APPENDIX "A"
STORM DRAINAGE EXHIBITS

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NOTES FOR STORM SEWER CONSTRUCTION

1. All construction and materials shall conform where applicable to the current Virginia Department of Transportation Road and Bridge Specifications.
2. All concrete shall be Class A3 if cast in place, Class A4 if precast.
3. Manholes and drop inlets shall be constructed from invert to top as follows:

   A. Manholes to eight feet deep.

      (1) Block construction – minimum eight inch walls.

      (2) Poured in place concrete – minimum eight inch walls and nonreinforced.

      (3) Precast – minimum eight inch walls in conjunction with precast throat and precast base slab.

      (4) Precast.

   B. Manholes over eight feet deep.

      (1) Precast.

      (2) Poured in place reinforced concrete.

      (3) Special design, i.e., bends, precast tees, precast boxes, wyes.

4. Drop inlets and curb inlets shall have steps. The maximum dimension from finish grade to the first step in the inlet shall not exceed three feet.
5. Unless stated on the approved plans, symmetrical channels shall be installed in the invert of all structures according to VDOT standards IS–1 to prevent standing or ponding of water.
6. If block construction is used, the inside and outside walls, as they are laid, shall be plastered with mortar a minimum of 1/2" thick.
7. All precast drop inlets, curb inlets and manholes shall conform to ASTM C–478.
8. VDOT inlets where pipe size is larger than 48 inches I.D. require a special design. In case of special design inlets that deviate from the standard, the precast manufacturer or design engineer must submit five copies of detail drawings to the City of Manassas Public Works Department for proper approval.
9. The opening in precast storm sewer structures for all size pipe shall be a minimum of four inches and a maximum of six inches larger than the outside diameter of the pipe.
10. The "H" dimension shown on the standards and specified on the plans will be measured from the invert of the outfall pipe to the top of the structure.
11. Two (2) inch weep holes shall be provided in endwalls where directed by the City Site Inspector.
12. The contractor must notify the design engineer as to which will be precast so that the proper stakeout procedures can be followed.

GENERAL NOTES

REVISION & DATE

4/19/96

DIRECTOR — DATE

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER

0

COEFFICIENTS OF RUNOFF TO BE USED WITH THE RATIONAL FORMULA

ZONE		"C" FACTOR	Tc (MIN)
R-1, R-2, R-2-S	Residential (Average lot size)		
	a. 10,000 sq. ft. to 20,000 sq. ft.	0.35 - 0.45	10 - 15
	b. 20,000 sq. ft. to 5 Ac	0.30 - 0.40	10 - 15
A-1	Parks and Agriculture (over 5 acres)	0.25 - 0.35	to be computed
I-1	Cemeteries	0.25 - 0.35	to be computed
R-3	Townhouses	0.65 - 0.75	5 - 10
- -	Schools	0.50 - 0.60	10 - 15
R-5	Apartments	0.65 - 0.75	5 - 10
I-1, I-2	Industrial	0.80 - 0.90	5
B-1, B-2, B-3	Business, Commercial or Office	0.80 - 0.90	5
B-4	Residential Planned Community		

NOTES:

1. When calculating flow to a structure if all run-off to the structure is from impervious areas (i.e. pavement & roofs) the C to be used is 0.90.
2. The lowest range of run-off coefficients may be used for flat areas (areas where the majority of the grades and slopes are 2% and less).
3. The average range of run-off coefficients should be used for Intermediate areas (areas where the majority of the grades and slopes are from 2% to 5%).
4. The highest range of run-off coefficients shall be used for steep areas (areas where the majority of the grades are greater than 5%), for cluster areas, and for development in clay soil areas.

COEFFICIENTS OF RUNOFF

REVISION & DATE	

4/19/96

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CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER
1

LAND USE DESCRIPTION		HYDROLOGIC SOIL GROUP			
		A	B	C	D
Cultivated land [1/]	: without conservation treatment	72	81	88	91
	: with conservation treatment	62	71	78	81
Pasture or range land: poor condition		68	79	86	89
good condition		39	61	74	80
Meadow: good condition		30	58	71	78
Wood or Forest land: thin stand, poor cover, no mulch		45	66	77	83
good cover [2/]		25	55	70	77
Open Spaces, lawns, parks, golf courses, cemeteries, etc.					
good condition: grass cover on 75% or more of the area		39	61	74	80
fair condition: grass cover on 50% to 75% of the area		49	69	79	84
Commercial and business areas (85% impervious)		89	92	94	95
Industrial districts (72% impervious)		81	88	91	93
Residential: [3/]					
Average lot size	Average % impervious [4/]				
1/8 acre or less	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
Paved parking lots, roofs, driveways, etc. [5/]		98	98	98	98
Streets and roads:					
paved with curbs and storm sewers [5/]		98	98	98	98
gravel		76	85	89	91
dirt		72	82	87	89

[1/] For a more detailed description of agricultural land use curve numbers refer to National Engineering Handbook, Section 4, Hydrology, Chapter 9, Aug. 1972.

[2/] Good cover is protected from grazing and litter and brush cover soil.

[3/] Curve numbers are computed assuming the runoff from the house and driveway is directed towards the street with a minimum of roof water directed to lawns where additional infiltration could occur.

[4/] The remaining pervious areas (lawn) are considered to be in good pasture condition for these curve numbers.

[5/] In some warmer climates of the country a curve number of 95 may be used.

SOURCE: Urban Hydrology for Small Watersheds, SCS Technical Release No. 55, Table 2-2, January 1975.

RUNOFF CURVE NUMBERS FOR SELECTED AGRICULTURAL, SUBURBAN, AND URBAN LAND USE

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4/19/96

DIRECTOR DATE

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER
2

PERCENT IMPERVIOUSNESS FOR VARIOUS ZONING CLASSIFICATIONS*

Business and Commercial	85%
Industrial	75%
Schools and Churches	60%

Residential

Apartments, Townhouses, Mobile Homes	75%
1/4 Acre (R-10)	40%
1/3 Acre (R-20 Cluster)	35%
1/2 Acre (R-20)	30%
1 Acre (R-1-1)	25%
5 Acres and over	15%

*Table may be used in lieu of computation of actual area of impreviousness.

PERCENT IMPERVIOUSNESS FOR VARIOUS ZONING CLASSIFICATIONS

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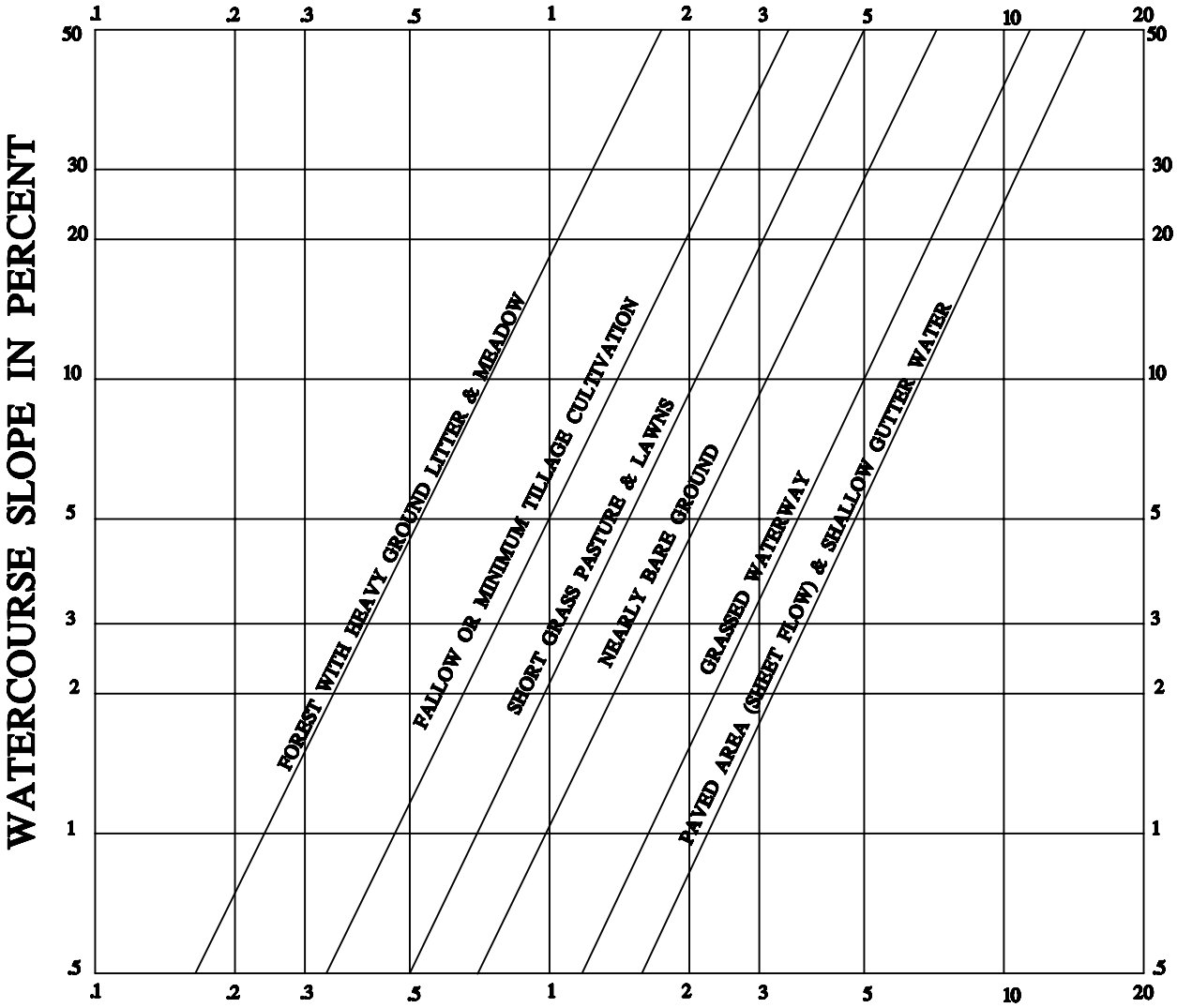
CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER
3



SOURCE: URBAN HYDROLOGY FOR WATERSHEDS, TECHNICAL RELEASE NO. 55, U.S. DEPARTMENT OF AGRICULTURE, JANUARY 1975.

AVERAGE VELOCITIES FOR ESTIMATING TIMES OF CONCENTRATION

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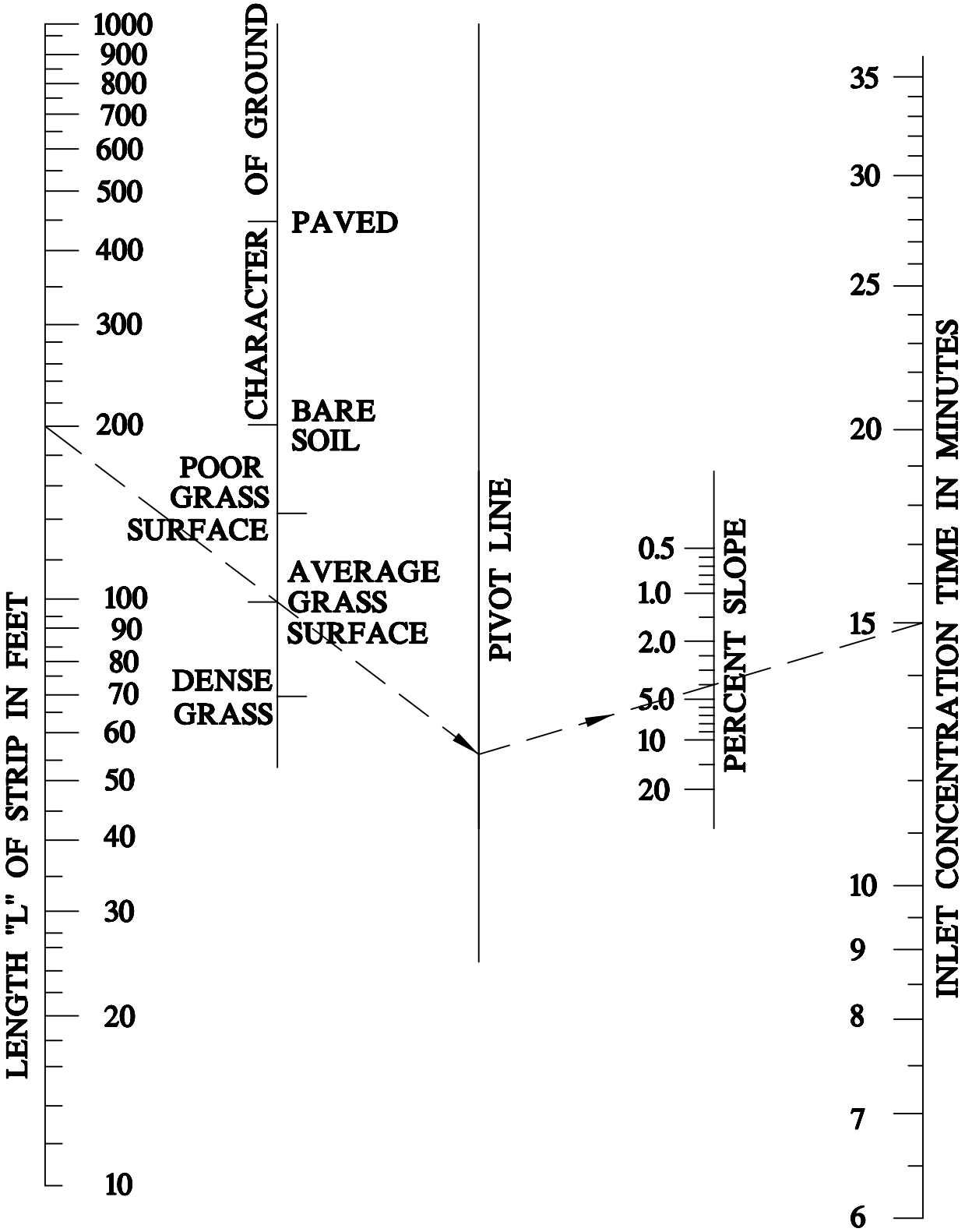
4



OVERLAND FLOW TIME

(USED WITH THE RATIONAL FORMULA)

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CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER
5

Duration / Frequency	5-Min.	15-Min.	1-Hour	2-Hour	3-Hour	6-Hour	12-Hour	24-Hour
2	0.46	0.90	1.50	2.0	2.1	2.6	3.1	3.4
5	0.54	1.11	1.91	2.5	2.7	3.3	3.8	4.5
10	0.59	1.26	2.20	3.0	3.2	3.9	4.7	5.3
25	0.68	1.47	2.61	3.5	3.7	4.3	5.2	6.0
50	0.74	1.63	2.93	4.0	4.3	5.1	6.0	7.0
100	0.81	1.80	3.25	4.4	4.8	5.8	6.4	7.8

SOURCES:

- NOAA Technical Memorandum, NWS HYDRO - 35
  Five to 60-Minute Precipitation Frequency for the Eastern and Central U.S., 1977.

- U.S. Department of Commerce, Weather Bureau, Technical Paper No. 40 Rainfall Frequency Atlas of the United States, 1961.

Rainfall Frequency-Duration-Depth relationships
(Rainfall Depth In Inches, Rainfall Frequency in Years)

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CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER
6

Rainfall Intensity (INCHES PER HOUR)

Frequency	1-year	2-year	5-year	10-year	25-year	50-year	100-year
Duration							
5 minutes	4.26	5.23	6.06	6.77	7.69	8.39	9.10
10 minutes	3.40	4.19	4.89	5.45	6.15	6.76	7.28
15 minutes	2.83	3.51	4.13	4.62	5.22	5.77	6.22
30 minutes	1.94	2.41	2.88	3.26	3.73	4.20	4.57
1 hour	1.21	1.53	1.87	2.16	2.54	2.93	3.25
2 hours	0.711	0.868	1.10	1.28	1.54	1.75	1.97
3 hours	0.507	0.617	0.783	0.915	1.10	1.26	1.43
6 hours	0.312	0.379	0.479	0.560	0.682	0.785	0.897
12 hours	0.189	0.228	0.289	0.342	0.421	0.491	0.569
24 hours	0.109	0.132	0.170	0.203	0.254	0.299	0.351

PEAK RAINFALL INTENSITIES

REVISION & DATE

DIRECTOR _____ DATE _____

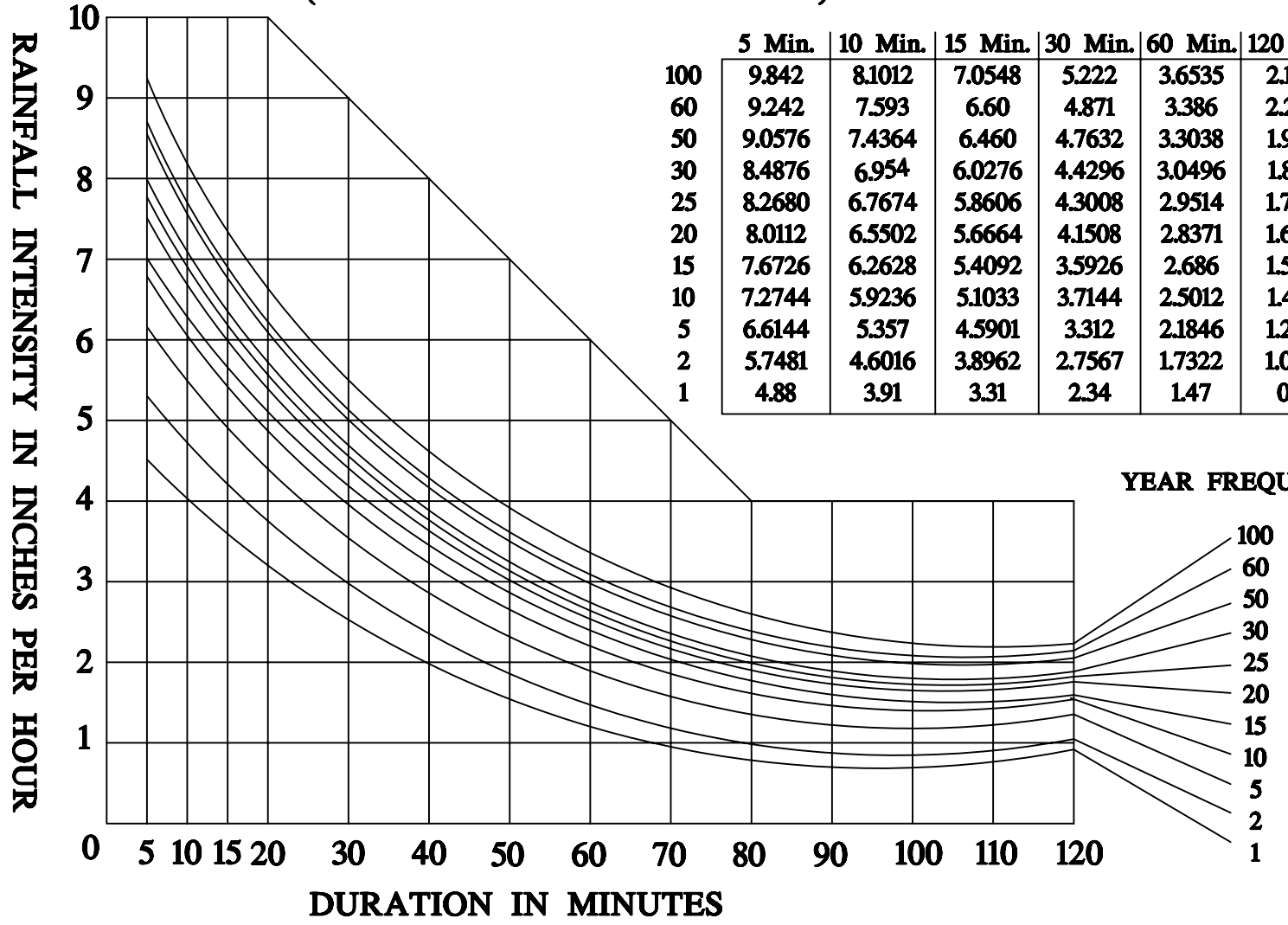
CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER
7

