Cincinnati-Dayton Road Drainage Study

Project #: 150594.000

West Chester Township
Butler County, Ohio
Prepared: July 25, 2016

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Appendix A - Cobblers Creek Stormwater Detention Calculations

Project Summary:

At the request of the Butler County Stormwater District, The Kleingers Group investigated an existing private storm sewer system running through several properties on the southern side of the 7500 block of Cincinnati-Dayton Road. This existing storm sewer system has not functioning properly and is causing localized flooding on several of the properties in the area. The Kleingers Group studied the existing system to try and determine the cause of the issue and also has provided a preliminary recommendation to resolve the issue.

An attempt was made to video the existing storm pipes (ranging from 24" diameter to 36" diameter) that are part of this existing storm network to verify the condition of the pipes. Unfortunately, due to the silt and debris within the pipes, only a very small portion of the pipes were able to be video'd. For the portions that were able to be video'd, the pipe conditions varied, as some portions were in decent condition whereas another section was not in good shape and was showing signs of deformation.

As part of the study of the drainage system, watersheds for each of the storm inlets within this network were delineated using Butler County GIS data as well as visual site observations. Runoff coefficients and times-of-concentration were calculated for each watershed within this study area to determine the 10-year flows. The 10-year flows from the watersheds for the two existing detention basin systems within the Cobbler's Creek subdivisions were based on the existing detention calculations provided to us by Butler County (refer to Appendix A for a copy of those calculations). The 10-year flows within this study area were then used to size a new storm sewer network designed to carry a 10-year storm event within the pipes. Once the pipe sizes were determined that would be able to carry the 10-year storm event, the pipe sizes each were increased by one pipe size to account for any debris that could eventually get trapped within these new storm pipes. A copy of the storm calculations can be found on 5 of this report.

The proposed storm network (consisting of pipes ranging from 36" diameter to 48" diameter) is shown in an exhibit on Page 6 of this report. A preliminary option of probable construction cost for the work shown that exhibit is $180,000 and a full breakdown on this cost amount is shown on Page 7 of this report.

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KEYNOTES:

1. NORTHERN DETENTION BASIN
2. SOUTHERN DETENTION BASIN
3. PIPE INLET
4. PIPE INLET
5. PIPE INLET
6. PIPE INLET

OHIO Utilities Protection SERVICE
811 or 1-800-362-2764 Call Before You Dig

NOTE:
UNDERGROUND UTILITIES ARE PLOTTED FROM A COMPILATION OF AVAILABLE RECORD INFORMATION AND SURFACE INDICATIONS OF UNDERGROUND STRUCTURES AND MAY NOT BE INCLUSIVE. PRECISE LOCATIONS AND THE EXISTENCE OR NON EXISTENCE OF UNDERGROUND UTILITIES CANNOT BE VERIFIED. PLEASE NOTIFY THE OHIO UTILITY PROTECTION SERVICE AT 1-800-362-2764 BEFORE ANY PERIOD OF EXCAVATION OR CONSTRUCTION ACTIVITY.

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SEAL:

NO. DATE DESCRIPTION

CINCINNATI DAYTON ROAD DRAINAGE STUDY

7546 CINCINNATI DAYTON RD.
WEST CHESTER TOWNSHIP, OH 45069

PROJECT NO: **150594.000**
DATE: **07/25/2016**
SCALE: 0 50 100 200

SHEET NAME:
DRAINAGE MAP

SHEET NO.
3

THE KLEINGERS GROUP

STORM SEWER COMPUTATIONS

07/25/2016

6305 Centre Park Drive
West Chester, OH 45069
513.779.7851

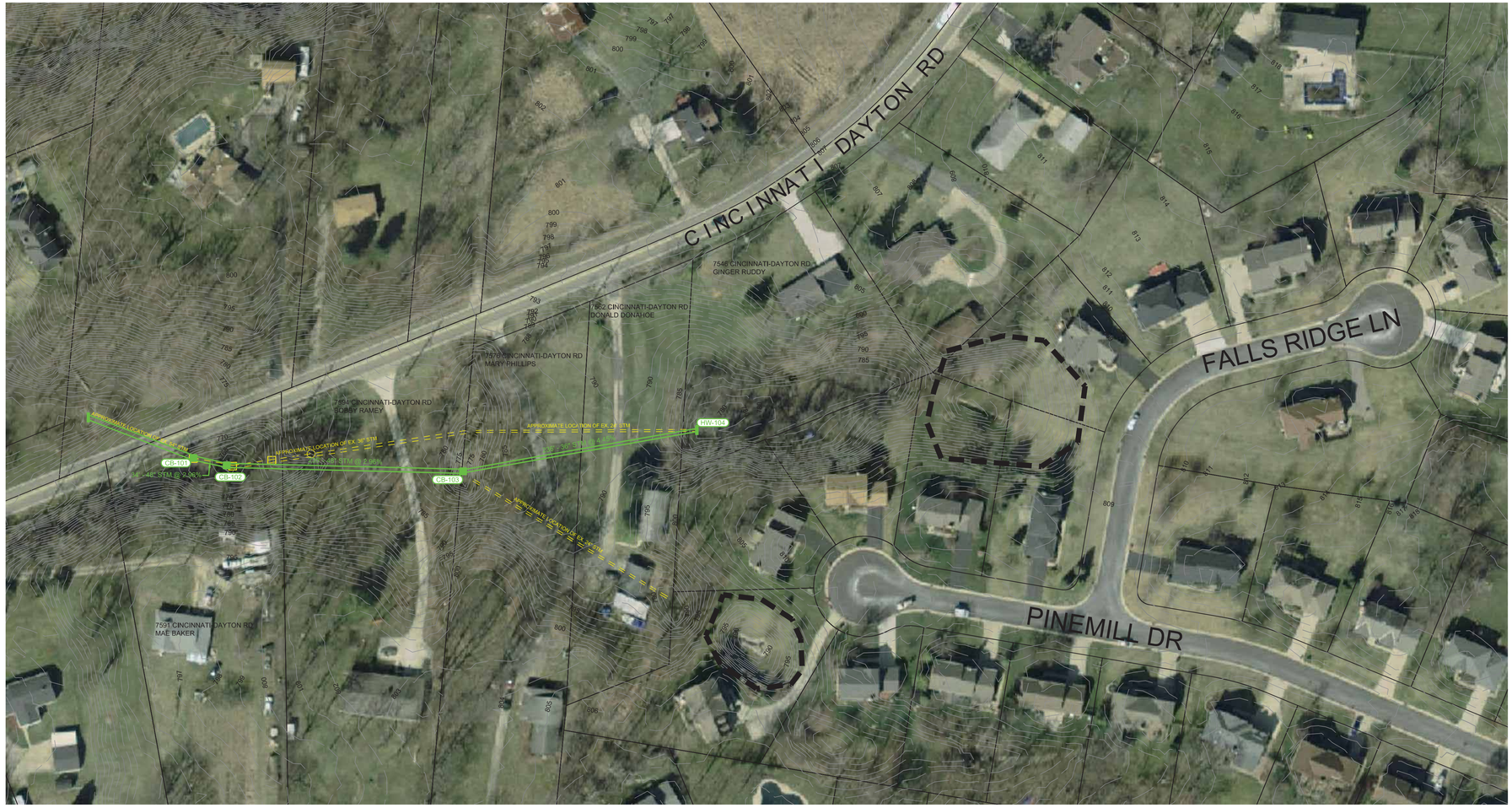
Project: CINCINNATI-DAYTON RD DRAINAGE STUDY
Project Number: 150594

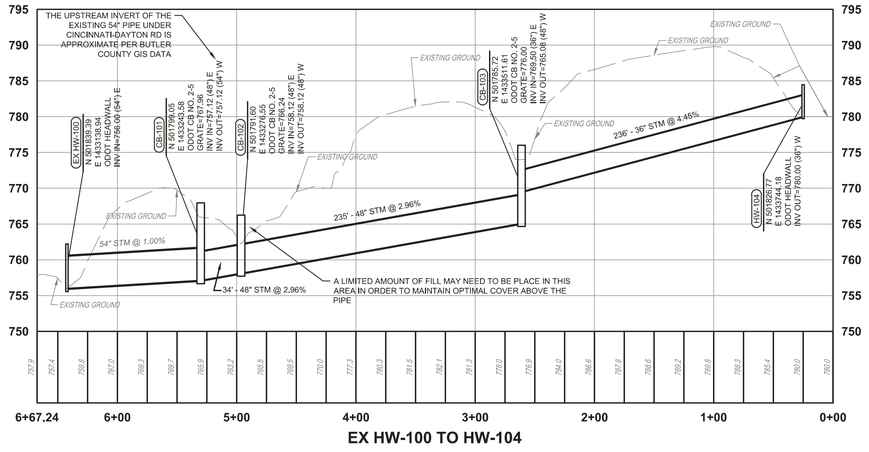
Design Storm: 10.00 yr
Manning's n: 0.013

