

STORM DRAINAGE ANALYSIS

CROSSROADS

I-164 & Lloyd Expressway
Evansville, Indiana
BLA Project No. 193-0133-OPD

Prepared for:

HARTMANN FARM LAND TRUST
c/o Joseph Ream
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By:

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(revised)

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INTRODUCTION

The Hartmann Farm Land Trust owns a large tract of land which lies in the northwest quadrant of the I-164/Lloyd Expressway interchange. The developer of the property, Joseph Ream, is actively pursuing development of the property.

The original drainage plan, as presented and approved in January 1994 is no longer applicable due to changes in the development plan. Subsequent to the original drainage approval, the Owner/Developer successfully rezoned a portion of the property. A five (±) acre tract of this property has been sold. Development plans are underway for site improvements. With this in mind, the Owner/Developer is hereby resubmitting, in conjunction with a plat, a drainage plan for approval

The first stage of the proposed development entails the construction of roadway improvements and storm detention basins No. 1 and 2A. These roadways are necessary to provide proper access to and from the project and the basins are required for the proper development of Lots 1 through 5. In order to properly design and drain these proposed roads, the basins will serve as a borrow source for the roadway subgrade and provide a vehicle into which the storm sewers draining the roadway can empty.

The proposed development lies in an area that is very flat and has a slight gradient from east to west toward the Nurrenbern Ditch. Said ditch is a Legal Drain which flows from south to north along the west line of said development. The site development is being marketed as six parcels shown on the marketing plat in Appendix A. There are three primary detention areas planned for the site strategically located along the north/south road which will help drain the roadway and surrounding areas.

The developers of Lots 2 through 5 shall utilize Basin 1 located near the south end of the project adjacent to the Lloyd Expressway. The total contributory area for this basin will be 7.81 acres. This area and basin are hereby submitted for final approval.

That part of this drainage report that addresses Lots 1 through 5 shall be considered as request for final drainage approval. The storm drainage facilities for these lots will be constructed and installed as part of the roadway construction planned for Spring 1995.

The remainder of the property shown as Lot 6 on the subdivision plat is to be considered a preliminary drainage plan submitted to satisfy the requirements of the Vanderburgh County Area Plan Commission (APC). The ability to sell real estate by the square foot rather than by platted lots, which is crucial in the marketing of real

estate, prohibits the submittal of the final drainage plan for the remainder of the property.

The developers of Lot 1, which contains 5.5 acres, and the south 28± acres of Lot 6 shall use Basin No 2. This basin located along the north/south collector road will also facilitate the drainage from the roadway. The total contributing area will be 39.5 acres, more or less. Basin No. 2A directly north of Lot 1 is hereby submitted for final approval to satisfy the requirements for Lot No. 1. Basin No. 2B is submitted for *preliminary* approval to meet certain APC criteria whereby a drainage plan must be approved prior to plat approval. As required in the ordinance, we will depict a probable location and configuration of Basin No. 2B, its estimated depth, the amount of storage required, and the available freeboard based upon existing site conditions. The Basin No. 2B presented in this preliminary plan as shown is a workable plan in accordance with the same criteria presented in that portion of this report being submitted as a *final* drainage plan, however, the Owner reserves the right to resubmit another plan meeting the criteria which best meets his development plan.

The developers of the north end of Lot 6 shall use Basin 3 located north of the future northern roadway extension. Construction of future sections of roadway and accompanying Basin No. 3 is also being submitted for *preliminary* approval to meet certain APC criteria as stated above. The total contributory area being equal to 16.3 acres.

Additional sections of roadway, known as Virginia Street and Cross Pointe Boulevard, will be constructed in the right-of-way provided offsite. These roadways will be adequately drained and runoff conveyed by sewer to the Nurrenbern Ditch within the available right-of-way. Borrow material required for the construction of these sections of roadway will come from Basin No. 2. All of the storm sewers associated with the planned roadway construction, including the large culvert to be placed in the Nurrenbern Ditch, are also submitted for approval.

A set of construction plans for said roadways is available upon request.

METHOD

The purpose of this report is to establish the storm water storage requirements for this area and establish the appropriate outfall structure for each of the three basins. In addition, the large culvert crossing beneath the proposed Virginia Street extension and the storm sewers which drain the proposed roadway improvements will be analyzed.

The Rational Method ($Q = CIA$) will form the basis for this analysis. The inflow/outflow analysis will be calculated so as to determine the storage requirements needed to preserve the runoff rate from the existing 10 year storm and store the additional runoff generated by the developed 25 year storm.

- A value of 0.2 will be used for the undeveloped runoff coefficient ("c"). This is a value that has been accepted by the local authorities to best describe those drainage characteristics for that portion of the east side of Evansville from green River Road east to the county line and from the Lloyd Expressway north to Morgan Avenue.
- A rainfall intensity of 1.82 was selected from Table 3 for a 10 year storm, 60 minute duration.
- The allowable outflow rates calculated using the values of 0.2 and 1.82 listed above for each basin based on the planned contributory area listed above are as follows:

- Basin 1 - 2.84 CFS $Q = (0.2)(1.82)(7.81)$
- Basin 2 - 14.38 CFS $Q = (0.2)(1.82)(39.5)$
- Basin 3 - 5.93 CFS $Q = (0.2)(1.82)(16.3)$

Refer to the input/output data sheets shown in Appendix B.

- The developed runoff coefficients for each area have been calculated and weighted as shown in Appendix C.
- The resulting storage requirements were calculated as shown in Appendix B and are listed as follows:
 - Basin 1 (25 yr.) - 44,786 CF
 - Basin 2 (25 yr.) - 214,315 CF
 - Basin 3 (25 yr.) - 91,911 CF
- All outlet structures will be piped to the Nurrenbern Ditch and allowable outlet rates will be controlled as stated in Appendix D. The results are as follows:
- All basins have pool elevations of 386.50 at which primary outlet flows begin.
 - Basin 1 - 15" outlet pipe (2.84 CFS @ elevation 387.50)
 - Basin 2 - Twin 21" outlet pipes (14.38 CFS @ elevation 388.10)
 - Basin 3 - 21" outlet pipe (5.93 CFS @ elevation @ 387.84)
- All erosion control ditches shall be implemented in accordance with the drainage ordinance.
- All basins shall be constructed as shown in Appendix E providing the storage listed thereon. Basin 1 as constructed under Phases 1 and 4 of the roadway improvements will provide 100% of the storm requirements for Lots 2

through 5. Basin 2A will provide for 100% of the Lot 1 requirement and part of the Lot 6 requirement. Basin No. 1B submitted for *preliminary* approval as per the Vanderburgh County Drainage Ordinance will provide the additional storage. The developer of Lot 6 will be required to submit this basin or another drainage plan to the drainage board for approval at a later date. Any deviation from this plan must be approved by the Vanderburgh County Drainage Board prior to implementation. Basin No. 3 is also being submitted for preliminary approval. These basins shall be constructed as shown or rearranged and relocated to meet the owner's needs. Any deviation from this plan, however, must be approved by the Vanderburgh County Drainage Board prior to implementation.

- A separate hydraulic analysis of the culvert required for the Virginia Street extension was undertaken. The outline of predicted flows and output data are published in Appendix F. A combined flow of 316 CFS was calculated as the demand and a 12'x4' box culvert with a flow of 326 CFS at the assumed overtopping elevation of 390.00 will handle the demand. The actual box installed will, however, be 12'x5' or 12' x 6' as established by the county surveyor once the legal flow line for this ditch is established. This larger box will also insure additional flow capacity. A 12'x5' box will pass 388 CFS at elevation 390.00.

SUMMARY

The developers of this property and the buyers of the lots contained therein will assume maintenance of the proposed facilities through the establishment of a jointly funded maintenance program. This is spelled out in more detail in the restrictive covenants for the development. A note on the subdivision plat indicates the Deed Drawer and Card number of restrictions pertaining to drainage facility maintenance.

The basins will be constructed at the owner's expense as outlined herein as a part of the roadway improvements for utilization by the developers of lots as set forth herein.

The limited number of basins designed herein with larger water surface areas and intended shared use will produce a better drainage network with fewer and easier areas to maintain.

