

**Appendix B  
Storm Drain Design Calculations  
MCR Engineering**

**A. Detention Basin Design Calculations**

**MCR ENGINEERING**

1242 Dupont Court  
Manteca, CA 95336  
**(209) 239-6229**  
**FAX (209) 239-8839**

JOB	09-020 NW Airport Way MP		
SHEET	1	OF	4
BY	SLS	DATE	7/2/2010

**BASIN A - Design Calculations**

Per City of Manteca Design Standards

Volume Requirements:

Design Frequency = 10 Year  
Runoff, R = 3.56 inches 0.30 ft

	C	R (ft)	A (ac)	V (ac-ft)
Commercial	0.75	0.30	21.64	4.82
Basin	1.00	0.30	1.94	0.58
Total			23.58	5.39

Required Volume of Storage (100%) = 5.39 ac-ft 234,836 cf

Volume Calculations:

Lowest T.C. = 22.2  
Side Slopes = 6:1

Max. W.S.L. = 21.2	Water Surface Area = 64,257 sf
Basin Bottom Elev. = 16.2	Bottom Surface Area = 35,938 sf
Water Depth = 5 ft	Average Area = 50,098 sf

Basin Volume = 5.75 ac-ft 250,488 cf

Pump Station Requirements:

Empty Basin in 96 hrs Qreq 0.7 cfs  
305 gpm

# MCR ENGINEERING

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JOB 09-020 NW Airport Way MP  
SHEET 2 OF 4  
BY SLS DATE 7/2/2010

## BASIN B- Design Calculations

Per City of Manteca Design Standards

Volume Requirements:

Design Frequency = 10 Year  
Runoff, R = 3.56 inches 0.30 ft

	C	R (ft)	A (ac)	V (ac-ft)
Industrial	0.80	0.30	38.40	9.11
Basin	1.00	0.30	2.89	0.86
Total			41.29	9.97

Required Volume of Storage (100%) =  ac-ft  cf

Volume Calculations:

Lowest T.C. = 22.2  
Side Slopes = 6:1

Max. W.S.L. = 21.2      Water Surface Area = 112,729 sf  
Basin Bottom Elev. = 16.2      Bottom Surface Area = 63,763 sf  
Water Depth = 5 ft      Average Area = 88,246 sf

Basin Volume =  ac-ft  cf

Pump Station Requirements:

Empty Basin in 96 hrs      Qreq  cfs  
564 gpm

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JOB 09-020 NW Airport Way MP  
SHEET 3 OF 4  
BY SLS DATE 7/2/2010

**BASIN C - Design Calculations**

Per City of Manteca Design Standards

Volume Requirements:

Design Frequency = 10 Year  
Runoff, R = 3.56 inches 0.30 ft

	C	R (ft)	A (ac)	V (ac-ft)
Industrial	0.80	0.30	41.28	9.80
Basin	1.00	0.30	3.94	1.17
	Total		45.22	10.97

Required Volume of Storage (100%) = 10.97 ac-ft 477,678 cf

Volume Calculations:

Lowest T.C. = 22.2  
Side Slopes = 6:1

Max. W.S.L. = 21.2	Water Surface Area = 130,102 sf
Basin Bottom Elev. = 16.2	Bottom Surface Area = 63,069 sf
Water Depth = 5 ft	Average Area = 96,586 sf

Basin Volume = 11.09 ac-ft 482,928 cf

Pump Station Requirements:

Empty Basin in 96 hrs Qreq 1.4 cfs  
620 gpm

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JOB 09-020 NW Airport Way MP  
SHEET 4 OF 4  
BY SLS DATE 7/2/2010

## BASIN D - Design Calculations

Per City of Manteca Design Standards

Volume Requirements:

Design Frequency = 10 Year  
Runoff, R = 3.56 inches 0.30 ft

	C	R (ft)	A (ac)	V (ac-ft)
Industrial	0.80	0.30	191.38	45.42
Basin	1.00	0.30	11.60	3.44
Total			202.98	48.86

Required Volume of Storage (100%) = 48.86 ac-ft 2,128,489 cf

Volume Calculations:

Lowest T.C. = 22.2  
Side Slopes = 6:1

Max. W.S.L. = 21.2      Water Surface Area = 505,382 sf  
Basin Bottom Elev. = 16.2      Bottom Surface Area = 384,184 sf  
Water Depth = 5 ft      Average Area = 444,783 sf

