn Area, sf	Lawn 5-yr C	Roof Area, sf	Roof 5-yr C	Concrete Walk Area, sf	Concrete Walk 5-yr C	Street Area, sf	Street 5-yr C	Alley Area, sf	Alley 5-yr C	Gravel Walk Area, sf	Gravel Walk 5-yr C	Total Area, sf	Weighted 5-yr C
A	65743	* 0.15 +	35482	* 0.75 +	8348	* 0.75 +	24839	* 0.90 +	13569	* 0.75 +	4047	* 0.35 /	152028	= 0.50
B	47307	* 0.15 +	19364	* 0.75 +	7549	* 0.75 +	23959	* 0.90 +	6042	* 0.75 +	1148	* 0.35 /	105369	= 0.51
C	28094	* 0.15 +	32650	* 0.75 +	8450	* 0.75 +	5871	* 0.90 +	25871	* 0.75 +	0	* 0.35 /	100936	= 0.59
D	54298	* 0.15 +	28378	* 0.75 +	3840	* 0.75 +	16934	* 0.90 +	11293	* 0.75 +	4095	* 0.35 /	118838	= 0.48
E	22550	* 0.15 +	14405	* 0.75 +	2090	* 0.75 +	5843	* 0.90 +	4212	* 0.75 +	0	* 0.35 /	49100	= 0.49
F	45065	* 0.15 +	20548	* 0.75 +	3025	* 0.75 +	10700	* 0.90 +	4243	* 0.75 +	6084	* 0.35 /	89665	= 0.44
G	31470	* 0.15 +	25882	* 0.75 +	4491	* 0.75 +	13584	* 0.90 +	5975	* 0.75 +	2969	* 0.35 /	84371	= 0.54
H	2780	* 0.15 +	6558	* 0.75 +	4408	* 0.75 +	5772	* 0.90 +	5142	* 0.75 +	1168	* 0.35 /	25828	= 0.70
I	22986	* 0.15 +	6300	* 0.75 +	4862	* 0.75 +	0	* 0.90 +	0	* 0.75 +	2500	* 0.35 /	36648	= 0.35
J	28314	* 0.15 +	19426	* 0.75 +	0	* 0.75 +	0	* 0.90 +	12968	* 0.75 +	478	* 0.35 /	61186	= 0.47
K	303196	* 0.15 +	0	* 0.75 +	0	* 0.75 +	0	* 0.90 +	0	* 0.75 +	0	* 0.35 /	303196	= 0.15

Weighted 10-year Runoff Coefficients, from UDFCD Table RO-5 for type C soils.

GEOS

Date 7/18/2007

By TJN

Basin ID	Lawn Area, sf	Lawn 10-yr C	Roof Area, sf	Roof 10-yr C	Concrete Walk Area, sf	Concrete Walk 10-yr C	Street Area, sf	Street 10-yr C	Alley Area, sf	Alley 10-yr C	Gravel Walk Area, sf	Gravel Walk 10-yr C	Total Area, sf	Weighted 10-yr C
A	65743	* 0.25	+ 35482	* 0.77	+ 8348	* 0.77	+ 24839	* 0.92	+ 13569	* 0.77	+ 4047	* 0.42	/ 152028	= 0.56
B	47307	* 0.25	+ 19364	* 0.77	+ 7549	* 0.77	+ 23959	* 0.92	+ 6042	* 0.77	+ 1148	* 0.42	/ 105369	= 0.57
C	28094	* 0.25	+ 32650	* 0.77	+ 8450	* 0.77	+ 5871	* 0.92	+ 25871	* 0.77	+ 0	* 0.42	/ 100936	= 0.63
D	54298	* 0.25	+ 28378	* 0.77	+ 3840	* 0.77	+ 16934	* 0.92	+ 11293	* 0.77	+ 4095	* 0.42	/ 118838	= 0.54
E	22550	* 0.25	+ 14405	* 0.77	+ 2090	* 0.77	+ 5843	* 0.92	+ 4212	* 0.77	+ 0	* 0.42	/ 49100	= 0.55
F	45065	* 0.25	+ 20548	* 0.77	+ 3025	* 0.77	+ 10700	* 0.92	+ 4243	* 0.77	+ 6084	* 0.42	/ 89665	= 0.50
G	31470	* 0.25	+ 25882	* 0.77	+ 4491	* 0.77	+ 13584	* 0.92	+ 5975	* 0.77	+ 2969	* 0.42	/ 84371	= 0.59
H	2780	* 0.25	+ 6558	* 0.77	+ 4408	* 0.77	+ 5772	* 0.92	+ 5142	* 0.77	+ 1168	* 0.42	/ 25828	= 0.73
I	22986	* 0.25	+ 6300	* 0.77	+ 4862	* 0.77	+ 0	* 0.92	+ 0	* 0.77	+ 2500	* 0.42	/ 36648	= 0.42
J	28314	* 0.25	+ 19426	* 0.77	+ 0	* 0.77	+ 0	* 0.92	+ 12968	* 0.77	+ 478	* 0.42	/ 61186	= 0.53
K	303196	* 0.25	+ 0	* 0.77	+ 0	* 0.77	+ 0	* 0.92	+ 0	* 0.77	+ 0	* 0.42	/ 303196	= 0.25

Weighted 100-year Runoff Coefficients, from UDFCD Table RO-5 for type C soils.

GEOS

Date 7/18/2007

By TJN

Basin ID	Lawn Area, sf	Lawn 100-yr C	Roof Area, sf	Roof 100-yr C	Concrete Walk Area, sf	Concrete Walk 100-yr C	Street Area, sf	Street 100-yr C	Alley Area, sf	Alley 100-yr C	Gravel Walk Area, sf	Gravel Walk 100-yr C	Total Area, sf	Weighted 100-yr C
A	65743	* 0.5 +	35482	* 0.83 +	8348	* 0.83 +	24839	* 0.96 +	13569	* 0.83 +	4047	* 0.58 /	152028	= 0.70
B	47307	* 0.5 +	19364	* 0.83 +	7549	* 0.83 +	23959	* 0.96 +	6042	* 0.83 +	1148	* 0.58 /	105369	= 0.71
C	28094	* 0.5 +	32650	* 0.83 +	8450	* 0.83 +	5871	* 0.96 +	25871	* 0.83 +	0	* 0.58 /	100936	= 0.75
D	54298	* 0.5 +	28378	* 0.83 +	3840	* 0.83 +	16934	* 0.96 +	11293	* 0.83 +	4095	* 0.58 /	118838	= 0.69
E	22550	* 0.5 +	14405	* 0.83 +	2090	* 0.83 +	5843	* 0.96 +	4212	* 0.83 +	0	* 0.58 /	49100	= 0.69
F	45065	* 0.5 +	20548	* 0.83 +	3025	* 0.83 +	10700	* 0.96 +	4243	* 0.83 +	6084	* 0.58 /	89665	= 0.66
G	31470	* 0.5 +	25882	* 0.83 +	4491	* 0.83 +	13584	* 0.96 +	5975	* 0.83 +	2969	* 0.58 /	84371	= 0.72
H	2780	* 0.5 +	6558	* 0.83 +	4408	* 0.83 +	5772	* 0.96 +	5142	* 0.83 +	1168	* 0.58 /	25828	= 0.81
I	22986	* 0.5 +	6300	* 0.83 +	4862	* 0.83 +	0	* 0.96 +	0	* 0.83 +	2500	* 0.58 /	36648	= 0.61
J	28314	* 0.5 +	19426	* 0.83 +	0	* 0.83 +	0	* 0.96 +	12968	* 0.83 +	478	* 0.58 /	61186	= 0.68
K	303196	* 0.5 +	0	* 0.83 +	0	* 0.83 +	0	* 0.96 +	0	* 0.83 +	0	* 0.58 /	303196	= 0.50

Table RO-3—Recommended Percentage Imperviousness Values

Land Use or Surface Characteristics	Percentage Imperviousness
Business:	
Commercial areas	95
Neighborhood areas	85
Residential:	
Single-family	*
Multi-unit (detached)	60
Multi-unit (attached)	75
Half-acre lot or larger	*
Apartments	80
Industrial:	
Light areas	80
Heavy areas	90
Parks, cemeteries	5
Playgrounds	10
Schools	50
Railroad yard areas	15
Undeveloped Areas:	
Historic flow analysis	2
Greenbelts, agricultural	2
Off-site flow analysis (when land use not defined)	45
Streets:	
Paved	100
Gravel (packed)	40
Drive and walks	90
Roofs	90
Lawns, sandy soil	0
Lawns, clayey soil	0

* See [Figures RO-3 through RO-5](#) for percentage imperviousness.

Based in part on the data collected by the District since 1969, an empirical relationship between C and the percentage imperviousness for various storm return periods was developed. Thus, values for C can be determined using the following equations (Urbonas, Guo and Tucker 1990).

$$C_A = K_A + (1.31i^3 - 1.44i^2 + 1.135i - 0.12) \text{ for } C_A \geq 0, \text{ otherwise } C_A = 0 \quad (\text{RO-6})$$

TABLE RO-5
Runoff Coefficients, C

Percentage Imperviousness	Type C and D NRCS Hydrologic Soil Groups					
	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
0%	0.04	0.15	0.25	0.37	0.44	0.50
5%	0.08	0.18	0.28	0.39	0.46	0.52
10%	0.11	0.21	0.30	0.41	0.47	0.53
15%	0.14	0.24	0.32	0.43	0.49	0.54
20%	0.17	0.26	0.34	0.44	0.50	0.55
25%	0.20	0.28	0.36	0.46	0.51	0.56
30%	0.22	0.30	0.38	0.47	0.52	0.57
35%	0.25	0.33	0.40	0.48	0.53	0.57
40%	0.28	0.35	0.42	0.50	0.54	0.58
45%	0.31	0.37	0.44	0.51	0.55	0.59
50%	0.34	0.40	0.46	0.53	0.57	0.60
55%	0.37	0.43	0.48	0.55	0.58	0.62
60%	0.41	0.46	0.51	0.57	0.60	0.63
65%	0.45	0.49	0.54	0.59	0.62	0.65
70%	0.49	0.53	0.57	0.62	0.65	0.68
75%	0.54	0.58	0.62	0.66	0.68	0.71
80%	0.60	0.63	0.66	0.70	0.72	0.74
85%	0.66	0.68	0.71	0.75	0.77	0.79
90%	0.73	0.75	0.77	0.80	0.82	0.83
95%	0.80	0.82	0.84	0.87	0.88	0.89
100%	0.89	0.90	0.92	0.94	0.95	0.96
	Type B NRCS Hydrologic Soils Group					
0%	0.02	0.08	0.15	0.25	0.30	0.35
5%	0.04	0.10	0.19	0.28	0.33	0.38
10%	0.06	0.14	0.22	0.31	0.36	0.40
15%	0.08	0.17	0.25	0.33	0.38	0.42
20%	0.12	0.20	0.27	0.35	0.40	0.44
25%	0.15	0.22	0.30	0.37	0.41	0.46
30%	0.18	0.25	0.32	0.39	0.43	0.47
35%	0.20	0.27	0.34	0.41	0.44	0.48
40%	0.23	0.30	0.36	0.42	0.46	0.50
45%	0.26	0.32	0.38	0.44	0.48	0.51
50%	0.29	0.35	0.40	0.46	0.49	0.52
55%	0.33	0.38	0.43	0.48	0.51	0.54
60%	0.37	0.41	0.46	0.51	0.54	0.56
65%	0.41	0.45	0.49	0.54	0.57	0.59
70%	0.45	0.49	0.53	0.58	0.60	0.62
75%	0.51	0.54	0.58	0.62	0.64	0.66
80%	0.57	0.59	0.63	0.66	0.68	0.70
85%	0.63	0.66	0.69	0.72	0.73	0.75
90%	0.71	0.73	0.75	0.78	0.80	0.81
95%	0.79	0.81	0.83	0.85	0.87	0.88
100%	0.89	0.90	0.92	0.94	0.95	0.96

Lawn

gravel walk

 all concrete, roof
walks
Street

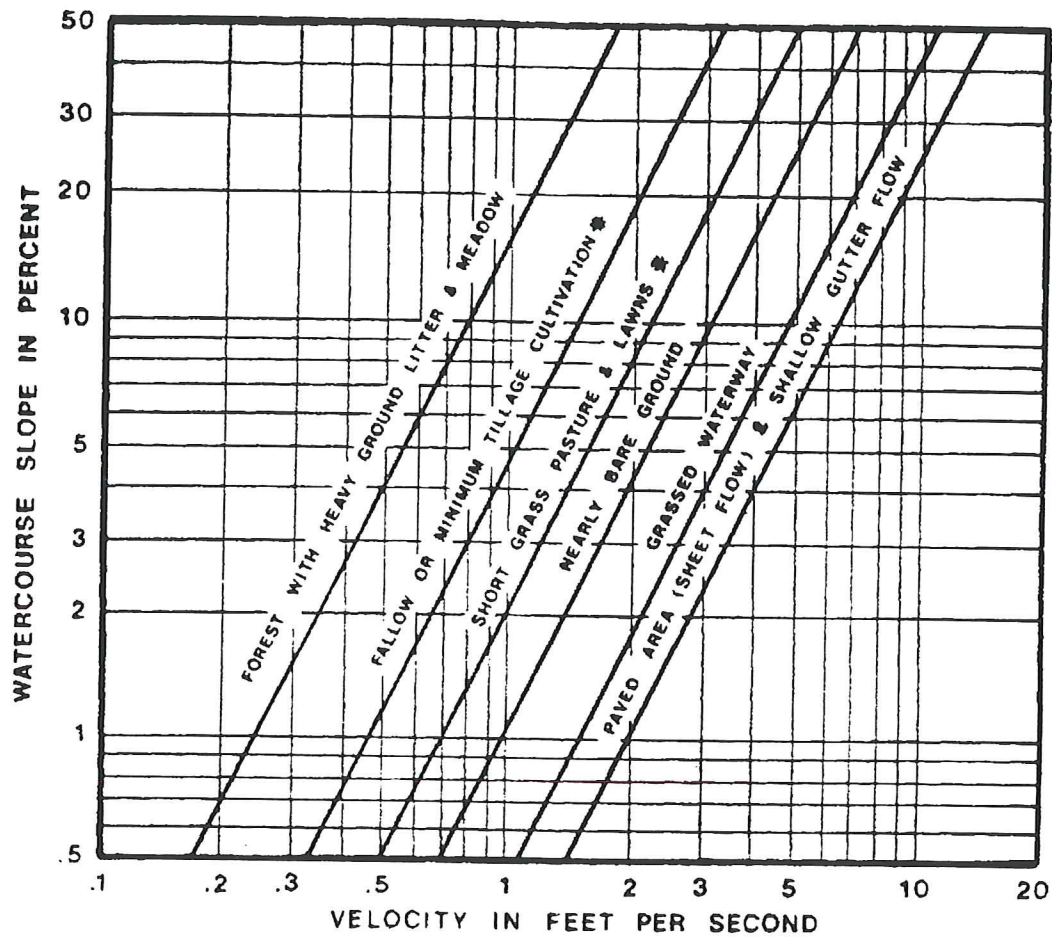
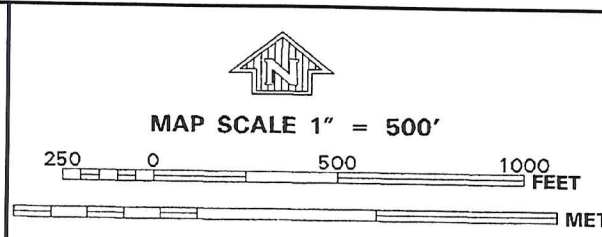
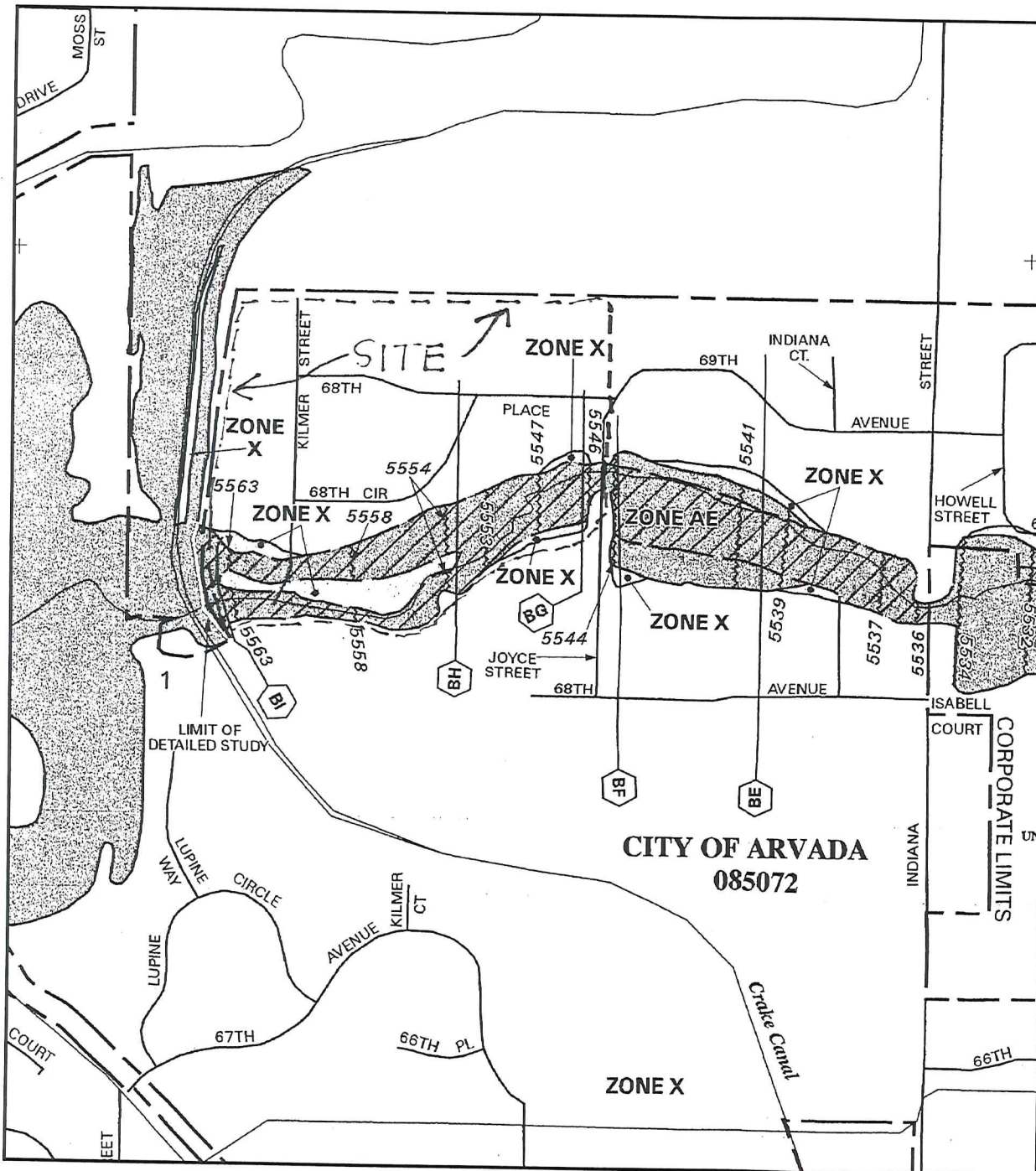


Figure RO-1—Estimate of Average Overland Flow Velocity for Use With the Rational Formula



FIRM FLOOD INSURANCE RATE MAP

PANEL 0183 E

FIRM

FLOOD INSURANCE RATE MAP

JEFFERSON COUNTY,
COLORADO AND
INCORPORATED AREAS

PANEL 183 OF 675

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
JEFFERSON COUNTY, UNINCORPORATED AREAS	080587	0183	E
ARVADA, CITY OF	080572	0183	E

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER
08059C0183 E

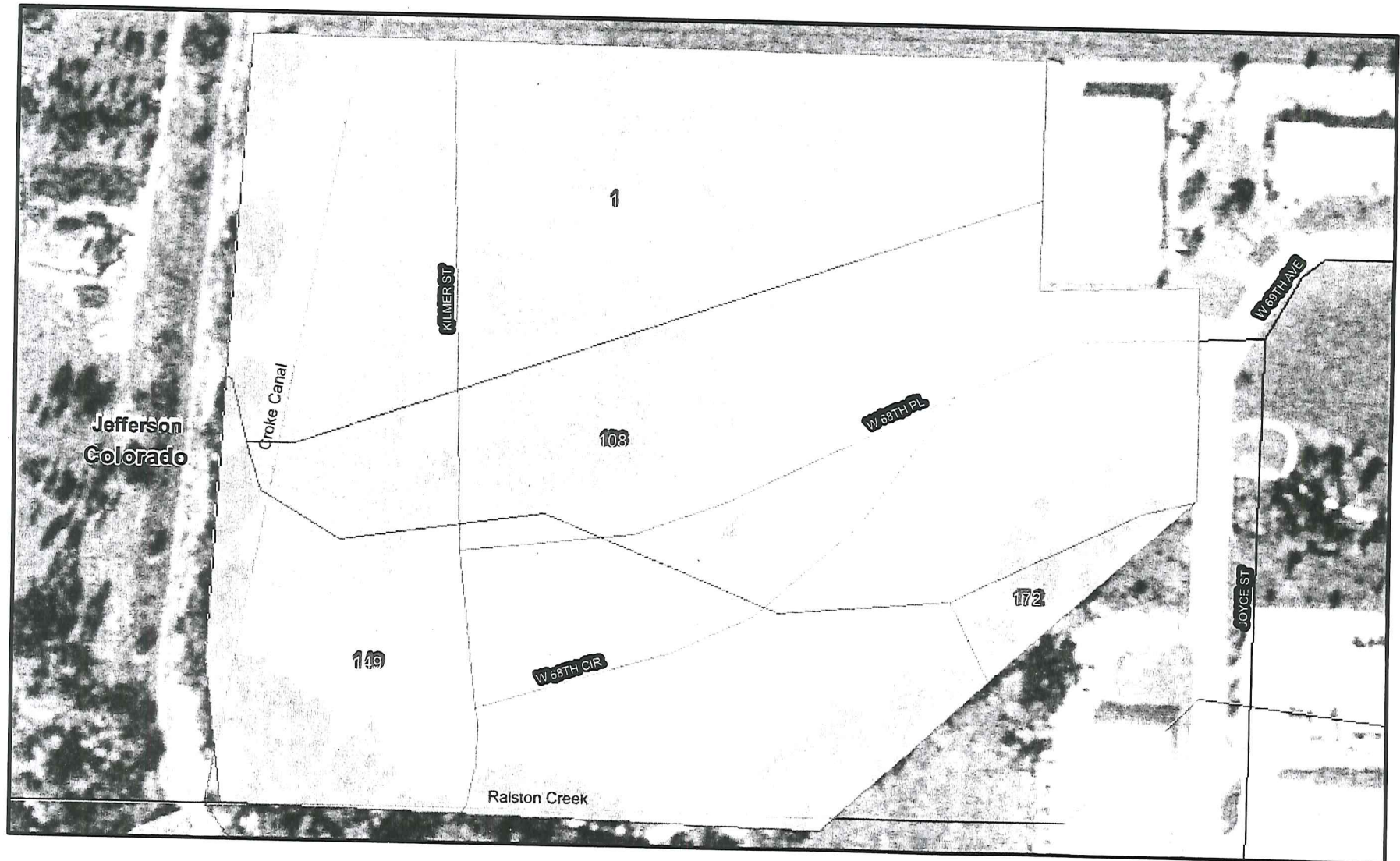
EFFECTIVE DATE:
JUNE 17, 2003

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

HYDROLOGIC GROUP RATING FOR GOLDEN AREA, COLORADO, PARTS OF DENVER, DOUGLAS, JEFFERSON, AND PARK COUNTIES

GEOS Neighborhood



0 20 40 80 Meters

0 50 100 200 300 400 Feet

HYDROLOGIC GROUP RATING FOR GOLDEN AREA, COLORADO, PARTS OF DENVER, DOUGLAS, JEFFERSON, AND PARK COUNTIES

GEOS Neighborhood

MAP LEGEND

Hydrologic Group

{Dominant Condition, <};

-  A
-  A/D
-  B
-  B/D
-  C
-  C/D
-  D
-  Not rated or not available

Soil Map Units

• Cities

 Detailed Counties

 Detailed States

 Interstate Highways

 Roads

 Rails

Water

Hydrography

Oceans

MAP INFORMATION

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>

Coordinate System: UTM Zone 13

Soil Survey Area: Golden Area, Colorado, Parts of Denver,
Douglas, Jefferson, and Park Counties

Spatial Version of Data: 3

Soil Map Compilation Scale: 1:24000

Map comprised of aerial images photographed on these dates:
1999

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

Tables - Hydrologic Group

Summary by Map Unit - Golden Area, Colorado, Parts of Denver, Douglas, Jefferson, and Park Counties

Soil Survey Area Map Unit Symbol	Map Unit Name	Rating	Total Acres in AOI	Percent of AOI
1	Alda loam, 0 to 2 percent slopes	C	8.5	34.9
108	Nunn variant-Urban land complex, 0 to 3 percent slopes	C	8.2	33.5
149	Standley-Nunn gravelly clay loams, 0 to 5 percent slopes	C	7.2	29.6
172	Wann fine sandy loam, 0 to 2 percent slopes	C	0.5	2.0

Description - Hydrologic Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are placed into four groups A, B, C, and D, and three dual classes, A/D, B/D, and C/D. Definitions of the classes are as follows:

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only soils that are rated D in their natural condition are assigned to dual classes.

Parameter Summary - Hydrologic Group

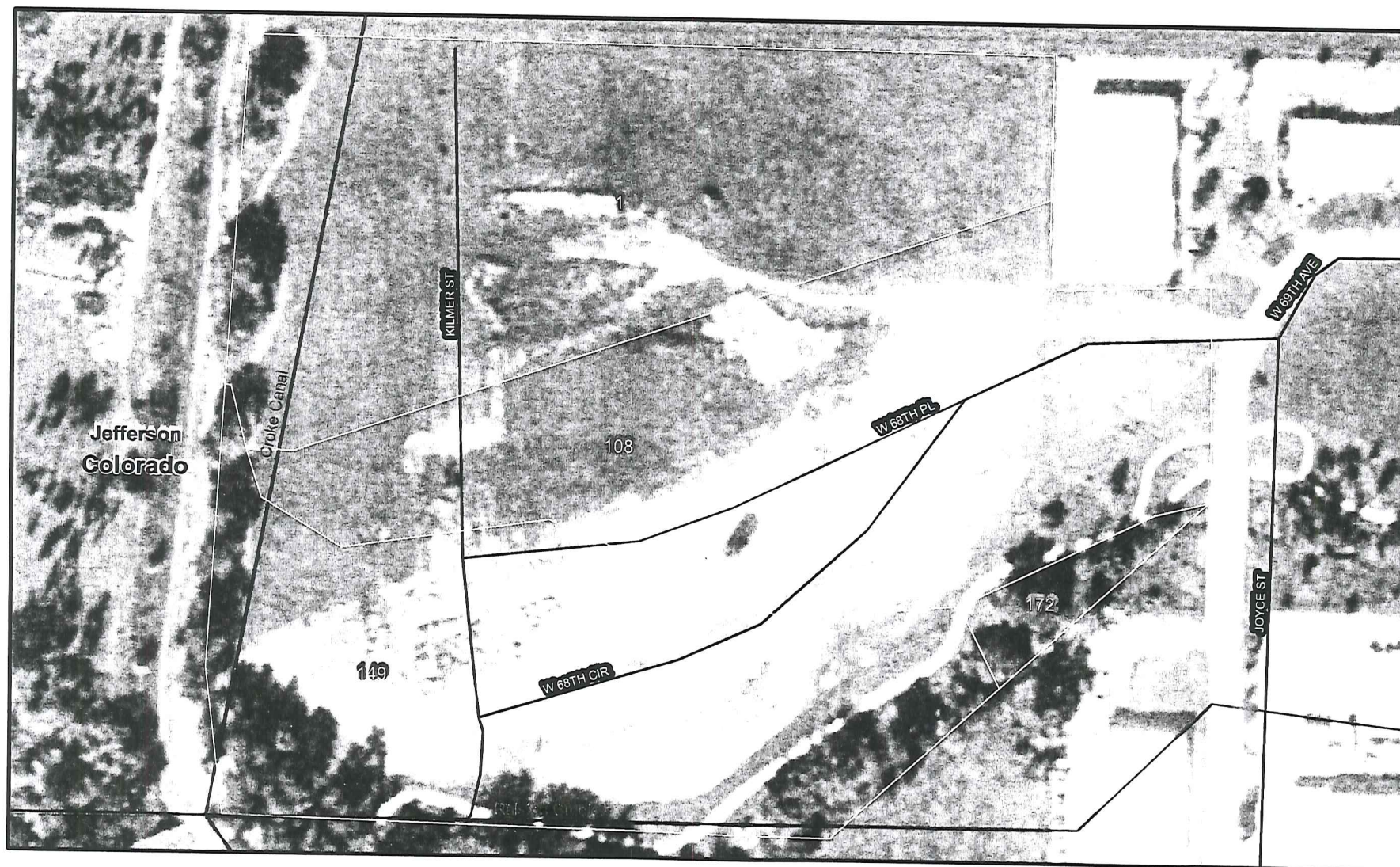
Aggregation Method: Dominant Condition

Component Percent Cutoff:

Tie-break Rule: Lower

SOIL SURVEY OF GOLDEN AREA, COLORADO, PARTS OF DENVER, DOUGLAS, JEFFERSON, AND PARK COUNTIES

GEOS Neighborhood



0 20 40 80 Meters

0 50 100 200 300 400 Feet

SOIL SURVEY OF GOLDEN AREA, COLORADO, PARTS OF DENVER, DOUGLAS, JEFFERSON, AND PARK COUNTIES

GEOS Neighborhood

MAP LEGEND

●	Soil Map Units
○	Cities
□	Detailed Counties
▤	Detailed States
—+—+—+—	Interstate Highways
—	Roads
—+—+—	Rails
—	Water
—	Hydrography
—	Oceans
▲▼▲▼▲▼	Escarpment, bedrock
▼▼▼▼▼	Escarpment, non-bedrock
~~~~~	Gulley
	Levee
.....	Slope
⊂	Blowout
⊠	Borrow Pit
✱	Clay Spot
◆	Depression, closed
⊖	Eroded Spot
⊗	Gravel Pit
⊙	Gravelly Spot
~	Gulley
Λ	Lava Flow
⊙	Landfill
⬇	Marsh or Swamp
⊙	Miscellaneous Water
✓	Rock Outcrop
+	Saline Spot
⋯	Sandy Spot
⋈	Slide or Slip
◇	Sinkhole
⊗	Sodic Spot
≡	Spoil Area
◊	Stony Spot
⊖	Very Stony Spot
⊙	Perennial Water
⚡	Wet Spot

## MAP INFORMATION

Source of Map: Natural Resources Conservation Service  
Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>

Coordinate System: UTM Zone 13

Soil Survey Area: Golden Area, Colorado, Parts of Denver,  
Douglas, Jefferson, and Park Counties

Spatial Version of Data: 3

Soil Map Compilation Scale: 1:24000

Map comprised of aerial images photographed on these dates:  
1999

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

## Map Unit Legend Summary

Golden Area, Colorado, Parts of Denver, Douglas, Jefferson, and Park Counties

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1	Alda loam, 0 to 2 percent slopes	8.5	34.9
108	Nunn variant-Urban land complex, 0 to 3 percent slopes	8.2	33.5
149	Standley-Nunn gravelly clay loams, 0 to 5 percent slopes	7.2	29.6
172	Wann fine sandy loam, 0 to 2 percent slopes	0.5	2.0



# Appendix B

## Hydraulics

### Required Detention Pond Volume Summary

Minor Detention Volume – Pond A  
Major Detention Volume – Pond A  
Water Quality Capture Volume – Pond A  
Minor Detention Volume – Pond B  
Major Detention Volume – Pond B  
Water Quality Capture Volume – Pond B  
Minor Detention Volume – Pond C  
Major Detention Volume – Pond C  
Water Quality Capture Volume – Pond C  
Minor Detention Volume – Pond D  
Major Detention Volume – Pond D  
Water Quality Capture Volume – Pond D  
Minor Detention Volume – Pond E  
Major Detention Volume – Pond E  
Water Quality Capture Volume – Pond E  
Minor Detention Volume – Pond F  
Major Detention Volume – Pond F  
Water Quality Capture Volume – Pond F  
Minor Detention Volume – Pond G  
Major Detention Volume – Pond G  
Water Quality Capture Volume – Pond G  
Minor Detention Volume – Pond H  
Major Detention Volume – Pond H  
Water Quality Capture Volume – Pond H  
Minor Detention Volume – Pond I  
Major Detention Volume – Pond I  
Water Quality Capture Volume – Pond I  
Minor Detention Volume – Pond J  
Major Detention Volume – Pond J  
Water Quality Capture Volume – Pond J

### Figure RO-8

### Provided Detention Pond Volume Summaries

Allowable Release Rates  
Sizing Outlet Structures  
Inlet Calculations for Type R inlets  
Curb Opening Sizing  
Emergency Overflow Calculation  
Culvert Sizing for OS-1  
Hydroflow Storm Sewer ® Calculations

## Required Detention Pond Volume Summary

## GEOS Neighborhood, MDCIA

TJN

7/26/2007

	MDCIA Pond Sizing			
Pond ID	100-Year Required acre-ft	10-Year Required acre-ft	WQCV Required acre-ft	Total Volume 100-year+.5*WQCV acre-ft
Basin A	0.27	0.16	0.07	0.31
Basin B	0.18	0.10	0.04	0.20
Basin C	0.16	0.08	0.03	0.18
Basin D	0.21	0.12	0.05	0.24
Basin E	0.23	0.13	0.06	0.26
Basin F	0.13	0.08	0.03	0.15
Basin G	0.10	0.06	0.03	0.12
Basin H	0.07	0.05	0.02	0.08
Basin I	0.06	0.03	0.01	0.07
Basin J	0.10	0.05	0.01	0.11

**MINOR DETENTION VOLUME BY FAA & MODIFIED FAA METHOD**  
(See USDCM Volume I Runoff Chapter for description of method)

Project: Geos Neighborhood MDCIA  
Basin ID: Major Basin A

(For catchments less than 160 acres only. For larger catchments, use hydrograph routing method)  
(Note: for catchments larger than 90 acres, CUHP hydrograph and routing are recommended)

The user must fill in all of the blue cells for these sheets to function.

<b>Design Information (Input):</b>	
Catchment Drainage Imperviousness	$I_a =$ 46.00 percent
Catchment Drainage Area	$A =$ 3.5900 acres
Predevelopment NRCS Soil Group	Type = C A, B, C, or D
Return Period for Detention Control	$T =$ 10 years (2, 5, 10, 25, 50, or 100)
Time of Concentration of Watershed	$T_c =$ 13 minutes
Allowable Unit Release Rate (See Table A)	$q =$ 0.30 cfs/acre
One-hour Precipitation	$P_1 =$ 1.61 inches
Design Rainfall IDF Formula $I = C_1 \cdot P_1 / (C_2 + T_c)^{C_3}$	
Coefficient One	$C_1 =$ 28.50
Coefficient Two	$C_2 =$ 10.00
Coefficient Three	$C_3 =$ 0.79
<b>Determination of Average Outflow from the Basin (Calculated):</b>	
Runoff Coefficient	$C =$ 0.44
Inflow Peak Runoff	$Q_{p-in} =$ 6.11 cfs
Allowable Peak Outflow Rate	$Q_{p-out} =$ 1.08 cfs
Ratio of $Q_{p-out}/Q_{p-in}$	Ratio = 0.18
<b>Determination of MINOR Detention Volume Using FAA &amp; Modified FAA Method</b>	

5	<- Enter Rainfall Duration Incremental Increase Value Here (e.g. 5 for 5-Minutes)								
Rainfall Duration minutes (input)	Rainfall Intensity inches / hr (output)	Inflow Volume cubic feet (output)	Average Outflow (FAA, cfs) (output)	Outflow Volume (FAA, cf) (output)	Storage Volume (FAA, cf) (output)	Adjustment Factor (Modified) (output)	Average Outflow (Mod, cfs) (output)	Outflow Volume (Mod, cf) (output)	Storage Volume (Mod, cf) (output)
5	5.40	2,580	0.62	185	2,375	1.00	1.08	323	2,237
10	4.30	4,079	0.62	369	3,710	1.00	1.08	646	3,433
15	3.61	5,130	0.62	554	4,576	0.93	1.00	901	4,228
20	3.12	5,922	0.62	739	5,183	0.82	0.89	1,063	4,859
25	2.77	6,554	0.62	924	5,630	0.76	0.82	1,225	5,329
30	2.49	7,077	0.62	1,108	5,989	0.72	0.77	1,386	5,691
35	2.27	7,523	0.62	1,293	6,230	0.68	0.74	1,548	5,975
40	2.09	7,911	0.62	1,478	6,434	0.66	0.71	1,709	6,202
45	1.94	8,255	0.62	1,662	6,592	0.64	0.69	1,871	6,384
50	1.81	8,562	0.62	1,847	6,715	0.63	0.68	2,032	6,530
55	1.70	8,842	0.62	2,032	6,810	0.62	0.66	2,194	6,648
60	1.60	9,097	0.62	2,216	6,880	0.61	0.65	2,355	6,741
65	1.51	9,332	0.62	2,401	6,931	0.60	0.65	2,517	6,815
70	1.44	9,550	0.62	2,586	6,965	0.59	0.64	2,678	6,872
75	1.37	9,754	0.62	2,771	6,984	0.59	0.63	2,840	6,914
80	1.31	9,945	0.62	2,955	6,990	0.58	0.63	3,002	6,943
85	1.26	10,125	0.62	3,140	6,985	0.58	0.62	3,163	6,962
90	1.21	10,295	0.62	3,325	6,970	0.57	0.62	3,325	6,970
95	1.16	10,456	0.62	3,509	6,946	0.57	0.61	3,486	6,969
100	1.12	10,609	0.62	3,694	6,915	0.56	0.61	3,648	6,961
105	1.08	10,755	0.62	3,879	6,876	0.56	0.60	3,809	6,946
110	1.05	10,895	0.62	4,064	6,831	0.56	0.60	3,971	6,924
115	1.01	11,028	0.62	4,248	6,780	0.56	0.60	4,132	6,896
120	0.98	11,157	0.62	4,433	6,724	0.55	0.60	4,294	6,863
125	0.95	11,280	0.62	4,618	6,663	0.55	0.59	4,456	6,825
130	0.93	11,399	0.62	4,802	6,597	0.55	0.59	4,617	6,782
135	0.90	11,514	0.62	4,987	6,527	0.55	0.59	4,779	6,735
140	0.88	11,625	0.62	5,172	6,453	0.55	0.59	4,940	6,685
145	0.85	11,732	0.62	5,356	6,376	0.54	0.59	5,102	6,630
150	0.83	11,836	0.62	5,541	6,295	0.54	0.58	5,263	6,573
155	0.81	11,937	0.62	5,726	6,211	0.54	0.58	5,425	6,512
160	0.79	12,035	0.62	5,911	6,124	0.54	0.58	5,586	6,448
165	0.78	12,130	0.62	6,095	6,035	0.54	0.58	5,748	6,382
170	0.76	12,222	0.62	6,280	5,942	0.54	0.58	5,909	6,313
175	0.74	12,312	0.62	6,465	5,848	0.54	0.58	6,071	6,241
180	0.73	12,400	0.62	6,649	5,751	0.54	0.58	6,233	6,168
185	0.71	12,486	0.62	6,834	5,652	0.53	0.58	6,394	6,092
FAA Minor Storage Volume (cubic ft.) =				6,990	Mod. FAA Minor Storage Volume (cubic ft.) =				6,970
FAA Minor Storage Volume (acre-ft.) =				0.1605	Mod. FAA Minor Storage Volume (acre-ft.) =				0.1600

UDFCD DETENTION VOLUME ESTIMATING WORKBOOK Version 2.02, Released January 2007



**MAJOR DETENTION VOLUME BY FAA & MODIFIED FAA METHOD**  
(See USDCM Volume I Runoff Chapter for description of method)

Project: Geos Neighborhood MDCIA

Basin ID: Major Basin A

(For catchments less than 160 acres only. For larger catchments, use hydrograph routing method)  
(Note: for catchments larger than 90 acres, CUHP hydrograph and routing are recommended)

The user must fill in all of the blue cells for these sheets to function.

**Design Information (Input):**

Catchment Drainage Imperviousness	$I_p =$ 46.00 percent
Catchment Drainage Area	$A =$ 3.5900 acres
Predevelopment NRCS Soil Group	Type = C A, B, C, or D
Return Period for Detention Control	$T =$ 100 years (2, 5, 10, 25, 50, or 100)
Time of Concentration of Watershed	$T_c =$ 13 minutes
Allowable Unit Release Rate (See Table A)	$q =$ 1.00 cfs/acre
One-hour Precipitation	$P_1 =$ 2.61 inches
<b>Design Rainfall IDF Formula $I = C_1 \cdot P_1 / (C_2 + T_c)^{C_3}$</b>	
Coefficient One	$C_1 =$ 28.50
Coefficient Two	$C_2 =$ 10.00
Coefficient Three	$C_3 =$ 0.79

**Determination of Average Outflow from the Basin (Calculated):**

Runoff Coefficient	$C =$ 0.59
Inflow Peak Runoff	$Q_{p-in} =$ 13.28 cfs
Allowable Peak Outflow Rate	$Q_{p-out} =$ 3.59 cfs
Ratio of $Q_{p-out}/Q_{p-in}$	Ratio = 0.27

**Determination of MAJOR Detention Volume Using FAA & Modified FAA Method**

5	<- Enter Rainfall Duration Incremental Increase Value Here (e.g. 5 for 5-Minutes)								
Rainfall Duration minutes (input)	Rainfall Intensity inches / hr (output)	Inflow Volume cubic feet (output)	Average Outflow (FAA, cfs) (output)	Outflow Volume (FAA, cf) (output)	Storage Volume (FAA, cf) (output)	Adjustment Factor (Modified) (output)	Average Outflow (Mod, cfs) (output)	Outflow Volume (Mod, cf) (output)	Storage Volume (Mod, cf) (output)
5	8.76	5,585	2.18	654	4,910	1.00	3.59	1,077	4,488
10	6.88	8,867	2.18	1,309	7,558	1.00	3.59	2,154	6,713
15	5.85	11,151	2.18	1,963	9,188	0.93	3.34	3,005	8,146
20	5.06	12,873	2.18	2,617	10,256	0.82	2.95	3,543	9,330
25	4.48	14,247	2.18	3,271	10,975	0.76	2.72	4,082	10,165
30	4.04	15,384	2.18	3,926	11,459	0.72	2.57	4,620	10,764
35	3.68	16,354	2.18	4,580	11,774	0.68	2.46	5,169	11,195
40	3.38	17,197	2.18	5,234	11,983	0.66	2.37	5,697	11,500
45	3.14	17,944	2.18	5,888	12,055	0.64	2.31	6,236	11,708
50	2.93	18,613	2.18	6,543	12,070	0.63	2.26	6,774	11,839
55	2.75	19,220	2.18	7,197	12,023	0.62	2.22	7,313	11,907
60	2.59	19,775	2.18	7,851	11,923	0.61	2.18	7,851	11,923
65	2.46	20,286	2.18	8,506	11,780	0.60	2.15	8,390	11,896
70	2.33	20,761	2.18	9,160	11,601	0.59	2.13	8,928	11,832
75	2.22	21,203	2.18	9,814	11,389	0.59	2.10	9,467	11,736
80	2.13	21,618	2.18	10,468	11,150	0.58	2.08	10,005	11,613
85	2.04	22,009	2.18	11,123	10,886	0.58	2.07	10,544	11,465
90	1.96	22,378	2.18	11,777	10,601	0.57	2.05	11,082	11,296
95	1.88	22,728	2.18	12,431	10,297	0.57	2.04	11,621	11,107
100	1.81	23,061	2.18	13,086	9,976	0.56	2.03	12,169	10,902
105	1.75	23,379	2.18	13,740	9,639	0.56	2.02	12,698	10,681
110	1.69	23,682	2.18	14,394	9,288	0.56	2.01	13,236	10,446
115	1.64	23,973	2.18	15,048	8,925	0.56	2.00	13,775	10,198
120	1.59	24,252	2.18	15,703	8,549	0.55	1.99	14,313	9,939
125	1.54	24,521	2.18	16,357	8,164	0.55	1.98	14,852	9,669
130	1.50	24,779	2.18	17,011	7,768	0.55	1.97	15,390	9,389
135	1.46	25,029	2.18	17,665	7,363	0.55	1.97	15,929	9,100
140	1.42	25,270	2.18	18,320	6,950	0.55	1.96	16,467	8,802
145	1.38	25,503	2.18	18,974	6,529	0.54	1.95	17,006	8,497
150	1.35	25,729	2.18	19,628	6,100	0.54	1.95	17,544	8,184
155	1.32	25,948	2.18	20,283	5,665	0.54	1.94	18,083	7,865
160	1.29	26,161	2.18	20,937	5,224	0.54	1.94	18,621	7,539
165	1.26	26,367	2.18	21,591	4,776	0.54	1.94	19,160	7,208
170	1.23	26,568	2.18	22,245	4,323	0.54	1.93	19,698	6,870
175	1.20	26,764	2.18	22,900	3,865	0.54	1.93	20,237	6,527
180	1.18	26,955	2.18	23,554	3,401	0.54	1.92	20,775	6,180
185	1.15	27,141	2.18	24,208	2,933	0.53	1.92	21,314	5,827
FAA Major Storage Volume (cubic ft.) =				12,070	Mod. FAA Major Storage Volume (cubic ft.) =				11,923
FAA Major Storage Volume (acre-ft.) =				0.2771	Mod. FAA Major Storage Volume (acre-ft.) =				0.2737

UDFCD DETENTION VOLUME ESTIMATING WORKBOOK Version 2.02, Released January 2007

# **STAGE-DISCHARGE SIZING OF THE WATER QUALITY CAPTURE VOLUME (WQCV) OUTLET**

Project: **Geos Neighborhood MDCIA**

Geos Neighborhood MDCIA

Basin ID: **Major Basin A**

## **WQCV Design Volume (Input):**

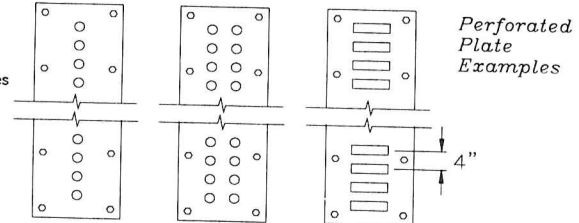
Catchment Imperviousness,  $I_p$  = 46.0 percent  
 Catchment Area, A = 3.5900 acres  
 Depth at WQCV outlet above lowest perforation, H = 29.76 inches  
 Number of layers,  $N_L$  = 7  
 Vertical distance between layers, h = 4.00 inches  
 Orifice discharge coefficient,  $C_o$  = 0.65

Diameter of holes, D = 0.440 in.  
 Number of holes per layer, N = 1  
 OR  
 Height of slot, H = in.  
 Width of slot, W = in.

Time to Drain the Pond = 40 hours  
 Water Quality Capture Volume Method Selected (40-Hour Release)

## **Outlet Design Information (Output):**

Water Quality Capture Volume ( $1.0 * (0.91 * I^3 - 1.19 * I^2 + 0.78 * I)$ ), WQCV = 0.20 watershed inches  
 Design Volume (WQCV / 12 * Area * 1.2) Vol = 0.0702 acre-feet  
 Recommended maximum outlet area per layer (based on 4" vertical spacing of layers),  $A_o$  = 0.1521 square inches  
 Total opening area at each layer based on user-input above,  $A_o$  = 0.15 square inches  
 Total opening area at each layer based on user-input above,  $A_o$  = 0.0011 square feet



## **Calculation of Collection Capacity :**

Stage ft (input)	Central Elevations of Layers of Holes in feet																		Flow cfs
	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7	Layer 8	Layer 9	Layer 10	Layer 11	Layer 12	Layer 13	Layer 14	Layer 15	Layer 16	Layer 17	Layer 18	
	5551.20	5551.53	5551.87	5552.20	5552.53	5552.87	5553.20												
	Collection Capacity for Each Layer of Holes in cfs																		
5551.20	0.000	0.000	0.000	0.000	0.000	0.000	0.000												0.00
5551.53	0.003	0.000	0.000	0.000	0.000	0.000	0.000												0.00
5551.86	0.004	0.003	0.000	0.000	0.000	0.000	0.000												0.01
5552.19	0.005	0.004	0.003	0.000	0.000	0.000	0.000												0.01
5552.52	0.006	0.005	0.004	0.003	0.000	0.000	0.000												0.02
5552.85	0.007	0.006	0.005	0.004	0.003	0.000	0.000												0.03
5553.18	0.008	0.007	0.006	0.005	0.004	0.003	0.000												0.03
5553.51	0.008	0.008	0.007	0.006	0.005	0.004	0.003												0.04
5553.84	0.009	0.008	0.008	0.007	0.006	0.005	0.004												0.05
5554.17	0.009	0.009	0.008	0.008	0.007	0.006	0.005												0.05
5554.50	0.010	0.009	0.009	0.008	0.008	0.007	0.006												0.06
5554.83	0.010	0.010	0.009	0.009	0.008	0.008	0.007												0.06
5555.16	0.011	0.010	0.010	0.009	0.008	0.008	0.007												0.07
5555.49	0.011	0.011	0.010	0.010	0.009	0.009	0.008												0.07
5555.82	0.012	0.011	0.011	0.010	0.010	0.009	0.009												0.07
5556.15	0.012	0.012	0.011	0.011	0.010	0.010	0.009												0.08
5556.48	0.013	0.012	0.012	0.011	0.011	0.010	0.010												0.08
5556.81	0.013	0.013	0.012	0.012	0.011	0.011	0.010												0.08
5557.14	0.013	0.013	0.013	0.012	0.012	0.011	0.011												0.09
5557.47	0.014	0.013	0.013	0.013	0.012	0.012	0.011												0.09
5557.80	0.014	0.014	0.013	0.013	0.013	0.012	0.012												0.09
5558.13	0.015	0.014	0.014	0.013	0.013	0.013	0.012												0.09
5558.46	0.015	0.015	0.014	0.014	0.013	0.013	0.013												0.10
5558.79	0.015	0.015	0.014	0.014	0.014	0.013	0.013												0.10
5559.12	0.016	0.015	0.015	0.014	0.014	0.014	0.013												0.10
5559.45	0.016	0.016	0.015	0.015	0.015	0.014	0.014												0.10
5559.78	0.016	0.016	0.015	0.015	0.015	0.015	0.014												0.11
5560.11	0.016	0.016	0.016	0.015	0.015	0.015	0.015												0.11
5560.44	0.017	0.016	0.016	0.016	0.015	0.015	0.015												0.11
5560.77	0.017	0.017	0.016	0.016	0.016	0.015	0.015												0.11
5561.10	0.017	0.017	0.017	0.016	0.016	0.016	0.015												0.11
5561.43	0.018	0.017	0.017	0.017	0.016	0.016	0.016												0.12
5561.76	0.018	0.018	0.017	0.017	0.017	0.016	0.016												0.12
5562.09	0.018	0.018	0.018	0.017	0.017	0.017	0.016												0.12
5562.42	0.018	0.018	0.018	0.018	0.017	0.017	0.017												0.12
5562.75	0.019	0.018	0.018	0.018	0.018	0.017	0.017												0.12
5563.08	0.019	0.019	0.018	0.018	0.018	0.018	0.017												0.13
5563.41	0.019	0.019	0.019	0.018	0.018	0.018	0.018												0.13
5563.74	0.020	0.019	0.019	0.019	0.019	0.018	0.018												0.13
5564.07	0.020	0.020	0.019	0.019	0.019	0.019	0.018												0.13
5564.40	0.020	0.020	0.019	0.019	0.019	0.019	0.019												0.13
5564.73	0.020	0.020	0.020	0.019	0.019	0.019	0.019												0.14
5565.06	0.021	0.020	0.020	0.020	0.019	0.019	0.019												0.14
5565.39	0.021	0.021	0.020	0.020	0.020	0.019	0.019												0.14



**MINOR DETENTION VOLUME BY FAA & MODIFIED FAA METHOD**  
(See USDCM Volume I Runoff Chapter for description of method)

Project: Geos Neighborhood MDCIA

Basin ID: Major Basin B

(For catchments less than 160 acres only. For larger catchments, use hydrograph routing method)  
(Note: for catchments larger than 90 acres, CUHP hydrograph and routing are recommended)

The user must fill in all of the blue cells for these sheets to function.

**Design Information (Input):**

Catchment Drainage Imperviousness	I _a = 48.00 percent
Catchment Drainage Area	A = 2.3500 acres
Predevelopment NRCS Soil Group	Type = C A, B, C, or D
Return Period for Detention Control	T = 10 years (2, 5, 10, 25, 50, or 100)
Time of Concentration of Watershed	T _c = 13 minutes
Allowable Unit Release Rate (See Table A)	q = 0.30 cfs/acre
One-hour Precipitation	P ₁ = 1.61 inches
<b>Design Rainfall IDF Formula I = C₁* P₁/(C₂+T_c)^C₃</b>	
Coefficient One	C ₁ = 28.50
Coefficient Two	C ₂ = 10.00
Coefficient Three	C ₃ = 0.79

**Determination of Average Outflow from the Basin (Calculated):**

Runoff Coefficient	C = 0.45
Inflow Peak Runoff	Q _{p-in} = 4.13 cfs
Allowable Peak Outflow Rate	Q _{p-out} = 0.71 cfs
Ratio of Q _{p-out} /Q _{p-in}	Ratio = 0.17

**Determination of MINOR Detention Volume Using FAA & Modified FAA Method**

5	<- Enter Rainfall Duration Incremental Increase Value Here (e.g. 5 for 5-Minutes)								
Rainfall Duration minutes (input)	Rainfall Intensity inches / hr (output)	Inflow Volume cubic feet (output)	Average Outflow (FAA, cfs) (output)	Outflow Volume (FAA, cf) (output)	Storage Volume (FAA, cf) (output)	Adjustment Factor (Modified) (output)	Average Outflow (Mod, cfs) (output)	Outflow Volume (Mod, cf) (output)	Storage Volume (Mod, cf) (output)
5	5.40	1,714	0.40	120	1,594	1.00	0.71	212	1,502
10	4.30	2,731	0.40	240	2,491	1.00	0.71	423	2,308
15	3.61	3,434	0.40	359	3,075	0.92	0.65	584	2,850
20	3.12	3,985	0.40	479	3,486	0.82	0.57	689	3,275
25	2.77	4,388	0.40	599	3,789	0.75	0.53	795	3,592
30	2.49	4,738	0.40	719	4,019	0.71	0.50	901	3,837
35	2.27	5,037	0.40	838	4,198	0.68	0.48	1,007	4,030
40	2.09	5,296	0.40	958	4,338	0.66	0.46	1,112	4,184
45	1.94	5,526	0.40	1,078	4,448	0.64	0.45	1,218	4,308
50	1.81	5,732	0.40	1,198	4,535	0.63	0.44	1,324	4,408
55	1.70	5,919	0.40	1,318	4,602	0.61	0.43	1,430	4,489
60	1.60	6,090	0.40	1,437	4,653	0.61	0.43	1,535	4,555
65	1.51	6,248	0.40	1,557	4,691	0.60	0.42	1,641	4,606
70	1.44	6,394	0.40	1,677	4,717	0.59	0.42	1,747	4,647
75	1.37	6,530	0.40	1,797	4,734	0.58	0.41	1,853	4,677
80	1.31	6,658	0.40	1,916	4,742	0.58	0.41	1,958	4,699
85	1.26	6,778	0.40	2,036	4,742	0.57	0.40	2,064	4,714
90	1.21	6,892	0.40	2,156	4,736	0.57	0.40	2,170	4,722
95	1.16	7,000	0.40	2,276	4,724	0.57	0.40	2,276	4,724
100	1.12	7,102	0.40	2,396	4,707	0.56	0.40	2,381	4,721
105	1.08	7,200	0.40	2,515	4,685	0.56	0.39	2,487	4,713
110	1.05	7,294	0.40	2,635	4,659	0.56	0.39	2,593	4,701
115	1.01	7,383	0.40	2,755	4,628	0.55	0.39	2,699	4,684
120	0.98	7,469	0.40	2,875	4,594	0.55	0.39	2,804	4,665
125	0.95	7,552	0.40	2,994	4,557	0.55	0.39	2,910	4,642
130	0.93	7,631	0.40	3,114	4,517	0.55	0.39	3,016	4,615
135	0.90	7,708	0.40	3,234	4,474	0.55	0.39	3,122	4,587
140	0.88	7,782	0.40	3,354	4,429	0.55	0.38	3,227	4,555
145	0.85	7,854	0.40	3,473	4,381	0.54	0.38	3,333	4,521
150	0.83	7,924	0.40	3,593	4,331	0.54	0.38	3,439	4,485
155	0.81	7,991	0.40	3,713	4,278	0.54	0.38	3,545	4,447
160	0.79	8,057	0.40	3,833	4,224	0.54	0.38	3,650	4,406
165	0.78	8,121	0.40	3,953	4,168	0.54	0.38	3,756	4,364
170	0.76	8,182	0.40	4,072	4,110	0.54	0.38	3,862	4,321
175	0.74	8,243	0.40	4,192	4,051	0.54	0.38	3,968	4,275
180	0.73	8,302	0.40	4,312	3,990	0.54	0.38	4,073	4,228
185	0.71	8,359	0.40	4,432	3,927	0.53	0.38	4,179	4,180
FAA Minor Storage Volume (cubic ft.) =				4,742	Mod. FAA Minor Storage Volume (cubic ft.) =				4,724
FAA Minor Storage Volume (acre-ft.) =				0.1089	Mod. FAA Minor Storage Volume (acre-ft.) =				0.1084

UDFCD DETENTION VOLUME ESTIMATING WORKBOOK Version 2.02, Released January 2007



**MAJOR DETENTION VOLUME BY FAA & MODIFIED FAA METHOD**  
(See USDCM Volume I Runoff Chapter for description of method)

Project: Geos Neighborhood MDCIA  
Basin ID: Major Basin B

(For catchments less than 160 acres only. For larger catchments, use hydrograph routing method)  
(Note: for catchments larger than 90 acres, CUHP hydrograph and routing are recommended)

The user must fill in all of the blue cells for these sheets to function.

<b>Design Information (Input):</b>	
Catchment Drainage Imperviousness	I _a = 48.00 percent
Catchment Drainage Area	A = 2.3500 acres
Predevelopment NRCS Soil Group	Type = C A, B, C, or D
Return Period for Detention Control	T = 100 years (2, 5, 10, 25, 50, or 100)
Time of Concentration of Watershed	T _c = 13 minutes
Allowable Unit Release Rate (See Table A)	q = 1.00 cfs/acre
One-hour Precipitation	P ₁ = 2.61 inches
Design Rainfall IDF Formula I = C ₁ * P ₁ / (C ₂ + T _c ) ^{C₃}	
Coefficient One	C ₁ = 28.50
Coefficient Two	C ₂ = 10.00
Coefficient Three	C ₃ = 0.79

<b>Determination of Average Outflow from the Basin (Calculated):</b>	
Runoff Coefficient	C = 0.60
Inflow Peak Runoff	Q _{p-in} = 8.93 cfs
Allowable Peak Outflow Rate	Q _{p-out} = 2.35 cfs
Ratio of Q _{p-out} /Q _{p-in}	Ratio = 0.26

**Determination of MAJOR Detention Volume Using FAA & Modified FAA Method**

5	<- Enter Rainfall Duration Incremental Increase Value Here (e.g. 5 for 5-Minutes)								
Rainfall Duration minutes (input)	Rainfall Intensity inches / hr (output)	Inflow Volume cubic feet (output)	Average Outflow (FAA, cfs) (output)	Outflow Volume (FAA, cf) (output)	Storage Volume (FAA, cf) (output)	Adjustment Factor (Modified) (output)	Average Outflow (Mod, cfs) (output)	Outflow Volume (Mod, cf) (output)	Storage Volume (Mod, cf) (output)
5	8.76	3,704	1.42	427	3,278	1.00	2.35	705	2,999
10	6.98	5,903	1.42	853	5,050	1.00	2.35	1,410	4,493
15	5.85	7,423	1.42	1,280	6,143	0.92	2.16	1,946	5,477
20	5.06	8,570	1.42	1,706	6,863	0.82	1.92	2,298	6,271
25	4.48	9,484	1.42	2,133	7,351	0.75	1.77	2,651	6,833
30	4.04	10,241	1.42	2,559	7,682	0.71	1.67	3,003	7,238
35	3.68	10,886	1.42	2,986	7,901	0.68	1.60	3,356	7,531
40	3.38	11,448	1.42	3,412	8,036	0.66	1.55	3,708	7,740
45	3.14	11,945	1.42	3,839	8,106	0.64	1.50	4,061	7,884
50	2.93	12,390	1.42	4,265	8,125	0.63	1.47	4,413	7,977
55	2.75	12,784	1.42	4,692	8,103	0.61	1.44	4,766	8,029
60	2.59	13,164	1.42	5,118	8,045	0.61	1.42	5,118	8,045
65	2.46	13,504	1.42	5,545	7,959	0.60	1.40	5,471	8,033
70	2.33	13,820	1.42	5,971	7,849	0.59	1.39	5,823	7,997
75	2.22	14,115	1.42	6,398	7,717	0.58	1.37	6,176	7,939
80	2.13	14,391	1.42	6,824	7,567	0.58	1.36	6,528	7,863
85	2.04	14,651	1.42	7,251	7,400	0.57	1.35	6,881	7,770
90	1.96	14,897	1.42	7,677	7,220	0.57	1.34	7,233	7,664
95	1.88	15,130	1.42	8,104	7,026	0.57	1.33	7,586	7,544
100	1.81	15,352	1.42	8,531	6,821	0.56	1.32	7,938	7,413
105	1.75	15,563	1.42	8,957	6,606	0.56	1.32	8,291	7,272
110	1.69	15,765	1.42	9,384	6,381	0.56	1.31	8,643	7,122
115	1.64	15,959	1.42	9,810	6,149	0.55	1.30	8,996	6,963
120	1.59	16,144	1.42	10,237	5,908	0.55	1.30	9,348	6,796
125	1.54	16,323	1.42	10,663	5,660	0.55	1.29	9,701	6,622
130	1.50	16,495	1.42	11,090	5,406	0.55	1.29	10,053	6,442
135	1.46	16,661	1.42	11,516	5,145	0.55	1.28	10,406	6,255
140	1.42	16,822	1.42	11,943	4,879	0.55	1.28	10,758	6,063
145	1.38	16,977	1.42	12,369	4,608	0.54	1.28	11,111	5,866
150	1.35	17,127	1.42	12,796	4,332	0.54	1.27	11,463	5,664
155	1.32	17,273	1.42	13,222	4,051	0.54	1.27	11,816	5,457
160	1.29	17,415	1.42	13,649	3,766	0.54	1.27	12,168	5,247
165	1.26	17,553	1.42	14,075	3,477	0.54	1.26	12,521	5,032
170	1.23	17,686	1.42	14,502	3,185	0.54	1.26	12,873	4,813
175	1.20	17,817	1.42	14,928	2,888	0.54	1.26	13,226	4,591
180	1.18	17,944	1.42	15,355	2,589	0.54	1.26	13,578	4,365
185	1.15	18,068	1.42	15,781	2,286	0.53	1.26	13,931	4,137
FAA Major Storage Volume (cubic ft.) =				8,125	Mod. FAA Major Storage Volume (cubic ft.) =				8,045
FAA Major Storage Volume (acre-ft.) =				0.1865	Mod. FAA Major Storage Volume (acre-ft.) =				0.1847

UDFCD DETENTION VOLUME ESTIMATING WORKBOOK Version 2.02, Released January 2007

# STAGE-DISCHARGE SIZING OF THE WATER QUALITY CAPTURE VOLUME (WQCV) OUTLET

Project: **Geos Neighborhood MDCIA**

Basin ID: **Major Basin B**

## WQCV Design Volume (Input):

Catchment Imperviousness,  $I_p$  = 48.0 percent  
 Catchment Area, A = 2.3500 acres  
 Depth at WQCV outlet above lowest perforation, H = 27.60 inches  
 Number of layers,  $N_L$  = 7  
 Vertical distance between layers, h = 4.00 inches  
 Orifice discharge coefficient,  $C_o$  = 0.65

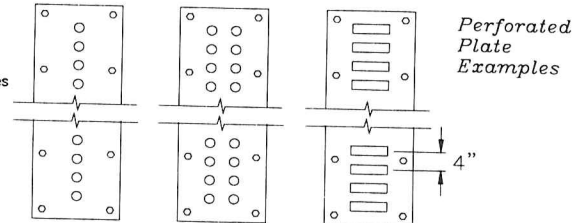
Diameter of holes, D = 0.373 in.  
 Number of holes per layer, N = 1  
 OR  
 Height of slot, H = in.  
 Width of slot, W = in.

Time to Drain the Pond = 40 hours  
 Water Quality Capture Volume Method Selected (40-Hour Release)

## Outlet Design Information (Output):

Water Quality Capture Volume  $(1.0 * (0.91 * I^3 - 1.19 * I^2 + 0.78 * I))$ , WQCV = 0.20 watershed inches  
 Design Volume  $(WQCV / 12 * \text{Area} * 1.2)$  Vol = 0.0472 acre-feet  
 Recommended maximum outlet area per layer (based on 4" vertical spacing of layers),  $A_o$  = 0.1093 square inches  
 Total opening area at each layer based on user-input above,  $A_o$  = 0.11 square inches  
 Total opening area at each layer based on user-input above,  $A_o$  = 0.0008 square feet

## Calculation of Collection Capacity :



Stage ft (input)	Central Elevations of Layers of Holes in feet																		Flow cfs
	Layer 1 5545.50	Layer 2 5545.83	Layer 3 5546.17	Layer 4 5546.50	Layer 5 5546.83	Layer 6 5547.17	Layer 7 5547.50	Layer 8	Layer 9	Layer 10	Layer 11	Layer 12	Layer 13	Layer 14	Layer 15	Layer 16	Layer 17	Layer 18	
	Collection Capacity for Each Layer of Holes in cfs																		
5545.50	0.000	0.000	0.000	0.000	0.000	0.000	0.000												
5545.83	0.002	0.000	0.000	0.000	0.000	0.000	0.000												0.00
5546.16	0.003	0.002	0.000	0.000	0.000	0.000	0.000												0.00
5546.49	0.004	0.003	0.002	0.000	0.000	0.000	0.000												0.01
5546.82	0.005	0.004	0.003	0.002	0.000	0.000	0.000												0.01
5547.15	0.005	0.005	0.004	0.003	0.002	0.000	0.000												0.01
5547.48	0.006	0.005	0.005	0.004	0.003	0.002	0.000												0.02
5547.81	0.006	0.006	0.005	0.005	0.004	0.003	0.002												0.02
5548.14	0.006	0.006	0.006	0.005	0.005	0.004	0.003												0.03
5548.47	0.007	0.006	0.006	0.006	0.005	0.005	0.004												0.03
5548.80	0.007	0.007	0.006	0.006	0.006	0.005	0.005												0.04
5549.13	0.008	0.007	0.007	0.006	0.006	0.006	0.005												0.04
5549.46	0.008	0.008	0.007	0.007	0.006	0.006	0.006												0.05
5549.79	0.008	0.008	0.008	0.007	0.007	0.006	0.006												0.05
5550.12	0.009	0.008	0.008	0.008	0.007	0.007	0.007												0.05
5550.45	0.009	0.009	0.008	0.008	0.008	0.007	0.007												0.05
5550.78	0.009	0.009	0.008	0.008	0.008	0.008	0.007												0.06
5551.11	0.009	0.009	0.009	0.008	0.008	0.008	0.008												0.06
5551.44	0.010	0.009	0.009	0.009	0.008	0.008	0.008												0.06
5551.77	0.010	0.010	0.009	0.009	0.009	0.008	0.008												0.06
5552.10	0.010	0.010	0.010	0.009	0.009	0.009	0.008												0.07
5552.43	0.010	0.010	0.010	0.010	0.010	0.009	0.009												0.07
5552.76	0.011	0.010	0.010	0.010	0.010	0.010	0.009												0.07
5553.09	0.011	0.011	0.010	0.010	0.010	0.010	0.010												0.07
5553.42	0.011	0.011	0.011	0.011	0.010	0.010	0.010												0.07
5553.75	0.011	0.011	0.011	0.011	0.011	0.010	0.010												0.07
5554.08	0.012	0.011	0.011	0.011	0.011	0.011	0.010												0.08
5554.41	0.012	0.012	0.011	0.011	0.011	0.011	0.011												0.08
5554.74	0.012	0.012	0.012	0.011	0.011	0.011	0.011												0.08
5555.07	0.012	0.012	0.012	0.012	0.012	0.011	0.011												0.08
5555.40	0.012	0.012	0.012	0.012	0.012	0.012	0.011												0.08
5555.73	0.013	0.012	0.012	0.012	0.012	0.012	0.012												0.08
5556.06	0.013	0.013	0.012	0.012	0.012	0.012	0.012												0.09
5556.39	0.013	0.013	0.013	0.012	0.012	0.012	0.012												0.09
5556.72	0.013	0.013	0.013	0.013	0.013	0.012	0.012												0.09
5557.05	0.013	0.013	0.013	0.013	0.013	0.013	0.012												0.09
5557.38	0.014	0.013	0.013	0.013	0.013	0.013	0.013												0.09
5557.71	0.014	0.014	0.013	0.013	0.013	0.013	0.013												0.09
5558.04	0.014	0.014	0.014	0.013	0.013	0.013	0.013												0.09
5558.37	0.014	0.014	0.014	0.014	0.014	0.013	0.013												0.10
5558.70	0.014	0.014	0.014	0.014	0.014	0.014	0.013												0.10
5559.03	0.015	0.014	0.014	0.014	0.014	0.014	0.014												0.10
5559.36	0.015	0.015	0.014	0.014	0.014	0.014	0.014												0.10
5559.69	0.015	0.015	0.015	0.014	0.014	0.014	0.014												0.10



**MINOR DETENTION VOLUME BY FAA & MODIFIED FAA METHOD**  
(See USDCM Volume I Runoff Chapter for description of method)

Project: Geos Neighborhood MDCIA

Basin ID: Major Basin C

(For catchments less than 160 acres only. For larger catchments, use hydrograph routing method)  
(Note: for catchments larger than 90 acres, CUHP hydrograph and routing are recommended)

The user must fill in all of the blue cells for these sheets to function.

**Design Information (Input):**

Catchment Drainage Imperviousness	I _a = 39.00 percent
