Hillside

FILE
HILLSIDE MOBIC MANOR

City of O'Fallon, Missouri

138 South Main Street
O'Fallon, MO 63366
Phone 314-240-2000
Fax 314-978-4144

June 8, 1998

Mr. and Mrs. Clem Huse
Hillside Mobile Manor
9288 Mexico Road
O'Fallon, Missouri 63366

Re: Existing Detention Basin
East Side of Bryan Road;
300 Feet North of Mexico Road

Dear Mr. and Mrs. Huse:

As requested, this letter verifies that the above referenced tract will serve as the storm water detention facility for the existing Amoco service station and approximate twenty (20) acres located on the southeast corner of Bryan Road and Mexico Road. While the detention obtained in the basin does not provide for the 100 year storm requirement as far a release rate, the negotiations for ROW along Bryan Road included relaxing the design requirements slightly. As you are aware this facility was designed and constructed as part of the right of way considerations for the Bryan Road Improvements Project.

If you have any questions, please contact this office at 240-5555 ext. 308.

Sincerely,

Frank Godwin

Frank Godwin, P.E.
Chief of Engineering

Cc file thru B. Hedden

GBA
GEORGE BUTLER ASSOCIATES, INC.

Job No. 7219.06
Date
By Chk'd By

HOUSE BASIN
100 RTI GLG

100 YEAR EVENT

T	I_n	I_{n+1}	$2S/\Delta t_n - O_n$	$2S/\Delta t_{n+1} + O_{n+1}$	ELEV	OUTFLOW	STORAGE
0	0	0	0	0	572.75	0	0
1	84.61	84.61	0	84.61		2.60	
2	84.61	169.22	79.41	248.82		6.00	
3	84.61	169.22	224.82	394.04		7.50	
4	84.61	169.22	399.04	548.26		8.50	
5	84.61	169.22	531.26	700.48		9.40	
6	84.61	169.22	681.68	850.90		10.00	
7	84.61	169.22	830.90	1000.12		10.70	
8	84.61	169.22	978.72	1147.94		11.40	
9	84.61	169.22	1125.14	1294.36		11.80	
10	84.61	169.22	1270.76	1439.98		12.20	
11	84.61	169.22	1415.58	1584.80		12.60	
12	84.61	169.22	1559.60	1728.82		12.90	
13	84.61	169.22	1703.02	1872.24		13.20	
14	84.61	169.22	1845.84	2015.06		13.60	
15	84.61	169.22	1987.86	2157.08		13.90	
16	84.61	169.22	2129.28	2298.50		14.20	
17	84.61	169.22	2270.10	2439.32		14.50	
18	84.61	169.22	2410.32	2579.54		15.40	
19	84.61	169.22	2548.74	2717.96		17.00	
20	84.61	169.22	2683.96	2853.18		21.00	
21	0	84.61	2811.18	2895.36	578.20	22.50	
22	0	0	2850.36	2850.36		21.00	
23	0	0	2808.36	2808.36		20.00	
24	0	0	2768.36	2768.36		18.50	

EXCEED 9000CF MAX. RATE FOR 3 MIN.

PRE DEV. → Q_{100} MAX RELEASE RATE = 13.72 x 1.39 = 19.07 CFS

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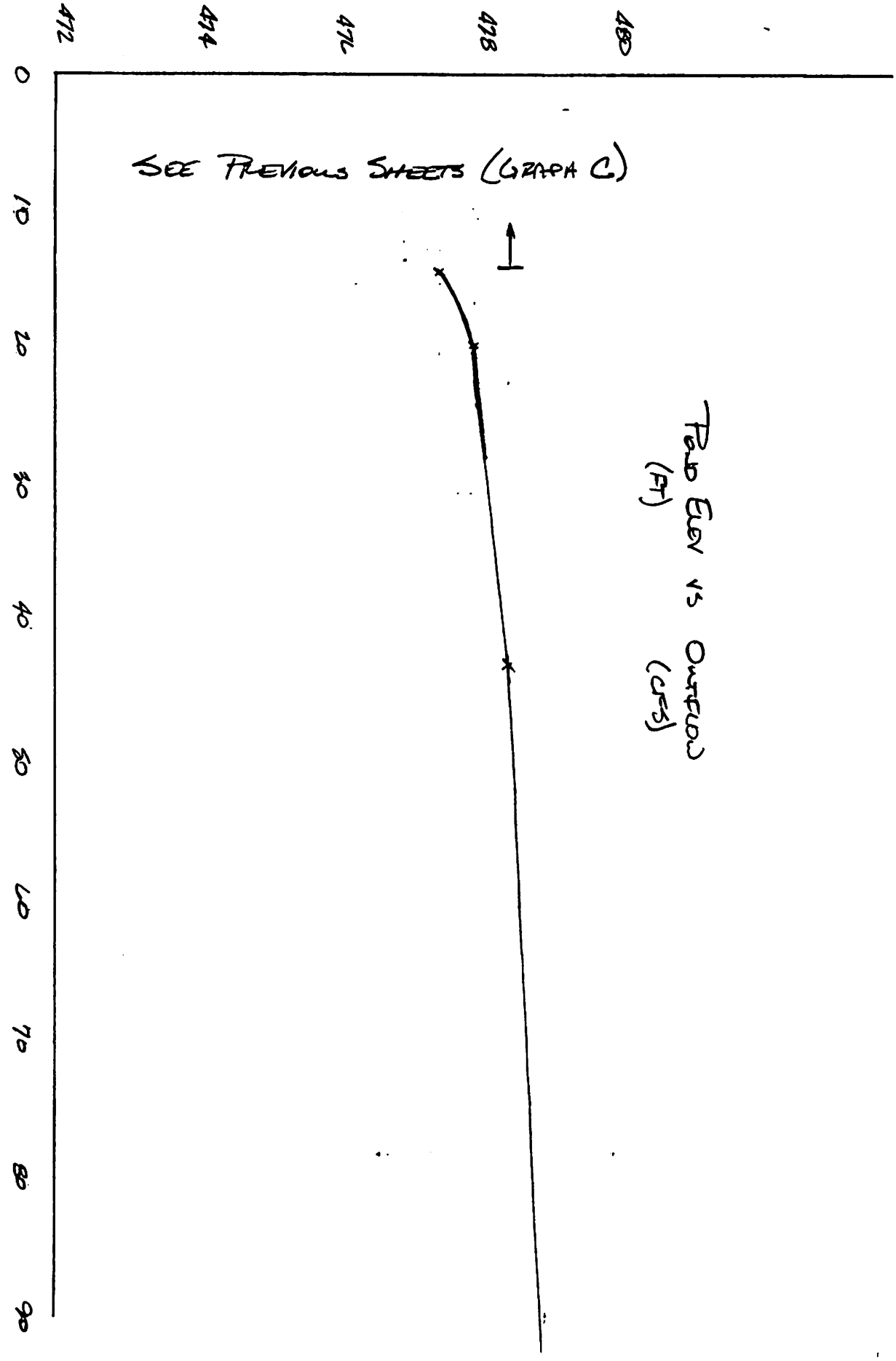