Basin Volume = 51.05 ac-ft 2,223,915 cf

Pump Station Requirements:

Empty Basin in 96 hrs      Qreq 6.2 cfs  
2,764 gpm

## B. Storm Drain System Design Calculations



MCR ENGINEERING, INC.  
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## STORM DRAIN SYSTEM A DESIGN

### Northwest Airport Way Master Plan

RUNOFF COEFFICIENTS: Land Use <u>COM</u> <u>IND</u> Weighted Coeff. <u>0.75</u> <u>0.80</u>															Date: <u>7/2/2010</u> By: <u>SLS</u>						
RAINFALL CURVES: Scource <u>Manteca Standards</u> M.A.P. <u>15.0</u> inches Frequency <u>10</u> Years										TIME OF CONCENTRATION: Overland Flow      _____ Min Gutter Flow          _____ Min Total Inlet Time    _____ 20 Min					PIPE: Type _____ Roughness Coeff. <u>0.013</u> inches Min. Velocity at _____ Design Flow v =      2.5      fps						
Line Designation	From	Invert Elev.	To	Invert Elev.	Area (Acres)	Runoff Coeff.	Area X Coeff.	Duration (min)	Intensity (in/hr)	Runoff (cfs)	Length (ft)	Pipe Diam (in)	Pipe Slope	Capacity (cfs)	Velocity (fps)	Flow Time (min)	Fall (feet)	HL Factor	Head Loss-HL (ft)	Hyd. Grade-HGL (ft)	Velocity (fps) full
COM	A1	10.39	A3	10.38	16.36	0.75	12.270	20.00	1.20	14.78	10	36	0.0007	17.69	2.5	0.07	0.01	1.50	0.11	0.63	2.1
COM	A2	11.40	A3	11.38	5.28	0.75	3.960	20.00	1.20	4.77	10	24	0.0012	7.85	2.5	0.07	0.01	1.50	0.06	0.63	1.5
JUNCT-3	A3	10.38	A4	10.08	0.00	0.75	0.000	20.07	1.20	19.55	305	36	0.0010	21.14	3.0	1.70	0.31	1.25	0.41	0.22	2.8
JUNCT-2	A4	10.08	OUT	10.00	0.00	0.75	0.000	21.77	1.15	19.55	79	36	0.0010	21.14	3.0	0.44	0.08	1.25	0.22	0.00	2.8



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## STORM DRAIN SYSTEM B DESIGN

### Northwest Airport Way Master Plan

**RUNOFF COEFFICIENTS:**

Land Use IND  
 Weighted Coeff. 0.80

Date: 7/2/2010  
 By: SLS

**RAINFALL CURVES:**

Scource Manteca Standards  
 M.A.P. 15.0 inches  
 Frequency 10 Years

**TIME OF CONCENTRATION:**

Overland Flow \_\_\_\_\_ Min  
 Gutter Flow \_\_\_\_\_ Min  
 Total Inlet Time 20 Min

**PIPE:**

Type \_\_\_\_\_  
 Roughness Coeff. 0.013 inches  
 Min. Velocity at \_\_\_\_\_  
 Design Flow v = 2.5 fps

Line Designation	From	Invert Elev.	To	Invert Elev.	Area (Acres)	Runoff Coeff.	Area X Coeff.	Duration (min)	Intensity (in/hr)	Runoff (cfs)	Length (ft)	Pipe Diam (in)	Pipe Slope	Capacity (cfs)	Velocity (fps)	Flow Time (min)	Fall (feet)	HL Factor	Head Loss-HL (ft)	Hyd. Grade-HGL (ft)	Velocity (fps) full
					A	C	AxC	T	I	Q	L	D	S	Qc	V	T	F	K	HL	HGL	V
IND	B1	10.94	B3	10.93	10.37	0.80	8.296	20.00	1.20	9.99	10	30	0.0010	13.00	2.6	0.06	0.01	1.50	0.10	14.31	2.0
IND	B2	10.94	B3	10.93	15.70	0.80	12.560	20.00	1.20	15.13	10	36	0.0008	18.91	2.7	0.06	0.01	1.50	0.11	13.11	2.1
IND	B3	10.83	B4	10.24	0.00	0.80	0.000	20.06	1.20	25.12	839	42	0.0007	26.68	2.8	5.04	0.59	1.25	0.66	13.66	2.6
IND	B4	10.24	OUT	10.00	0.00	0.80	0.000	25.10	1.06	25.12	346	42	0.0007	26.68	2.8	2.08	0.24	1.00	0.32	13.32	2.6
IND	B5	10.05	OUT	10.00	12.34	0.80	9.872	20.00	1.20	11.89	54	30	0.0010	13.00	2.6	0.34	0.05	1.00	0.14	0.14	2.4