Catchment Drainage Area	A = 2.0700 acres
Predevelopment NRCS Soil Group	Type = C A, B, C, or D
Return Period for Detention Control	T = 10 years (2, 5, 10, 25, 50, or 100)
Time of Concentration of Watershed	T _c = 10 minutes
Allowable Unit Release Rate (See Table A)	q = 0.30 cfs/acre
One-hour Precipitation	P ₁ = 1.61 inches
<b>Design Rainfall IDF Formula I = C₁* P₁/(C₂+T_c)^C₃</b>	
Coefficient One	C ₁ = 28.50
Coefficient Two	C ₂ = 10.00
Coefficient Three	C ₃ = 0.79

**Determination of Average Outflow from the Basin (Calculated):**

Runoff Coefficient	C = 0.41
Inflow Peak Runoff	Q _{p-in} = 3.65 cfs
Allowable Peak Outflow Rate	Q _{p-out} = 0.62 cfs
Ratio of Q _{p-out} /Q _{p-in}	Ratio = 0.17

**Determination of MINOR Detention Volume Using FAA & Modified FAA Method**

5	Enter Rainfall Duration Incremental Increase Value Here (e.g. 5 for 5-Minutes)								
Rainfall Duration minutes (input)	Rainfall Intensity inches / hr (output)	Inflow Volume cubic feet (output)	Average Outflow (FAA, cfs) (output)	Outflow Volume (FAA, cf) (output)	Storage Volume (FAA, cf) (output)	Adjustment Factor (Modified) (output)	Average Outflow (Mod, cfs) (output)	Outflow Volume (Mod, cf) (output)	Storage Volume (Mod, cf) (output)
5	5.40	1,375	0.35	104	1,271	1.00	0.62	186	1,189
10	4.30	2,192	0.35	208	1,983	1.00	0.62	373	1,819
15	3.61	2,756	0.35	312	2,444	0.83	0.52	466	2,290
20	3.12	3,182	0.35	416	2,765	0.75	0.47	559	2,623
25	2.77	3,521	0.35	521	3,001	0.70	0.43	652	2,869
30	2.49	3,803	0.35	625	3,178	0.67	0.41	745	3,057
35	2.27	4,042	0.35	729	3,313	0.64	0.40	838	3,204
40	2.09	4,251	0.35	833	3,418	0.63	0.39	932	3,319
45	1.94	4,435	0.35	937	3,498	0.61	0.38	1,025	3,410
50	1.81	4,601	0.35	1,041	3,559	0.60	0.37	1,118	3,483
55	1.70	4,750	0.35	1,145	3,605	0.59	0.37	1,211	3,540
60	1.60	4,888	0.35	1,249	3,638	0.58	0.36	1,304	3,584
65	1.51	5,014	0.35	1,353	3,661	0.58	0.36	1,397	3,617
70	1.44	5,131	0.35	1,458	3,674	0.57	0.35	1,490	3,641
75	1.37	5,241	0.35	1,562	3,679	0.57	0.35	1,584	3,657
80	1.31	5,343	0.35	1,666	3,678	0.56	0.35	1,677	3,667
85	1.26	5,440	0.35	1,770	3,670	0.56	0.35	1,770	3,670
90	1.21	5,531	0.35	1,874	3,657	0.56	0.35	1,863	3,668
95	1.16	5,618	0.35	1,978	3,640	0.55	0.34	1,956	3,662
100	1.12	5,700	0.35	2,082	3,618	0.55	0.34	2,049	3,651
105	1.08	5,778	0.35	2,186	3,592	0.55	0.34	2,142	3,636
110	1.05	5,854	0.35	2,290	3,563	0.55	0.34	2,236	3,618
115	1.01	5,925	0.35	2,395	3,531	0.54	0.34	2,329	3,597
120	0.98	5,994	0.35	2,499	3,496	0.54	0.34	2,422	3,572
125	0.95	6,061	0.35	2,603	3,458	0.54	0.34	2,515	3,546
130	0.93	6,125	0.35	2,707	3,418	0.54	0.33	2,608	3,516
135	0.90	6,186	0.35	2,811	3,375	0.54	0.33	2,701	3,485
140	0.88	6,246	0.35	2,915	3,331	0.54	0.33	2,795	3,451
145	0.85	6,304	0.35	3,019	3,284	0.53	0.33	2,888	3,416
150	0.83	6,359	0.35	3,123	3,236	0.53	0.33	2,981	3,379
155	0.81	6,414	0.35	3,227	3,186	0.53	0.33	3,074	3,340
160	0.79	6,466	0.35	3,331	3,135	0.53	0.33	3,167	3,299
165	0.78	6,517	0.35	3,436	3,082	0.53	0.33	3,260	3,257
170	0.76	6,567	0.35	3,540	3,027	0.53	0.33	3,353	3,213
175	0.74	6,615	0.35	3,644	2,971	0.53	0.33	3,447	3,169
180	0.73	6,662	0.35	3,748	2,915	0.53	0.33	3,540	3,123
185	0.71	6,708	0.35	3,852	2,856	0.53	0.33	3,633	3,076
FAA Minor Storage Volume (cubic ft.) =				3,679	Mod. FAA Minor Storage Volume (cubic ft.) =				3,670
FAA Minor Storage Volume (acre-ft.) =				0.0845	Mod. FAA Minor Storage Volume (acre-ft.) =				0.0843

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**MAJOR DETENTION VOLUME BY FAA & MODIFIED FAA METHOD**  
(See USDCM Volume I Runoff Chapter for description of method)

Project: Geos Neighborhood MDCIA  
Basin ID: Major Basin C

(For catchments less than 160 acres only. For larger catchments, use hydrograph routing method)  
(Note: for catchments larger than 90 acres, CUHP hydrograph and routing are recommended)

The user must fill in all of the blue cells for these sheets to function.

<b>Design Information (Input):</b>	
Catchment Drainage Imperviousness	I _a = 39.00 percent
Catchment Drainage Area	A = 2.0700 acres
Predevelopment NRCS Soil Group	Type = C A, B, C, or D
Return Period for Detention Control	T = 100 years (2, 5, 10, 25, 50, or 100)
Time of Concentration of Watershed	T _c = 10 minutes
Allowable Unit Release Rate (See Table A)	q = 1.00 cfs/acre
One-hour Precipitation	P ₁ = 2.61 inches
Design Rainfall IDF Formula I = C ₁ * P ₁ /(C ₂ +T _c )^C ₃	
Coefficient One	C ₁ = 28.50
Coefficient Two	C ₂ = 10.00
Coefficient Three	C ₃ = 0.79
<b>Determination of Average Outflow from the Basin (Calculated):</b>	
Runoff Coefficient	C = 0.58
Inflow Peak Runoff	Q _{p-in} = 8.38 cfs
Allowable Peak Outflow Rate	Q _{p-out} = 2.07 cfs
Ratio of Q _{p-out} /Q _{p-in}	Ratio = 0.25
<b>Determination of MAJOR Detention Volume Using FAA &amp; Modified FAA Method</b>	

5	<- Enter Rainfall Duration Incremental Increase Value Here (e.g. 5 for 5-Minutes)								
Rainfall Duration minutes (input)	Rainfall Intensity inches / hr (output)	Inflow Volume cubic feet (output)	Average Outflow (FAA, cfs) (output)	Outflow Volume (FAA, cf) (output)	Storage Volume (FAA, cf) (output)	Adjustment Factor (Modified) (output)	Average Outflow (Mod, cfs) (output)	Outflow Volume (Mod, cf) (output)	Storage Volume (Mod, cf) (output)
5	8.76	3,154	1.21	362	2,792	1.00	2.07	621	2,533
10	6.98	5,026	1.21	725	4,301	1.00	2.07	1,242	3,784
15	5.85	6,321	1.21	1,087	5,234	0.83	1.73	1,553	4,768
20	5.06	7,297	1.21	1,449	5,848	0.75	1.55	1,863	5,434
25	4.48	8,075	1.21	1,811	6,264	0.70	1.45	2,174	5,902
30	4.04	8,720	1.21	2,174	6,547	0.67	1.38	2,484	6,236
35	3.68	9,270	1.21	2,536	6,734	0.64	1.33	2,795	6,475
40	3.38	9,748	1.21	2,898	6,850	0.63	1.29	3,105	6,643
45	3.14	10,171	1.21	3,260	6,911	0.61	1.27	3,416	6,755
50	2.93	10,550	1.21	3,623	6,928	0.60	1.24	3,726	6,824
55	2.75	10,894	1.21	3,985	6,909	0.59	1.22	4,037	6,858
60	2.59	11,209	1.21	4,347	6,862	0.58	1.21	4,347	6,862
65	2.46	11,499	1.21	4,709	6,789	0.58	1.19	4,658	6,841
70	2.33	11,768	1.21	5,072	6,696	0.57	1.18	4,968	6,800
75	2.22	12,019	1.21	5,434	6,585	0.57	1.17	5,279	6,740
80	2.13	12,254	1.21	5,796	6,458	0.56	1.16	5,589	6,665
85	2.04	12,475	1.21	6,158	6,317	0.56	1.16	5,900	6,576
90	1.96	12,685	1.21	6,521	6,164	0.56	1.15	6,210	6,475
95	1.88	12,883	1.21	6,883	6,000	0.55	1.14	6,521	6,363
100	1.81	13,072	1.21	7,245	5,827	0.55	1.14	6,831	6,241
105	1.75	13,252	1.21	7,607	5,644	0.55	1.13	7,142	6,110
110	1.69	13,424	1.21	7,970	5,454	0.55	1.13	7,452	5,972
115	1.64	13,589	1.21	8,332	5,257	0.54	1.13	7,763	5,826
120	1.59	13,747	1.21	8,694	5,053	0.54	1.12	8,073	5,674
125	1.54	13,899	1.21	9,056	4,843	0.54	1.12	8,384	5,515
130	1.50	14,045	1.21	9,419	4,627	0.54	1.11	8,694	5,351
135	1.46	14,187	1.21	9,781	4,406	0.54	1.11	9,005	5,182
140	1.42	14,324	1.21	10,143	4,181	0.54	1.11	9,315	5,009
145	1.38	14,456	1.21	10,505	3,951	0.53	1.11	9,626	4,830
150	1.35	14,584	1.21	10,868	3,716	0.53	1.10	9,936	4,648
155	1.32	14,708	1.21	11,230	3,478	0.53	1.10	10,247	4,462
160	1.29	14,829	1.21	11,592	3,237	0.53	1.10	10,557	4,272
165	1.26	14,946	1.21	11,954	2,992	0.53	1.10	10,868	4,078
170	1.23	15,060	1.21	12,317	2,743	0.53	1.10	11,178	3,882
175	1.20	15,171	1.21	12,679	2,492	0.53	1.09	11,489	3,682
180	1.18	15,279	1.21	13,041	2,238	0.53	1.09	11,799	3,480
185	1.15	15,384	1.21	13,403	1,981	0.53	1.09	12,110	3,275
FAA Major Storage Volume (cubic ft.) =				6,928	Mod. FAA Major Storage Volume (cubic ft.) =				6,862
FAA Major Storage Volume (acre-ft.) =				0.1590	Mod. FAA Major Storage Volume (acre-ft.) =				0.1575

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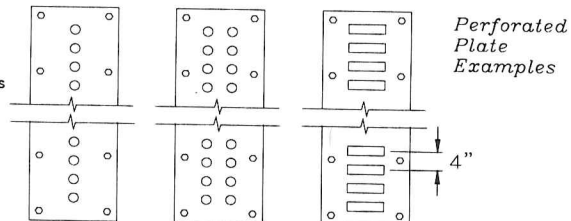
Project: Cape May, NJ - LMBOM

Basin ID: Major Basin C

Variable	Mean	SD	Min	Max
Catchment Imperviousness, I =	22.9	20.0	0	100

Time to Drain the Pond =                      hours

Height of slot,  $H =$  _____ in.  
Width of slot,  $W =$  _____ in.

[illegible]

Water Quality Capture Volume ( $1.0 * (0.91 * I^0.3 - 1.19 * I^0.2 + 0.78 * I)$ ), WQCV =	0.18	watershed inches
Design Volume (WQCV / 12 * Area * 1.2) Vol =	0.0367	acre-feet
Recommended maximum outlet area per layer (based on 4" vertical spacing of layers), A _o =	N/A	square inches
Total opening area at each layer based on user-input above, A _o =	0.00	square inches
Total opening area at each layer based on user-input above, A _o =	0.0000	square feet

○	○ ○	□ □ □ □	↑
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[illegible]



**MINOR DETENTION VOLUME BY FAA & MODIFIED FAA METHOD**  
(See USDCM Volume I Runoff Chapter for description of method)

Project: Geos Neighborhood MDCIA  
Basin ID: Major Basin D

(For catchments less than 160 acres only. For larger catchments, use hydrograph routing method)  
(Note: for catchments larger than 90 acres, CUHP hydrograph and routing are recommended)

The user must fill in all of the blue cells for these sheets to function.

Design Information (Input):	
Catchment Drainage Imperviousness	I _a = 43.00 percent
Catchment Drainage Area	A = 2.7500 acres
Predevelopment NRCS Soil Group	Type = C A, B, C, or D
Return Period for Detention Control	T = 10 years (2, 5, 10, 25, 50, or 100)
Time of Concentration of Watershed	T _c = 13 minutes
Allowable Unit Release Rate (See Table A)	q = 0.30 cfs/acre
One-hour Precipitation	P ₁ = 1.61 inches
Design Rainfall IDF Formula I = C ₁ * P ₁ / (C ₂ + T _c ) ^{C₃}	
Coefficient One	C ₁ = 28.50
Coefficient Two	C ₂ = 10.00
Coefficient Three	C ₃ = 0.79
Determination of Average Outflow from the Basin (Calculated):	
Runoff Coefficient	C = 0.43
Inflow Peak Runoff	Q _{p-in} = 4.59 cfs
Allowable Peak Outflow Rate	Q _{p-out} = 0.83 cfs
Ratio of Q _{p-out} /Q _{p-in}	Ratio = 0.18
Determination of MINOR Detention Volume Using FAA & Modified FAA Method	

5	<- Enter Rainfall Duration Incremental Increase Value Here (e.g. 5 for 5-Minutes)								
Rainfall Duration minutes (input)	Rainfall Intensity inches / hr (output)	Inflow Volume cubic feet (output)	Average Outflow (FAA, cfs) (output)	Outflow Volume (FAA, cf) (output)	Storage Volume (FAA, cf) (output)	Adjustment Factor (Modified) (output)	Average Outflow (Mod, cfs) (output)	Outflow Volume (Mod, cf) (output)	Storage Volume (Mod, cf) (output)
5	5.40	1,816	0.47	141	1,775	1.00	0.83	248	1,669
10	4.30	3,054	0.47	283	2,771	1.00	0.83	495	2,559
15	3.61	3,840	0.47	424	3,416	0.93	0.76	688	3,152
20	3.12	4,433	0.47	565	3,868	0.82	0.68	812	3,622
25	2.77	4,906	0.47	707	4,199	0.76	0.62	936	3,971
30	2.49	5,298	0.47	848	4,450	0.71	0.59	1,059	4,239
35	2.27	5,632	0.47	989	4,642	0.68	0.56	1,183	4,449
40	2.09	5,922	0.47	1,131	4,792	0.66	0.54	1,307	4,616
45	1.84	6,179	0.47	1,272	4,907	0.64	0.53	1,431	4,749
50	1.81	6,410	0.47	1,414	4,996	0.63	0.52	1,554	4,856
55	1.70	6,619	0.47	1,555	5,064	0.62	0.51	1,678	4,941
60	1.60	6,810	0.47	1,698	5,114	0.61	0.50	1,802	5,008
65	1.51	6,986	0.47	1,838	5,149	0.60	0.49	1,926	5,061
70	1.44	7,150	0.47	1,979	5,171	0.59	0.49	2,049	5,100
75	1.37	7,302	0.47	2,120	5,182	0.59	0.48	2,173	5,129
80	1.31	7,445	0.47	2,262	5,183	0.58	0.48	2,297	5,148
85	1.26	7,579	0.47	2,403	5,177	0.58	0.47	2,421	5,159
90	1.21	7,707	0.47	2,544	5,162	0.57	0.47	2,544	5,162
95	1.16	7,827	0.47	2,686	5,142	0.57	0.47	2,668	5,159
100	1.12	7,942	0.47	2,827	5,115	0.56	0.47	2,792	5,150
105	1.08	8,051	0.47	2,968	5,083	0.56	0.46	2,916	5,136
110	1.05	8,156	0.47	3,110	5,046	0.56	0.46	3,039	5,116
115	1.01	8,256	0.47	3,251	5,005	0.56	0.46	3,163	5,093
120	0.98	8,352	0.47	3,392	4,960	0.55	0.46	3,287	5,065
125	0.95	8,444	0.47	3,534	4,911	0.55	0.45	3,411	5,034
130	0.93	8,533	0.47	3,675	4,858	0.55	0.45	3,534	4,999
135	0.90	8,619	0.47	3,816	4,803	0.55	0.45	3,658	4,961
140	0.88	8,702	0.47	3,958	4,745	0.55	0.45	3,782	4,921
145	0.85	8,783	0.47	4,099	4,684	0.54	0.45	3,906	4,877
150	0.83	8,861	0.47	4,241	4,620	0.54	0.45	4,029	4,831
155	0.81	8,936	0.47	4,382	4,554	0.54	0.45	4,153	4,783
160	0.79	9,009	0.47	4,523	4,486	0.54	0.45	4,277	4,732
165	0.78	9,080	0.47	4,665	4,416	0.54	0.44	4,401	4,680
170	0.76	9,150	0.47	4,806	4,344	0.54	0.44	4,524	4,625
175	0.74	9,217	0.47	4,947	4,270	0.54	0.44	4,648	4,569
180	0.73	9,283	0.47	5,089	4,194	0.54	0.44	4,772	4,511
185	0.71	9,347	0.47	5,230	4,117	0.53	0.44	4,896	4,451
FAA Minor Storage Volume (cubic ft.) =				5,183	Mod. FAA Minor Storage Volume (cubic ft.) =				5,162
FAA Minor Storage Volume (acre-ft.) =				0.1190	Mod. FAA Minor Storage Volume (acre-ft.) =				0.1185

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**MAJOR DETENTION VOLUME BY FAA & MODIFIED FAA METHOD**  
(See USDCM Volume I Runoff Chapter for description of method)

Project: Geos Neighborhood MDCIA

Basin ID: Major Basin D

(For catchments less than 160 acres only. For larger catchments, use hydrograph routing method)  
(Note: for catchments larger than 90 acres, CUHP hydrograph and routing are recommended)

The user must fill in all of the blue cells for these sheets to function.

<b>Design Information (Input):</b>	
Catchment Drainage Imperviousness	I _a = 43.00 percent
Catchment Drainage Area	A = 2.7500 acres
Predevelopment NRCS Soil Group	Type = C A, B, C, or D
Return Period for Detention Control	T = 100 years (2, 5, 10, 25, 50, or 100)
Time of Concentration of Watershed	T _c = 13 minutes
Allowable Unit Release Rate (See Table A)	q = 1.00 cfs/acre
One-hour Precipitation	P ₁ = 2.61 inches
Design Rainfall IDF Formula I = C ₁ * P ₁ / (C ₂ + T _c ) ^{C₃}	
Coefficient One	C ₁ = 28.50
Coefficient Two	C ₂ = 10.00
Coefficient Three	C ₃ = 0.79
<b>Determination of Average Outflow from the Basin (Calculated):</b>	
Runoff Coefficient	C = 0.59
Inflow Peak Runoff	Q _{p-in} = 10.21 cfs
Allowable Peak Outflow Rate	Q _{p-out} = 2.75 cfs
Ratio of Q _{p-out} /Q _{p-in}	Ratio = 0.27
<b>Determination of MAJOR Detention Volume Using FAA &amp; Modified FAA Method</b>	

5	<- Enter Rainfall Duration Incremental Increase Value Here (e.g. 5 for 5-Minutes)								
Rainfall Duration (input) minutes	Rainfall Intensity inches / hr	Inflow Volume cubic feet (output)	Average Outflow (FAA, cfs) (output)	Outflow Volume (FAA, cf) (output)	Storage Volume (FAA, cf) (output)	Adjustment Factor (Modified) (output)	Average Outflow (Mod, cfs) (output)	Outflow Volume (Mod, cf) (output)	Storage Volume (Mod, cf) (output)
5	8.76	4,263	1.67	501	3,762	1.00	2.75	825	3,438
10	6.98	6,792	1.67	1,001	5,791	1.00	2.75	1,650	5,142
15	5.85	8,542	1.67	1,502	7,040	0.93	2.55	2,294	6,248
20	5.06	9,861	1.67	2,002	7,859	0.82	2.26	2,706	7,155
25	4.48	10,913	1.67	2,503	8,411	0.76	2.08	3,119	7,795
30	4.04	11,785	1.67	3,003	8,782	0.71	1.96	3,531	8,254
35	3.68	12,527	1.67	3,504	9,024	0.68	1.88	3,944	8,584
40	3.38	13,173	1.67	4,004	9,169	0.66	1.82	4,356	8,817
45	3.14	13,745	1.67	4,505	9,241	0.64	1.77	4,769	8,977
50	2.93	14,258	1.67	5,005	9,253	0.63	1.73	5,181	9,077
55	2.75	14,723	1.67	5,506	9,217	0.62	1.70	5,594	9,129
60	2.59	15,148	1.67	6,006	9,142	0.61	1.67	6,006	9,142
65	2.46	15,539	1.67	6,507	9,033	0.60	1.65	6,419	9,121
70	2.33	15,903	1.67	7,007	8,896	0.59	1.63	6,831	9,072
75	2.22	16,242	1.67	7,508	8,735	0.59	1.61	7,244	8,999
80	2.13	16,560	1.67	8,008	8,552	0.58	1.60	7,656	8,904
85	2.04	16,859	1.67	8,509	8,351	0.58	1.58	8,069	8,791
90	1.96	17,142	1.67	9,009	8,133	0.57	1.57	8,481	8,661
95	1.88	17,410	1.67	9,510	7,901	0.57	1.56	8,894	8,517
100	1.81	17,665	1.67	10,010	7,655	0.56	1.55	9,306	8,359
105	1.75	17,909	1.67	10,511	7,398	0.56	1.54	9,719	8,190
110	1.69	18,141	1.67	11,011	7,130	0.56	1.54	10,131	8,010
115	1.64	18,364	1.67	11,512	6,852	0.56	1.53	10,544	7,820
120	1.59	18,578	1.67	12,012	6,566	0.55	1.52	10,956	7,622
125	1.54	18,783	1.67	12,513	6,271	0.55	1.52	11,369	7,415
130	1.50	18,981	1.67	13,013	5,968	0.55	1.51	11,781	7,200
135	1.46	19,172	1.67	13,514	5,659	0.55	1.51	12,194	6,979
140	1.42	19,357	1.67	14,014	5,343	0.55	1.50	12,606	6,751
145	1.38	19,536	1.67	14,515	5,021	0.54	1.50	13,019	6,517
150	1.35	19,709	1.67	15,015	4,694	0.54	1.49	13,431	6,278
155	1.32	19,877	1.67	15,516	4,361	0.54	1.49	13,844	6,033
160	1.29	20,039	1.67	16,016	4,023	0.54	1.49	14,256	5,783
165	1.26	20,198	1.67	16,517	3,681	0.54	1.48	14,669	5,529
170	1.23	20,352	1.67	17,017	3,335	0.54	1.48	15,081	5,271
175	1.20	20,502	1.67	17,518	2,984	0.54	1.48	15,494	5,008
180	1.18	20,648	1.67	18,018	2,630	0.54	1.47	15,906	4,742
185	1.15	20,791	1.67	18,519	2,272	0.53	1.47	16,319	4,472
FAA Major Storage Volume (cubic ft.) =				9,253	Mod. FAA Major Storage Volume (cubic ft.) =				
FAA Major Storage Volume (acre-ft.) =				0.2124	Mod. FAA Major Storage Volume (acre-ft.) =				0.2099

UDFCD DETENTION VOLUME ESTIMATING WORKBOOK Version 2.02, Released January 2007

# STAGE-DISCHARGE SIZING OF THE WATER QUALITY CAPTURE VOLUME (WQCV) OUTLET

Project: **Geos Neighborhood MDCIA**

Basin ID: **Major Basin D**

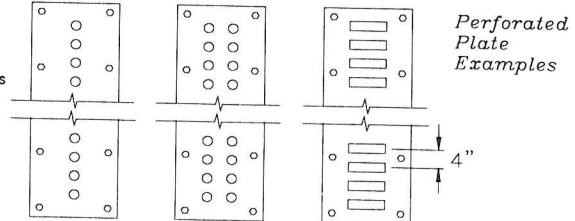
## WQCV Design Volume (Input):

Catchment Imperviousness,  $I_p$  = 43.0 percent  
 Catchment Area,  $A$  = 2.7500 acres  
 Depth at WQCV outlet above lowest perforation,  $H$  = 25.56 inches  
 Number of layers,  $N_L$  = 6  
 Vertical distance between layers,  $h$  = 4.00 inches  
 Orifice discharge coefficient,  $C_o$  = 0.65

Diameter of holes,  $D$  = 0.406 in.  
 Number of holes per layer,  $N$  = 1  
 OR

Time to Drain the Pond = 40 hours  
 Water Quality Capture Volume Method Selected (40-Hour Release)

Height of slot,  $H$  = in.  
 Width of slot,  $W$  = in.



## Outlet Design Information (Output):

Water Quality Capture Volume ( $1.0 * (0.91 * I_p^3 - 1.19 * I_p^2 + 0.76 * I_p)$ ), WQCV = 0.19 watershed inches  
 Design Volume (WQCV / 12 * Area * 1.2) Vol = 0.0516 acre-feet  
 Recommended maximum outlet area per layer (based on 4" vertical spacing of layers),  $A_o$  = 0.1292 square inches  
 Total opening area at each layer based on user-input above,  $A_o$  = 0.13 square inches  
 Total opening area at each layer based on user-input above,  $A_o$  = 0.0009 square feet

## Calculation of Collection Capacity :

Stage ft (input)	Central Elevations of Layers of Holes in feet																		Flow cfs
	Layer 1 5552.70	Layer 2 5553.03	Layer 3 5553.37	Layer 4 5553.70	Layer 5 5554.03	Layer 6 5554.37	Layer 7	Layer 8	Layer 9	Layer 10	Layer 11	Layer 12	Layer 13	Layer 14	Layer 15	Layer 16	Layer 17	Layer 18	
	Collection Capacity for Each Layer of Holes in cfs																		
5552.70	0.000	0.000	0.000	0.000	0.000	0.000													
5551.83	0.000	0.000	0.000	0.000	0.000	0.000													0.00
5552.16	0.000	0.000	0.000	0.000	0.000	0.000													0.00
5552.49	0.000	0.000	0.000	0.000	0.000	0.000													0.00
5552.82	0.002	0.000	0.000	0.000	0.000	0.000													0.00
5553.15	0.003	0.002	0.000	0.000	0.000	0.000													0.00
5553.48	0.004	0.003	0.002	0.000	0.000	0.000													0.00
5553.81	0.005	0.004	0.003	0.002	0.000	0.000													0.01
5554.14	0.006	0.005	0.004	0.003	0.002	0.000													0.01
5554.47	0.006	0.006	0.005	0.004	0.003	0.001													0.02
5554.80	0.007	0.006	0.006	0.005	0.004	0.003													0.03
5555.13	0.007	0.007	0.006	0.006	0.005	0.004													0.03
5555.46	0.008	0.007	0.007	0.006	0.006	0.005													0.03
5555.79	0.008	0.008	0.007	0.007	0.006	0.006													0.04
5556.12	0.009	0.008	0.008	0.007	0.007	0.006													0.04
5556.45	0.009	0.009	0.008	0.008	0.007	0.007													0.05
5556.78	0.009	0.009	0.009	0.008	0.008	0.007													0.05
5557.11	0.010	0.009	0.009	0.009	0.008	0.008													0.05
5557.44	0.010	0.010	0.009	0.009	0.009	0.008													0.06
5557.77	0.011	0.010	0.010	0.009	0.009	0.009													0.06
5558.10	0.011	0.011	0.010	0.010	0.009	0.009													0.06
5558.43	0.011	0.011	0.011	0.010	0.010	0.009													0.06
5558.76	0.012	0.011	0.011	0.011	0.010	0.010													0.06
5559.09	0.012	0.012	0.011	0.011	0.011	0.010													0.07
5559.42	0.012	0.012	0.012	0.011	0.011	0.011													0.07
5559.75	0.012	0.012	0.012	0.012	0.011	0.011													0.07
5560.08	0.013	0.012	0.012	0.012	0.012	0.011													0.07
5560.41	0.013	0.013	0.012	0.012	0.012	0.012													0.07
5560.74	0.013	0.013	0.013	0.012	0.012	0.012													0.07
5561.07	0.014	0.013	0.013	0.013	0.012	0.012													0.08
5561.40	0.014	0.014	0.013	0.013	0.013	0.012													0.08
5561.73	0.014	0.014	0.014	0.013	0.013	0.013													0.08
5562.06	0.014	0.014	0.014	0.014	0.013	0.013													0.08
5562.39	0.015	0.014	0.014	0.014	0.014	0.013													0.08
5562.72	0.015	0.015	0.014	0.014	0.014	0.014													0.08
5563.05	0.015	0.015	0.015	0.014	0.014	0.014													0.09
5563.38	0.015	0.015	0.015	0.015	0.014	0.014													0.09
5563.71	0.016	0.015	0.015	0.015	0.015	0.014													0.09
5564.04	0.016	0.016	0.015	0.015	0.015	0.015													0.09
5564.37	0.016	0.016	0.016	0.015	0.015	0.015													0.09
5564.70	0.016	0.016	0.016	0.016	0.015	0.015													0.09
5565.03	0.016	0.016	0.016	0.016	0.016	0.015													0.09
5565.36	0.017	0.016	0.016	0.016	0.016	0.016													0.10
5565.69	0.017	0.017	0.016	0.016	0.016	0.016													0.10



**MINOR DETENTION VOLUME BY FAA & MODIFIED FAA METHOD**  
(See USDCM Volume I Runoff Chapter for description of method)

Project: Geos Neighborhood MDCIA

Basin ID: Major Basin E

(For catchments less than 160 acres only. For larger catchments, use hydrograph routing method)  
(Note: for catchments larger than 90 acres, CUHP hydrograph and routing are recommended)

The user must fill in all of the blue cells for these sheets to function.

**Design Information (Input):**

Catchment Drainage Imperviousness	$I_p =$ 45.00 percent
Catchment Drainage Area	$A =$ 3.0000 acres
Predevelopment NRCS Soil Group	Type = C A, B, C, or D
Return Period for Detention Control	$T =$ 10 years (2, 5, 10, 25, 50, or 100)
Time of Concentration of Watershed	$T_c =$ 12 minutes
Allowable Unit Release Rate (See Table A)	$q =$ 0.30 cfs/acre
One-hour Precipitation	$P_1 =$ 1.61 inches
<b>Design Rainfall IDF Formula $I = C_1 \cdot P_1 / (C_2 + T_c)^{C_3}$</b>	
Coefficient One	$C_1 =$ 28.50
Coefficient Two	$C_2 =$ 10.00
Coefficient Three	$C_3 =$ 0.79

**Determination of Average Outflow from the Basin (Calculated):**

Runoff Coefficient	$C =$ 0.44
Inflow Peak Runoff	$Q_{p-in} =$ 5.21 cfs
Allowable Peak Outflow Rate	$Q_{p-out} =$ 0.90 cfs
Ratio of $Q_{p-out}/Q_{p-in}$	Ratio = 0.17

**Determination of MINOR Detention Volume Using FAA & Modified FAA Method**

5 <- Enter Rainfall Duration Incremental Increase Value Here (e.g. 5 for 5-Minutes)									
Rainfall Duration minutes (input)	Rainfall Intensity inches / hr (output)	Inflow Volume cubic feet (output)	Average Outflow (FAA, cfs) (output)	Outflow Volume (FAA, cf) (output)	Storage Volume (FAA, cf) (output)	Adjustment Factor (Modified) (output)	Average Outflow (Mod, cfs) (output)	Outflow Volume (Mod, cf) (output)	Storage Volume (Mod, cf) (output)
5	5.40	2,139	0.51	153	1,986	1.00	0.90	270	1,869
10	4.30	3,409	0.51	307	3,102	1.00	0.90	540	2,869
15	3.61	4,287	0.51	460	3,826	0.91	0.82	737	3,550
20	3.12	4,949	0.51	614	4,335	0.81	0.73	872	4,077
25	2.77	5,477	0.51	767	4,709	0.75	0.67	1,007	4,470
30	2.49	5,914	0.51	921	4,993	0.71	0.63	1,142	4,772
35	2.27	6,287	0.51	1,074	5,213	0.68	0.61	1,277	5,010
40	2.09	6,611	0.51	1,228	5,383	0.65	0.59	1,412	5,199
45	1.94	6,898	0.51	1,381	5,517	0.64	0.57	1,547	5,351
50	1.81	7,155	0.51	1,535	5,621	0.62	0.56	1,682	5,473
55	1.70	7,389	0.51	1,688	5,701	0.61	0.55	1,817	5,571
60	1.60	7,602	0.51	1,841	5,760	0.60	0.54	1,952	5,650
65	1.51	7,798	0.51	1,995	5,804	0.59	0.54	2,087	5,711
70	1.44	7,981	0.51	2,148	5,833	0.59	0.53	2,222	5,759
75	1.37	8,151	0.51	2,302	5,849	0.58	0.52	2,357	5,794
80	1.31	8,311	0.51	2,455	5,855	0.58	0.52	2,492	5,819
85	1.26	8,461	0.51	2,609	5,852	0.57	0.52	2,627	5,834
90	1.21	8,603	0.51	2,762	5,841	0.57	0.51	2,762	5,841
95	1.16	8,737	0.51	2,916	5,822	0.56	0.51	2,897	5,840
100	1.12	8,865	0.51	3,069	5,796	0.56	0.51	3,032	5,833
105	1.08	8,987	0.51	3,222	5,765	0.56	0.50	3,167	5,820
110	1.05	9,104	0.51	3,376	5,728	0.56	0.50	3,302	5,802
115	1.01	9,216	0.51	3,529	5,686	0.55	0.50	3,437	5,779
120	0.98	9,323	0.51	3,683	5,640	0.55	0.50	3,572	5,751
125	0.95	9,426	0.51	3,836	5,590	0.55	0.49	3,707	5,719
130	0.93	9,526	0.51	3,990	5,536	0.55	0.49	3,842	5,684
135	0.90	9,622	0.51	4,143	5,478	0.55	0.49	3,977	5,645
140	0.88	9,714	0.51	4,297	5,418	0.54	0.49	4,112	5,602
145	0.85	9,804	0.51	4,450	5,354	0.54	0.49	4,247	5,557
150	0.83	9,891	0.51	4,604	5,287	0.54	0.49	4,382	5,509
155	0.81	9,975	0.51	4,757	5,218	0.54	0.49	4,517	5,458
160	0.79	10,057	0.51	4,910	5,146	0.54	0.48	4,652	5,405
165	0.78	10,136	0.51	5,064	5,072	0.54	0.48	4,787	5,349
170	0.76	10,214	0.51	5,217	4,996	0.54	0.48	4,922	5,292
175	0.74	10,289	0.51	5,371	4,918	0.54	0.48	5,057	5,232
180	0.73	10,362	0.51	5,524	4,838	0.53	0.48	5,192	5,170
185	0.71	10,434	0.51	5,678	4,756	0.53	0.48	5,327	5,107
FAA Minor Storage Volume (cubic ft.) =				5,855	Mod. FAA Minor Storage Volume (cubic ft.) =				5,841
FAA Minor Storage Volume (acre-ft.) =				0.1344	Mod. FAA Minor Storage Volume (acre-ft.) =				0.1341

UDFCD DETENTION VOLUME ESTIMATING WORKBOOK Version 2.02, Released January 2007



**MAJOR DETENTION VOLUME BY FAA & MODIFIED FAA METHOD**  
(See USDCM Volume I Runoff Chapter for description of method)

Project: Geos Neighborhood MDCIA

Basin ID: Major Basin E

(For catchments less than 160 acres only. For larger catchments, use hydrograph routing method)  
(Note: for catchments larger than 90 acres, CUHP hydrograph and routing are recommended)

The user must fill in all of the blue cells for these sheets to function.

<b>Design Information (Input):</b>	
Catchment Drainage Imperviousness	I _a = 45.00 percent
Catchment Drainage Area	A = 3.0000 acres
Predevelopment NRCS Soil Group	Type = C A, B, C, or D
Return Period for Detention Control	T = 100 years (2, 5, 10, 25, 50, or 100)
Time of Concentration of Watershed	T _c = 12 minutes
Allowable Unit Release Rate (See Table A)	q = 1.00 cfs/acre
One-hour Precipitation	P ₁ = 2.61 inches
<b>Design Rainfall IDF Formula I = C₁* P₁/(C₂+T_c)*C₃</b>	
Coefficient One	C ₁ = 28.50
Coefficient Two	C ₂ = 10.00
Coefficient Three	C ₃ = 0.79
<b>Determination of Average Outflow from the Basin (Calculated):</b>	
Runoff Coefficient	C = 0.59
Inflow Peak Runoff	Q _{p-in} = 11.33 cfs
Allowable Peak Outflow Rate	Q _{p-out} = 3.00 cfs
Ratio of Q _{p-out} /Q _{p-in}	Ratio = 0.26
<b>Determination of MAJOR Detention Volume Using FAA &amp; Modified FAA Method</b>	

5	Enter Rainfall Duration Incremental Increase Value Here (e.g. 5 for 5-Minutes)								
Rainfall Duration minutes (input)	Rainfall Intensity inches / hr (output)	Inflow Volume cubic feet (output)	Average Outflow (FAA, cfs) (output)	Outflow Volume (FAA, cf) (output)	Storage Volume (FAA, cf) (output)	Adjustment Factor (Modified) (output)	Average Outflow (Mod, cfs) (output)	Outflow Volume (Mod, cf) (output)	Storage Volume (Mod, cf) (output)
5	8.76	4,650	1.81	542	4,108	1.00	3.00	900	3,750
10	6.98	7,410	1.81	1,085	6,325	1.00	3.00	1,800	5,610
15	5.85	9,318	1.81	1,627	7,691	0.91	2.73	2,457	6,861
20	5.08	10,758	1.81	2,169	8,589	0.81	2.42	2,907	7,851
25	4.48	11,905	1.81	2,711	9,194	0.75	2.24	3,357	8,548
30	4.04	12,856	1.81	3,254	9,602	0.71	2.12	3,807	9,049
35	3.68	13,666	1.81	3,796	9,870	0.68	2.03	4,257	9,409
40	3.38	14,371	1.81	4,338	10,033	0.65	1.96	4,707	9,664
45	3.14	14,995	1.81	4,880	10,114	0.64	1.91	5,157	9,838
50	2.93	15,554	1.81	5,423	10,131	0.62	1.87	5,607	9,947
55	2.75	16,061	1.81	5,965	10,096	0.61	1.84	6,057	10,004
60	2.59	16,525	1.81	6,507	10,018	0.60	1.81	6,507	10,018
65	2.46	16,952	1.81	7,049	9,903	0.59	1.78	6,957	9,995
70	2.33	17,349	1.81	7,592	9,757	0.59	1.76	7,407	9,942
75	2.22	17,719	1.81	8,134	9,585	0.58	1.75	7,857	9,862
80	2.13	18,065	1.81	8,676	9,389	0.58	1.73	8,307	9,758
85	2.04	18,392	1.81	9,218	9,174	0.57	1.72	8,757	9,635
90	1.96	18,700	1.81	9,761	8,940	0.57	1.71	9,207	9,493
95	1.88	18,993	1.81	10,303	8,690	0.56	1.69	9,657	9,336
100	1.81	19,271	1.81	10,845	8,426	0.56	1.68	10,107	9,164
105	1.75	19,537	1.81	11,387	8,149	0.56	1.68	10,557	8,980
110	1.69	19,790	1.81	11,930	7,861	0.56	1.67	11,007	8,783
115	1.64	20,033	1.81	12,472	7,561	0.55	1.66	11,457	8,576
120	1.59	20,266	1.81	13,014	7,252	0.55	1.65	11,907	8,359
125	1.54	20,491	1.81	13,556	6,934	0.55	1.65	12,357	8,134
130	1.50	20,707	1.81	14,099	6,608	0.55	1.64	12,807	7,900
135	1.46	20,915	1.81	14,641	6,274	0.55	1.64	13,257	7,658
140	1.42	21,117	1.81	15,183	5,934	0.54	1.63	13,707	7,410
145	1.38	21,312	1.81	15,725	5,586	0.54	1.63	14,157	7,155
150	1.35	21,500	1.81	16,268	5,233	0.54	1.62	14,607	6,893
155	1.32	21,683	1.81	16,810	4,874	0.54	1.62	15,057	6,626
160	1.29	21,861	1.81	17,352	4,509	0.54	1.62	15,507	6,354
165	1.26	22,034	1.81	17,894	4,140	0.54	1.61	15,957	6,077
170	1.23	22,202	1.81	18,437	3,766	0.54	1.61	16,407	5,795
175	1.20	22,366	1.81	18,979	3,387	0.54	1.61	16,857	5,509
180	1.18	22,525	1.81	19,521	3,004	0.53	1.60	17,307	5,218
185	1.15	22,681	1.81	20,063	2,617	0.53	1.60	17,757	4,924
FAA Major Storage Volume (cubic ft.) =				10,131	Mod. FAA Major Storage Volume (cubic ft.) =				10,018
FAA Major Storage Volume (acre-ft.) =				0.2326	Mod. FAA Major Storage Volume (acre-ft.) =				0.2300

UDFCD DETENTION VOLUME ESTIMATING WORKBOOK Version 2.02, Released January 2007

# **STAGE-DISCHARGE SIZING OF THE WATER QUALITY CAPTURE VOLUME (WQCV) OUTLET**

Project: Geos Neighborhood MDCIA

Basin ID: Major Basin E

## **WQCV Design Volume (Input):**

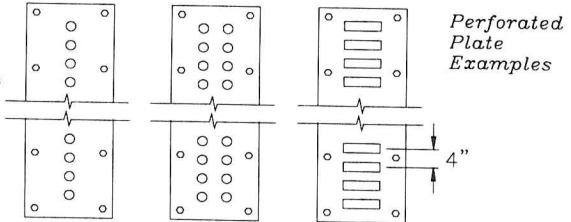
Catchment imperviousness,  $I_a$  = 45.0 percent  
 Catchment Area,  $A$  = 3.0000 acres  
 Depth at WQCV outlet above lowest perforation,  $H$  = 46.80 inches  
 Number of layers,  $N_L$  = 12  
 Vertical distance between layers,  $h$  = 4.00 inches  
 Orifice discharge coefficient,  $C_o$  = 0.65

Diameter of holes,  $D$  = 0.305 in.  
 Number of holes per layer,  $N$  = 1

OR

Height of slot,  $H$  = in.  
 Width of slot,  $W$  = in.

Time to Drain the Pond = 40 hours  
 Water Quality Capture Volume Method Selected (40-Hour Release)