CURVES SHOWING RAINFALL INTENSITY vs. DURATION FOR VARIOUS FREQUENCES OF OCCURRENCE

(Used with the Rational Formula)

YEAR FREQUECY	5 Min.	10 Min.	15 Min.	30 Min.	60 Min.	120 Min.
100	9.842	8.1012	7.0548	5.222	3.6535	2.1848
60	9.242	7.593	6.60	4.871	3.386	2.2017
50	9.0576	7.4364	6.460	4.7632	3.3038	1.9716
30	8.4876	6.954	6.0276	4.4296	3.0496	1.8167
25	8.2680	6.7674	5.8606	4.3008	2.9514	1.7569
20	8.0112	6.5502	5.6664	4.1508	2.8371	1.6872
15	7.6726	6.2628	5.4092	3.5926	2.686	1.5952
10	7.2744	5.9236	5.1033	3.7144	2.5012	1.4821
5	6.6144	5.357	4.5901	3.312	2.1846	1.2876
2	5.7481	4.6016	3.8962	2.7567	1.7322	1.0084
1	4.88	3.91	3.31	2.34	1.47	0.86



DIRECTOR

3/4/97
DATE

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

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EXHIBIT NUMBER
8

RADIUS OF CURVATURE FOR STRAIGHT DEFLECTED PIPE LENGTH OF 4 FEET												
Per Diameter	Joint Opening in Inches											
in D Inches	1/8	1/4	3/8	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4	1-3/8	1-1/2
18	736	368	245	184	147	123	105	92	82	74	67	61
21	848	424	283	212	170	141	121	106	94	85	77	71
24	960	480	320	240	192	160	137	120	107	96	87	80
27	1072	536	357	268	214	179	153	134	119	107	97	89
30	1184	592	395	296	237	197	169	148	132	118	107	99
33	1296	648	432	324	259	216	185	162	144	130	118	108
36	1408	704	469	352	282	235	201	176	156	141	128	117
42	1632	816	544	408	326	272	233	204	181	163	148	136
48	1856	928	619	464	371	309	265	232	206	186	169	155
54	2080	1040	693	520	416	347	297	260	231	208	189	173
60	2304	1152	768	576	461	384	329	288	256	230	209	191
66	2528	1264	843	632	506	421	361	316	281	253	230	211
72	2752	1376	917	688	550	459	393	344	306	275	250	229
RADIUS OF CURVATURE FOR STRAIGHT DEFLECTED PIPE LENGTH OF 6 FEET												
18	1104	552	368	276	221	184	158	138	123	110	100	92
21	1272	636	424	318	254	212	182	159	141	127	116	106
24	1440	720	480	360	288	240	206	180	160	144	131	120
27	1608	804	536	402	322	268	230	201	179	161	146	134
30	1776	888	592	444	355	296	254	222	197	178	161	148
33	1944	972	648	486	389	324	278	243	216	194	177	162
36	2112	1056	704	528	422	352	302	264	235	211	192	176
42	2448	1224	816	612	490	408	350	306	272	245	223	204
48	2784	1392	928	696	557	464	398	348	309	278	253	232
54	3120	1560	1040	780	624	520	446	390	347	312	284	260
60	3456	1728	1152	864	691	576	494	432	384	346	314	288
66	3792	1896	1264	946	758	632	542	474	421	379	345	316
72	4128	2064	1376	1032	826	688	590	516	459	413	375	344
RADIUS OF CURVATURE FOR STRAIGHT DEFLECTED PIPE LENGTH OF 8 FEET												
18	1472	736	491	368	294	245	210	184	164	147	134	123
21	1696	848	565	424	339	283	242	212	188	170	154	141
24	1920	960	640	480	384	320	274	240	213	192	175	160
27	2144	1072	715	436	429	357	306	268	238	214	195	189
30	2368	1184	789	592	474	395	338	296	263	237	215	197
33	2592	1296	864	648	518	432	370	324	288	259	236	216
36	2816	1408	939	704	563	469	402	352	313	282	256	235
42	3264	1632	1088	816	653	544	466	408	363	326	297	272
48	3712	1856	1237	928	742	619	530	464	412	371	337	310
54	4160	2080	1387	1040	832	693	594	520	462	416	378	347
60	4608	2304	1536	1152	922	768	658	576	512	461	419	384
66	5056	2528	1685	1264	1011	843	722	632	562	506	460	421
72	5504	2752	1835	1376	1101	917	786	688	612	550	500	459

RADIUS OF CURVATURE FOR CONCRETE PIPE

REVISION & DATE	

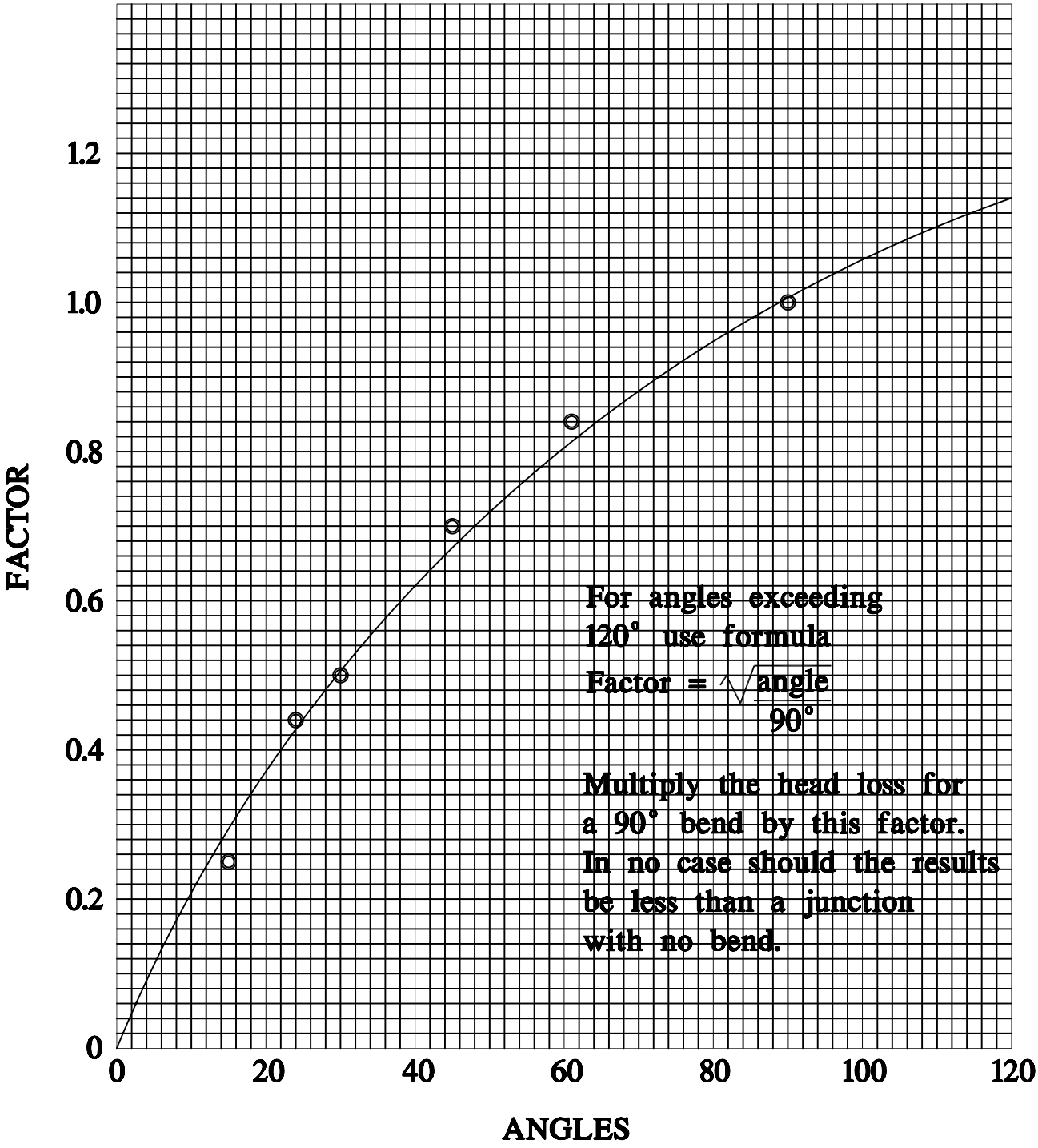
4/19/96

DIRECTOR DATE

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER
9

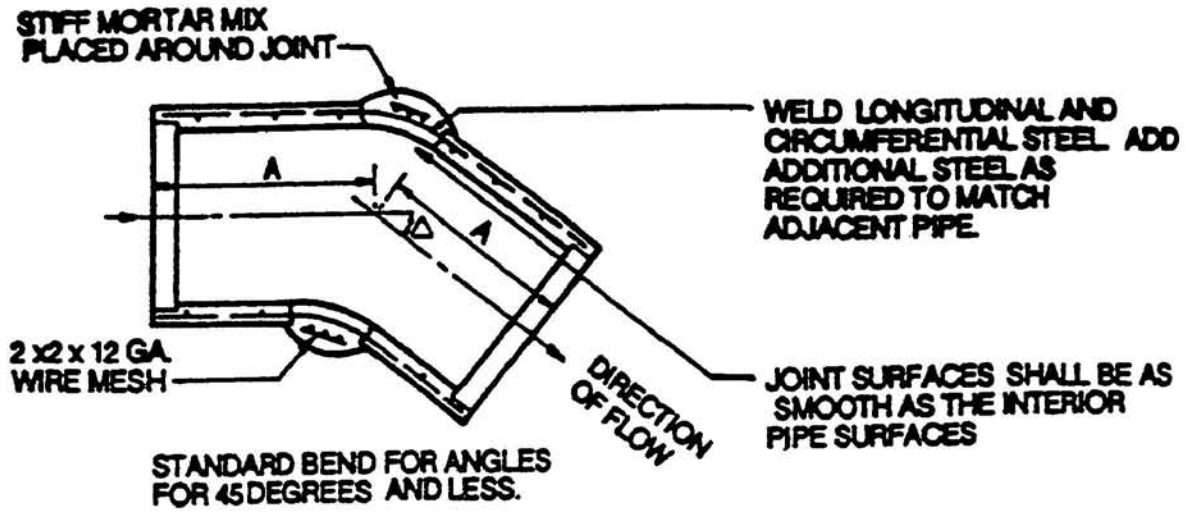
ANGLES OF BEND IN DEGREES
FACTORS OTHER THAN 90° BENDS



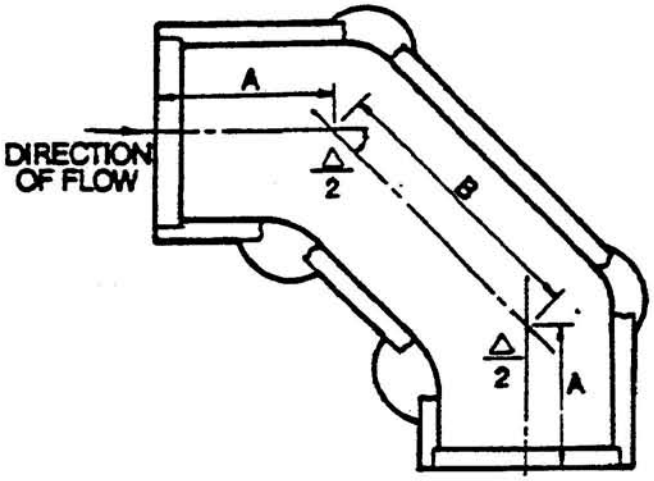
ANGLE OF BEND IN DEGREES

REVISION & DATE	

DIRECTOR	DATE	CITY OF MANASSAS, VIRGINIA DEPARTMENT OF PUBLIC WORKS	EXHIBIT NUMBER 10
	4/19/96		



STANDARD BEND FOR ANGLES FOR 45 DEGREES AND LESS.



STANDARD BEND FOR ANGLES BETWEEN 45 TO 90

PIPE SIZE	ANGLES 0°-45° A MIN.	ANGLES 45° TO 90° B MIN.
15"	1'-6"	-
18"	1'-6"	-
21"	2'-0"	-
24"	2'-0"	-
27"	2'-0"	-
30"	2'-0"	-
33"	2'-3"	2'-9"
36"	2'-3"	2'-9"
42"	2'-3"	3'-0"
48"	2'-6"	3'-3"
54"	2'-6"	3'-6"
60"	2'-9"	3'-6"

1. FOR PIPE SIZES 15" TO 30" IN DIA., BENDS NO GREATER THAN 30 DEGREES WILL BE ALLOWED UNLESS THERE ARE ACCESS OPENINGS WITHIN 50 FEET OF THE BEND.
2. FOR PIPE SIZES 33" TO 42" IN DIA., BENDS GREATER THAN 30° BUT LESS THAN 90° WILL BE ALLOWED PROVIDED THERE IS AN ACCESS OPENING WITHIN 50 FEET. BENDS UP TO 30 DEGREES HAVE NO RESTRICTION DISTANCE TO ACCESS OPENINGS.
3. THE USE OF THESE BENDS IS NOT ALLOWED WITHIN PUBLIC RIGHT - OF - WAYS.

NOT TO SCALE

REINFORCED CONCRETE PREFABRICATED BENDS

REVISION & DATE	

DIRECTOR 4/19/96 DATE

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER
11

PIPE CAPACITIES FLOWING FULL BY MANNING'S FORMULA

with n= 0.013 for concrete pipe

$$Q = a \times \frac{1.486}{0.013} \times \left(\frac{a}{p}\right)^{2/3} \times s^{1/2}$$

$$Q = F \times (s)^{1/2}$$

$$F = a \times \frac{1.486}{0.013} \times \frac{a}{p}^{2/3}$$

PIPE DIAMETER, inches	F
12"	35.64
15"	64.59
18"	105.04
21"	158.32
24"	226.20
27"	309.50
30"	410.20
33"	528.90
36"	666.60
42"	1006.10
48"	1436.00
54"	1965.00
60"	2604.00
66"	3357.00
72"	4234.00
78"	5242.00
84"	6387.00
90"	7679.00
96"	9119.00
102"	10720.00
108"	12490.00
114"	14420.00
120"	16540.00

$(s)^{1/2}$ values

Number	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
.00001	.003162	.003317	.003464	.003606	.003742	.003873	.004000	.004123	.004243	.004359
.00002	.004472	.004583	.004690	.004796	.004899	.005000	.005099	.005196	.005292	.005385
.00003	.005477	.005568	.005657	.005745	.005831	.005916	.006000	.006083	.006164	.006245
.00004	.006325	.006403	.006481	.006557	.006633	.006708	.006782	.006856	.006928	.007000
.00005	.007071	.007141	.007211	.007280	.007348	.007416	.007483	.007550	.007616	.007681
.00006	.007746	.007810	.007874	.007937	.008000	.008062	.008124	.008185	.008246	.008307
.00007	.008367	.008426	.008485	.008544	.008602	.008660	.008718	.008775	.008832	.008888
.00008	.008944	.009000	.009055	.009110	.009165	.009220	.009274	.009327	.009381	.009434
.00009	.009487	.009539	.009592	.009644	.009695	.009747	.009798	.009849	.009899	.009950
.00010	.010000	.010050	.010100	.010149	.010198	.010247	.010296	.010344	.010392	.010440
.0001	.01000	.01049	.01095	.01140	.01183	.01225	.01265	.01304	.01342	.01378
.0002	.01414	.01449	.01483	.01517	.01549	.01581	.01612	.01643	.01673	.01703
.0003	.01732	.01761	.01789	.01817	.01844	.01871	.01897	.01924	.01949	.01975
.0004	.02000	.02025	.02049	.02074	.02098	.02121	.02145	.02168	.02191	.02214
.0005	.02236	.02258	.02280	.02302	.02324	.02345	.02366	.02387	.02408	.02429
.0006	.02449	.02470	.02490	.02510	.02530	.02550	.02569	.02588	.02608	.02627
.0007	.02646	.02665	.02683	.02702	.02720	.02739	.02757	.02775	.02793	.02811
.0008	.02828	.02846	.02864	.02881	.02898	.02915	.02933	.02950	.02966	.02983
.0009	.03000	.03017	.03033	.03050	.03066	.03082	.03098	.03114	.03130	.03146
.0010	.03162	.03178	.03194	.03209	.03225	.03240	.03256	.03271	.03286	.03302
.001	.03162	.03317	.03464	.03606	.03742	.03873	.04000	.04123	.04243	.04359
.002	.04472	.04583	.04690	.04796	.04899	.05000	.05099	.05196	.05292	.05385
.003	.05477	.05568	.05657	.05745	.05831	.05916	.06000	.06083	.06164	.06245
.004	.06325	.06403	.06481	.06557	.06633	.06708	.06782	.06856	.06928	.07000
.005	.07071	.07141	.07211	.07280	.07348	.07416	.07483	.07550	.07616	.07681
.006	.07746	.07810	.07874	.07937	.08000	.08062	.08124	.08185	.08246	.08307
.007	.08367	.08426	.08485	.08544	.08602	.08660	.08718	.08775	.08832	.08888
.008	.08944	.09000	.09055	.09110	.09165	.09220	.09274	.09327	.09381	.09434
.009	.09487	.09539	.09592	.09644	.09695	.09747	.09798	.09849	.09899	.09950
.010	.10000	.10050	.10100	.10149	.10198	.10247	.10296	.10344	.10392	.10440
.01	.1000	.1049	.1095	.1140	.1183	.1225	.1265	.1304	.1342	.1378
.02	.1414	.1449	.1483	.1517	.1549	.1581	.1612	.1643	.1673	.1703
.03	.1732	.1761	.1789	.1817	.1844	.1871	.1897	.1924	.1949	.1975
.04	.2000	.2025	.2049	.2074	.2098	.2121	.2145	.2168	.2191	.2214
.05	.2236	.2258	.2280	.2302	.2324	.2345	.2366	.2387	.2408	.2429
.06	.2449	.2470	.2490	.2510	.2530	.2550	.2569	.2588	.2608	.2627
.07	.2646	.2665	.2683	.2702	.2720	.2739	.2757	.2775	.2793	.2811
.08	.2828	.2846	.2864	.2881	.2898	.2915	.2933	.2950	.2966	.2983
.09	.3000	.3017	.3033	.3050	.3066	.3082	.3098	.3114	.3130	.3146
.10	.3162	.3178	.3194	.3209	.3225	.3240	.3256	.3271	.3286	.3302

To obtain Q, multiply F by the square root of the slope, S, in ft. per ft.

