APPENDIX E

STORM SEWER NETWORK

E

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CALCULATION COVER SHEET

Date: 6/11/08 **Page** 1 **of** 2

Project No.: 89241 **Project Title:** Stormsewer Network

Calculation No.: 89241.6-6

Calculation Title: Stormsewer Network Design

Design Verification Required: ☐ Yes ☒ No

Calculation Type: ☐ Scoping ☐ Preliminary ☒ Final ☐ Voided
☐ Superseded by Calculation No.:

ORIGINAL AND REVISED CALCULATIONS/ANALYSIS APPROVAL

	Rev. 1 Printed Name/Signature/Date	Rev. ____ Printed Name/Signature/Date	Rev. ____ Printed Name/Signature/Date
Originator:	T. Kluthe 6/11/08		
Checked By:	C. Larson 10/14/08		
Approved By:	C. Larson 12/12/08		
Other:			

AFFECTED DOCUMENTS

Document Number	Document Title	Rev. No.	Responsible Project Manager Initials
DEN BR179	SITE DRAINAGE ANALYSES & DESIGN RPT — PINON RIDGE PROJ.		CL

RECORD OF REVISION

Rev.	Reason for Revision

ATTACHMENTS

Attachment No.	Title	Total Pages
1	Stormsewer Network Calculations	8

Length (ft)	Pipe Diam. (in)	Pipe Inlet Invert El. (ft)	Slope (%)	Pipe Outlet Invert El. (ft)	Inlet Manhole ID
Main Line					
225	36	5449.2	0.98	5447	MH-1
500	36	5454.4	1.00	5449.4	MH-2
500	36	5463.1	1.70	5454.6	MH-3
500	30	5476.3	2.60	5463.3	MH-4
500	30	5488.5	2.40	5476.5	MH-5
500	30	5500.7	2.40	5488.7	MH-6
500	30	5507.9	1.40	5500.9	MH-7
East Pond Line					
450	30	5511.7	0.80	5508.1	MH-8
500	30	5515.4	0.70	5511.9	MH-9
490	30	5520	0.90	5515.6	East Pond
West Pond Line					
166	18	5508.1	0.12	5507.9	West Pond

Proposed Storm Network

12/12/08

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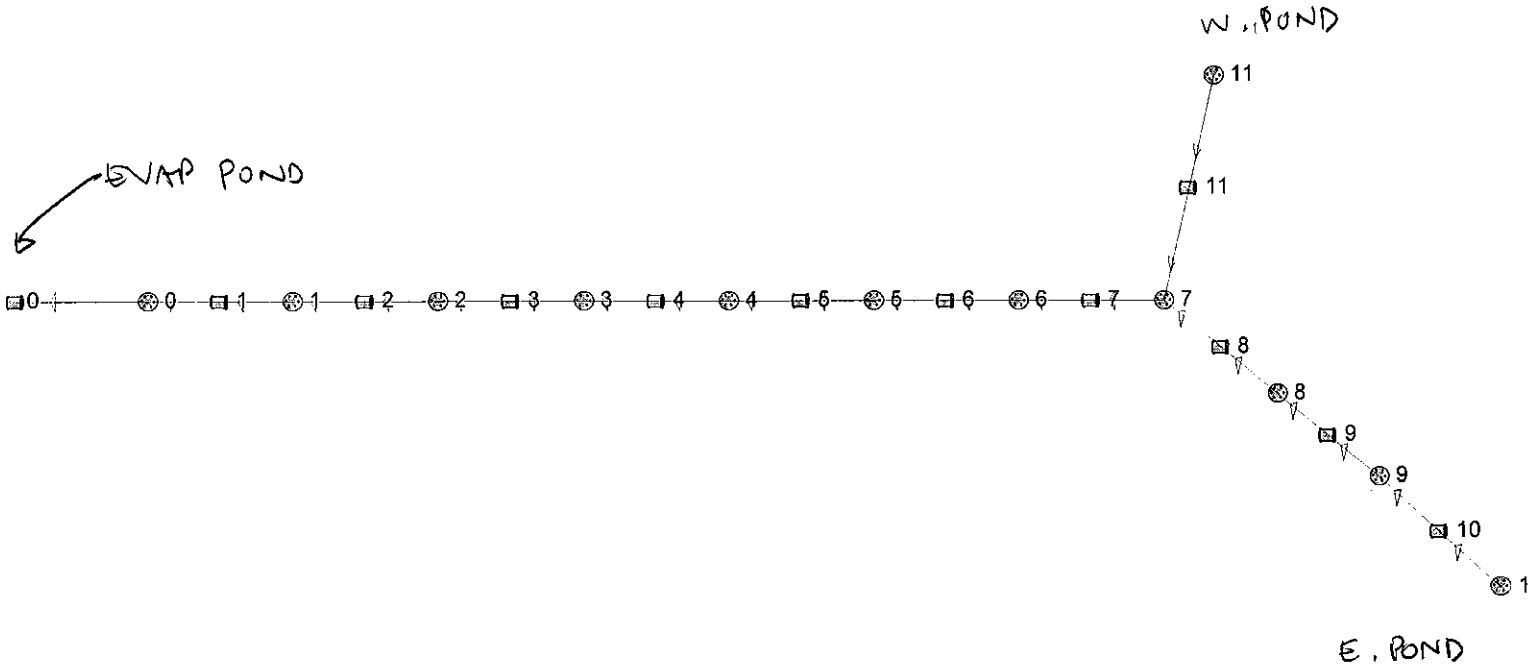
CCL 12/12/08