## **Outlet Design Information (Output):**

Water Quality Capture Volume  $(1.0 * (0.91 * I_a^3 - 1.19 * I_a^2 + 0.78 * I_a))$ , WQCV = 0.19 watershed inches  
 Design Volume  $(WQCV / 12 * Area * 1.2)$  Vol = 0.0579 acre-feet  
 Recommended maximum outlet area per layer (based on 4" vertical spacing or layers),  $A_o$  = 0.0728 square inches  
 Total opening area at each layer based on user-input above,  $A_o$  = 0.07 square inches  
 Total opening area at each layer based on user-input above,  $A_o$  = 0.0005 square feet

## **Calculation of Collection Capacity :**

Stage ft (input)	Central Elevations of Layers of Holes in feet																		Flow cfs
	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7	Layer 8	Layer 9	Layer 10	Layer 11	Layer 12	Layer 13	Layer 14	Layer 15	Layer 16	Layer 17	Layer 18	
	5550.90	5551.23	5551.57	5551.90	5552.23	5552.57	5552.90	5553.23	5553.57	5553.90	5554.23	5554.57							
Collection Capacity for Each Layer of Holes in cfs																			
5550.90	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000							0.00
5551.23	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000							0.00
5551.56	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000							0.00
5551.89	0.003	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000							0.00
5552.22	0.003	0.003	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000							0.01
5552.55	0.003	0.003	0.003	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000							0.01
5552.88	0.004	0.003	0.003	0.003	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000							0.01
5553.21	0.004	0.004	0.003	0.003	0.003	0.002	0.001	0.000	0.000	0.000	0.000	0.000							0.02
5553.54	0.004	0.004	0.004	0.003	0.003	0.003	0.002	0.001	0.000	0.000	0.000	0.000							0.02
5553.87	0.005	0.004	0.004	0.004	0.003	0.003	0.002	0.001	0.000	0.000	0.000	0.000							0.02
5554.20	0.005	0.005	0.004	0.004	0.004	0.003	0.003	0.003	0.002	0.001	0.000	0.000							0.03
5554.53	0.005	0.005	0.005	0.004	0.004	0.004	0.003	0.003	0.003	0.002	0.001	0.000							0.03
5554.86	0.005	0.005	0.005	0.005	0.004	0.004	0.004	0.003	0.003	0.003	0.002	0.001							0.04
5555.19	0.005	0.005	0.005	0.005	0.005	0.004	0.004	0.004	0.003	0.003	0.003	0.002							0.04
5555.52	0.006	0.005	0.005	0.005	0.005	0.005	0.004	0.004	0.004	0.003	0.003	0.003							0.05
5555.85	0.006	0.006	0.005	0.005	0.005	0.005	0.005	0.004	0.004	0.004	0.003	0.003							0.05
5556.18	0.006	0.006	0.006	0.005	0.005	0.005	0.005	0.005	0.004	0.004	0.004	0.003							0.05
5556.51	0.006	0.006	0.006	0.006	0.005	0.005	0.005	0.005	0.005	0.004	0.004	0.003							0.06
5556.84	0.006	0.006	0.006	0.006	0.006	0.005	0.005	0.005	0.005	0.005	0.004	0.004							0.06
5557.17	0.007	0.006	0.006	0.006	0.006	0.005	0.005	0.005	0.005	0.005	0.005	0.004							0.06
5557.50	0.007	0.007	0.006	0.006	0.006	0.006	0.006	0.005	0.005	0.005	0.005	0.004							0.07
5557.83	0.007	0.007	0.007	0.006	0.006	0.006	0.006	0.006	0.005	0.005	0.005	0.005							0.07
5558.16	0.007	0.007	0.007	0.007	0.006	0.006	0.006	0.006	0.006	0.005	0.005	0.005							0.07
5558.49	0.007	0.007	0.007	0.007	0.007	0.006	0.006	0.006	0.006	0.006	0.005	0.005							0.07
5558.82	0.007	0.007	0.007	0.007	0.007	0.007	0.006	0.006	0.006	0.006	0.006	0.005							0.08
5559.15	0.008	0.007	0.007	0.007	0.007	0.007	0.007	0.006	0.006	0.006	0.006	0.005							0.08
5559.48	0.008	0.008	0.007	0.007	0.007	0.007	0.007	0.007	0.006	0.006	0.006	0.006							0.08
5559.81	0.008	0.008	0.008	0.007	0.007	0.007	0.007	0.007	0.007	0.006	0.006	0.006							0.08
5560.14	0.008	0.008	0.008	0.008	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.006							0.08
5560.47	0.008	0.008	0.008	0.008	0.008	0.007	0.007	0.007	0.007	0.007	0.007	0.006							0.09
5560.80	0.008	0.008	0.008	0.008	0.008	0.008	0.007	0.007	0.007	0.007	0.007	0.006							0.09
5561.13	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.007	0.007	0.007	0.007	0.006							0.09
5561.46	0.009	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.007	0.007	0.007	0.006							0.09
5561.79	0.009	0.009	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.007	0.007	0.006							0.09
5562.12	0.009	0.009	0.009	0.008	0.008	0.008	0.008	0.008	0.008	0.007	0.007	0.006							0.10
5562.45	0.009	0.009	0.009	0.009	0.008	0.008	0.008	0.008	0.008	0.008	0.007	0.006							0.10
5562.78	0.009	0.009	0.009	0.009	0.009	0.008	0.008	0.008	0.008	0.008	0.008	0.007							0.10
5563.11	0.009	0.009	0.009	0.009	0.009	0.009	0.008	0.008	0.008	0.008	0.008	0.008							0.10
5563.44	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.008	0.008	0.008	0.008	0.008							0.10
5563.77	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.008	0.008	0.008	0.008							0.10
5564.10	0.010	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.008	0.008	0.008							0.11
5564.43	0.010	0.010	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.008	0.008							0.11
5564.76	0.010	0.010	0.010	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.008							0.11
5565.09	0.010	0.010	0.010	0.010	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009							0.11



**MINOR DETENTION VOLUME BY FAA & MODIFIED FAA METHOD**  
(See USDCM Volume I Runoff Chapter for description of method)

Project: Geos Neighborhood MDCIA

Basin ID: Major Basin F

(For catchments less than 160 acres only. For larger catchments, use hydrograph routing method)  
(Note: for catchments larger than 90 acres, CUHP hydrograph and routing are recommended)

The user must fill in all of the blue cells for these sheets to function.

**Design Information (Input):**

Catchment Drainage Imperviousness	I _a = 40.00 percent
Catchment Drainage Area	A = 1.8600 acres
Predevelopment NRCS Soil Group	Type = C A, B, C, or D
Return Period for Detention Control	T = 10 years (2, 5, 10, 25, 50, or 100)
Time of Concentration of Watershed	T _c = 17 minutes
Allowable Unit Release Rate (See Table A)	q = 0.30 cfs/acre
One-hour Precipitation	P ₁ = 1.61 inches
<b>Design Rainfall IDF Formula $I = C_1 \cdot P_1 / (C_2 + T_c)^{C_3}$</b>	
Coefficient One	C ₁ = 28.50
Coefficient Two	C ₂ = 10.00
Coefficient Three	C ₃ = 0.79

**Determination of Average Outflow from the Basin (Calculated):**

Runoff Coefficient	C = 0.42
Inflow Peak Runoff	Q _{p-in} = 2.62 cfs
Allowable Peak Outflow Rate	Q _{p-out} = 0.56 cfs
Ratio of Q _{p-out} /Q _{p-in}	Ratio = 0.21

**Determination of MINOR Detention Volume Using FAA & Modified FAA Method**

5	<- Enter Rainfall Duration Incremental Increase Value Here (e.g. 5 for 5-Minutes)								
Rainfall Duration minutes (input)	Rainfall Intensity inches / hr (output)	Inflow Volume cubic feet (output)	Average Outflow (FAA, cfs) (output)	Outflow Volume (FAA, cf) (output)	Storage Volume (FAA, cf) (output)	Adjustment Factor (Modified) (output)	Average Outflow (Mod, cfs) (output)	Outflow Volume (Mod, cf) (output)	Storage Volume (Mod, cf) (output)
5	5.40	1,266	0.33	100	1,166	1.00	0.56	167	1,099
10	4.30	2,017	0.33	200	1,818	1.00	0.56	335	1,683
15	3.61	2,537	0.33	300	2,237	1.00	0.56	502	2,035
20	3.12	2,929	0.33	400	2,529	0.94	0.52	626	2,303
25	2.77	3,241	0.33	499	2,742	0.85	0.47	710	2,531
30	2.49	3,500	0.33	599	2,901	0.79	0.44	793	2,707
35	2.27	3,721	0.33	699	3,021	0.75	0.42	877	2,843
40	2.09	3,913	0.33	799	3,113	0.72	0.40	961	2,952
45	1.94	4,082	0.33	899	3,183	0.69	0.39	1,045	3,038
50	1.81	4,235	0.33	999	3,236	0.67	0.38	1,128	3,106
55	1.70	4,373	0.33	1,099	3,274	0.66	0.37	1,212	3,161
60	1.60	4,499	0.33	1,199	3,300	0.65	0.36	1,296	3,203
65	1.51	4,615	0.33	1,298	3,317	0.63	0.35	1,379	3,236
70	1.44	4,723	0.33	1,398	3,325	0.62	0.35	1,463	3,260
75	1.37	4,824	0.33	1,498	3,326	0.62	0.34	1,547	3,277
80	1.31	4,918	0.33	1,598	3,320	0.61	0.34	1,630	3,288
85	1.26	5,007	0.33	1,698	3,309	0.60	0.34	1,714	3,293
90	1.21	5,091	0.33	1,798	3,293	0.60	0.33	1,798	3,293
95	1.16	5,171	0.33	1,898	3,273	0.59	0.33	1,882	3,289
100	1.12	5,247	0.33	1,998	3,249	0.59	0.33	1,965	3,281
105	1.08	5,319	0.33	2,098	3,221	0.58	0.33	2,049	3,270
110	1.05	5,388	0.33	2,197	3,191	0.58	0.32	2,133	3,255
115	1.01	5,454	0.33	2,297	3,157	0.58	0.32	2,216	3,238
120	0.98	5,518	0.33	2,397	3,120	0.57	0.32	2,300	3,218
125	0.95	5,579	0.33	2,497	3,082	0.57	0.32	2,384	3,195
130	0.93	5,637	0.33	2,597	3,041	0.57	0.32	2,467	3,170
135	0.90	5,694	0.33	2,697	2,997	0.56	0.31	2,551	3,143
140	0.88	5,749	0.33	2,797	2,952	0.56	0.31	2,635	3,114
145	0.85	5,802	0.33	2,897	2,906	0.56	0.31	2,719	3,084
150	0.83	5,854	0.33	2,996	2,857	0.56	0.31	2,802	3,051
155	0.81	5,903	0.33	3,096	2,807	0.56	0.31	2,886	3,017
160	0.79	5,952	0.33	3,196	2,756	0.55	0.31	2,970	2,982
165	0.78	5,999	0.33	3,296	2,703	0.55	0.31	3,053	2,945
170	0.76	6,045	0.33	3,396	2,649	0.55	0.31	3,137	2,908
175	0.74	6,089	0.33	3,496	2,593	0.55	0.31	3,221	2,868
180	0.73	6,133	0.33	3,596	2,537	0.55	0.31	3,304	2,828
185	0.71	6,175	0.33	3,696	2,479	0.55	0.31	3,388	2,787
FAA Minor Storage Volume (cubic ft.) =				3,326	Mod. FAA Minor Storage Volume (cubic ft.) =				3,293
FAA Minor Storage Volume (acre-ft.) =				0.0763	Mod. FAA Minor Storage Volume (acre-ft.) =				0.0756

UDFCD DETENTION VOLUME ESTIMATING WORKBOOK Version 2.02, Released January 2007



**MAJOR DETENTION VOLUME BY FAA & MODIFIED FAA METHOD**  
(See USDCM Volume I Runoff Chapter for description of method)

Project: Geos Neighborhood MDCIA  
Basin ID: Major Basin F

(For catchments less than 160 acres only. For larger catchments, use hydrograph routing method)  
(Note: for catchments larger than 90 acres, CUHP hydrograph and routing are recommended)

The user must fill in all of the blue cells for these sheets to function.

**Design Information (Input):**

Catchment Drainage Imperviousness	$I_a =$ 40.00 percent
Catchment Drainage Area	$A =$ 1.8600 acres
Predevelopment NRCS Soil Group	Type = C A, B, C, or D
Return Period for Detention Control	$T =$ 100 years (2, 5, 10, 25, 50, or 100)
Time of Concentration of Watershed	$T_c =$ 17 minutes
Allowable Unit Release Rate (See Table A)	$q =$ 1.00 cfs/acre
One-hour Precipitation	$P_1 =$ 2.61 inches
<b>Design Rainfall IDF Formula $I = C_1 \cdot P_1 / (C_2 + T_c)^{C_3}$</b>	
Coefficient One	$C_1 =$ 28.50
Coefficient Two	$C_2 =$ 10.00
Coefficient Three	$C_3 =$ 0.79

**Determination of Average Outflow from the Basin (Calculated):**

Runoff Coefficient	$C =$ 0.58
Inflow Peak Runoff	$Q_{p-in} =$ 5.87 cfs
Allowable Peak Outflow Rate	$Q_{p-out} =$ 1.86 cfs
Ratio of $Q_{p-out}/Q_{p-in}$	Ratio = 0.32

**Determination of MAJOR Detention Volume Using FAA & Modified FAA Method**

5	<- Enter Rainfall Duration Incremental Increase Value Here (e.g. 5 for 5-Minutes)								
Rainfall Duration minutes (input)	Rainfall Intensity inches / hr (output)	Inflow Volume cubic feet (output)	Average Outflow (FAA, cfs) (output)	Outflow Volume (FAA, cf) (output)	Storage Volume (FAA, cf) (output)	Adjustment Factor (Modified) (output)	Average Outflow (Mod, cfs) (output)	Outflow Volume (Mod, cf) (output)	Storage Volume (Mod, cf) (output)
5	8.76	2,834	1.20	360	2,474	1.00	1.86	558	2,276
10	6.98	4,516	1.20	720	3,796	1.00	1.86	1,116	3,400
15	5.85	5,679	1.20	1,080	4,600	1.00	1.86	1,674	4,005
20	5.06	6,557	1.20	1,440	5,117	0.94	1.74	2,087	4,470
25	4.48	7,256	1.20	1,800	5,457	0.85	1.58	2,368	4,890
30	4.04	7,836	1.20	2,159	5,676	0.79	1.47	2,645	5,191
35	3.68	8,329	1.20	2,519	5,810	0.75	1.39	2,924	5,405
40	3.38	8,759	1.20	2,879	5,880	0.72	1.33	3,203	5,556
45	3.14	9,139	1.20	3,239	5,900	0.69	1.29	3,482	5,657
50	2.93	9,480	1.20	3,599	5,881	0.67	1.25	3,761	5,719
55	2.75	9,789	1.20	3,959	5,830	0.66	1.22	4,040	5,749
60	2.59	10,072	1.20	4,319	5,753	0.65	1.20	4,319	5,753
65	2.46	10,332	1.20	4,679	5,653	0.63	1.18	4,598	5,734
70	2.33	10,574	1.20	5,039	5,535	0.62	1.16	4,877	5,697
75	2.22	10,799	1.20	5,399	5,401	0.62	1.15	5,156	5,643
80	2.13	11,011	1.20	5,759	5,252	0.61	1.13	5,435	5,576
85	2.04	11,210	1.20	6,118	5,091	0.60	1.12	5,714	5,496
90	1.96	11,398	1.20	6,478	4,919	0.60	1.11	5,993	5,405
95	1.88	11,576	1.20	6,838	4,738	0.59	1.10	6,272	5,304
100	1.81	11,746	1.20	7,198	4,547	0.59	1.09	6,551	5,195
105	1.75	11,907	1.20	7,558	4,349	0.58	1.08	6,830	5,077
110	1.69	12,062	1.20	7,918	4,144	0.58	1.08	7,109	4,953
115	1.64	12,210	1.20	8,278	3,932	0.58	1.07	7,388	4,822
120	1.59	12,352	1.20	8,638	3,714	0.57	1.06	7,667	4,685
125	1.54	12,489	1.20	8,998	3,491	0.57	1.06	7,946	4,543
130	1.50	12,621	1.20	9,358	3,263	0.57	1.05	8,225	4,396
135	1.46	12,748	1.20	9,718	3,030	0.56	1.05	8,504	4,244
140	1.42	12,870	1.20	10,077	2,793	0.56	1.05	8,783	4,088
145	1.38	12,989	1.20	10,437	2,552	0.56	1.04	9,062	3,927
150	1.35	13,104	1.20	10,797	2,307	0.56	1.04	9,341	3,763
155	1.32	13,216	1.20	11,157	2,059	0.56	1.03	9,620	3,596
160	1.29	13,324	1.20	11,517	1,807	0.55	1.03	9,899	3,425
165	1.26	13,430	1.20	11,877	1,553	0.55	1.03	10,178	3,252
170	1.23	13,532	1.20	12,237	1,295	0.55	1.03	10,457	3,075
175	1.20	13,632	1.20	12,597	1,035	0.55	1.02	10,736	2,896
180	1.18	13,729	1.20	12,957	772	0.55	1.02	11,015	2,714
185	1.15	13,824	1.20	13,317	507	0.55	1.02	11,294	2,530
FAA Major Storage Volume (cubic ft.) =		5,900	Mod. FAA Major Storage Volume (cubic ft.) =		5,753				
FAA Major Storage Volume (acre-ft.) =		0.1354	Mod. FAA Major Storage Volume (acre-ft.) =		0.1321				

UDFCD DETENTION VOLUME ESTIMATING WORKBOOK Version 2.02, Released January 2007

# **STAGE-DISCHARGE SIZING OF THE WATER QUALITY CAPTURE VOLUME (WQCV) OUTLET**

Project: **Geos Neighborhood MDCIA**

Basin ID: **Major Basin F**

**WQCV Design Volume (Input):**

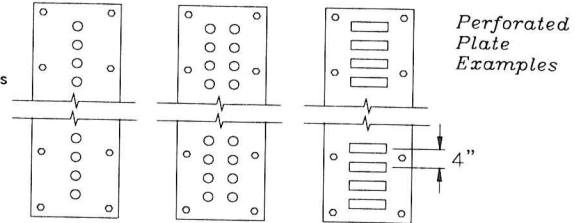
Catchment imperviousness,  $I_a$  = 40.0 percent  
 Catchment Area,  $A$  = 1.8600 acres  
 Depth at WQCV outlet above lowest perforation,  $H$  = 25.00 inches  
 Number of layers,  $N_L$  = 6  
 Vertical distance between layers,  $h$  = 4.00 inches  
 Orifice discharge coefficient,  $C_o$  = 0.65

Diameter of holes,  $D$  = 0.328 in.  
 Number of holes per layer,  $N$  = 1

OR

Height of slot,  $H$  = in.  
 Width of slot,  $W$  = in.

Time to Drain the Pond = 40 hours  
 Water Quality Capture Volume Method Selected (40-Hour Release)



**Outlet Design Information (Output):**

Water Quality Capture Volume ( $1.0 * (0.91 * I_a^3 - 1.19 * I_a^2 + 0.78 * I_a)$ ), WQCV = 0.18 watershed inches  
 Design Volume (WQCV / 12 * Area * 1.2) Vol = 0.0335 acre-feet  
 Recommended maximum outlet area per layer (based on 4" vertical spacing of layers),  $A_o$  = 0.0847 square inches  
 Total opening area at each layer based on user-input above,  $A_o$  = 0.08 square inches  
 Total opening area at each layer based on user-input above,  $A_o$  = 0.0006 square feet

**Calculation of Collection Capacity:**

Stage ft (input)	Central Elevations of Layers of Holes in feet																		Flow cfs
	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7	Layer 8	Layer 9	Layer 10	Layer 11	Layer 12	Layer 13	Layer 14	Layer 15	Layer 16	Layer 17	Layer 18	
	5552.10	5552.43	5552.77	5553.10	5553.43	5553.77													
	Collection Capacity for Each Layer of Holes in cfs																		
5552.10	0.000	0.000	0.000	0.000	0.000	0.000													0.00
5552.43	0.002	0.000	0.000	0.000	0.000	0.000													0.00
5552.76	0.002	0.002	0.000	0.000	0.000	0.000													0.00
5553.09	0.003	0.002	0.002	0.000	0.000	0.000													0.00
5553.42	0.004	0.003	0.002	0.002	0.000	0.000													0.01
5553.75	0.004	0.004	0.003	0.002	0.002	0.000													0.01
5554.08	0.004	0.004	0.004	0.003	0.002	0.002													0.01
5554.41	0.005	0.004	0.004	0.004	0.003	0.002													0.01
5554.74	0.005	0.005	0.004	0.004	0.004	0.003													0.02
5555.07	0.005	0.005	0.005	0.004	0.004	0.003													0.02
5555.40	0.006	0.005	0.005	0.005	0.004	0.004													0.02
5555.73	0.006	0.006	0.005	0.005	0.005	0.004													0.03
5556.06	0.006	0.006	0.006	0.005	0.005	0.005													0.03
5556.39	0.006	0.006	0.006	0.006	0.005	0.005													0.03
5556.72	0.007	0.006	0.006	0.006	0.006	0.005													0.03
5557.05	0.007	0.007	0.006	0.006	0.006	0.006													0.04
5557.38	0.007	0.007	0.007	0.006	0.006	0.006													0.04
5557.71	0.007	0.007	0.007	0.007	0.006	0.006													0.04
5558.04	0.007	0.007	0.007	0.007	0.007	0.006													0.04
5558.37	0.008	0.007	0.007	0.007	0.007	0.007													0.04
5558.70	0.008	0.008	0.007	0.007	0.007	0.007													0.04
5559.03	0.008	0.008	0.008	0.007	0.007	0.007													0.04
5559.36	0.008	0.008	0.008	0.008	0.007	0.007													0.05
5559.69	0.008	0.008	0.008	0.008	0.008	0.007													0.05
5560.02	0.009	0.008	0.008	0.008	0.008	0.008													0.05
5560.35	0.009	0.009	0.008	0.008	0.008	0.008													0.05
5560.68	0.009	0.009	0.009	0.008	0.008	0.008													0.05
5561.01	0.009	0.009	0.009	0.009	0.008	0.008													0.05
5561.34	0.009	0.009	0.009	0.009	0.009	0.008													0.05
5561.67	0.009	0.009	0.009	0.009	0.009	0.009													0.05
5562.00	0.010	0.009	0.009	0.009	0.009	0.009													0.05
5562.33	0.010	0.010	0.009	0.009	0.009	0.009													0.06
5562.66	0.010	0.010	0.010	0.009	0.009	0.009													0.06
5562.99	0.010	0.010	0.010	0.010	0.009	0.009													0.06
5563.32	0.010	0.010	0.010	0.010	0.010	0.009													0.06
5563.65	0.010	0.010	0.010	0.010	0.010	0.010													0.06
5563.98	0.011	0.010	0.010	0.010	0.010	0.010													0.06
5564.31	0.011	0.011	0.010	0.010	0.010	0.010													0.06
5564.64	0.011	0.011	0.011	0.010	0.010	0.010													0.06
5564.97	0.011	0.011	0.011	0.011	0.011	0.010													0.06
5565.30	0.011	0.011	0.011	0.011	0.011	0.010													0.06
5565.63	0.011	0.011	0.011	0.011	0.011	0.011													0.06
5565.96	0.011	0.011	0.011	0.011	0.011	0.011													0.07
5566.29	0.012	0.011	0.011	0.011	0.011	0.011													0.07



**MINOR DETENTION VOLUME BY FAA & MODIFIED FAA METHOD**  
(See USDCM Volume I Runoff Chapter for description of method)

Project: Geos Neighborhood MDCIA

Basin ID: Major Basin G

(For catchments less than 160 acres only. For larger catchments, use hydrograph routing method)  
(Note: for catchments larger than 90 acres, CUHP hydrograph and routing are recommended)

The user must fill in all of the blue cells for these sheets to function.

**Design Information (Input):**

Catchment Drainage Imperviousness	$I_p =$ 52.00 percent
Catchment Drainage Area	$A =$ 1.2800 acres
Predevelopment NRCS Soil Group	Type = C A, B, C, or D
Return Period for Detention Control	$T =$ 10 years (2, 5, 10, 25, 50, or 100)
Time of Concentration of Watershed	$T_c =$ 12 minutes
Allowable Unit Release Rate (See Table A)	$q =$ 0.30 cfs/acre
One-hour Precipitation	$P_1 =$ 1.61 inches
<b>Design Rainfall IDF Formula $I = C_1 \cdot P_1 / (C_2 + T_c) \cdot C_3$</b>	
Coefficient One	$C_1 =$ 28.50
Coefficient Two	$C_2 =$ 10.00
Coefficient Three	$C_3 =$ 0.79

**Determination of Average Outflow from the Basin (Calculated):**

Runoff Coefficient	$C =$ 0.47
Inflow Peak Runoff	$Q_{p-in} =$ 2.40 cfs
Allowable Peak Outflow Rate	$Q_{p-out} =$ 0.38 cfs
Ratio of $Q_{p-out}/Q_{p-in}$	Ratio = 0.16

**Determination of MINOR Detention Volume Using FAA & Modified FAA Method**

5	<- Enter Rainfall Duration Incremental Increase Value Here (e.g. 5 for 5-Minutes)								
Rainfall Duration minutes (input)	Rainfall Intensity inches / hr (output)	Inflow Volume cubic feet (output)	Average Outflow (FAA, cfs) (output)	Outflow Volume (FAA, cf) (output)	Storage Volume (FAA, cf) (output)	Adjustment Factor (Modified) (output)	Average Outflow (Mod, cfs) (output)	Outflow Volume (Mod, cf) (output)	Storage Volume (Mod, cf) (output)
5	5.40	975	0.22	65	910	1.00	0.38	115	860
10	4.30	1,554	0.22	129	1,424	1.00	0.38	230	1,323
15	3.61	1,954	0.22	194	1,760	0.90	0.35	311	1,643
20	3.12	2,255	0.22	258	1,997	0.80	0.31	369	1,887
25	2.77	2,496	0.22	323	2,174	0.74	0.28	426	2,070
30	2.49	2,695	0.22	387	2,308	0.70	0.27	484	2,212
35	2.27	2,865	0.22	452	2,414	0.67	0.26	541	2,324
40	2.09	3,013	0.22	516	2,497	0.65	0.25	599	2,414
45	1.94	3,144	0.22	581	2,563	0.63	0.24	657	2,487
50	1.81	3,261	0.22	645	2,616	0.62	0.24	714	2,547
55	1.70	3,367	0.22	710	2,658	0.61	0.23	772	2,596
60	1.60	3,465	0.22	774	2,690	0.60	0.23	829	2,635
65	1.51	3,554	0.22	839	2,716	0.59	0.23	887	2,667
70	1.44	3,637	0.22	903	2,734	0.59	0.22	945	2,693
75	1.37	3,715	0.22	968	2,747	0.58	0.22	1,002	2,713
80	1.31	3,788	0.22	1,032	2,755	0.58	0.22	1,060	2,728
85	1.26	3,856	0.22	1,097	2,759	0.57	0.22	1,117	2,739
90	1.21	3,921	0.22	1,161	2,760	0.57	0.22	1,175	2,746
95	1.16	3,982	0.22	1,226	2,756	0.56	0.22	1,233	2,749
100	1.12	4,040	0.22	1,290	2,750	0.56	0.22	1,290	2,750
105	1.08	4,096	0.22	1,355	2,741	0.56	0.21	1,348	2,748
110	1.05	4,149	0.22	1,419	2,730	0.55	0.21	1,405	2,744
115	1.01	4,200	0.22	1,484	2,716	0.55	0.21	1,463	2,737
120	0.98	4,249	0.22	1,548	2,701	0.55	0.21	1,521	2,728
125	0.95	4,296	0.22	1,613	2,683	0.55	0.21	1,578	2,718
130	0.93	4,341	0.22	1,677	2,664	0.55	0.21	1,636	2,706
135	0.90	4,385	0.22	1,742	2,643	0.54	0.21	1,693	2,692
140	0.88	4,427	0.22	1,806	2,621	0.54	0.21	1,751	2,676
145	0.85	4,468	0.22	1,871	2,597	0.54	0.21	1,809	2,660
150	0.83	4,508	0.22	1,935	2,572	0.54	0.21	1,866	2,642
155	0.81	4,546	0.22	2,000	2,546	0.54	0.21	1,924	2,622
160	0.79	4,583	0.22	2,064	2,519	0.54	0.21	1,981	2,602
165	0.78	4,620	0.22	2,129	2,491	0.54	0.21	2,039	2,581
170	0.76	4,655	0.22	2,193	2,462	0.54	0.21	2,097	2,558
175	0.74	4,689	0.22	2,258	2,431	0.53	0.21	2,154	2,535
180	0.73	4,723	0.22	2,322	2,400	0.53	0.20	2,212	2,511
185	0.71	4,755	0.22	2,387	2,368	0.53	0.20	2,269	2,486
FAA Minor Storage Volume (cubic ft.) =				2,760	Mod. FAA Minor Storage Volume (cubic ft.) =				2,750
FAA Minor Storage Volume (acre-ft.) =				0.0634	Mod. FAA Minor Storage Volume (acre-ft.) =				0.0631

UDFCD DETENTION VOLUME ESTIMATING WORKBOOK Version 2.02, Released January 2007



**MAJOR DETENTION VOLUME BY FAA & MODIFIED FAA METHOD**  
(See USDCM Volume I Runoff Chapter for description of method)

Project: Geos Neighborhood MDCIA

Basin ID: Major Basin G

(For catchments less than 160 acres only. For larger catchments, use hydrograph routing method)

(Note: for catchments larger than 90 acres, CUHP hydrograph and routing are recommended)

The user must fill in all of the blue cells for these sheets to function.

**Design Information (Input):**

Catchment Drainage Imperviousness	$I_a =$ 52.00 percent
Catchment Drainage Area	$A =$ 1.2800 acres
Predevelopment NRCS Soil Group	Type = C A, B, C, or D
Return Period for Detention Control	$T =$ 100 years (2, 5, 10, 25, 50, or 100)
Time of Concentration of Watershed	$T_c =$ 12 minutes
Allowable Unit Release Rate (See Table A)	$q =$ 1.00 cfs/acre
One-hour Precipitation	$P_1 =$ 2.61 inches
<b>Design Rainfall IDF Formula $I = C_1 \cdot P_1 / (C_2 + T_c) \cdot C_3$</b>	
Coefficient One	$C_1 =$ 28.50
Coefficient Two	$C_2 =$ 10.00
Coefficient Three	$C_3 =$ 0.79

**Determination of Average Outflow from the Basin (Calculated):**

Runoff Coefficient	$C =$ 0.61
Inflow Peak Runoff	$Q_{p-in} =$ 5.05 cfs
Allowable Peak Outflow Rate	$Q_{p-out} =$ 1.28 cfs
Ratio of $Q_{p-out}/Q_{p-in}$	$Ratio =$ 0.25

**Determination of MAJOR Detention Volume Using FAA & Modified FAA Method**

5	<- Enter Rainfall Duration Incremental Increase Value Here (e.g. 5 for 5-Minutes)								
Rainfall Duration minutes (input)	Rainfall Intensity inches / hr (output)	Inflow Volume cubic feet (output)	Average Outflow (FAA, cfs) (output)	Outflow Volume (FAA, cf) (output)	Storage Volume (FAA, cf) (output)	Adjustment Factor (Modified) (output)	Average Outflow (Mod, cfs) (output)	Outflow Volume (Mod, cf) (output)	Storage Volume (Mod, cf) (output)
5	8.76	2,051	0.77	230	1,821	1.00	1.28	384	1,687
10	6.98	3,269	0.77	461	2,808	1.00	1.28	768	2,501
15	5.85	4,111	0.77	691	3,419	0.80	1.15	1,037	3,074
20	5.08	4,745	0.77	922	3,824	0.80	1.02	1,229	3,517
25	4.48	5,252	0.77	1,152	4,100	0.74	0.95	1,421	3,831
30	4.04	5,671	0.77	1,382	4,289	0.70	0.90	1,613	4,058
35	3.68	6,028	0.77	1,613	4,416	0.67	0.86	1,805	4,224
40	3.38	6,339	0.77	1,843	4,496	0.65	0.83	1,997	4,343
45	3.14	6,615	0.77	2,074	4,541	0.63	0.81	2,189	4,426
50	2.93	6,861	0.77	2,304	4,557	0.62	0.79	2,381	4,481
55	2.75	7,085	0.77	2,534	4,551	0.61	0.78	2,573	4,512
60	2.59	7,290	0.77	2,765	4,525	0.60	0.77	2,765	4,525
65	2.46	7,478	0.77	2,995	4,483	0.59	0.76	2,957	4,521
70	2.33	7,653	0.77	3,226	4,427	0.59	0.75	3,149	4,504
75	2.22	7,816	0.77	3,456	4,360	0.58	0.74	3,341	4,475
80	2.13	7,969	0.77	3,686	4,283	0.58	0.74	3,533	4,436
85	2.04	8,113	0.77	3,917	4,196	0.57	0.73	3,725	4,388
90	1.96	8,249	0.77	4,147	4,102	0.57	0.73	3,917	4,333
95	1.88	8,378	0.77	4,378	4,001	0.56	0.72	4,109	4,270
100	1.81	8,501	0.77	4,608	3,893	0.56	0.72	4,301	4,200
105	1.75	8,618	0.77	4,838	3,780	0.56	0.71	4,493	4,125
110	1.69	8,730	0.77	5,069	3,661	0.55	0.71	4,685	4,045
115	1.64	8,837	0.77	5,299	3,538	0.55	0.71	4,877	3,960
120	1.59	8,940	0.77	5,530	3,411	0.55	0.70	5,069	3,871
125	1.54	9,039	0.77	5,760	3,279	0.55	0.70	5,261	3,778
130	1.50	9,134	0.77	5,990	3,144	0.55	0.70	5,453	3,682
135	1.46	9,226	0.77	6,221	3,006	0.54	0.70	5,645	3,582
140	1.42	9,315	0.77	6,451	2,864	0.54	0.69	5,837	3,478
145	1.38	9,401	0.77	6,682	2,720	0.54	0.69	6,029	3,372
150	1.35	9,484	0.77	6,912	2,572	0.54	0.69	6,221	3,264
155	1.32	9,565	0.77	7,142	2,423	0.54	0.69	6,413	3,152
160	1.29	9,644	0.77	7,373	2,271	0.54	0.69	6,605	3,039
165	1.26	9,720	0.77	7,603	2,117	0.54	0.69	6,797	2,923
170	1.23	9,794	0.77	7,834	1,960	0.54	0.69	6,989	2,805
175	1.20	9,866	0.77	8,064	1,802	0.53	0.68	7,181	2,685
180	1.18	9,937	0.77	8,294	1,642	0.53	0.68	7,373	2,564
185	1.15	10,005	0.77	8,525	1,480	0.53	0.68	7,565	2,440
FAA Major Storage Volume (cubic ft.) =			4,557	Mod. FAA Major Storage Volume (cubic ft.) =			4,525		
FAA Major Storage Volume (acre-ft.) =			0.1046	Mod. FAA Major Storage Volume (acre-ft.) =			0.1039		

UDFCD DETENTION VOLUME ESTIMATING WORKBOOK Version 2.02, Released January 2007

# **STAGE-DISCHARGE SIZING OF THE WATER QUALITY CAPTURE VOLUME (WQCV) OUTLET**

Project: **Geos Neighborhood MDCIA**

Basin ID: **Major Basin G**

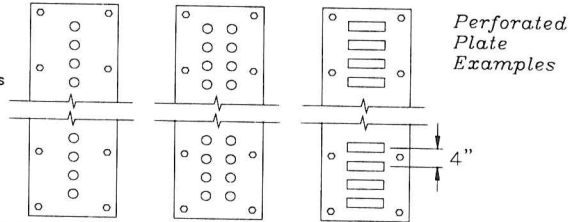
**WQCV Design Volume (Input):**

Catchment Imperviousness,  $I_a$  = 52.0 percent  
 Catchment Area,  $A$  = 1.2800 acres  
 Depth at WQCV outlet above lowest perforation,  $H$  = 22.92 inches  
 Number of layers,  $N_L$  = 6  
 Vertical distance between layers,  $h$  = 4.00 inches  
 Orifice discharge coefficient,  $C_o$  = 0.65

Diameter of holes,  $D$  = 0.306 in.  
 Number of holes per layer,  $N$  = 1  
 OR

Height of slot,  $H$  = _____ in.  
 Width of slot,  $W$  = _____ in.

Time to Drain the Pond = 40 hours  
 Water Quality Capture Volume Method Selected (40-Hour Release)



**Outlet Design Information (Output):**

Water Quality Capture Volume ( $1.0 * (0.91 * I_a^3 - 1.19 * I_a^2 + 0.78 * I_a)$ ), WQCV = 0.21 watershed inches  
 Design Volume (WQCV / 12 * Area * 1.2) Vol = 0.0271 acre-feet  
 Recommended maximum outlet area per layer (based on 4" vertical spacing of layers),  $A_o$  = 0.0742 square inches  
 Total opening area at each layer based on user-input above,  $A_o$  = 0.07 square inches  
 Total opening area at each layer based on user-input above,  $A_o$  = 0.0005 square feet

**Calculation of Collection Capacity :**

Stage ft (input)	Central Elevations of Layers of Holes in feet																		Flow cfs
	Layer 1 5549.10	Layer 2 5549.43	Layer 3 5549.77	Layer 4 5550.10	Layer 5 5550.43	Layer 6 5550.77	Layer 7	Layer 8	Layer 9	Layer 10	Layer 11	Layer 12	Layer 13	Layer 14	Layer 15	Layer 16	Layer 17	Layer 18	
	Collection Capacity for Each Layer of Holes in cfs																		
5549.10	0.000	0.000	0.000	0.000	0.000	0.000													0.00
5549.43	0.002	0.000	0.000	0.000	0.000	0.000													0.00
5549.76	0.002	0.002	0.000	0.000	0.000	0.000													0.00
5550.09	0.003	0.002	0.002	0.000	0.000	0.000													0.00
5550.42	0.003	0.003	0.002	0.002	0.000	0.000													0.01
5550.75	0.003	0.003	0.003	0.002	0.002	0.000													0.01
5551.08	0.004	0.003	0.003	0.003	0.002	0.001													0.01
5551.41	0.004	0.004	0.003	0.003	0.003	0.002													0.02
5551.74	0.004	0.004	0.004	0.003	0.003	0.003													0.02
5552.07	0.005	0.004	0.004	0.004	0.003	0.003													0.02
5552.40	0.005	0.005	0.004	0.004	0.004	0.003													0.02
5552.73	0.005	0.005	0.005	0.004	0.004	0.004													0.02
5553.06	0.005	0.005	0.005	0.005	0.004	0.004													0.03
5553.39	0.006	0.005	0.005	0.005	0.005	0.004													0.03
5553.72	0.006	0.006	0.005	0.005	0.005	0.005													0.03
5554.05	0.006	0.006	0.006	0.005	0.005	0.005													0.03
5554.38	0.006	0.006	0.006	0.006	0.005	0.005													0.03
5554.71	0.006	0.006	0.006	0.006	0.006	0.005													0.03
5555.04	0.007	0.006	0.006	0.006	0.006	0.006													0.03
5555.37	0.007	0.007	0.006	0.006	0.006	0.006													0.04
5555.70	0.007	0.007	0.006	0.006	0.006	0.006													0.04
5556.03	0.007	0.007	0.007	0.006	0.006	0.006													0.04
5556.36	0.007	0.007	0.007	0.007	0.006	0.006													0.04
5556.69	0.007	0.007	0.007	0.007	0.007	0.006													0.04
5557.02	0.008	0.007	0.007	0.007	0.007	0.007													0.04
5557.35	0.008	0.008	0.007	0.007	0.007	0.007													0.04
5557.68	0.008	0.008	0.008	0.007	0.007	0.007													0.04
5558.01	0.008	0.008	0.008	0.008	0.007	0.007													0.04
5558.34	0.008	0.008	0.008	0.008	0.008	0.007													0.05
5558.67	0.008	0.008	0.008	0.008	0.008	0.008													0.05
5559.00	0.008	0.008	0.008	0.008	0.008	0.008													0.05
5559.33	0.009	0.008	0.008	0.008	0.008	0.008													0.05
5559.66	0.009	0.009	0.008	0.008	0.008	0.008													0.05
5559.99	0.009	0.009	0.009	0.008	0.008	0.008													0.05
5560.32	0.009	0.009	0.009	0.009	0.008	0.008													0.05
5560.65	0.009	0.009	0.009	0.009	0.009	0.008													0.05
5560.98	0.009	0.009	0.009	0.009	0.009	0.009													0.05
5561.31	0.009	0.009	0.009	0.009	0.009	0.009													0.05
5561.64	0.009	0.009	0.009	0.009	0.009	0.009													0.05
5561.97	0.010	0.009	0.009	0.009	0.009	0.009													0.05