APPENDICES INDEX

Appendix A	Drainage Plan
Appendix B	Basin Storage Requirements
Appendix C	Weighted Developed Runoff Coefficients
Appendix D1	South Basin No. 1 - Outlet Pipe Calculations
Appendix D2	Central Basin No. 2 - Outlet Pipe Calculations
Appendix D3	North Basin No. 3 - Outlet Pipe Calculations
Appendix E	Existing/Proposed Basin Capacities - All Basins
Appendix F	Box Culvert Data

APPENDIX A
DRAINAGE PLAN

APPENDIX B

BASIN STORAGE REQUIREMENTS

PROJECT: CROSSROADS BASIN 1 DATE: 12/10/94
 ENGINEER: BERNARDIN LOCHMUELLER AND ASSOCIATES, INC

DESIGN RETURN PERIOD: 5\10\25\100
 RELEASE RATE PERIOD: 5\10\25\100
 WATERSHED AREA (ACRES): 7.81
 TIME OF CONCENTRATION UNDEV. (min): 60
 RAINFALL INTENSITY (INCHES/HR): 1.82
 UNDEVELOPED RUNOFF COEFFICIENT: 0.2
 UNDEVELOPED RUNOFF RATE (CFS): 2.84
 DEVELOPED RUNOFF COEFFICIENT: 0.76

25 YEAR STORM

STORM DURATION (HRS)	RAINFALL INTENSITY (INCH/HR)	INFLOW RATE (CFS)	OUTFLOW RATE (CFS)	STORAGE REQUIRED RATE (CFS)	STORAGE REQUIRED (ACRE-FT)	
0.08	8.02	47.58	2.84	44.73	0.298	6.85
0.17	6.20	36.79	2.84	33.95	0.481	5.45
0.25	5.26	31.25	2.84	28.41	0.592	4.65
0.33	4.62	27.42	2.84	24.58	0.676	4.15
0.42	4.09	24.26	2.84	21.41	0.749	3.80
0.50	3.72	22.08	2.84	19.24	0.802	3.40
0.58	3.42	20.32	2.84	17.47	0.845	3.20
0.67	3.15	18.68	2.84	15.84	0.884	2.85
0.75	2.94	17.46	2.84	14.61	0.913	2.75
0.83	2.76	16.40	2.84	13.56	0.938	2.60
0.92	2.59	15.37	2.84	12.52	0.960	2.45
1.00	2.45	14.56	2.84	11.72	0.977	2.30
1.25	2.11	12.55	2.84	9.71	1.011	2.05
1.50	1.86	11.05	2.84	8.21	1.026	1.85
1.75	1.67	9.89	2.84	7.05	1.028	1.60
2.00	1.51	8.96	2.84	6.12	1.020	1.40
2.50	1.27	7.55	2.84	4.71	0.981	1.25
3.00	1.10	6.53	2.84	3.69	0.922	1.10
4.00	0.87	5.15	2.84	2.30	0.768	0.84

PEAK STORAGE (ACRE/FT): 1.03
 PEAK STORAGE (CUBIC FT): 44786.42

5 YEAR STORM

STORM DURATION (HRS)	RAINFALL INTENSITY (INCH/HR)	INFLOW RATE (CFS)	OUTFLOW RATE (CFS)	STORAGE RATE (CFS)	STORAGE REQUIRED STORAGE (ACRE-FT)
0.08	6.17	36.62	2.84	33.78	0.225
0.17	4.73	28.05	2.84	25.21	0.357
0.25	3.99	23.69	2.84	20.84	0.434
0.33	3.49	20.69	2.84	17.85	0.491
0.42	3.07	18.23	2.84	15.38	0.538
0.50	2.79	16.54	2.84	13.70	0.571
0.58	2.56	15.18	2.84	12.33	0.596
0.67	2.34	13.91	2.84	11.07	0.618
0.75	2.19	12.97	2.84	10.13	0.633
0.83	2.05	12.16	2.84	9.32	0.644
0.92	1.92	11.37	2.84	8.53	0.654
1.00	1.81	10.76	2.84	7.91	0.660
1.25	1.55	9.23	2.84	6.38	0.665
1.50	1.36	8.09	2.84	5.25	0.656
1.75	1.22	7.22	2.84	4.37	0.638
2.00	1.10	6.52	2.84	3.67	0.612
2.50	0.92	5.46	2.84	2.62	0.546
3.00	0.79	4.70	2.84	1.86	0.465
4.00	0.62	3.68	2.84	0.83	0.278

100 YEAR STORM

STORM DURATION (HRS)	RAINFALL INTENSITY (INCH/HR)	INFLOW RATE (CFS)	OUTFLOW RATE (CFS)	STORAGE RATE (CFS)	STORAGE REQUIRED STORAGE (ACRE-FT)
0.08	9.52	56.52	2.84	53.68	0.358
0.17	7.40	43.90	2.84	41.06	0.582
0.25	6.30	37.39	2.84	34.55	0.720
0.33	5.54	32.88	2.84	30.04	0.826
0.42	4.91	29.14	2.84	26.30	0.921
0.50	4.48	26.57	2.84	23.73	0.989
0.58	4.12	24.48	2.84	21.64	1.046
0.67	3.80	22.54	2.84	19.69	1.100
0.75	3.55	21.08	2.84	18.24	1.140
0.83	3.34	19.83	2.84	16.98	1.175
0.92	3.13	18.60	2.84	15.75	1.208
1.00	2.97	17.64	2.84	14.80	1.233
1.25	2.57	15.24	2.84	12.39	1.291
1.50	2.27	13.45	2.84	10.60	1.326
1.75	2.03	12.06	2.84	9.21	1.343
2.00	1.84	10.94	2.84	8.09	1.349
2.50	1.56	9.24	2.84	6.40	1.333
3.00	1.35	8.01	2.84	5.17	1.292
4.00	1.07	6.33	2.84	3.49	1.164

DESIGN RETURN PERIOD: 5\10\25\100
 RELEASE RATE PERIOD: 5\10\25\100
 WATERSHED AREA (ACRES): 39.5
 TIME OF CONCENTRATION UNDEV. (min): 60
 RAINFALL INTENSITY (INCHES/HR): 1.82
 UNDEVELOPED RUNOFF COEFFICIENT: 0.2
 UNDEVELOPED RUNOFF RATE (CFS): 14.38
 DEVELOPED RUNOFF COEFFICIENT: 0.73

25 YEAR STORM

STORM DURATION (HRS)	RAINFALL INTENSITY (INCH/HR)	INFLOW RATE (CFS)	OUTFLOW RATE (CFS)	STORAGE REQUIRED RATE (CFS)	STORAGE REQUIRED STORAGE (ACRE-FT)	
0.08	8.02	231.13	14.38	216.75	1.445	6.85
0.17	6.20	178.72	14.38	164.34	2.328	5.45
0.25	5.26	151.81	14.38	137.43	2.863	4.65
0.33	4.62	133.20	14.38	118.82	3.268	4.15
0.42	4.09	117.83	14.38	103.46	3.621	3.80
0.50	3.72	107.28	14.38	92.90	3.871	3.40
0.58	3.42	98.70	14.38	84.32	4.076	3.20
0.67	3.15	90.75	14.38	76.37	4.264	2.85
0.75	2.94	84.80	14.38	70.42	4.401	2.75
0.83	2.76	79.66	14.38	65.28	4.516	2.60
0.92	2.59	74.65	14.38	60.27	4.621	2.45
1.00	2.45	70.74	14.38	56.37	4.697	2.30
1.25	2.11	60.97	14.38	46.59	4.853	2.05
1.50	1.86	53.70	14.38	39.32	4.916	1.85
1.75	1.67	48.06	14.38	33.68	4.912	1.60
2.00	1.51	43.53	14.38	29.16	4.859	1.40
2.50	1.27	36.69	14.38	22.31	4.648	1.25
3.00	1.10	31.74	14.38	17.36	4.339	1.10
4.00	0.87	25.00	14.38	10.62	3.540	0.84

PEAK STORAGE (ACRE/FT): 4.92
 PEAK STORAGE (CUBIC FT): *****

5 YEAR STORM

	STORM DURATION (HRS)	RAINFALL INTENSITY (INCH/HR)	INFLOW RATE (CFS)	OUTFLOW RATE (CFS)	STORAGE RATE (CFS)	REQU STO (ACR)	
	5.5	0.08	6.17	177.92	14.38	163.54	1
	4.25	0.17	4.73	136.26	14.38	121.88	1
	3.70	0.25	3.99	115.07	14.38	100.69	2
	3.20	0.33	3.49	100.51	14.38	86.13	2
	2.90	0.42	3.07	88.54	14.38	74.16	2
	2.65	0.50	2.79	80.35	14.38	65.97	2
	2.40	0.58	2.56	73.72	14.38	59.34	2
	2.25	0.67	2.34	67.59	14.38	53.21	2
	2.10	0.75	2.19	63.02	14.38	48.64	3
	1.95	0.83	2.05	59.08	14.38	44.70	3
	1.80	0.92	1.92	55.24	14.38	40.86	3
	1.75	1.00	1.81	52.26	14.38	37.88	3
	1.55	1.25	1.55	44.82	14.38	30.44	3
	1.35	1.50	1.36	39.31	14.38	24.94	3
	1.20	1.75	1.22	35.06	14.38	20.68	3
	1.10	2.00	1.10	31.65	14.38	17.28	2
	0.90	2.50	0.92	26.53	14.38	12.15	2
	0.79	3.00	0.79	22.84	14.38	8.47	2
	0.63	4.00	0.62	17.86	14.38	3.48	1

100 YEAR STORM

	STORM DURATION (HRS)	RAINFALL INTENSITY (INCH/HR)	INFLOW RATE (CFS)	OUTFLOW RATE (CFS)	STORAGE RATE (CFS)	REQU STO (ACR)	
	8.00	0.08	9.52	274.58	14.38	260.21	1
	6.40	0.17	7.40	213.27	14.38	198.89	2
	5.55	0.25	6.30	181.64	14.38	167.27	3
	4.90	0.33	5.54	159.72	14.38	145.34	3
	4.50	0.42	4.91	141.58	14.38	127.20	4