NeoUDS Results Summary

CBL 12/12/08 3/

Project Title: Pinon Ridge Stormsewer Network
Project Description: 1000-Year Stormwater Pond Overflow
Output Created On: 12/12/2008 at 4:23:47 PM
Using NeoUDSewer Version 1.5.
Rainfall Intensity Formula **Used.**
Return Period of Flood is 0 **Years.**

Sub Basin Information

		Time of Concentration				
Manhole ID #	Basin Area * C	Overland (Minutes)	Gutter (Minutes)	Basin (Minutes)	Rain I (Inch/Hour)	Peak Flow (CFS)
0	50.00	5.0	0.0	0.0	1.34	67.0
1	50.00	5.0	0.0	0.0	1.34	67.0
2	50.00	5.0	0.0	0.0	1.34	67.0
3	50.00	5.0	0.0	0.0	1.34	67.0
4	50.00	5.0	0.0	0.0	1.34	67.0
5	50.00	5.0	0.0	0.0	1.34	67.0
6	50.00	5.0	0.0	0.0	1.34	67.0
7	50.00	5.0	0.0	0.0	1.34	67.0
8	50.00	5.0	0.0	0.0	0.78	39.0
9	50.00	5.0	0.0	0.0	0.78	39.0
10	50.00	5.0	0.0	0.0	0.78	39.0
11	50.00	5.0	0.0	0.0	0.56	28.0

The shortest design rainfall duration is 5 minutes.
For rural areas, the catchment time of concentration is always => 10 minutes.
For urban areas, the catchment time of concentration is always => 5 minutes.
At the first design point, the time constant is <= (10+Total Length/180) in minutes.
When the weighted runoff coefficient => 0.2, then the basin is considered to be urbanized.
When the Overland Tc plus the Gutter Tc does not equal the catchment Tc, the above criteria supersedes the calculated values.