5562.30	0.010	0.010	0.009	0.009	0.009	0.009													0.06
5562.63	0.010	0.010	0.010	0.009	0.009	0.009													0.06
5562.96	0.010	0.010	0.010	0.010	0.009	0.009													0.06
5563.29	0.010	0.010	0.010	0.010	0.010	0.009													0.06



**MINOR DETENTION VOLUME BY FAA & MODIFIED FAA METHOD**  
(See USDCM Volume I Runoff Chapter for description of method)

Project: **Geos Neighborhood MDCIA**  
Basin ID: **Major Basin H**

(For catchments less than 160 acres only. For larger catchments, use hydrograph routing method)  
(Note: for catchments larger than 90 acres, CUHP hydrograph and routing are recommended)

The user must fill in all of the blue cells for these sheets to function.

Design Information (Input):	
Catchment Drainage Imperviousness	$I_a =$ 58.00 percent
Catchment Drainage Area	$A =$ 0.9100 acres
Predevelopment NRCS Soil Group	Type = C A, B, C, or D
Return Period for Detention Control	$T =$ 10 years (2, 5, 10, 25, 50, or 100)
Time of Concentration of Watershed	$T_c =$ 11 minutes
Allowable Unit Release Rate (See Table A)	$q =$ 0.30 cfs/acre
One-hour Precipitation	$P_1 =$ 1.61 inches
Design Rainfall IDF Formula $I = C_1 \cdot P_1 / (C_2 + T_c)^{C_3}$	
Coefficient One	$C_1 =$ 28.50
Coefficient Two	$C_2 =$ 10.00
Coefficient Three	$C_3 =$ 0.79

Determination of Average Outflow from the Basin (Calculated):	
Runoff Coefficient	$C =$ 0.50
Inflow Peak Runoff	$Q_{p-in} =$ 1.91 cfs
Allowable Peak Outflow Rate	$Q_{p-out} =$ 0.27 cfs
Ratio of $Q_{p-out}/Q_{p-in}$	Ratio = 0.14

**Determination of MINOR Detention Volume Using FAA & Modified FAA Method**

5	<- Enter Rainfall Duration Incremental Increase Value Here (e.g. 5 for 5-Minutes)								
Rainfall Duration minutes (input)	Rainfall Intensity inches / hr (output)	Inflow Volume cubic feet (output)	Average Outflow (FAA, cfs) (output)	Outflow Volume (FAA, cf) (output)	Storage Volume (FAA, cf) (output)	Adjustment Factor (Modified) (output)	Average Outflow (Mod, cfs) (output)	Outflow Volume (Mod, cf) (output)	Storage Volume (Mod, cf) (output)
5	5.40	737	0.15	45	692	1.00	0.27	82	655
10	4.30	1,175	0.15	90	1,085	1.00	0.27	164	1,011
15	3.61	1,478	0.15	135	1,342	0.85	0.23	210	1,268
20	3.12	1,706	0.15	180	1,526	0.77	0.21	251	1,455
25	2.77	1,888	0.15	225	1,662	0.71	0.19	292	1,596
30	2.49	2,039	0.15	271	1,768	0.68	0.18	333	1,706
35	2.27	2,167	0.15	316	1,851	0.65	0.18	373	1,794
40	2.09	2,279	0.15	361	1,918	0.63	0.17	414	1,864
45	1.94	2,378	0.15	406	1,972	0.62	0.17	455	1,922
50	1.81	2,466	0.15	451	2,016	0.61	0.17	496	1,970
55	1.70	2,547	0.15	496	2,051	0.60	0.16	537	2,010
60	1.60	2,620	0.15	541	2,079	0.59	0.16	578	2,042
65	1.51	2,688	0.15	586	2,102	0.58	0.16	619	2,069
70	1.44	2,751	0.15	631	2,120	0.58	0.16	660	2,091
75	1.37	2,810	0.15	676	2,133	0.57	0.16	701	2,109
80	1.31	2,865	0.15	721	2,143	0.57	0.15	742	2,123
85	1.26	2,916	0.15	766	2,150	0.56	0.15	783	2,133
90	1.21	2,965	0.15	812	2,154	0.56	0.15	824	2,141
95	1.16	3,012	0.15	857	2,155	0.56	0.15	865	2,147
100	1.12	3,056	0.15	902	2,154	0.55	0.15	906	2,150
105	1.08	3,098	0.15	947	2,151	0.55	0.15	947	2,151
110	1.05	3,138	0.15	992	2,146	0.55	0.15	988	2,150
115	1.01	3,177	0.15	1,037	2,140	0.55	0.15	1,029	2,148
120	0.98	3,214	0.15	1,082	2,132	0.54	0.15	1,070	2,144
125	0.95	3,249	0.15	1,127	2,122	0.54	0.15	1,111	2,139
130	0.93	3,283	0.15	1,172	2,111	0.54	0.15	1,152	2,132
135	0.90	3,317	0.15	1,217	2,099	0.54	0.15	1,192	2,124
140	0.88	3,348	0.15	1,262	2,086	0.54	0.15	1,233	2,115
145	0.85	3,379	0.15	1,307	2,072	0.54	0.15	1,274	2,105
150	0.83	3,409	0.15	1,353	2,057	0.54	0.15	1,315	2,094
155	0.81	3,438	0.15	1,398	2,041	0.53	0.15	1,356	2,082
160	0.79	3,467	0.15	1,443	2,024	0.53	0.15	1,397	2,069
165	0.78	3,494	0.15	1,488	2,006	0.53	0.15	1,438	2,056
170	0.76	3,521	0.15	1,533	1,988	0.53	0.15	1,479	2,041
175	0.74	3,547	0.15	1,578	1,969	0.53	0.14	1,520	2,026
180	0.73	3,572	0.15	1,623	1,949	0.53	0.14	1,561	2,011
185	0.71	3,596	0.15	1,668	1,928	0.53	0.14	1,602	1,995
FAA Minor Storage Volume (cubic ft.) =				2,155	Mod. FAA Minor Storage Volume (cubic ft.) =				2,151
FAA Minor Storage Volume (acre-ft.) =				0.0495	Mod. FAA Minor Storage Volume (acre-ft.) =				0.0494

UDFCD DETENTION VOLUME ESTIMATING WORKBOOK Version 2.02, Released January 2007



**MAJOR DETENTION VOLUME BY FAA & MODIFIED FAA METHOD**  
(See USDCM Volume I Runoff Chapter for description of method)

Project: Geos Neighborhood MDCIA  
Basin ID: Major Basin H

(For catchments less than 160 acres only. For larger catchments, use hydrograph routing method)  
(Note: for catchments larger than 90 acres, CUHP hydrograph and routing are recommended)

The user must fill in all of the blue cells for these sheets to function.

<b>Design Information (Input):</b>	
Catchment Drainage Imperviousness	I _a = 58.00 percent
Catchment Drainage Area	A = 0.9100 acres
Predevelopment NRCS Soil Group	Type = C A, B, C, or D
Return Period for Detention Control	T = 100 years (2, 5, 10, 25, 50, or 100)
Time of Concentration of Watershed	T _c = 11 minutes
Allowable Unit Release Rate (See Table A)	q = 1.00 cfs/acre
One-hour Precipitation	P ₁ = 2.61 inches
Design Rainfall IDF Formula I = C ₁ * P ₁ /(C ₂ +T _c )^C ₃	
Coefficient One	C ₁ = 28.50
Coefficient Two	C ₂ = 10.00
Coefficient Three	C ₃ = 0.79
<b>Determination of Average Outflow from the Basin (Calculated):</b>	
Runoff Coefficient	C = 0.63
Inflow Peak Runoff	Q _{p-in} = 3.91 cfs
Allowable Peak Outflow Rate	Q _{p-out} = 0.91 cfs
Ratio of Q _{p-out} /Q _{p-in}	Ratio = 0.23
<b>Determination of MAJOR Detention Volume Using FAA &amp; Modified FAA Method</b>	

5	<- Enter Rainfall Duration Incremental Increase Value Here (e.g. 5 for 5-Minutes)								
Rainfall Duration minutes (input)	Rainfall Intensity inches / hr (output)	Inflow Volume cubic feet (output)	Average Outflow (FAA, cfs) (output)	Outflow Volume (FAA, cf) (output)	Storage Volume (FAA, cf) (output)	Adjustment Factor (Modified) (output)	Average Outflow (Mod, cfs) (output)	Outflow Volume (Mod, cf) (output)	Storage Volume (Mod, cf) (output)
5	8.76	1,506	0.53	159	1,347	1.00	0.91	273	1,233
10	6.98	2,400	0.53	318	2,082	1.00	0.91	546	1,854
15	5.85	3,018	0.53	476	2,542	0.85	0.78	699	2,319
20	5.06	3,484	0.53	635	2,849	0.77	0.70	835	2,649
25	4.48	3,856	0.53	794	3,062	0.71	0.65	972	2,884
30	4.04	4,164	0.53	953	3,211	0.68	0.62	1,108	3,056
35	3.68	4,426	0.53	1,111	3,315	0.65	0.59	1,245	3,182
40	3.38	4,655	0.53	1,270	3,385	0.63	0.58	1,381	3,273
45	3.14	4,857	0.53	1,429	3,428	0.62	0.56	1,518	3,339
50	2.93	5,038	0.53	1,588	3,460	0.61	0.55	1,654	3,384
55	2.75	5,202	0.53	1,746	3,466	0.60	0.54	1,791	3,411
60	2.59	5,352	0.53	1,905	3,447	0.59	0.54	1,927	3,425
65	2.46	5,491	0.53	2,064	3,427	0.58	0.53	2,064	3,427
70	2.33	5,619	0.53	2,223	3,397	0.58	0.52	2,200	3,419
75	2.22	5,739	0.53	2,381	3,358	0.57	0.52	2,337	3,402
80	2.13	5,851	0.53	2,540	3,311	0.57	0.52	2,473	3,378
85	2.04	5,957	0.53	2,699	3,258	0.56	0.51	2,610	3,347
90	1.96	6,057	0.53	2,858	3,199	0.56	0.51	2,746	3,311
95	1.88	6,152	0.53	3,016	3,135	0.56	0.51	2,883	3,269
100	1.81	6,242	0.53	3,175	3,067	0.55	0.50	3,019	3,223
105	1.75	6,328	0.53	3,334	2,994	0.55	0.50	3,156	3,172
110	1.69	6,410	0.53	3,493	2,917	0.55	0.50	3,292	3,118
115	1.64	6,489	0.53	3,651	2,837	0.55	0.50	3,429	3,060
120	1.59	6,564	0.53	3,810	2,754	0.54	0.50	3,565	2,999
125	1.54	6,637	0.53	3,969	2,668	0.54	0.49	3,702	2,935
130	1.50	6,707	0.53	4,128	2,579	0.54	0.49	3,838	2,869
135	1.46	6,774	0.53	4,287	2,488	0.54	0.49	3,975	2,800
140	1.42	6,840	0.53	4,445	2,394	0.54	0.49	4,111	2,728
145	1.38	6,903	0.53	4,604	2,299	0.54	0.49	4,248	2,655
150	1.35	6,964	0.53	4,763	2,201	0.54	0.49	4,384	2,580
155	1.32	7,023	0.53	4,922	2,102	0.53	0.49	4,521	2,502
160	1.29	7,081	0.53	5,080	2,001	0.53	0.49	4,657	2,423
165	1.26	7,137	0.53	5,239	1,898	0.53	0.48	4,794	2,343
170	1.23	7,191	0.53	5,398	1,793	0.53	0.48	4,930	2,261
175	1.20	7,244	0.53	5,557	1,688	0.53	0.48	5,067	2,177
180	1.18	7,296	0.53	5,715	1,580	0.53	0.48	5,203	2,092
185	1.15	7,346	0.53	5,874	1,472	0.53	0.48	5,340	2,006
FAA Major Storage Volume (cubic ft.) =				3,456	Mod. FAA Major Storage Volume (cubic ft.) =				3,427
FAA Major Storage Volume (acre-ft.) =				0.0793	Mod. FAA Major Storage Volume (acre-ft.) =				0.0787

UDFCD DETENTION VOLUME ESTIMATING WORKBOOK Version 2.02, Released January 2007

# STAGE-DISCHARGE SIZING OF THE WATER QUALITY CAPTURE VOLUME (WQCV) OUTLET

Project: Geos Neighborhood MDCIA

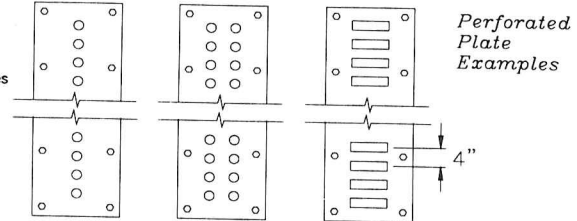
Basin ID: Major Basin H

## WQCV Design Volume (Input):

Catchment Imperviousness,  $I_p$  = 58.0 percent  
 Catchment Area,  $A$  = 0.9100 acres  
 Depth at WQCV outlet above lowest perforation,  $H$  = 25.00 inches  
 Number of layers,  $N_L$  = 6  
 Vertical distance between layers,  $h$  = 4.00 inches  
 Orifice discharge coefficient,  $C_o$  = 0.65

Diameter of holes,  $D$  = 0.257 in.  
 Number of holes per layer,  $N$  = 1  
 OR  
 Height of slot,  $H$  = in.  
 Width of slot,  $W$  = in.

Time to Drain the Pond = 40 hours  
 Water Quality Capture Volume Method Selected (40-Hour Release)



## Outlet Design Information (Output):

Water Quality Capture Volume  $(1.0 * (0.91 * I_p^3 - 1.19 * I_p^2 + 0.78 * I_p))$ , WQCV = 0.23 watershed inches  
 Design Volume  $(WQCV / 12 * \text{Area} * 1.2)$  Vol = 0.0209 acre-feet  
 Recommended maximum outlet area per layer (based on 4" vertical spacing of layers),  $A_o$  = 0.0524 square inches  
 Total opening area at each layer based on user-input above,  $A_o$  = 0.05 square inches  
 Total opening area at each layer based on user-input above,  $A_o$  = 0.0004 square feet

## Calculation of Collection Capacity :

Stage ft (input)	Central Elevations of Layers of Holes in feet																		Flow cfs
	Layer 1 5546.40	Layer 2 5546.73	Layer 3 5547.07	Layer 4 5547.40	Layer 5 5547.73	Layer 6 5548.07	Layer 7	Layer 8	Layer 9	Layer 10	Layer 11	Layer 12	Layer 13	Layer 14	Layer 15	Layer 16	Layer 17	Layer 18	
	Collection Capacity for Each Layer of Holes in cfs																		
5546.40	0.000	0.000	0.000	0.000	0.000	0.000													0.00
5546.73	0.001	0.000	0.000	0.000	0.000	0.000													0.00
5547.06	0.002	0.001	0.000	0.000	0.000	0.000													0.00
5547.39	0.002	0.002	0.001	0.000	0.000	0.000													0.00
5547.72	0.002	0.002	0.002	0.001	0.000	0.000													0.00
5548.05	0.002	0.002	0.002	0.002	0.001	0.000													0.01
5548.38	0.003	0.002	0.002	0.002	0.002	0.001													0.01
5548.71	0.003	0.003	0.002	0.002	0.002	0.001													0.01
5549.04	0.003	0.003	0.003	0.002	0.002	0.002													0.01
5549.37	0.003	0.003	0.003	0.003	0.002	0.002													0.01
5549.70	0.003	0.003	0.003	0.003	0.003	0.002													0.02
5550.03	0.004	0.003	0.003	0.003	0.003	0.003													0.02
5550.36	0.004	0.004	0.003	0.003	0.003	0.003													0.02
5550.69	0.004	0.004	0.004	0.004	0.003	0.003													0.02
5551.02	0.004	0.004	0.004	0.004	0.004	0.003													0.02
5551.35	0.004	0.004	0.004	0.004	0.004	0.004													0.02
5551.68	0.004	0.004	0.004	0.004	0.004	0.004													0.02
5552.01	0.004	0.004	0.004	0.004	0.004	0.004													0.02
5552.34	0.005	0.004	0.004	0.004	0.004	0.004													0.02
5552.67	0.005	0.005	0.004	0.004	0.004	0.004													0.03
5553.00	0.005	0.005	0.005	0.004	0.004	0.004													0.03
5553.33	0.005	0.005	0.005	0.005	0.004	0.004													0.03
5553.66	0.005	0.005	0.005	0.005	0.005	0.004													0.03
5553.99	0.005	0.005	0.005	0.005	0.005	0.005													0.03
5554.32	0.005	0.005	0.005	0.005	0.005	0.005													0.03
5554.65	0.005	0.005	0.005	0.005	0.005	0.005													0.03
5554.98	0.005	0.005	0.005	0.005	0.005	0.005													0.03
5555.31	0.006	0.005	0.005	0.005	0.005	0.005													0.03
5555.64	0.006	0.006	0.005	0.005	0.005	0.005													0.03
5555.97	0.006	0.006	0.006	0.005	0.005	0.005													0.03
5556.30	0.006	0.006	0.006	0.006	0.005	0.005													0.03
5556.63	0.006	0.006	0.006	0.006	0.006	0.005													0.03
5556.96	0.006	0.006	0.006	0.006	0.006	0.006													0.03
5557.29	0.006	0.006	0.006	0.006	0.006	0.006													0.04
5557.62	0.006	0.006	0.006	0.006	0.006	0.006													0.04
5557.95	0.006	0.006	0.006	0.006	0.006	0.006													0.04
5558.28	0.006	0.006	0.006	0.006	0.006	0.006													0.04
5558.61	0.007	0.006	0.006	0.006	0.006	0.006													0.04
5558.94	0.007	0.007	0.006	0.006	0.006	0.006													0.04
5559.27	0.007	0.007	0.007	0.006	0.006	0.006													0.04
5559.60	0.007	0.007	0.007	0.007	0.006	0.006													0.04
5559.93	0.007	0.007	0.007	0.007	0.007	0.006													0.04
5560.26	0.007	0.007	0.007	0.007	0.007	0.007													0.04
5560.59	0.007	0.007	0.007	0.007	0.007	0.007													0.04



**MINOR DETENTION VOLUME BY FAA & MODIFIED FAA METHOD**  
(See USDCM Volume I Runoff Chapter for description of method)

Project: Geos Neighborhood MDCIA

Basin ID: Major Basin I

(For catchments less than 160 acres only. For larger catchments, use hydrograph routing method)  
(Note: for catchments larger than 90 acres, CUHP hydrograph and routing are recommended)

The user must fill in all of the blue cells for these sheets to function.

**Design Information (Input):**

Catchment Drainage Imperviousness	$I_p =$ 30.00 percent
Catchment Drainage Area	$A =$ 0.8400 acres
Predevelopment NRCS Soil Group	Type = C A, B, C, or D
Return Period for Detention Control	$T =$ 10 years (2, 5, 10, 25, 50, or 100)
Time of Concentration of Watershed	$T_c =$ 12 minutes
Allowable Unit Release Rate (See Table A)	$q =$ 0.30 cfs/acre
One-hour Precipitation	$P_1 =$ 1.61 inches
<b>Design Rainfall IDF Formula $I = C_1 * P_1 / (C_2 + T_c)^{C_3}$</b>	
Coefficient One	$C_1 =$ 28.50
Coefficient Two	$C_2 =$ 10.00
Coefficient Three	$C_3 =$ 0.79

**Determination of Average Outflow from the Basin (Calculated):**

Runoff Coefficient	$C =$ 0.38
Inflow Peak Runoff	$Q_{p-in} =$ 1.27 cfs
Allowable Peak Outflow Rate	$Q_{p-out} =$ 0.25 cfs
Ratio of $Q_{p-out}/Q_{p-in}$	Ratio = 0.20

**Determination of MINOR Detention Volume Using FAA & Modified FAA Method**

5	Enter Rainfall Duration Incremental Increase Value Here (e.g. 5 for 5-Minutes)								
Rainfall Duration minutes (input)	Rainfall Intensity inches / hr (output)	Inflow Volume cubic feet (output)	Average Outflow (FAA, cfs) (output)	Outflow Volume (FAA, cf) (output)	Storage Volume (FAA, cf) (output)	Adjustment Factor (Modified) (output)	Average Outflow (Mod, cfs) (output)	Outflow Volume (Mod, cf) (output)	Storage Volume (Mod, cf) (output)
5	5.40	517	0.15	44	474	1.00	0.25	76	442
10	4.30	824	0.15	87	737	1.00	0.25	151	673
15	3.61	1,037	0.15	131	906	0.90	0.23	205	832
20	3.12	1,197	0.15	174	1,023	0.80	0.20	243	954
25	2.77	1,324	0.15	218	1,107	0.74	0.19	280	1,044
30	2.49	1,430	0.15	261	1,169	0.70	0.18	318	1,112
35	2.27	1,520	0.15	305	1,216	0.67	0.17	356	1,164
40	2.09	1,599	0.15	348	1,251	0.65	0.16	394	1,205
45	1.94	1,668	0.15	392	1,276	0.63	0.16	432	1,236
50	1.81	1,730	0.15	435	1,295	0.62	0.16	469	1,261
55	1.70	1,787	0.15	479	1,308	0.61	0.15	507	1,279
60	1.60	1,838	0.15	522	1,316	0.60	0.15	545	1,293
65	1.51	1,886	0.15	566	1,320	0.59	0.15	583	1,303
70	1.44	1,930	0.15	609	1,321	0.59	0.15	621	1,309
75	1.37	1,971	0.15	653	1,318	0.58	0.15	658	1,313
80	1.31	2,010	0.15	696	1,313	0.58	0.15	696	1,313
85	1.26	2,046	0.15	740	1,306	0.57	0.14	734	1,312
90	1.21	2,080	0.15	783	1,297	0.57	0.14	772	1,308
95	1.16	2,113	0.15	827	1,286	0.56	0.14	810	1,303
100	1.12	2,144	0.15	870	1,273	0.56	0.14	847	1,296
105	1.08	2,173	0.15	914	1,259	0.56	0.14	885	1,288
110	1.05	2,202	0.15	957	1,244	0.56	0.14	923	1,278
115	1.01	2,229	0.15	1,001	1,228	0.55	0.14	961	1,268
120	0.98	2,255	0.15	1,044	1,210	0.55	0.14	999	1,256
125	0.95	2,279	0.15	1,088	1,192	0.55	0.14	1,036	1,243
130	0.93	2,303	0.15	1,131	1,172	0.55	0.14	1,074	1,229
135	0.90	2,327	0.15	1,175	1,152	0.54	0.14	1,112	1,215
140	0.88	2,349	0.15	1,218	1,131	0.54	0.14	1,150	1,199
145	0.85	2,371	0.15	1,262	1,109	0.54	0.14	1,188	1,183
150	0.83	2,392	0.15	1,306	1,086	0.54	0.14	1,225	1,166
155	0.81	2,412	0.15	1,349	1,063	0.54	0.14	1,263	1,149
160	0.79	2,432	0.15	1,393	1,039	0.54	0.14	1,301	1,131
165	0.78	2,451	0.15	1,436	1,015	0.54	0.14	1,339	1,112
170	0.76	2,470	0.15	1,480	990	0.54	0.13	1,377	1,093
175	0.74	2,488	0.15	1,523	965	0.53	0.13	1,414	1,074
180	0.73	2,506	0.15	1,567	939	0.53	0.13	1,452	1,053
185	0.71	2,523	0.15	1,610	913	0.53	0.13	1,490	1,033
FAA Minor Storage Volume (cubic ft.) =			1,321	Mod. FAA Minor Storage Volume (cubic ft.) =			1,313		
FAA Minor Storage Volume (acre-ft.) =			0.0303	Mod. FAA Minor Storage Volume (acre-ft.) =			0.0302		

UDFCD DETENTION VOLUME ESTIMATING WORKBOOK Version 2.02, Released January 2007



**MAJOR DETENTION VOLUME BY FAA & MODIFIED FAA METHOD**  
(See USDCM Volume I Runoff Chapter for description of method)

Project: **Geos Neighborhood MDCIA**  
Basin ID: **Major Basin I**

(For catchments less than 160 acres only. For larger catchments, use hydrograph routing method)  
(Note: for catchments larger than 90 acres, CUHP hydrograph and routing are recommended)

The user must fill in all of the blue cells for these sheets to function.

<b>Design Information (Input):</b>	
Catchment Drainage Imperviousness	$I_a =$ 30.00 percent
Catchment Drainage Area	$A =$ 0.8400 acres
Predevelopment NRCS Soil Group	Type = C A, B, C, or D
Return Period for Detention Control	$T =$ 100 years (2, 5, 10, 25, 50, or 100)
Time of Concentration of Watershed	$T_c =$ 12 minutes
Allowable Unit Release Rate (See Table A)	$q =$ 1.00 cfs/acre
One-hour Precipitation	$P_1 =$ 2.61 inches
Design Rainfall IDF Formula $I = C_1 \cdot P_1 / (C_2 + T_c)^{C_3}$	
Coefficient One	$C_1 =$ 28.50
Coefficient Two	$C_2 =$ 10.00
Coefficient Three	$C_3 =$ 0.79
<b>Determination of Average Outflow from the Basin (Calculated):</b>	
Runoff Coefficient	$C =$ 0.57
Inflow Peak Runoff	$Q_{p-in} =$ 3.09 cfs
Allowable Peak Outflow Rate	$Q_{p-out} =$ 0.84 cfs
Ratio of $Q_{p-out}/Q_{p-in}$	Ratio = 0.27
<b>Determination of MAJOR Detention Volume Using FAA &amp; Modified FAA Method</b>	

5	Enter Rainfall Duration Incremental Increase Value Here (e.g. 5 for 5-Minutes)								
Rainfall Duration minutes (input)	Rainfall Intensity inches / hr (output)	Inflow Volume cubic feet (output)	Average Outflow (FAA, cfs) (output)	Outflow Volume (FAA, cf) (output)	Storage Volume (FAA, cf) (output)	Adjustment Factor (Modified) (output)	Average Outflow (Mod, cfs) (output)	Outflow Volume (Mod, cf) (output)	Storage Volume (Mod, cf) (output)
5	8.76	1,258	0.51	154	1,104	1.00	0.84	252	1,006
10	6.98	2,004	0.51	307	1,697	1.00	0.84	504	1,500
15	5.85	2,521	0.51	461	2,059	0.90	0.76	683	1,838
20	5.06	2,910	0.51	615	2,295	0.80	0.67	809	2,101
25	4.48	3,220	0.51	769	2,452	0.74	0.62	935	2,286
30	4.04	3,478	0.51	922	2,555	0.70	0.59	1,061	2,417
35	3.68	3,697	0.51	1,076	2,621	0.67	0.57	1,187	2,510
40	3.38	3,887	0.51	1,230	2,658	0.65	0.55	1,313	2,575
45	3.14	4,056	0.51	1,383	2,673	0.63	0.53	1,439	2,617
50	2.93	4,207	0.51	1,537	2,670	0.62	0.52	1,565	2,643
55	2.75	4,345	0.51	1,691	2,654	0.61	0.51	1,691	2,654
60	2.59	4,470	0.51	1,845	2,625	0.60	0.50	1,817	2,653
65	2.46	4,586	0.51	1,998	2,587	0.59	0.50	1,943	2,643
70	2.33	4,693	0.51	2,152	2,541	0.59	0.49	2,069	2,624
75	2.22	4,793	0.51	2,306	2,487	0.58	0.49	2,195	2,598
80	2.13	4,887	0.51	2,460	2,427	0.58	0.48	2,321	2,566
85	2.04	4,975	0.51	2,613	2,362	0.57	0.48	2,447	2,528
90	1.96	5,059	0.51	2,767	2,292	0.57	0.48	2,573	2,486
95	1.88	5,138	0.51	2,921	2,217	0.56	0.47	2,699	2,439
100	1.81	5,213	0.51	3,074	2,139	0.56	0.47	2,825	2,388
105	1.75	5,285	0.51	3,228	2,057	0.56	0.47	2,951	2,334
110	1.69	5,353	0.51	3,382	1,972	0.56	0.47	3,077	2,276
115	1.64	5,419	0.51	3,536	1,884	0.55	0.46	3,203	2,216
120	1.59	5,482	0.51	3,689	1,793	0.55	0.46	3,329	2,153
125	1.54	5,543	0.51	3,843	1,700	0.55	0.46	3,455	2,088
130	1.50	5,601	0.51	3,997	1,605	0.55	0.46	3,581	2,020
135	1.46	5,658	0.51	4,150	1,507	0.54	0.46	3,707	1,951
140	1.42	5,712	0.51	4,304	1,408	0.54	0.46	3,833	1,879
145	1.38	5,765	0.51	4,458	1,307	0.54	0.46	3,959	1,806
150	1.35	5,816	0.51	4,612	1,204	0.54	0.45	4,085	1,731
155	1.32	5,866	0.51	4,765	1,100	0.54	0.45	4,211	1,655
160	1.29	5,914	0.51	4,919	995	0.54	0.45	4,337	1,577
165	1.26	5,960	0.51	5,073	888	0.54	0.45	4,463	1,497
170	1.23	6,006	0.51	5,226	779	0.54	0.45	4,589	1,417
175	1.20	6,050	0.51	5,380	670	0.53	0.45	4,715	1,335
180	1.18	6,093	0.51	5,534	559	0.53	0.45	4,841	1,252
185	1.15	6,135	0.51	5,688	448	0.53	0.45	4,967	1,168
FAA Major Storage Volume (cubic ft.) =				2,673	Mod. FAA Major Storage Volume (cubic ft.) =				2,654
FAA Major Storage Volume (acre-ft.) =				0.0614	Mod. FAA Major Storage Volume (acre-ft.) =				0.0609

UDFCD DETENTION VOLUME ESTIMATING WORKBOOK Version 2.02, Released January 2007





**MINOR DETENTION VOLUME BY FAA & MODIFIED FAA METHOD**  
(See USDCM Volume I Runoff Chapter for description of method)

Project: Geos Neighborhood MDCIA

Basin ID: Major Basin J

(For catchments less than 160 acres only. For larger catchments, use hydrograph routing method)  
(Note: for catchments larger than 90 acres, CUHP hydrograph and routing are recommended)

The user must fill in all of the blue cells for these sheets to function.

<b>Design Information (Input):</b>	
Catchment Drainage Imperviousness	I _a = 26.00 percent
Catchment Drainage Area	A = 1.4000 acres
Predevelopment NRCS Soil Group	Type = C A, B, C, or D
Return Period for Detention Control	T = 10 years (2, 5, 10, 25, 50, or 100)
Time of Concentration of Watershed	T _c = 12 minutes
Allowable Unit Release Rate (See Table A)	q = 0.30 cfs/acre
One-hour Precipitation	P ₁ = 1.61 inches
Design Rainfall IDF Formula I = C ₁ *P ₁ /(C ₂ +T _c )*C ₃	
Coefficient One	C ₁ = 28.50
Coefficient Two	C ₂ = 10.00
Coefficient Three	C ₃ = 0.79
<b>Determination of Average Outflow from the Basin (Calculated):</b>	
Runoff Coefficient	C = 0.37
Inflow Peak Runoff	Q _{p-in} = 2.05 cfs
Allowable Peak Outflow Rate	Q _{p-out} = 0.42 cfs
Ratio of Q _{p-out} /Q _{p-in}	Ratio = 0.21
<b>Determination of MINOR Detention Volume Using FAA &amp; Modified FAA Method</b>	

5	<- Enter Rainfall Duration Incremental Increase Value Here (e.g. 5 for 5-Minutes)								
Rainfall Duration minutes (input)	Rainfall Intensity inches / hr (output)	Inflow Volume cubic feet (output)	Average Outflow (FAA, cfs) (output)	Outflow Volume (FAA, cf) (output)	Storage Volume (FAA, cf) (output)	Adjustment Factor (Modified) (output)	Average Outflow (Mod, cfs) (output)	Outflow Volume (Mod, cf) (output)	Storage Volume (Mod, cf) (output)
5	5.40	839	0.24	73	766	1.00	0.42	126	713
10	4.30	1,338	0.24	147	1,191	1.00	0.42	252	1,086
15	3.61	1,682	0.24	220	1,462	0.91	0.38	344	1,338
20	3.12	1,942	0.24	293	1,649	0.81	0.34	407	1,535
25	2.77	2,149	0.24	367	1,783	0.75	0.31	470	1,679
30	2.49	2,321	0.24	440	1,881	0.71	0.30	533	1,788
35	2.27	2,467	0.24	513	1,954	0.68	0.28	596	1,871
40	2.09	2,594	0.24	587	2,008	0.65	0.27	659	1,935
45	1.94	2,707	0.24	660	2,047	0.64	0.27	722	1,985
50	1.81	2,808	0.24	733	2,075	0.62	0.26	785	2,023
55	1.70	2,899	0.24	807	2,093	0.61	0.26	848	2,051
60	1.60	2,983	0.24	880	2,103	0.60	0.25	911	2,072
65	1.51	3,060	0.24	953	2,107	0.59	0.25	974	2,086
70	1.44	3,132	0.24	1,027	2,105	0.59	0.25	1,037	2,095
75	1.37	3,199	0.24	1,100	2,099	0.58	0.24	1,100	2,099
80	1.31	3,261	0.24	1,173	2,088	0.58	0.24	1,163	2,098
85	1.26	3,320	0.24	1,247	2,074	0.57	0.24	1,226	2,094
90	1.21	3,376	0.24	1,320	2,056	0.57	0.24	1,289	2,087
95	1.16	3,429	0.24	1,393	2,035	0.56	0.24	1,352	2,077
100	1.12	3,479	0.24	1,467	2,012	0.56	0.24	1,415	2,064
105	1.08	3,527	0.24	1,540	1,987	0.56	0.23	1,478	2,049
110	1.05	3,573	0.24	1,613	1,959	0.56	0.23	1,541	2,032
115	1.01	3,617	0.24	1,687	1,930	0.55	0.23	1,604	2,013
120	0.98	3,659	0.24	1,760	1,899	0.55	0.23	1,667	1,992
125	0.95	3,699	0.24	1,833	1,866	0.55	0.23	1,730	1,969
130	0.93	3,738	0.24	1,907	1,831	0.55	0.23	1,793	1,945
135	0.90	3,776	0.24	1,980	1,796	0.55	0.23	1,856	1,920
140	0.88	3,812	0.24	2,053	1,759	0.54	0.23	1,919	1,893
145	0.85	3,847	0.24	2,127	1,721	0.54	0.23	1,982	1,865
150	0.83	3,881	0.24	2,200	1,681	0.54	0.23	2,045	1,836
155	0.81	3,914	0.24	2,273	1,641	0.54	0.23	2,108	1,806
160	0.79	3,947	0.24	2,347	1,600	0.54	0.23	2,171	1,776
165	0.78	3,978	0.24	2,420	1,558	0.54	0.23	2,234	1,744
170	0.76	4,008	0.24	2,493	1,515	0.54	0.23	2,297	1,711
175	0.74	4,038	0.24	2,567	1,471	0.54	0.22	2,360	1,678
180	0.73	4,066	0.24	2,640	1,426	0.53	0.22	2,423	1,643
185	0.71	4,094	0.24	2,713	1,381	0.53	0.22	2,486	1,608
FAA Minor Storage Volume (cubic ft.) =				2,107	Mod. FAA Minor Storage Volume (cubic ft.) =				2,099
FAA Minor Storage Volume (acre-ft.) =				0.0484	Mod. FAA Minor Storage Volume (acre-ft.) =				0.0482

UDFCD DETENTION VOLUME ESTIMATING WORKBOOK Version 2.02, Released January 2007



**MAJOR DETENTION VOLUME BY FAA & MODIFIED FAA METHOD**  
(See USDCM Volume I Runoff Chapter for description of method)

Project: Geos Neighborhood MDCIA  
Basin ID: Major Basin J

(For catchments less than 160 acres only. For larger catchments, use hydrograph routing method)  
(Note: for catchments larger than 90 acres, CUHP hydrograph and routing are recommended)

The user must fill in all of the blue cells for these sheets to function.

**Design Information (Input):**

Catchment Drainage Imperviousness	$I_a =$ 26.00 percent
Catchment Drainage Area	$A =$ 1.4000 acres
Predevelopment NRCS Soil Group	Type = C A, B, C, or D
Return Period for Detention Control	$T =$ 100 years (2, 5, 10, 25, 50, or 100)
Time of Concentration of Watershed	$T_c =$ 12 minutes
Allowable Unit Release Rate (See Table A)	$q =$ 1.00 cfs/acre
One-hour Precipitation	$P_1 =$ 2.61 inches
<b>Design Rainfall IDF Formula $I = C_1 \cdot P_1 / (C_2 + T_c)^{C_3}$</b>	
Coefficient One	$C_1 =$ 28.50
Coefficient Two	$C_2 =$ 10.00
Coefficient Three	$C_3 =$ 0.79

**Determination of Average Outflow from the Basin (Calculated):**

Runoff Coefficient	$C =$ 0.56
Inflow Peak Runoff	$Q_{p-in} =$ 5.02 cfs
Allowable Peak Outflow Rate	$Q_{p-out} =$ 1.40 cfs
Ratio of $Q_{p-out}/Q_{p-in}$	Ratio = 0.28

**Determination of MAJOR Detention Volume Using FAA & Modified FAA Method**

5	<- Enter Rainfall Duration Incremental Increase Value Here (e.g. 5 for 5-Minutes)								
Rainfall Duration minutes (input)	Rainfall Intensity inches / hr (output)	Inflow Volume cubic feet (output)	Average Outflow (FAA, cfs) (output)	Outflow Volume (FAA, cf) (output)	Storage Volume (FAA, cf) (output)	Adjustment Factor (Modified) (output)	Average Outflow (Mod, cfs) (output)	Outflow Volume (Mod, cf) (output)	Storage Volume (Mod, cf) (output)
5	8.76	2,060	0.86	257	1,803	1.00	1.40	420	1,640
10	6.98	3,282	0.86	514	2,768	1.00	1.40	840	2,442
15	5.85	4,127	0.86	771	3,356	0.91	1.27	1,147	2,981
20	5.06	4,765	0.86	1,028	3,737	0.81	1.13	1,357	3,408
25	4.48	5,273	0.86	1,285	3,988	0.75	1.04	1,567	3,707
30	4.04	5,694	0.86	1,542	4,153	0.71	0.99	1,777	3,918
35	3.68	6,053	0.86	1,789	4,254	0.68	0.95	1,987	4,087
40	3.38	6,365	0.86	2,056	4,310	0.65	0.92	2,197	4,169
45	3.14	6,642	0.86	2,313	4,329	0.64	0.89	2,407	4,235
50	2.93	6,889	0.86	2,570	4,320	0.62	0.87	2,617	4,273
55	2.75	7,114	0.86	2,827	4,287	0.61	0.86	2,827	4,287
60	2.59	7,319	0.86	3,084	4,236	0.60	0.84	3,037	4,283
65	2.46	7,509	0.86	3,341	4,168	0.59	0.83	3,247	4,262
70	2.33	7,684	0.86	3,597	4,087	0.59	0.82	3,457	4,228
75	2.22	7,848	0.86	3,854	3,994	0.58	0.81	3,667	4,182
80	2.13	8,002	0.86	4,111	3,890	0.58	0.81	3,877	4,125
85	2.04	8,146	0.86	4,368	3,778	0.57	0.80	4,087	4,060
90	1.96	8,283	0.86	4,625	3,658	0.57	0.80	4,297	3,987
95	1.88	8,413	0.86	4,882	3,530	0.56	0.79	4,507	3,906
100	1.81	8,536	0.86	5,139	3,397	0.56	0.79	4,717	3,819
105	1.75	8,653	0.86	5,396	3,257	0.56	0.78	4,927	3,727
110	1.69	8,766	0.86	5,653	3,113	0.56	0.78	5,137	3,629
115	1.64	8,873	0.86	5,910	2,963	0.55	0.77	5,347	3,527
120	1.59	8,977	0.86	6,167	2,810	0.55	0.77	5,557	3,420
125	1.54	9,076	0.86	6,424	2,652	0.55	0.77	5,767	3,309
130	1.50	9,172	0.86	6,681	2,491	0.55	0.77	5,977	3,195
135	1.46	9,264	0.86	6,938	2,326	0.55	0.76	6,187	3,078
140	1.42	9,353	0.86	7,195	2,158	0.54	0.76	6,397	2,957
145	1.38	9,440	0.86	7,452	1,988	0.54	0.76	6,607	2,833
150	1.35	9,523	0.86	7,709	1,814	0.54	0.76	6,817	2,707
155	1.32	9,604	0.86	7,966	1,639	0.54	0.76	7,027	2,578
160	1.29	9,683	0.86	8,223	1,460	0.54	0.75	7,237	2,447
165	1.26	9,760	0.86	8,480	1,280	0.54	0.75	7,447	2,313
170	1.23	9,834	0.86	8,737	1,097	0.54	0.75	7,657	2,178
175	1.20	9,907	0.86	8,994	913	0.54	0.75	7,867	2,040
180	1.18	9,977	0.86	9,251	727	0.53	0.75	8,077	1,901
185	1.15	10,046	0.86	9,508	538	0.53	0.75	8,287	1,759
FAA Major Storage Volume (cubic ft.) =				4,329	Mod. FAA Major Storage Volume (cubic ft.) =				4,287
FAA Major Storage Volume (acre-ft.) =				0.0994	Mod. FAA Major Storage Volume (acre-ft.) =				0.0984

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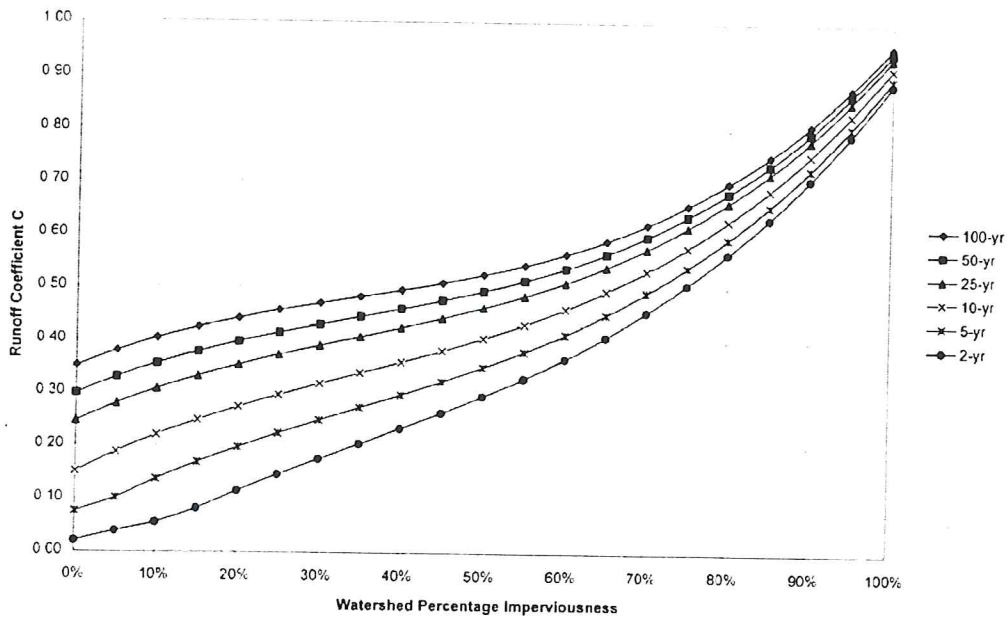


Figure RO-7—Runoff Coefficient,  $C$ , vs. Watershed Percentage Imperviousness NRCS Hydrologic Soil Group B

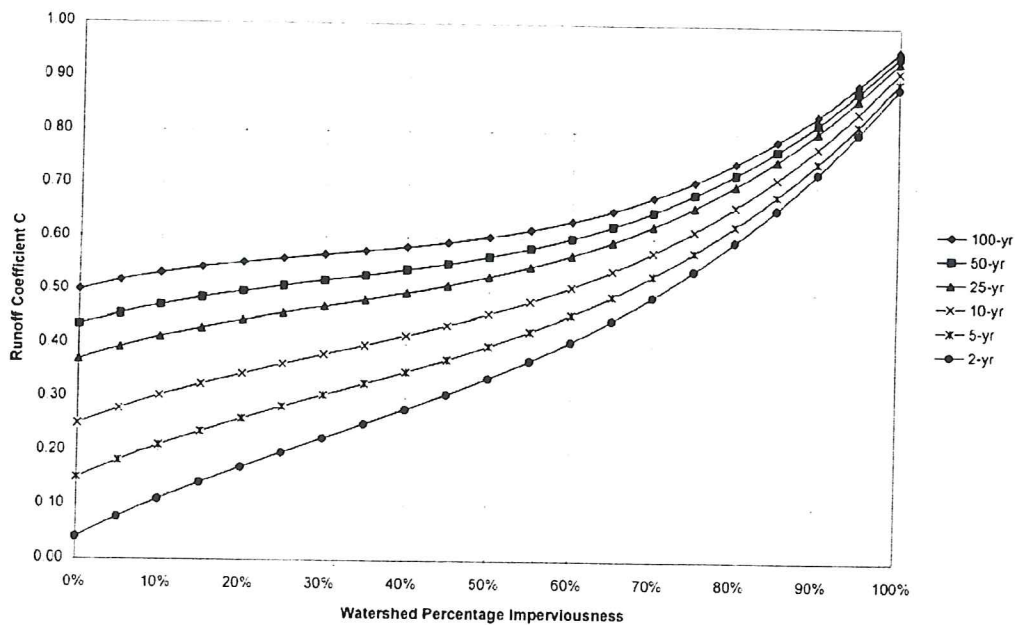


Figure RO-8—Runoff Coefficient,  $C$ , vs. Watershed Percentage Imperviousness NRCS Hydrologic Soil Groups C and D



# GEOS Neighborhood

## Provided Detention Pond Volume Summaries

Detention pond 100-yr volume with .5 * WQCV

1/23/2008

By: TJN

### Northcentral Pond (Pond A)

Total Pond Volume required = 0.31 acre feet

100-year Volume needed from detention pond sizing summary = 0.27 acre feet

10-year Volume needed from detention pond sizing summary = 0.16 acre feet

WQCV Volume needed = 0.07 acre feet

Elevation	Area	Volume	Cumulative volume		100-YEAR WSE
			CF	AF	
5551.2	15.3		0	0	5555.95
		36.792			
5551.5	229.98		36.792	0.00	10-YEAR WSE
		72.0765			
5551.8	250.53		108.8685	0.00	5554.70
		88.7025			
5552.1	340.82		197.571	0.00	WQCV WSE
		166.737			
5552.4	770.76		364.308	0.01	5553.68
		320.6145			
5552.7	1366.67		684.9225	0.02	
		509.7045			
5553	2031.36		1194.627	0.03	
		708.993			