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## STORM DRAIN SYSTEM C DESIGN

### Northwest Airport Way Master Plan

**RUNOFF COEFFICIENTS:**

Land Use IND  
 Weighted Coeff. 0.80

Date: 7/2/2010  
 By: SLS

**RAINFALL CURVES:**

Scource Manteca Standards  
 M.A.P. 15.0 inches  
 Frequency 10 Years

**TIME OF CONCENTRATION:**

Overland Flow \_\_\_\_\_ Min  
 Gutter Flow \_\_\_\_\_ Min  
 Total Inlet Time 20 Min

**PIPE:**

Type \_\_\_\_\_  
 Roughness Coeff. 0.013 inches  
 Min. Velocity at \_\_\_\_\_  
 Design Flow v = 2.5 fps

Line Designation	From	Invert Elev.	To	Invert Elev.	Area (Acres)	Runoff Coeff.	Area X Coeff.	Duration (min)	Intensity (in/hr)	Runoff (cfs)	Length (ft)	Pipe Diam (in)	Pipe Slope	Capacity (cfs)	Velocity (fps)	Flow Time (min)	Fall (feet)	HL Factor	Head Loss-HL (ft)	Hyd. Grade-HGL (ft)	Velocity (fps) full
					A	C	AxC	T	I	Q	L	D	S	Qc	V	T	F	K	HL	HGL	V
IND	C1	14.16	C3	14.00	4.00	0.80	3.200	20.00	1.20	3.85	80	18	0.0020	4.71	2.7	0.50	0.16	1.50	0.22	13.22	2.2
IND	C2	12.47	C3	11.95	12.61	0.80	10.088	20.00	1.20	12.15	522	30	0.0010	13.00	2.6	3.29	0.52	1.50	0.60	1.21	2.5
JUNCT-3	C3	11.45	C4	11.08	0.00	0.80	0.000	23.29	1.11	16.00	465	36	0.0008	18.91	2.7	2.89	0.37	1.50	0.39	0.82	2.3
IND	C4	11.08	C5	10.93	3.70	0.80	2.960	26.18	1.04	19.07	165	36	0.0009	20.05	2.8	0.97	0.15	1.25	0.28	0.55	2.7
IND	C5	10.43	C6	10.17	4.19	0.80	3.352	27.15	1.01	22.47	373	42	0.0007	26.68	2.8	2.24	0.26	1.00	0.27	0.28	2.3
IND	C6	10.17	OUT	10.00	6.17	0.80	4.936	29.39	0.97	27.26	207	42	0.0008	28.52	3.0	1.16	0.17	1.00	0.28	0.00	2.8
IND	C7	10.23	OUT	10.00	10.61	0.80	8.488	20.00	1.20	10.22	228	30	0.0010	13.00	2.6	1.43	0.23	0.17	0.15	13.15	2.1



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## STORM DRAIN SYSTEM D DESIGN

### Northwest Airport Way Master Plan

**RUNOFF COEFFICIENTS:**

Land Use IND  
 Weighted Coeff. 0.80

Date: 7/2/2010  
 By: SLS

**RAINFALL CURVES:**

Source Manteca Standards  
 M.A.P. 15.0 inches  
 Frequency 10 Years

**TIME OF CONCENTRATION:**

Overland Flow          Min  
 Gutter Flow          Min  
 Total Inlet Time 20 Min

