ENGINEERING

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STORMWATER DETENTION ANALYSIS
PREPARED BY: BAX ENGINEERING CO., INC.
CROOKED CREEK (Monticello phase 5)- O'FALLON
BAX PROJECT NO. **94-4896**
September 27, 2000

INTRODUCTION:

This tract of land is presently an existing residential subdivision located in the City of O'Fallon, Missouri. The 25.74 acre tract contains a lake that is used for detention purposes. The lake was detaining the storm water longer than desired, so a new outlet was developed with a higher release rate. The storage volume and outflow rates shall be proportioned to insure that the peak rate of runoff leaving the tract under post-developed conditions is less than or equal to the peak rate of runoff under pre-developed conditions for the 2, 15, and 25 year-20 minute design storm. The basin was also analyzed for the 100-year frequency - 20 minute duration design storm.

GENERAL SITE DATA AND RUNOFF CALCULATIONS:

The pre-developed P.I. factors to be used for the analysis are:

2 year - 5% impervious	1.15 cfs/ac.
15 year - 5% impervious	1.87 cfs/ac.
25 year - 5% impervious	2.31 cfs/ac.
100 year - 5% impervious	2.95 cfs/ac.

The post-developed P.I. factors to be used for the analysis are:

2 year - 40% impervious	1.61 cfs/ac.
15 year - 40% impervious	2.64 cfs/ac.
25 year - 40% impervious	3.26 cfs/ac.
100 year - 40% impervious	4.17 cfs/ac.

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TIME OF CONCENTRATION:

Of the inflows to the basin, the most remote point lies to the west near lot 13. Flows will travel approximately 485 feet overland to CI 9 then 200 feet via storm pipe to the detention basin. Time of concentration is estimated as follows:

T(overland): L = 485 feet
Elevation difference = 489 - 484 = 5 feet
T(overland) = 2 minutes: See figure 1

T(storm pipe): L = 200 feet (estimated velocity 7 feet per second)
T(storm pipe) = .48 minutes:

Total 2.48 min >> Use **2** min.

BASIN PEAK INFLOWS:

Inflows to the basin have been estimated from the drainage area map.

2 year-20 minute storm:	81.48 cfs
15 year-20 minute storm:	133.61 cfs
25 year-20 minute storm:	164.82 cfs
100 year-20 minute storm:	211.04 cfs

OUTFLOW STRUCTURE:

The outflow structure consist of the following:

Pipe size	Length	Flow line	Slope
8" PVC (existing)	40	478.00	FLAT
15" RCP	40	478.00	FLAT
15" RCP	40	478.00	FLAT
15" RCP	40	478.00	FLAT

STORM ROUTING CALCULATIONS AND RESULTS:

The computer program "Pondpack 7.0" was used in routing the 2, 15, and 25 year-20 minute storm through the basin. As found in the routing calculations, the results are as follows:

20 MIN STORM	PERMITTED RELEASE RATE	CALCULATED RELEASE RATE	PEAK ELEVATION
2 YR	70.00 cfs	4.24 cfs	478.59
15 YR	113.79 cfs	9.08 cfs	478.96
25 YR	156.58 cfs	12.03 cfs	479.17

CHECK 100-YEAR OUTFLOW: (low-flow blocked)

If the outflow should be blocked the lake would act as a retention lake. The 100 yr high water would be at

SUMMARY

2 year-20min H.W.	478.59
15 year-20min H.W.	478.96
25 year-20min H.W.	479.17
100 year-20min H.W.(low flow blocked)	479.53
Top Of Berm	482.80