5553.3	2695.26		1903.62	0.04	
		892.3095			
5553.6	3253.47		2795.93	0.06	
		1008.87			
5553.9	3472.33		3804.799	0.09	
		1090.299			
5554.2	3796.33		4895.098	0.11	
		1205.64			
5554.5	4241.27		6100.739	0.14	
		1305.359			
5554.8	4461.12		7406.097	0.17	
		1369.334			
5555.1	4667.77		8775.431	0.20	
		1428.037			
5555.4	4852.48		10203.47	0.23	
		1537.13			
5555.7	5395.05		11740.6	0.27	
		2074.541			

5556	8435.22	13815.14	0.32
	2596.167		
5556.3	8872.56	16411.31	0.38
	1775.834		
5556.5	8885.78	18187.14	0.42

#### Northeast Pond (Pond B)

Total Pond Volume required = 0.20 acre feet

100-year Volume needed from detention pond sizing summary = 0.18 acre feet

10-year Volume needed from detention pond sizing summary = 0.10 acre feet

WQCV Volume needed = 0.04 acre feet

Elevation	Area	Volume	Cumulative volume		100-YEAR WSE
			CF	AF	
5545.5	0		0	0	5550.34
		41.13			
5545.8	274.2		41.13	0.00	10-YEAR WSE
		102.009			
5546.1	405.86		143.139	0.00	5549.02
		122.0535			
5546.4	407.83		265.1925	0.01	WQCV WSE
		122.664			
5546.7	409.93		387.8565	0.01	5547.80
		179.565			
5547	787.17		567.4215	0.01	
		346.3395			
5547.3	1521.76		913.761	0.02	
		484.284			
5547.6	1706.8		1398.045	0.03	
		514.8075			
5547.9	1725.25		1912.852	0.04	
		519.6795			
5548.2	1739.28		2432.532	0.06	
		569.208			
5548.5	2055.44		3001.74	0.07	
		729.6075			
5548.8	2808.61		3731.348	0.09	
		864.996			
5549.1	2958.03		4596.344	0.11	
		889.3905			
5549.4	2971.24		5485.734	0.13	
		896.313			
5549.7	3004.18		6382.047	0.15	
		994.893			
5550	3628.44		7376.94	0.17	
		1154.27			

5550.3	4066.69	8531.21	0.20
	1233.195		
5550.6	4154.61	9764.405	0.22
	1295.176		
5550.9	4479.9	11059.58	0.25
	1388.978		
5551.2	4779.95	12448.56	0.29
	1505.745		
5551.5	5258.35	13954.3	0.32
	1563.833		
5551.8	5167.2	15518.14	0.36
	1504.646		
5552.1	4863.77	17022.78	0.39
	1385.856		
5552.4	4375.27	18408.64	0.42
	1259.898		
5552.7	4024.05	19668.54	0.45
	1197.846		
5553	3961.59	20866.38	0.48
	1223.342		
5553.3	4194.02	22089.72	0.51
	1326.954		
5553.6	4652.34	23416.68	0.54
	1472.406		
5553.9	5163.7	24889.08	0.57
	1655.015		
5554.2	5869.73	26544.1	0.61

#### Pond C

Total Pond Volume required = 0.20 acre feet

100-year Volume needed from detention pond sizing summary = 0.16 acre feet

10-year Volume needed from detention pond sizing summary = 0.08 acre feet

WQCV Volume needed = 0.03 acre feet

Provided 0.00 ac-ft  
Need to make up 0.20 ac-ft  
Detention Pond F will  
Overdetain 0.20 ac-ft above  
the required volume for  
Pond F

#### South Central Green (Pond D)

Total Pond Volume required = 0.24 acre feet

100-year Volume needed from detention pond sizing summary = 0.21 acre feet

10-year Volume needed from detention pond sizing summary = 0.12 acre feet



WQCV Volume needed = 0.05 acre feet

Elevation	Area	Volume	Cumulative volume		100-YEAR WSE
			CF	AF	
5552.7	141.8		0	0	5556.44
		239.6055			
5553	242.78		239.6055	0.01	10-YEAR WSE
		73.11			
5553.3	244.59		312.71	0.01	5555.54
		73.64			
5553.6	246.37		386.36	0.01	WQCV WSE
		93.30			
5553.9	375.62		479.65	0.01	5554.83
		234.64			
5554.2	1188.65		714.29	0.02	
		540.58			
5554.5	2415.23		1254.88	0.03	
		846.81			
5554.8	3230.16		2101.68	0.05	
		1083.46			
5555.1	3992.9		3185.14	0.07	
		1339.30			
5555.4	4935.79		4524.45	0.10	
		1550.51			
5555.7	5400.96		6074.96	0.14	
		1712.05			
5556	6012.7		7787.01	0.18	
		1823.73			
5556.3	6145.51		9610.74	0.22	
		1864.45			
5556.6	6284.16		11475.19	0.26	
		1897.98			
5556.9	6369.02		13373.17	0.31	
		1925.14			
5557.2	6465.26		15298.31	0.35	
		1955.35			
5557.5	6570.38		17253.66	0.40	
		1989.66			
5557.8	6694.02		19243.32	0.44	
		2501.15			
5558.1	9980.33		21744.47	0.50	

Pond Southeast (Pond E)

Total Pond Volume required = 0.26 acre feet

100-year Volume needed from detention pond sizing summary = 0.23 acre feet

10-year Volume needed from detention pond sizing summary = 0.13 acre feet

WQCV Volume needed = 0.06 acre feet

Elevation	Area	Volume	Cumulative volume	
			CF	AF
5550.90	31.10		0.00	0.00
		40.26		
5551.20	237.30		40.26	0.00
		71.33		
5551.50	238.22		111.59	0.00
		71.60		
5551.80	239.12		183.19	0.00
		81.68		
5552.10	305.43		264.87	0.01
		106.20		
5552.40	402.54		371.07	0.01
		173.65		
5552.70	755.13		544.72	0.01
		255.60		
5553.00	948.90		800.32	0.02
		308.06		
5553.30	1104.86		1108.39	0.03
		332.09		
5553.60	1109.08		1440.48	0.03
		334.51		
5553.90	1121.02		1774.99	0.04
		276.09		
5554.20	719.57		2051.08	0.05
		206.87		
5554.50	659.58		2257.95	0.05
		180.63		
5554.80	544.63		2438.58	0.06

Need to make up 0.20 ac-ft ✓  
 Detention Pond F will  
 Overdetain 0.20 ac-ft above  
 the required volume for  
 Pond F

#### Central Square (Pond F)

Overdetain for Basin C = 0.20 ac-ft

Overdetain for Basin E = 0.20 ac-ft

Total Pond Volume required = 0.15 + 0.20 + 0.20 = 0.55 acre feet

100-year Volume needed from detention pond sizing summary = 0.13 acre feet

Overdetain for Basin C = 0.08 ac-ft

Overdetain for Basin E = 0.12 ac-ft

10-year Volume needed from detention pond sizing summary = 0.08 acre feet

10-year Volume = 0.08 + 0.08 + 0.12 = 0.28 ac-ft

Overdetain for Basin C = 0.03 ac-ft

Overdetain for Basin E = 0.06 ac-ft

WQCV Volume needed = 0.03 acre feet

WQCV Volume = 0.03 + 0.03 + 0.06 = 0.12 ac-ft

Elevation	Area	Volume	Cumulative volume		100-YEAR WSE
			CF	AF	
5552.1	337.34		0	0	5557.85
		103.356			
5552.4	351.7		103.356	0.00	10-YEAR WSE
		108.618			
5552.7	372.42		211.974	0.00	5556.58
		119.9325			
5553	427.13		331.9065	0.01	WQCV WSE
		135.909			
5553.3	478.93		467.8155	0.01	5555.56
		184.629			
5553.6	751.93		652.4445	0.01	
		283.752			
5553.9	1139.75		936.1965	0.02	
		399.4635			
5554.2	1523.34		1335.66	0.03	
		493.3995			
5554.5	1765.99		1829.059	0.04	
		639.078			
5554.8	2494.53		2468.138	0.06	
		878.697			
5555.1	3363.45		3346.835	0.08	
		1145.313			
5555.4	4271.97		4492.147	0.10	
		1419.999			
5555.7	5194.69		5912.146	0.14	
		1813.476			
5556	6895.15		7725.623	0.18	
		2208.146			
5556.3	7825.82		9933.768	0.23	
		2434.478			
5556.6	8404.03		12368.25	0.28	
		2576.841			
5556.9	8774.91		14945.09	0.34	
		2700.365			
5557.2	9227.52		17645.45	0.41	
		2823.584			
5557.5	9596.37		20469.03	0.47	
		2976.006			
5557.8	10243.67		23445.04	0.54	
		3084.41			
5558.1	10319.06		26529.45	0.61	
		3109.732			
5558.4	10412.49		29639.18	0.68	
		3211.808			
5558.7	10999.56		32850.99	0.75	

Pond Eastsquare (Pond G)

Total Pond Volume required = 0.12 acre feet



100-year Volume needed from detention pond sizing summary = 0.10 acre feet

10-year Volume needed from detention pond sizing summary = 0.06 acre feet

WQCV Volume needed = 0.03 acre feet

Elevation	Area	Volume	Cumulative volume		100-YEAR WSE
			CF	AF	
5549.10	13.56		0.00	0.00	5551.97
		16.73			
5549.40	97.97		16.73	0.00	10-YEAR WSE
		45.45			
5549.70	205.01		62.18	0.00	5551.41
		84.70			
5550.00	359.65		146.88	0.00	WQCV WSE
		151.07			
5550.30	647.48		297.95	0.01	5551.01
		255.96			
5550.60	1058.90		553.90	0.01	
		461.79			
5550.90	2019.72		1015.69	0.02	
		783.26			
5551.20	3202.02		1798.96	0.04	
		1153.20			
5551.50	4486.01		2952.16	0.07	
		1416.44			
5551.80	4956.90		4368.60	0.10	
		1534.25			
5552.10	5271.43		5902.85	0.14	
		1602.38			
5552.40	5411.13		7505.23	0.17	
		1645.17			
5552.70	5556.65		9150.40	0.21	
		1699.16			
5553.00	5771.06		10849.55	0.25	
		1746.28			
5553.30	5870.78		12595.83	0.29	
		1108.65			
5553.60	1520.23		13704.48	0.31	
		283.92			
5553.90	372.60		13988.41	0.32	

Entry Green (Pond H)

Total Pond Volume required = 0.08 acre feet

100-year Volume needed from detention pond sizing summary = 0.07 acre feet

10-year Volume needed from detention pond sizing summary = 0.05 acre feet

WQCV Volume needed = 0.02 acre feet

Elevation	Area	Volume	Cumulative volume		100-YEAR WSE
			CF	AF	
5546.4	19.14		0	0	5549.03
		53.226			
5546.7	335.7		53.226	0.00	10-YEAR WSE
		127.2645			
5547	512.73		180.4905	0.00	5548.48
		190.5465			
5547.3	757.58		371.037	0.01	WQCV WSE
		282.195			
5547.6	1123.72		653.232	0.01	5547.76
		419.9325			
5547.9	1675.83		1073.164	0.02	
		542.2815			
5548.2	1939.38		1615.446	0.04	
		608.904			
5548.5	2119.98		2224.35	0.05	
		652.4385			
5548.8	2229.61		2876.789	0.07	
		788.229			
5549.1	3025.25		3665.018	0.08	
		927.9255			
5549.4	3160.92		4592.943	0.11	
		962.3205			
5549.7	3254.55		5555.263	0.13	

#### Pond I

Total Pond Volume required = 0.07 acre feet

100-year Volume needed from detention pond sizing summary = 0.06 acre feet

10-year Volume needed from detention pond sizing summary = 0.03 acre feet

WQCV Volume needed = 0.01 acre feet

Pond I to be designed by site developer to meet the above required volumes.

#### Pond J

Total Pond Volume required = 0.11 acre feet

100-year Volume needed from detention pond sizing summary = 0.10 acre feet

10-year Volume needed from detention pond sizing summary = 0.05 acre feet

WQCV Volume needed = 0.01 acre feet

Pond J to be designed by site developer to meet the above required volumes.

## GEOS Neighborhood

### Allowable Release Rates

7/26/2007

By: TJN

Allowable release rates from the detention ponds is based on UDFCD Table SO-1.

For type C soils the allowable release rate is 1.0 cfs per acre for the 100-year event.

For type C soils the allowable release rate is 0.3 cfs per acre for the 10-year event.

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#### Pond A - 3.59 acres

100-year event --  $1.0 \text{ cfs per acre} \times 3.59 \text{ acres} = 3.59 \text{ cfs}$

10-year event --  $0.3 \text{ cfs per acre} \times 3.59 \text{ acres} = 1.07 \text{ cfs}$

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#### Pond B - 2.35 acres

100-year event --  $1.0 \text{ cfs per acre} \times 2.35 \text{ acres} = 2.35 \text{ cfs}$

10-year event --  $0.3 \text{ cfs per acre} \times 2.35 \text{ acres} = 0.70 \text{ cfs}$

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#### Pond C - 2.07 acres

100-year event --  $1.0 \text{ cfs per acre} \times 2.07 \text{ acres} = 2.07 \text{ cfs}$

10-year event --  $0.3 \text{ cfs per acre} \times 2.07 \text{ acres} = 0.62 \text{ cfs}$

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#### Pond D - 2.75 acres

100-year event --  $1.0 \text{ cfs per acre} \times 2.75 \text{ acres} = 2.75 \text{ cfs}$

10-year event --  $0.3 \text{ cfs per acre} \times 2.75 \text{ acres} = 0.82 \text{ cfs}$

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#### Pond E - 3.00 acres

100-year event --  $1.0 \text{ cfs per acre} \times 3.00 \text{ acres} = 3.00 \text{ cfs}$

10-year event --  $0.3 \text{ cfs per acre} \times 3.00 \text{ acres} = 0.90 \text{ cfs}$

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#### Pond F - 1.86 acres

100-year event --  $1.0 \text{ cfs per acre} \times 1.86 \text{ acres} = 1.86 \text{ cfs}$

10-year event --  $0.3 \text{ cfs per acre} \times 1.86 \text{ acres} = 0.56 \text{ cfs}$

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#### Pond G - 1.28 acres

100-year event --  $1.0 \text{ cfs per acre} \times 1.28 \text{ acres} = 1.28 \text{ cfs}$

10-year event --  $0.3 \text{ cfs per acre} \times 1.28 \text{ acres} = 0.38 \text{ cfs}$



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Pond H - 0.91 acres

100-year event --  $1.0 \text{ cfs per acre} * 0.91 \text{ acres} = 0.91 \text{ cfs}$

10-year event --  $0.3 \text{ cfs per acre} * 0.91 \text{ acres} = 0.27 \text{ cfs}$

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Pond I - 0.84 acres

100-year event --  $1.0 \text{ cfs per acre} * 0.84 \text{ acres} = 0.84 \text{ cfs}$

10-year event --  $0.3 \text{ cfs per acre} * 0.84 \text{ acres} = 0.25 \text{ cfs}$

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Pond J - 1.40 acres

100-year event --  $1.0 \text{ cfs per acre} * 1.40 \text{ acres} = 1.40 \text{ cfs}$

10-year event --  $0.3 \text{ cfs per acre} * 1.40 \text{ acres} = 0.42 \text{ cfs}$

## SIZING OUTLET STRUCTURES

Project: Geos Neighborhood  
 Job # 05-056-01  
 Date 1/24/2008  
 By: TJN

### Pond A Outlet Design

100-Year Allowable Release Rate 3.59 cfs  
 10-year Allowable Release Rate 1.07 cfs

Orifice Equation  
 $Q = C_o A_o (2gH)^{0.5}$

Q= orifice flow rate (cfs)  
 C_o= discharge coefficient (0.40 - 0.60) use 0.60  
 A= Area of orifice (ft²)  
 H_o= effective head on orifice measured from centroid of the opening (ft)

Orifice Invert= 5551.20  
 100-year WSE= 5555.95  
 Orifice diameter (ft)= 0.67

Q=	3.57 cfs		
C _o =	0.60	Diameter	Diameter
A=	0.35 ft ²	0.67 ft	8.04 in
H _o =	4.42 ft		

Weir Equation 10-year  
 $Q = C_{bcw} L H^{1.5}$

Q=Discharge (cfs)  
 C_{bcw}=broad-crested weir coefficient (2.38 to 3.32)  
 L=broad-crested weir length (ft)  
 H=head above weir crest (ft)

Weir Invert= 5553.68  
 10-year WSE= 5554.70  
 Weir Length (ft)= 0.35 ft

Q= 1.09 cfs  
 C_{bcw}= 3  
 L= 0.35 ft  
 H= 1.02 ft

Weir Equation 100-year  
 $Q = C_{bcw} L H^{1.5}$

Q=Discharge (cfs)  
 C_{bcw}=broad-crested weir coefficient (2.38 to 3.32)  
 L=broad-crested weir length (ft)  
 H=head above weir crest (ft)

Weir Invert= 5554.70  
 100-year WSE= 5555.95  
 Weir Length (ft)= 12.00 ft

Q= 50.61 cfs  
 C_{bcw}= 3  
 L= 12.00 ft  
 H= 1.25 ft

### Pond B Outlet Design

100-Year Allowable Release Rate 2.35 cfs  
 10-year Allowable Release Rate 0.7 cfs

Orifice Equation  
 $Q = C_o A_o (2gH)^{.5}$

Q= orifice flow rate (cfs)  
C_o= discharge coefficient (0.40 - 0.60) use 0.60  
A= Area of orifice (ft²)  
H_o= effective head on orifice measured from centroid of the opening (ft)

Orifice Invert= 5545.50  
100-year WSE= 5550.34  
Orifice diameter (ft)= 0.54

Q=	2.36 cfs		
C _o =	0.60	Diameter	Diameter
A=	0.23 ft ²	0.54 ft	6.48 in
H _o =	4.57 ft		

Weir Equation 10-year  
 $Q = C_{bcw} L H^{1.5}$

Q=Discharge (cfs)  
C_{bcw}=broad-crested weir coefficient (2.38 to 3.32)  
L=broad-crested weir length (ft)  
H=head above weir crest (ft)

Weir Invert= 5547.80  
10-year WSE= 5549.02  
Weir Length (ft)= 0.17 ft

Q= 0.68 cfs  
C_{bcw}= 3  
L= 0.17 ft  
H= 1.22 ft

Weir Equation 100-year  
 $Q = C_{bcw} L H^{1.5}$

Q=Discharge (cfs)  
C_{bcw}=broad-crested weir coefficient (2.38 to 3.32)  
L=broad-crested weir length (ft)  
H=head above weir crest (ft)

Weir Invert= 5549.02  
100-year WSE= 5550.34  
Weir Length (ft)= 12.00 ft

Q= 54.84 cfs  
C_{bcw}= 3  
L= 12.00 ft  
H= 1.32 ft

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#### Pond C Outlet Design

No outlet structure

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#### Pond D Outlet Design

100-Year Allowable Release Rate 2.75 cfs  
10-year Allowable Release Rate 0.82 cfs

Orifice Equation  
 $Q = C_o A_o (2gH)^{.5}$

Q= orifice flow rate (cfs)  
C_o= discharge coefficient (0.40 - 0.60) use 0.60



A= Area of orifice (ft²)

Ho= effective head on orifice measured from centroid of the opening (ft)

Orifice Invert= 5552.70

100-year WSE= 5556.44

Orifice diameter (ft)= 0.63

Q= 2.78 cfs

Co= 0.60

A= 0.31 ft²

Ho= 3.42 ft

Diameter

0.63 ft

Diameter

7.56 in

Weir Equation 10-year

$Q=CbcwLH^{1.5}$

Weir Equation 100-year

$Q=CbcwLH^{1.5}$

Q=Discharge (cfs)

Cbcw=broad-crested weir coefficient (2.38 to 3.32)

L=broad-crested weir length (ft)

H=head above weir crest (ft)

Q=Discharge (cfs)

Cbcw=broad-crested weir coefficient (2.38 to 3.32)

L=broad-crested weir length (ft)

H=head above weir crest (ft)

Weir Invert= 5554.83

10-year WSE= 5555.54

Weir Length (ft)= 0.45 ft

Weir Invert= 5555.54

100-year WSE= 5556.44

Weir Length (ft)= 12.00 ft

Q= 0.81 cfs

Cbcw= 3

L= 0.45 ft

H= 0.71 ft

Q= 30.74 cfs

Cbcw= 3

L= 12.00 ft

H= 0.90 ft

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#### Pond E Outlet Design

100-Year Allowable Release Rate 3.0 cfs

10-year Allowable Release Rate cfs

Orifice Equation

$Q=CoAo(2gH)^{.5}$

Q= orifice flow rate (cfs)

Co= discharge coefficient (0.40 - 0.60) use 0.60

A= Area of orifice (ft²)

Ho= effective head on orifice measured from centroid of the opening (ft)

Orifice Invert= 5550.9

100-year WSE= 5554.8

Orifice diameter (ft)= 0.65

Q= 3.02 cfs

Co= 0.60

A= 0.33 ft²

Ho= 3.58 ft

Diameter

0.65 ft

Diameter

7.8 in

Weir Equation 10-year  
 $Q = CbcwLH^{1.5}$

Q=Discharge (cfs)  
Cbcw=broad-crested weir coefficient (2.38 to 3.32)  
L=broad-crested weir length (ft)  
H=head above weir crest (ft)

Weir Invert= Not provided  
10-year WSE= Not provided  
Weir Length (ft)= Not provided

Weir Equation 100-year  
 $Q = CbcwLH^{1.5}$

Q=Discharge (cfs)  
Cbcw=broad-crested weir coefficient (2.38 to 3.32)  
L=broad-crested weir length (ft)  
H=head above weir crest (ft)

Weir Invert= 5554.25  
100-year WSE= 5554.80  
Weir Length (ft)= 12.00 ft

Q= cfs  
Cbcw=  
L= ft  
H= ft

Q= 14.68 cfs  
Cbcw= 3  
L= 12.00 ft  
H= 0.55 ft

---

#### Pond F Outlet Design

100-Year Allowable Release Rate 1.86 cfs  
10-year Allowable Release Rate 0.56 cfs

Orifice Equation  
 $Q = CoAo(2gH)^{.5}$

Q= orifice flow rate (cfs)  
Co= discharge coefficient (0.40 - 0.60) use 0.60  
A= Area of orifice (ft²)  
Ho= effective head on orifice measured from centroid of the opening (ft)

Orifice Invert= 5552.10  
100-year WSE= 5557.85  
Orifice diameter (ft)= 0.52

Q=	2.39 cfs		
Co=	0.60	Diameter	Diameter
A=	0.21 ft ²	0.52 ft	6.24 in
Ho=	5.49 ft		

Weir Equation 10-year  
 $Q = CbcwLH^{1.5}$

Q=Discharge (cfs)  
Cbcw=broad-crested weir coefficient (2.38 to 3.32)  
L=broad-crested weir length (ft)  
H=head above weir crest (ft)

Weir Invert= 5554.18  
10-year WSE= 5556.58

Weir Equation 100-year  
 $Q = CbcwLH^{1.5}$

Q=Discharge (cfs)  
Cbcw=broad-crested weir coefficient (2.38 to 3.32)  
L=broad-crested weir length (ft)  
H=head above weir crest (ft)

Weir Invert= 5556.58  
100-year WSE= 5557.85

Weir Length (ft)= 0.20 ft

Weir Length (ft)= 12.00 ft

Q= 0.57 cfs  
Cbcw= 3  
L= 0.20 ft  
H= 0.97 ft

Q= 8.07 cfs  
Cbcw= 3  
L= 12.00 ft  
H= 0.37 ft

---

#### Pond G Outlet Design

100-Year Allowable Release Rate 1.28 cfs  
10-year Allowable Release Rate 0.38 cfs

#### Orifice Equation

$$Q = C_o A_o (2gH)^{0.5}$$

Q= orifice flow rate (cfs)

C_o= discharge coefficient (0.40 - 0.60) use 0.60

A= Area of orifice (ft²)

H_o= effective head on orifice measured from centroid of the opening (ft)

Orifice Invert= 5549.1  
100-year WSE= 5551.97  
Orifice diameter (ft)= 0.45

Q=	1.24 cfs		
C _o =	0.60	Diameter	Diameter
A=	0.16 ft ²	0.45 ft	5.4 in
H _o =	2.64 ft		

#### Weir Equation 10-year

$$Q = C_{bcw} L H^{1.5}$$

Q=Discharge (cfs)

C_{bcw}=broad-crested weir coefficient (2.38 to 3.32)

L=broad-crested weir length (ft)

H=head above weir crest (ft)

Weir Invert= 5551.01  
10-year WSE= 5551.41  
Weir Length (ft)= 0.50 ft

#### Weir Equation 100-year

$$Q = C_{bcw} L H^{1.5}$$

Q=Discharge (cfs)

C_{bcw}=broad-crested weir coefficient (2.38 to 3.32)

L=broad-crested weir length (ft)

H=head above weir crest (ft)

Weir Invert= 5551.60  
100-year WSE= 5551.97  
Weir Length (ft)= 12.00 ft

Q= 0.38 cfs  
Cbcw= 3  
L= 0.50 ft  
H= 0.40 ft

Q= 8.03 cfs  
Cbcw= 3  
L= 12.00 ft  
H= 0.37 ft

---

#### Pond H Outlet Design

100-Year Allowable Release Rate 0.91 cfs



10-year Allowable Release Rate                      0.27 cfs

Orifice Equation  
 $Q = C_o A_o (2gH)^{.5}$

Q= orifice flow rate (cfs)  
C_o= discharge coefficient (0.40 - 0.60) use 0.60  
A= Area of orifice (ft²)  
H_o= effective head on orifice measured from centroid of the opening (ft)

Orifice Invert=                      5546.40  
100-year WSE=                      5549.03  
Orifice diameter (ft)=                      0.39

Q=	0.90 cfs		
C _o =	0.60	Diameter	Diameter
A=	0.12 ft ²	0.39 ft	4.68 in
H _o =	2.44 ft		

Weir Equation 10-year	Weir Equation 100-year
$Q = C_{bcw} L H^{1.5}$	$Q = C_{bcw} L H^{1.5}$

Q=Discharge (cfs)	Q=Discharge (cfs)
C _{bcw} =broad-crested weir coefficient (2.38 to 3.32)	C _{bcw} =broad-crested weir coefficient (2.38 to 3.32)
L=broad-crested weir length (ft)	L=broad-crested weir length (ft)
H=head above weir crest (ft)	H=head above weir crest (ft)

Weir Invert=                      5547.76  
10-year WSE=                      5548.48  
Weir Length (ft)=                      0.15 ft

Weir Invert=                      5548.48  
100-year WSE=                      5549.03  
Weir Length (ft)=                      12.00 ft

Q=                      0.27 cfs  
C_{bcw}=                      3  
L=                      0.15 ft  
H=                      0.72 ft

Q=                      14.68 cfs  
C_{bcw}=                      3  
L=                      12.00 ft  
H=                      0.55 ft

---

#### Pond I Outlet Design

100-Year Allowable Release Rate                      0.84 cfs  
10-year Allowable Release Rate                      0.25 cfs

Outlet structure to be designed by block developer

---

#### Pond J Outlet Design

100-Year Allowable Release Rate                      1.4 cfs  
10-year Allowable Release Rate                      0.42 cfs

Orifice Equation  
 $Q = C_o A_o (2gH)^{.5}$

Q= orifice flow rate (cfs)

$C_o$ = discharge coefficient (0.40 - 0.60) use 0.60

A= Area of orifice (ft²)

$H_o$ = effective head on orifice measured from centroid of the opening (ft)

Orifice Invert= 5558.1

100-year WSE= 5560.30

Orifice diameter (ft)= 0.52

Q= 1.43 cfs

$C_o$ = 0.60

A= 0.21 ft²

$H_o$ = 1.94 ft

Diameter

0.52 ft

Diameter

6.24 in

Weir Equation

$Q = C_{bcw} L H^{1.5}$

Q=Discharge (cfs)

$C_{bcw}$ =broad-crested weir coefficient (2.38 to 3.32)

L=broad-crested weir length (ft)

H=head above weir crest (ft)

Weir Invert= 5558.79

10-year WSE= 5559.52

Weir Length (ft)= 0.22 ft

Q= 0.41 cfs

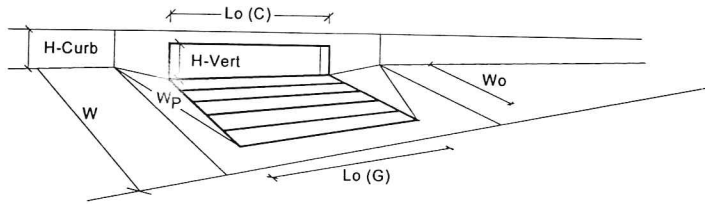
$C_{bcw}$ = 3

L= 0.22 ft

H= 0.73 ft

# INLET ON A CONTINUOUS GRADE

Project: _____  
 Inlet ID: _____  
 Geos Neighborhood  
 Design Point 7



## Design Information (Input)

Type of Inlet  
 Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')  
 Total Number of Units in the Inlet (Grate or Curb Opening)  
 Length of a Single Unit Inlet (Grate or Curb Opening)  
 Width of a Unit Grate (cannot be greater than W from Q-Allow)  
 Clogging Factor for a Single Unit Grate (typical min. value = 0.5)  
 Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)

	MINOR	MAJOR
Type =	CDOT Type R Curb Opening	
a _{LOCAL} =	2.0	2.0
No =	1	1
L _o =	15.00	15.00
W _o =	N/A	N/A
C _r -G =	N/A	N/A
C _r -C =	0.10	0.10

Street Hydraulics: OK - Q < maximum allowable from sheet 'Q-Allow'

## Design Discharge for Half of Street (from Sheet Q-Peak)

Water Spread Width  
 Water Depth at Flowline (outside of local depression)  
 Water Depth at Street Crown (or at T_{MAX})  
 Ratio of Gutter Flow to Design Flow  
 Discharge outside the Gutter Section W, carried in Section T_x  
 Discharge within the Gutter Section W  
 Discharge Behind the Curb Face  
 Street Flow Area  
 Street Flow Velocity  
 Water Depth for Design Condition

	MINOR	MAJOR
Q _o =	3.90	10.00
T =	9.4	14.5
d =	4.3	5.5
d _{CROWN} =	0.0	0.0
E _o =	0.844	0.436
Q _x =	1.39	5.65
Q _w =	2.51	4.37
Q _{BACK} =	0.00	0.00
A _s =	1.05	2.28
V _s =	3.73	4.42
d _{LOCAL} =	6.3	7.5

## Grate Analysis (Calculated)

Total Length of Inlet Grate Opening  
 Ratio of Grate Flow to Design Flow  
 Under No-Clogging Condition  
 Minimum Velocity Where Grate Spash-Over Begins  
 Interception Rate of Frontal Flow  
 Interception Rate of Side Flow  
 Interception Capacity  
 Under Clogging Condition  
 Clogging Coefficient for Multiple-unit Grate Inlet  
 Clogging Factor for Multiple-unit Grate Inlet  
 Effective (unclogged) Length of Multiple-unit Grate Inlet  
 Minimum Velocity Where Grate Spash-Over Begins  
 Interception Rate of Frontal Flow  
 Interception Rate of Side Flow  
 Actual Interception Capacity  
 Carry-Over Flow = Q_o-Q_s (to be applied to curb opening or next d/s inlet)

	MINOR	MAJOR
L =		
E _o -GRATE =		
	MINOR	MAJOR
V _o =		
R _f =		
R _s =		
Q _i =		
	MINOR	MAJOR
GrateCoef =		
GrateClog =		
L _s =		
V _o =		
R _f =		
R _s =		
Q _s =	N/A	N/A
Q _b =	N/A	N/A

## Curb or Slotted Inlet Opening Analysis (Calculated)

Equivalent Slope S_e (based on grate carry-over)  
 Required Length L_r to Have 100% Interception  
 Under No-Clogging Condition  
 Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_r)  
 Interception Capacity  
 Under Clogging Condition  
 Clogging Coefficient  
 Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet  
 Effective (Unclogged) Length  
 Actual Interception Capacity  
 Carry-Over Flow = Q_o(GRATE)-Q_s

	MINOR	MAJOR
S _e =	0.1273	0.0927
L _r =	12.90	23.18
	MINOR	MAJOR
L =	12.89	15.00
Q _i =	3.90	8.47
	MINOR	MAJOR
CurbCoef =	1.00	1.00
CurbClog =	0.10	0.10
L _s =	12.89	13.50
Q _s =	3.90	7.92
Q _b =	0.00	2.08

## Summary

Total Inlet Interception Capacity  
 Total Inlet Carry-Over Flow (flow bypassing inlet)  
 Capture Percentage = Q_s/Q_o =

	MINOR	MAJOR
Q =	3.90	7.92
Q _b =	0.00	2.08
C% =	100.0	79.2



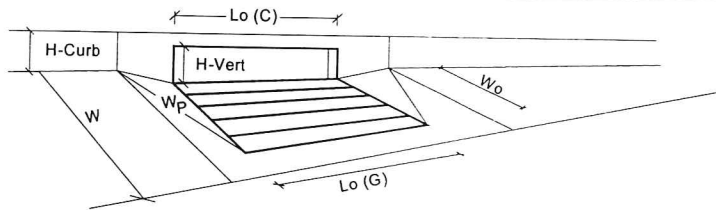
# INLET IN A SUMP OR SAG LOCATION

Project =

Geos Neighborhood

Inlet ID =

Design Point 10



## Design Information (Input)

Type of Inlet

Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')

Number of Unit Inlets (Grate or Curb Opening)

### Grate Information

Length of a Unit Grate

Width of a Unit Grate

Area Opening Ratio for a Grate (typical values 0.15-0.90)

Clogging Factor for a Single Grate (typical value 0.50 - 0.70)

Grate Weir Coefficient (typical value 3.00)

Grate Orifice Coefficient (typical value 0.67)

### Curb Opening Information

Length of a Unit Curb Opening

Height of Vertical Curb Opening in Inches

Height of Curb Orifice Throat in Inches

Angle of Throat (see USDCM Figure ST-5)

Side Width for Depression Pan (typically the gutter width of 2 feet)

Clogging Factor for a Single Curb Opening (typical value 0.10)

Curb Opening Weir Coefficient (typical value 2.30-3.00)

Curb Opening Orifice Coefficient (typical value 0.67)

	MINOR	MAJOR
Type =	CDOT Type R Curb Opening	
$a_{local}$ =	2.00	2.00
No =	1	1

	MINOR	MAJOR
$L_o (G)$ =	N/A	N/A
$W_o$ =	N/A	N/A
$A_{ratio}$ =	N/A	N/A
$C_l (G)$ =	N/A	N/A
$C_w (G)$ =	N/A	N/A
$C_o (G)$ =	N/A	N/A

	MINOR	MAJOR
$L_o (C)$ =	5.00	5.00
$H_{vert}$ =	5.00	5.00
$H_{throat}$ =	4.95	4.95
Theta =	63.4	63.4
$W_p$ =	2.00	2.00
$C_l (C)$ =	0.10	0.10
$C_w (C)$ =	2.30	2.30
$C_o (C)$ =	0.67	0.67

## Resulting Gutter Flow Depth for Grate Inlet Capacity in a Sump

Clogging Coefficient for Multiple Units

Clogging Factor for Multiple Units

### Grate as a Weir

Flow Depth at Local Depression without Clogging (0 cfs grate, 0.4 cfs curb)

This Row Used for Combination Inlets Only

Flow Depth at Local Depression with Clogging (0 cfs grate, 0.4 cfs curb)

This Row Used for Combination Inlets Only

### Grate as an Orifice

Flow Depth at Local Depression without Clogging (0 cfs grate, 0.4 cfs curb)

Flow Depth at Local Depression with Clogging (0 cfs grate, 0.4 cfs curb)

## Resulting Gutter Flow Depth Outside of Local Depression

	MINOR	MAJOR
Coef =	N/A	N/A
Clog =	N/A	N/A
$d_{wt}$ =	N/A	N/A
$d_{curb-un}$ =	N/A	N/A
$d_{wa}$ =	N/A	N/A
$d_{curb-cl}$ =	N/A	N/A
	MINOR	MAJOR
$d_{oi}$ =	N/A	N/A
$d_{oa}$ =	N/A	N/A
$d_{a-Grate}$ =	N/A	N/A

## Resulting Gutter Flow Depth for Curb Opening Inlet Capacity in a Sump

Clogging Coefficient for Multiple Units

Clogging Factor for Multiple Units

### Curb as a Weir, Grate as an Orifice

Flow Depth at Local Depression without Clogging (0 cfs grate, 0.4 cfs curb)

Flow Depth at Local Depression with Clogging (0 cfs grate, 0.4 cfs curb)

### Curb as an Orifice, Grate as an Orifice

Flow Depth at Local Depression without Clogging (0 cfs grate, 0.4 cfs curb)

Flow Depth at Local Depression with Clogging (0 cfs grate, 0.4 cfs curb)

## Resulting Gutter Flow Depth Outside of Local Depression

	MINOR	MAJOR
Coef =	1.00	1.00
Clog =	0.10	0.10
	MINOR	MAJOR
$d_{wt}$ =	0.89	1.53
$d_{wa}$ =	0.93	1.59
	MINOR	MAJOR
$d_{oi}$ =	2.23	2.29
$d_{oa}$ =	2.23	2.31
$d_{a-Curb}$ =	0.23	0.31

## Resultant Street Conditions

Total Inlet Length

Total Inlet Interception Capacity (Design Discharge from Q-Peak)

Resultant Gutter Flow Depth (based on sheet Q-Allow geometry)

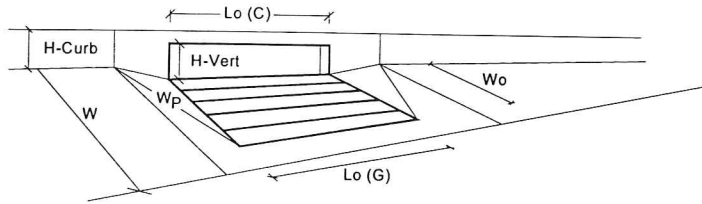
Resultant Street Flow Spread (based on sheet Q-Allow geometry)

Resultant Flow Depth at Street Crown

	MINOR	MAJOR
L =	5.0	5.0
$Q_a$ =	0.4	0.8
d =	0.23	0.31
T =	0.2	0.3
$d_{crown}$ =	0.00	0.00

# INLET ON A CONTINUOUS GRADE

Project: Geos Neighborhood  
Inlet ID: Design Point 16



## Design Information (Input)

Type of Inlet  
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')  
Total Number of Units in the Inlet (Grate or Curb Opening)  
Length of a Single Unit Inlet (Grate or Curb Opening)  
Width of a Unit Grate (cannot be greater than W from Q-Allow)  
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)  
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)

	MINOR	MAJOR
Type =	CDOT Type R Curb Opening	
$a_{LOCAL}$ =	2.0	2.0 inches
No =	1	1
$L_o$ =	10.00	10.00 ft
$W_o$ =	N/A	N/A ft
$C_rG$ =	N/A	N/A
$C_rC$ =	0.10	0.10

Street Hydraulics: OK - Q < maximum allowable from sheet 'Q-Allow'

## Design Discharge for Half of Street (from Sheet Q-Peak)

Water Spread Width  
Water Depth at Flowline (outside of local depression)  
Water Depth at Street Crown (or at  $T_{MAX}$ )  
Ratio of Gutter Flow to Design Flow  
Discharge outside the Gutter Section W, carried in Section  $T_x$   
Discharge within the Gutter Section W  
Discharge Behind the Curb Face  
Street Flow Area  
Street Flow Velocity  
Water Depth for Design Condition

	MINOR	MAJOR
$Q_o$ =	0.80	2.20 cfs
T =	2.2	6.9 ft
d =	2.5	3.6 inches
$d_{CROWN}$ =	0.0	0.0 inches
$E_o$ =	1.000	0.785
$Q_x$ =	0.00	0.45 cfs
$Q_w$ =	0.80	1.75 cfs
$Q_{BACK}$ =	0.00	0.00 cfs
$A_s$ =	0.21	0.63 sq ft
$V_s$ =	3.76	3.47 fps
$d_{LOCAL}$ =	4.5	5.6 inches

## Grate Analysis (Calculated)

Total Length of Inlet Grate Opening  
Ratio of Grate Flow to Design Flow  