LOCATION		BASIN DATA										Comments	PIPE DATA									
Inlet	Outlet	ΔA (ac)	ΣA (ac)	ΔT_c (min)	ΣT_c (min)	Design i (in/hr)	Coeff. C	ΔCA (ac)	ΣCA (ac)	Design Discharge (cfs)	Total Design Discharge (cfs)	Total Design Discharge Column Explanation	Pipe Size (in)	Pipe Length (ft)	Pipe Slope (ft/ft)	US Invert (ft)	DS Invert (ft)	Mean Velocity (ft/sec)	Pipe Full Capacity (cfs)	Grate Elevation (ft)	Cover Upstream (ft)	Cover (Downstream) (ft)
	Ex. Basin 1									68.20	68.20	Release rate from Detention 1 per report										
HW-104	CB-103	1.98	1.98	14	14	4.59	0.42	0.83	0.83	3.82	72.02	Q_{10}(HW-104) + Detention 1 cfs	36	236	0.0445	780.00	769.50	19.96	141.06		0.00	1.50
	Ex. Basin 2									15.30	15.30	Release rate from Detention 2 per report										
Existing pipe #1	CB-103	0.78	0.78	13	13	4.72	0.43	0.34	0.34	1.58	16.88	Q_{10}(Existing pipe #1) + Detention 1 cfs	24	225	0.0168	783.50	779.72	9.36	29.40	788.00	0.00	-7.72
CB-103	CB-101	6.58	9.34	25	25	3.54	0.49	3.22	4.39	15.55	99.05	Q_{10}(CB-103) + cfs outlet into CB-103	48	269	0.0296	765.08	757.12	19.72	247.76	774.00	4.92	4.88
CB-101	EX HW-100	1.29	10.63	14	25	3.54	0.46	0.59	4.98	17.65	116.71	Q_{10}(CB-101) + cfs outlet into CB-101	54	112	0.0100	757.12	756.00	12.40	197.18	766.00	4.38	0.00

Designed: ACB

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EX HW-100 TO HW-104

NOTE:
ALL INFORMATION IS BASED OFF OF THE BUTLER COUNTY GIS DATABASE

PRELIMINARY- NOT FOR CONSTRUCTION

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SEAL:

NO.	DATE	DESCRIPTION

CINCINNATI DAYTON ROAD DRAINAGE STUDY

7546 CINCINNATI DAYTON RD.
WEST CHESTER TOWNSHIP, OH
45069

PROJECT NO: **150594.000**
DATE: **07/25/2016**
SCALE: V 0 5 10 20 / H 0 30 60 120

SHEET NAME:
STORM PLAN & PROFILE

SHEET NO.
5

Date: 07/25/2016
Designed By: ACB

CINCINNATI DAYTON ROAD DRAINAGE STUDY

Engineer's Opinion of Probable Costs

THE KLEINGERS GROUP

Item	Description	Actual Quantity	Unit	Unit Price	Total
	DEMOLITION				
1	Existing Storm	455	LF	$25.00	$11,375.00
2	Existing Catch Basin	3	EA	$550.00	$1,650.00
3	Existing Gravel Drive	60	SY	$1.00	$60.00
4	Existing Storm MH	1	EA	$1,000.00	$1,000.00
5	Existing Concrete Drive	30	SY	$5.00	$150.00
6	Sawcut	1	LS	$500.00	$500.00
7	Tree Clearing	1	LS	$24,200.00	$24,200.00
				Demolition Total=	$38,935.00
	ROADWAY				
8	Gravel Driveway	60	SY	$12.00	$720.00
9	Concrete Driveway	30	SY	$75.00	$2,250.00
				Roadway Total=	$2,970.00
	DRAINAGE				
1	36" Storm	236	LF	$125.00	$29,500.00
2	48" Storm	269	LF	$150.00	$40,350.00
3	ODOT Type 2-5 Catch Basin	3	EA	$3,300.00	$9,900.00
4	ODOT Full Height Headwall (36" Pipe)	1	EA	$1,900.00	$1,900.00
				Drainage Total=	$81,650.00
	MISC. UTILITIES				
1	Remove/Replace Water Service Line	4	EA	$5,000.00	$20,000.00
				Misc. Utilites Total=	$20,000.00
	EROSION				
1	Seeding and Mulching	470	SY	$2.00	$940.00
2	Erosion Control	1	LS	$5,000.00	$5,000.00
				Erosion Total=	$5,940.00
				Total Construction Subtotal=	$149,495.00
				20% Design Contingency ± =	$30,505.00
				Grand Total=	$180,000.00

Note: These engineer's quantities are not intended to be all inclusive. It is expected that the contractor will perform a detailed analysis and calculation of all construction materials necessary to complete the job according to the approved set of construction plans.

Based on Concept drawings plans in July, 2016

Appendix A

RATIONAL METHOD OF

RETENTION BASIN DESIGN OF STORAGE VOLUME

(30 acres or less)

Calculate 10 yr. existing flow qo=ACi

L = 700' DIFF. EL. 816.4 - 794 = 32.4 ÷ 7 = 4.63% t_c = 21 MIN

Drainage area, A= 4.3 acres

X

Runoff coefficient, C= 0.4

X

Calculate intensity, i

i = a/b + tc

a = 170

b = 23

tc = 21

$$i = \frac{170}{23 + 21}$$

i = 3.86

=

The allowable release rate, qo, is 6.65 c.f.s.

6.65 + 61.5 (OFFSITE DRAINAGE) = 68.2 cfs

Calculate the 100 yr. proposed flow Qo=ACI max

Drainage area, A= 4.3 acres

Runoff coefficient, C= 0.5

Calculate maximum time of concentration, TC max

a=290

b=31

$$Tcmax = \sqrt{\frac{A \times C \times a \times b}{\frac{2 \times qo}{3} - \frac{qo^2 \times tc}{6 \times C \times A \times a}}} - b$$

$$Tcmax = \sqrt{\frac{4.3 \times 0.5 \times 290 \times 31}{\frac{2 \times 6.65}{3} - \frac{6.65^2 \times 21}{0.5 \times 4.3 \times 290 \times 6}}} - 31$$

Tcmax = 37

Calculate maximum intensity, I max

$$Imax = \frac{a}{b+Tcmax}$$

a=290
b=31

Tcmax = [37]

$$Imax = \frac{290}{31+[37]}$$

Imax =

A = [4.3] acres

x

C = [0.5]

x

Imax = [4.3]

=

[9.2] c.f.s.

The flow at maximum duration, Qo is

CALCULATE STORAGE VOLUME NEEDED

$$Vol = 60 \times Qo \times Tcmax - \frac{2 \times qo \times (TCmax + tc) \times 60}{3} + \frac{qo^2 \times tc \times 60}{6 \times Qo}$$

20,412 15,428 1029.6

$$Vol = 60 \times [9.2] \times [37] - \frac{2 \times [6.65] \times ([37]+[21]) \times 60^{10}}{3} + \frac{[6.65]^2 \times [21] \times 60}{6 \times [9.2]}$$

Vol = [6005] cubic feet PROVIDED 6500 C.F.

ALLOWABLE RELEASE RATE = 68.2 cfs

ORIFICE 3'W x 2.5'H = 7.5 ϕ

$Q = 7.5(0.62)\sqrt{2gh} = 67.7$ cfs ✓

Detention Volumes

Lot 110

Area @ Elev. 787 = 0

" @ " 788 = 500 s.f. $\frac{0+500}{2}(1)$ = 250 c.f.

" @ " 790 = 1250 s.f. $\frac{500+1250}{2}(2)$ = 1750 c.f.