Page _____ Of _____

Date _____

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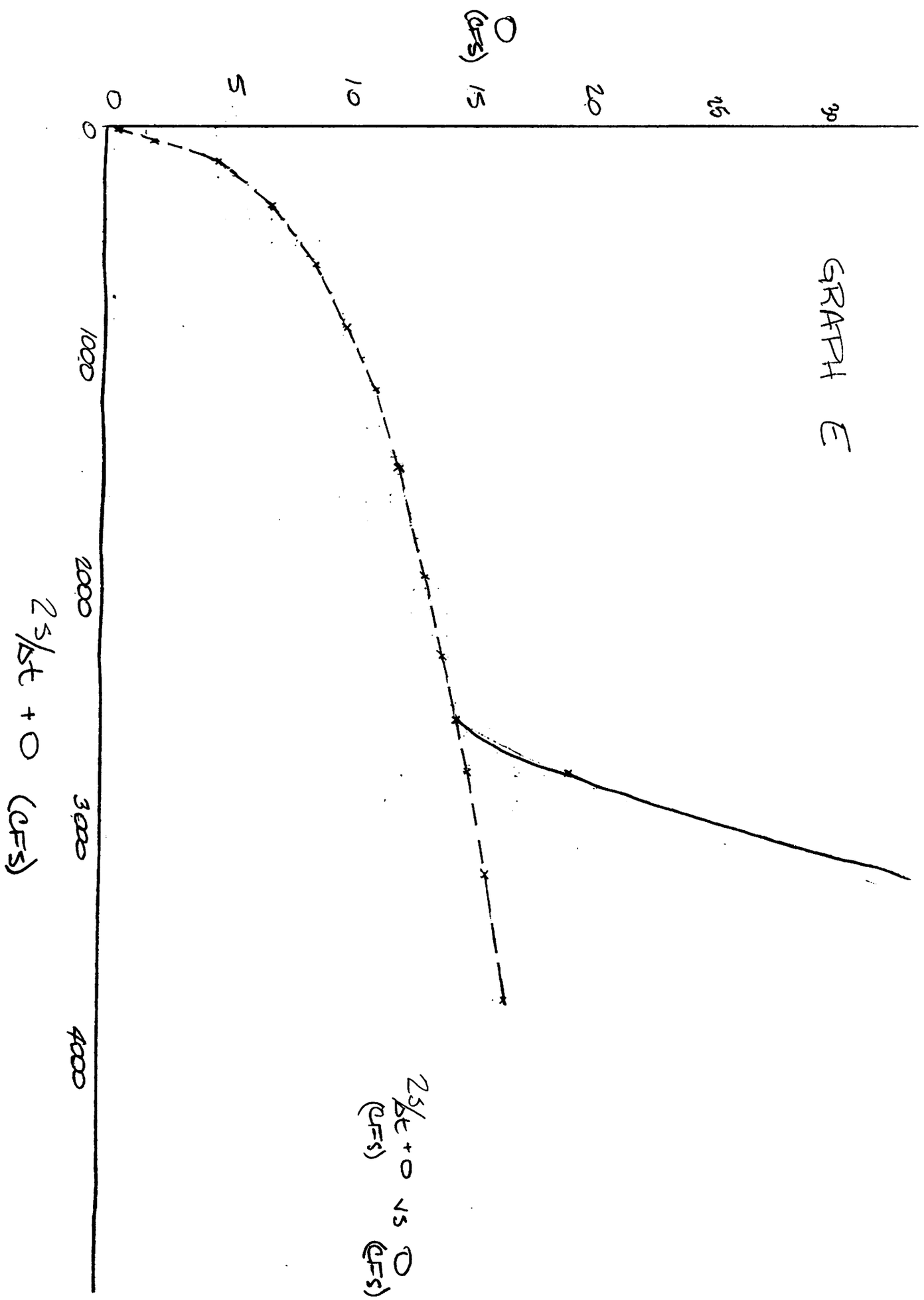

GRAPH E

HUSE/HILLMANN DETENTION BASIN FOR 20 AC SITE AND 3.81 AC SITE LOCATED ON THE SE AND NE CORNERS OF MEXICO ROAD AND BRYN ROAD RESPECTIVELY.

ONE DETENTION BASIN HAS BEEN DESIGNED IN THE FOLLOWING CALCULATIONS TO SERVE BOTH OF THESE SITES.