PROJECT: CROSSROADS BASIN 3
 ENGINEER: BERNARDIN LOCHMUELLER AND ASSOCIATES, INC

DATE: 12/10/94

DESIGN RETURN PERIOD: 5\10\25\100
 RELEASE RATE PERIOD: 5\10\25\100
 WATERSHED AREA (ACRES): 16.3
 TIME OF CONCENTRATION UNDEV. (min): 60
 RAINFALL INTENSITY (INCHES/HR): 1.82
 UNDEVELOPED RUNOFF COEFFICIENT: 0.2
 UNDEVELOPED RUNOFF RATE (CFS): 14.38
 DEVELOPED RUNOFF COEFFICIENT: 0.75

25 YEAR STORM

STORM DURATION (HRS)	RAINFALL INTENSITY (INCH/HR)	INFLOW RATE (CFS)	OUTFLOW RATE (CFS)	STORAGE RATE (CFS)	REQUIRED STORAGE (ACRE-FT)	
0.08	8.02	97.99	5.93	92.06	0.614	6.85
0.17	6.20	75.77	5.93	69.84	0.989	5.45
0.25	5.26	64.36	5.93	58.43	1.217	4.65
0.33	4.62	56.47	5.93	50.54	1.390	4.15
0.42	4.09	49.96	5.93	44.02	1.541	3.80
0.50	3.72	45.48	5.93	39.55	1.648	3.40
0.58	3.42	41.85	5.93	35.91	1.736	3.20
0.67	3.15	38.47	5.93	32.54	1.817	2.85
0.75	2.94	35.95	5.93	30.02	1.876	2.75
0.83	2.76	33.77	5.93	27.84	1.926	2.60
0.92	2.59	31.65	5.93	25.72	1.972	2.45
1.00	2.45	29.99	5.93	24.06	2.005	2.30
1.25	2.11	25.85	5.93	19.91	2.074	2.05
1.50	1.86	22.77	5.93	16.83	2.104	1.85
1.75	1.67	20.38	5.93	14.44	2.106	1.60
2.00	1.51	18.46	5.93	12.52	2.087	1.40
2.50	1.27	15.56	5.93	9.62	2.005	1.25
3.00	1.10	13.45	5.93	7.52	1.880	1.10
4.00	0.87	10.60	5.93	4.67	1.555	0.84

PEAK STORAGE (ACRE/FT): 2.11

5 YEAR STORM

STORM DURATION (HRS)	RAINFALL INTENSITY (INCH/HR)	INFLOW RATE (CFS)	OUTFLOW RATE (CFS)	STORAGE RATE (CFS)	REQUIRED STORAGE (ACRE-FT)
0.08	6.17	177.92	14.38	163.54	1.090
0.17	4.73	136.26	14.38	121.88	1.727
0.25	3.99	115.07	14.38	100.69	2.098
0.33	3.49	100.51	14.38	86.13	2.369
0.42	3.07	88.54	14.38	74.16	2.596
0.50	2.79	80.35	14.38	65.97	2.749
0.58	2.56	73.72	14.38	59.34	2.868
0.67	2.34	67.59	14.38	53.21	2.971
0.75	2.19	63.02	14.38	48.64	3.040
0.83	2.05	59.08	14.38	44.70	3.092
0.92	1.92	55.24	14.38	40.86	3.133
1.00	1.81	52.26	14.38	37.88	3.157
1.25	1.55	44.82	14.38	30.44	3.171
1.50	1.36	39.31	14.38	24.94	3.117
1.75	1.22	35.06	14.38	20.68	3.016
2.00	1.10	31.65	14.38	17.28	2.879
2.50	0.92	26.53	14.38	12.15	2.532
3.00	0.79	22.84	14.38	8.47	2.116
4.00	0.62	17.86	14.38	3.48	1.160

100 YEAR STORM

STORM DURATION (HRS)	RAINFALL INTENSITY (INCH/HR)	INFLOW RATE (CFS)	OUTFLOW RATE (CFS)	STORAGE RATE (CFS)	REQUIRED STORAGE (ACRE-FT)
0.08	9.52	274.58	14.38	260.21	1.735
0.17	7.40	213.27	14.38	198.89	2.818
0.25	6.30	181.64	14.38	167.27	3.485
0.33	5.54	159.72	14.38	145.34	3.997
0.42	4.91	141.58	14.38	127.20	4.452
0.50	4.48	129.09	14.38	114.71	4.780
0.58	4.12	118.93	14.38	104.55	5.053
0.67	3.80	109.49	14.38	95.11	5.310
0.75	3.55	102.42	14.38	88.04	5.503
0.83	3.34	96.31	14.38	81.93	5.667
0.92	3.13	90.34	14.38	75.97	5.824
1.00	2.97	85.69	14.38	71.31	5.943
1.25	2.57	74.02	14.38	59.64	6.212
1.50	2.27	65.33	14.38	50.95	6.368
1.75	2.03	58.56	14.38	44.19	6.444
2.00	1.84	53.13	14.38	38.75	6.458
2.50	1.56	44.89	14.38	30.52	6.358
3.00	1.35	38.92	14.38	24.54	6.135
4.00	1.07	30.77	14.38	16.39	5.464

PEAK STORAGE (CUBIC FT): *****

5 YEAR STORM

STORM DURATION (HRS)	RAINFALL INTENSITY (INCH/HR)	INFLOW RATE (CFS)	OUTFLOW RATE (CFS)	STORAGE RATE (CFS)	REQUIRED STORAGE (ACRE-FT)
0.08	6.17	75.43	5.93	69.50	0.463
0.17	4.73	57.77	5.93	51.84	0.734
0.25	3.99	48.79	5.93	42.85	0.893
0.33	3.49	42.61	5.93	36.68	1.009
0.42	3.07	37.54	5.93	31.60	1.106
0.50	2.79	34.07	5.93	28.13	1.172
0.58	2.56	31.25	5.93	25.32	1.224
0.67	2.34	28.66	5.93	22.72	1.269
0.75	2.19	26.72	5.93	20.78	1.299
0.83	2.05	25.05	5.93	19.11	1.322
0.92	1.92	23.42	5.93	17.49	1.341
1.00	1.81	22.16	5.93	16.22	1.352
1.25	1.55	19.00	5.93	13.07	1.361
1.50	1.36	16.67	5.93	10.73	1.342
1.75	1.22	14.86	5.93	8.93	1.302
2.00	1.10	13.42	5.93	7.49	1.248
2.50	0.92	11.25	5.93	5.32	1.107
3.00	0.79	9.68	5.93	3.75	0.938
4.00	0.62	7.57	5.93	1.64	0.546

100 YEAR STORM

STORM DURATION (HRS)	RAINFALL INTENSITY (INCH/HR)	INFLOW RATE (CFS)	OUTFLOW RATE (CFS)	STORAGE RATE (CFS)	REQUIRED STORAGE (ACRE-FT)
0.08	9.52	116.41	5.93	110.48	0.737
0.17	7.40	90.42	5.93	84.48	1.197
0.25	6.30	77.01	5.93	71.08	1.481
0.33	5.54	67.72	5.93	61.78	1.699
0.42	4.91	60.02	5.93	54.09	1.893
0.50	4.48	54.73	5.93	48.80	2.033
0.58	4.12	50.42	5.93	44.49	2.150
0.67	3.80	46.42	5.93	40.48	2.260
0.75	3.55	43.42	5.93	37.49	2.343
0.83	3.34	40.83	5.93	34.90	2.414
0.92	3.13	38.30	5.93	32.37	2.482
1.00	2.97	36.33	5.93	30.40	2.533
1.25	2.57	31.38	5.93	25.45	2.651
1.50	2.27	27.70	5.93	21.76	2.720
1.75	2.03	24.83	5.93	18.90	2.756
2.00	1.84	22.52	5.93	16.59	2.765
2.50	1.56	19.03	5.93	13.10	2.729
3.00	1.35	16.50	5.93	10.57	2.642
4.00	1.07	13.04	5.93	7.11	2.371

PROJECT: CROSSRD 3 OVERFLOW CHECK
 ENGINEER: BERNARDIN LOCHMUELLER AND ASSOCIATES, INC

DATE: 12/10/94

DESIGN RETURN PERIOD: 5\10\25\100
 RELEASE RATE PERIOD: 5\10\25\100
 WATERSHED AREA (ACRES): 7.81
 TIME OF CONCENTRATION UNDEV. (min): 60
 RAINFALL INTENSITY (INCHES/HR): 1.82

UNDEVELOPED RUNOFF COEFFICIENT: 0.352
 UNDEVELOPED RUNOFF RATE (CFS): 14.38
 DEVELOPED RUNOFF COEFFICIENT: 0.75

25 YEAR STORM

STORM DURATION (HRS)	RAINFALL INTENSITY (INCH/HR)	INFLOW RATE (CFS)	OUTFLOW RATE (CFS)	STORAGE RATE (CFS)	STORAGE REQUIRED (ACRE-FT)	
0.08	8.02	46.95	5.00	41.95	0.280	6.85
0.17	6.20	36.30	5.00	31.30	0.443	5.45
0.25	5.26	30.84	5.00	25.83	0.538	4.65
0.33	4.62	27.06	5.00	22.05	0.607	4.15
0.42	4.09	23.94	5.00	18.93	0.663	3.80
0.50	3.72	21.79	5.00	16.79	0.700	3.40
0.58	3.42	20.05	5.00	15.05	0.727	3.20
0.67	3.15	18.43	5.00	13.43	0.750	2.85
0.75	2.94	17.23	5.00	12.22	0.764	2.75
0.83	2.76	16.18	5.00	11.18	0.773	2.60
0.92	2.59	15.16	5.00	10.16	0.779	2.45
1.00	2.45	14.37	5.00	9.37	0.781	2.45
1.25	2.11	12.38	5.00	7.38	0.769	2.05
1.50	1.86	10.91	5.00	5.91	0.738	1.85
1.75	1.67	9.76	5.00	4.76	0.694	1.60
2.00	1.51	8.84	5.00	3.84	0.640	1.40
2.50	1.27	7.45	5.00	2.45	0.510	1.25
3.00	1.10	6.45	5.00	1.44	0.361	1.10
4.00	0.87	5.08	5.00	0.07	0.025	0.84