To utilize this table for values of n* other than 0.013, first obtain Q based on 0.013, then multiply this Q by the ratio: other value of n divided into .013.

The full flowing capacity of the pipe should equal or exceed the 10 year storm water runoff.

In reviewing the adequacy of submitted designs, first check the capacity by graphic methods. If this check indicates a border-line case where the pipe size may or may not be adequate use this table to compute the capacity of the pipe.

Q in cubic feet per second n is friction factor

a is cross sectional area, square feet

p is wetted perimeter, feet, the inside circumference of the pipe

s is pipe slope in ft. per ft.

1.486 is a constant

*n = .024 plain CMP n = .021 paved CMP

PIPE CAPACITIES FLOWING FULL BY MANNING'S FORMULA

REVISION & DATE	

3/4/97

DIRECTOR — DATE

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER
12

CULVERT DESIGN FORM

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

DIRECTOR _____ DATE 3/4/97

EXHIBIT NUMBER 13

REVISION & DATE

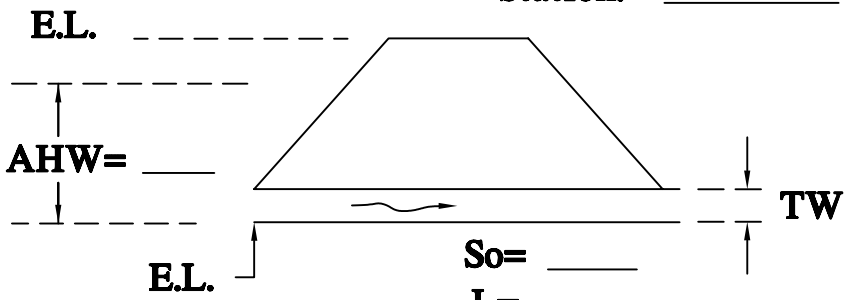
Project: **Designer:**
Date:

Hydrologic and Channel Information

Q_1 =
Q_2 =
TW_1 =
TW_2 =

SKETCH

Station: _____



Allowable Outlet Velocity= _____

Culvert Type	Q	Size	Headwater Computation									Controlling HW	Outlet Velocity	Cost	Comments
			Inlet Cont.		Outlet Control										
			HW/D	HW	Kc	dc	(dc+O)/2	ho	H	LSo	HW				

Summary & Recommendations:

LOCATION _____ ENGINEER _____

STA	WS	BTM	DEPTH	AREA	CFS	WP	$R=\frac{A}{WP}$	$S^{4/3}$	$V=\frac{Q}{A}$	$\frac{V^2}{2g}$ $\frac{V_2^2}{2g}-\frac{V_1^2}{2g}$	AVG. S	L	h_f L x Avg.S	h_f^{**}	E_{hi}^{h} h_f	ENERGY UPSTREAM	ENERGY DWST	EN	E_h

* $S = \left(\frac{n^2 v^2}{2.2092\ R^{4/3}}\right)^2$

** Contraction = 0.1 (Difference in Velocity Head)

Expansion = 0.2 (Difference in Velocity Head)

FLOOD PLAIN STUDY COMPUTATION FORM

REVISION & DATE	

R. C. Dey 4/19/96

DIRECTOR DATE

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER

14

Stream	Project	Job No.

Subject ROUGHNESS COEFFICIENT "n" COMP.	By	Date	Checked By	Date	Sheet_____of_____

1 + 2 + 3 + 4 + 5 6 7

Description of Reach Station, or X-Section	Basic "n"				Surface Irregularity				Variations in Size and Shape X-Sections			Obstructions				Vegatation				Meandering (1 to 5) X 6			Total "n" 1 to 6
	.020	.023	.024	.028	.000	.005	.010	.020	.000	.005	.010 .015	.000	.010 .015	.020 .030	.040 .060	.005 .010	.010 .025	.025 .050	.050 .100	1.00n	1.15n	1.30n	
	Earth	Rock	Fine Gravel	Coarse Gravel	Smooth	Minor	Moderate	Severe	Straight Gradual	Occasional Shifting	Frequent Shifting	Negligible	Minor	Appreciable	Severe	Low	Medium	High	Very High	Minor 1.0 to 1.2	Appreciable 1.2 to 1.5	Severe 1.5 +	

ROUGHNESS COEFFICIENT COMPUTATION CHART (FLOOD PLAIN STUDIES)

[signature] 3/4/97

DIRECTOR DATE

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

REVISION & DATE

EXHIBIT NUMBER

15

EGL = ENERGY GRADE LINE

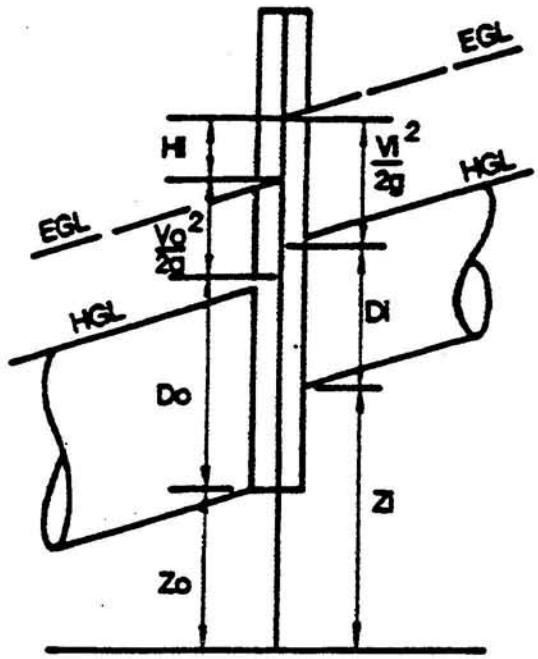
HGL = HYDRAULIC GRADE LINE

h = ENERGY LOSS THROUGH A BEND

hi = ENERGY LOSS THROUGH EXPANSION

ho = ENERGY LOSS THROUGH CONTRACTION

HI = TOTAL ENERGY LOSS THROUGH A JUNCTION



NON - PRESSURE FLOW

$DROP = Zi - Zo = (Do - Di) + \left(\frac{Vo^2}{2g} - \frac{Vi^2}{2g}\right) + HI$

$HI = hi + ho + h$

$h = C \times \frac{Vi^2}{2g}$

$ho = 0.25 \frac{Vo^2}{2g}$

$hi = 0.35 \frac{Vi^2}{2g}$

BEND ANGLE	C FACTOR
90	0.70
80	0.66
70	0.61
60	0.55
50	0.47
40	0.38
30	0.28
25	0.22
20	0.16
15	0.10

Zi, Zo = INCOMING AND OUTGOING PIPE INVERT

Di, Do = INCOMING AND OUTGOING DEPTH OF FLOW

Pi, Po = INCOMING AND OUTGOING PRESSURE HEADS

$\frac{Vi^2}{2g}, \frac{Vo^2}{2g}$ = INCOMING AND OUTGOING VELOCITY HEADS

HYDRAULIC GRADE LINE IN CLOSED PIPE JUNCTION

REVISION & DATE

DIRECTOR — DATE 4/19/96

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER
16

H_p AND SLOPE RANGE AT RETARDANCE VALUES FOR VARIOUS DISCHARGES, VELOCITIES, AND CREST LENGTHS

	MAXIMUM VELOCITY V	DISCHARGE q	H_p L(ft) 25	50	100	200	SLOPE MIN.	MAX.
	ft/s	$ft^3/s/ft$	ft	ft	ft	ft		pct
Retardance A	3	3	2.3	2.5	2.5	2.5	1	11
	4	4	2.3	2.5	2.8	3.1	1	12
	4	5	2.5	2.6	2.9	3.2	1	7
	5	6	2.6	2.7	3.0	3.3	1	9
	6	7	2.7	2.8	3.1	3.5	1	12
	7	10	3.0	3.2	3.4	3.8	1	9
	8	12.5	3.3	3.5	3.7	4.1	1	10
Retardance B	2	1	1.2	1.4	1.5	1.8	1	12
	2	1.25	1.3	1.4	1.6	1.9	1	7
	3	1.5	1.3	1.5	1.7	1.9	1	12
	3	2	1.4	1.5	1.7	1.9	1	8
	4	3	1.6	1.7	1.9	2.2	1	9
	5	4	1.8	1.9	2.1	2.4	1	8
	6	5	1.9	2.1	2.3	2.5	1	10
	7	6	2.1	2.1	2.4	2.7	1	11
	8	7	2.2	2.4	2.6	2.9	1	12
Retardance D	2	0.5	0.6	0.7	0.8	0.9	1	6
	3	1	0.8	0.9	1.0	1.1	1	6
	3	1.25	0.8	0.9	1.0	1.2	1	4
	4	1.25	0.8	0.9	1.0	1.2	1	10
	4	2	1.0	1.1	1.3	1.4	1	4
	5	1.5	0.9	1.0	1.2	1.3	1	12
	5	2	1.0	1.2	1.3	1.4	1	9
	5	3	1.2	1.3	1.5	1.7	1	4
	6	2.5	1.1	1.2	1.4	1.5	1	11
	6	3	1.2	1.3	1.5	1.7	1	7
	7	3	1.2	1.3	1.5	1.7	1	12
	7	4	1.4	1.5	1.7	1.9	1	7
	8	4	1.4	1.5	1.7	1.9	1	12
	8	5	1.6	1.7	1.9	2.0	1	8
	10	6	1.8	1.9	2.0	2.2	1	12
Retardance E	2	0.5	0.5	0.5	0.6	0.7	1	2
	3	0.5	0.5	0.5	0.6	0.7	1	9
	3	1	0.7	0.7	0.8	0.9	1	3
	4	1	0.7	0.7	0.8	0.9	1	6
	4	1.25	0.7	0.8	0.9	1.0	1	5
	5	1	0.7	0.7	0.8	0.9	1	12
	5	2	0.9	1.0	1.1	1.2	1	4
	6	1.5	0.8	0.9	1.0	1.1	1	12
	6	2	0.9	1.0	1.1	1.2	1	7
	6	3	1.2	1.2	1.4	1.5	1	4
	7	2	0.9	1.0	1.1	1.2	1	12
	7	3	1.2	1.2	1.3	1.5	1	7

Hp & SLOPE AT RETARDANCE VALUES

REVISION & DATE

DIRECTOR 4/19/96 DATE

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER
17

	Tc / Time	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90
10 - Year	5 min.	7.27	4.68	3.46	2.77	2.29	1.94	1.68	1.47	1.31	1.18	1.08	0.99						
	10 min.	3.25	5.92	4.53	3.14	2.43	1.99	1.67	1.41	1.21	1.04	0.92	0.80						
	15 min.	2.20	4.24	5.10	4.36	3.08	2.34	1.89	1.56	1.29	1.07	0.89	0.73						
	20 min.	1.98	3.37	4.20	4.56	4.16	3.02	2.22	1.83	1.58	1.41	1.27	1.17						
	25 min.	1.28	2.40	3.25	3.83	4.03	3.89	3.35	2.68	2.05	1.58	1.29	1.12						
	30 min.	0.80	1.57	2.32	3.00	3.52	3.71	3.48	3.03	2.49	1.97	1.58	1.32	1.11	0.97				
100 - Year	5 min.	9.84	6.37	4.73	3.74	3.13	2.65	2.33	2.07	1.88	1.69	1.55							
	10 min.	3.68	8.10	6.47	4.44	3.50	2.86	2.43	2.17	1.93	1.78	1.67	1.58						
	15 min.	2.81	5.99	7.05	5.69	3.89	3.17	2.73	2.40	2.16	1.98	1.83	1.68						
	20 min.	1.43	3.36	5.33	6.32	5.15	3.78	3.03	2.55	2.23	2.00	1.87	1.75						
	25 min.	0.98	2.26	3.79	5.05	5.75	5.17	3.99	2.90	2.28	1.96	1.77	1.65	1.53	1.43	1.39			
	30 min.	0.97	1.88	2.80	3.79	4.73	5.22	4.78	3.92	3.04	2.52	2.20	1.97	1.81	1.65	1.55	1.51	1.49	1.45

INCREMENTAL UNIT HYDROGRAPH VALUES

REVISION & DATE

DIRECTOR

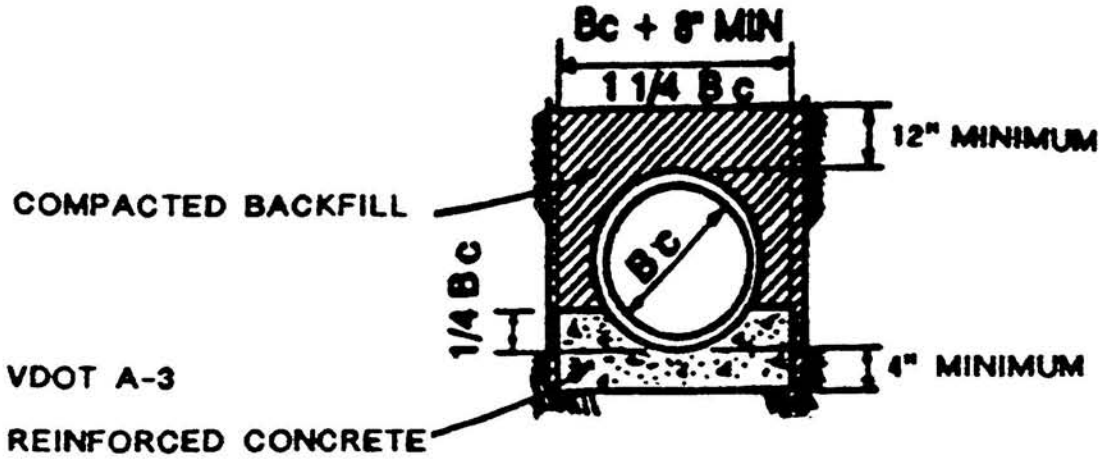
4/19/96

DATE

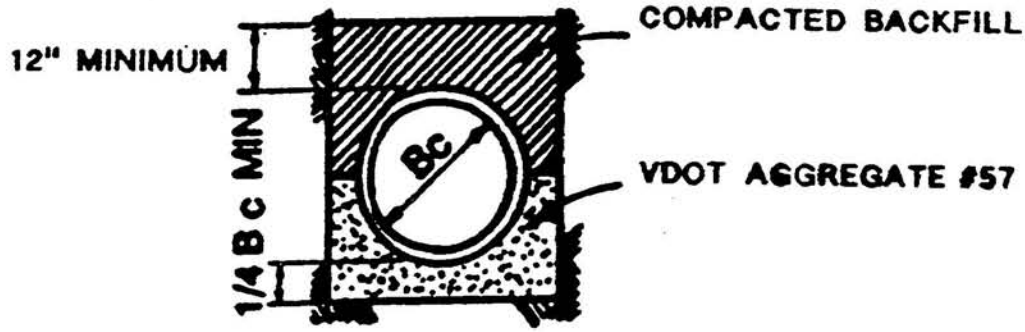
CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER

18



CONCRETE CRADLE



GRANULAR BEDDING

NOTE:

A. IN ROCK TRENCH, EXCAVATE AT LEAST 6 IN. (15 CM) BELOW THE BELL OF THE PIPE EXCEPT WHERE CONCRETE CRADLE IS USED.

NOT TO SCALE

PIPE BEDDING FOR STORM SEWER LINES

REVISION & DATE	

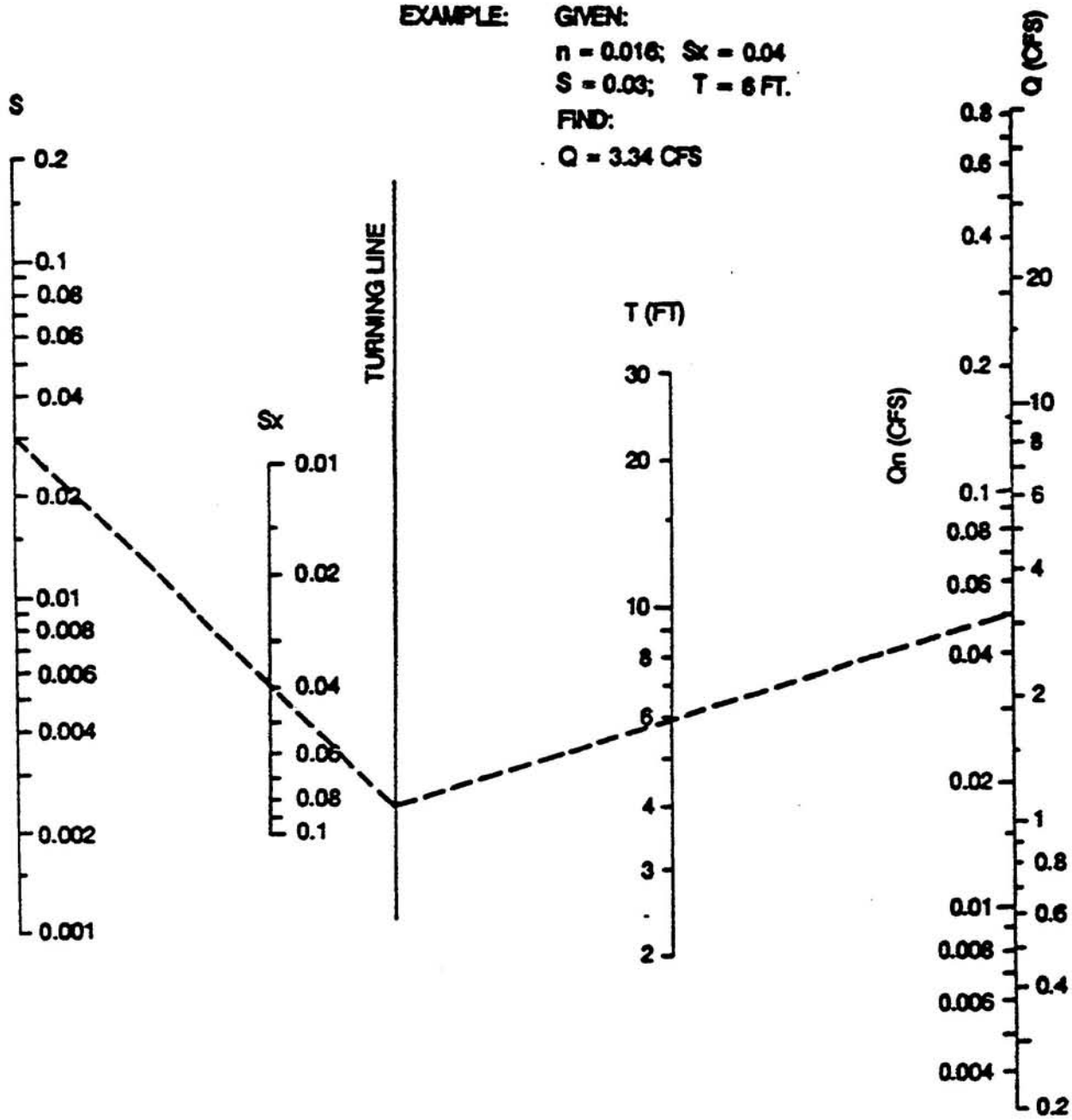
D.C. May 4/19/96
DIRECTOR DATE

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER
19

$$Q = \frac{0.56}{n} S_x^{1.67} S^{0.5} T^{2.67}$$

EXAMPLE: GIVEN:
n = 0.016; Sx = 0.04
S = 0.03; T = 6 FT.
FIND:
Q = 3.34 CFS



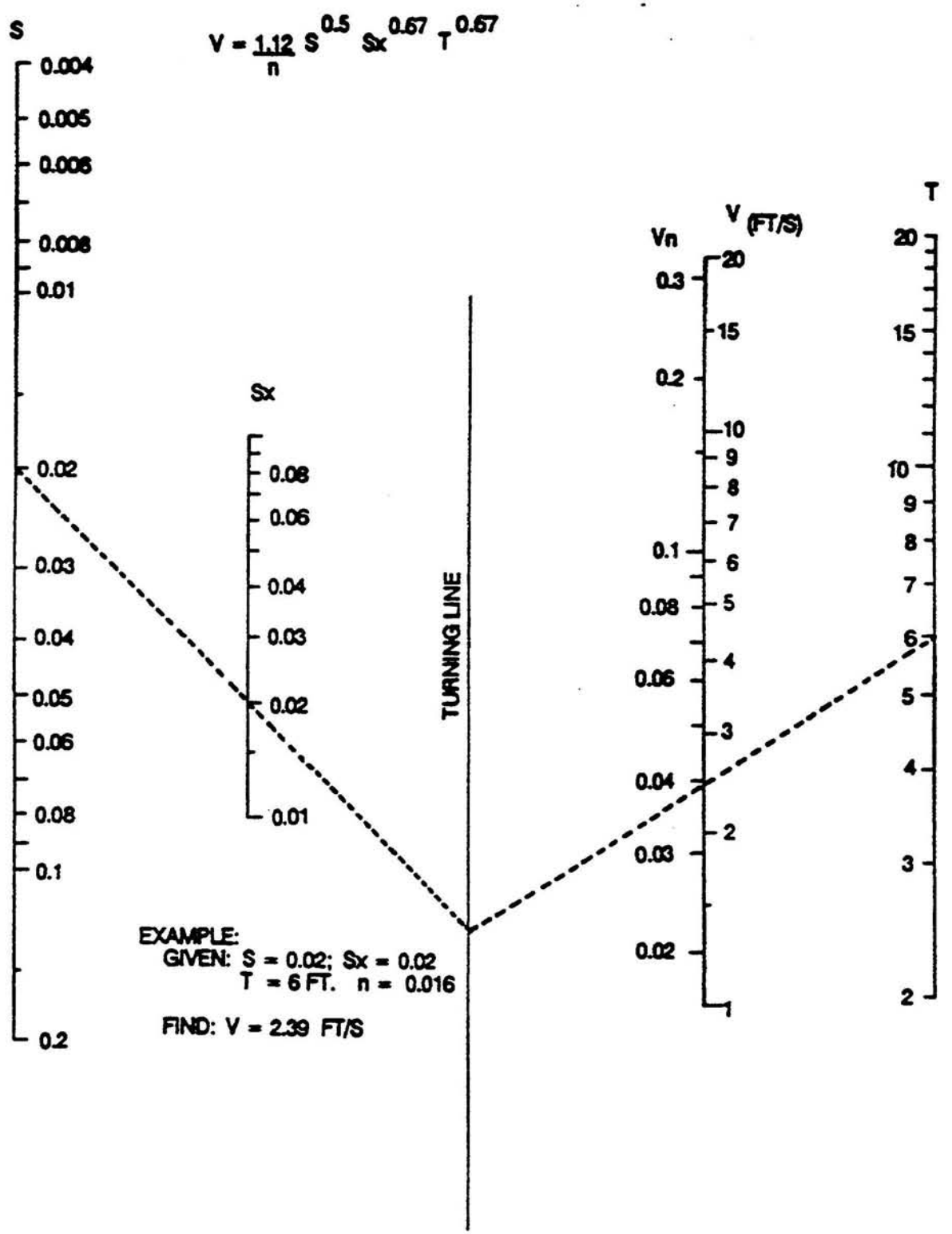
FLOW CHART TRIANGULAR GUTTER SECTIONS

REVISION & DATE	

D.C. 4/19/96
DIRECTOR DATE

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER
20



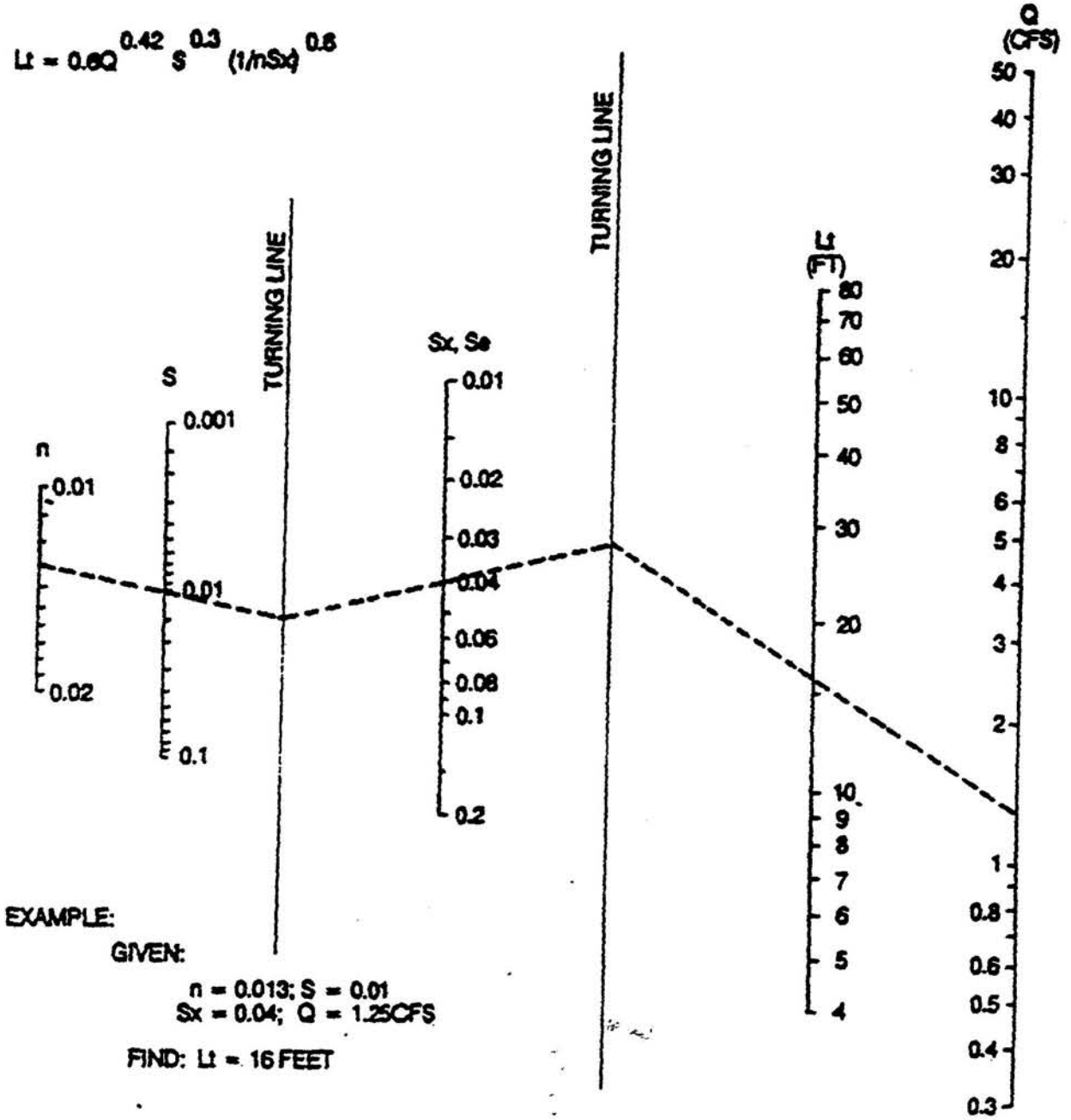
VELOCITY CHART TRIANGULAR GUTTER SECTIONS

REVISION & DATE

DIRECTOR 4/19/96 DATE

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER
21



CURB INLET DESIGN CHART ON GRADE CONDITION

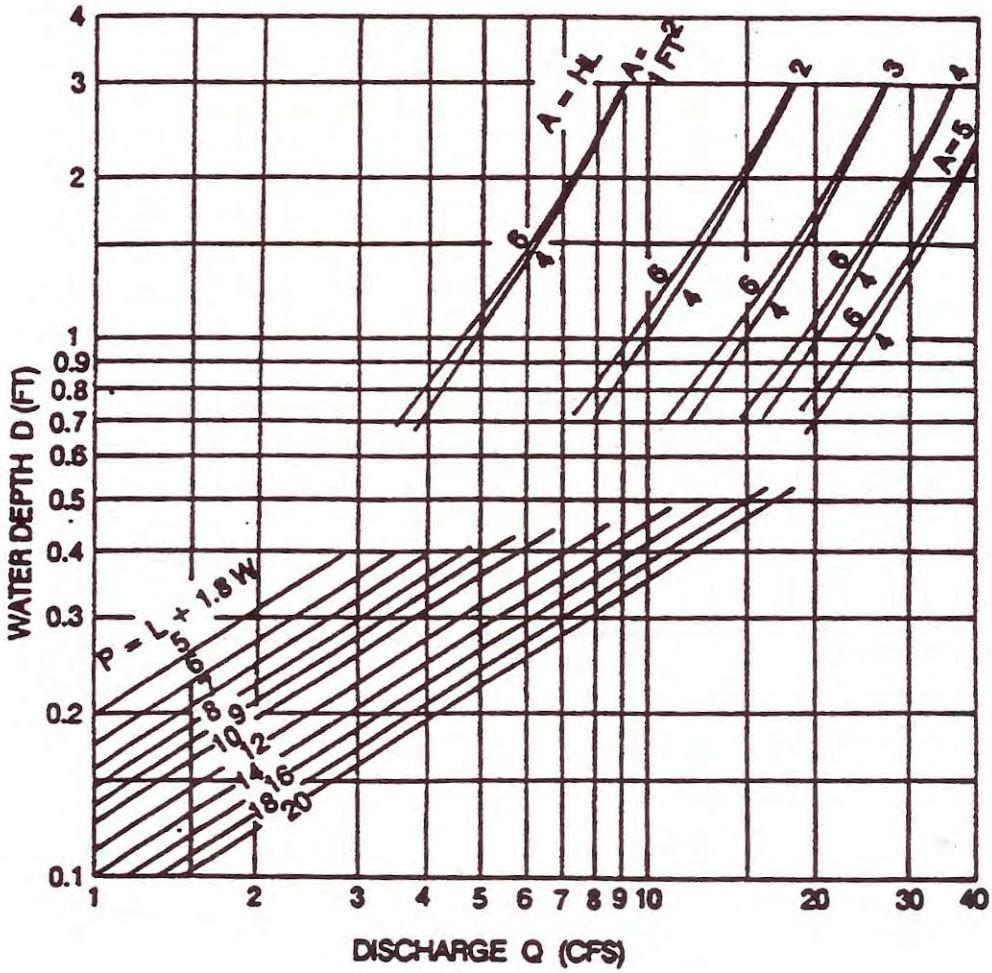
REVISION & DATE	

DIRECTOR 4/19/96 DATE

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER
22

SECTION A - A

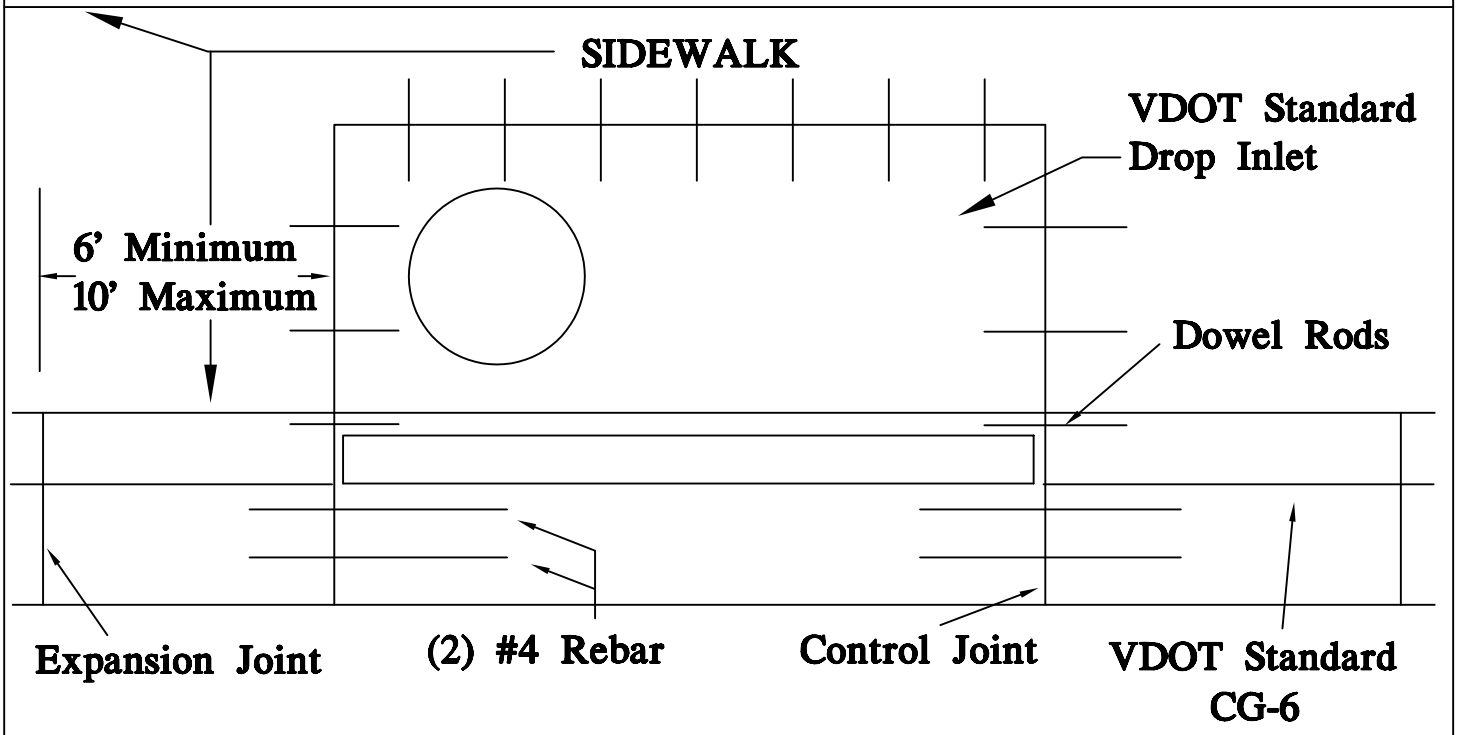


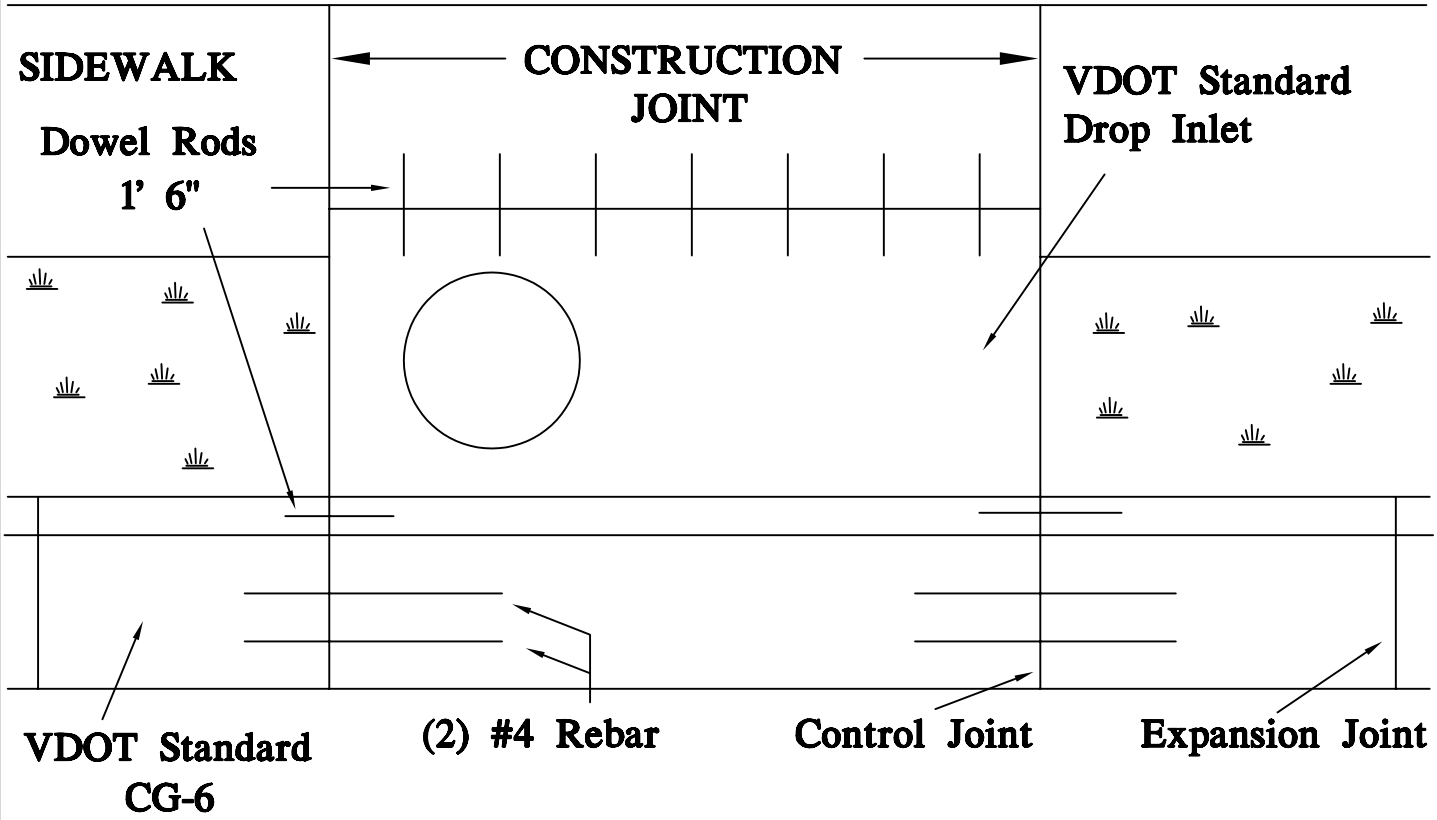
CURB INLET DESIGN CHART SUMP CONDITION

REVISION & DATE	
EXHIBIT NUMBER	23

DIRECTOR — DATE 4/19/96

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS





REINFORCEMENT DETAIL FOR DROP INLETS

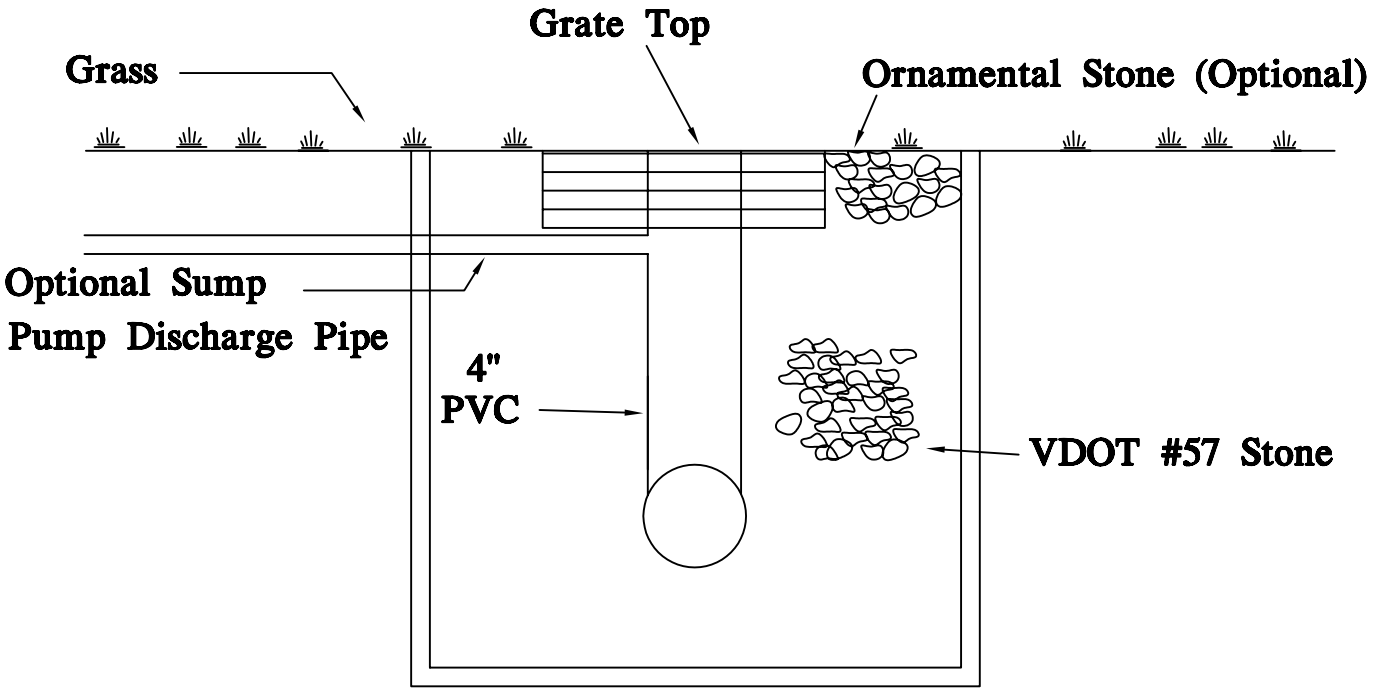
REVISION & DATE

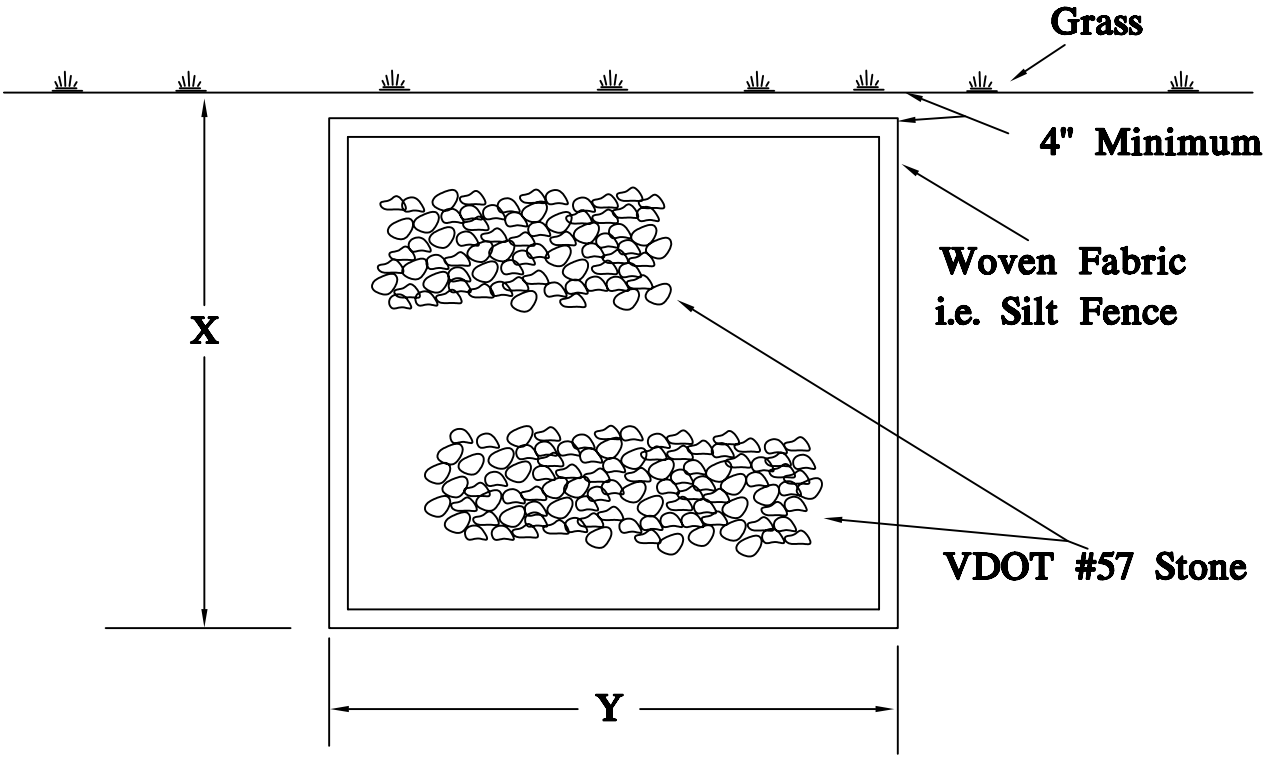
5/1/04

DIRECTOR DATE

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER
24





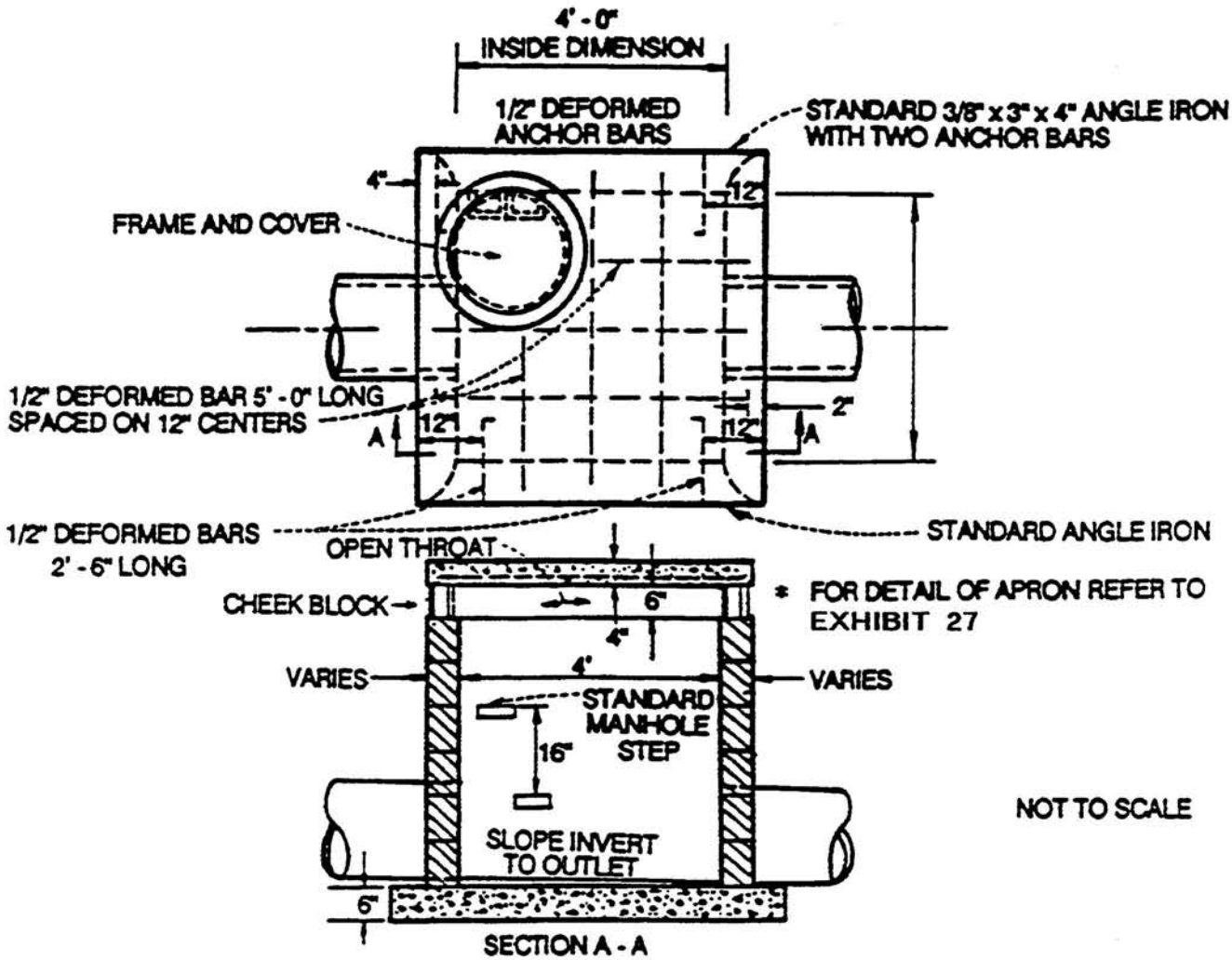
X = Approx. 4-6' deep of Fine Material

Y = Minimum of 6' x 6'

DRY WELL

REVISION & DATE	

4/19/96	CITY OF MANASSAS, VIRGINIA DEPARTMENT OF PUBLIC WORKS	EXHIBIT NUMBER 25
DIRECTOR / DATE		



NOT TO SCALE

A. YARD INLETS DEEPER THAN 4 FEET SHALL HAVE STEPS AS SHOWN.
B. DIMENSIONS OF YARD INLET SHOWN IS FOR PIPE SIZES UP TO AND INCLUDING 33 INCHES DIA. PIPE, WHILE PROVIDING A MINIMUM OF 6 INCHES OF CLEARANCE FROM THE INSIDE WALL OF THE STRUCTURE.
C. INLETS FOR SIZES LARGER THAN 36 INCHES (DIA) WILL REQUIRE A SPECIAL DESIGN.
D. SYMMETRICAL CHANNELS SHALL BE FORMED IN THE INVERT OF THE BOX FROM THE INLET PIPE TO THE OUTLET PIPE PER V.D.O.T. IS - 1 STANDARD.
E. ANGLE IRON SHALL BE ASPHALT COATED.
F. THE INSIDE AND OUTSIDE WALLS, AS THEY ARE LAID, SHALL BE PLASTERED WITH MORTAR A MINIMUM OF 1/2" THICK WHEN THE INLET IS CONSTRUCTED OF SOLID BLOCK
G. ALL YARD INLETS MUST HAVE APRONS AT ALL THROATS UNLESS APPROVED BY THE DIRECTOR.

* INLET CAGES ARE REQUIRED IN ALL RESIDENTIAL DEVELOPEMENTS

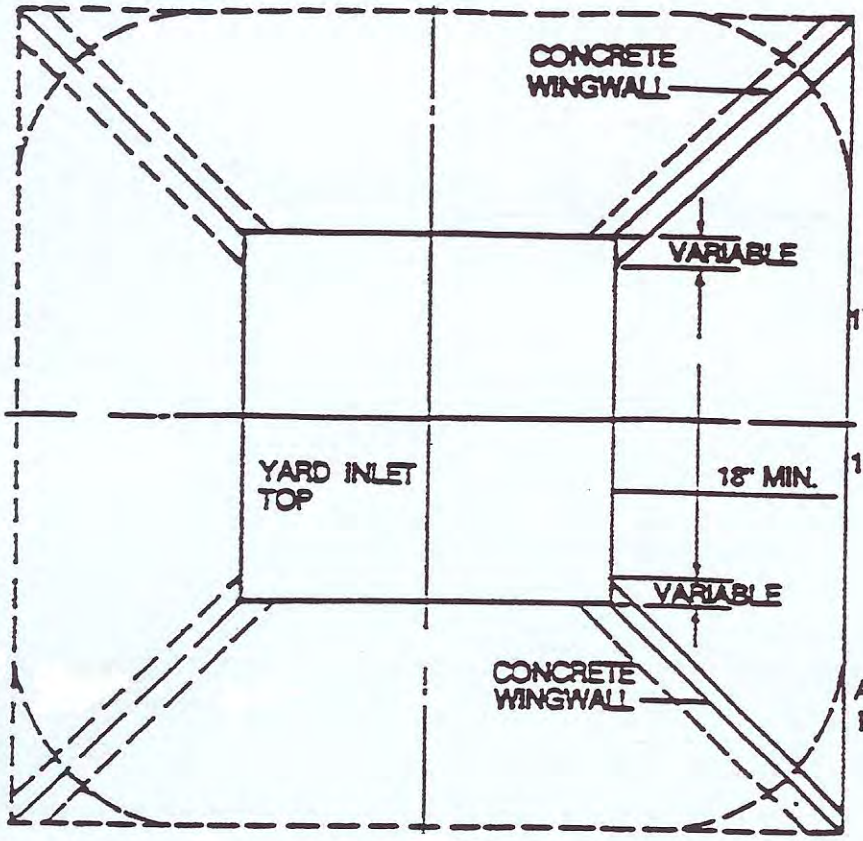
YARD INLET

REVISION & DATE

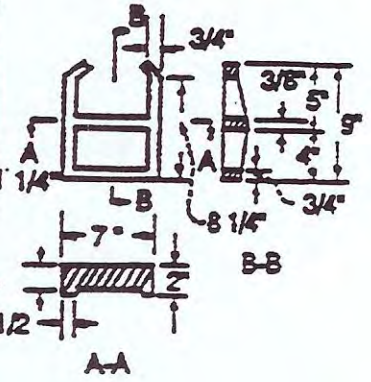
DIRECTOR 4/19/96 DATE

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

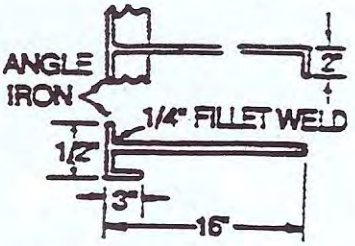
EXHIBIT NUMBER
26

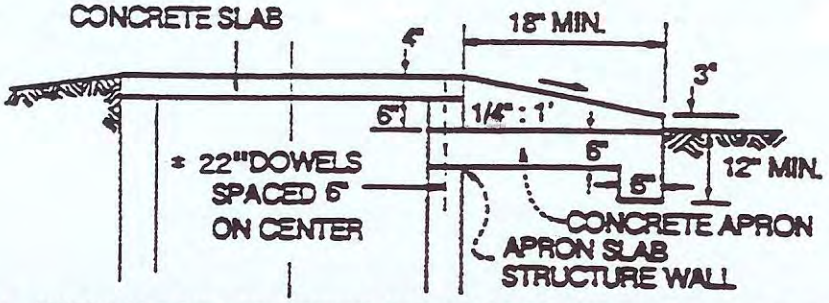


ALTERNATE STEP DETAIL

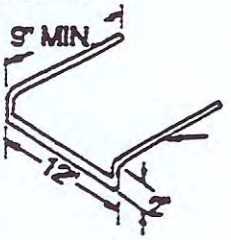


ANCHOR BAR DETAIL PLAN





STEP DETAIL