Summary of Manhole Hydraulics

Manhole ID #	Contributing Area * C	Rainfall Duration	Rainfall Intensity	Design Peak Flow	Ground Elevation	Water Elevation	Comments

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		(Minutes)	(Inch/Hour)	(CFS)	(Feet)	(Feet)	
0	0	0.0	0.00	67.0	5450.00	5446.00	
1	550	5.0	0.12	67.0	5454.00	5451.29	
2	500	5.0	0.13	67.0	5460.00	5456.49	
3	450	5.0	0.15	67.0	5469.00	5465.37	
4	400	5.0	0.17	67.0	5482.00	5478.69	
5	350	5.0	0.19	67.0	5495.00	5490.89	
6	300	5.0	0.22	67.0	5507.00	5503.09	
7	250	5.0	0.27	67.0	5521.00	5514.70	
8	150	5.0	0.26	39.0	5528.00	5520.11	
9	100	5.0	0.39	39.0	5524.00	5523.99	
10	50	5.0	0.78	39.0	5525.00	5527.79	**Surface Water Present**
11	50	5.0	0.56	28.0	5522.50	5523.88	**Surface Water Present**

Summary of Sewer Hydraulics

Note: The given depth to flow ratio is 0.9.

	Manhole ID Number			Calculated	Suggested	Existing	
Sewer ID #	Upstream	Downstream	Sewer Shape	Diameter (Rise) (Inches) (FT)	Diameter (Rise) (Inches) (FT)	Diameter (Rise) (Inches) (FT)	Width (FT)
1	1	0	Round	35.0	36	36	N/A
2	2	1	Round	35.0	36	36	N/A
3	3	2	Round	31.7	33	33	N/A
4	4	3	Round	29.3	30	30	N/A
5	5	4	Round	29.7	30	30	N/A
6	6	5	Round	29.7	30	30	N/A
7	7	6	Round	32.9	33	30	N/A
8	8	7	Round	29.8	30	30	N/A
9	9	8	Round	30.5	33	30	N/A
10	10	9	Round	29.1	30	30	N/A
11	11	7	Round	17.8	18	18	N/A

Round and arch sewers are measured in inches.
Box sewers are measured in feet.
Calculated diameter was determined by sewer hydraulic capacity.

Suggested diameter was rounded up to the nearest commercially available size
All hydraulics where calculated using the existing parameters.
If sewer was sized mathematically, the suggested diameter was used for hydraulic calculations.

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Sewer ID	Design Flow (CFS)	Full Flow (CFS)	Normal Depth (Feet)	Normal Velocity (FPS)	Critical Depth (Feet)	Critical Velocity (FPS)	Full Velocity (FPS)	Froude Number	Comment
1	67.0	72.5	2.28	11.6	2.59	10.3	9.5	1.37	
2	67.0	72.5	2.28	11.6	2.59	10.3	9.5	1.37	
3	67.0	74.9	2.03	14.3	2.52	11.7	11.3	1.8	
4	67.0	71.8	1.91	16.6	2.39	13.9	13.6	2.13	
5	67.0	69.0	1.99	16.0	2.39	13.9	13.6	1.96	
6	67.0	69.0	1.99	16.0	2.39	13.9	13.6	1.96	
7	67.0	52.7	2.50	13.6	2.39	13.9	13.6	N/A	
8	39.0	39.9	2.00	9.3	2.10	8.9	7.9	1.12	
9	39.0	37.3	2.50	7.9	2.10	8.9	7.9	N/A	
10	39.0	42.3	1.89	9.8	2.10	8.9	7.9	1.26	
11	28.0	29.1	1.18	18.7	1.48	15.9	15.8	2.99	Velocity Is High

A Froude number = 0 indicated that a pressured flow occurs.

Summary of Sewer Design Information

		Invert Elevation		Buried Depth		
Sewer ID	Slope %	Upstream (Feet)	Downstream (Feet)	Upstream (Feet)	Downstream (Feet)	Comment
1	1.00	5448.70	5446.45	2.30	0.55	Sewer Too Shallow
2	1.00	5453.90	5448.90	3.10	2.10	
3	1.70	5462.85	5454.35	3.40	2.90	
4	2.60	5476.30	5463.30	3.20	3.20	
5	2.40	5488.50	5476.50	4.00	3.00	
6	2.40	5500.70	5488.70	3.80	3.80	
7	1.40	5507.90	5500.90	10.60	3.60	
8	0.80	5511.70	5508.10	13.80	10.40	
9	0.70	5515.40	5511.90	6.10	13.60	
10	0.90	5520.00	5515.59	2.50	5.91	
11	6.50	5519.00	5508.21	2.00	11.29	

