BAYER-BECKER ENGINEERS
1230 BELLEVIEW DRIVE
LAWRENCEBURG, INDIANA 47025

STORM SEWER CALCULATIONS

FORMULAE USED
$Q_r = AC * I$ (required)
$V_p = (1.486 / n) * R^{2/3} * S^{1/2}$
$Q_p = A_p * V_p$
R = (Pipe Dia. / 4)

Designed By: CAR
Reviewed By:
Date: 5-5-98
Sheet:
Job # 95-79

LOCATION		TOPOGRAPHY					TIME					DESIGN					TIME		PIPE		REMARKS
From	To	Area Number	Acres	"C" Value	"AC" for Area	"AC" Acumulate	To Inlet "Ti" (minutes)	In Pipe "Tp" (minutes)	Concentration "T" (minutes)	Intensity "I" 10 ~~25~~ Year Storm Sewer	"Q" Required (c.f.s.)	Pipe Size (inches)	"n" Value	Slope in %	Velocity (ft. / sec)	"Q" Provided (c.f.s.)	Length of Pipe (feet)	In Pipe "Tp"	Inlet Invert	Outlet Invert	
			0.60	0.85	0.51	0.51	10	–	10	5.15	2.63	12	0.015	0.80	3.51	2.76	125	0.6			
			0.03	0.50	0.02	0.53	10	0.6	10.6	5.06	2.68	12	0.015	0.80	3.51	2.76	14	0.1			
			0.28	0.85	0.24	0.24	10	–	10	5.15	1.24	12	0.015	0.53	2.86	2.25	114	0.7			
			0.20	0.85	0.17	0.41	10	0.7	10.7	5.04	2.07	12	0.015	0.53	2.86	2.25	20	0.1			
			0.43	0.85	0.37	0.78	10.7	0.1	10.8	5.03	3.92	15	0.015	0.53	3.32	4.61	52	0.3			
			0.25	0.85	0.21	0.21	10	–	10	5.15	1.08	12	0.015	0.50	2.78	2.18	~~112~~ 95'	0.7			
			0.19	0.85	0.61	0.88	10	0.1	10.1	5.04	4.43	~~15~~ 18	0.015	0.85	~~4.41~~ 4.75	~~5.19~~ 8.39	~~140~~ 145'	0.6			
			0.96	0.50	0.48	0.48	15	–	15	4.47	2.15	12	0.015	0.50	2.78	2.18	103	0.6			
			0.19	0.85	0.17	1.57	15	0.6	15.6	4.40	6.91	18	0.015	1.05	5.28	9.33	165' ~~177~~	0.6			
			1.47	0.85	1.25	2.78	15.6	0.6	16.2	4.34	12.07	24	0.015	0.50	4.41	13.87	~~94~~ 105'	0.3			
			0.37	0.85	0.31	0.31	10	–	10	5.15	1.60	12	0.015	0.50	2.78	2.18	58'	0.3			

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BAYER-BECKER ENGINEERS
1230 BELLEVIEW DRIVE
LAWRENCEBURG, INDIANA 47025

STORM SEWER CALCULATIONS

FORMULAE USED
$Q_r = AC * I$ (required)
$V_p = (1.486 / n) * R^{2/3} * S^{1/2}$
$Q_p = A_p * V_p$
R = (Pipe Dia. / 4)