THE FOLLOWING ASSUMPTIONS WERE USED AND SHOULD BE FOLLOWED DURING THE DEVELOPMENT OF THESE TWO TRACTS:

1. THE FLOW FROM BOTH OF THESE SITES WAS DETERMINED USING THE P.I. FACTORS FOR COMMERCIAL TRACTS. (BOTH TRACTS ARE CURRENTLY ZONED COMMERCIAL)
2. 12 ACRES OF THE 20 ACRE TRACT AND ALL OF THE 3.81 ACRE TRACT WERE ASSUMED TO FLOW TO THE PROPOSED BASIN. THE STORM SEWER SYSTEM ASSOCIATED WITH THIS BASIN HAS BEEN DESIGNED TO CARRY THE 25yr STORM EVENT (FOR 12 ACRES OF THE 20 ACRE SITE) TO THE DETENTION BASIN.

I. Allowable Release Rate

The maximum allowable release rate for these two tracts is calculated as follows:

25yr event (3.81 Ac + 20.00 Ac) 2.31 CFS/Ac = 55.00 CFS

15yr event (3.81 Ac + 20.00 Ac) 1.87 CFS/Ac = 44.52 CFS

II. Maximum Release Rate from Basin

Assumes that 15.81 Ac (12.00 Ac + 3.81 Ac) of drainage area will be directed to the detention basin 8.00 Ac (20.00 Ac - 12.00 Ac) will bypass the basin. The amount of flow that will bypass the basin is calculated as follows:

25yr event: 8.00 Ac (4.75 CFS/Ac) = 38.00 CFS

15yr event: 8.00 Ac (3.85 CFS/Ac) = 30.80 CFS

Maximum Release Rate from Basin = Allowable Release Rate from two tracts - Release Rate Bypassing Basin

Max. Release Rate from Basin (25yr) = 55.00 CFS - 38.00 CFS
= 17.00 CFS

MAX. RELEASE RATE FROM BASIN (15yr) = 44.52 CFS - 30.80 CFS
= 13.72 CFS

III. STORAGE VOLUME OF BASIN

STAGE VS STORAGE

ELEV. (FT)	AREA (SF)	AVG AREA (SF)	DEPTH (FT)	INCR VOL (FT³)	CUMM VOL (FT³)
572.75	0				0
		3565	1.25	4456	
574.0	7130				4456
		14725	2.00	29450	
576.0	22320				33906
		24587	2.00	49174	
578.0	26854				83080
		29295	2.00	58590	
580.0	31736				141670

SEE GRAPH B

IV. ESTIMATED STORAGE VOLUME REQ.

VOLUME REQD = ALLOWABLE RELEASE RATE X STORM DURATION

VOLUME REQD. (25yr) = 55.00 CFS x 30 MIN x 60 SEC/MIN
= 99000 FT³

VOLUME REQD (15yr) = 44.52 CFS x 30 MIN x 60 SEC/MIN
= 80131 FT³

V

CALC. SIZE OF OUTFALL PIPE

FL out = 571.50

FL in = 572.25

LENGTH = 75.0

SLOPE = $\frac{572.25 - 571.50}{75.0}$ = 0.01% OR 1.00%

100 YR FLOW = 25 yr FLOW x 1.39

= 15.81 AC x 4.75 CFS/AC x 1.39

= 104.39 CFS

ALLOWABLE H.W. = 578.50 - 572.25 = 6.25

TRY 48" DIA. RCP

HW/D = 1.38

HW = 1.38 x 4 = 5.52 < 6.25 OK

TRY 42" DIA RCP

HW/D = 2.10

HW = 2.1 x 3.5 = 7.35 NG

75 L.F OF 48" DIA. RCP @ 1.0%

SEE GRAPH A FOR HW ELEV VS FLOW

VI DETERMINE SIZE OF METERING DEVISE FOR 25yr EVENT USING ORIFACE EQUATION

$Q = Ca(2gh)^{1/2}$ ⇒ THIS EQUATION IS VALID WHEN THE HEAD OF THE OUTFALL PIPE IS LESS THAN THE CENTROID OF THE ORIFACE. THE AREA (a) IS THE AREA OF FLOW THROUGH THE ORIFACE. THE HEAD (h) ON THE ORIFACE IS MEASURED FROM THE POND SURFACE TO THE CENTROID OF THE ORIFACE OR THE DOWNSTREAM WATER SURFACE ELEVATION, WHICHEVER RESULTS IS THE LOWER VALUE.

ASSUMING THE CENTROID OF THE ORIFACE CONTROLS : TRY 1.0' WIDE x 1.5' HIGH ORIFACE

$Q = 0.6\,a\,(2(32.2)(\text{TOP OF DAM} - \text{FREEBOARD} - \text{CENTROID ELEV.})$

$Q = 0.6(1.0)(1.5)[(64.4)(580.00 - 2.00 - 573.50)$

$Q = (0.6)(1.5)[(64.4)(4.5)]^{1/2}$

$Q(25) = 15.32$ CFS < 17.00 CFS ∴ OK

SEE GRAPH C_A FOR POND ELEV VS OUTFLOW AND TABLE D

~~VII~~

PREPARE OUTFLOW VS $2S/\Delta t + O$ CURVE AND TABLE

$\frac{2S(FT^3)}{1\ MIN} \left| \frac{1\ MIN}{60\ SEC} \right. + O \Rightarrow 0.0\bar{3}S + O$

ELEV	STORAGE	OUTFLOW	$2S/\Delta t + O$
572.75	0	0	0
573.0	500	0.43	17.1
573.5	2000	2.00	68.7
574.0	4456	4.76	153.3
574.5	10000	7.00	340.3
575.0	17500	8.85	592.18
575.5	25500	10.15	860.2
576.0	33906	11.42	1141.7
576.5	44000	12.40	1479.1
577.0	58000	13.51	1946.8
577.5	68000	14.35	2281.0
578.0	83080	15.32	2784.7
578.5	96000	16.15	3216.2
579.0	112000	16.94	3750.3