**PIPE:**

Type           
 Min. Velocity at Design Flow v = 0.013 inches  
2.5 fps

Line Designation	From	Invert Elev.	To	Invert Elev.	Area (Acres)	Runoff Coeff.	Area X Coeff.	Duration (min)	Intensity (in/hr)	Runoff (cfs)	Length (ft)	Pipe Diam (in)	Pipe Slope	Capacity (cfs)	Velocity (fps)	Flow Time (min)	Fall (feet)	HL Factor	Head Loss-HL (ft)	Hyd. Grade-HGL (ft)	Velocity (fps) full
		A	C	AxC	T	I	Q	L	D	S	Qc	V	T	F	K	HL	HGL	V			
IND	D1	15.50	D4	14.78	3.65	0.80	2.919	20.00	1.20	3.51	359	18	0.0020	4.71	2.7	2.24	0.72	1.50	0.49	16.62	2.0
IND	D2	15.81	D3	15.08	3.67	0.80	2.933	20.00	1.20	3.53	361	18	0.0020	4.71	2.7	2.26	0.72	1.50	0.50	16.93	2.0
IND	D3	14.58	D4	14.28	3.65	0.80	2.918	22.26	1.13	6.84	255	24	0.0012	7.85	2.5	1.70	0.31	1.00	0.31	16.62	2.2
IND	D4	13.28	D5	12.85	4.19	0.80	3.349	23.96	1.09	14.00	538	36	0.0008	18.91	2.7	3.35	0.43	1.25	0.31	16.31	2.0
	D5	12.35	D6	12.18	9.71	0.80	7.765	27.31	1.01	21.85	275	42	0.0006	24.70	2.6	1.79	0.17	1.25	0.23	16.08	2.3
	D6	12.18	OUT	12.15	0.00	0.80	0.000	29.09	0.98	21.85	55	42	0.0006	24.70	2.6	0.35	0.03	0.17	0.04	16.04	2.3
IND	D7	11.08	OUT	11.00	12.06	0.80	9.648	20.00	1.20	11.62	80	30	0.0010	13.00	2.6	0.50	0.08	1.50	0.19	16.19	2.4
IND	D8	11.08	OUT	11.00	10.53	0.80	8.424	20.00	1.20	10.15	80	30	0.0010	13.00	2.6	0.50	0.08	1.50	0.15	16.15	2.1
IND	D9	11.08	OUT	11.00	9.90	0.80	7.920	20.00	1.20	9.54	80	30	0.0010	13.00	2.6	0.50	0.08	1.50	0.13	16.13	1.9
IND	D10	15.68	D12	15.52	4.53	0.80	3.624	20.00	1.20	4.36	80	18	0.0020	4.71	2.7	0.50	0.16	1.50	0.28	17.02	2.5
IND	D11	14.08	D12	14.02	15.02	0.80	12.016	20.00	1.20	14.47	80	36	0.0008	18.91	2.7	0.50	0.06	1.50	0.14	17.02	2.0
JUNCT-3	D12	14.02	D14	13.56	0.00	0.80	0.000	20.50	1.19	18.84	577	36	0.0008	18.91	2.7	3.59	0.46	1.25	0.60	16.42	2.7
IND	D13	13.62	D14	13.56	14.65	0.80	11.718	20.00	1.20	14.11	80	36	0.0008	18.91	2.7	0.50	0.06	0.75	0.08	16.42	2.0
Junct-3	D14	12.56	OUT	12.50	0.00	0.80	0.000	24.09	1.08	32.95	97	48	0.0006	35.26	2.8	0.58	0.06	1.50	0.21	16.21	2.6
IND	D15	11.06	OUT	11.00	25.34	0.80	20.269	20.00	1.20	24.41	80	42	0.0007	26.68	2.8	0.48	0.06	1.50	0.20	16.20	2.5
IND	D16	11.05	OUT	11.00	36.36	0.80	29.085	20.00	1.20	35.03	80	48	0.0006	35.26	2.8	0.47	0.05	1.50	0.23	16.23	2.8
IND	D17	11.06	OUT	11.00	38.15	0.80	30.520	20.00	1.20	36.76	80	48	0.0007	38.09	3.0	0.44	0.06	1.50	0.25	16.25	2.9