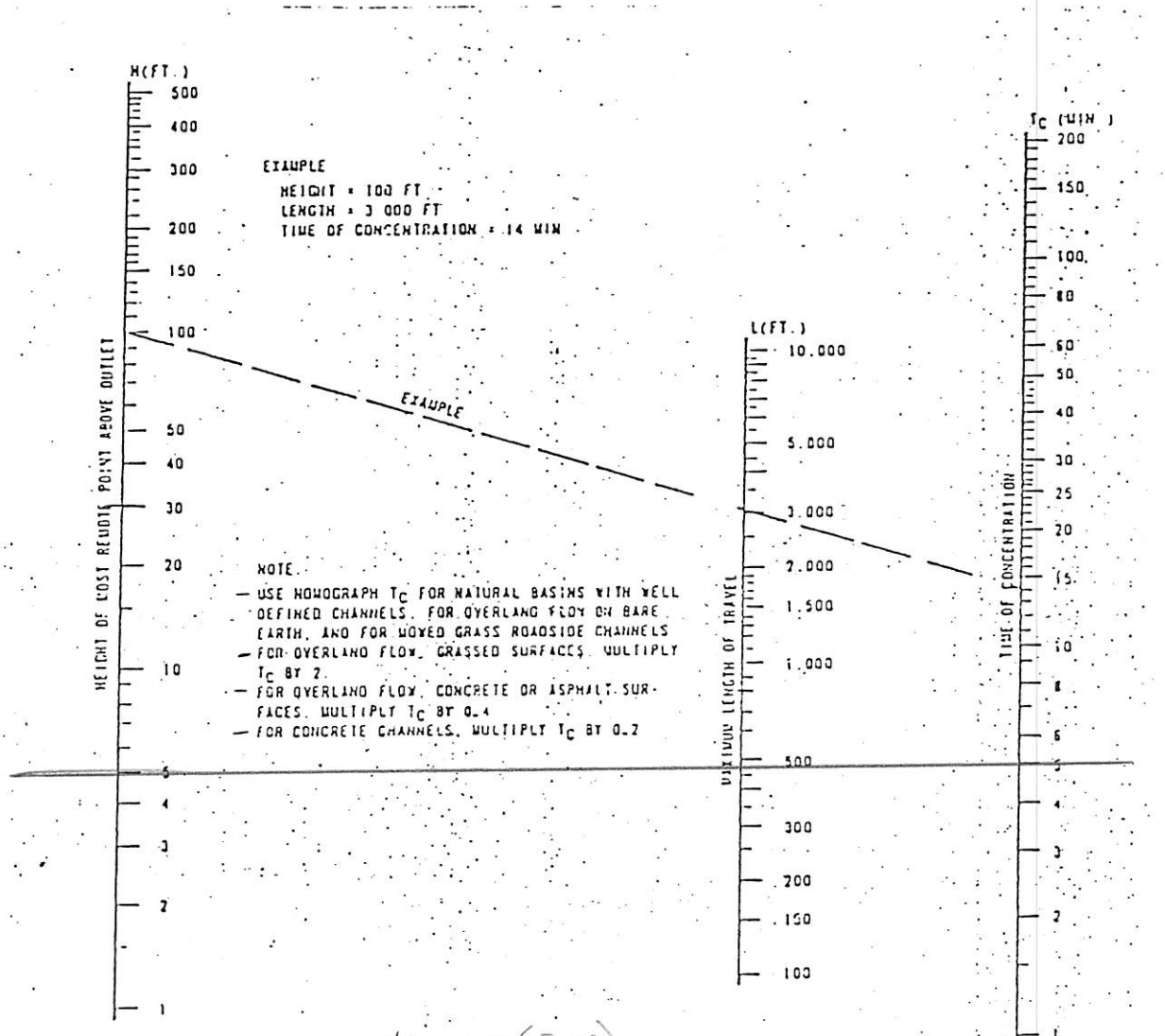
BAX ENGINEERING

SHEET ___ of ___

Project: CROOKED CREEK (Monticello)

Date: 9-27-00 Project No: 94-4896

Designed: TCF Checked: RLF



$t_c = 0.4 (5.00)$

$= 2 \text{ min}$

FIGURE 1

TIME OF CONCENTRATION OF SMALL DRAINAGE BASINS

152 South Cloverleaf Drive
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Table of Contents

File.... C:\HAESTAD\PPKW\SAMPLE\TFRR.PPW

POND VOLUME CALCULATIONS

Planimeter scale: 1.00 ft/in

Elevation (ft)	Planimeter (sq.in)	Area (acres)	A1+A2+sqr(A1*A2) (acres)	Volume (ac-ft)	Volume Sum (ac-ft)
478.00	158123.000	3.6300	.0000	.000	.000
480.00	173805.000	3.9900	11.4258	7.617	7.617
482.00	212138.000	4.8700	13.2681	8.845	16.463

POND VOLUME EQUATIONS

* Incremental volume computed by the Conic Method for Reservoir Volumes.

Volume = (1/3) * (EL2-EL1) * (Area1 + Area2 + sq.rt.(Area1*Area2))

where: EL1, EL2 = Lower and upper elevations of the increment
Area1,Area2 = Areas computed for EL1, EL2, respectively
Volume = Incremental volume between EL1 and EL2

REQUESTED POND WS ELEVATIONS:

Min. Elev.= 478.00 ft
Increment = .50 ft
Max. Elev.= 482.00 ft

****
OUTLET CONNECTIVITY
****

---> Forward Flow Only (UpStream to DnStream)
<--- Reverse Flow Only (DnStream to UpStream)
<---> Forward and Reverse Both Allowed

Structure	No.		Outfall	E1, ft	E2, ft
Culvert-Circular	2	--->	TW	478.000	482.000
Culvert-Circular	1	--->	TW	478.000	482.000

TW SETUP, DS Channel

OUTLET STRUCTURE INPUT DATA

Structure ID	=	2	
Structure Type	=	Culvert-Circular	
No. Barrels	=	1	
Barrel Diameter	=	8.00	in
Upstream Invert	=	478.00	ft
Dnstream Invert	=	478.00	ft
Horiz. Length	=	40.00	ft
Barrel Length	=	40.00	ft
Barrel Slope	=	.00000	ft/ft

OUTLET CONTROL DATA...