PEAK STORAGE (ACRE/FT): 0.78
 PEAK STORAGE (CUBIC FT): *****

PROJECT: CROSSROADS BASIN 2
 ENGINEER: BERNARDIN LOCHMUELLER AND ASSOCIATES, INC

DATE: 12/10/94

DESIGN RETURN PERIOD: 5\10\25\100
 RELEASE RATE PERIOD: 5\10\25\100
 WATERSHED AREA (ACRES): 39.5
 TIME OF CONCENTRATION UNDEV. (min): 60
 RAINFALL INTENSITY (INCHES/HR): 1.82
 UNDEVELOPED RUNOFF COEFFICIENT: 0.2
 UNDEVELOPED RUNOFF RATE (CFS): 14.38
 DEVELOPED RUNOFF COEFFICIENT: 0.73

25 YEAR STORM

STORM DURATION (HRS)	RAINFALL INTENSITY (INCH/HR)	INFLOW RATE (CFS)	OUTFLOW RATE (CFS)	STORAGE REQUIRED RATE (CFS)	STORAGE REQUIRED (ACRE-FT)
0.08	8.02	231.13	14.38	216.75	1.445
0.17	6.20	178.72	14.38	164.34	2.328
0.25	5.26	151.81	14.38	137.43	2.863
0.33	4.62	133.20	14.38	118.82	3.268
0.42	4.09	117.83	14.38	103.46	3.621
0.50	3.72	107.28	14.38	92.90	3.871
0.58	3.42	98.70	14.38	84.32	4.076
0.67	3.15	90.75	14.38	76.37	4.264
0.75	2.94	84.80	14.38	70.42	4.401
0.83	2.76	79.66	14.38	65.28	4.516
0.92	2.59	74.65	14.38	60.27	4.621
1.00	2.45	70.74	14.38	56.37	4.697
1.25	2.11	60.97	14.38	46.59	4.853
1.50	1.86	53.70	14.38	39.32	4.916
1.75	1.67	48.06	14.38	33.68	4.912
2.00	1.51	43.53	14.38	29.16	4.859
2.50	1.27	36.63	14.38	22.31	4.648
3.00	1.10	31.74	14.38	17.36	4.339
4.00	0.87	25.00	14.38	10.62	3.540

PEAK STORAGE (ACRE/FT): 4.92
 PEAK STORAGE (CUBIC FT): *****

PROJECT: CROSSROADS BASIN 3
 ENGINEER: BERNARDIN LOCHMUELLER AND ASSOCIATES, INC

DATE: 12/10/94

DESIGN RETURN PERIOD: 5\10\25\100
 RELEASE RATE PERIOD: 5\10\25\100
 WATERSHED AREA (ACRES): 16.3
 TIME OF CONCENTRATION UNDEV. (min): 60
 RAINFALL INTENSITY (INCHES/HR): 1.82
 UNDEVELOPED RUNOFF COEFFICIENT: 0.2
 UNDEVELOPED RUNOFF RATE (CFS): 14.38
 DEVELOPED RUNOFF COEFFICIENT: 0.75

25 YEAR STORM

STORM DURATION (HRS)	RAINFALL INTENSITY (INCH/HR)	INFLOW RATE (CFS)	OUTFLOW RATE (CFS)	STORAGE RATE (CFS)	REQUIRED STORAGE (ACRE-FT)	
0.08	8.02	97.99	5.93	92.06	0.614	6.85
0.17	6.20	75.77	5.93	69.84	0.989	5.45
0.25	5.26	64.36	5.93	58.43	1.217	4.65
0.33	4.62	56.47	5.93	50.54	1.390	4.15
0.42	4.09	49.96	5.93	44.02	1.541	3.80
0.50	3.72	45.48	5.93	39.55	1.648	3.40
0.58	3.42	41.85	5.93	35.91	1.736	3.20
0.67	3.15	38.47	5.93	32.54	1.817	2.85
0.75	2.94	35.95	5.93	30.02	1.876	2.75
0.83	2.76	33.77	5.93	27.84	1.926	2.60
0.92	2.59	31.65	5.93	25.72	1.972	2.45
1.00	2.45	29.99	5.93	24.06	2.005	2.30
1.25	2.11	25.85	5.93	19.91	2.074	2.05
1.50	1.86	22.77	5.93	16.83	2.104	1.85
1.75	1.67	20.38	5.93	14.44	2.106	1.60
2.00	1.51	18.46	5.93	12.52	2.087	1.40
2.50	1.27	15.56	5.93	9.62	2.005	1.25
3.00	1.10	13.45	5.93	7.52	1.880	1.10
4.00	0.87	10.60	5.93	4.67	1.555	0.84

PEAK STORAGE (ACRE/FT): 2.11

APPENDIX C

**WEIGHTED DEVELOPED
RUNOFF COEFFICIENTS**



**BERNARDIN • LOCHMUELLER
& ASSOC.**

PROJECT NAME _____
PROJECT NO. _____ SHEET NO. _____
MADE BY _____ DATE _____
CHKD. BY _____ DATE _____
BLA PROJECT NO. _____

DETAIL SKETCH

WEIGHTED DEVELOPED RUNOFF COEFFICIENTS

BASIN No 1

ROADS & R/W COMBINED	0.61 AC X 0.7 =	0.427
LOTS 2 THRU 5	6.30 AC X 0.73 =	4.725
OUTLET	0.195 AC X 0.60 =	0.117
RETENTION AREA	0.70 AC X 1.00 =	0.700
	<hr/>	<hr/>
	7.805 AC	5.969
		$5.969 / 7.805 =$ 0.76

BASIN No 2.

ROADS & R/W COMBINED	2.289 AC X 0.7 =	1.602
LOT No 1	5.508 X 0.75 =	4.13
OUTLOT No 2	2.40 X 0.4 =	0.96
RETENTION AREA	1.07 X 1.0 =	1.07
Southern PART OF LOT No 6	28.3 AC X 0.75 =	21.24
	<hr/>	<hr/>
	39.6 AC	29.0
		$29 / 39.6 =$ 0.73

SUMMARY

ITEM	QUANTITY	PAGE

COMPUTED BY

CKD



**BERNARDIN • LOCHMUELLER
& ASSOC.**

PROJECT NAME _____
PROJECT NO. _____ SHEET NO. _____
MADE BY _____ DATE _____
CHKD. BY _____ DATE _____
BLA PROJECT NO. _____

DETAIL SKETCH

BASIN No 3.

ROADSIDE R/W COMBINED $1.077 \times .70 = 0.75$
NORTHERN PART OF LOT No 6 $14.68 \times .75 = 11.01$
LAKE $0.5 \times 1.0 = 0.50$
16.257 12.26

$12.26 / 16.257 = \boxed{0.75}$

SUMMARY

ITEM	QUANTITY	PAGE

COMPUTED BY _____ CKD

APPENDIX D1

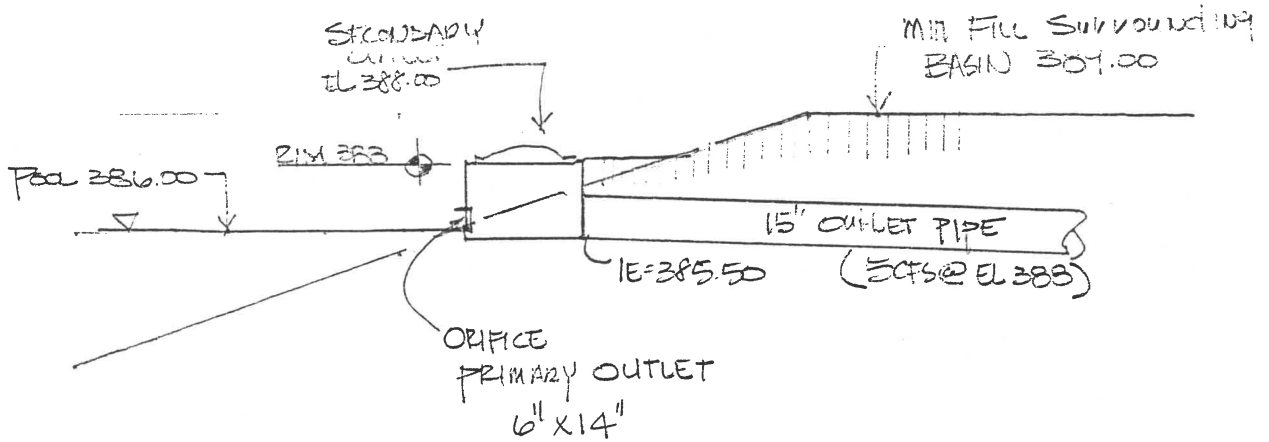
**SOUTH BASIN NO. 1
(OUTLET PIPE CALCULATIONS)**



**BERNARDIN · LOCHMUELLER
& ASSOC.**

Project Name _____
Project No. _____ Sheet No. _____
Made By _____ Date _____
Chkd. By _____ Date _____
BLA Project No. _____

DETAIL SKETCH



ORIFICE CALCULATION

Allow. outflow: $Q = cd A \sqrt{2g (h_2^{3/2} - h_1^{3/2})}$

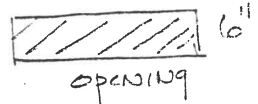
$2.84 = (0.6)(A) \sqrt{2(32.2)(2^{3/2} - 1.5^{3/2})}$

$2.84 = 4.79 A$

$A = 0.592$

opening $6'' \times 14''$

L = ?