" @ " 792 = 2300 s.f. $\frac{1250+2300}{2}(2)$ = 3550 "

" @ " 794 = 3700 s.f. $\frac{2300+3700}{2}(2)$ = 6000 "

" @ " 796 = 5250 s.f. $\frac{3700+5250}{2}(2)$ = 8950 "

Total 20,500 c.f.

Lot 109

Area @ Elev 794 = 100 s.f.

" " " 796 = 750 s.f. $\frac{100+750}{2}(2)$ = 850 c.f.

Grand Total = 21,350 c.f.

Lots 113-115

Area @ Elev 783.2 = 0

" " " 786 = 800 $\frac{0+800}{2}(2.8)$ = 1120

" " " 788 = 1950 $\frac{800+1950}{2}(2)$ = 2750

" " " 789.2 = 2500 $\frac{1950+2500}{2}(1.2)$ = 2670

Total 6540 c.f.

Capacity C.B. "L" 3.0' Head (from window sill)

From ODOT Chart: 1 Window(4') = 37.9 cfs − 19.8 (Grate Capacity) = 18.10

18.1(3) = 54.3 cfs (3 windows) + 19.8 (Grate) = **74.1 cfs** Total

Lot 1 & 2 Corsicana Creek Block "C"

RATIONAL METHOD OF RETENTION BASIN DESIGN OF STORAGE VOLUME

(30 acres or less)

Calculate 10 yr. existing flow qo=ACi

L=1800' DIFF. ELEV. 839.3-786.5 = 52.8 = 1.93 = 2.93 t_c = 33 Min

Drainage area, A= 12.6 ✓ acres

X

Runoff coefficient, C= 0.4

X

Calculate intensity, i

i = a/b + tc

a = 170

b = 23

tc = 33

$i = \frac{170}{23+33}$

i = 3.04

=

The allowable release rate, qo, is 15.3 c.f.s.

Calculate the 100 yr. proposed flow Qo=ACI max

Drainage area, A= 12.6 ✓ acres

Runoff coefficient, C= 0.5

Calculate maximum time of concentration, TC max

a=290

b=31

$$Tcmax = \sqrt{\frac{A \times C \times a \times b}{\frac{2 \times qo}{3} - \frac{qo^2 \times tc}{6 \times C \times A \times a}}} - b$$

56637

$$Tcmax = \sqrt{\frac{12.6 \times 0.5 \times 290 \times 31}{\frac{2 \times 15.3}{3} - \frac{15.3^2 \times 33}{0.5 \times 12.6 \times 290 \times 6}}} - 31$$

10.2

95

Tcmax = 46.2

Calculate maximum intensity, I max

$$Imax = \frac{a}{b+Tcmax}$$

a=290
b=31

Tcmax = 46.2

$$Imax = \frac{290}{31+46.2}$$

Imax =

A = 12.6 acres

x

C = 0.5

x

Imax = 3.76

=

23.7 c.f.s.

The flow at maximum duration, Qo is

CALCULATE STORAGE VOLUME NEEDED

$$Vol = 60 \times Qo \times Tcmax - \frac{2 \times qo \times (TCmax + tc) \times 60}{3} + \frac{qo^2 \times tc \times 60}{6 \times Qo}$$

$$Vol = 60 \times 23.7 \times 46.2 - \frac{2 \times 15.3 \times (46.2 + 33) \times 60}{3} + \frac{15.3^2 \times 33 \times 60}{6 \times 23.7}$$

Vol = 20,485 cubic feet PROVIDED 20,600 c.f.