Under No-Clogging Condition  
Minimum Velocity Where Grate Spash-Over Begins  
Interception Rate of Frontal Flow  
Interception Rate of Side Flow  
Interception Capacity  
Under Clogging Condition  
Clogging Coefficient for Multiple-unit Grate Inlet  
Clogging Factor for Multiple-unit Grate Inlet  
Effective (unclogged) Length of Multiple-unit Grate Inlet  
Minimum Velocity Where Grate Spash-Over Begins  
Interception Rate of Frontal Flow  
Interception Rate of Side Flow  
Actual Interception Capacity  
Carry-Over Flow =  $Q_o - Q_s$  (to be applied to curb opening or next d/s inlet)

	MINOR	MAJOR
L =		ft
$E_{O-GRATE}$ =		
	MINOR	MAJOR
$V_o$ =		fps
$R_f$ =		
$R_s$ =		
$Q_i$ =		cfs
	MINOR	MAJOR
GrateCoef =		
GrateClog =		
$L_u$ =		ft
$V_o$ =		fps
$R_f$ =		
$R_s$ =		
$Q_s$ =	N/A	N/A cfs
$Q_b$ =	N/A	N/A cfs

## Curb or Slotted Inlet Opening Analysis (Calculated)

Equivalent Slope  $S_e$  (based on grate carry-over)  
Required Length  $L_T$  to Have 100% Interception  
Under No-Clogging Condition  
Effective Length of Curb Opening or Slotted Inlet (minimum of  $L$ ,  $L_T$ )  
Interception Capacity  
Under Clogging Condition  
Clogging Coefficient  
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet  
Effective (Unclogged) Length  
Actual Interception Capacity  
Carry-Over Flow =  $Q_{(GRATE)} - Q_s$

	MINOR	MAJOR
$S_e$ =	0.1867	0.1526 ft/ft
$L_T$ =	5.27	9.10 ft
	MINOR	MAJOR
L =	5.26	9.09 ft
$Q_i$ =	0.80	2.20 cfs
	MINOR	MAJOR
CurbCoef =	1.00	1.00
CurbClog =	0.10	0.10
$L_u$ =	5.26	9.00 ft
$Q_s$ =	0.80	2.20 cfs
$Q_b$ =	0.00	0.00 cfs

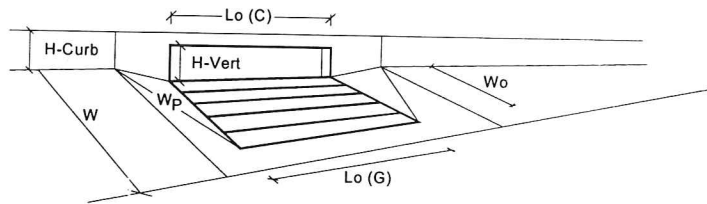
## Summary

Total Inlet Interception Capacity  
Total Inlet Carry-Over Flow (flow bypassing inlet)  
Capture Percentage =  $Q_s/Q_o$  =

	MINOR	MAJOR
$Q_i$ =	0.80	2.20 cfs
$Q_b$ =	0.00	0.00 cfs
C% =	100.0	100.0 %

# INLET ON A CONTINUOUS GRADE

Project: Geos Neighborhood  
Inlet ID: Design Point 18



## Design Information (Input)

Type of Inlet  
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')  
Total Number of Units in the Inlet (Grate or Curb Opening)  
Length of a Single Unit Inlet (Grate or Curb Opening)  
Width of a Unit Grate (cannot be greater than W from Q-Allow)  
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)  
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)

	MINOR	MAJOR
Type =	CDOT Type R Curb Opening	
a _{LOCAL} =	2.0	2.0
No =	1	1
L _o =	10.00	10.00
W _o =	N/A	N/A
C _{r-G} =	N/A	N/A
C _{r-C} =	0.10	0.10

Street Hydraulics: OK - Q < maximum allowable from sheet 'Q-Allow'

## Design Discharge for Half of Street (from Sheet Q-Peak)

Water Spread Width  
Water Depth at Flowline (outside of local depression)  
Water Depth at Street Crown (or at T_{MAX})  
Ratio of Gutter Flow to Design Flow  
Discharge outside the Gutter Section W, carried in Section T_x  
Discharge within the Gutter Section W  
Discharge Behind the Curb Face  
Street Flow Area  
Street Flow Velocity  
Water Depth for Design Condition

	MINOR	MAJOR
Q _o =	1.50	3.90
T =	6.3	10.6
d =	3.5	4.8
d _{CROWN} =	0.0	0.0
E _o =	0.830	0.581
Q _x =	0.26	1.64
Q _w =	1.24	2.27
Q _{BACK} =	0.00	0.00
A _s =	0.56	1.30
V _s =	2.68	3.01
d _{LOCAL} =	5.5	6.6

## Grate Analysis (Calculated)

Total Length of Inlet Grate Opening  
Ratio of Grate Flow to Design Flow  
Under No-Clogging Condition  
Minimum Velocity Where Grate Splash-Over Begins  
Interception Rate of Frontal Flow  
Interception Rate of Side Flow  
Interception Capacity  
Under Clogging Condition  
Clogging Coefficient for Multiple-unit Grate Inlet  
Clogging Factor for Multiple-unit Grate Inlet  
Effective (unclogged) Length of Multiple-unit Grate Inlet  
Minimum Velocity Where Grate Splash-Over Begins  
Interception Rate of Frontal Flow  
Interception Rate of Side Flow  
Actual Interception Capacity  
Carry-Over Flow = Q_o - Q_a (to be applied to curb opening or next d/s inlet)

	MINOR	MAJOR
L =		
E _{D-GRATE} =		
	MINOR	MAJOR
V _o =		
R _f =		
R _s =		
Q _i =		
	MINOR	MAJOR
GrateCoef =		
GrateClog =		
L _u =		
V _u =		
R _f =		
R _s =		
Q _a =	N/A	N/A
Q _b =	N/A	N/A

## Curb or Slotted Inlet Opening Analysis (Calculated)

Equivalent Slope S_e (based on grate carry-over)  
Required Length L₁ to Have 100% Interception  
Under No-Clogging Condition  
Effective Length of Curb Opening or Slotted Inlet (minimum of L₁, L₂)  
Interception Capacity  
Under Clogging Condition  
Clogging Coefficient  
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet  
Effective (Unclogged) Length  
Actual Interception Capacity  
Carry-Over Flow = Q_{b(Grate)} - Q_a

	MINOR	MAJOR
S _e =	0.1583	0.1168
L ₁ =	6.50	11.65
	MINOR	MAJOR
L =	6.49	10.00
Q _i =	1.50	3.78
	MINOR	MAJOR
CurbCoef =	1.00	1.00
CurbClog =	0.10	0.10
L _u =	6.49	9.00
Q _a =	1.50	3.63
Q _b =	0.00	0.27

## Summary

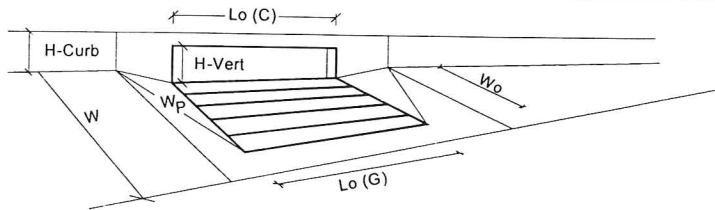
Total Inlet Interception Capacity  
Total Inlet Carry-Over Flow (flow bypassing Inlet)  
Capture Percentage = Q_a/Q_o =

	MINOR	MAJOR
Q =	1.50	3.63
Q _b =	0.00	0.27
C% =	100.0	93.0



# INLET IN A SUMP OR SAG LOCATION

Project = **Geos Neighborhood**  
Inlet ID = **Design Point 26**



## Design Information (Input)

Type of Inlet

Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')

Number of Unit Inlets (Grate or Curb Opening)

### Grate Information

Length of a Unit Grate

Width of a Unit Grate

Area Opening Ratio for a Grate (typical values 0.15-0.90)

Clogging Factor for a Single Grate (typical value 0.50 - 0.70)

Grate Weir Coefficient (typical value 3.00)

Grate Orifice Coefficient (typical value 0.67)

### Curb Opening Information

Length of a Unit Curb Opening

Height of Vertical Curb Opening in Inches

Height of Curb Orifice Throat in Inches

Angle of Throat (see USDCM Figure ST-5)

Side Width for Depression Pan (typically the gutter width of 2 feet)

Clogging Factor for a Single Curb Opening (typical value 0.10)

Curb Opening Weir Coefficient (typical value 2.30-3.00)

Curb Opening Orifice Coefficient (typical value 0.67)

	MINOR	MAJOR
Type =	CDOT Type R Curb Opening	
a _{local} =	2.00	2.00 inches
No =	1	1

	MINOR	MAJOR
L _o (G) =	N/A	N/A feet
W _o =	N/A	N/A feet
A _{ratio} =	N/A	N/A
C _i (G) =	N/A	N/A
C _w (G) =	N/A	N/A
C _o (G) =	N/A	N/A

	MINOR	MAJOR
L _o (C) =	5.00	5.00 feet
H _{vert} =	5.00	5.00 inches
H _{throat} =	4.95	4.95 inches
Theta =	63.4	63.4 degrees
W _p =	2.00	2.00 feet
C _i (C) =	0.10	0.10
C _w (C) =	2.30	2.30
C _o (C) =	0.67	0.67

## Resulting Gutter Flow Depth for Grate Inlet Capacity in a Sump

Clogging Coefficient for Multiple Units

Clogging Factor for Multiple Units

### Grate as a Weir

Flow Depth at Local Depression without Clogging (0 cfs grate, 2.5 cfs curb)

This Row Used for Combination Inlets Only

Flow Depth at Local Depression with Clogging (0 cfs grate, 2.5 cfs curb)

This Row Used for Combination Inlets Only

### Grate as an Orifice

Flow Depth at Local Depression without Clogging (0 cfs grate, 2.5 cfs curb)

Flow Depth at Local Depression with Clogging (0 cfs grate, 2.5 cfs curb)

	MINOR	MAJOR
Coef =	N/A	N/A
Clog =	N/A	N/A
d _{wt} =	N/A	N/A inches
d _{curb-un} =	N/A	N/A inches
d _{wa} =	N/A	N/A inches
d _{curb-cl} =	N/A	N/A inches

	MINOR	MAJOR
d _{oi} =	N/A	N/A inches
d _{oa} =	N/A	N/A inches
d _{s-grate} =	N/A	N/A inches

## Resulting Gutter Flow Depth for Curb Opening Inlet Capacity in a Sump

Clogging Coefficient for Multiple Units

Clogging Factor for Multiple Units

### Curb as a Weir, Grate as an Orifice

Flow Depth at Local Depression without Clogging (0 cfs grate, 2.5 cfs curb)

Flow Depth at Local Depression with Clogging (0 cfs grate, 2.5 cfs curb)

### Curb as an Orifice, Grate as an Orifice

Flow Depth at Local Depression without Clogging (0 cfs grate, 2.5 cfs curb)

Flow Depth at Local Depression with Clogging (0 cfs grate, 2.5 cfs curb)

## Resulting Gutter Flow Depth Outside of Local Depression

	MINOR	MAJOR
Coef =	1.00	1.00
Clog =	0.10	0.10

	MINOR	MAJOR
d _{wt} =	3.02	5.77 inches
d _{wa} =	3.15	6.01 inches

	MINOR	MAJOR
d _{oi} =	2.82	6.46 inches
d _{oa} =	2.97	7.46 inches
d _{s-curb} =	1.14	5.46 inches

## Resultant Street Conditions

Total Inlet Length

Total Inlet Interception Capacity (Design Discharge from Q-Peak)

Resultant Gutter Flow Depth (based on sheet Q-Allow geometry)

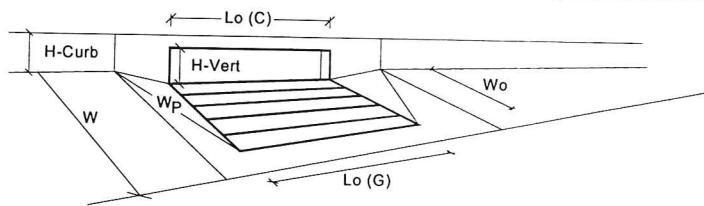
Resultant Street Flow Spread (based on sheet Q-Allow geometry)

Resultant Flow Depth at Street Crown

	MINOR	MAJOR
L =	5.0	5.0 feet
Q _a =	2.5	6.6 cfs
d =	1.14	5.46 inches
T =	0.9	13.1 feet
d _{crown} =	0.00	0.00 inches

# INLET ON A CONTINUOUS GRADE

Project: Geos Neighborhood  
Inlet ID: Design Point 29



## Design Information (Input)

Type of Inlet  
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')  
Total Number of Units in the Inlet (Grate or Curb Opening)  
Length of a Single Unit Inlet (Grate or Curb Opening)  
Width of a Unit Grate (cannot be greater than W from Q-Allow)  
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)  
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)

	MINOR	MAJOR
Type =	CDOT Type R Curb Opening	
a _{LOCAL} =	2.0	2.0 inches
No =	1	1
L _o =	5.00	5.00 ft
W _o =	N/A	N/A ft
C _r G =	N/A	N/A
C _r C =	0.10	0.10

Street Hydraulics: OK - Q < maximum allowable from sheet 'Q-Allow'

## Design Discharge for Half of Street (from Sheet Q-Peak)

Water Spread Width  
Water Depth at Flowline (outside of local depression)  
Water Depth at Street Crown (or at T_{MAX})  
Ratio of Gutter Flow to Design Flow  
Discharge outside the Gutter Section W, carried in Section T_x  
Discharge within the Gutter Section W  
Discharge Behind the Curb Face  
Street Flow Area  
Street Flow Velocity  
Water Depth for Design Condition

	MINOR	MAJOR
Q _o =	0.50	1.40 cfs
T =	1.7	4.5 ft
d =	2.2	3.1 inches
d _{CROWN} =	0.0	0.0 inches
E _o =	1.000	0.938
Q _x =	0.00	0.09 cfs
Q _w =	0.51	1.31 cfs
Q _{BACK} =	0.00	0.00 cfs
A _s =	0.16	0.37 sq ft
V _s =	3.23	3.78 fps
d _{LOCAL} =	4.2	5.1 inches

## Grate Analysis (Calculated)

Total Length of Inlet Grate Opening  
Ratio of Grate Flow to Design Flow  
Under No-Clogging Condition  
Minimum Velocity Where Grate Splash-Over Begins  
Interception Rate of Frontal Flow  
Interception Rate of Side Flow  
Interception Capacity

	MINOR	MAJOR
L =		ft
E _o -GRATE =		
V _o =		fps
R _f =		
R _s =		
Q _i =		cfs

Under Clogging Condition  
Clogging Coefficient for Multiple-unit Grate Inlet  
Clogging Factor for Multiple-unit Grate Inlet  
Effective (unclogged) Length of Multiple-unit Grate Inlet  
Minimum Velocity Where Grate Splash-Over Begins  
Interception Rate of Frontal Flow  
Interception Rate of Side Flow

	MINOR	MAJOR
GrateCoef =		
GrateClog =		
L _e =		ft
V _o =		fps
R _f =		
R _s =		
Q _s =	N/A	N/A cfs
Q _o =	N/A	N/A cfs

## Actual Interception Capacity

Carry-Over Flow = Q_o - Q_s (to be applied to curb opening or next d/s inlet)

## Curb or Slotted Inlet Opening Analysis (Calculated)

Equivalent Slope S_e (based on grate carry-over)  
Required Length L_r to Have 100% Interception  
Under No-Clogging Condition  
Effective Length of Curb Opening or Slotted Inlet (minimum of L_r, L₁)  
Interception Capacity

	MINOR	MAJOR
S _e =	0.1867	0.1781 ft/ft
L _r =	4.65	7.41 ft
L =	4.64	5.00 ft
Q _i =	0.50	1.21 cfs

## Under Clogging Condition

Clogging Coefficient  
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet  
Effective (Unclogged) Length  
Actual Interception Capacity

	MINOR	MAJOR
CurbCoef =	1.00	1.00
CurbClog =	0.10	0.10
L _e =	4.50	4.50 ft
Q _s =	0.50	1.14 cfs
Q _o =	0.00	0.26 cfs

Carry-Over Flow = Q_o(GRATE) - Q_s

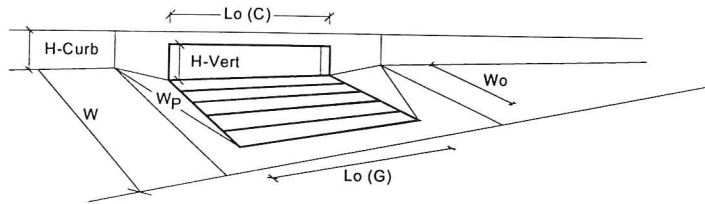
## Summary

Total Inlet Interception Capacity  
Total Inlet Carry-Over Flow (flow bypassing inlet)  
Capture Percentage = Q_o/Q_o =

	MINOR	MAJOR
Q =	0.50	1.14 cfs
Q _o =	0.00	0.26 cfs
C% =	99.8	81.4 %

# INLET ON A CONTINUOUS GRADE

Project: **Geos Neighborhood**  
 Inlet ID: **Design Point 34**

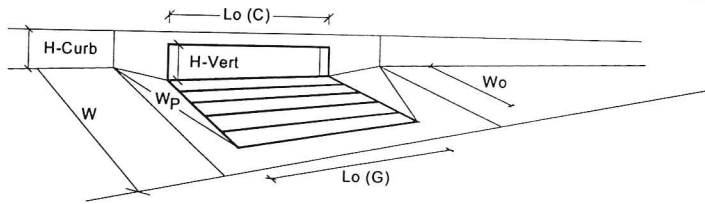


Design Information (Input)		MINOR		MAJOR	
Type of Inlet		Type = <b>CDOT Type R Curb Opening</b>			
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')		$a_{LOCAL} =$	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		$N_o =$	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		$L_o =$	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W from Q-Allow)		$W_o =$	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		$C_r-G =$	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		$C_r-C =$	0.10	0.10	
<b>Street Hydraulics: OK - Q &lt; maximum allowable from sheet 'Q-Allow'</b>					
Design Discharge for Half of Street (from Sheet Q-Peak)		MINOR		MAJOR	
Water Spread Width		$Q_o =$	0.20	0.50	cfs
Water Depth at Flowline (outside of local depression)		$T =$	1.6	2.2	ft
Water Depth at Street Crown (or at $T_{MAX}$ )		$d =$	2.0	2.5	inches
Ratio of Gutter Flow to Design Flow		$d_{CROWN} =$	0.0	0.0	inches
Discharge outside the Gutter Section W, carried in Section $T_x$		$E_o =$	1.000	1.000	
Discharge within the Gutter Section W		$Q_x =$	0.00	0.00	cfs
Discharge Behind the Curb Face		$Q_w =$	0.20	0.50	cfs
Street Flow Area		$Q_{BACK} =$	0.00	0.00	cfs
Street Flow Velocity		$A_s =$	0.13	0.22	sq ft
Water Depth for Design Condition		$V_s =$	1.55	2.33	fps
		$d_{LOCAL} =$	4.0	4.5	inches
<b>Grate Analysis (Calculated)</b>		MINOR		MAJOR	
Total Length of Inlet Grate Opening		$L =$			ft
Ratio of Grate Flow to Design Flow		$E_o-GRATE =$			
<b>Under No-Clogging Condition</b>					
Minimum Velocity Where Grate Spash-Over Begins		MINOR		MAJOR	
Interception Rate of Frontal Flow		$V_o =$			fps
Interception Rate of Side Flow		$R_f =$			
Interception Capacity		$R_s =$			
		$Q_i =$			cfs
<b>Under Clogging Condition</b>					
Clogging Coefficient for Multiple-unit Grate Inlet		MINOR		MAJOR	
Clogging Factor for Multiple-unit Grate Inlet		GrateCoef =			
Effective (unclogged) Length of Multiple-unit Grate Inlet		GrateClog =			
Minimum Velocity Where Grate Spash-Over Begins		$L_o =$			ft
Interception Rate of Frontal Flow		$V_o =$			fps
Interception Rate of Side Flow		$R_f =$			
Actual Interception Capacity		$R_s =$			
		$Q_s =$	N/A	N/A	cfs
		$Q_o =$	N/A	N/A	cfs
<b>Carry-Over Flow = $Q_o - Q_s$ (to be applied to curb opening or next d/s inlet)</b>					
<b>Curb or Slotted Inlet Opening Analysis (Calculated)</b>		MINOR		MAJOR	
Equivalent Slope $S_e$ (based on grate carry-over)		$S_e =$	0.1867	0.1867	ft/ft
Required Length $L_1$ to Have 100% Interception		$L_1 =$	2.12	3.11	ft
<b>Under No-Clogging Condition</b>					
Effective Length of Curb Opening or Slotted Inlet (minimum of $L_1$ , $L_2$ )		MINOR		MAJOR	
Interception Capacity		$L =$	2.11	3.10	ft
		$Q_i =$	0.20	0.50	cfs
<b>Under Clogging Condition</b>					
Clogging Coefficient		MINOR		MAJOR	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet		CurbCoef =	1.00	1.00	
Effective (Unclogged) Length		CurbClog =	0.10	0.10	
Actual Interception Capacity		$L_o =$	2.11	3.10	ft
		$Q_s =$	0.20	0.50	cfs
		$Q_o =$	0.00	0.00	cfs
<b>Carry-Over Flow = $Q_o - Q_s$</b>					
<b>Summary</b>		MINOR		MAJOR	
Total Inlet Interception Capacity		$Q =$	0.20	0.50	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)		$Q_b =$	0.00	0.00	cfs
Capture Percentage = $Q_s/Q_o =$		$C\% =$	100.0	100.0	%



# INLET ON A CONTINUOUS GRADE

Project: Geos Neighborhood  
Inlet ID: Design Point 36



## Design Information (Input)

Type of Inlet  
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')  
Total Number of Units in the Inlet (Grate or Curb Opening)  
Length of a Single Unit Inlet (Grate or Curb Opening)  
Width of a Unit Grate (cannot be greater than W from Q-Allow)  
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)  
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)

	MINOR	MAJOR
Type =	CDOT Type R Curb Opening	
a _{LOCAL} =	2.0	2.0 inches
No =	1	1
L _o =	10.00	10.00 ft
W _o =	N/A	N/A ft
C _{r-G} =	N/A	N/A
C _{r-C} =	0.10	0.10

Street Hydraulics: OK - Q < maximum allowable from sheet 'Q-Allow'

## Design Discharge for Half of Street (from Sheet Q-Peak)

Water Spread Width  
Water Depth at Flowline (outside of local depression)  
Water Depth at Street Crown (or at T_{MAX})  
Ratio of Gutter Flow to Design Flow  
Discharge outside the Gutter Section W, carried in Section T_x  
Discharge within the Gutter Section W  
Discharge Behind the Curb Face  
Street Flow Area  
Street Flow Velocity  
Water Depth for Design Condition

	MINOR	MAJOR
Q _o =	1.10	2.80 cfs
T =	5.4	9.5 ft
d =	3.3	4.3 inches
d _{CROWN} =	0.0	0.0 inches
E _o =	0.886	0.640
Q _x =	0.13	1.01 cfs
Q _w =	0.88	1.79 cfs
Q _{BACK} =	0.00	0.00 cfs
A _s =	0.48	1.06 sq ft
V _s =	2.40	2.64 fps
d _{LOCAL} =	5.3	6.3 inches

## Grate Analysis (Calculated)

Total Length of Inlet Grate Opening  
Ratio of Grate Flow to Design Flow  
Under No-Clogging Condition  
Minimum Velocity Where Grate Splash-Over Begins  
Interception Rate of Frontal Flow  
Interception Rate of Side Flow  
Interception Capacity

	MINOR	MAJOR
L =		ft
E _{o-GRATE} =		
	MINOR	MAJOR
V _o =		fps
R _f =		
R _s =		
Q _i =		cfs

## Under Clogging Condition

Clogging Coefficient for Multiple-unit Grate Inlet  
Clogging Factor for Multiple-unit Grate Inlet  
Effective (unclogged) Length of Multiple-unit Grate Inlet  
Minimum Velocity Where Grate Splash-Over Begins  
Interception Rate of Frontal Flow  
Interception Rate of Side Flow

	MINOR	MAJOR
GrateCoef =		
GrateClog =		
L _e =		ft
V _o =		fps
R _f =		
R _s =		
Q _s =	N/A	N/A cfs
Q _b =	N/A	N/A cfs

## Actual Interception Capacity

Carry-Over Flow = Q_o - Q_s (to be applied to curb opening or next d/s inlet)

## Curb or Slotted Inlet Opening Analysis (Calculated)

Equivalent Slope S_e (based on grate carry-over)  
Required Length L_r to Have 100% Interception  
Under No-Clogging Condition  
Effective Length of Curb Opening or Slotted Inlet (minimum of L_r, L_t)  
Interception Capacity

	MINOR	MAJOR
S _e =	0.1677	0.1267 ft/ft
L _r =	5.22	9.15 ft
	MINOR	MAJOR
L =	5.21	9.14 ft
Q _i =	1.10	2.80 cfs

## Under Clogging Condition

Clogging Coefficient  
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet  
Effective (Unclogged) Length  
Actual Interception Capacity

	MINOR	MAJOR
CurbCoef =	1.00	1.00
CurbClog =	0.10	0.10
L _e =	5.21	9.00 ft
Q _s =	1.10	2.80 cfs
Q _b =	0.00	0.00 cfs

## Carry-Over Flow = Q_b(GRATE) - Q_s

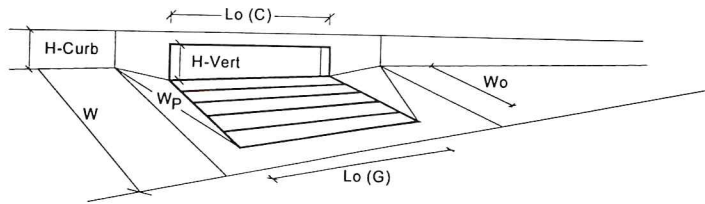
## Summary

Total Inlet Interception Capacity  
Total Inlet Carry-Over Flow (flow bypassing inlet)  
Capture Percentage = Q_i/Q_o =

	MINOR	MAJOR
Q =	1.10	2.80 cfs
Q _b =	0.00	0.00 cfs
C% =	100.0	99.9 %

# INLET ON A CONTINUOUS GRADE

Project: Geos Neighborhood  
 Inlet ID: Design Point 38



## Design Information (Input)

Type of Inlet  
 Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')  
 Total Number of Units in the Inlet (Grate or Curb Opening)  
 Length of a Single Unit Inlet (Grate or Curb Opening)  
 Width of a Unit Grate (cannot be greater than W from Q-Allow)  
 Clogging Factor for a Single Unit Grate (typical min. value = 0.5)  
 Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)

	MINOR	MAJOR
Type =	CDOT Type R Curb Opening	
a _{LOCAL} =	2.0	2.0 inches
No =	1	1
L _o =	10.00	10.00 ft
W _o =	N/A	N/A ft
C _r -G =	N/A	N/A
C _r -C =	0.10	0.10

Street Hydraulics: OK - Q < maximum allowable from sheet 'Q-Allow'

## Design Discharge for Half of Street (from Sheet Q-Peak)

Water Spread Width  
 Water Depth at Flowline (outside of local depression)  
 Water Depth at Street Crown (or at T_{MAX})  
 Ratio of Gutter Flow to Design Flow  
 Discharge outside the Gutter Section W, carried in Section T_x  
 Discharge within the Gutter Section W  
 Discharge Behind the Curb Face  
 Street Flow Area  
 Street Flow Velocity  
 Water Depth for Design Condition

	MINOR	MAJOR
Q _o =	1.20	3.40 cfs
T =	4.1	8.5 ft
d =	3.0	4.0 inches
d _{CROWN} =	0.0	0.0 inches
E _o =	0.955	0.695
Q _x =	0.05	1.04 cfs
Q _w =	1.15	2.37 cfs
Q _{BACK} =	0.00	0.00 cfs
A _s =	0.34	0.88 sq ft
V _s =	3.57	3.86 fps
d _{LOCAL} =	5.0	6.0 inches

## Grate Analysis (Calculated)

Total Length of Inlet Grate Opening  
 Ratio of Grate Flow to Design Flow  
 Under No-Clogging Condition  
 Minimum Velocity Where Grate Spash-Over Begins  
 Interception Rate of Frontal Flow  
 Interception Rate of Side Flow  
 Interception Capacity  
 Under Clogging Condition  
 Clogging Coefficient for Multiple-unit Grate Inlet  
 Clogging Factor for Multiple-unit Grate Inlet  
 Effective (unclogged) Length of Multiple-unit Grate Inlet  
 Minimum Velocity Where Grate Spash-Over Begins  
 Interception Rate of Frontal Flow  
 Interception Rate of Side Flow  
 Actual Interception Capacity  
 Carry-Over Flow = Q_o-Q_s (to be applied to curb opening or next d/s inlet)

	MINOR	MAJOR
L =		ft
E _o -GRATE =		
	MINOR	MAJOR
V _o =		fps
R _f =		
R _s =		
Q _i =		cfs
	MINOR	MAJOR
GrateCoef =		
GrateClog =		
L _e =		ft
V _o =		fps
R _f =		
R _s =		
Q _s =	N/A	N/A cfs
Q _b =	N/A	N/A cfs

## Curb or Slotted Inlet Opening Analysis (Calculated)

Equivalent Slope S_e (based on grate carry-over)  
 Required Length L_r to Have 100% Interception  
 Under No-Clogging Condition  
 Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_r)  
 Interception Capacity  
 Under Clogging Condition  
 Clogging Coefficient  
 Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet  
 Effective (Unclogged) Length  
 Actual Interception Capacity  
 Carry-Over Flow = Q_b(GRATE)-Q_s

	MINOR	MAJOR
S _e =	0.1792	0.1359 ft/ft
L _r =	6.65	12.16 ft
	MINOR	MAJOR
L =	6.64	10.00 ft
Q _i =	1.20	3.25 cfs
	MINOR	MAJOR
CurbCoef =	1.00	1.00
CurbClog =	0.10	0.10
L _e =	6.64	9.00 ft
Q _s =	1.20	3.10 cfs
Q _b =	0.00	0.30 cfs

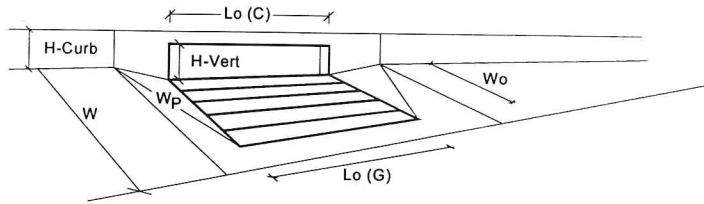
## Summary

Total Inlet Interception Capacity  
 Total Inlet Carry-Over Flow (flow bypassing inlet)  
 Capture Percentage = Q_i/Q_o =

	MINOR	MAJOR
Q =	1.20	3.10 cfs
Q _b =	0.00	0.30 cfs
C% =	100.0	91.2 %

# INLET ON A CONTINUOUS GRADE

Project: Geos Neighborhood  
Inlet ID: Design Point 41



## Design Information (Input)

Type of Inlet  
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')  
Total Number of Units in the Inlet (Grate or Curb Opening)  
Length of a Single Unit Inlet (Grate or Curb Opening)  
Width of a Unit Grate (cannot be greater than W from Q-Allow)  
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)  
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)

	MINOR	MAJOR
Type =	CDOT Type R Curb Opening	
$a_{LOCAL}$ =	2.0	2.0
No =	1	1
$L_u$ =	5.00	5.00
$W_o$ =	N/A	N/A
$C_{r-G}$ =	N/A	N/A
$C_{r-C}$ =	0.10	0.10

Street Hydraulics: OK -  $Q < Q_{MAX}$  allowable from sheet 'Q-Allow'

## Design Discharge for Half of Street (from Sheet Q-Peak)

Water Spread Width  
Water Depth at Flowline (outside of local depression)  
Water Depth at Street Crown (or at  $T_{MAX}$ )  
Ratio of Gutter Flow to Design Flow  
Discharge outside the Gutter Section W, carried in Section  $T_x$   
Discharge within the Gutter Section W  
Discharge Behind the Curb Face  
Street Flow Area  
Street Flow Velocity  
Water Depth for Design Condition

	MINOR	MAJOR
$Q_o$ =	0.40	1.10
T =	1.8	5.1
d =	2.3	3.2
$d_{CROWN}$ =	0.0	0.0
$E_o$ =	1.000	0.807
$Q_x$ =	0.00	0.10
$Q_w$ =	0.40	1.00
$Q_{BACK}$ =	0.00	0.00
$A_s$ =	0.18	0.42
$V_s$ =	2.31	2.61
$d_{LOCAL}$ =	4.3	5.2

## Grate Analysis (Calculated)

Total Length of Inlet Grate Opening  
Ratio of Grate Flow to Design Flow  
Under No-Clogging Condition  
Minimum Velocity Where Grate Spash-Over Begins  
Interception Rate of Frontal Flow  
Interception Rate of Side Flow  
Interception Capacity  
Under Clogging Condition  
Clogging Coefficient for Multiple-unit Grate Inlet  
Clogging Factor for Multiple-unit Grate Inlet  
Effective (unclogged) Length of Multiple-unit Grate Inlet  
Minimum Velocity Where Grate Spash-Over Begins  
Interception Rate of Frontal Flow  
Interception Rate of Side Flow  
Actual Interception Capacity  
Carry-Over Flow =  $Q_o - Q_s$  (to be applied to curb opening or next d/s inlet)

	MINOR	MAJOR
L =		
$E_{O-GRATE}$ =		
	MINOR	MAJOR
$V_o$ =		
$R_f$ =		
$R_s$ =		
$Q_i$ =		
	MINOR	MAJOR
GrateCoef =		
GrateClog =		
$L_e$ =		
$V_o$ =		
$R_f$ =		
$R_s$ =		
$Q_s$ =	N/A	N/A
$Q_o$ =	N/A	N/A

## Curb or Slotted Inlet Opening Analysis (Calculated)

Equivalent Slope  $S_e$  (based on grate carry-over)  
Required Length  $L_T$  to Have 100% Interception  
Under No-Clogging Condition  
Effective Length of Curb Opening or Slotted Inlet (minimum of  $L$ ,  $L_T$ )  
Interception Capacity  
Under Clogging Condition  
Clogging Coefficient  
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet  
Effective (Unclogged) Length  
Actual Interception Capacity  
Carry-Over Flow =  $Q_o - Q_s$

	MINOR	MAJOR
$S_e$ =	0.1867	0.1713
$L_T$ =	3.38	5.44
	MINOR	MAJOR
L =	3.37	5.00
$Q_i$ =	0.40	1.09
	MINOR	MAJOR
CurbCoef =	1.00	1.00
CurbClog =	0.10	0.10
$L_e$ =	3.37	4.50
$Q_s$ =	0.40	1.05
$Q_o$ =	0.00	0.05

## Summary

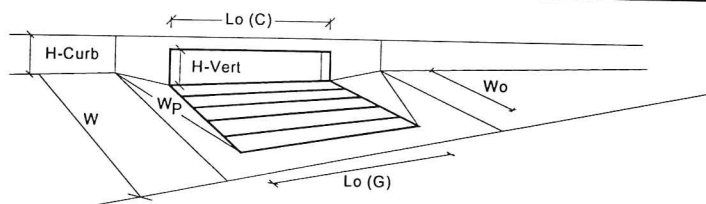
Total Inlet Interception Capacity  
Total Inlet Carry-Over Flow (flow bypassing inlet)  
Capture Percentage =  $Q_s/Q_o$  =

	MINOR	MAJOR
Q =	0.40	1.05
$Q_o$ =	0.00	0.05
C% =	100.0	95.7



# INLET ON A CONTINUOUS GRADE

Project: Geos Neighborhood  
Inlet ID: Design Point 44



## Design Information (Input)

Type of Inlet  
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')  
Total Number of Units in the Inlet (Grate or Curb Opening)  
Length of a Single Unit Inlet (Grate or Curb Opening)  
Width of a Unit Grate (cannot be greater than W from Q-Allow)  
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)  
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)

	MINOR	MAJOR
Type =	CDOT Type R Curb Opening	
a _{LOCAL} =	2.0	2.0 inches
No =	1	1
L _o =	10.00	10.00 ft
W _o =	N/A	N/A ft
C _r G =	N/A	N/A
C _r C =	0.10	0.10

Street Hydraulics: OK - Q < maximum allowable from sheet 'Q-Allow'

## Design Discharge for Half of Street (from Sheet Q-Peak)

Water Spread Width  
Water Depth at Flowline (outside of local depression)  
Water Depth at Street Crown (or at T_{MAX})  
Ratio of Gutter Flow to Design Flow  
Discharge outside the Gutter Section W, carried in Section T_x  
Discharge within the Gutter Section W  
Discharge Behind the Curb Face  
Street Flow Area  
Street Flow Velocity  
Water Depth for Design Condition

	MINOR	MAJOR
Q _o =	0.90	1.90 cfs
T =	2.2	6.0 ft
d =	2.5	3.4 inches
d _{CROWN} =	0.0	0.0 inches
E _o =	1.000	0.851
Q _x =	0.00	0.28 cfs
Q _w =	0.91	1.62 cfs
Q _{BACK} =	0.00	0.00 cfs
A _s =	0.22	0.52 sq ft
V _s =	4.22	3.64 fps
d _{LOCAL} =	4.5	5.4 inches

## Grate Analysis (Calculated)

Total Length of Inlet Grate Opening  
Ratio of Grate Flow to Design Flow  
Under No-Clogging Condition  
Minimum Velocity Where Grate Splash-Over Begins  
Interception Rate of Frontal Flow  
Interception Rate of Side Flow  
Interception Capacity

	MINOR	MAJOR
L =		ft
E _o -GRATE =		
V _o =		fps
R _f =		
R _s =		
Q _i =		cfs

## Under Clogging Condition

Clogging Coefficient for Multiple-unit Grate Inlet  
Clogging Factor for Multiple-unit Grate Inlet  
Effective (unclogged) Length of Multiple-unit Grate Inlet  
Minimum Velocity Where Grate Splash-Over Begins  
Interception Rate of Frontal Flow  
Interception Rate of Side Flow

	MINOR	MAJOR
GrateCoef =		
GrateClog =		
L _e =		ft
V _o =		fps
R _f =		
R _s =		
Q _s =	N/A	N/A cfs
Q _o =	N/A	N/A cfs

## Actual Interception Capacity

Carry-Over Flow = Q_o - Q_s (to be applied to curb opening or next d/s inlet)

## Curb or Slotted Inlet Opening Analysis (Calculated)

Equivalent Slope S_e (based on grate carry-over)  
Required Length L_r to Have 100% Interception  
Under No-Clogging Condition  
Effective Length of Curb Opening or Slotted Inlet (minimum of L_r, L_t)  
Interception Capacity

	MINOR	MAJOR
S _e =	0.1867	0.1619 ft/ft
L _r =	5.75	8.57 ft
L =	5.74	8.56 ft
Q _i =	0.90	1.90 cfs

## Under Clogging Condition

Clogging Coefficient  
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet  
Effective (Unclogged) Length  
Actual Interception Capacity

	MINOR	MAJOR
CurbCoef =	1.00	1.00
CurbClog =	0.10	0.10
L _e =	5.74	8.56 ft
Q _s =	0.90	1.90 cfs
Q _o =	0.00	0.00 cfs

Carry-Over Flow = Q_o(GRATE) - Q_s

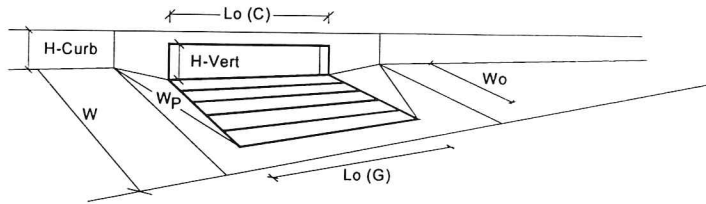
## Summary

Total Inlet Interception Capacity  
Total Inlet Carry-Over Flow (flow bypassing inlet)  
Capture Percentage = Q_i/Q_o =

	MINOR	MAJOR
Q =	0.90	1.90 cfs
Q _o =	0.00	0.00 cfs
C% =	100.0	100.0 %

# INLET ON A CONTINUOUS GRADE

Project: Geos Neighborhood  
Inlet ID: Design Point 46



## Design Information (Input)

Type of Inlet  
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')  
Total Number of Units in the Inlet (Grate or Curb Opening)  
Length of a Single Unit Inlet (Grate or Curb Opening)  
Width of a Unit Grate (cannot be greater than W from Q-Allow)  
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)  
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)

	MINOR	MAJOR
Type =	CDOT Type R Curb Opening	
a _{LOCAL} =	2.0	2.0 inches
No =	1	1
L _o =	10.00	10.00 ft
W _o =	N/A	N/A ft
C _{r-G} =	N/A	N/A
C _{r-C} =	0.10	0.10

Street Hydraulics: OK - Q < maximum allowable from sheet 'Q-Allow'

## Design Discharge for Half of Street (from Sheet Q-Peak)

Water Spread Width  
Water Depth at Flowline (outside of local depression)  
Water Depth at Street Crown (or at T_{MAX})  
Ratio of Gutter Flow to Design Flow  
Discharge outside the Gutter Section W, carried in Section T_x  
Discharge within the Gutter Section W  
Discharge Behind the Curb Face  
Street Flow Area  
Street Flow Velocity  
Water Depth for Design Condition

	MINOR	MAJOR
Q _o =	1.50	3.20 cfs
T =	5.0	8.2 ft
d =	3.2	4.0 inches
d _{CROWN} =	0.0	0.0 inches
E _o =	0.910	0.711
Q _x =	0.14	0.93 cfs
Q _w =	1.36	2.28 cfs
Q _{BACK} =	0.00	0.00 cfs
A _s =	0.42	0.84 sq ft
V _s =	3.59	3.83 fps
d _{LOCAL} =	5.2	8.0 inches

## Grate Analysis (Calculated)

Total Length of Inlet Grate Opening  