SUMMARY

ITEM	QUANTITY	PAGE

COMPUTED BY
Z. B. Z.

CKD

dd

dd

FILE: CROSSRD1 CULVERT HEADWATER ELEVATION (FT) DATE: 10/19/94

DISCHARGE	1	2	3	4	5	6	ROADWAY
0	386.50 (700)	0.00	0.00	0.00	0.00	0.00	388.50
1	386.83	0.00	0.00	0.00	0.00	0.00	388.52
1	387.02	0.00	0.00	0.00	0.00	0.00	388.54
2	387.18	0.00	0.00	0.00	0.00	0.00	388.55
2	387.31	0.00	0.00	0.00	0.00	0.00	388.56
3	387.43	0.00	0.00	0.00	0.00	0.00	388.57
3	387.54	0.00	0.00	0.00	0.00	0.00	388.58
3	387.55	0.00	0.00	0.00	0.00	0.00	388.58
4	387.76	0.00	0.00	0.00	0.00	0.00	388.60
5	387.87	0.00	0.00	0.00	0.00	0.00	388.61
5	388.00	0.00	0.00	0.00	0.00	0.00	388.61
8	388.80	0.00	0.00	0.00	0.00	0.00	0.00

2.85 CFS @ 57.4 FT

The above Q and HW are for a point above the roadway.

dd

THE ONLY OUTLET 2.85 CFS @ ELEV 351.4 FT
 Therefore pipe size Adequate
 HOWEVER Actual outflow is Being Regulated
 BY WIER OPENING IN FRONT OF BOX
 (REFER TO WIER CALC SKT ONE
 OF THIS APPENDIX.)

CURRENT DATE: 10-19-1994

FILE DATE: 10/19/94

CURRENT TIME: 11:55:45

FILE NAME: CROSSRD1

Performance curve data header line

PERFORMANCE CURVE FOR CULVERT # 1 - 1 (1.25 BY 1.25) RCP

Performance curve data header line

DIS- HEAD- INLET OUTLET

CHARGE WATER CONTROL CONTROL FLOW NORMAL CRITICAL OUTLET TAILWATER

FLOW ELEV. DEPTH DEPTH TYPE DEPTH DEPTH VEL. DEPTH VEL. DEPTH

(cfs) (ft) (ft) (ft) <F4> (ft) (ft) (fps) (ft) (fps) (ft)

Performance curve data header line

0	386.50	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	1.00
1	386.83	0.33	0.33	1-S2n	0.22	0.27	3.39	0.22	0.00	1.00
1	387.02	0.52	0.52	1-S2n	0.31	0.39	4.11	0.31	0.00	1.00
2	387.18	0.68	0.68	1-S2n	0.39	0.48	4.59	0.39	0.00	1.00
2	387.31	0.81	0.81	1-S2n	0.45	0.56	4.95	0.45	0.00	1.00
3	387.43	0.93	0.93	1-S2n	0.51	0.63	5.25	0.51	0.00	1.00
3	387.54	1.04	1.04	1-S2n	0.57	0.69	5.51	0.57	0.00	1.00
3	387.55	1.05	1.05	1-S2n	0.58	0.70	5.53	0.58	0.00	1.00
4	387.76	1.26	1.26	5-S2n	0.68	0.81	5.91	0.68	0.00	1.00
5	387.87	1.37	1.37	5-S2n	0.73	0.86	6.07	0.73	0.00	1.00
5	388.00	1.50	1.50	5-S2n	0.78	0.90	6.19	0.78	0.00	1.00

Performance curve data header line

E1. inlet face invert 386.50 ft E1. outlet invert 385.00 ft

E1. inlet throat invert 0.00 ft E1. inlet crest 0.00 ft

Performance curve data header line

CURRENT TIME: 11:55:45

FILE NAME: CROSSRD1

dddddd
 dddddd TAILWATER dddddd
 dddddd
 dddddd

CONSTANT WATER SURFACE ELEVATION

386.00

dddddd
 dddddd ROADWAY OVERTOPPING DATA dddddd
 dddddd

ROADWAY SURFACE	GRAVEL
EMBANKMENT TOP WIDTH (FT)	10.00
CREST LENGTH (FT)	50.00
OVERTOPPING CREST ELEVATION (FT)	388.50

ddddd

APPENDIX D2

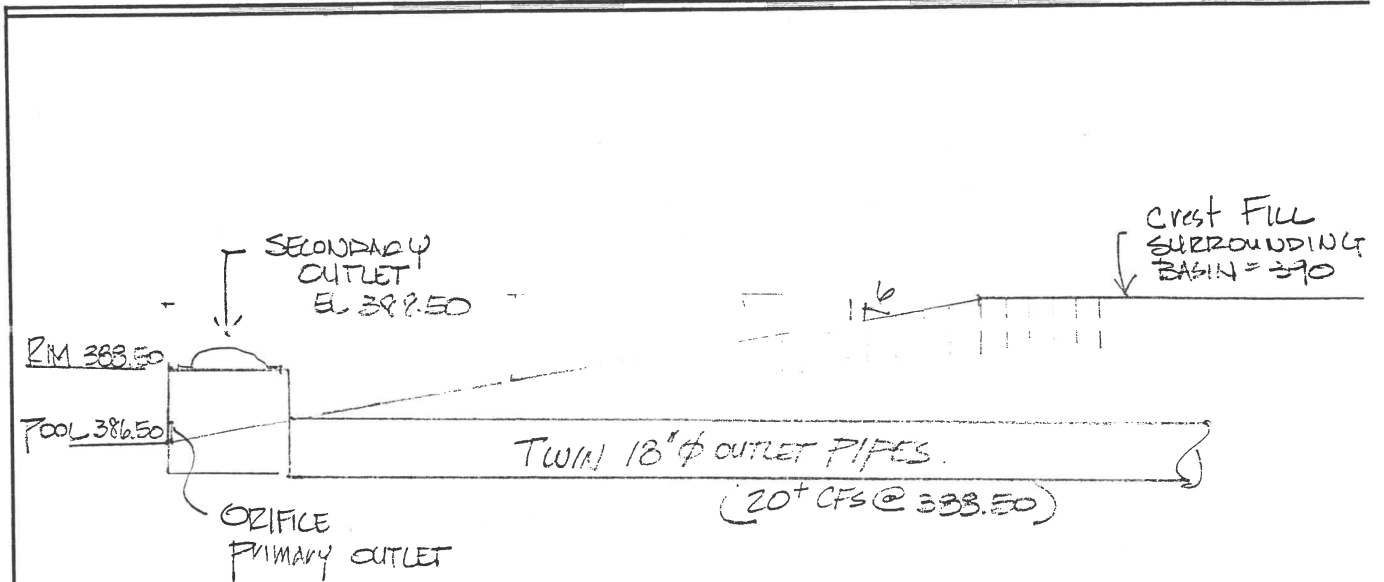
**CENTRAL BASIN NO. 2
(OUTLET PIPE CALCULATIONS)**



**BERNARDIN · LOCHMUELLER
& ASSOC.**

Project Name _____
Project No. _____ Sheet No. _____
Made By _____ Date _____
Chkd. By _____ Date _____
BLA Project No. _____

DETAIL SKETCH



ORIFICE CALCULATION

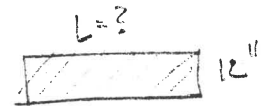
Allow OUTFLOW $Q = cd \times \sqrt{2g(h_2^{3/2} - h_1^{3/2})}$

$$14.38 = (0.6)(A) \sqrt{2g(e^{3/2} - 1^{3/2})}$$

$$14.38 = 6.51(A)$$

$$A = 2.208F$$

opening = 2'-3" x 1'-0"



SUMMARY

ITEM	QUANTITY	PAGE

COMPUTED BY

CKD

CURRENT DATE: 12-01-1994

FILE DATE: 1-12-94

CURRENT TIME: 07:41:51

FILE NAME: CROSSRD2

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#####
##### FHWA CULVERT ANALYSIS #####
##### HY-8, VERSION 4.0 #####
#####

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SITE DATA			CULVERT SHAPE, MATERIAL, INLET					
INLET	OUTLET	CULVERT	BARRELS					
ELEV.	ELEV.	LENGTH	SHAPE	SPAN	RISE	MANNING	INLET	
(FT)	(FT)	(FT)	MATERIAL	(FT)	(FT)	n	TYPE	
386.40	386.06	115.00	2 RCP	1.50	1.50	.012	CONVENTIONAL	
2								
3								
4								
5								
6								

