

APPENDIX M
Level Spreader Calculations

LEVEL SPREADER DESIGN
BASIN OUTLETS
PROJECT PPLS0902
DATE 7/5/2010
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BY JMO
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BASIN ID	OUTLET NUMBER	CULVERT PIPE FROM BASIN TO DROP STRUCTURE						DROP STRUCTURE		CULVERT PIPE FROM DROP STRUCTURE TO OUTLET PROTECTION				OUTLET PROTECTION				LEVEL SPREADER						PLUNGE POOL		DOWNSTREAM FLOW PATH			VELOCITY				
		INVERT IN	INVERT OUT	SIZE D (IN)	LENGTH (LF)	SLOPE (%)	10-YR STORM FLOW (CFS)	INVERT IN	INVERT OUT	INVERT IN	INVERT OUT	LENGTH (LF)	SLOPE (%)	WIDTH W (FT)	LENGTH La (FT)	THICKNESS (IN)	RIP-RAP SIZE	EXISTING GRADE ELEV.	CLEARANCE Y (IN)	WIDTH X (FT)	# OF LEVEL SPREADERS	LENGTH Lb (FT)	TOP EL. TE	TOE SLOPE TOP EL. STE	DEPTH H (IN)	BOTTOM EL. BE	LENGTH (FT)	SLOPE FOR FIRST 10 FT (%)	OVERALL SLOPE (%)	DOWNSTREAM COVER	ALLOWABLE (FPS)	DESIGN (FPS)	ACTUAL (FPS)
1.1	1.1	664.00	663.55	24	23	1.96	2.77	663.55	661.87	661.87	661.63	24	1.00	10.80	12.00	18	R-4	662.38	12	6.00	1	84	662.63	662.78	24	659.63	100	3.03	7.37 ¹	mulch	2.00	0.66	0.64
1.2	1.2.A	686.70	684.00	24	145	1.87	8.47	684.00	662.56	662.56	661.97	59	1.00	16.40	26.00	18	R-4	662.72	12	6.00	2	128	662.97	663.12	24	659.97	110	4.00	3.74	mulch	2.00	0.66	0.64
	1.2.B	686.70	678.00	24	448	1.94		678.00	657.98	657.98	657.64	34	1.00	16.40	26.00	18	R-4	658.39	12	6.00		128	658.64	658.79	24	655.64	160	1.57	1.57	mulch	2.00	0.66	0.64
1.3	1.3	687.00	677.00	24	611	1.64	0.37	677.00	669.99	669.99	669.35	64	1.00	10.80	12.00	18	R-4	670.10	12	6.00	1	12	670.35	670.50	24	667.35	123	2.65	2.65	mulch	2.00	0.66	0.62
1.5	1.5.A	686.00	684.00	36	123	1.62	7.57	684.00	667.69	667.69	666.75	94	1.00	18.60	24.00	18	R-4	668.00	18	9.00	2	114	668.25	668.48	36	663.75	85	4.00	9.91 ¹	mulch	2.00	0.66	0.64
	1.5.B	686.00	685.50	36	42	1.18		685.50	665.26	665.26	664.95	31	1.00	18.60	24.00	18	R-4	666.20	18	9.00		114	666.45	666.67	36	661.95	188	2.28	2.28	mulch	2.00	0.66	0.64
3.1	3.1	674.00	673.55	24	25	1.83	5.27	673.25	672.23	672.23	672.12	11	1.00	12.40	16.00	18	R-4	672.87	12	6.00	1	159	673.12	673.27	24	670.12	43	1.96	1.96	mulch	2.00	0.66	0.64