SEE GRAPH E

VIII Flow Rates to Basin

25yr event -

Flow to A1 204 = 12.0 ac @ 4.75 = 57.00 cfs
" " MH 203 = — = 0.00
" " MH 202 = — = 0.00
" " A1 201 = 1.46 ac @ 4.75 = 6.94 cfs
= 0.46 ac @ 4.07 = 1.87 cfs
Basin (Direct) = 1.02 ac @ 4.75 = 4.85 cfs
= 1.09 ac @ 4.07 = 4.44 cfs

75.01 cfs ✓

15yr event -

Flow to A1 204 = 12.0 ac @ 3.85 = 46.20
" " MH 203 = — = 0.00
" " MH 202 = — = 0.00
" " A1 201 = 1.46 ac @ 3.85 = 5.62
= 0.46 ac @ 3.30 = 1.52
Basin (Direct) = 1.02 ac @ 3.85 = 3.93
1.09 ac @ 3.30 = 3.60

IX Route 25yr Event Through Basin

Time	In	In+1	$2S/\Delta t_n - O_n$	$2S/\Delta t_{n+1} + O_{n+1}$	ELEV	Outflow	Storage
0	0	0	0	0	572.75	0	
1	75.10	75.10	0	75.10		2.50	
2	75.10	150.20	70.10	220.30		5.50	
3	75.10	150.20	209.30	359.50		7.10	
4	75.10	150.20	345.3	495.50		8.10	
5	75.10	150.20	479.30	629.50		9.00	
6	75.10	150.20	611.50	761.70		9.60	
7	75.10	150.20	742.5	892.50		10.30	
8	75.10	150.20	871.90	1022.10		10.80	
9	75.10	150.20	1000.50	1150.70		11.40	
10	75.10	150.20	1127.90	1278.10		11.75	
11	75.10	150.20	1254.60	1404.80		12.10	
12	75.10	150.20	1380.60	1530.80		12.50	
13	75.10	150.20	1505.80	1656.00		12.80	
14	75.10	150.20	1630.40	1780.60		13.10	
15	75.10	150.20	1754.40	1904.60		13.40	
16	75.10	150.20	1877.80	2028.00		13.60	
17	75.10	150.20	2000.80	2151.00		13.95	
18	75.10	150.20	2123.10	2273.30		14.20	
19	75.10	150.20	2244.90	2395.10		14.50	
20	75.10	150.20	2366.10	2516.30		14.75	
21	0	75.10	2486.80	2561.90	577.80*	14.90***	76000**
22		0	2537.10	2537.10			

* FROM GRAPH C

** FROM GRAPH B

*** LESS THAN 17.00 (ALLOWABLE RELEASE RATE)

∴ OK

X

ROUTE 15 1/r EVENT

TIME	I_n	I_{n+1}	$2S/\Delta t_n - O_n$	$2S/\Delta t_{n+1} + O_{n+1}$	ELEV	OUTFLOW	STORAGE
0	0	0	0	0	572.75	0	0
1	60.87	60.87	0	60.87		1.80	
2	60.87	121.74	57.27	179.01		5.10	
3	60.87	121.74	168.81	290.55		6.40	
4	60.87	121.74	277.75	399.49		7.40	
5	60.87	121.74	384.69	506.43		8.20	
6	60.87	121.74	490.03	611.77		8.90	
7	60.87	121.74	593.97	715.71		9.40	
8	60.87	121.74	696.91	818.65		9.85	
9	60.87	121.74	798.95	920.69		10.30	
10	60.87	121.74	900.09	1021.83		10.80	
11	60.87	121.74	1000.23	1121.97		11.20	
12	60.87	121.74	1099.57	1221.31		11.60	
13	60.87	121.74	1198.11	1319.85		11.90	
14	60.87	121.74	1296.05	1417.79		12.20	
15	60.87	121.74	1393.39	1515.13		12.40	
16	60.87	121.74	1490.33	1612.07		12.60	
17	60.87	121.74	1586.87	1708.61		12.90	
18	60.87	121.74	1682.81	1804.55		13.10	
19	60.87	121.74	1778.35	1900.09		13.40	
20	60.87	121.74	1873.29	1995.03		13.60	
21	0	60.87	1967.83	2028.70	577.10*	13.70***	58000***
22		0	2001.3	2001.30			

* FROM GRAPH C

** FROM GRAPH B

*** LESS THAN 13.72 CFS (ALLOWABLE RELEASE RATE) ∴ OK

XI 100 yr OVERFLOW CALCULATIONS

USE MHTD DROP INLET EE w/ TYPE "C" COVER. (5'x3')

CHECK IF INLET CAN PASS 100 yr EVENT

100 yr EVENT = 15 yr EVENT x 1.39

= 60.87 (1.39) = 84.61 CFS

ASSUMING THE 1'W x 1.5'H ORIFICE IS PLUGGED ALL STORMWATER MUST BYPASS BASIN THROUGH DROP INLET.

ALLOWABLE HW = TOP of DAM = 580.00

VERIFY IF STRUCTURE WILL ACT AS A WIER OR AN ORIFICE WITH THE HEAD @ 580.0.