A. WHEN APRONS ARE ON ADJACENT SIDES OF THE INLET, THE ADJOINING WINGWALLS SHALL BE OMITTED AND THE APRON SHALL HAVE A 1.5' RADIUS.

B. WHEN THE INLET IS LARGER THAN 5' x 5' OPPOSITE CONCRETE APRONS SHALL BE CONSTRUCTED ON THE CENTERLINE OF THE INLET; TWO ADJACENT APRONS SHALL BE BUILT ADJOINING THE COMMON CORNER; IF THERE ARE THREE OR FOUR APRONS ON ONE INLET, THEN ALL SHALL BE BUILT ON CENTERLINE.

C. NO. 6 GALVANIZED STEEL BAR OR NO. 3 REINFORCING ROD COMPLETELY ENCASED IN CORROSION RESISTANT RUBBER, VINYL, OR EPOXY.

D. REINFORCING STEEL SHALL BE 6" x 6" NO. 6 WIRE MESH.

NOT TO SCALE

E. INLET CAGES ARE REQUIRED IN ALL RESIDENTIAL DEVELOPEMENTS

CONCRETE APRON FOR YARD INLETS

REVISION & DATE

M. C. Dan 4/19/96
DIRECTOR DATE

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER
27

STORMWATER MANAGEMENT FACT SHEET

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

DIRECTOR _____ DATE 3/4/97

EXHIBIT NUMBER 28

REVISION & DATE

SWM FACILITY INFORMATION

Basin Name _____

Subbasin _____

Stream Name _____

Drainage Area (acres) draining to the facility _____

Avg. Basin Slope (ft/ft) _____

Type of facility
(a) Dry pond _____
(b) Wet pond _____
(c) Park. lot storg. _____
(d) Rooftop storg. _____
(e) Underground storg. _____
(f) Porous pavement _____
(g) Storm drains _____
(h) Land cover control _____
(i) Other _____

Is the facility ON - SITE _____

Is the facility OFF - SITE _____

C.O.M. File # _____

Development Name _____

Tax Map # _____

Was a fldpln. study prepared _yes _no

If yes, File # _____

Facility designed by: _____
(Engr. Firm)

DESIGN INFORMATION (*)

Were hydrologic & hydraulic models developed _yes _no

(a) Hydrologic Models
HEC-1 __ TR-20 __
Other_____

(b) Hydraulic Models
HEC-1 __ WSP-20 __
Other_____

Method used to develop hydrographs _____

Hydrograph routing methodology _____

Reservoir routing methodology _____

If the facility was not modeled, were elevation-discharge-storage tables developed _yes _no

Outlet structure type _____

Emergency spillway type _____

Were elev.-disch. tables for the emer. spway. developed _yes _no

Dam height (ft) ____, Invert elev. upst. ____, dwnst. ____

Rainfall depth (inches) 2-yr. ____, 10-yr. ____, 100-yr. ____

Rainfall depth (in.) 2-yr. ____, 10-yr. ____, 100-yr. ____

Rainfall duration (hrs.) ___, Rainfall distribution _____

Exist peak inflows (cfs) 2-yr. ____, 10-yr. ____, 100-yr. ____

Devlp. peak inflows (cfs) 2-yr. ____, 10-yr. ____, 100-yr. ____

Devlp. peak outflow (cfs) 2-yr. ____, 10-yr. ____, 100-yr. ____

Water surface elev. (ft.) 2-yr. ____, 10-yr. ____, 100-yr. ____

Reservoir storage (ac.-ft.) 2-yr. ____, 10-yr. ____, 100-yr. ____

Surface area (acres) 2-yr. ____, 10-yr. ____, 100-yr. ____

Normal pool elevation (ft.) _____, Storage (ac.-ft.) _____

Surface area (acres) _____

(*) For facilities type (a) and (b). For other types provide rainfall intensities data, storage vol., and discharges, if applicable.