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#####

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dd

FILE: CROSSRD2

CULVERT HEADWATER ELEVATION (FT)

DATE: 1-12-94

DISCHARGE	1	2	3	4	5	6	ROADWAY
0	386.40	0.00	0.00	0.00	0.00	0.00	389.00
2	386.97	0.00	0.00	0.00	0.00	0.00	389.18
4	387.21	0.00	0.00	0.00	0.00	0.00	389.28
6	387.42	0.00	0.00	0.00	0.00	0.00	389.37
8	387.60	0.00	0.00	0.00	0.00	0.00	389.45
10	387.78	0.00	0.00	0.00	0.00	0.00	389.51
12	387.95	0.00	0.00	0.00	0.00	0.00	389.58
14	388.12	0.00	0.00	0.00	0.00	0.00	389.64
15	388.32	0.00	0.00	0.00	0.00	0.00	389.68
18	388.71	0.00	0.00	0.00	0.00	0.00	389.75
20	389.05	0.00	0.00	0.00	0.00	0.00	389.80
24	389.81	0.00	0.00	0.00	0.00	0.00	0.00

14.38 CFS @ 388.20

The above Q and HW are for a point above the roadway.

dd

Twin pipes will outlet 14.38 CFS @ 5' @ 388.2 ±
 Therefore pipes are Adequate

HOWEVER ACTUAL OVERFLOW UNDER Normal
 Conditions IS BEING regulated
 BY WIER OPENING IN FRONT FACE OF
 BOX. (REFER TO ORIFICE CALC Sht ONE
 OF THIS APPENDIX)

CURRENT DATE: 12-01-1994

FILE DATE: 1-12-94

CURRENT TIME: 07:41:51

FILE NAME: CROSSRD2

Performance curve data header line

PERFORMANCE CURVE FOR CULVERT # 1 - 2 (1.5 BY 1.5) RCP

Performance curve data header line

DIS- CHARGE FLOW (cfs)	HEAD- WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRITICAL DEPTH (ft)	OUTLET VEL. (fps)	OUTLET DEPTH (ft)	TAILWATER VEL. (fps)	TAILWATER DEPTH (ft)
---------------------------------	---------------------------------	-----------------------------------	------------------------------------	----------------------	-------------------------	---------------------------	-------------------------	-------------------------	----------------------------	----------------------------

Performance curve data header line

0	386.40	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	-0.06
2	386.97	0.47	0.57	2-M2c	0.40	0.37	2.97	0.37	0.00	-0.06
4	387.21	0.73	0.81	2-M2c	0.58	0.53	3.59	0.53	0.00	-0.06
6	387.42	0.95	1.02	2-M2c	0.74	0.65	4.04	0.65	0.00	-0.06
8	387.60	1.13	1.20	2-M2c	0.88	0.76	4.42	0.76	0.00	-0.06
10	387.78	1.30	1.38	2-M2c	1.02	0.86	4.79	0.86	0.00	-0.06
12	387.95	1.46	1.55	2-M2c	1.19	0.94	5.12	0.94	0.00	-0.06
14	388.12	1.64	1.72	6-FFn	1.50	1.02	3.96	1.50	0.00	-0.06
15	388.32	1.77	1.92	6-FFn	1.50	1.07	4.37	1.50	0.00	-0.06
18	388.71	2.03	2.31	6-FFn	1.50	1.16	5.09	1.50	0.00	-0.06
20	389.05	2.27	2.65	6-FFn	1.50	1.22	5.66	1.50	0.00	-0.06

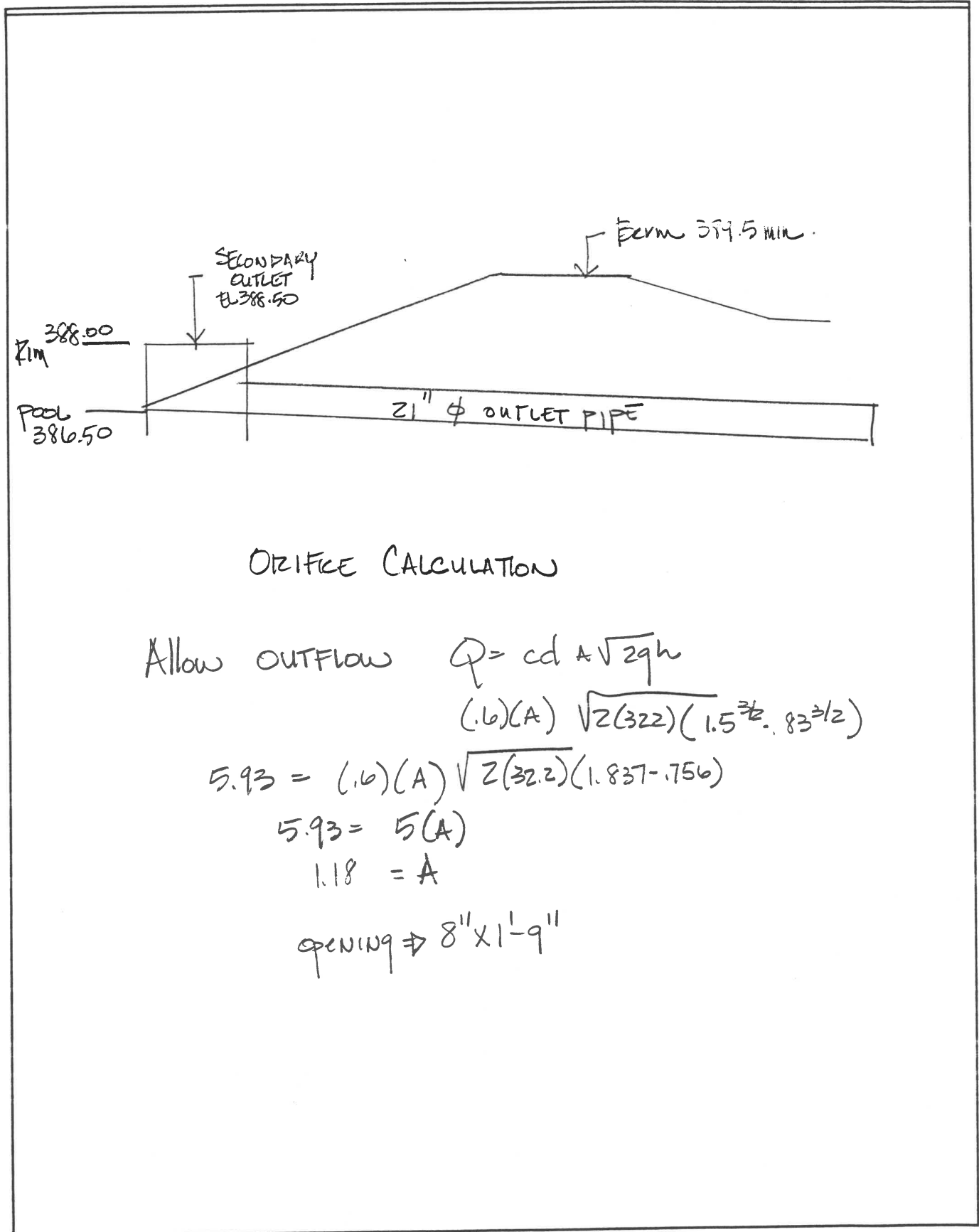
Performance curve data header line

El. inlet face invert 386.40 ft El. outlet invert 386.06 ft
 El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

Performance curve data header line

APPENDIX D3

**NORTH BASIN NO. 3
(OUTLET PIPE CALCULATIONS)**



ORIFICE CALCULATION

Allow outflow $Q = cd A \sqrt{2gh}$
 $(.6)(A) \sqrt{2(32.2)(1.5^{3/2} \cdot 83^{3/2})}$

$$5.93 = (.6)(A) \sqrt{2(32.2)(1.837 \cdot 756)}$$

$$5.93 = .5(A)$$

$$1.18 = A$$

opening $\Rightarrow 8" \times 1'-9"$

CURRENT DATE: 10-19-1994

FILE DATE: 10/19/94

CURRENT TIME: 12:51:21

FILE NAME: CROSSRD3

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#####
##### FHWA CULVERT ANALYSIS #####
##### HY-9, VERSION 4.0 #####
#####

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SITE DATA			CULVERT SHAPE, MATERIAL, INLET					
INLET	OUTLET	CULVERT	BARRELS					
ELEV.	ELEV.	LENGTH	SHAPE	SPAN	RISE	MANNING	INLET	
#	(FT)	(FT)	(FT)	MATERIAL	(FT)	(FT)	n	TYPE
1	386.38	386.16	112.00	1 RCP	1.75	1.75	.012	CONVENTIONAL
2								
3								
4								
5								
6								

Single 21" ϕ PIPE

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CURRENT DATE: 10-19-1994

FILE DATE: 10/19/94

CURRENT TIME: 12:51:21

FILE NAME: CROSSRD3

Performance curve data header line

PERFORMANCE CURVE FOR CULVERT # 1 - 1 (1.75 BY 1.75) RCP

Performance curve data header line

DIS- CHARGE FLOW	HEAD- ELEV. (ft)	INLET DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE	NORMAL DEPTH (ft)	CRITICAL DEPTH (ft)	OUTLET VEL. (fps)	TAILWATER VEL. (fps)	TAILWATER DEPTH (ft)
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6.34 CFS