Summary of Hydraulic Grade Line

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			Invert Elevation		Water Elevation		
Sewer ID #	Sewer Length (Feet)	Surcharged Length (Feet)	Upstream (Feet)	Downstream (Feet)	Upstream (Feet)	Downstream (Feet)	Condition
1	225	-0.04	5448.70	5446.45	5451.29	5446.00	Jump
2	500	-0.09	5453.90	5448.90	5456.49	5451.29	Jump
3	500	0.11	5462.85	5454.35	5465.37	5456.49	Jump
4	500	0.1	5476.30	5463.30	5478.69	5465.37	Jump
5	500	0.24	5488.50	5476.50	5490.89	5478.69	Jump
6	500	0.24	5500.70	5488.70	5503.09	5490.89	Jump
7	500	500	5507.90	5500.90	5514.70	5503.09	Pressured
8	450	450	5511.70	5508.10	5520.11	5514.70	Pressured
9	500	500	5515.40	5511.90	5523.99	5520.11	Pressured
10	490	490	5520.00	5515.59	5527.79	5523.99	Pressured
11	166	166	5519.00	5508.21	5523.88	5514.70	Pressured

Summary of Energy Grade Line

	Upstream Manhole			Juncture Losses				Downstream Manhole	
Sewer ID #	Manhole ID #	Energy Elevation (Feet)	Sewer Friction (Feet)	Bend K Coefficient	Bend Loss (Feet)	Lateral K Coefficient	Lateral Loss (Feet)	Manhole ID #	Energy Elevation (Feet)
1	1	5452.95	6.95	0.05	0.00	0.00	0.00	0	5446.00
2	2	5458.15	5.13	0.05	0.07	0.00	0.00	1	5452.95
3	3	5467.51	9.27	0.05	0.10	0.00	0.00	2	5458.15
4	4	5481.67	14.02	0.05	0.14	0.00	0.00	3	5467.51
5	5	5493.87	12.06	0.05	0.14	0.00	0.00	4	5481.67
6	6	5506.07	12.06	0.05	0.14	0.00	0.00	5	5493.87
7	7	5517.60	11.38	0.05	0.14	0.00	0.00	6	5506.07
8	8	5521.09	3.45	0.05	0.05	0.00	0.00	7	5517.60
9	9	5524.97	3.83	0.05	0.05	0.00	0.00	8	5521.09
10	10	5528.77	3.75	0.05	0.05	0.00	0.00	9	5524.97
11	11	5527.78	9.99	0.05	0.19	0.00	0.00	7	5517.60

Bend loss = Bend K * Flowing full vhead in sewer.
Lateral loss = Outflow full vhead - Junction Loss K * Inflow full vhead.

A friction loss of 0 means it was negligible or possible error due to jump.
Friction loss includes sewer invert drop at manhole.
Notice: Vhead denotes the velocity head of the full flow condition.
A minimum junction loss of 0.05 Feet would be introduced unless Lateral K is 0.
Friction loss was estimated by backwater curve computations.

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Summary of Earth Excavation Volume for Cost Estimate

The user given trench side slope is 1.