### C. Swale Design

## NORTHWEST AIRPORT WAY MASTER PLAN VEGETATED SWALE DESIGN - 1

#### DESIGN FLOW

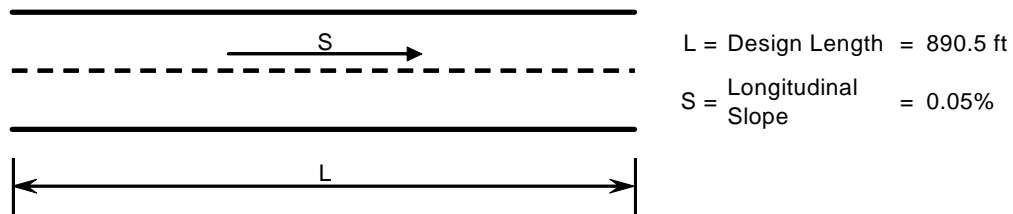
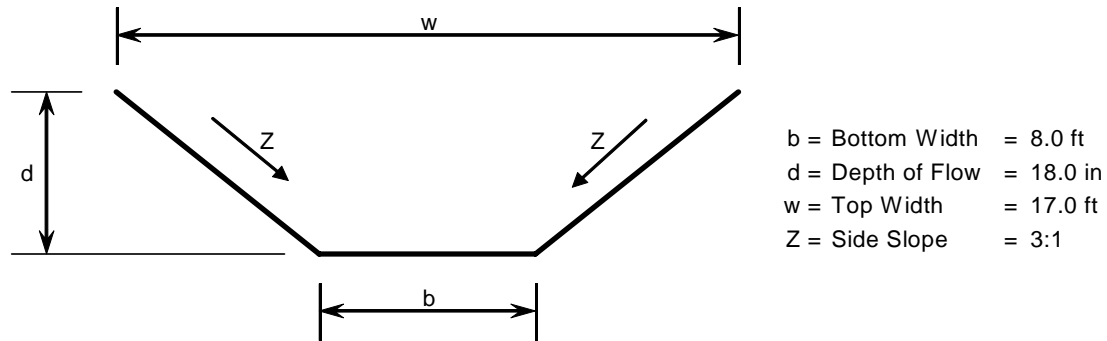
Total Contributing Area	7.41
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#### Stormwater Design Flow

C = Runoff Coeff.	=	0.80
I = Intensity (100-Year)	=	1.88 in/hr
A = Area	=	7.41 AC

$Q = C \times I \times A = \boxed{11.12 \text{ cfs}}$

#### SWALE GEOMETRY



#### HYDRAULIC CALCULATIONS

##### Channel Information

a = Cross-Sectional Area	=	18.75 SF
P = Wetted Perimeter	=	17.49 ft
R <sub>H</sub> = Hydraulic Radius	=	1.07 ft
S = Slope	=	0.05 %
n = Manning Roughness Coefficient	=	0.05

##### Velocity and Flow Rate

V = Velocity = $(1.49/n) \cdot R_H^{2/3} \cdot S^{0.5}$	=	0.70 ft/sec
Q = Volumetric Flow Rate	=	13.09 cfs

## NORTHWEST AIRPORT WAY MASTER PLAN VEGETATED SWALE DESIGN - 2

### DESIGN FLOW

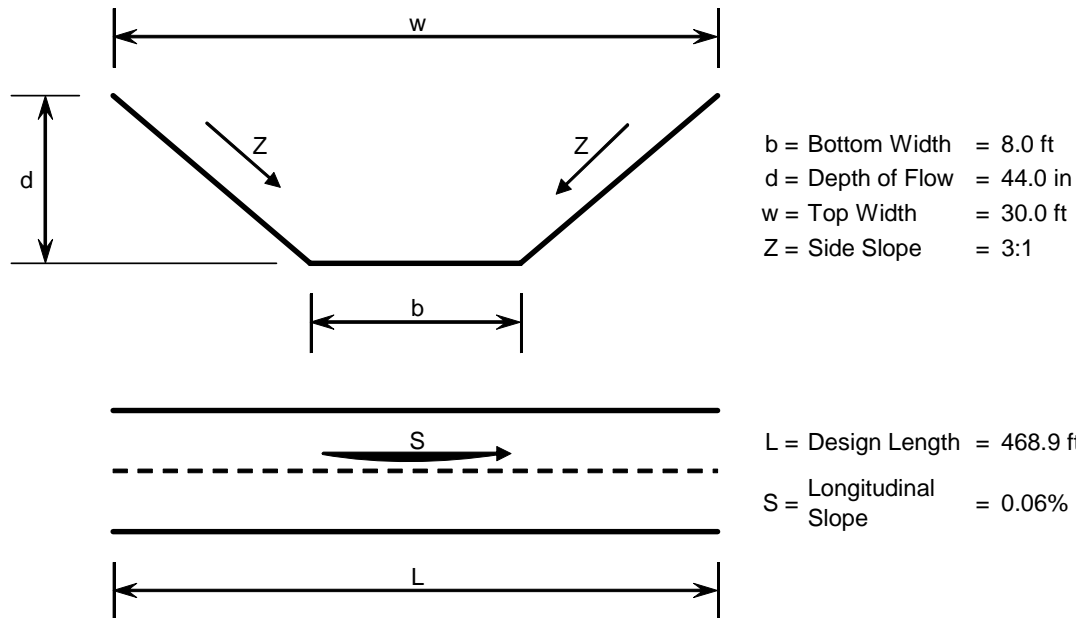
Total Contributing Area	<b>57.28</b>
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#### Stormwater Design Flow