CHECK WIER,

$$Q = CLH^{3/2}$$

$$Q_w = 3.0(16)(580 - 579.8)^{3/2}$$

$$Q_w = 156.63 \text{ CFS}$$

CHECK ORIFACE

$$Q_o = C_d(2gh)^{1/2}$$

$$Q_o = 0.6(15)(2(32.2)2.2)^{1/2}$$

$$Q_o = 107.13 \text{ CFS}$$

SINCE $Q_o < Q_w$ THE STRUCTURE WILL ACT AS AN ORIFACE @ THIS ELEVATION AND IS CAPABLE OF BYPASSING 100yr EVENT

<u>CALC. 100yr HW</u>

$$Q_o = 84.61 = 3.0(16)H^{3/2}$$

$$1.46' = H \quad \leftarrow \text{CONTROLS}$$

$$Q_o = 84.61 = 0.6(15)(64.4)^{1/2} h^{1/2}$$

$$1.37' = h$$

$\therefore$ 100yr HW = 577.8 + 1.46

= 579.17

Page____ Of____

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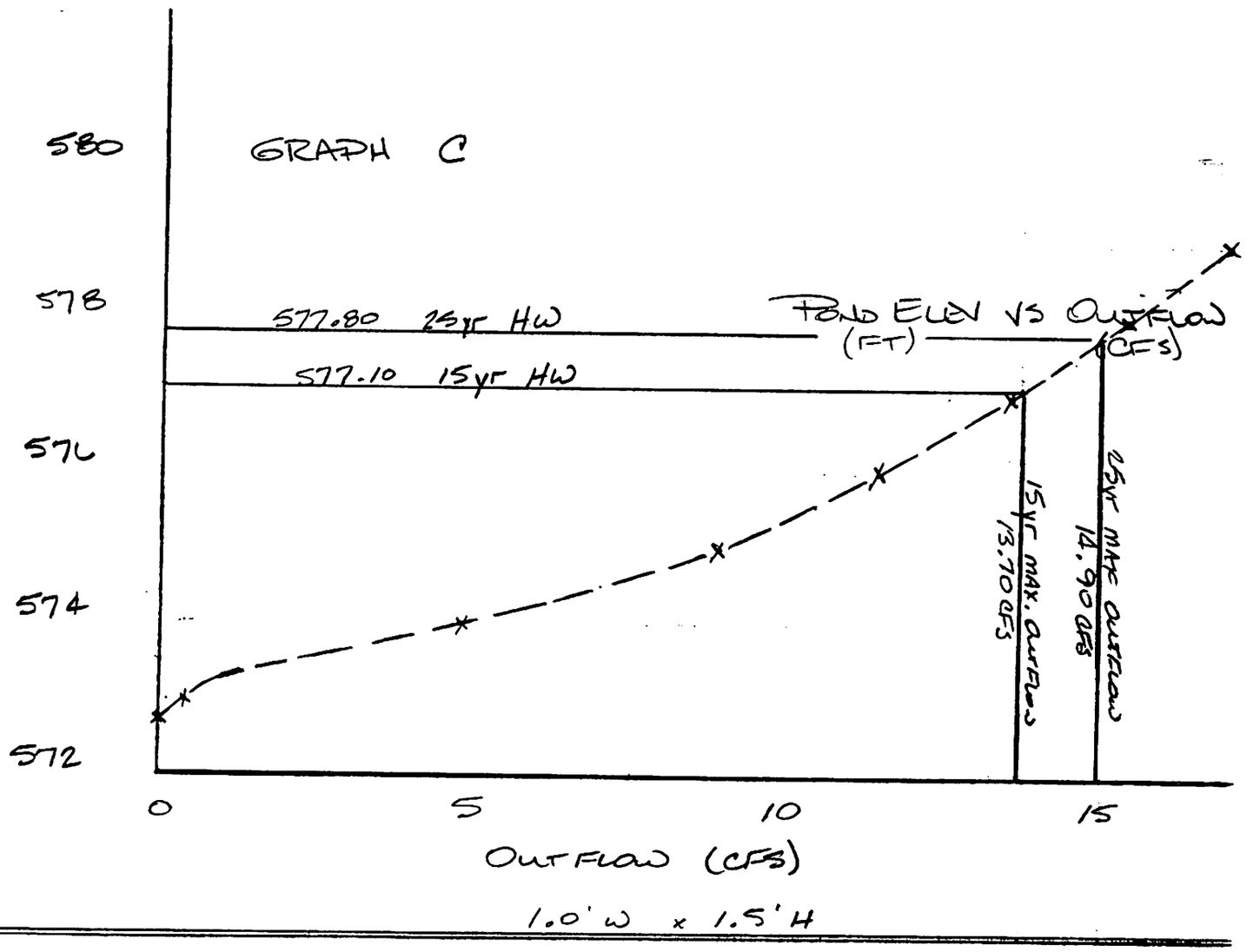

1.0' W x 1.5' H

TABLE D

ELEV	H(1'W x 1.5H)	AREA	Q	HW (48"Ø OUTFALL) F = 572.25	COMMENTS
572.75	0	0	0	0	—
573.0	0.13	0.25	0.43	572.35 ✓	—
574.0	0.63	1.25	4.76	572.60 ✓	—
575.0	1.50	1.50	8.85	572.80 ✓	—
576.0	2.50	1.50	11.42	573.00 ✓	-
577.0	3.50	1.50	13.51	573.20 ✓	—
578.0	4.50	1.50	15.32	573.30 ✓	—
579.0	5.50	1.50	16.94	573.50 ✓	= OK