3.2	3.2.A	650.50	649.25	24	100	1.25	16.01	*	*	-	-	-	-	21.20	38.00	18	R-4	650.00	12	6.00	2	209	650.25	650.40	24	647.25	128	1.00	1.00	grass	4.00	1.32	0.84
	3.2.B	650.50	649.25	24	100	1.25		*	*	-	-	-	-	-	21.20	38.00	18	R-4	650.00	12		6.00	209	650.25	650.40	24	647.25	128	1.00	1.00	grass	4.00	1.32
6	6	630.00	624.15	24	327	1.79	3.75	*	*	-	-	-	-	10.80	12.00	18	R-4	624.90	12	6.00	1	49	625.15	625.30	24	622.15	68	4.00	6.65 ¹	grass	4.00	1.32	0.84
8	8	664.00	658.05	24	379	1.57	0.23	-	-	-	-	-	-	10.80	12.00	18	R-4	658.80	12	6.00	1	10	659.05	659.20	24	656.05	295	4.00	5.40	grass	4.00	1.32	0.84
9	9	663.00	662.00	24	51	1.96	0.12	662.00	659.82	659.82	659.12	69	1.00	10.80	12.00	18	R-4	659.87	12	6.00	1	10	660.12	660.27	24	657.12	98	1.79	1.79	grass	4.00	1.32	0.78
10.1	10.1	685.00	684.75	24	16	1.55	8.04	684.75	683.11	683.11	683.02	8	1.00	16.40	26.00	18	R-4	683.77	12	6.00	1	105	684.02	684.17	24	681.02	240	4.00	5.77	grass	4.00	1.32	0.84
10.4	10.4	664.00	663.50	24	28	1.80	3.55	663.50	660.65	660.65	660.37	28	1.00	10.80	12.00	18	R-4	661.12	12	6.00	1	47	661.37	661.52	24	658.37	104	3.68	3.68	grass	4.00	1.32	0.84
12	12	685.00	681.72	24	209	1.57	0.17	-	-	-	681.72	-	-	10.80	12.00	18	R-4	682.47	12	6.00	1	10	682.72	682.87	24	679.72	64	4.00	4.75	grass	4.00	1.32	0.76
13.1	13.1	718.00	717.50	24	31	1.61	0.34	717.50	716.79	716.79	716.60	20	1.00	10.80	12.00	18	R-4	717.35	12	6.00	1	10	717.60	717.75	24	714.60	91	3.28	3.28	grass	4.00	1.32	0.81
	13.2A	700.00	699.00	24	111	0.90	16.66	699.00	694.43	694.43	693.25	118	1.00	22.00	40.00	18	R-4	694.00	12	6.00	2	108.5	694.25	694.40	24	691.25	50	4.00	5.00	grass	4.00	1.32	0.76
	13.2B	700.00	699.00	24	111	0.90		699.00	694.39	694.39	693.25	114	1.00	22.00	40.00	18	R-4	694.00	12	6.00		108.5	694.25	694.40	24	691.25	50	4.00	5.00	grass	4.00	1.32	0.81
18	18	619.00	618.50	24	39	1.29		0.00	618.50	616.99	616.99	616.65	34	1.00	10.80	12.00	18	R-4	617.40	12		6.00	1	10	617.65	617.80	24	614.65	30	4.00	11.89 ¹	mulch	2.00
22	22	677.00	675.25	24	166	1.05	0.73	-	-	-	-	-	-	10.80	12.00	18	R-4	676.00	12	6.00	1	22	676.25	676.40	24	673.25	112	4.00	7.72 ¹	mulch	2.00	0.66	0.64