Mannings n	=	.0090	
Ke	=	.5000	(forward entrance loss)
Kb	=	.025737	(per ft of full flow)
Kr	=	.5000	(reverse entrance loss)
HW Convergence	=	.001	+/- ft

INLET CONTROL DATA...

Equation form	=	1
Inlet Control K	=	.0098
Inlet Control M	=	2.0000
Inlet Control c	=	.03980
Inlet Control Y	=	.6700
T1 ratio (HW/D)	=	1.160
T2 ratio (HW/D)	=	1.307
Slope Factor	=	-.500

Use unsubmerged inlet control Form 1 equ. below T1 elev.
Use submerged inlet control Form 1 equ. above T2 elev.

In transition zone between unsubmerged and submerged inlet control, interpolate between flows at T1 & T2...
At T1 Elev = 478.77 ft ---> Flow = 1.00 cfs
At T2 Elev = 478.87 ft ---> Flow = 1.14 cfs

OUTLET STRUCTURE INPUT DATA

Structure ID = 1
Structure Type = Culvert-Circular

No. Barrels	=	3	
Barrel Diameter	=	15.00	in
Upstream Invert	=	478.00	ft
Dnstream Invert	=	478.00	ft
Horiz. Length	=	40.00	ft
Barrel Length	=	40.00	ft
Barrel Slope	=	.00000	ft/ft

OUTLET CONTROL DATA...

Mannings n	=	.0130	
Ke	=	.5000	(forward entrance loss)
Kb	=	.023225	(per ft of full flow)
Kr	=	.5000	(reverse entrance loss)
HW Convergence	=	.001	+/- ft

INLET CONTROL DATA...

Equation form	=	1
Inlet Control K	=	.0098
Inlet Control M	=	2.0000
Inlet Control c	=	.03980
Inlet Control Y	=	.6700
T1 ratio (HW/D)	=	1.161
T2 ratio (HW/D)	=	1.307
Slope Factor	=	-.500
Calc inlet only	=	Yes

Use unsubmerged inlet control Form 1 equ. below T1 elev.
Use submerged inlet control Form 1 equ. above T2 elev.

In transition zone between unsubmerged and submerged inlet control, interpolate between flows at T1 & T2...
At T1 Elev = 479.45 ft ---> Flow = 4.80 cfs
At T2 Elev = 479.63 ft ---> Flow = 5.49 cfs

Structure ID = TW
Structure Type = TW SETUP, DS Channel

FREE OUTFALL CONDITIONS SPECIFIED

CONVERGENCE TOLERANCES...

Maximum Iterations	=	30
Min. TW tolerance	=	.01 ft
Max. TW tolerance	=	.01 ft
Min. HW tolerance	=	.01 ft
Max. HW tolerance	=	.01 ft
Min. Q tolerance	=	.10 cfs

Max. Q tolerance = .10 cfs

S/N: f21101d06a84 Bax Engineering
PondPack Ver: 7.0 (325) Compute Time: 10:37:01 Date: 09-27-2000

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = 2 (Culvert-Circular)

Mannings open channel maximum capacity: .00 cfs
Upstream ID = (Pond Water Surface)
DNstream ID = TW (Pond Outfall)

WS Elev,Device Q Tail Water Notes

WS Elev. ft	Q cfs	TW Elev ft	Converge +/-ft	Computation Messages
478.00	.00	Free Outfall		
		Upstream HW & DNstream TW < Inv.El		
478.50	.42	Free Outfall		
		BACKWATER CONTROL.. Vh= .048ft hwDi= .427ft Lbw= 40.0ft		
479.00	1.13	Free Outfall		
		FULL FLOW...Lfull=20.57ft Vh=.164ft HL=.333ft		
479.50	1.64	Free Outfall		
		FULL FLOW...Lfull=36.51ft Vh=.341ft HL=.833ft		
480.00	2.04	Free Outfall		
		FULL FLOW...Lfull=39.00ft Vh=.533ft HL=1.334ft		
480.50	2.39	Free Outfall		
		FULL FLOW...Lfull=39.58ft Vh=.728ft HL=1.833ft		
481.00	2.69	Free Outfall		
		FULL FLOW...Lfull=39.80ft Vh=.924ft HL=2.333ft		
481.50	2.97	Free Outfall		
		FULL FLOW...Lfull=39.89ft Vh=1.121ft HL=2.833ft		
482.00	3.22	Free Outfall		
		FULL FLOW...Lfull=39.94ft Vh=1.319ft HL=3.333ft		