Page____ Of____

Date ____

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Client ____

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Subject ____

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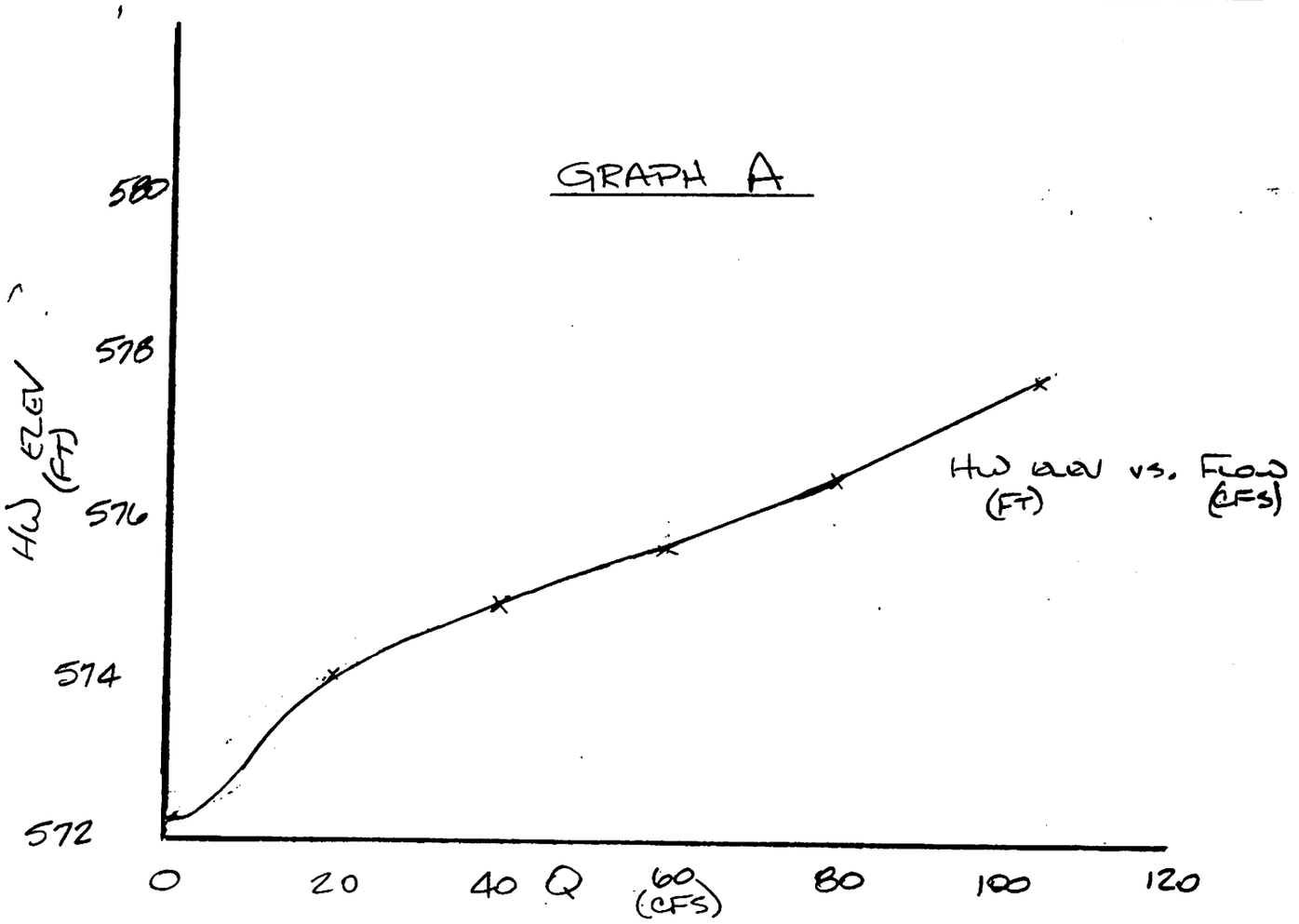
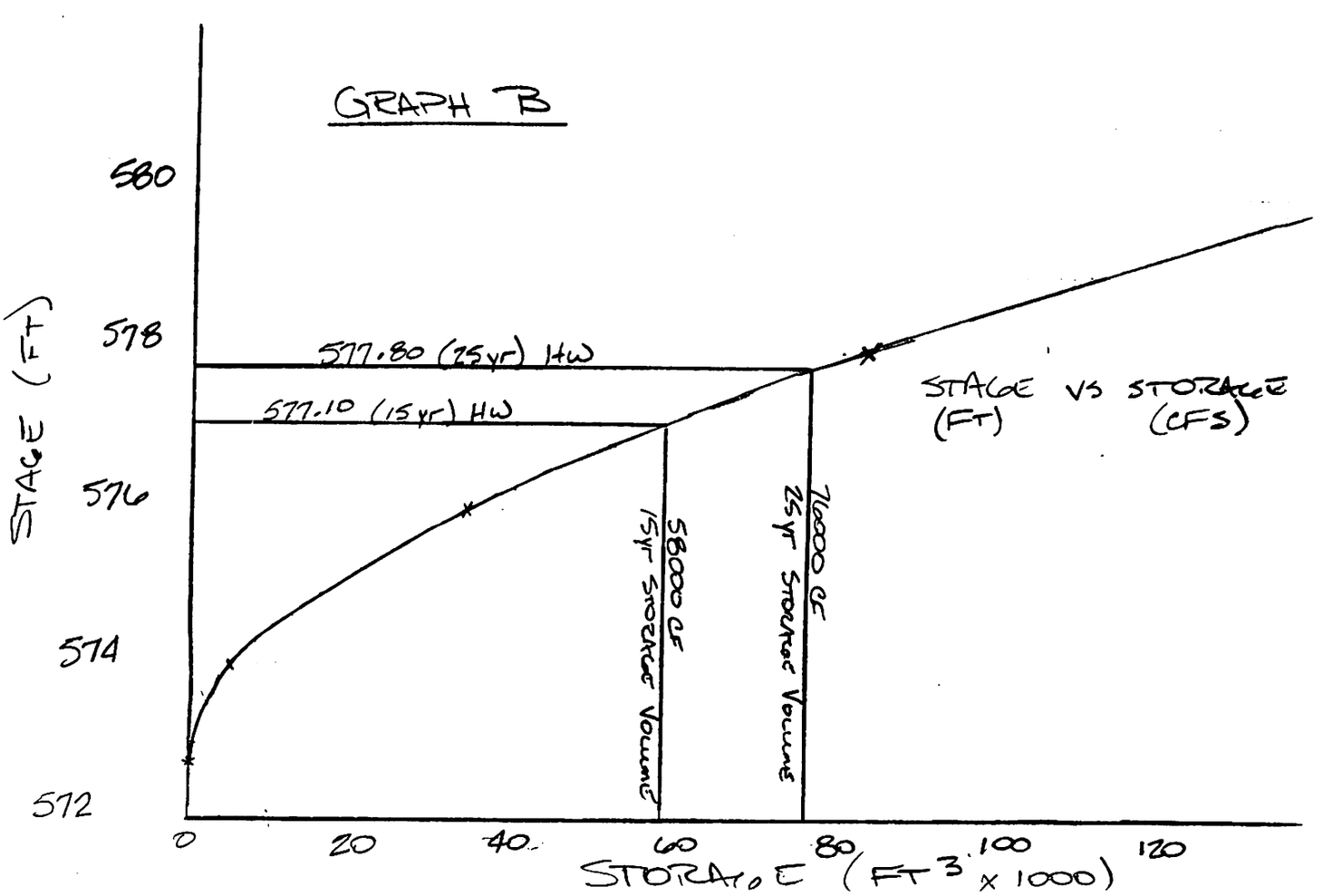
GRAPH A