* Structures shown on plans are not required for drop structure in level spreader calculations.

¹ Due to site constraints downstream flow path requirement cannot be met

NOTES

- 1 FIRST 10 FT DOWNSLOPE HAS TO BE LESS THAN OR EQUAL TO 4%
- 2 MAXIMUM DOWNSLOPE SLOPE IS 6%
- 3 MAXIMUM FLOW LENGTH IS 100FT
- 4 MINIMUM STRUCTURE LENGTH IS 10FT, MAX IS 200FT
- 5 LENGTH IS DEPENDENT ON FLOW AND DOWNSTREAM GROUND COVER (13FT TO 100FT PER CFS)
- 6 ALLOWABLE DOWNSTREAM VELOCITY
GRAVEL 5FPS
GRASS 4FPS
MULCH 1-2FPS
- 7 DESIGN DOWNSTREAM VELOCITY =33% OF ALLOWABLE
GRAVEL 1.65FPS
GRASS 1.32FPS
MULCH 0.33-0.66FPS
- 8 FLOW TO LEVEL SPREADER SHOULD PASS THROUGH A DROP MANHOLD BEFORE ENTERING THE PIPE TO THE LEVEL SPREADER. THE PIPE ENTERING THE LEVEL SPREADER MUST BE LESS THAN OR EQUAL TO 1.0%

LEVEL SPREADER CALCULATIONS

Completed 2011-06-24
Printed 7/6/2011

Design Criteria:

L=30 L.F. for every 1 cfs of flow (mature forest/mulch)
Outlet Velocity < 3 ft/s
Design per Pennsylvania DEP

Level Spreader 1.1 (Basin 1.1)

Flow= 2.77 cfs

Min. Length= 83.10 ft

Design Length 84.00

$Q = (CLH)^{3/2}$ Weir Equation
C=2.80 Broad Crested Weir

Height of Flow = 0.05 ft

Flow Velocity=Q/A= 0.64 ft/s

LEVEL SPREADER CALCULATIONS

Completed 2011-06-24
Printed 7/6/2011

Design Criteria:

L=30 L.F. for every 1 cfs of flow (mature forest/mulch)
Outlet Velocity < 3 ft/s
Design per Pennsylvania DEP

Level Spreader 1.2 (Basin 1.2)

Flow= 8.47 cfs

Min. Length= 254.10 ft

Design Length 255.00

$Q=(CLH)^{3/2}$ Weir Equation
C=2.80 Broad Crested Weir

Height of Flow = 0.05 ft

Flow Velocity=Q/A= 0.64 ft/s

LEVEL SPREADER CALCULATIONS

Completed 2011-06-24
Printed 7/6/2011

Design Criteria:

L=30 L.F. for every 1 cfs of flow (mature forest/mulch)
Outlet Velocity < 3 ft/s
Design per Pennsylvania DEP

Level Spreader 1.3 (Basin 1.3)

Flow= 0.37 cfs

Min. Length= 11.10 ft

Design Length 12.00

$Q = (CLH)^{3/2}$ Weir Equation
C=2.80 Broad Crested Weir

Height of Flow = 0.05 ft

Flow Velocity=Q/A= 0.62 ft/s

LEVEL SPREADER CALCULATIONS

Completed 2011-06-24
Printed 7/6/2011

Design Criteria:

L=30 L.F. for every 1 cfs of flow (mature forest/mulch)
Outlet Velocity < 3 ft/s
Design per Pennsylvania DEP

Level Spreader 1.5 (Basin 1.5)

Flow= 7.57 cfs

Min. Length= 227.10 ft

Design Length 228.00

$Q=(CLH)^{3/2}$ Weir Equation
C=2.80 Broad Crested Weir

Height of Flow = 0.05 ft

Flow Velocity=Q/A= 0.64 ft/s

LEVEL SPREADER CALCULATIONS

Completed 2011-06-24
Printed 7/6/2011

Design Criteria:

L=30 L.F. for every 1 cfs of flow (mature forest/mulch cover)
Outlet Velocity < 3 ft/s
Design per Pennsylvania DEP

Level Spreader 3.1 (Basin 3.1)

Flow= 5.27 cfs

Min. Length= 158.10 ft

Design Length 159.00

$Q=(CLH)^{3/2}$ Weir Equation
C=2.80 Broad Crested Weir

Height of Flow = 0.05 ft

Flow Velocity=Q/A= 0.64 ft/s

LEVEL SPREADER CALCULATIONS

Completed 2011-06-24
Printed 7/6/2011

Design Criteria:

L=13 L.F. for every 1 cfs of flow
Outlet Velocity < 3 ft/s
Design per Pennsylvania DEP

Level Spreader 3.2 (Basin 3.2)

Flow= 16.01 cfs

Min. Length= 208.13 ft

Design Length 209.00

$Q=(CLH)^{3/2}$ Weir Equation
C=2.80 Broad Crested Weir

Height of Flow = 0.09 ft

Flow Velocity=Q/A= 0.84 ft/s

LEVEL SPREADER CALCULATIONS

Completed 2011-06-24
Printed 7/6/2011

Design Criteria:

L=13 L.F. for every 1 cfs of flow
Outlet Velocity < 3 ft/s
Design per Pennsylvania DEP

Level Spreader 6 (Basin 6)

Flow= 3.75 cfs

Min. Length= 48.75 ft

Design Length 49.00

$Q=(CLH)^{3/2}$ Weir Equation
C=2.80 Broad Crested Weir

Height of Flow = 0.09 ft

Flow Velocity=Q/A= 0.84 ft/s

LEVEL SPREADER CALCULATIONS

Completed 2011-06-24
Printed 7/6/2011

Design Criteria:

L=13 L.F. for every 1 cfs of flow
Outlet Velocity < 3 ft/s
Design per Pennsylvania DEP

Level Spreader 8 (Basin 8)

Flow= 0.23 cfs

Min. Length= 2.99 ft

Design Length 3.00 USE MIN. 10'

$Q = (CLH)^{3/2}$ Weir Equation
C=2.80 Broad Crested Weir

Height of Flow = 0.09 ft

Flow Velocity=Q/A= 0.84 ft/s

LEVEL SPREADER CALCULATIONS

Completed 2011-06-24
Printed 7/6/2011

Design Criteria:

L=13 L.F. for every 1 cfs of flow
Outlet Velocity < 3 ft/s
Design per Pennsylvania DEP

Level Spreader 9 (Basin 9)

Flow= 0.12 cfs

Min. Length= 1.56 ft

Design Length 2.00 USE MIN. 10'

$Q = (CLH)^{3/2}$ Weir Equation
C=2.80 Broad Crested Weir

Height of Flow = 0.08 ft

Flow Velocity=Q/A= 0.78 ft/s

LEVEL SPREADER CALCULATIONS

Completed 2011-06-24
Printed 7/6/2011

Design Criteria:

L=13 L.F. for every 1 cfs of flow
Outlet Velocity < 3 ft/s
Design per Pennsylvania DEP

Level Spreader 10.1 (Basin 10.1)

Flow= 8.04 cfs

Min. Length= 104.52 ft

Design Length 105.00

$Q=(CLH)^{3/2}$ Weir Equation
C=2.80 Broad Crested Weir

Height of Flow = 0.09 ft

Flow Velocity=Q/A= 0.84 ft/s

LEVEL SPREADER CALCULATIONS

Completed 2011-06-24
Printed 7/6/2011

Design Criteria:

L=13 L.F. for every 1 cfs of flow
Outlet Velocity < 3 ft/s
Design per Pennsylvania DEP

Level Spreader 10.4 (Basin 10.4)

Flow= 3.55 cfs

Min. Length= 46.15 ft

Design Length 47.00

$Q = (CLH)^{3/2}$ Weir Equation
C=2.80 Broad Crested Weir

Height of Flow = 0.09 ft

Flow Velocity=Q/A= 0.84 ft/s

LEVEL SPREADER CALCULATIONS

Completed 2011-06-24
Printed 7/6/2011

Design Criteria:

L=13 L.F. for every 1 cfs of flow
Outlet Velocity < 3 ft/s
Design per Pennsylvania DEP

Level Spreader 12 (Basin 12)

Flow= 0.17 cfs

Min. Length= 2.21 ft

Design Length 3.00 USE MIN. 10'