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = 1 (Culvert-Circular)

Mannings open channel maximum capacity: .00 cfs
Upstream ID = (Pond Water Surface)
DNstream ID = TW (Pond Outfall)

NUMBER OF BARRELS = 3
EACH FLOW = SUM OF BARRELS x FLOW FOR ONE BARREL

WS Elev,Device Q Tail Water Notes

WS Elev. ft	Q cfs	TW Elev ft	Converge +/-ft	Computation Messages
478.00	.00	Free Outfall		
		Upstream HW & DNstream TW < Inv.El		
478.50	2.59	Free Outfall		
		INLET CONTROL...	Equ.1: HW =.50	dc=.365 Ac=.2980
479.00	8.49	Free Outfall		
		INLET CONTROL...	Equ.1: HW =1.00	dc=.676 Ac=.6772
479.50	14.96	Free Outfall		
		INLET CONTROL...	Transition: HW =1.50	
480.00	19.90	Free Outfall		
		INLET CONTROL...	Submerged: HW =2.00	
480.50	23.80	Free Outfall		
		INLET CONTROL...	Submerged: HW =2.50	
481.00	27.14	Free Outfall		
		INLET CONTROL...	Submerged: HW =3.00	
481.50	30.11	Free Outfall		
		INLET CONTROL...	Submerged: HW =3.50	
482.00	32.81	Free Outfall		
		INLET CONTROL...	Submerged: HW =4.00	

File.... C:\HAESTAD\PPKW\SAMPLE\TFRR.PPW

***** COMPOSITE OUTFLOW SUMMARY ****

WS Elev, Total Q		Converge		Notes
Elev. ft	Q cfs	TW Elev ft	Error +/-ft	Contributing Structures
478.00	.00	Free Outfall		None contributing
478.50	3.01	Free Outfall		2 +1
479.00	9.63	Free Outfall		2 +1
479.50	16.60	Free Outfall		2 +1
480.00	21.95	Free Outfall		2 +1
480.50	26.19	Free Outfall		2 +1
481.00	29.83	Free Outfall		2 +1
481.50	33.08	Free Outfall		2 +1
482.00	36.03	Free Outfall		2 +1

SUMMARY FOR HYDROGRAPH ADDITION
at Node: P 10 IN

HYG Directory: C:\HAESTAD\PPKW\SAMPLE\

Upstream Link ID	Upstream Node ID	HYG file	HYG ID	HYG tag
A 10	READ HYG	10	2 yr	

INFLOWS TO: P 10 IN

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time min	Peak Flow cfs
	2 yr		2.245	2.00	81.48

TOTAL FLOW INTO: P 10 IN

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time min	Peak Flow cfs
	P 10 IN	02	2.245	2.00	81.48

TOTAL NODE INFLOW...
HYG file =
HYG ID = P 10 IN
HYG Tag = 02

Peak Discharge =	81.48 cfs
Time to Peak =	2.00 min
HYG Volume =	2.245 ac-ft

HYDROGRAPH ORDINATES (cfs)
Output Time increment = 1.00 min
Time on left represents time for first value in each row.

Time min					
.00	.00	40.74	81.48	81.48	81.48
5.00	81.48	81.48	81.48	81.48	81.48
10.00	81.48	81.48	81.48	81.48	81.48
15.00	81.48	81.48	81.48	81.48	81.48
20.00	81.48	40.74	.00		

SUMMARY FOR HYDROGRAPH ADDITION
at Node: P 10 IN

HYG Directory: C:\HAESTAD\PPKW\SAMPLE\

Upstream Link ID	Upstream Node ID	HYG file	HYG ID	HYG tag
A 10	READ HYG 10		15 yr	

INFLOWS TO: P 10 IN

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time min	Peak Flow cfs
	15 yr		3.681	2.00	133.61

TOTAL FLOW INTO: P 10 IN

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time min	Peak Flow cfs
	P 10 IN	15	3.681	2.00	133.61

TOTAL NODE INFLOW...
HYG file =
HYG ID   = P 10   IN
HYG Tag = 15

Peak Discharge =	133.61 cfs
Time to Peak =	2.00 min
HYG Volume =	3.681 ac-ft

HYDROGRAPH ORDINATES (cfs)
Output Time increment = 1.00 min
Time on left represents time for first value in each row.