GRAPH B



Page ____ Of ____

Date ____

Made By ____

Checked By ____

Client ____

Job No. 7219.06

Subject ____

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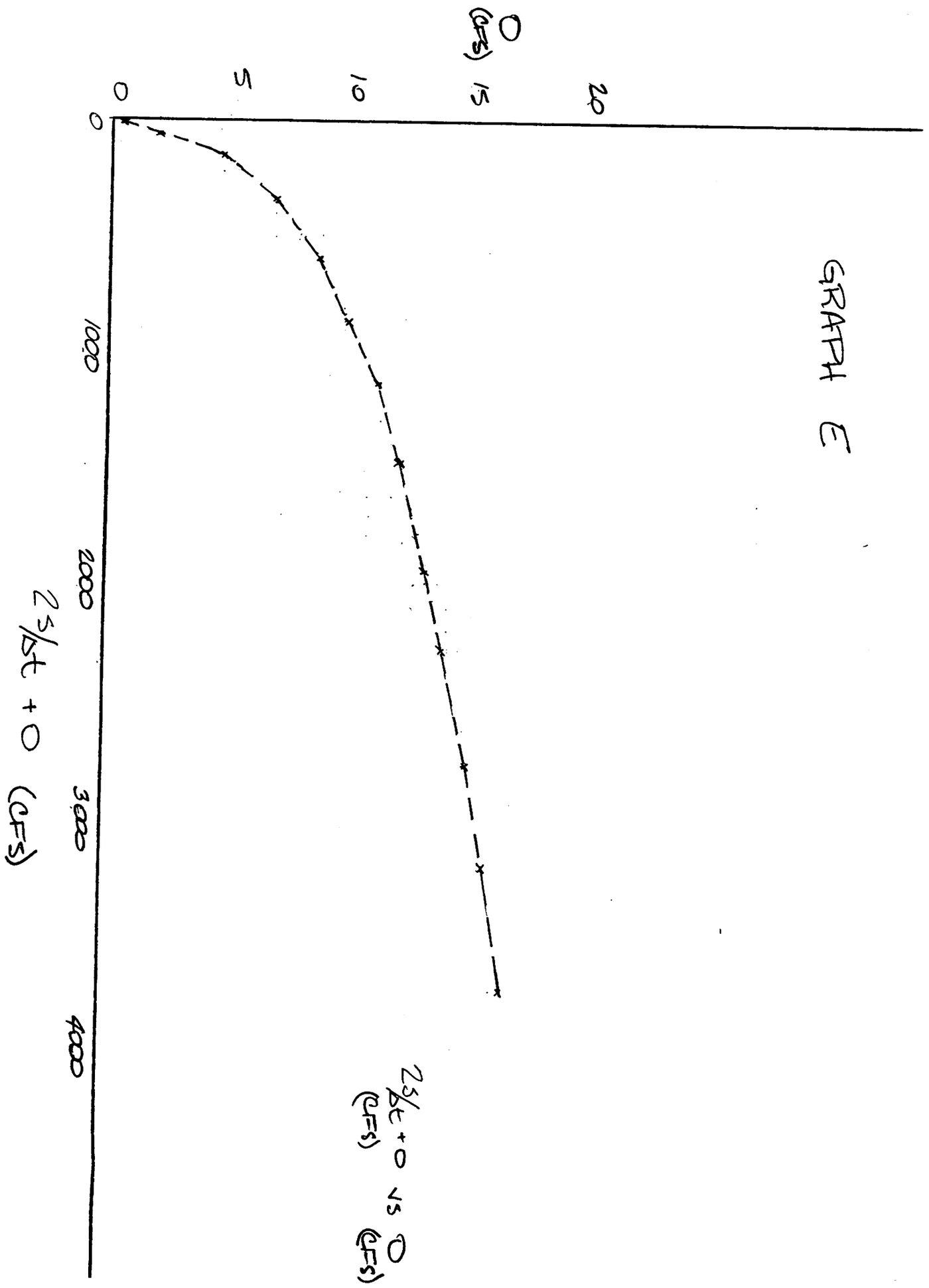