Manhole ID #	Rim Elevation (Feet)	Invert Elevation (Feet)	Manhole Height (Feet)
0	5450.00	5446.45	3.55
1	5454.00	5448.70	5.30
2	5460.00	5453.90	6.10
3	5469.00	5462.85	6.15
4	5482.00	5476.30	5.70
5	5495.00	5488.50	6.50
6	5507.00	5500.70	6.30
7	5521.00	5507.90	13.10
8	5528.00	5511.70	16.30
9	5524.00	5515.40	8.60
10	5525.00	5520.00	5.00
11	5522.50	5519.00	3.50

	Upstream Trench Width		Downstream Trench Width				
Sewer ID #	On Ground (Feet)	At Invert (Feet)	On Ground (Feet)	At Invert (Feet)	Trench Length (Feet)	Wall Thickness (Inches)	Earth Volume (Cubic Yards)
1	8.9	5.7	5.4	5.7	225	4.00	267
2	10.5	5.7	8.5	5.7	500	4.00	766
3	10.9	5.4	9.9	5.4	500	3.75	806
4	10.3	5.1	10.3	5.1	500	3.50	758
5	11.9	5.1	9.9	5.1	500	3.50	821
6	11.5	5.1	11.5	5.1	500	3.50	879
7	25.1	5.1	11.1	5.1	500	3.50	2011
8	31.5	5.1	24.7	5.1	450	3.50	3580
9	16.1	5.1	31.1	5.1	500	3.50	3107

10	8.9	5.1	15.7	5.1	490	3.50	1002
11	7.1	3.9	25.7	3.9	166	2.50	591

Total earth volume for sewer trenches = 14589.08 Cubic Yards. The earth volume was estimated to have a bottom width equal to the diameter (or width) of the sewer plus two times either 1 foot for diameters less than 48 inches or 2 feet for pipes larger than 48 inches.
If the bottom width is less than the minimum width, the minimum width was used.
The backfill depth under the sewer was assumed to be 1 foot.
The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1

PINON RIDGE MILL STORMWATER OVERFLOW

Q_{max} = 67 cfs

TABLE 11.—*Stilling basin dimensions (Basin VI). Impact-type energy dissipator.*

Suggested pipe size [1]		Max discharge Q	Feet and inches										Inches					
Dia in.	Area (sq ft)		W	H	L	a	b	c	d	e	f	g	t_w	t_f	t_b	t_p	K	Suggested riprap size
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19) [3]
18	1. 77	[2] 21	5–6	4–3	7–4	3–3	4–1	2–4	0–11	0–6	1–6	2–1	6	6½	6	6	3	4. 0
24	3. 14	38	6–9	5–3	9–0	3–11	5–1	2–10	1–2	0–6	2–0	2–6	6	6½	6	6	3	7. 0
30	4. 91	59	8–0	6–3	10–8	4–7	6–1	3–4	1–4	0–8	2–6	3–0	6	6½	7	7	3	8. 5
USE 27 36	7. 07	85	9–3	7–3	12–4	5–3	7–1	3–10	1–7	0–8	3–0	3–6	7	7½	8	8	3	9. 0
42	9. 62	115	10–6	8–0	14–0	6–0	8–0	4–5	1–9	0–10	3–0	3–11	8	8½	9	8	4	9. 5
48	12. 57	151	11–9	9–0	15–8	6–9	8–11	4–11	2–0	0–10	3–0	4–5	9	9½	10	8	4	10. 5
54	15. 90	191	13–0	9–9	17–4	7–4	10–0	5–5	2–2	1–0	3–0	4–11	10	10½	10	8	4	12. 0
60	19. 63	236	14–3	10–9	19–0	8–0	11–0	5–11	2–5	1–0	3–0	5–4	11	11½	11	8	6	13. 0
72	28. 27	339	16–6	12–3	22–0	9–3	12–9	6–11	2–9	1–3	3–0	6–2	12	12½	12	8	6	14. 0

[1] Suggested pipe will run full when velocity is 12 feet per second or half full when velocity is 24 feet per second. Size may be modified for other velocities by Q=AV, but relation between Q and basin dimensions shown must be maintained.

[2] For discharges less than 21 second-feet, obtain basin width from curve of Fig. 42. Other dimensions proportional to W; $H=\frac{3W}{4}$, $L=\frac{4W}{3}$, $d=\frac{W}{6}$, etc.

[3] Determination of riprap size explained in Sec. 10.