Time min					
.00	.00	66.81	133.61	133.61	133.61
5.00	133.61	133.61	133.61	133.61	133.61
10.00	133.61	133.61	133.61	133.61	133.61
15.00	133.61	133.61	133.61	133.61	133.61
20.00	133.61	66.81	.00		

Type.... Node: Pond Inflow Summary
Name.... P 10 IN
File.... C:\HAESTAD\PPKW\SAMPLE\TFRR.PPW
Storm... 25 Tag: 25

SUMMARY FOR HYDROGRAPH ADDITION
at Node: P 10 IN

HYG Directory: C:\HAESTAD\PPKW\SAMPLE\

Upstream Link ID	Upstream Node ID	HYG file	HYG ID	HYG tag
A 10	READ HYG 10		25 yr	

INFLOWS TO: P 10 IN

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time min	Peak Flow cfs
	25 yr		4.541	2.00	164.82

TOTAL FLOW INTO: P 10 IN

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time min	Peak Flow cfs
	P 10 IN	25	4.541	2.00	164.82

Type.... Node: Pond Inflow Summary
Name.... P 10 IN
File.... C:\HAESTAD\PPKW\SAMPLE\TFRR.PPW
Storm... 25 Tag: 25

TOTAL NODE INFLOW...
HYG file =
HYG ID = P 10 IN
HYG Tag = 25

Peak Discharge =	164.82 cfs
Time to Peak =	2.00 min
HYG Volume =	4.541 ac-ft

HYDROGRAPH ORDINATES (cfs)
Output Time increment = 1.00 min
Time on left represents time for first value in each row.

Time min					
.00	.00	82.41	164.82	164.82	164.82
5.00	164.82	164.82	164.82	164.82	164.82
10.00	164.82	164.82	164.82	164.82	164.82
15.00	164.82	164.82	164.82	164.82	164.82
20.00	164.82	82.41	.00		

Type.... Node: Pond Inflow Summary
Name.... P 10 IN
File.... C:\HAESTAD\PPKW\SAMPLE\TFRR.PPW
Storm... 100 Tag: 100 low flow blocked

SUMMARY FOR HYDROGRAPH ADDITION
at Node: P 10 IN

HYG Directory: C:\HAESTAD\PPKW\SAMPLE\

Upstream Link ID	Upstream Node ID	HYG file	HYG ID	HYG tag
A 10	READ HYG 10		100yr	

INFLOWS TO: P 10 IN

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time min	Peak Flow cfs
	100yr		5.814	2.00	211.04

TOTAL FLOW INTO: P 10 IN

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time min	Peak Flow cfs
	P 10 IN	100	5.814	2.00	211.04

S/N: f21101d06a84 Bax Engineering
PondPack Ver: 7.0 (325) Compute Time: 09:58:13 Date: 09-27-2000

Type.... Node: Pond Inflow Summary
Name.... P 10 IN
File.... C:\HAESTAD\PPKW\SAMPLE\TFRR.PPW
Storm... 100 Tag: 100 low flow blocked

TOTAL NODE INFLOW...
HYG file =
HYG ID = P 10 IN
HYG Tag = 100

Peak Discharge =	211.04 cfs
Time to Peak =	2.00 min
HYG Volume =	5.814 ac-ft

HYDROGRAPH ORDINATES (cfs)
Output Time increment = 1.00 min
Time on left represents time for first value in each row.

Time min					
.00	.00	105.52	211.04	211.04	211.04
5.00	211.04	211.04	211.04	211.04	211.04
10.00	211.04	211.04	211.04	211.04	211.04
15.00	211.04	211.04	211.04	211.04	211.04
20.00	211.04	105.52	.00		

Type.... Pond Routing Summary
Name.... P 10 OUT Tag: 02
File.... C:\HAESTAD\PPKW\SAMPLE\TFRR.PPW
Storm... 02 Tag: 02

LEVEL POOL ROUTING SUMMARY

HYG Dir = C:\HAESTAD\PPKW\SAMPLE\
Inflow HYG file = NONE STORED - P 10 IN 02
Outflow HYG file = NONE STORED - P 10 OUT 02

Pond Node Data = P 10
Pond Volume Data = P 10
Pond Outlet Data = PR 144

No Infiltration

INITIAL CONDITIONS

Starting WS Elev	=	478.00 ft
Starting Volume	=	.000 ac-ft
Starting Outflow	=	.00 cfs
Starting Infiltr.	=	.00 cfs
Starting Total Qout	=	.00 cfs
Time Increment	=	1.00 min