GRAPH E

Page _____ Of _____

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Subject STRUCTURE DETAIL

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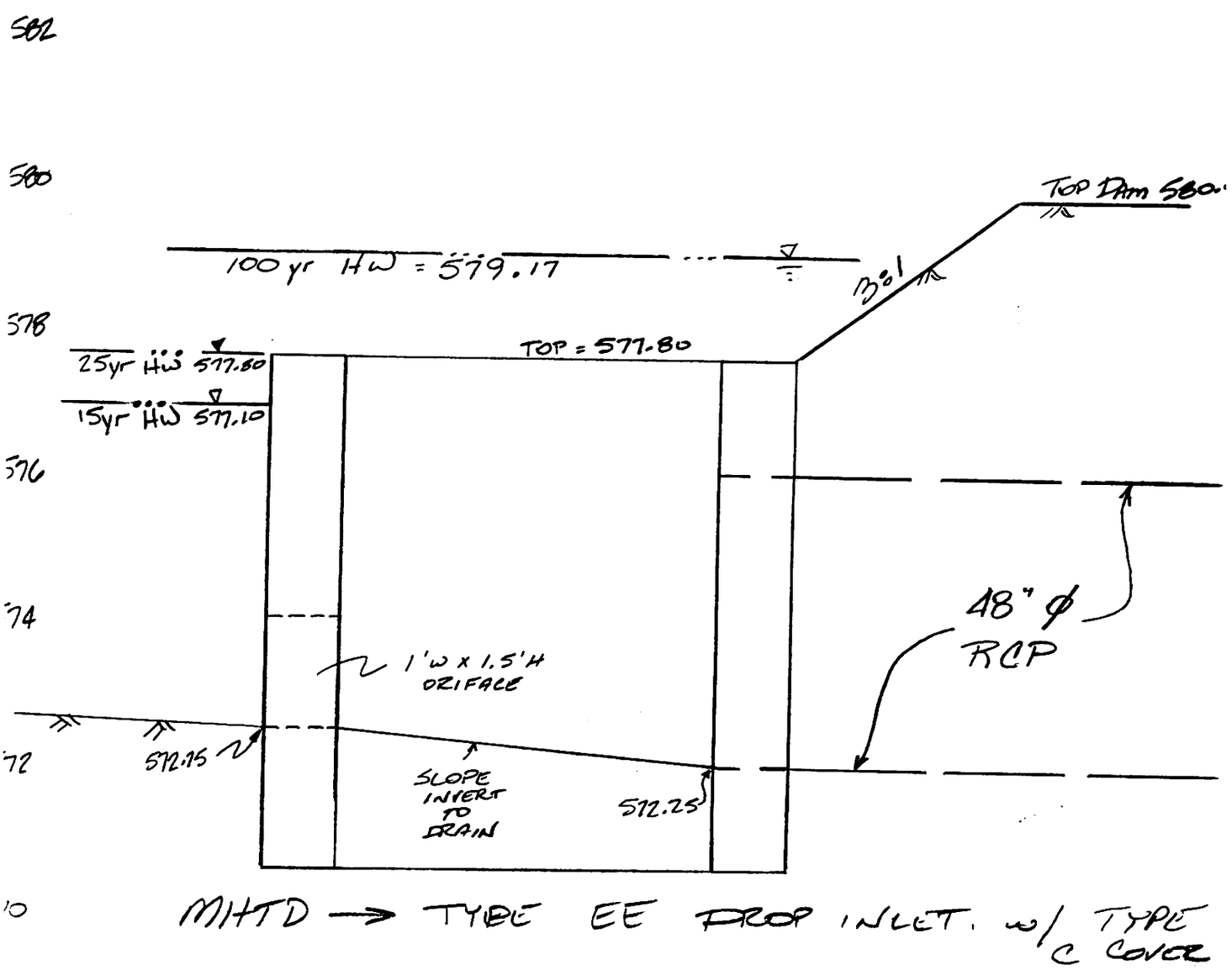

MHTD → TYPE EE DROP INLET. w/ TYPE C COVER

25yr EVENT

HYDRAULIC DATA PROJECT: 7219.01 HILLMANN / HUSE DETENTION BASIN PARCEL 21055 SHEET 1 OF 1

Line																								
Upper Structure	Lower Structure	Length **	Size	Upper Flow Line Elevation	Lower Flow Line Elevation	Flow Line Grade %	Upper Structure Elevation	Lower Structure Elevation	Depth to Hyd. Grd. Upper End	Upper Hydraulic Elevation	Lower Hydraulic Elevation	Hydraulic Grade	Friction Head	Velocity ft./sec.	$V^2/2g$ ft.	$+V^2/2g$ V-Head	Turn Loss	Street Grade @ Inlet	Inlet Capacity C.F.S.	Area Acres	P.I.	Quantity C.F.S.	T.Q.	Pipe Capacity C.F.S.
		**	5'Ø	MH's / INLETS USED TO DETERMINE LENGTH																				
A1204	MH203	93.08	36"	584.75	583.81	0.01	592.5	595.8	5.80	586.70	586.02	0.00731	0.68	8.06	1.01	—	—	N.A	11.0*	12.00	4.75	57.0	57.0	66.6
MH203	MH202	39.55	36"	583.42	581.05	0.065	595.8	591.0	10.99	584.81	584.05	0.00731	0.29	8.06	1.01	0	.47 0.47	N.A	N.A	—	—	0	57.0	169.95
MH202	A1201	294.00	36"	578.87	575.93	0.01	591.0	583.3	10.05	580.95	578.93	0.00731	2.14	8.06	1.01	0	.47 0.47	N.A.	N.A.	—	—	0	57.0	66.6
A1201	FES200	75.12	42"	575.73	574.98	0.01	583.3	—	4.96	578.34	577.80	0.00431	0.32	6.84	0.73	0	.3 0.22	N.A.	11.0	1.26 0.46	4.75 4.07	8.81	65.81	100.6

← BASIN 25yr HW ELEV.

* CURRENT FLOW TO INLET ≈ 4.15 AC @ 2.31 CFS/AC = 9.59 CFS

9.59 CFS < 11.0 CFS ✓

CHECK (VERIFY, ADJUST)