$Q=(CLH)^{3/2}$ Weir Equation
C=2.80 Broad Crested Weir

Height of Flow = 0.07 ft

Flow Velocity=Q/A= 0.76 ft/s

LEVEL SPREADER CALCULATIONS

Completed 2011-06-24
Printed 7/6/2011

Design Criteria:

L=13 L.F. for every 1 cfs of flow
Outlet Velocity < 3 ft/s
Design per Pennsylvania DEP

Level Spreader 13.1 (Basin 13.1)

Flow= 0.34 cfs

Min. Length= 4.42 ft

Design Length 5.00 USE MIN. 10'

$Q = (CLH)^{3/2}$ Weir Equation
C=2.80 Broad Crested Weir

Height of Flow = 0.08 ft

Flow Velocity=Q/A= 0.81 ft/s

LEVEL SPREADER CALCULATIONS

Completed 2011-06-24
Printed 8/11/2011

Design Criteria:

L=13 L.F. for every 1 cfs of flow
Outlet Velocity < 3 ft/s
Design per Pennsylvania DEP

Level Spreader 13.2

Flow= 16.66 cfs

Min. Length= 216.58 ft

Design Length 217.00

$Q = (CLH)^{3/2}$ Weir Equation
C=2.80 Broad Crested Weir

Height of Flow = 0.09 ft

Flow Velocity=Q/A= 0.84 ft/s

LEVEL SPREADER CALCULATIONS

Completed 2011-06-24
Printed 7/6/2011

Design Criteria:

L=30 L.F. for every 1 cfs of flow (mature forest/mulch cover)
Outlet Velocity < 3 ft/s
Design per Pennsylvania DEP

Level Spreader 15.3 (Basin 15.3)

Flow= 10.23 cfs

Min. Length= 306.90 ft

Design Length 307.00

$Q=(CLH)^{3/2}$ Weir Equation
C=2.80 Broad Crested Weir

Height of Flow = 0.05 ft

Flow Velocity=Q/A= 0.64 ft/s

LEVEL SPREADER CALCULATIONS

Completed 2011-06-24
Printed 7/6/2011

Design Criteria:

L=30 L.F. for every 1 cfs of flow (mature forest/mulch cover)
Outlet Velocity < 3 ft/s
Design per Pennsylvania DEP

Level Spreader 18 (Basin 18)

Flow= 0.00 cfs

Min. Length= 0.00 ft

Design Length 0.00 USE MIN. 10'

Q=(CLH)^{3/2} Weir Equation
C=2.80 Broad Crested Weir

Height of Flow = 0.00 ft

Flow Velocity=Q/A= 0.00 ft/s

LEVEL SPREADER CALCULATIONS

Completed 2011-06-24
Printed 7/6/2011

Design Criteria:

L=30 L.F. for every 1 cfs of flow (mature forest/mulch cover)
Outlet Velocity < 3 ft/s
Design per Pennsylvania DEP

Level Spreader 21 (Basin 21)

Flow= 1.07 cfs

Min. Length= 32.10 ft

Design Length 33.00

$Q=(CLH)^{3/2}$ Weir Equation
C=2.80 Broad Crested Weir

Height of Flow = 0.05 ft

Flow Velocity=Q/A= 0.63 ft/s

LEVEL SPREADER CALCULATIONS

Completed 2011-06-24
Printed 7/6/2011

Design Criteria:

L=30 L.F. for every 1 cfs of flow (mature forest/mulch cover)
Outlet Velocity < 3 ft/s
Design per Pennsylvania DEP

Level Spreader 22 (Basin 22)

Flow= 0.73 cfs

Min. Length= 21.90 ft

Design Length 22.00

$Q = (CLH)^{3/2}$ Weir Equation
C=2.80 Broad Crested Weir

Height of Flow = 0.05 ft

Flow Velocity=Q/A= 0.64 ft/s