ALLOWABLE RELEASE RATE = 15.3 cfs ✓

ORIFICE SIZE 15" ϕ H = 6.55'

$Q = 1.2272(0.62)\sqrt{2g(6.55)} = 15.6$ cfs ✓ CLOSE ENUFF!

n_{RCP} = 0.013 n_{36} = 0.013 n_{42} = 0.013 $n_{12"}$ = 0.011 $n_{15"}$ = 0.013 n_{18} 0.014 $n_{24"}$ = 0.016

TOWN SEWER DESIGN FOR BLOCK "C" COBBLERS CREEK BY JJD

JOHN J. DUFFY & ASSOCIATES Q=ACi RUNOFF COEFFICIENT (C) 0.50 Craig 6-25-90 DATE 6-4-90

Street	From	To	Dist. ft.	Time (Min.) Inc.	Time (Min.) Total	Area (Acres) Inc.	Area (Acres) Total	Runoff (Q) c.f.s.	Grade %	Size in.	Cap. c.f.s.	Vel. f.p.s.
PINEMILL DR	CB "A"	CB "B"	270'		15.0		2.6 ✓	5.8	2.3	12" ✓	5.17 7.05	9.0
" "	CB "B"	CB "C"	306	0.5	15.5	2.7 ✓	5.3	11.7 ✓	2.0	18" ✓	12.89 13.8 ✓	7.8
" "	CB C	CB D	360'	0.65	16.15	3.1 ✓	8.4	18.2 ✓	1.5	24" ✓	24.01 22.5 ✓	7.2
" "	CB D	CB E	250'	0.83	18.0	1.9 ✓	10.3	21.4 ✓	1.0	30" ✓	29.6 ✓	6.0
" "	CB E	CB F	223'	0.7	18.7	1.9 ✓	12.2	24.9 ✓	1.0	30" ✓	29.6 ✓	6.0
" "	CB F	CB G	98'	0.6	19.3	1.4 ✓	13.6	27.3 ✓	2.4	30" ✓	45.9 ✓	9.3
" "	CB G	HW "H"	73'	0.2	19.5	0.4 ✓	14.0 ✓	28.0 ✓	6.0	24" ✓	48.03 45.0 ✓	14.3
DETENTION OUTLET	CB-2-3	HW-4	44'				14.0	28.0 ✓	2.4	30" ✓	45.9 ✓	9.4
FALLS RIDGE LA	CB "Q"	CB "R"	88'		14.0		2.2 ✓	5.1 ✓	1.0	15" ✓	6.61 6.6 ✓	5.2
	CB "R"	CB "M"	28'	0.3	14.3	0.3 0.6	2.5	5.7 ✓	1.0	15" ✓	6.61 6.6 ✓	5.2
T CB "K" D.A =	34.0 Ac.	L = 1600'	Diff El = 823 - 809 =	34'		Slope	= 34/1600 = 2.13%	t_c =	24 Min.	C=0.5		
FALL RIDGE LA	CB "K"	CB "L"	95'		24.0		34.0 ✓	61.5 ✓	3.6	36" ✓	86.56 ✓	12.2
" " "	CB "L"	CB "M"	108'	0.1	24.1	0.3 ✓	34.3	61.9 ✓	3.6	36" ✓	86.56 ✓	12.2
" " "	CB "M"	MH "N"	175'	0.1	24.2	2.9 ✓	37.2	67.0 ✓	2.4%	36" ✓	70.7 ✓	10.0
" " "	MH "N"	CB "O"	94	0.3	24.5	— ✓	37.2	66.6 ✓	2.4	36" ✓	70.7 ✓	10.0
" " "	CB "O"	HW "P"	114'	0.2	24.7	2.4 ✓	39.6 ✓	70.6 ✓	3.8	36" ✓	88.9 ✓	12.6
OUTLET	CB-2-4	HW-4	36'					70.6 ✓	3.0	36" ✓	79.0 ✓	11.2