Designed By: CAR
Reviewed By:
Date: 5-5-9
Sheet:
Job # 95-7

LOCATION		TOPOGRAPHY					TIME					DESIGN					TIME		PIPE		REMARKS
From	To	Area Number	Acres	"C" Value	"AC" for Area	"AC" Acumulate	To Inlet "Ti" (minutes)	In Pipe "Tp" (minutes)	Concentration "T" (minues)	10 Intensity "I" 25 Year Storm Sewer	"Q" Required (c.f.s.)	Pipe Size (inches)	"n" Value	Slope in %	Velocity (ft. / sec)	"Q" Provided (c.f.s.)	Length of Pipe (feet)	In Pipe "Tp"	Inlet Invert	Outlet Invert	
			0.60	0.85	0.51	0.51	10	–	10	5.15	2.63	12	0.015	0.80	3.51	2.76	125	0.6			
			0.03	0.50	0.02	0.53	10	0.6	10.6	5.06	2.68	12	0.015	0.80	3.51	2.76	14	0.1			
			0.28	0.85	0.24	0.24	10	–	10	5.15	1.24	12	0.015	0.53	2.86	2.25	114	0.7			
			0.20	0.85	0.17	0.41	10	0.7	10.7	5.04	2.07	12	0.015	0.53	2.86	2.25	20	0.1			
			0.43	0.85	0.37	0.78	10.7	0.1	10.8	5.03	3.92	15	0.015	0.53	3.32	4.07	52	0.3			
			0.25	0.85	0.21	0.21	10	–	10	5.15	1.08	12	0.015	0.50	2.78	2.18	95'	0.7			
			0.19	0.85	0.61	0.88	10	0.7	10.7	5.04	4.43	~~15~~ 18	0.015	0.85	~~4.41~~ 4.75	~~5.19~~ 8.39	~~40~~ 145	0.6			
			0.96	0.50	0.48	0.48	15	–	15	4.47	2.15	12	0.015	0.50	2.78	2.18	103	0.6			
			0.19	0.85	0.17	1.57	15	0.6	15.6	4.40	6.91	18	0.015	1.05	5.28	9.33	165' ~~177~~	0.6			
			1.47	0.85	1.25	2.78	15.6	0.6	16.2	4.34	12.07	24	0.015	0.50	4.41	13.87	~~84~~ 105	0.3			
			0.37	0.85	0.31	0.31	10	–	10	5.15	1.60	12	0.015	0.50	2.78	2.18	58'	0.3			

WATER-BECKER ENGINEERS
230 BELLEVIEW DRIVE
LAWRENCEBURG, INDIANA 47025

STORM SEWER CALCULATIONS

CHECK COURTYARDS FOR 100 YEAR HYDRAULIC GRADIENT

FORMULAE USED
$Q_r = AC * I$ (required)
$V_p = (1.486 / n) * R^{2/3} * S^{1/2}$
$Q_p = A_p * V_p$
R = (Pipe Dia. / 4)

Designed By: CHRIS
Reviewed By:
Date: 5-5-98
Sheet:
Job # 95-19

LOCATION		TOPOGRAPHY					TIME					DESIGN					TIME		PIPE		REMARKS
From	To	Area Number	Acres	"C" Value	"AC" for Area	"AC" Acumulate	To Inlet "Ti" (minutes)	In Pipe "Tp" (minutes)	Concentration "T" (minutes)	Intensity "I" 100 ~~25~~ Year Storm Sewer	"Q" Required (c.f.s.)	Pipe Size (inches)	"n" Value	Slope in %	Velocity (ft. / sec)	"Q" Provided (c.f.s.)	Length of Pipe (feet)	In Pipe "Tp"	~~Inlet Invert~~	~~Outlet Invert~~	
			0.15	0.85	0.21	0.21	16.2			6.36	1.34	12	0.015	0.19			112		892.50 < 893.00		∴ OK
			0.79	0.85	0.67	0.88	16.2			6.36	5.60	~~15~~ 18	0.015	~~1.00~~ 0.38			140		~~892.37~~ ~~891.91~~ 891.79	~~893.16~~ 892.29	
			0.96	0.50	0.48	0.48	16.2			6.36	3.05	12	0.015	0.98			103		892.11		
			0.19	0.85	0.17	1.53	16.2			6.36	9.73	18	0.015	1.15			177		891.26	~~891.51~~ 891.26	← 891.26
			1.47	0.85	1.25	1.78	16.2			6.36	17.68	24	0.015	0.81			84		888.13	889.23	
			0.33	0.85	0.28	3.06	16.2			6.36	19.46	24	0.015	0.98			10		888.05		
																		CROWN =	887.95		

SEE ALSO 100 YEAR FLOOD ROUTE CALCULATIONS

DATE MAY 1998
BY CAR
CK'D.

BAYER & BECKER ENGINEERS
CIVIL ENGINEERS • SURVEYORS • PLANNERS

PROJECT 95-79
CHESTERWOOD PHASE TWO
PAGE NUMBER A.

SUBJECT 100 YEAR FLOOD ROUTE ALONG EAST SIDE OF BUILDING (IN BETWEEN BUILDING AND EX. MOUND)

@ INLET ALONG EAST PROPERTY LINE:

$A = 0.96$ ACRES
$C = 0.5$
$T_c = 15$ MINUTES $\Rightarrow$ $I_{100} = \frac{300}{T_c + 31}$

$$I_{100} = \frac{300}{15+31}$$

$$I_{100} = 6.52$$

$$Q_{100} = C\, I_{100}\, A$$

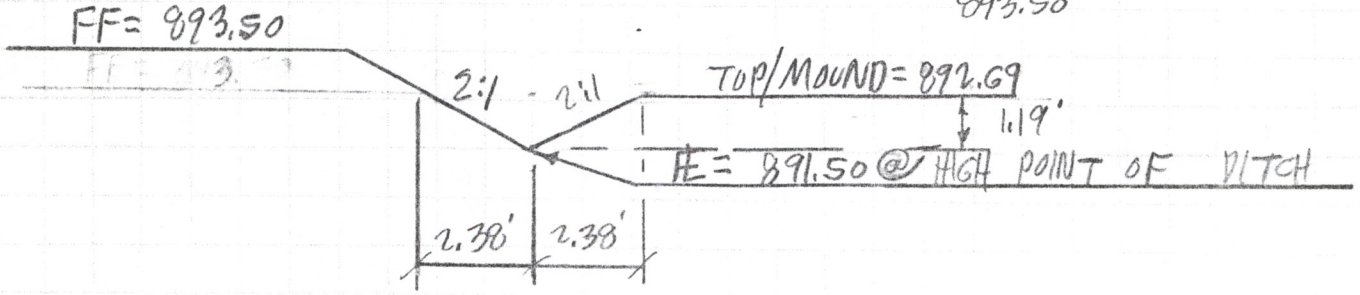
$$Q_{100} = 0.5 \times 6.52 \times 0.96$$

$$Q_{100} = 3.13 \text{ CFS}$$

Slope in prop. ditch in between Ex. Mounding Screen and Prop. Building along East Property Line: $(891.50 - 890.19) \div 192' = 0.68\%$

Assume Worst-Case Ditch:
No Bottom, 2:1 side slopes At Elev. 891.50:

NOTE: WATER WILL SPILL OVER MOUND BEFORE IT REACHES 893.50



DATE MAY 1998
BY CAR
CK'D.

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PROJECT 95-79
CHESTERWOOD PHASE TWO
PAGE NUMBER 8.

SUBJECT 100 YEAR FLOOD ROUTE ALONG EAST SIDE OF BUILDING (IN BETWEEN BUILDING AND EX. MOUND)

$$Q = \left(\frac{1.486}{0.04}\right)(2.83)\left(\frac{2.83}{5.32}\right)^{2/3}(0.0068)^{1/2}$$

$Q = 5.69$ CFS > 3.13 CFS

NOTE: THE 110' OF 12" @ 0.50% UNDER THE EAST SIDE OF THE BUILDING WILL PROVIDE AN OUTLET FOR THE COURTYARD DRAINAGE IF THE 165' OF 18" @ 1.05% IS BLOCKED. THE FLOW WILL EXIT THROUGH THE 110' OF 12" @ 0.50% AND FLOW DOWN THE DITCH ALONG THE EAST PROPERTY LINE BEFORE IT REACHES ELEV. 893.50 IN THE COURTYARDS.

DATE MAY 1998
BY CAR
CK'D.

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PROJECT 95-79
CHESTERWOOD PHASE TWO
PAGE NUMBER C.

SUBJECT 100 YEAR FLOOD ROUTE ALONG EAST SIDE OF BUILDING (IN BETWEEN BUILDING AND EX. MOUND)

ASSUME ENTIRE EAST HALF OF BUILDING, INCLUDING COURTYARDS, IS GOING TO THIS DITCH ALSO.

TOTAL ADDITIONAL DRAINAGE AREA = (0.25 AC. + 0.79 AC. + 0.19 AC. + 0.16 AC. + 0.13 AC. + 0.10 AC. + 0.10 AC.) = 1.72 Acres

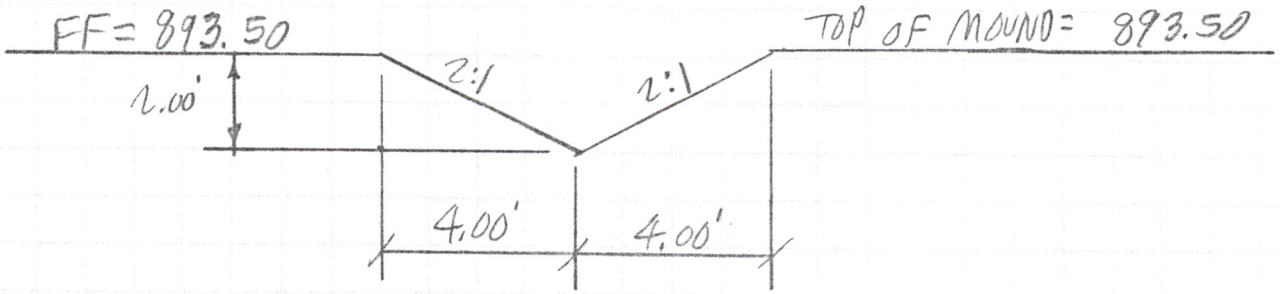
$Q = CIA$

$Q_{100} = (0.5 \times 6.52 \times 0.96) + (0.85 \times 6.52 \times 1.72)$

$Q_{100} = 12.66$ CFS

SINCE WATER WILL SPILL OVER TOP OF MOUND WITHOUT FLOODING BUILDING IF MOUND IS LOWER THAN ELEV. 893.50, ASSUME TOP OF MOUND IS ALSO AT ELEV. 893.50:

CHECK THIS AT HP OF DITCH (CONSERVATIVE)



$$Q = \left(\frac{1.486}{0.04}\right)(8.00)\left(\frac{8.00}{8.95}\right)^{2/3}(0.0068)^{1/2} = 12.74 \text{ cfs} > 12.66 \text{ cfs}$$

DATE MAY 1998
BY CAR
CK'D.

BAYER & BECKER ENGINEERS
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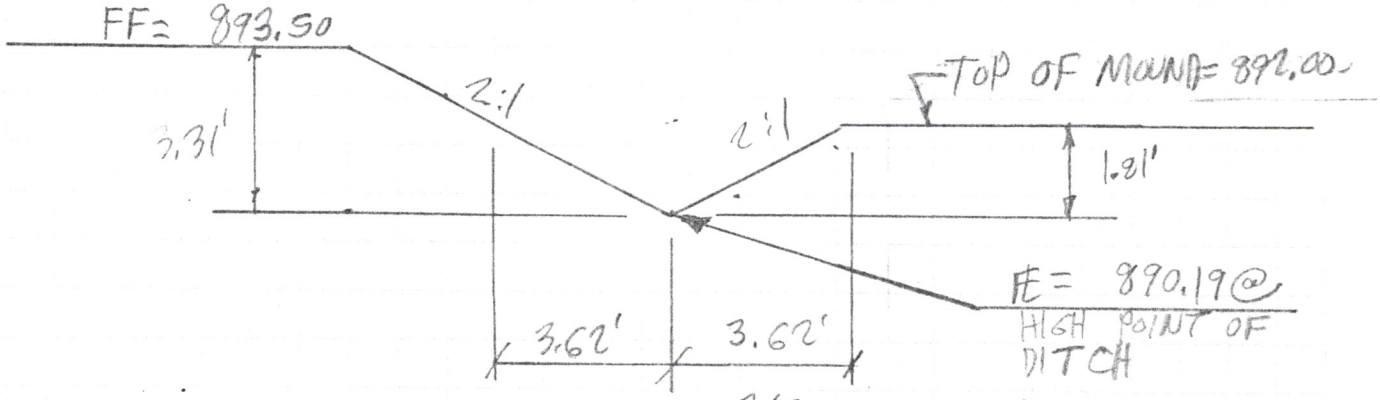
PROJECT 95-79
CHESTERWOOD PHASE TWO
PAGE NUMBER D.

SUBJECT 100 YEAR FLOOD ROUTE ALONG SOUTH SIDE OF BUILDING

Slope = (890.19 - 888.79) ÷ 255' = 0.55%

(PROP. TOP OF INLET ELEV.)



$$Q = \frac{1.486}{0.04}\left(6.55\right)\left(\frac{6.55}{8.09}\right)^{2/3}\left(0.0055\right)^{1/2}$$

Q = 15.68 CFS > 12.66 CFS

THE 255' OF 30" @ 0.50% ALONG THE SOUTH END OF THE BUILDING WILL ALSO STORE PART OF THE 100 YEAR FLOW.

DATE MAY 1999
BY CAR
CK'D.