Date: _____

MISCELLANEOUS

Is additional storage capacity necessary to correct an existing problem __ yes __ no

Does the facility incorporate BMP structural controls _ yes _ no

If no, does the facility regulate the 2-yr. storm _ yes _no

Was a description of the operation and maintenance needs of the facility included in the plans. _ yes _ no

Back up data location
plan ____, sheets ____
report ____, pages ____

SWM bond estimate ($) _____

To be completed by C.O.M. staff

Facility # _____

Upstream POI _____

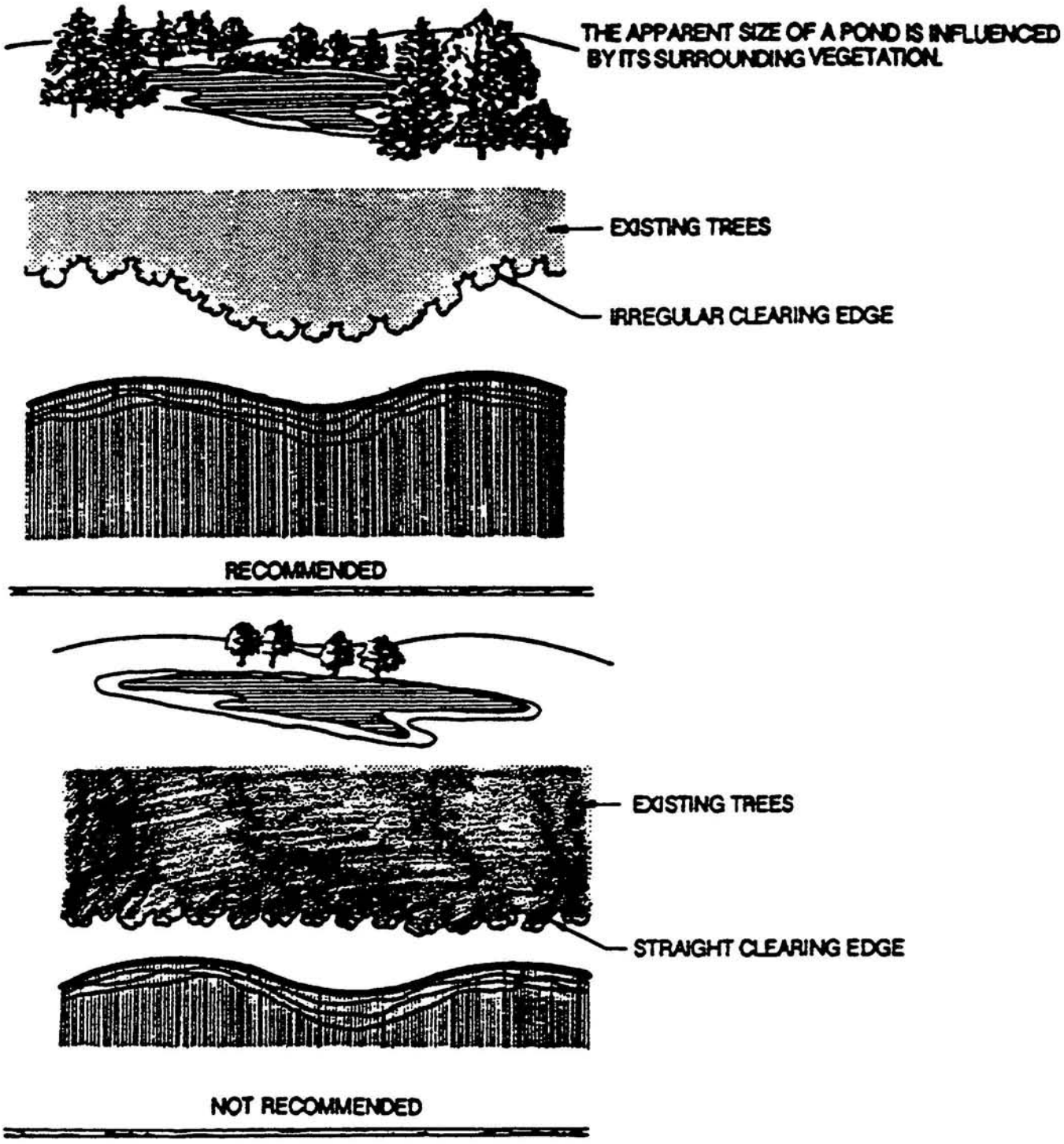
Downstream POI _____

Do the C.O.M. H & H models need to be updated _ yes _ no

Model updated ___/___/___

COM engineer _____

Comments:



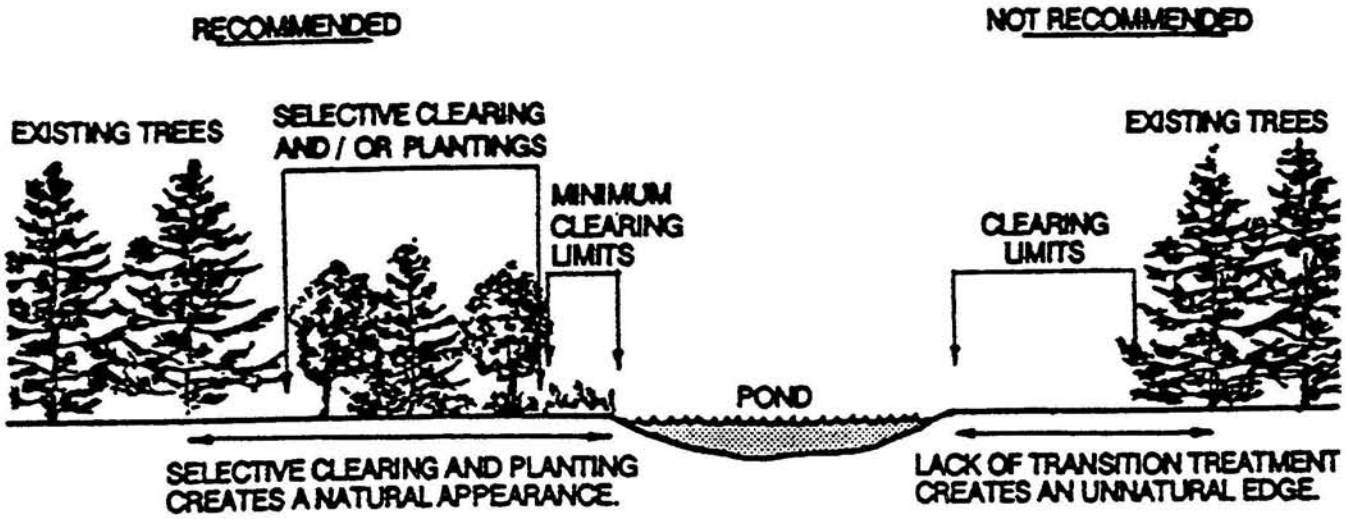
EDGE TREATMENT OF PONDS

REVISION & DATE	

DIRECTOR 4/19/96 DATE

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER
29



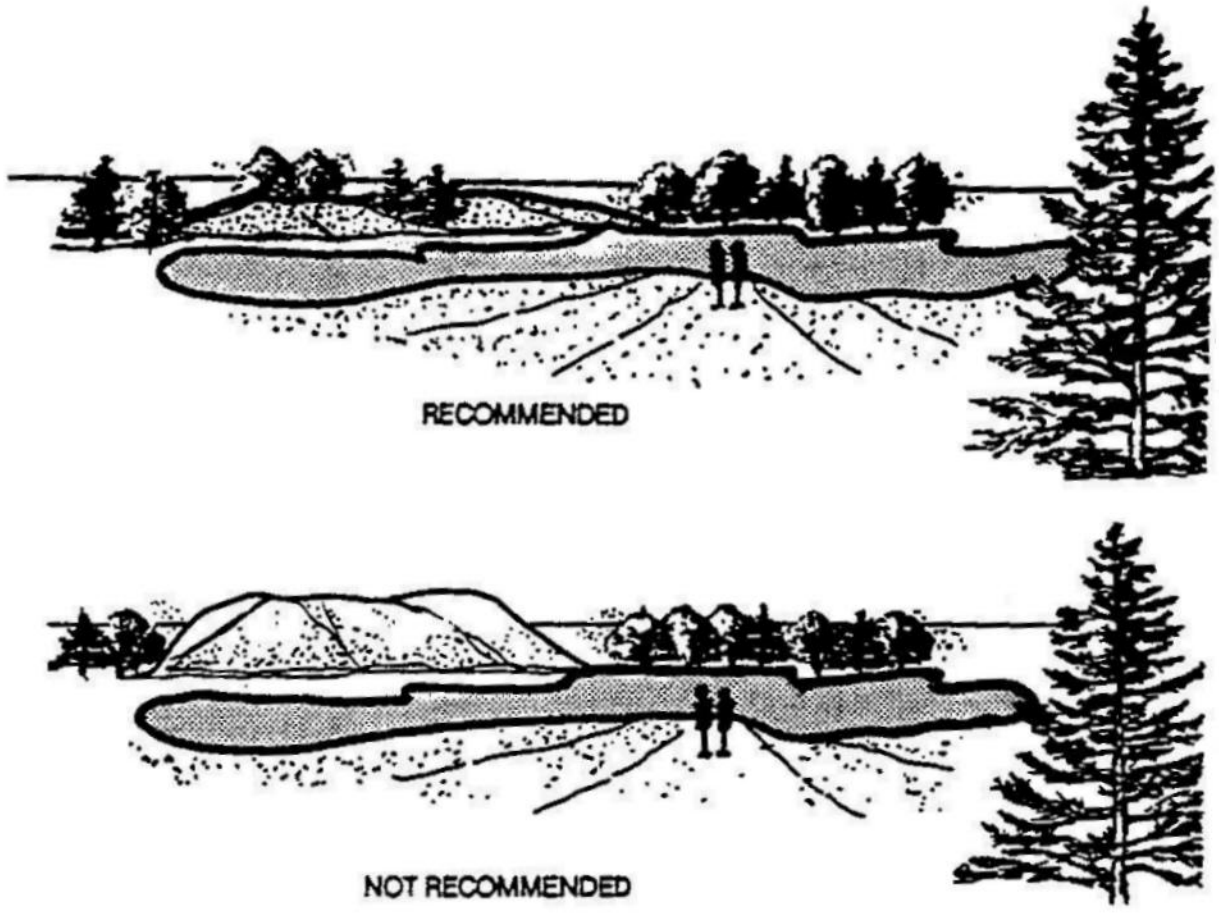
WET POND EDGE TREATMENT

REVISION & DATE	

D.C.D. 4/19/96
DIRECTOR DATE

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER
30



RECOMMENDED

NOT RECOMMENDED

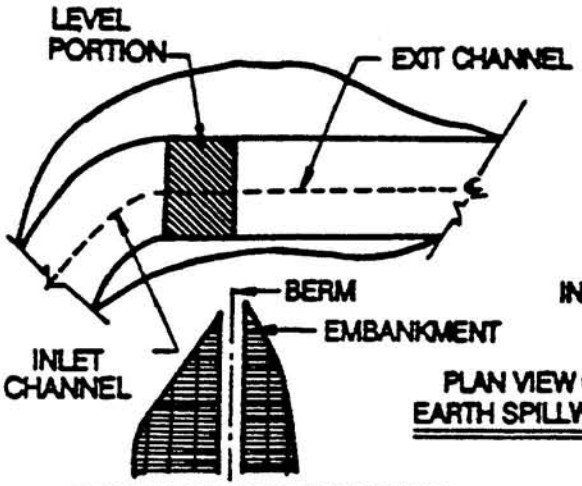
EXCAVATED MATERIAL RESPREAD

REVISION & DATE	

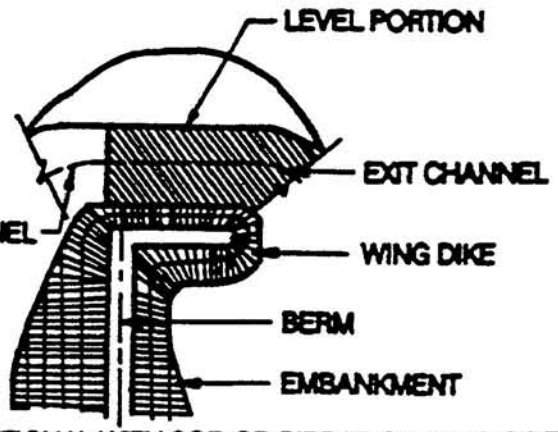
DIRECTOR 4/19/96 DATE

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER
31



PLAN VIEW OF EARTH SPILLWAYS

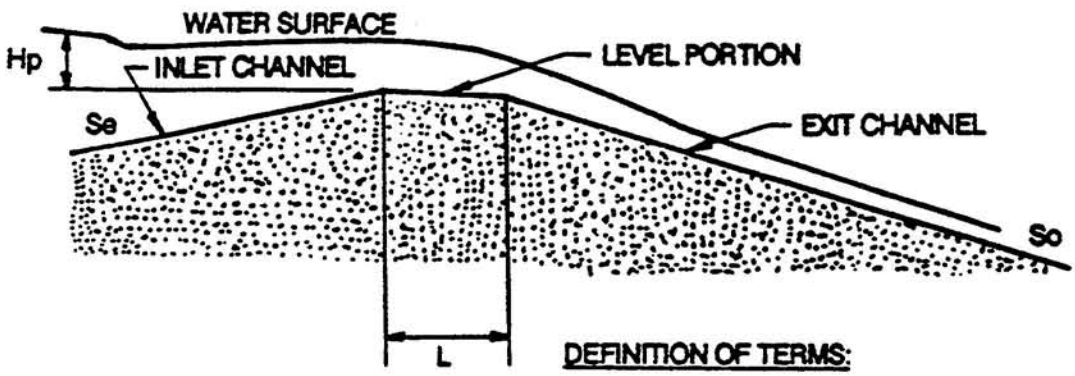


EXCAVATED EARTH SPILLWAY

NEITHER THE LOCATION NOR THE ALIGNMENT OF THE LEVEL PORTION NEEDS TO COINCIDE WITH THE CENTERLINE OF THE DAM EMBANKMENT.

OPTIONAL WITH SOD OR RIPRAP ON WING SIDE

CARE SHALL BE EXERCISED TO KEEP MACHINERY AND TRAFFIC OUT OF THE SPILLWAY DISCHARGE AREA TO PROTECT CHANNEL LINING.

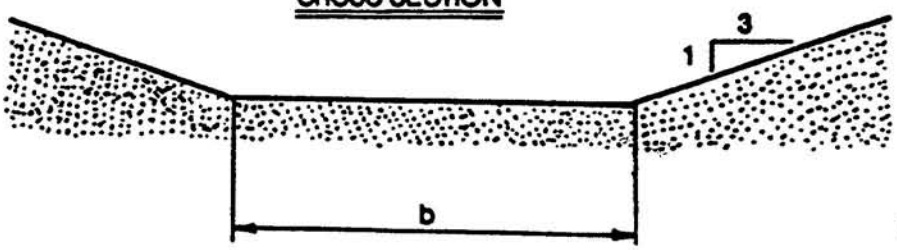


PROFILE ALONG CENTERLINE

DEFINITION OF TERMS:

Hp = DEPTH OF WATER IN POND ABOVE CREST
L = LENGTH OF LEVEL PORTION (25' MINIMUM)
b = BOTTOM WIDTH OF SPILLWAY
So = SLOPE FOR EXIT CHANNEL
Se = SLOPE OF INLET CHANNEL