INFLOW/OUTFLOW HYDROGRAPH SUMMARY

Peak Inflow	=	81.48 cfs	at	2.00 min
Peak Outflow	=	4.24 cfs	at	22.00 min
Peak Elevation	=	478.59 ft		
Peak Storage	=	2.184 ac-ft		

MASS BALANCE (ac-ft)

+ Initial Vol	=	.000
+ HYG Vol IN	=	2.245
- Infiltration	=	.000
- HYG Vol OUT	=	2.220
- Retained Vol	=	.025
Unrouted Vol	=	-.000 ac-ft (.011% of Inflow Volume)

WARNING: Outflow hydrograph truncated on right side.

Type.... Pond Routing Summary
Name.... P 10 OUT Tag: 15
File.... C:\HAESTAD\PPKW\SAMPLE\TFRR.PPW
Storm... 15 Tag: 15

LEVEL POOL ROUTING SUMMARY

HYG Dir = C:\HAESTAD\PPKW\SAMPLE\
Inflow HYG file = NONE STORED - P 10 IN 15
Outflow HYG file = NONE STORED - P 10 OUT 15

Pond Node Data = P 10
Pond Volume Data = P 10
Pond Outlet Data = PR 144

No Infiltration

INITIAL CONDITIONS

Starting WS Elev	=	478.00 ft
Starting Volume	=	.000 ac-ft
Starting Outflow	=	.00 cfs
Starting Infiltr.	=	.00 cfs
Starting Total Qout	=	.00 cfs
Time Increment	=	1.00 min

INFLOW/OUTFLOW HYDROGRAPH SUMMARY

Peak Inflow	=	133.61 cfs	at	2.00 min
Peak Outflow	=	9.08 cfs	at	22.00 min
Peak Elevation	=	478.96 ft		
Peak Storage	=	3.562 ac-ft		

MASS BALANCE (ac-ft)

+ Initial Vol	=	.000
+ HYG Vol IN	=	3.681
- Infiltration	=	.000
- HYG Vol OUT	=	3.645
- Retained Vol	=	.035
Unrouted Vol	=	-.000 ac-ft (.011% of Inflow Volume)

WARNING: Outflow hydrograph truncated on right side.

Type.... Pond Routing Summary
Name.... P 10 OUT Tag: 25
File.... C:\HAESTAD\PPKW\SAMPLE\TFRR.PPW
Storm... 25 Tag: 25

LEVEL POOL ROUTING SUMMARY

HYG Dir = C:\HAESTAD\PPKW\SAMPLE\
Inflow HYG file = NONE STORED - P 10 IN 25
Outflow HYG file = NONE STORED - P 10 OUT 25

Pond Node Data = P 10
Pond Volume Data = P 10
Pond Outlet Data = PR 144

No Infiltration

INITIAL CONDITIONS

Starting WS Elev	=	478.00 ft
Starting Volume	=	.000 ac-ft
Starting Outflow	=	.00 cfs
Starting Infiltr.	=	.00 cfs
Starting Total Qout	=	.00 cfs
Time Increment	=	1.00 min

INFLOW/OUTFLOW HYDROGRAPH SUMMARY

Peak Inflow	=	164.82 cfs	at	2.00 min
Peak Outflow	=	12.03 cfs	at	22.00 min
Peak Elevation	=	479.17 ft		
Peak Storage	=	4.379 ac-ft		

MASS BALANCE (ac-ft)

+ Initial Vol	=	.000
+ HYG Vol IN	=	4.541
- Infiltration	=	.000
- HYG Vol OUT	=	4.500
- Retained Vol	=	.040
Unrouted Vol	=	-.000 ac-ft (.010% of Inflow Volume)

WARNING: Outflow hydrograph truncated on right side.

Type.... Pond Routing Summary
Name.... P 10 OUT Tag: 100
File.... C:\HAESTAD\PPKW\SAMPLE\TFRR.PPW
Storm... 100 Tag: 100 low flow blocked

LEVEL POOL ROUTING SUMMARY

HYG Dir = C:\HAESTAD\PPKW\SAMPLE\
Inflow HYG file = NONE STORED - P 10 IN 100
Outflow HYG file = NONE STORED - P 10 OUT 100

Pond Node Data = P 10
Pond Volume Data = P 10
Pond Outlet Data = NONE (retention pond)

No Infiltration

INITIAL CONDITIONS

Starting WS Elev	=	478.00 ft
Starting Volume	=	.000 ac-ft
Starting Outflow	=	.00 cfs
Starting Infiltr.	=	.00 cfs
Starting Total Qout	=	.00 cfs
Time Increment	=	1.00 min