C = Runoff Coeff.		= 0.80
I = Intensity (100-Year)		= 1.88 in/hr
A = Area		= 57.28 AC

Q = C x I x A		= <b>85.96 cfs</b>
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### SWALE GEOMETRY



### HYDRAULIC CALCULATIONS

#### Channel Information

a = Cross-Sectional Area		= 69.67 SF
P = Wetted Perimeter		= 31.19 ft
R <sub>H</sub> = Hydraulic Radius		= 2.23 ft
S = Slope		= 0.06 %
n = Manning Roughness Coefficient		= 0.05

#### Velocity and Flow Rate

V = Velocity = $(1.49/n) \cdot R_H^{2/3} \cdot S^{0.5}$		= 1.25 ft/sec
Q = Volumetric Flow Rate		= 86.89 cfs

## NORTHWEST AIRPORT WAY MASTER PLAN VEGETATED SWALE DESIGN - 3

### DESIGN FLOW

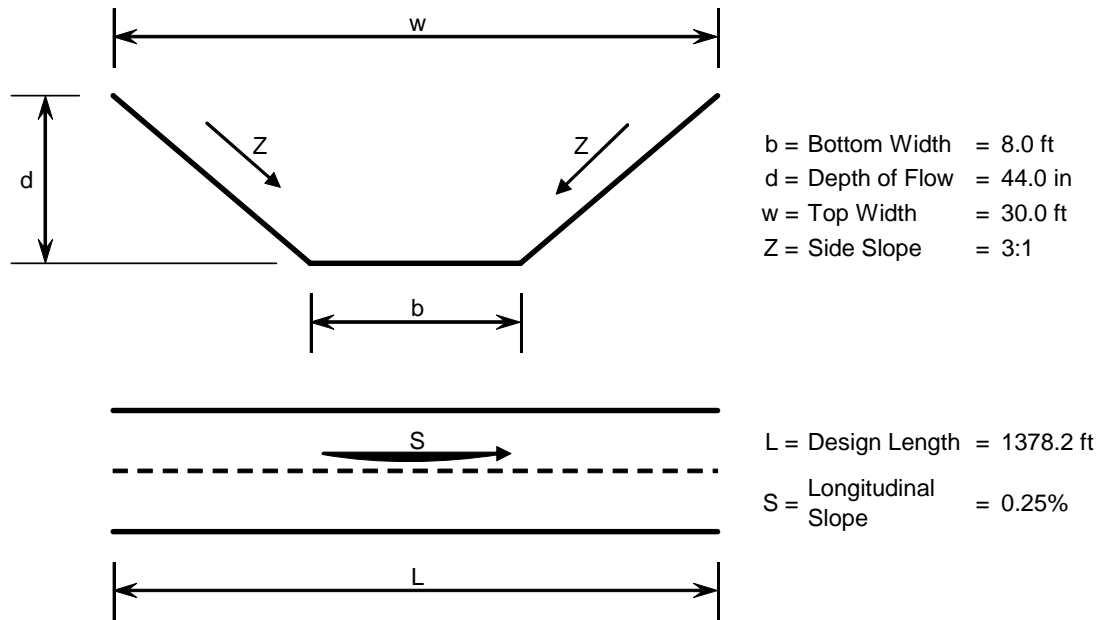
<b>Total Contributing Area</b>	<b>109.42</b>
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#### Stormwater Design Flow

C = Runoff Coeff.	= 0.80
I = Intensity (100-Year)	= 1.88 in/hr
A = Area	= 109.42 AC

$Q = C \times I \times A = \boxed{164.20 \text{ cfs}}$

### SWALE GEOMETRY



### HYDRAULIC CALCULATIONS

#### Channel Information

a = Cross-Sectional Area	= 69.67 SF
P = Wetted Perimeter	= 31.19 ft
R <sub>H</sub> = Hydraulic Radius	= 2.23 ft
S = Slope	= 0.25 %
n = Manning Roughness Coefficient	= 0.05

#### Velocity and Flow Rate

V = Velocity = $(1.49/n) \cdot R_H^{2/3} \cdot S^{0.5}$	= 2.55 ft/sec
Q = Volumetric Flow Rate	= 177.37 cfs