CROSS SECTION



NOT TO SCALE

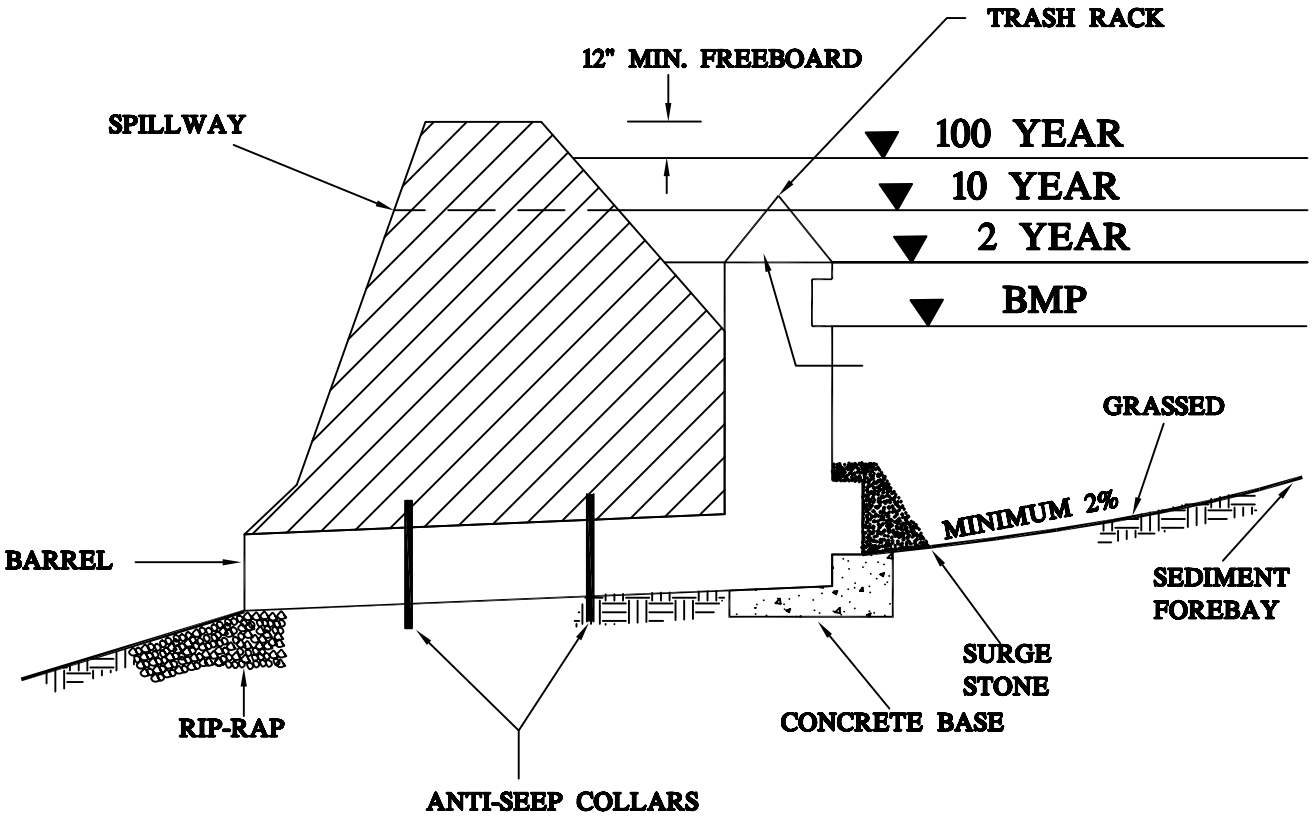
EMBANKMENTS AND SPILLWAYS

REVISION & DATE

DIRECTOR 4/19/96 DATE

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER
32

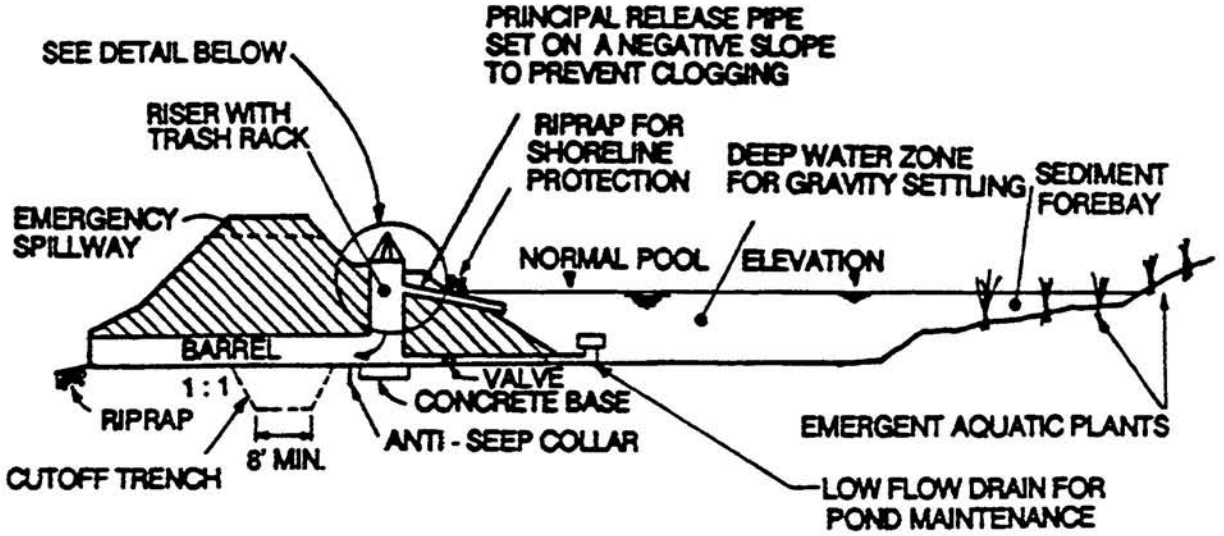


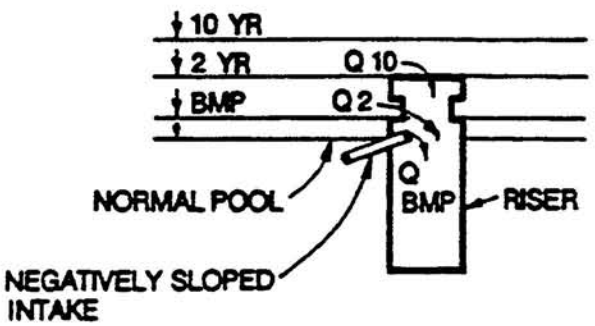
NOT TO SCALE

TYPICAL DRY POND

REVISION & DATE	

DIRECTOR 4/19/96 DATE	CITY OF MANASSAS, VIRGINIA DEPARTMENT OF PUBLIC WORKS	EXHIBIT NUMBER 33





NOT TO SCALE

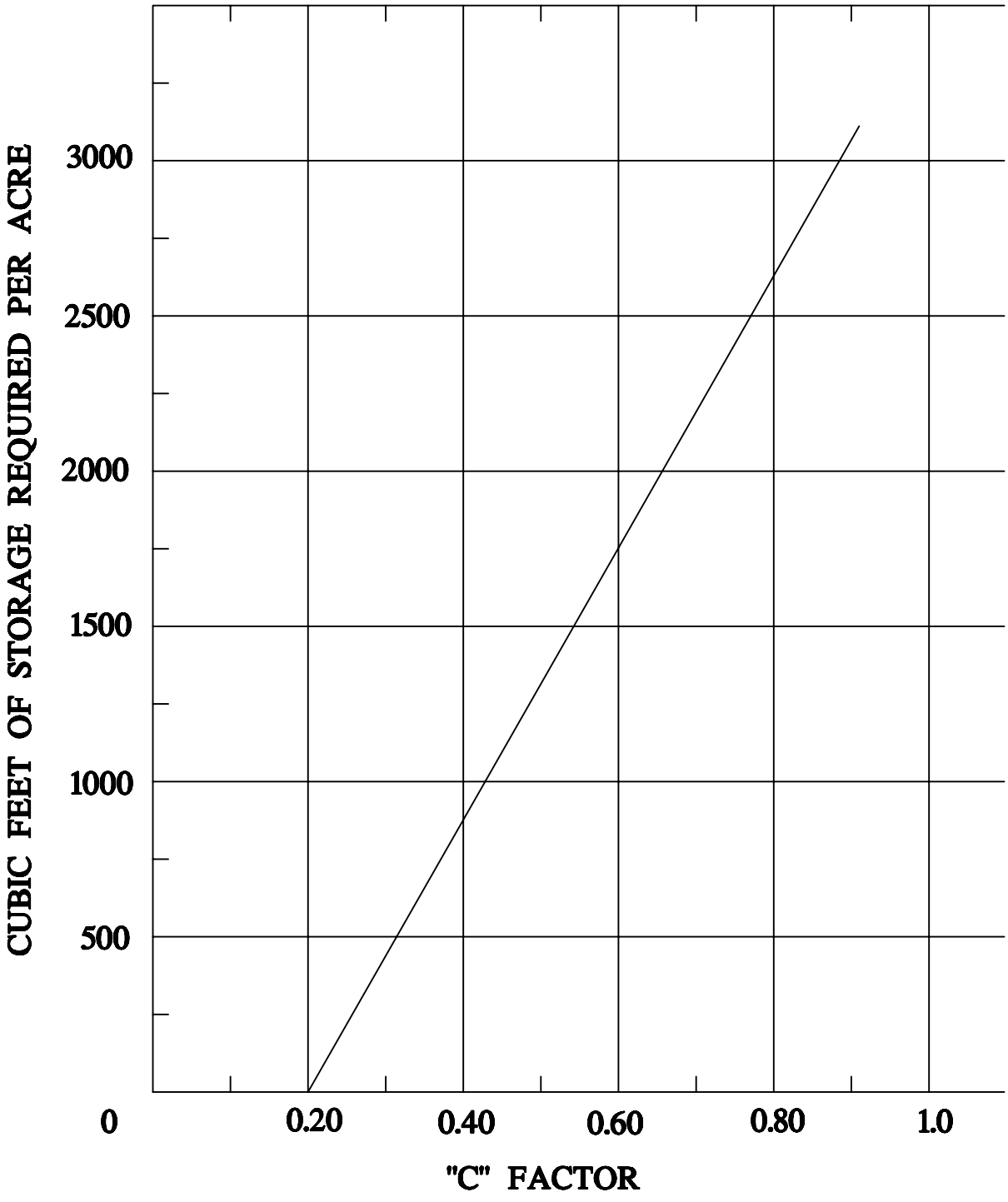
TYPICAL WET POND

REVISION & DATE	

DIRECTOR 4/19/96 DATE

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

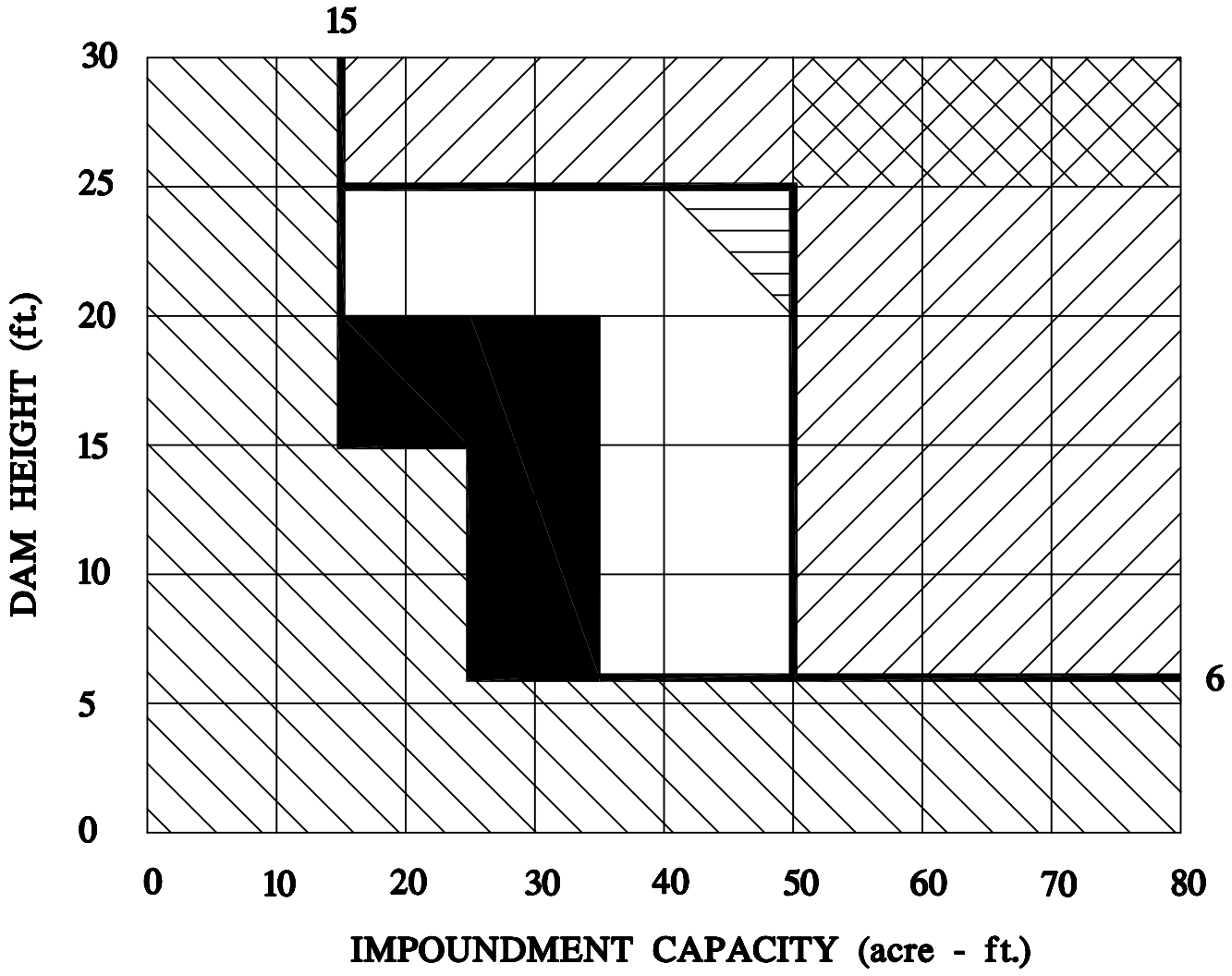
EXHIBIT NUMBER
34



WATER QUALITY REQUIREMENTS

REVISION & DATE	

5/3/96 DIRECTOR / DATE	CITY OF MANASSAS, VIRGINIA DEPARTMENT OF PUBLIC WORKS	EXHIBIT NUMBER 35



DAMS REGULATED BY THE DEPARTMENT OF CONSERVATION AND HISTORIC RESOURCES

1 (100 yr.) = PMF DESIGN MINIMUM
1.5 (100 yr.) = 0.3 PMF
2.0 (100 yr.) = 0.4 PMF
2.5 (100 yr.) = 0.5 PMF
5.0 (100 yr.) = 1.0 PMF

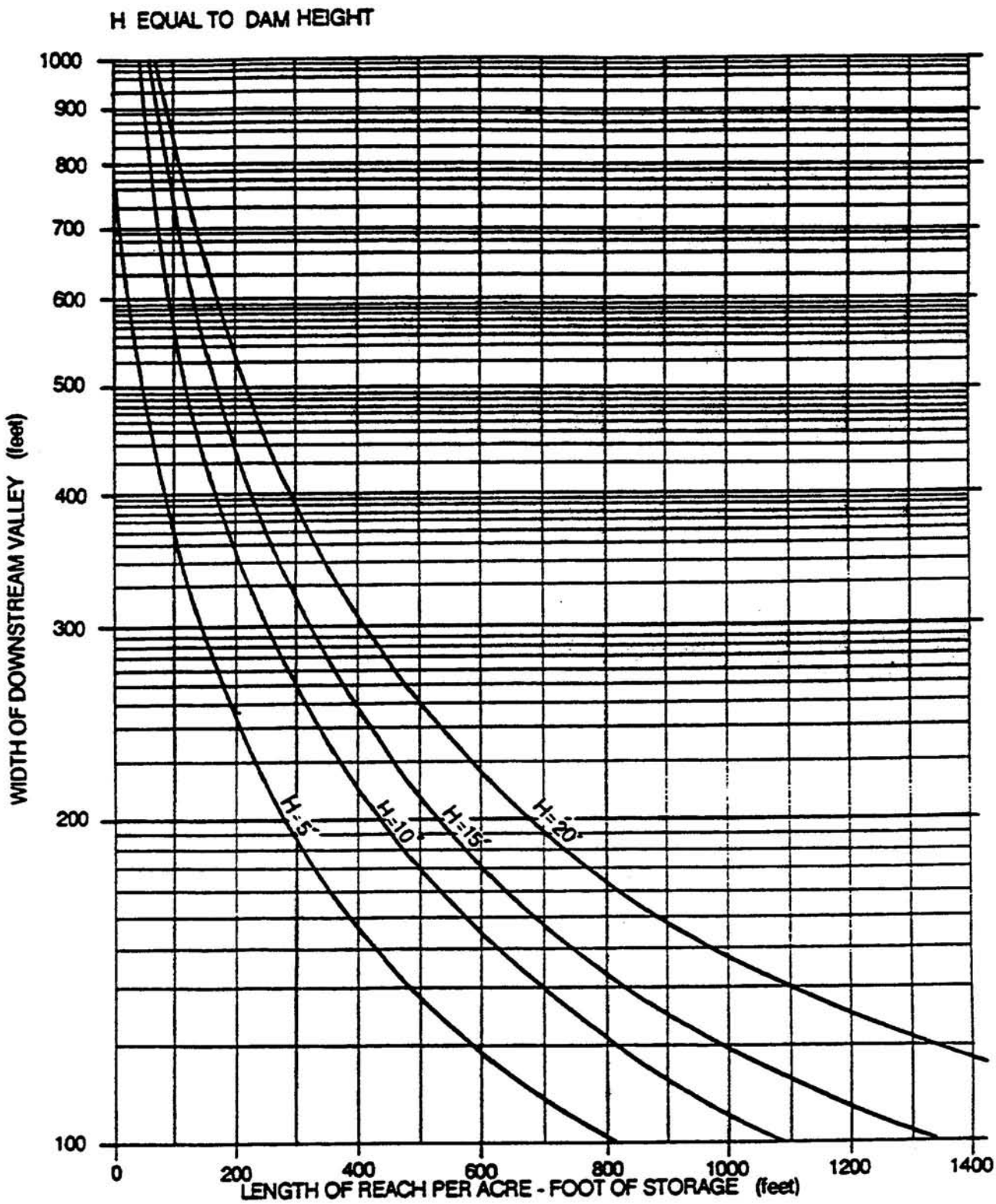
PMF = probable maximum flood

DESIGN STORM FOR DAMS

REVISION & DATE	

DIRECTOR	DATE: 4/19/96	CITY OF MANASSAS, VIRGINIA DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER
36



DANGER REACH LENGTH

REVISION & DATE	

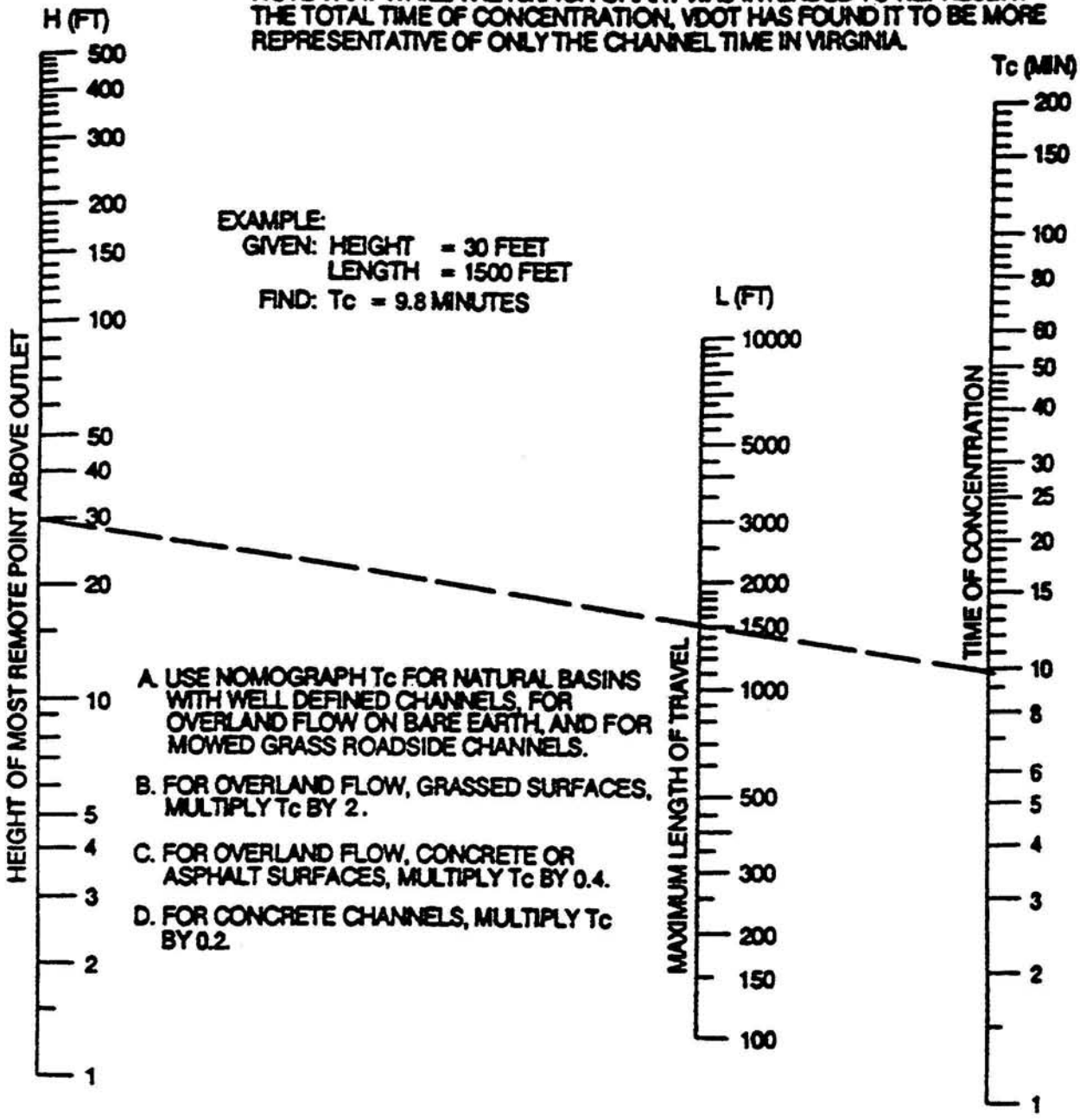
D. C. Daley
DIRECTOR

4/19/96
DATE

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER
37

NOTE THAT WHILE THE KIRPICH CHART WAS INTENDED TO REPRESENT THE TOTAL TIME OF CONCENTRATION, VDOT HAS FOUND IT TO BE MORE REPRESENTATIVE OF ONLY THE CHANNEL TIME IN VIRGINIA.