INFLOW/OUTFLOW HYDROGRAPH SUMMARY

Peak Inflow	=	211.04 cfs	at	2.00 min
Peak Outflow	=	.00 cfs	at	1.00 min
Peak Elevation	=	479.53 ft		
Peak Storage	=	5.748 ac-ft		

MASS BALANCE (ac-ft)

+ Initial Vol	=	.000
+ HYG Vol IN	=	5.814
- Infiltration	=	.000
- HYG Vol OUT	=	.000
- Retained Vol	=	5.748
Unrouted Vol	=	-.065 ac-ft (1.124% of Inflow Volume)

WARNING: Mass balance for routing volumes vary by more than .5%

BAX ENGINEERING

Project: CROOKED CREEK ESTATES
Date: 3/22/94 Project No: 93-4896
Designed: E.O.K. Checked: _____

STORM WATER DETENTION ANALYSIS

1.) AREA OF SITE = 25.74 A^c

2.) PRE-DEVELOPED R.I. FACTOR OF SITE: 2.31 C.F.S./A^c (25YR-20 MIN. STORM)
POST-DEVELOPED R.I. FACTOR OF SITE: 3.26 C.F.S./A^c (25YR.-20MIN. STORM)

3.) REQUIRED ATTENUATION = 25.74 A^c × (3.26 C.F.S./A^c − 2.31 C.F.S./A^c)
(25YR.-20 MIN. STORM) = 24.45 C.F.S. (ASSUMES FULL RESIDENTIAL DEVELOPMENT OF ENTIRE 25.74 A^c - CONSERVATIVE SINCE IT DOES NOT SEPERATE OUT COMMON GROUND AREAS)

4.) DETENTION BASIN VOLUMES:

ELEV.	AREA (A^c)	AVG. AREA (A^c.)	INCREMENT DEPTH (FT.)	INCREMENT VOL. (FT.)	TOTAL VOLUME (AC.-FT.)
479.0	4.32			0	0
		4.465	1.0		
480.0	4.61			4.465	4.465
		4.98	2.0		
482.0	5.35			9.96	14.425

5.) FROM DRAINAGE AREA MAP OF PROJECT, FLOW TO BASIN IS:
$Q_{25/20}$ = 135.35 C.F.S.
∴ $Q_{25/20}$ = 135.35 C.F.S. × (1.15/1.1) × (1.18) = 166.97 C.F.S.
∴ $Q_{100/20}$ = 135.35 C.F.S. × (1.25/1.1) × (1.39) = 213.79 C.F.S.

6.) It is anticipated that due to the overall size of the lake/detention basin, approximately 100% of the total 25 year-20 minute inflow to the basin as well as approximately 100% of the total 100 year-20 minute inflow to the basin will be detained with a minimal discharge through the outflow pipe which shall provide for the normal pool elevation at 479.0.

STATE OF MISSOURI
SCOTT O. KOLKMEYER
NUMBER E-24744
REGISTERED PROFESSIONAL ENGINEER
3/22/94

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7.) Based on the "1800 rule" the volume required to detain the 25 yr.-20 min. storm inflow is:
Vol. = 166.97 c.f.s. × 1800 = 6.90 A^c-Ft. (provided at elevation 480.49)

The volume required to detain the 100 yr.-20 min storm inflow is:
Vol. = 213.79 c.f.s. × 1800 = 8.83 A^c-Ft. (provided at elevation 480.88)

8.) An 8 inch discharge pipe shall be installed with an upstream flowline at 479.0 to limit the normal pool elevation to 479.0. A flap gate will be installed to prohibit creek flow from backing up into the basin. The 25 year-20 min storm discharge and 100 year-20 min storm discharge is estimated as:

$Q_{25/20} = .6(a)\sqrt{2gh}$ $\quad a = 0.349$ Ft.^{2}
$= .6(0.349)\sqrt{2(32.2)1.82}$ $\quad h = (480.49 - 479.0) + (4/12) = 1.82$
$= 2.27$ c.f.s.

(Permitted release rate = 166.97 c.f.s. - 24.45 c.f.s. = 142.52 c.f.s. ✓)

Approximately 98.64 % of the total 25 yr.-20 min. inflow is detained. $(\frac{164.7}{166.97} = 0.9864)$

$Q_{100/20} = .6(a)\sqrt{2gh}$ $\quad a = 0.349$ Ft.^{2}
$= .6(.349)\sqrt{2(32.2)2.21}$ $\quad h = (480.88 - 479.0) + (9/12) = 2.21$
$= 2.50$ c.f.s.