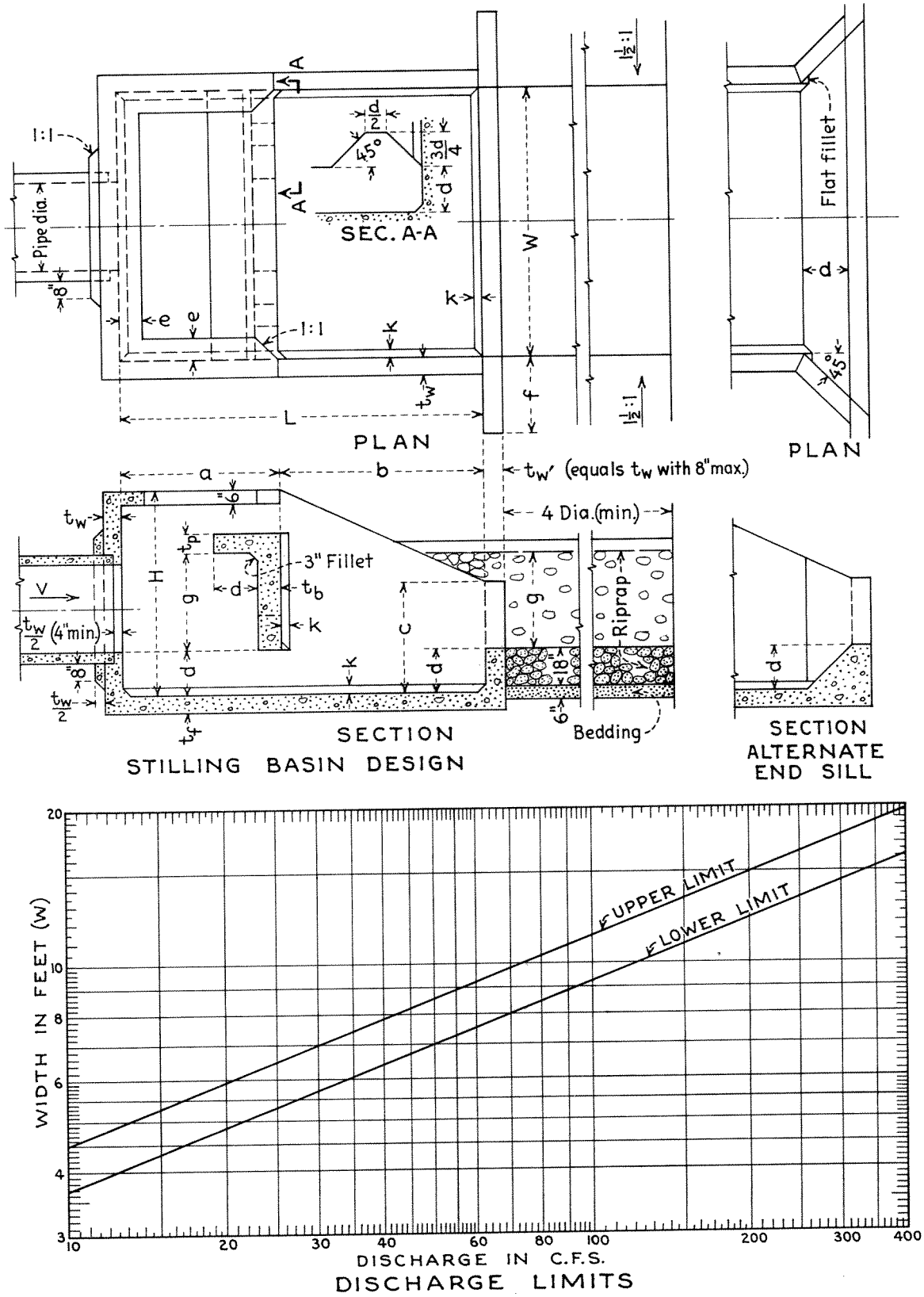

FIGURE 42.—*Impact-type energy dissipator (Basin VI).*