CATCH BASIN 2-3 OR 2-4 GRATE AND WINDOW WITH NO CLOGGING

H MEASURED FROM WINDOW SILL TOP OF GRATE IS 11 INCHES ABOVE WINDOWSILL

	WIDTH OF WINDOW (FT)							
H	0	2	3	4	5	6	7	8
.1	.0	1.6	2.4	3.2	4.1	4.9		
.2	.0	2.3	3.4	4.6	5.8	6.9		
.3	.0	2.8	4.2	5.7	7.1	8.5		
.4	.0	3.2	4.9	6.5	8.2	9.8		
.5	.0	3.6	5.5	7.3	9.2	11.0		
.6	.0	4.0	6.0	8.0	10.1	12.1		
.7	.0	4.3	6.5	8.7	10.9	13.0		
.8	.0	4.6	6.9	9.3	11.6	13.9		
.9	.0	4.9	7.4	9.8	12.3	14.8		
1.0	.7	5.9	8.5	11.1	13.7	16.3		
1.1	2.0	7.5	10.2	12.9	15.7	18.4		
1.2	3.7	9.4	12.3	15.2	18.0	20.9	23.8	26.7
1.3	5.8	11.7	14.7	17.7	20.6	26.5		
1.4	8.1	14.3	17.3	20.4	23.5	28.2		
1.5	10.6	17.0	20.1	23.3	26.5	29.7		
1.6	11.4	18.0	21.3	24.6	27.9	31.2		
1.7	12.2	19.0	22.4	25.8	29.2	32.6		
1.8	12.9	19.9	23.4	26.9	30.4	33.9		
1.9	13.7	20.8	24.4	28.0	31.6	35.2		
2.0	14.3	21.7	25.4	29.1	32.8	36.4		
2.1	15.0	22.5	26.3	30.1	33.9	37.6		
2.2	15.6	23.3	27.2	31.0	34.9	38.8		
2.3	16.2	24.1	28.0	32.0	35.9	39.9		
2.4	16.7	24.8	28.9	32.9	36.9	41.0		
2.5	17.3	25.5	29.7	33.8	37.9	42.0		
2.6	17.8	26.2	30.4	34.6	38.8	43.0		
2.7	18.3	26.9	31.2	35.5	39.6	44.0		
2.8	18.8	27.6	31.9	36.3	40.7	45.0		
2.9	19.3	28.2	32.6	37.1	41.5	46.0		
3.0	19.8	28.8	33.4	37.9	42.4	46.9	51.4	55.9
3.1	20.3	29.5	34.0	38.6	43.2	47.8		
3.2	20.7	30.1	34.7	39.4	44.1	48.7		
3.3	21.2	30.6	35.4	40.1	44.9	49.6		
3.4	21.6	31.2	36.0	40.8	45.7	50.5		
3.5	22.0	31.8	36.7	41.6	46.4	51.3		
3.6	22.5	32.4	37.3	42.3	47.2	52.2		
3.7	22.9	32.9	37.9	42.9	48.0	53.0		
3.8	23.3	33.4	38.5	43.6	48.7	53.8		
3.9	23.7	34.0	39.1	44.3	49.4	54.6		
4.0	24.1	34.5	39.7	44.9	50.2	55.4		
4.1	24.5	35.0	40.3	45.6	50.9	56.1		
4.2	24.8	35.5	40.9	46.2	51.6	56.9		
4.3	25.2	36.0	41.4	46.8	52.3	57.7		
4.4	25.6	36.5	42.0	47.5	52.9	58.4		
4.5	25.9	37.0	42.5	48.1	53.6	59.1		
4.6	26.3	37.5	43.1	48.7	54.3	59.9		
4.7	26.7	38.0	43.6	49.3	54.9	60.6		
4.8	27.0	38.4	44.1	49.9	55.6	61.3		
4.9	27.4	38.9	44.7	50.4	56.2	62.0		
5.0	27.7	39.4	45.2	51.0	56.8	62.7		
5.1	28.0	39.8	45.7	51.6	57.5	63.4		
5.2	28.4	40.3	46.2	52.1	58.1	64.0		
	28.7	40.7	46.7	52.7	58.7	64.7		

COBBLERS CREEK, BLOCK "C"
ESTIMATE OF PEAK DISCHARGE
USGS REPORT 86-4197

$A = 34$ Ac. $= 0.053$ sq. Mi

$SL = 843 - 809 / .30 mi = 113.3'/Mi$

$EL = 843 + 809 / 2(1000) = 0.826$

BDF (5)