EXAMPLE:
GIVEN: HEIGHT = 30 FEET
LENGTH = 1500 FEET
FIND: Tc = 9.8 MINUTES

A. USE NOMOGRAPH Tc FOR NATURAL BASINS WITH WELL DEFINED CHANNELS, FOR OVERLAND FLOW ON BARE EARTH, AND FOR MOWED GRASS ROADSIDE CHANNELS.

B. FOR OVERLAND FLOW, GRASSED SURFACES, MULTIPLY Tc BY 2.

C. FOR OVERLAND FLOW, CONCRETE OR ASPHALT SURFACES, MULTIPLY Tc BY 0.4.

D. FOR CONCRETE CHANNELS, MULTIPLY Tc BY 0.2.

BASED ON STUDY BY P.Z. KIRPICH

TIME OF CONCENTRATION SMALL BASINS

REVISION & DATE

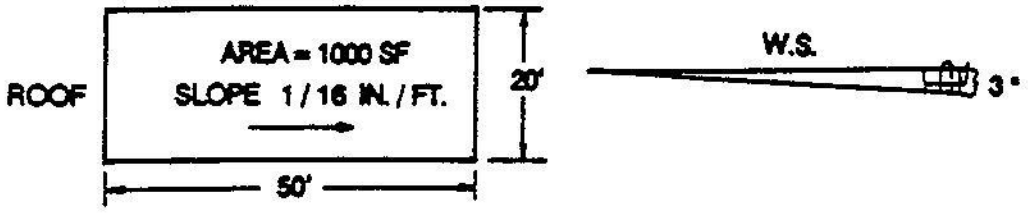
DIRECTOR — DATE 4/19/96

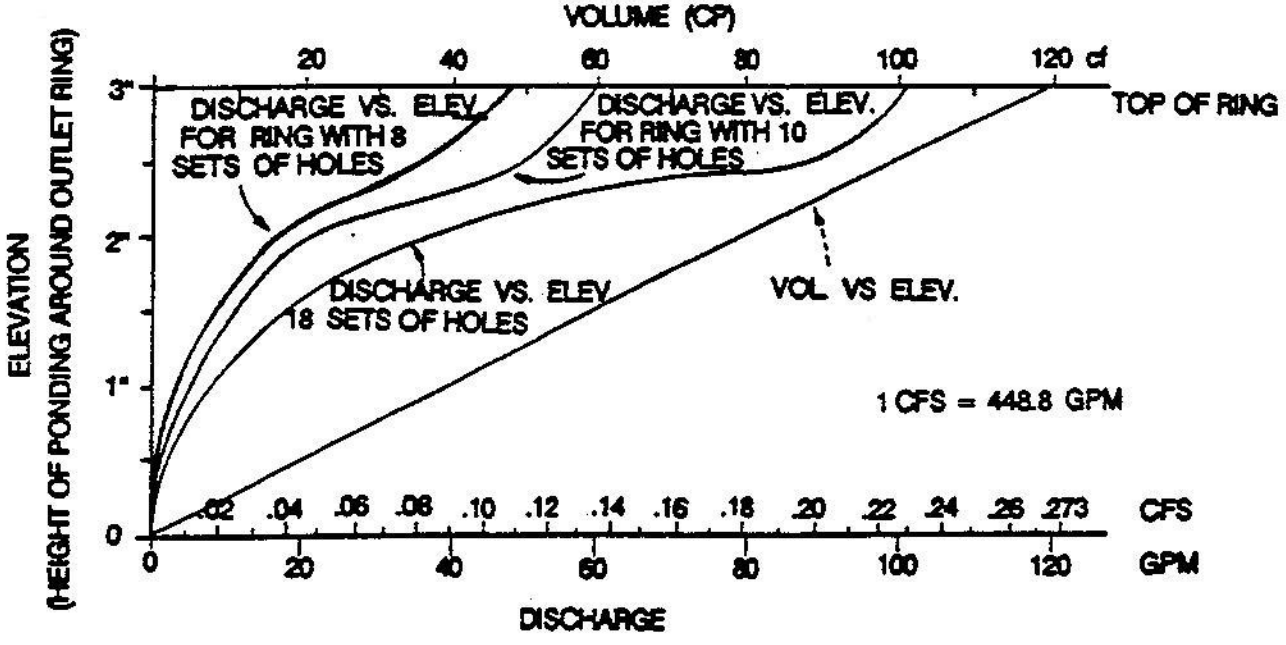
CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER
38

CAPACITY THROUGH HOLES				
WATER DEPTH AT INLET (INCHES)	DISCHARGE (GPM)			
	1 SET HOLES	8 SETS	10 SETS	18 SETS
1.5	1	8	10	18
2.0	2	16	20	36
2.5	5	40	50	90
3.0	6	48	60	108

ROOFTOP DETENTION PERFORMANCE CURVE





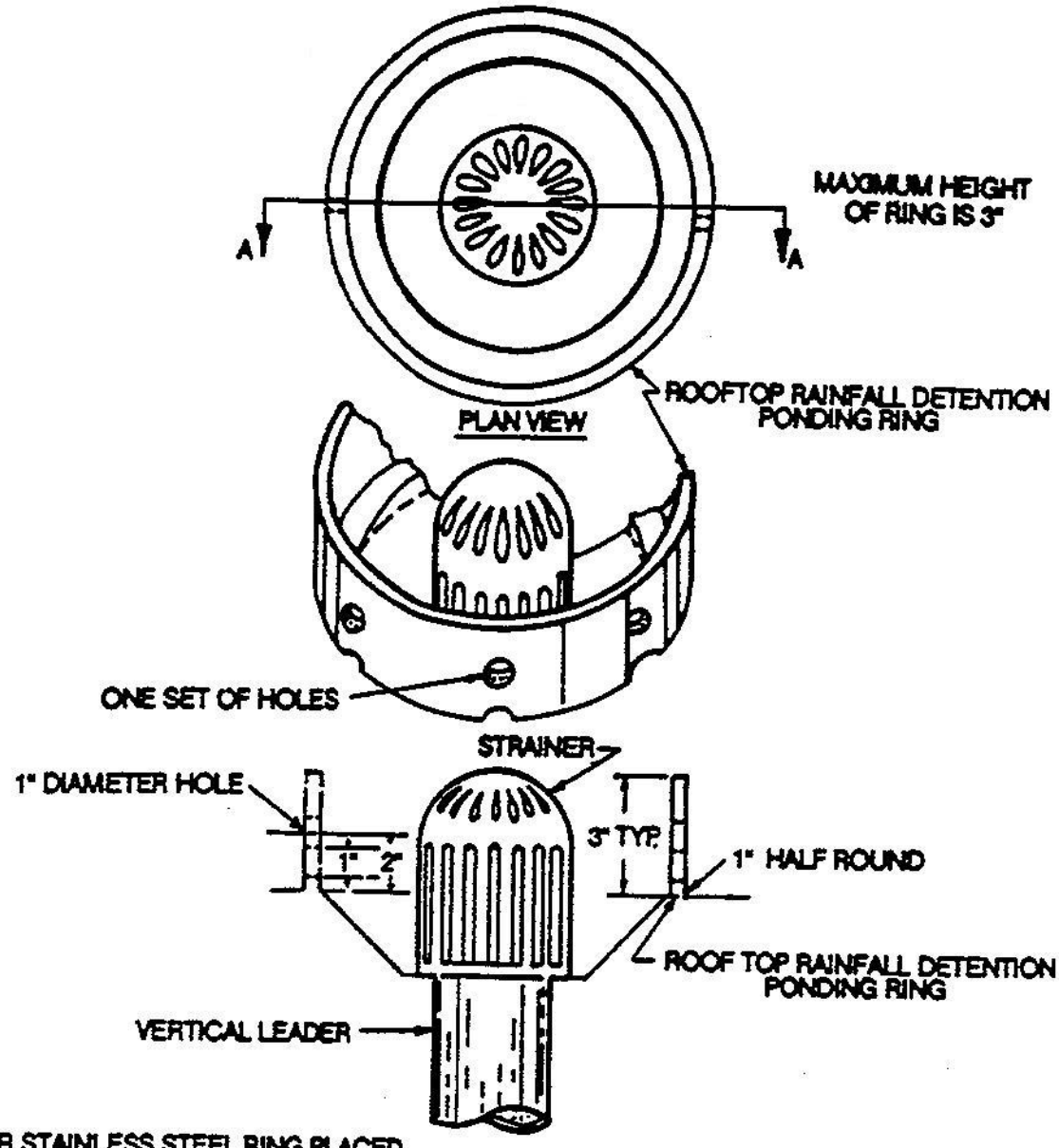
ROOF TOP STORM WATER DETENTION

REVISION & DATE	

DIRECTOR 4/19/96 DATE

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER
39



SECTION VIEW A-A

A. BRASS OR STAINLESS STEEL RING PLACED AROUND STANDARD ROOF DRAIN.

B. RING HEIGHT AND DIAMETER AND NUMBER AND SIZES OF HOLES ARE DETERMINED BY THE ROOF AREA DRAINED, THE NUMBER OF DRAINS, AND THE RAINFALL DESIGN CRITERIA.

NOT TO SCALE

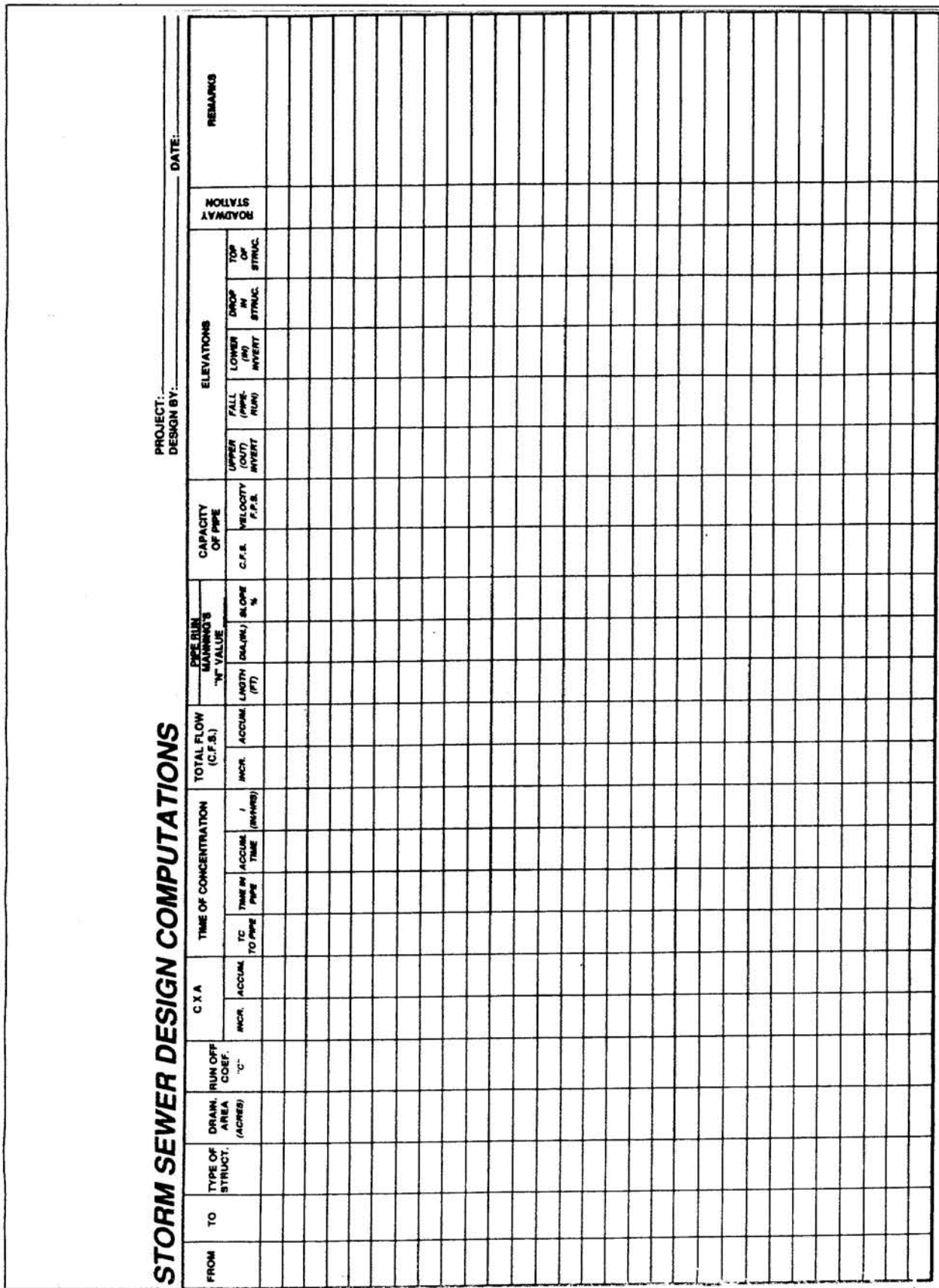
ROOFTOP RAINFALL PONDING RING

REVISION & DATE	

DIRECTOR 4/19/96 DATE

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER
40



STORM SEWER DESIGN COMPUTATIONS

REVISION & DATE

4/19/96

DIRECTOR — DATE

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER
41

PROJECT:
DESIGN BY:
DATE:

STORM WATER INLET COMPUTATIONS

INLET	NUMBER																		
	TYPE																		
	LENGTH (ft)																		
STATION																			
DRAINAGE AREA (ac)																			
C																			
CA																			
$\sum$ CA																			
I (IN/HR)																			
Q INCR (cfs)																			
Q CARRY OVER (cfs)																			
Qt GUTTER FLOW																			
S GUTTER SLOPE (ft/ft)																			
Sx CROSS SLOPE (ft/ft)																			
T (SPREAD) (ft)																			
W (ft)																			
W/T																			
Sw (ft/ft)																			
Sw/Sx																			
Eo																			
a=12W(Sw-Sx)+LOC. DEP.																			
SW=a/12W																			
Se(ft/ft)=Sx+Sw Eo																			
Lt (ft)																			
P EFFEC. (length ft)																			
L/LT																			
d (ft)																			
E																			
h (ft)																			
Ql INTERCEPTED (cfs)																			
d/h																			
Qb CARRYOVER (cfs)																			
T SPREAD @ SAG (ft)																			
REMARKS																			

NOTE: REFER TO THE VIRGINIA DEPARTMENT OF TRANSPORTATION DRAINAGE MANUAL

STORM WATER INLET COMPUTATIONS

REVISION & DATE	

DIRECTOR — DATE: 4/19/96

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER
42

HYDRAULIC GRADE LINE

PROJECT: _____ DATE: _____
DESIGN BY: _____

INLET STATION	OUTLET WATER SURFACE ELEV.	D_o	Q_o	L_o	S_f $_o$ %	H_f	JUNCTION LOSS											FINAL H	INLET WATER SURFACE ELEV.	RIM ELEV.	REMARKS
							V_o	H_o	Q_1	V_1	Q_1V_1	$\frac{V_1^2}{2g}$	H_1	STDNV	H_Δ	H_t	1.3 H_t	0.5 H_t				

NOTES:

$H_1 = 0.35 \frac{V_1^2}{2g}$

$H_o = 0.25 \frac{V_o^2}{2g}$

$H_\Delta = K \frac{V_1^2}{2g}$

$H_t = H_o + H_1 + H_\Delta$

FINAL $H = H_f + H_t$

90 K=0.70
80 K=0.66
70 K=0.61
60 K=0.55
50 K=0.47
40 K=0.38
30 K=0.28
25 K=0.22
20 K=0.16
15 K=0.10

HYDRAULIC GRADE LINE

REVISION & DATE	

DIRECTOR

3/4/97
DATE

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER
43

REQUEST FOR STORMWATER WAIVER FORM

Name of Owner: _____

Address: _____

_____

_____

Phone: _____

Engineer: _____

RE (Site Name:) _____

Waiver Category: _____

I hereby request that the City of Manassas waive the requirement for stormwater management for the above-named site. I believe that my development falls into the waiver category indicated above based on the following information which I hereby certify as being accurate.

Proposed amount of disturbed area: _____ **Acres**

Proposed amount of impervious area: _____ **Acres**

I understand that if any changes are made in the above figures, I will notify the City of Manassas in writing.

I further understand that I will receive written notification from the City of Manassas informing me of the status of this request within 30 days of receipt by the Department of Public Works.

_____ _____

Date: **Owner's Signature**

Attachment: Site development plan showing existing and proposed grading, including information concerning the outfall and receiving downstream conditions.

STORMWATER WAIVER FORM

REVISION & DATE

4/19/96

DIRECTOR DATE

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER
44

REQUEST FOR ON-SITE DETENTION WAIVER FORM

Four (4) copies of the following information should be submitted to the City of Manassas Department of Public Works.

Subdivision (Record Plat Title) _____

Name of Owner: _____

Address: _____

Phone: _____

Engineer: _____

Address: _____

Phone: _____

Size of Tract _____ **(Gross Ac.)** **No. of Lots** _____ **Zone** _____

Watershed _____

Plat No. _____ **Date** _____

I hereby request that the City of Manassas waive the requirement for on-site detention for the above-named site. I understand that I will receive written notification from the City of Manassas informing me of the status of this request within 30 days of receipt by the Department of Public Works.

_____ _____

Date: **Owner's Signature**

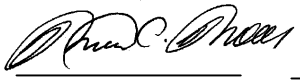
I believe that this request is justified based upon the attached information which I hereby certify as being accurate.

_____ _____

Date: **Professional Engineer's Signature**

ON-SITE DETENTION WAIVER FORM

REVISION & DATE	



4/19/96

DIRECTOR **DATE**

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER

45

REQUEST FOR ON-SITE DETENTION WAIVER FORM

The following supporting information is to be provided as part of the request for waiver for on-site detention under Section 8-510.6:

1. **Location Map - The map should outline development and watershed tributary to the proposed development.**

2. **Proposed Plat - (as available)**

3. **Plan of Proposed Development - The plan is to show streets, parking lots,topography, 100-year flood plains, easements for storm drains, sewers, and other utilities; major building locations (except single-family detached buildings); etc.**

4. **Peak Flows For the 10-year, 6-hour storm - Before and after development (without any on-site detention).**

5. **Justification For Requesting Waiver - In addition, the following would be useful in supporting the waiver request:**

   - ✳ **Location of site and type of existing or proposed off-site central stormwater management structure and estimated available storage or alternate control measures.**
   - ✳ **Peak flows for 10-year, 6-hour and 100-year, 24-hour storms computed before and after development and volume of storage to be provided for control of these storms.**
   - ✳ **If applicable, availability of land rights for a proposed central stormwater management structure and preliminary cost estimate for land and construction.**

6. **Related Drainage Area Studies which may support the request for the waiver.**

ON-SITE DETENTION WAIVER FORM

REVISION & DATE

4/19/96

DIRECTOR — DATE

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

EXHIBIT NUMBER
45 (cont.)

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