0	386.38	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	-0.16
1	386.92	0.43	0.54	2-M2c	0.42	0.36	2.86	0.36	0.00	-0.16
2	387.16	0.67	0.78	2-M2c	0.61	0.51	3.45	0.51	0.00	-0.16
3	387.34	0.87	0.96	2-M2c	0.76	0.62	3.89	0.62	0.00	-0.16
4	387.51	1.04	1.13	2-M2c	0.90	0.73	4.24	0.73	0.00	-0.16
5	387.65	1.20	1.27	2-M2c	1.03	0.82	4.54	0.82	0.00	-0.16
6	387.82	1.34	1.44	2-M2c	1.17	0.90	4.81	0.90	0.00	-0.16
6	387.87	1.38	1.49	2-M2c	1.22	0.93	4.91	0.93	0.00	-0.16
8	388.07	1.60	1.69	2-M2c	1.54	1.05	5.32	1.05	0.00	-0.16
9	388.22	1.73	1.84	6-FFn	1.75	1.11	3.74	1.75	0.00	-0.16
10	388.40	1.87	2.02	6-FFn	1.75	1.17	4.16	1.75	0.00	-0.16

Performance curve data header line

El. inlet face invert 386.38 ft El. outlet invert 386.16 ft
 El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

Performance curve data header line

***** SITE DATA ***** CULVERT INVERT *****

INLET STATION (FT)	0.00
INLET ELEVATION (FT)	<u>386.38</u>
OUTLET STATION (FT)	<u>112.00</u>
OUTLET ELEVATION (FT)	<u>386.16</u>
NUMBER OF BARRELS	1
SLOPE (V-FT/H-FT)	<u>0.0020</u>
CULVERT LENGTH ALONG SLOPE (FT)	112.00

***** CULVERT DATA SUMMARY *****

BARREL SHAPE	CIRCULAR
BARREL DIAMETER	<u>1.75 FT</u>
BARREL MATERIAL	CONCRETE
BARREL MANNING'S N	0.012
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	SQUARE EDGE WITH HEADWALL
INLET DEPRESSION	NONE

APPENDIX E

**EXISTING/PROPOSED BASIN CAPACITIES
(ALL BASINS)**

BASIN No 1

Pool	386.00	13,940 SF	>	15,563 CF	→	15,563 CF
	387.00	17,186 SF	>	22,872 CF	→	38,435 CF
	388.00	28,559 SF	>	14,736 CF	→	55,171 CF
	388.50	38,368 SF				

EXCEEDS 44,786 REQD.

BASIN No 2A

Pool	386.50	19,985 SF	>	10,429 CF	→	10,429 CF
	387.00	21,730 SF	>	23,400 CF	→	33,829 CF
	388.00	25,070 SF	>	13,267 CF	→	47,096 CF
	388.50	27,999 SF				

BASIN 2A & 2B Combined	
386.50	> 49,593 CF
387.00	> 158,591 CF
388.00	>
388.50	>
218,276 CF exceeds 214,315 REQD.	

BASIN No 2B

Pool	386.50	75,883 SF	>	39,164 CF	→	39,164 CF
	387.00	80,772 SF	>	85,598 CF	→	124,762 CF
	388.00	90,423 SF	>	46,418 CF	→	171,180 CF
	388.50	95,250 SF				

BASIN No 3

POOL	386.50	60,104 SF	}	31,138 CF -
	387.00	64,446 SF		}
	388.00	73,300 SF		

LOT 5

1.825 AC.
(79,500 SF)

SET NO. 65

LOT 4

1.703 AC.
(74,199 SF)

SET NO. 66

LOT 3

1.772 AC.
(77,207 SF)

SET NO. 60

LOT 2

1.701 AC.
(74,101 SF)

SET NO. 51

150' BLDG SETBACK

PROPOSED 12" STORM SEWERS

25' GREENSPACE

Drainage Basin Division Line

10' PU ESMI

25' GREENSPACE

50' BLDG SETBACK

South Basin

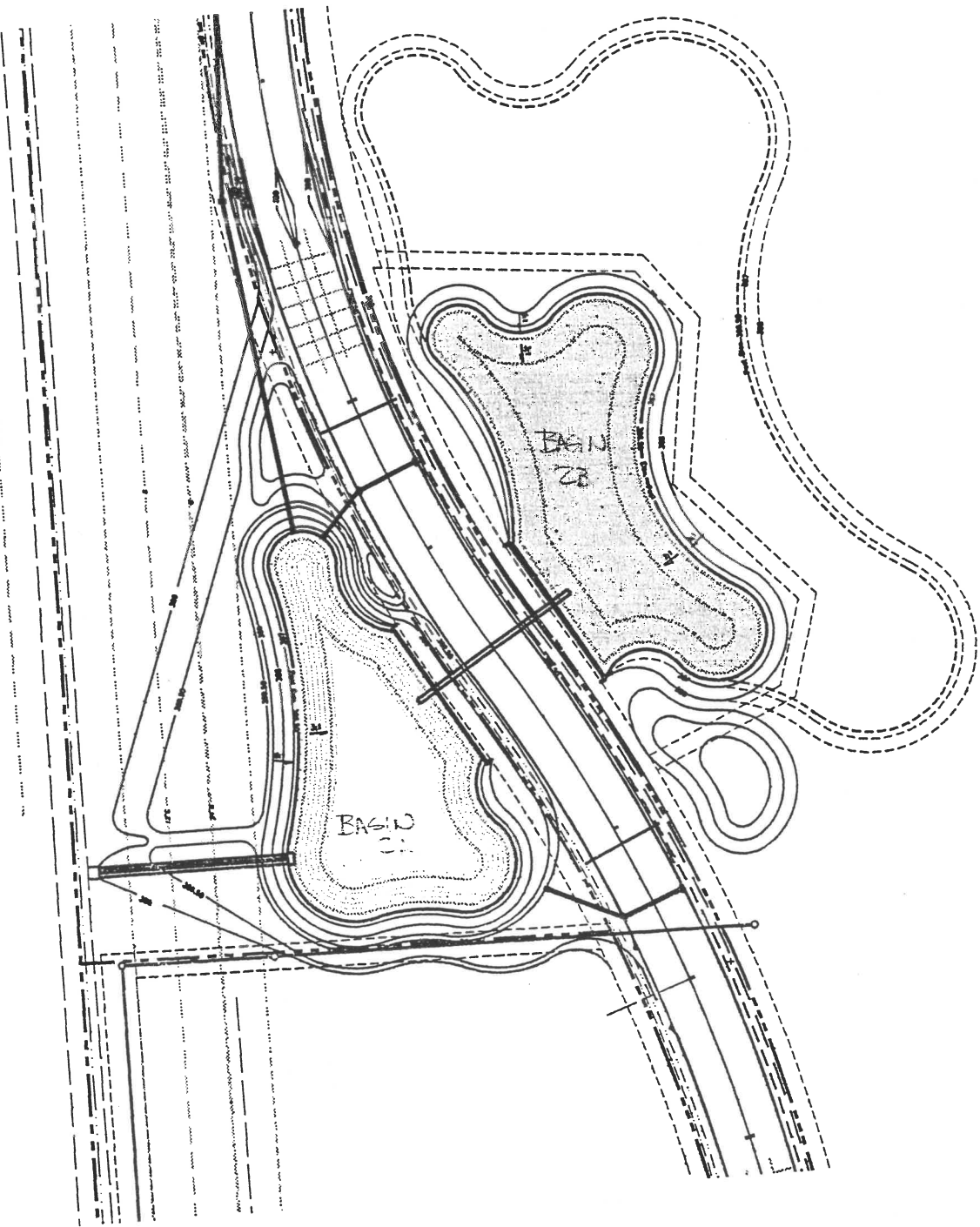
Part of Phase 1
Roadway Construction

Part of Phase 4
Roadway Construction

CIRCLE FRONT DRIVE
Phase 4 Construction

C-4

SE Co
Sec. 1



20' P.U. ESMT.

25' TEXAS GAS
PIPELINE ESMT
(DR. 3, 0416366)

50' TEXAS GAS
PIPELINE ESMT
(DR. 378, P. 454)

75' LEGAL
DRAIN ESMT.

DRAINAGE ESMT

PROPOSED 12"
STORM SEWERS

PROPOSED DRAIN
& P.U. ESMT

(top of Bank)

55'

NURENBERN DITCH

PROPOSED LAKE
OUTFALL STR.
21" ϕ PIPE
W/HEADWALL

24'c

12'c

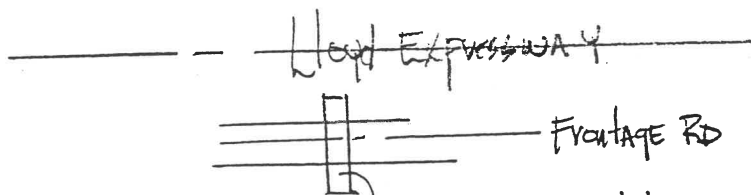
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APPENDIX F

BOX CULVERT DATA



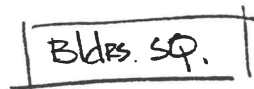
Schematic of Predicted Flows
 Contributing To VIRGINIA STREET CROSSING



15" pipe
 3± CFS.