$$Q_{10} = 192(A)^{0.76}(SL)^{0.34}(EL)^{0.91}(13-BDF)^{-0.34}$$

$$Q_{10} = 192(0.053)^{0.76}(113.3)^{0.34}(0.826)^{0.91}(8)^{-0.34}$$

$$Q_{10} = (20.6)(5.0)(0.84)(0.49) = \underline{42.4 \text{ cfs}}$$

$$Q_{25} = 209(0.053)^{0.78}(113.5)^{0.37}(0.826)^{1.00}(8)^{-0.29}$$

$$Q_{25} = (21.14)(5.76)(0.826)(0.55) = \underline{55.3 \text{ cfs}}$$

Q_{10} By RATIONAL METHOD $= \underline{61.5 \text{ cfs}}$

PERSONNAL

℄ π

GF ϕ

BUTLER COUNTY ENGINEER'S OFFICE AND OPERATIONS FACILITY
1921 FAIRGROVE AV. HAMILTON, OH 45011

ROAD

LOCATION

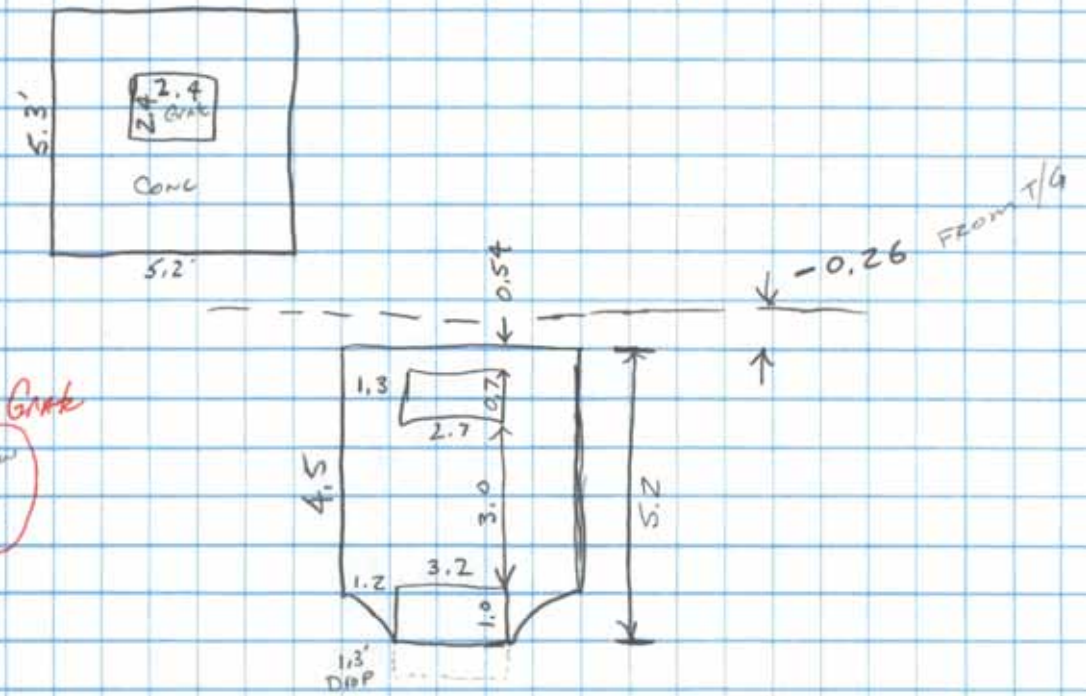
SHEET NO 1/1

DATE 8-13-02

WEATHER SUNNY

TEMP.

PROJ. NO. Cobblers Creek Det. Basin



Depths From Grate
6.5 by Window
7.1' by Pipe

80.48 Top of Grate
80.22 Top of Dam

DETENTION BASIN TOTAL DEPTH: 5.2 - 0.26 = 4.94' → TOP OF LEVEE TO CB ORIFICE

DEPTH FROM CB WINDOW: 3 + (1 - 0.5) = 3.50' => H
(TO CENTROID OF ORIFICE)

ORIFICE EQUATION: $Q = C \cdot AREA \sqrt{2gH}$ C = 0.60

$= 0.6 \cdot 3.2 \sqrt{2 \cdot 32.17 \cdot 3.5}$

$= 1.92 \sqrt{225.4}$

$= 1.92 \cdot 15.01$

$= 28.819$ CFS

WINDOW
A = 1.89 SQFT
H = 0.63' — DUE TO LOWER LEVEE ELEVATION
Q = 7.22

AREA OF 36" 7.06 SQ FT
24" 3.14 SQ FT
18" 1.77 SQ FT

TOTAL Q TO 36" CMP = 28.82 + 7.22
= 36.04 CFS