Approximately 98.83% of the total 100yr.-20 min. inflow is detained. $(\frac{211.29}{213.79} = 0.9883)$

9.) The top of berm of the detention basin/lake is proposed at 482.8. The 100 year storm elevation assuming the discharge pipe blocked is 480.88. 1.92 feet of freeboard is provided when the discharge pipe is assumed blocked therefore an emergency spillway is not proposed.

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BAX ENGINEERING

SHEET 1 of 2

Project: CROOKED CREEK ESTATES

Date: 3/22/94 Project No: 93-1896

Designed: S.O.K. Checked:

Rev. 7/18/94

STORM WATER DETENTION ANALYSIS

1.) AREA OF SITE = 25.74 A^c

2.) PRE-DEVELOPED R.I. FACTOR OF SITE: 2.31 C.F.S./A^c (25YR-20 MIN. STORM)
POST-DEVELOPED R.I. FACTOR OF SITE: 3.26 C.F.S./A^c (25 YR.-20 MIN. STORM)

3.) REQUIRED ATTENUATION = 25.74 A^c × (3.26 C.F.S./A^c − 2.31 C.F.S./A^c)
(25YR.-20 MIN. STORM) = 24.45 C.F.S. (ASSUMES FULL RESIDENTIAL DEVELOPMENT OF ENTIRE 25.74 A^c − CONSERVATIVE SINCE IT DOES NOT SEPERATE OUT COMMON GROUND AREAS)

4.) DETENTION BASIN VOLUMES:

ELEV.	AREA (A^c)	AVG. AREA (A^c.)	INCREMENT DEPTH (FT.)	INCREMENT VOL. (AC-FT.)	TOTAL VOLUME (AC.-FT.)
478º	3.63				0
		3.81	2.0	7.62	
480º	3.99				7.62
		4.43	2.0	8.86	
482º	4.87				16.48

5.) FROM DRAINAGE AREA MAP OF PROJECT, FLOW TO BASIN IS:
$Q_{15/20}$ = 133.61 C.F.S.
∴ $Q_{25/20}$ = 133.61 C.F.S. × (1.15/1.1) × (1.18) = 164.83 C.F.S.
∴ $Q_{100/20}$ = 133.61 C.F.S. × (1.25/1.1) × (1.39) = 211.04 C.F.S.

6.) It is anticipated that due to the overall size of the lake/detention basin approximately 100% of the total 25 year-20 minute inflow to the basin as well as approximately 100% of the total 100 year-20 minute inflow to the basin may be detained with a minimal discharge through the outflow pipe which shall provide for the normal pool elevation at 478º.

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Project: CROOKED CREEK ESTATES
Date: 3/22/94 Project No: 93-4896
Designed: _____ Checked: _____

7.) Based on the "1800 rule" the volume required to detain the 25 yr.-20 min. storm inflow is:
Vol. = 164.83 c.f.s. × 1800 = 6.81 Ac-Ft. (provided at elevation 479.79)

The volume required to detain the 100 yr.-20 min storm inflow is:
Vol. = 211.04 c.f.s. × 1800 = 8.72 Ac-Ft. (provided at elevation 480.25)

8.) An 8 inch discharge pipe shall be installed with an upstream flowline at 478.0 to limit the normal pool elevation to 478.0. A flap gate will be installed to prohibit creek flow from backing up into the basin. The 25 year-20 min storm discharge and 100 year-20 min storm discharge is estimated as:

$Q_{25/20} = .6(a)\sqrt{2gh}$ $a = 0.349$ Ft.^{2}
$= .6(0.349)\sqrt{2(32.2)2.12}$ $h = (479.79 - 478.0) + (4/12) = 2.12$
$= 2.45$ C.F.S.

(Permitted release rate = 164.83 c.f.s. - 24.45 c.f.s. = 140.38 c.f.s. ✓)

Approximately 98.51 % of the total 25 yr.-20 min. inflow is detained. ($\frac{162.38}{164.83} = 0.985$

$Q_{100/20} = .6(a)\sqrt{2gh}$ $a = 0.349$ Ft.^{2}
$= .6(.349)\sqrt{2(32.2)2.21}$ $h = (480.25 - 478.0) + (4/12) = 2.58$
$= 2.58$ C.F.S.

Approximately 98.78% of the total 100yr.-20 min. inflow is detained. ($\frac{208.46}{211.04} = 0.9878$

9.) The top of berm of the detention basin/lake is proposed at 482.8. The 100 year storm elevation assuming the discharge pipe blocked is 480.25. 2.55 feet of freeboard is provided when the discharge pipe is assumed blocked therefore an emergency spillway is not proposed.

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