Existing Arch Plate
 Drainage 40± Acres (INDOT PLAN)
 $Q = CIA = (.2)(3)(408) = 245 \text{ CFS.}$
 OR.
 Model of flow through culvert
 produced 247 CFS @ EL 389.67

21" pipe from CFC
 Model shows 25 CFS @ EL 87.7

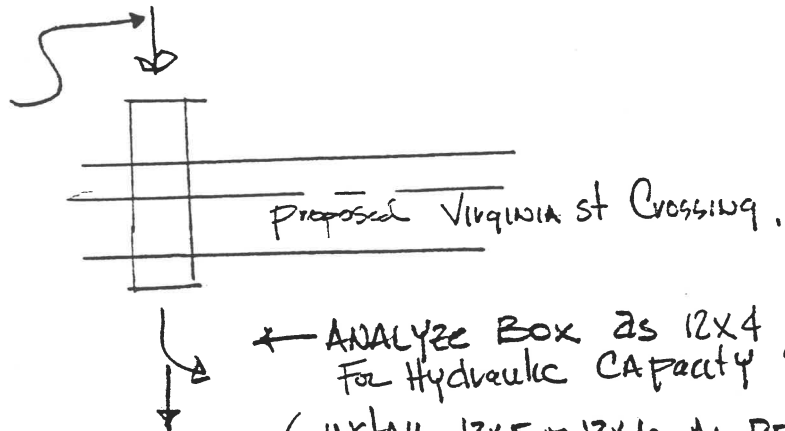


Two 21" pipes
 15.44 CFS
 (see report)

21" pipe from CFC
 Model shows 25 CFS @ EL 87.7

Summary Flows

247
 3
 15
 25
25
 315 CFS.



ANALYZE BOX as 12x4
 for Hydraulic Capacity check
 (INSTALL 12x5 or 12x6 As REQD.)

Exist pipe
Under Frontage Rd

CURRENT DATE: 10-27-1994

FILE DATE: 10/15/94

CURRENT TIME: 14:29:46

FILE NAME: HARTARCH

FHWA CULVERT ANALYSIS #####
HY-8, VERSION 4.0 #####
#####

| C | SITE DATA | CULVERT SHAPE, MATERIAL, INLET |

| U |-----|-----|

| L | INLET OUTLET CULVERT | BARRELS |

| V | ELEV. ELEV. LENGTH | SHAPE SPAN RISE MANNING INLET |

| # | (FT) (FT) (FT) | MATERIAL (FT) (FT) n TYPE |

| |-----|-----|

| 1 | 383.80 383.64 60.00 | 1 CSPA 10.22 6.77 .034 CONVENTIONAL |

| 2 | | |

| 3 | | |

| 4 | | |

| 5 | | |

| 6 | | |

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DATE: 10-27-1994

FILE DATE: 10/15/94

TIME: 14:29:46

FILE NAME: HARTARCH

Performance Curve for Culvert # 1 - 1 (10.21667 BY 6.76666) CSPA

PERFORMANCE CURVE FOR CULVERT # 1 - 1 (10.21667 BY 6.76666) CSPA

PERFORMANCE CURVE FOR CULVERT # 1 - 1 (10.21667 BY 6.76666) CSPA

HEAD- INLET OUTLET

WATER CONTROL	CONTROL	FLOW	NORMAL	CRITICAL	OUTLET	TAILWATER	
ELEV.	DEPTH	DEPTH	TYPE	DEPTH	DEPTH	VEL. DEPTH	VEL. DEPTH
(ft)	(ft)	(ft)	<F4>	(ft)	(ft)	(fps)	(ft) (fps) (ft)

Performance Curve for Culvert # 1 - 1 (10.21667 BY 6.76666) CSPA

33.80	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	-0.04
35.74	1.45	1.94	3-M1t	1.53	0.90	1.90	1.89	1.70	1.89
386.61	2.11	2.81	3-M1t	2.26	1.35	2.53	2.67	2.07	2.67
37.31	2.67	3.51	3-M1t	2.91	1.66	3.03	3.27	2.32	3.27
387.92	3.16	4.12	3-M1t	3.53	1.96	3.48	3.78	2.51	3.78
38.47	3.63	4.67	3-M1t	4.18	2.22	3.90	4.22	2.66	4.22
38.97	4.07	5.17	3-M2t	4.93	2.45	4.31	4.61	2.79	4.61
389.22	4.48	5.42	6-FFn	6.77	2.69	3.85	6.77	2.92	4.96
39.60	4.87	5.80	6-FFn	6.77	2.90	4.40	6.77	3.03	5.14
389.71	5.00	5.91	6-FFn	6.77	2.97	4.59	6.77	3.05	5.18
90.25	5.63	6.45	6-FFn	6.77	3.31	5.51	6.77	3.14	5.33

Performance Curve for Culvert # 1 - 1 (10.21667 BY 6.76666) CSPA

Performance Curve for Culvert # 1 - 1 (10.21667 BY 6.76666) CSPA

El. inlet face invert 383.80 ft El. outlet invert 383.64 ft

El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

Performance Curve for Culvert # 1 - 1 (10.21667 BY 6.76666) CSPA

CURRENT DATE: 10-27-1994

FILE DATE: 10/15/94

CURRENT TIME: 14:29:46

FILE NAME: HARTARCH

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##### TAILWATER #####
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***** USER DEFINED CHANNEL CROSS-SECTION

FILE NAME: HART

MAIN CHANNEL AND LT & RT OVER BANKS

FILE DATE: 10/15/94

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LEFT CHANNEL BOUNDARY      3
RIGHT CHANNEL BOUNDARY     7
MANNING N LEFT OVER BANK   0.040
MANNING N MAIN CHANNEL     0.045
MANNING N RIGHT OVER BAN   0.040
SLOPE OF CHANNEL (FT/FT)   0.0019

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CROSS-SECTION COORD. NO.	X (FT)	Y (FT)
1	0.00	390.00
2	1.00	389.00
3	200.00	388.50
4	207.00	384.90
5	212.00	383.60
6	217.00	383.60
7	222.00	388.60
8	441.00	389.00
9	442.00	390.00

***** UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (CFS)	W.S.E. (FT)	FROUDE NUMBER	DEPTH (FT)	VEL. (FPS)	SHEAR (PSF)
0.00	383.60	0.000	-0.04	0.00	0.00
30.00	385.53	0.254	1.89	1.70	0.15
60.00	386.31	0.264	2.67	2.07	0.20
90.00	386.91	0.270	3.27	2.32	0.24
120.00	387.42	0.275	3.78	2.51	0.27
150.00	387.86	0.278	4.22	2.66	0.30
180.00	388.25	0.281	4.61	2.79	0.32
210.00	388.60	0.283	4.96	2.92	0.34
240.00	388.78	0.286	5.14	3.03	0.36
250.00	388.82	0.286	5.18	3.05	0.37
300.00	388.97	0.288	5.33	3.14	0.38

dddddd
 dddddd ROADWAY OVERTOPPING DATA dddddd
 dddddd

ROADWAY SURFACE	GRAVEL
EMBANKMENT TOP WIDTH (FT)	24.00
CREST LENGTH (FT)	50.00
OVERTOPPING CREST ELEVATION (FT)	389.67

dddddd
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CURRENT DATE: 10-27-1994

FILE DATE: 10/15/94

CURRENT TIME: 15:23:36

FILE NAME: HARTBOX

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#####                               TAILWATER                               #####
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***** USER DEFINED CHANNEL CROSS-SECTION.

FILE NAME: DITCHBOX

MAIN CHANNEL AND LT & RT OVER BANKS

FILE DATE: 10/15/94

LEFT CHANNEL BOUNDARY	3
RIGHT CHANNEL BOUNDARY	7
MANNING N LEFT OVER BANK	0.040
MANNING N MAIN CHANNEL	0.045
MANNING N RIGHT OVER BAN	0.040
SLOPE OF CHANNEL (FT/FT)	0.0019

CROSS-SECTION	X	Y
COORD. NO.	(FT)	(FT)
1	0.00	388.00
2	1.00	387.40
3	200.00	387.57
4	207.00	383.20
5	212.00	383.10
6	217.00	383.10
7	222.00	387.60
8	441.00	387.60
9	442.00	388.00

***** UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (CFS)	W.S.E. (FT)	FROUDE NUMBER	DEPTH (FT)	VEL. (FPS)	SHEAR (PSF)
0.00	383.60	0.000	1.85	0.00	0.00
40.00	385.53	0.254	3.78	1.70	0.15
80.00	386.31	0.264	4.56	2.07	0.20
120.00	386.91	0.270	5.16	2.32	0.24
160.00	387.42	0.275	5.67	2.51	0.27
200.00	387.86	0.278	6.11	2.66	0.30
240.00	388.25	0.281	6.50	2.79	0.32
280.00	388.60	0.283	6.85	2.92	0.34
316.00	388.78	0.286	7.03	3.03	0.36
360.00	388.82	0.286	7.07	3.05	0.37
400.00	388.97	0.288	7.22	3.14	0.38

dddddd
 dddddd ROADWAY OVERTOPPING DATA dddddd
 dddddd

ROADWAY SURFACE	GRAVEL
EMBANKMENT TOP WIDTH (FT)	40.00
CREST LENGTH (FT)	25.00
OVERTOPPING CREST ELEVATION (FT)	390.00

ddddd