Ratio of Grate Flow to Design Flow  
Under No-Clogging Condition  
Minimum Velocity Where Grate Spash-Over Begins  
Interception Rate of Frontal Flow  
Interception Rate of Side Flow  
Interception Capacity  
Under Clogging Condition  
Clogging Coefficient for Multiple-unit Grate Inlet  
Clogging Factor for Multiple-unit Grate Inlet  
Effective (unclogged) Length of Multiple-unit Grate Inlet  
Minimum Velocity Where Grate Spash-Over Begins  
Interception Rate of Frontal Flow  
Interception Rate of Side Flow  
Actual Interception Capacity  
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)

	MINOR	MAJOR
L =		ft
E _{o-GRATE} =		
	MINOR	MAJOR
V _o =		fps
R _f =		
R _s =		
Q _i =		cfs
	MINOR	MAJOR
GrateCoef =		
GrateClog =		
L _o =		ft
V _o =		fps
R _f =		
R _s =		
Q _a =	N/A	N/A cfs
Q _b =	N/A	N/A cfs

## Curb or Slotted Inlet Opening Analysis (Calculated)

Equivalent Slope S_e (based on grate carry-over)  
Required Length L₁ to Have 100% Interception  
Under No-Clogging Condition  
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L₁)  
Interception Capacity  
Under Clogging Condition  
Clogging Coefficient  
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet  
Effective (Unclogged) Length  
Actual Interception Capacity  
Carry-Over Flow = Q_{b(GRATE)}-Q_a

	MINOR	MAJOR
S _e =	0.1716	0.1385 ft/ft
L ₁ =	7.50	11.72 ft
	MINOR	MAJOR
L =	7.49	10.00 ft
Q _i =	1.50	3.10 cfs
	MINOR	MAJOR
CurbCoef =	1.00	1.00
CurbClog =	0.10	0.10
L _o =	7.49	9.00 ft
Q _a =	1.50	2.97 cfs
Q _b =	0.00	0.23 cfs

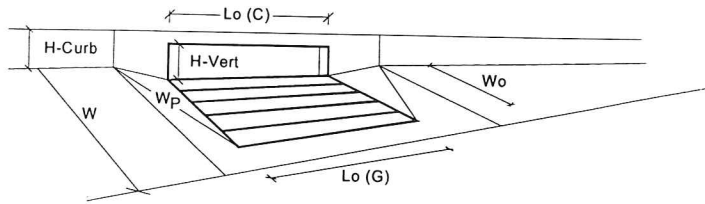
## Summary

Total Inlet Interception Capacity  
Total Inlet Carry-Over Flow (flow bypassing inlet)  
Capture Percentage = Q_a/Q_o =

	MINOR	MAJOR
Q =	1.50	2.97 cfs
Q _b =	0.00	0.23 cfs
C% =	100.0	92.8 %

# INLET ON A CONTINUOUS GRADE

Project: Geos Neighborhood  
Inlet ID: Curb Openings



## Design Information (Input)

Type of Inlet  
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')  
Total Number of Units in the Inlet (Grate or Curb Opening)  
Length of a Single Unit Inlet (Grate or Curb Opening)  
Width of a Unit Grate (cannot be greater than W from Q-Allow)  
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)  
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)

	MINOR	MAJOR
Type =	CDOT Type R Curb Opening	
$a_{LOCAL}$ =	0.0	0.0 inches
$N_o$ =	1	1
$L_o$ =	0.50	0.50 ft
$W_o$ =	N/A	N/A ft
$C_r-G$ =	N/A	N/A
$C_r-C$ =	0.10	0.10

Street Hydraulics: OK - Q < maximum allowable from sheet 'Q-Allow'

Design Discharge for Half of Street (from Sheet Q-Peak)

Water Spread Width  
Water Depth at Flowline (outside of local depression)  
Water Depth at Street Crown (or at  $T_{MAX}$ )  
Ratio of Gutter Flow to Design Flow  
Discharge outside the Gutter Section W, carried in Section  $T_x$   
Discharge within the Gutter Section W  
Discharge Behind the Curb Face  
Street Flow Area  
Street Flow Velocity  
Water Depth for Design Condition

	MINOR	MAJOR
$Q_o$ =	0.30	0.60 cfs
$T$ =	4.2	5.4 ft
$d$ =	1.0	1.3 inches
$d_{CROWN}$ =	0.0	0.0 inches
$E_o$ =	0.826	0.710
$Q_x$ =	0.00	0.00 cfs
$Q_w$ =	0.25	0.43 cfs
$Q_{BACK}$ =	0.00	0.00 cfs
$A_s$ =	0.17	0.29 sq ft
$V_s$ =	1.74	2.07 fps
$d_{LOCAL}$ =	1.0	1.3 inches

## Grate Analysis (Calculated)

Total Length of Inlet Grate Opening  
Ratio of Grate Flow to Design Flow  
Under No-Clogging Condition  
Minimum Velocity Where Grate Spash-Over Begins  
Interception Rate of Frontal Flow  
Interception Rate of Side Flow  
Interception Capacity

	MINOR	MAJOR
$L$ =		ft
$E_{o-GRATE}$ =		
$V_o$ =		fps
$R_f$ =		
$R_s$ =		
$Q_i$ =		cfs

## Under Clogging Condition

Clogging Coefficient for Multiple-unit Grate Inlet  
Clogging Factor for Multiple-unit Grate Inlet  
Effective (unclogged) Length of Multiple-unit Grate Inlet  
Minimum Velocity Where Grate Spash-Over Begins  
Interception Rate of Frontal Flow  
Interception Rate of Side Flow

	MINOR	MAJOR
GrateCoef =		
GrateClog =		
$L_e$ =		ft
$V_o$ =		fps
$R_f$ =		
$R_s$ =		
$Q_a$ =	N/A	N/A cfs
$Q_b$ =	N/A	N/A cfs

## Actual Interception Capacity

Carry-Over Flow =  $Q_o - Q_a$  (to be applied to curb opening or next d/s inlet)

## Curb or Slotted Inlet Opening Analysis (Calculated)

Equivalent Slope  $S_e$  (based on grate carry-over)  
Required Length  $L_T$  to Have 100% Interception  
Under No-Clogging Condition  
Effective Length of Curb Opening or Slotted Inlet (minimum of  $L$ ,  $L_T$ )  
Interception Capacity

	MINOR	MAJOR
$S_e$ =	0.0200	0.0200 ft/ft
$L_T$ =	13.34	17.85 ft
$L$ =	0.50	0.50 ft
$Q_i$ =	0.02	0.03 cfs

## Under Clogging Condition

Clogging Coefficient  
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet  
Effective (Unclogged) Length  
Actual Interception Capacity

	MINOR	MAJOR
CurbCoef =	1.00	1.00
CurbClog =	0.10	0.10
$L_e$ =	0.45	0.45 ft
$Q_a$ =	0.02	0.03 cfs
$Q_b$ =	0.28	0.57 cfs

Carry-Over Flow =  $Q_{o(GRATE)} - Q_a$

## Summary

Total Inlet Interception Capacity  
Total Inlet Carry-Over Flow (flow bypassing inlet)  
Capture Percentage =  $Q_a/Q_o$  =

	MINOR	MAJOR
$Q$ =	0.02	0.03 cfs
$Q_o$ =	0.28	0.57 cfs
$C\%$ =	6.0	4.5 %

Warning 3: CDOT Type R unit length should be a multiple of 5'.



## EMERGENCY OVERFLOW CALCULATION

Project: Geos Neighborhood  
Job # 05-056-01  
Date 2/8/2008  
By: TJN

---

### Pond A Emergency Overflow

100-Year Inflow 14.4 cfs  
100-Year Emergency Capacity 28.8 cfs

Weir Equation 100-year

$$Q = CbcwLH^{1.5}$$

Q=Discharge (cfs)

Cbcw=broad-crested weir coefficient (2.38 to 3.32)

L=broad-crested weir length (ft)

H=head above weir crest (ft)

Weir Invert= 5556.30  
Emergency WSE= 5556.80  
Weir Length (ft)= 30.00 ft

Q= 31.82 cfs  
Cbcw= 3  
L= 30.00 ft  
H= 0.50 ft

---

### Pond B Emergency Overflow

100-Year Inflow 9.3 cfs  
100-Year Emergency Capacity 18.6 cfs

Weir Equation 100-year

$$Q = CbcwLH^{1.5}$$

Q=Discharge (cfs)

Cbcw=broad-crested weir coefficient (2.38 to 3.32)

L=broad-crested weir length (ft)

H=head above weir crest (ft)

Weir Invert= 5552.00  
Emergency WSE= 5552.20  
Weir Length (ft)= 70.00 ft

Q= 18.78 cfs  
Cbcw= 3

L= 70.00 ft  
H= 0.20 ft

---

Pond D Emergency Overflow

100-Year Inflow 11.8 cfs  
100-Year Emergency Capacity 23.6 cfs

Weir Equation 100-year  
 $Q = C_{bcw} L H^{1.5}$

Q=Discharge (cfs)  
Cbcw=broad-crested weir coefficient (2.38 to 3.32)  
L=broad-crested weir length (ft)  
H=head above weir crest (ft)

Weir Invert= 5557.85  
Emergency WSE= 5558.15  
Weir Length (ft)= 50.00 ft

Q= 24.65 cfs  
Cbcw= 3  
L= 50.00 ft  
H= 0.30 ft

---

Pond E Emergency Overflow

100-Year Inflow 13.1 cfs  
100-Year Emergency Capacity 26.2 cfs

Weir Equation 100-year  
 $Q = C_{bcw} L H^{1.5}$

Q=Discharge (cfs)  
Cbcw=broad-crested weir coefficient (2.38 to 3.32)  
L=broad-crested weir length (ft)  
H=head above weir crest (ft)

Weir Invert= 5554.50  
Emergency WSE= 5554.90  
Weir Length (ft)= 45.00 ft

Q= 34.15 cfs  
Cbcw= 3  
L= 45.00 ft  
H= 0.40 ft

---

#### Pond F Emergency Overflow

100-Year Inflow 7.3 cfs  
100-Year Emergency Capacity 14.6 cfs

Weir Equation 100-year  
 $Q = C_{bcw} L H^{1.5}$

Q=Discharge (cfs)  
Cbcw=broad-crested weir coefficient (2.38 to 3.32)  
L=broad-crested weir length (ft)  
H=head above weir crest (ft)

Weir Invert= 5558.78  
Emergency WSE= 5558.92  
Weir Length (ft)= 100.00 ft

Q= 15.71 cfs  
Cbcw= 3  
L= 100.00 ft  
H= 0.14 ft

---

#### Pond G Emergency Overflow

100-Year Inflow 5.9 cfs  
100-Year Emergency Capacity 11.8 cfs

Weir Equation 100-year  
 $Q = C_{bcw} L H^{1.5}$

Q=Discharge (cfs)  
Cbcw=broad-crested weir coefficient (2.38 to 3.32)  
L=broad-crested weir length (ft)  
H=head above weir crest (ft)

Weir Invert= 5553.35  
Emergency WSE= 5553.46  
Weir Length (ft)= 115.00 ft

Q= 12.59 cfs  
Cbcw= 3  
L= 115.00 ft  
H= 0.11 ft

---

#### Pond H Emergency Overflow

100-Year Inflow 5.5 cfs  
100-Year Emergency Capacity 11 cfs



Weir Equation 100-year

$$Q = C_{bcw} L H^{1.5}$$

Q=Discharge (cfs)

$C_{bcw}$ =broad-crested weir coefficient (2.38 to 3.32)

L=broad-crested weir length (ft)

H=head above weir crest (ft)

Weir Invert= 5549.70

Emergency WSE= 5549.80

Weir Length (ft)= 125.00 ft

Q= 11.86 cfs

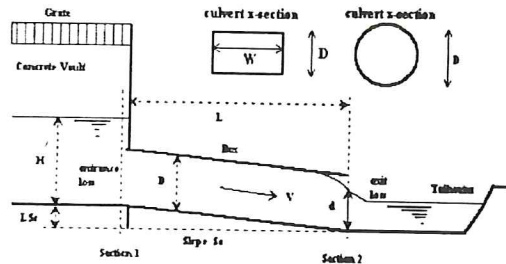
$C_{bcw}$ = 3

L= 125.00 ft

H= 0.10 ft

# CULVERT STAGE-DISCHARGE SIZING (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

Project: **Geos Neighborhood**  
 Basin ID: **Historic Basin OS-1**



## Design Information (Input):

Circular Culvert: Barrel Diameter in Inches  
 Inlet Edge Type (choose from pull-down list)

OR:

Box Culvert: Barrel Height (Rise) in Feet  
 Barrel Width (Span) in Feet  
 Inlet Edge Type (choose from pull-down list)

Number of Barrels  
 Inlet Elevation at Culvert Invert  
 Outlet Elevation at Culvert Invert OR Slope of Culvert (ft v./ft h.)  
 Culvert Length in Feet  
 Manning's Roughness  
 Bend Loss Coefficient  
 Exit Loss Coefficient

D = 30.00 inches  
 Square End Projection  
 OR:  
 Height (Rise) = ft.  
 Width (Span) = ft.  
 1 : 1 Bevel w/ Headwall  
 No = 1  
 Inlet Elev = 5535 ft. elev.  
 Slope = 0.0072 ft. vert. / ft. horiz.  
 L = 25.00 ft.  
 n = 0.0130  
 K_b = 0.00  
 K_x = 1.00

## Design Information (calculated):

Entrance Loss Coefficient  
 Friction Loss Coefficient  
 Sum of All Loss Coefficients  
 Orifice Inlet Condition Coefficient  
 Minimum Energy Condition Coefficient

K_e = 0.20  
 K_f = 0.23  
 K_s = 1.43  
 C_d = 0.85  
 KE_{low} = -0.2959

## Calculations of Culvert Capacity (output):

Water Surface Elevation (ft., linked)	Tailwater Surface Elevation ft (input if known)	Culvert Inlet-Control Flowrate cfs (output)	Culvert Outlet-Control Flowrate cfs (output)	Controlling Culvert Flowrate cfs (output)	Inlet Equation Used: (output)
5536.00		5.82	0.02	0.02	min. energy equation
5536.10		6.70	0.05	0.05	min. energy equation
5536.20		7.61	0.47	0.47	min. energy equation
5536.30		7.70	1.38	1.38	regression equation
5536.40		8.76	3.09	3.09	regression equation
5536.50		9.87	4.50	4.50	regression equation
5536.60		11.01	6.80	6.80	regression equation
5536.70		12.19	8.44	8.44	regression equation
5536.80		13.40	9.78	9.78	regression equation
5536.90		14.64	12.01	12.01	regression equation
5537.00		15.90	13.55	13.55	regression equation
5537.10		17.16	14.59	14.59	regression equation
5537.20		18.43	16.48	16.48	regression equation
5537.30		19.69	17.41	17.41	regression equation
5537.40		20.93	18.98	18.98	regression equation
5537.50		22.16	20.43	20.43	regression equation
5537.60		23.36	21.21	21.21	regression equation
5537.70		24.54	22.66	22.66	regression equation
5537.80		25.69	23.62	23.62	regression equation
5537.90		26.81	24.58	24.58	regression equation
5538.00		27.90	25.85	25.85	regression equation
5538.10		28.96	26.98	26.98	regression equation
5538.20		29.99	27.58	27.58	regression equation
5538.30		30.99	28.71	28.71	regression equation
5538.40		31.96	29.81	29.81	regression equation
5538.50		32.91	30.48	30.48	regression equation
5538.60		33.83	31.35	31.35	regression equation
5538.70		34.73	32.35	32.35	regression equation
5538.80		35.60	33.33	33.33	regression equation
5538.90		36.46	34.14	34.14	regression equation

Processing Time: 3 seconds

W 69th Avenue  
Worksheet for Triangular Channel

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Project Description

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Project File	e:\sdsdk\proj\05-056-01 cottonwood west\drainage\fdp submittals\2nd submittal 11-09-07\2nd
Worksheet	69TH AVENUE SWALE
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

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Input Data

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Mannings Coefficient	0.030
Channel Slope	0.020000 ft/ft
Left Side Slope	4.000000 H : V
Right Side Slope	4.000000 H : V
Discharge	9.20 cfs

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Results

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Depth	0.79	ft
Flow Area	2.49	ft ²
Wetted Perimeter	6.51	ft
Top Width	6.31	ft
Critical Depth	0.80	ft
Critical Slope	0.018528	ft/ft
Velocity	3.69	ft/s
Velocity Head	0.21	ft
Specific Energy	1.00	ft
Froude Number	1.04	

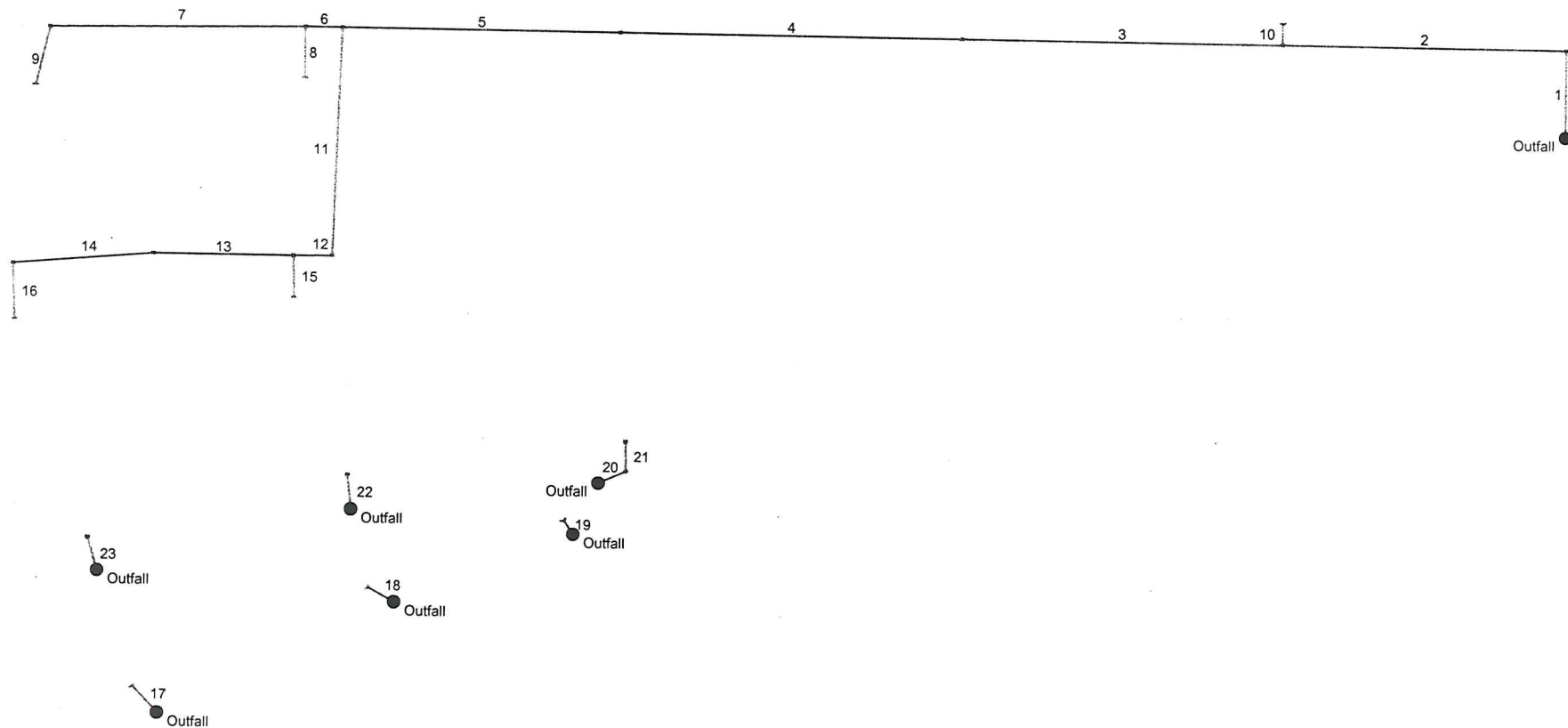
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Flow is supercritical.

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# Hydraflow Storm Sewers Plan



Project File: STORM 2-22-08.stm

Number of lines: 23

Date: 02-28-2008

# Storm Sewer Summary Report

Summary Report																Page
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		40.60	36	Cir	103	5530.90	5531.76	0.833	5533.40	5533.79	n/a	5535.11 i	End	Manhole		
2		40.60	36	Cir	329	5531.96	5534.62	0.809	5535.11	5536.65	n/a	5537.97 i	1	Manhole		
3		15.60	24	Cir	373	5535.62	5538.12	0.671	5537.97	5539.68	n/a	5540.44 i	2	Manhole		
4		15.60	24	Cir	400	5538.32	5541.80	0.870	5540.44	5543.20	n/a	5544.12 i	3	Manhole		
5		15.60	24	Cir	323	5542.00	5543.94	0.602	5544.12	5545.55	n/a	5546.26 i	4	Manhole		
6		5.40	15	Cir	43	5544.69	5544.90	0.488	5546.26*	5546.56*	0.30	5546.86	5	Manhole		
7		5.40	15	Cir	295	5545.10	5550.65	1.879	5546.86	5551.58	n/a	5552.25 i	6	Manhole		
8		2.10	15	Cir	59	5545.20	5545.50	0.508	5547.12*	5547.18*	0.05	5547.23	6	OpenHeadwall		
9		3.30	15	Cir	69	5550.85	5551.20	0.507	5552.25	5552.41	0.11	5552.53	7	OpenHeadwall		
10		25.00	30	Cir	25	5534.82	5535.00	0.721	5537.97*	5538.07*	0.40	5538.47	2	OpenHeadwall		
11		10.20	18	Cir	269	5544.79	5549.01	1.569	5546.26	5550.23	n/a	5551.33 i	5	Manhole		
12		10.20	18	Cir	45	5549.21	5549.66	1.000	5551.33*	5551.75*	n/a	5551.98 i	11	Manhole		
13		2.80	15	Cir	162	5549.91	5551.66	1.080	5551.98	5552.38	n/a	5552.68 i	12	Manhole		
14		2.80	15	Cir	163	5551.86	5552.19	0.203	5552.85	5553.18	n/a	5553.21 i	13	Manhole		
15		7.40	15	Cir	49	5549.91	5550.40	0.999	5551.98*	5552.63*	n/a	5552.68 i	12	OpenHeadwall		
16		2.80	15	Cir	66	5552.39	5552.65	0.394	5553.21	5553.42	n/a	5553.67 i	14	OpenHeadwall		
17		1.90	12	Cir	42	5552.75	5553.25	1.190	5553.33	5553.83	n/a	5554.16 i	End	OpenHeadwall		
18		1.30	12	Cir	35	5548.58	5550.68	6.000	5549.06	5551.16	n/a	5551.40 i	End	OpenHeadwall		
19		0.90	12	Cir	20	5544.44	5545.60	5.801	5546.99*	5547.00*	0.02	5547.02	End	OpenHeadwall		
20		3.20	15	Cir	35	5546.03	5546.37	0.972	5547.49	5547.57	0.15	5547.72	End	Curb-Horiz		
21		1.90	15	Cir	36	5546.48	5546.59	0.305	5547.78	5547.81	0.04	5547.85	20	Curb-Horiz		
22		1.10	15	Cir	41	5551.70	5551.94	0.585	5556.97*	5556.98*	0.01	5557.00	End	DropCurb		
23		3.40	12	Cir	40	5556.19	5556.44	0.625	5556.97	5557.43	n/a	5557.85 i	End	DropCurb		
Project File: STORM 2-22-08.stm									Number of lines: 23			Run Date: 02-28-2008				
NOTES: Return period = 100 Yrs. ; *Surcharged (HGL above crown). ; i - Inlet control.																

# Storm Sewer Tabulation

Station		Len (ft)	Drng Area		Rnoff coeff (C)	Area x C		Tc		Rain (l) (in/hr)	Total flow (cfs)	Cap full (cfs)	Vel (ft/s)	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr (ac)	Total (ac)		Incr	Total	Inlet (min)	Syst (min)					Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	103	0.00	0.00	0.00	0.00	0.00	0.0	8.4	0.0	40.60	60.87	7.21	36	0.83	5530.90	5531.76	5533.40	5533.79	5533.00	5535.68	
2	1	329	0.00	0.00	0.00	0.00	0.00	0.0	7.4	0.0	40.60	59.97	6.86	36	0.81	5531.96	5534.62	5535.11	5536.65	5535.68	5538.95	
3	2	373	0.00	0.00	0.00	0.00	0.00	0.0	6.2	0.0	15.60	18.53	5.46	24	0.67	5535.62	5538.12	5537.97	5539.68	5538.95	5543.24	
4	3	400	0.00	0.00	0.00	0.00	0.00	0.0	4.8	0.0	15.60	21.10	5.81	24	0.87	5538.32	5541.80	5540.44	5543.20	5543.24	5547.80	
5	4	323	0.00	0.00	0.00	0.00	0.00	0.0	3.8	0.0	15.60	17.55	5.36	24	0.60	5542.00	5543.94	5544.12	5545.55	5547.80	5551.11	
6	5	43	0.00	0.00	0.00	0.00	0.00	0.0	1.5	0.0	5.40	4.51	4.40	15	0.49	5544.69	5544.90	5546.26	5546.56	5551.11	5551.70	
7	6	295	0.00	0.00	0.00	0.00	0.00	0.0	0.4	0.0	5.40	8.85	4.96	15	1.88	5545.10	5550.65	5546.86	5551.58	5551.70	5556.98	
8	6	59	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	2.10	4.60	1.71	15	0.51	5545.20	5545.50	5547.12	5547.18	5551.70	5549.02	
9	7	69	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	3.30	4.60	2.70	15	0.51	5550.85	5551.20	5552.25	5552.41	5556.98	5554.70	
10	2	25	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	25.00	34.82	5.09	30	0.72	5534.82	5535.00	5537.97	5538.07	5538.95	5538.00	
11	5	269	0.00	0.00	0.00	0.00	0.00	0.0	3.0	0.0	10.20	13.15	6.21	18	1.57	5544.79	5549.01	5546.26	5550.23	5551.11	5553.78	
12	11	45	0.00	0.00	0.00	0.00	0.00	0.0	2.9	0.0	10.20	10.50	5.77	18	1.00	5549.21	5549.66	5551.33	5551.75	5553.78	5553.71	
13	12	162	0.00	0.00	0.00	0.00	0.00	0.0	1.7	0.0	2.80	6.71	3.07	15	1.08	5549.91	5551.66	5551.98	5552.38	5553.71	5554.88	
14	13	163	0.00	0.00	0.00	0.00	0.00	0.0	0.5	0.0	2.80	2.91	2.70	15	0.20	5551.86	5552.19	5552.85	5553.18	5554.88	5556.76	
15	12	49	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	7.40	6.46	6.03	15	1.00	5549.91	5550.40	5551.98	5552.63	5553.71	5554.70	
16	14	66	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	2.80	4.05	3.41	15	0.39	5552.39	5552.65	5553.21	5553.42	5556.76	5554.20	
17	End	42	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.90	3.89	3.98	12	1.19	5552.75	5553.25	5553.33	5553.83	0.00	5558.86	
18	End	35	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.30	8.72	3.46	12	6.00	5548.58	5550.68	5549.06	5551.16	0.00	5552.46	
19	End	20	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.90	8.58	1.15	12	5.80	5544.44	5545.60	5546.99	5547.00	0.00	5547.50	
20	End	35	0.00	0.00	0.00	0.00	0.00	0.0	0.4	0.0	3.20	6.37	2.63	15	0.97	5546.03	5546.37	5547.49	5547.57	0.00	5548.89	
21	20	36	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.90	3.57	1.55	15	0.31	5546.48	5546.59	5547.78	5547.81	5548.89	5548.89	
22	End	41	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.10	4.94	0.90	15	0.58	5551.70	5551.94	5556.97	5556.98	0.00	5553.78	

Project File: STORM 2-22-08.stm

Number of lines: 23

Run Date: 02-28-2008

NOTES: Intensity =  $94.01 / (\text{Inlet time} + 11.10)^{0.84}$ ; Return period = 100 Yrs. ; c = cir e = ellip b = box



# Storm Sewer Tabulation

Station		Len (ft)	Drng Area		Rnoff coeff (C)	Area x C		Tc		Rain (l) (in/hr)	Total flow (cfs)	Cap full (cfs)	Vel (ft/s)	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr (ac)	Total (ac)		Incr	Total	Inlet (min)	Syst (min)					Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
23	End	40	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	3.40	2.82	4.75	12	0.63	5556.19	5556.44	5556.97	5557.43	0.00	5559.41	
Project File: STORM 2-22-08.stm																Number of lines: 23				Run Date: 02-28-2008		
NOTES: Intensity = 94.01 / (Inlet time + 11.10) ^ 0.84; Return period = 100 Yrs. ; c = cir e = ellip b = box																						

# Hydraulic Grade Line Computations

Line	Size (in)	Q (cfs)	Downstream								Len (ft)	Upstream								Check		JL coeff (K)	Minor loss (ft)
			Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)		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)		
1	36	40.60	5530.90	5533.40	2.50	6.29	6.45	0.65	5534.05	n/a	103	5531.76	5533.79 j	2.03**	5.09	7.97	0.99	5534.78i	n/a	n/a	n/a	1.00	n/a
2	36	40.60	5531.96	5535.11	3.00	7.07	5.74	0.51	5535.63	n/a	329	5534.62	5536.65 j	2.03**	5.09	7.97	0.99	5537.64i	n/a	n/a	n/a	1.00	n/a
3	24	15.60	5535.62	5537.97	2.00	3.14	4.97	0.38	5538.36	n/a	373	5538.12	5539.68	1.56	2.62	5.95	0.55	5540.23i	n/a	n/a	1.324	0.15	n/a
4	24	15.60	5538.32	5540.44	2.00	3.14	4.97	0.38	5540.82	n/a	400	5541.80	5543.20 j	1.40**	2.35	6.65	0.69	5543.89i	n/a	n/a	n/a	0.15	n/a
5	24	15.60	5542.00	5544.12	2.00	3.14	4.97	0.38	5544.50	n/a	323	5543.94	5545.55	1.61	2.71	5.76	0.52	5546.07i	n/a	n/a	1.048	1.00	n/a
6	15	5.40	5544.69	5546.26	1.25	1.23	4.40	0.30	5546.56	0.700	43	5544.90	5546.56	1.25	1.23	4.40	0.30	5546.86	0.699	0.699	0.301	1.00	0.30
7	15	5.40	5545.10	5546.86	1.25	1.23	4.40	0.30	5547.17	n/a	295	5550.65	5551.58 j	0.93**	0.98	5.52	0.47	5552.05i	n/a	n/a	n/a	0.98	n/a
8	15	2.10	5545.20	5547.12	1.25	1.23	1.71	0.05	5547.17	0.106	59	5545.50	5547.18	1.25	1.23	1.71	0.05	5547.23	0.106	0.106	0.062	1.00	0.05
9	15	3.30	5550.85	5552.25	1.25	1.23	2.69	0.11	5552.36	0.261	69	5551.20	5552.41	1.21	1.22	2.71	0.11	5552.53	0.230	0.246	0.170	1.00	0.11
10	30	25.00	5534.82	5537.97	2.50	4.91	5.09	0.40	5538.38	0.372	25	5535.00	5538.07	2.50	4.91	5.09	0.40	5538.47	0.372	0.372	0.093	1.00	0.40
11	18	10.20	5544.79	5546.26	1.47	1.76	5.80	0.52	5546.78	n/a	269	5549.01	5550.23 j	1.22**	1.54	6.63	0.68	5550.91i	n/a	n/a	n/a	1.00	n/a
12	18	10.20	5549.21	5551.33	1.50	1.77	5.77	0.52	5551.85	n/a	45	5549.66	5551.75	1.50	1.77	5.77	0.52	5552.27i	n/a	n/a	-0.093	1.00	n/a
13	15	2.80	5549.91	5551.98	1.25	1.23	2.28	0.08	5552.06	n/a	162	5551.66	5552.38	0.72	0.73	3.85	0.23	5552.61i	n/a	n/a	0.312	0.15	n/a
14	15	2.80	5551.86	5552.85	0.99*	1.04	2.70	0.11	5552.96	n/a	163	5552.19	5553.18	0.99	1.04	2.70	0.11	5553.29i	n/a	n/a	0.217	1.00	n/a
15	15	7.40	5549.91	5551.98	1.25	1.23	6.03	0.57	5552.55	n/a	49	5550.40	5552.63	1.25	1.23	6.03	0.57	5553.19i	n/a	n/a	0.079	1.00	n/a
16	15	2.80	5552.39	5553.21	0.82	0.86	3.26	0.17	5553.38	n/a	66	5552.65	5553.42	0.77	0.79	3.56	0.20	5553.61i	n/a	n/a	0.036	1.00	n/a
17	12	1.90	5552.75	5553.33	0.58*	0.48	3.99	0.25	5553.58	n/a	42	5553.25	5553.83	0.58**	0.48	3.98	0.25	5554.08i	n/a	n/a	n/a	1.00	n/a
18	12	1.30	5548.58	5549.06	0.48*	0.38	3.46	0.19	5549.25	n/a	35	5550.68	5551.16	0.48**	0.38	3.45	0.19	5551.35i	n/a	n/a	n/a	1.00	n/a
19	12	0.90	5544.44	5546.99	1.00	0.79	1.15	0.02	5547.01	0.064	20	5545.60	5547.00	1.00	0.79	1.15	0.02	5547.02	0.064	0.064	0.013	1.00	0.02
20	15	3.20	5546.03	5547.49	1.25	1.23	2.61	0.11	5547.60	0.246	35	5546.37	5547.57	1.20	1.21	2.65	0.11	5547.68	0.214	0.230	0.080	1.40	0.15
21	15	1.90	5546.48	5547.78	1.25	1.23	1.55	0.04	5547.82	0.087	36	5546.59	5547.81	1.22	1.22	1.56	0.04	5547.85	0.077	0.082	0.029	1.00	0.04
22	15	1.10	5551.70	5556.97	1.25	1.23	0.90	0.01	5556.98	0.029	41	5551.94	5556.98	1.25	1.23	0.90	0.01	5557.00	0.029	0.029	0.012	1.00	0.01

Project File: STORM 2-22-08.stm

Number of lines: 23

Run Date: 02-28-2008

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

# Hydraulic Grade Line Computations

Line	Size (in)	Q (cfs)	Downstream								Len (ft)	Upstream								Check		JL coeff (K)	Minor loss (ft)
			Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)		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)		
23	12	3.40	5556.19	5556.97	0.78*	0.66	5.16	0.41	5557.39	n/a	40	5556.44	5557.43	0.99	0.78	4.33	0.29	5557.73i	n/a	n/a	0.048	1.00	n/a

Project File: STORM 2-22-08.stm

Number of lines: 23

Run Date: 02-28-2008

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



# Appendix C

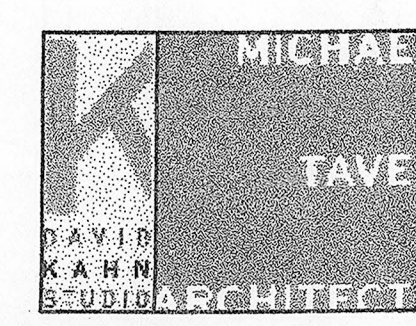
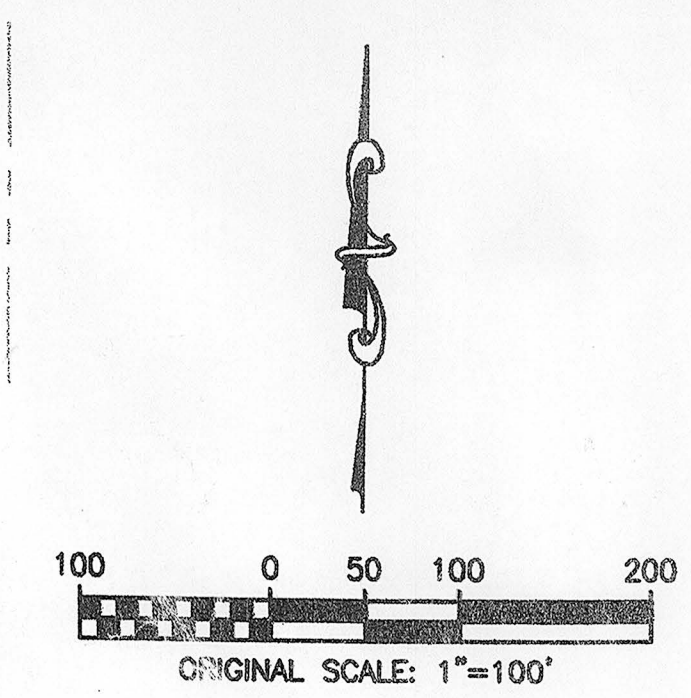
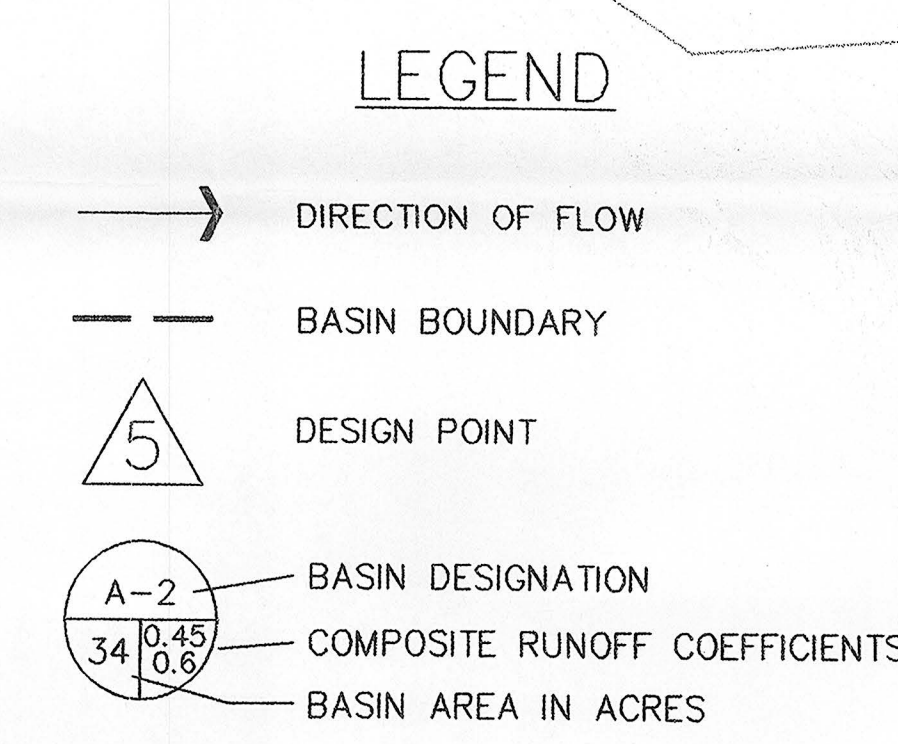
## Drainage Maps

Historic Map 1 of 4  
Developed Map 2 of 4  
Developed Map 3 of 4  
Usage Map 4 of 4



**CALL 2-BUSINESS DAYS IN ADVANCE  
BEFORE YOU DIG, GRADE, OR  
EXCAVATE FOR THE MARKING OF  
UNDERGROUND MEMBER UTILITIES.**

**CALL 2-BUSINESS DAYS IN ADVANCE  
BEFORE YOU DIG, GRADE, OR  
EXCAVATE FOR THE MARKING OF  
UNDERGROUND MEMBER UTILITIES.**



CEOS NEIGHBORHOOD - FDP  
HISTORIC DRAINAGE MAP



**PROJECT MANAGEMENT • CIVIL ENGINEERING  
PLANNING • LANDSCAPE ARCHITECTURE**

333 West Colfax Avenue #500  
Denver, Colorado 80204  
Office 303 / 257-7475 Fax 303 / 895-7341

PREPARED-FOR  
NORBERT KIEBL  
1240 LEHIGH STREET  
BOULDER, COLORADO 80305

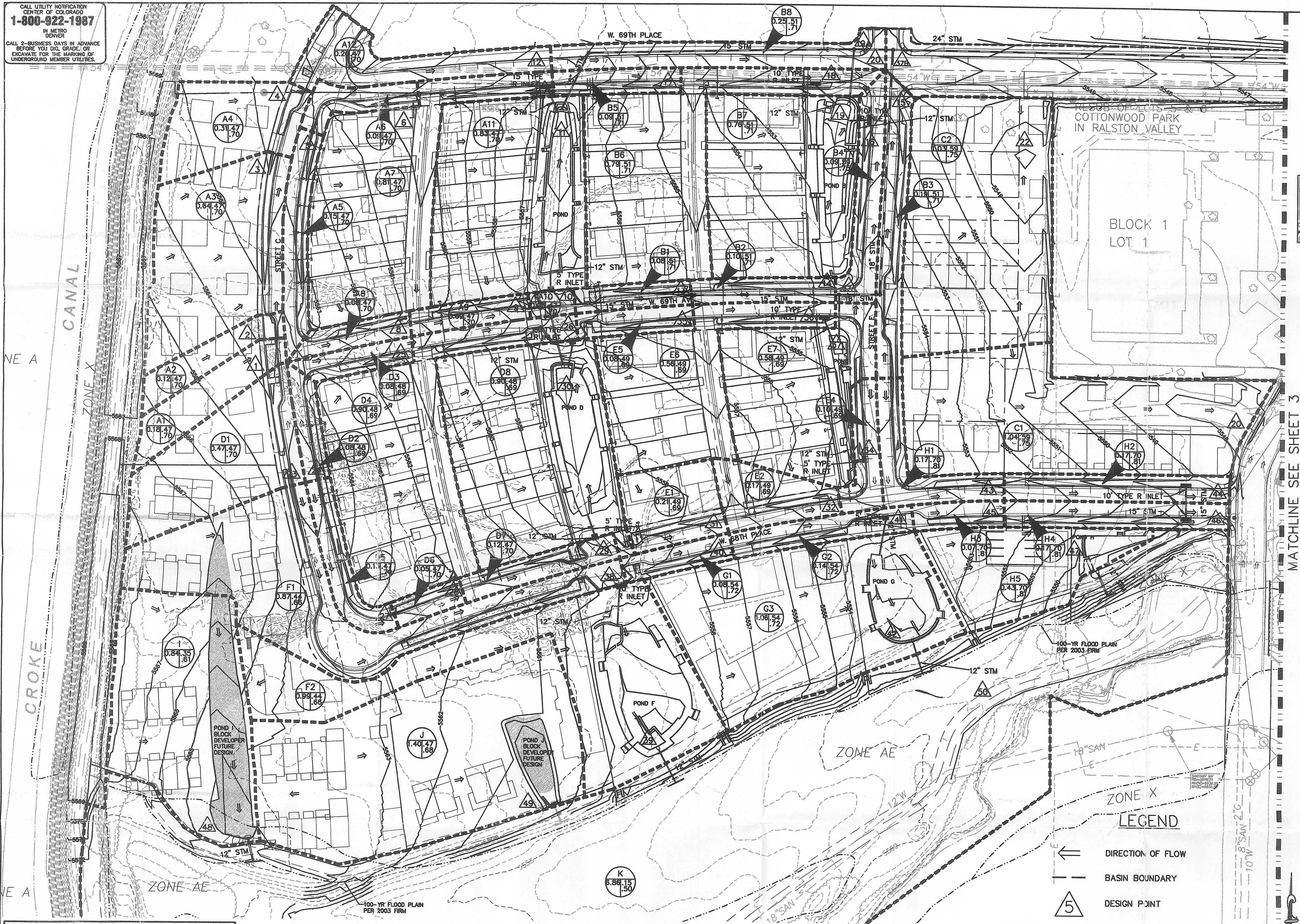
REVISIONS			BY
DATE	DESCRIPTION		
11/09/07	REVISED PER FIRST CITY OF ARVADA COMMENTS		T.J.N
12/07/07	REVISED PER SECOND CITY OF ARVADA COMMENTS		T.J.N
01/07/08	REVISED PER PHASING COMMENTS		T.J.N

DESIGNED BY: TJN  
DRAWN BY: JUP  
CHECKED BY: DSC  
JOB NO: 05-056-01 DATE: 08-01-07

SHEET NUMBER  
1 OF 4



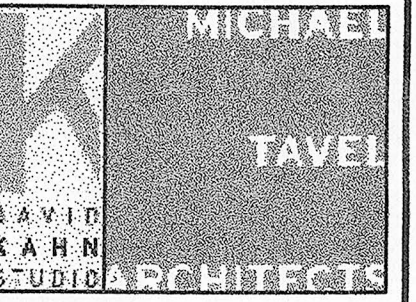
CALL UTILITY NOTIFICATION  
CENTER OF COLORADO  
1-800-922-1987  
IN METRO  
DENVER  
CALL 2-BUSINESS DAYS IN ADVANCE  
BEFORE YOU DIG. GRADE, OR  
EXCAVATE FOR THE MARKING OF  
UNDERGROUND MEMBER UTILITIES.



DETENTION POND SUMMARY					
POND	V _{100yr}	V ₁₀	V ₂	Q ₁₀	Q ₁₀₀
A	0.07	0.16	0.27	1.07	3.59
B	0.04	0.10	0.18	0.70	2.35
C	0.03	0.08	0.16	0.62	2.07
D	0.05	0.12	0.21	0.82	2.75
E	0.06	0.13	0.23	0.90	3.00
F	0.03	0.08	0.13	0.56	1.86
G	0.03	0.06	0.10	0.38	1.28
H	0.02	0.03	0.07	0.27	0.91
I	0.01	0.05	0.06	0.25	0.84

- LEGEND
- DIRECTION OF FLOW
  - BASIN BOUNDARY
  - DESIGN POINT
  - BASIN DESIGNATION
  - COMPOSITE RUNOFF COEFFICIENTS
  - 3.5 & 100 YEAR
  - BASIN AREA IN ACRES

50 0 25 50 100  
ORIGINAL SCALE: 1"=50'



GEOS NEIGHBORHOOD - FDP  
FINAL DRAINAGE MAP

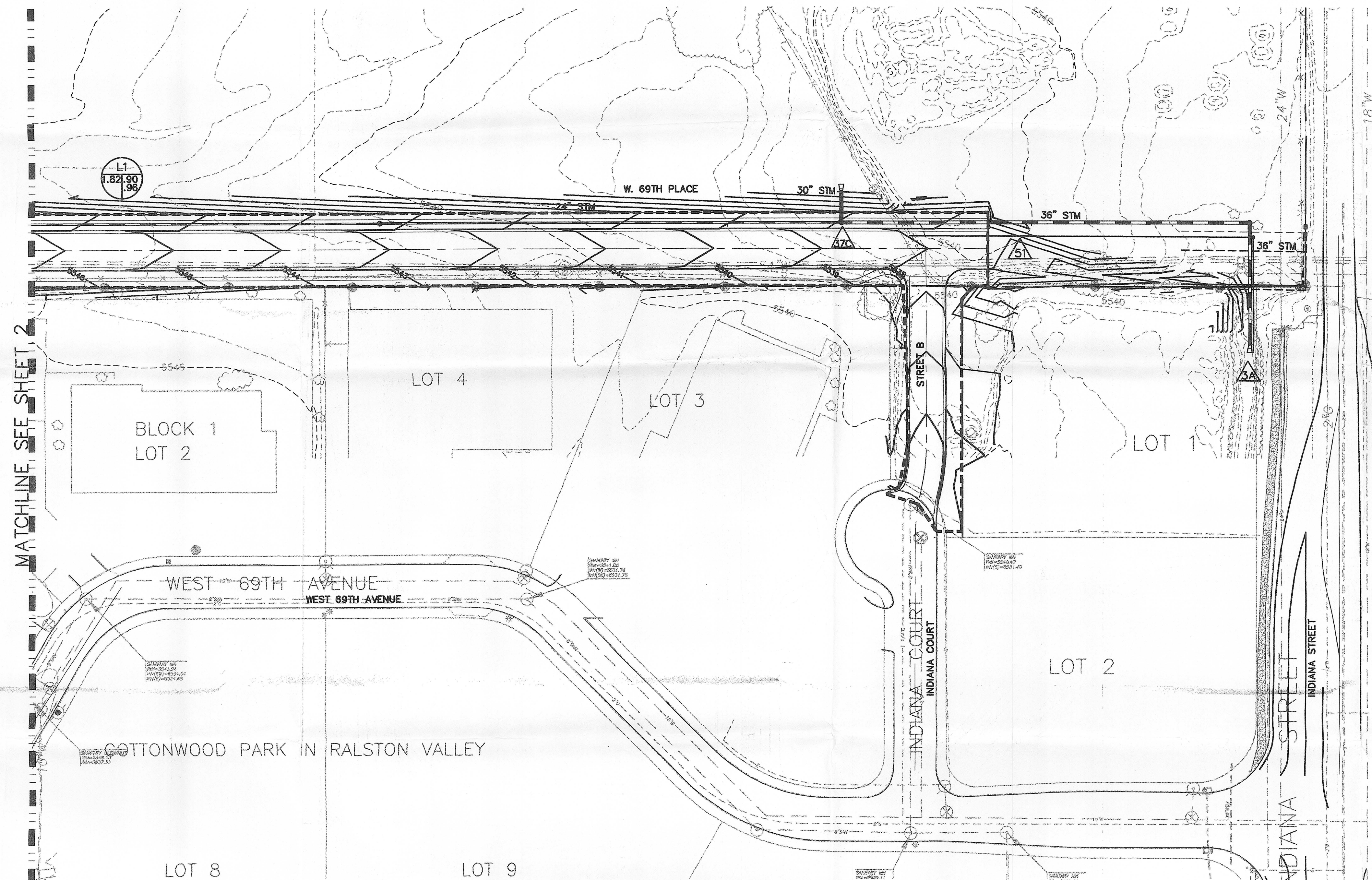
PREPARED FOR  
NORBERT KLEBL  
1240 LEHIGH STREET  
BOULDER, COLORADO 80305

DATE	REVISIONS	DESCRIPTION	BY
11/09/07	REVISED	PER FIRST CITY OF ARVADA COMMENTS	TJN
12/07/07	REVISED	PER SECOND CITY OF ARVADA COMMENTS	TJN
01/07/08	REVISED	PER PHASING COMMENTS	TJN
01/29/08	REVISED	PER ERC COMMENTS ON FRICO ACCESS	TJN
03/04/08	REVISED	PER THIRD ARVADA COMMENTS	TJN

DESIGNED BY: TJN  
DRAWN BY: JUP  
CHECKED BY: DSC  
JOB NO: 05-056-01 DATE: 08-01-07



CALL UTILITY NOTIFICATION  
CENTER OF COLORADO  
1-800-922-1987  
IN METRO  
DENVER  
CALL 2-BUSINESS DAYS IN ADVANCE  
BEFORE YOU DIG, GRADE, OR  
EXCAVATE FOR THE MARKING OF  
UNDERGROUND MEMBER UTILITIES.

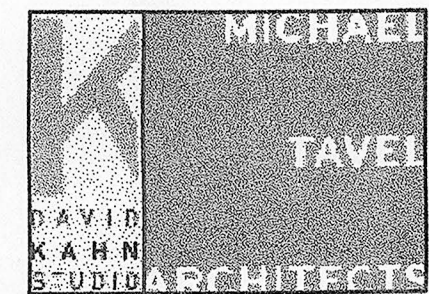
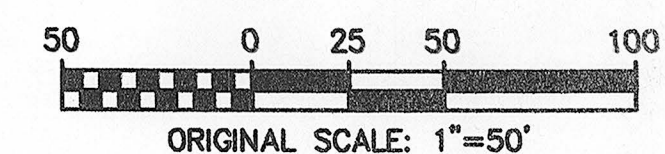


SUMMARY RUNOFF TABLE				
DESIGN PTS	BASIN	AREA(acres)	3.5 YR Q	100 YR Q
1	A1	0.18	0.3	0.8
2	A2	0.12	0.2	0.6
3	A3	0.64	1.1	2.9
4	A4	0.31	0.6	1.4
5	A5	0.15	0.3	0.7
6	A6	0.09	0.2	0.4
7	A7	0.81	1.4	3.5
8	A8	0.08	0.1	0.4
9	A9	0.09	0.2	0.4
10	A10	0.03	0.1	0.1
11	A11	0.83	1.5	4.0
12	A12	0.26	0.5	1.2
13	B1	0.08	0.1	0.4
14	B2	0.10	0.2	0.5
15	B3	0.19	0.4	0.9
16	B4	0.09	0.2	0.4
17	B5	0.09	0.2	0.4
18	B6	0.79	1.3	3.5
19	B7	0.76	1.3	3.5
20	B8	0.25	0.5	1.2
21	C1	1.04	2.3	5.3
22	C2	1.03	2.3	5.1
23	D1	0.47	0.8	2.1
24	D2	0.08	0.1	0.4
25	D3	0.08	0.1	0.4
26	D4	0.90	1.5	3.9
27	D5	0.13	0.2	0.6
28	D6	0.05	0.1	0.2
29	D7	0.12	0.2	0.6
30	D8	0.92	1.6	4.3
31	E1	0.21	0.4	1.0
32	E2	0.17	0.3	0.8
33	E3	REMOVED		
34	E4	0.10	0.2	0.5
35	E5	0.08	0.1	0.4
36	E6	0.56	0.9	2.5
37	E7	0.56	1.0	2.7

SUMMARY RUNOFF TABLE				
DESIGN PTS	BASIN	AREA(acres)	3.5 YR Q	100 YR Q
38	F1	0.87	1.2	3.4
39	F2	0.99	1.4	4.0
40	G1	0.08	0.2	0.4
41	G2	0.31	0.3	0.7
42	G3	1.06	1.9	4.9
43	H1	0.07	0.2	0.4
44	H2	0.17	0.5	0.9
45	H3	0.07	0.2	0.4
46	H4	0.17	0.5	0.9
47	H5	0.43	1.1	0.4
48	I	0.84	0.9	3.3
49	J	1.40	2.2	6.0
50	K	6.89	2.0	17.7
51	L	1.22	5.2	9.2

LEGEND

- ← DIRECTION OF FLOW
- BASIN BOUNDARY
- 5 DESIGN POINT
- A-2 BASIN DESIGNATION  
34 0.45 COMPOSITE RUNOFF COEFFICIENTS  
10.6 3.5 & 100 YEAR  
BASIN AREA IN ACRES



GEOS NEIGHBORHOOD - FDP  
FINAL DRAINAGE MAP

PROJECT MANAGEMENT - CIVIL ENGINEERING  
PLANNING - LANDSCAPE ARCHITECTURE  
MBC  
333 West Colfax Avenue #400 Denver, Colorado 80204  
Office 303.435-7475 Fax 303.435-7341

PREPARED FOR  
NOBBERT KLEBL  
1240 LEHIGH STREET  
BOULDER, COLORADO 80305

REVISIONS		BY
DATE	DESCRIPTION	TJN
11/09/07	REVISED PER FIRST CITY OF ARVADA COMMENTS	TJN
12/07/07	REVISED PER SECOND CITY OF ARVADA COMMENTS	TJN
01/07/08	REVISED PER PHASING COMMENTS	TJN
01/29/08	REVISED PER ERC COMMENTS ON FRICO ACCESS	TJN
03/04/08	REVISED PER THIRD ARVADA COMMENTS	TJN

DESIGNED BY: TJN	SHEET NUMBER <b>3 OF 4</b>
DRAWN BY: JJP	
CHECKED BY: DSC	
JOB NO: 05-056-01 DATE: 08-01-07	



CALL UTILITY NOTIFICATION  
CENTER OF COLORADO  
1-800-922-1987  
IN METRO  
DENVER

CALL 2-BUSINESS DAYS IN ADVANCE  
BEFORE YOU DIG, GRADE, OR  
EXCAVATE FOR THE MARKING OF  
UNDERGROUND MEMBER UTILITIES.

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DENVER

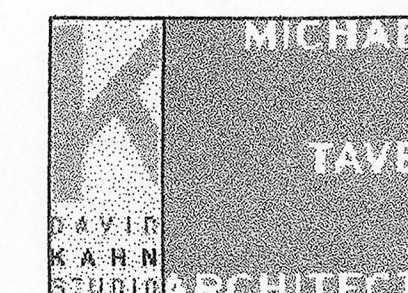
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PROJECT MANAGEMENT • CIVIL ENGINEERING  
PLANNING • LANDSCAPE ARCHITECTURE  
383 First Circle Avenue #500 Denver, Colorado 80204  
Office 303/825-4775 Fax 303/825-7341



# GEOS NEIGHBORHOOD - FDP DRAINAGE MAP USAGE

PREPARED FOR  
NORBERT KLEBEIT  
1540 LEHIGH STREET  
BOULDER, COLORADO 80305



50 0 25 50 100  
ORIGINAL SCALE: 1"=50'

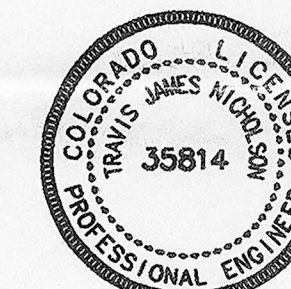
## LEGEND

- RIGHT OF WAY
- EASEMENT
- ROAD CENTERLINE
- CURB AND GUTTER (TYP)
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- DETENTION POND WALL
- STORM LINE
- STORM INLET TYP.
- STORM MANHOLE
- FLOW DIRECTION

PCR = POINT OF CURB RETURN  
PC = POINT OF CURVATURE  
PT = POINT OF TANGENT

- POROUS PAVEMENT
- GRAVEL WALKWAYS
- STONE PAVERS

BENCHMARK #858:  
3" BRASS CAP IN CONCRETE STAMPED "UDFCD RL-3 2002"  
LOCATED WEST OF INDIANA STREET NORTH OF RALSTON  
CREEK TRAIL, 23 FEET NORTHEAST OF THE NORTHWEST END  
OF WING WALL, 16.5 FEET NORTHWEST OF NORTH END OF  
JERSEY BARRIER AND 84 FEET SES OF END OF STEEL GUARD  
RAIL. CITY OF ARVADA DATUM, ELEVATION=5538.77.



THESE CONSTRUCTION PLANS FOR GEOS NEIGHBORHOOD  
WERE PREPARED UNDER THE DIRECT SUPERVISION IN  
ACCORDANCE WITH THE REQUIREMENTS OF THE CITY OF  
ARVADA "ENGINEERING CODE OF STANDARDS AND  
FOR SPECIFICATIONS, THE DESIGN AND CONSTRUCTION OF  
PUBLIC IMPROVEMENTS"  
TRAVIS J. NICHOLSON P.E. 35814, MB CONSULTING, INC.

APPROVED: CITY ENGINEER DATE 3/28/08 JOB NO.

REVIEW IS FOR GENERAL COMPLIANCE WITH THE CITY OF  
ARVADA "ENGINEERING CODE OF STANDARDS AND  
SPECIFICATIONS FOR THE DESIGN AND CONSTRUCTION OF  
PUBLIC IMPROVEMENTS", LATEST EDITION. SOLE RESPONSIBILITY  
FOR COMPLETENESS AND/OR ACCURACY OF THESE  
DOCUMENTS SHALL REMAIN WITH THE REGISTERED  
PROFESSIONAL ENGINEER SEALING THESE PLANS. THE CITY  
DOES NOT ACCEPT LIABILITY FOR FACILITIES DESIGNED BY  
OTHERS.

DATE	REVISIONS	DESCRIPTION	BY
11/09/07	REVISED PER FIRST CITY OF ARVADA COMMENTS		TJN
12/07/07	REVISED PER SECOND CITY OF ARVADA COMMENTS		TJN
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DESIGNED BY: TJN	DATE: 08-01-07
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CHECKED BY: DSC	
JOB NO: 05-056-01	

SHEET NUMBER

4 OF 4