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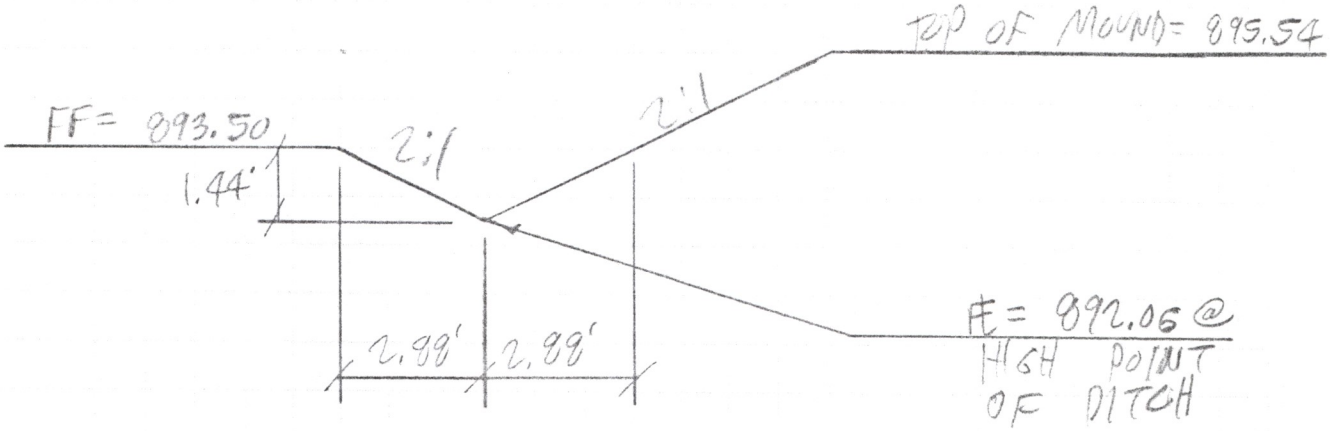
PROJECT 95-79
CHESTERWOOD PHASE TW
PAGE NUMBER E.

SUBJECT 100 YEAR FLOOD ROUTE ALONG NORTH SIDE OF BUILDING

SLOPE OF DITCH = (892.06 − 890.50) ÷ 312' = 0.50%

CHECK 2:1 SIDE SLOPES:



$$Q = \left(\frac{1.486}{0.04}\right)\left(4.15\right)\left(\frac{4.15}{6.44}\right)^{2/3}\left(0.005\right)^{1/2} = 8.13 \text{ CFS}$$

ASSUME HALF OF DRAINAGE GOES TO THIS DITCH FROM ENTIRE EAST HALF OF BUILDING, INCLUDING COURTYARDS = (12.66 CFS ÷ 2) = 6.33 CFS

ALSO ASSUME NORTH END OF BUILDING GOES TO THIS DITCH:

$Q_{100} = C I_{100} A = 0.85 \times 6.52 \times 0.25$ = 1.39 CFS

7.72 CFS

8.13 CFS > 7.72 CFS

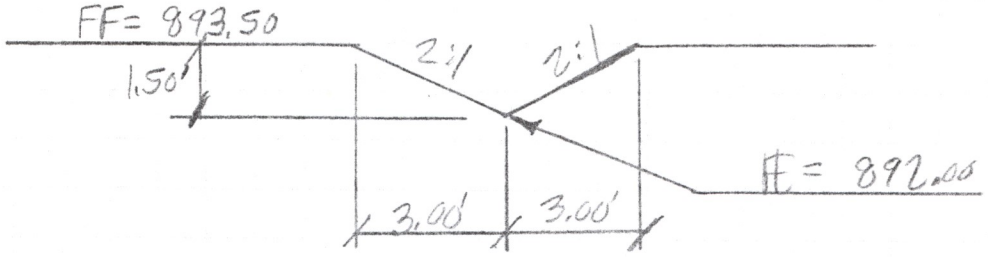
HAVE NOTE FOR PLANS:
DITCH SLOPES SHALL BE NO STEEPER THAN 2:1.

DATE MAY 1998
BY CAR
CK'D.

BAYER & BECKER ENGINEERS
CIVIL ENGINEERS • SURVEYORS • PLANNERS

PROJECT 95-79
CHESTERWOOD PHASE TWO
PAGE NUMBER F.

SUBJECT CHECK OF 100 YEAR FLOOD ROUTE ALONG EAST SIDE OF NORTH HALF OF BUILDING



SLOPE= 1.20%

$$Q=\left(\frac{1.486}{0.04}\right)(4.50)\left(\frac{4.50}{6.70}\right)^{2/3}(0.012)^{1/2}=14.04\ CFS$$

ASSUME HALF OF BUILDING DRAINS TO THIS DITCH:

$(12.66\ CFS \div 2) = 6.33\ CFS$

ALSO ASSUME THE NORTH END OF THE BUILDING DRAINS TO THIS DITCH:

$Q_{100} = CI_{100}A = 0.85 \times 6.52 \times 0.25 = 1.39\ CFS$

TOTAL FLOW= 7.72 CFS

CAPACITY OF THIS DITCH = 14.04 CFS > 7.72 CFS

∴ OK

Check 2' wide ditch bottom with 3:1 side slopes:

AREA= 9.75 S.F.
WP= 11.49 ft

$$Q=\left(\frac{1.486}{0.04}\right)(9.75)\left(\frac{9.75}{11.49}\right)^{2/3}(0.012)^{1/2}=35.56\ CFS >> 14.04\ CFS$$